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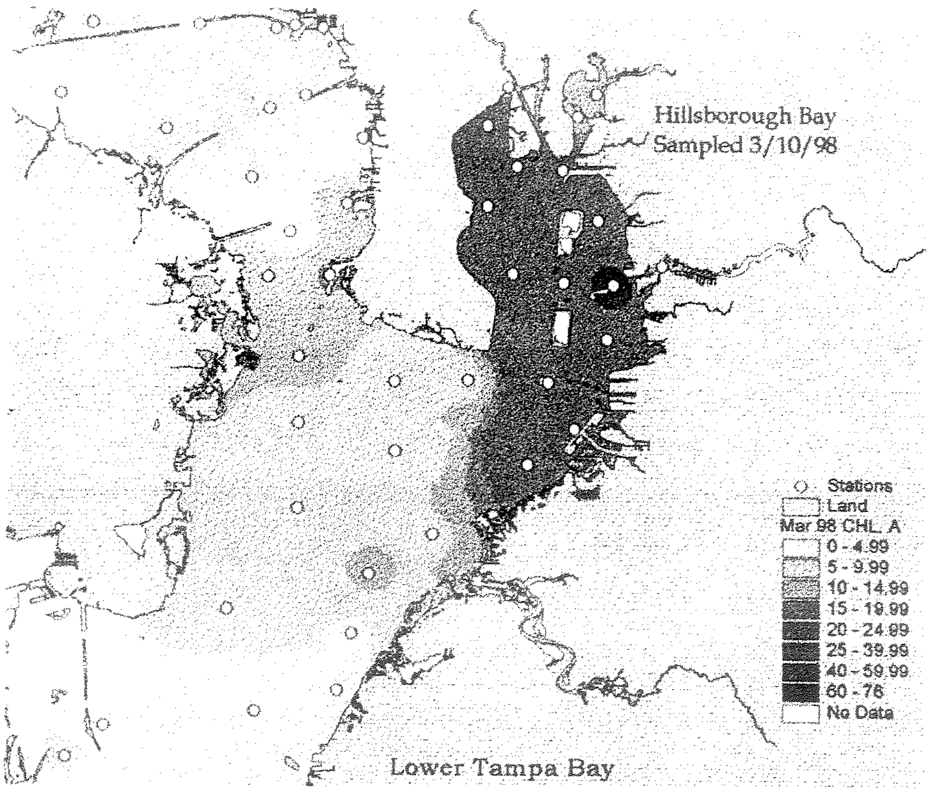
Mulberry Phosphates Inc. - December 1997 Acid Spill

Water Quality Impacts on

Alafia River and Tampa Bay



Environmental Protection Commission

Hillsborough County, Florida

May 29, 1998

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Water Quality Impacts on

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by

Tom Cardinale

A Water Management Division Report

Environmental Protection Commission

of

Hillsborough County, Florida

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All of the GIS maps were produced by Eric Lesnett, using ArcView® Spatial Analyst by ESRI and a base map produced by the Florida Department of Environmental Protection.

Introduction

This report summarizes Alafia River water quality data collected by the Environmental Protection Commission (EPC) of Hillsborough County Florida in relation to a spill that occurred on December 7, 1997 at the Mulberry Phosphates Inc. facility located near Mulberry Florida in Polk County. Long term water quality data are available from five EPC monitoring sites on the Alafia River. Short-term surface water quality monitoring also took place immediately following the incident.

Geographical Information

Alafia River: The Alafia River is located in Hillsborough and Polk Counties and drains approximately 460 square miles. Four to six miles of river originate in Polk County and about 29 miles of the river are in Hillsborough County. The river starts out in the middle of the phosphate mining area of Polk County. Much of that portion of the river has been modified by mining activities over the past 60 years. The river in the vicinity of Mulberry Phosphates Inc. near Mulberry Florida is a shallow broad freshwater marsh. The gypsum stack that failed sits at an elevation about 100 to 115 feet above this marsh environment. Skinned Sapling Creek lies just south of the gypsum stack and flows west, connecting to the Alafia River.

The river flows west towards Hillsborough County and narrows. Three to four miles from the Polk County line, the river flows through the small community of Keysville. Three miles down stream from Keysville the river joins the South Prong of the Alafia River at Alderman Ford Park. EPC has fixed water sampling sites at this location (#115 & #116). Seven to eight miles downstream from Alderman Ford Park, Lithia Springs joins the river. This second-magnitude spring[1] has an average flow of approximately 50 cfs. Other smaller springs also flow to the river downstream from here.

Four to five miles downstream, Bell Shoals Road crosses the river. EPC has another long term monitoring site at this location (#114). From this point the river starts to be tidally influenced and it's shoreline is heavily developed by private homes. The river continues to flow west for 11 miles, where it discharges to Hillsborough Bay. EPC has another long term monitoring site (#74) at the Hwy. 41 bridge which is one mile east of the river's mouth.

The mouth of the river was radically altered by a phosphate facility (currently called Cargill Fertilizer Inc.) in the 1920 or 30's. The river mouth was filled and relocated. The spoil from this alteration was deposited to form two islands just west of the river mouth.. These islands have become a major sea bird colony. The reconfigured Alafia River Channel, that primarily serves Cargill, is 30 to 34 feet deep.

[1] U.S. Geological Survey Report 95-4107, 1996.

Tampa Bay: Tampa Bay is located in west central Florida along the Gulf Coast. It is a complex of adjoining bays, tidal streams, and estuaries. It includes Boca Ciega Bay, Old Tampa Bay, Hillsborough Bay, McKay Bay, Middle Tampa Bay, Cockroach Bay, Terra Ceia Bay, and the Manatee River estuary.

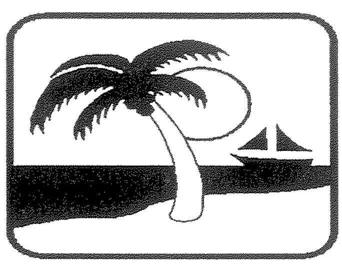
The open water area of Tampa Bay covers about 370 square miles, not including emergent wetlands[2]. The Bay's shoreline length is approximately 903 miles. Much of the original area of Tampa Bay has been dredged and filled to create man-made islands and lands for residential and commercial use. Much of this development took place in the 1920's and continued through the 1960's. Some continues today but on a smaller scale and under tighter regulations.

Three counties and over 19 municipalities border the Bay. The Bay has Florida's most industrialized coastline and is home to the nation's seventh largest port.

Hillsborough Bay is surrounded by the City of Tampa and has a major port located in its northern reach. The area known as Hookers Point has most of the major heavy industry and port terminals. The port area east of Hookers Point is known as East Bay and is a major phosphate shipping area. These areas are served by a major shipping channel that connects with the Gulf of Mexico.

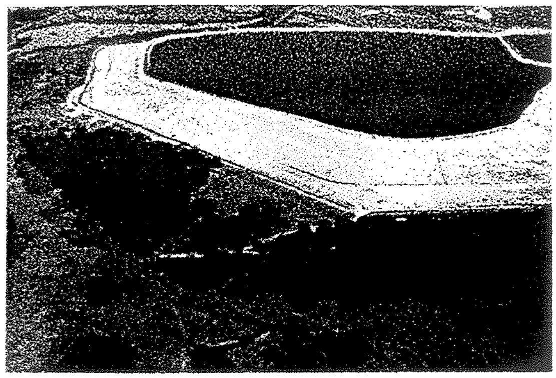
Three major rivers (Hillsborough, Palm, and Alafia) discharge to Hillsborough Bay. The Little Manatee River and Manatee River flow into the lower reaches of the Bay. Pinellas County and the City of St. Petersburg lie to the west of the Bay and have no major rivers. Most of Tampa Bay's seagrass beds are located[3] on the western side of the Bay and the eastern shoreline of middle and lower Tampa Bay. There are relatively few seagrass beds in Hillsborough Bay. The eastern shore of Old Tampa Bay also contains seagrass beds. The surrounding uplands of Tampa Bay are nearly level with numerous ponds, swamps, marshes, lakes and perennial streams.

With greatly improved water quality over the last 15 to 20 years, Tampa Bay has become a popular place to swim, fish, and boat.



[2] Lewis & Whitman, BASIS 1, May 1982.
[3] NEP Boaters Guide To Tampa Bay, January 1997.

Mulberry
Phosphates
May 14, 1998



Failed Gypsum Stack

Acid Spill Chronology

The following account of the December 7 acid spill came from information gathered from various news reports, consultant documents[4], water monitoring results, meetings, conversations with Department of Environmental Protection (DEP) staff, and EPC staff.

The process used in central Florida for manufacturing phosphoric acid and other fertilizer products creates huge gypsum stacks that contain acidic process water. This acidic process water is a continuing closed loop system that results in the containment of millions of gallons of process water. Much of this water is contained on top of these continuously growing gypsum piles which are also surrounded by secondary containment facilities. This process water contains radionuclides, some organic compounds, trace metals, major constituents and miscellaneous parameters. The process water is essentially dilute phosphoric acid (approx. 1%) with a pH in the range of 1.5 to 2.0. A release of this process water to the environment (Alafia River) can be lethal to all aquatic life if not neutralized or diluted prior to contact.

At about 5:30AM Sunday morning December 7, 1997, an upper gypsum stack dike broke and released process water to an outer embankment area (return water ditch) which exceeded its capacity and overtopped its banks, and flowed to the seepage collection ditch at the base of the stack. The water then overtopped the containment berms bordering the seepage collection ditch. The failure followed the relocation of the company's gypsum stack decanting system.

The water made its way to Skinned Sapling Creek. By 10AM that morning, Mulberry Phosphates Inc. had sealed the breached dike. Approximately 50 million gallons of process water was released to the environment. The company's prompt response apparently averted a more catastrophic release.

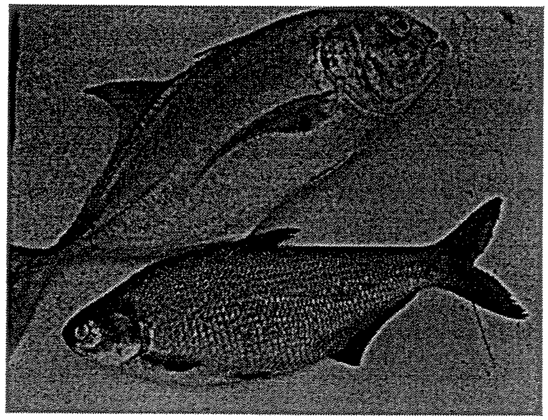
Skinned Sapling Creek flows to the north prong of the Alafia River. The confluence of the creek and the river forms a broad marsh-like environment with no clear channel. The aerial photographs taken after the spill reveal that the process water spread out over this wide wetland and also moved into ponds owned by other companies. Approximately 6000 fish[5] died in ponds owned by CF Industries. The pH in this wetland probably dropped in the range of 2.0 to 4.0 which was lethal to most aquatic life. Three days prior to the release, the Tampa Bay area[6] experienced over 2 inches of rainfall. Whether or not this contributed to the release is unclear at this time. The Alafia River in Polk County flows west for about 7 miles to the Hillsborough County line and then continues west another 30 miles to Tampa Bay.

[4] Amundsen & Moore, Summary Report of Determination of Cause of Process Water Discharge... January 19, 1998.

[5] Preliminary Report, Biological and Physical Assessment, compiled by Amundsen & Moore, Jan. 20, 1998.

[6] Local Climatological Data, December 1997, NOAA.

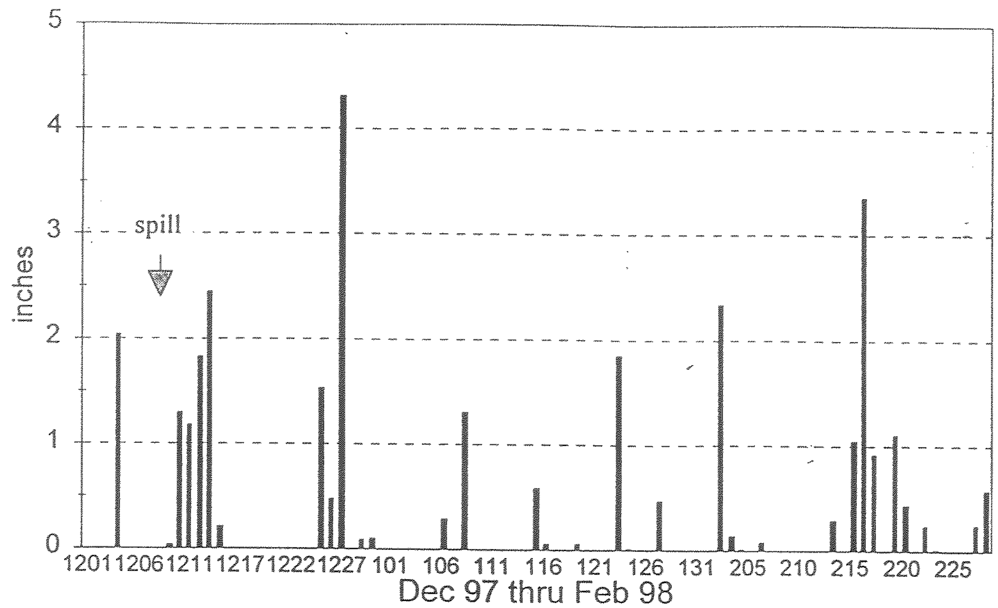
The released water was diluted by the creek and river water but the pH remained low, enough to kill most aquatic life in the entire 37 mile length of the Alafia River. Infrared aerial photography, taken after the spill, dramatically reveals the wetlands damage that occurred in Polk County. All forms of life, from alligators to fish were killed in the immediate area of the spill and downstream for the next 37 miles.



EPC became aware of the incident on Monday morning December 8 and immediately began planning and coordination with DEP and other agencies. In cooperation with DEP, EPC took the lead in tracking the plume and monitored it for the next 10 days as it moved towards the Bay.

By 11:50AM, Monday Dec. 8, the plume had traveled about 12 miles and was somewhere near river mile 24 (between Alderman Ford Park and Keysville). This indicates that the slug of contaminated water was traveling about 0.4 mph and should arrive in Tampa Bay in about 60 hours. Water sampling confirmed its arrival by Dec. 12^{th}. Three days after the spill, abnormally heavy rains began to fall at 3PM on Wednesday Dec. 10 and continued for the next four days, dropping 6.97 inches. The month of December 1997 went into the history books with a record total of 15.57 inches of rainfall. The good news is that the rain helped wash the plume from the river. The bad news is that rain water has very little neutralizing capacity and that the bulk of the neutralization would have to take place in estuarine waters near the mouth of the river or in Tampa Bay.

Tampa Bay Area - Rainfall



By Tuesday Dec. 9, the plume had traveled past Bell Shoals Road. The Alafia River upstream from Bell Shoals is a fresh water environment. From Bell Shoals heading downstream the water starts to mix with estuarine (marine) water. Up to this point all of the fish killed were probably freshwater fish, but now the low pH waters were to affect marine species such as snook and mullet.

As the fresh water meets the marine water, mixing and neutralization began. However, fresh water is lighter than salt water and a salinity gradient formed. This was most noticeable near the mouth of the river. The salinity gradient may have helped protect some bottom dwelling benthic organisms and biota because the highly acidic water tended to remain near the surface in the upper water column. The most lethal water remained on the surface.

By Wednesday Dec. 10, the plume was only about 4 miles from Tampa Bay and very close to the I-75 bridge. Citizen complaints of fish dying started to come into EPC offices. Up to this point EPC monitoring staff had not seen any dead fish, but on Dec. 10th , dead freshwater and saltwater catfish were seen on the shoreline under the I-75 bridge. The pH from the Hwy. 301 bridge to the Polk County line was below 4.0. State of Florida surface water standards dictates that the pH shall not get below 6.0. At pH 4.0 most, if not all aquatic life cannot survive. The plume was so strong that even microscopic plankton were killed. Most of the dying fish were seen near the Hwy. 301 bridge. Large gar and snook were slowly swimming on the surface and could be easily caught by hand. The fish appeared to be experiencing a coagulation of their outer slime coating, had slightly cloudy eyes, and their gills had lost their normal red color. We suspect that the low pH (acidity) had burned their gills, interfering with their ability to extract oxygen from the water. They ultimately suffocated (died of asphyxia).

By Thursday Dec. 11, the entire river in Hillsborough County had dropped below the State standard pH limit of 6.0 and was at pH 3.7 at the Hwy. 301 bridge. The flow in the river had also dramatically increased due to the heavy rains. A massive fish kill was underway in the lower river.

By Friday Dec. 12, the upper 20 miles of the river from the Polk County line to an area about 2 miles downstream of Bell Shoals road had recovered to pH levels above 6.0. EPC measured a pH of 6.8 at the Bell Shoals bridge at 4 PM. Normal pH in any part of the Alafia in Hillsborough County should be about 7.4. EPC staff counted dead fish on the shore at William's Park, which is just west of the Hwy. 41 bridge. Twelve different species were observed. Gulls were observed scooping small (less than 2 inches) fish from the river's surface. The bird feeding activity may explain the relative absence of small (<2 inches) fish on the shorelines. During the incident, unusually large numbers of birds were observed in the area. A lone fisherman gave up fishing from the pier and complained about his live shrimp dying in less than 30 minutes. A light rain was still falling.

By Monday Dec. 15, the pH of the entire river in Hillsborough County had returned to levels above the DEP surface water quality standard of not less than 6.0.

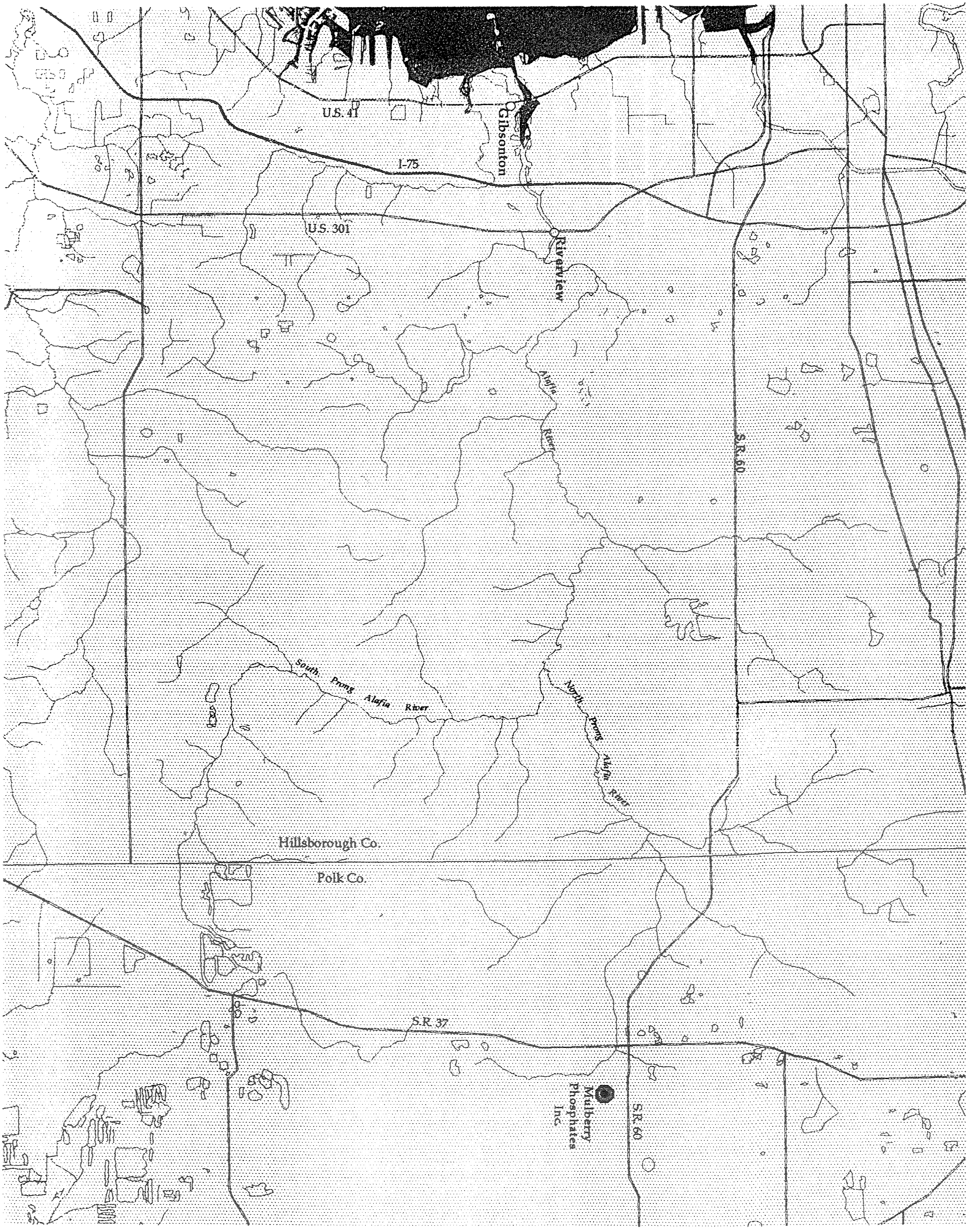
Alafia River - Water Monitoring

Special Short Term Monitoring (Incident Monitoring):

As a result of the Dec. 7 spill, EPC began its sampling at two river locations on Monday Dec. 8th and found the pH at the Keysville bridge to be 2.8. A normal pH is about 7.4. The conductivity, sulfate, fluoride, and phosphorous concentrations were all abnormally high. Turbidity was slightly higher and dissolved oxygen was normal. The plume had not yet reached the Alderman Ford Park area which still had a normal pH of 7.2. No dead fish were observed. These sampling results along with all of the following results can be found in appendix 4-A.

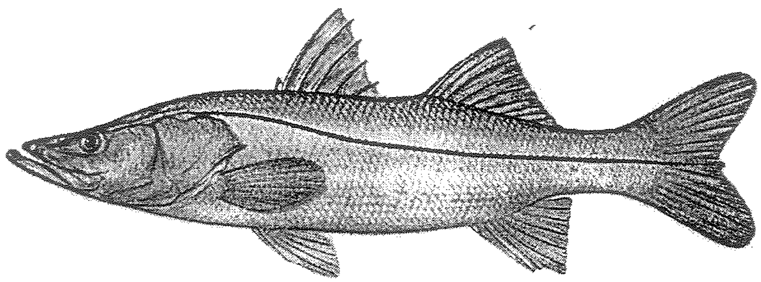
Five sites were monitored on Tuesday Dec. 9 from the Keysville bridge, down river to Hwy. 301, for pH and twelve other parameters. The pH readings from Keysville downstream to Bell Shoals were all below 3.1. The pH at Hwy. 301 was still normal at 7.6. A salinity gradient was very noticeable at Hwy. 301 with a surface conductivity of 574 μmhos and 23,200 μmhos on the bottom. A normal orthophosphorus concentration at Alderman Ford Park should be under 3 mg/l but 485 mg/l was measured. Total nitrogen at the four affected sites were in the range of 42 to 120 mg/l. No dead fish were observed at any of these five sites.

On Wednesday Dec. 10, fourteen sites on the Alafia River were sampled. The first 10 sites from the mouth of the river to John Moore Road were sampled by boat. Bell Shoals and Alderman Ford were sampled from bridges. Many dead and dying fish were observed in the vicinity of the Hwy. 301 bridge. Dead fish were not seen at Hwy. 41, Bells Shoals, or Alderman Ford Park. By Dec. 10, the plume was near the Interstate 75 bridge. The pH from Alderman Ford Park downstream to Hwy. 301 was below 4.0. Orthophosphorus concentrations from Hwy. 301 upstream to Alderman Ford were still above 100 mg/l. Plankton samples were collected from the mouth of the river to Alderman Ford Park. The first five samples from the mouth to about I-75 contained living plankton but no visible life, could be observed in samples from all other sites.


U.S. 41
Gibsonton
I-75
U.S. 301
Riverview
Alafia River
S.R. 60
South Prong Alafia River
North Prong Alafia River
Hillsborough Co.
Polk Co.
S.R. 37
Mulberry Phosphates Inc.
S.R. 60

pH measurements were taken by DEP on Thursday Dec. 11. Hwy. 301 was 3.7 and at the Hwy. 41 bridge, pH was 4.1. EPC calculated that over 27 miles of river were in violation of DEP's pH minimum standard on this date; however, the upper river was showing signs of improvement.

On Friday Dec. 12, EPC sampled three locations (Hwy. 301, Bell Shoals and Hwy. 41). The Hwy. 41 bridge site had a pH of 5.0 at the surface and was 6.2 on the bottom. pH at the other sites were all above 6.0. The river at the Hwy. 301 bridge was high and flowing strong due to heavy rainfall on the preceding 2 to 3 days. Ninety dead fish were counted along a 300 foot shoreline segment of William's Park at Hwy. 41. The dead fish consisted of *sand perch, lady fish, sheepshead, glass minnows, salt water catfish, gar, spade fish, spotted sea trout, red fish, snook and toad fish.*



On Monday Dec. 15, EPC sampled the river by boat at 6 locations from Hillsborough Bay upstream to Winn Road (8.2 miles upstream). A review of both EPC and DEP data revealed that the river no longer violated the "less than 6.0 pH" criteria anywhere in Hillsborough County. The lowest pH measured was 6.2 at Alderman Ford Park. The acidic plume had been pushed downstream by the flow of the river and neutralized by the estuarine water. Total phosphorus values at Hwy. 41 are typically about 1.0 mg/l but 6.4 mg/l was measured. There are no numeric DEP surface water quality standards for phosphorus. While the six sites on the lower river were being sampled, another EPC crew sampled the upper river at five locations. The pH at Keysville was at 8.1, fluoride was 10.9 mg/l, total phosphorus was 20 mg/l, and total nitrogen was at 3.7 mg/l. The other four sites further downstream had better water quality than the Keysville site.

On Wednesday Dec. 17, EPC sampled the lower estuarine river area benthic community by boat. The results of this survey are summarized in a separate document written by Stephen Grabe.

Long term monitoring program:

EPC has had a monitoring program at four sites on the Alafia River since 1973. About 35 different parameters are measured each month. This program has generated a large, comprehensive, long term data set. Tables 1 and 2 list the sites and parameters.

Table 1

EPC Alafia River Monitoring Locations

Site	Description
116	Alderman Ford, South Prong
115	Alderman Ford, North Prong
114	Bell Shoals road bridge
74	U.S. Hwy. 41 bridge

The typical chemical composition[7] of gypsum stack process water would potentially affect most of the parameters normally measured by EPC's monthly monitoring program. DEP information on typical process water, indicates that acidity, as CaCO3, is in the range of 30,000 to 50,000 mg/l and the pH ranges between 1.5 and 2.0. Specific conductance ranges between 20,000 and 35,000 µmhos/cm with the total dissolved solids range between 35,000 and 45,000 mg/l. Fluoride, sulfate and phosphorus range between 4,000 and 10,000 mg/l. In process water, aluminum is the most concentrated of all metals followed by iron, manganese, chromium, and others. The process water also contains radionuclides with expected gross alpha particle activity between 1000 and 5000 picocurie per liter (pCi/l).

[7] DEP document Composition of Process Water , faxed to NOAA 2-3-98.

Table 2

EPC Routinely Monitored Parameters

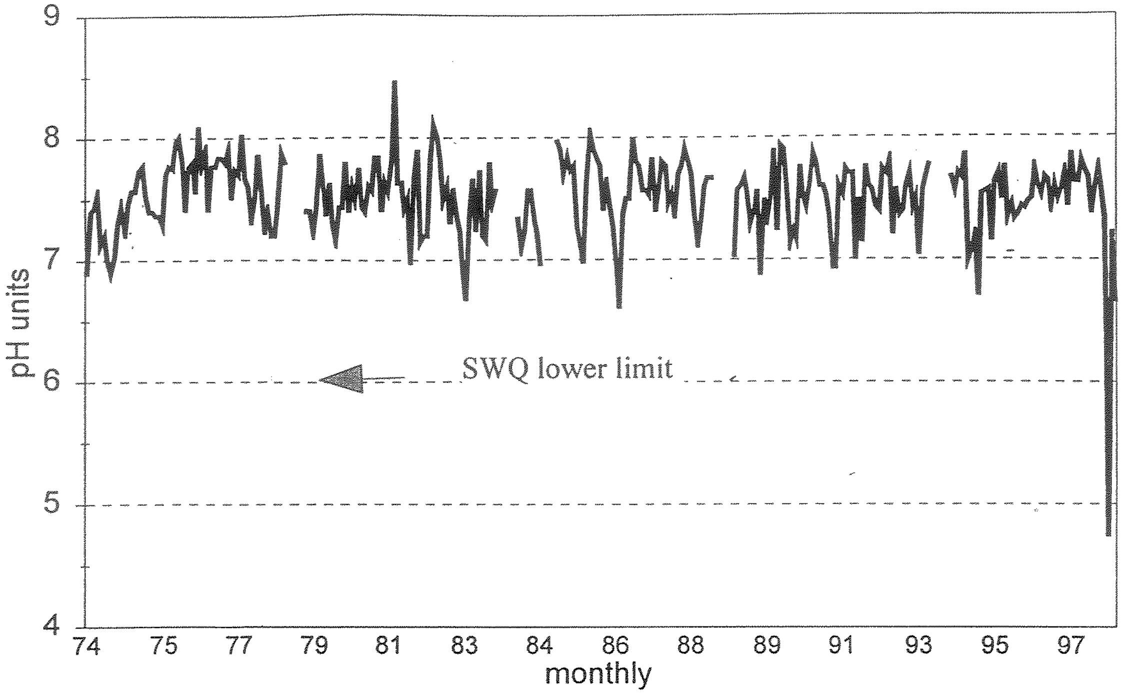
Number	**Parameter**	**Number**	**Parameter**	**Number**	**Parameter**
1	bottom depth	13	pH	25	total nitrogen
2	air temperature	14	BOD5	26	ortho P
3	water temp.	15	Chlorophyll a	27	total P
4	color (PtCo)	16	Chlorophyll b	28	calcium
5	Secchi disk	17	Chlorophyll c	29	magnesium
6	turbidity	18	Chlorophyll T	30	potassium
7	TSS mg/l	19	t. coli. bacteria	31	sodium
8	residue, total	20	f. coli bacteria	32	iron
9	residue, diss.	21	kjeldahl N	33	lead
10	conductivity	22	ammonia N	34	fluoride (diss.)
11	salinity	23	nitrate nitrite N	35	sulfates
12	diss. oxygen	24	organic N		

pH: The parameter of greatest interest to EPC during the spill was pH. The following graphs were prepared to show the overall pH trend in the river. In order to simplify the data, the pH from the three sites affected by the spill were averaged for each month. For comparative purposes, EPC's site #116 on the south prong of the Alafia was also graphed. This site was not affected by the Mulberry spill and is located at Alderman Ford Park a short distance from site 115 on the north prong.

The graphs show that the pH is normally between 7 and 8. **The spill caused the pH to reach the lowest value ever recorded by EPC in 24 years.**

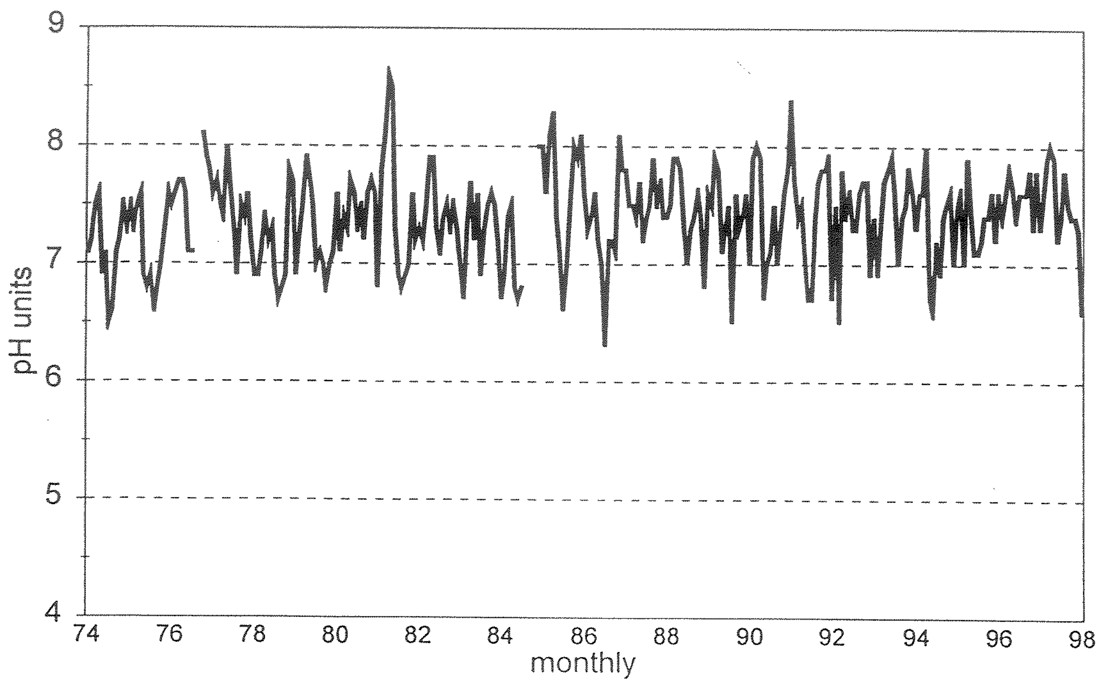
pH Trend - Alafia River

Average of 3 EPC sites (115,114,74)



pH Trend - S. Prong Alafia R.

EPC site 116



Appendix 4-1 lists the actual data used to produce these graphs. Following, table 3 lists the mean, minimum and maximum pH measured by EPC for the three years prior to the spill.

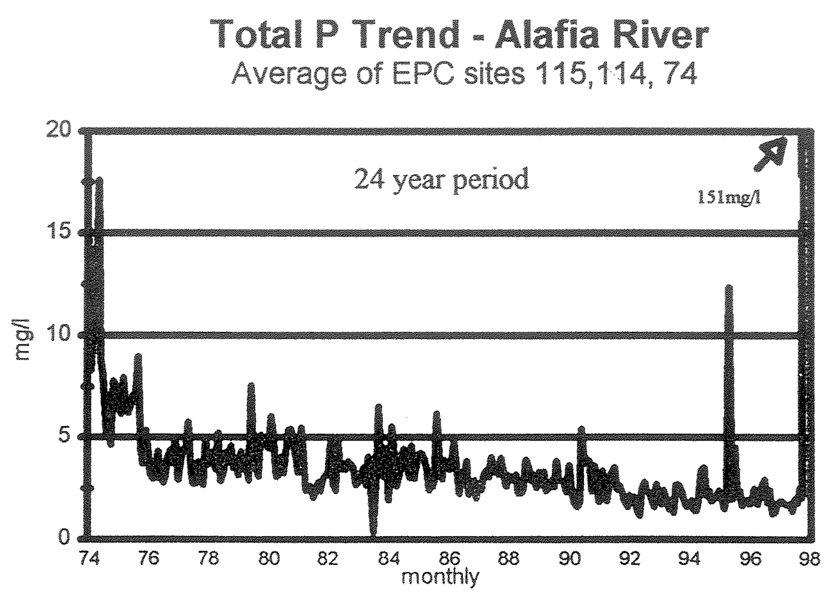
Table 3

pH - Prior to Dec. 7th Spill

Means - Minimums- Maximums (1994 thru 1996)

Site #	pH 3 year mean	pH min 3 years	pH max 3 years
116	7.4	6.6	8.0
115	7.4	6.4	8.0
114	7.4	6.8	7.7
74	7.6	6.4	8.0

Phosphorus: One of the most improved parameters monitored in the Alafia River over the past 24 years is phosphorus. As illustrated in the following graph, concentrations exceeded 10 mg/l as P were measured in the early 1970's but has declined below 3.0 mg/l for 1996 and 1997.



The Dec. 7th spill resulted in the highest phosphorus values ever recorded by EPC for these three sites.

Table 4 lists the mean, minimum and maximum total phosphorus concentration measured at four sites routinely monitored by EPC for the three years prior to the spill.

Table 4

Total Phosphorus - Prior to Dec. 7th Spill

Means - Minimums - Maximums (1994 thru 1996)

Site #	Total P 3 year mean	Total P min 3 years	Total P max 3 years
116	1.0	.41	2.57
115	4.5	2.41	24.86
114	1.9	.70	10.49
74	1.0	.24	1.94

Total Nitrogen: Another important parameter, particularly because of its affects on microscopic algae growth in the river and in the bay, is total nitrogen. Total nitrogen is the sum of two separate tests, Kjeldahl nitrogen and nitrate-nitrite nitrogen. This parameter has also shown remarkable improvements in the river and in Tampa Bay over the past 24 years. There is no specific DEP numeric criteria for this parameter; the criteria is narrative. The DEP standard states "that in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna."

Table 5 lists the mean, minimum, and maximum total nitrogen concentration measured at four sites routinely monitored by EPC for the three years prior to the spill.

The spill caused readings to be the highest ever measured by EPC for the entire river.

Total N Trend - Alafia River

Average of EPC sites 115,114, 74

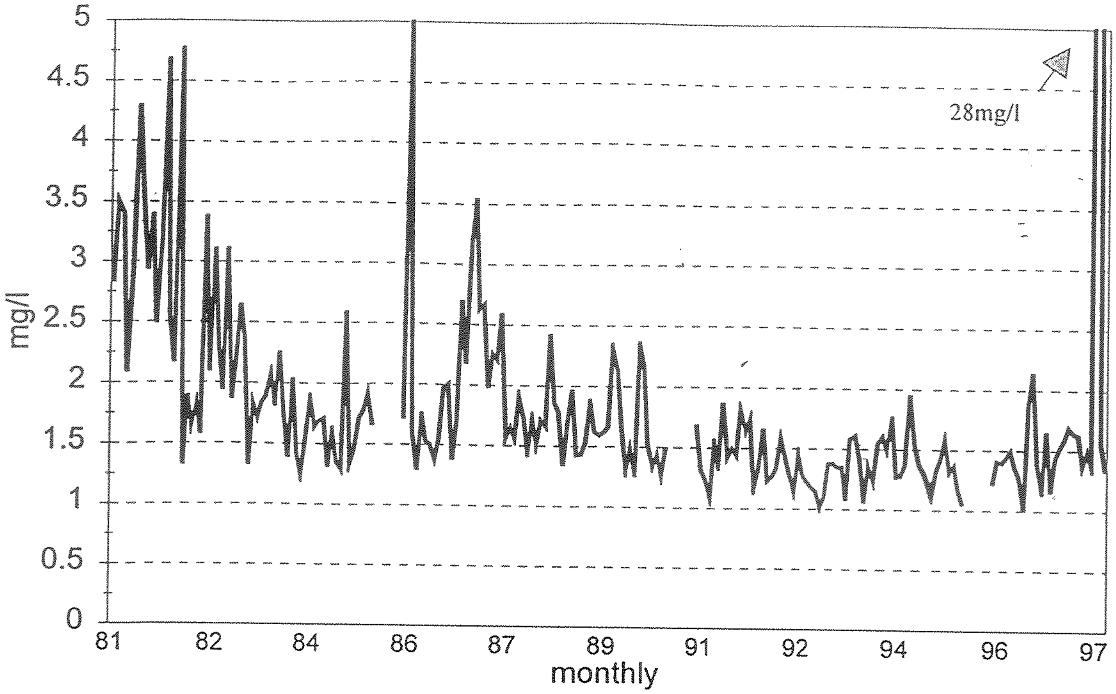


Table 5

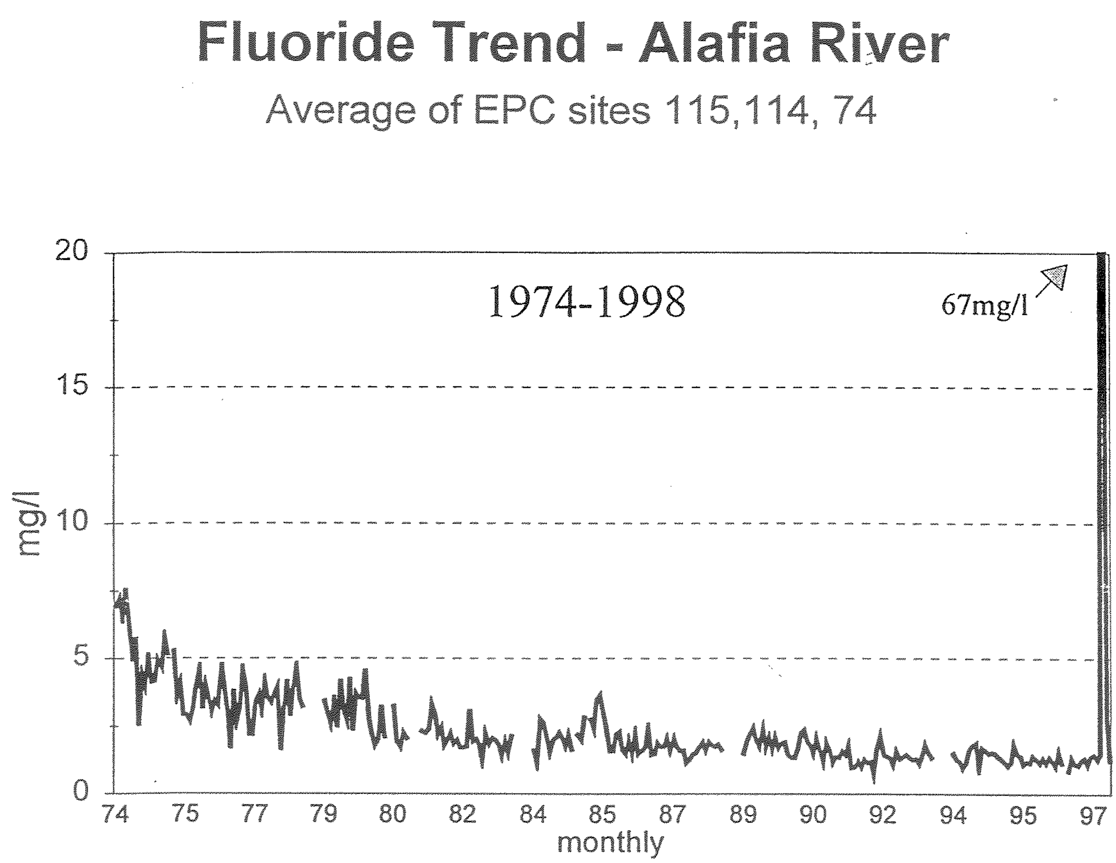
Total Nitrogen - Prior to Dec. 7th Spill

Means - Minimums - Maximums (1994 thru 1996)

Site #	Total N 3 year mean	Total N min 3 years	Total N max 3 years
116	1.0	.44	2.79
115	1.3	.54	3.07
114	1.5	1.15	2.26
74	1.4	.35	3.23

Fluoride: Fluoride is another parameter routinely monitored by EPC in the Alafia River. It is a byproduct of fertilizer manufacturing and has long been a pollutant of special concern because of the phosphate industry. The DEP surface water criteria states that the concentration shall not exceed 10.0 mg/l for the Class II freshwater area of the river and shall not exceed 5.0 mg/l for the Class III marine area.

The 24 year fluoride trend has been declining, similar to phosphorus and nitrogen trends. **The spill caused the concentration to rise to the highest ever recorded by EPC in the river. Portions of the river exceeded 280 mg/l as F during the spill.**



The following graph shows the fluoride trend for site # 116, south prong Alafia River, which was not affected by the Mulberry spill.

Fluoride Trend - South Prong Alafia River

EPC site 116 (not affected by spill)

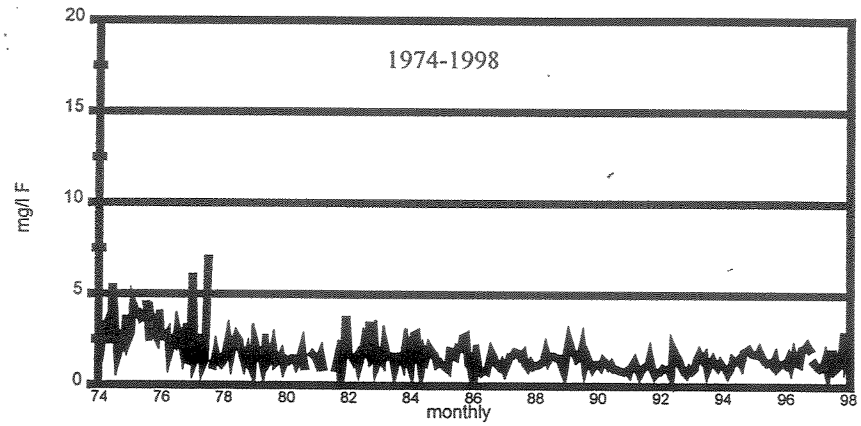


Table 6 lists the mean, minimum and maximum fluoride concentrations measured in the river over the past three years (1994-1996) at four sites.

Table 6

Fluoride - Prior to Dec. 7th Spill

Means - Minimums - Maximums (1994 thru 1996)

Site #	F mg/l 3 year mean	F mg/l min 3 years	F mg/l max 3 years
116	1.5	.76	2.27
115	1.8	1.25	2.53
114	1.2	.68	1.75
74	1.0	.65	1.49

Other parameters: Several of the other 31 different parameters routinely monitored by EPC may have also been affected by the process water release but were not evaluated for this report. Upon request, EPC makes all of its routine monitoring data available to any interested party via hard copy, fax, computer disk or email.

Tampa Bay Water Quality Impacts

The slug of water, contaminated by the spilled process water from Mulberry Phosphates, reached Tampa Bay on Thursday, December 11th. The pH in the bay in the vicinity of the mouth of the river probably reached a range between 5.0 and 6.2 for a couple of days. Dead or dying fish in Hillsborough Bay were not reported or seen by EPC staff. Bay water is slightly alkaline and has a great capacity for neutralizing acids (buffering). Phosphorus and nitrogen are major components of the spilled process water and are contaminants of primary concern to EPC.

Once the contaminants reach the bay, they will remain in the Bay for months. Phosphorus and nitrogen, have historically caused considerable harm to Tampa Bay. Over the past 25 years, an enormous amount of money and effort has gone into reducing the level of these nutrients in Tampa Bay. These nutrients produce excessive phytoplankton which reduces the amount of sunlight on the seagrass beds. The ecological damage can be great as seagrass beds recede and growth rates are reduced, the habitat they provide is diminished. The end result is a damaged ecosystem producing less fish and less recreational opportunities for our citizens and visitors.

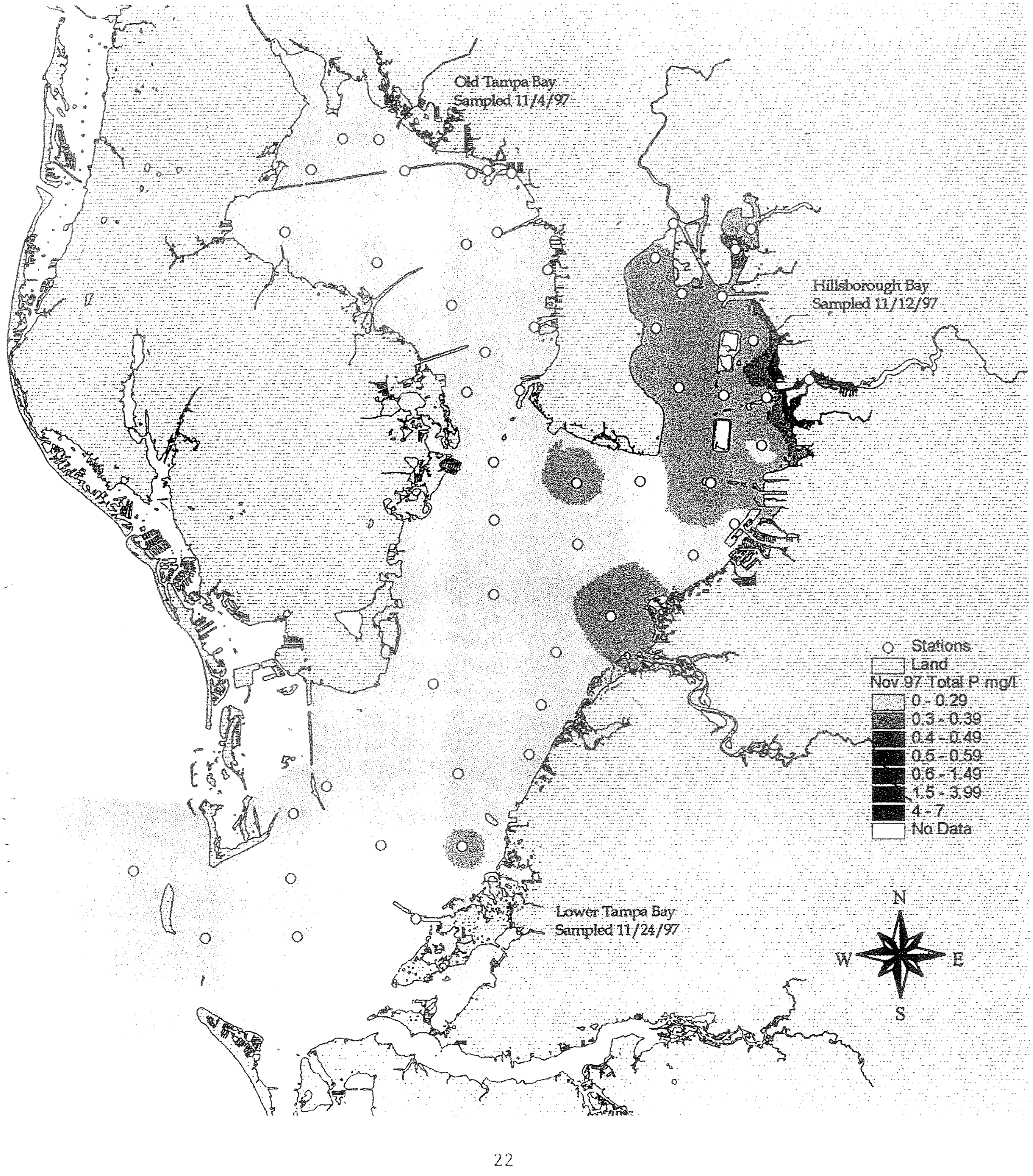
Phosphorus: EPC has sampled the Bay over a 3 week period each month of each year for the past 24 years. The last complete monthly sampling <u>prior</u> to the spill occurred in November 1997. Old Tampa Bay was sampled Nov. 4th, Hillsborough Bay Nov. 12th and Lower Tampa Bay Nov. 24th. The November data was combined to generate a GIS map depicting the spatial distribution of phosphorus in Tampa Bay, prior to the December 7 spill. Note that the sampling for the following series of GIS maps were not synoptic, but actually occurred over a 1 to 3 week period.

During the month of December 1997, the bay-wide normal routine sampling occurred on the 2nd (Old Tampa Bay), the 3rd (Hillsborough Bay), and on the 16th (Lower Tampa Bay). Since the spill occurred in December, two GIS maps were produced, a pre-spill and a post-spill December map. Data for the 2nd and 3rd of December was mapped (see map titled <u>Total Phosphorus December 1997 Pre-Spill</u>). This GIS map reveals phosphorus distribution in Old Tampa Bay and Hillsborough Bay just 4 to 5 days prior to the spill. A post spill Dec. 1997 GIS map was produced, which included only data from samples collected 8 to 9 days after the spill. This data for December 15 and 16, produced GIS map titled <u>Total Phosphorus December 1997 Post Spill</u>. The maps clearly reveal that the contamination had already affected an area as far south as the Sunshine Skyway bridge, by Dec. 16. Both Pinellas and Manatee county waters were affected.

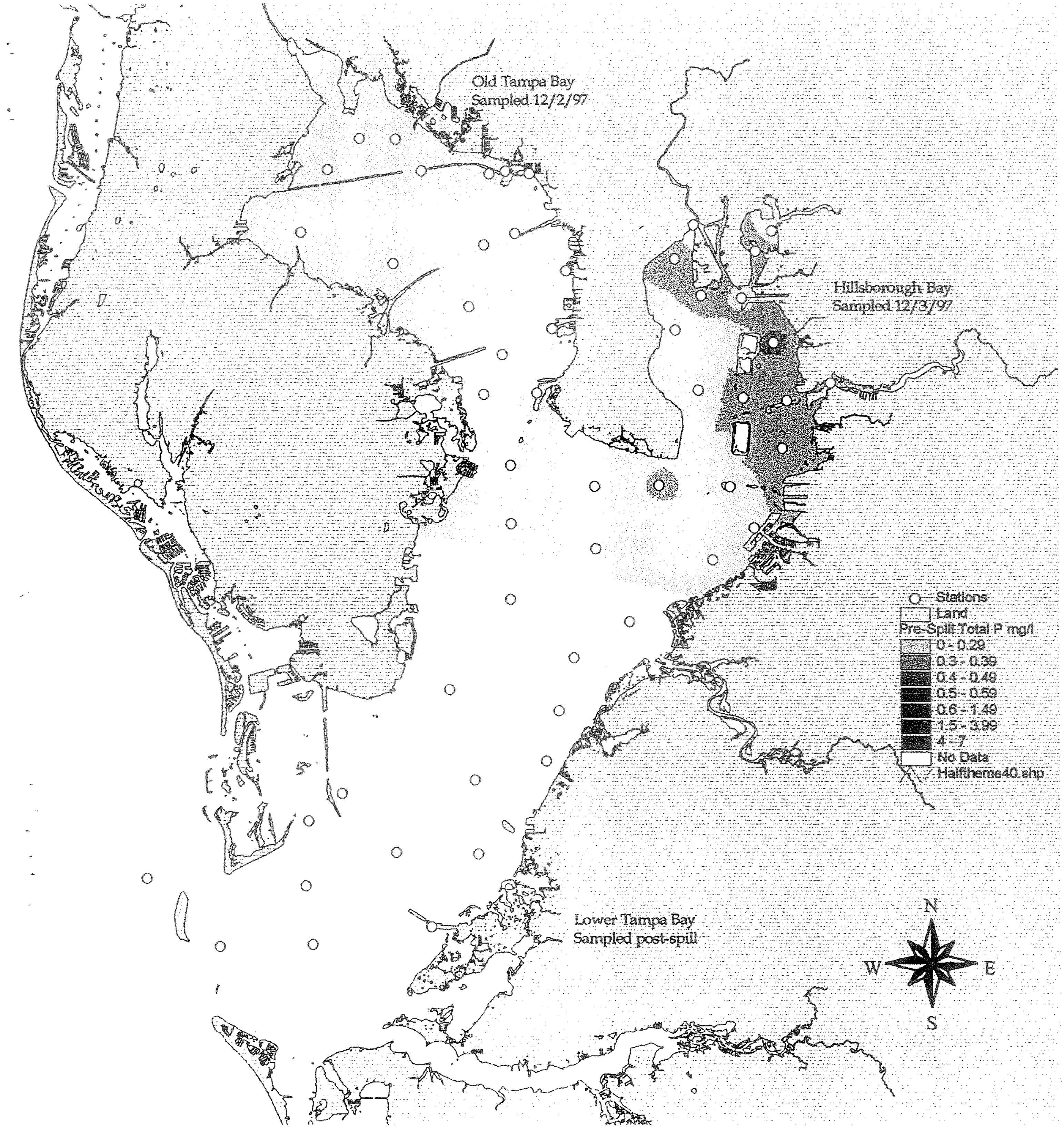
EPC's next normal full month sampling after the spill occurred in January 1998. Old Tampa Bay was sampled on Jan. 6th, Hillsborough Bay on Jan. 13th, and Lower Tampa Bay on Jan. 27th. This data was also combined for a spatial analysis. As depicted in the GIS map (Total Phosphorus January 1998), elevated phosphorus in Tampa Bay can still be seen some 30 to 50 days after the spill. Hillsborough Bay and Middle Tampa Bay were the most affected, but even the lower parts of Old Tampa Bay experienced elevated phosphorus concentrations.

By February 1998, the phosphorus levels began to subside, but Hillsborough Bay and Middle Tampa Bay are still relatively contaminated. By March the contamination is still quite evident in Hillsborough Bay and Middle Tampa Bay. The April GIS map reveals a substantial improvement, with Hillsborough Bay and the upper parts of Middle Tampa Bay still affected.

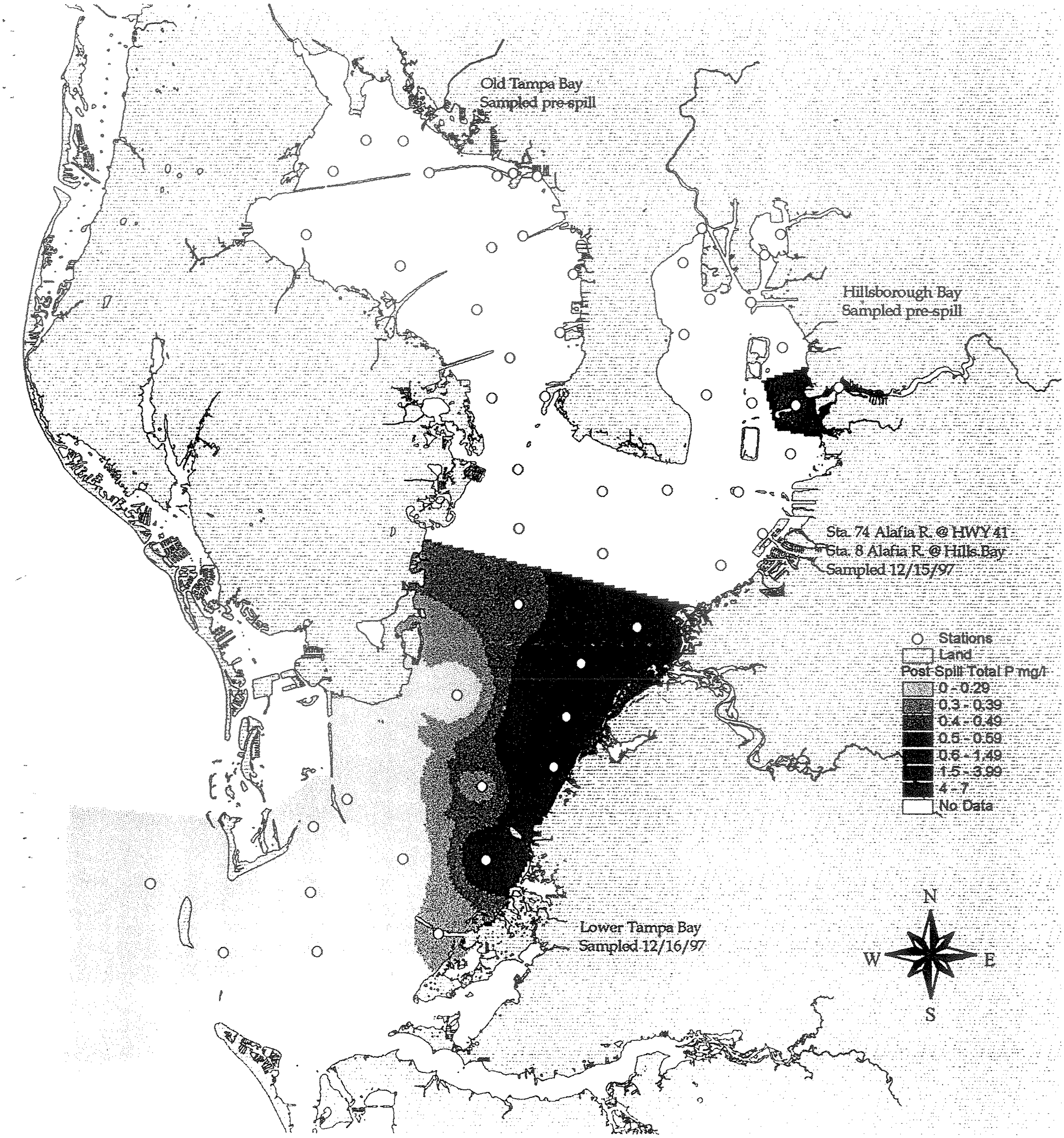
Total Phosphorus
November 1997



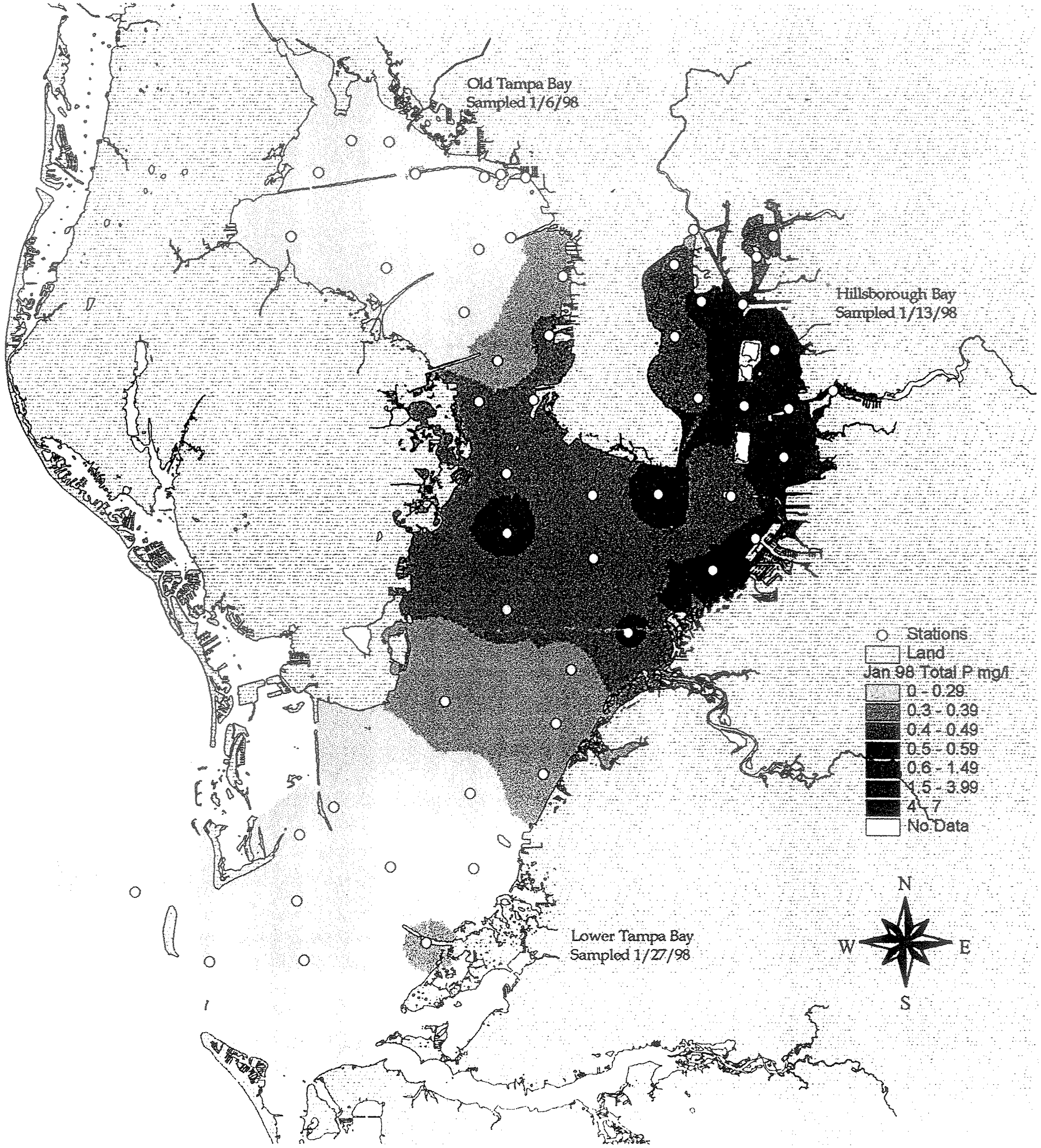
Total Phosphorus
December 1997
Pre-Spill



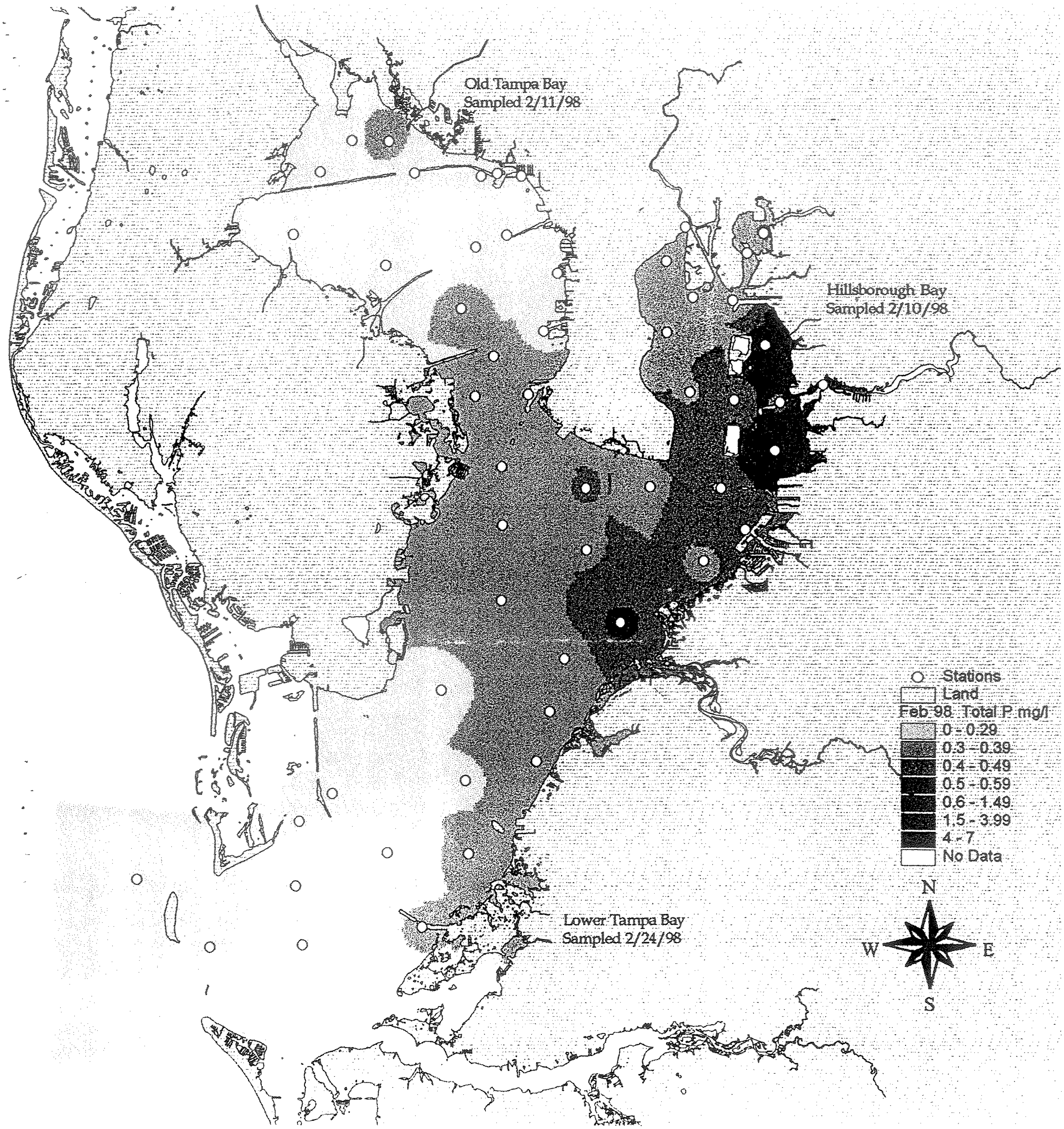
Total Phosphorus
December 1997
Post Spill



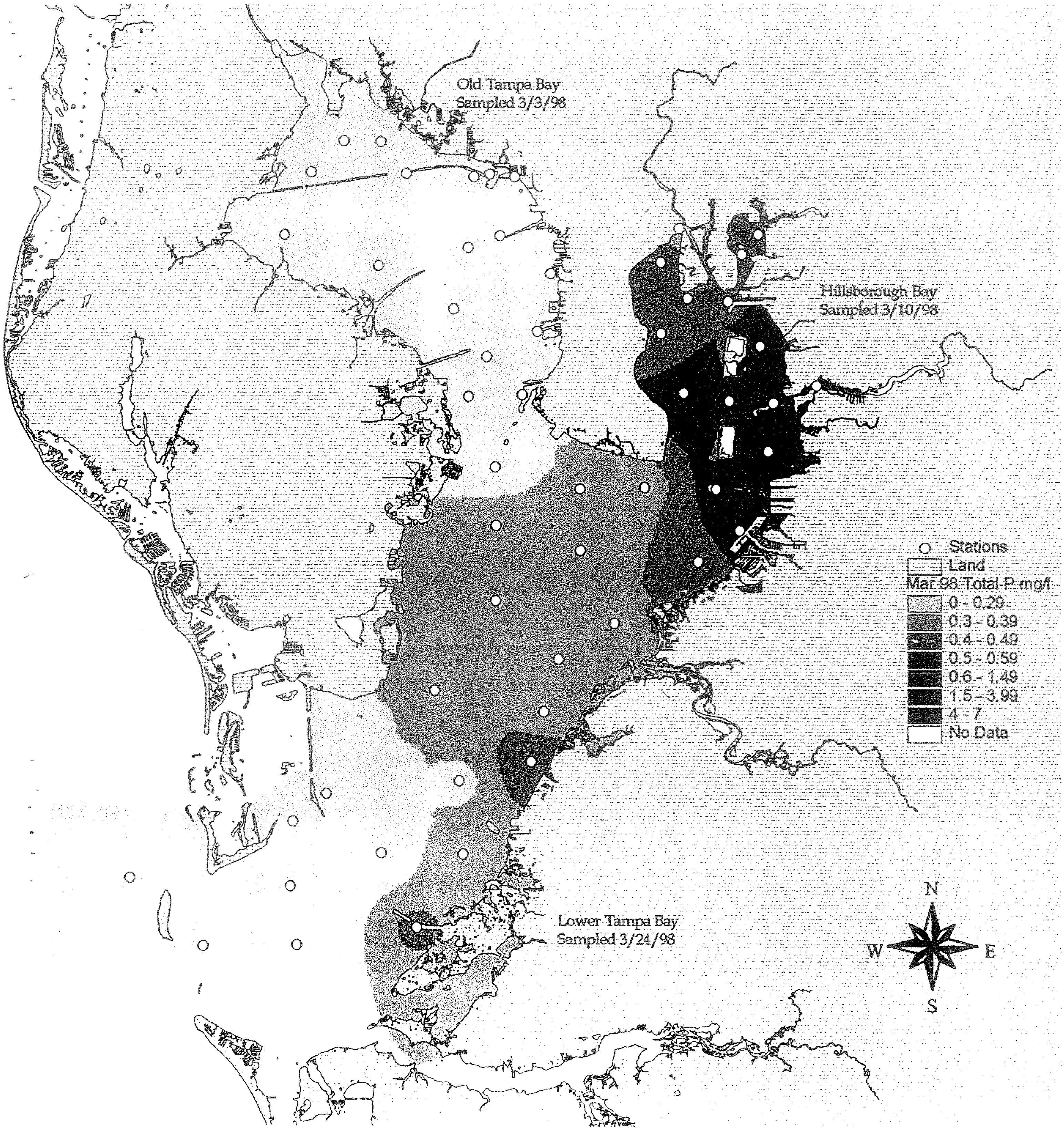
Total Phosphorus
January 1998



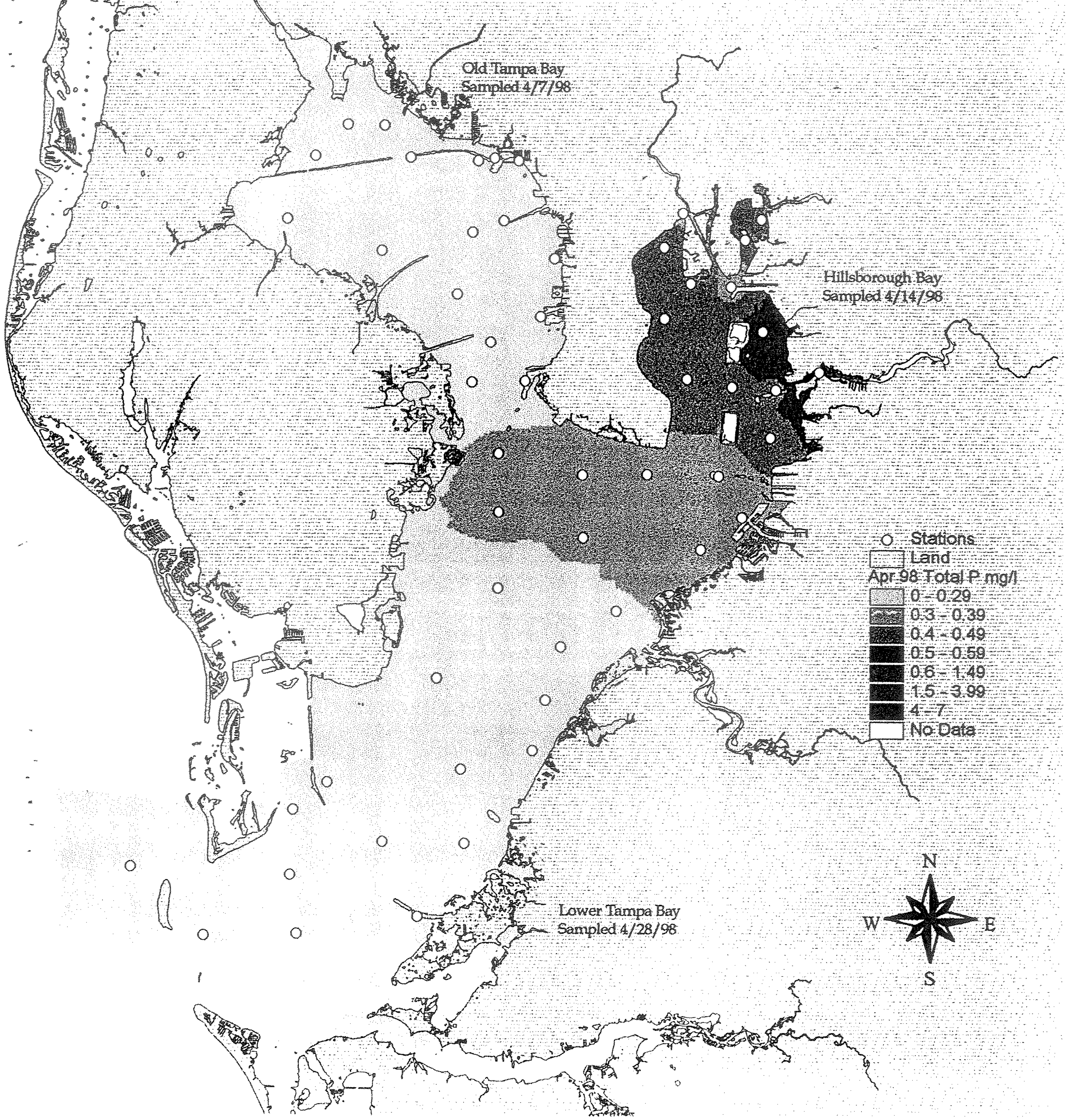
Total Phosphorus
February 1998



Total Phosphorus
March 1998



Total Phosphorus
April 1998



Historically, February has been the month with the ***lowest*** chlorophyll concentrations and October the ***highest***. Table 7, shows mean chlorophyll *a* values for each site over a 24 year period by month of the year. For example, all of the data for January of each year over 24 years for site 19, averaged 3.9 µg/l.

Table 7

Chlorophyll "*a*" - 24 year mean by month

Six EPC Sites

Month	19	23	80	81	84	91	
1	3.9	4.0	3.9	3.9	3.7	3.8	
2	**3.8**	**3.8**	**3.9**	**3.9**	**3.6**	**3.4**	Low month
3	5.5	5.4	5.4	5.4	5.3	5.2	
4	5.4	5.3	5.2	4.6	4.2	4.0	
5	4.9	5.0	4.8	4.6	4.6	4.6	
6	5.0	5.0	5.1	5.0	5.0	4.8	
7	5.7	5.6	5.5	5.6	5.5	5.3	
8	7.8	7.7	7.7	7.8	8.0	7.9	
9	7.7	7.8	7.8	7.7	7.7	7.5	
10	**8.4**	**8.3**	**8.3**	**8.3**	**8.0**	**8.1**	High month
11	7.2	7.3	7.2	6.6	6.5	6.7	
12	4.5	4.5	4.4	4.2	4.1	4.1	

In 1996, the Tampa Bay Estuary Program adopted chlorophyll-*a* targets for major segments of the bay[9]. Table 8 lists these target values.

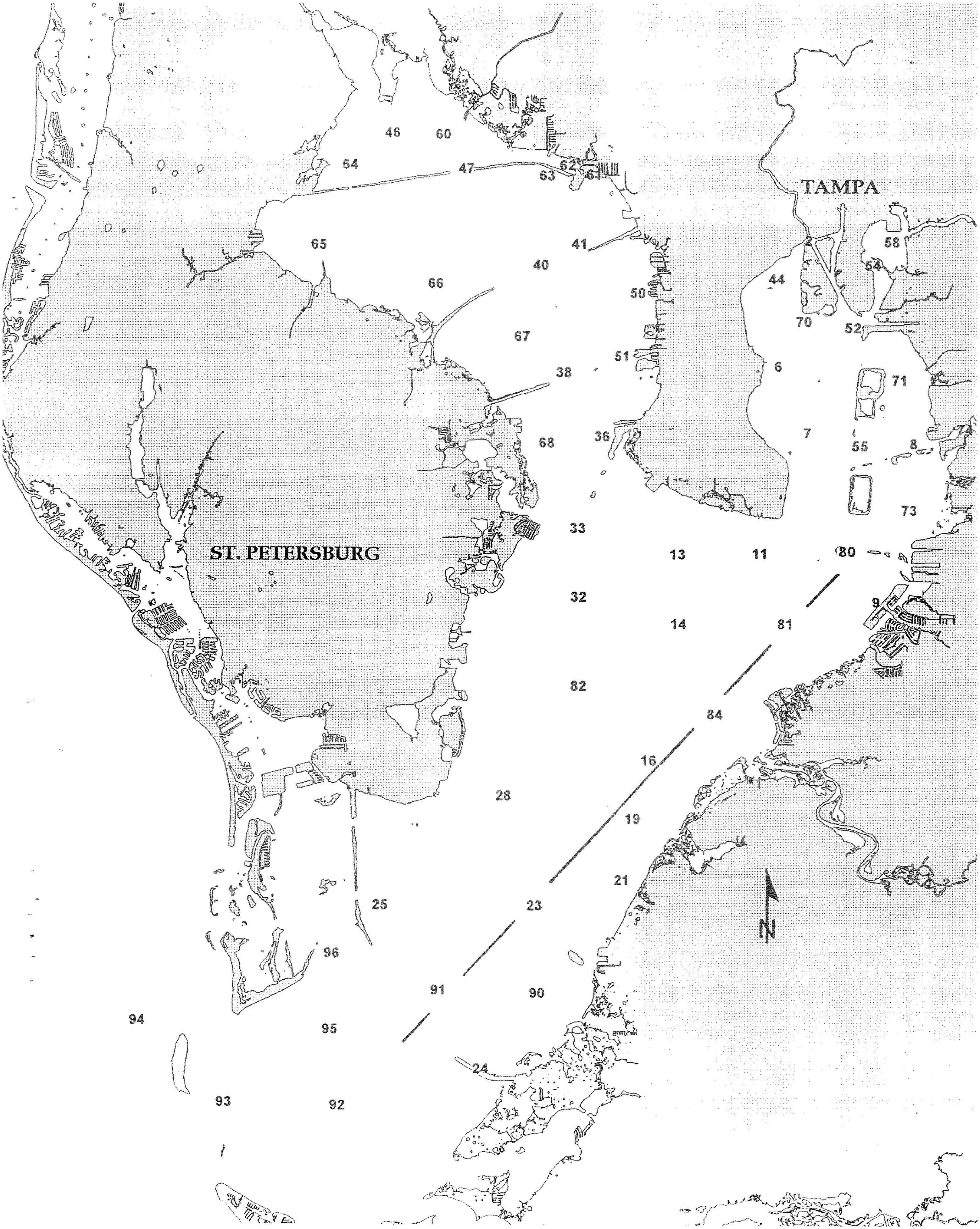
Table 8

Tampa Bay Estuary Program

Chlorophyll "*a*" Targets (µg/l)

Hills. Bay	Old Tpa Bay	Mid Tpa Bay	Lower Tpa Bay
13.2	**8.5**	**7.4**	**4.6**

[9] State of the Bay 1997, TBRPC Agency on Bay Management, April 1998, Annual Update of Tampa Bay Chlorophyll-*a* Concentrations.



TAMPA
ST. PETERSBURG
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N
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24
93
92

Chlorophyll A - GIS MAPS

The following series of GIS maps reveals how chlorophyll "*a*" concentrations (an indirect measure of phytoplankton) in Tampa Bay, changed before and after the spill.

As previously discussed, October is the month when chlorophyll normally peaks. By November and December, a decline in concentration is expected. February should be the month with the lowest values. As can be seen, November 1997 and December 1997 GIS maps are consistent with this pattern. However, by January 1998, chlorophyll began to increase, baywide. By February, large areas in Hillsborough Bay and Middle Tampa Bay were producing abnormally high amounts of phytoplankton. By March, Hillsborough Bay was wholly engrossed with an atypical phytoplankton growth. Other parts of the bay appeared to be relatively normal. By April 1998, chlorophyll began to decline baywide, with only areas in Hillsborough Bay near the Alafia River mouth still elevated.

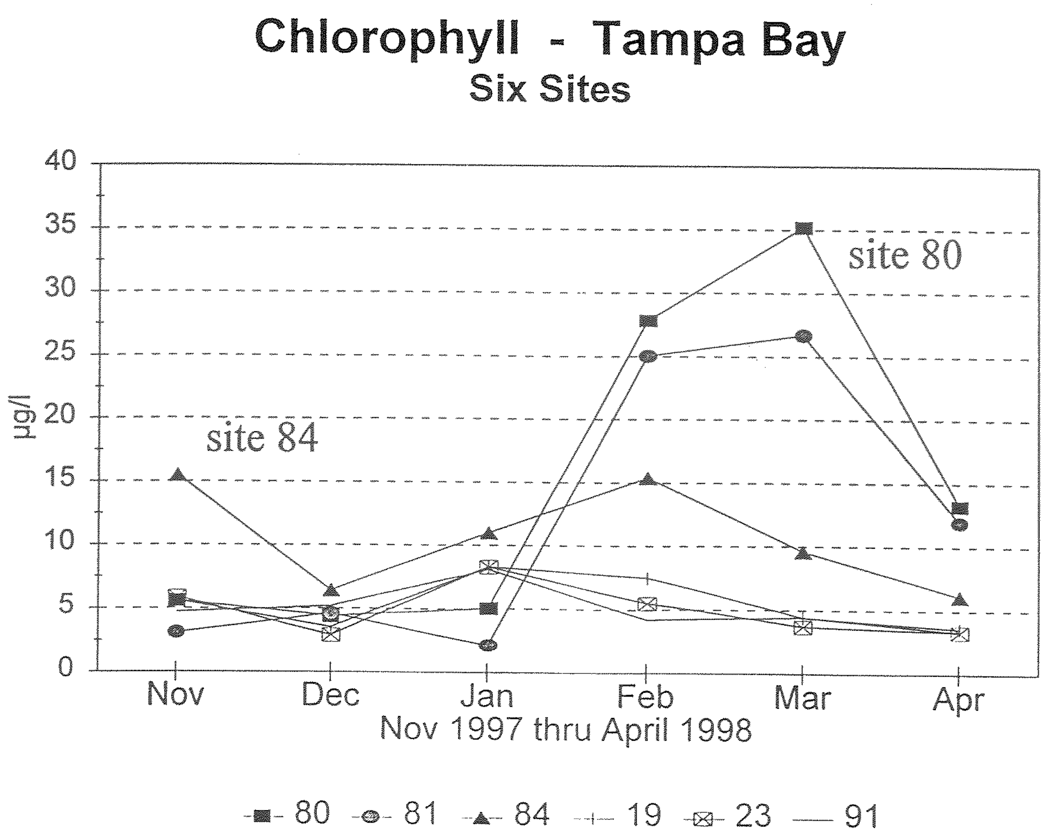
As of May 1998, the effects of the acid release on Tampa Bay's chlorophyll levels have subsided to the point that the Bay appears to be back to near normal. The actual effects on our seagrass beds and overall ecosystem are difficult to assess or quantitate. It may be too soon to make this type of assessment.

In addition, it is still possible that the Bay could still experience an outbreak of red tide or some other toxic algae bloom that is related to the released contaminants. Another problem, from a bay management perspective, is the effects that the increased chlorophyll will have on the Tampa Bay Estuary Programs chlorophyll targets.

Chlorophyll: As previously stated, nutrients, such as phosphorus and nitrogen are of great concern in Tampa Bay because of their ultimate affects on sea grass beds. Beginning in the 1950s[8], dredging and pollution destroyed more than half of the Bay's seagrass meadows and natural shoreline. This hastened the decline of popular recreational and commercial fish species, such as seatrout and snook. Excessive nutrients, particularly nitrogen, fueled algal growth, clouding the water and cutting off sunlight to the seagrass beds. Chlorophyll measurements on water samples has been the principal yard stick for monitoring this complex physical, chemical, biological relationship.

In an attempt to see if the nutrient contaminants, as depicted in the previous series of GIS maps, resulted in an abnormal amount of phytoplankton production, a group of six EPC long term sampling sites (see map page 30) were evaluated for Chlorophyll. These sites were chosen because they are in the general contamination area (as depicted in the GIS maps) and formed a line down the eastern shore of the bay.

The following graph reveals the monthly Chlorophyll concentration at each site from November 1997 (pre-spill) through April 1998. Sites 80, 81, and 84 had elevated chlorophyll after the spill, with peaks in February and March. At this time, data for May 1998 or later has not been collected or processed, but EPC will continue to monitor Chlorophyll each month.



Artificial Oyster Reefs and Bars

The Alafia River oyster reef at the Williams Park pier and another nearby man made oyster bar, were designed to encourage oyster growth within the Alafia River and were partially created as a mitigation effort related to the Gardinier, Inc. (Cargill) phosphoric acid spill of May 1, 1988. The Alafia River Oyster Bar Demonstration Project and the Williams Park Pier Oyster Reef Project are both located just west of the U.S. Hwy. 41 bridge and are on the south and north sides of the river respectively. The Oyster Bar project is located about ¾ mile downstream from the Williams Park pier. EPC monitors both of these projects.

On September 15, 1995 construction began on the Alafia River Oyster Bar Restoration Demonstration Project. It is a joint project of the Tampa Bay Estuary Program, Tampa Bay Regional Planning Council (TBRPC) and Environmental Protection Commission of Hillsborough County. The intent of the project is to re-establish healthy oyster bars in the Alafia River which have historically been lost to dredging of the shipping channel and the associated turning basin adjacent to Cargill Fertilizer Company. EPC's responsibility, is to monitor the oyster bar for a two year period and to report the findings to the TBRPC annually. The last report to TBRPC, which covered the period from September 1995 to September 1996, is available from EPC.

Light colored areas are the 3 artificial oyster bars .

The Alafia River Oyster Bar Restoration Demonstration Project was inspected on January 20, 1998 to determine the effect, of the acid spill on that project. Live oysters were found to be as abundant as previously last seen by EPC on December 4, 1997. In addition, juvenile crabs and numerous amphipods were still found attached to the oysters and the associated substrate. There were no apparent signs of any biological stress present on the day of investigation. EPC's next scheduled inspection of this site was to be March 1998 but because of the Mulberry spill the bar was re-inspected on January 20, 1998. The oyster bars are not scheduled for further inspection until September 1998.

The Williams Park Pier Oyster Reef Project was a joint EPC / FDEP project funded by the Gardinier Settlement Trust Fund to test the use of artificial substrate for the development and colonization of live oysters in the Alafia River. The project was built on Wednesday, April 24, 1996 by EPC and DEP staff under the supervision of Mr. Gus Muench, the owner of Oyster Reef Designs. A total of 40 hollow polyethylene mesh tubes were placed under the pier and anchored with clay bricks, steel reinforcing-rod stakes and polypropylene line. The tubes were not seeded with any oysters or other biological organisms.

During the nineteen months after installation of the polyethylene tube substrates and prior to the Mulberry Phosphates acid release, heavy biological / oyster growth had occurred on the reef. Oysters were in the 1 to 4 inch size range and had a diverse biological community associated with them.

The low pH water reached the Williams Park area on or about Thursday, Dec. 11 and dropped to a low of pH 4.1. The reef was exposed to pH levels below the DEP minimum of 6.0 for about 2 days. There was also a salinity gradient in the vicinity of the pier. This salinity gradient helped keep the low pH river water nearer the surface. For example, at 2:22 PM on the 12th of December, the pH at Hwy. 41 was 5.0 at the surface but was 6.2 on the bottom. This salinity gradient may have protected oysters growing in deeper water. Oysters also have the ability to close up under adverse environmental conditions, provided the conditions are not too severe or prolonged.

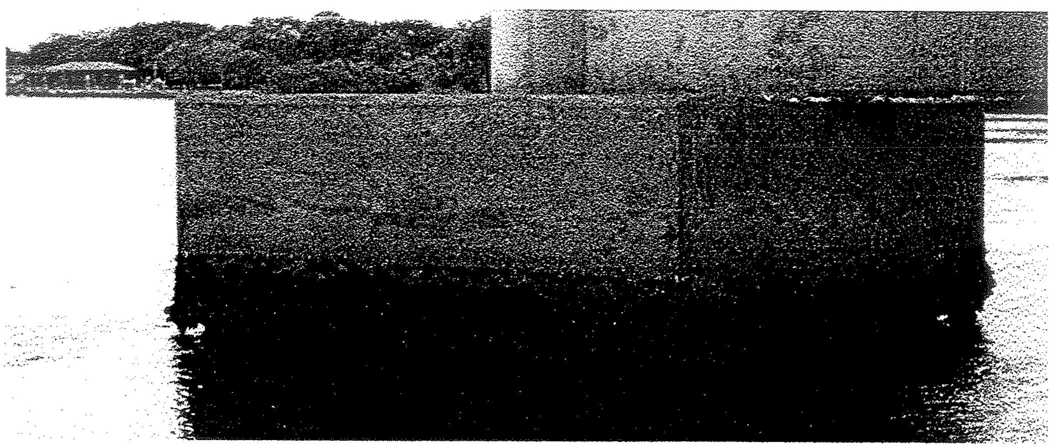
Shortly after the spill, a cursory examination of the Williams Park Oyster Reefs on January 14, 1998 yielded no live oysters. Other organisms which typically occupy the crevices created by barnacle and oyster growth, most notably juvenile crabs and marine worms, were absent also. Six days later on Jan. 20, EPC surveyed the nearby Oyster Bar site and was surprised to find no apparent harm to this artificial oyster bar. As a result of these findings, a more detailed re-examination of the Williams Park reef was scheduled on January 27, 1998.

This time, the field investigator used snorkeling gear to examine the entire shallow and deeper reef areas. Samples were collected for closer examination. Based on this more thorough investigation it was concluded that the acid spill had less of an impact on the oysters than previously reported. The oysters growing in shallower, near-shore waters were the most severely affected, however, oysters growing near the end of the pier in deeper water were still alive. Like the January 14 investigation, there were still no associated crabs or other invertebrates found on any of the reef units, shallow or deep.

In an effort to make a quantitative estimate of damage to this oyster reef, EPC re-visited the site on May 13, 1998. Clusters of oysters from three areas (shallow, mid, deep) under the pier were removed, sorted (live or dead), and counted. The percent of dead oysters was estimated, based on this methodology. Only oysters greater than about 1 inch were tabulated because oysters of this size or larger would have been exposed to spill conditions. Oysters under this size may have developed after the spill. **Using this approach, EPC estimated that over 33% of the oysters under the Williams Park pier died as a result of the acid spill.**

Appendix 7 also contains copies of the three field investigation reports, for each visit in January 1998, plus a description of the methods used for the May 13, 1998 survey.

EPC staff observed that all mussels attached to the I-75 bridge pilings were dead. The I-75 bridge is two miles upstream from the oyster reef projects.



On December 15th the putrid odor of dead mussels could be detected as EPC staff approached the bridge pilings under the I75 Bridge.

Williams Park - Artificial Oyster Reef Evaluation

Survey Date: May 13, 1998

Shallow Area		Mid Depth Area		Deeper Area	
Oyster Size inches	Condition Live/Dead	Oyster Size inches	Condition Live/Dead	Oyster Size inches	Condition Live/Dead
1.0	L	1.0	L	1.0	L
1.0	D	1.5	L	1.0	L
1.5	D	1.5	D	1.5	L
1.5	L	1.5	L	1.5	L
1.5	D	1.5	L	2.0	L
1.5	L	1.5	L	2.0	L
1.5	L	2.0	L	2.0	D
1.5	D	2.0	L	2.0	D
1.5	D	2.0	L	2.0	D
2.0	L	2.0	D	2.0	D
2.0	D	2.0	L	2.5	D
2.0	L	2.0	L	2.5	D
2.0	L	2.0	L	2.5	L
2.0	L	2.0	L	2.5	L
2.0	L	2.5	L	2.5	L
2.5	D	2.5	L	2.5	D
2.5	L	2.5	L	3.0	L
2.5	D	2.5	D	3.0	L
2.5	D	2.5	L	3.0	L
2.5	D	2.5	L	3.0	L
2.5	D	2.5	L	3.0	L
2.5	D	3.0	L	3.0	D
2.5	L	3.0	D	3.5	L
2.5	D	3.0	D	3.5	D
2.5	L	3.0	D	4.0	L
3.0	L	3.0	L	4.0	L
3.0	D	3.0	L		
3.0	L				
3.5	D				
4.0	D				
4.0	L				

	Shallow	Mid Depth	Deeper
Count	31	27	26
Count L	15	21	17
Count D	16	6	9
% Live	48.4	77.8	65.4
% Dead	51.6	22.2	34.6

Total Reef Average (Dead Oysters) = 36.1%

CONCLUSIONS:

Alafia River: The Alafia River has a relatively long history of environmental incidents and spills, most related to central Florida's phosphate industry. From a water quality and ecological perspective, the Mulberry Phosphate Inc. acid spill was probably the worst environmental incident ever experienced in the Alafia River.

The quantity of the released "process water" was probably the largest ever recorded for the Alafia River and perhaps the largest for any Florida river.

Although the released "process water" has a long list of chemical components and physical characteristics, the pH or acidity of the water was probably the most immediately damaging, primarily to fish.

About 50 million gallons of low pH "process water" was spilled into the environment, resulting in the death of as many as 1 million fresh and marine fish.

Most of the river's 37 miles experienced violations of Florida's surface water quality standards, Chapters 62-302 F.A.C., for a period of 2 to 5 days (Dec. 7 - Dec. 11).

The spill caused the pH to reach the lowest values ever recorded by EPC in 24 years of monitoring the river. The spill also caused the river to have record high concentrations of phosphorus, nitrogen and fluoride.

In addition to water quality problems, the spill was probably responsible for the death of over 33% of the oysters under the Williams Park pier. This artificial oyster reef had been, partially constructed as a mitigation effort for a previous phosphate industry spill.

Tampa Bay: The slightly alkaline water of Tampa Bay neutralized most of the acid discharge, raising the pH to safer levels. However, most of the other components of the discharge were simply diluted and not removed from the water.

The contaminants of chief concern for the bay are the nutrients (phosphorus and nitrogen). The spill caused abnormally high values for phosphorus to persist, throughout a very large area of the Bay, but especially in the Hillsborough and Middle Tampa Bay. Phosphorus appears to have peaked in December/January. A declining trend was apparent for February, March, and April 1998.

The nutrients from the spill stimulated excessive growth of phytoplankton in the Bay.

February has historically been the month with the <u>lowest</u> chlorophyll concentrations. However, the nutrients caused atypical concentrations of chlorophyll to be measured in the Bay from January through April of 1998. Hillsborough Bay and Middle Tampa Bay were the most affected. This may have had a detrimental effect on Tampa Bay's seagrass meadows.

The spill will likely pose some difficult management decisions for the Tampa Bay Estuary Program. This program has worked diligently to reduce nitrogen loading to the Bay and has set specific targets or goals for chlorophyll.

Appendix 4-A

Alafia River - Mulberry Phosphate Inc. Acid Spill Incident of December 7, 1997

EPC Surface Water Quality Sampling Results

Date Sampled Monday	Sample or site #	Location Sampled Alafia River	Time Sampled military	pH-T field units	pH-M field units	pH-B field units	W.Temp Top °C	W.Temp Middle °C	W.Temp Bottom °C	DO-T field mg/l	DO-M field mg/l	DO-B field mg/l	Cond-T field µmhos	Cond-M field µmhos	Cond-B field µmhos	Sulfates SO4 mg/l	Fluorides Dissolved mg/l	Turbidity NTU	Ortho P filtered mg/l	T Phos as P mg/l	Kjel N as N mg/l	NH3N as N mg/l	NO2NO3 as N mg/l	Pb total µg/l	Cr total µg/l	Cd total µg/l	Mn total µg/l
12-08-97	1	Keysville	1150	-	2.8	-	-	13.5	-	-	9.1	-	-	2880	-	500	261	9	396.7	-	-	-	-	-	-	-	-
12-08-97	2	Alderman	1230	-	7.2	-	-	13.8	-	-	9.3	-	-	0.561	-	117	6	6	7.2	-	-	-	-	-	-	-	-
Note: No dead fish were observed during this sampling event.																						Sampler: Eric Lesnett					
12-09-97	1	Hwy 301	1215	7.6	7.6	7.2	16.7	16.8	17.9	8.0	7.9	3.0	574*	926	23200	92	3.9	3	1.03	0.93	0.57	0.05	0.83	-	-	-	-
12-09-97	2	Bell Shoals	1306	3.1	-	3.1	16.5	-	16.3	8.0	-	8.2	1750	-	1750	350	150.0	4	178.84	152.80	41.25	49.73	0.95	-	-	-	-
12-09-97	3	Lithia Pine	1350	3.0	-	3.0	15.2	-	15.2	8.8	-	8.8	2330	-	2320	400	195.0	6	288.37	254.67	51.80	72.75	0.69	-	-	-	-
12-09-97	4	Alderman	1430	2.7	-	2.7	16.0	-	16.0	8.4	-	8.4	3620	-	3620	725	280.0	5	485.68	416.91	91.61	120.15	0.70	-	-	-	-
12-09-97	5	Keysville	1530	-	2.8	-	-	16.5	-	-	8.2	-	-	2860	-	575	234.0	3	371.60	326.34	65.63	92.79	0.72	-	-	-	-
Note: No dead fish were observed during this sampling event.													* Saltwater layer begins at approx. -7.0 ft.									Sampler: Richard Boler					
12-10-97	1	Mouth of river	900	8.0	-	-	20	-	-	-	-	-	26100	-	-	-	0.79	6	0.26	-	-	-	-	-	-	-	-
12-10-97	2	Hickory Ln.	915	7.7	-	-	20	-	-	-	-	-	7800	-	-	-	1.05	4	0.66	-	-	-	-	-	-	-	-
12-10-97	3	Bay Drive	925	7.6	-	-	20	-	-	-	-	-	11600	-	-	-	1.10	3	0.62	-	-	-	-	-	-	-	-
12-10-97	4	Magnolia St.	940	6.5	-	-	20	-	-	-	-	-	6700	-	-	-	1.63	3	1.19	-	-	-	-	-	-	-	-
12-10-97	5	Interstate 75	950	6.7	-	-	21	-	-	-	-	-	5190	-	-	-	7.36	9	4.52	-	-	-	-	-	-	-	-
12-10-97	6	Elbow Bend Rd.	1010	6.0	-	-	20	-	-	-	-	-	3490	-	-	-	31.00	6	35.88	-	-	-	-	-	-	-	-
12-10-97	7	HiWay 301	1040	3.6	-	-	20	-	-	-	-	-	1770	-	-	-	99.30	4	114.33	-	-	-	-	-	-	-	-
12-10-97	8	McMullen Rd.	1100	3.5	-	-	20	-	-	-	-	-	1500	-	-	-	133.00	5	160.00	-	-	-	-	-	-	-	-
12-10-97	9	Winn Rd.	1110	3.4	-	-	19	-	-	-	-	-	1680	-	-	-	148.00	4	185.00	-	-	-	-	-	-	-	-
12-10-97	10	John Moore Rd.	1135	3.4	-	-	19	-	-	-	-	-	1420	-	-	-	125.00	8	165.00	-	-	-	-	-	-	-	-
																						Samplers: Cardinale & Ash					
12-10-97	74	US 41	900	7.6	7.7	7.7	18.7	18.1	18.0	7.2	6.5	6.2	16600	34400	35800	-	0.88	5	0.35	0.36	0.70	0.08	0.062	-	-	-	-
12-10-97	114	Bell Shoals	910	3.2	3.2	3.2	17.8	17.8	17.8	8.0	8.0	8.0	1460	1460	1461	260	109.00	4	122.11	234.83	36.62	43.36	0.807	-	-	-	-
12-10-97	115	Alderman N Pron	1325	3.3	3.3	3.3	19.0	19.0	19.0	8.1	8.1	8.0	1530	1530	1530	305	91.00	8	138.73	220.21	45.50	36.48	0.764	-	-	-	-
12-10-97	116	Alderman S Prong	1335	7.4	7.4	7.4	17.4	17.4	17.4	8.1	8.1	8.1	402	402	403	73	2.56	5	0.72	0.65	0.58	0.04	0.356	-	-	-	-
Note: No dead fish seen at 74, 114, 115, 116																						Samplers: Boler, Wright, Lockwood & Lesnett					
12-12-97	1	Hwy 301	1502	6.6	6.6	6.6	20.9	21.0	21.0	5.9	6.3	6.4	454	453	455	-	-	-	-	-	-	-	-	-	-	-	-
12-12-97	74	Hwy 41	1422	5.0	5.8	6.2	20.3	20.0	19.7	6.7	5.6	5.5	10450	22500	31400	-	-	-	-	-	-	-	-	-	-	-	-
12-12-97	114	Bell Shoals	1543	6.8	-	6.8	21.1	-	21.1	6.9	-	6.7	379	-	381	-	-	-	-	-	-	-	-	-	-	-	-
																						Sampler: Richard Boler					
12-15-97	1	Hills. Bay #8	1046	-	6.7	-	-	17.6	-	-	6.7	-	-	2200	-	-	2.23	38	2.88	3.80	1.29	0.58	0.299	<16	<11	<11	10
12-15-97	oyster	TBRPC Oyster	1128	-	7.0	-	-	16.9	-	-	6.8	-	-	900	-	-	-	-	-	-	-	-	-	-	-	-	-
12-15-97	2	Hwy 41(#74)	1143	7.0	7.0	7.0	17.8	17.8	17.8	7.2	6.5	6.5	260	260	260	39	2.33	51	3.02	6.40	1.02	0.53	0.317	<16	40	<11	30
12-15-97	3	Interstate 75	1204	6.7	6.7	6.7	17.7	17.7	17.7	7.0	8.1	6.8	200	200	200	38	2.31	23	3.29	5.25	1.06	0.50	0.314	<16	20	<11	10
12-15-97	4	Hwy 301	1220	6.6	6.6	6.6	17.6	17.6	17.6	7.0	8.2	7.0	200	200	200	36	2.35	19	2.88	4.55	1.09	0.49	0.310	<16	20	<11	10
12-15-97	5	Winn Rd.	1242	6.6	6.6	6.6	17.5	17.6	17.6	9.2	-	7.8	180	180	180	35	2.38	14	2.77	4.70	1.24	0.47	0.322	<16	<11	<11	10
Note: many dead fish still floating on the water and on the shoreline.																						Samplers: Cardinale & Ash					
12-15-97	1	Keysville Rd.	1125	8.1	-	-	-	-	-	-	-	-	346	-	-	85	10.90	19	14.64	20.00	3.28	2.97	0.468	<16	<11	<11	80
12-15-97	2	Alderman Ford	1201	6.2	-	-	-	-	-	-	-	-	297	-	-	69	3.77	18	10.58	12.80	2.46	2.04	0.453	<16	<11	<11	40
12-15-97	3	Lithia Pinecrest	1245	6.2	-	-	-	-	-	-	-	-	180	-	-	48	3.59	14	4.05	5.85	1.30	0.75	0.311	<16	<11	<11	10
12-15-97	4	Bell Shoals	1320	6.2	-	-	-	-	-	-	-	-	158	-	-	38	2.67	13	3.11	4.90	1.19	0.58	0.287	<16	<11	<11	10
12-15-97	5	Kings (Ramp)	1355	6.2	-	-	-	-	-	-	-	-	155	-	-	37	2.51	15	2.91	4.45	1.19	0.64	0.308	<16	30	<11	10
																						Sampler: Lockwood					

Appendix 4-B1

Site #	DATE yymmdd	pH.T units	pH.M units	pH.B units	Site #	DATE yymmdd	pH.T units	pH.M units	pH.B units	Site #	DATE yymmdd	pH.T units	pH.M units	pH.B units	Average 115,114,74
74	740109		7.3		114	740123		7.1		115	740122		6.3		6.9
74	740207		7.9		114	740220		7.5		115	740219		6.8		7.4
74	740306		8.2		114	740327		7.3		115	740326		6.8		7.4
74	740410		8.1		114	740424		7.5		115	740423		7.0		7.5
74	740508		7.9		114	740522		7.0		115	740521		6.5		7.1
74	740605		7.7		114	740619		7.2		115	740618		6.7		7.2
74	740702		7.6		114	740717		7.0		115	740716		6.4		7.0
74	740731		7.4		114	740814		6.8		115	740814		6.5		6.9
74	740829		7.3		114	740911		6.9		115	740910		6.9		7.0
74	740925		7.7		114	741009		7.4		115	741008		6.8		7.3
74	741030		7.8		114	741113		7.5		115	741112		7.0		7.4
74	741204		7.6		114	741218		7.2		115	741217		6.9		7.2
74	750107		7.8		114	750122		7.5		115	750121		7.1		7.5
74	750206	8.1	8.0	8.0	114	750219		7.5		115	750220		7.2		7.6
74	750305	8.3	8.2	8.0	114	750319		7.4		115	750318		7.1		7.6
74	750402	8.3	8.3	8.2	114	750416		7.6		115	750415		7.3		7.7
74	750430	8.0	8.0	8.0	114	750514		7.9		115	750513		7.4		7.8
74	750528	8.2	8.0	8.0	114	750611		7.4		115	750610		7.2		7.5
74	750624	8.0	7.7	7.8	114	750709		7.3		115	750710		7.2		7.4
74	750723	7.9	7.9	7.9	114	750806		7.4		115	750807		6.9		7.4
74	750821	7.7	7.9	7.9	114	750902		7.3		115	750902		6.9		7.4
74	750917	8.3	7.9	7.5	114	751001		7.3		115	751002		6.9		7.4
74	751015	8.0	8.0	8.0	114	751029		6.6		115	751028		7.3		7.3
74	751112	7.6	7.9	7.9	114	751203		7.6		115	751202		7.6		7.7
74	760107	8.0	8.3	8.4	114	760121		7.8		115	760122		7.2		7.8
74	760203		7.9		114	760218		7.9		115	760217		7.6		7.8
74	760302	8.4	8.5	8.4	114	760317		7.8		115	760318		7.6		8.0
74	760331	8.4	8.4	8.4	114	760414		7.9		115	760415		7.7		8.0
74	760428	8.1	8.2	8.2	114	760512		7.5		115	760512		7.7		7.8
74	760526	8.7	7.9	7.9	114	760609		7.2		115	760609		7.1		7.4
74	760701	9.5	9.3	9.4	114	760714		7.1		115	760714		6.9		7.8
74	760728	8.1	7.8	7.8	114	760811				115	760810				7.8
74	760902	8.1	7.8	7.8	114	760915		7.3		115	760914				7.6
74	760929	8.9	8.4	8.1	114	761013				115	761013		7.8		8.1
74	761027	7.9	7.8	7.8	114	761110		7.9		115	761110		7.6		7.8
74	761201	8.6	8.6	8.6	114	761215		7.6		115	761214		7.5		7.9
74	770105		7.8		114	770202		7.5		115	770202		7.3		7.4
74	770216	8.7	8.5	8.5	114	770302		7.6		115	770302		7.2		7.8
74	770316	8.4	8.2	7.7	114	770330		7.6		115	770330		7.5		7.8
74	770420	8.4	8.4	8.4	114	770504		7.8		115	770503		7.3		7.8
74	770516		8.4		114	770602		7.7		115	770602		7.4		7.8
74	770615	7.9	7.9	7.7	114	770630		7.8		115	770630		7.7		7.8
74	770713		8.5		114	770727		7.6		115	770727		7.6		7.9
74	770810		8.4		114	770824		7.0		115	770824		7.1		7.5
74	770908	7.3	8.3	7.8	114	770921		7.4		115	770921		7.5		7.7
74	771005	8.1	8.0	7.9	114	771019		7.8		115	771019		7.3		7.7
74	771102	8.9	8.5	8.4	114	771116		7.8		115	771116		7.8		8.0
74	771208	8.6	8.7	8.7	114	771220		7.3		115	771220		7.0		7.7
74	780111	8.3	8.4	8.2	114	780125		7.4		115	780125		7.0		7.6
74	780214	8.9	8.5	8.8	114	780222		6.7		115	780228		6.8		7.3
74	780308	8.5	8.5	8.4	114	780321		7.3		115	780321		6.7		7.5
74	780405	8.3	8.2	8.1	114	780419		7.9		115	780419		7.5		7.9
74	780503	9.0	8.6	8.4	114	780517		6.9		115	780517		7.1		7.5
74	780531	8.1	8.0	7.8	114	780614		7.3		115	780614		6.4		7.2
74	780628	8.0	8.3	8.3	114	780712		7.0		115	780712		6.9		7.4
74	780726	8.5	8.0	8.0	114	780809		6.8		115	780809		6.8		7.2
74	780823	7.5	7.4	7.6	114	780906		7.0		115	780906		7.2		7.2
74	780920		8.3		114	781004		7.1		115	781004		6.9		7.4
74	781101	8.3	8.3	8.3	114	781115		7.7		115	781115		7.6		7.9
					114	781218		7.9		115	781218		7.7		7.8

Site #	DATE yymmdd	pH.T units	pH.M units	pH.B units	Site #	DATE yymmdd	pH.T units	pH.M units	pH.B units	Site #	DATE yymmdd	pH.T units	pH.M units	pH.B units	Average 115,114,74
74	790110		8.5		114	790124		7.1		115	790124		6.6		7.4
74	790208		8.4		114	790221		7.0		115	790221		6.8		7.4
74	790307		7.5		114	790320		7.4		115	790320		6.8		7.2
74	790404	8.6	8.0	7.8	114	790424		6.8		115	790424		7.5		7.4
74	790502	8.5	8.6	8.5	114	790517		7.5		115	790517		7.5		7.9
74	790530	7.8	7.9	7.7	114	790613		7.8		115	790613		7.2		7.6
74	790627	8.4	8.4	8.4	114	790711		6.9		115	790711		6.8		7.4
74	790725	8.2	8.4	8.4	114	790808		8.0		115	790809		6.5		7.6
74	790822	8.0	8.1	8.0	114	790905		7.0		115	790905		6.8		7.3
74	790919	8.0	8.3	8.1	114	791003		6.7		115	791003		6.5		7.2
74	791017	7.9	8.2	7.9	114	791031		7.4		115	791031		6.7		7.4
74	791114	8.5	8.5	8.5	114	791205		7.0		115	791205		6.8		7.4
74	800116	8.2	8.2	8.1	114	800131		7.6		115	800131		7.6		7.8
74	800213	8.5	8.5	8.5	114	800227		6.9		115	800227		6.8		7.4
74	800312	8.5	8.5	8.5	114	800327		7.2		115	800327		7.1		7.6
74	800409	8.0	8.0	7.9	114	800423		7.4		115	800423		7.1		7.5
74	800507	7.9	8.5	8.8	114	800521		7.4		115	800521		7.3		7.7
74	800604	8.2	8.2	8.0	114	800618		7.1		115	800618		7.0		7.4
74	800702	7.6	7.6	7.5	114	800716		7.4		115	800716		7.2		7.4
74	800730	7.7	8.4	8.4	114	800813		7.3		115	800813		7.1		7.6
74	800827	9.2	8.7	8.8	114	800910		7.0		115	800910		7.0		7.6
74	801001	8.4	8.3	8.3	114	801015		7.7		115	801015		7.5		7.8
74	801029		8.1		114	801113		7.8		115	801113		7.6		7.8
74	801203	7.0	7.0	6.9	114	801217		7.7		115	801217		7.5		7.4
74	810114	8.3	8.4	8.4	114	810128		7.7		115	810128		6.8		7.6
74	810211		7.4		114	810225		7.8		115	810225		7.5		7.6
74	810311	7.6	7.7	7.7	114	810325		8.0		115	810325		7.7		7.8
74	810422	8.8	8.8	8.8	114	810506		8.4		115	810506		8.2		8.5
74	810520	6.5	6.3	6.2	114	810603		8.5		115	810603		8.1		7.6
74	810617		8.7		114	810701		7.6		115	810701		6.6		7.6
74	810715	9.0	8.8	8.6	114	810729		7.1		115	810729		6.4		7.4
74	810812	8.7	8.6	8.5	114	810826		7.1		115	810826		6.8		7.5
74	810909	6.8	7.2	8.0	114	810923		7.0		115	810923		6.7		7.0
74	811007	8.5	8.3	8.0	114	811015		7.4		115	811015		7.3		7.7
74	811028	8.6	8.7	8.7	114	811104		7.6		115	811104		7.4		7.9
74	811209				114	811209		7.2		115	811209		7.1		7.2
74	820127		6.9		114	820127		7.5		115	820127		7.2		7.2
74	820224		7.4		114	820224		7.2		115	820224		7.0		7.2
74	820324		8.7		114	820324		7.4		115	820324		7.4		7.8
74	820407		8.6		114	820421		7.9		115	820421		7.8		8.1
74	820722	8.3	8.2	8.2	114	820519		7.9		115	820519		7.9		8.0
74	820818	8.5	8.6	8.5	114	820616		7.5		115	820616		7.3		7.8
74	820908	8.3	8.3	8.1	114	820714		7.2		115	820714		7.0		7.5
74	821006		8.0		114	820811		7.5		115	820811		7.3		7.6
74	821103		8.2		114	820915		7.1		115	820915		6.6		7.3
74	821117		8.1		114	821013		7.4		115	821013		7.2		7.6
					114	821117		7.5		115	821117		7.2		7.4
74	830126		7.3		114	830126		7.3		115	830126		7.1		7.2
74	830223	6.8	7.0	6.9	114	830302		6.9		115	830302		6.8		6.9
74	830323		6.9		114	830330		6.7		115	830330		6.4		6.7
74	830420	7.6	7.5	7.2	114	830427		7.4		115	830427		7.3		7.4
74	830525	7.7	7.7	7.5	114	830525		7.7		115	830525		7.6		7.7
74	830622		7.5		114	830622		7.3		115	830622		6.9		7.2
74	830720		8.0		114	830720		7.7		115	830720		7.5		7.7
74	830817		7.2		114	830817		7.4		115	830817		7.0		7.2
74	830914		7.4		114	830914		7.1		115	830914		7.0		7.2
74	831012		8.1		114	831012		7.6		115	831012		7.7		7.8
74	831115		7.9		114	831116		7.4		115	831116		7.1		7.5
74	831214		8.3		114	831214		7.3		115	831214		7.1		7.6

Site #	DATE yymmdd	pH.T units	pH.M units	pH.B units	Site #	DATE yymmdd	pH.T units	pH.M units	pH.B units	Site #	DATE yymmdd	pH.T units	pH.M units	pH.B units	Average 115,114,74
74	840125		7.8		114	840125		7.3		115	840125		6.9		7.3
74	840222		7.6		114	840222		7.0		115	840222		6.7		7.1
74	840328		7.4		114	840328		7.1		115	840328		7.2		7.2
74	840425		7.5		114	840425		7.6		115	840425		7.6		7.6
74	840523		7.8		114	840523		7.4		115	840523		7.5		7.6
74	840620		7.6		114	840620		7.1		115	840620		7.3		7.3
74	840718		7.6		114	840718		7.0		115	840718		7.0		7.2
74	840815		7.2		114	840815		6.9		115	840815		6.8		7.0
74	840912				114	840912				115	840912				
74	841010				114	841010				115	841010				
74	841107		7.8		114	841107		7.7		115	841107		7.8		7.8
74	841212				114	841212				115	841212				
74	850116		8.0		114	850116		7.9		115	850116		8.0		8.0
74	850227		8.0		114	850227		7.8		115	850227		7.9		7.9
74	850327	7.6	7.8	7.9	114	850327		7.6		115	850327		7.7		7.7
74	850417		8.0		114	850417		7.8		115	850417		7.7		7.8
74	850515		7.7		114	850515		7.7		115	850515		7.8		7.7
74	850626		8.2		114	850626		7.5		115	850626		7.6		7.8
74	850724		7.6		114	850724		7.2		115	850724		7.0		7.3
74	850814		7.5		114	850814		7.2		115	850814		6.7		7.1
74	850911		7.4		114	850911		6.8		115	850911		6.7		7.0
74	851016		7.8		114	851016		7.6		115	851016		7.5		7.6
74	851113		8.4		114	851113		7.8		115	851113		7.9		8.0
74	851218		8.0		114	851218		7.9		115	851218		7.8		7.9
74	860129		7.6		114	860129		7.9		115	860129		8.0		7.8
74	860226		7.7		114	860226		8.1		115	860226		7.5		7.8
74	860326		7.5		114	860326		7.4		115	860326		7.3		7.4
74	860423		7.8		114	860423		7.9		115	860423		7.2		7.6
74	860521		7.4		114	860521		7.5		115	860521		7.4		7.4
74	860618		7.5		114	860618		7.0		115	860618		7.3		7.3
74	860723		7.5		114	860723		6.3		115	860723		7.1		7.0
74	860827		7.0		114	860827		6.5		115	860827		6.3		6.6
74	860924		7.8		114	860924		7.1		115	860924		7.2		7.4
74	861015		7.7		114	861015		7.2		115	861015		7.6		7.5
74	861105	7.5	7.5	7.4	114	861105		7.9		115	861105		7.1		7.5
74	861217	8.0	8.0	8.0	114	861217		7.9		115	861217		8.1		8.0
74	870128	7.6	7.6		114	870128	7.7	7.7		115	870128		8.1		7.8
74	870225	7.5	7.5	7.7	114	870225	7.9	7.8	7.7	115	870225		8.0		7.8
74	870325	7.4	7.5	7.8	114	870325	7.7	7.6	7.8	115	870325		7.6		7.6
74	870422		7.9		114	870422		7.4		115	870422		7.4		7.6
74	870527	7.5	7.6	7.6	114	870527	7.7	7.6	7.6	115	870527		7.4		7.5
74	870624	7.9	7.9	7.9	114	870624	7.8	7.9	7.9	115	870624		7.7		7.8
74	870729	7.4	7.6	7.4	114	870729	7.5	7.5	7.5	115	870729	7.1	7.1	7.1	7.4
74	870826	7.5	7.6	7.6	114	870826	7.6	7.6	7.6	115	870826		7.5		7.6
74	870923	7.8	8.0	7.7	114	870923	7.9	7.7	7.7	115	870923		7.7		7.8
74	871021		7.7		114	871021		7.8		115	871021		7.8		7.8
74	871118		7.6		114	871118		7.5		115	871118		7.3		7.5
74	871216		7.4		114	871216		7.6		115	871216		7.6		7.5
74	880127		7.3		114	880127		7.4		115	880127		7.4		7.4
74	880224	8.0	7.9	7.9	114	880224	7.4	7.4	7.5	115	880224	7.8	7.8	7.8	7.7
74	880316		7.9		114	880316		7.5		115	880316		7.9		7.8
74	880427	7.8	7.8	7.7	114	880427	7.8	7.9	8.2	115	880427		8.0		7.9
74	880525	7.9	7.9	7.8	114	880525	7.6	7.6	7.6	115	880525		7.9		7.8
74	880622	7.7	7.5	7.5	114	880622	7.6	7.7	7.7	115	880622		7.9		7.7
74	880726	7.7	7.5	7.3	114	880726	7.2	7.2	7.3	115	880726		7.4		7.4
74	880824	6.8	7.0	7.2	114	880824	7.1	7.0	7.0	115	880824		7.4		7.1
74	880928	7.0	7.0	6.9	114	880928	7.4	7.3	7.3	115	880928		7.7		7.3
74	881026	7.6	7.6	7.4	114	881026	7.6	7.6	7.6	115	881026		7.6		7.6
74	881130		7.6		114	881130		7.7		115	881130		7.7		7.7
74	881228	7.9	7.9	7.7	114	881228	7.7	7.6	7.7	115	881228		7.5		7.7

Site #	DATE yymmdd	pH.T units	pH.M units	pH.B units	Site #	DATE yymmdd	pH.T units	pH.M units	pH.B units	Site #	DATE yymmdd	pH.T units	pH.M units	pH.B units	Average 115,114,74
74	890125	7.0	7.1	7.1	114	890125	7.1	7.0	7.0	115	890125	7.0	7.0	7.0	7.0
74	890222	7.6	7.6	7.5	114	890222	7.5	7.5	7.5	115	890222		7.6		7.6
74	890322	7.7	7.6	7.6	114	890322	7.5	7.5	7.5	115	890322		7.7		7.6
74	890426	7.8	7.6	7.5	114	890426	7.7	7.7	7.7	115	890426		7.7		7.7
74	890531	7.3	7.3	7.3	114	890531	7.6	7.5	7.5	115	890531		7.8		7.5
74	890628	8.0	7.2	7.1	114	890628	7.2	7.2	7.2	115	890628		7.5		7.3
74	890726	7.5	7.5	7.4	114	890726	7.3	7.3	7.3	115	890726		7.4		7.4
74	890830	7.4	7.5	7.4	114	890830	7.5	7.4	7.4	115	890830		7.8		7.6
74	890927	6.7	7.1	7.0	114	890927	6.8	6.8	6.8	115	890927	6.7	6.7	6.7	6.9
74	891025	6.9	7.3	7.2	114	891025	7.6	7.6	7.6	115	891025		7.6		7.5
74	891128	7.3	7.2	7.0	114	891129	7.5	7.4	7.4	115	891129		7.4		7.3
74	891220		7.9		114	891220	7.3	7.3	7.3	115	891220		7.3		7.5
74	900130		8.5		114	900131	7.7	7.6	7.6	115	900131		7.6		7.9
74	900228		7.6		114	900228		7.1		115	900228		7.0		7.2
74	900328		8.2		114	900328		7.8		115	900328		7.8		7.9
74	900425		8.1		114	900425		7.7		115	900425		7.9		7.9
74	900530	7.4	7.2	7.1	114	900530	7.6	7.6	7.6	115	900530		7.8		7.5
74	900627	7.0	7.2	7.1	114	900627	7.0	7.0	7.0	115	900627		7.2		7.1
74	900731	7.4	7.3	7.1	114	900801	7.3	7.3	7.3	115	900801		7.1		7.2
74	900829		7.9		114	900829	6.8	6.9	6.9	115	900829		6.7		7.2
74	900926		8.7		114	900926	7.2	7.2	7.2	115	900926		7.4		7.8
74	901024		8.1		114	901024	7.1	7.1	7.1	115	901024		7.3		7.5
74	901128	7.8	7.8	7.9	114	901128	7.1	7.1	7.1	115	901128		7.4		7.4
74	901219	7.9	7.9	7.9	114	901219	7.4	7.4	7.4	115	901219		7.6		7.6
74	910123	7.9	7.9	7.9	114	910123		7.7		115	910123		8.0		7.9
74	910226	7.7	7.7	7.7	114	910226	7.7	7.7	7.7	115	910226		8.0		7.8
74	910327	7.8	7.8	7.9	114	910327	7.4	7.4	7.5	115	910327		7.6		7.6
74	910424	7.8	7.7	7.7	114	910424	7.4	7.4	7.4	115	910424		7.7		7.6
74	910522	7.7	7.8	7.8	114	910522	7.4	7.4	7.4	115	910522		7.4		7.5
74	910626	7.6	7.7	7.6	114	910626		7.3		115	910626		7.1		7.4
74	910731	7.1	7.3	7.7	114	910731	6.7	6.7	6.7	115	910731		6.8		6.9
74	910828	7.0	7.1	7.3	114	910828	6.8	6.8	6.8	115	910828		6.9		6.9
74	910925	7.7	7.8	7.8	114	910925		7.5		115	910925		7.5		7.6
74	911023	7.2	7.4	7.5	114	911023	7.6	7.6	7.6	115	911023		7.6		7.5
74	911120	7.6	7.7	7.7	114	911120		7.7		115	911120		7.8		7.7
74	911211	7.7	7.7	7.7	114	911211	7.6	7.6	7.7	115	911211		7.8		7.7
74	920129	7.8	7.9	7.9	114	920129	7.5	7.5	7.6	115	920129		7.7		7.7
74	920226		7.6		114	920226	6.8	6.8	6.8	115	920226		6.6		7.0
74	920325	7.6	7.7	7.6	114	920325	7.3	7.3	7.3	115	920325		7.5		7.5
74	920422	7.2	7.6	7.5	114	920422	6.9	6.9	6.9	115	920422		6.9		7.1
74	920527	7.7	7.7	7.7	114	920527	7.7	7.7	7.7	115	920527		7.9		7.8
74	920624	7.8	7.6	7.6	114	920624	7.5	7.5	7.6	115	920624		7.7		7.6
74	920729	7.4	7.5	7.4	114	920729	7.7	7.6	7.6	115	920729		7.6		7.6
74	920826	7.4	7.5	7.5	114	920826	7.4	7.4	7.4	115	920826		7.4		7.4
74	920922	7.2	7.4	7.4	114	920923	7.3	7.3	7.3	115	920923		7.5		7.4
74	921028	8.0	8.0	7.9	114	921028	7.6	7.6	7.6	115	921028		7.6		7.7
74	921118	8.0	7.8	7.7	114	921118	7.6	7.6	7.6	115	921118		7.7		7.7
74	921216	8.0	7.9	7.8	114	921216	7.7	7.7	7.7	115	921216		7.8		7.8
74	930120	7.0	7.2	7.2	114	930120	7.2		7.2	115	930120	7.2		7.2	7.2
74	930217	7.8	7.7	7.7	114	930217	7.5	7.5	7.5	115	930217		7.5		7.6
74	930317	7.3	7.6	7.6	114	930317	7.4	7.3	7.3	115	930317		7.2		7.4
74	930421	7.1	7.3	7.4	114	930421	7.5	7.5	7.5	115	930421	7.4	7.4	7.3	7.4
74	930519	7.8	7.5	7.5	114	930519	7.6	7.6	7.6	115	930519		7.7		7.6
74	930616	7.7	7.6	7.6	114	930616	7.7	7.7	7.7	115	930616		7.8		7.7
74	930721	7.2	7.2	7.3	114	930721	7.6	7.5	7.5	115	930721		7.6		7.4
74	930818	7.2	7.5	7.3	114	930818	7.5	7.4	7.4	115	930818		7.6		7.5
74	930915	7.2	7.2	7.5	114	930915	7.0	7.1	7.0	115	930915	6.8	6.8	6.8	7.0
74	931020	7.5	7.7	7.7	114	931020	7.6	7.6	7.5	115	931020	7.4	7.4	7.4	7.6
74	931117	7.7	7.8	7.7	114	931117	7.6	7.6	7.6	115	931117		7.6		7.7
74	931215	7.9	7.9	8.0	114	931215	7.7	7.7	7.7	115	931215		7.7		7.8

Site #	DATE yymmdd	pH.T units	pH.M units	pH.B units	Site #	DATE yymmdd	pH.T units	pH.M units	pH.B units	Site #	DATE yymmdd	pH.T units	pH.M units	pH.B units	Average 115,114,74
74	940126	7.5	7.6	7.7	114	940126	7.7	7.7	7.7	115	940126		7.7		7.7
74	940223	7.6	7.7	7.7	114	940223	7.5	7.4	7.4	115	940223		7.6		7.6
74	940323	7.9	7.9	7.8	114	940323	7.6	7.6	7.6	115	940323		7.6		7.7
74	940427	7.5	7.8	7.7	114	940427	7.5	7.5	7.5	115	940427		7.7		7.7
74	940525	7.9	7.9	7.8	114	940525		7.7	7.7	115	940525		8.0		7.9
74	940622	6.8	7.7	7.7	114	940622	6.9	6.9	6.9	115	940622	6.4	6.4	6.4	7.0
74	940727	7.1	7.5	7.7	114	940727	7.0	7.0	7.0	115	940727	6.7	6.7	6.6	7.1
74	940824	7.1	7.1	7.5	114	940824	7.3	7.3	7.3	115	940824	7.2	7.2	7.2	7.2
74	940928	6.4	6.4	6.5	114	940928	6.7	6.8	6.8	115	940928	6.9	6.9	6.9	6.7
74	941026	7.2	7.7	7.6	114	941026	7.5	7.5	7.5	115	941026	7.4	7.4	7.4	7.5
74	941130	7.8			114	941130	7.6	7.6	7.6	115	941130	7.5	7.5	7.5	7.6
74	941214	7.6	7.8	7.7	114	941214	7.5	7.5	7.5	115	941214	7.4	7.4	7.4	7.6
74	950125	7.6			114	950125	7.3	7.3	6.9	115	950125	7.0	7.0	7.1	7.2
74	950222	7.8	7.9	7.8	114	950222	7.5	7.5	7.5	115	950222	7.5	7.5	7.5	7.6
74	950322	7.6	7.9	7.9	114	950322	7.6	7.6	7.6	115	950322		7.6		7.7
74	950426	7.8	7.9	7.9	114	950426	7.5	7.5	7.4	115	950426		7.1		7.5
74	950524	7.9	7.8	7.7	114	950524	7.7	7.7	7.7	115	950524		7.8		7.8
74	950628	7.7	7.7	7.8	114	950628	6.9	7.0	7.0	115	950628	6.8		6.8	7.4
74	950726	7.8	7.7	7.7	114	950726	7.2	7.2	7.2	115	950726	6.9		6.9	7.5
74	950823	7.5	7.5	7.5	114	950823	7.3	7.3	7.3	115	950823	7.2	7.2	7.2	7.3
74	950927	7.4	7.4	7.5	114	950927	7.4	7.4	7.4	115	950927	7.3	7.3	7.3	7.4
74	951025	7.4	7.5	7.5	114	951025	7.4	7.4	7.4	115	951025	7.4	7.4	7.4	7.4
74	951129	7.0	7.3	7.2	114	951129	7.6	7.5	7.5	115	951129		7.5		7.4
74	951213	6.8	7.2	7.2	114	951213	7.6	7.6	7.6	115	951213		7.6		7.5
74	960124	7.7	7.9	8.0	114	960124	7.4	7.4	7.4	115	960124	7.2	7.2	7.2	7.5
74	960221	8.0	8.0	8.2	114	960221	7.6	7.6	7.5	115	960221		7.6		7.7
74	960320	7.8	7.7	7.7	114	960320	7.6	7.6	7.6	115	960320		7.5		7.6
74	960417	7.6	7.4	7.4	114	960417	7.6	7.6	7.6	115	960417	7.6	7.6	7.6	7.5
74	960515	7.6	7.6	7.6	114	960515	7.7	7.7	7.7	115	960515		7.7		7.7
74	960619	7.5	7.7	7.7	114	960619	7.6	7.6	7.6	115	960619		7.6		7.6
74	960717	7.4	7.6	7.6	114	960717	7.4	7.4	7.4	115	960717	7.3	7.3	7.3	7.4
74	960821	7.8	7.8	7.8	114	960821	7.6	7.6	7.5	115	960821	7.4	7.4	7.4	7.6
74	960925	7.8	7.8	7.8	114	960925	7.4	7.4	7.4	115	960925	7.3	7.3	7.4	7.5
74	961016	7.6	7.8	7.9	114	961016	7.5	7.5	7.5	115	961016		7.4		7.6
74	961120	8.0	7.9	7.8	114	961120	7.6	7.6	7.6	115	961120		7.6		7.7
74	961211	7.3	7.4	7.6	114	961211	7.4	7.4	7.4	115	961211		7.5		7.4
74	970122	8.2	8.2	8.1	114	970122	7.6	7.6	7.6	115	970122		7.8		7.9
74	970219	8.1	8.1	8.1	114	970219	7.4	7.4	7.4	115	970219		7.4		7.6
74	970319	7.9	7.8	7.8	114	970319	7.5	7.5	7.5	115	970319		7.6		7.6
74	970416	8.0	8.0	8.0	114	970416	7.6	7.6	7.6	115	970416		7.8		7.8
74	970521	8.0	7.7	7.6	114	970521	7.7	7.7	7.7	115	970521		7.8		7.7
74	970618	7.8	7.7	7.7	114	970618	7.5	7.5	7.5	115	970618		7.8		7.7
74	970723	7.4	7.7	7.7	114	970723	7.3	7.3	7.3	115	970723	7.2	7.2	7.2	7.4
74	970820	7.4	7.6	7.7	114	970820	7.5	7.5	7.5	115	970820		7.6		7.6
74	970917	7.9	7.8	7.7	114	970917	7.6	7.6	7.6	115	970917		7.8		7.7
74	971015	7.6	7.7	7.7	114	971015	7.5	7.5	7.5	115	971015		7.4		7.5
74	971119	7.2	7.2	7.5	114	971119	7.2	7.3	7.3	115	971119	7.3	7.5	7.5	7.3
74	971210	7.0	7.7	7.7	114	971210	3.2	3.2	3.2	115	971210	3.3	3.3	3.3	4.7
74	980121	7.4	7.4	7.4	114	980121	7.3	7.3	7.3	115	980121	7.0	7.0	7.0	7.2
74	980218	6.8	6.8	6.8	114	980218	6.6	6.6	6.6	115	980218	6.6	6.6	6.6	6.7
74	980318	7.5	7.5	7.5	114	980318	7.3	7.3	7.3	115	980318	7.1	7.1	7.1	7.3

Site #	DATE yymmdd	P.TOTAL mg/l	Site #	DATE yymmdd	P.TOTAL mg/l	Site #	DATE yymmdd	P.TOTAL mg/l	AVERAGE 74,114,115
74	740109	6.92	114	740123	12.74	115	740122	25.99	**15.22**
74	740207	3.88	114	740220	3.05	115	740219	17.92	**8.28**
74	740306	2.13	114	740327	10.21	115	740326	18.64	**10.33**
74	740410	4.35	114	740424	11.75	115	740423	21.29	**12.46**
74	740508		114	740522	11.85	115	740521	23.34	**17.60**
74	740605		114	740619	8.98	115	740618	8.67	**8.83**
74	740702	2.57	114	740717	8.85	115	740716	12.58	**8.00**
74	740731	2.75	114	740814	5.37	115	740814	7.50	**5.21**
74	740829	1.96	114	740911	5.78	115	740910	13.34	**7.03**
74	740925	2.05	114	741009	4.87	115	741008	7.08	**4.67**
74	741030	1.91	114	741113	8.44	115	741112	12.91	**7.75**
74	741204	3.44	114	741218	6.98	115	741217	12.27	**7.56**
74	750107	1.56	114	750122	6.54	115	750121	11.21	**6.44**
74	750206	2.25	114	750219	6.63	115	750220	9.65	**6.18**
74	750305		114	750319	6.11	115	750318	9.74	**7.93**
74	750402	1.99	114	750416	6.56	115	750415	11.18	**6.58**
74	750430	3.20	114	750514	4.73	115	750513	10.72	**6.22**
74	750528	2.26	114	750611	6.72	115	750610	10.65	**6.54**
74	750624	2.22	114	750709	7.03	115	750710	11.95	**7.07**
74	750723	1.84	114	750806	6.59	115	750807	11.74	**6.72**
74	750821	2.04	114	750902	7.15	115	750902	17.65	**8.95**
74	750917	1.68	114	751001	4.65	115	751002	7.10	**4.48**
74	751015	1.41	114	751029	2.17	115	751028	7.58	**3.72**
74	751112	1.18	114	751203	9.95	115	751202	4.91	**5.35**
74	760107	0.98	114	760121	5.08	115	760122	7.53	**4.53**
74	760203	1.36	114	760218	3.22	115	760217	5.09	**3.22**
74	760302	0.96	114	760317	3.32	115	760318	4.77	**3.02**
74	760331	1.02	114	760414	3.19	115	760415	4.90	**3.04**
74	760428	1.02	114	760512	5.60	115	760512	6.30	**4.31**
74	760526	1.44	114	760609	3.40	115	760609	4.20	**3.01**
74	760701	1.38	114	760714	2.80	115	760714	4.29	**2.82**
74	760728	1.42	114	760811	2.65	115	760810	5.22	**3.10**
74	760902	1.90	114	760915	2.80	115	760914	7.74	**4.15**
74	760929	1.92	114	761013	3.85	115	761013	7.43	**4.40**
74	761027	1.88	114	761110	4.13	115	761110	5.17	**3.73**
74	761201	0.97	114	761215	4.77	115	761214	9.04	**4.93**
74	770105	1.02	114	770202	2.14	115	770202	5.62	**2.93**
74	770216	1.58	114	770302	3.87	115	770302	6.01	**3.82**
74	770316	1.77	114	770330	4.00	115	770330	7.53	**4.43**
74	770420	1.01	114	770504	4.48	115	770503	7.66	**4.38**
74	770516	1.11	114	770602	6.04	115	770602	10.07	**5.74**
74	770615	1.27	114	770630	4.05	115	770630	6.55	**3.96**
74	770713	0.95	114	770727	2.70	115	770727	4.61	**2.75**
74	770810	1.73	114	770824	2.59	115	770824	3.88	**2.73**
74	770908	2.09	114	770921	3.25	115	770921	6.08	**3.81**
74	771005	1.65	114	771019	2.23	115	771019	5.34	**3.07**
74	771102	1.44	114	771116	1.41	115	771116	5.19	**2.68**
74	771208	1.08	114	771220	4.72	115	771220	9.12	**4.97**
74	780111	2.03	114	780125	3.00	115	780125	5.95	**3.66**
74	780214	1.83	114	780222	3.67	115	780228	6.50	**4.00**
74	780308	2.20	114	780321	3.41	115	780321	7.34	**4.32**
74	780405	1.87	114	780419	3.00	115	780419	5.45	**3.44**
74	780503	1.62	114	780517	4.00	115	780517	10.10	**5.24**
74	780531	1.60	114	780614	0.37	115	780614	6.63	**2.87**
74	780628	1.53	114	780712	2.73	115	780712	5.71	**3.32**
74	780726	2.08	114	780809	3.30	115	780809	7.50	**4.29**
74	780823	1.60	114	780906	3.25	115	780906	6.45	**3.77**
74	780920	2.11	114	781004	2.74	115	781004	8.89	**4.58**
74	781101	1.57	114	781115	2.87	115	781115	6.03	**3.49**

Appendix 4-B2

Site #	DATE yymmdd	P.TOTAL mg/l	Site #	DATE yymmdd	P.TOTAL mg/l	Site #	DATE yymmdd	P.TOTAL mg/l	AVERAGE 74,114,115
74	790110	2.35	114	781218	3.05	115	781218	5.98	3.79
74	790208	1.92	114	790124	3.10	115	790124	4.49	3.17
74	790307	2.14	114	790221	2.94	115	790221	7.83	4.30
74	790404	1.65	114	790320	3.10	115	790320	5.60	3.45
74	790502	1.44	114	790424	4.76	115	790424	4.99	3.73
74	790530	1.94	114	790517	2.20	115	790517	4.59	2.91
74	790627	1.54	114	790613	1.30	115	790613	19.80	7.55
74	790725	1.23	114	790711	4.02	115	790711	6.46	3.90
74	790822	1.43	114	790808	4.29	115	790809	5.16	3.63
74	790919	1.23	114	790905	4.17	115	790905	3.90	3.10
74	791017	1.04	114	791003	5.23	115	791003	9.07	5.11
74	791114	0.92	114	791031	3.91	115	791031	9.99	4.94
74			114	791205	1.92	115	791205	7.57	4.75
74	800116	0.71	114	800131	4.94	115	800131	7.81	4.49
74	800213	1.33	114	800227	5.80	115	800227	11.00	6.04
74	800312	0.83	114	800327	8.85	115	800327	5.90	5.19
74	800409	1.23	114	800423	2.49	115	800423	5.55	3.09
74	800507	1.33	114	800521	2.22	115	800521	5.94	3.16
74	800604	1.29	114	800618	3.62	115	800618	7.28	4.06
74	800702	1.22	114	800716	2.71	115	800716	5.78	3.24
74	800730	1.70	114	800813	4.32	115	800813	6.69	4.24
74	800827	1.45	114	800910	5.25	115	800910	9.49	5.40
74	801001	2.50	114	801015	4.68	115	801015	9.08	5.42
74	801029	1.93	114	801113	4.52	115	801113	7.70	4.72
74	801203	1.48	114	801217	3.87	115	801217	6.60	3.98
74	810114	0.76	114	810128	3.20	115	810128	5.91	3.29
74	810211	3.11	114	810225	4.68	115	810225	8.62	5.47
74	810311	1.59	114	810325	4.88	115	810325	7.35	4.61
74	810422	0.51	114	810506	2.35	115	810506	4.35	2.40
74	810520	0.89	114	810603	2.02	115	810603	4.41	2.44
74	810617	0.84	114	810701	1.20	115	810701	5.86	2.63
74	810715	1.10	114	810729	1.73	115	810729	3.39	2.07
74	810812	0.77	114	810826	2.20	115	810826	4.33	2.43
74	810909	1.40	114	810923	2.29	115	810923	4.80	2.83
74	811007	1.95	114	811015	1.52	115	811015	3.60	2.36
74	811028	0.89	114	811104	2.33	115	811104	5.57	2.93
74	811209	1.99	114	811209	2.00	115	811209	5.50	3.16
74	820127	2.00	114	820127	1.92	115	820127	5.53	3.15
74	820224	1.79	114	820224	1.48	115	820224	10.90	4.72
74	820324	1.59	114	820324	1.80	115	820324	4.77	2.72
74	820407	0.73	114	820421	1.70	115	820421	4.78	2.40
74			114	820519		115	820519	5.01	5.01
74	820722	1.18	114	820616	2.20	115	820616	6.87	3.42
74	820818	0.75	114	820714	3.60	115	820714	6.04	3.46
74	820908	1.44	114	820811	3.06	115	820811	5.83	3.44
74	821006	0.94	114	820915	3.88	115	820915	6.66	3.83
74	821103	1.41	114	821013	3.33	115	821013	6.40	3.71
74	821117	1.72	114	821117	2.60	115	821117	6.33	3.55
74	830126	1.13	114	830126	2.00	115	830126	4.88	2.67
74	830223	1.89	114	830302	2.18	115	830302	4.34	2.80
74	830323	2.36	114	830330	2.27	115	830330	4.11	2.91
74	830420	2.32	114	830427	2.81	115	830427	5.50	3.54
74	830525	1.37	114	830525	1.61	115	830525	5.00	2.66
74	830622	1.49	114	830622	2.32	115	830622	8.40	4.07
74	830720	2.36	114	830720	2.67	115	830720		2.52
74	830817	0.37	114	830817	0.38	115	830817		0.38
74	830914	2.06	114	830914	2.04	115	830914	4.33	2.81
74	831012	3.01	114	831012	4.32	115	831012	12.20	6.51
74	831115	1.20	114	831116	2.44	115	831116	7.00	3.55
74	831214	1.80	114	831214	2.94	115	831214	4.38	3.04

Appendix 4-B2

Site #	DATE yymmdd	P.TOTAL mg/l	Site #	DATE yymmdd	P.TOTAL mg/l	Site #	DATE yymmdd	P.TOTAL mg/l	AVERAGE 74,114,115
74	840125	2.62	114	840125	2.66	115	840125	8.10	4.46
74	840222	2.00	114	840222	2.44	115	840222	1.32	1.92
74	840328	1.51	114	840328	2.49	115	840328	12.60	5.53
74	840425	1.58	114	840425	1.81	115	840425	10.30	4.56
74	840523	1.06	114	840523	1.64	115	840523	5.13	2.61
74	840620	1.24	114	840620	2.08	115	840620	6.20	3.17
74	840718	1.42	114	840718	1.71	115	840718	7.80	3.64
74	840815	2.07	114	840815	2.49	115	840815	8.80	4.45
74	840912	1.46	114	840912	1.79	115	840912	9.00	4.08
74	841010	1.38	114	841010	1.72	115	841010	6.00	3.03
74	841107	1.02	114	841107	1.56	115	841107	11.20	4.59
74	841212	1.20	114	841212	2.13	115	841212	5.71	3.01
74	850116	0.62	114	850116	2.04	115	850116	8.76	3.81
74	850227	1.53	114	850227	2.46	115	850227	8.68	4.22
74	850327	1.47	114	850327	2.96	115	850327	8.23	4.22
74	850417	1.22	114	850417	2.80	115	850417	7.77	3.93
74	850515	0.82	114	850515	3.50	115	850515	5.75	3.36
74	850626	1.51	114	850626	2.27	115	850626	3.55	2.44
74	850724	1.28	114	850724	2.20	115	850724	4.25	2.58
74	850814	1.54	114	850814	2.86	115	850814	4.18	2.86
74	850911	3.87	114	850911	5.43	115	850911	9.22	6.17
74	851016	1.84	114	851016	2.74	115	851016	8.16	4.25
74	851113	1.58	114	851113	1.66	115	851113	5.66	2.97
74	851218	1.76	114	851218	2.21	115	851218	7.73	3.90
74	860129	1.44	114	860129	2.17	115	860129	7.25	3.62
74	860226	1.60	114	860226	1.92	115	860226	6.78	3.43
74	860326	1.78	114	860326	2.33	115	860326	7.29	3.80
74	860423	1.44	114	860423	3.00	115	860423	9.88	4.77
74	860521	0.83	114	860521	1.91	115	860521	7.23	3.32
74	860618	1.20	114	860618	1.62	115	860618	3.94	2.25
74	860723	1.45	114	860723	2.51	115	860723	5.80	3.25
74	860827	2.02	114	860827	2.34	115	860827	4.40	2.92
74	860924	1.92	114	860924	2.74	115	860924	6.87	3.84
74	861015	1.21	114	861015	1.68	115	861015	3.80	2.23
74	861105	1.05	114	861105	1.72	115	861105	4.88	2.55
74	861217	1.13	114	861217	1.25	115	861217	6.31	2.90
74	870128	1.54	114	870128	1.74	115	870128	2.79	2.02
74	870225	1.60	114	870225	2.29	115	870225	4.25	2.71
74	870325	1.13	114	870325	1.91	115	870325	4.23	2.42
74	870422	1.64	114	870422	2.05	115	870422	5.91	3.20
74	870527	1.28	114	870527	2.29	115	870527	6.65	3.41
74	870624	1.55	114	870624	1.83	115	870624	5.74	3.04
74	870729	2.24	114	870729	3.21	115	870729	6.63	4.03
74	870826	2.58	114	870826	3.61	115	870826	3.64	3.28
74	870923	1.71	114	870923	2.19	115	870923	6.75	3.55
74	871021	1.36	114	871021	2.29	115	871021	5.95	3.20
74	871118	2.82	114	871118	3.23	115	871118	5.90	3.98
74	871216	1.53	114	871216	2.20	115	871216	6.25	3.33
74	880127	1.65	114	880127	2.08	115	880127	4.15	2.63
74	880224	1.29	114	880224	2.29	115	880224	5.90	3.16
74	880316	2.00	114	880316	1.94	115	880316	4.75	2.90
74	880427	1.25	114	880427	1.92	115	880427	6.10	3.09
74	880525	2.24	114	880525	1.99	115	880525	5.35	3.19
74	880622	0.90	114	880622	1.33	115	880622	4.58	2.27
74	880726	1.21	114	880726	1.90	115	880726	3.75	2.29
74	880824	0.85	114	880824	2.33	115	880824	4.74	2.64
74	880928	1.93	114	880928	2.81	115	880928	7.03	3.92
74	881026	1.43	114	881026	1.74	115	881026	7.45	3.54
74	881130	1.91	114	881130	2.16	115	881130	4.51	2.86
74	881228	1.39	114	881228	3.31	115	881228	4.97	3.22

Site #	DATE yymmdd	P.TOTAL mg/l	Site #	DATE yymmdd	P.TOTAL mg/l	Site #	DATE yymmdd	P.TOTAL mg/l	AVERAGE 74,114,115
74	890125	1.80	114	890125	2.19	115	890125	3.71	2.57
74	890222	1.49	114	890222	2.61	115	890222	5.87	3.32
74	890322	1.39	114	890322	2.17	115	890322	4.43	2.66
74	890426	1.19	114	890426	2.55	115	890426	6.19	3.31
74	890531	0.71	114	890531	2.33	115	890531	4.16	2.40
74	890628	0.94	114	890628	1.13	115	890628	5.53	2.53
74	890726	1.31	114	890726	1.91	115	890726	5.53	2.92
74	890830	1.09	114	890830	2.01	115	890830	4.71	2.60
74	890927	2.81	114	890927	3.27	115	890927	5.45	3.84
74	891025	0.98	114	891025	2.31	115	891025	5.54	2.94
74	891128	1.51	114	891129	1.99	115	891129	5.07	2.86
74	891220	1.49	114	891220	2.34	115	891220	4.63	2.82
74	900130	1.59	114	900131	2.31	115	900131	3.07	2.32
74	900228	1.70	114	900228	2.54	115	900228	6.65	3.63
74	900328	0.99	114	900328	1.82	115	900328	4.38	2.40
74	900425	0.48	114	900425	0.98	115	900425	3.86	1.77
74	900530	0.90	114	900530	1.28	115	900530	2.64	1.61
74	900627	1.02	114	900627	1.56	115	900627	3.03	1.87
74	900731	1.15	114	900801	1.86	115	900801	13.27	5.43
74	900829	1.61	114	900829	3.97	115	900829	5.66	3.75
74	900926	1.41	114	900926	2.07	115	900926	8.40	3.96
74	901024	1.14	114	901024	1.80	115	901024	8.61	3.85
74	901128	0.45	114	901128	1.43	115	901128	5.25	2.38
74	901219	0.68	114	901219	1.72	115	901219	8.44	3.61
74	910123	0.83	114	910123	1.47	115	910123	5.83	2.71
74	910226	0.66	114	910226	1.24	115	910226	3.67	1.86
74	910327	0.71	114	910327	2.66	115	910327	6.81	3.39
74	910424	1.31	114	910424	2.07	115	910424	5.53	2.97
74	910522	0.44	114	910522	1.82	115	910522	3.44	1.90
74	910626	1.34	114	910626	2.26	115	910626	4.53	2.71
74	910731	2.22	114	910731	2.81	115	910731	4.86	3.30
74	910828	1.85	114	910828	2.71	115	910828	6.03	3.53
74	910925	1.07	114	910925	1.68	115	910925	4.64	2.46
74	911023	1.07	114	911023	1.92	115	911023	4.98	2.66
74	911120	0.82	114	911120	1.45	115	911120	4.62	2.30
74	911211	0.80	114	911211	1.29	115	911211	3.72	1.94
74	920129	0.55	114	920129	1.27	115	920129	3.08	1.63
74	920226	0.87	114	920226	2.29	115	920226	3.34	2.17
74	920325	0.64	114	920325	1.49	115	920325	3.25	1.79
74	920422	0.94	114	920422	1.50	115	920422	3.81	2.08
74	920527	0.48	114	920527	1.04	115	920527	2.89	1.47
74	920624	0.48	114	920624	0.65	115	920624	2.41	1.18
74	920729	1.00	114	920729	2.11	115	920729	4.36	2.49
74	920826	1.04	114	920826	2.44	115	920826	4.99	2.82
74	920922	1.04	114	920923	1.60	115	920923	4.70	2.45
74	921028	0.78	114	921028	1.49	115	921028	4.69	2.32
74	921118	0.79	114	921118	1.15	115	921118	3.66	1.87
74	921216	0.43	114	921216	1.04	115	921216	3.36	1.61
74	930120	1.24	114	930120	2.23	115	930120	4.70	2.72
74	930217	0.92	114	930217	1.67	115	930217	4.05	2.21
74	930317	0.85	114	930317	1.46	115	930317	2.92	1.74
74	930421	1.32	114	930421	1.82	115	930421	4.21	2.45
74	930519	1.03	114	930519	1.26	115	930519	3.44	1.91
74	930616	0.42	114	930616	1.27	115	930616	2.85	1.51
74	930721	0.72	114	930721	1.60	115	930721	3.52	1.95
74	930818	0.65	114	930818	1.07	115	930818	2.27	1.33
74	930915	2.24	114	930915	2.50	115	930915	3.31	2.68
74	931020	1.30	114	931020	2.02	115	931020	4.76	2.69
74	931117	0.83	114	931117	1.67	115	931117	4.68	2.39
74	931215	0.71	114	931215	1.34	115	931215	3.83	1.96

Appendix 4-B2

Site #	DATE yymmdd	P.TOTAL mg/l	Site #	DATE yymmdd	P.TOTAL mg/l	Site #	DATE yymmdd	P.TOTAL mg/l	AVERAGE 74,114,115
74	940126	0.89	114	940126	1.30	115	940126	2.70	**1.63**
74	940223	0.63	114	940223	1.38	115	940223	3.30	**1.77**
74	940323	0.61	114	940323	1.49	115	940323	3.72	**1.94**
74	940427	0.57	114	940427	1.15	115	940427	2.62	**1.45**
74	940525	0.67	114	940525	0.88	115	940525	2.75	**1.43**
74	940622	1.41	114	940622	2.03	115	940622	2.90	**2.11**
74	940727	1.83	114	940727	2.68	115	940727	5.75	**3.42**
74	940824	1.94	114	940824	2.50	115	940824	6.20	**3.55**
74	940928	1.65	114	940928	1.78	115	940928	3.02	**2.15**
74	941026	1.29	114	941026	1.60	115	941026	4.31	**2.40**
74	941130	1.04	114	941130	1.49	115	941130	3.18	**1.90**
74	941214	1.25	114	941214	1.67	115	941214	3.08	**2.00**
74	950125	1.15	114	950125	1.49	115	950125	3.63	**2.09**
74	950222	1.56	114	950222	1.84	115	950222	3.77	**2.39**
74	950322	1.04	114	950322	1.45	115	950322	3.86	**2.12**
74	950426	0.78	114	950426	1.36	115	950426	2.41	**1.52**
74	950524	0.61	114	950524	1.33	115	950524	4.71	**2.22**
74	950628	1.65	114	950628	10.49	115	950628	24.86	**12.33**
74	950726	1.03	114	950726	1.97	115	950726	2.94	**1.98**
74	950823	1.84	114	950823	4.65	115	950823	7.10	**4.53**
74	950927	1.42	114	950927	1.71	115	950927	4.25	**2.46**
74	951025	1.04	114	951025	1.52	115	951025	4.70	**2.42**
74	951129	0.37	114	951129	1.10	115	951129	3.55	**1.67**
74	951213	0.73	114	951213	1.39	115	951213	3.62	**1.91**
74	960124	0.51	114	960124	1.49	115	960124	3.84	**1.95**
74	960221	0.72	114	960221	1.03	115	960221	3.48	**1.74**
74	960320	1.06	114	960320	1.56	115	960320	3.34	**1.99**
74	960417	0.95	114	960417	1.56	115	960417	4.95	**2.49**
74	960515	0.50	114	960515	1.30	115	960515	3.40	**1.73**
74	960619	0.53	114	960619	1.63	115	960619	4.26	**2.14**
74	960717	0.76	114	960717	2.52	115	960717	4.78	**2.69**
74	960821	0.61	114	960821	2.75	115	960821	5.45	**2.94**
74	960925	0.70	114	960925	1.68	115	960925	3.00	**1.79**
74	961016	1.01	114	961016	1.91	115	961016	4.39	**2.44**
74	961120	0.24	114	961120	0.84	115	961120	2.75	**1.28**
74	961211	0.71	114	961211	0.70	115	961211	2.60	**1.34**
74	970122	0.49	114	970122	1.02	115	970122	3.51	**1.67**
74	970219	0.31	114	970219	1.30	115	970219	4.00	**1.87**
74	970319	0.39	114	970319	1.56	115	970319	3.66	**1.87**
74	970416	0.31	114	970416	1.74	115	970416	3.16	**1.74**
74	970521	0.54	114	970521	1.32	115	970521	3.26	**1.71**
74	970618	0.33	114	970618	1.76	115	970618	3.15	**1.75**
74	970723	0.48	114	970723	1.50	115	970723	2.24	**1.41**
74	970820	0.71	114	970820	2.00	115	970820	3.31	**2.01**
74	970917	0.65	114	970917	1.65	115	970917	3.15	**1.82**
74	971015	0.56	114	971015	1.66	115	971015	5.45	**2.56**
74	971119	1.33	114	971119	1.65	115	971119	3.25	**2.08**
74	971210	0.36	114	971210	234.83	115	971210	220.21	**151.80**
74	980121	0.72	114	980121	2.82	115	980121	6.14	**3.23**
74	980218	1.30	114	980218	1.68	115	980218	3.47	**2.15**
74	980318	0.61	114	980318	2.05	115	980318	4.90	**2.52**

Appendix 4-B3

Site #	DATE yymmdd	N.TOTAL mg/l	Site #	DATE yymmdd	N.TOTAL mg/l	Site #	DATE yymmdd	N.TOTAL mg/l	Average 115,114,74
74	810114	0.90	114	810128	3.34	115	810128	4.29	2.84
74	810211	1.68	114	810225	3.23	115	810225	5.58	3.50
74	810311	1.33	114	810325	4.13	115	810325	4.76	3.41
74	810422	1.01	114	810506	2.43	115	810506	2.81	2.08
74	810520	1.15	114	810603	2.56	115	810603	5.01	2.91
74	810617	1.21	114	810701	4.15	115	810701	7.56	4.31
74	810715	1.18	114	810729	5.62	115	810729	3.72	3.51
74	810812	1.35	114	810826	2.85	115	810826	4.59	2.93
74	810909	1.52	114	810923	3.37	115	810923	5.33	3.41
74	811007	1.19	114	811015	2.57	115	811015	3.71	2.49
74	811028	0.80	114	811104	2.22	115	811104	6.61	3.21
74	811209		114	811209	3.42	115	811209	5.97	4.70
74	820127	1.35	114	820127	2.23	115	820127	4.03	2.54
74	820224	1.93	114	820224	2.40	115	820224		2.17
74	820324		114	820324	4.53	115	820324	5.04	4.79
74	820407	0.86	114	820421	1.96	115	820421	1.15	1.32
74			114	820519		115	820519	1.90	1.90
74	820722	0.83	114	820616	1.75	115	820616	2.38	1.65
74	820818	1.18	114	820714	1.75	115	820714	2.54	1.82
74	820908	1.20	114	820811	1.63	115	820811	1.90	1.58
74	821006	0.89	114	820915	3.59	115	820915	5.70	3.39
74	821103	1.58	114	821013	1.93	115	821013	2.76	2.09
74	821117	1.55	114	821117	4.34	115	821117	3.46	3.12
74	830126	1.22	114	830126	2.24	115	830126	3.39	2.28
74	830223	2.39	114	830302	1.85	115	830302	1.58	1.94
74	830323	2.00	114	830330	2.44	115	830330	4.94	3.13
74	830420	1.86	114	830427	1.79	115	830427	1.94	1.86
74	830525	1.28	114	830525	3.08	115	830525	2.26	2.21
74	830622	1.34	114	830622	2.64	115	830622	3.99	2.66
74	830720	1.84	114	830720	2.50	115	830720	2.70	2.35
74	830817	1.72	114	830817	1.17	115	830817	1.08	1.32
74	830914	1.63	114	830914	1.81	115	830914	2.05	1.83
74	831012	1.34	114	831012	2.17	115	831012	1.65	1.72
74	831115	1.84	114	831116	1.86	115	831116	1.81	1.84
74	831214	1.37	114	831214	2.18	115	831214	2.13	1.89
74	840125	0.95	114	840125	2.15	115	840125	3.09	2.06
74	840222	1.56	114	840222	1.75	115	840222	2.20	1.84
74	840328	1.88	114	840328	2.90	115	840328	2.01	2.26
74	840425	2.26	114	840425	1.47	115	840425	1.65	1.79
74	840523	1.19	114	840523	1.64	115	840523	1.34	1.39
74	840620	1.28	114	840620	2.44	115	840620	2.42	2.05
74	840718	1.68	114	840718	1.23	115	840718	1.37	1.43
74	840815	1.39	114	840815	1.35	115	840815	1.00	1.25
74	840912	1.82	114	840912	1.49	115	840912	1.42	1.58
74	841010	1.73	114	841010	1.88	115	841010	1.99	1.87
74	841107	1.24	114	841107	1.99	115	841107	1.71	1.65
74	841212	1.24	114	841212	2.27	115	841212	1.56	1.69
74	850116	1.02	114	850116	2.31	115	850116	1.80	1.71
74	850227	1.15	114	850227	1.58	115	850227	1.25	1.33
74	850327	1.28	114	850327	2.03	115	850327	1.50	1.60
74	850417	0.77	114	850417	2.00	115	850417	1.29	1.35
74	850515	1.11	114	850515	1.70	115	850515	1.08	1.30
74	850626	3.80	114	850626	2.20	115	850626	1.80	2.60
74	850724	1.07	114	850724	1.66	115	850724	1.28	1.34
74	850814	1.45	114	850814	1.60	115	850814	1.29	1.45
74	850911	1.59	114	850911	1.61	115	850911	1.94	1.71
74	851016	1.44	114	851016	1.98	115	851016	1.92	1.78
74	851113	1.89	114	851113	1.80	115	851113	2.04	1.91
74	851218	1.39	114	851218	1.83	115	851218	1.80	1.67

Appendix 4-B3

Site #	DATE yymmdd	N.TOTAL mg/l	Site #	DATE yymmdd	N.TOTAL mg/l	Site #	DATE yymmdd	N.TOTAL mg/l	Average 115,114,74
74	860129	1.32	114	860129	1.71	115	860129	2.16	1.73
74	860226	1.36	114	860226	1.55	115	860226	12.11	5.01
74	860326	1.31	114	860326	1.60	115	860326	1.93	1.61
74	860423	1.00	114	860423	1.61	115	860423	1.26	1.29
74	860521	0.82	114	860521	1.94	115	860521	2.44	1.73
74	860618	1.23	114	860618	1.57	115	860618	1.79	1.53
74	860723	1.22	114	860723	1.86	115	860723	1.43	1.50
74	860827	1.36	114	860827	1.39	115	860827	1.41	1.39
74	860924	1.27	114	860924	1.83	115	860924	1.56	1.55
74	861015	1.29	114	861015	3.07	115	861015	1.55	1.97
74	861105	1.21	114	861105	2.58	115	861105	2.21	2.00
74	861217	1.56	114	861217	0.68	115	861217	1.90	1.38
74	870128	1.76	114	870128	1.68	115	870128	1.69	1.71
74	870225	3.07	114	870225	2.84	115	870225	2.19	2.70
74	870325	1.70	114	870325	2.43	115	870325	2.39	2.17
74	870422	2.36	114	870422	2.28	115	870422	4.92	3.19
74	870527	3.03	114	870527	3.38	115	870527	4.24	3.55
74	870624	3.32	114	870624	2.43	115	870624	2.15	2.63
74	870729	2.36	114	870729	2.65	115	870729	2.99	2.67
74	870826	2.02	114	870826	1.97	115	870826	1.95	1.98
74	870923	2.08	114	870923	2.51	115	870923	2.18	2.26
74	871021	2.29	114	871021	2.46	115	871021	1.89	2.21
74	871118	2.36	114	871118	2.40	115	871118	3.03	2.60
74	871216	1.39	114	871216	1.70	115	871216	1.63	1.57
74	880127	1.74	114	880127	1.82	115	880127	1.38	1.65
74	880224	1.48	114	880224	1.89	115	880224	1.35	1.57
74	880316	2.30	114	880316	2.08	115	880316	1.30	1.89
74	880427	1.19	114	880427	2.47	115	880427	1.50	1.72
74	880525	1.08	114	880525	1.89	115	880525	1.39	1.45
74	880622	0.76	114	880622	2.44	115	880622	1.96	1.72
74	880726	1.32	114	880726	1.66	115	880726	1.57	1.52
74	880824	1.37	114	880824	1.91	115	880824	1.85	1.71
74	880928	1.72	114	880928	1.49	115	880928	1.79	1.67
74	881026	1.54	114	881026	2.32	115	881026	3.43	2.43
74	881130	1.93	114	881130	2.05	115	881130	1.60	1.86
74	881228	1.45	114	881228	2.65	115	881228	1.25	1.78
74	890125	1.44	114	890125	1.28	115	890125	1.29	1.34
74	890222	1.51	114	890222	1.97	115	890222	1.69	1.72
74	890322	2.34	114	890322	2.17	115	890322	1.39	1.97
74	890426	0.97	114	890426	1.77	115	890426	1.54	1.43
74	890531	0.93	114	890531	2.01	115	890531	1.37	1.44
74	890628	0.78	114	890628	1.56	115	890628	2.25	1.53
74	890726	1.65	114	890726	1.81	115	890726	2.11	1.86
74	890830	1.35	114	890830	1.83	115	890830	1.70	1.63
74	890927	1.55	114	890927	1.41	115	890927	1.83	1.60
74	891025	1.01	114	891025	1.97	115	891025	1.88	1.62
74	891128	2.61	114	891129	1.16	115	891129	1.22	1.66
74	891220	1.81	114	891220	2.35	115	891220	2.77	2.31
74	900130	1.94	114	900131	1.94	115	900131	2.51	2.13
74	900228	1.13	114	900228	1.51	115	900228	2.34	1.66
74	900328	0.91	114	900328	1.81	115	900328	1.21	1.31
74	900425	0.73	114	900425	1.87	115	900425	1.82	1.47
74	900530	0.74	114	900530	1.95	115	900530	1.14	1.28
74	900627	0.72	114	900627	2.08	115	900627	4.25	2.35
74	900731	1.34	114	900801	1.26	115	900801	3.95	2.18
74	900829	1.05	114	900829	2.26	115	900829	1.27	1.53
74	900926	0.82	114	900926	2.05	115	900926	1.17	1.35
74	901024	1.13	114	901024	1.97	115	901024	1.18	1.43
74	901128	0.44	114	901128	1.91	115	901128	1.48	1.28
74	901219	0.89	114	901219	2.12	115	901219	1.45	1.49

Appendix 4-B3

Site #	DATE yymmdd	N.TOTAL mg/l	Site #	DATE yymmdd	N.TOTAL mg/l	Site #	DATE yymmdd	N.TOTAL mg/l	Average 115,114,74
74	910123	1.25	114	910123	1.96	115	910123	1.81	1.67
74	910226	1.10	114	910226	1.86	115	910226	1.01	1.32
74	910327	0.67	114	910327	1.78	115	910327	1.28	1.24
74	910424	0.92	114	910424	1.49	115	910424	0.87	1.09
74	910522	0.46	114	910522	1.92	115	910522	2.24	1.54
74	910626	0.97	114	910626	1.50	115	910626	1.56	1.34
74	910731	1.49	114	910731	2.63	115	910731	1.50	1.87
74	910828	1.47	114	910828	1.59	115	910828	1.22	1.43
74	910925	0.99	114	910925	2.01	115	910925	1.48	1.49
74	911023	1.19	114	911023	1.83	115	911023	1.31	1.44
74	911120	1.58	114	911120	2.05	115	911120	1.79	1.81
74	911211	1.14	114	911211	2.11	115	911211	1.69	1.65
74	920129	0.84	114	920129	2.25	115	920129	2.11	1.73
74	920226	1.01	114	920226	1.51	115	920226	0.98	1.17
74	920325	0.98	114	920325	1.64	115	920325	1.38	1.33
74	920422	1.15	114	920422	1.89	115	920422	1.95	1.66
74	920527	1.01	114	920527	1.94	115	920527	0.76	1.24
74	920624	1.22	114	920624	1.69	115	920624	0.89	1.27
74	920729	1.44	114	920729	1.45	115	920729	1.11	1.33
74	920826	1.21	114	920826	2.35	115	920826	1.17	1.58
74	920922	1.65	114	920923	1.38	115	920923	1.24	1.42
74	921028	1.05	114	921028	1.73	115	921028	1.08	1.29
74	921118	0.83	114	921118	1.71	115	921118	0.93	1.16
74	921216	0.97	114	921216	2.00	115	921216	1.34	1.44
74	930120	1.41	114	930120	1.26	115	930120	1.16	1.28
74	930217	1.06	114	930217	1.37	115	930217	1.24	1.22
74	930317	1.33	114	930317	1.13	115	930317	1.09	1.18
74	930421	1.18	114	930421	1.28	115	930421	0.98	1.15
74	930519	0.68	114	930519	1.27	115	930519	1.09	1.01
74	930616	0.83	114	930616	1.37	115	930616	1.10	1.10
74	930721	0.74	114	930721	1.80	115	930721	1.59	1.38
74	930818	1.53	114	930818	1.40	115	930818	1.21	1.38
74	930915	1.78	114	930915	1.24	115	930915	1.02	1.35
74	931020	1.41	114	931020	1.33	115	931020	1.31	1.35
74	931117	0.80	114	931117	1.16	115	931117	1.26	1.07
74	931215	1.14	114	931215	1.85	115	931215	1.76	1.58
74	940126	1.95	114	940126	1.45	115	940126	1.43	1.61
74	940223	1.40	114	940223	1.41	115	940223	1.47	1.43
74	940323	0.35	114	940323	1.54	115	940323	1.34	1.08
74	940427	1.52	114	940427	1.30	115	940427	1.22	1.35
74	940525	1.71	114	940525	1.47	115	940525	0.54	1.24
74	940622	1.91	114	940622	1.47	115	940622	1.27	1.55
74	940727	1.86	114	940727	1.29	115	940727	1.64	1.60
74	940824	2.29	114	940824	1.15	115	940824	1.07	1.50
74	940928	1.94	114	940928	2.09	115	940928	1.21	1.75
74	941026	1.39	114	941026	1.18	115	941026	1.25	1.27
74	941130	1.49	114	941130	1.24	115	941130	1.11	1.28
74	941214	1.56	114	941214	1.22	115	941214	1.35	1.38
74	950125	1.30	114	950125	1.51	115	950125	3.07	1.96
74	950222	1.64	114	950222	1.57	115	950222	1.41	1.54
74	950322	1.44	114	950322	1.28	115	950322	1.40	1.37
74	950426	0.96	114	950426	1.47	115	950426	1.47	1.30
74	950524	0.65	114	950524	1.44	115	950524	1.32	1.14
74	950628	1.70	114	950628	1.19	115	950628	1.10	1.33
74	950726	1.34	114	950726	1.53	115	950726	1.38	1.42
74	950823	1.40	114	950823	2.04	115	950823	1.29	1.58
74	950927	1.37	114	950927	1.26	115	950927	1.33	1.32
74	951025	1.54	114	951025	1.18	115	951025	1.37	1.36
74	951129	0.58	114	951129	1.56	115	951129	1.38	1.17
74	951213	0.84	114	951213	1.23	115	951213	1.11	1.06

Appendix 4-B3

Site #	DATE yymmdd	N.TOTAL mg/l	Site #	DATE yymmdd	N.TOTAL mg/l	Site #	DATE yymmdd	N.TOTAL mg/l	Average 115,114,74
74	960124	0.92	114	960124	1.28	115	960124	1.51	1.24
74	960221	1.32	114	960221	1.60	115	960221	1.30	1.41
74	960320	1.74	114	960320	1.56	115	960320	0.88	1.39
74	960417	1.40	114	960417	1.53	115	960417	1.39	1.44
74	960515	1.22	114	960515	1.88	115	960515	1.37	1.49
74	960619	0.92	114	960619	1.62	115	960619	1.52	1.35
74	960717	1.09	114	960717	1.40	115	960717	1.33	1.27
74	960821	0.74	114	960821	1.24	115	960821	1.02	1.00
74	960925	3.01	114	960925	1.45	115	960925	1.20	1.89
74	961016	3.23	114	961016	2.26	115	961016	0.95	2.15
74	961120	0.79	114	961120	1.95	115	961120	1.41	1.38
74	961211	0.95	114	961211	1.34	115	961211	1.21	1.17
74	970122	0.84	114	970122	2.46	115	970122	1.67	1.66
74	970219	0.75	114	970219	1.47	115	970219	1.23	1.15
74	970319	0.92	114	970319	2.00	115	970319	1.36	1.43
74	970416	0.78	114	970416	1.68	115	970416	2.10	1.52
74	970521	0.95	114	970521	2.00	115	970521	1.82	1.59
74	970618	0.97	114	970618	2.41	115	970618	1.68	1.69
74	970723	1.30	114	970723	1.72	115	970723	1.91	1.64
74	970820	1.08	114	970820	1.82	115	970820	1.97	1.62
74	970917	1.16	114	970917	1.77	115	970917	1.21	1.38
74	971015	1.05	114	971015	1.96	115	971015	1.44	1.48
74	971119	1.53	114	971119	1.30	115	971119	1.27	1.37
74	971210	0.76	114	971210	37.43	115	971210	46.26	28.15
74	980121	0.84	114	980121	1.81	115	980121	2.02	1.56
74	980218	1.43	114	980218	1.28	115	980218	1.34	1.35
74	980318	0.77	114	980318	1.61	115	980318	1.63	1.34

Appendix 4-B4

month	Site #	DATE yymmdd	F.DISS mg/l	Site #	DATE yymmdd	F.DISS mg/l	Site #	DATE yymmdd	F.DISS mg/l	**AVG 74,114,115 F Diss**
1	74	740109	2.64	114	740123	6.20	115	740122	11.98	**6.94**
2	74	740207	3.50	114	740220	5.46	115	740219	12.60	**7.19**
3	74	740306	2.70	114	740327	6.16	115	740326	10.64	**6.50**
4	74	740410	3.22	114	740424	7.00	115	740423	12.60	**7.61**
5	74	740508	2.64	114	740522	5.10	115	740521	10.80	**6.18**
6	74	740605	2.36	114	740619	4.80	115	740618	7.80	**4.99**
7	74	740702	3.00	114	740717	5.40	115	740716	9.00	**5.80**
8	74	740731	3.60	114	740814	1.96	115	740814	2.00	**2.52**
9	74	740829		114	740911	2.52	115	740910	6.30	**4.41**
10	74	740925	0.70	114	741009	3.40	115	741008	8.00	**4.03**
11	74	741030	1.76	114	741113	4.60	115	741112	8.80	**5.05**
12	74	741204	1.84	114	741218	3.60	115	741217	7.00	**4.15**
1	74	750107	1.32	114	750122	4.20	115	750121	7.00	**4.17**
2	74	750206	2.40	114	750219	4.40	115	750220	8.00	**4.93**
3	74	750305	2.60	114	750319	4.08	115	750318	7.40	**4.69**
4	74	750402	2.40	114	750416	6.00	115	750415	9.00	**5.80**
5	74	750430	2.30	114	750514	3.20	115	750513	10.00	**5.17**
6	74	750528		114	750611		115	750610		
7	74	750624	2.60	114	750709	4.40	115	750710	8.80	**5.27**
8	74	750723	2.20	114	750806	3.00	115	750807	5.60	**3.60**
9	74	750821	2.00	114	750902	3.20	115	750902	7.00	**4.07**
10	74	750917	1.96	114	751001	2.40	115	751002	4.40	**2.92**
11	74	751015	2.00	114	751029	0.80	115	751028	6.00	**2.93**
12	74	751112	1.76	114	751203	0.54	115	751202	5.80	**2.70**
1	74	760107	1.60	114	760121	3.00	115	760122	5.00	**3.20**
2	74	760203		114	760218	3.00	115	760217	5.00	**4.00**
3	74	760302		114	760317	3.60	115	760318	5.60	**4.60**
4	74	760331	1.60	114	760414	3.20	115	760415	4.60	**3.13**
5	74	760428		114	760512	2.60	115	760512	5.40	**4.00**
6	74	760526		114	760609	2.80	115	760609	4.20	**3.50**
7	74	760701		114	760714	1.94	115	760714	4.20	**3.07**
8	74	760728	1.82	114	760811	2.48	115	760810	5.96	**3.42**
9	74	760902		114	760915	1.88	115	760914	4.70	**3.29**
10	74	760929		114	761013	3.10	115	761013	6.40	**4.75**
11	74	761027		114	761110	3.00	115	761110	4.80	**3.90**
12	74	761201	1.64	114	761215	2.68	115	761214	4.80	**3.04**
1	74	770105		114	770202	0.24	115	770202	3.11	**1.68**
2	74	770216		114	770302	2.90	115	770302	4.80	**3.85**
3	74	770316	2.00	114	770330	2.40	115	770330	3.60	**2.67**
4	74	770420	1.60	114	770504	2.56	115	770503	5.40	**3.19**
5	74	770516		114	770602	3.28	115	770602	5.90	**4.59**
6	74	770615		114	770630	2.86	115	770630	5.00	**3.93**
7	74	770713		114	770727	2.90	115	770727	1.52	**2.21**
8	74	770810	2.20	114	770824		115	770824		**2.20**
9	74	770908		114	770921	2.40	115	770921	4.40	**3.40**
10	74	771005		114	771019	2.40	115	771019	4.90	**3.65**
11	74	771102	2.08	114	771116	2.40	115	771116	4.80	**3.09**
12	74	771208		114	771220	3.13	115	771220	5.13	**4.13**
1	74	780111		114	780125	2.51	115	780125	4.50	**3.51**
2	74	780214		114	780222	2.30	115	780228	4.49	**3.40**
3	74	780308	2.95	114	780321	2.86	115	780321	5.22	**3.68**
4	74	780405		114	780419	2.84	115	780419	5.00	**3.92**
5	74	780503		114	780517	2.82	115	780517	0.40	**1.61**
6	74	780531	2.45	114	780614	2.75	115	780614	4.38	**3.19**
7	74	780628		114	780712	2.70	115	780712	5.66	**4.18**
8	74	780726		114	780809	2.30	115	780809	3.40	**2.85**
9	74	780823		114	780906	2.85	115	780906	5.02	**3.94**
10	74	780920		114	781004	2.48	115	781004	6.88	**4.68**
11	74	781101		114	781115	2.38	115	781115	4.62	**3.50**
12	74			114	781218	2.17	115	781218	4.31	**3.24**

month	Site #	DATE yymmdd	F.DISS mg/l	Site #	DATE yymmdd	F.DISS mg/l	Site #	DATE yymmdd	F.DISS mg/l	**AVG 74,114,115 F Diss**
1	74	790110		114	790124	2.95	115	790124	3.86	**3.41**
2	74	790208		114	790221	2.18	115	790221	3.71	**2.95**
3	74	790307		114	790320	1.94	115	790320	3.28	**2.61**
4	74	790404		114	790424	3.06	115	790424	3.80	**3.43**
5	74	790502		114	790517	2.04	115	790517	2.84	**2.44**
6	74	790530		114	790613	3.33	115	790613	5.12	**4.23**
7	74	790627		114	790711	2.27	115	790711	3.74	**3.01**
8	74	790725		114	790808	2.59	115	790809	2.85	**2.72**
9	74	790822		114	790905	3.74	115	790905	4.86	**4.30**
10	74	790919		114	791003	1.65	115	791003	2.99	**2.32**
11	74	791017		114	791031	2.46	115	791031	4.94	**3.70**
12	74	791114		114	791205	2.41	115	791205	4.68	**3.55**
1	74	800116	1.09	114	800131	3.66	115	800131	5.81	**3.52**
2	74	800213		114	800227	3.10	115	800227	6.11	**4.61**
3	74	800312	1.06	114	800327	3.75	115	800327	3.53	**2.78**
4	74	800409		114	800423	1.52	115	800423	2.94	**2.23**
5	74	800507		114	800521	1.23	115	800521	2.38	**1.81**
6	74	800604	0.82	114	800618	1.75	115	800618	3.49	**2.02**
7	74	800702		114	800716	2.63	115	800716	3.88	**3.26**
8	74	800730		114	800813	1.59	115	800813	2.65	**2.12**
9	74	800827		114	800910		115	800910		
10	74	801001		114	801015		115	801015		
11	74	801029		114	801113	2.51	115	801113	3.93	**3.22**
12	74	801203	1.06	114	801217	1.96	115	801217	2.78	**1.93**
1	74	810114	1.25	114	810128	1.59	115	810128	2.42	**1.75**
2	74	810211		114	810225	1.72	115	810225	2.76	**2.24**
3	74	810311		114	810325	1.57	115	810325	2.57	**2.07**
4	74	810422		114	810506		115	810506		
5	74	810520		114	810603		115	810603		
6	74	810617	2.62	114	810701	3.68	115	810701	8.10	**4.80**
7	74	810715		114	810729		115	810729		
8	74	810812		114	810826	1.50	115	810826	3.11	**2.31**
9	74	810909	1.08	114	810923	2.11	115	810923	3.58	**2.26**
10	74	811007		114	811015	3.10	115	811015	1.65	**2.38**
11	74	811028		114	811104	1.81	115	811104	4.65	**3.23**
12	74	811209		114	811209	1.94	115	811209	3.83	**2.89**
1	74	820127	1.45	114	820127	1.64	115	820127	3.56	**2.22**
2	74	820224		114	820224	1.65	115	820224	3.20	**2.43**
3	74	820324	1.26	114	820324	1.25	115	820324	2.92	**1.81**
4	74	820407	1.11	114	820421	1.40	115	820421	3.44	**1.98**
5	74			114	820519	1.28	115	820519	3.14	**2.21**
6	74			114	820616	1.22	115	820616	2.55	**1.89**
7	74	820722	1.07	114	820714	1.88	115	820714	2.99	**1.98**
8	74	820818	0.98	114	820811	1.42	115	820811	2.80	**1.73**
9	74	820908	1.73	114	820915	2.97	115	820915	0.47	**1.72**
10	74	821006	1.56	114	821013	0.21	115	821013	3.50	**1.76**
11	74	821103	1.19	114			115	821117	5.03	**3.11**
12	74	821117	1.64	114	821117	2.27	115			**1.96**
1	74	830126	1.05	114	830126	1.70	115	830126	3.31	**2.02**
2	74	830223	1.15	114	830302	1.68	115	830302	2.70	**1.84**
3	74	830323	0.20	114	830330	1.24	115	830330	2.39	**1.28**
4	74	830420	1.52	114	830427	1.85	115	830427	3.27	**2.21**
5	74	830525	1.09	114	830525	1.35	115	830525	3.14	**1.86**
6	74	830622	0.85	114	830622	1.63	115	830622	3.68	**2.05**
7	74	830720	1.37	114	830720	1.47	115	830720	3.10	**1.98**
8	74	830817	1.29	114	830817	1.44	115	830817	2.80	**1.84**
9	74	830914	1.42	114	830914	1.15	115	830914	1.80	**1.46**
10	74	831012	1.20	114	831012	1.58	115	831012	2.90	**1.89**
11	74	831115	0.83	114	831116	1.26	115	831116	2.58	**1.56**
12	74	831214	2.09	114	831214	1.74	115	831214	2.53	**2.12**

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month	Site #	DATE yymmdd	F.DISS mg/l	Site #	DATE yymmdd	F.DISS mg/l	Site #	DATE yymmdd	F.DISS mg/l	AVG 74,114,115 F Diss
1	74	840125	1.04	114	840125	1.41	115	840125	2.38	**1.61**
2	74	840222	1.01	114	840222	1.04	115	840222	1.42	**1.16**
3	74	840328	1.53	114	840328	2.34	115	840328	4.39	**2.75**
4	74	840425	1.56	114	840425	2.33	115	840425	4.00	**2.63**
5	74	840523	1.24	114	840523	1.81	115	840523	3.25	**2.10**
6	74	840620	0.99	114	840620	1.15	115	840620	2.63	**1.59**
7	74	840718	1.41	114	840718	1.64	115	840718	3.02	**2.02**
8	74	840815	1.39	114	840815	1.53	115	840815	3.34	**2.09**
9	74	840912	1.36	114	840912	1.58	115	840912	3.80	**2.25**
10	74	841010	1.18	114	841010	1.54	115	841010	3.42	**2.05**
11	74	841107	1.06	114	841107	1.32	115	841107	3.01	**1.80**
12	74	841212	1.12	114	841212	1.76	115	841212	3.47	**2.12**
1	74	850116	1.00	114	850116	1.28	115	850116	2.72	**1.67**
2	74	850227		114	850227		115	850227		
3	74	850327	1.23	114	850327	1.59	115	850327	3.72	**2.18**
4	74	850417	1.01	114	850417	1.38	115	850417	3.62	**2.00**
5	74	850515	1.38	114	850515	2.73	115	850515	4.30	**2.80**
6	74	850626		114	850626		115	850626		
7	74	850724	1.53	114	850724	2.45	115	850724	4.29	**2.76**
8	74	850814	1.89	114	850814	2.37	115	850814	3.08	**2.45**
9	74	850911	2.47	114	850911	3.11	115	850911	4.89	**3.49**
10	74	851016	1.87	114	851016	2.82	115	851016	6.20	**3.63**
11	74	851113	1.89	114	851113	2.21	115	851113	4.92	**3.01**
12	74	851218		114	851218	1.41	115	851218	3.60	**2.51**
1	74	850129	0.99	114	860129	1.22	115	860129	2.55	**1.59**
2	74	860226	1.00	114	860226	1.23	115	860226	2.54	**1.59**
3	74	860326	1.41	114	860326	1.79	115	860326	3.35	**2.18**
4	74	860423	1.01	114	860423	1.59	115	860423	4.25	**2.28**
5	74	860521	0.90	114	860521	1.00	115	860521	2.90	**1.60**
6	74	860618	0.92	114	860618	1.10	115	860618	2.44	**1.49**
7	74	860723	1.29	114	860723	1.61	115	860723	2.90	**1.93**
8	74	860827	1.13	114	860827	1.35	115	860827	2.07	**1.52**
9	74	860924	1.42	114	860924	1.83	115	860924	3.28	**2.18**
10	74	861015	1.10	114	861015	1.24	115	861015	2.14	**1.49**
11	74	861105	1.03	114	861105	1.23	115	861105	2.57	**1.61**
12	74	861217	1.06	114	861217	1.20	115	861217	2.92	**1.73**
1	74	870128	1.65	114	870128	1.82	115	870128	3.68	**2.38**
2	74	870225	0.43	114	870225	1.32	115	870225	2.63	**1.46**
3	74	870325	1.01	114	870325	1.20	115	870325	2.27	**1.49**
4	74	870422	1.29	114	870422	1.54	115	870422	2.79	**1.87**
5	74	870527	1.09	114	870527	1.44	115	870527	2.72	**1.75**
6	74	870624	1.08	114	870624	1.30	115	870624	2.90	**1.76**
7	74	870729	1.36	114	870729	1.75	115	870729	2.96	**2.02**
8	74	870826	1.53	114	870826	0.19	115	870826	3.16	**1.63**
9	74	870923	1.44	114	870923	1.67	115	870923	2.93	**2.01**
10	74	871021	1.10	114	871021	1.36	115	871021	2.70	**1.72**
11	74	871118	1.27	114	871118	1.61	115	871118	1.91	**1.60**
12	74	871216	1.02	114	871216	1.42	115	871216	2.35	**1.60**
1	74	880127	0.91	114	880127	1.02	115	880127	1.57	**1.17**
2	74	880224	0.86	114	880224	1.04	115	880224	1.91	**1.27**
3	74	880316	0.99	114	880316	1.23	115	880316	2.20	**1.47**
4	74	880427	1.05	114	880427	1.20	115	880427	2.28	**1.51**
5	74	880525	1.04	114	880525	1.30	115	880525	2.73	**1.69**
6	74	880622	1.13	114	880622	1.61	115	880622	2.92	**1.89**
7	74	880726	1.06	114	880726	1.50	115	880726	2.31	**1.62**
8	74	880824	1.52	114	880824	1.74	115	880824	2.43	**1.90**
9	74	880928	1.23	114	880928	1.54	115	880928	2.60	**1.79**
10	74	881026	1.17	114	881026	1.43	115	881026	2.62	**1.74**
11	74	881130	1.39	114	881130	1.61	115	881130	2.44	**1.81**
12	74	881228	1.10	114	881228	1.40	115	881228	2.45	**1.65**

month	Site #	DATE yymmdd	F.DISS mg/l	Site #	DATE yymmdd	F.DISS mg/l	Site #	DATE yymmdd	F.DISS mg/l	**AVG 74,114,115 F Diss**
1	74	890125	1.11	114	890125	1.31	115	890125	2.11	**1.51**
2	74	890222	1.31	114	890222	1.73	115	890222	2.69	**1.91**
3	74	890322	1.42	114	890322	2.07	115	890322	3.06	**2.18**
4	74	890426	1.48	114	890426	2.13	115	890426	3.63	**2.41**
5	74	890531	1.12	114	890531	1.75	115	890531	3.16	**2.01**
6	74	890628	1.16	114	890628	1.52	115	890628	2.67	**1.78**
7	74	890726	1.48	114	890726	1.84	115	890726	3.72	**2.35**
8	74	890830	1.12	114	890830	1.58	115	890830	2.52	**1.74**
9	74	890927	1.62	114	890927	1.83	115	890927	2.76	**2.07**
10	74	891025	1.00	114	891025	1.46	115	891025	2.60	**1.69**
11	74	891128	1.23	114	891129	1.75	115	891129	3.23	**2.07**
12	74	891220	1.20	114	891220	1.52	115	891220	2.46	**1.73**
1	74	900130	1.21	114	900131	1.53	115	900131	2.93	**1.89**
2	74	900228	1.21	114	900228	1.70	115	900228	2.80	**1.90**
3	74	900328	1.03	114	900328	1.22	115	900328	2.12	**1.46**
4	74	900425	1.05	114	900425	1.21	115	900425	1.78	**1.35**
5	74	900530	1.02	114	900530	1.15	115	900530	1.89	**1.35**
6	74	900627	1.02	114	900627	1.32	115	900627	2.67	**1.67**
7	74	900731	1.04	114	900801	1.58	115	900801	4.14	**2.25**
8	74	900829	1.32	114	900829	2.28	115	900829	3.42	**2.34**
9	74	900926	1.10	114	900926	1.18	115	900926	3.52	**1.93**
10	74	901024	0.91	114	901024	1.12	115	901024	3.36	**1.80**
11	74	901128	0.87	114	901128	0.94	115	901128	2.75	**1.52**
12	74	901219	0.92	114	901219	1.15	115	901219	4.00	**2.02**
1	74	910123	0.99	114	910123	1.11	115	910123	2.79	**1.63**
2	74	910226	0.85	114	910226	0.90	115	910226	1.90	**1.22**
3	74	910327	0.90	114	910327	1.58	115	910327	3.09	**1.86**
4	74	910424	1.07	114	910424	1.27	115	910424	2.46	**1.60**
5	74	910522	0.92	114	910522	1.13	115	910522	1.47	**1.17**
6	74	910626	0.95	114	910626	1.22	115	910626	1.93	**1.37**
7	74	910731	1.12	114	910731	1.11	115	910731	1.83	**1.35**
8	74	910828	1.00	114	910828	1.20	115	910828	2.45	**1.55**
9	74	910925	0.96	114	910925	1.08	115	910925	2.34	**1.46**
10	74	911023	1.11	114	911023	1.51	115	911023	2.67	**1.76**
11	74	911120	0.67	114	911120	0.77	115	911120	1.50	**0.98**
12	74	911211	0.74	114	911211	0.77	115	911211	1.47	**0.99**
1	74	920129	0.91	114	920129	0.93	115	920129	1.70	**1.18**
2	74	920226	1.03	114	920226	0.75	115	920226	1.25	**1.01**
3	74	920325	0.93	114	920325	1.09	115	920325	1.75	**1.26**
4	74	920422	0.98	114	920422	0.95	115	920422	1.49	**1.14**
5	74	920527	1.01	114	920527	0.89	115	920527	1.71	**1.20**
6	74	920624	0.77	114	920624	0.67	115	920624	0.94	**0.79**
7	74	920729	1.11	114	920729	1.60	115	920729	2.33	**1.68**
8	74	920826	1.10	114	920826	1.70	115	920826	3.47	**2.09**
9	74	920922	0.84	114	920923	1.01	115	920923	2.53	**1.46**
10	74	921028	0.90	114	921028	1.04	115	921028	2.22	**1.39**
11	74	921118	0.98	114	921118	1.02	115	921118	1.99	**1.33**
12	74	921216	0.89	114	921216	0.82	115	921216	1.65	**1.12**
1	74	930120	1.00	114	930120	1.34	115	930120	2.27	**1.54**
2	74	930217	0.93	114	930217	1.11	115	930217	1.87	**1.30**
3	74	930317	0.94	114	930317	1.18	115	930317	2.00	**1.37**
4	74	930421	1.00	114	930421	1.33	115	930421	1.98	**1.44**
5	74	930519	1.09	114	930519	1.24	115	930519	1.71	**1.35**
6	74	930616	0.89	114	930616	1.20	115	930616	1.73	**1.27**
7	74	930721	0.99	114	930721	1.15	115	930721	1.70	**1.28**
8	74	930818	0.93	114	930818	0.91	115	930818	1.53	**1.12**
9	74	930915	1.38	114	930915	1.32	115	930915	1.56	**1.42**
10	74	931020	1.22	114	931020	1.53	115	931020	2.58	**1.78**
11	74	931117	0.99	114	931117	1.45	115	931117	2.14	**1.53**
12	74	931215	0.96	114	931215	1.04	115	931215	2.08	**1.36**

month	Site #	DATE yymmdd	F.DISS mg/l	Site #	DATE yymmdd	F.DISS mg/l	Site #	DATE yymmdd	F.DISS mg/l	**AVG 74,114,115 F Diss**
1	74	940126	1.09	114	940126	1.33	115	940126	2.05	**1.49**
2	74	940223	0.92	114	940223	1.09	115	940223	1.79	**1.27**
3	74	940323	0.84	114	940323	1.01	115	940323	1.76	**1.20**
4	74	940427	0.85	114	940427	0.76	115	940427	1.32	**0.98**
5	74	940525	0.97	114	940525	0.68	115	940525	1.77	**1.14**
6	74	940622	1.34	114	940622	1.53	115	940622	1.94	**1.60**
7	74	940727	1.31	114	940727	1.75	115	940727	2.28	**1.78**
8	74	940824	1.30	114	940824	1.74	115	940824	2.53	**1.86**
9	74	940928	0.68	114	940928	0.84	115	940928	1.38	**0.97**
10	74	941026	1.36	114	941026	1.48	115	941026	2.22	**1.69**
11	74	941130	1.31	114	941130	1.54	115	941130	1.98	**1.61**
12	74	941214	1.21	114	941214	1.45	115	941214	1.83	**1.50**
1	74	950125	1.26	114	950125	1.50	115	950125	1.87	**1.54**
2	74	950222	1.30	114	950222	1.38	115	950222	1.86	**1.51**
3	74	950322	1.09	114	950322	1.32	115	950322	1.76	**1.39**
4	74	950426	0.95	114	950426	1.35	115	950426	1.57	**1.29**
5	74	950524	0.84	114	950524	1.10	115	950524	1.55	**1.16**
6	74	950628	0.91	114	950628	0.96	115	950628	1.25	**1.04**
7	74	950726	1.01	114	950726	1.15	115	950726	1.37	**1.18**
8	74	950823	1.49	114	950823	1.65	115	950823	2.17	**1.77**
9	74	950927	1.13	114	950927	1.36	115	950927	1.86	**1.45**
10	74	951025	1.05	114	951025	1.35	115	951025	1.75	**1.38**
11	74	951129	0.77	114	951129	0.97	115	951129	1.56	**1.10**
12	74	951213	0.83	114	951213	1.08	115	951213	1.65	**1.19**
1	74	960124	0.75	114	960124	1.12	115	960124	1.59	**1.15**
2	74	960221	0.94	114	960221	1.16	115	960221	2.05	**1.38**
3	74	960320	0.86	114	960320	1.24	115	960320	1.72	**1.27**
4	74	960417	0.93	114	960417	1.03	115	960417	1.50	**1.15**
5	74	960515	0.82	114	960515	1.19	115	960515	1.87	**1.29**
6	74	960619	0.85	114	960619	1.02	115	960619	1.58	**1.15**
7	74	960717	0.71	114	960717	1.20	115	960717	2.11	**1.34**
8	74	960821	0.65	114	960821	1.36	115	960821	1.66	**1.22**
9	74	960925	0.75	114	960925	1.01	115	960925	1.36	**1.04**
10	74	961016	1.07	114	961016	1.51	115	961016	1.95	**1.51**
11	74	961120	0.75	114	961120	1.02	115	961120	1.65	**1.14**
12	74	961211		114	961211		115	961211		
1	74	970122	0.59	114	970122	0.80	115	970122	1.19	**0.86**
2	74	970219	0.75	114	970219	0.99	115	970219	2.13	**1.29**
3	74	970319	0.75	114	970319	0.88	115	970319	1.67	**1.10**
4	74	970416	0.89	114	970416	0.97	115	970416	1.34	**1.07**
5	74	970521	0.89	114	970521	1.01	115	970521	1.78	**1.23**
6	74	970618	0.90	114	970618	1.01	115	970618	2.05	**1.32**
7	74	970723	0.93	114	970723	1.21	115	970723	1.14	**1.09**
8	74	970820	1.04	114	970820	1.40	115	970820	1.65	**1.36**
9	74	970917	0.91	114	970917	1.20	115	970917	2.19	**1.43**
10	74	971015	0.94	114	971015	1.67	115	971015	1.24	**1.28**
11	74	971119	0.98	114	971119	1.32	115	971119	2.18	**1.49**
12	74	971210	0.88	114	971210	109.00	115	971210	91.30	**67.06**
1	74	980121	0.98	114	980121	2.39	115	980121	5.04	**2.80**
2	74	980218	0.86	114	980218	0.96	115	980218	1.95	**1.26**
3	74	980318	0.19	114	980318	1.87	115	980318	3.54	**1.87**

Appendix 4-B4

STATION #	DATE yymmdd	F.DISS mg/l	P.ORTH mg/l	P.TOTAL mg/l	N.KJEL mg/l	NH3N mg/l	NO3.NO2 mg/l	N.TOTAL mg/l
116	740122	2.84	4.57	4.33				
116	740219	2.28	3.61	2.91				
116	740326	3.14	4.94	4.62				
116	740423	3.44	4.31	4.76				
116	740521	2.22	1.97	2.83				
116	740618	5.54	6.54	6.54				
116	740716	3.40	5.69	6.05				
116	740813	1.60	4.80	5.44		0.12		
116	740910	2.00		4.16		0.10		
116	741008	2.00		3.84	0.22	0.26		
116	741112	3.40		5.66	0.23	0.21		
116	741217	2.40		3.32	0.44	0.17		
116	750121	2.80	3.61	3.53	0.40	0.12		
116	750220	4.40	5.32	5.19	0.36	0.09		
116	750318	4.00	4.59	4.46	0.29	0.13		
116	750415	4.00	4.73	4.92	0.28	0.19		
116	750513	3.60	12.65	13.50	99.99	3.90		
116	750610		8.06	8.01	0.65	0.37		
116	750710	4.40	8.23	7.53	0.57	0.22		
116	750807	2.80		8.90	1.93	2.02		
116	750904	3.60		6.08				
116	751002	2.80	4.58	4.51	0.25	0.18		
116	751028	2.60		3.08	0.33	0.23		
116	751202	3.80		4.84	0.17	0.09		
116	760122	2.60		3.02				
116	760217	2.60		2.95	0.14			
116	760318	2.80		2.68	0.27			
116	760414	1.76		2.77				
116	760512	2.30		2.80	0.18			
116	760609	2.20		3.40	0.27			
116	760714	3.06		2.61	0.26			
116	760810	2.66		4.99	0.22			
116	760914	2.00		3.70	0.22			
116	761013	2.80		3.38	0.49			
116	761110	1.34		3.19	0.36			
116	761214	1.28	1.35	1.38	0.65			
116	770202	6.14		2.87	0.51	0.22		
116	770302	1.32		1.96	0.55	0.21		
116	770330	1.68		2.80	0.54	0.19		
116	770503	2.80		1.59	0.59	0.23		
116	770602	1.10		1.11	0.28	0.18		
116	770630	1.36		2.28	2.20	0.74		
116	770727	6.90		1.62	5.80	0.48		
116	770824			2.65	0.60	0.30		
116	770921	1.06		2.51	0.81	0.64		
116	771019	1.74		1.39	0.54	0.40		
116	771116	1.28		1.28	3.20	2.33		
116	771220	1.15		1.97	0.61	0.27		
116	780125	1.29		1.89	0.12	0.05		
116	780228	1.92		2.49	0.22	0.08		
116	780321	2.46		5.22	0.24	0.05		
116	780419	1.67		1.78	0.04	0.04		
116	780517	2.36		6.30	0.21	0.08		
116	780614	2.65		2.96	0.41	0.24		
116	780712	2.40		1.94	0.03	0.11		
116	780809	1.80		2.30	0.10	0.08		
116	780906	1.30		1.73	0.06	0.06		
116	781004	1.73		1.69	0.05	0.03		
116	781115	1.17		1.00	0.22	0.22		
116	781218	0.81		0.31	0.08	0.07		

Appendix 4-B4

STATION #	DATE yymmdd	F.DISS mg/l	P.ORTH mg/l	P.TOTAL mg/l	N.KJEL mg/l	NH3N mg/l	NO3.NO2 mg/l	N.TOTAL mg/l
116	790124	2.35		1.60	0.35	0.24		
116	790221	1.80		2.01	0.12	0.12		
116	790320	1.82		2.10	0.08	0.04		
116	790424	1.14		1.42	0.03	0.02		
116	790517	2.23		4.75	0.19	0.15		
116	790613	1.25		2.04	0.16	0.16		
116	790711	1.45		1.81	0.04	0.03		
116	790809	2.00		1.83	0.06	0.06		
116	790905	1.23		2.07	0.07	0.06		
116	791003	1.33		5.58	0.09	0.09		
116	791031	1.61		1.74	0.13	0.13		
116	791205	1.11		1.29	0.05	0.05		
116	800131	1.41		2.14	0.03	0.02		
116	800227	1.33		2.10	0.07	0.07		
116	800327	1.47		2.40	1.35	0.05		
116	800423	1.48		2.50	0.45	0.07		
116	800521	1.16		1.79	0.50	0.05		
116	800618	1.37		1.80	0.35	0.08		
116	800716	1.88		1.28	0.41	0.05		
116	800813	1.07		2.00	0.91	0.40		
116	800910			3.66	0.81	0.05		
116	801015			2.30	0.36	0.05		
116	801113	1.71		2.33	0.31	0.05		
116	801217	1.56		2.42	0.47	0.06		
116	810128	1.29		1.65	0.38	0.05		1.57
116	810225	1.63		3.00	0.36	0.11		1.05
116	810325	1.02		1.55	0.47	0.07		1.92
116	810506			1.15	0.50	0.05		0.61
116	810603			0.54	0.70	0.06		1.02
116	810701	2.12		0.55	0.90	0.13		0.94
116	810729			0.84	1.33	0.06		8.43
116	810826	0.96		1.05	1.21	0.15		1.51
116	810923	1.67		1.32	0.92	0.12		0.99
116	811015	0.38		1.45	1.39	0.08		2.39
116	811104	1.68		1.10	0.33	0.07		0.84
116	811209	3.81		0.96	0.93	0.05		1.19
116	820127	1.69	0.29	1.03	0.64	0.06		0.98
116	820224	1.56	1.37	1.06	0.91	0.05		1.33
116	820324	1.37	1.08	1.39	0.65	0.09		1.14
116	820421	1.61	0.59	0.98	0.57	0.05		0.91
116	820519	1.12	0.59	0.59	0.84	0.05		1.20
116	820616	1.65	1.42	2.01	0.17	0.05		0.46
116	820714	2.36	6.40	3.00	1.20	0.15		1.31
116	820811	2.00	1.40	2.14	0.82	0.05		1.04
116	820915	3.32	2.24	2.21	1.25	0.16		1.44
116	821013	2.10	2.60	2.30	0.77	0.09		0.99
116	821117	2.66	1.49	1.88	0.95	0.05		1.40
116	830126	1.17		0.84	0.10	0.05		0.47
116	830302	1.50	1.29	1.52	1.12			1.33
116	830330	1.33		1.61	1.16	0.07	0.24	1.40
116	830427	2.24		1.96	0.58	0.12	0.24	0.82
116	830525	1.59		1.40	0.48	0.05	0.38	0.86
116	830622	1.65		1.66	0.62	0.10	0.53	1.15
116	830720	1.61		1.53	0.60	0.05	0.36	0.96
116	830817	0.98		0.54	1.20	0.06	0.11	1.31
116	830914	1.61		1.56	0.85	0.05	0.11	0.96
116	831012	1.63		4.53	0.25	0.05	0.37	0.62
116	831116	1.35		1.72	1.05	0.15	0.55	1.60
116	831214	2.23		1.74	0.50	0.05	0.25	0.75

Appendix 4-B4

STATION #	DATE yymmdd	F.DISS mg/l	P.ORTH mg/l	P.TOTAL mg/l	N.KJEL mg/l	NH3N mg/l	NO3.NO2 mg/l	N.TOTAL mg/l
116	840125	1.46		1.54	0.41	0.10	0.83	1.24
116	840222	0.97		2.06	0.81	0.11	0.38	1.19
116	840328	2.77		1.87	0.79	0.01	0.35	1.14
116	840425	2.83		1.94	0.57	0.03	0.19	0.76
116	840523	1.71		0.65	0.48	0.15	0.57	1.05
116	840620	0.93		1.00	0.63	0.11	0.34	0.97
116	840718	1.81		1.08	0.66	0.16	0.18	0.84
116	840815	1.55		2.03	0.55	0.06	0.32	0.87
116	840912	2.05		1.34	0.52	0.15	0.19	0.71
116	841010	1.83		1.06	0.55	0.06	0.41	0.96
116	841107	1.67		0.76	0.39	0.03	0.36	0.75
116	841212	1.22		0.54	0.33	0.05	0.7	1.03
116	850116	1.28		0.89	0.71	0.19	0.83	1.54
116	850227			1.05	0.62	0.08	0.48	1.10
116	850327	1.06		0.96	0.65	0.08	0.6	1.25
116	850417	0.94		0.86	0.22	0.24	0.5	0.72
116	850515	1.90		0.71	0.96	0.17	2.15	3.11
116	850626			0.64	0.70	0.09	1	1.70
116	850724	1.58		0.73	4.46	0.30	1.03	5.49
116	850814	2.09		1.57	1.35	0.11	0.3	1.65
116	850911	2.04		2.34	1.08	0.16	0.31	1.39
116	851016	2.63		1.21	0.85	0.63	1.21	2.06
116	851113	2.71		2.01	0.64	0.02	0.61	1.25
116	851218	1.22		1.39	0.48	0.05	0.78	1.26
116	860129	1.07		1.48	0.55	0.06	0.75	1.30
116	860226	0.07		1.39	0.67	0.19	0.41	1.08
116	860326	1.76		1.34	0.76	0.11	0.23	0.99
116	860423	0.97		1.00	0.61	0.10	0.52	1.13
116	860521	0.74		0.70	0.68	0.10	0.48	1.16
116	860618	0.82		0.67	1.13	0.28	0.41	1.54
116	860723	0.79		1.28	0.89	0.10	0.77	1.66
116	860827	1.23		1.16	1.34	0.21	0.38	1.72
116	860924	1.80		1.44	0.62	0.08	0.54	1.16
116	861015	1.57		0.98	0.66	0.10	2.15	2.81
116	861105	1.18		0.73	0.69	0.05	1.67	2.36
116	861217	1.05		1.05	0.55	0.06	0.74	1.29
116	870128	1.23		0.73	0.62	0.05	0.61	1.23
116	870225	0.92		0.94	2.23	0.36	0.78	3.01
116	870325	1.22		0.95	1.42	0.13	0.36	1.78
116	870422	1.61		1.02	1.61	0.33	0.42	2.03
116	870527	1.65		1.52	2.19	0.12	0.32	2.51
116	870624	1.85		1.66	1.62	0.16	0.38	2.00
116	870729	1.79		1.56	2.04	0.28	0.28	2.32
116	870826	1.63		1.48	1.33	0.15	0.22	1.55
116	870923	1.77		1.08	1.37	0.11	0.67	2.04
116	871021	1.26		1.13	1.49	0.10	0.85	2.34
116	871118	1.05		1.37	2.02	0.09	0.87	2.89
116	871216	1.26		1.17	0.78	0.06	0.78	1.56
116	880127	1.07		0.83	0.97	0.30	1.14	2.11
116	880224	1.14		1.01	0.70	0.04	1.98	2.68
116	880316	1.16		0.94	0.73	0.03	1.69	2.42
116	880427	1.27		1.25	0.56	0.08	1.62	2.18
116	880525	1.32		1.07	0.94	0.10	1.24	2.18
116	880622	1.87		0.87	1.34	0.12	1.43	2.77
116	880726	1.44		1.06	0.90	0.05	0.78	1.68
116	880824	1.66		1.61	0.85	0.02	0.96	1.81
116	880928	1.65		1.63	0.86	0.03	0.41	1.27
116	881026	1.54		1.28	0.82	0.06	2	2.82
116	881130	1.54		1.11	0.75	0.03	1.88	2.63
116	881228	1.21		1.04	0.45	0.05	1.75	2.20

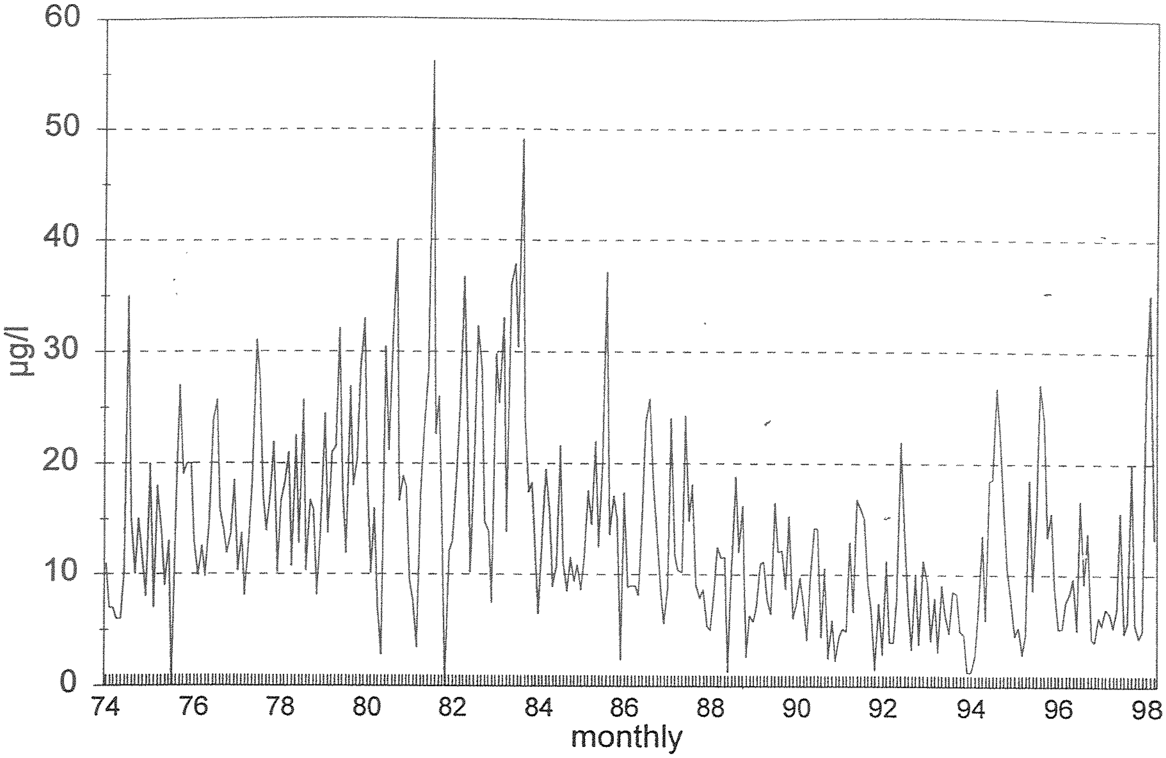
Appendix 4-B4

STATION #	DATE yymmdd	F.DISS mg/l	P.ORTH mg/l	P.TOTAL mg/l	N.KJEL mg/l	NH3N mg/l	NO3.NO2 mg/l	N.TOTAL mg/l
116	890125	0.82		0.84	0.72	0.04	0.46	1.18
116	890222	1.85		1.28	0.85	0.10	0.98	1.83
116	890322	2.44		1.50	0.77	0.04	1.96	2.73
116	890426	1.94		0.95	0.47	0.03	1	1.47
116	890531	1.81		1.16	0.69	0.09	0.24	0.93
116	890628	1.50		0.85	0.86	0.07	0.54	1.40
116	890726	1.58		1.13	0.87	0.05	0.65	1.52
116	890830	2.15		1.61	0.82	0.05	0.71	1.53
116	890927	1.17		1.03	1.01	0.10	0.19	1.20
116	891025	1.57		0.92	0.52	0.06	0.55	1.07
116	891129	1.18		0.82	0.57	0.07	0.73	1.30
116	891220	1.01		0.82	0.88	0.09	0.9	1.78
116	900131	1.21		0.77	0.74	0.06	0.87	1.61
116	900228	1.20		1.00	0.74	0.07	0.5	1.24
116	900328	1.08		0.55	0.49	0.03	0.66	1.15
116	900425	1.40		0.73	0.79	0.01	0.63	1.42
116	900530	1.30		0.94	0.57	0.05	0.46	1.03
116	900627	1.11		0.69	0.97	0.07	0.36	1.33
116	900801	1.22		0.92	0.69	0.04	0.28	0.97
116	900829	0.95		0.54	0.71	0.03	0.52	1.23
116	900926	0.93		0.87	0.50	0.02	0.57	1.07
116	901024	0.85		0.75	0.61	0.06	0.7	1.31
116	901128	0.82	0.58	0.59	0.37	0.03	0.79	1.16
116	901219	0.79	0.39	0.48	0.47	0.01	0.86	1.33
116	910123	0.88	0.53	0.51	0.58	0.02	0.81	1.39
116	910226	0.73	0.53	0.63	0.58	0.03	0.53	1.11
116	910327	1.12	0.83	0.96	0.63	0.01	0.51	1.14
116	910424	1.34	1.12	1.29	0.65	0.02	0.38	1.03
116	910522	1.02	1.05	0.94	0.62	0.04	0.54	1.16
116	910626	0.68	0.63	0.81	0.75	0.06	0.47	1.22
116	910731	0.95	1.27	1.34	1.37	0.01	0.33	1.70
116	910828	1.08	0.89	1.11	1.00	0.04	0.41	1.41
116	910925	1.11	0.78	0.89	0.56	0.01	0.825	1.39
116	911023	1.54	0.95		0.45	0.04	0.446	0.90
116	911120	0.89	0.61	0.70	0.59	0.01	0.751	1.34
116	911211	0.64	0.75	1.22	0.36	0.02	0.875	1.24
116	920129	0.80	0.44	0.53	0.59	0.02	1.007	1.60
116	920226	0.81	0.72	1.10	0.18	0.04	0.62	0.80
116	920325	0.97	0.49	0.52	0.44	0.02	0.645	1.09
116	920422	0.93	0.64	1.18	1.03	0.05	0.284	1.31
116	920527	0.97	0.78	0.82	0.37	0.02	0.481	0.85
116	920624	0.60	0.53	0.54	0.63	0.02	0.656	1.29
116	920729	2.03	1.39	1.45	1.17	0.02	0.486	1.66
116	920826	1.71	1.07	1.20	1.26	0.02	0.401	1.66
116	920923	1.49	1.05	1.04	0.73	0.11	0.466	1.20
116	921028	1.10	0.65	0.63	0.27	0.05	0.842	1.11
116	921118	0.80	0.60	0.64	0.26	0.06	0.998	1.26
116	921216	0.68	0.47	0.65	0.33	0.04	1.076	1.41
116	930120	0.95	0.72	0.85	0.65	0.02	0.458	1.11
116	930217	0.84	0.62	0.79	0.50	0.02	0.825	1.33
116	930317	0.97	0.77	0.89	0.62	0.02	0.359	0.98
116	930421	1.45	0.88	0.99	0.53	0.02	0.261	0.79
116	930519	1.76	0.89	0.88	0.38	0.02	0.215	0.60
116	930616	1.50	0.71	0.74	0.44	0.03	0.232	0.67
116	930721	1.64	0.52	0.52	0.68	0.02	0.41	1.09
116	930818	0.95	0.38	0.49	0.60	0.02	0.479	1.08
116	930915	1.27	0.80	0.86	0.73	0.04	0.261	0.99
116	931020	1.48	0.87	0.93	0.61	0.05	0.245	0.86
116	931117	1.24	0.75	0.90	0.35	0.05	0.43	0.78
116	931215	1.09	0.53	0.61	0.40	0.03	0.94	1.34

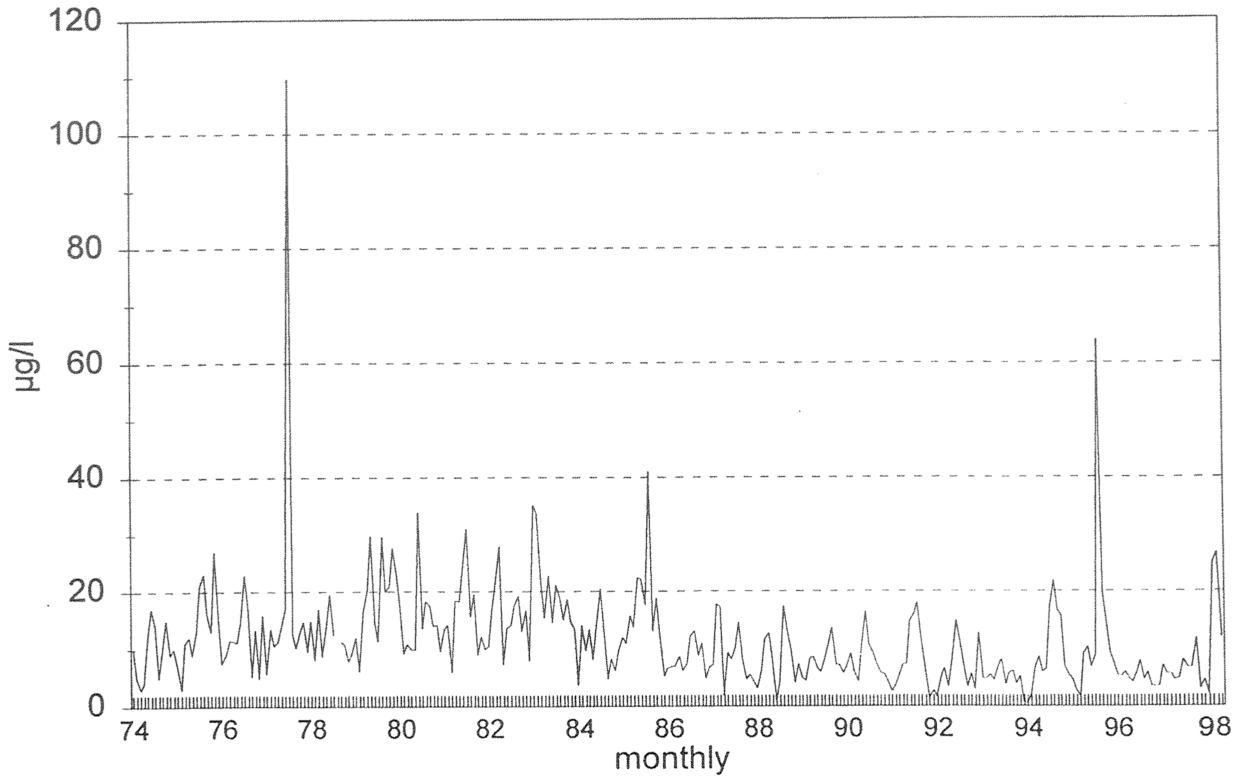
STATION #	DATE yymmdd	F.DISS mg/l	P.ORTHO mg/l	P.TOTAL mg/l	N.KJEL mg/l	NH3N mg/l	NO3.NO2 mg/l	N.TOTAL mg/l
116	940126	1.29	0.45	0.72	0.53	0.03	0.545	1.08
116	940223	1.12	0.76	0.83	0.44	0.04	0.634	1.07
116	940323	1.00	0.64	0.64	0.48	0.05	0.388	0.87
116	940427	0.76	0.57	0.59	0.37	0.03	0.242	0.61
116	940525	0.98	0.68	0.89	0.25	0.07	0.185	0.44
116	940622	1.48	0.90	0.88	1.04	0.02	0.178	1.22
116	940727	1.38	1.06	1.14	0.84	0.02	0.128	0.97
116	940824	1.51	1.06	1.14	0.79	0.10	0.204	0.99
116	940928	1.30	2.39	2.57	0.98	0.01	0.22	1.20
116	941026	1.86	1.10	1.26	0.37	0.03	0.196	0.57
116	941130	1.95	1.02	1.05	0.36	0.01	0.246	0.61
116	941214	2.03	1.15	1.21	0.40	0.01	0.281	0.68
116	950125	1.83	0.94	0.98	0.34	0.01	0.2	0.54
116	950222	1.78	1.12	1.34	0.48	0.01	0.249	0.73
116	950322	1.75	1.04	1.23	0.51	0.01	0.31	0.82
116	950426	1.95	1.12	1.17	0.52	0.05	0.411	0.93
116	950524	1.61	1.32	1.34	0.40	0.01	0.371	0.77
116	950628	1.40	0.55	0.41	0.76	0.01	0.395	1.16
116	950726	1.29	0.70	0.83	0.96	0.01	0.324	1.28
116	950823	1.35	0.76	0.99	0.74	0.01	0.143	0.88
116	950927	1.22	0.84	1.00	0.70	0.01	0.251	0.95
116	951025	1.52	0.70	0.77	0.51	0.02	0.169	0.68
116	951129	1.10	0.49	0.57	0.34	0.03	0.555	0.90
116	951213	1.24	0.50	0.56	0.16	0.02	0.376	0.54
116	960124	1.30	0.55	0.59	0.39	0.01	0.303	0.69
116	960221	1.22	0.54	0.69	0.47	0.01	0.576	1.05
116	960320	1.54	0.77	1.05	0.52	0.03	0.311	0.83
116	960417	1.21	0.73	0.84	0.35	0.01	0.434	0.78
116	960515	1.71	0.85	0.92	0.49	0.02	0.35	0.84
116	960619	1.31	0.63	0.66	0.75	0.02	1.008	1.76
116	960717	1.27	0.68	0.81	0.68	0.05	0.273	0.95
116	960821	2.05	0.99	1.05	0.54	0.03	0.17	0.71
116	960925	2.08	1.23	1.40	0.35	0.01	1.208	1.56
116	961016	2.27	1.55	1.63	0.53	0.01	2.259	2.79
116	961120	2.09	1.02	0.99	0.32	0.01	0.69	1.01
116	961211		0.60	0.76	0.61	0.01	0.33	0.94
116	970122	1.30	0.62	0.65	0.54	0.01	0.875	1.42
116	970219	1.10	0.66	0.72	0.65	0.05	0.539	1.19
116	970319	1.01	0.70	0.76	0.54	0.02	0.714	1.25
116	970416	1.05	0.66	0.72	0.53	0.02	0.953	1.48
116	970521	1.44	0.92	0.96	0.45	0.02	0.542	0.99
116	970618	0.83	0.60	0.60	0.72	0.01	0.68	1.40
116	970723	1.85	0.90	0.97	0.92	0.02	0.238	1.16
116	970820	1.86	0.97	1.03	0.77	0.02	0.21	0.98
116	970917	0.99	0.73	0.76	0.51	0.01	0.5	1.01
116	971015	1.13	0.65	0.72	0.53	0.03	0.706	1.24
116	971119	1.34	0.60	0.65	0.66	0.02	0.19	0.85
116	971210	2.56	0.72	0.65	0.58	0.03	0.356	0.94
116	980121	1.58	0.73	0.62	0.49	0.01	0.234	0.72
116	980218	2.01	2.40	3.52	0.82	0.06	0.451	1.27
116	980318	1.53	0.75	0.82	0.50	0.01	0.248	0.75

STATION	November DATE	CHL.A	December DATE	CHL.A	January DATE	CHL.A	February DATE	CHL.A	March DATE	CHL.A	April DATE	CHL.A
2	971112	1.8	971203	3.4	11398	3.5	21098	3.8	31098	10.0		
6	971112	9.4	971203	3.3	11398	10.9	21098	10.4	31098	50.0	41498	10.0
7	971112	8.5	971203	3.9	11398	4.0	21098	12.3	31098	43.0	41498	9.6
8	971112	13.2	971203	8.7	11398	14.1	21098	30.3	31098	75.7	41498	19.9
9	971112	8.5	971203	6.6	11398	10.2	21098	27.6	31098	32.7	41498	4.6
11	971112	5.9	971203	3.8	11398	5.8	21098	11.1	31098	7.9	41498	7.9
13	971104	5.5	971202	2.5	10698	2.5	21198	25.2	30398	5.2	40798	10.0
14	971112	2.3	971203	2.9	11398	4.7	21098	19.1	31098	6.1	41498	14.2
16	971124	7.3	971216	3.2	12798	7.5	22498	8.1	32498	11.2	42898	4.0
19	971124	5.6	971216	3.5	12798	8.3	22498	7.5	32498	4.4	42898	3.6
21	971124	3.4	971216	5.8	12798	6.9	22498	8.6	32498	4.4	42898	4.1
23	971124	5.9	971216	2.9	12798	8.3	22498	5.5	32498	3.7	42898	3.3
24	971124	7.5	971216	5.0	12798	14.2	22498	9.9	32498	7.8	42898	4.1
25	971124	10.0	971216	4.9	12798	28.9	22498	5.6	32498	4.8	42898	5.0
28	971124	7.0	971216	2.6	12798	17.6	22498	7.7	32498	5.9	42898	2.9
32	971104	8.5	971202	2.8	10698	3.9	21198	16	30398	5.2	40798	4.9
33	971104	12.9	971202	3.9	10698	3.1	21198	17.2	30398	14.8	40798	8.4
36	971104	14.8	971202	5.9	10698	5.3	21198	19.7	30398	15.7	40798	6.8
38	971104	14.9	971202	7.8	10698	10.3	21198	13.6	30398	6.1	40798	5.2
40	971104	19.0	971202	7.6	10698	4.0	21198	7.7	30398	10.1	40798	6.3
41	971104	13.6	971202	6.0	10698	7.2	21198	5.9	30398	5.8	40798	2.8
44	971112	31.6	971203	23.8	11398	9.7	21098	10	31098	61.3	41498	11.9
46	971104	14.5	971202	4.4	10698	22.3	21198	5.1	30398	7.8	40798	3.6
47	971104	8.7	971202	6.0	10698	6.0	21198	5.1	30398	6.7	40798	5.2
50	971104	11.9	971202	4.2	10698	5.9	21198	7.4	30398	5.2	40798	4.2
51	971104	8.1	971202	4.2	10698	4.3	21198	8	30398	13.8	40798	5.3
52	971112	12.9	971203	7.9	11398	12.4	21098	13	31098	28.0	41498	15.3
54	971112	6.9	971203	4.0	11398	1.2	21098	9.3	31098	12.0	41498	6.7
55	971112	8.4	971203	4.0	11398	7.4	21098	20	31098	50.1	41498	11.3
58	971112	17.5	971203	7.1	11398	1.6	21098	14.3	31098	14.1	41498	40.4
60	971104	10.7	971202	2.9	10698	9.0	21198	12.2	30398	2.0	40798	2.8
61	971104	26.6	971202	5.1	10698	5.6	21198	11.2	30398	10.0	40798	8.4
62	971104	15.1	971202	8.4	10698	13.4	21198	6.6	30398	6.1	40798	7.3
63	971104	11.8	971202	6.1	10698	8.0	21198	4.4	30398	5.5	40798	3.6
64	971104	11.9	971202	6.3	10698	9.3	21198	8.4	30398	6.7	40798	4.0
65	971104	15.6	971202	7.6	10698	14.4	21198	7.9	30398	3.9	40798	3.7
66	971104	7.8	971202	7.1	10698	9.1	21198	6.4	30398	5.1	40798	4.7
67	971104	13.5	971202	7.3	10698	11.1	21198	11.3	30398	5.3	40798	3.0
68	971104	17.5	971202	6.7	10698	7.3	21198	14	30398	13.4	40798	3.7
70	971112	16.6	971203	4.8	11398	12.8	21098	18.3	31098	46.0	41498	14.5
71	971112	13.6	971203	11.3	11398	10.4	21098	22.1	31098	29.0	41498	16.9
73	971112	6.9	971203	5.2	11398	10.7	21098	26.3	31098	49.9	41498	9.8
74	971119	6.7	971210	11.6	12198	4.4	21898	8	31898	7.7	42298	13.5
80	971112	5.6	971203	4.4	11398	5.0	21098	27.8	31098	35.2	41498	13.2
81	971112	3.1	971203	4.6	11398	2.1	21098	25	31098	26.7	41498	11.9
82	971124	5.8	971216	2.1	12798	16.1	22498	6	32498	7.7	42898	3.2
84	971124	15.5	971216	6.4	12798	11.0	22498	15.4	32498	9.6	42898	6.1
90	971124	7.5	971216	6.2	12798	10.7	22498	6.8	32498	4.5	42898	3.0
91	971124	4.7	971216	5.2	12798	8.1	22498	4.2	32498	4.4	42898	3.3
92	971124	5.0	971216	6.1	12798	7.6	22498	4.2	32498	5.4	42898	2.6
93	971124	2.9	971216	4.4	12798	5.3	22498	4.6	32498	3.5	42898	1.4
94	971124	5.7	971216	4.4	12798	4.9	22498	6.2	32498	3.2	42898	1.5
95	971124	3.4	971216	5.3	12798	11.0	22498	6.2	32498	3.8	42898	2.6
96	971124	9.4	971216	8.5	12798	15.9	22498	6.7	32498	5.2	42898	2.9

Chlorophyll A - Site 80



Chlorophyll A - Site 81



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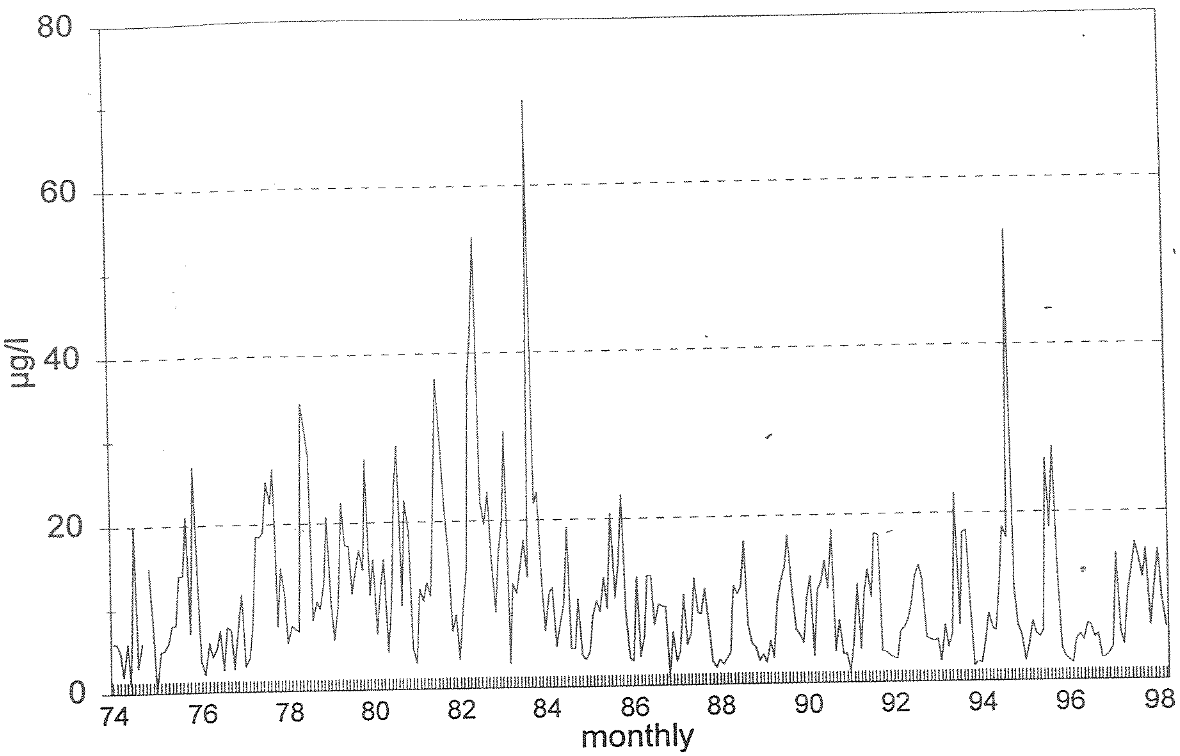

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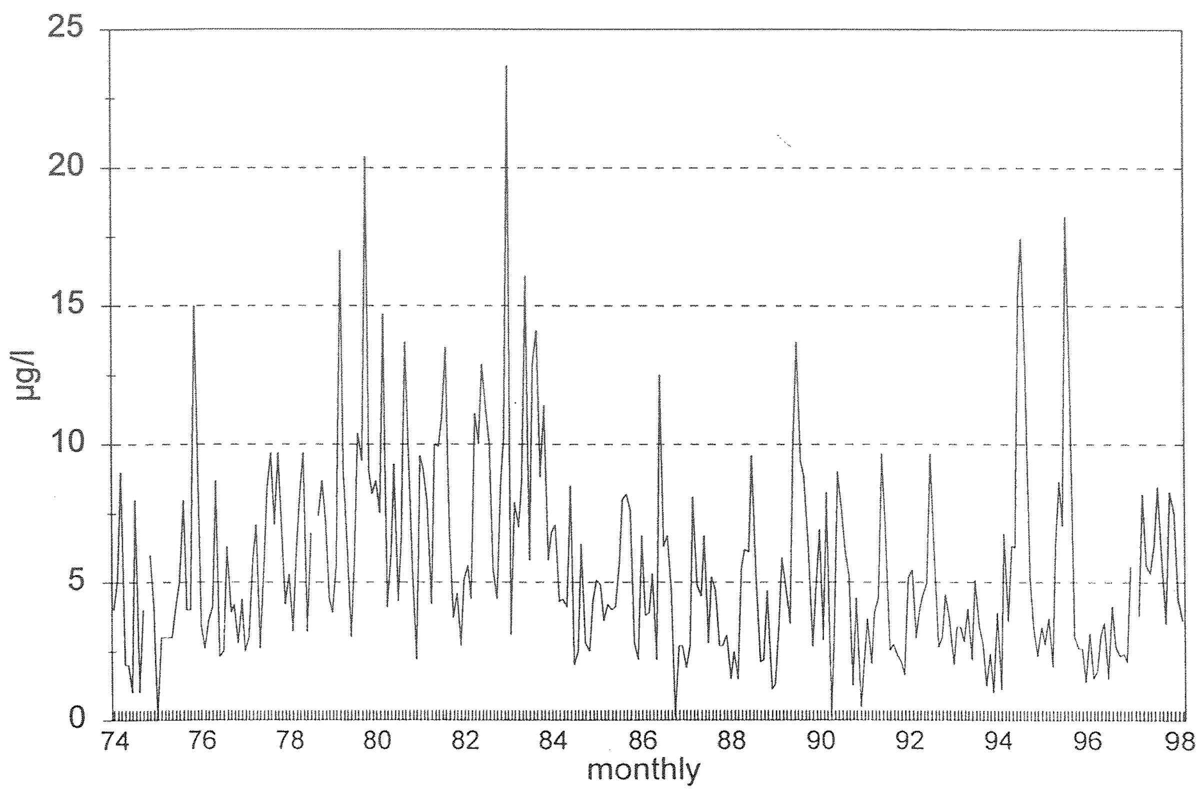

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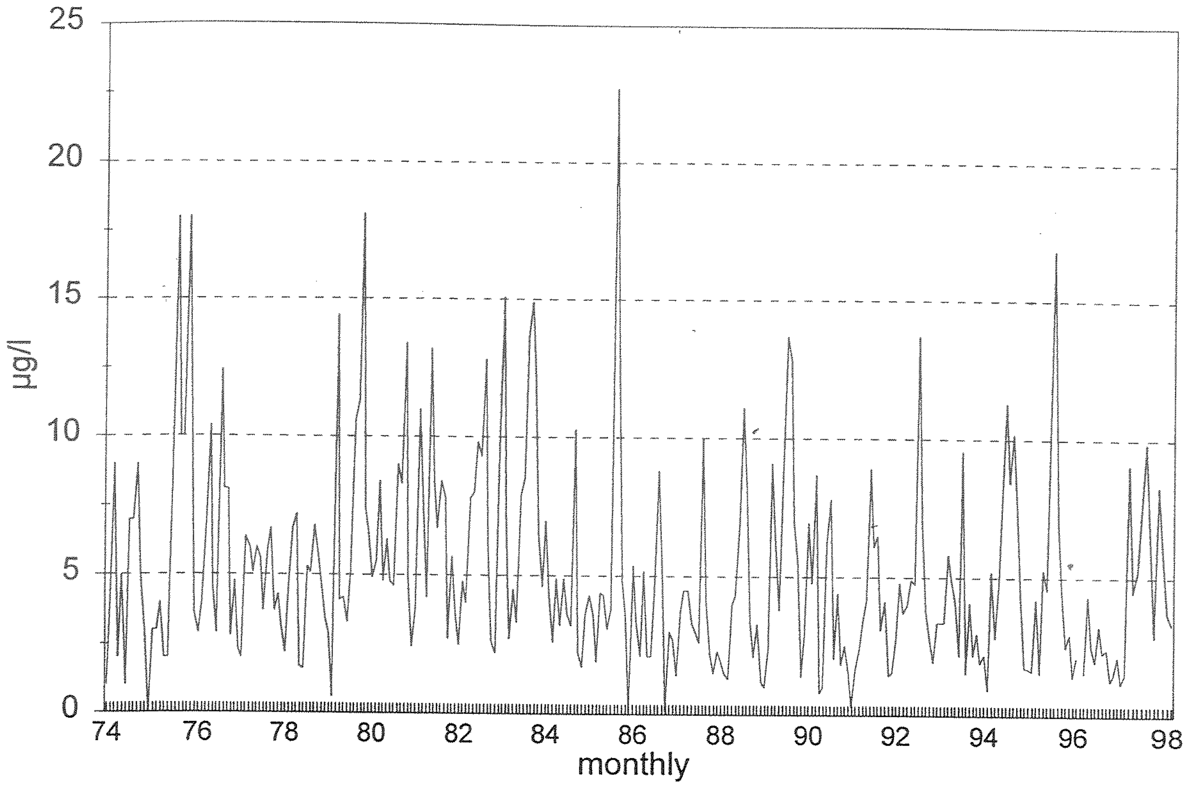

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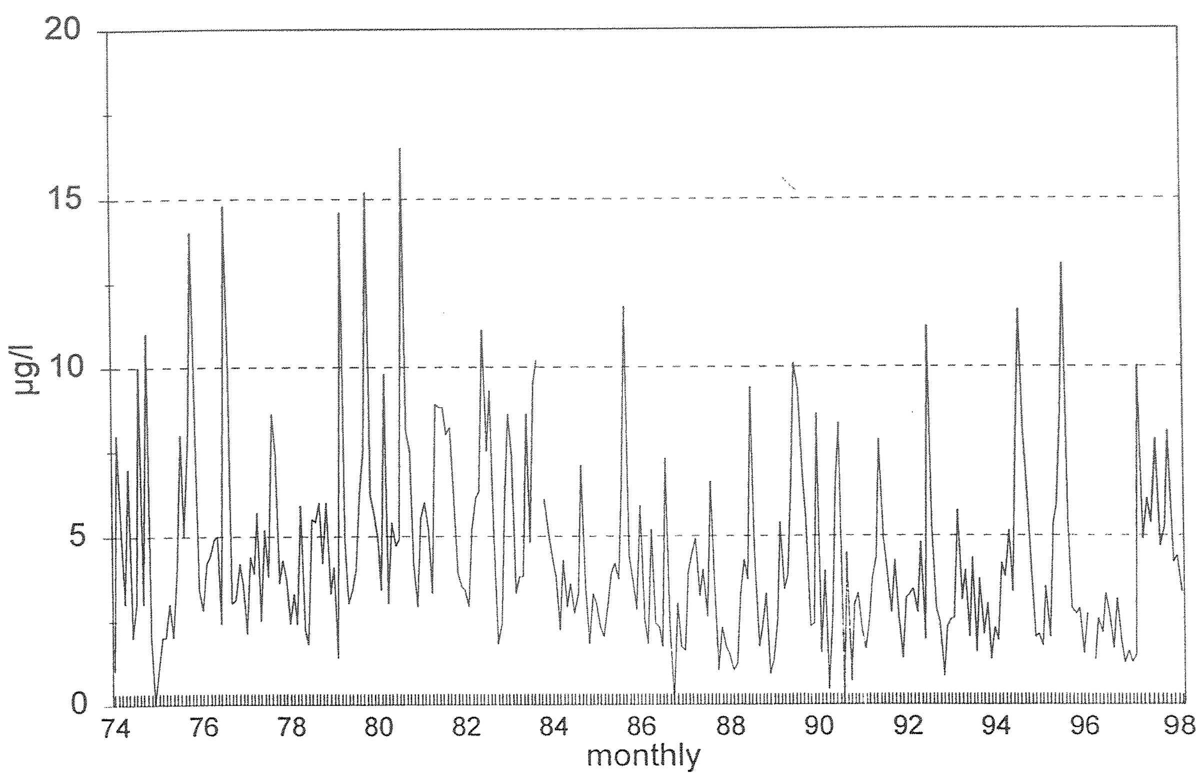

EPC Field Investigation Report 1/15/98

Reason for Investigation: **To Determine Possible Effects of Múlberry Phosphates, Inc. Acid Spill on Oyster Reef Projects in Alafia River**

Date of Investigation: January 14 & 15, 1998

Investigator: Tom Ash, EPC Water Management Division

Location: Williams Park Pier Oyster Reef Project / US Hwy.41 and Alafia River

Background: The Williams Park Pier Oyster Reef Project was funded by the Gardinier Settlement Trust Fund as an experimental project on the use of artificial substrate for the development and colonization of live oyster bars in the Alafia River. The project was built on Wednesday, April 24, 1996. With the exception of clay bricks, steel reinforcing bar stakes and polypropylene line to anchor the reef units, each unit was a hollow, polyethylene mesh tube with no prior biological growth in or on it. The most recent monitoring event for the project was on May 14, 1997 at which time all but the most frequently exposed areas of the landward-most units were fully encrusted with barnacles, macro-algae and oysters ranging in size from 1-3inches. Also noted were juvenile sheepshead and glass minnows.

Findings: No live oysters were noted on the day of investigation. Oysters which still had the remains of the organism enclosed within the valves, were clearly decomposed and smelled of putrefaction. Also noted was the absence of any other organisms which typically occupy the crevices created by barnacle and oyster growth, most notably juvenile crabs and marine worms. No fish were observed.

Live mussels were observed at or near the mean high water line adjacent to the boat ramps. Since these organisms were only submerged occasionally, they apparently were able to handle the acidic waters better than those that were always submerged.

In order to eliminate other possible causes of these findings, similar oyster habitats were investigated on both the Little Manatee and the Hillsborough Rivers which have recently undergone the same physical stresses as the Alafia (i.e. Above normal volumes of rainwater and subsequent decreases in salinity).

On January 15, 1998, live oysters, barnacles and associated juvenile crabs were observed on the identical type of polyethylene substrate in the Little Manatee River. These same animals were also found to be alive and apparently healthy in the Hillsborough River on concrete substrate. Therefore, prolonged exposure to the acidic waters following the spill, is the most likely reason for the death of these organisms on the Alafia River.

Tom Ash 1/15/98

EPC Field Investigation Report 1/20/98

Reason for Investigation: **To Determine Possible Effects of Mulberry Phosphates, Inc. Acid Spill on Oyster Bar Project in Alafia River**

Date of Investigation: January 20, 1998

Investigator: Tom Ash, EPC Water Management Division

Location: Alafia River Oyster Bar Project

Background: On September 15, 1995 construction began on the Alafia River Oyster Bar Restoration Demonstration Project. The project is a joint Tampa Bay National Estuary Program , Tampa Bay Regional Planning Council and Environmental Protection Commission of Hillsborough County effort. The intent of the project is to re-establish healthy oyster bars in the Alafia River which have historically been lost to dredging of the shipping channel and associated turning basin adjacent to Cargill Fertilizer Company.

Findings: Live oysters were found at the site on the day of the investigation. Also present were associated juvenile stone crabs and numerous amphipods attached to the same small concrete substrates as some of the oysters. There was no apparent signs of biological damage done by the December 7, 1997 acid spill.

Tom Ash 1/20/98

EPC Field Investigation Report 1/27/98

Reason for Investigation: **Re-Evaluation of Williams Park Pier Oyster Reefs Subsequent to Mulberry Phosphates December 7, 1997 Acid Spill.**

Date of Investigation: January 27, 1998

Investigators: Tom Ash and Glenn Lockwood, EPC Water Management Division

Location: Williams Park Pier Oyster Reef Project / US Hwy.41 and Alafia River

Background: The Williams Park Pier Oyster Reef Project was funded by the Gardinier Settlement Trust Fund as an experimental project on the use of artificial substrate for the development and colonization of live oyster bars in the Alafia River. The project was built on Wednesday, April 24, 1996. With the exception of clay bricks, steel reinforcing bar stakes and polypropylene line to anchor the reef units, each unit was a hollow, polyethylene mesh tube with no prior biological growth in or on it. The most recent pre-acid spill monitoring event for the project was on May 14, 1997 at which time all but the most frequently exposed areas of the landward-most units were fully encrusted with barnacles, macro-algae and oysters ranging in size from 1-3inches. Also noted were amphipods , juvenile crabs, marine worms, juvenile sheepshead and glass minnows.

A preliminary investigation was also performed on January 14, 1998 to determine what effects, if any, the December 7, 1997 acid spill had on this reef project. At that time, dozens of oysters from the landward-most reef units were opened and no live oysters were found. However, due to weather conditions, only a small area close to shore was examined. Also noted at that time was the total lack of any juvenile crabs, amphipods, or marine worms which typically inhabit the interstices of oyster and barnacle communities.

Findings: Live oysters were observed, both at the end of the fishing pier (5-8 ft. deep) and farther landward. It was apparent that oyster health on the majority of the reef was not effected by the acid spill. There were still dead oysters present on the most landward portions of the reef, however, live oysters were also observed in the deeper sections of that area which were not accessible or noticed during the initial January 14, 1998 investigation.

With the exception of one juvenile stone crab, there were still no other associated organisms observed on this day. The fact that the investigator was able to snorkel on, brush up against and crawl over most of the reef without picking up a single amphipod or juvenile crab attached to his wetsuit was remarkable.

Tom Ash 1/27/98

Williams Park Artificial Oyster Bar Project

Methodology for Oyster Collection on 5/13/98

Three areas of the Williams Park Oyster Reef were sampled; Deep, Middle and Shallow. The samples labeled Deep were collected from reef units at the distal end of the fishing pier. Those labeled Middle were collected from approximately the midpoint of the pier. The Shallow samples were collected from the landward-most reef units.

Using small buckets to hold the oysters, investigators collected a representative sample (25-35 oysters) from each area of the reef by wading among the reef units and simply grabbing oyster clumps from various locations within a given area. Collectors were careful to choose only those oyster clumps which were still firmly attached to the artificial reef units. Oysters were then transported back to the lab for further analysis.

Each bucket was carefully drained through a sieve to catch any associated organisms prior to a final rinse. Since previous sampling events yielded very few, if any, amphipods, polychaetes, or stone crabs associated with the oysters, it was important to qualitatively assess any signs of recovery. Each oyster was then measured from the umbo to the most distant point on the shell and subsequently opened to determine if it was alive or dead. This process was repeated for each of the three representative samples.

Findings:

Oyster sizes did not vary from reef area to reef area, averaging just over two inches. The status of the oysters (live or dead), however, did vary from Deep, Middle and Shallow.

Those oysters which were classified as "dead" had no remaining trace of the organism inside the valves. This is in contrast to those collected in the January 1998 samples which still had the dead flesh of the organism within the valves. It is important to note that these reef units had no previous biological growth on them when they were installed so, therefore, any oyster shells attached to them at the time of sampling were at one time alive.

In contrast to field investigations earlier this year, the amphipods, polychaetes, and juvenile crabs typically associated with oyster communities were notably more abundant in each of the reef areas during this sampling event. In addition to the invertebrates mentioned, two juvenile oyster toad fish (Opsanus tau) approximately 1.5 inches long were also sieved from the samples.