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Water Quality Monitoring of Saginaw and Grand Traverse Bays

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1.0 INTRODUCTION

The Water Bureau (WB) of the Michigan Department of Environmental Quality (MDEQ) is charged with monitoring ambient surface water quality in Michigan. Beginning in June 1998, the MDEQ-WB initiated partial implementation of its Water Chemistry Monitoring Project (WCMP) using a portion of a $500,000 appropriation by the state legislature to the MDEQ-WB for water quality monitoring. The WCMP was a first step towards improving water quality monitoring in Michigan since funding reductions resulted in severely restricted monitoring capabilities. Past limitations in analytical quantification levels further restricted the effectiveness of MDEQ-WB monitoring activities, but recent technological advances in affordable, low-level analytical techniques have been incorporated into the WCMP.

The WCMP is an important component of the statewide surface water quality monitoring activities outlined in the January 1997 report prepared by the MDEQ-SWQD and the Land and Water Management Division entitled, "A Strategic Environmental Quality Monitoring Program for Michigan's Surface Waters" (Strategy). The WCMP incorporates the goals of the Strategy, which are as follows:

1. Assess the current status and condition of individual waters of the state and determine whether Michigan’s water quality standards are being met;
2. Measure temporal and spatial trends in the quality of Michigan's surface waters;
3. Provide data to support MDEQ water quality programs and evaluate their effectiveness; and
4. Detect new and emerging water quality problems.

The November 1998 passage of the Clean Michigan Initiative (CMI) bond proposal resulted in a substantial increase in annual funding for statewide surface water quality monitoring beginning in 2000. The CMI bond also offers the availability of consistent, reliable funding for surface water quality monitoring over a long period of time, an essential component to realizing the second goal of the Strategy: measuring temporal and spatial trends in the quality of Michigan's surface waters. Following passage of the CMI bond proposal, the study design of the WCMP was modified and expanded to facilitate use of the CMI funding source in a manner that will help ensure implementation of statewide water chemistry trend monitoring activities capable of more fully realizing the goals set forth in the Strategy. The MDEQ has contracted Great Lakes Environmental Center (GLEC) to assist with the implementation of the WCMP, including the work conducted for this project.

The WCMP calls for annual water chemistry monitoring on Saginaw Bay (Lake Huron) and Grand Traverse Bay (Lake Michigan), as well as selected Michigan streams tributary to the Great Lakes (tributaries), and Great Lakes connecting waters. This report outlines the WCMP activities and results for Saginaw and Grand Traverse Bays. The MDEQ conducted seasonal sampling in Saginaw Bay from 1993 to 1998 and in Grand Traverse Bay beginning in 1998. In 1999, GLEC conducted seasonal sampling of surface water for the MDEQ in Saginaw Bay and in Grand Traverse Bay. In 2000 and 2001, the MDEQ conducted seasonal sampling in Saginaw Bay and, in conjunction with the Grand Traverse Band of Ottawa and Chippewa Indians (GTBOCI), Grand Traverse Bay. From 2002 to 2004, GLEC conducted the monthly sampling of Saginaw Bay and seasonal sampling on Grand Traverse Bay. The water quality sampling locations for Saginaw Bay and Grand Traverse Bay are shown in Figures 1 and 2, respectively. The

goals of these monitoring efforts have been to:

- Assess water quality trends in the Grand Traverse and Saginaw Bays;
- Evaluate compliance with the Michigan Water Quality Values;
- Evaluate the overall effectiveness of the MDEQ's regulatory, pollution prevention and remedial programs; and
- Determine whether the target phosphorus concentrations, established by the "State of Michigan Phosphorus Reduction Strategy for the Michigan Portion of Lake Erie and Saginaw Bay," have been achieved.

GLEC has reviewed MDEQ and other historical water quality monitoring data in Saginaw and Grand Traverse Bays to assess relevant trends, and those results are presented in this report. Water quality monitoring field data for each bay for all available years are shown in Appendices A and B.

2.0 SITE DESCRIPTION

2.1 SAGINAW BAY

2.1.1 Physical Characteristics and Monitoring Locations

Saginaw Bay is a large estuary and embayment of Lake Huron on the eastern coast of the state of Michigan that extends southwest 82 km from Lake Huron to the mouth of the Saginaw River in Bay City, Michigan. With respect to morphometry, the bay is essentially divided into inner and outer bay regions, marked by a constriction extending from Point Lookout on the western shoreline to Sand Point on the eastern shoreline (Figure 1). Although the respective surface areas are similar, the inner bay is relatively shallow and only contains approximately 30 percent of the bay's total water volume (Budd *et al.* 1998), with a relative mean depth of 4.6 m. The outer bay has a relative mean depth of 15 m. Seven water quality monitoring stations are located in the inner bay area (Figure 1). The monitoring stations are distributed throughout the inner bay, with stations near the western and eastern shores, the central inner bay region and one station near the Saginaw River outlet.

2.1.2 Hydrologic Influences

Saginaw Bay has a drainage basin seven times larger (ca. 21,000 km^2) than the immediate area of the bay (Budd *et al.* 1998). The Saginaw River, located near the southwestern end of the bay near Bay City, is the dominant source of surface drainage into the bay, accounting for approximately 70 percent of the total drainage of tributaries

to the bay and drawing from 80 percent of the bay's total basin area. Consequently, the inner bay is heavily impacted by occasionally large seasonal inputs from the Saginaw River. Saginaw River daily discharge rates vary by season, ranging from 28 million cubic meters per day in the spring to 2.4 million cubic meters per day in the fall (Beeton *et al.* 1967). The outer bay is primarily influenced by Lake Huron.

Circulation patterns within the bay can be quite complex and are driven both by Lake Huron coastal currents and by wind stress (Budd *et al.* 1998). Movement and mixing of water within the bay determines, to a large extent, the concentration and distribution of nutrients, and the seasonal development of biota (e.g. phytoplankton and zooplankton). For example, predominant southwest winds may initiate a counterclockwise circulation pattern in the inner bay and result in water originating from the Saginaw River being pushed against the eastern shore of the bay (Budd *et al.* 1998). Consequently, nutrient concentrations may be greater along the eastern shore with an associated increase in algae concentrations.

2.2 GRAND TRAVERSE BAY

2.2.1 Physical Characteristics and Monitoring Locations

Grand Traverse Bay is located in the northwestern portion of the lower peninsula of Michigan and is connected to Lake Michigan. The total distance from the head to the mouth of the bay is approximately 48 km. The general axis of the bay is north to south and is divided into western and eastern arms by a peninsula, which extends northward approximately 29 km from the base of the bay in Traverse City. Each arm of the bay is

approximately the same width, and both contain a deep basin. West and East Grand Traverse Bay have a maximum depth of 123 and 187 m, respectively. Approximately 75 percent of the volume of the bay lies below a depth of 15 m. Four monitoring stations, positioned at the base and near the northern edge of the central peninsula in each arm, are located in Grand Traverse Bay (Figure 2). The southern sampling station in the western arm is near the mouth of the Boardman River, while the northern station in the eastern arm is located near the mouth of the Elk River.

2.2.2 Hydrologic Influences

The average total daily inflow to Grand Traverse Bay from the watershed is approximately 2.29 million cubic meters per day (Auer *et al.* 1975). There are two primary inflow sources (the Boardman and Elk Rivers) that contribute over 93 percent of the surface water input to the bay: the Elk River at Elk Rapids contributes 1.42 million cubic meters of water per day to East Grand Traverse Bay, and the Boardman River at Traverse City contributes 721,000 cubic meters of water per day to West Grand Traverse Bay. The Elk and Boardman Rivers constitute approximately 60 percent and 30 percent of the tributary flow to the bay, respectively, and are likely the primary source of nutrients and other anthropogenic inputs into the bay. Included in the flow from the Boardman River is potentially 32,000 cubic meters per day (plant capacity) of treated effluent from the Traverse City Wastewater Treatment Plant. The Elk Rapids Wastewater Treatment Plant also contributes up to 1,541 cubic meters per day of treated effluent (permit limit) through the Elk River into East Grand Traverse Bay.

The exchange of water between Grand Traverse Bay and Lake Michigan is significantly

influenced by the presence of a sill along the bottom of the bay at its northern extent, which averages approximately 15 meters in depth. The presence of the sill generates a large gyre (ring-like system of currents), which rotates in the northeastern portion of the bay and impedes water exchange with Lake Michigan (Johnson, 1975). The primary site of water exchange between the bay and Lake Michigan is at the western edge of the sill, where there is an approximately 43 meter deep trench in the sill. Circulation within the bay is reduced at the southern ends of each arm. This is important with respect to nutrient inputs from the Boardman River, as the flushing rates at the southern base of West Grand Traverse Bay can be dramatically lower than other bay regions.

3.0 METHODS

3.1 SAMPLING OF SAGINAW AND GRAND TRAVERSE BAYS

3.1.1 Sampling Dates

Sampling was completed monthly on Saginaw Bay and seasonally on Grand Traverse Bay. Saginaw and Grand Traverse Bays were sampled on the following dates in 2004:

Grand Traverse Bay	Saginaw Bay
April 14, 2004	April 20, 2004
July 20, 2004	May 11, 2004
October 21, 2004	June 9, 2004
	July 6, 2004
	August 3, 2004
	September 27, 2004
	October 28, 2004
	November 9, 2004

The results from these sampling efforts were combined with results from previous work for this study.

3.1.2 Sample Collection, Handling and Analysis

Sampling stations are identified in Figures 1 and 2. Surface water samples were

collected and handled in accordance with MDEQ-approved procedures at depths of one meter, except at Saginaw Bay station 060062, which was also sampled at mid-depth. Formerly station #068062M, the mid-depth sample was designated as station 060078 in 2000.

Limnological and conventional parameters (see Table 1) were either analyzed in the field using standardized techniques or by the MDEQ Environmental Science and Services Division (ESSD) Laboratory using Environmental Protection Agency (EPA)-approved methods. From 1993-1995, metals analyses were performed by the MDEQ Laboratory using 200-series analytical methods. Low-concentration analytical methods were adopted for mercury (Hg) and trace metals in 1998, and since then, Hg and trace metals samples have been collected and handled using ultra-clean techniques in accordance with EPA Method 1669; Hg has been analyzed using EPA Method 1631; and the trace metals cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni), and zinc (Zn) have been analyzed using EPA Method 1638. From 1998-1999, Hg and trace metals analyses were performed by the University of Michigan Air Quality Laboratory. Since 2000, Hg and trace metals analyses have been performed by the Wisconsin State Laboratory of Hygiene. Mercury and trace metals quantification levels for the three laboratories are compared in Table 2.

Additionally, surficial sediment samples were collected in accordance with MDEQ-approved procedures from four locations in Saginaw Bay during August 2001, and from four locations in Grand Traverse Bay during July 2002. These samples were analyzed by the MDEQ ESSD Laboratory using EPA-approved methods. Saginaw Bay sediments were analyzed for volatile organics, base/neutral organics, pesticides, polychlorinated

biphenyls (PCBs), nutrients and metals. Grand Traverse Bay sediments were analyzed for metals and nutrients.

3.1.3 Data Analysis

An analysis of historical and current water quality data in Saginaw and Grand Traverse Bays was completed. Water quality data were summarized for each sampling year by averaging across sampling events at a particular station, where multiple events per year were available. Station 060062 in Saginaw Bay was sampled at two depths; all of the data from the two depths (stations 060062 and 060078) were averaged for analysis. A wide range of data were collected throughout the study, but not all water quality parameters were consistently gathered at each sampling event during every year. For completeness, all data for Saginaw Bay, separated by year and station for 1993 through 2004, are presented in Appendix A, Tables A1.1 through A12.7. All data for Grand Traverse Bay, separated by year and station for 1998 through 2004, are provided in Appendix B, Tables B1.1 through B7.4.

Examination of the analytical laboratory data indicated that many measurements were flagged with Laboratory Result Remark Codes. Of these codes, the following were predominant:

C = Value calculated from other independent parameters.

H and **HT** = Recommended laboratory holding time was exceeded before analysis.

K = Actual value is known to be less than the value given, i.e., substance, if present, is below the quantification limit.

ND = Observed result was below the quantification level.

T = Value reported is less than criteria of quantification.

W = Reported value is less than the method detection limit.

Of the above remark codes, values flagged with a "C", "T" and "W" were utilized directly in the data summary. Codes flagged "K" or "ND" were assigned a value one half the quantification level. Values flagged "H" and "HT" were not included in the data summary.

For Hg and trace metals, the application of ultra-clean sampling techniques and low-concentration analytical methods began in 1998. Therefore, the analysis of Hg and trace metals data was restricted to data obtained between 1998 and 2004, due to comparability concerns with Hg and trace metals data obtained prior to this period (see Appendices A and B for metals data prior to 1998).

When less than 10 years of data for a specified water quality parameter existed, qualitative assessments of the data were performed, including plots depicting the mean annual concentration data at each station. In the event that 10 or more years of water quality data existed, temporal and spatial trends were assessed in addition to the examination of mean annual concentration data at each station. Temporal trends were assessed by plotting mean annual water quality data in "box and whisker" plots and then performing a simple regression analysis of parameter concentrations across all stations (i.e. "bay-wide" assessment of trending). The regression analysis was considered

significant (i.e. there is a long-term trend in the data) at $p \leq 0.05$. Spatial trends were assessed by completing a one-way analysis of variance (ANOVA) of the water quality data. The results of this analysis indicate whether or not there was a significant ($p \leq 0.05$) difference in concentrations between stations across sampling years.

For all statistical analyses, the water quality data were examined to determine whether the following assumptions were satisfied: 1) the data were distributed normally; 2) the data variances were equal and 3) the data were independent and random. If these assumptions were not fulfilled based on normal probability plots and histograms of residuals (regression analyses), the data were transformed.

Based on the 10-year threshold for trend analysis, nearly all of the Saginaw Bay water quality data were examined for trends, while Grand Traverse Bay data were simply examined in a qualitative manner (i.e. 10 years of data did not exist for any of the monitored water quality parameters). It is anticipated that 10 years of data will be available for nearly all water quality parameters collected from Saginaw and Grand Traverse Bays after the 2007 sampling season. Certain parameters, such as turbidity, potassium and sodium, will not have 10 years of data available until after the 2010 sampling season.

3.2 OVERVIEW OF WATER QUALITY PARAMETERS

The assessment of water quality in Saginaw and Grand Traverse Bays required the evaluation of physical, chemical and biological parameters. The WB has been monitoring a variety of parameters since 1993 in Saginaw Bay and since 1998 in Grand

Traverse Bay, but not all parameters have been monitored in each year. In order to evaluate water quality, the range of parameters has been reduced to two subsets of relevant indicators of water quality. The first subset of parameters are accepted "limnological" indicators (Table 3) and the second subset is composed of other "conventional" water quality indicators (Table 4), which includes base/neutral organics, volatile organic compounds (added to conventional parameters in 1999) and cyanide (added to conventional parameters in 2001). In addition, trace metals (Cd, Cr, Cu, Pb, Ni and Zn) and Hg were analyzed (data availability listed in Table 5).

3.2.1 Overview of Limnological Parameters

- **Total Phosphorus.** Total phosphorus (TP) includes soluble orthophosphate and the insoluble phosphates complexed in organic and inorganic compounds. Although only orthophosphate is bio-available, total phosphorus is commonly used as a relative index of phosphorus load. Generally, total phosphorus concentrations greater than 10 µg/L may contribute to increased aquatic plant growth and are indicative of impaired water quality. Inputs from tributaries and storm sewers may cause localized aquatic macrophyte growth, particularly in areas where currents do not readily flush accumulations of influent water and associated suspended solids.

- **Orthophosphate**. Orthophosphate, an oxidized form of phosphorus, is primarily a measure of biologically available phosphorus and is often the most limiting nutrient in freshwater aquatic ecosystems. Although phosphorus concentrations in surface waters are usually reported in terms of total phosphorus, only orthophosphate can be immediately utilized by aquatic plants. Orthophosphate is rapidly removed from the

water column by algae, and therefore levels are usually very low. Typically, measured concentrations are near instrument detection limits. Because orthophosphate is readily utilized by plants, inputs to the Bays from tributaries and storm sewers can have a significant localized effect on macrophyte growth.

- **Nitrate+Nitrite Nitrogen.** Nitrate (NO_3) and nitrite (NO_2) nitrogen are inorganic forms of nitrogen that affect the productivity of fresh waters and are utilized by aquatic plants and bacteria for growth. The nitrogen requirements of microorganisms are about ten times that of phosphorus. Because nitrogen/phosphorus ratios exceed 10:1 in most freshwater systems, nitrogen is not usually a limiting nutrient. Nitrates and nitrites exist in the natural environment and arise from the bacterial oxidation of ammonia and organic nitrogen compounds. In well-oxygenated waters, the dominant component of the nitrate+nitrite measurement is nitrate.

  The primary artificial sources of nitrate+nitrite nitrogen to surface waters are atmospheric input (wet and dry deposition) and fertilizers, which enter receiving waters in the form of runoff from agricultural, urban and recreational lands. Other sources can include any land use that increases the loading of organic debris to runoff water, such as animal waste. This organic debris can ultimately be broken down into oxidized nitrogen compounds.

- **Ammonium Nitrogen.** Ammonium nitrogen (NH_4^+) is the primary form of ammonia (NH_3) in surface water. Ammonium nitrogen is generated by heterotrophic bacteria as a primary end product of decomposition of organic matter, either from proteins or

from other nitrogenous organic compounds. Ammonium nitrogen is easily assimilated by aquatic plants. Among blue-green algae, the highest growth rates occur with ammonium nitrogen as the nitrogen source. The distribution of ammonium nitrogen in fresh water is highly variable within lakes, both seasonally and spatially, and is dependent on the level of productivity of the lake and the extent of organic pollution. Because of its rapid assimilation by algae, ammonium nitrogen concentrations are usually low in trophogenic zones of well-oxygenated waters.

- **Kjeldahl Nitrogen.** Total Kjeldahl nitrogen (TKN) is a measure of dissolved and particulate organic nitrogen plus any ammonia present. The dissolved fraction of organic nitrogen often constitutes up to 50 percent of the total soluble nitrogen. Except for ammonia, the nitrogen in this group of compounds is tightly bound in organic molecules and is slowly released for plant use only by bacterial degradation. The presence of high levels of Kjeldahl nitrogen is indicative of soil erosion, surface water runoff and organic wastes. Much of the organic nitrogen is absorbed by lake sediments.

- **Chlorophyll *a*.** Because all green plants contain chlorophyll *a*, the concentration of chlorophyll *a* is an indirect method to estimate the amount and activity of phytoplankton in the water. Many limnologists argue that lower concentrations of chlorophyll *a* are associated with better water quality, although certain amounts are a normal part of a functioning aquatic ecosystem. Phytoplankton growth rates are dependent on nutrient supply (phosphorus, nitrogen, etc.), sunlight and temperature. Given these requirements and lake-dependent characteristics, chlorophyll *a* concentrations tend to fluctuate seasonally, with peak levels in spring or summer.

However, phytoplankton (and therefore, chlorophyll *a*) are also subject to predation by zooplankton, which may cause dramatic decreases in the chlorophyll *a* concentration.

- **Temperature and Dissolved Oxygen.** Temperature and dissolved oxygen (DO) play an important part in the ecology and chemistry of aquatic ecosystems. The parameters are related because the solubility of dissolved oxygen in water is primarily a function of temperature. The solubility (or saturation) of dissolved oxygen is defined as the concentration in water that is in equilibrium with the atmosphere at one atmosphere of pressure. Temperature and dissolved oxygen profiles are commonly measured in lakes to determine if stratification occurs during summer months and during winter if the lake is covered with ice. Thermal stratification results in a thermocline, which inhibits the vertical mixing of surface and bottom waters. During stratification, bottom oxygen concentrations can be depleted as a result of bacterial decomposition of organic material, and the resultant anoxic conditions can lead to a release of dissolved inorganic phosphorus from the sediments. Thermal stratification usually occurs in large, deep lakes and is typically removed in the fall and spring when surface water temperatures near 4ºC (maximum density) and strong winds induce a seasonal "turn-over". Shallow lakes often continue to be internally mixed by prevailing winds and therefore do not often stratify.

  Surface water samples usually do not exhibit oxygen depletion because of the establishment of equilibrium conditions with the atmosphere and therefore are usually at or near oxygen saturation. Similarly, surface water temperatures are

usually a function of ambient air temperatures and mixing of the upper water column.

- **Secchi Disk Transparency Depth.** Secchi disk transparency depth is a measure of the transparency of water to light. Water clarity is critical because it influences the depth of light penetration (photic zone) and can modify the range and distribution of aquatic macrophytes as well as phytoplankton and a variety of algal species. Secchi disk transparency is influenced by the absorption characteristics of both the water and its dissolved and particulate matter. Northern Michigan lakes have relatively hard water with excess calcium carbonate and, as a result, there may be a chemical clouding or "whiting" which occurs during the summer peak photosynthetic periods. In addition, as lakes become more eutrophic, the higher algal productivity may reduce water clarity and further limit the effective photic zone.

The importance of each of the above limnological and conventional parameters and the trace metals and Hg concentration data are discussed below within the context of the reported water quality data for Saginaw and Grand Traverse Bays, 1993-2004.

3.2.2 Comparisons With Michigan Rule 57 Water Quality Values

Data obtained for Hg; trace metals; total cyanide (CN); methyl tert butyl ether (MTBE); benzene, toluene, ethylbenzene and xylene (BTEX); and a subset of base/neutral organics were compared with applicable Rule 57 water quality values. These values were developed in accordance with the Michigan Part 4 Rules (MAC 1999).

For Hg, the applicable Rule 57 water quality value is the wildlife value (WV); and for Cd, Cr, Cu, Pb, Ni and Zn, the applicable Rule 57 water quality value is either the final chronic value (FCV) or the human non-cancer value (HNV), depending upon the station and the metal. The FCV for Cd, Cr, Cu, Pb, Ni and Zn is hardness-dependent and was calculated for each station using station-specific hardness data. Ambient Cd, Cr, Cu, Pb, Ni and Zn concentrations are for total metal, whereas the FCVs for these metals are expressed as dissolved metal. Therefore, a direct comparison between ambient total metal concentrations and their Rule 57 water quality values cannot be made. This is not an important consideration when the ambient total metal concentration is less than the applicable Rule 57 water quality value. However, in the event that the total metal concentration exceeds the Rule 57 water quality value, the available data cannot show whether the ambient concentration of dissolved metal exceeds the Rule 57 water quality value. Additional, more sophisticated monitoring or the application of a suitable translator value would be necessary to resolve an ambiguity of this nature, and caution must be exercised when drawing conclusions from the available data. Saginaw Bay and Grand Traverse Bay Rule 57 water quality values for Hg and trace metals are shown in Table 6 and Table 7, respectively.

For MTBE and benzene, the applicable Rule 57 water quality value is the human cancer value (HCV). For total CN, toluene, ethylbenzene and xylene, the applicable Rule 57 water quality value is the FCV. Ambient CN concentrations are for total CN, whereas the FCV for this contaminant is expressed as free CN; therefore, a direct comparison between ambient total CN concentrations and the Rule 57 water quality value cannot be made. This is not an important consideration when the ambient total CN concentration is less than the Rule 57 water quality value. However, in the event that the total CN

concentration exceeds the Rule 57 water quality value, the available data cannot show whether the ambient concentration of free CN exceeds the Rule 57 water quality value. Rule 57 water quality values for MTBE, BTEX and total CN are shown in Table 8.

For base/neutral organics, the applicable Rule 57 water quality value differs among the 28 of 50 chemicals in this category for which these values have been developed. The base/neutral organics analyzed and (where available) their Rule 57 water quality values are shown in Table 9.

4.0 RESULTS AND DISCUSSION

4.1 SAGINAW BAY

4.1.1 Limnological Parameter Data, 1993 - 2004

4.1.1.1 Total Phosphorus

Mean total phosphorus concentrations were variable from year to year at each station, and exhibited considerable variability between stations during a given year (Figure 3 a-g). Virtually all stations in all years were characterized by mean total phosphorus concentrations at or exceeding 0.010 mg/L, which indicates that Saginaw Bay is classified as a mesotrophic water body. Relatively high mean total phosphorus concentrations were observed at stations 060062 (Figure 3 a) and 060063 (Figure 3 b) in 1998, both of which are located in the northwestern portion of the inner bay. These increases were due to high concentrations measured in June of 1998, which skewed the data. Since 1993, mean total phosphorus concentrations have remained relatively constant at all stations (except for the above noted exceptions with the 1998 data). Since 1993, mean concentrations have remained above the target total phosphorus concentration of 0.015 mg/L (International Joint Commission 1987) at station 090252 (Figure 3 g), located near the mouth of the Saginaw River, and at station 090250, located north-northeast of station 090252 (Figure 3 c).

Figure 4 and the regression analysis of the total phosphorus data indicated no trend with time ($p=0.112$) in “bay-wide” total phosphorus concentration. There was virtually no

change in mean total phosphorus concentrations between 1993 and 2004. Additionally, all annual median concentrations, as well as the bulk of the data, are greater than the target total phosphorus concentration of 0.015 mg/L (Figure 4).

ANOVA results indicated that the mean annual total phosphorus concentration was significantly ($p \leq 0.001$) different between sampling stations. Across all sampling years, station 090252 (near the mouth of the Saginaw River) had the greatest mean total phosphorus concentration, and station 320188 (in the northwestern portion of Saginaw Bay) had the lowest mean total phosphorus concentration.

4.1.1.2 Orthophosphate

Orthophosphate is readily used by algae and other aquatic vegetation, and concentrations are expected to be relatively low, as long as nitrogen is not limiting. Mean concentrations of orthophosphate remained relatively low (≤ 0.005 mg/L) and constant across years at most sampling stations (Figure 5 a-g). Since 2002, mean orthophosphate concentrations have decreased at all stations except 090252. From 1993 through 1997 and in 2004, mean orthophosphate concentrations at station 090252 (Figure 5 g – near the mouth of the Saginaw River) ranged from two to six times higher than average concentrations found at other stations.

ANOVA results indicated that there was a significant ($p \leq 0.001$) difference in mean orthophosphate concentrations between the stations. As expected, station 090252 had the greatest overall mean orthophosphate concentration. These results and the data provided in Figure 5 indicate that the Saginaw River is a major source of

orthophosphate to Saginaw Bay. Station 790134 had the lowest mean orthophosphate concentration across sampling years.

The regression analysis of the orthophosphate data indicated no trend with time between 1993 and 2004 ($p=0.079$). "Bay-wide" orthophosphate concentrations were most elevated between 2001 and 2003 (Figure 6). One exceptional orthophosphate concentration was observed in 2004.

4.1.1.3 Nitrate + Nitrite Nitrogen

Inorganic nitrogen in the form of nitrates and nitrites (NO_x) are utilized by aquatic vegetation and phytoplankton. Although NO_x concentrations in Saginaw Bay are higher than most inland lakes and bays in Michigan, concentrations can be highly variable. Mean concentrations of NO_x consistently declined at all stations in Saginaw Bay from 1996 through 1998 (Figure 7 a-g); however all stations showed an increase between 1999 and 2001. Mean concentrations decreased at all stations between 2001 and 2003, and increased in 2004. At station 090252, the mean NO_x concentration was exceptionally elevated in 2004 (3.02 mg/L). This was due to a NO_x concentration of 7.70 mg/L measured in May 2004, which corresponded with tremendously abundant rain in the watershed prior to the May sampling event. Overall, mean NO_x concentrations have been lowest at the open water station 060062 (Figure 7 a) and highest at stations 090252, 090250 and 320189 (Figures 7 g, 7 c and 7 f, respectively). Because nitrogen levels from all sources in Saginaw Bay exceed phosphorus levels by greater than a ratio of 10:1, phosphorus is the primary limiting nutrient for aquatic plant growth. However, if phosphorus concentrations are not limited, continued elevated inputs of nitrogen into

Saginaw Bay may lead to increases in primary productivity.

4.1.1.4 Ammonium Nitrogen (Ammonia)

With two exceptions, mean ammonia concentrations in Saginaw Bay remained consistent or decreased slightly at all stations from 1996 through 2004 (Figure 7 a-g). There were two instances when mean ammonia concentrations increased substantially (>0.03 mg/L) in a given year relative to the prior year: station 320188 in 1998 (Figure 7 e) and station 320189 in 2000 (Figure 7 f). The increases in mean ammonia at stations 320188 and 320189 were attributed to the influence of high concentrations measured in samples collected on June 10, 1998 and July 25, 2000, respectively. Overall, mean ammonia levels were highest at station 090252 near the mouth of the Saginaw River (particularly in 1996) (Figure 7 g), suggesting that significant inputs to the Bay are continuing via the Saginaw River. Overall, mean concentrations of ammonia were relatively low at all stations.

4.1.1.5 Total Kjeldahl (Organic) Nitrogen

Mean concentrations of TKN remained relatively constant from 1993 through 2004 at all stations (Figure 8 a-g). Station 320189 (northeastern inner bay near Sand Point) demonstrated a large increase in mean organic nitrogen in 1994, but mean concentrations decreased beginning in 1995 to their lowest point in 1996 (Figure 8 f). Mean TKN concentrations increased between 2003 and 2004 at all stations except 060063. There was no significant trend ($p=0.328$) with time in “bay-wide” TKN concentrations (Figure 9).

ANOVA results indicated that there was a significant ($p \leq 0.001$) difference in mean TKN concentrations between the stations across sampling years. Station 320189 had the greatest mean TKN concentration, and station 060062 had the smallest mean TKN concentration.

4.1.1.6 Chlorophyll *a*

Chlorophyll *a* concentrations exceeding 4 µg/L are considered indicative of mesotrophic conditions (moderately enriched), and those exceeding 10 µg/L are indicative of eutrophic conditions (greatly enriched). In Saginaw Bay, almost all stations exhibited mean annual chlorophyll *a* concentrations greater than 4 µg/L, and several stations (060062, 90250, 090252, 320188 and 320189) had mean chlorophyll *a* concentrations approaching or exceeding 12 µg/L between 1993 and 2004 (Figure 10 a-g). Only stations 060063, 320188 and 090252 have routinely had mean chlorophyll *a* concentrations below 4 µg/L (Figures 10 b, 10 e and 10 g).

ANOVA results indicated that there was a significant ($p=0.001$) difference in mean chlorophyll *a* concentrations between sampling stations across years. Station 090250 had the greatest mean chlorophyll *a* concentration and station 060063 had the lowest mean chlorophyll *a* concentration.

In order to assess the "bay-wide" trend in chlorophyll *a* concentrations, the mean annual chlorophyll *a* data were plotted with a box plot to demonstrate the range of the data (Figure 11). Regression analysis indicated that there was no significant ($p=0.560$) change in mean annual chlorophyll a concentrations between 1993 and 2004. Similar

mean annual concentrations were observed in 1993, 1994, 1998 through 2000, and in 2004. Notably lower chlorophyll *a* concentrations were observed in 1996, and higher average chlorophyll *a* concentrations were observed in 1997.

Because chlorophyll *a* is an indirect measure of phytoplankton in water, samples taken at the surface only (or at a specific depth) may significantly under or over estimate concentrations, depending on recent meteorological conditions and turbulent mixing. Since 1999, sampling through the entire photic zone of the water column (generally considered twice the Secchi disk transparency depth) was conducted to provide more representative and consistent data.

4.1.1.7 Temperature and Dissolved Oxygen

Mean temperature and DO measurements (Figure 12 a-g) demonstrated a relatively consistent relationship at all stations; surface DO levels ranged from 95 percent to 105 percent of saturation at all stations. These oxygen saturation levels are sufficient to provide adequate oxygen for aquatic organisms. Based on results of the ANOVA analyses, mean water temperature and DO concentrations were not significantly different between stations across sampling years ($p=0.505$ and $p=0.948$, respectively).

Figure 13 and regression analysis of the mean data indicated a significant ($p=0.002$) long-term increase in “bay-wide” DO concentrations. The increase in mean DO concentrations corresponded to a significant ($p\leq0.001$) decrease in water temperature over the same sampling period. These trends can be attributed to the fact that during the first several years of sampling on Saginaw Bay, surface water quality parameters were only collected during summer months when water temperature is greater and DO

concentrations are less than in spring or autumn months. Since approximately 2001, water temperature and DO have been collected monthly between April and November, resulting in overall lower water temperatures and greater DO concentrations.

Because there is a direct relationship between DO concentrations, temperature and atmospheric conditions prevalent during the sampling period, variability in temperature and DO is expected. DO levels were not measured at depths below one meter from 1993 through 1999. Beginning in 2000, measurements were taken at mid depths; however, we would not expect the DO concentration to change dramatically from the surface to the bottom due to the shallow depth of Saginaw Bay and turbulent mixing resulting from wind and waves. Development of a thermocline would not be expected throughout much of Saginaw Bay, but may occur periodically in warm, calm years in the deepest center trough near station 060062.

4.1.1.8 Secchi Disk Transparency Depth

Based on the trophic state classification offered by Chapra (1997), secchi disk transparency depth data collected in Saginaw Bay from 1993 through 2004 was typical of lakes characterized as mesotrophic (< 13 feet secchi disk transparency depth) to eutrophic (< 6.5 feet secchi disk transparency depth). Mean secchi disk transparency depth remained relatively constant or decreased slightly between 1993 and 2004 at all stations (Figure 15 a-g). ANOVA results indicated a significant ($p \leq 0.001$) difference in mean secchi disk transparency depth between the stations across all sampling events. Overall, water clarity was greatest at station 060062 (Figure 15 a), located near outer

Saginaw Bay, and least at station 320189 (Figure 15 f), where the secchi disk transparency depth never exceeded five feet.

Results of the regression analysis indicated that the "bay-wide" secchi disk transparency depth has not significantly (p=0.382) changed between 1993 and 2004 (Figure 16). However, secchi disk transparency depth measured between the periods 1979 through 1980 and 1991 through 1993 indicated a nearly 88% increase in secchi disk transparency depth, corresponding with the establishment of zebra mussels (*Dreissena polymorpha*) in Saginaw Bay (Fahnenstiel *et al.* 1995). These data, along with the data from this study, indicate that secchi disk transparency depth improved significantly shortly after the establishment of zebra mussels. Nevertheless, water clarity has remained relatively constant since approximately three years after zebra mussels were first discovered in Saginaw Bay.

4.1.2 Conventional Parameter Data, 1993-2004

A range of conventional parameters (calcium, magnesium, sulfate, chloride, silicon, sodium, potassium, hardness, alkalinity, specific conductance, pH, turbidity, dissolved and suspended solids and total organic carbon) was measured from 1993 through 2004, though not all parameters were measured in all years. Table 4 lists the years that conventional parameters were measured in Saginaw Bay.

4.1.2.1 Calcium, Magnesium and Sulfate

Both calcium and magnesium are nutrients required by higher aquatic plants for normal metabolism. Calcium can exhibit noticeable seasonal and spatial variation, and levels of

calcium can decrease as a result of the precipitation of calcium carbonate during summer months (May through September). Indeed, based on the ANOVA analysis, mean concentrations of calcium were significantly ($p=0.034$) different between sampling locations. Station 090252 had the greatest mean calcium concentration, and station 060062 had the lowest mean calcium concentration across sampling events (Figure 17 a-g). However, there was no significant ($p=0.557$) long-term trend in "bay-wide" mean calcium concentrations (Figure 18).

In contrast to calcium concentrations, magnesium compounds are more soluble than calcium and therefore are rarely precipitated. Consequently, magnesium concentrations normally fluctuate very little within a water body. Based on the ANOVA analysis, however, there was significant ($p=\leq 0.001$) variability in mean magnesium concentrations between stations in Saginaw Bay. Mean magnesium concentrations were greatest at station 090252 and least at station 060062 (Figure 17 a-g). "Bay-wide" magnesium concentrations also increased significantly ($p=0.004$) between 1993 and 2004 (Figure 19).

Sulfur (measured as sulfate), in both organic and inorganic forms, is also required by all living organisms and is reduced to sulfhydryl groups (-SH) during protein synthesis. Sulfur has both natural (rocks and soil/sediment) and anthropogenic (atmospheric deposition as a result of the combustion of fossil fuels) sources. Within water, nearly all assimilation of sulfur is as sulfate, and the usual range for freshwater systems is 5 to 30 mg/L, with an approximate mean of 11 mg/L (Horne and Goldman 1994). Mean concentrations of sulfate in Saginaw Bay have generally ranged between 15 and 25

mg/L among all seven sampling stations (Figure 17 a-g), and 'bay-wide" concentrations have significantly ($p=0.040$) increased between 1993 and 2004 (Figure 20). Mean sulfate concentrations, based on the ANOVA analysis, were significantly ($p \leq 0.001$) different between stations across all sampling years. The smallest mean sulfate concentration was observed at station 060062, and the greatest mean concentration was observed at station 320189.

4.1.2.2 Total Chloride

The chloride ion is not usually a significant parameter in freshwater, open lake systems; however, anthropogenic sources (road salting, industrial sources and municipal wastewaters) of chloride can greatly modify natural concentrations of this anion. Although the average chloride concentration in natural freshwater is 8.3 mg/L (Livingstone 1963), an examination of mean chloride concentrations in Saginaw Bay demonstrate that concentrations were generally 1.5 to 2 times higher than this average (Figure 21 a-g). Based on results from the ANOVA analysis, mean chloride concentrations were significantly ($p \leq 0.001$) different between stations. Overall, mean concentrations were lowest and least variable at station 060062 (Figure 21 a), and were most elevated at station 090252 (Figure 21 g). "Bay-wide" chloride concentrations, as indicated by the regression analysis, did not exhibit a significant ($p=0.102$) trend with time (Figure 22).

4.1.2.3 Silicon

Silicon occurs in freshwater in either dissolved or particulate forms; dissolved forms are generally stable acidic compounds, while the particulate silica is either in biological form

(structural components of diatoms, for example), or bound to inorganic and organic particles. Diatom algae tend to assimilate large quantities of silica and can significantly reduce concentrations, although noticeable seasonal variations are also often observed. When concentrations fall below 0.5 mg/L, many diatoms cannot compete successfully with other algae and their populations decrease until silica supplies are renewed.

In Saginaw Bay, mean silicon concentrations showed yearly variation from 1993 through 1997, but generally fluctuated around 0.5 mg/L (Figure 23 a-g). Slightly higher mean concentrations were noted at station 090252 near the Saginaw River between 1993 and 1997 (Figure 14 g). Silicon has not been monitored since 1997.

4.1.2.4 Hardness and Alkalinity

Water hardness is often used as an assessment of water quality, and is determined by the content of calcium and magnesium salts (primarily combined with bicarbonate and carbonate or with sulfates), chlorides and other anions of mineral acids. In calcareous lakes and waters typical of Michigan, most of the hardness in water is a result of calcium carbonate. Similarly, alkalinity refers to the quantity and types of compounds present in the water that shift the pH to the alkaline side of neutrality. The property of alkalinity is usually imparted by the presence of carbonates, bicarbonates and hydroxides.

Mean values of hardness in Saginaw Bay were relatively consistent at all stations from 1993 through 2004 (Figure 24 a-g), and are typical of freshwater lakes in Michigan. Increases in mean hardness were observed sporadically at several stations between

1993 and 2004, although these values were attributed to one sample with an unusually high hardness skewing the data. "Bay-wide" hardness values have not significantly ($p=0.430$) changed between 1993 and 2004 (Figure 25). ANOVA analysis indicated a significant ($p=0.049$) difference in mean hardness values between stations; station 060063 had the smallest mean hardness value, and station 090252 had the largest hardness value.

Mean alkalinity values were also typical of the lakes in Michigan and have remained relatively constant throughout the sampling period (Figure 24 a-g). Mean alkalinity values decreased at all stations between 2001 and 2003, and increased at all stations between 2003 and 2004.

4.1.2.5 Specific Conductance

The specific conductance (conductivity) of lake water is a measure of the resistance of a solution to electrical flow. As the ion content of the water increases, so does the conductivity (resistance to electrical flow will decrease). The conductivity of a typical bicarbonate lake is closely related to the concentration of the major ion species (calcium, magnesium, sodium, potassium, carbonate, sulfate and chloride). Conductivity varies seasonally and yearly, depending on the relative distribution of these major ions within the water column.

An examination of the mean field (Figure 26 a-g) and laboratory (Figure 27 a-g) measured specific conductance of Saginaw Bay from 1993 through 2004 demonstrates values that are typical of hard water lakes in Michigan. Based on ANOVA analyses, mean conductivity values were significantly different between stations for both field

($p \leq 0.001$) and laboratory ($p \leq 0.001$) measured water. Station 090252 near the mouth of the Saginaw River had the greatest overall mean conductivity value, and the open water station 060062 had the smallest mean conductivity value. Figures 28 and 29 and the regression analyses of the field and laboratory conductivity data indicated that there were no significant ($p=0.647$ and $p=0.482$, respectively) trends with time.

4.1.2.6 Dissolved and Suspended Solids

The measurement of dissolved solids is used as an estimate of the inorganic materials (i.e., magnesium carbonate, chlorides, etc.) dissolved in water. Similarly, suspended solids (total non-filtered residue) are particulates or compounds that are suspended and generally insoluble in water. There can be considerable temporal and seasonal variation in these values, depending on temperature, dissolved oxygen and pH.

Concentrations of mean dissolved solids (Figure 30 a-g) in Saginaw Bay from 1993 through 2004 were typical of regional lakes. Mean dissolved solids were somewhat higher and more variable at station 090252 (Figure 30 g) near the Saginaw River when compared to the other stations, and the least variable station was 060062 in the deeper part of the open Bay (Figure 30 a). Indeed, the ANOVA analysis indicated that there was a significant ($p \leq 0.001$) difference in mean dissolved solids concentrations between the sampling stations. However, when examining the results of the regression analysis, there was no significant ($p=0.966$) trend with time when considering the “bay-wide” dissolved solids concentrations (Figure 31).

Mean suspended solids concentrations were unremarkable at all seven stations in Saginaw Bay, with the exception of station 320189 near Sand Point (Figure 32 f), where

the mean suspended solids concentration varied considerably from year to year since 1993. Mean suspended solids concentrations were significantly ($p \leq 0.001$) different between stations across all sampling years based on the ANOVA analysis. Station 320189 had the greatest mean suspended solids concentration, and station 060062 had the smallest concentration. The regression analysis indicated no significant ($p=0.342$) trend with time (Figure 33).

4.1.2.7 Total Organic Carbon

Total Organic Carbon (TOC) is a measure of both the dissolved and particulate organic carbon in the water that is bound as part of living matter (i.e., algae and diatoms) and by decomposition. A high organic content is associated with increased growth of microorganisms, which contribute to the depletion of oxygen. Therefore, elevated TOC concentrations may be associated with depleted oxygen concentrations. TOC also determines, to some extent, the bioavailability of contaminants to organisms, thereby affecting both acute and chronic toxicity.

Mean TOC concentrations were relatively constant among all stations from 1998 through 2004 (Figure 34 a-g), and generally ranged from approximately 3 to 5 mg/L. These mean concentrations are typical of regional lakes, and agree with data reported by Johengen *et al.* (2000). One exceptional mean TOC concentration was measured at station 090252 in 2004 and was attributed to elevated concentrations in May and June. Overall, mean TOC concentrations were greatest at station 090252, located near the

mouth of the Saginaw River (Figure 34 g).

4.1.2.8 pH

The number of free hydrogen ions in water represents its pH. pH values can vary between zero and 14; pH values near zero are characterized as acidic, and values near 14 are considered basic. In Michigan, the pH of water typically ranges between 6.5 and 8.5, primarily due to the presence of calcium carbonate.

Mean field (Figure 35) and laboratory (Figure 36) pH values measured in Saginaw Bay between 1993 and 2004 were relatively stable, and were consistent with those observed in regional lakes. Although mean field pH values were more variable between years than those measured in the laboratory, both were similar. Mean pH values were not significantly ($p=0.288$) different. Mean laboratory pH values were most elevated at station 790134 and lowest at station 090252. Figure 37 and the regression analysis of the field data indicated no significant ($p=0.573$) 'bay-wide" trend with time. The regression analysis of the laboratory data, however, illustrated a significant ($p=0.013$) decrease in "bay-wide" pH values between 1993 and 2004 (Figure 38).

4.1.2.9 Potassium and Sodium

Potassium and sodium are chemicals required by aquatic plants for growth. Natural levels of these minerals are normally relatively low in aquatic environments. Elevated levels are likely an indication of anthropogenic pollution from road salts, human wastes, animal wastes and fertilizers.

In Saginaw Bay, mean concentrations of total sodium were relatively consistent over time and generally ranged between 7 and 13 mg/L (Figure 39). The greatest mean concentrations were observed at station 090252 (Figure 39 g) near the mouth of the Saginaw River. Mean concentrations of sodium increased at all stations between 2003 and 2004.

Mean potassium concentrations in Saginaw Bay were relatively constant between 2001 and 2004 (Figure 40) and generally ranged between 1 and 3 mg/L. The highest mean concentrations were observed at stations 320189 (Figure 40 f) and 090252 (Figure 40 g). Similar to mean sodium concentrations, potassium concentrations increased between 2003 and 2004 at all stations.

4.1.2.10 Turbidity

Turbidity is a direct measure of water clarity, and is primarily influenced by total suspended solids. The major sources of turbidity include phytoplankton, small particulate matter from shoreline erosion, re-suspended bottom sediments, and organic detritus from wastewater and/or stream discharges.

In Saginaw Bay, mean turbidity values generally ranged between two and seven NTU (Figure 41). During 1998, mean turbidity values were elevated at station 320189 (Figure 41 f) and station 090252 (Figure 41 g). Mean turbidity values appeared to increase or remain relatively stable at all stations between 1996 and 2004. The most elevated mean turbidity values were at stations 320189 and 090252; the lowest mean turbidity

values were at stations 060062 and 060063.

4.1.3 Trace Metals and Mercury Data, 1993 - 2004

Data availability for trace metals and Hg analyses are shown in Table 5. Hg and trace metals concentrations were quantified for samples collected at seven stations in 1993 through 1995, three stations in 1998 (weather limited monitoring to three stations from the designated four stations), four stations in 1999, one station in 2000 (again, weather limited monitoring), and four stations between 2001 and 2004. One sample was collected per station during each sampling event. Comparisons of Hg and trace metals concentrations at all stations in Saginaw Bay for the years 1998 through 2004 are shown in Table 10. Data collected prior to 1998 were excluded from Table 10 due to comparability concerns (see Appendix A for these data).

4.1.3.1 Cadmium, Chromium and Lead

Mean Cr concentrations at the four selected stations in Saginaw Bay were relatively low in 1998, increased dramatically in 1999, and then decreased or remained relatively constant between 1999 and 2004 (Figure 42 a-d). Overall, Cr concentrations were lowest at station 060062 (Figure 42 a). Mean Pb concentrations remained relatively constant at stations 060062 (Figure 42 a) and 060063 (Figure 42 b), and have decreased since 1998 at stations 320189 (Figure 42 d) and 090252 (Figure 42 c). Between 1998 and 2004, mean Pb concentrations were greatest at station 320189 (Figure 42 d). Mean concentrations of Cd remained relatively constant at all four stations between 1998 and 2004, and there was little difference among the four stations. All mean concentrations of Cd, Cr and Pb met the applicable Michigan Rule 57 water

quality values for all years at all stations (Tables 6 and 10).

4.1.3.2 Copper, Nickel and Zinc

Figure 43 a-d shows mean concentration data for Cu, Ni and Zn at four selected sampling stations in Saginaw Bay. Mean Cu and Ni concentrations were relatively consistent between 1998 and 2004, although there was a decrease and subsequent increase in mean Cu levels between 2002 and 2003 at station 090252 (Figure 43 c). Additionally, mean Ni concentrations at station 060062 have increased since 1999 (Figure 43 a). Mean Zn concentrations were elevated in 1998 at the three sampled stations, but have remained relatively constant between 1999 and 2004 (Figure 43 b-d). Except for Ni at station 060062 (Figure 43 a), all mean concentrations of Cu, Ni and Zn have either decreased or remained relatively constant between 1998 and 2004 at each of the four stations. Overall, mean concentrations of Cu, Ni and Zn have been lowest at station 060062 (Figure 43 a). All mean concentrations measured at the four selected sites met the applicable Rule 57 water quality values during all years (Tables 6 and 10).

4.1.3.3 "Bay-wide" Average of Trace Metals

Mean trace metals concentrations were calculated as a "Bay-wide" average by year to examine overall qualitative trends. Examination of mean Cr and Pb concentrations (Figure 44 a) demonstrated a generally decreasing trend from 1998 through 2004, while mean Cd concentrations remained relatively constant during this time period. All mean concentrations met the applicable Rule 57 water quality values, adjusted for hardness (using the highest observed hardness value among all samples). Similarly, mean concentrations of Ni, Cu and Zn decreased from 1998 through 2004 (Figure 44 b). Mean

concentrations of these trace metals also met the applicable Rule 57 water quality values. Excluding Cd, all mean trace metals concentrations increased between 2003 and 2004.

4.1.3.4 Mercury

The toxicity of Hg is well established for biological systems, and the potential for Hg to bioaccumulate is a major concern in aquatic communities. In Michigan, the Rule 57 water quality value for Hg is 1.3 ng/L. This value was exceeded in 1998 at stations 090252 (Figure 45 c) and 320189 (Figure 45 d), in 1999 at all stations (Figures 45 a-d) and in 2004 at station 320189. The greatest mean Hg concentration measured was at station 060063 in 1999, when the mean Hg concentration was 12.7 ng/L (Figure 45 b and Table 10).

Mean Hg concentrations were calculated as a "Bay-wide" average by year to examine overall qualitative trends. Average Hg concentrations exceeded the Michigan Rule 57 water quality value of 1.3 ng/L in 1998 and 1999, and met this value between 2001 and 2004 (Figure 46). One possible explanation for the variability in the data between the two periods, 1988 through 1999 and 2000 through 2004 (Figure 46), is inter-laboratory variability, given that the University of Michigan Air Quality Laboratory performed analyses during 1998 through 1999, and the Wisconsin State Laboratory of Hygiene performed analyses after 1999. However, insufficient data are available to perform valid statistical analyses at this time.

4.1.4 Base /Neutral Organics and Volatile Organics Data, 1999 – 2004

Beginning in 1999, analyses of base/neutral organics and volatile organics in water samples were added to supplement revised monitoring objectives for detection of new and emerging water quality problems. Base/neutral organics are used in industry in a wide range of applications, many involving petroleum products such as fuels and plastics. The volatile organic compounds analyzed included MTBE and BTEX. MTBE, an octane-enhancing replacement for lead in gasoline that has been used since 1979, was investigated in response to mounting national concerns of pollution problems caused by this chemical. BTEX chemicals are common components of gasoline.

4.1.4.1 Base/Neutral Organics

In 1999, all base/neutral organics were below quantification limits except for Bis(2-ethylhexyl)phthalate, which was detected at station 790134 at 1.8 μg/L. In 2002, Bis(2-ethylhexyl)phthalate was detected at stations 090250, 790134 and 090252 at 8.6, 7.7 and 4.2 μg/L, respectively. Bis(2-ethylhexyl)phthalate was also detected in 2004 at station 060078 at 4.1 μg/L. Those concentrations met the Rule 57 water quality value for this compound (see Table 9).

In 2000, diethyl phthalate was found at all stations in Saginaw Bay at concentrations that ranged between 1.0 μg/L and 2.1 μg/L (see Appendix A, Tables A8.1 - A8-7). In 2001, diethyl phthalate was detected at stations 320189 and 090252 at 1.1μg/L (see Appendix A , Tables A9.1 - A9.7). Diethyl phthalate was also detected in 2004 at all stations, except 060062 and 060078, at concentrations ranging between 0.18 and 0.25 μg/L (see

Appendix A , Tables A12.1 - A12.7). These concentrations all met the Rule 57 water quality value for this compound (see Table 9).

4.1.4.2 Volatile Organics

All samples analyzed for volatile organic compounds between 1999 and 2004 were below quantification limits and met applicable Rule 57 water quality values (see Table 8).

4.1.5 Total Cyanide Data

Beginning in 2001, CN was analyzed in a single sample collected during the spring at each sampling station. CN was not measured above the quantification limit in any of the samples collected between 2001 and 2004, and all samples met the CN Rule 57 water quality value (see Table 8).

4.1.6 Sediment Quality Data

Surficial sediment samples are periodically collected from water bodies to better understand potential sources of contaminants in water. Due to the physical characteristics of Saginaw Bay such as shallow water depth and its vulnerability to wind stress, sediments within the bay may become disturbed, re-suspending nutrients and other contaminants into the water column. Sediment samples were collected from Saginaw Bay in August, 2001.

Concentrations of volatile organic compounds, base/neutral organic compounds, pesticides and PCBs in Saginaw Bay sediment were all below detection limits. Total

phosphorus and TKN in the sediments were not exceptionally elevated (Table 11), and concentrations were similar to what would be expected in regional water bodies. Concentrations of TKN and total phosphorus were greatest at station 060062 and least at station 090252. Metals data were all below levels that may cause toxicity to benthic organisms (see MacDonald *et al.* 2000), and were lower than those reported in 1988 in Saginaw Bay (Rossmann 1988). Concentrations of metals were generally greatest at station 060062. Although many sediment data results were below the quantification limit in Saginaw Bay, the data collected from Saginaw Bay indicate that the sediment may act as a source for certain contaminants to the water column, especially nutrients and metals, during re-suspension.

4.1.7 Conclusions - Saginaw Bay

Nutrient data collected from Saginaw Bay between 1993 and 2004 are indicative of mesotrophic to eutrophic conditions. Levels of total phosphorus have remained relatively constant, and continue to be above the target total phosphorus concentration of 0.015 mg/L. Concentrations of NO_x are also relatively high, but the data indicate that phosphorus is the limiting nutrient in the Bay. Productivity is quite high in Saginaw Bay, likely due to the elevated phosphorus concentrations. This observation is supported by the high concentration of chlorophyll *a* at all of the stations (which often exceeded 10 μg/L - an accepted threshold for eutrophic conditions), and by water clarity measurements based on the secchi disk transparency depth.

Levels of most of the conventional parameters were consistent with concentrations noted in regional lakes. Concentrations of calcium, magnesium, sulfate and chloride were generally consistent among sampling stations, with slightly higher concentrations occasionally noted at station 090252, near the mouth of the Saginaw River. Hardness, alkalinity, pH, specific conductance and dissolved and suspended solids concentrations were generally typical of regional lakes at most sampling stations. Higher dissolved solids concentrations were noted near the mouth of the Saginaw River and may reflect the contribution of the river into Saginaw Bay.

Concentrations of limnological and conventional parameters at various sampling stations in Saginaw Bay appear to be influenced by the physical characteristics of the Bay, especially circulation patterns established by prevailing winds (causing the re-suspension of sediment), inflow from Lake Huron and the Saginaw River, predominant lake currents and water depth. Nutrient loading from the Saginaw River, and the watershed in general, may flow along the southeastern region of the Bay and impact the sampling stations in this area. Although this circulation pattern (counter clockwise) does not always occur, it may occur often enough to enhance nutrient loading in this region of Saginaw Bay. This observation is somewhat supported by the data which indicate that, over time, the open water stations and stations in the northwestern region exhibit slightly lower concentrations of numerous nutrients. These data indicate that reductions in source nutrients within the Saginaw River and the Saginaw Bay watershed are needed. Overall, however, there does not appear to haven been a significant change in nutrient levels (i.e., total phosphorus and NO_x) in Saginaw Bay between 1993 and 2004.

Trace metals concentrations met applicable Michigan Rule 57 water quality values between 1998 and 2004. Mean Hg concentrations exceeded the Michigan Rule 57

water quality value at all sampled sites between 1998 and 1999, except at station 060063 in 1998. Beginning in 2000, the Rule 57 water quality value for mean Hg has been met, except at station 320189 in 2004. Further monitoring will help to better understand whether Hg concentrations in Saginaw Bay consistently exceed the Rule 57 water quality value. Concentrations of base/neutral organic compounds, MTBE, BTEX and CN were almost always below quantification limits, and all samples met applicable Rule 57 water quality values.

4.2 GRAND TRAVERSE BAY

4.2.1 Historical Water Quality Data

The water quality of Grand Traverse Bay was previously reviewed by Shuey *et al.* (1992). This review noted that Grand Traverse Bay was an oligotrophic system with high overall water quality (from Auer *et al.* 1975). Total phosphorus concentrations at open bay stations averaged 0.0079 mg/L, one of the lowest concentrations in the Great Lakes. Macrophyte beds present in the southern portion of the west arm of Grand Traverse Bay were attributed to the discharge of nutrients from the wastewater treatment plant in Traverse City, via the Boardman River. Additional treatment at this plant in recent years has eliminated up to 90 percent of the phosphorus from effluent discharged into the Boardman River. Shuey *et al.* (1992) also noted that although phosphorus was the primary pollutant/limiting nutrient of concern in Grand Traverse Bay, the levels had not increased in the open bay since 1975 and were actually lower than in 1975. Phosphorus concentrations in the southern portion of the western arm were slightly higher, probably a result of nutrient loading from the Boardman River and storm sewers. Further studies in 1998 (Grand Traverse Bay Watershed Initiative 2000) indicated a steady decline in total phosphorus concentrations in the west arm, which is consistent with the total phosphorus concentrations throughout the entire bay. The decline in phosphorus can be partially attributed to improvements in the wastewater treatment plant on the Boardman River from 1973 to 1992. The continued decline since 1992 may be partially attributed to the increase in zebra mussel density in the bay. If zebra mussels are playing a significant role in the nutrient balance in Grand Traverse Bay, the mussels could cycle phosphorus into the sediments through metabolic routes, or hold the phosphorus in an unavailable form. It is reasonable to conclude that infestations of

zebra mussels in Grand Traverse Bay influence the cycling and availability of nutrients.

Levels of nitrate were not considered problematic and averaged 1.03 mg/L in the open Bay (Shuey *et al.* 1992). Concentrations in the southern portion of the west arm of the bay were 1.06 mg/L, indicating that there was no build-up of nitrate associated with the Boardman River. More recent measurements of nitrate/nitrite nitrogen (Grand Traverse Bay Watershed Initiative 2000) were very similar overall to the nitrogen concentrations measured by Auer *et al.* (1976) and Shuey *et al.* (1992).

Chlorophyll *a* concentrations in the open bay and sub-embayments (e.g., Suttons Bay, Northport Bay and Bowers Harbor) averaged 0.618 and 0.800 µg/L, respectively, in 1992, with a bay-wide average of 1.04 µg/L in 1998 (Grand Traverse Bay Watershed Initiative 2000). Historically, average concentrations in the southern portion of the west arm were slightly higher than open bay stations, indicating a higher biomass of phytoplankton near the mouth of the Boardman River.

4.2.2 Limnological Parameter Data, 1998-2004

4.2.2.1 Total Phosphorus

Mean total phosphorus concentrations in Grand Traverse Bay between 1998 and 2004 are shown in Figure 47 a-d. Mean total phosphorus concentrations have either remained relatively constant or declined slightly between 1998 and 2004 at all stations. Little variability in mean total phosphorus concentrations between years was observed at station 450132, while the most variability between years was at station 280288. Mean concentrations of total phosphorus were similar between sites, and are indicative of

excellent water quality.

4.2.2.2 Orthophosphate

Available mean phosphorus (orthophosphate) levels were extremely low (0.001 mg/L) at all four sampling stations in Grand Traverse Bay in 1998 (Figure 48 a-d). Between 1998 and 2001, mean orthophosphate concentrations steadily increased at the two southern stations and remained relatively constant at the two northern stations. Between 2002 and 2004, however, there was either no change or a small decrease in mean concentrations at all stations. Overall, mean orthophosphate concentrations were greater in the west arm, which receives 30 percent of its volume from the Boardman River.

4.2.2.3 Nitrate + Nitrite Nitrogen

Mean concentrations of NO_x have remained very consistent between 1998 and 2004 at all stations (Figure 49 a-d), and are at levels characteristic of oligotrophic lakes in the region. There was no significant difference in mean NO_x concentrations between the four stations in Grand Traverse Bay.

4.2.2.4 Ammonium Nitrogen (Ammonia)

Excluding year to year variability, mean ammonia concentrations in Grand Traverse Bay have increased slightly or remained relatively constant since 1998 at all stations (Figure 49 a-d), and are greater than levels reported in 1992 (Shuey *et al*. 1992). The most consistent increase was at station 450133 in the northern portion of the west arm (Figure 49 c). These increases are not of great concern, however, because levels of N:P are greater than 10:1. Therefore, nitrogen is not a limiting nutrient in Grand Traverse Bay and the increases in ammonia concentrations are unlikely to bring negative impacts to the ecology of the bay.

4.2.2.5 Total Kjeldahl (Organic) Nitrogen

Mean TKN concentrations decreased at all four stations in Grand Traverse Bay between 1998 and 2001 (Figure 50 a-d). Since 2001, mean concentrations have increased or remained relatively constant at all stations. Mean concentrations of TKN were reasonably consistent between stations and were at levels characteristic of oligotrophic lakes.

4.2.2.6 Chlorophyll *a*

There can be significant temporal and spatial variability in chlorophyll *a* concentrations, particularly when optimal light and temperature conditions are present. This was true for Grand Traverse Bay, where there were significant year to year fluctuations in mean chlorophyll *a* concentrations at all four monitoring stations (Figure 51 a-d). However,

levels since 1998 have always been greater than, and in fact nearly double, those measured by Shuey *at al.* (1992), both in the sub-embayments and in the open bay. Mean chlorophyll *a* concentrations were greatest at station 450132 (Figure 51 a), located near the mouth of the Boardman River in the west arm. All mean chlorophyll *a* concentrations measured in Grand Traverse Bay were characteristic of oligotrophic lakes.

4.2.2.7 Temperature and Dissolved Oxygen

The mean DO concentrations and mean temperature measurements at all stations in Grand Traverse Bay varied between 1998 and 2004 (Figure 52 a-d). Year to year variability between mean DO concentrations and mean temperature is not surprising and is normally based on atmospheric conditions prevalent during the sampling period. Variability in Grand Traverse Bay was best explained by the date on which the sample was collected. During 1998, 1999 and 2001, only two samples were collected from each of the four stations in Grand Traverse Bay between April and October (see Appendix B). Between 2002 and 2004, three samples were collected; one in spring, summer and fall. Regardless of temporal temperature and DO fluctuations, DO levels at all four sampling stations over all years indicated well-oxygenated surface waters, ranging from 87 to 107 percent of saturation.

4.2.2.8 Secchi Disck Transparency Depth

Mean secchi disk transparency depth increased at all four stations in Grand Traverse Bay between 1998 and 2004 (Figure 53 a-d). The greatest mean secchi disk

transparency depth was at station 280289, located in the northern portion of the east arm, and the lowest was at station 450132, located near the mouth of the Boardman River in the west arm. The water clarity measured between 1998 and 2004 at all stations is indicative of excellent water quality and oligotrophic conditions.

4.2.3 Conventional Parameter Data, 1998-2004

A range of conventional parameters (calcium, magnesium, sulfate, chloride, silicon, hardness, alkalinity, pH, potassium, sodium, turbidity, specific conductance, dissolved and suspended solids and total organic carbon) were measured from 1998 through 2004, though not all variables were measured in all years. Table 4 lists the years that conventional parameters were measured.

4.2.3.1 Calcium, Magnesium and Sulfate

Although there was some small, yearly variability in concentrations, mean levels of calcium and magnesium have varied little between 1998 and 2004 among all four monitoring stations in Grand Traverse Bay (Figure 54 a-d). There was also no difference in mean concentrations between the four stations since 1998.

Mean concentrations of sulfate in Grand Traverse Bay have also remained relatively constant between 1998 and 2004 (Figure 54 a-d), although there was a slight increase between 1999 and 2002 at all stations. All monitoring stations were characterized by a decrease in mean sulfate concentrations between 2003 and 2004.

4.2.3.2 Total Chloride

Mean concentrations of total chloride increased at all four stations in Grand Traverse Bay between 1998 and 2004 (Figure 55 a-d). The most dramatic increase (9 to 13 mg/L) between 1998 and 2003 was observed at station 280289 (Figure 55 d); however, this mean concentration decreased to 10 mg/L in 2004. Overall, station 280289 had the greatest overall mean concentration of total chloride (10.2 mg/L), although this concentration was not much greater than the overall mean chloride concentration in natural freshwater (8.3 mg/L) reported by Livingstone (1963).

4.2.3.3 Hardness and Alkalinity

Mean values of hardness and alkalinity in Grand Traverse Bay were very consistent at all stations from 1998 through 2004 (Figure 56 a-d), and were typical of lakes in Michigan. There were no significant differences noted between alkalinity and hardness among the four monitored stations.

4.2.3.4 Specific Conductance

An examination of the mean field- and laboratory-measured specific conductance of Grand Traverse Bay from 1998 through 2004 (Figures 57 a-d and 58 a-d, respectively) demonstrated values that were typical of hard water lakes in Michigan. Values in Grand Traverse Bay varied little both spatially and temporally between 1998 and 2004.

4.2.3.5 Dissolved and Suspended Solids

Mean concentrations of dissolved solids (Figure 59 a-d) in Grand Traverse Bay from 1998 through 2004 were typical of other regional lakes, almost always between 180 and 190 mg/L. Mean concentrations of dissolved solids varied very little both spatially and temporally. Suspended solids concentrations in Grand Traverse Bay were near or below quantification limits for all samples (see Appendix B), indicating that Grand Traverse Bay is an oligotrophic water body.

4.2.3.6 Total Organic Carbon

Mean TOC concentrations in Grand Traverse Bay ranged from approximately 1.9 - 2.7 mg/L. Over the sampling period, mean concentrations of TOC generally decreased at stations 450132 and 280288, and remained relatively constant at stations 450133 and 280289 (Figure 60 a-d). There was an increase in mean TOC concentrations at all stations between 2003 and 2004, and there was no dramatic difference in mean TOC concentrations between the four stations in Grand Traverse Bay.

4.2.3.7 pH

Mean field and laboratory pH values measured in Grand Traverse Bay were relatively constant between 1998 and 2004 at all stations (Figures 61 a-d and 62 a-d, respectively). Mean field pH values decreased slightly between 1998 and 1999 and between 2003 and 2004 at all stations; however, there was little change in laboratory pH during these same time periods. Mean field pH values ranged between 7.5 and 8.2,

while mean laboratory pH values ranged between 8.2 and 8.4. Overall, pH values measured in Grand Traverse Bay were consistent with those measured in regional lakes.

4.2.3.8 Potassium and Sodium

Mean concentrations of potassium were relatively constant between 2001 and 2004 at all stations in Grand Traverse Bay (Figure 63 a-d), and ranged between 1.2 and 1.6 mg/L. Mean concentrations were least variable at station 450133 and most variable at station 280289. There was little difference in concentrations between stations across sampling years.

Mean sodium concentrations measured in Grand Traverse Bay have ranged between 5.0 and 6.3 mg/L. Mean concentrations have increased at all stations between 2001 and 2004 (64 a-d); however, only four years of data are available. There was little difference in mean sodium concentrations between the four stations across sampling years

4.2.3.9 Turbidity

Turbidity values measured in Grand Traverse Bay between 1998 and 2004 were below quantification levels in virtually all samples. These data indicate that Grand Traverse Bay is an oligotrophic water body. Turbidity data for Grand Traverse Bay are provided in Appendix B for completeness.

4.2.4 Trace Metals and Mercury Data, 1998 - 2004

Monitoring of trace metals was conducted from 1998 through 2004 at four locations in Grand Traverse Bay. As was done for Saginaw Bay, concentrations of trace metals and Hg were compared to applicable Michigan Rule 57 water quality values. Table 12 summarizes the trace metals and Hg data from all four sampling stations in Grand Traverse Bay, and Table 7 presents applicable Rule 57 water quality values for each parameter.

4.2.4.1 Cadmium, Chromium and Lead

Mean concentrations of Cd, Cr and Pb were normally below quantification limits in 1998 (Table 12). Between 1999 and 2004, mean concentrations of Cd and Pb were above quantification limits, but were very low (Figure 65 a-d). In contrast, mean Cr concentrations fluctuated more markedly during this period (Figure 65 a-d). There were, however, no significant differences in mean Cd, Cr and Pb concentrations between the four stations in Grand Traverse Bay over time, and all mean concentrations met applicable Rule 57 water quality values during all years (Tables 7 and 10).

4.2.4.2 Copper, Nickel and Zinc

Mean Zn concentrations were generally below quantification limits in 1998, but were above quantification limits beginning in 1999, and have increased at all stations between 1999 and 2004 (Figure 66 a-d). Mean Zn levels increased most dramatically between 2003 and 2004 at all stations (Figure 66 a-d). Mean concentrations of Cu have been

consistent between 1998 and 2004 at all stations, while mean Ni concentrations decreased between 1998 and 2004 at all stations (Figure 66 a-d). There were no noteable differences in mean Cu, Ni and Zn concentrations among the four stations between 1998 and 2004. All mean concentrations of these three trace metals met applicable Rule 57 water quality values during all years (Tables 7 and 10).

4.2.4.3 "Bay-wide" Average of Trace Metals

Trace metals concentrations were calculated as a "Bay-wide" average by year to examine overall qualitative trends. Examination of mean Cd concentrations indicated little change between 1998 and 2004 (Figure 67 a). "Bay-wide" concentrations of all other trace metals have decreased between 1998 and 2004, with the exception of Zn, which had a notable increase between 2003 and 2004 (Figure 67 b).

All mean concentrations of all trace metals met the applicable Rule 57 water quality values adjusted for hardness (using the highest observed hardness value among all samples).

4.2.4.4 Mercury

Mean concentrations of Hg in Grand Traverse Bay were relatively low at all stations in 1998, whereas in 1999, mean concentrations were at the highest levels recorded between 1998 and 2004 (Figure 68 a-d). Between 2000 and 2001, mean concentrations decreased at all stations except 450133 (Figure 68 b). Since 2001, mean concentrations of Hg have remained relatively constant at all stations. There was no

noteable difference in mean Hg concentrations between the four sampling stations from 1998 through 2004. Mean Hg concentrations met the Rule 57 water quality value of 1.3 ng/L on all occasions, except at stations 450133 and 280288 in 1999 (Tables 7 and 12).

Hg concentrations were calculated as a "Bay-wide" average by year to examine the overall qualitative trend. Average Hg concentrations exceeded the Michigan Rule 57 water quality value of 1.3 ng/L in 1999, and met this water quality value during all other years (Figure 69). Mean concentrations of Hg have remained relatively constant in Grand Traverse Bay between 2000 and 2004. Just as with the Saginaw Bay Hg data, the 1999 Grand Traverse Bay data were relatively variable.

4.2.5 Base /Neutral Organics and Volatile Organics Data, 1999 – 2004

4.2.5.1 Base/Neutral Organics

Nearly all base/neutral organics samples collected in Grand Traverse Bay between 1999 and 2004 have been below quantification limits. In 2002, Bis(2-ethylhexyl)phthalate was detected at stations 280288 (2.9 μg/L) and 280289 (4 μg/L). In 2004, Diethyl phthalate (ranging from 0.22 - 0.25 μg/L) and Di-n-butyl phthalate (ranging from 2.2 - 7.1 μg/L) were detected at all four stations. All of these concentrations met applicable Rule 57 water quality values (see Table 9).

4.2.5.2 Volatile Organics

Volatile organic compounds were below quantification limits between 1999 and 2004 at

all stations in Grand Traverse Bay, and met applicable Rule 57 water quality values.

4.2.6 Total Cyanide Data

Total CN concentrations were below quantification limits, and therefore met the CN Rule 57 water quality value of 0.0052 mg/L, in nearly all samples collected from Grand Traverse Bay between 2001 and 2004. In 2004, total CN was detected at station 280288 at 0.009 mg/L. This concentration may have exceeded the Rule 57 water quality value (which is based on free CN), although a definitive determination cannot be made from these data.

4.2.7 Sediment Quality Data

Total phosphorus concentrations in the sediments collected in Grand Traverse Bay during July 2002 were not exceptionally elevated (Table 11), and concentrations were comparable to what would be expected in similar water bodies. A separate study completed between 1994 and 1998 (GLEC 1998) indicated that total phosphorus concentrations in sediment collected from Omena Bay (asub-embayment of Grand Traverse Bay) ranged from 8.8 to 485.6 mg/kg dry weight. These concentrations were lower than those observed in this study. Total phosphorus concentrations in sediment were greater at the stations located in the northern portions of the east arm (station 280289) and the west arm (station 450133).

Concentrations of metals in Grand Traverse Bay sediment (Table 11) were all below levels that may cause toxicity to benthic organisms (see MacDonald *et al.* 2000). Just

as with total phosphorus, concentrations of metals in sediment were greater at the sites located in the northern portions of the east and west arms.

4.2.8 Conclusions - Grand Traverse Bay

Based on total phosphorus, chlorophyll *a* and water clarity, Grand Traverse Bay can be classified as an oligotrophic water body with excellent water quality. Concentrations of total phosphorus in Grand Traverse Bay have continued to decline since 1975, which may be explained in part by improvements in wastewater and storm water management, as well as potential nutrient removal by zebra mussel infestations. Since 1998, concentrations of total phosphorus have remained relatively constant and low. Levels of chlorophyll *a* and NO_x have slightly increased, but are still within guidelines for oligotrophic waters. The concentration increases for these two parameters may be related to the increase in human population in the area encompassing the Grand Traverse Bay watershed, and the resulting increases in nutrients via surface water runoff from anthropogenic activities.

Water clarity in Grand Traverse Bay (as measured by Secchi disk transparency depth) increased 30 percent from 1975 to 1997 (Grand Traverse Bay Watershed Initiative 1998), even though chlorophyll a concentrations also increased during this period. Based on annual mean water clarity data from this study, water transparency has continued to increase since 1997. This increase in water clarity in Grand Traverse Bay may be attributed to the establishment of zebra mussels within the bay.

The Rule 57 water quality value for mean Hg was exceeded at stations 450133 and

280288 in 1999. However, the 1998 and 2000 - 2004 monitoring data do not support evidence that high Hg levels are consistently found in Grand Traverse Bay. Continued monitoring will further define this apparent trend. Applicable Rule 57 water quality values were met in all samples for trace metals, base/neutral organics, volatile organics and (with one possible exception) CN.

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FIGURES

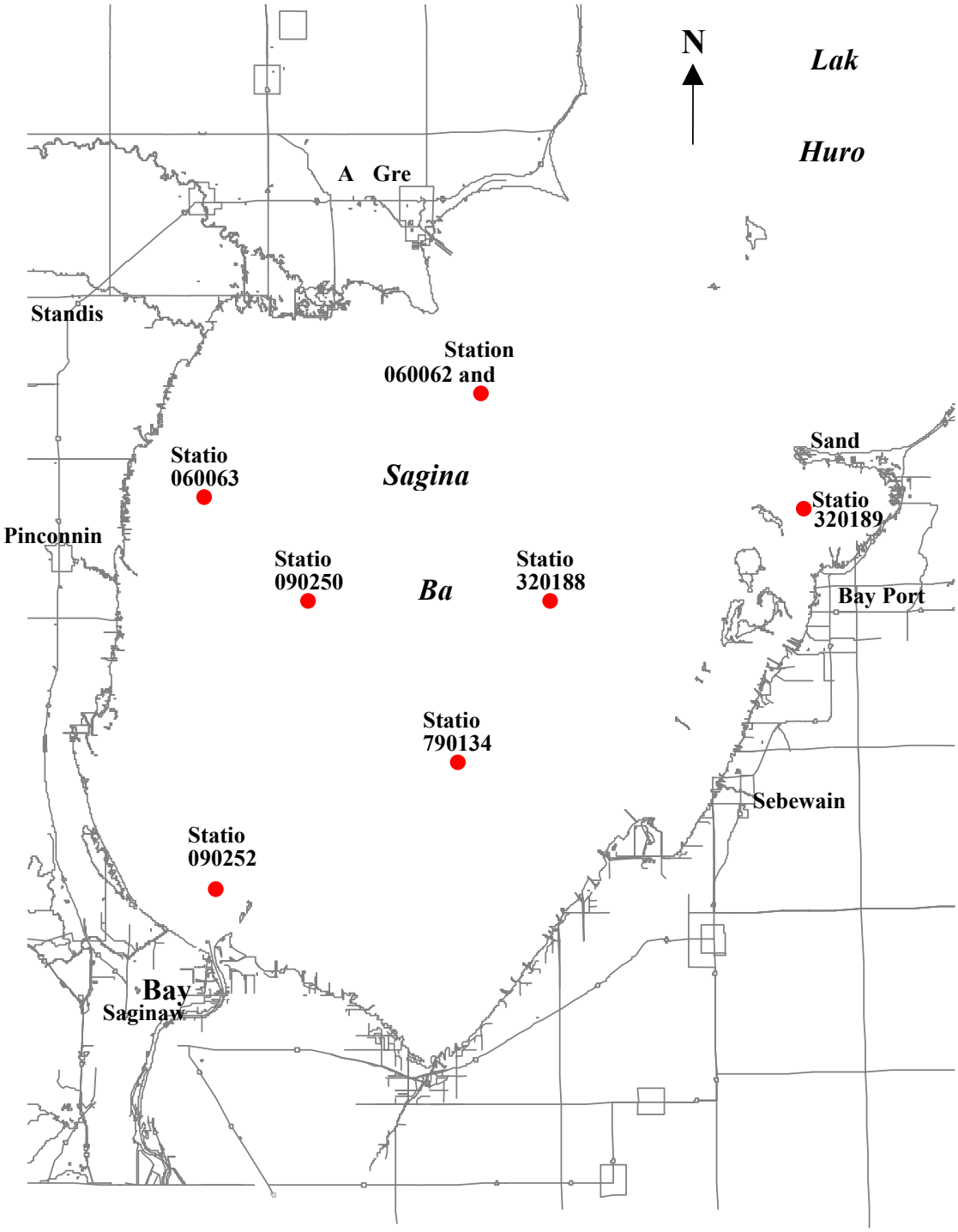


Figure 1. Saginaw Bay Monitoring Stations.

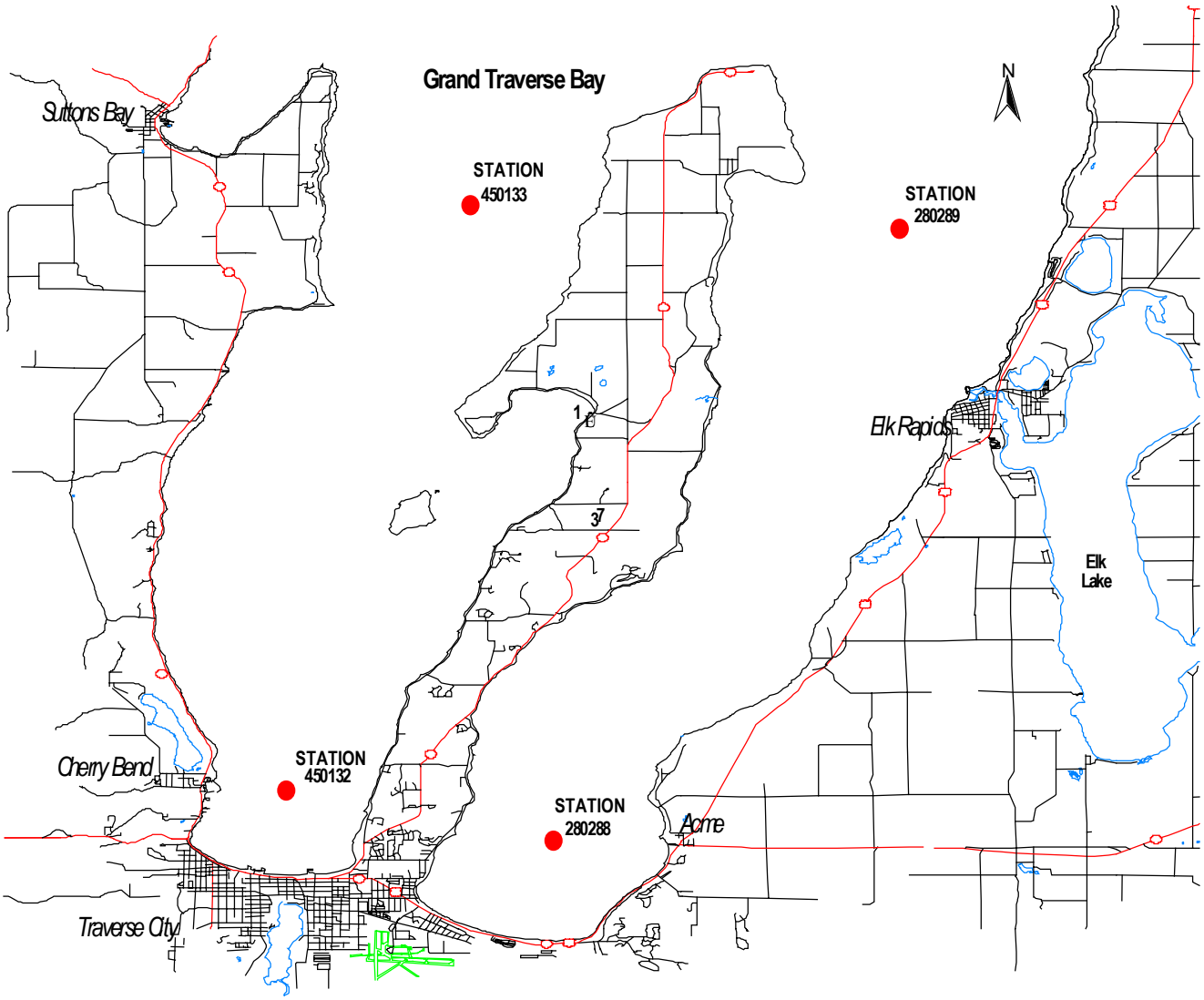


Figure 2. Grand Traverse Bay Monitoring Stations.

FIGURE 3 a-g. SUMMARY OF MEAN TOTAL PHOSPHORUS CONCENTRATIONS AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004) RELATIVE TO THE TARGET TOTAL PHOSPHORUS CONCENTRATION OF 0.015 MG/L (DASHED LINE). VALUES OFF SCALE ARE SHOWN IN ( ).

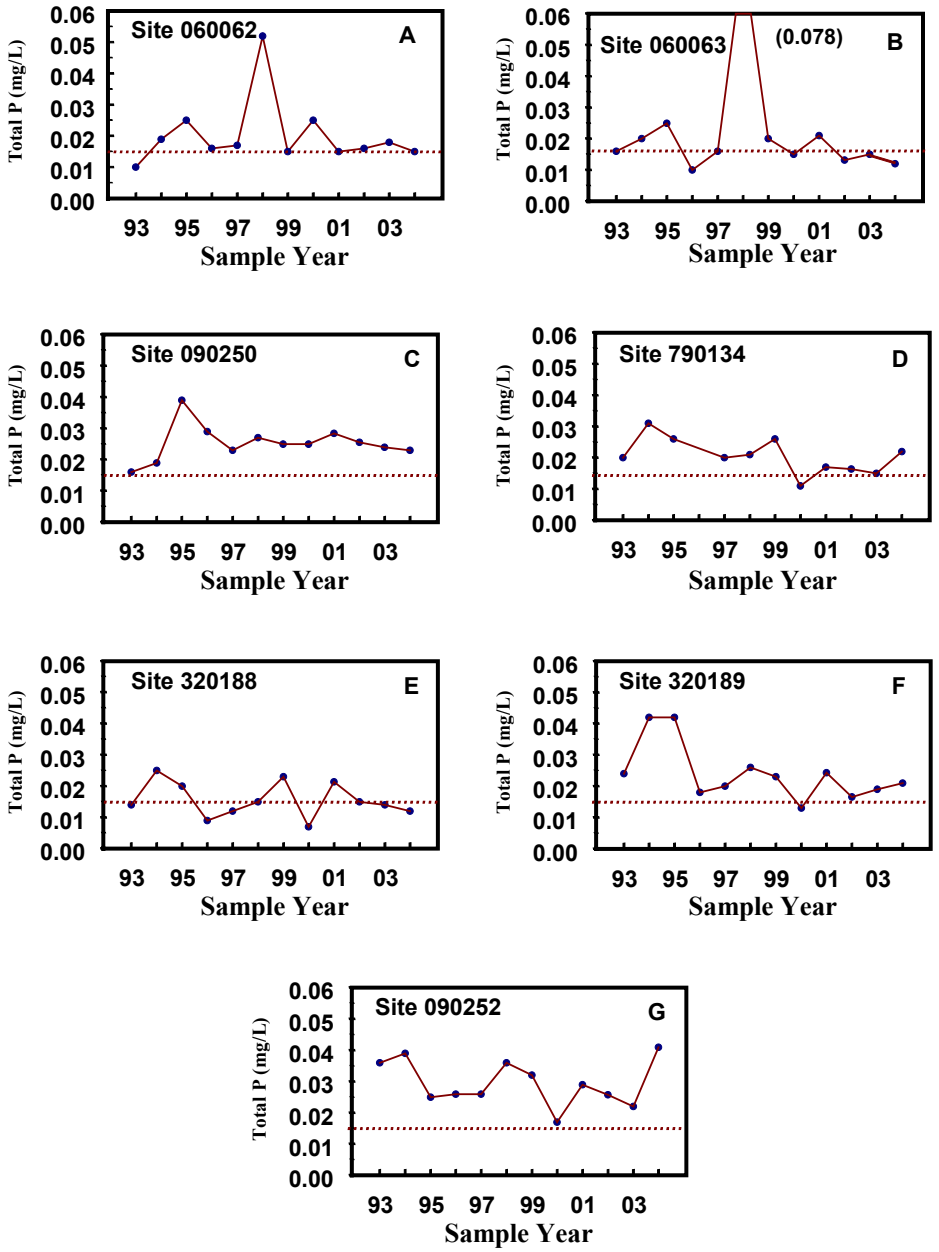


FIGURE 4. BOX PLOT OF SAGINAW BAY TOTAL PHOSPHORUS CONCENTRATIONS, 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.03. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOT (2004 DATA) IS A STATISTICAL OUTLIER.

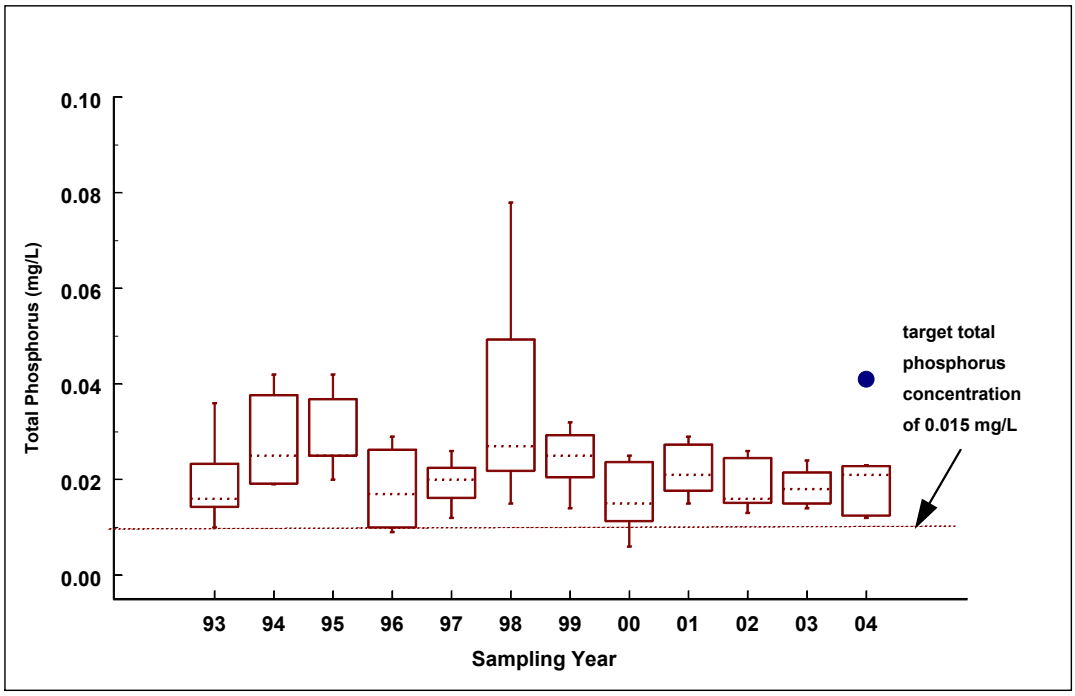


FIGURE 5 a-g. SUMMARY OF MEAN ORTHOPHOSPHATE CONCENTRATIONS AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004).

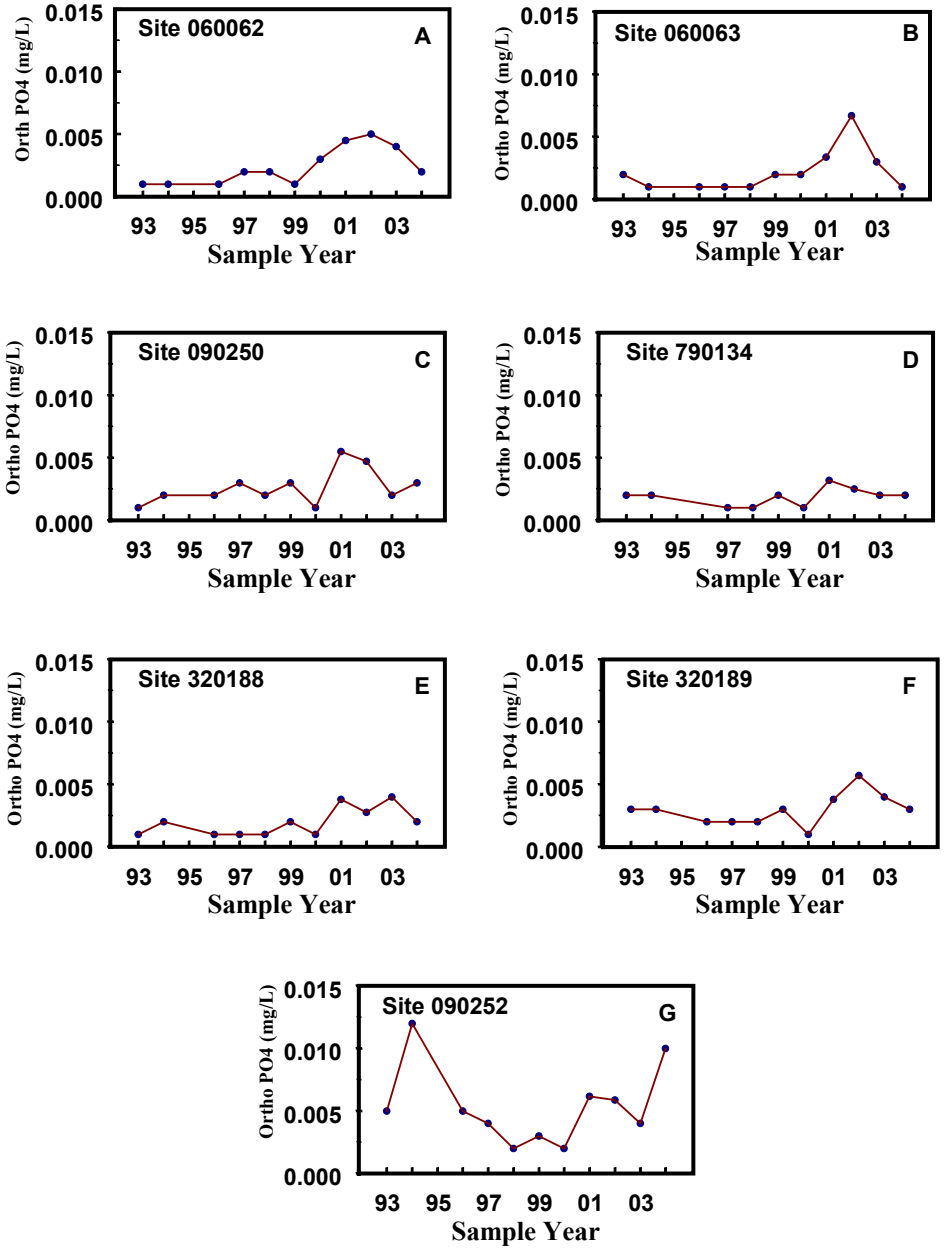


FIGURE 6. BOX PLOT OF SAGINAW BAY ORTHOPHOSPHATE CONCENTRATIONS, 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.04. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOTS ARE STATISTICAL OUTLIERS.

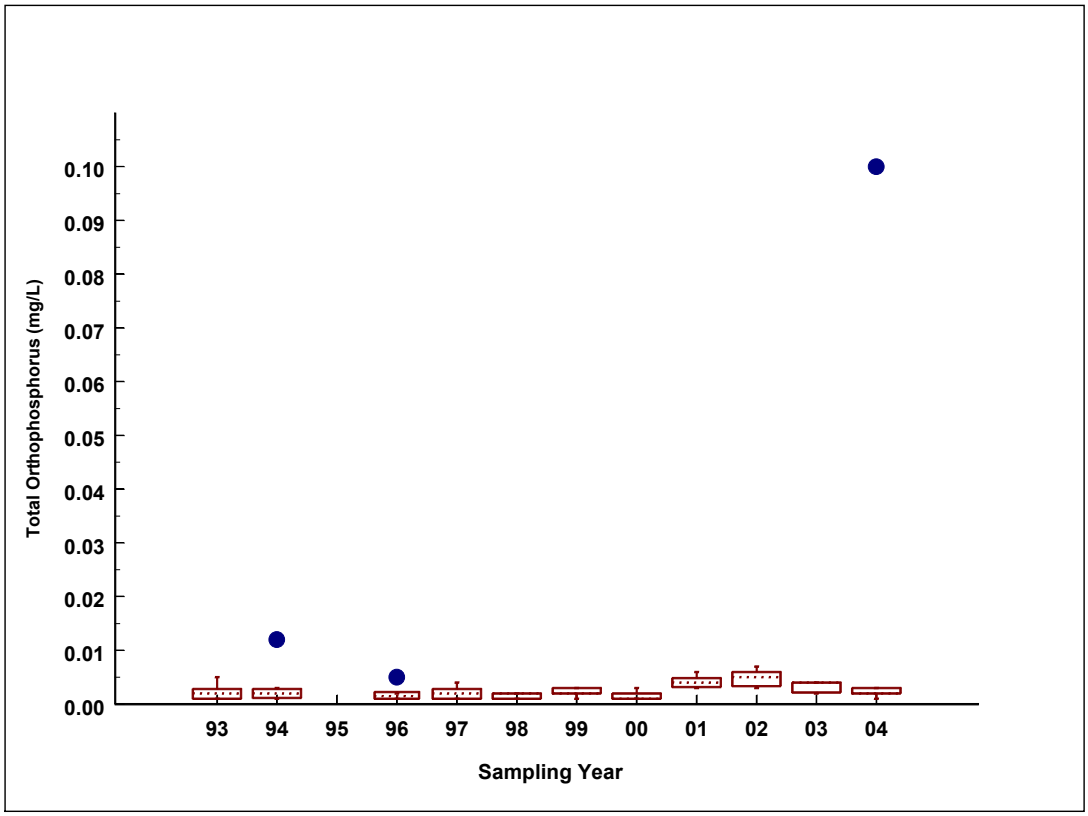


FIGURE 7 a-g. SUMMARY OF MEAN NITRATE + NITRITE AND MEAN AMMONIA CONCENTRATIONS AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004). VALUES OFF SCALE ARE SHOWN IN ( ).

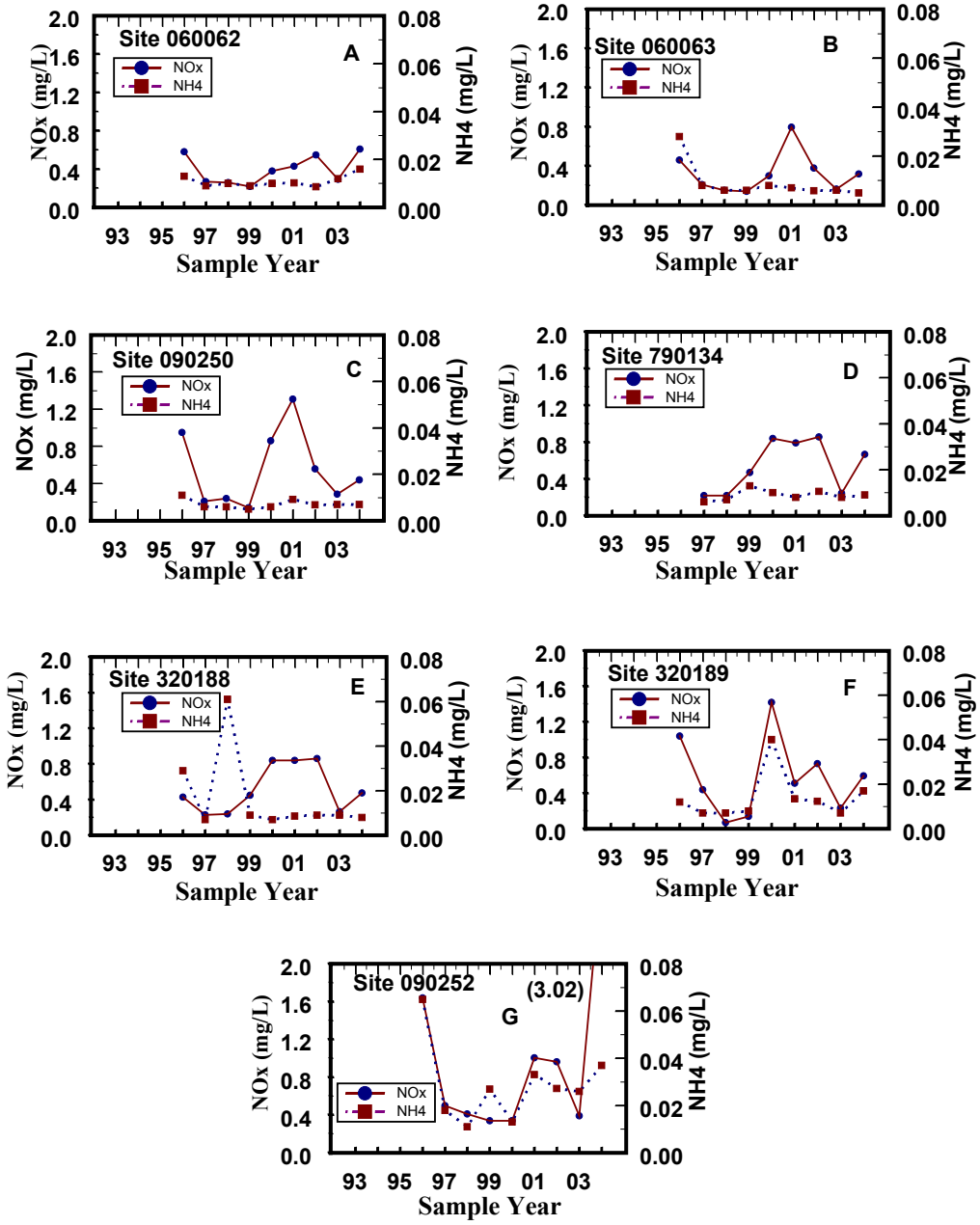


FIGURE 8 a-g. SUMMARY OF MEAN TOTAL KJELDAHL NITROGEN CONCENTRATIONS AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004).

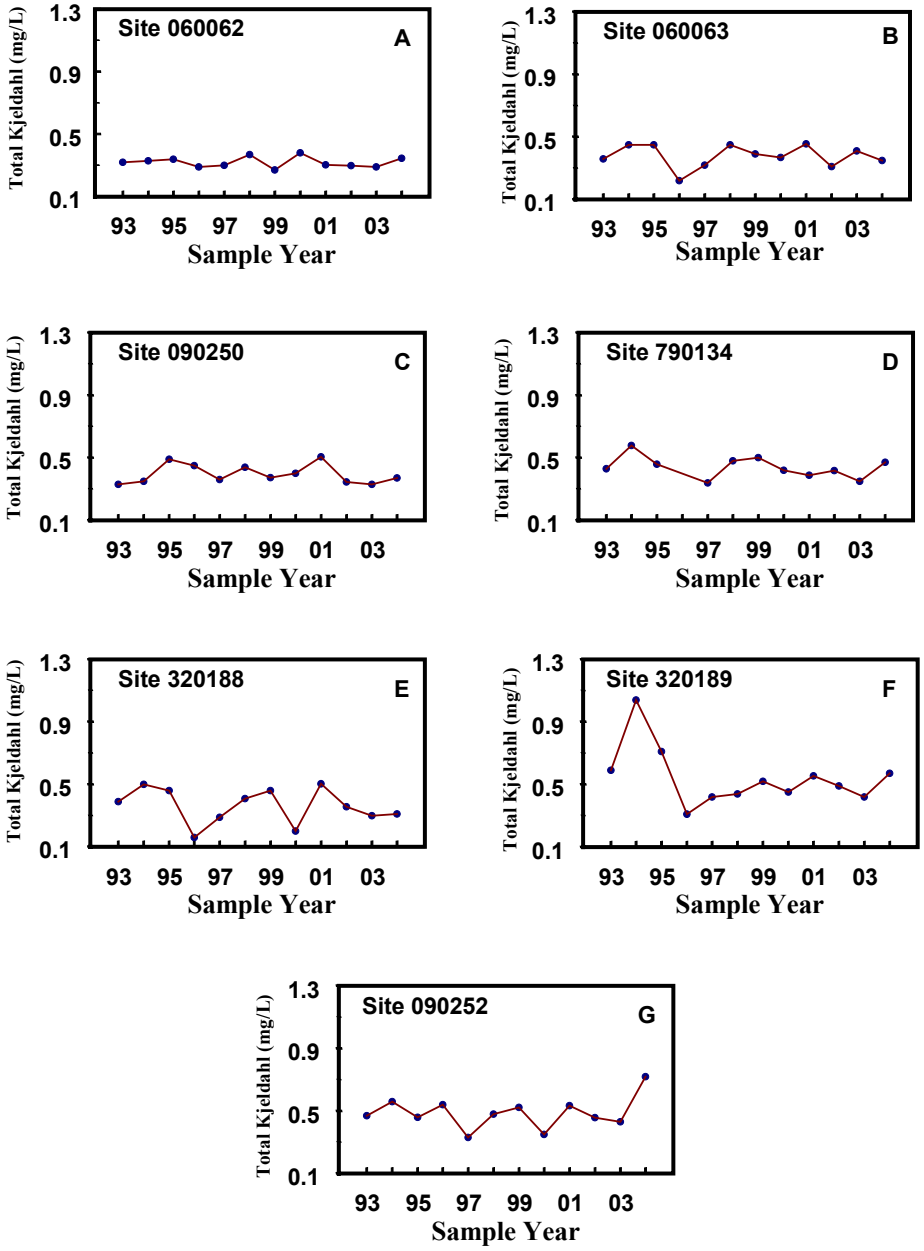


FIGURE 9. BOX PLOT OF SAGINAW BAY TOTAL KJELDAHL NITROGEN CONCENTRATIONS, 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.01. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOTS ARE STATISTICAL OUTLIERS.

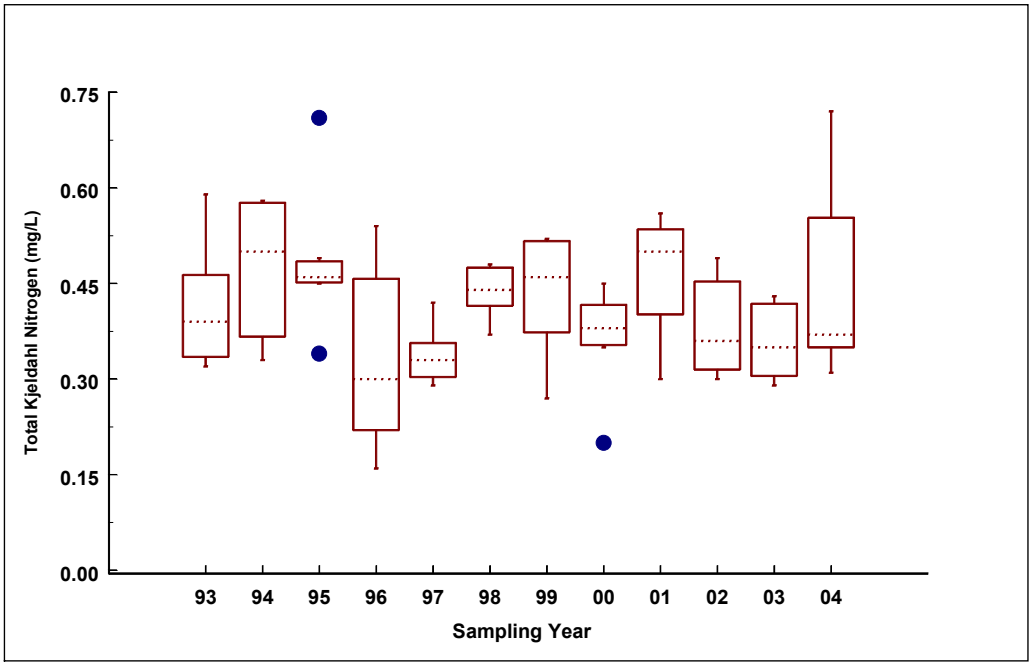


FIGURE 10 a-g. SUMMARY OF MEAN CHLOROPHYLL *a* CONCENTRATIONS AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004).

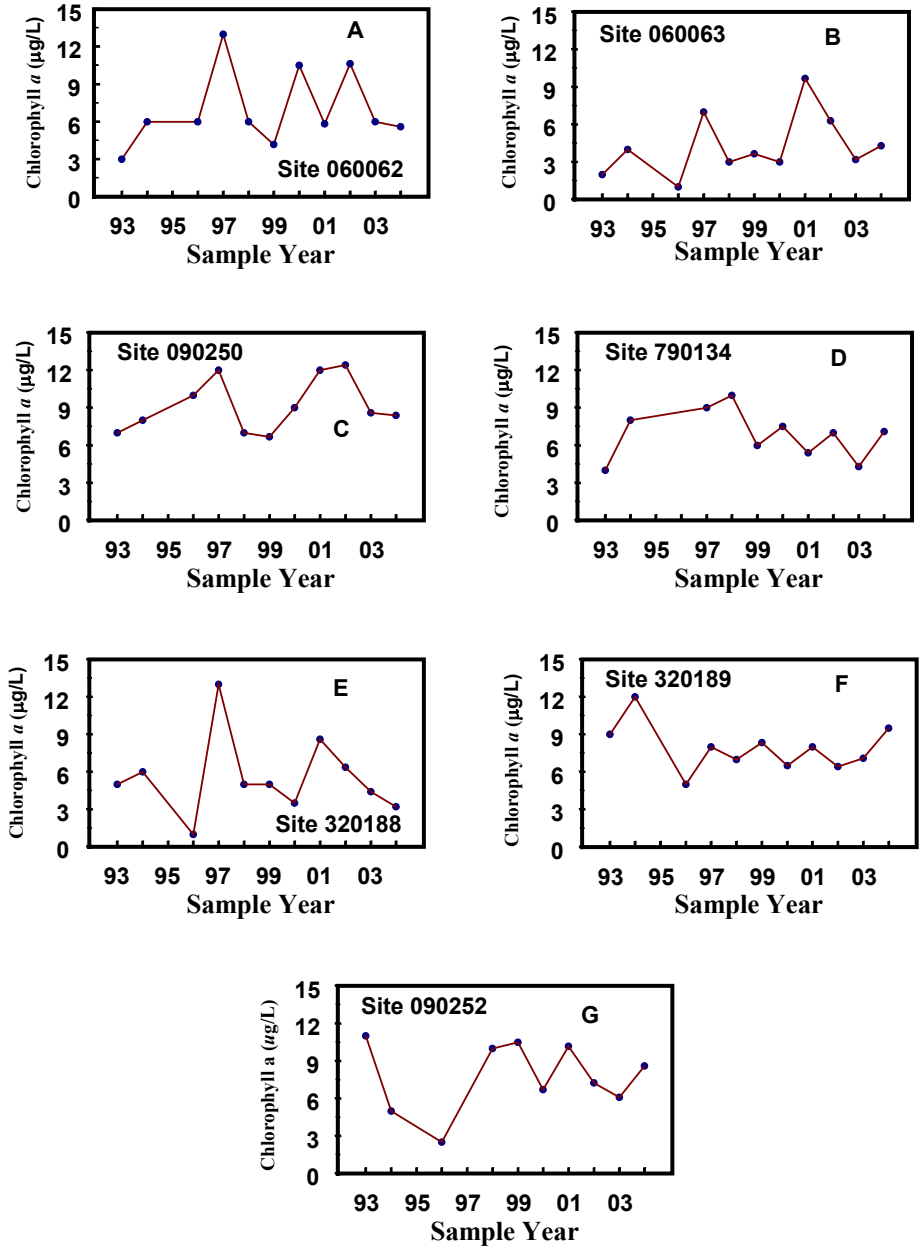


FIGURE 11. BOX PLOT OF SAGINAW BAY CHLOROPHYLL *a* CONCENTRATIONS, 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.01. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA.

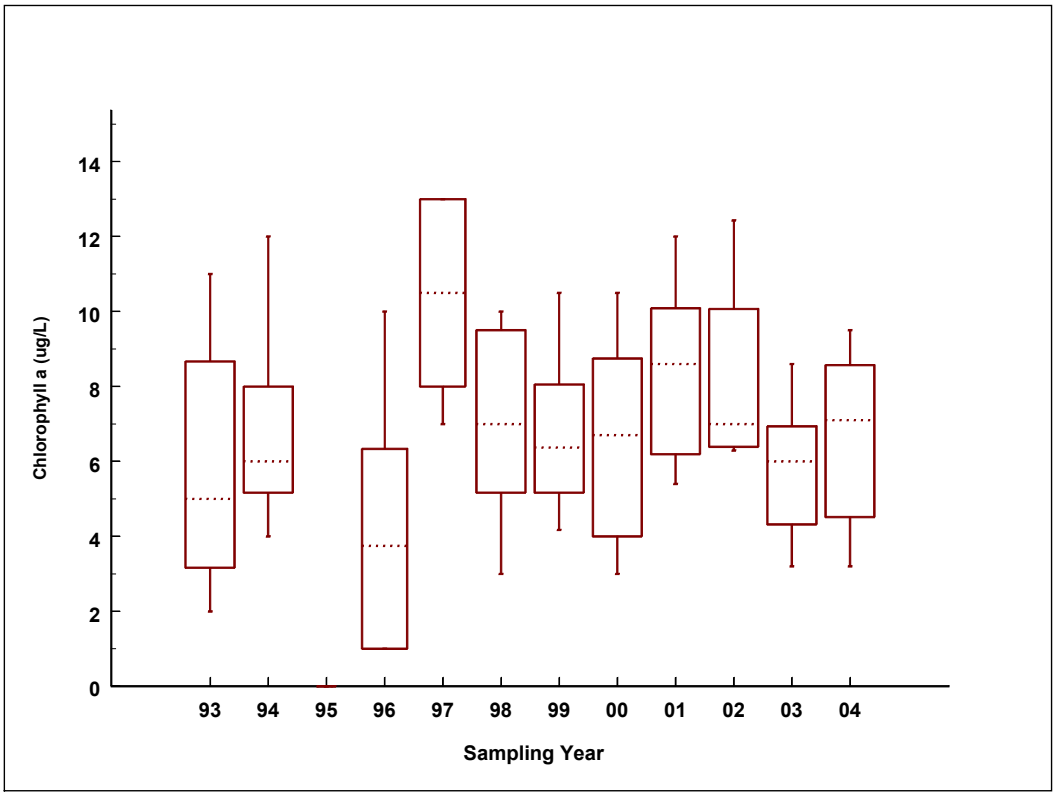


FIGURE 12 a-g. SUMMARY OF MEAN TEMPERATURE MEASUREMENTS AND MEAN DISSOLVED OXYGEN CONCENTRATIONS AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004).

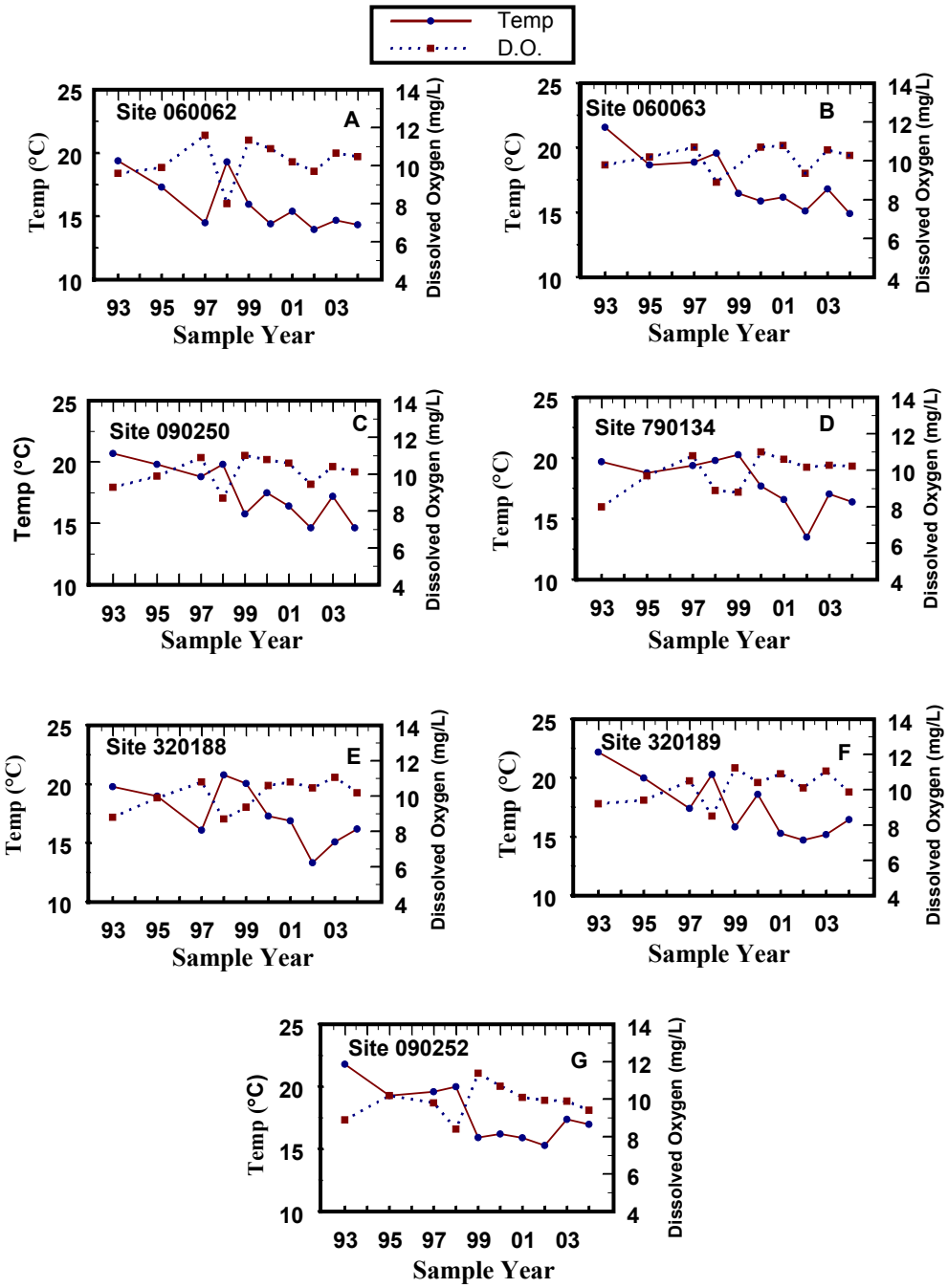


FIGURE 13. BOX PLOT OF SAGINAW BAY DISSOLVED OXYGEN CONCENTRATIONS, 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.12. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOTS ARE STATISTICAL OUTLIERS.

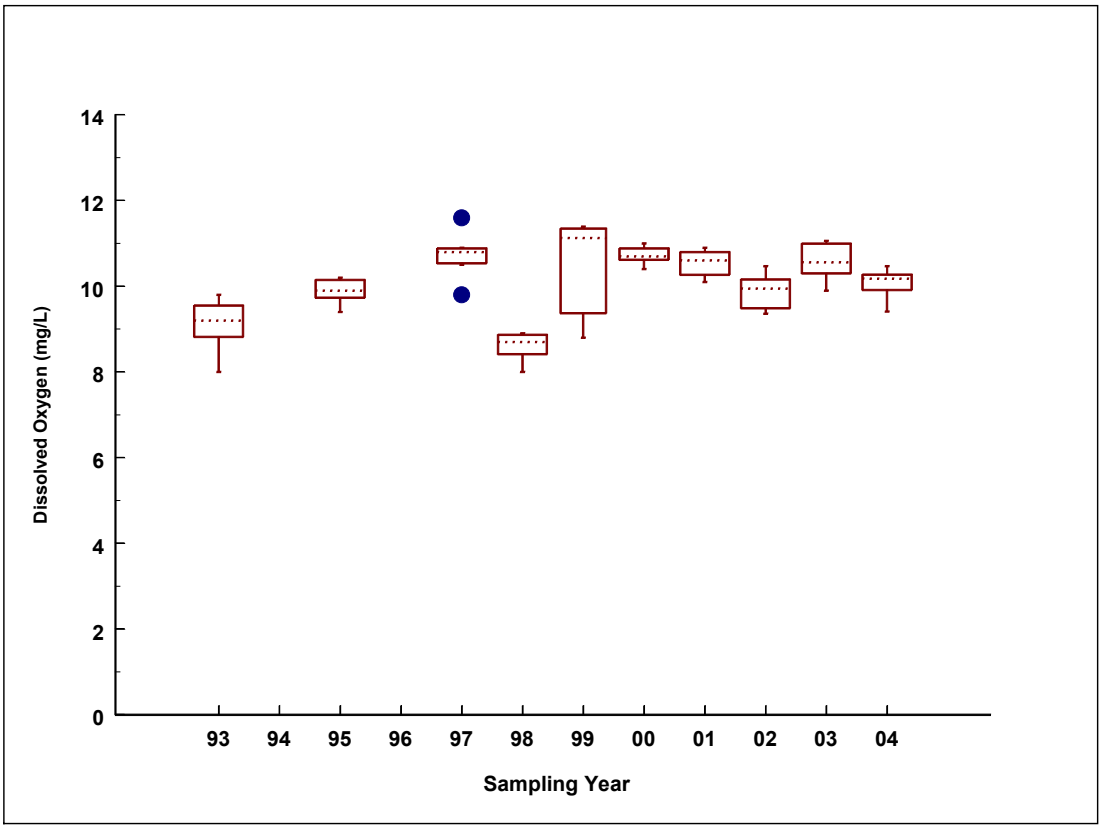


FIGURE 14. BOX PLOT OF SAGINAW BAY WATER TEMPERATURE, 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.55. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA.

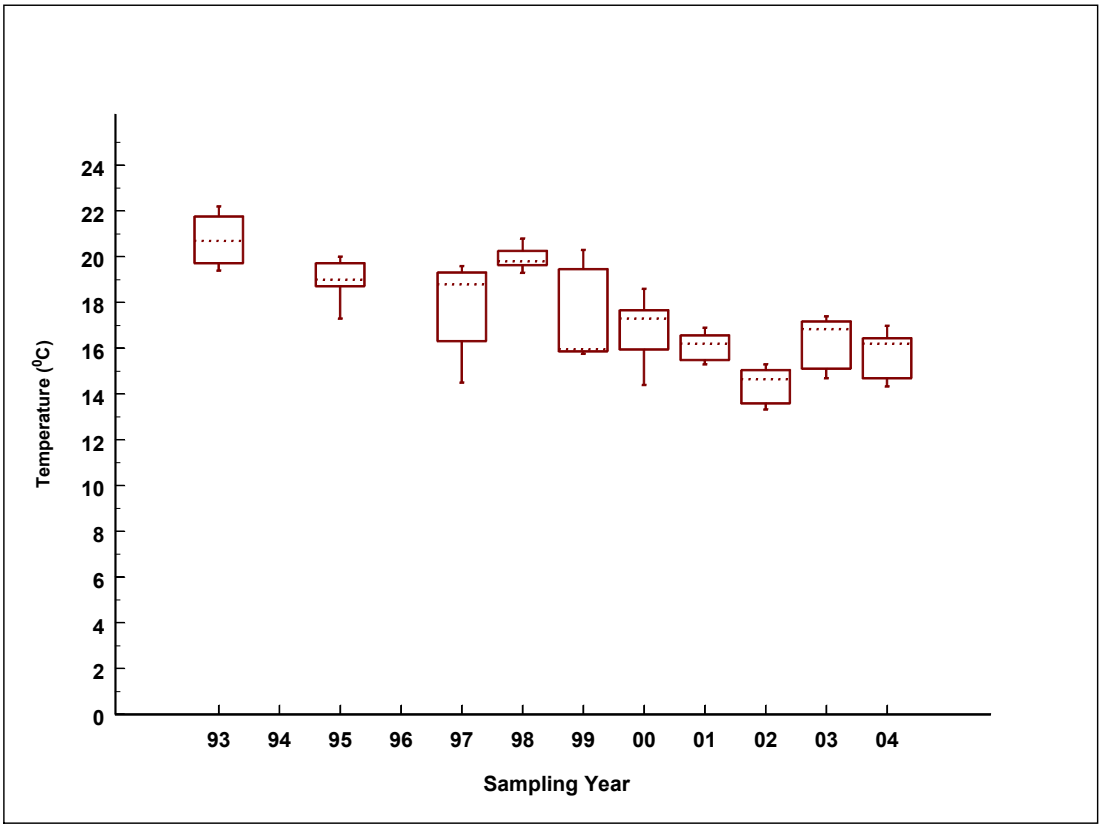


FIGURE 15 a-g. MEAN SECCHI DISK TRANSPARENCY DEPTH AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004).

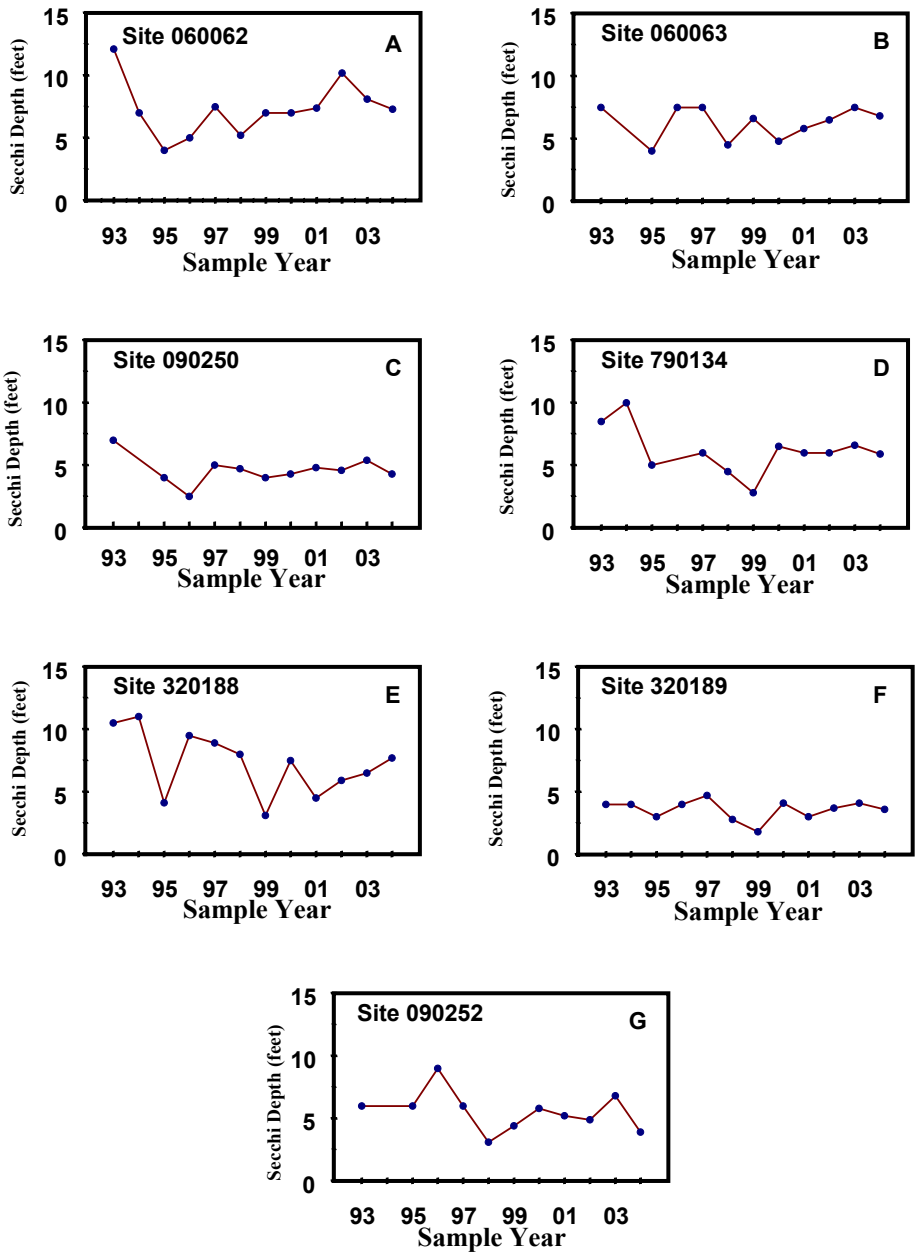


FIGURE 16. BOX PLOT OF SAGINAW BAY SECCHI DISK TRANSPARENCY DEPTH, 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.01. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOTS ARE STATISTICAL OUTLIERS.

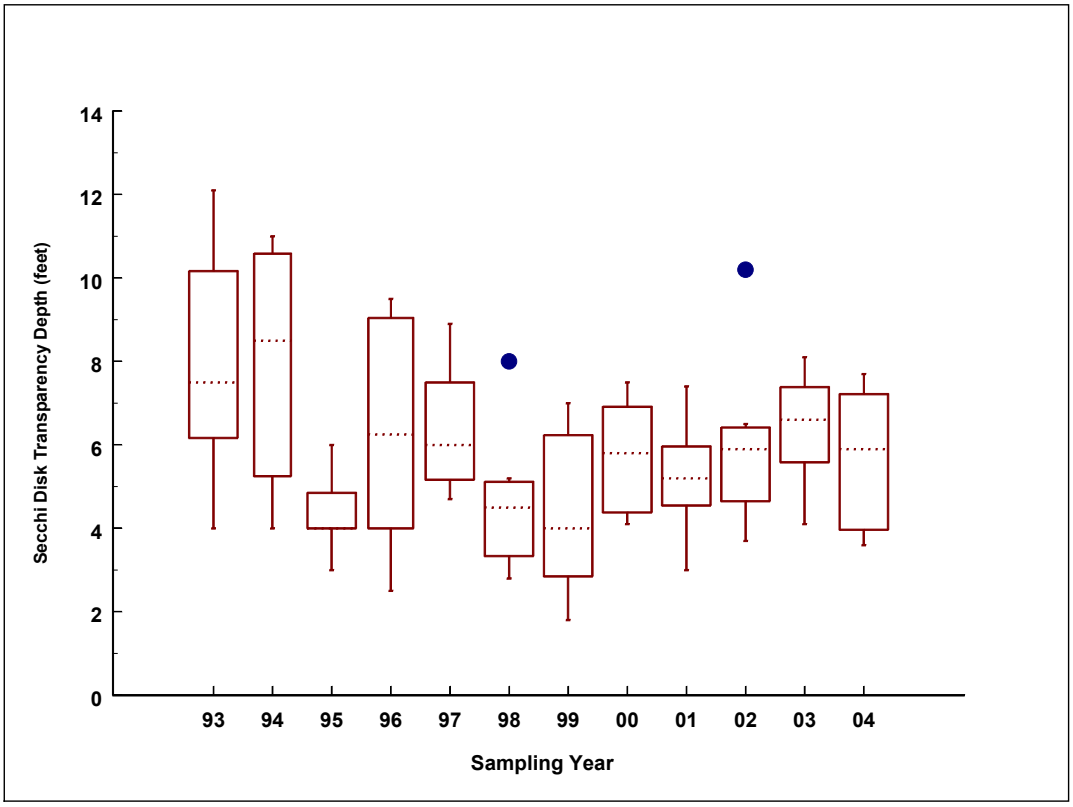


FIGURE 17 a-g. MEAN CALCIUM, MAGNESIUM AND SULFATE CONCENTRATIONS AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004).

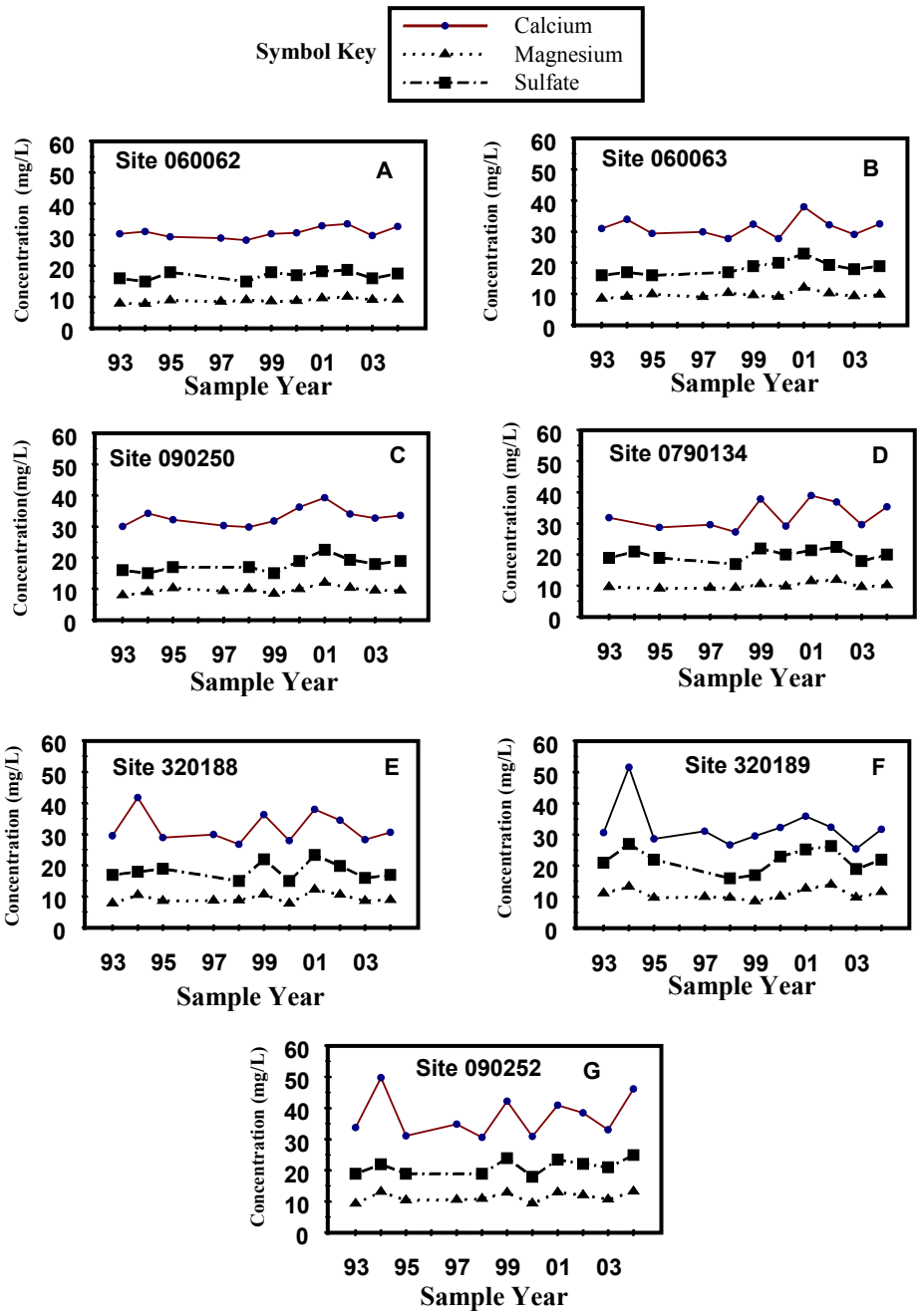


FIGURE 18. BOX PLOT OF SAGINAW BAY CALCIUM CONCENTRATIONS, 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.01. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOTS ARE STATISTICAL OUTLIERS.

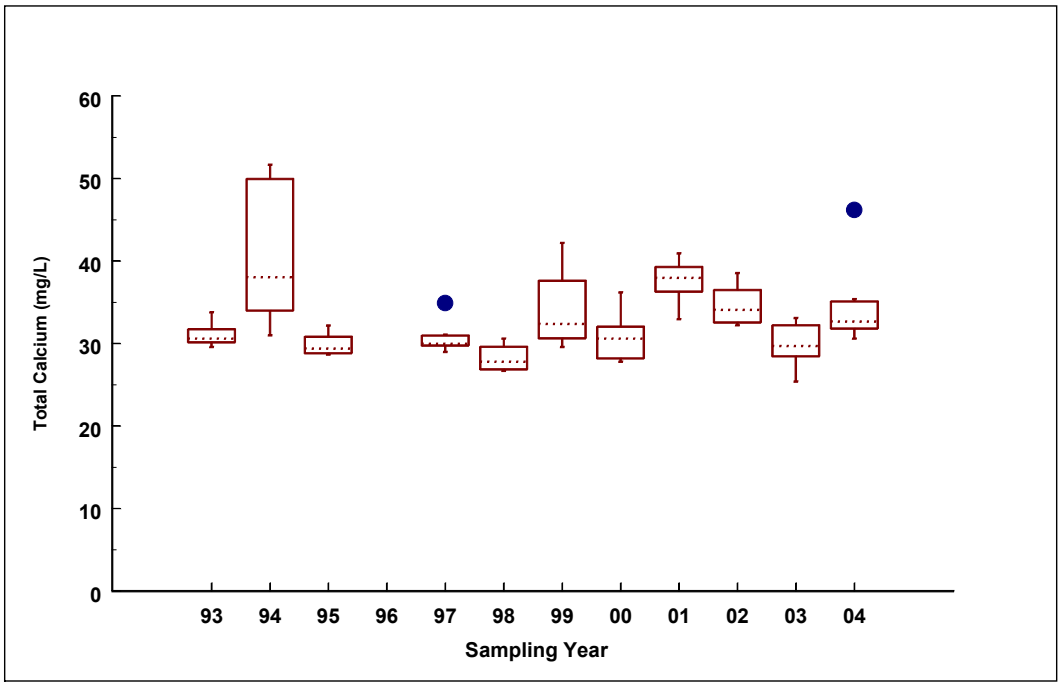


FIGURE 19. BOX PLOT OF SAGINAW BAY MAGNESIUM CONCENTRATIONS, 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.10. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOT IS A STATISTICAL OUTLIER.

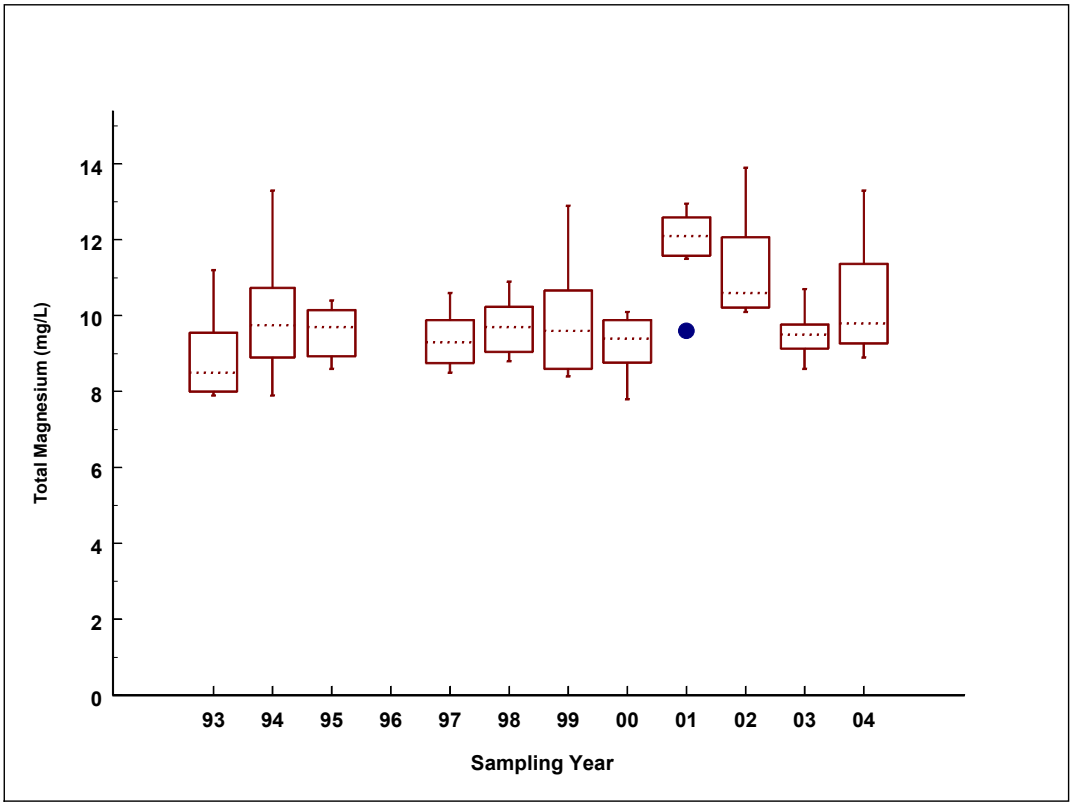


FIGURE 20. BOX PLOT OF SAGINAW BAY SULFATE CONCENTRATIONS, 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.06. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOTS ARE STATISTICAL OUTLIERS.

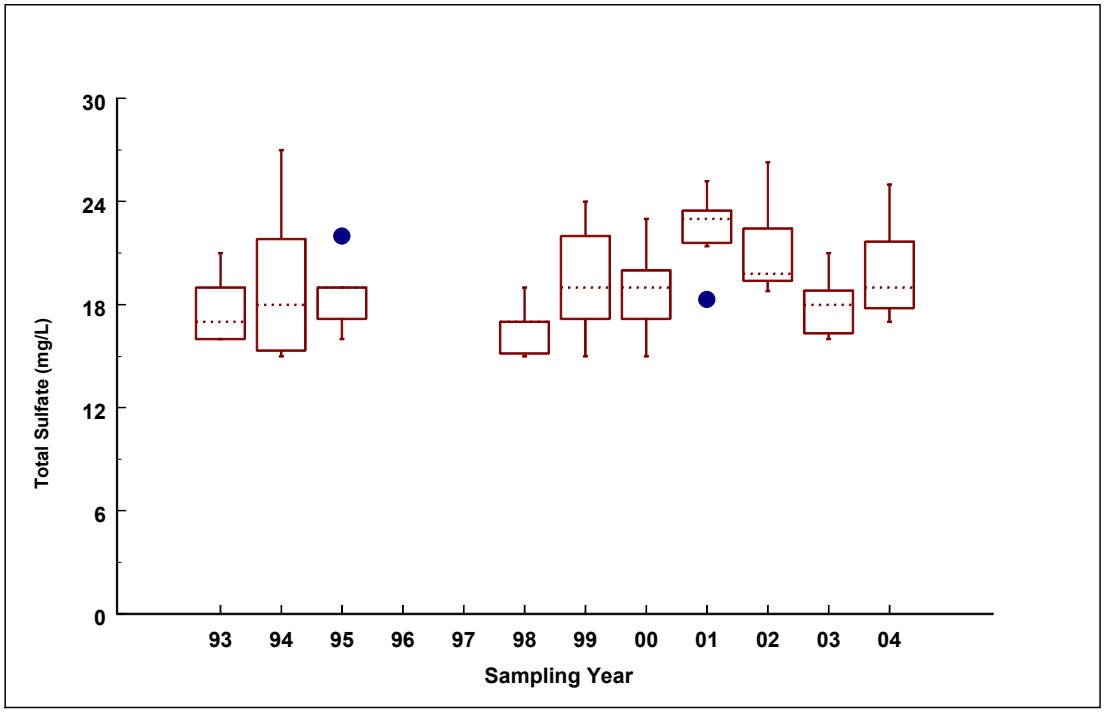


FIGURE 21 a-g. MEAN TOTAL CHLORIDE CONCENTRATIONS AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004). VALUES OFF SCALE ARE SHOWN IN ().

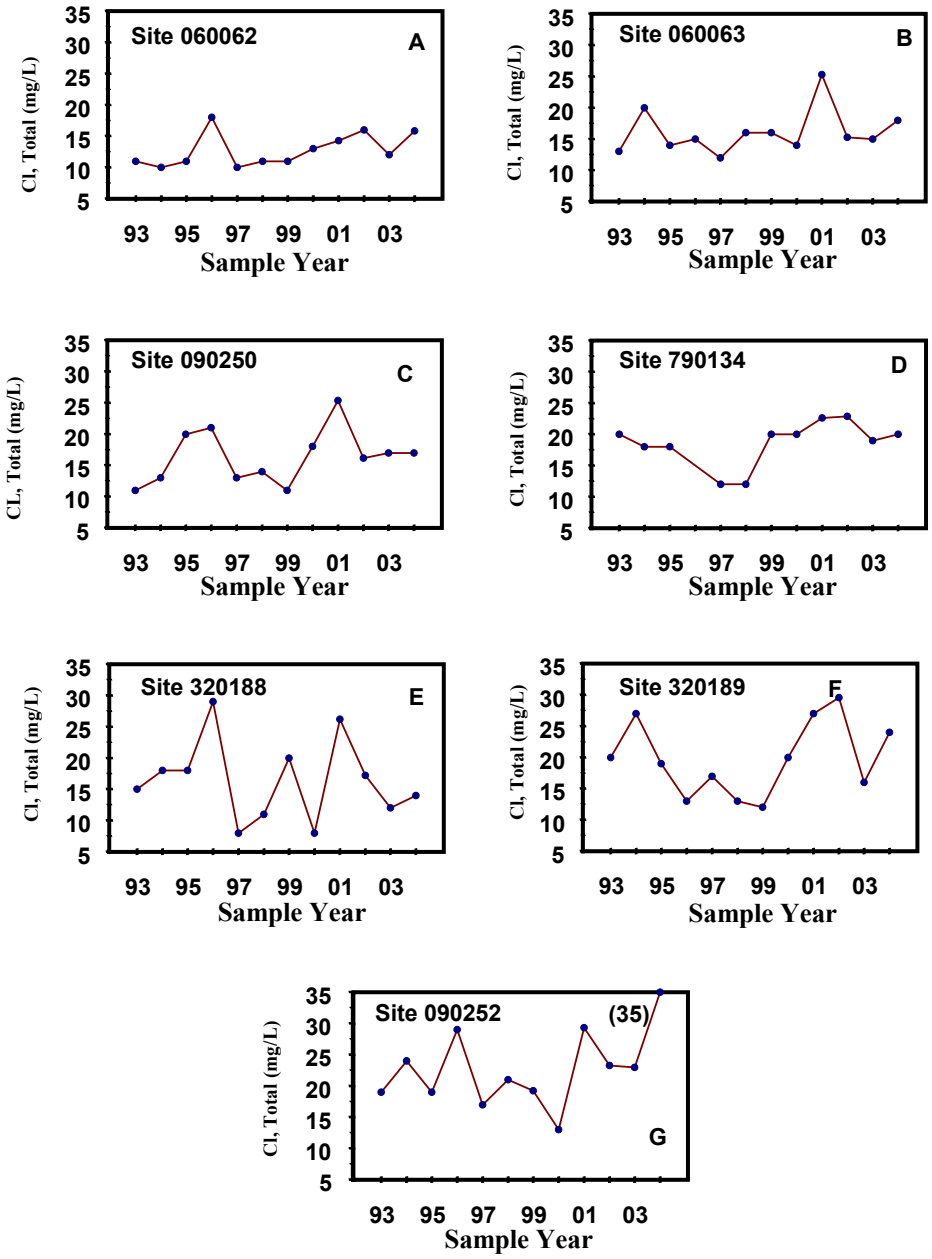


FIGURE 22. BOX PLOT OF SAGINAW BAY CHLORIDE CONCENTRATIONS, 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.03. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOTS ARE STATISTICAL OUTLIERS.

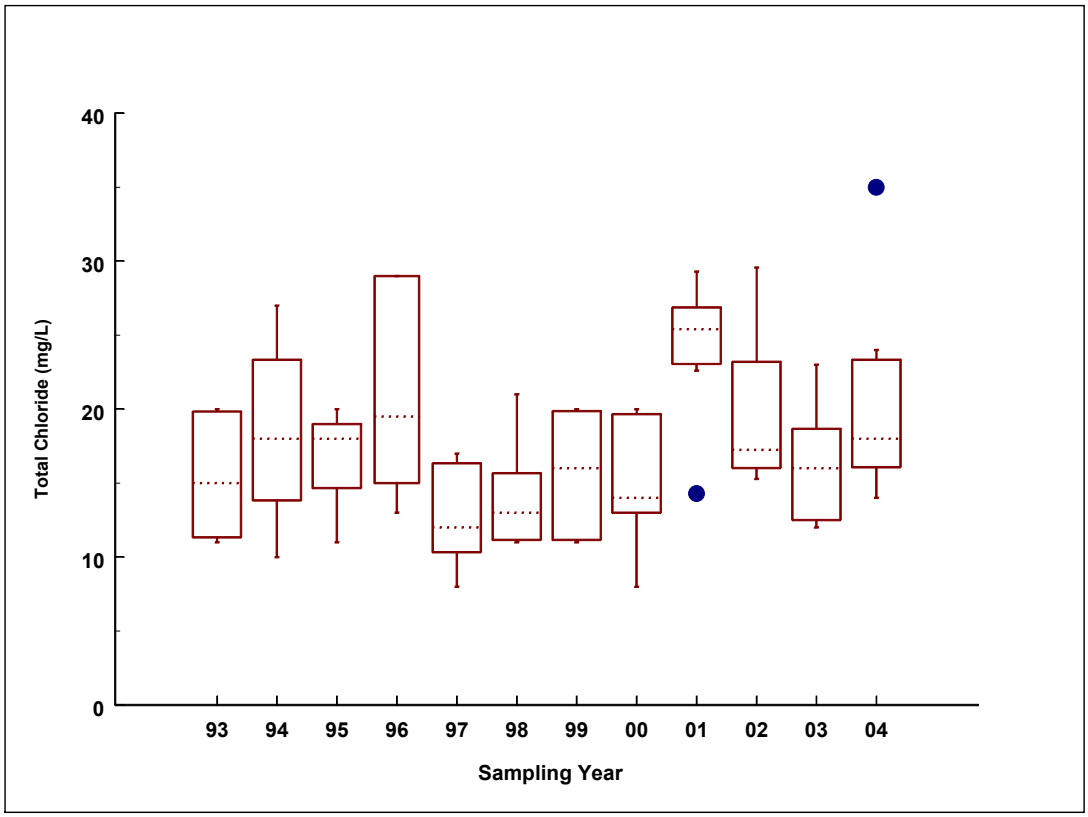


FIGURE 23 a-g. MEAN SILICON CONCENTRATIONS AT SEVEN LOCATIONS IN SAGINAW BAY (1993-1997).

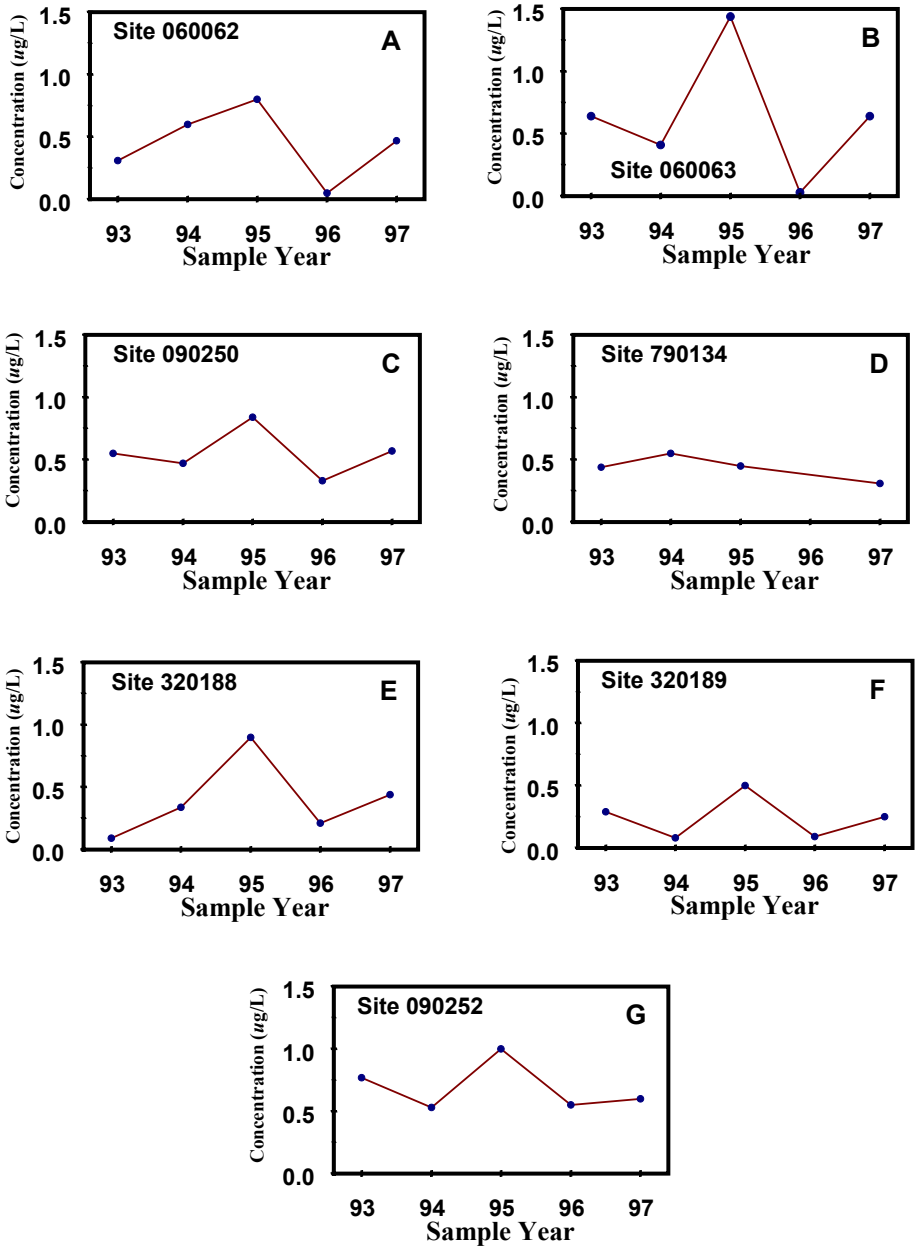


FIGURE 24 a-g. MEAN ALKALINITY AND HARDNESS AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004). ALKALINITY WAS NOT ANALYZED FROM 1998-2000.

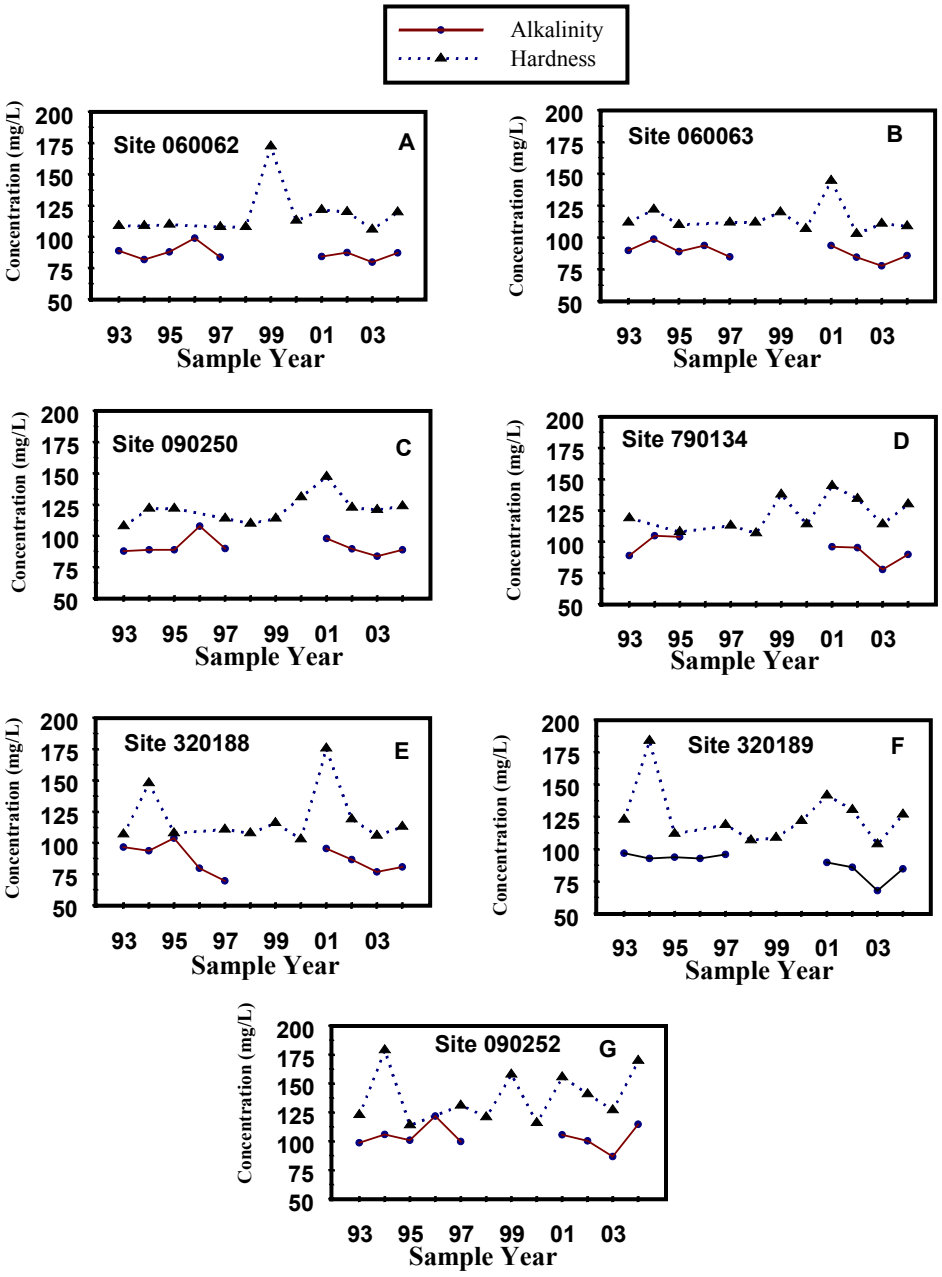


FIGURE 25. BOX PLOT OF SAGINAW BAY HARDNESS, 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.01. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOTS ARE STATISTICAL OUTLIERS.

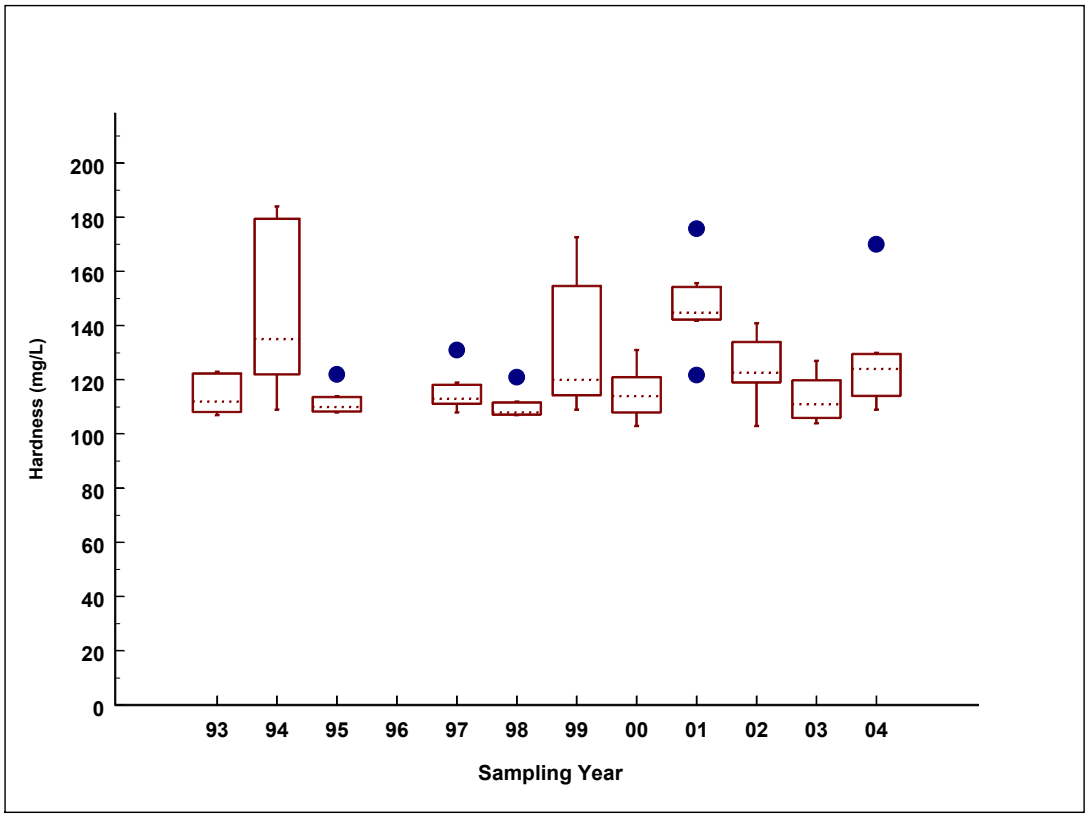


FIGURE 26 a-g. MEAN SPECIFIC CONDUCTANCE (FIELD) AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004).

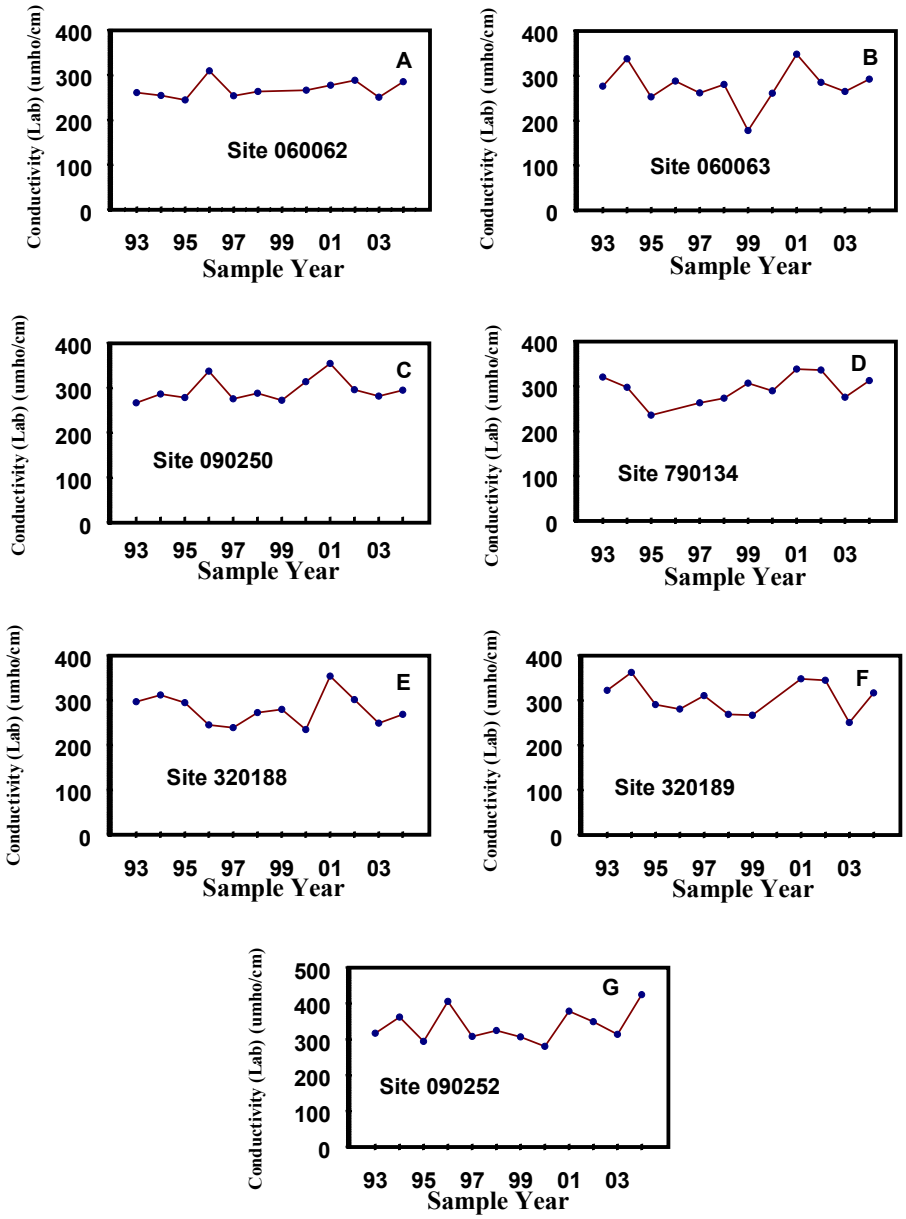


FIGURE 27 a-g. MEAN SPECIFIC CONDUCTANCE (LAB) AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004).

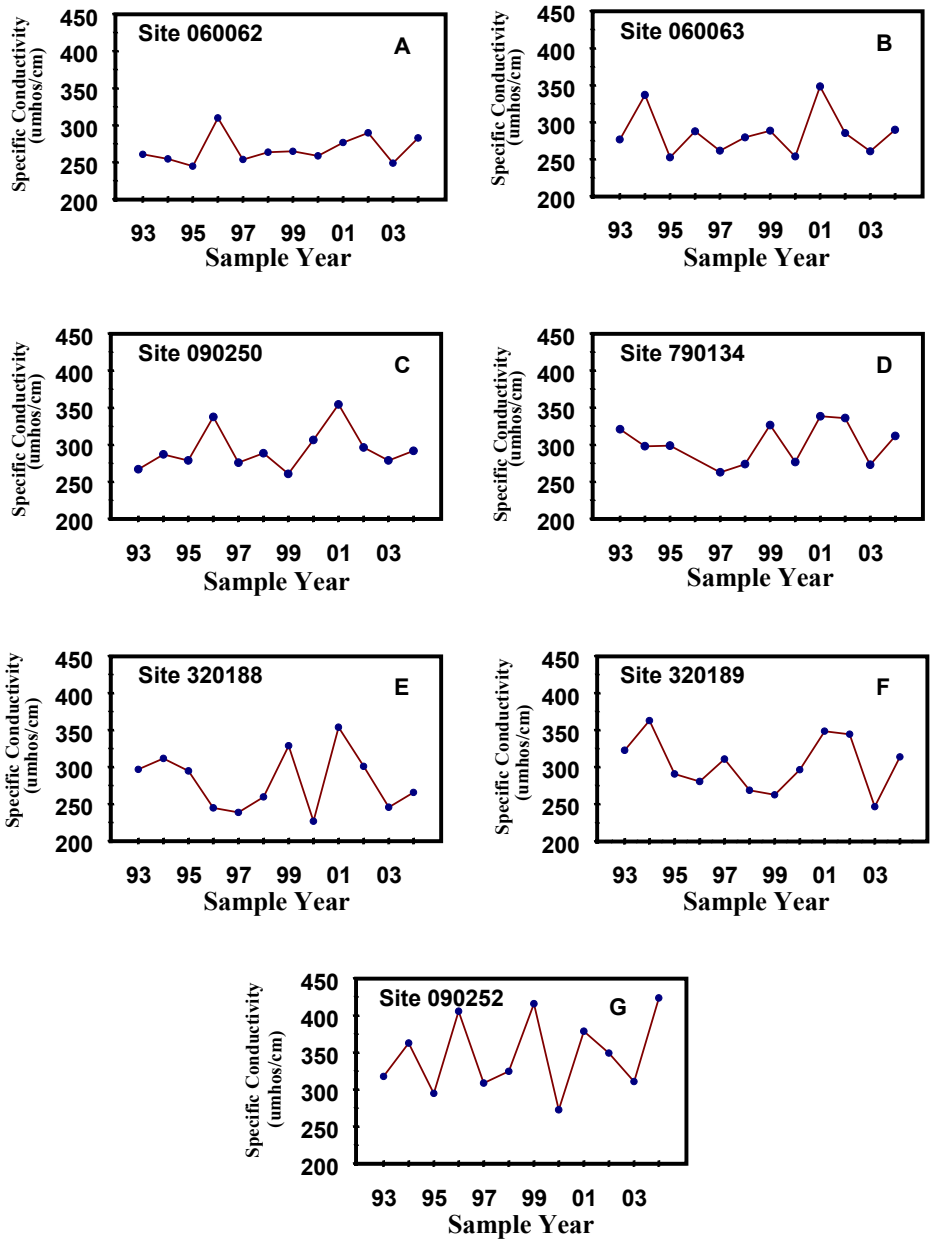


FIGURE 28. BOX PLOT OF SAGINAW BAY CONDUCTIVITY (FIELD), 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.01. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOTS ARE STATISTICAL OUTLIERS.

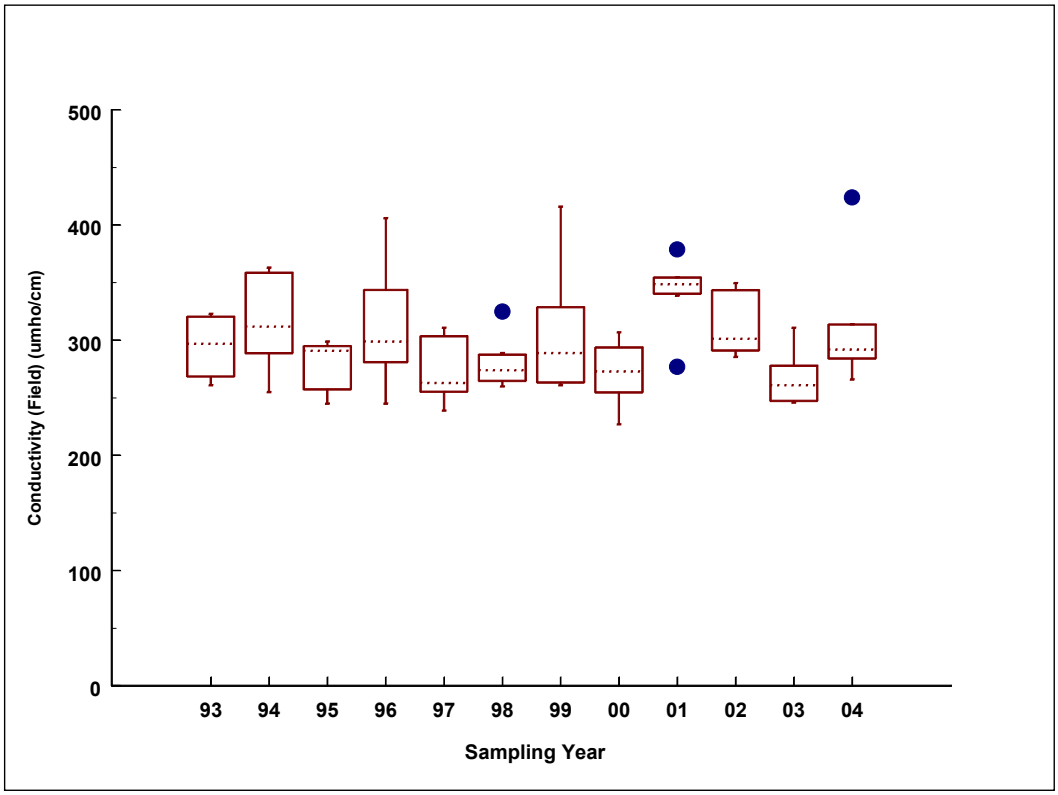


FIGURE 29. BOX PLOT OF SAGINAW BAY CONDUCTIVITY (LAB), 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.01. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOTS ARE STATISTICAL OUTLIERS.

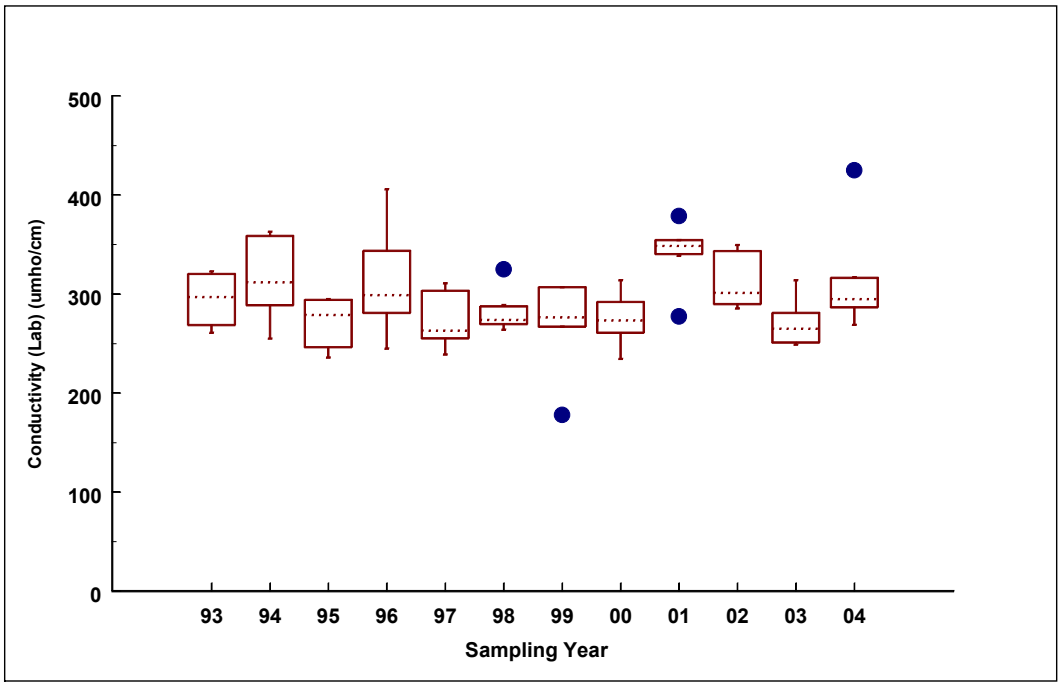


FIGURE 30 a-g. MEAN DISSOLVED SOLIDS CONCENTRATIONS AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004). VALUES OFF SCALE ARE SHOWN IN ().

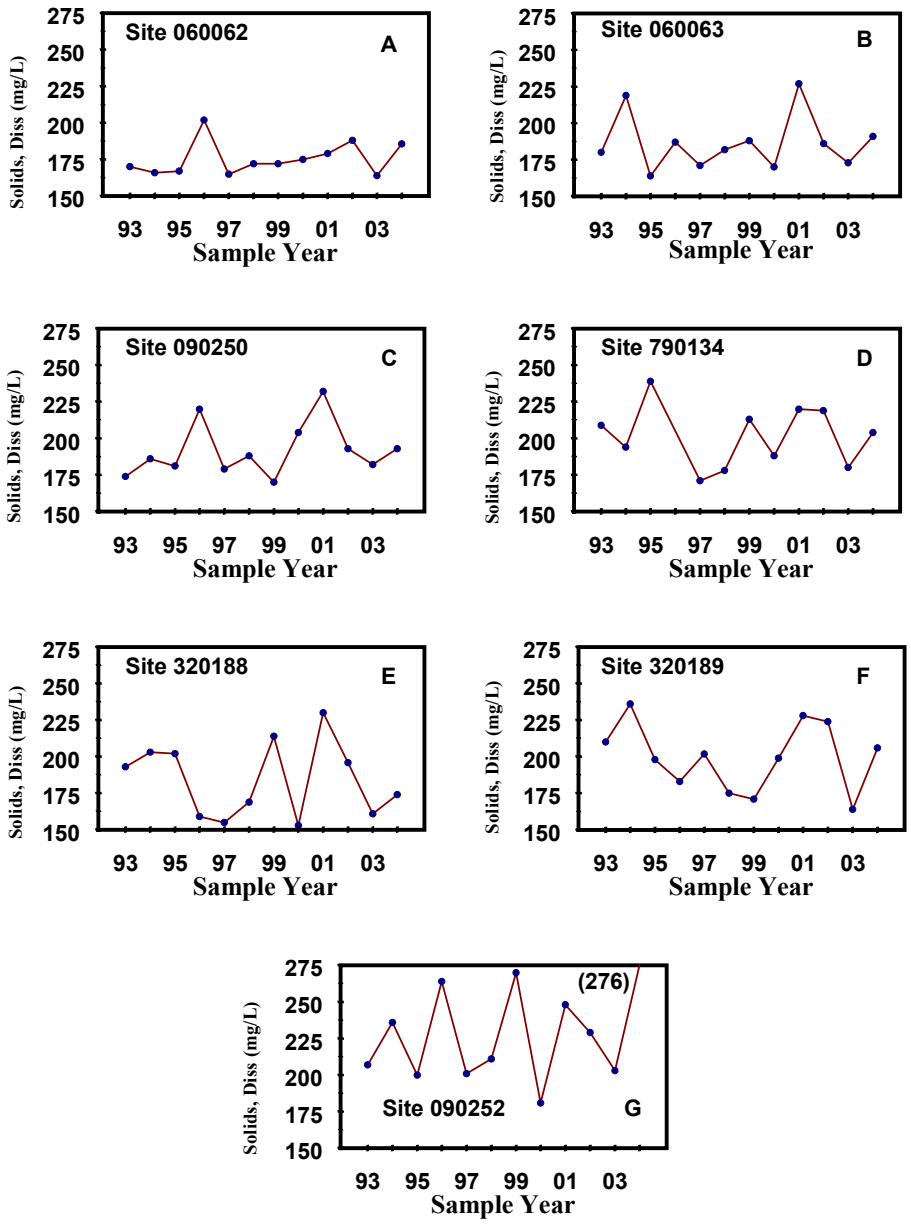


FIGURE 31. BOX PLOT OF SAGINAW BAY DISSOLVED SOLIDS CONCENTRATIONS 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.01. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOTS ARE STATISTICAL OUTLIERS.

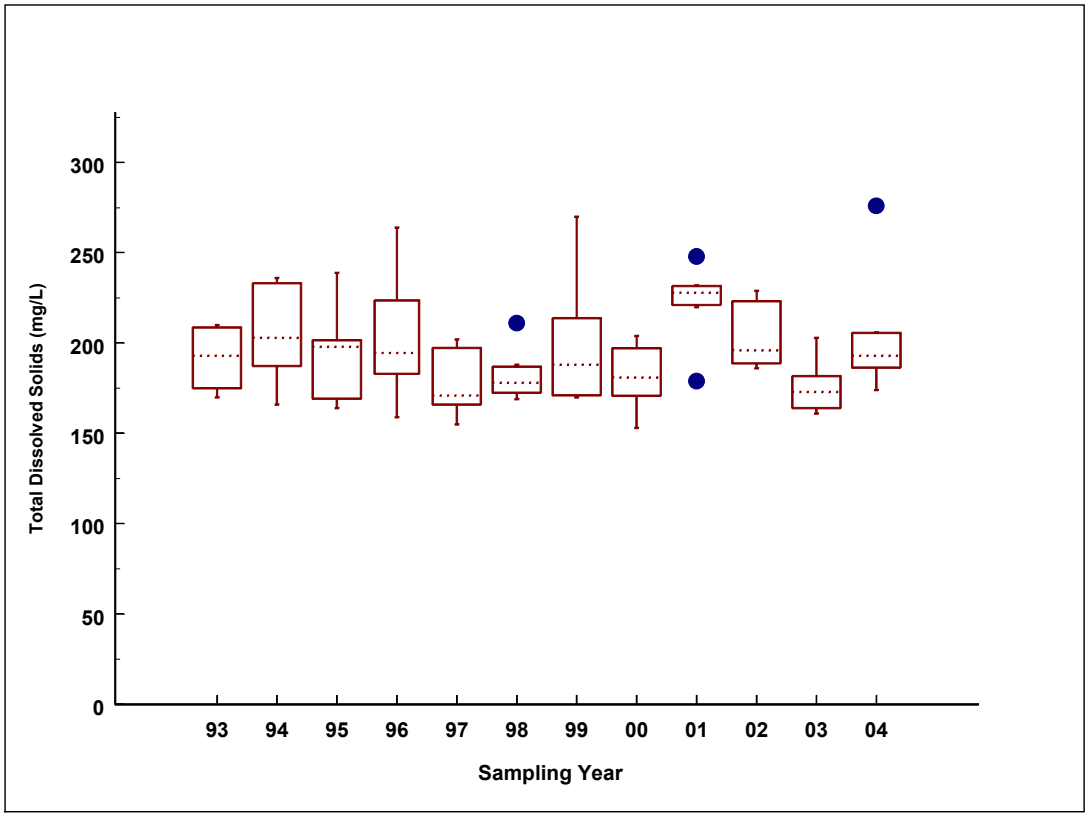


FIGURE 32 a-g. MEAN SUSPENDED SOLIDS CONCENTRATIONS AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004).

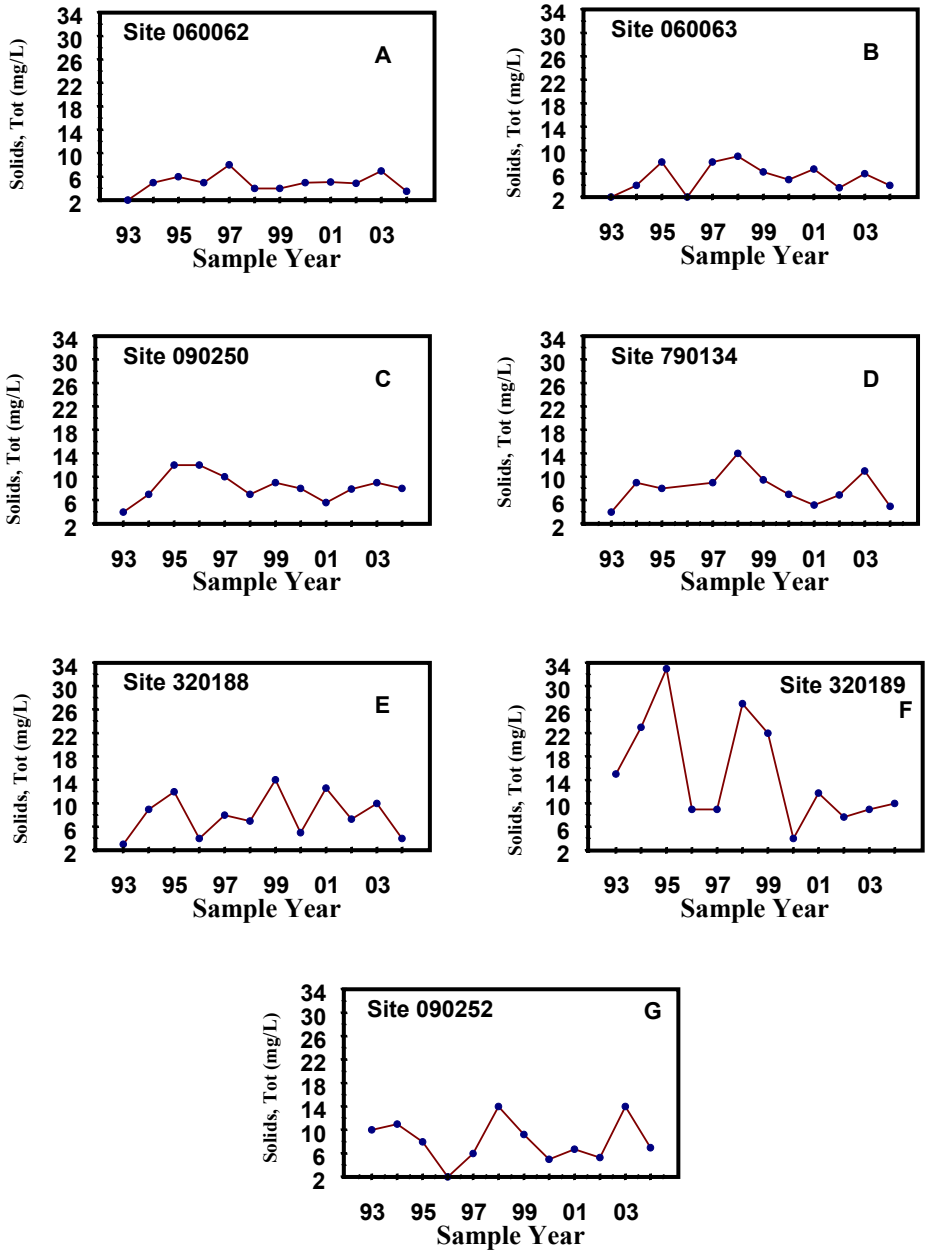


FIGURE 33. BOX PLOT OF SAGINAW BAY SUSPENDED SOLIDS CONCENTRATIONS 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.01. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOTS ARE STATISTICAL OUTLIERS.

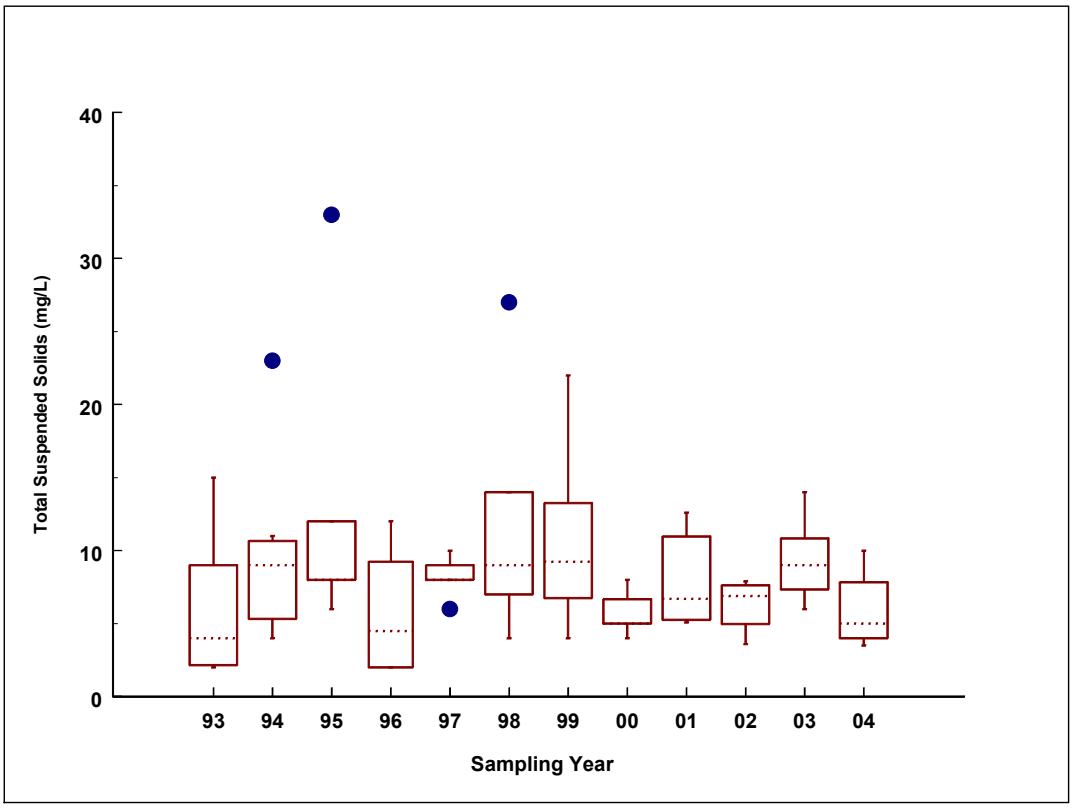


FIGURE 34 a-g. MEAN TOTAL ORGANIC CARBON CONCENTRATIONS AT SEVEN LOCATIONS IN SAGINAW BAY (1998-2004). VALUES OFF SCALE ARE SHOWN IN ( ).

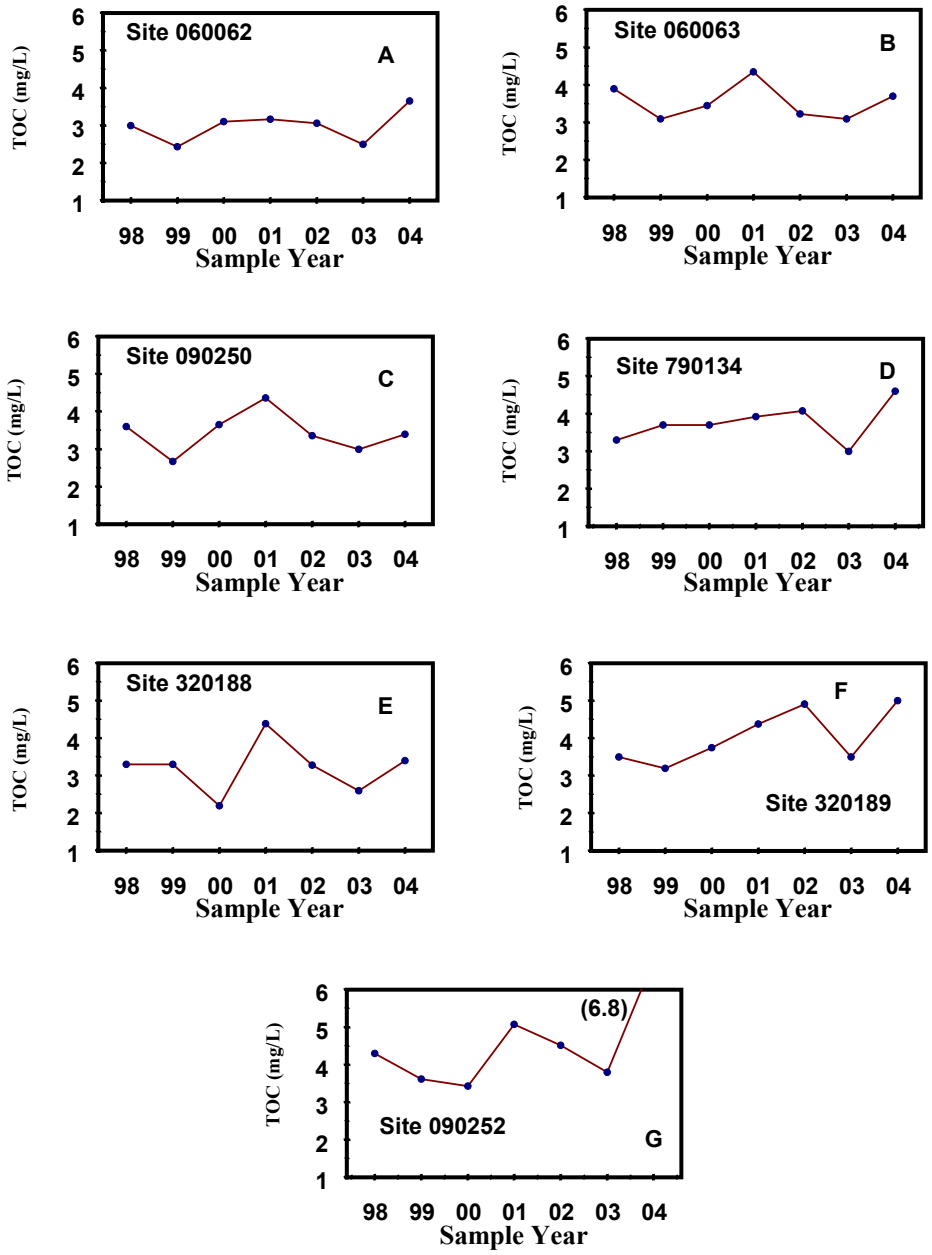


FIGURE 35 a-g. MEAN PH (FIELD) AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004).

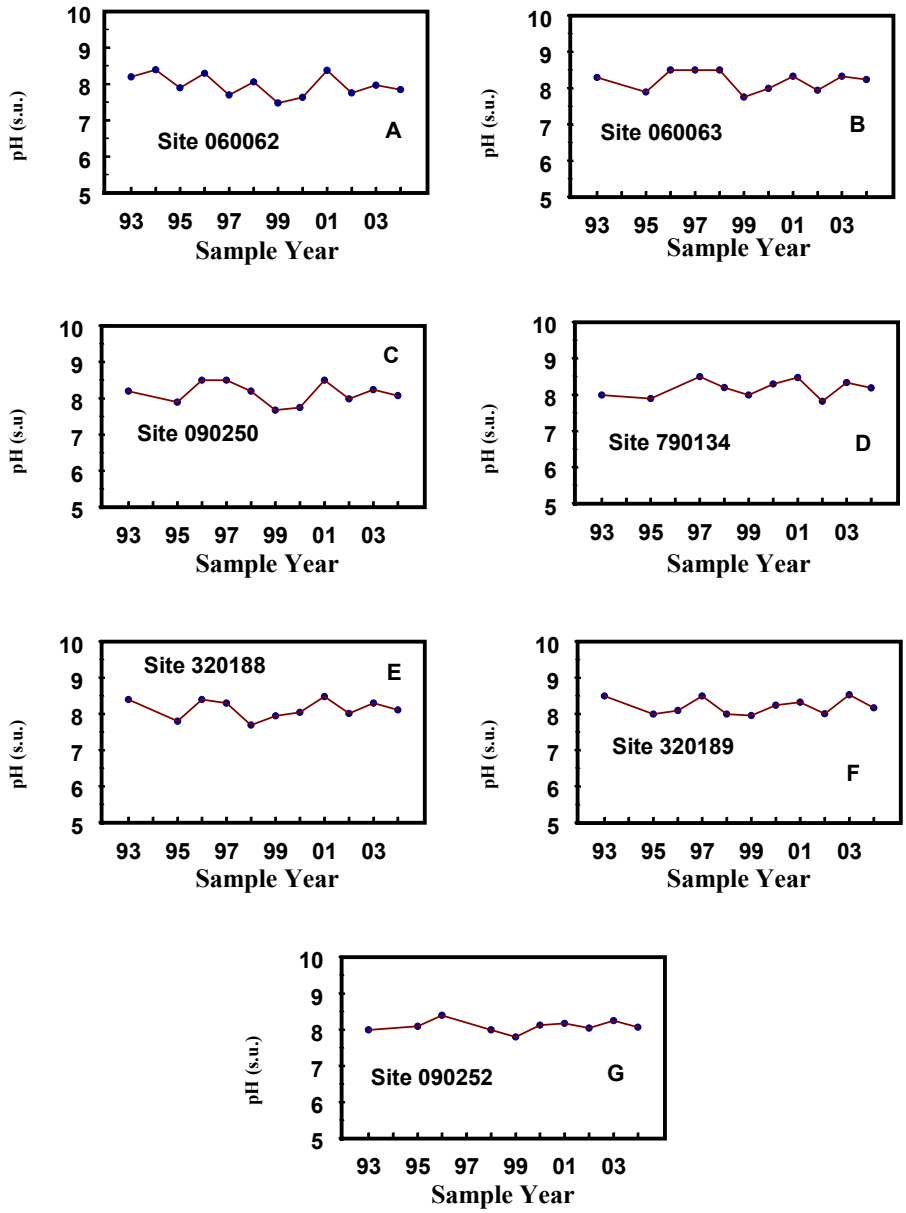


FIGURE 36 a-g. MEAN PH (LAB) AT SEVEN LOCATIONS IN SAGINAW BAY (1993-2004).

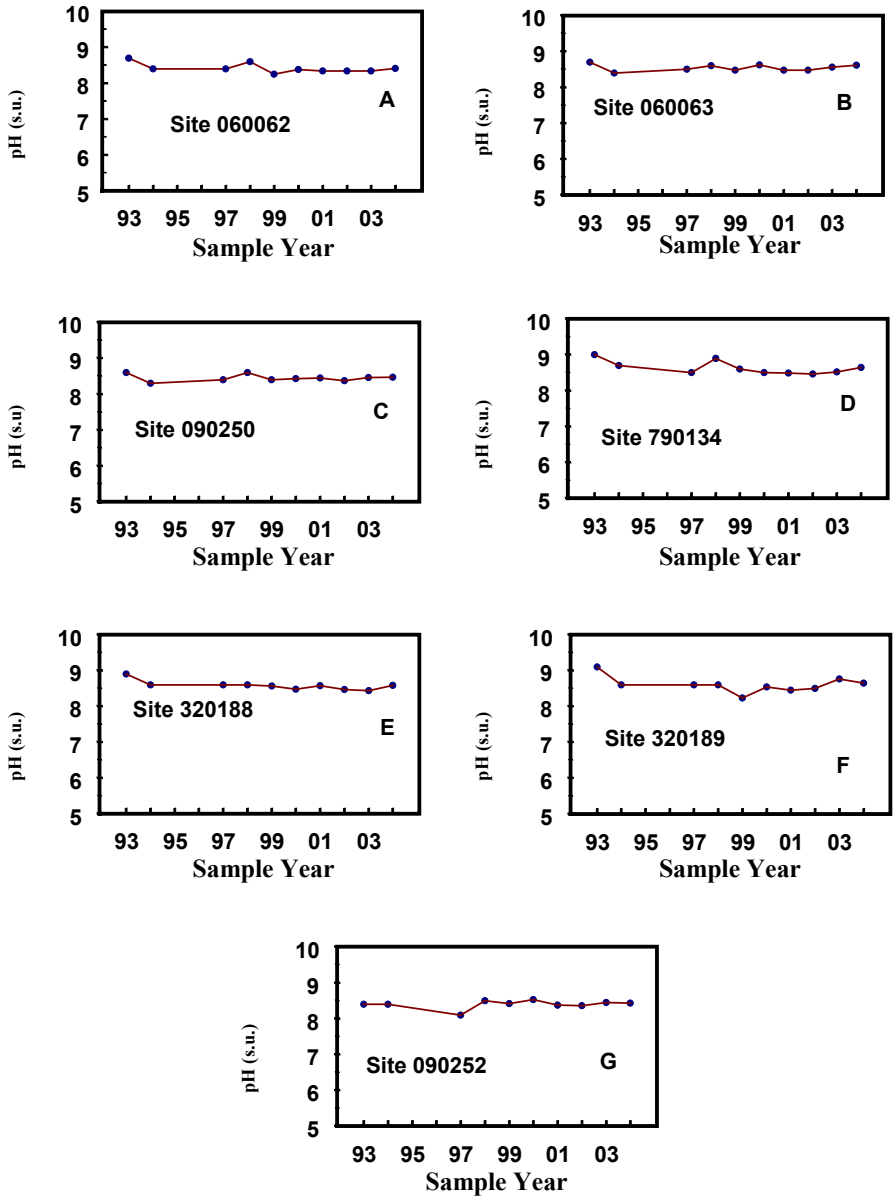


FIGURE 37. BOX PLOT OF SAGINAW BAY PH VALUES (FIELD), 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.01. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOTS ARE STATISTICAL OUTLIERS.

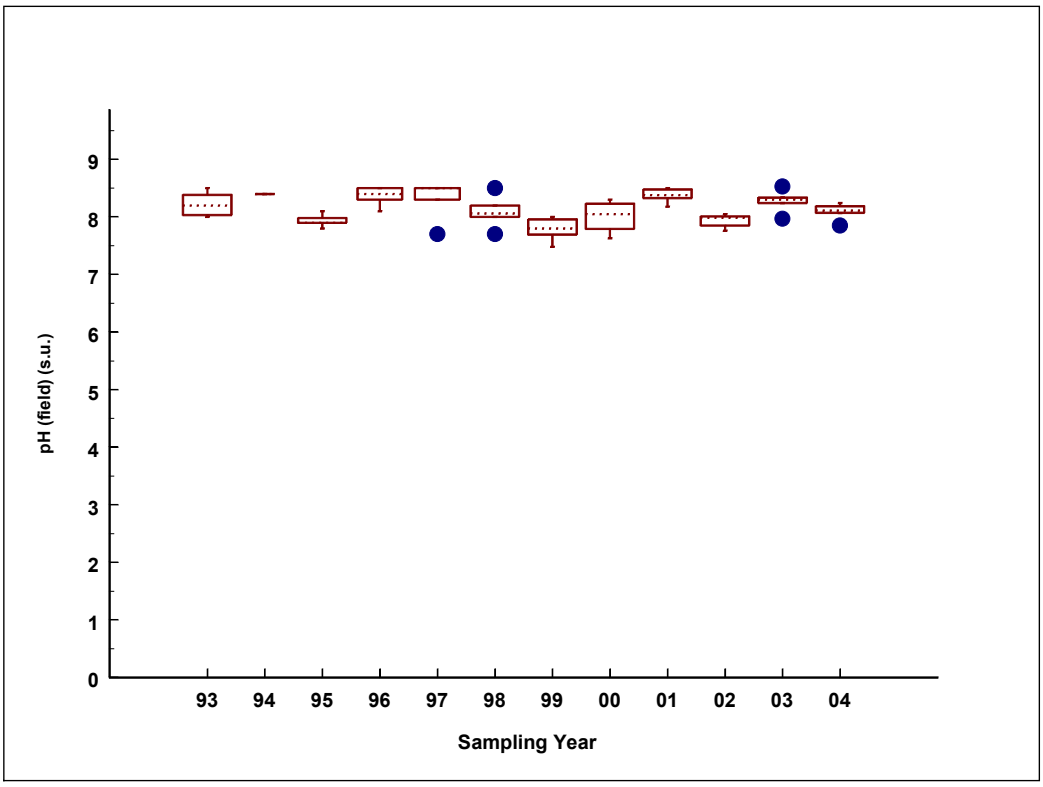


FIGURE 38. BOX PLOT OF SAGINAW BAY PH VALUES (FIELD), 1993-2004. REGRESSION OF DATA YIELDED R^2 = 0.08. EACH BOX EXHIBITS UPPER AND LOWER QUARTILES OF THE DATA, THE DASHED LINE IS THE MEDIAN AND "WHISKERS" ARE 1.5 TIMES THE INTERQUARTILE RANGE UP TO THE HIGHEST OR LOWEST VALUE OF THE DATA. THE DOTS ARE STATISTICAL OUTLIERS.

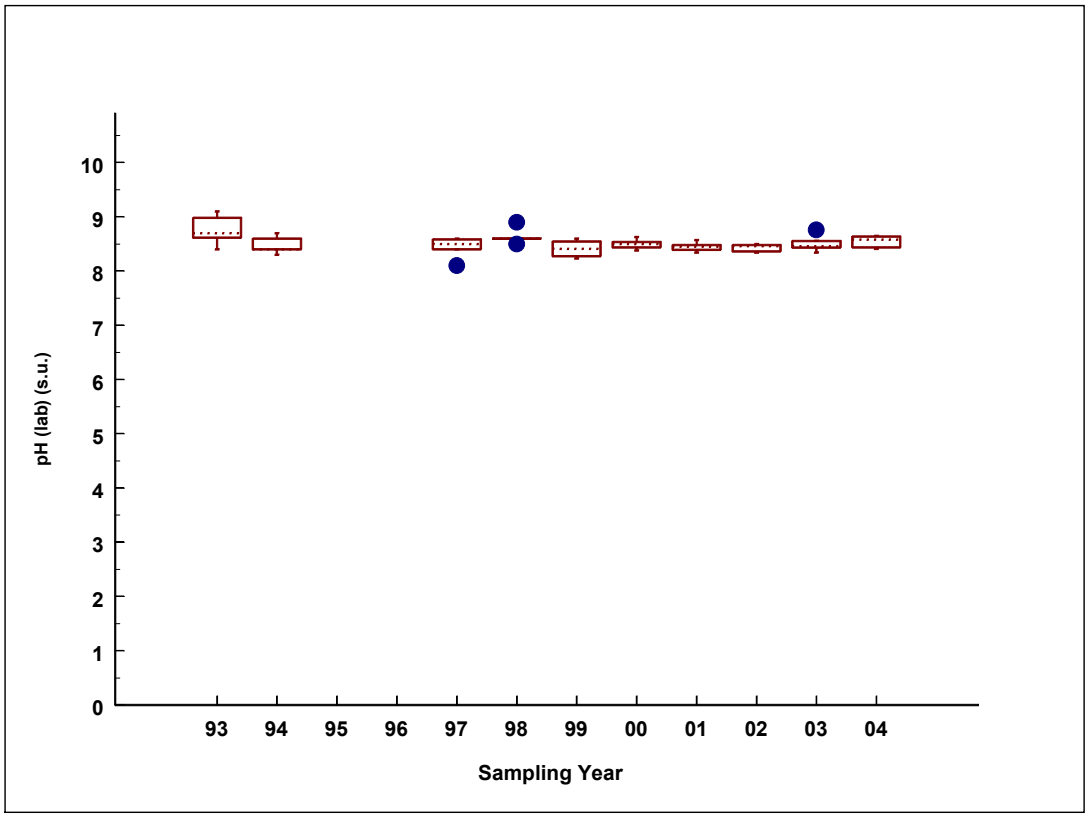


FIGURE 39 a-g. MEAN TOTAL SODIUM CONCENTRATIONS AT SEVEN LOCATIONS IN SAGINAW BAY (2001-2004).

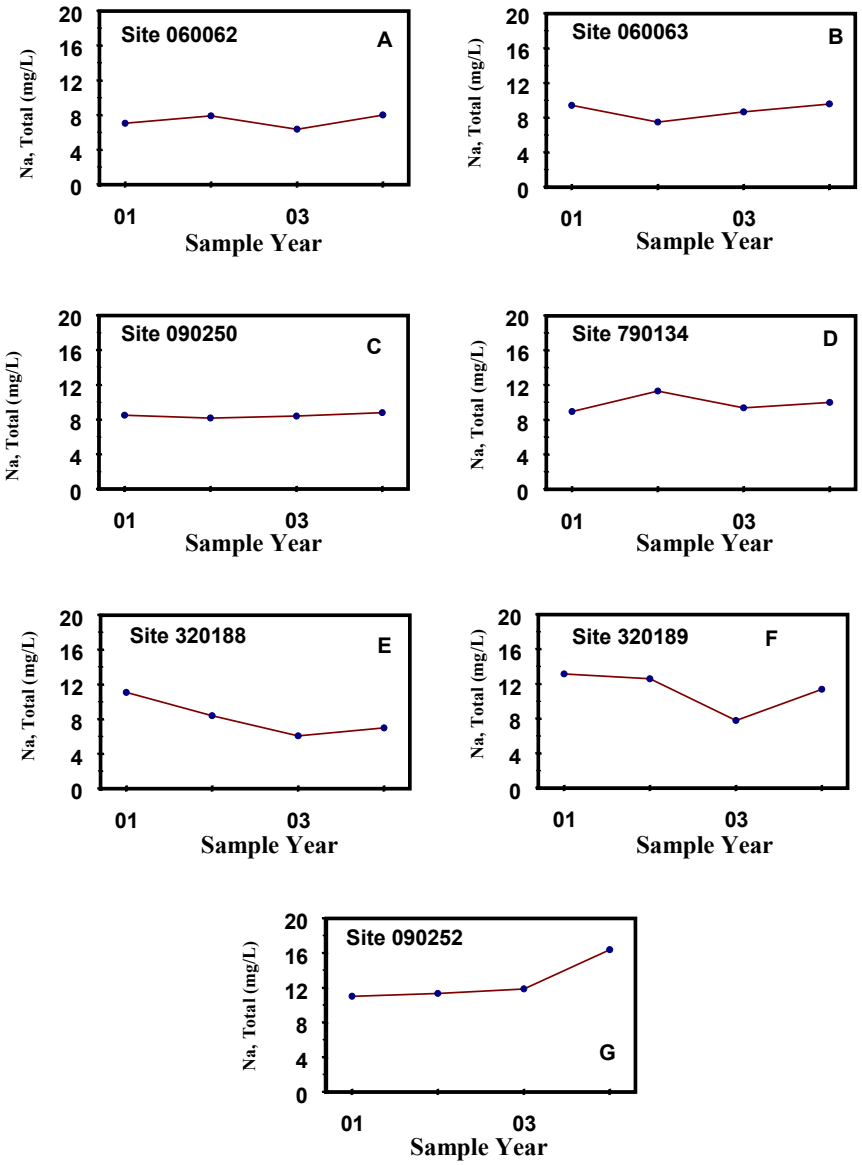


FIGURE 40 a-g. MEAN TOTAL POTASSIUM CONCENTRATIONS AT SEVEN LOCATIONS IN SAGINAW BAY (2001-2004).

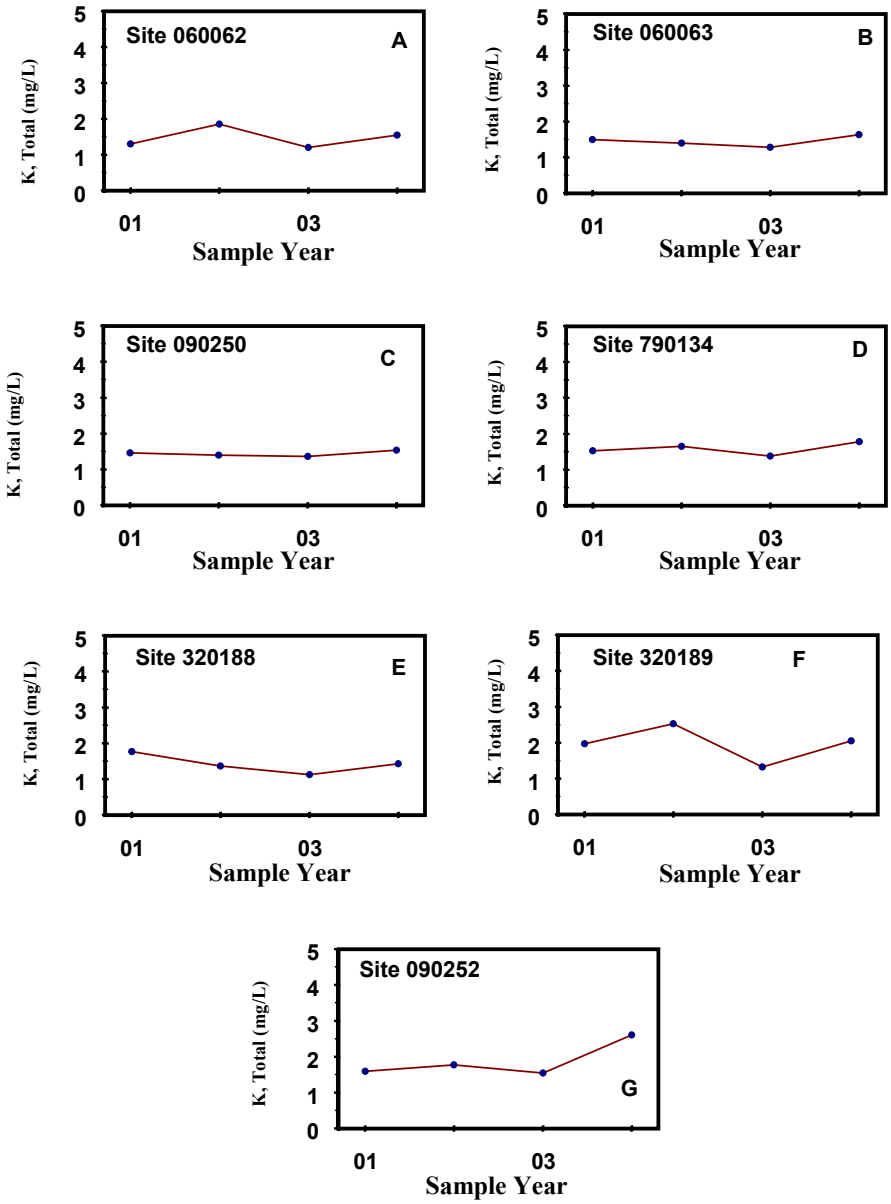


FIGURE 41. MEAN TURBIDITY VALUES AT SEVEN LOCATIONS IN SAGINAW BAY (1996-2004). VALUES OFF SCALE ARE SHOWN IN ( ).

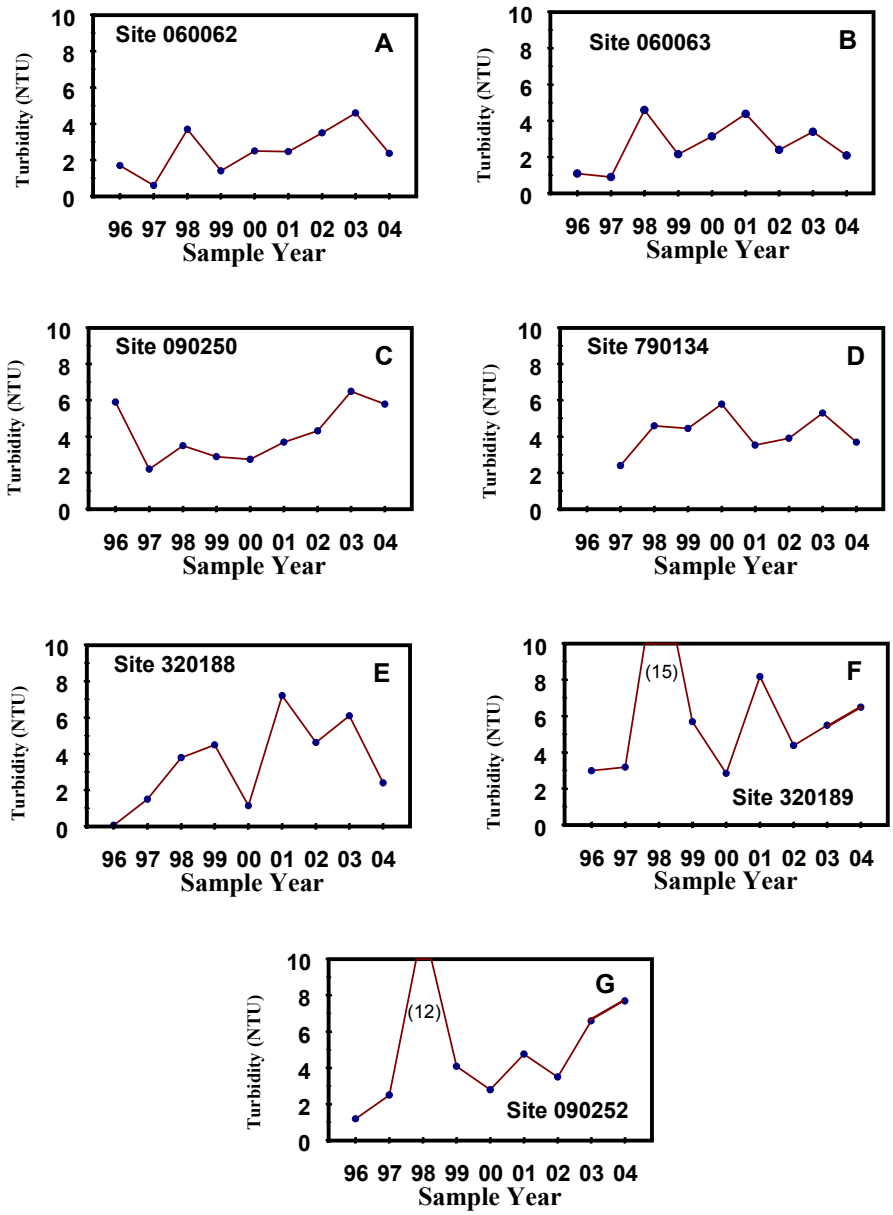


FIGURE 42 a-d. MEAN CHROMIUM, CADMIUM AND LEAD CONCENTRATIONS AT FOUR SELECTED LOCATIONS IN SAGINAW BAY (1998-2004).

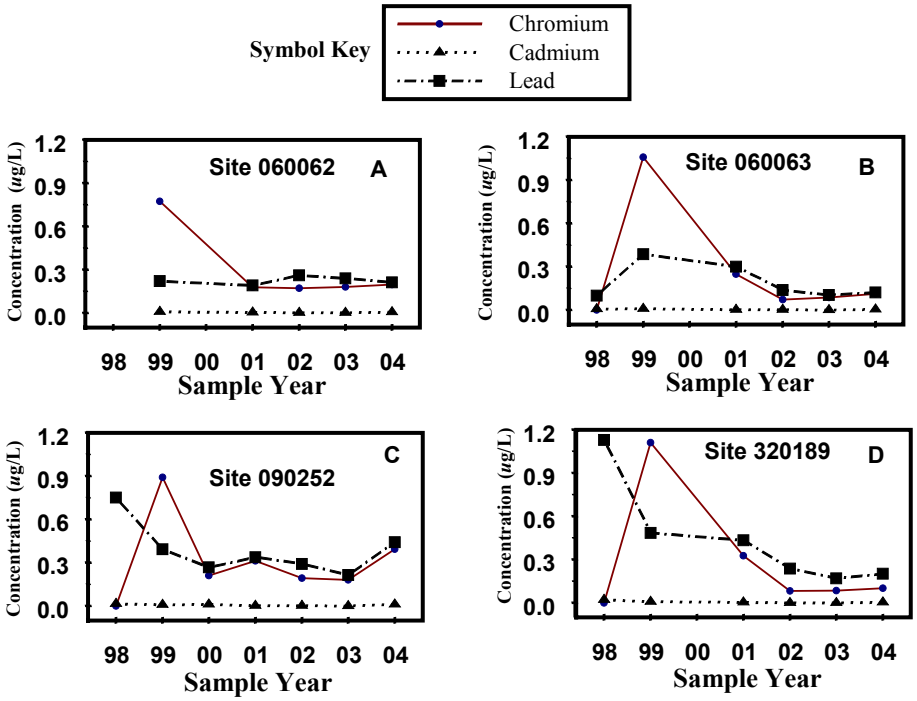


FIGURE 43 a-d. MEAN COPPER, NICKEL AND ZINC CONCENTRATIONS AT FOUR SELECTED LOCATIONS IN SAGINAW BAY (1998-2004).

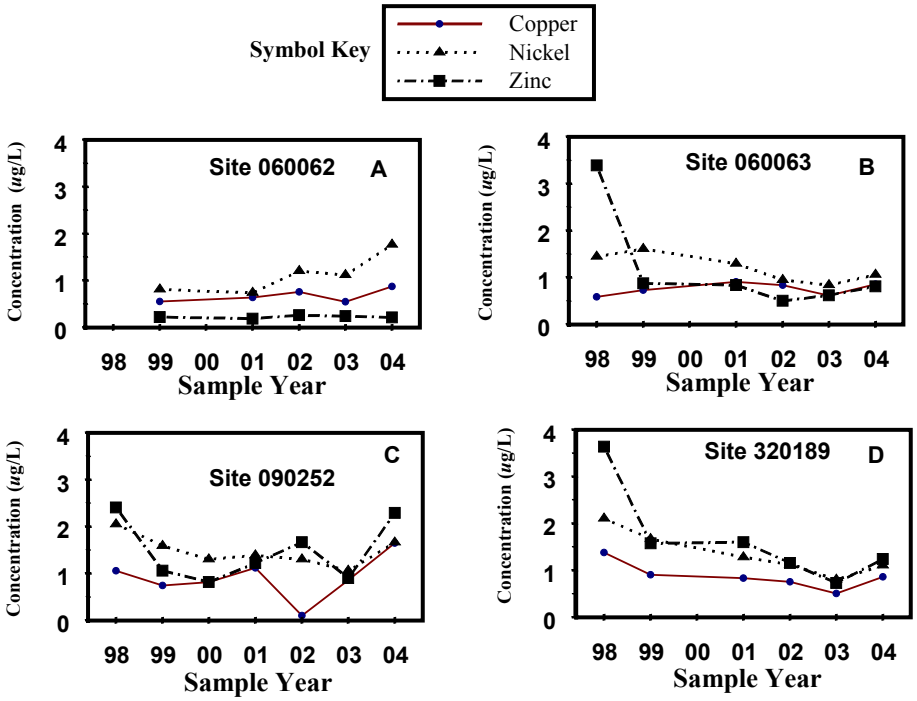


FIGURE 44 a-b. MEAN TRACE METALS CONCENTRATIONS IN SAGINAW BAY (1998-2004).

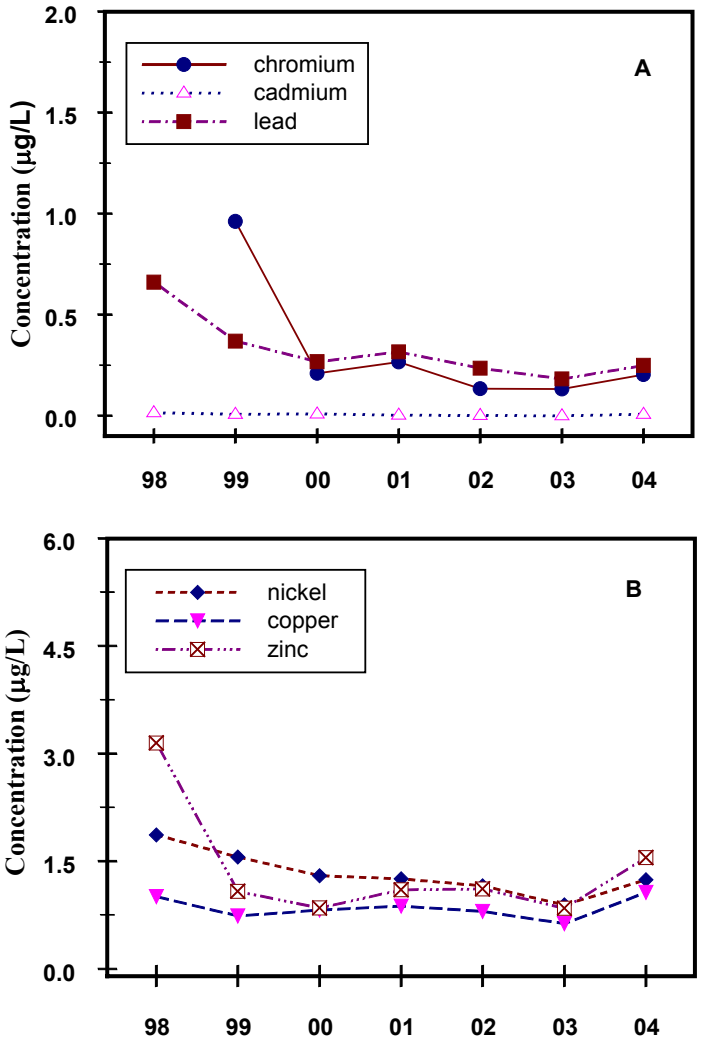


FIGURE 45 a-d. MEAN MERCURY CONCENTRATIONS AT FOUR SELECTED LOCATIONS IN SAGINAW BAY (1998-2004). DASHED LINE IS MICHIGAN'S RULE 57 MERCURY WATER QUALITY VALUE OF 1.3 NG/L. VALUES OFF SCALE ARE SHOWN IN ( ).

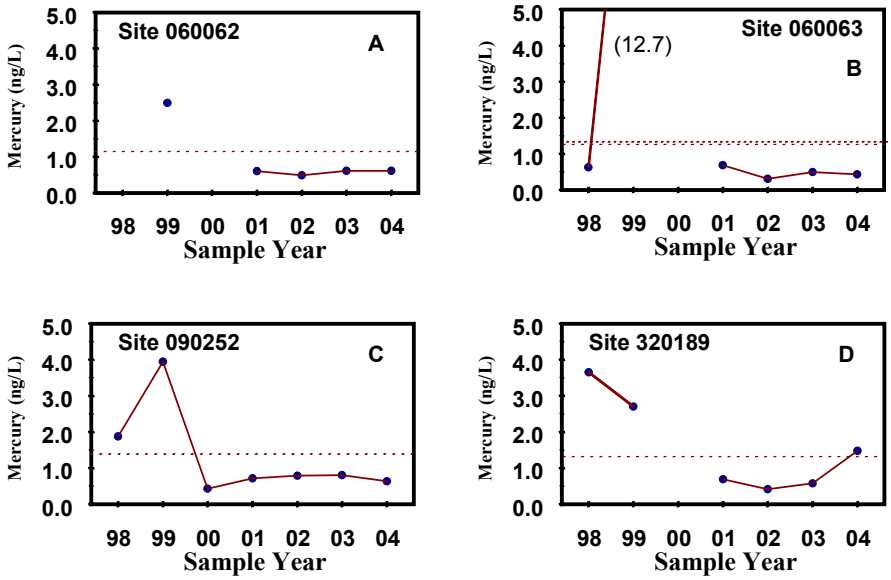


FIGURE 46. MEAN MERCURY CONCENTRATIONS IN SAGINAW BAY FROM 1998 TO 2004.

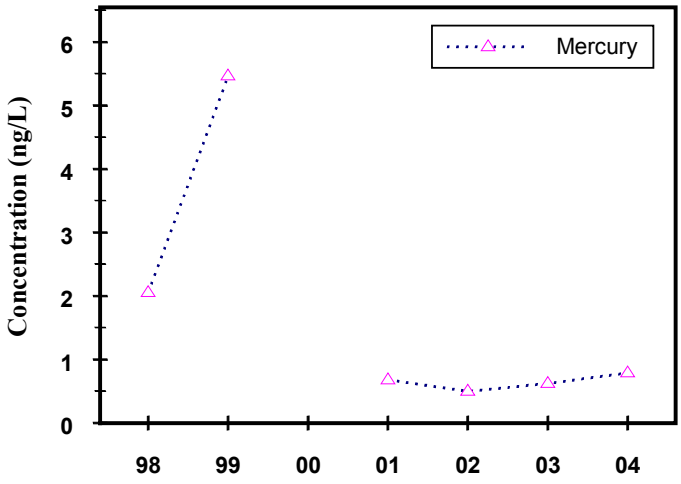


FIGURE 47 a-d. SUMMARY OF MEAN TOTAL PHOSPHORUS CONCENTRATIONS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004).

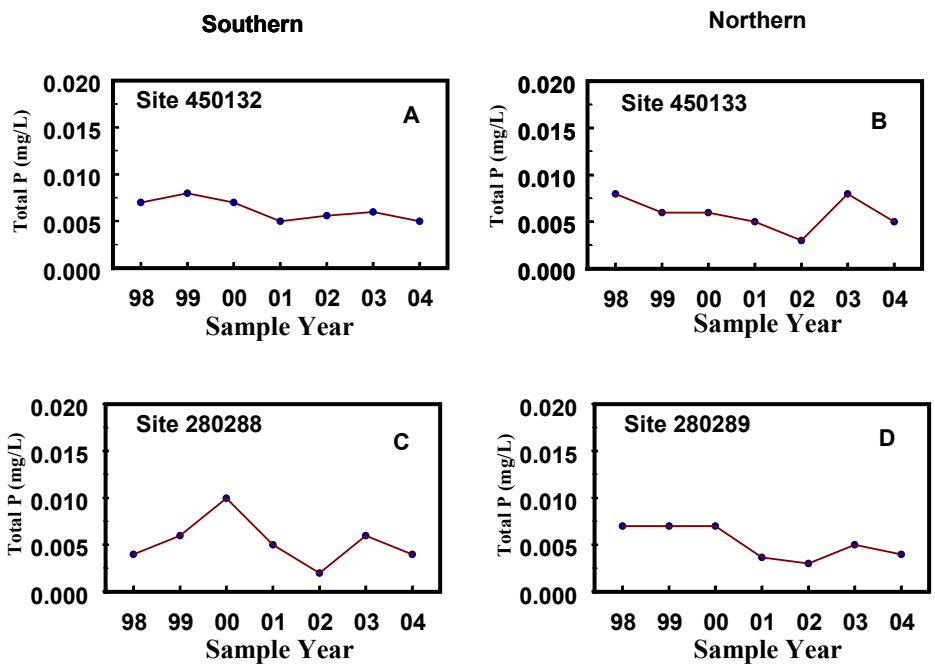


FIGURE 48 a-d. SUMMARY OF MEAN ORTHOPHOSPHATE CONCENTRATIONS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004).

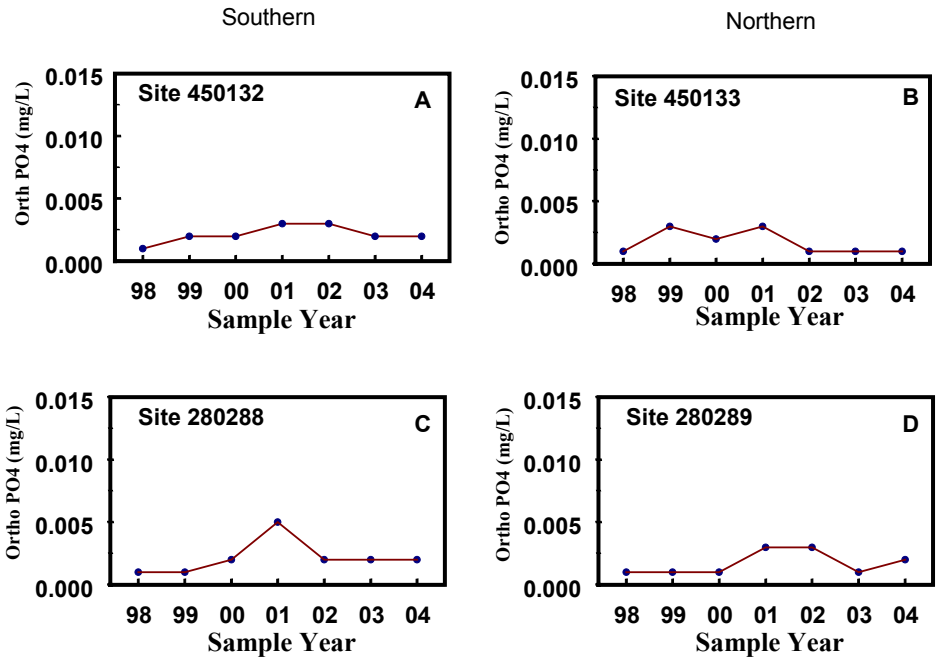


FIGURE 49 a-d. SUMMARY OF MEAN NITRATE+NITRITE AND MEAN AMMONIA CONCENTRATIONS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004).

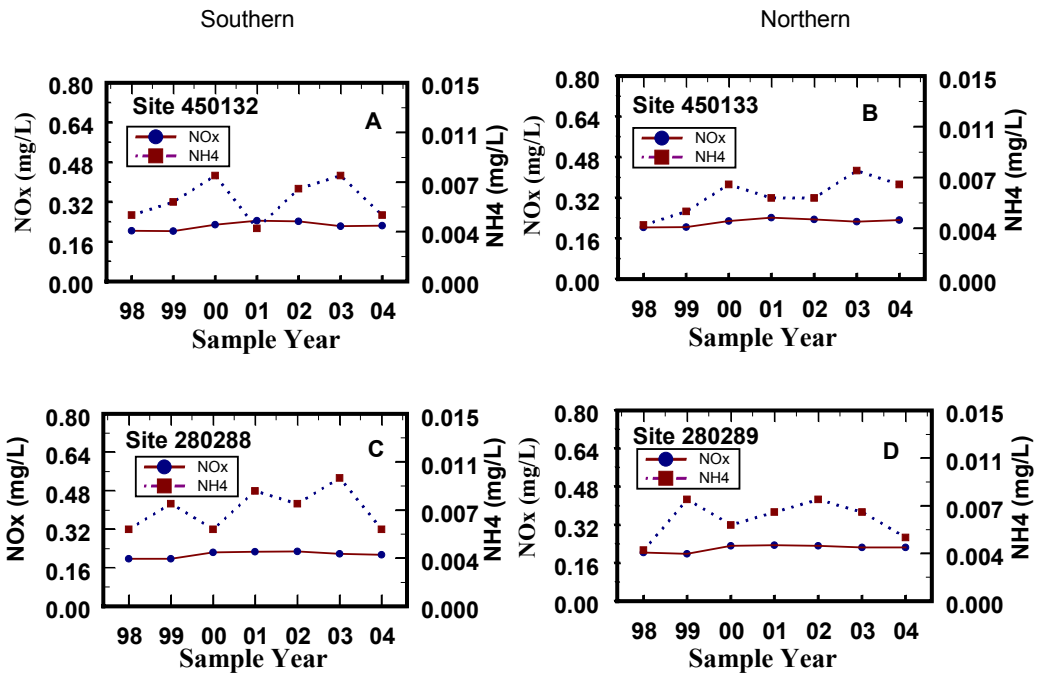


FIGURE 50 a-d. SUMMARY OF MEAN TOTAL KJELDAHL NITROGEN CONCENTRATIONS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004).

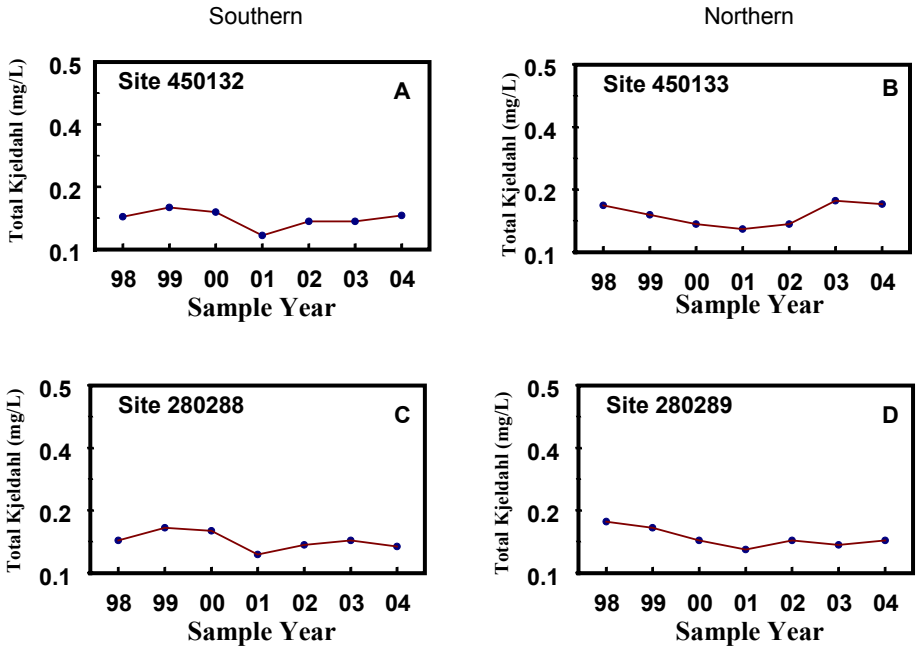


FIGURE 51 a-d. SUMMARY OF MEAN CHLOROPHYLL *a* CONCENTRATIONS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004). HISTORICAL 1992 CHLOROPHYLL *a* LEVELS FOR OPEN BAY STATIONS AND SUB-EMBAYMENTS ARE SHOWN FOR COMPARATIVE PURPOSES BY THE DOTTED LINE IN EACH GRAPH.

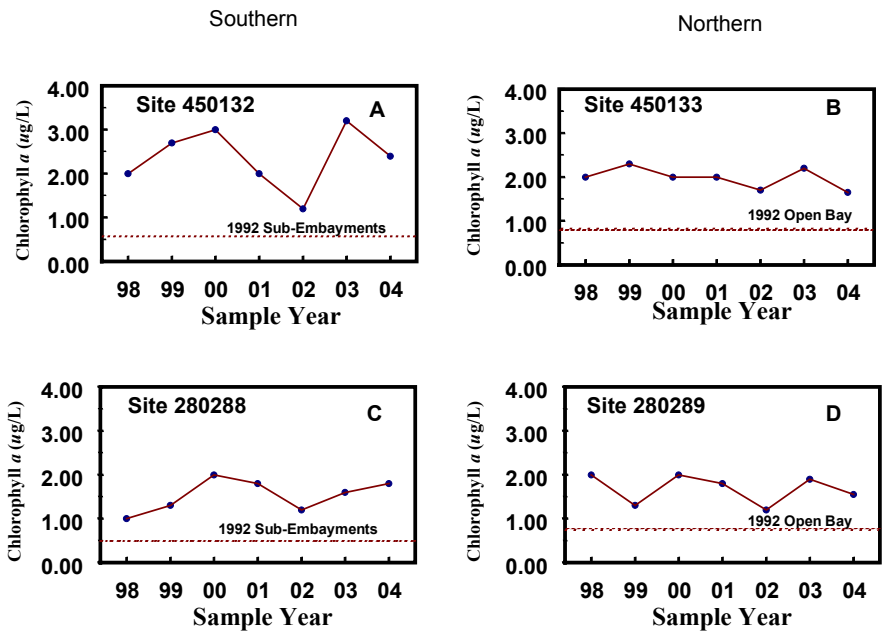


FIGURE 52 a-d. SUMMARY OF MEAN TEMPERATURE MEASUREMENTS AND MEAN DISSOLVED OXYGEN CONCENTRATIONS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004).

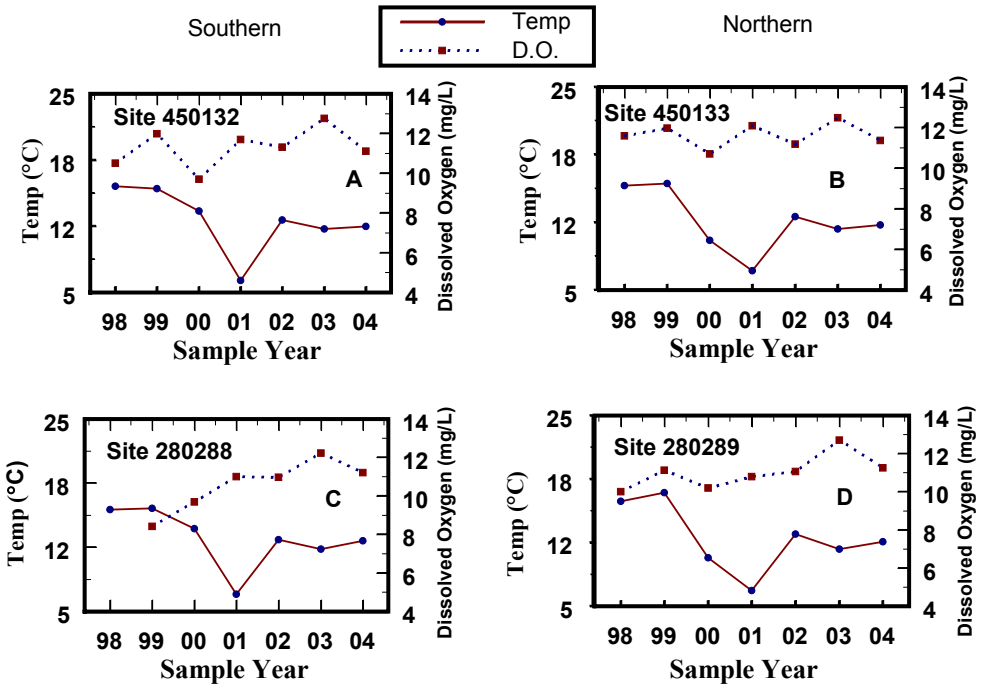


FIGURE 53 a-d. SUMMARY OF MEAN SECCHI DISK TRANSPARENCY DEPTH AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004).

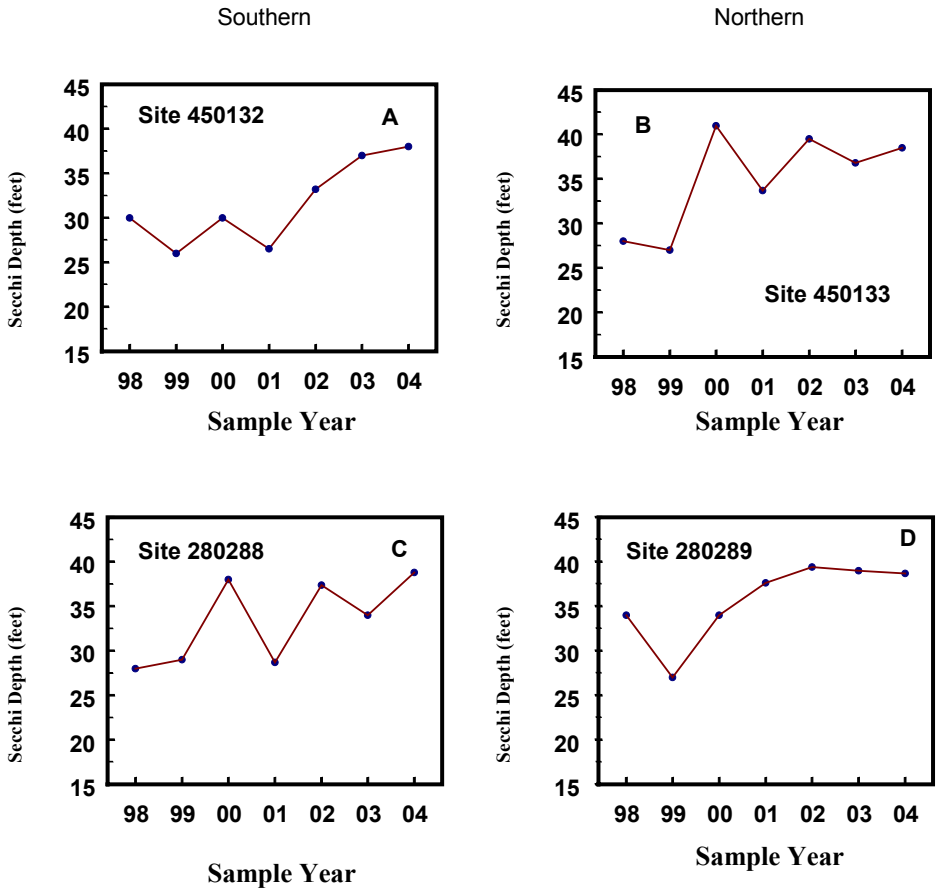


FIGURE 54 a-d. MEAN CALCIUM, MAGNESIUM AND SULFATE CONCENTRATIONS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004).

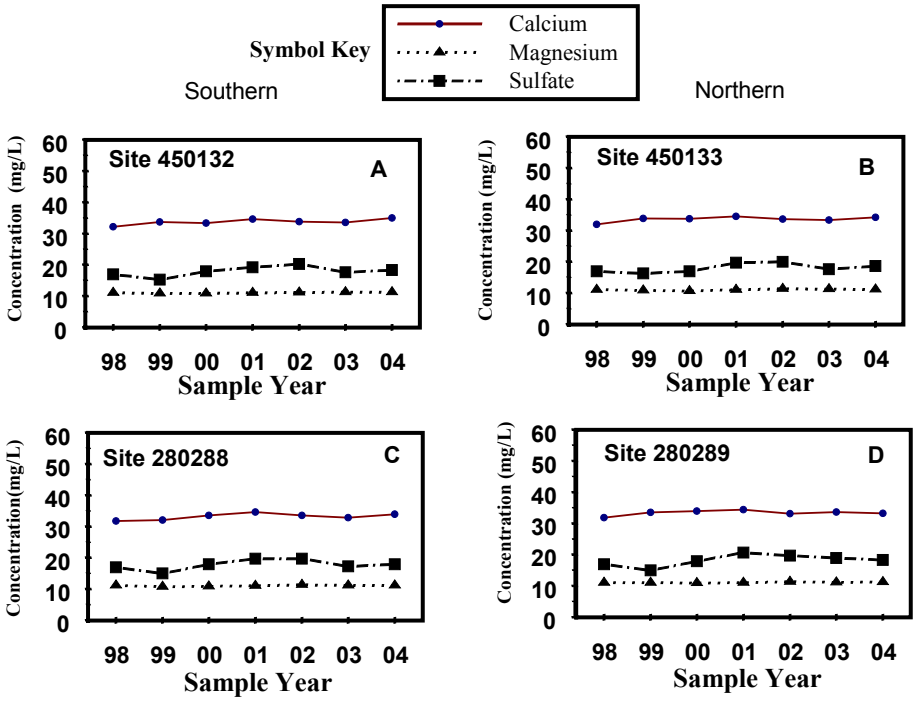


FIGURE 55 a-d. MEAN TOTAL CHLORIDE CONCENTRATIONS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004).

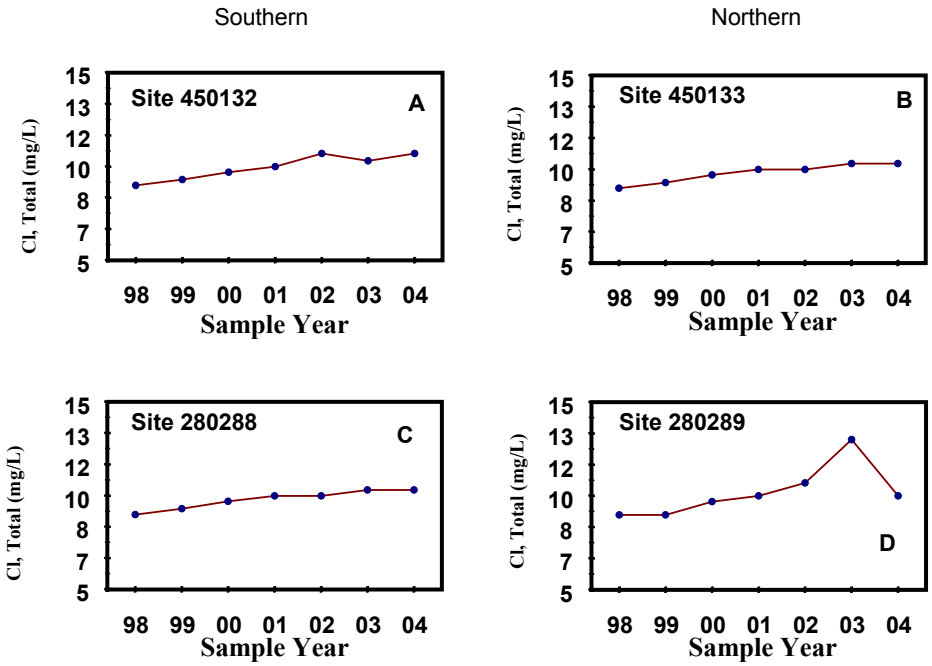


FIGURE 56 a-d. MEAN ALKALINITY AND HARDNESS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004). ALKALINITY WAS NOT ANALYZED FROM 1998-2000.

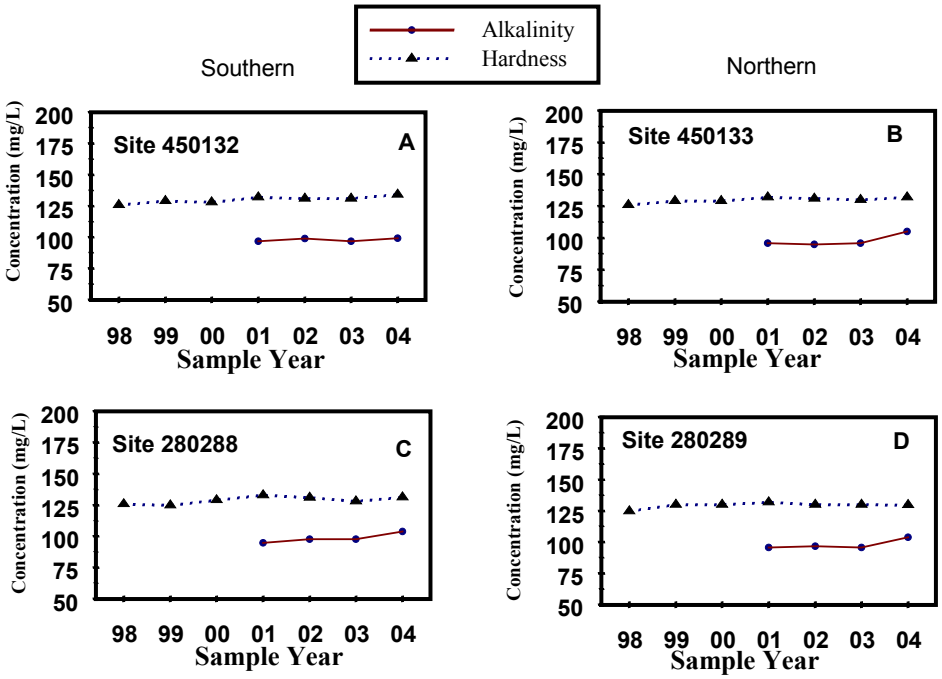


FIGURE 57 a-d. MEAN SPECIFIC CONDUCTANCE (FIELD) AT FOUR LOCATIONS ON GRAND TRAVERSE BAY (1998-2004).

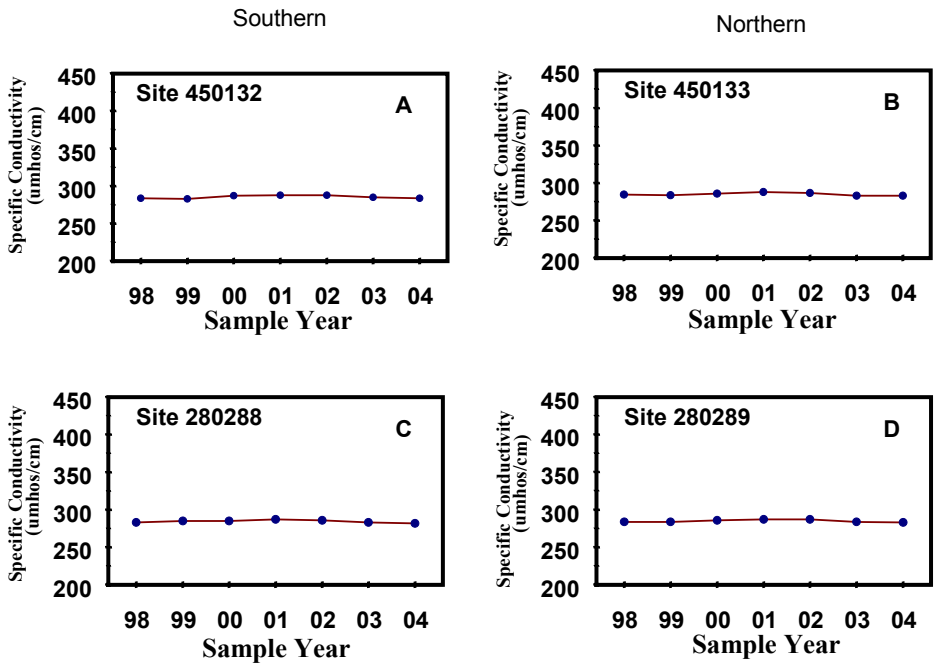


FIGURE 58 a-d. MEAN SPECIFIC CONDUCTANCE (LAB) AT FOUR LOCATIONS ON GRAND TRAVERSE BAY (1998-2004).

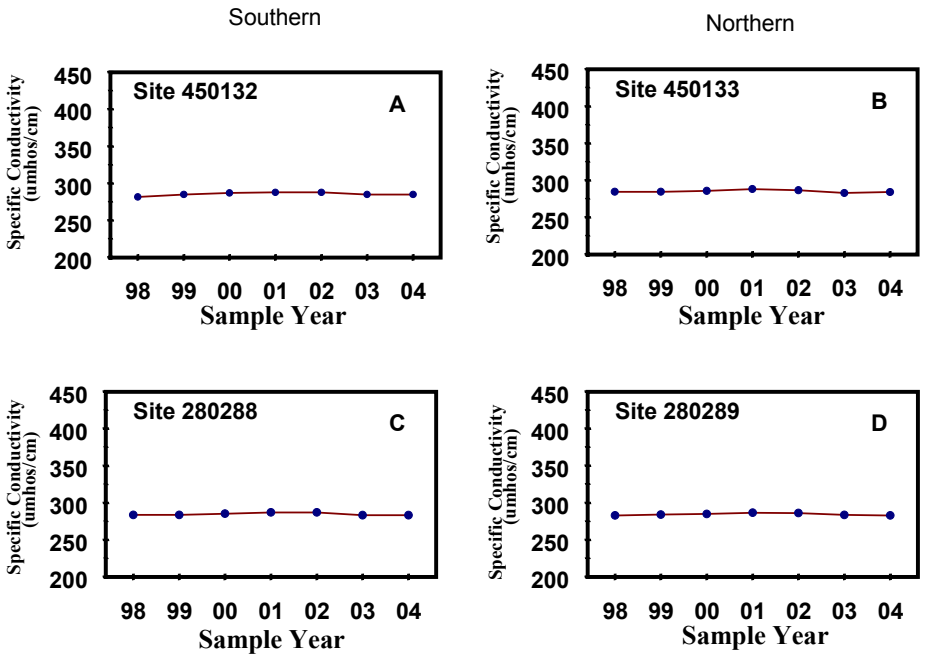


FIGURE 59 a-d. MEAN DISSOLVED SOLIDS CONCENTRATIONS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004).

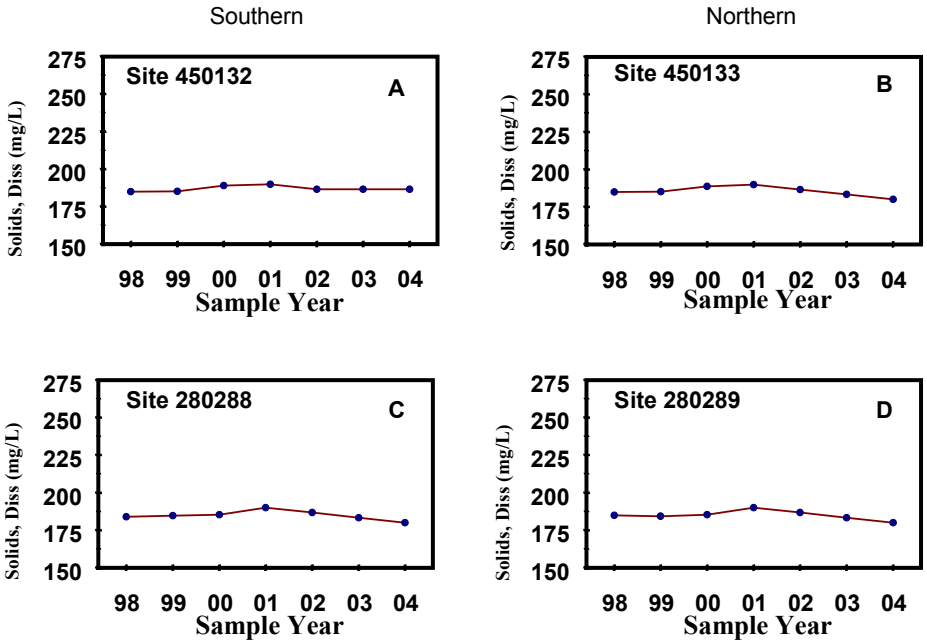


FIGURE 60 a-d. MEAN TOTAL ORGANIC CARBON CONCENTRATIONS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004).

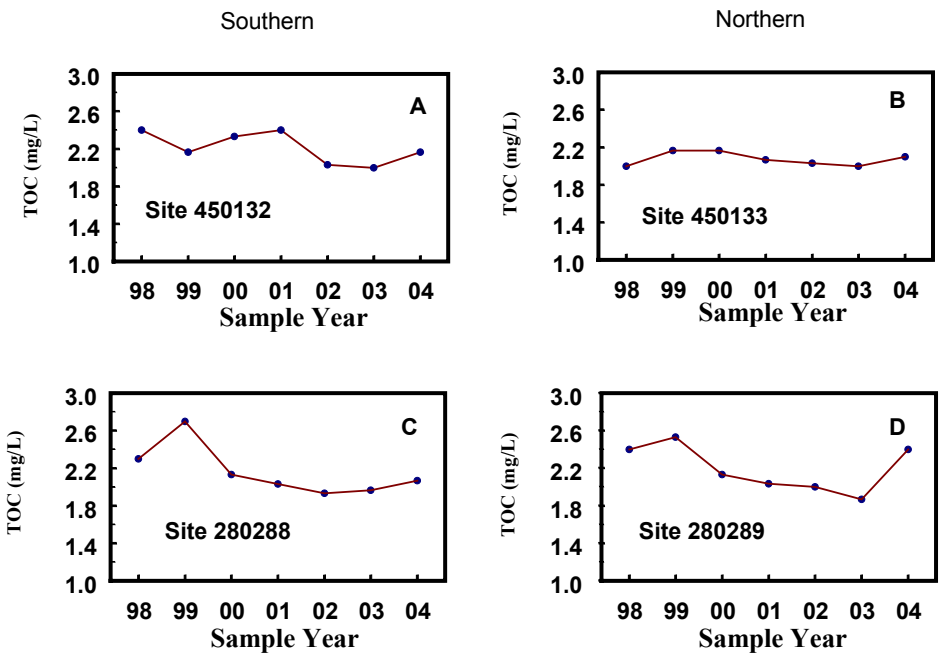


FIGURE 61 a-d. MEAN PH (FIELD) AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004).

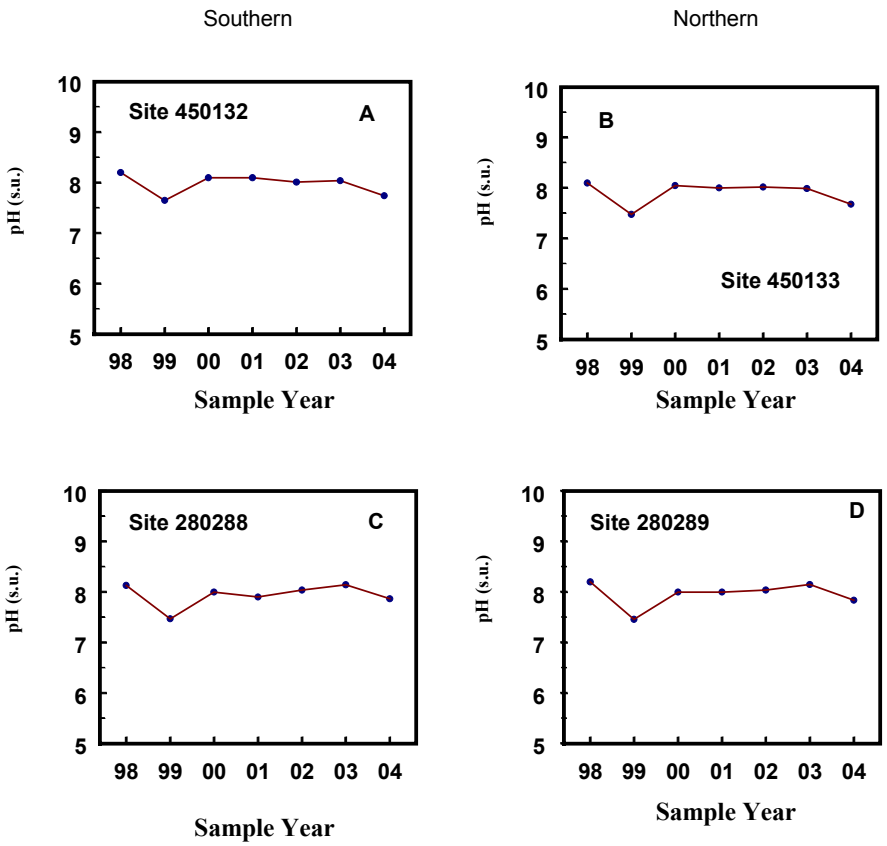


FIGURE 62 a-d. MEAN PH (LAB) AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004).

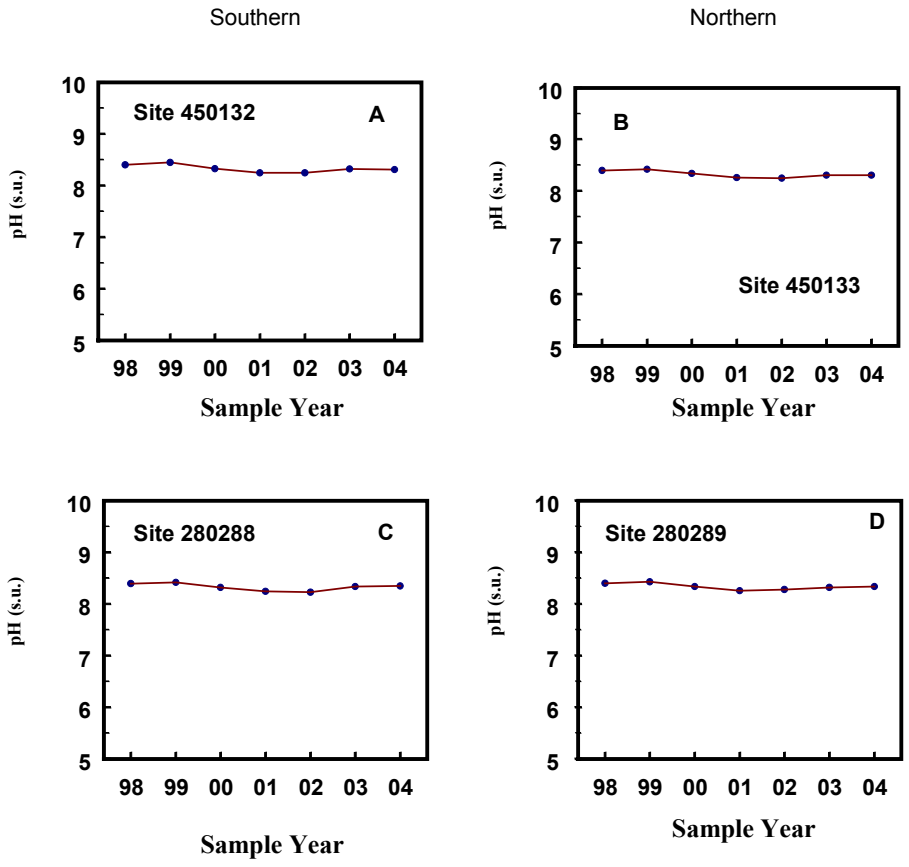


FIGURE 63 a-d. MEAN POTASSIUM CONCENTRATIONS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (2001-2004).

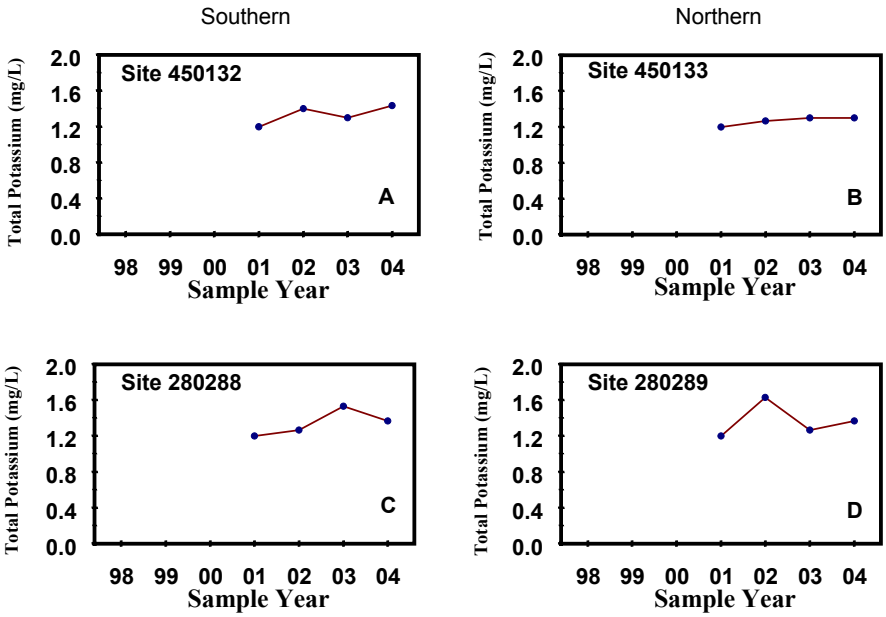


FIGURE 64 a-d. MEAN SODIUM CONCENTRATIONS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (2001-2004).

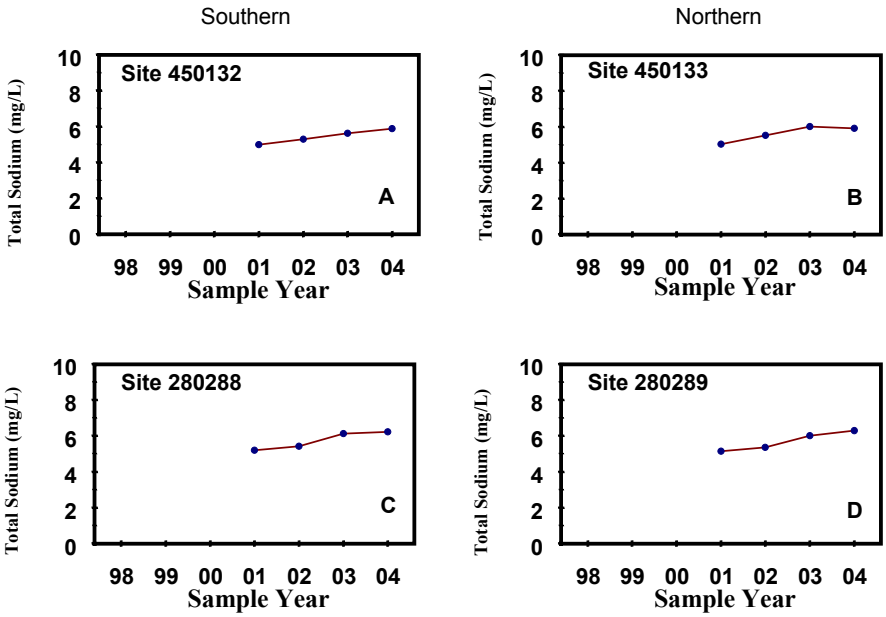


FIGURE 65 a-d. MEAN CHROMIUM, CADMIUM AND LEAD CONCENTRATIONS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004).

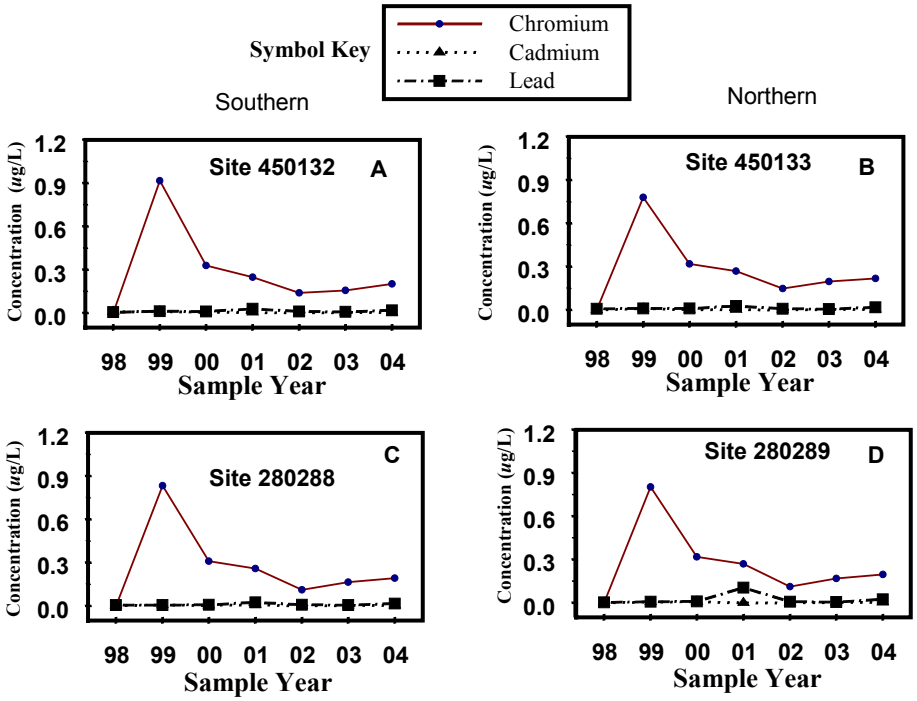


FIGURE 66 a-d. MEAN COPPER, NICKEL AND ZINC CONCENTRATIONS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004). VALUES OFF SCALE ARE SHOWN IN ( ).

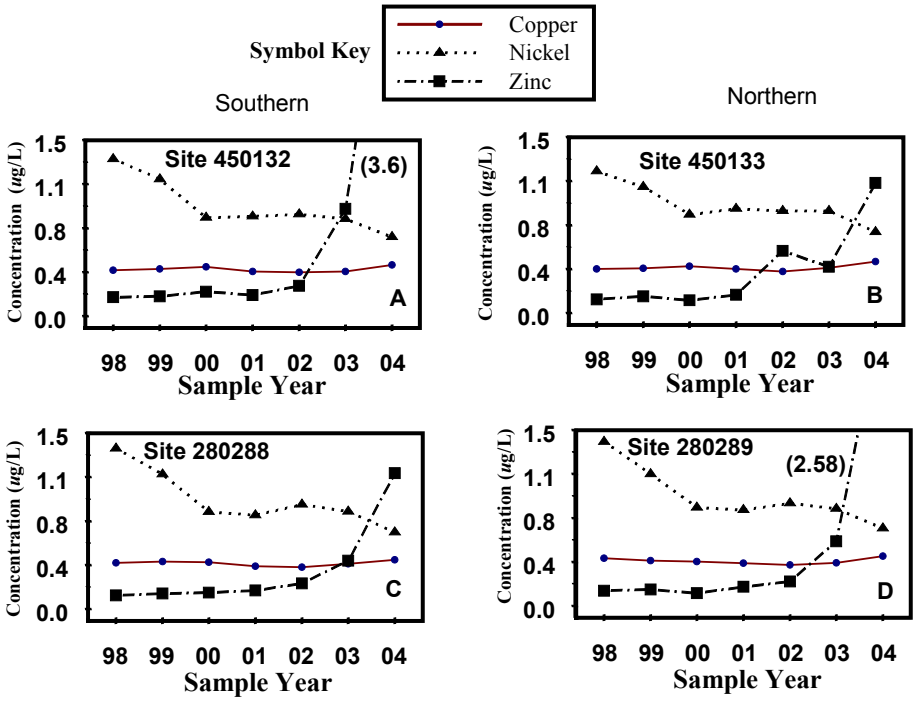


FIGURE 67 a-b. MEAN TRACE METALS CONCENTRATIONS IN GRAND TRAVERSE BAY FROM 1998 TO 2004.

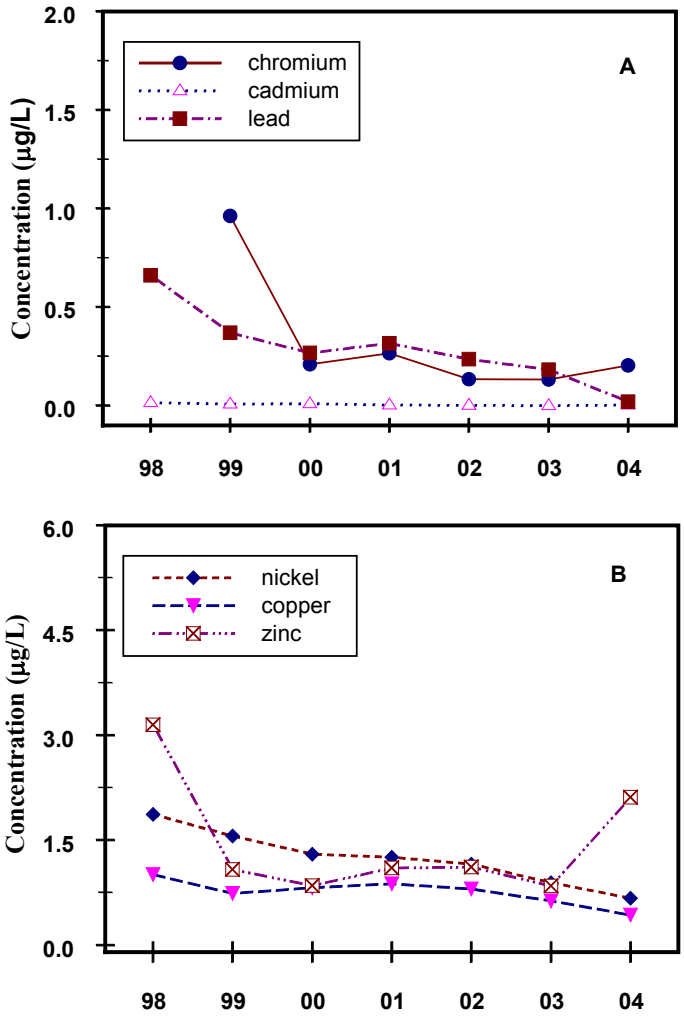


FIGURE 68 a-d. MEAN MERCURY CONCENTRATIONS AT FOUR LOCATIONS IN GRAND TRAVERSE BAY (1998-2004). DASHED LINE IS THE RULE 57 MERCURY WATER QUALITY VALUE OF 1.3 NG/L. VALUES OFF SCALE ARE SHOWN IN ( ).

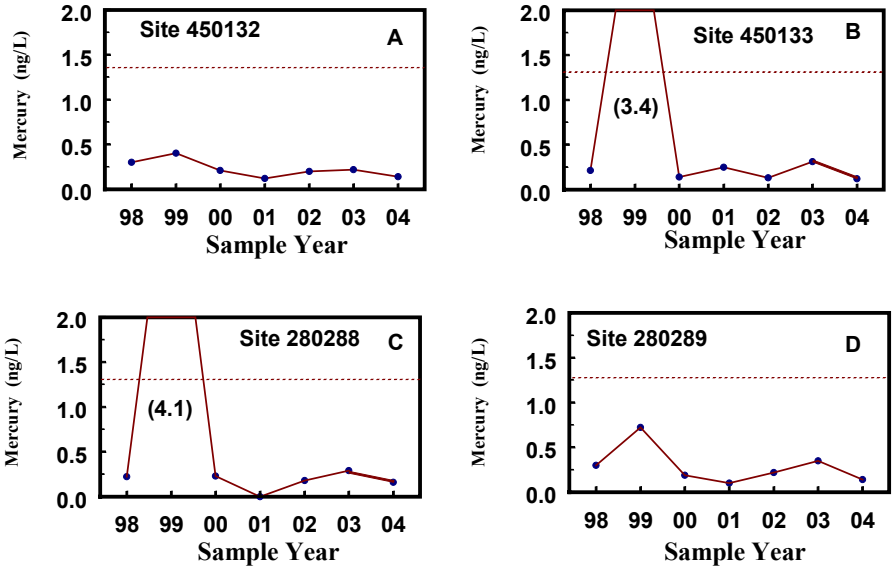
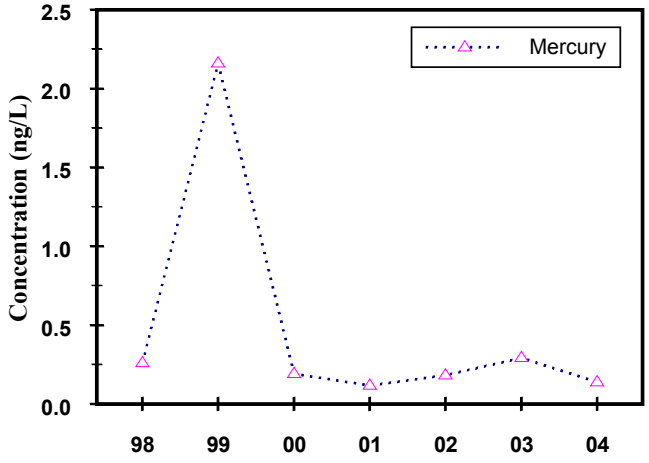


FIGURE 69. MEAN MERCURY CONCENTRATIONS IN GRAND TRAVERSE BAY FROM 1998 TO 2004.



TABLES

TABLE 1. PARAMETERS ANALYZED IN SAMPLES COLLECTED IN SAGINAW BAY AND GRAND TRAVERSE BAY AT SELECTED STATIONS.

LIMNOLOGIGAL AND CONVENTIONAL PARAMETERS	TRACE METALS AND MERCURY
Alkalinity - Bicarbonate	Cadmium
Alkalinity - Carbonate	Copper
Total Alkalinity	Chromium
Ammonia (NH_3-N)	Lead
Base/Neutral Organics	Nickel
BTEX/MTBE	Zinc
Calcium - Total	
Chloride	
Chlorophyll a	Mercury
Conductance	
Conductivity - Field	
Cyanide	
Dissolved Oxygen	
Dissolved Oxygen - Field	
Hardness - Calculated	
Magnesium - Total	
Nitrate-N (NO_3+NO_2) - (NO_2) Calculated	
Nitrate+Nitrite (NO_3+NO_2)	
Nitrite-N (NO_2-N)	
Orthophosphate	
pH	
pH - Field	
Potassium - Total	
Secchi Disk Reading (Light transparency measurement)	
Silicon	
Sodium - Total	
Sulfate (SO_4)	
Temperature	
Totals Dissolved Solids (TDS) - Calculated	
Total Kjeldahl Nitrogen	
Total Organic Carbon	
Total Phosphorus	
Total Suspended Solids (TSS)	
Turbidity	

TABLE 2. LABORATORY QUANTIFICATION LEVELS FOR TRACE METALS AND MERCURY ANALYSES.

	MDEQ ESSD Lab [1] 1993 -1995 *u* g/L	*UMAQ Lab* [2] 1998 -1999 *u* g/L	*WSLH* [3] 2000 - May 2002 *u* g/L	*WSLH* [3] May 2002 - 2004 *u* g/L
Cadmium	0.1	0.031	0.03	0.037
Chromium	1	0.086	0.06	0.19
Copper	0.5	0.57	0.04	0.1
Lead	0.5	0.017	0.15	0.014
Nickel	1	0.073	0.3	0.31
Zinc	2	0.18	0.13	0.43
Mercury	0.1	0.41 ng/L	0.30 ng/L	0.45 ng/L

[1] Michigan Department of Environmental Quality, Environmental Science and Services Division Laboratory

[2] University of Michigan Air Quality Laboratory

[3] Wisconsin State Laboratory of Hygiene

TABLE 3. BASIC LIMNOLOGICAL PARAMETERS MEASURED IN SAGINAW BAY (SB) AND GRAND TRAVERSE BAY (GTB) BY MONITORING YEAR FOR SAMPLES COLLECTED BY THE MDEQ, GTBOCI AND GLEC.

	Data Year											
Parameter	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total Phosphorus	SB	SB	SB	SB	SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Orthophosphate	SB	SB	SB	SB	SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Nitrate/Nitrite N				SB	SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Ammonia			SB	SB	SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Total Kjeldahl Nitrogen	SB	SB	SB	SB	SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Dissolved Oxygen	SB	SB	SB	SB	SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Temperature	SB	SB	SB	SB	SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Chlorophyll a	SB	SB		SB	SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
pH	SB	SB	SB	SB	SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Secchi Disk Depth	SB	SB	SB	SB	SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB

TABLE 4. CONVENTIONAL PARAMETERS MEASURED IN SAGINAW BAY (SB) AND GRAND TRAVERSE BAY (GTB) BY MONITORING YEAR FOR SAMPLES COLLECTED BY THE MDEQ, GTBOCI AND GLEC.

	Data Year											
Parameter	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Calcium	SB	SB			SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Magnesium	SB	SB			SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Sulfate	SB	SB	SB		SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Chloride	SB	SB	SB	SB	SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Silicon	SB	SB	SB	SB	SB							
Alkalinity	SB	SB	SB		SB	SB GTB	SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Hardness	SB	SB	SB		SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Conductivity	SB	SB	SB	SB	SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Dissolved Solids	SB	SB	SB	SB	SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Suspended Solids	SB	SB	SB	SB	SB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Total Organic Carbon						SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Base Neutrals/ BTEX/MTBE							SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Cyanide									SB GTB	SB GTB	SB GTB	SB GTB

TABLE 5. TRACE METALS AND MERCURY MEASURED IN SAGINAW BAY (SB) AND GRAND TRAVERSE BAY (GTB) BY MONITORING YEAR FOR SAMPLES COLLECTED BY THE MDEQ, GTBOCI AND GLEC.

	Data Year											
Parameter	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Cadmium	SB	SB	SB			SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Chromium	SB	SB	SB			SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Copper	SB	SB	SB			SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Lead	SB	SB	SB			SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Nickel	SB	SB	SB			SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Zinc	SB	SB	SB			SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB
Mercury	SB		SB			SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB	SB GTB

TABLE 6. MICHIGAN RULE 57 WATER QUALITY VALUES FOR SELECTED METALS IN SAGINAW BAY. WITH THE EXCEPTION OF MERCURY, RULE 57 WATER QUALITY VALUES ARE EXPRESSED AS DISSOLVED METALS.

Station #60062	1998	1999	2000	2001	2002	2003	2004
Cadmium (ug/L)	2.37	2.24	2.45	2.50	2.50	2.34	2.54
Chromium (ug/L)	78.9	74.1	81.9	88.4	86.1	77.7	85.5
Copper (ug/L)	9.56	8.96	9.94	10.8	10.5	9.41	10.4
Lead (ug/L)	11.2	10.3	11.8	12.8	12.6	11.0	12.4
Nickel (ug/L)	55.0	51.5	57.2	61.0	60.1	54.2	60.3
Zinc (ug/L)	110.2	103.2	114.5	122.2	120.5	108.5	136.9
Mercury (ng/L)	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Mean Hardness (mg/L)	108	100	113	122	120	106	119
Station #60063	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Cadmium (ug/L)	2.45	2.47	2.35	2.50	2.29	2.43	2.38
Chromium (ug/L)	81.9	82.5	78.3	100.5	75.9	80.7	19.5
Copper (ug/L)	9.94	10.0	9.49	12.3	9.18	9.79	9.64
Lead (ug/L)	11.8	11.9	11.1	14.0	10.6	11.5	11.3
Nickel (ug/L)	57.2	57.6	54.6	71.2	53.3	56.3	55.9
Zinc (ug/L)	114.5	115.3	109.3	141.4	105.8	112.8	127.1
Mercury (ng/L)	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Mean Hardness (mg/L)	113	114	107	145	103	111	109
Station #90252	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Cadmium (ug/L)	2.50	2.43	2.50	2.50	2.50	2.50	2.50
Chromium (ug/L)	86.1	81.3	83.7	106.7	98.2	90.1	111.1
Copper (ug/L)	10.5	9.87	10.2	13.1	12.0	11.0	13.7
Lead (ug/L)	12.6	11.7	12.1	14.0	14.0	13.4	14.0
Nickel (ug/L)	60.1	56.7	58.4	75.8	69.6	63.1	79.0
Zinc (ug/L)	120.5	113.6	117.1	150.5	138.1	126.4	179.7
Mercury (ng/L)	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Mean Hardness (mg/L)	120	112	116	156	141	127	164
Station #320189	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Cadmium (ug/L)	2.35	2.47	2.50	2.50	2.50	2.30	2.50
Chromium (ug/L)	78.3	82.5	87.2	98.8	92.5	76.5	90.7
Copper (ug/L)	9.49	10.0	10.6	12.1	11.3	9.3	11.1
Lead (ug/L)	11.1	11.9	12.8	14.0	13.8	10.8	13.5
Nickel (ug/L)	54.6	57.6	61.0	70.0	65.4	64.8	64.1
Zinc (ug/L)	109.3	115.3	122.2	138.9	129.8	106.7	145.6
Mercury (ng/L)	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Mean Hardness (mg/L)	107	114	122	142	131	104	128

TABLE 7. MICHIGAN RULE 57 WATER QUALITY VALUES FOR SELECTED METALS IN GRAND TRAVERSE BAY. WITH THE EXCEPTION OF MERCURY, RULE 57 WATER QUALITY VALUES ARE EXPRESSED AS DISSOLVED METALS.

Station #450132	1998	1999	2000	2001	2002	2003	2004
Cadmium (ug/L)	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Chromium (ug/L)	90.1	92.5	90.7	93.0	92.5	92.5	94.2
Copper (ug/L)	11.0	11.3	11.1	11.4	11.3	11.3	11.5
Lead (ug/L)	13.3	13.8	13.5	13.9	13.7	13.8	14.1
Nickel (ug/L)	63.1	65.4	63.5	65.8	65.4	64.8	66.6
Zinc (ug/L)	126.4	128.9	127.2	133.9	128.9	129.8	151.4
Mercury (ng/L)	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Mean Hardness (mg/L)	127	130	128	136	130	131	134
Station #450133	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Cadmium (ug/L)	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Chromium (ug/L)	90.1	93.0	92.5	93.0	92.5	92.5	93.0
Copper (ug/L)	11.0	11.4	11.1	11.4	11.3	11.3	11.4
Lead (ug/L)	13.3	13.9	13.6	13.9	13.8	13.8	13.9
Nickel (ug/L)	63.1	65.8	63.9	65.8	65.4	65.4	65.8
Zinc (ug/L)	126.4	129.8	128.1	129.8	128.9	128.9	65.8
Mercury (ng/L)	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Mean Hardness (mg/L)	127	131	129	131	130	130	132
Station #280288	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Cadmium (ug/L)	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Chromium (ug/L)	90.1	92.5	92.5	93.6	92.5	90.7	92.5
Copper (ug/L)	11.0	11.2	11.3	11.4	11.3	11.1	11.3
Lead (ug/L)	13.3	13.7	13.8	14.0	13.6	13.5	13.8
Nickel (ug/L)	63.1	65.8	65.4	66.2	65.4	63.5	65.4
Zinc (ug/L)	126.4	128.9	128.1	133.1	128.1	127.2	148.5
Mercury (ng/L)	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Mean Hardness (mg/L)	127	130	129	135	129	128	131
Station #280289	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Cadmium (ug/L)	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Chromium (ug/L)	86.6	94.2	92.5	93.0	91.9	92.5	91.9
Copper (ug/L)	10.5	11.5	11.2	11.4	11.2	11.2	11.2
Lead (ug/L)	12.7	14.0	13.7	13.9	13.7	13.7	13.7
Nickel (ug/L)	60.6	66.0	65.8	65.8	64.9	65.8	64.9
Zinc (ug/L)	121.3	132.3	128.9	133.9	129.8	128.9	147.6
Mercury (ng/L)	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Mean Hardness (mg/L)	121	134	130	136	131	130	130

TABLE 8. MICHIGAN RULE 57 WATER QUALITY VALUES FOR BTEX, MTBE AND TOTAL CYANIDE.

Analyte	Water Quality Value
CN	FCV = 5.2 ug/L
MTBE	HCV = 100 ug/L
Benzene	HCV = 12 ug/L
Toluene	FCV = 140 ug/L
Ethylbenzene	FCV = 18 ug/L
Xylene	FCV = 35 ug/L

TABLE 9. MICHIGAN RULE 57 WATER QUALITY VALUES FOR BASE/NEUTRAL ORGANICS.

Analyte	Quantification Level (ug/L)	R. 57 Water Quality Value (ug/L)	
Group 1: Quantification Level Below R. 57 Water Quality Value			
1,2,4-Trichlorobenzene	2.0	FCV =	30
1,2-Dichlorobenzene	1.0	FCV =	13
1,3-Dichlorobenzene	1.0	FCV =	28
1,4-Dichlorobenzene	1.0	FCV =	16
Acenaphthylene	1.0	FCV =	7.2*
Acenapthene	1.0	FCV =	38
Anthracene	1.0	FCV =	2.8*
Bis(2-chloroisopropyl)ether	1.0	HCV =	6
Bis(2-ethylhexyl)phthalate	2.0	HCV =	25
Butyl benzyl phthalate	1.0	HNV =	6.9
Chrysene	1.0	HCV =	1.5*
Diethyl phthalate	1.0	FCV =	110
Di-n-butyl phthalate	1.0	FCV =	9.7
Fluoranthene	1.0	FCV =	1.6
Fluorene	1.0	FCV =	12
Hexachloroethane	1.0	HCV =	5.3
Isophorone	1.0	HCV =	310
Naphthalene	1.0	FCV =	13
Nitrobenzene	2.0	HCV =	4.7
Phenanthrene	1.0	FCV =	2.4
Pyrene	1.0	FCV =	2.5*
Group 2: Quantification Level Above R. 57 Water Quality Value			
2-Methylnaphthalene	5.0	FCV =	4.8*
Bis(2-chloroethyl)ether	1.0	HCV =	0.79
Carbazole	10	FCV =	4
Dibenzofuran	5.0	FCV =	4
Hexachlorobenzene	2.0	WV =	0.0003
Hexachlorobutadiene	2.0	WV =	0.053
Hexachlorocyclopentadiene	10	FCV =	0.07*

TABLE 9 (cont). MICHIGAN RULE 57 WATER QUALITY VALUES FOR BASE/NEUTRAL ORGANICS.

Analyte	Quantification Level (ug/L)	R. 57 Water Quality Value (ug/L)
Group 3: No R. 57 Water Quality Value Currently Developed		
2,4-Dinitrotoluene	5.0	
2,6-Dinitrotoluene	5.0	
2-Chloronaphthalene	2.0	
2-Nitroaniline	20	
3-Nitroaniline	20	
4-Bromophenyl phenylether	2.0	
4-Chlorophenyl phenylether	1.0	
4-Nitroaniline	20	
Azobenzene	2.0	
Benzo(a)anthracene	1.0	
Benzo(a)pyrene	2.0	
Benzo(b)fluoranthene	2.0	
Benzo(g,h,i)perylene	2.0	
Benzo(k)fluoranthene	2.0	
Bis(2-chloroethoxy)methane	2.0	
Dibenz(a,h)anthracene	2.0	
Dimethyl phthalate	2.0	
Di-n-octyl phthalate	2.0	
Indeno(1,2,3-cd)pyrene	2.0	
N-Nitrosodimethylamine	5.0	
N-Nitrosodi-n-propylamine	2.0	
N-Nitrosodiphenylamine	2.0	

FCV = Final Chronic Value.
HCV = Human Cancer Value (Drinking Water).
HNV = Human Non-Cancer Value (Drinking Water).
WV = Wildlife Value.
* = Value shown is an estimate based on available data.

TABLE 10. MEAN TRACE METALS CONCENTRATIONS AND HARDNESS AT SELECTED LOCATIONS IN SAGINAW BAY (1998-2004).

Station #60062	1998	1999	2000	2001	2002	2003	2004
Cadmium (ug/L)	n.a.	0.008	n.a.	0.004	0.002	0.002	0.007
Chromium (ug/L)	n.a.	0.774	n.a.	0.178	0.172	0.181	0.199
Copper (ug/L)	n.a.	0.555	n.a.	0.639	0.758	0.550	0.878
Lead (ug/L)	n.a.	0.222	n.a.	0.192	0.262	0.240	0.214
Nickel (ug/L)	n.a.	1.360	n.a.	1.053	1.217	0.859	1.122
Zinc (ug/L)	n.a.	0.813	n.a.	0.739	1.208	1.120	1.768
Mercury (ng/L)	n.a.	*2.5	n.a.	0.608	0.490	0.617	0.610
Mean Hardness (mg/L)	108	100	113	122	120	106	119
Station #60063	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Cadmium (ug/L)	0.007	0.008	n.a.	0.003	0.002	0.000	0.005
Chromium (ug/L)	0.000	1.060	n.a.	0.248	0.073	0.087	0.112
Copper (ug/L)	0.591	0.735	n.a.	0.913	0.838	0.616	0.859
Lead (ug/L)	0.101	0.388	n.a.	0.301	0.139	0.105	0.122
Nickel (ug/L)	1.450	1.610	n.a.	1.298	0.951	0.840	1.061
Zinc (ug/L)	3.390	0.878	n.a.	0.840	0.504	0.620	0.810
Mercury (ng/L)	0.633	*12.7	n.a.	0.693	0.310	0.500	0.437
Mean Hardness (mg/L)	113	114	107	145	103	111	109
Station #90252	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Cadmium (ug/L)	0.015	0.009	0.010	0.003	0.003	0.001	0.012
Chromium (ug/L)	0.000	0.892	0.210	0.312	0.194	0.180	0.394
Copper (ug/L)	1.060	0.745	0.820	1.121	1.030	0.856	1.652
Lead (ug/L)	0.752	0.393	0.268	0.339	0.291	0.214	0.443
Nickel (ug/L)	2.050	1.590	1.300	1.390	1.306	1.059	1.663
Zinc (ug/L)	2.410	1.060	0.820	1.225	1.669	0.907	2.293
Mercury (ng/L)	*1.88	*3.95	0.430	0.723	0.791	0.810	*1.48
Mean Hardness (mg/L)	120	112	116	156	141	127	164
Station #320189	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Cadmium (ug/L)	0.022	0.008	n.a.	0.005	0.001	0.001	0.005
Chromium (ug/L)	0.000	1.110	n.a.	0.328	0.083	0.085	0.103
Copper (ug/L)	1.380	0.912	n.a.	0.839	0.757	0.509	0.864
Lead (ug/L)	1.130	0.485	n.a.	0.435	0.239	0.170	0.201
Nickel (ug/L)	2.110	1.670	n.a.	1.283	1.129	0.805	1.109
Zinc (ug/L)	3.640	1.580	n.a.	1.603	1.160	0.731	1.248
Mercury (ng/L)	*3.66	*2.71	n.a.	0.695	0.417	0.581	0.639
Mean Hardness (mg/L)	107	114	122	142	131	104	128

n.a. = not analyzed

* Exceeds the current Michigan Rule 57 water quality value of 1.3 ng/L.

TABLE 11. SEDIMENT CHEMISTRY DATA AT FOUR SITES ON SAGINAW BAY AND GRAND TRAVERSE BAY.

Parameter	Saginaw Bay				Grand Traverse Bay			
	60062	60063	320189	90252	450132	450133	280288	280289
Arsenic (mg/kg DW)	5.8	1.4	2.3	3.0				
Barium (mg/kg DW)	78	22	14	37				
Cadmium (mg/kg DW)	2 K	2 K	2 K	2 K	2 K	2 K	2 K	2.1
Calcium (mg/kg DW)	24600	33800	25600	64900				
Chromium (mg/kg DW)	45	8	8	10	9	19	8	23
COD (mg/kg DW)	160000	6200	36000	5200				
Copper (mg/kg DW)	40	9	10	11	11	31	9	37
Cyanide (mg/kg DW)	0.5 K	0.2 K	0.2 K	0.2 K				
Lead (mg/kg DW)	41	5 K	10	5 K	16	50	5 K	74
Magnesium (mg/kg DW)	18300	13700	11000	22100				
Mercury (mg/kg DW)	0.3 K	0.05 K	0.1 K	0.05 K	0.1 K	0.2 K	0.05 K	0.2 K
Nickel (mg/kg DW)	30	7	8	10	8	18	8	22
Kjeldahl Nitrogen (mg/kg DW)	7000	240	1900	150				
Phenolics (mg/kg DW)	4.1	0.5 K	0.8 K	0.5 K				
Total Phosphorus (mg/kg DW)	1000	150	280	140	410	800	420	900
Potassium (mg/kg DW)	1880	530	343	731				
Selenium (mg/kg DW)	0.9	0.5 K	0.5 K	0.5 K				
Silver (mg/kg DW)	0.3	0.25 K	0.25 K	0.25 K				
Sodium (mg/kg DW)	104	50 K	50 K	50 K				
Total Solids (%TS)	16.1	74.8	49.4	76.5	47.4	24.7	59.4	22.3
Zinc (mg/kg DW)	149	15	40	26	32	95	22	133

K = below quantification limit

TABLE 12. MEAN TRACE METALS CONCENTRATIONS AND HARDNESS AT SELECTED LOCATIONS IN GRAND TRAVERSE BAY (1998-2004).

Station #450132	1998	1999	2000	2001	2002	2003	2004
Cadmium (ug/L)	0.009 BDL	0.010	0.007	0.004	0.000	0.004	0.004
Chromium (ug/L)	0 BDL	0.918	0.330	0.250	0.140	0.157	0.203
Copper (ug/L)	0.393	0.403	0.420	0.382	0.373	0.383	0.436
Lead (ug/L)	0.0073 BDL	0.012	0.011	0.030	0.010	0.008	0.019
Nickel (ug/L)	1.340	1.169	0.840	0.850	0.869	0.831	0.675
Zinc (ug/L)	0.1628 BDL	0.170	0.210	0.179	0.260	0.916	3.600
Mercury (ng/L)	0.302	0.404	0.210	0.120	0.200	0.220	0.140
Mean Hardness (mg/L)	127	130	128	136	130	131	134
Station #450133	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Cadmium (ug/L)	0 BDL	0.011	0.003	0.002	0.000	0.004	0.005
Chromium (ug/L)	0 BDL	0.781	0.320	0.270	0.150	0.197	0.220
Copper (ug/L)	0.378	0.383	0.400	0.376	0.356	0.388	0.439
Lead (ug/L)	0.0091 BDL	0.010	0.011	0.028	0.009	0.006	0.019
Nickel (ug/L)	1.210	1.076	0.840	0.890	0.872	0.872	0.690
Zinc (ug/L)	0.1183 BDL	0.143	0.110	0.158	0.530	0.394	1.110
Mercury (ng/L)	0.214	*3.388	0.140	0.250	0.130	0.310	0.120
Mean Hardness (mg/L)	127	131	129	131	130	130	132
Station #280288	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Cadmium (ug/L)	0.0042 BDL	0.007	0.004	0.008	0.000	0.004	0.004
Chromium (ug/L)	0 BDL	0.835	0.310	0.260	0.113	0.167	0.193
Copper (ug/L)	0.395	0.406	0.400	0.366	0.358	0.388	0.420
Lead (ug/L)	0.0062 BDL	0.007	0.009	0.025	0.009	0.006	0.017
Nickel (ug/L)	1.370	1.149	0.830	0.800	0.893	0.833	0.655
Zinc (ug/L)	0.1178 BDL	0.133	0.140	0.160	0.220	0.414	1.160
Mercury (ng/L)	0.222	*4.133	0.230	0.000	0.180	0.290	0.160
Mean Hardness (mg/L)	127	130	129	135	129	128	131
Station #280289	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Cadmium (ug/L)	0.0026 BDL	0.007	0.008	0.001	0.000	0.004	0.004
Chromium (ug/L)	0 BDL	0.805	0.320	0.270	0.112	0.170	0.198
Copper (ug/L)	0.4071 BDL	0.388	0.380	0.365	0.350	0.369	0.426
Lead (ug/L)	0.0053 BDL	0.009	0.011	0.106	0.009	0.006	0.025
Nickel (ug/L)	1.400	1.127	0.840	0.820	0.878	0.829	0.663
Zinc (ug/L)	0.1308 BDL	0.141	0.110	0.165	0.210	0.552	2.580
Mercury (ng/L)	0.302	0.723	0.190	0.100	0.220	0.350	0.140
Mean Hardness (mg/L)	121	134	130	136	131	130	130

BDL = below detection limit

* Exceeds the current Michigan Rule 57 water quality value of 1.3 ng/L.

APPENDIX A

Saginaw Bay Water Chemistry Data

Table A1.1. Water chemistry data collected in 1993 from Saginaw Bay station #060062.

PARAMETER	Units	6/22/1993	7/20/1993	9/7/1993	Mean	Median	Standard Deviation
Total Ammonia	mg N/L						
Total Nitrate	mg N/L						
Total Nitrite	mg N/L	0.005	0.004	0.005	0.005	0.005	0.001
Total Kjeldahl Nitrogen	mg N/L	0.39	0.27	0.31	0.32	0.31	0.06
Total Phosphorus	mg P/L	0.01	0.011	0.009	0.010	0.010	0.001
Total Ortho Phosphate	mg P/L	0.002	0.001	0.001	0.001	0.001	0.001
Total Sulfate	mg/L	17	17	15	16	17	1
Total Calcium	mg/L			30.4	30.4		
Total Chloride	mg/L	12	12	9	11	12	2
Total Magnesium	mg/L			8	8		
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	182	177	152	170	177	16
Total Suspended Solids	mg/L	4 K	4 K	4 K	2	2	0
Hardness ($CaCO_3$)	mg/L			109	109		
Chlorophyll a	ug/L	2	6	6	5	6	2
Conductivity (lab)	umho/cm	279	272	231	261	272	26
Conductivity (field)	umho/cm	262	255	234	250	259	15
Dissolved Oxygen (field)	mg/L	9.1	10.1	9.6	9.6	9.6	0.5
pH (lab)	pH		8.7	8.6	8.7	8.7	0.1
pH (field)	pH	8	8.3	8.3	8.2	8.2	0.2
Temperature (field)	^{o}C	17.3	21.5	19.6	19.5	19.4	2.1
Turbidity	NTU						
Secchi Disk reading	feet	17.1	7.0		12.1	12.1	7.1
Station Depth	feet	21/42	21/42	21/42			
Cadmium	ug/L	0.35					
Chromium	ug/L	1 K					
Copper	ug/L	0.75					
Lead	ug/L	0.5 K					
Nickel	ug/L	1 K					
Zinc	ug/L	6					
Mercury	ug/L	0.1 K					

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A1.2. Water chemistry data collected in 1993 from Saginaw Bay station #060063.

PARAMETER	Units	6/23/1993	7/20/1993	9/7/1993	Mean	Median	Standard Deviation
Total Ammonia	mg N/L						
Total Nitrate	mg N/L						
Total Nitrite	mg N/L	0.005	0.008	0.004	0.006	0.005	0.002
Total Kjeldahl Nitrogen	mg N/L	0.34	0.32	0.41	0.36	0.34	0.05
Total Phosphorus	mg P/L	0.013	0.017	0.017	0.016	0.017	0.002
Total Ortho Phosphate	mg P/L	0.003	0.001	0.001	0.002	0.001	0.001
Total Sulfate	mg/L	14	18	14	15	14	2
Total Calcium	mg/L			31	31		
Total Chloride	mg/L	14	14	10	13	14	2
Total Magnesium	mg/L			8.5	8.5		
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	193+	187+	161+	180	187	17
Total Suspended Solids	mg/L	4 K	4 K	4 K	2	2	0
Hardness ($CaCO_3$)	mg/L			112	112		
Chlorophyll a	ug/L	1	3	2	2	2	1
Conductivity (lab)	umho/cm	297	287	248	277	287	26
Conductivity (field)	umho/cm	279	270	247	265	275	17
Dissolved Oxygen (field)	mg/L		9.8	9.8	9.8	276	0
pH (lab)	pH		8.5	8.8	8.7	8.7	0.2
pH (field)	pH	8.1	8.2	8.5	8.3	8.2	0.2
Temperature (field)	°C	20.3	22.9	19.8	21.0	21.6	1.7
Turbidity	NTU						
Secchi Disk reading	feet	10	5	7.5	7.5	7.4	2.5
Station Depth	feet	12	12	12			
Cadmium	ug/L	0.3					
Chromium	ug/L	1K					
Copper	ug/L	0.5K					
Lead	ug/L	0.5K					
Nickel	ug/L	1K					
Zinc	ug/L	2K					
Mercury	ug/L	0.1K					

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A1.3. Water chemistry data collected in 1993 from Saginaw Bay station #090250.

PARAMETER	Units	6/23/1993	7/20/1993	9/7/1993	Mean	Median	Standard Deviation
Total Ammonia	mg N/L						
Total Nitrate	mg N/L						
Total Nitrite	mg N/L	0.004	0.004	0.004	0.004	0.004	0.000
Total Kjeldahl Nitrogen	mg N/L	0.34	0.32	0.34	0.33	0.34	0.01
Total Phosphorus	mg P/L	0.016	0.015	0.016	0.016	0.016	0.001
Total Ortho Phosphate	mg P/L	0.002	0.001	0.001	0.001	0.001	0.001
Total Sulfate	mg/L	16	16	17	16	16	1
Total Calcium	mg/L			30.1	30.1		
Total Chloride	mg/L	12	12	9	11	12	2
Total Magnesium	mg/L			8	8		
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	185+	181+	156+	174	181	16
Total Suspended Solids	mg/L	7 A	4 K	4 K	4	2	3
Hardness ($CaCO_3$)	mg/L			108	108		
Chlorophyll a	ug/L	5	7	8	7	7	2
Conductivity (lab)	umho/cm	284	278	240	267	278	24
Conductivity (field)	umho/cm	267	262	240	256	262	14
Dissolved Oxygen (field)	mg/L	8.9	9.6	9.2	9.2	9.2	0.4
pH (lab)	pH		8.6	8.6	8.6	8.6	0.0
pH (field)	pH	8	8.3		8.2	8.2	0.2
Temperature (field)	^{o}C	18.7	22.6	20.6	20.6	20.6	2.0
Turbidity	NTU						
Secchi Disk reading	feet	8	6.0	5	6.3	6.0	1.5
Station Depth	feet	26	26	26			
Cadmium	ug/L	0.23					
Chromium	ug/L	1K					
Copper	ug/L	1.15K					
Lead	ug/L	0.5K					
Nickel	ug/L	1K					
Zinc	ug/L	4					
Mercury	ug/L	0.1K					

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A1.4. Water chemistry data collected in 1993 from Saginaw Bay Station # 790134.

PARAMETER	Units	6/23/1993	9/7/1993	Mean	Median	Standard Deviation
Total Ammonia	mg N/L					
Total Nitrate	mg N/L					
Total Nitrite	mg N/L	0.007	0.001 W	0.004	0.004	0.004
Total Kjeldahl Nitrogen	mg N/L	0.43	0.42	0.43	0.43	0.01
Total Phosphorus	mg P/L	0.018	0.021	0.020	0.020	0.002
Total Ortho Phosphate	mg P/L	0.001	0.002	0.002	0.002	0.001
Total Sulfate	mg/L	20	17	19	19	2
Total Calcium	mg/L		31.9	31.9		
Total Chloride	mg/L	22	17	20	20	4
Total Magnesium	mg/L		9.6	9.6		
Total Organic Carbon	mg/L					
Total Dissolved Solids	mg/L	234+	183+			
Total Suspended Solids	mg/L	4	4	4	4	0
Hardness ($CaCO_3$)	mg/L		119	119		
Chlorophyll a	ug/L	1	7	4	4	4
Conductivity (lab)	umho/cm	360	282	321	321	55
Conductivity (field)	umho/cm	337	278	308	308	42
Dissolved Oxygen (field)	mg/L	8	9.6	9	9	1
pH (lab)	pH		9	9	9	
pH (field)	pH	8	8.6	8	8	0
Temperature (field)	°C	19.7	21	20.4	20.4	1
Turbidity	NTU					
Secchi Disk reading	feet	9.5	5	7	7	3
Station Depth	feet	13	13			
Cadmium	ug/L	0.123K				
Chromium	ug/L	1K				
Copper	ug/L	0.930K				
Lead	ug/L	0.5K				
Nickel	ug/L	1K				
Zinc	ug/L	2K				
Mercury	ug/L	0.1K				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A1.5. Water chemistry data collected in 1993 from Saginaw Bay station #320188.

PARAMETER	Units	6/23/1993	9/7/1993	Mean	Median	Standard Deviation
Total Ammonia	mg N/L					
Total Nitrate	mg N/L					
Total Nitrite	mg N/L	0.006	0.003	0.005	0.005	0.002
Total Kjeldahl Nitrogen	mg N/L	0.41	0.36	0.39	0.39	0.04
Total Phosphorus	mg P/L	0.014	0.013	0.014	0.014	0.001
Total Ortho Phosphate	mg P/L	0.001	0.001	0.001	0.001	0.000
Total Sulfate	mg/L	20	14	17	17	4
Total Calcium	mg/L		29.6	29.6		
Total Chloride	mg/L	21	8	15	15	9
Total Magnesium	mg/L		7.9	7.9		
Total Organic Carbon	mg/L					
Total Dissolved Solids	mg/L	233+	153+	193	193	57
Total Suspended Solids	mg/L	4 K	4	2	2	0
Hardness ($CaCO_3$)	mg/L		107	107		
Chlorophyll a	ug/L	4	5	5	5	1
Conductivity (lab)	umho/cm	359	235	297	297	88
Conductivity (field)	umho/cm	331	234	283	283	69
Dissolved Oxygen (field)	mg/L	8.8	9.8	9.3	9	1
pH (lab)	pH		8.9	8.9	9	
pH (field)	pH	8.4	8.4	8.4	8	0
Temperature (field)	°C	19.8	20.3	20.1	20	0
Turbidity	NTU					
Secchi Disk reading	feet	10.5	5	7.8	8	4
Station Depth	feet	12	12			
Cadmium	ug/L	0.18				
Chromium	ug/L	1K				
Copper	ug/L	0.98				
Lead	ug/L	0.5K				
Nickel	ug/L	1K				
Zinc	ug/L	6.5				
Mercury	ug/L	0.1K				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
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ID = Insufficient data for calculation.
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JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
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Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A1.6. Water chemistry data collected in 1993 from Saginaw Bay station # 320189.

PARAMETER	Units	6/22/1993	7/20/1993	9/7/1993	Mean	Median	Standard Deviation
Total Ammonia	mg N/L						
Total Nitrate	mg N/L						
Total Nitrite	mg N/L	0.011	0.005	0.002	0.006	0.005	0.005
Total Kjeldahl Nitrogen	mg N/L	0.55	0.62	0.60	0.59	0.60	0.04
Total Phosphorus	mg P/L	0.021	0.026	0.024	0.024	0.024	0.003
Total Ortho Phosphate	mg P/L	0.002	0.003	0.004	0.003	0.003	0.001
Total Sulfate	mg/L	25	20	18	21	20	4
Total Calcium	mg/L			30.6	30.6		
Total Chloride	mg/L	22	19	19	20	19	2
Total Magnesium	mg/L			11.2	11.2		
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	240+	202+	188+	210	202	27
Total Suspended Solids	mg/L	15	16	13	15	15	2
Hardness ($CaCO_3$)	mg/L			123	123		
Chlorophyll a	ug/L	7	12	8	9	8	3
Conductivity (lab)	umho/cm	369	310	290	323	310	41
Conductivity (field)	umho/cm	342	296	286	308	296	30
Dissolved Oxygen (field)	mg/L	9.1	9.2	9.5	9.3	9.2	0.2
pH (lab)	pH		8.8	9.3	9.1	9.1	0.4
pH (field)	pH	8.4	8.5		8.5	8.5	0.1
Temperature (field)	°C	21.1	23.3	20.1	21.5	21.1	1.6
Turbidity	NTU						
Secchi Disk reading	feet	6	2	3	4	3	2
Station Depth	feet	12	12	12			
Cadmium	ug/L	0.23					
Chromium	ug/L	1K					
Copper	ug/L	1.13					
Lead	ug/L	0.5K					
Nickel	ug/L	1K					
Zinc	ug/L	2K					
Mercury	ug/L	0.1K					

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A1.7. Water chemistry data collected in 1993 from Saginaw Bay station #090252.

PARAMETER	Units	6/22/1993	7/21/1993	9/8/1993	Mean	Median	Standard Deviation
Total Ammonia	mg N/L						
Total Nitrate	mg N/L						
Total Nitrite	mg N/L	0.018	0.006	0.006	0.010	0.006	0.007
Total Kjeldahl Nitrogen	mg N/L	0.57	0.45	0.39	0.47	0.45	0.09
Total Phosphorus	mg P/L	0.055	0.027	0.025	0.036	0.027	0.017
Total Ortho Phosphate	mg P/L	0.009	0.003	0.004	0.005	0.004	0.003
Total Sulfate	mg/L	22	17	18	19	18	3
Total Calcium	mg/L			33.8	33.8		
Total Chloride	mg/L	29	13	15	19	15	9
Total Magnesium	mg/L			9.3	9.3		
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	261+	179+	181+	207	181	47
Total Suspended Solids	mg/L	22	4	3	10	4	11
Hardness ($CaCO_3$)	mg/L			123	123		
Chlorophyll a	ug/L	16	5	12	11	12	6
Conductivity (lab)	umho/cm	401	275	278	318	278	72
Conductivity (field)	umho/cm	376	260	276	304	276	63
Dissolved Oxygen (field)	mg/L	9.1	8.7	9.2	9.0	9.1	0.3
pH (lab)	pH		8.2	8.6	8.4	8.4	0.3
pH (field)	pH	7.9	7.9	8.1	8.0	7.9	0.1
Temperature (field)	^{o}C	21.2	22.4	19.9	21.2	21.2	1.3
Turbidity	NTU						
Secchi Disk reading	feet		6	5.5	5.8	5.8	0.4
Station Depth	feet	16	16	16			
Cadmium	ug/L	0.1K					
Chromium	ug/L	1K					
Copper	ug/L	1.13					
Lead	ug/L	0.5K					
Nickel	ug/L	1K					
Zinc	ug/L	6					
Mercury	ug/L	0.1K					

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A2.1. Water chemistry data collected* in 1994 from Saginaw Bay station #060062.

PARAMETER	Units	5/17/1994	7/12/1994	9/13/1994	Mean	Median	Standard Deviation
Total Ammonia	mg N/L						
Total Nitrate	mg N/L						
Total Nitrite	mg N/L	0.003	0.006	0.003	0.004	0.003	0.002
Total Kjeldahl Nitrogen	mg N/L	0.22	0.3	0.48	0.33	0.30	0.13
Total Phosphorus	mg P/L	0.013	0.017	0.027	0.019	0.017	0.007
Total Ortho Phosphate	mg P/L	0.001 WT	0.001 WT	0.002 T	0.001	0.001	0.001
Total Sulfate	mg/L	10	18	17	15	17	4
Total Calcium	mg/L	31			31		
Total Chloride	mg/L	9	12	9	10	9	2
Total Magnesium	mg/L	7.9			7.9		
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	172	170	155	166	170	9
Total Suspended Solids	mg/L	4A+4	4K+4K	8	5	4	3
Hardness ($CaCO_3$)	mg/L	109			109		
Chlorophyll a	ug/L	6	6		6	6	0
Conductivity (lab)	umho/cm	265	262	239	255	262	14
Conductivity (field)	umho/cm	264	261	240	255	261	13
Dissolved Oxygen (field)	mg/L	10	8.3	9.1	9.133		
pH (lab)	pH	8.2	8.5	8.6	8.4	8.5	0.2
pH (field)	pH	8	8.5	8.6	8.4	8.5	0.3
Temperature (field)	^{o}C	10.2	20.6	19.2	16.7	19.2	5.6
Turbidity	NTU						
Secchi Disk reading	feet	7	7	8	7	7	1
Station Depth	feet	21	21	21			
Cadmium	ug/L	0.1K					
Chromium	ug/L	1K					
Copper	ug/L	0.5K					
Lead	ug/L	0.5K					
Nickel	ug/L	1K					
Zinc	ug/L	2K					
Mercury	ug/L						

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A2.2. Water chemistry data collected in 1994 from Saginaw Bay station #060063.

PARAMETER	Units	5/17/1994		7/12/1994		Mean	Median	Standard Deviation
Total Ammonia	mg N/L							
Total Nitrate	mg N/L							
Total Nitrite	mg N/L	0.004		0.051		0.028	0.028	0.033
Total Kjeldahl Nitrogen	mg N/L	0.30		0.59		0.45	0.45	0.21
Total Phosphorus	mg P/L	0.013		0.026		0.020	0.020	0.009
Total Ortho Phosphate	mg P/L	0.001	W	0.001	T	0.001	0.001	0.000
Total Sulfate	mg/L	11		23		17	17	8
Total Calcium	mg/L	34				34		
Total Chloride	mg/L	16		24		20	20	6
Total Magnesium	mg/L	9.1				9.1		
Total Organic Carbon	mg/L							
Total Dissolved Solids	mg/L	201		237		219	219	25
Total Suspended Solids	mg/L	4	A	4		4	4	0
Hardness ($CaCO_3$)	mg/L	122				122		
Chlorophyll a	ug/L	1		7		4	4	4
Conductivity (lab)	umho/cm	310		365		338	338	39
Conductivity (field)	umho/cm							
Dissolved Oxygen (field)	mg/L	10.6						
pH (lab)	pH	8.3		8.5		8.4	8.4	0.1
pH (field)	pH							
Temperature (field)	^{o}C	12.3						
Turbidity	NTU							
Secchi Disk reading	feet							
Station Depth	feet	12		12				
Cadmium	ug/L	0.1K						
Chromium	ug/L	1K						
Copper	ug/L	4.6						
Lead	ug/L	0.5K						
Nickel	ug/L	1K						
Zinc	ug/L	6						
Mercury	ug/L							

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A2.3. Water chemistry data collected in 1994 from Saginaw Bay station #090250.

PARAMETER	Units	5/17/1994	7/12/1994	Mean	Median	Standard Deviation
Total Ammonia	mg N/L					
Total Nitrate	mg N/L					
Total Nitrite	mg N/L	0.004	0.007	0.006	0.006	0.002
Total Kjeldahl Nitrogen	mg N/L	0.32	0.38	0.35	0.35	0.04
Total Phosphorus	mg P/L	0.017	0.020	0.019	0.019	0.002
Total Ortho Phosphate	mg P/L	0.001 W	0.002 T	0.002	0.002	0.001
Total Sulfate	mg/L	11	18	15	15	5
Total Calcium	mg/L	34.3		34.3		
Total Chloride	mg/L	14	11	13	13	2
Total Magnesium	mg/L	8.9		8.9		
Total Organic Carbon	mg/L					
Total Dissolved Solids	mg/L	195	177	186	186	13
Total Suspended Solids	mg/L	6	7	7	7	1
Hardness ($CaCO_3$)	mg/L	122		122		
Chlorophyll a	ug/L	7	9	8	8	1
Conductivity (lab)	umho/cm	300	273	287	287	19
Conductivity (field)	umho/cm					
Dissolved Oxygen (field)	mg/L	10.3	8.2			
pH (lab)	pH	8.2	8.4	8.3	8.3	0.1
pH (field)	pH					
Temperature (field)	^{o}C	11.6	22.5	17.1	17.1	7.7
Turbidity	NTU					
Secchi Disk reading	feet					
Station Depth	feet	26	26			
Cadmium	ug/L	0.7				
Chromium	ug/L	1K				
Copper	ug/L	1.5				
Lead	ug/L	0.5K				
Nickel	ug/L	1K				
Zinc	ug/L	8				
Mercury	ug/L					

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A2.4. Water chemistry data collected in 1994 from Saginaw Bay station #790134.

PARAMETER	Units	7/13/1994	9/14/1994	Mean	Median	Standard Deviation
Total Ammonia	mg N/L					
Total Nitrate	mg N/L					
Total Nitrite	mg N/L	0.035	0.001 W	0.018	0.018	0.024
Total Kjeldahl Nitrogen	mg N/L	0.54	0.61	0.58	0.58	0.05
Total Phosphorus	mg P/L	0.031	0.031	0.031	0.031	0.000
Total Ortho Phosphate	mg P/L	0.001 T	0.003	0.002	0.002	0.001
Total Sulfate	mg/L	23	18	21	21	4
Total Calcium	mg/L					
Total Chloride	mg/L	21	14	18	18	5
Total Magnesium	mg/L					
Total Organic Carbon	mg/L					
Total Dissolved Solids	mg/L	216	172	194	194	31
Total Suspended Solids	mg/L	10	8	9	9	1
Hardness ($CaCO_3$)	mg/L					
Chlorophyll a	ug/L	8		8		
Conductivity (lab)	umho/cm	332	264	298	298	48
Conductivity (field)	umho/cm					
Dissolved Oxygen (field)	mg/L	7.6	9.2			
pH (lab)	pH	8.5	8.8	8.7	8.7	0.2
pH (field)	pH					
Temperature (field)	°C	22.2		22.2		
Turbidity	NTU					
Secchi Disk reading	feet	10		10.0		
Station Depth	feet	13	13			
Cadmium	ug/L	0.1K				
Chromium	ug/L	1K				
Copper	ug/L	0.5K				
Lead	ug/L	0.5K				
Nickel	ug/L	1K				
Zinc	ug/L	2K				
Mercury	ug/L					

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A2.5. Water chemistry data collected in 1994 from Saginaw Bay station #320188.

PARAMETER	Units	5/18/1994	7/13/1994	9/14/1994	Mean	Median	Standard Deviation
Total Ammonia	mg N/L						
Total Nitrate	mg N/L						
Total Nitrite	mg N/L	0.007	0.016	0.001 W	0.008	0.007	0.008
Total Kjeldahl Nitrogen	mg N/L	0.39	0.55	0.56	0.50	0.55	0.10
Total Phosphorus	mg P/L	0.013	0.034	0.027	0.025	0.027	0.011
Total Ortho Phosphate	mg P/L	0.003	0.001 T	0.002 T	0.002	0.002	0.001
Total Sulfate	mg/L	14	21	20	18	20	4
Total Calcium	mg/L	41.8			41.8		
Total Chloride	mg/L	23	19	13	18	19	5
Total Magnesium	mg/L	10.5			10.5		
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	241	203	164	203	203	39
Total Suspended Solids	mg/L	4 K	12	13	9	12	6
Hardness ($CaCO_3$)	mg/L	148			148		
Chlorophyll a	ug/L	1 K	10		5	5	7
Conductivity (lab)	umho/cm	371	313	253	312	313	59
Conductivity (field)	umho/cm						
Dissolved Oxygen (field)	mg/L	10.7					
pH (lab)	pH	8.3	8.6	8.8	8.6	8.6	0.3
pH (field)	pH						
Temperature (field)	^{o}C	11.5	22.4		17.0	17.0	7.7
Turbidity	NTU						
Secchi Disk reading	feet	11					
Station Depth	feet	12	12	12			
Cadmium	ug/L	0.1K					
Chromium	ug/L	1K					
Copper	ug/L	2.15					
Lead	ug/L	0.5K					
Nickel	ug/L	1K					
Zinc	ug/L	2K					
Mercury	ug/L						

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A2.6. Water chemistry data collected in 1994 from Saginaw Bay station #320189.

PARAMETER	Units	5/17/1994	7/13/1994	9/13/1994	Mean	Median	Standard Deviation
Total Ammonia	mg N/L						
Total Nitrate	mg N/L						
Total Nitrite	mg N/L	0.022	0.083	0.012	0.039	0.022	0.038
Total Kjeldahl Nitrogen	mg N/L	0.63	1.17	1.32	1.04	1.17	0.36
Total Phosphorus	mg P/L	0.032	0.04	0.054	0.042	0.040	0.011
Total Ortho Phosphate	mg P/L	0.004	0.001 T	0.005	0.003	0.004	0.002
Total Sulfate	mg/L	19	33	29	27	29	7
Total Calcium	mg/L	51.7			51.7		
Total Chloride	mg/L	29	30	22	27	29	4
Total Magnesium	mg/L	13.3			13.3		
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	285	235	188	236	235	49
Total Suspended Solids	mg/L	22	20	26	23	22	3
Hardness ($CaCO_3$)	mg/L	184			184		
Chlorophyll a	ug/L	7	16		12	12	6
Conductivity (lab)	umho/cm	438	361	290	363	361	74
Conductivity (field)	umho/cm						
Dissolved Oxygen (field)	mg/L						
pH (lab)	pH	8.4	8.8	8.6	8.6	8.6	0.2
pH (field)	pH						
Temperature (field)	^{o}C	12.4	22.9	20	18.4	20.0	5.4
Turbidity	NTU						
Secchi Disk reading	feet	6	2		4	4	3
Station Depth	feet	12	12	12			
Cadmium	ug/L	0.95					
Chromium	ug/L	1K					
Copper	ug/L	3					
Lead	ug/L	1.15					
Nickel	ug/L	1K					
Zinc	ug/L	20					
Mercury	ug/L						

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A2.7. Water chemistry data collected in 1994 from Saginaw Bay station # 090252.

PARAMETER	Units	5/18/1994	7/13/1994	9/14/1994	Mean	Median	Standard Deviation
Total Ammonia	mg N/L						
Total Nitrate	mg N/L						
Total Nitrite	mg N/L	0.001 T	0.053	0.017	0.024	0.017	0.027
Total Kjeldahl Nitrogen	mg N/L	0.65	0.59	0.45	0.56	0.59	0.10
Total Phosphorus	mg P/L	0.065	0.029	0.023	0.039	0.029	0.023
Total Ortho Phosphate	mg P/L	0.026	0.003	0.006	0.012	0.006	0.013
Total Sulfate	mg/L	15	24	27	22	24	6
Total Calcium	mg/L	49.8			49.8		
Total Chloride	mg/L	32	28	11	24	28	11
Total Magnesium	mg/L	13.2			13.2		
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	295	244	168	236	244	64
Total Suspended Solids	mg/L	4	4	25	11	4	12
Hardness ($CaCO_3$)	mg/L	179			179		
Chlorophyll a	ug/L	4	5		5	5	1
Conductivity (lab)	umho/cm	454	376	258	363	376	99
Conductivity (field)	umho/cm						
Dissolved Oxygen (field)	mg/L	10.1	7.6	9.1	8.9	9.1	1.3
pH (lab)	pH	8.2	8.3	8.7	8.4	8.3	0.3
pH (field)	pH						
Temperature (field)	^{o}C	12.5	22.3	19.3	18.0	19.3	5.0
Turbidity	NTU						
Secchi Disk reading	feet						
Station Depth	feet	16	16	16			
Cadmium	ug/L	0.1K					
Chromium	ug/L	1K					
Copper	ug/L	1.8					
Lead	ug/L	0.93					
Nickel	ug/L	1K					
Zinc	ug/L	4.5					
Mercury	ug/L						

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A3.1. Water chemistry data collected in 1995 from Saginaw Bay station #060062.

PARAMETER	Units	5/23/1995	7/18/1995	9/12/1995	Mean	Median	Standard Deviation
Total Ammonia	mg N/L						
Total Nitrate	mg N/L						
Total Nitrite	mg N/L	0.003	0.004	0.001 T	0.003	0.003	0.002
Total Kjeldahl Nitrogen	mg N/L	0.25	0.29	0.47	0.34	0.29	0.12
Total Phosphorus	mg P/L	0.01	0.012	0.031	0.018	0.012	0.012
Total Ortho Phosphate	mg P/L	0.002 T	0.001 W	0.003	0.002	0.002	0.001
Total Sulfate	mg/L	21	16	18	18	18	3
Total Calcium	mg/L						
Total Chloride	mg/L	13	10	11	11	11	2
Total Magnesium	mg/L						
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	185	163	153	167	163	16
Total Suspended Solids	mg/L	1	6	11	6	6	5
Hardness ($CaCO_3$)	mg/L			110	110		
Chlorophyll a	ug/L						
Conductivity (lab)	umho/cm	260	239	236	245	239	13
Conductivity (field)	umho/cm						
Dissolved Oxygen (field)	mg/L	10.5	9.4	9.7	9.9	9.7	0.6
pH (lab)	pH						
pH (field)	pH	7.6	8.3	7.8	7.9	7.8	0.4
Temperature (field)	^{o}C	13.6	18.6	19.6	17.3	18.6	3.2
Turbidity	NTU						
Secchi Disk reading	feet	5	2	4	4	4	2
Station Depth	feet	21/42	21/42	21/42			
Cadmium	ug/L						
Chromium	ug/L	1K					
Copper	ug/L	2.5					
Lead	ug/L	1.4					
Nickel	ug/L	1K					
Zinc	ug/L	10					
Mercury	ug/L	0.1K					

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A3.2. Water chemistry data collected in 1995 from Saginaw Bay station # 060063.

PARAMETER	Units	9/12/1995	Mean	Median	Standard Deviation
Total Ammonia	mg N/L				
Total Nitrate	mg N/L				
Total Nitrite	mg N/L	0.001	0.001		
Total Kjeldahl Nitrogen	mg N/L	0.45	0.45		
Total Phosphorus	mg P/L	0.025	0.025		
Total Ortho Phosphate	mg P/L	0.001 T	0.001		
Total Sulfate	mg/L	16	16		
Total Calcium	mg/L				
Total Chloride	mg/L	14	14		
Total Magnesium	mg/L				
Total Organic Carbon	mg/L				
Total Dissolved Solids	mg/L	164	164		
Total Suspended Solids	mg/L	8	8		
Hardness ($CaCO_3$)	mg/L	110	110		
Chlorophyll a	ug/L				
Conductivity (lab)	umho/cm	253	253		
Conductivity (field)	umho/cm				
Dissolved Oxygen (field)	mg/L	10.2	10.2		
pH (lab)	pH				
pH (field)	pH	7.9	7.9		
Temperature (field)	°C	18.7	18.7		
Turbidity	NTU				
Secchi Disk reading	feet	4	4		
Station Depth	feet	12			
Cadmium	ug/L	0.6			
Chromium	ug/L	1K			
Copper	ug/L	1.8			
Lead	ug/L	0.5K			
Nickel	ug/L	1K			
Zinc	ug/L	8			
Mercury	ug/L	0.1K			

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A3.3. Water chemistry data collected in 1995 from Saginaw Bay station #90250.

PARAMETER	Units	9/12/1995		Mean	Median	Standard Deviation
Total Ammonia	mg N/L					
Total Nitrate	mg N/L					
Total Nitrite	mg N/L	0.001	T	0.001		
Total Kjeldahl Nitrogen	mg N/L	0.49		0.49		
Total Phosphorus	mg P/L	0.039		0.039		
Total Ortho Phosphate	mg P/L	0.002	T	0.002		
Total Sulfate	mg/L	17		17		
Total Calcium	mg/L					
Total Chloride	mg/L	20		20		
Total Magnesium	mg/L					
Total Organic Carbon	mg/L					
Total Dissolved Solids	mg/L	181		181		
Total Suspended Solids	mg/L	12		12		
Hardness ($CaCO_3$)	mg/L	122		122		
Chlorophyll a	ug/L					
Conductivity (lab)	umho/cm	279		279		
Conductivity (field)	umho/cm					
Dissolved Oxygen (field)	mg/L	9.9		9.9		
pH (lab)	pH					
pH (field)	pH	7.9		7.9		
Temperature (field)	°C	19.8		19.8		
Turbidity	NTU					
Secchi Disk reading	feet	4		4		
Station Depth	feet	26		26		
Cadmium	ug/L	0.4				
Chromium	ug/L	1K				
Copper	ug/L	0.5K				
Lead	ug/L	1.4				
Nickel	ug/L	1K				
Zinc	ug/L	2K				
Mercury	ug/L	0.1K				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A3.4. Water chemistry data collected in 1995 from Saginaw Bay station #790134.

PARAMETER	Units	5/23/1995	7/18/1995	9/12/1995	Mean	Median	Standard Deviation
Total Ammonia	mg N/L						
Total Nitrate	mg N/L						
Total Nitrite	mg N/L	0.007	0.004	0.001 T	0.004	0.004	0.003
Total Kjeldahl Nitrogen	mg N/L	0.42	0.47	0.48	0.46	0.47	0.03
Total Phosphorus	mg P/L	0.014	0.041	0.022	0.026	0.022	0.014
Total Ortho Phosphate	mg P/L	0.001 W	0.001 W	0.001 W	0.001	0.001	0.000
Total Sulfate	mg/L	24	18	16	19	18	4
Total Calcium	mg/L						
Total Chloride	mg/L	28	15	12	18	15	9
Total Magnesium	mg/L						
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	267	296	153	239	267	76
Total Suspended Solids	mg/L	6	10	8	8	8	2
Hardness ($CaCO_3$)	mg/L			108	108		
Chlorophyll a	ug/L						
Conductivity (lab)	umho/cm	371	290	236	299	290	68
Conductivity (field)	umho/cm						
Dissolved Oxygen (field)	mg/L	10.4	8.6	10.0	9.7	10.0	0.9
pH (lab)	pH						
pH (field)	pH	7.8	8.1	7.9	7.9	7.9	0.2
Temperature (field)	^{o}C	14.7	22.8	18.8	18.8	18.8	4.1
Turbidity	NTU						
Secchi Disk reading	feet	9	4	3	5	4	3
Station Depth	feet	13	13	13			
Cadmium	ug/L	0.3					
Chromium	ug/L	1K					
Copper	ug/L	0.5K					
Lead	ug/L	0.5K					
Nickel	ug/L	1K					
Zinc	ug/L	5					
Mercury	ug/L	0.1K					

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A3.5. Water chemistry data collected in 1995 from Saginaw Bay station #320188.

PARAMETER	Units	5/23/1995	7/18/1995	9/12/1995	Mean	Median	Standard Deviation
Total Ammonia	mg N/L						
Total Nitrate	mg N/L						
Total Nitrite	mg N/L	0.006	0.003	0.001	0.003	0.002	0.003
Total Kjeldahl Nitrogen	mg N/L	0.37	0.59	0.41	0.46	0.49	0.12
Total Phosphorus	mg P/L	0.01	0.028	0.021	0.020	0.023	0.009
Total Ortho Phosphate	mg P/L	0.001 T	0.001 W	0.001 W	0.001	0.001	0.000
Total Sulfate	mg/L	25	17	15	19	17	5
Total Calcium	mg/L						
Total Chloride	mg/L	29	15	10	18	14	10
Total Magnesium	mg/L						
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	270	186	149	202	179	62
Total Suspended Solids	mg/L	9	14	13	12	13	3
Hardness ($CaCO_3$)	mg/L			108	108		
Chlorophyll a	ug/L						
Conductivity (lab)	umho/cm	376	281	229	295	268	75
Conductivity (field)	umho/cm						
Dissolved Oxygen (field)	mg/L	10.5	8.8	10.4	9.9	9.7	1.0
pH (lab)	pH						
pH (field)	pH	7.8	7.6	7.9	7.8	7.8	0.2
Temperature (field)	^{o}C	15.3	22.7	18.9	19.0	20.2	3.7
Turbidity	NTU						
Secchi Disk reading	feet	6.0	2.9	3.3	4.1	3.4	1.7
Station Depth	feet	12	12	12			
Cadmium	ug/L	0.3					
Chromium	ug/L	1K					
Copper	ug/L	0.5K					
Lead	ug/L	1.2					
Nickel	ug/L	1K					
Zinc	ug/L	2K					
Mercury	ug/L	0.1K					

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A3.6. Water chemistry data collected in 1995 from Saginaw Bay station #320189.

PARAMETER	Units	5/23/1995	7/18/1995	9/12/1995	Mean	Median	Standard Deviation
Total Ammonia	mg N/L						
Total Nitrate	mg N/L						
Total Nitrite	mg N/L	0.013	0.001 T	0.001 T	0.005	0.001	0.007
Total Kjeldahl Nitrogen	mg N/L	0.64	1.00	0.50	0.71	0.64	0.26
Total Phosphorus	mg P/L	0.041	0.061	0.024	0.042	0.041	0.019
Total Ortho Phosphate	mg P/L	0.003	0.001 T	0.001 T	0.002	0.001	0.001
Total Sulfate	mg/L	29	22	16	22	22	7
Total Calcium	mg/L						
Total Chloride	mg/L	21	23	14	19	21	5
Total Magnesium	mg/L						
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	239	194	160	198	194	40
Total Suspended Solids	mg/L	40	48	12	33	40	19
Hardness ($CaCO_3$)	mg/L			112	112		
Chlorophyll a	ug/L						
Conductivity (lab)	umho/cm	334	293	246	291	293	44
Conductivity (field)	umho/cm						
Dissolved Oxygen (field)	mg/L	10.2	7.8	10.1	9.4	10.1	1.4
pH (lab)	pH						
pH (field)	pH	7.8	8.3	7.9	8.0	7.9	0.3
Temperature (field)	^{o}C	16.1	24.5	19.3	20.0	19.3	4.2
Turbidity	NTU						
Secchi Disk reading	feet	6	1	3	3	3	3
Station Depth	feet	12	12	12			
Cadmium	ug/L	0.3					
Chromium	ug/L	1K					
Copper	ug/L	1.2					
Lead	ug/L	1.2					
Nickel	ug/L	1K					
Zinc	ug/L	2K					
Mercury	ug/L	0.1K					

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A3.7. Water chemistry data collected in 1995 from Saginaw Bay station #090252.

PARAMETER	Units	5/23/1995	7/18/1995	9/12/1995	Mean	Median	Standard Deviation
Total Ammonia	mg N/L						
Total Nitrate	mg N/L						
Total Nitrite	mg N/L	0.004	0.005	0.001 T	0.003	0.004	0.002
Total Kjeldahl Nitrogen	mg N/L	0.39	0.43	0.55	0.46	0.43	0.08
Total Phosphorus	mg P/L	0.021	0.022	0.033	0.025	0.022	0.007
Total Ortho Phosphate	mg P/L	0.001 T	0.001	0.001 W	0.001	0.001	0.000
Total Sulfate	mg/L	20	18	19	19	19	1
Total Calcium	mg/L						
Total Chloride	mg/L	21	16	20	19	20	3
Total Magnesium	mg/L						
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	226	195	180	200	195	23
Total Suspended Solids	mg/L	13	5	5	8	5	5
Hardness ($CaCO_3$)	mg/L			114	114		
Chlorophyll a	ug/L						
Conductivity (lab)	umho/cm	315	294	277	295	294	19
Conductivity (field)	umho/cm						
Dissolved Oxygen (field)	mg/L	10.8	9.6	10.1	10.2	10.1	0.6
pH (lab)	pH						
pH (field)	pH	7.9	8.4	7.9	8.1	7.9	0.3
Temperature (field)	°C	14.6	23.5	19.7	19.3	19.7	4.5
Turbidity	NTU						
Secchi Disk reading	feet	6	6		6	6	0
Station Depth	feet	16	16	16			
Cadmium	ug/L	0.5					
Chromium	ug/L	1K					
Copper	ug/L	1.7					
Lead	ug/L	0.5K					
Nickel	ug/L	1K					
Zinc	ug/L	13					
Mercury	ug/L	0.1K					

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A4.1. Water chemistry data collected in 1996 from Saginaw Bay station #060062.

PARAMETER	Units	6/3/1996		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.013		0.013		
Total Nitrate	mg N/L	0.57	C	0.57		
Total Nitrite	mg N/L	0.007		0.007		
Total Kjeldahl Nitrogen	mg N/L	0.29		0.29		
Total Phosphorus	mg P/L	0.016		0.016		
Total Ortho Phosphate	mg P/L	0.002	T	0.002		
Total Sulfate	mg/L					
Total Calcium	mg/L					
Total Chloride	mg/L	18		18		
Total Magnesium	mg/L					
Total Organic Carbon	mg/L					
Total Dissolved Solids	mg/L	202		202		
Total Suspended Solids	mg/L	207		207		
Hardness ($CaCO_3$)	mg/L					
Chlorophyll a	ug/L	6		6		
Conductivity (lab)	umho/cm	310		310		
Conductivity (field)	umho/cm	283				
Dissolved Oxygen (field)	mg/L	10.1				
pH (lab)	pH					
pH (field)	pH	8.3				
Temperature (field)	°C	15.2				
Turbidity	NTU	1.7		1.7		
Secchi Disk reading	feet	5		5		
Station Depth	feet	19/38		19/38		

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A4.2. Water chemistry data collected in 1996 from Saginaw Bay Station #060063.

PARAMETER	Units	6/3/1996		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.028		0.028		
Total Nitrate	mg N/L	0.46	C	0.46		
Total Nitrite	mg N/L	0.005		0.005		
Total Kjeldahl Nitrogen	mg N/L	0.22		0.22		
Total Phosphorus	mg P/L	0.01		0.01		
Total Ortho Phosphate	mg P/L	0.001	T	0.001		
Total Sulfate	mg/L					
Total Calcium	mg/L					
Total Chloride	mg/L	15		15		
Total Magnesium	mg/L					
Total Organic Carbon	mg/L					
Total Dissolved Solids	mg/L	187		187		
Total Suspended Solids	mg/L	4	K	2		
Hardness ($CaCO_3$)	mg/L					
Chlorophyll a	ug/L	1		1		
Conductivity (lab)	umho/cm	288		288		
Conductivity (field)	umho/cm	265				
Dissolved Oxygen (field)	mg/L	9.5				
pH (lab)	pH					
pH (field)	pH	8.5				
Temperature (field)	^{o}C	16.6				
Turbidity	NTU	1.1		1.1		
Secchi Disk reading	feet	7.5		7.5		
Station Depth	feet	11				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A4.3. Water chemistry data collected in 1996 from Saginaw Bay station # 090250.

PARAMETER	Units	6/3/1996		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.011		0.011		
Total Nitrate	mg N/L	0.94	C	0.94		
Total Nitrite	mg N/L	0.015		0.015		
Total Kjeldahl Nitrogen	mg N/L	0.45		0.45		
Total Phosphorus	mg P/L	0.029		0.029		
Total Ortho Phosphate	mg P/L	0.002	T	0.002		
Total Sulfate	mg/L					
Total Calcium	mg/L					
Total Chloride	mg/L	21		21		
Total Magnesium	mg/L					
Total Organic Carbon	mg/L					
Total Dissolved Solids	mg/L	220		220		
Total Suspended Solids	mg/L	232		232		
Hardness ($CaCO_3$)	mg/L					
Chlorophyll a	ug/L	10		10		
Conductivity (lab)	umho/cm	338		338		
Conductivity (field)	umho/cm	311				
Dissolved Oxygen (field)	mg/L	9.7				
pH (lab)	pH					
pH (field)	pH	8.5				
Temperature (field)	^{o}C	15.5				
Turbidity	NTU	5.9		5.9		
Secchi Disk reading	feet	2.5		2.5		
Station Depth	feet	25				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A4.4. Water chemistry data collected in 1996 from Saginaw Bay station #790134.

PARAMETER	Units	not sampled	not sampled	not sampled	Mean	Median	Standard Deviation
Total Ammonia	mg N/L						
Total Nitrate	mg N/L						
Total Nitrite	mg N/L						
Total Kjeldahl Nitrogen	mg N/L						
Total Phosphorus	mg P/L						
Total Ortho Phosphate	mg P/L						
Total Sulfate	mg/L						
Total Calcium	mg/L						
Total Chloride	mg/L						
Total Magnesium	mg/L						
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L						
Total Suspended Solids	mg/L						
Hardness ($CaCO_3$)	mg/L						
Chlorophyll a	ug/L						
Conductivity (lab)	umho/cm						
Conductivity (field)	umho/cm						
Dissolved Oxygen (field)	mg/L						
pH (lab)	pH						
pH (field)	pH						
Temperature (field)	^{o}C						
Turbidity	NTU						
Secchi Disk reading	feet						
Station Depth	feet						

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A4.5. Water chemistry data collected in 1996 from Saginaw Bay station #320188.

PARAMETER	Units	6/4/1996		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.029				
Total Nitrate	mg N/L	0.42	C			
Total Nitrite	mg N/L	0.021				
Total Kjeldahl Nitrogen	mg N/L	0.16				
Total Phosphorus	mg P/L	0.009				
Total Ortho Phosphate	mg P/L	0.001	T			
Total Sulfate	mg/L					
Total Calcium	mg/L					
Total Chloride	mg/L	29				
Total Magnesium	mg/L					
Total Organic Carbon	mg/L					
Total Dissolved Solids	mg/L	159				
Total Suspended Solids	mg/L	4				
Hardness ($CaCO_3$)	mg/L					
Chlorophyll a	ug/L	1	K			
Conductivity (lab)	umho/cm	245				
Conductivity (field)	umho/cm	224				
Dissolved Oxygen (field)	mg/L	9.4				
pH (lab)	pH					
pH (field)	pH	8.4				
Temperature (field)	^{o}C	16.5				
Turbidity	NTU	0.07				
Secchi Disk reading	feet	9.5				
Station Depth	feet	11				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A4.6. Water chemistry data collected in 1996 from Saginaw Bay station #320189.

PARAMETER	Units	6/3/1996	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.012			
Total Nitrate	mg N/L	1.02 C			
Total Nitrite	mg N/L	0.021			
Total Kjeldahl Nitrogen	mg N/L	0.31			
Total Phosphorus	mg P/L	0.018			
Total Ortho Phosphate	mg P/L	0.002 T			
Total Sulfate	mg/L				
Total Calcium	mg/L				
Total Chloride	mg/L	13			
Total Magnesium	mg/L				
Total Organic Carbon	mg/L				
Total Dissolved Solids	mg/L	183			
Total Suspended Solids	mg/L	9			
Hardness ($CaCO_3$)	mg/L				
Chlorophyll a	ug/L	5			
Conductivity (lab)	umho/cm	281			
Conductivity (field)	umho/cm	257			
Dissolved Oxygen (field)	mg/L	10.2			
pH (lab)	pH				
pH (field)	pH	8.1			
Temperature (field)	^{o}C	17.6			
Turbidity	NTU	3			
Secchi Disk reading	feet	4+			
Station Depth	feet	12			

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A4.7. Water chemistry data collected in 1996 from Saginaw Bay station # 090252.

PARAMETER	Units	6/3/1996		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.065				
Total Nitrate	mg N/L	1.63	C			
Total Nitrite	mg N/L	0.021				
Total Kjeldahl Nitrogen	mg N/L	0.54				
Total Phosphorus	mg P/L	0.026				
Total Ortho Phosphate	mg P/L	0.005				
Total Sulfate	mg/L					
Total Calcium	mg/L					
Total Chloride	mg/L	29				
Total Magnesium	mg/L					
Total Organic Carbon	mg/L					
Total Dissolved Solids	mg/L	264				
Total Suspended Solids	mg/L	2				
Hardness ($CaCO_3$)	mg/L					
Chlorophyll a	ug/L	3				
Conductivity (lab)	umho/cm	406				
Conductivity (field)	umho/cm	368				
Dissolved Oxygen (field)	mg/L	8.8				
pH (lab)	pH					
pH (field)	pH	8.4				
Temperature (field)	^{o}C	17.1				
Turbidity	NTU	1.2				
Secchi Disk reading	feet	9				
Station Depth	feet	14				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A5.1. Water chemistry data collected in 1997 from Saginaw Bay station # 060062.

PARAMETER	Units	5/27/1997	7/9/1997	9/9/1997	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.006 T	0.011	0.009 T	0.009	0.009	0.003
Total Nitrate	mg N/L	0.41	0.36	0.03	0.27	0.36	0.21
Total Nitrite	mg N/L	0.004	0.005	0.003	0.004	0.004	0.001
Total Kjeldahl Nitrogen	mg N/L	0.28	0.22	0.39	0.30	0.28	0.09
Total Phosphorus	mg P/L	0.016	0.014	0.021	0.017	0.016	0.004
Total Ortho Phosphate	mg P/L	0.002 T	0.001 TW	0.003 T	0.002	0.002	0.001
Total Sulfate	mg/L						
Total Calcium	mg/L		29.5	28.6	29.1	29.1	0.6
Total Chloride	mg/L	11	10	10	10	10	1
Total Magnesium	mg/L		8.6	8.4	8.5	8.5	0.1
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	174	158	163	165	163	8
Total Suspended Solids	mg/L	6	7	11	8	7	3
Hardness ($CaCO_3$)	mg/L		109	106	108	108	2
Chlorophyll a	ug/L			13	13		
Conductivity (lab)	umho/cm	268	243	251	254	251	13
Conductivity (field)	umho/cm	269	250	254	258	254	10
Dissolved Oxygen (field)	mg/L	11.6	12.6	10.7	11.6	11.6	1.0
pH (lab)	pH		8.2	8.6	8.4	8.4	0.3
pH (field)	pH			7.7	7.7		
Temperature (field)	°C	10.3	14.8	18.4	14.5	14.8	4.1
Turbidity	NTU		0.6		0.6		
Secchi Disk reading	feet	5.0	13.0	4.6	7.5	5.0	4.7
Station Depth	feet	19/38	19/38	19/38			

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A5.2. Water chemistry data collected in 1997 from Saginaw Bay station #060063.

PARAMETER	Units	7/9/1997	9/9/1997	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.014	0.002 T	0.008	0.008	0.008
Total Nitrate	mg N/L	0.42	0	0.21	0.21	0.30
Total Nitrite	mg N/L	0.005	0.001 T	0.003	0.003	0.003
Total Kjeldahl Nitrogen	mg N/L	0.27	0.38	0.33	0.33	0.08
Total Phosphorus	mg P/L	0.017	0.015	0.016	0.016	0.001
Total Ortho Phosphate	mg P/L	0.001 W	0.001 T	0.001	0.001	0.000
Total Sulfate	mg/L					
Total Calcium	mg/L	32.1	27.9	30.0	30.0	3.0
Total Chloride	mg/L	13	10	12	12	2
Total Magnesium	mg/L	9.4	8.6	9.0	9.0	0.6
Total Organic Carbon	mg/L					
Total Dissolved Solids	mg/L	179	162	171	171	12
Total Suspended Solids	mg/L	5	10	8	8	4
Hardness ($CaCO_3$)	mg/L	119	105	112	112	10
Chlorophyll a	ug/L		7	7		
Conductivity (lab)	umho/cm	275	249	262	262	18
Conductivity (field)	umho/cm	276	259	268	268	12
Dissolved Oxygen (field)	mg/L	10.7	10.6	10.7	10.7	0.1
pH (lab)	pH	8.2	8.7	8.5	8.5	0.4
pH (field)	pH		8.5	8.5		
Temperature (field)	°C	19.3	18.4	18.9	18.9	0.6
Turbidity	NTU	0.9		0.9		
Secchi Disk reading	feet	11.0	4.0	7.5	7.5	4.9
Station Depth	feet	12	12			

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A5.3. Water chemistry data collected in 1997 from Saginaw Bay station # 090250.

PARAMETER	Units	7/9/1997		9/9/1997		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.009	T	0.003	T	0.006	0.006	0.004
Total Nitrate	mg N/L	0.42		0		0.21	0.21	0.30
Total Nitrite	mg N/L	0.004		0.002		0.003	0.003	0.001
Total Kjeldahl Nitrogen	mg N/L	0.32		0.40		0.36	0.36	0.06
Total Phosphorus	mg P/L	0.019		0.026		0.023	0.023	0.005
Total Ortho Phosphate	mg P/L	0.001	T	0.004		0.003	0.003	0.002
Total Sulfate	mg/L							
Total Calcium	mg/L	31.4		29.4		30.4	30.4	1.4
Total Chloride	mg/L	12		14		13	13	1
Total Magnesium	mg/L	9.4		9.1		9.3	9.3	0.2
Total Organic Carbon	mg/L							
Total Dissolved Solids	mg/L	177		181		179	179	3
Total Suspended Solids	mg/L	12		7		10	10	4
Hardness ($CaCO_3$)	mg/L	117		111		114	114	4
Chlorophyll a	ug/L			12		12		
Conductivity (lab)	umho/cm	272		279		276	276	5
Conductivity (field)	umho/cm	277		259		268	268	13
Dissolved Oxygen (field)	mg/L	11.2		10.6		10.9	10.9	0.4
pH (lab)	pH	8.2		8.6		8.4	8.4	0.3
pH (field)	pH			8.5		8.5		
Temperature (field)	°C	19.1		18.4		18.8	18.8	0.5
Turbidity	NTU	2.2				2.2		
Secchi Disk reading	feet	6.0		4.0		5.0	5.0	1.4
Station Depth	feet	24		24				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A5.4. Water chemistry data collected in 1997 from Saginaw Bay station #790134.

PARAMETER	Units	7/9/1997		9/9/1997		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.008	T	0.004	T	0.006	0.006	0.003
Total Nitrate	mg N/L	0.44		0.00		0.22	0.22	0.31
Total Nitrite	mg N/L	0.005		0.001	T	0.003	0.003	0.003
Total Kjeldahl Nitrogen	mg N/L	0.30		0.37		0.34	0.34	0.05
Total Phosphorus	mg P/L	0.022		0.018		0.020	0.020	0.003
Total Ortho Phosphate	mg P/L	0.001	T	0.001	W	0.001	0.001	0.000
Total Sulfate	mg/L							
Total Calcium	mg/L	32.6		26.8		29.7	29.7	4.1
Total Chloride	mg/L	12		12		12	12	0
Total Magnesium	mg/L	9.6		8.9		9.3	9.3	0.5
Total Organic Carbon	mg/L							
Total Dissolved Solids	mg/L	179		163		171	171	11
Total Suspended Solids	mg/L	8		10		9	9	1
Hardness ($CaCO_3$)	mg/L	121		104		113	113	12
Chlorophyll a	ug/L			9		9		
Conductivity (lab)	umho/cm	275		251		263	263	17
Conductivity (field)	umho/cm	272		261		267	267	8
Dissolved Oxygen (field)	mg/L	11.1		10.4		10.8	10.8	0.5
pH (lab)	pH	8.3		8.7		8.5	8.5	0.3
pH (field)	pH			8.5		8.5		
Temperature (field)	^{o}C	20.3		18.5		19.4	19.4	1.3
Turbidity	NTU	2.4				2.4		
Secchi Disk reading	feet	8.0		4.0		6.0	6.0	2.8
Station Depth	feet	13		13				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A5.5. Water chemistry data collected in 1997 from Saginaw Bay station #320188.

PARAMETER	Units	5/28/1997	7/9/1997	9/9/1997	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.01	0.009 T	0.003 T	0.007	0.009	0.004
Total Nitrate	mg N/L	0.26	0.44	0.00	0.23	0.26	0.22
Total Nitrite	mg N/L	0.003	0.005	0.001 T	0.003	0.003	0.002
Total Kjeldahl Nitrogen	mg N/L	0.13	0.26	0.47	0.29	0.26	0.17
Total Phosphorus	mg P/L	0.003 T	0.015	0.018	0.012	0.015	0.008
Total Ortho Phosphate	mg P/L	0.001 W	0.001 T	0.002 T	0.001	0.001	0.001
Total Sulfate	mg/L						
Total Calcium	mg/L		32.8	27.2	30.0	30.0	4.0
Total Chloride	mg/L	5	12	8	8	8	4
Total Magnesium	mg/L		9.5	7.9	8.7	8.7	1.1
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	135	179	151	155	151	22
Total Suspended Solids	mg/L	4	6	13	8	6	5
Hardness ($CaCO_3$)	mg/L		121	101	111	111	14
Chlorophyll a	ug/L			13	13		
Conductivity (lab)	umho/cm	208	276	233	239	233	34
Conductivity (field)	umho/cm	217	276	245	246	245	30
Dissolved Oxygen (field)	mg/L	11.3	10.3	10.9	10.8	10.9	0.5
pH (lab)	pH		8.3	8.9	8.6	8.6	0.4
pH (field)	pH	7.8		8.7	8.3	8.3	0.6
Temperature (field)	°C	10.2	19.7	18.5	16.1	18.5	5.2
Turbidity	NTU		1.5		1.5		
Secchi Disk reading	feet	13.0	10.0	3.8	8.9	10.0	4.7
Station Depth	feet	12	12	12			

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A5.6. Water Chemistry data collected in 1997 from Saginaw Bay station #320189.

PARAMETER	Units	5/28/1997	7/9/1997	9/9/1997	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.006 T	0.012	0.002 T	0.007	0.006	0.005
Total Nitrate	mg N/L	0.99	0.30	0.00	0.43	0.30	0.51
Total Nitrite	mg N/L	0.01	0.009	0.001	0.007	0.009	0.005
Total Kjeldahl Nitrogen	mg N/L	0.37	0.59	0.29	0.42	0.37	0.16
Total Phosphorus	mg P/L	0.016	0.029	0.016	0.020	0.016	0.008
Total Ortho Phosphate	mg P/L	0.002 T	0.002 T	0.001	0.002	0.002	0.001
Total Sulfate	mg/L						
Total Calcium	mg/L		34.7	27.5	31.1	31.1	5.1
Total Chloride	mg/L	23	18	9	17	18	7
Total Magnesium	mg/L		11.7	8.3	10.0	10.0	2.4
Total Organic Carbon	mg/L						
Total Dissolved Solids	mg/L	246	204	156	202	204	45
Total Suspended Solids	mg/L	8	14	6	9	8	4
Hardness ($CaCO_3$)	mg/L		135	103	119	119	23
Chlorophyll a	ug/L			8	8		
Conductivity (lab)	umho/cm	379	314	240	311	314	70
Conductivity (field)	umho/cm	365	307	250	307	307	58
Dissolved Oxygen (field)	mg/L	10.5	10.2	10.9	10.5	10.5	0.4
pH (lab)	pH		8.5	8.7	8.6	8.6	0.1
pH (field)	pH			8.5	8.5		
Temperature (field)	°C	13.2	20.0	18.9	17.4	18.9	3.7
Turbidity	NTU		3.2		3.2		
Secchi Disk reading	feet	5.0	5.0	4.0	4.7	5.0	0.6
Station Depth	feet	11	11	11			

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A5.7. Water chemistry data collected in 1997 from Saginaw Bay station #090252.

PARAMETER	Units	7/10/1997	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.018			
Total Nitrate	mg N/L	0.49			
Total Nitrite	mg N/L	0.009			
Total Kjeldahl Nitrogen	mg N/L	0.33			
Total Phosphorus	mg P/L	0.026			
Total Ortho Phosphate	mg P/L	0.004			
Total Sulfate	mg/L				
Total Calcium	mg/L	34.9			
Total Chloride	mg/L	17			
Total Magnesium	mg/L	10.6			
Total Organic Carbon	mg/L				
Total Dissolved Solids	mg/L	201			
Total Suspended Solids	mg/L	6			
Hardness ($CaCO_3$)	mg/L	131			
Chlorophyll a	ug/L				
Conductivity (lab)	umho/cm	309			
Conductivity (field)	umho/cm	308			
Dissolved Oxygen (field)	mg/L	9.8			
pH (lab)	pH	8.1			
pH (field)	pH				
Temperature (field)	^{o}C	19.6			
Turbidity	NTU	2.5			
Secchi Disk reading	feet	6.0			
Station Depth	feet	13			

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A6.1. Water chemistry data collected in 1998 from Saginaw Bay station #060062.

PARAMETER	Units	6/9/1998	8/12/1998	9/30/1998	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.010	0.009	0.010	0.010	0.010	0.001
Total Nitrate	mg N/L	0.68	0.01	0.08	0.26	0.08	0.37
Total Nitrite	mg N/L	0.00	0.00	0.01	0.00	0.00	0.01
Total Kjeldahl Nitrogen	mg N/L	0.31	0.43	0.40	0.38	0.40	0.06
Total Phosphorus	mg P/L	0.078	0.026	0.022 Q	0.052	0.052	0.037
Total Ortho Phosphate	mg P/L	0.003	0.001	0.002	0.002	0.002	0.001
Total Sulfate	mg/L	19	14	12	15	14	4
Total Calcium	mg/L	32.6	25.9	26.5	28.3	26.5	3.7
Total Chloride	mg/L	14	12	8	11	12	3
Total Magnesium	mg/L	10.1		8.3	9.2	9.2	1.3
Total Organic Carbon	mg/L	3.4	2.8	2.8	3.0	2.8	0.3
Total Dissolved Solids	mg/L	204	162	150	172	162	28
Total Suspended Solids	mg/L	5	5	2	4	5	2
Hardness ($CaCO_3$)	mg/L	123	101	100	108	101	13
Chlorophyll a	ug/L	3	8	8	6	8	3
Conductivity (lab)	umho/cm	313	249	231	264	249	43
Conductivity (field)	umho/cm	302	247	207	252	247	48
Dissolved Oxygen (field)	mg/L	8.5	7.5	8.9	8.3	8.5	0.7
pH (lab)	pH	8.3	8.9	8.5	8.6	8.5	0.3
pH (field)	pH	7.97	7.90	8.3	8.06	7.97	0.21
Temperature (field)	°C	15.9	22.7	18.6	19.1	18.6	3.4
Turbidity	NTU		3.7	2 Q	3.7		
Secchi Disk reading	feet	6.0	3.9	5.8	5.2	5.8	1.2
Station Depth	feet	19/38	19/38	19/38			

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A6.2. Water chemistry data collected in 1998 from Saginaw Bay station # 060063.

PARAMETER	Units	6/9/1998		8/12/1998		9/30/1998		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.008	T	0.004	T	0.006	T	0.006	0.006	0.002
Total Nitrate	mg N/L	0.59	C	0.00	T	0.00	T	0.20	0.00	0.34
Total Nitrite	mg N/L	0.24		0.00		0.00		0.08	0.00	0.14
Total Kjeldahl Nitrogen	mg N/L	0.35		0.54		0.44	Q	0.45	0.45	0.13
Total Phosphorus	mg P/L	0.130		0.025		0.020	Q	0.078	0.078	0.074
Total Ortho Phosphate	mg P/L	0.001	T	0.001	TW	0.001	T	0.001	0.001	0.000
Total Sulfate	mg/L	20		17		15		17	17	3
Total Calcium	mg/L	32.8		22.3		28.1		27.7	28.1	5.3
Total Chloride	mg/L	14		16		16		15	16	1
Total Magnesium	mg/L	10.2		10.1		10.4		10.2	10.2	0.2
Total Organic Carbon	mg/L	3.5		4.2		3.9		3.9	3.9	0.4
Total Dissolved Solids	mg/L	205		166		178		183	178	20
Total Suspended Solids	mg/L	7		20	A	3		10	7	9
Hardness ($CaCO_3$)	mg/L	124		97		113		111	113	14
Chlorophyll a	ug/L	2		7		2		4	2	3
Conductivity (lab)	umho/cm	315		255		274		281	274	31
Conductivity (field)	umho/cm	302		263		248		271	263	28
Dissolved Oxygen (field)	mg/L	9.5		8.3		9.2		9.0	9.2	0.6
pH (lab)	pH	8.5		8.9		8.5		8.6	8.5	0.2
pH (field)	pH	8.3		8.0		9.2		8.5	8.3	0.6
Temperature (field)	°C	15.9		23.2		18.5		19.2	18.5	3.7
Turbidity	NTU			4.6		1.3	Q	4.600		
Secchi Disk reading	feet	1.0		3.0		9.6		4.5	3.0	4.5
Station Depth	feet	12		12		12				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A6.3. Water chemistry data collected in 1998 from Saginaw Bay station #090250.

PARAMETER	Units	6/9/1998		8/12/1998		9/30/1998		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.006	T	0.006	T	0.005	T	0.006	0.006	0.001
Total Nitrate	mg N/L	0.07	C	0.00	T	0.00	T	0.02	0.00	0.04
Total Nitrite	mg N/L	0.00		0.00		0.00		0.00	0.00	0.00
Total Kjeldahl Nitrogen	mg N/L	0.44		0.44		0.45	Q	0.44	0.44	0.00
Total Phosphorus	mg P/L	0.24		0.29		0.034	Q	0.27	0.27	0.04
Total Ortho Phosphate	mg P/L	0.001	Q	0.001	W	0.003		0.002	0.002	0.001
Total Sulfate	mg/L	21		16		13		17	16	4
Total Calcium	mg/L	34.9		25.5		29.4		29.9	29.4	4.7
Total Chloride	mg/L	16		14		13		14	14	2
Total Magnesium	mg/L	10.7		9.4		9.5		9.9	9.5	0.7
Total Organic Carbon	mg/L	3.7		3.6		3.6		3.6	3.6	0.1
Total Dissolved Solids	mg/L	221		168		174		188	174	29
Total Suspended Solids	mg/L	6	A	11		5		7	6	3
Hardness ($CaCO_3$)	mg/L	131		102		97		110	102	18
Chlorophyll a	ug/L	6		8		8		7	8	1
Conductivity (lab)	umho/cm	340		259		267		289	267	45
Conductivity (field)	umho/cm	327		268		241		279	268	44
Dissolved Oxygen (field)	mg/L	9.2		8.2		8.6		8.7	8.6	0.5
pH (lab)	pH	8.4		8.9		8.4		8.6	8.4	0.3
pH (field)	pH	8.1		8.0		8.4		8.2	8.1	0.2
Temperature (field)	°C	16.3		23.2		19.1		19.5	19.1	3.5
Turbidity	NTU			3.5		1.9	Q	3.5		
Secchi Disk reading	feet	5.0		3.3		5.8		4.7	5.0	1.3
Station Depth	feet	25		25		25				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A6.4. Water chemistry data collected in 1998 from Saginaw Bay station #790134.

PARAMETER	Units	6/10/1998		8/12/1998		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.006	T	0.007	T	0.007	0.007	0.001
Total Nitrate	mg N/L	0.44	C	0.00		0.22	0.22	0.31
Total Nitrite	mg N/L	0.00		0.01		0.01	0.01	0.01
Total Kjeldahl Nitrogen	mg N/L	0.40		0.55		0.48	0.48	0.11
Total Phosphorus	mg P/L	0.017		0.025		0.021	0.021	0.006
Total Ortho Phosphate	mg P/L	0.001	T	0.001	W	0.001	0.001	0.000
Total Sulfate	mg/L	20		14		17	17	4
Total Calcium	mg/L	30.6		24.0		27.3	27.3	4.7
Total Chloride	mg/L	13		11		12	12	1
Total Magnesium	mg/L	10.1		8.5		9.3	9.3	1.1
Total Organic Carbon	mg/L	3.3		3.2		3.3	3.3	0.1
Total Dissolved Solids	mg/L	198		157		178	178	29
Total Suspended Solids	mg/L	2		24		13	13	16
Hardness ($CaCO_3$)	mg/L	118		95		107	107	16
Chlorophyll a	ug/L							
Conductivity (lab)	umho/cm	305		242		274	274	45
Conductivity (field)	umho/cm	288		247		268	268	29
Dissolved Oxygen (field)	mg/L	8.8		8.9		8.9	8.9	0.1
pH (lab)	pH	8.8		9.0		8.9	8.9	0.1
pH (field)	pH	8.5		7.8		8.2	8.2	0.5
Temperature (field)	^{o}C	16.1		23.4		19.8	19.8	5.2
Turbidity	NTU			4.6		4.6		
Secchi Disk reading	feet	6.5		2.4		4.5	4.5	2.9
Station Depth	feet	13		13		13	13	0

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A6.5. Water chemistry data collected in 1998 from Saginaw Bay station #320188.

PARAMETER	Units	6/10/1998		8/12/1998		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.170		0.007	T	0.089	0.089	0.115
Total Nitrate	mg N/L	0.68	C	0.02	C	0.35	0.35	0.47
Total Nitrite	mg N/L	0.00		0.00		0.00	0.00	0.00
Total Kjeldahl Nitrogen	mg N/L	0.30		0.47		0.39	0.39	0.12
Total Phosphorus	mg P/L	0.010		0.018		0.014	0.014	0.006
Total Ortho Phosphate	mg P/L	0.001	T	0.001	W	0.001	0.001	0.000
Total Sulfate	mg/L	18		14		16	16	3
Total Calcium	mg/L	32.5		24		28	28	6
Total Chloride	mg/L	13		10		12	12	2
Total Magnesium	mg/L	9.7		8.4		9.1	9.1	0.9
Total Organic Carbon	mg/L	3.3		3.2		3.3	3.3	0.1
Total Dissolved Solids	mg/L	202		153		178	178	35
Total Suspended Solids	mg/L	2		9		6	6	5
Hardness ($CaCO_3$)	mg/L	121		94		108	108	19
Chlorophyll a	ug/L	1	K	9		5	5	6
Conductivity (lab)	umho/cm	310		236		273	273	52
Conductivity (field)	umho/cm	294		242		268	268	37
Dissolved Oxygen (field)	mg/L	8.3		8.9		8.6	8.6	0.4
pH (lab)	pH	8.2		9.0		8.6	8.6	0.6
pH (field)	pH	7.5		7.9		7.7	7.7	0.3
Temperature (field)	^{o}C	15.9		23.3		19.6	19.6	5.2
Turbidity	NTU			3.8		3.8		
Secchi Disk reading	feet	12.0		4.0		8.0	8.0	5.7
Station Depth	feet	12		12				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
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D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A6.6. Water Chemistry data collected in 1998 from Saginaw Bay station #320189.

PARAMETER	Units	6/9/1998		8/11/1998		10/1/1998		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.008	T	0.009	T	0.005	T	0.007	0.008	0.002
Total Nitrate	mg N/L	0.21	C	0.00	T	0.00	T	0.07	0.00	0.12
Total Nitrite	mg N/L	0.00		0.01		0.00		0.00	0.00	0.01
Total Kjeldahl Nitrogen	mg N/L	0.26		0.61		0.82	Q	0.44	0.44	0.25
Total Phosphorus	mg P/L	0.015		0.036		0.057	Q	0.026	0.026	0.015
Total Ortho Phosphate	mg P/L	0.002	T	0.001	W	0.002	J	0.002	0.002	0.001
Total Sulfate	mg/L	17		18		14		16	17	2
Total Calcium	mg/L	30.1		22.6		27.3		26.7	27.3	3.8
Total Chloride	mg/L	9		18		12		13	12	5
Total Magnesium	mg/L	9.2		10.3		9.6		9.7	9.6	0.6
Total Organic Carbon	mg/L	2.9		4.2		3.4		3.5	3.4	0.7
Total Dissolved Solids	mg/L	185		175		164		175	175	11
Total Suspended Solids	mg/L	8		27		45		27	27	19
Hardness ($CaCO_3$)	mg/L	113		99		108		107	108	7
Chlorophyll a	ug/L	3		8		9		7	8	3
Conductivity (lab)	umho/cm	285		269		252		269	269	17
Conductivity (field)	umho/cm	266		275				271	271	6
Dissolved Oxygen (field)	mg/L	8.8		8.1				8.5	8.5	0.5
pH (lab)	pH	8.5		8.8		8.4		8.6	8.5	0.2
pH (field)	pH	8.1		7.8		8.2		8.0	8.1	0.2
Temperature (field)	°C	16.4		24.2				20.3	20.3	5.5
Turbidity	NTU			12		18		15	15	4
Secchi Disk reading	feet	5.5		2.0		1.0		2.8	2.0	2.4
Station Depth	feet	11		11		11				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
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A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
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ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A6.7. Water chemistry data collected in 1998 from Saginaw Bay station #090252.

PARAMETER	Units	6/10/1998		8/11/1998		10/1/1998		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.010		0.014	Q	0.015		0.013	0.013	0.004
Total Nitrate	mg N/L	0.61	C	0.02	C	0.01	C	0.21	0.02	0.34
Total Nitrite	mg N/L	0.00		0.00		0.00		0.00	0.00	0.00
Total Kjeldahl Nitrogen	mg N/L	0.36		0.73		0.76	Q	0.55	0.55	0.26
Total Phosphorus	mg P/L	0.024		0.059		0.054	Q	0.042	0.042	0.025
Total Ortho Phosphate	mg P/L	0.001	T	0.001	T	0.003		0.002	0.001	0.001
Total Sulfate	mg/L	20		21		15		19	20	3
Total Calcium	mg/L	32.7		27.6		29.5		29.9	29.5	2.6
Total Chloride	mg/L	14		36		19		23	19	12
Total Magnesium	mg/L	10.4		12.2		10.4		11.0	10.4	1.0
Total Organic Carbon	mg/L	3.6		4.9		4.3		4.3	4.3	0.7
Total Dissolved Solids	mg/L	210		235		190		212	210	23
Total Suspended Solids	mg/L	3		21		25		16	21	12
Hardness ($CaCO_3$)	mg/L	125		119		117		120	119	4
Chlorophyll a	ug/L	4		13		17		11	13	7
Conductivity (lab)	umho/cm	323		361		292		325	323	35
Conductivity (field)	umho/cm	306		345				326	326	28
Dissolved Oxygen (field)	mg/L	8.6		8.2				8.4	8.4	0.3
pH (lab)	pH	8.4		8.8		8.4		8.5	8.4	0.2
pH (field)	pH	8.0		7.9		8.1		8.0	8.0	0.1
Temperature (field)	°C	15.9		24.0		17.5		19.1	17.5	4.3
Turbidity	NTU			13		11		12	12	1
Secchi Disk reading	feet	6.0		1.3		2.0		3.1	2.0	2.5
Station Depth	feet	13		13		13				

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A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
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JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
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M = The level of the method preparation blank is reported in the qualifier column.
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ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A7.1 Water Chemistry data collected in 1999 from Saginaw Bay (Station #060062).

PARAMETER	Units	6/2/1999		8/17/1999		10/26/1999		Mean		Median	Standard Deviation
Total Ammonia	mg N/L	0.012		0.006	T	0.006	T	0.008		0.006	0.003
Total Nitrate	mg N/L	0.4	+	0.05	+	0.189	+	0.213		0.189	0.176
Total Nitrite	mg N/L	0.004		0.003		0.002		0.003		0.003	0.001
Total Kjeldahl Nitrogen	mg N/L	0.25		0.33		0.18		0.253		0.250	0.075
Total Phosphorus	mg P/L	0.008		0.023		0.01		0.014		0.010	0.008
Total Ortho Phosphate	mg P/L	0.001	W	0.002	T	0.001	W	0.001		0.001	0.001
Total Sulfate	mg/L	18		16		13		15.667		16.000	2.517
Total Calcium	mg/L	30.4		28.5		27.6		28.833		28.500	1.429
Total Chloride	mg/L	11		8		7		8.667		8.000	2.082
Total Magnesium	mg/L	8.6		8.2		7.5		8.100		8.200	0.557
Total Organic Carbon	mg/L	2.3		2.9		2.1		2.433		2.300	0.416
Total Dissolved Solids	mg/L	172	+	155	+	146	+	157.667		155.000	13.204
Total Suspended Solids	mg/L	4	K	4	K	8		4.000	@	4.000	2.309
Hardness ($CaCO_3$)	mg/L	313	+	105	+	100	+	172.667		105.000	121.558
Chlorophyll a	ug/L	2	K DL	9		4		4.667		4.000	3.606
Conductivity (lab)	umho/cm	265		238		225		242.667		238.000	20.404
Conductivity (field)	umho/cm	250		230		219		233.000		230.000	15.716
Dissolved Oxygen (lab)	mg/L	NA		NA		NA		NA		NA	NA
Dissolved Oxygen (field)	mg/L	9.9		9.26		13.79		10.983		9.900	2.452
pH (lab)	pH	8.2	HT	8.38	HT	8.18		8.253		8.200	0.110
pH (field)	pH	7.1		7.82		7.52		7.480		7.520	0.362
Temperature (field)	^{o}C	16.6		21.24		10.03		15.957		16.600	5.633
Turbidity	NTU	0.5		2.3	HT	1.4		1.400		1.400	0.900
Secchi Disk reading	feet	11		5.3		7		-		-	-
Station Depth	feet	38		38		38		-		-	-

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C = Value caclulated from other independent parameters.
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R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A7.2 Water chemistry data collected in 1999 from Saginaw Bay (Station # 060063).

PARAMETER	Units	6/2/1999		8/17/1999		10/27/1999		Mean		Median	Standard Deviation
Total Ammonia	mg N/L	0.01		0.002	T	0.006	T	0.006		0.006	0.004
Total Nitrate	mg N/L	0.41	+	0.001	+ T	0.002	+ T	0.138		0.002	0.236
Total Nitrite	mg N/L	0.003		0.001	T	0.001	T	0.002		0.001	0.001
Total Kjeldahl Nitrogen	mg N/L	0.28		0.55		0.34		0.390		0.340	0.142
Total Phosphorus	mg P/L	0.009		0.025		0.025		0.020		0.025	0.009
Total Ortho Phosphate	mg P/L	0.001	W	0.002	T	0.003		0.002		0.002	0.001
Total Sulfate	mg/L	19		15		18		17.333		18.000	2.082
Total Calcium	mg/L	32.4		27.1		30.6		30.033		30.600	2.695
Total Chloride	mg/L	16		9		14		13.000		14.000	3.606
Total Magnesium	mg/L	9.6		8.2		9.2		9.000		9.200	0.721
Total Organic Carbon	mg/L	3		3		3.3		3.100		3.000	0.173
Total Dissolved Solids	mg/L	188	+	157	+	179	+	174.667		179.000	15.948
Total Suspended Solids	mg/L	4	K	8		9		6.333	@	8.000	2.646
Hardness ($CaCO_3$)	mg/L	120	+	101	+	114	+	111.667		114.000	9.713
Chlorophyll a	ug/L	2	K DL	7		3		3.667	@	3.000	2.646
Conductivity (lab)	umho/cm	289		242		3		178.000		242.000	153.366
Conductivity (field)	umho/cm	281		233		264		259.333		264.000	24.338
Dissolved Oxygen (field)	mg/L	NA		NA		NA					
pH (lab)	pH	8.46	HT	8.72	HT	8.26		8.480		8.460	0.231
pH (field)	pH	7.2		8.17		7.91		7.760		7.910	0.502
Temperature (field)	°C	20.4		22.03		7		16.477		20.400	8.247
Turbidity	NTU	0.6		2.8	HT	3.1		2.167		2.800	1.365
Secchi Disk reading	feet	10.5		4.1		5.2		-		-	-
Station Depth	feet	10		10		11.5		-		-	-

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C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
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K = RL(s) raised due to matrix interferences.
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QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
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V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A7.3 Water chemistry data collected in 1999 from Saginaw Bay (Station #090250).

PARAMETER	Units	6/2/1999		8/17/1999		10/27/1999		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.008	T	0.002	T	0.006	T	0.005	0.006	0.003
Total Nitrate	mg N/L	0.41	+	0.001	+ T	0.009	+ T	0.140	0.009	0.234
Total Nitrite	mg N/L	0.003		0.001	T	0.002	T	0.002	0.002	0.001
Total Kjeldahl Nitrogen	mg N/L	0.24		0.55		0.33		0.373	0.33	0.159
Total Phosphorus	mg P/L	0.012		0.035		0.027		0.025	0.027	0.012
Total Ortho Phosphate	mg P/L	0.001	T	0.002	T	0.005		0.003	0.002	0.002
Total Sulfate	mg/L	15		14		17		15.333	15	1.528
Total Calcium	mg/L	31.8		31.2		33.3		32.100	31.8	1.082
Total Chloride	mg/L	11		9		14		11.333	11	2.517
Total Magnesium	mg/L	8.4		8.3		9.1		8.600	8.4	0.436
Total Organic Carbon	mg/L	2.3		2.6		3.1		2.667	2.6	0.404
Total Dissolved Solids	mg/L	170	+	162	+	177	+	169.667	170	7.506
Total Suspended Solids	mg/L	5		5		17		9.000	5	6.928
Hardness ($CaCO_3$)	mg/L	114	+	112	+	121	+	115.667	114	4.726
Chlorophyll a	ug/L	3		11		6		6.667	6	4.041
Conductivity (lab)	umho/cm	261		249		273		261.000	261	12.000
Conductivity (field)	umho/cm	253		240		261		251.333	253	10.599
Dissolved Oxygen (field)	mg/L	9.9		9.2				9.550	9.55	0.495
pH (lab)	pH	8.33	HT	8.64	HT	8.24		8.403	8.33	0.210
pH (field)	pH	7		8.01		8.02		7.677	8.01	0.586
Temperature (field)	^{o}C	16.8		22.33		8.15		15.760	16.8	7.147
Turbidity	NTU	1.8		3.2	HT	3.7		2.900	3.2	0.985
Secchi Disk reading	feet	4.5		3.6		3.9		-	-	-
Station Depth	feet	23		23		23.4		-	-	-

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A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
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QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
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V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A7.4 Water chemistry data collected in 1999 from Saginaw Bay (Station #790134).

PARAMETER	Units	6/3/1999		8/18/1999		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.023		0.002	T	0.013	0.013	0.015
Total Nitrate	mg N/L	0.94	+	0.001	+ W	0.4705	0.4705	0.664
Total Nitrite	mg N/L	0.006		0.001	T	0.004	0.004	0.004
Total Kjeldahl Nitrogen	mg N/L	0.44		0.56		0.50	0.50	0.08
Total Phosphorus	mg P/L	0.029		0.022		0.0255	0.0255	0.005
Total Ortho Phosphate	mg P/L	0.003		0.001	T	0.002	0.002	0.001
Total Sulfate	mg/L	22		20		21	21	1.4
Total Calcium	mg/L	37.9		26.5		32.2	32.2	8.06
Total Chloride	mg/L	20		21		20.5	20.5	0.7
Total Magnesium	mg/L	10.5		10.4		10.45	10.45	0.1
Total Organic Carbon	mg/L	3.3		4		3.7	3.7	0.5
Total Dissolved Solids	mg/L	213	+	186	+	200	200	19.1
Total Suspended Solids	mg/L	11		8		9.5	9.5	2
Hardness ($CaCO_3$)	mg/L	138	+	109	+	124	124	20.5
Chlorophyll a	ug/L	4		8		6	6	2.8
Conductivity (lab)	umho/cm	327		286		307	307	29.0
Conductivity (field)	umho/cm	319		275		297	297	31.1
Dissolved Oxygen (field)	mg/L	8.8		NA		8.8	8.8	0.00
pH (lab)	pH	8.3	HT	8.89	HT	8.6	8.6	0.42
pH (field)	pH	7.7		8.28		8.0	8.0	0.41
Temperature (field)	°C	18.5		22.1		20.3	20.3	2.55
Turbidity	NTU	5.3		3.6		4.45	4.45	1.20
Secchi Disk reading	feet	2.3		3.3		-	-	-
Station Depth	feet	11		10		-	-	-
Methyltertbutylether (MTBE)	ug/L	ND		ND		0.000	0.000	0.000
BTEX	ug/L	ND		ND		0.000	0.000	0.000
Base Neutrals	ug/L			ND				
Bis(2-ethylhexyl)phthalate	ug/L	1.8				1.8	1.8	0.000

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C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
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ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
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Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A7.5 Water chemistry data collected in 1999 from Saginaw Bay (Station #320188).

PARAMETER	Units	6/3/1999		8/18/1999		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.017		0.001	T	0.009	0.009	0.011
Total Nitrate	mg N/L	0.9	+	0.001	+ T	0.451	0.4505	0.636
Total Nitrite	mg N/L	0.007		0.001	T	0.004	0.004	0.004
Total Kjeldahl Nitrogen	mg N/L	0.49		0.43		0.460	0.46	0.042
Total Phosphorus	mg P/L	0.029		0.016		0.023	0.0225	0.009
Total Ortho Phosphate	mg P/L	0.002	T	0.001	T	0.002	0.0015	0.001
Total Sulfate	mg/L	22		14		18.000	18	5.657
Total Calcium	mg/L	36.3		25.6		30.950	30.95	7.566
Total Chloride	mg/L	20		9		14.500	14.5	7.778
Total Magnesium	mg/L	10.7		8.1		9.400	9.4	1.838
Total Organic Carbon	mg/L	4	DM	2.6		3.300	3.3	0.990
Total Dissolved Solids	mg/L	214	+	150	+	182.000	182	45.255
Total Suspended Solids	mg/L	18		10		14.000	14	5.657
Hardness ($CaCO_3$)	mg/L	135	+	97	+	116.000	116	26.870
Chlorophyll a	ug/L	4		6		5.000	5	1.414
Conductivity (lab)	umho/cm	329		231		280.000	280	69.296
Conductivity (field)	umho/cm	320		223		271.500	271.5	68.589
Dissolved Oxygen (field)	mg/L	8.8		9.94		9.370	9.37	0.806
pH (lab)	pH	8.29	HT	8.83	HT	8.560	8.56	0.382
pH (field)	pH	7.7		8.2		7.950	7.95	0.354
Temperature (field)	^{o}C	18.6		21.51		20.055	20.055	2.058
Turbidity	NTU	6		3		4.500	4.5	2.121
Secchi Disk reading	feet	2.3		4		-	-	-
Station Depth	feet	10		10		-	-	-

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@ = Mean includes samples with concentration below level of quantification.
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A = Value reported is the mean of two or more determinations.
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P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A7.6 Water chemistry data collected in 1999 from Saginaw Bay (Station #320189).

PARAMETER	Units	6/3/1999		8/18/1999		8/18/1999 **Replicate		10/28/1999		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.012		0.005	T	0.005	T	0.008	T	0.008	0.008	0.004
Total Nitrate	mg N/L	0.42	+	0.001	+ T	0.001	+ T	0.002	+ T	0.141	0.002	0.242
Total Nitrite	mg N/L	0.007		0.002		0.001	T	0.001	T	0.003	0.002	0.003
Total Kjeldahl Nitrogen	mg N/L	0.45		0.73		0.79		0.38		0.520	0.45	0.185
Total Phosphorus	mg P/L	0.031		0.035		0.035		0.023		0.030	0.031	0.006
Total Ortho Phosphate	mg P/L	0.002	T	0.002	T	0.002	T	0.005		0.003	0.002	0.002
Total Sulfate	mg/L	17		22		21		17		18.667	17	2.887
Total Calcium	mg/L	29.6		24.2		24.9		30.6		28.133	29.6	3.443
Total Chloride	mg/L	12		22		22		11		15.000	12	6.083
Total Magnesium	mg/L	8.6		10.8		10.8		9.2		9.533	9.2	1.137
Total Organic Carbon	mg/L	2.6		4.2		4.2		2.8		3.200	2.8	0.872
Total Dissolved Solids	mg/L	171	+	183	+	183	+	168	+	174.000	171	7.937
Total Suspended Solids	mg/L	23		24		28		19		22.000	23	2.646
Hardness ($CaCO_3$)	mg/L	109	+	105	+	107	+	114	+	109.333	109	4.509
Chlorophyll a	ug/L	9		11		11		5		8.333	9	3.055
Conductivity (lab)	umho/cm	263		282		281		258		267.667	263	12.662
Conductivity (field)	umho/cm	208		271		271		246		241.667	246	31.723
Dissolved Oxygen (lab)	mg/L	NA		NA		NA		NA		NA	NA	NA
Dissolved Oxygen (field)	mg/L	8.6		9.37		9.37		15.74		11.237	9.37	3.919
pH (lab)	pH	8.35	HT	8.71	HT	8.72	HT	8.23		8.430	8.35	0.250
pH (field)	pH	7.7		8.01		8.01		8.17		7.960	8.01	0.239
Temperature (field)	°C	19.4		21.28		21.28		6.88		15.853	19.4	7.828
Turbidity	NTU	6.3		5.1		8.7		5.7		5.700	5.7	0.600
Secchi Disk reading	feet	1.5		2		2		2.1		-	-	-
Station Depth	feet	9		9		9		8.8		-	-	-

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Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A7.7 Water chemistry data collected in 1999 from Saginaw Bay (Station #090252).

PARAMETER	Units	6/2/1999		6/2/1999 **Replicate		8/17/1999		10/12/1999		10/12/1999 **Replicate		10/25/1999		10/25/1999 **Replicate		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.083		0.078		0.008	T	0.004	T	0.004	T	0.014		0.014		0.027	0.011	0.037
Total Nitrate	mg N/L	1.32	+	1.3	+	0.003	+ T	0.002	+ T	0.003	+ T	0.002	+ T	0.002	+ T	0.332	0.003	0.659
Total Nitrite	mg N/L	0.019		0.018		0.001	T	0.001	T	0.001	T	0.001	T	0.001	T	0.006	0.001	0.009
Total Kjeldahl Nitrogen	mg N/L	0.6		0.57		0.73		0.41		0.41		0.35		0.36		0.523	0.505	0.175
Total Phosphorus	mg P/L	0.03		0.027		0.052		0.024		0.023		0.022		0.024		0.032	0.027	0.014
Total Ortho Phosphate	mg P/L	0.005		0.003		0.002	T	0.003		0.004		0.003		0.002	T	0.003	0.003	0.001
Total Sulfate	mg/L	25		23		16		19		19		14		14		18.500	17.500	4.796
Total Calcium	mg/L	42		42.3		29.9		30.4		31		31.4		31.1		33.425	30.900	5.751
Total Chloride	mg/L	35		35		14		14		14		14		14		19.250	14.000	10.500
Total Magnesium	mg/L	13		12.7		9.2		8.7		8.6		8.8		8.8		9.925	9.000	2.061
Total Organic Carbon	mg/L	4.3		4		3.4		4.1		3.7		2.7		3.9		3.625	3.750	0.727
Total Dissolved Solids	mg/L	270	+	270	+	177	+	175	+	176	+	175	+	175	+	199.250	176.000	47.176
Total Suspended Solids	mg/L	5		6		11		6	A	6	A	15		13		9.250	8.500	4.646
Hardness ($CaCO_3$)	mg/L	158	+	158	+	113	+	112	+	113	+	115	+	114	+	124.500	114.000	22.368
Chlorophyll a	ug/L	2		3		23		7	HT	7	HT	10		9		10.500	8.500	8.963
Conductivity (lab)	umho/cm	416		415		273		270		271		269		269		307.000	271.500	72.687
Conductivity (field)	umho/cm	406		406		262		260		260		259		259		296.750	261.000	72.844
Dissolved Oxygen (lab)	mg/L	8.8		8.4		NA		NA		NA		NA		NA		8.800	8.800	0.000
Dissolved Oxygen (field)	mg/L	8.4		8.2		10.98		12.04		12.04		14.12		14.12		11.385	11.510	2.379
pH (lab)	pH	8.14	HT	8.15	HT	8.91	HT	8.36		8.44		8.25		8.26		8.415	8.305	0.342
pH (field)	pH	7		7.1		8.32		8.14		8.14		7.76		7.76		7.805	7.950	0.585
Temperature (field)	°C	19.7		19.7		22.04		13.3		13.3		8.67		8.67		15.928	16.500	6.087
Turbidity	NTU	1.7		1.8		5.7	HT	3.5		3.3		5.5		5.2		4.100	4.500	1.883
Secchi Disk reading	feet	4.5		4.5		2.8		5.5		5.5		4.8		4.8		-	-	-
Station Depth	feet	11		11		13.8		11		11		12		12		-	-	-

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V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A8.1 Mean water chemistry data collected in 2000 from Saginaw Bay (Stations #060062 and #060078).

PARAMETER	Units	5/2/2000		7/24/2000		10/24/2000		Mean		Median	Standard Deviation
Total Ammonia	mg N/L	0.01		0.01	T	0.01	T	0.010		0.010	0.000
Total Nitrate	mg N/L	0.6	C	0.43	C	0.08	C	0.370		0.430	0.265
Total Nitrite	mg N/L	0.01		0.01		0.002		0.007		0.010	0.005
Total Kjeldahl Nitrogen	mg N/L	0.3		0.88		0.22		0.467		0.300	0.360
Total Phosphorus	mg P/L	0.02		0.08		0.01		0.037		0.020	0.038
Total Ortho Phosphate	mg P/L	0.002	T	0.002	T	0.005		0.003		0.002	0.002
Total Sulfate	mg/L	17		16		17		16.667		17.000	0.577
Total Calcium	mg/L	32		31.2		28.7		30.633		31.200	1.721
Total Chloride	mg/L	14		11		13		12.667		13.000	1.528
Total Magnesium	mg/L	9		8.2		8.9		8.700		8.900	0.436
Total Organic Carbon	mg/L	2.8		3.5		3		3.100		3.000	0.361
Total Dissolved Solids	mg/L	184		172		170		175.333		172.000	7.572
Total Suspended Solids	mg/L	4	K	4	K	6	A	3.333	@	4.000	1.155
Hardness ($CaCO_3$)	mg/L	118		112		108		112.667		112.000	5.033
Chlorophyll a	ug/L	8		3	HT	13		6.667		8.000	5.000
Conductivity (lab)	umho/cm	283		265		251		266.333		265.000	16.042
Conductivity (field)	umho/cm	288		243		246		259.000		246.000	25.159
Dissolved Oxygen (lab)	mg/L	NA		9.5		NA		NA		NA	NA
Dissolved Oxygen (field)	mg/L	12.3		9.9				11.100		11.100	1.697
pH (lab)	pH	8.05	HT	8.56	HT	8.52		8.377		8.520	0.284
pH (field)	pH	6.6		8.3		8		7.633		8.000	0.907
Temperature (field)	^{o}C	9.8		21.1		12.5		14.467		12.500	5.901
Turbidity	NTU	4.7		0.4	QC	2.4		2.500		2.400	2.152
Secchi Disk reading	feet	4		10		5		-		-	-
Station Depth	feet	38		38		38		-		-	-
Methyltertbutylether (MTBE)	ug/L			ND		ND		0.000		0.000	0.000
BTEX	ug/L			ND		ND		0.000		0.000	0.000
Base Neutrals	ug/L			ND		ND		0.000		0.000	0.000
Diethyl phthalate	ug/L			1.9		ND		1.9		1.9	0.000

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Figure A8.2 Water chemistry data collected in 2000 from Saginaw Bay (Station # 060063).

PARAMETER	Units	5/2/2000		7/24/2000		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.01		0.006	T	0.008	0.008	0.003
Total Nitrate	mg N/L	0.51	C	0.09	C	0.300	0.300	0.297
Total Nitrite	mg N/L	0.004		0.004		0.004	0.004	0.000
Total Kjeldahl Nitrogen	mg N/L	0.24		0.5		0.370	0.370	0.184
Total Phosphorus	mg P/L	0.01		0.02		0.015	0.015	0.007
Total Ortho Phosphate	mg P/L	0.001	W	0.003		0.002	0.002	0.001
Total Sulfate	mg/L	20		19		19.500	19.500	0.707
Total Calcium	mg/L	33		22.6		27.800	27.800	7.354
Total Chloride	mg/L	13		14		13.500	13.500	0.707
Total Magnesium	mg/L	8.9		9.2		9.050	9.050	0.212
Total Organic Carbon	mg/L	2.9		4		3.450	3.450	0.778
Total Dissolved Solids	mg/L	185		154		169.500	169.500	21.920
Total Suspended Solids	mg/L	4	K	5		4.500	4.500	0.707
Hardness ($CaCO_3$)	mg/L	120		94		107.000	107.000	18.385
Chlorophyll a	ug/L	3		9	HT	6.000	6.000	4.243
Conductivity (lab)	umho/cm	285		237		261.000	261.000	33.941
Conductivity (field)	umho/cm	289		218		253.500	253.500	50.205
Dissolved Oxygen (field)	mg/L	11.2		10.1		10.650	10.650	0.778
pH (lab)	pH	8.19	HT	9.06	HT	8.625	8.625	0.615
pH (field)	pH	7.4		8.6		8.000	8.000	0.849
Temperature (field)	°C	13.2		22.1		17.650	17.650	6.293
Turbidity	NTU	3.7		2.6	QC	3.150	3.150	0.778
Secchi Disk reading	feet	6		3.5		-	-	-
Station Depth	feet	14		14		-	-	-
Methyltertbutylether (MTBE)	ug/L			ND		0.000	0.000	0.000
BTEX	ug/L			ND		0.000	0.000	0.000
Base Neutrals	ug/L			ND		0.000	0.000	0.000
Diethyl phthalate	ug/L			1		1	1	0.000

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V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A8.3 Water chemistry data collected in 2000 from Saginaw Bay (Station #090250).

PARAMETER	Units	5/2/2000		7/24/2000		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.01		0.002	T	0.006	0.006	0.006
Total Nitrate	mg N/L	1.35	C	0.35	C	0.850	0.85	0.707
Total Nitrite	mg N/L	0.01		0.01		0.010	0.01	0.000
Total Kjeldahl Nitrogen	mg N/L	0.4		0.39		0.395	0.395	0.007
Total Phosphorus	mg P/L	0.03		0.02		0.025	0.025	0.007
Total Ortho Phosphate	mg P/L	0.001	T	0.001	W	0.001	0.001	0.000
Total Sulfate	mg/L	21		17		19.000	19	2.828
Total Calcium	mg/L	39		33.3		36.150	36.15	4.031
Total Chloride	mg/L	23		13		18.000	18	7.071
Total Magnesium	mg/L	10.8		8.9		9.850	9.85	1.344
Total Organic Carbon	mg/L	3.6		3.7		3.650	3.65	0.071
Total Dissolved Solids	mg/L	228		180		204.000	204	33.941
Total Suspended Solids	mg/L	12		4	K	8.000	8	5.657
Hardness ($CaCO_3$)	mg/L	142		120		131.000	131	15.556
Chlorophyll a	ug/L	9		6	HT	7.500	7.5	2.121
Conductivity (lab)	umho/cm	351		277		314.000	314	52.326
Conductivity (field)	umho/cm	358		256		307.000	307	72.125
Dissolved Oxygen (field)	mg/L	11.4		10.1		10.750	10.75	0.919
pH (lab)	pH	8.08	HT	8.78	HT	8.430	8.43	0.495
pH (field)	pH	7		8.5		7.750	7.75	1.061
Temperature (field)	^{o}C	11.8		23.1		17.450	17.45	7.990
Turbidity	NTU	3.4		2.1	QC	2.750	2.75	0.919
Secchi Disk reading	feet	2.5		6		-	-	-
Station Depth	feet	13		13		-	-	-
Methyltertbutylether (MTBE)	ug/L			ND		0.000	0.000	0.000
BTEX	ug/L			ND		0.000	0.000	0.000
Base Neutrals	ug/L			ND		0.000	0.000	0.000
Diethyl phthalate	ug/L			2.1		2.1	2.1	0.000

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J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A8.4 Water chemistry data collected in 2000 from Saginaw Bay (Station #790134).

PARAMETER	Units	5/2/2000		7/25/2000		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.01		0.01		0.010	0.010	0.000
Total Nitrate	mg N/L	0.32	C	1.3	C	0.81	0.81	0.693
Total Nitrite	mg N/L	0.003		0.02		0.012	0.012	0.012
Total Kjeldahl Nitrogen	mg N/L	0.14		0.7		0.42	0.42	0.40
Total Phosphorus	mg P/L	0.003	T	0.018		0.0105	0.0105	0.011
Total Ortho Phosphate	mg P/L	0.001	W	0.001	T	0.001	0.001	0.000
Total Sulfate	mg/L	14		26		20	20	8.5
Total Calcium	mg/L	27		31.4		29.2	29.2	3.11
Total Chloride	mg/L	7		32		19.5	19.5	17.7
Total Magnesium	mg/L	7.5		12		9.75	9.75	3.2
Total Organic Carbon	mg/L	1.7		5.7		3.7	3.7	2.8
Total Dissolved Solids	mg/L	148		228		188	188	56.6
Total Suspended Solids	mg/L	4	K	9		6.5	6.5	4
Hardness ($CaCO_3$)	mg/L	99		128		114	114	20.5
Chlorophyll a	ug/L	6		9		8	8	2.1
Conductivity (lab)	umho/cm	228		351		290	290	87.0
Conductivity (field)	umho/cm	231		322		277	277	64.3
Dissolved Oxygen (field)	mg/L	11.4		10.6		11.0	11.0	0.00
pH (lab)	pH	8.12	HT	8.95		8.5	8.5	0.59
pH (field)	pH	7.9		8.7		8.3	8.3	0.57
Temperature (field)	°C	13.1		22.3		17.7	17.7	6.51
Turbidity	NTU	5.5		6.1		5.8	5.8	0.42
Secchi Disk reading	feet	10		3		-	-	-
Station Depth	feet	17		17		-	-	-
Methyltertbutylether (MTBE)	ug/L			ND		0.000	0.000	0.000
BTEX	ug/L			ND		0.000	0.000	0.000
Base Neutrals	ug/L			ND		0.000	0.000	0.000
Diethyl phthalate	ug/L			1.5		1.5	1.5	0.000

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
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M = The level of the method preparation blank is reported in the qualifier column.
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PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A8.5 Water chemistry data collected in 2000 from Saginaw Bay (Station #320188).

PARAMETER	Units	5/2/2000		7/25/2000		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.01		0.004	T	0.007	0.007	0.004
Total Nitrate	mg N/L	0.32	C	1.29	C	0.805	0.805	0.686
Total Nitrite	mg N/L	0.004		0.048	T	0.026	0.026	0.031
Total Kjeldahl Nitrogen	mg N/L	0.12		0.28		0.200	0.2	0.113
Total Phosphorus	mg P/L	0.003	T	0.01		0.007	0.0065	0.005
Total Ortho Phosphate	mg P/L	0.001	W	0.001	T	0.001	0.001	0.000
Total Sulfate	mg/L	14		15		14.500	14.5	0.707
Total Calcium	mg/L	27		29		28.000	28	1.414
Total Chloride	mg/L	6		10		8.000	8	2.828
Total Magnesium	mg/L	7.5		8.1		7.800	7.8	0.424
Total Organic Carbon	mg/L	1.7	DM	2.7		2.200	2.2	0.707
Total Dissolved Solids	mg/L	145		160		152.500	152.5	10.607
Total Suspended Solids	mg/L	4	K	6		5.000	5	1.414
Hardness ($CaCO_3$)	mg/L	99		106		102.500	102.5	4.950
Chlorophyll a	ug/L	1	K	6		3.500	3.5	3.536
Conductivity (lab)	umho/cm	223		246		234.500	234.5	16.263
Conductivity (field)	umho/cm	228		225		226.500	226.5	2.121
Dissolved Oxygen (field)	mg/L	11		10.2		10.600	10.6	0.566
pH (lab)	pH	8.09	HT	8.85		8.470	8.47	0.537
pH (field)	pH	7.6		8.5		8.050	8.05	0.636
Temperature (field)	°C	13.5		21		17.250	17.25	5.303
Turbidity	NTU	1.8		0.5		1.150	1.15	0.919
Secchi Disk reading	feet	9		6		-	-	-
Station Depth	feet	14		14		-	-	-
Methyltertbutylether (MTBE)	ug/L			ND		0.000	0.000	0.000
BTEX	ug/L			ND		0.000	0.000	0.000
Base Neutrals	ug/L			ND		0.000	0.000	0.000
Diethyl phthalate	ug/L			1.4		1.4	1.4	0.000

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A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
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ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A8.6 Water chemistry data collected in 2000 from Saginaw Bay (Station #320189).

PARAMETER	Units	5/3/2000		7/25/2000		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.01		0.07		0.040	0.04	0.042
Total Nitrate	mg N/L	1.64	C	1.14	C	1.390	1.39	0.354
Total Nitrite	mg N/L	0.02		0.05		0.035	0.035	0.021
Total Kjeldahl Nitrogen	mg N/L	0.23		0.67		0.450	0.45	0.311
Total Phosphorus	mg P/L	0.01		0.016		0.013	0.013	0.004
Total Ortho Phosphate	mg P/L	0.001	W	0.001	W	0.001	0.001	0.000
Total Sulfate	mg/L	19		26		22.500	22.5	4.950
Total Calcium	mg/L	33		31.5		32.250	32.25	1.061
Total Chloride	mg/L	11		28		19.500	19.5	12.021
Total Magnesium	mg/L	9		11.1		10.050	10.05	1.485
Total Organic Carbon	mg/L	2.5		5		3.750	3.75	1.768
Total Dissolved Solids	mg/L	180		218		199.000	199	26.870
Total Suspended Solids	mg/L	4	K	4	K	4.000	4	0.000
Hardness ($CaCO_3$)	mg/L	120		124		122.000	122	2.828
Chlorophyll a	ug/L	6		7		6.500	6.5	0.707
Conductivity (lab)	umho/cm	277		335		306.000	306	41.012
Conductivity (field)	umho/cm	285		308		296.500	296.5	16.263
Dissolved Oxygen (lab)	mg/L	NA		NA				
Dissolved Oxygen (field)	mg/L	10.9		9.9		10.400	10.4	0.707
pH (lab)	pH	8.24	HT	8.85		8.545	8.545	0.431
pH (field)	pH	7.9		8.6		8.250	8.25	0.495
Temperature (field)	^{o}C	14.6		22.5		18.550	18.55	5.586
Turbidity	NTU	2.7		3		2.850	2.85	0.212
Secchi Disk reading	feet	4.1		4		-	-	-
Station Depth	feet	13		13		-	-	-
Methyltertbutylether (MTBE)	ug/L			ND		0.000	0.000	0.000
BTEX	ug/L			ND		0.000	0.000	0.000
Base Neutrals	ug/L			ND		0.000	0.000	0.000
Diethyl phthalate	ug/L			1.8		1.8	1.8	

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V = Value not available due to dilution.
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Table A8.7 Water chemistry data collected in 2000 from Saginaw Bay (Station #090252).

PARAMETER	Units	5/3/2000		7/25/2000		10/25/2000		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.02		0.01	T	0.005	T	0.012	0.010	0.008
Total Nitrate	mg N/L	0.63	C	0.35	C	0.02	C	0.333	0.350	0.305
Total Nitrite	mg N/L	0.01		0.01	T	0.002		0.007	0.010	0.005
Total Kjeldahl Nitrogen	mg N/L	0.19		0.48		0.38		0.350	0.380	0.147
Total Phosphorus	mg P/L	0.01		0.02		0.02		0.017	0.020	0.006
Total Ortho Phosphate	mg P/L	0.001	W	0.003	T	0.003		0.002	0.003	0.001
Total Sulfate	mg/L	16		21		18		18.333	18.000	2.517
Total Calcium	mg/L	30		30.1		32.7		30.933	30.100	1.531
Total Chloride	mg/L	10		23		17		16.667	17.000	6.506
Total Magnesium	mg/L	8.2		10.3		9.6		9.367	9.600	1.069
Total Organic Carbon	mg/L	2.4		4.3		3.6		3.433	3.600	0.961
Total Dissolved Solids	mg/L	165		199		180		181.333	180.000	17.039
Total Suspended Solids	mg/L	4	K	7		4	A	5.000	4.000	1.732
Hardness ($CaCO_3$)	mg/L	109		118		121		116.000	118.000	6.245
Chlorophyll a	ug/L	3		10		7		6.667	7.000	3.512
Conductivity (lab)	umho/cm	254		306		282		280.667	282.000	26.026
Conductivity (field)	umho/cm	261		283		277		273.667	277.000	11.372
Dissolved Oxygen (lab)	mg/L	10.5		10.8		10.4		10.567	10.500	0.208
Dissolved Oxygen (field)	mg/L	10.8		10.6		NA		10.700	10.700	0.141
pH (lab)	pH	8.13	HT	9.01		8.45		8.530	8.450	0.445
pH (field)	pH	7.9		8.5		8		8.133	8.000	0.321
Temperature (field)	^{o}C	13.1		22.8		12.8		16.233	13.100	5.689
Turbidity	NTU	1.8		4.1		2.5		2.800	2.500	1.179
Secchi Disk reading	feet	7		4.5		6		-	-	-
Station Depth	feet	13		13		13		-	-	-
Methyltertbutylether (MTBE)	ug/L			ND		ND		0.000	0.000	0.000
BTEX	ug/L			ND		ND		0.000	0.000	0.000
Base Neutrals	ug/L			ND		ND		0.000	0.000	0.000
Diethyl phthalate	ug/L			1.3				1.3	1.3	0.000

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S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A9.1 Mean water chemistry data collected in 2001 from Saginaw Bay (Stations #060062 and #060078).

PARAMETER	Units	4/30/2001		6/4/2001		7/9/2001		8/6/2001		9/11/2001		11/12/2001		Mean		Median	Standard Deviation
Total Ammonia	mg N/L	0.007	T	0.032		0.006	T	0.0055	T	0.0045	T	0.008	T	0.011		0.007	0.011
Total Nitrate	mg N/L	0.57	C	0.89	C	0.45	C	0.0835	C	0.143	C	0.265	C HT	0.400		0.358	0.302
Total Nitrite	mg N/L	0.004		0.007		0.0055		0.0035		0.002		0.002	HT	0.004		0.004	0.002
Total Kjeldahl Nitrogen	mg N/L	0.29		0.43		0.225		0.405		0.295		0.2		0.308		0.293	0.093
Total Phosphorus	mg P/L	0.011		0.03		0.008		0.0215		0.014		0.0065		0.015		0.013	0.009
Total Ortho Phosphate	mg P/L	0.004	HT	0.0105		0.0025	T	0.0045		0.0025		0.0025	T	0.004		0.003	0.003
Total Sulfate	mg/L	17		22.5		19.5		18.5		16		16		18.250		17.750	2.505
Total Calcium	mg/L	32.65		40.55		34.1		33		29.1		28.3		32.950		32.825	4.373
Total Chloride	mg/L	13		23		15.5		16		10.5		8		14.333		14.250	5.212
Total Magnesium	mg/L	9.35		11.6		10		10.05		8.55		7.8		9.558		9.675	1.323
Total Organic Carbon	mg/L	3.2		3.9		3.25		3.15		3.2		2.3		3.167		3.200	0.510
Total Dissolved Solids	mg/L	180		230		185		180		150		150		179.167		180.000	29.397
Total Suspended Solids	mg/L	4	K	4.5		4	K	10.5		8.5		4	K	4.917	K	4.500	2.853
Hardness ($CaCO_3$)	mg/L	120.5		149		126.5		124		108		103		121.833		122.250	16.201
Chlorophyll a	ug/L	3		6		5		10		7		4		5.833		5.500	2.483
Conductivity (lab)	umho/cm	277		355		287		280		236		229.5		277.417		278.500	45.009
Conductivity (field)	umho/cm	268		346.5		276		255.5				217.5		272.700		268.000	46.964
Dissolved Oxygen (lab)	mg/L							9.1	HT	8.85		11		9.650		9.100	1.176
Dissolved Oxygen (field)	mg/L	11.7		9.5		10		8.255				11.3		10.151		10.000	1.393
pH (lab)	pH	8.1	HT	8.21	HT	8.45	HT	8.815	HT	8.42		8.06		8.343		8.315	0.282
pH (field)	pH	8.35		8.25		8.55		8.6				8.15		8.380		8.350	0.192
Temperature (field)	^oC	8.65		15.3		19.35		24.75		17.5				17.110		17.500	5.882
Turbidity	NTU	0.55		4.8		0.5		4.05		2.45				2.470		2.450	1.968
Total Sodium	mg/L					7.25		8.35		5.6				7.067		7.250	1.384
Total Potassium	mg/L					1.4		1.5		1.1				1.333		1.400	0.208
Total Sulfide	mg/L	0.02	K	0.02	K	0.02	K	0.02	K	0.02	K			0.010	K	0.020	0.000
Total Alkalinity	mg/L	85.5		101		84		87		75.5				86.600		85.500	9.202
Secchi Disk reading	feet	12		4		9		5		5		10		7.500		7.000	3.271
Cyanide	mg/L	0.005	K											0.003	K		
VOA	ug/L					ND								0.000		0.000	
Base Neutrals	ug/L					ND								0.000		0.000	

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S = Supernatant analyzed.
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V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A9.2 Water chemistry data collected in 2001 from Saginaw Bay (Station # 060063).

PARAMETER	Units	4/30/2001	6/4/2001	7/9/2001	8/7/2001	10/16/2001	11/12/2001	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.011	0.009 T	0.004 T	0.004 T	0.007 T	0.007 T	0.007	0.007	0.003
Total Nitrate	mg N/L	1.56 C	1.11 C	0.48 C	NAV	0.001 C T	0.141 C HT	0.658	0.480	0.661
Total Nitrite	mg N/L	0.012	0.008	0.008	0.001 W	0.001 T	0.002 HT	0.005	0.005	0.005
Total Kjeldahl Nitrogen	mg N/L	0.46	0.42	0.37	0.65	0.49	0.34	0.455	0.440	0.110
Total Phosphorus	mg P/L	0.016	0.016	0.015	0.021	0.038	0.02	0.021	0.018	0.009
Total Ortho Phosphate	mg P/L	0.005 HT	0.006	0.002 T	0.002 T	0.002 T	0.005	0.004	0.004	0.002
Total Sulfate	mg/L	30	27	22	21	19	19	23.000	21.500	4.517
Total Calcium	mg/L	52.3	43.9	38	30.6	31.4	31.6	37.967	34.800	8.701
Total Chloride	mg/L	40	35	21	25	16	15	25.333	23.000	10.211
Total Magnesium	mg/L	15.8	14.2	11.5	11.9	9.9	9.4	12.117	11.700	2.475
Total Organic Carbon	mg/L	6.3	4.8	3.9	4.4	3.7	3	4.350	4.150	1.136
Total Dissolved Solids	mg/L	310	270	220	200	180	180	226.667	210.000	52.789
Total Suspended Solids	mg/L	4 K	4	4	11	13	7	6.833	5.500	3.971
Hardness ($CaCO_3$)	mg/L	196	168	142	125	119	118	144.667	133.500	31.443
Chlorophyll a	ug/L	3	4	4	9	13	25	9.667	6.500	8.430
Conductivity (lab)	umho/cm	479	423	333	307	278	272	348.667	320.000	84.102
Conductivity (field)	umho/cm	465	413	326	280	284	259	337.833	305.000	82.968
Dissolved Oxygen (lab)	mg/L				8.6		12	10.300	10.300	2.404
Dissolved Oxygen (field)	mg/L	11	10.1	10.5	9.9	10.7	12.3	10.750	10.600	0.857
pH (lab)	pH	8.42 HT	8.46 HT	8.69 HT	8.79 HT	8.18	8.32	8.477	8.440	0.228
pH (field)	pH	8.5	8.5	8.7	8.7	7.3	8.3	8.333	8.500	0.528
Temperature (field)	°C	13.6	14.9	23.9	26.1	12.1	6.7	16.217	14.250	7.387
Turbidity	NTU	1.9	1.7	1.8	4.3	12	4.6	4.383	3.100	3.952
Total Sodium	mg/L			9.8	12.3	8.8	6.9	9.450	9.300	2.249
Total Potassium	mg/L			1.7	1.8	1.3	1.2	1.500	1.500	0.294
Total Sulfide	mg/L	0.02 K	0.02 K	0.02 K	0.02 K	0.02 K	0.02 K	0.010 K	0.020	0.000
Total Alkalinity	mg/L	125	105	93	81	82	78	94.000	87.500	18.177
Secchi Disk reading	feet	7	10	9	4	2	4	6.000	5.500	3.162
Cyanide	mg/L	0.005 K						0.003 K		
VOA	ug/L			ND				0.000	0.000	
Base Neutrals	ug/L			ND				0.000	0.000	

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@ = Mean includes samples with concentration below level of quantification.
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V = Value not available due to dilution.
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Table A9.3 Water chemistry data collected in 2001 from Saginaw Bay (Station #090250).

PARAMETER	Units	4/30/2001		6/4/2001		7/9/2001		8/7/2001		11/12/2001		Mean		Median	Standard Deviation
Total Ammonia	mg N/L	0.009	T	0.022		0.006	T	0.004	T	0.005	T	0.009		0.006	0.007
Total Nitrate	mg N/L	1.57	C	1.86	C	0.46	C		NAV	0.027	C HT	0.979		1.015	0.876
Total Nitrite	mg N/L	0.008		0.025		0.006		0.001	T	0.002	HT	0.008		0.006	0.010
Total Kjeldahl Nitrogen	mg N/L	0.57		0.79		0.32		0.57		0.28		0.506		0.570	0.209
Total Phosphorus	mg P/L	0.033		0.05		0.013		0.027		0.019		0.028		0.027	0.014
Total Ortho Phosphate	mg P/L	0.005	HT	0.009		0.002	T	0.006		0.005		0.005		0.005	0.003
Total Sulfate	mg/L	25		28		20		20		20		22.600		20.000	3.715
Total Calcium	mg/L	46.5		48.2		36.6		33		32.4		39.340		36.600	7.511
Total Chloride	mg/L	32		41		17		22		15		25.400		22.000	10.922
Total Magnesium	mg/L	13.4		15.5		10.4		11.3		9.4		12.000		11.300	2.451
Total Organic Carbon	mg/L	5.7		6.2		3.4		3.9		2.6		4.360		3.900	1.534
Total Dissolved Solids	mg/L	270		310		200		200		180		232.000		200.000	55.408
Total Suspended Solids	mg/L	4	K	6		4	K	10		8		5.600	K	6.000	2.608
Hardness ($CaCO_3$)	mg/L	171		184		134		129		120		147.600		134.000	28.130
Chlorophyll a	ug/L	19		10		4		11		16		12.000		11.000	5.788
Conductivity (lab)	umho/cm	412		476		304		305		276		354.600		305.000	85.486
Conductivity (field)	umho/cm	403		463		297		278		263		340.800		297.000	87.631
Dissolved Oxygen (lab)	mg/L									11		11.000		11.000	
Dissolved Oxygen (field)	mg/L	12.2		9.6		9.8		9.9		11.4		10.580		9.900	1.154
pH (lab)	pH	8.42	HT	8.3	HT	8.55	HT	8.79	HT	8.2		8.452	HT	8.420	0.230
pH (field)	pH	8.5		8.5		8.7		8.5		8.3		8.500		8.500	0.141
Temperature (field)	^oC	11.2		15.4		22.4		25.6		7.4		16.400		15.400	7.578
Turbidity	NTU	3		6.3		0.6		4		4.6		3.700		4.000	2.107
Total Sodium	mg/L					7.9		10.7		6.9		8.500		7.900	1.970
Total Potassium	mg/L					1.5		1.7		1.2		1.467		1.500	0.252
Total Sulfide	mg/L	0.02	K	0.02	K	0.02	K	0.02	K	0.02	K	0.010	K	0.020	0.000
Total Alkalinity	mg/L	118		121		86		86		80		98.200		86.000	19.627
Secchi Disk reading	feet	5		2		8		6		4		5.000		5.000	2.236
Cyanide	mg/L	0.005	K									0.003	K		
VOA	ug/L					ND						0.000		0.000	
Base Neutrals	ug/L					ND						0.000		0.000	

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Table A9.4 Water chemistry data collected in 2001 from Saginaw Bay (Station #790134).

C	Units	5/1/2001		6/5/2001		7/9/2001		8/7/2001		11/13/2001		Mean		Median	Standard Deviation
Total Ammonia	mg N/L	0.013		0.01		0.006	T	0.006	T	0.009	T	0.009		0.009	0.003
Total Nitrate	mg N/L	1.39	C	1.01	C	0.61	C	0.13	C	0.35	C HT	0.698		0.610	0.507
Total Nitrite	mg N/L	0.009		0.006		0.01		0.005		0.003	HT	0.007		0.006	0.003
Total Kjeldahl Nitrogen	mg N/L	0.4		0.32		0.42		0.44		0.36		0.388		0.400	0.048
Total Phosphorus	mg P/L	0.014		0.016		0.017		0.013		0.026		0.017		0.016	0.005
Total Ortho Phosphate	mg P/L	0.003		0.006		0.002	T	0.003		0.002	T	0.003		0.003	0.002
Total Sulfate	mg/L	24		24		23		18		18		21.400		23.000	3.130
Total Calcium	mg/L	47.9		43.3		40.4		31.4		32.1		39.020		40.400	7.159
Total Chloride	mg/L	31		28		22		18		14		22.600		22.000	6.986
Total Magnesium	mg/L	13.5		12.6		11.7		10.4		9.3		11.500		11.700	1.681
Total Organic Carbon	mg/L	5.2		4.2		4.1		3.4		2.7		3.920		4.100	0.936
Total Dissolved Solids	mg/L	1270		250		220		180		180		420.000		220.000	476.078
Total Suspended Solids	mg/L	4	K	4	K	4		9		9		5.200	K	4.000	2.739
Hardness ($CaCO_3$)	mg/L	175		160		149		121		119		144.800		149.000	24.458
Chlorophyll a	ug/L	3		2		5		8		9		5.400		5.000	3.050
Conductivity (lab)	umho/cm	408		387		341		282		276		338.800		341.000	59.764
Conductivity (field)	umho/cm	397		376		335		258		265		326.200		335.000	63.180
Dissolved Oxygen (lab)	mg/L							9.2		12		10.600		10.600	1.980
Dissolved Oxygen (field)	mg/L	11.3		10.2		10.2		9.8		11.6		10.620		10.200	0.782
pH (lab)	pH	8.35		8.39		8.79	HT	8.78	HT	8.11		8.484		8.390	0.295
pH (field)	pH	8.5		8.5		8.7		8.5		8.2		8.480		8.500	0.179
Temperature (field)	^{o}C	12.6		14.4		23.9		25.6		6.7		16.640		14.400	7.955
Turbidity	NTU	1.6		1.9		2.4		3.2		8.6		3.540		2.400	2.893
Total Sodium	mg/L					10.9		8.8		7.2		8.967		8.800	1.856
Total Potassium	mg/L					1.8		1.5		1.3		1.533		1.500	0.252
Total Sulfide	mg/L	0.02	K	0.02	K ST	0.02	K	0.02	K	0.02	K	0.010	K	0.020	0.000
Total Alkalinity	mg/L	113		102		101		84		81		96.200		101.000	13.405
Secchi Disk reading	feet	8		6		8		6		2		6.000		6.000	2.449
Cyanide	mg/L	0.005	K									0.005			
VOA	ug/L					ND						0.000		0.000	
Base Neutrals	ug/L					ND						0.000		0.000	

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W = Reported value is less then the method detection limit.

Table A9.5 Water chemistry data collected in 2001 from Saginaw Bay (Station #320188).

C	Units	5/1/2001	6/4/2001	7/9/2001	8/7/2001	11/12/2001	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.011	0.008 T	0.007 T	0.008 T	0.009 T	0.009	0.008	0.002
Total Nitrate	mg N/L	1.66 C	0.9 C	0.45 C	0.137 C	1.02 C HT	0.833	0.900	0.582
Total Nitrite	mg N/L	0.008	0.007	0.008	0.005	0.005 HT	0.007	0.007	0.002
Total Kjeldahl Nitrogen	mg N/L	0.42	0.43	0.39	0.68	0.6	0.504	0.430	0.128
Total Phosphorus	mg P/L	0.017	0.017	0.01	0.019	0.044	0.021	0.017	0.013
Total Ortho Phosphate	mg P/L	0.003	0.006	0.002 T	0.003	0.005	0.004	0.003	0.002
Total Sulfate	mg/L	26	23	22	24	22	23.400	23.000	1.673
Total Calcium	mg/L	48.6	39.8	35	29.1	37.4	37.980	37.400	7.144
Total Chloride	mg/L	35	27	22	26	21	26.200	26.000	5.541
Total Magnesium	mg/L	14.2	12.4	11.5	12.2	11.3	12.320	12.200	1.148
Total Organic Carbon	mg/L	5.5	4.4	3.9	4.5	3.6	4.380	4.400	0.726
Total Dissolved Solids	mg/L	280	240	210	200	220	230.000	220.000	31.623
Total Suspended Solids	mg/L	4 K	9	8	18	26	12.600 K	9.000	8.888
Hardness ($CaCO_3$)	mg/L	180	151	135	123	290	175.800	151.000	67.318
Chlorophyll a	ug/L	4	5	9	10	15	8.600	9.000	4.393
Conductivity (lab)	umho/cm	432	376	324	300	339	354.200	339.000	51.500
Conductivity (field)	umho/cm	420	365	319	276	322	340.400	322.000	54.510
Dissolved Oxygen (lab)	mg/L				8.8	11	9.900	9.900	1.556
Dissolved Oxygen (field)	mg/L	11.6	10.2	10.6	10	11.7	10.820	10.600	0.789
pH (lab)	pH	8.45	8.5 HT	8.87 HT	8.83 HT	8.21	8.572 HT	8.500	0.277
pH (field)	pH	8.5	8.5	8.7	8.5	8.2	8.480	8.500	0.179
Temperature (field)	^oC	13.3	14.3	24.3	26.1	6.6	16.920	14.300	8.143
Turbidity	NTU	2.5	4.7	2.6	7.3	19	7.220	4.700	6.869
Total Sodium	mg/L			10.2	12.9	10.2	11.100	10.200	1.559
Total Potassium	mg/L			1.6	1.9	1.8	1.767	1.800	0.153
Total Sulfide	mg/L	0.02 K	0.02 K	0.02 K	0.02 K	0.02 K	0.010 K	0.020	0.000
Total Alkalinity	mg/L	117	97	94	77	94	95.800	94.000	14.237
Secchi Disk reading	feet	7	4	6	3	2	4.400	4.000	2.074
Cyanide	mg/L	0.005 K					0.003 K		
VOA	ug/L			ND			0.000	0.000	
Base Neutrals	ug/L			ND			0.000	0.000	

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Table A9.6 Water chemistry data collected in 2001 from Saginaw Bay (Station #320189).

PARAMETER	Units	5/1/2001	6/5/2001	7/10/2001	8/7/2001	10/18/2001	11/13/2001	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.011	0.006 T	0.008 T	0.038	0.008 T	0.01	0.014	0.009	0.012
Total Nitrate	mg N/L	1.6 C	0.52 C	0.139 C	0.107 C	0.043 C PI	0.62 C	0.505	0.330	0.586
Total Nitrite	mg N/L	0.02	0.007	0.007	0.007	0.003 PI	0.005	0.008	0.007	0.006
Total Kjeldahl Nitrogen	mg N/L	0.42	0.41	0.73	0.66	0.73	0.38	0.555	0.540	0.169
Total Phosphorus	mg P/L	0.02	0.017	0.024	0.018	0.046	0.021	0.024	0.021	0.011
Total Ortho Phosphate	mg P/L	0.005	0.006	0.003	0.002 T	0.004	0.003	0.004	0.004	0.001
Total Sulfate	mg/L	28	23	29	24	24	23	25.167	24.000	2.639
Total Calcium	mg/L	45.3	36.8	29.9	32.1	34.5	37.1	35.950	35.650	5.348
Total Chloride	mg/L	25	21	30	30	31	25	27.000	27.500	3.950
Total Magnesium	mg/L	12.9	11.4	13.9	13.9	12.5	11.3	12.650	12.700	1.148
Total Organic Carbon	mg/L	4.2	3.7	5.2	5.2	4.5	3.5	4.383	4.350	0.725
Total Dissolved Solids	mg/L	250	220	220	220	230	230	228.333	225.000	11.690
Total Suspended Solids	mg/L	5	6	9	11	32	8	11.833	8.500	10.108
Hardness ($CaCO_3$)	mg/L	166	139	132	137	138	139	141.833	138.500	12.123
Chlorophyll a	ug/L	5	6	11	7	13	6	8.000	6.500	3.225
Conductivity (lab)	umho/cm	386	331	341	333	353	348	348.667	344.500	20.146
Conductivity (field)	umho/cm	376	322	334	305	361	332	338.333	333.000	25.959
Dissolved Oxygen (lab)	mg/L		9		8.6	11	11	9.900	10.000	1.281
Dissolved Oxygen (field)	mg/L	10.9	10.5	10.1	9.4	12.1	12.2	10.867	10.700	1.111
pH (lab)	pH	8.35	8.54	8.87 HT	8.8 HT	7.98	8.15	8.448	8.445	0.354
pH (field)	pH	8.4	8.6	8.7	8.2	7.8	8.3	8.333	8.350	0.320
Temperature (field)	^{o}C	13.4	14.5	24	27.4	6.9	5.4	15.267	13.950	8.887
Turbidity	NTU	5.2	3.3	4.6	3.4	26	6.6	8.183	4.900	8.814
Total Sodium	mg/L			13.6	13.7	14.1	11.2	13.150	13.650	1.318
Total Potassium	mg/L			2.2	2	2	1.7	1.975	2.000	0.206
Total Sulfide	mg/L	0.02 K	0.02 K	0.02 K	0.02 K	0.02 K PI	0.02 K	0.010 K	0.020	0.000
Total Alkalinity	mg/L	108	86	76	84	92	94	90.000	89.000	10.881
Secchi Disk reading	feet	3	4	4	4	1	2	3.000	3.500	1.265
Cyanide	mg/L	0.005 K						0.003 K		
VOA	ug/L			ND				0.000	0.000	
Diethyl phthalate	ug/L			1.1				1.100	1.100	

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Table A9.7 Water chemistry data collected in 2001 from Saginaw Bay (Station #090252).

PARAMETER	Units	5/1/2001	6/4/2001	7/10/2001	8/7/2001	10/18/2001	11/12/2001	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.02	0.091	0.031	0.013	0.023	0.021	0.033	0.022	0.029
Total Nitrate	mg N/L	1.47 C	2.9 C	0.5 C	0.02 C	0.076 C PI	0.071 C HT	0.840	0.288	1.149
Total Nitrite	mg N/L	0.012	0.039	0.006	0.003	0.003 PI	0.001 T HT	0.011	0.005	0.014
Total Kjeldahl Nitrogen	mg N/L	0.51	0.79	0.33	0.77	0.47	0.34	0.535	0.490	0.203
Total Phosphorus	mg P/L	0.025	0.046	0.015	0.034	0.036	0.019	0.029	0.030	0.012
Total Ortho Phosphate	mg P/L	0.003	0.023	0.001 T	0.002 T	0.004	0.004	0.006	0.004	0.008
Total Sulfate	mg/L	28	28	22	24	20	19	23.500	23.000	3.886
Total Calcium	mg/L	49.6	59.6	39.2	32.3	33.4	31.6	40.950	36.300	11.357
Total Chloride	mg/L	40	44	20	38	20	14	29.333	29.000	12.754
Total Magnesium	mg/L	15.4	18.2	11.4	13.2	10.3	9.2	12.950	12.300	3.380
Total Organic Carbon	mg/L	6.1	9.2	3.7	5	3.7	2.8	5.083	4.350	2.325
Total Dissolved Solids	mg/L	310	350	220	230	200	180	248.333	225.000	66.758
Total Suspended Solids	mg/L	4	4 K	4 K	15	12	5	6.667 K	4.500	4.885
Hardness ($CaCO_3$)	mg/L	187	224	145	135	126	117	155.667	140.000	41.394
Chlorophyll a	ug/L	17	2	2	18	13	9	10.167	11.000	7.083
Conductivity (lab)	umho/cm	475	542	332	350	303	271	378.833	341.000	106.089
Conductivity (field)	umho/cm	462	522	325	321	313	255	366.333	323.000	102.359
Dissolved Oxygen (lab)	mg/L	10.8		8.2	8.8	10	11	9.760	10.000	1.228
Dissolved Oxygen (field)	mg/L	11.6	9.5	8.6	8.73	10.7	11.4	10.088	10.100	1.326
pH (lab)	pH	8.54	8.22 HT	8.51 HT	8.86 HT	8.09	8.04	8.377	8.365	0.316
pH (field)	pH	8.5	8.4	8.5	8.7	7.3	7.7	8.183	8.450	0.553
Temperature (field)	^{o}C	14.2	16	22.7	25.6	10	6.8	15.883	15.100	7.223
Turbidity	NTU	3.6	2.5	1	6.1	11	4.4	4.767	4.000	3.506
Total Sodium	mg/L			9.1	17.8	10.3	6.9	11.025	9.700	4.731
Total Potassium	mg/L			1.7	2	1.5	1.2	1.600	1.600	0.337
Total Sulfide	mg/L	0.02 K	0.02 K	0.02 K	0.02 K	0.02 K	0.02 K	0.010 K	0.020	0.000
Total Alkalinity	mg/L	131	147	95	86	92	84	105.833	93.500	26.483
Secchi Disk reading	feet	4	8	11	3	2	4	5.333	4.000	3.445
Cyanide	mg/L	0.005 K						0.003 K		
VOA	ug/L			ND				0.000	0.000	
Diethyl phthalate	ug/L			1.1				1.100	1.100	

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D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
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Q = Quantity of sample insufficient to perform analyses requested.
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S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A10.1 Mean water chemistry data collected in 2002 from Saginaw Bay (Stations #060062 and #060078).

PARAMETER	Units	4/15/2002	5/21/2002	6/18/2002	7/24/2002	8/20/2002	9/25/2002	10/23/2002	11/12/2002	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.0035 T	0.005 T	0.0265	0.007 T	0.0045 T	0.0075 T	0.007 T	0.008 T	0.009	0.007	0.007
Total Nitrate	mg N/L	1.16 C	1.05 C	0.86 C	0.375 C	0.024 C	0.1235 C	NAV	0.205 C	0.543	0.375	0.470
Total Nitrite	mg N/L	0.005	0.004	0.005	0.006	0.0025	0.003	0.002	0.002	0.004	0.004	0.002
Total Kjeldahl Nitrogen	mg N/L	0.28	0.35	0.34	0.285	HT	0.3	0.39	0.19	0.305	0.300	0.064
Total Phosphorus	mg P/L	0.015	0.0185	0.0205	0.008	0.0205	0.0135	0.028	0.011	0.017	0.017	0.006
Total Ortho Phosphate	mg P/L	0.0025 T PI	0.0015 T	0.0015 T	0.002 T	0.014	0.0045	0.003	0.0075	0.005	0.003	0.004
Total Sulfate	mg/L	21	24	23.5	17.5	18	14	16	15	18.625	17.750	3.806
Total Calcium	mg/L	41.15	41.5	37.1	30.55	29.75	27.65	30.9	27.7	33.288	30.725	5.763
Total Chloride	mg/L	21.5	23	19.5	16.5	13.5	10.5	13	9	15.813	15.000	5.154
Total Magnesium	mg/L	11.2	12.3	10.95	9.75	9.6	9.2	9.1	8.35	10.056	9.675	1.309
Total Organic Carbon	mg/L	3.4	3.85	3.2	3.05	3.35	2.5	3.3	1.85	3.063	3.250	0.619
Total Dissolved Solids	mg/L	220	230	215	185	170	160	170	150	187.500	177.500	30.237
Total Suspended Solids	mg/L	3.5 K	4	4	5	6.5	3.5	16	2 K	5.220 K	4.000	4.411
Hardness ($CaCO_3$)	mg/L	149	154.5	99	116.5	114	107	115	103.5	119.813	114.500	20.655
Chlorophyll a	ug/L	11	12	2	7	26	10	14	3	10.625	10.500	7.520
Conductivity (lab)	umho/cm	339	359	327.5	281	262.5	243	266	231.5	288.688	273.500	47.206
Conductivity (field)	umho/cm	325.5	383.5	326.5	267	254.5	236	249	216.5	282.313	260.750	56.884
Dissolved Oxygen (lab)	mg/L	13.5								13.500	13.500	
Dissolved Oxygen (field)	mg/L		11.385	8.82	7.835	9.445	8.25	12.2	11.245	9.883	9.445	1.716
pH (lab)	pH	8.07	8.245		8.315	8.785	8.455	8.31	8.195	8.339	8.310	0.229
pH (field)	pH	8.4	7.35	7.985	7.985	7.675	7.42		7.52	7.762	7.675	0.378
Temperature (field)	°C	3.8	10.275	16.955	22.48	21.785	18.265	9.74	6.415	13.714	13.615	7.095
Turbidity	NTU	2.3	4.3	2.15	1.95	3.5	3.3	8	0.5 K	3.510 K	2.800	2.239
Total Sodium	mg/L	9.6	12.35	9.6	7.25	6.65	6.25	6.4	5.2	7.913	6.950	2.385
Total Potassium	mg/L	1.6	1.6	1.45	4.7	2.25	1.05	1.2	1.05	1.863	1.525	1.211
Total Sulfide	mg/L	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.005 K	0.010	0.000
Total Alkalinity	mg/L	97.5	104.5	97	85	76	75.5	87	78	87.563	86.000	11.034
Secchi Disk reading	feet	38	4.9	5.8	7.5	6.1	5.2	5.2	9	10.213	5.950	11.313
Cyanide	mg/L	0.005 K								0.003 K		
VOA	ug/L				ND					0.000	0.000	
Base Neutrals	ug/L				ND					0.000	0.000	

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@ = Mean includes samples with concentration below level of quantification.
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V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A10.2 Water chemistry data collected in 2002 from Saginaw Bay (Station # 060063).

PARAMETER	Units	4/15/2002	5/21/2002	6/18/2002	7/24/2002	8/20/2002	9/25/2002	#######	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.006 T	0.006 T	0.007 T	0.007 T	0.003 T	0.002 T	0.01	0.006	0.006	0.003
Total Nitrate	mg N/L	0.72 C	0.69 C	0.6 C	0.21 C	0.016 C T	NAV	0.021 C	0.376	0.405	0.332
Total Nitrite	mg N/L	0.004	0.004	0.005	0.006	0.001 T	0.001 T	0.001 T	0.003	0.004	0.002
Total Kjeldahl Nitrogen	mg N/L	0.27	0.24	0.25	0.45	HT	0.33	0.32	0.310	0.295	0.078
Total Phosphorus	mg P/L	0.011	0.008	0.01	0.008	0.022	0.015	0.018	0.013	0.011	0.005
Total Ortho Phosphate	mg P/L	0.002 T	0.001 W	0.001 T	0.002 T	0.01	0.006	0.025	0.007	0.002	0.009
Total Sulfate	mg/L	21	21	23	20	19	15	17	19.429	20.000	2.699
Total Calcium	mg/L	39.1	36.2	34.8	29.7	29.1	28.3	28.4	32.229	29.700	4.395
Total Chloride	mg/L	18	15	18	16	14	14	12	15.286	15.000	2.215
Total Magnesium	mg/L	10.3	10.4	10.8	10.7	9.8	10.1	9.3	10.200	10.300	0.523
Total Organic Carbon	mg/L	3.1	3.3	3.3	3.7	3.2	3.2	2.8	3.229	3.200	0.269
Total Dissolved Solids	mg/L	200	200	200	190	170	170	170	185.714	190.000	15.119
Total Suspended Solids	mg/L	2 K	2 K	2 K	6	7	2 K	4	3.000 K	2.000	2.149
Hardness ($CaCO_3$)	mg/L	42	134	93	118	113	112	109	103.000	112.000	29.507
Chlorophyll a	ug/L	4	3	1	11	11	9	5	6.286	5.000	4.030
Conductivity (lab)	umho/cm	312	300	309	287	266	266	259	285.571	287.000	22.097
Conductivity (field)	umho/cm	305	321	300	280	259	259	245	281.286	280.000	28.288
Dissolved Oxygen (lab)	mg/L	12.1			8.9				10.500	10.500	2.263
Dissolved Oxygen (field)	mg/L	NW	11.43	9.19	5.13	9.46	9.12	11.81	9.357	9.325	2.378
pH (lab)	pH	8.12	8.22	HT	8.7	8.88	8.71	8.3	8.488	8.500	0.313
pH (field)	pH	8.4	7.38	8.3	8.35	8.02	7.63	7.58	7.951	8.020	0.419
Temperature (field)	°C	9.4	9.45	17.96	23.59	22.64	16.99	5.72	15.107	16.990	6.989
Turbidity	NTU	0.5 K	2	0.5 K	2.3	4.2	3.8	3.5	2.400	2.300	1.517
Total Sodium	mg/L	8.1	7.7	8.8	7.4	7.4	8.5	4.6	7.500	7.700	1.386
Total Potassium	mg/L	1.4	1.3	1.5	1.3	1.9	1.2	1.2	1.400	1.300	0.245
Total Sulfide	mg/L	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.005 K	0.010	0.000
Total Alkalinity	mg/L	94	89	93	80	77	78	82	84.714	82.000	7.158
Secchi Disk reading	feet	5.8	6.9	10.3	4.7	7.2	5.3	5.6	6.543	5.800	1.873
Cyanide	mg/L	0.005 K							0.003 K		
VOA	ug/L				ND				0.000	0.000	
Base Neutrals	ug/L				ND				0.000	0.000	

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Table A10.3 Water chemistry data collected in 2002 from Saginaw Bay (Station #090250).

PARAMETER	Units	4/15/2002	5/21/2002	6/18/2002	7/24/2002	8/20/2002	9/25/2002	11/12/2002	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.006 T	0.004 T	0.017	0.009 T	0.004 T	0.004 T	0.004 T	0.007	0.004	0.005
Total Nitrate	mg N/L	1.22 C	0.9 C PI	0.74 C	0.41 C	0.054 C	NAV	0.002 C T	0.554	0.575	0.484
Total Nitrite	mg N/L	0.005	0.003 PI	0.005	0.008	0.004	0.001 T	0.001 T	0.004	0.004	0.002
Total Kjeldahl Nitrogen	mg N/L	0.34	0.32	0.31	0.4	HT	0.37	0.33	0.345	0.335	0.034
Total Phosphorus	mg P/L	0.016	0.019	0.023	0.019	0.028	0.031	0.043	0.026	0.023	0.009
Total Ortho Phosphate	mg P/L	0.005	0.001 T PI	0.001 T	0.002 T	0.013	0.005	0.006	0.005	0.005	0.004
Total Sulfate	mg/L	22	24	22	19	18	15	16	19.429	19.000	3.359
Total Calcium	mg/L	41.6	38.8	36.8	34.1	29.3	28	30	34.086	34.100	5.207
Total Chloride	mg/L	22	19	18	16	12	13	13	16.143	16.000	3.716
Total Magnesium	mg/L	11.3	11.3	10.5	10.3	9.4	9.8	9.6	10.314	10.300	0.773
Total Organic Carbon	mg/L	3.7	3.6	3.1	3.6	3.2	3.3	3	3.357	3.300	0.276
Total Dissolved Solids	mg/L	220	210	210	200	170	170	170	192.857	200.000	22.147
Total Suspended Solids	mg/L	5	7	5	14	9	8	7	7.857	7.000	3.078
Hardness ($CaCO_3$)	mg/L	151	144	98	128	112	110	115	122.571	115.000	19.269
Chlorophyll a	ug/L	11	13	2	14	18	19	10	12.429	13.000	5.682
Conductivity (lab)	umho/cm	343	328	319	303	259	261	262	296.429	303.000	35.496
Conductivity (field)	umho/cm	331	350	306	295	254	252	247	290.714	295.000	41.125
Dissolved Oxygen (lab)	mg/L	13.8		8.88			8.82	11.7	10.800	10.290	2.409
Dissolved Oxygen (field)	mg/L	NW	11.71	8.8	7.47	8.64	8.36	11.7	9.447	8.720	1.809
pH (lab)	pH	8.13	8.22	HT	8.26	8.78	8.58	8.27	8.373	8.265	0.251
pH (field)	pH	8.5	7.39	8.03	7.94	8.83	7.63	7.6	7.989	7.940	0.518
Temperature (field)	^{o}C	5.2	9.66	17.13	23.55	22.72	18.66	5.64	14.651	17.130	7.767
Turbidity	NTU	2.4	3.3	3.3	6.1	5	6.9	3.2	4.314	3.300	1.698
Total Sodium	mg/L	10.5	10.2	8	7.2	6.6	7.5	7.3	8.186	7.500	1.538
Total Potassium	mg/L	1.6	1.4	1.5	1.4	1.5	1.2	1.2	1.400	1.400	0.153
Total Sulfide	mg/L	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.005 K	0.010	0.000
Total Alkalinity	mg/L	98	99	95	92	79	82	83	89.714	92.000	8.240
Secchi Disk reading	feet	6.2	4.1	5	3.7	4.8	3.6	4.8	4.600	4.800	0.900
Cyanide	mg/L	0.005 K							0.003 K		
VOA	ug/L				ND				0.000	0.000	
bis(2-ethylhexyl)phthalate	ug/L				8.600				8.600	8.600	

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V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A10.4 Water chemistry data collected in 2002 from Saginaw Bay (Station #790134).

PARAMETER	Units	4/15/2002	5/21/2002	6/18/2002	7/24/2002	8/21/2002	9/25/2002	10/22/2002	########	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.017	0.012	0.019	0.009 T	0.004 T	0.006 T	0.007 T	0.011	0.011	0.010	0.005
Total Nitrate	mg N/L	1.67 C	1.74 C	2.7 C PI	0.62 C	0.035 C	0.016 C	0.001 C W	0.024 C	0.851	0.328	1.049
Total Nitrite	mg N/L	0.007	0.009	0.025 PI	0.01	0.003	0.002 0	0.001 T	0.002	0.007	0.005	0.008
Total Kjeldahl Nitrogen	mg N/L	0.31	0.4	0.54	0.51	0.4	0.26	0.57	0.35	0.418	0.400	0.112
Total Phosphorus	mg P/L	0.014	0.012	0.016	0.016	0.012	0.008	0.032	0.021	0.016	0.015	0.007
Total Ortho Phosphate	mg P/L	0.001 T	0.001 W	0.001 T PI	0.002 T	0.002 T	0.002 T	0.006	0.005	0.003	0.002	0.002
Total Sulfate	mg/L	25	31	31	22	18	14	21	18	22.500	21.500	6.164
Total Calcium	mg/L	45.4	50.6	50.7	31.4	27.8	28.8	29.9	30.5	36.888	30.950	10.135
Total Chloride	mg/L	27	36	36	21	13	11	21	18	22.875	21.000	9.493
Total Magnesium	mg/L	12.4	15.4	15.9	12	9.5	9.4	10.7	10.1	11.925	11.350	2.541
Total Organic Carbon	mg/L	3.9	5	6.6	4.4	2.9	2.6	4.1	3.1	4.075	4.000	1.302
Total Dissolved Solids	mg/L	250	290	300	210	170	160	190	180	218.750	200.000	54.625
Total Suspended Solids	mg/L	2 K	4	2 K	10	5	2 K	23	7	6.500 K	4.500	7.100
Hardness ($CaCO_3$)	mg/L	165	190	137	128	109	111	119	118	134.625	123.500	28.720
Chlorophyll a	ug/L	2	2	7	12	11	7	11	4	7.000	7.000	4.071
Conductivity (lab)	umho/cm	381	451	461	320	254	245	296	283	336.375	308.000	84.974
Conductivity (field)	umho/cm	371	477	448	312		239	282	267	342.286	312.000	92.227
Dissolved Oxygen (lab)	mg/L	12.8								12.800	12.800	
Dissolved Oxygen (field)	mg/L	NW	11	9.15	8.37		8.9	11.81	11.78	10.168	10.075	1.540
pH (lab)	pH	8.12	8.25	HT	8.69	8.88	8.69	8.35	8.25	8.461	8.350	0.288
pH (field)	pH	6.9	7.34	8.31	9.15		7.69		7.58	7.828	7.635	0.795
Temperature (field)	^{o}C	8	10.81	19.22	23.84		18.04	8.83	5.8	13.506	10.810	6.817
Turbidity	NTU	0.5 K	2.3	2.2	2.6	5	1.4	14	3.5	3.910 K	2.450	4.282
Total Sodium	mg/L	11.2	17.4	16.6	11	6	7	11.4	10	11.325	11.100	4.030
Total Potassium	mg/L	1.7	2	2.4	1.6	1.2	1	1.9	1.4	1.650	1.650	0.454
Total Sulfide	mg/L	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.005 K	0.010	0.000
Total Alkalinity	mg/L	107	124	127	80	83	77	81	85	95.500	84.000	20.688
Secchi Disk reading	feet	10.6	6.8	6.3	4	4.4	8	2.8	5.3	6.025	5.800	2.484
Cyanide	mg/L	0.005 K								0.003 K		
VOA	ug/L				ND					0.000	0.000	
bis(2-ethylhexyl)phthalate	ug/L				7.700					7.700	7.700	

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QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A10.5 Water chemistry data collected in 2002 from Saginaw Bay (Station #320188).

PARAMETER	Units	4/15/2002	5/21/2002	6/18/2002	7/24/2002	8/21/2002	9/25/2002	10/22/2002	11/12/2002	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.013	0.015	0.019	0.006 T	0.004 T	0.003 T	0.009 T	0.003 T	0.009	0.008	0.006
Total Nitrate	mg N/L	3.5 C	0.68 C	1.26 C	0.34 C	0.02 C	NAV	0.138 C	0.048 C	0.855	0.340	1.246
Total Nitrite	mg N/L	0.016	0.005	0.007	0.005	0.002	0.001 T	0.002	0.001 T	0.005	0.004	0.005
Total Kjeldahl Nitrogen	mg N/L	0.44	0.18	0.36	0.36	0.46	0.3	0.46	0.29	0.356	0.360	0.098
Total Phosphorus	mg P/L	0.015	0.004 T	0.019	0.001 T	0.019	0.012	0.035	0.015	0.015	0.015	0.010
Total Ortho Phosphate	mg P/L	0.002 T	0.001 W	0.001 T	0.002 T	0.002 T	0.003	0.006	0.005	0.003	0.002	0.002
Total Sulfate	mg/L	31	18	27	18	17	15	16	16	19.750	17.500	5.898
Total Calcium	mg/L	58.3	31.9	43	30.9	28.5	28.3	26.4	28.9	34.525	29.900	10.888
Total Chloride	mg/L	40	12	28	13	12	12	9	12	17.250	12.000	10.886
Total Magnesium	mg/L	15.4	9.4	12.9	9.9	9.5	9.5	8.7	9.2	10.563	9.500	2.337
Total Organic Carbon	mg/L	4.7	2.6	4.1	3.4	3.2	3	2.6	2.6	3.275	3.100	0.772
Total Dissolved Solids	mg/L	310	180	250	180	160	170	150	170	196.250	175.000	55.016
Total Suspended Solids	mg/L	2 K	2 K	2 K	6	8	6	23	9	6.875 K	6.000	6.944
Hardness ($CaCO_3$)	mg/L	209	118	115	77	110	110	102	110	118.875	110.000	38.569
Chlorophyll a	ug/L	5	0.5 K	3	8	13	6	11	4	6.281 K	5.500	4.166
Conductivity (lab)	umho/cm	478	270	391	275	250	254	239	254	301.375	262.000	86.129
Conductivity (field)	umho/cm	467	286	378	266		247	225	238	301.000	266.000	89.066
Dissolved Oxygen (lab)	mg/L	12.2								12.200	12.200	
Dissolved Oxygen (field)	mg/L	NW	11.6	9.52	8.61		9.2	11.93	11.94	10.467	10.560	1.519
pH (lab)	pH	8.25	8.12	HT	8.68	8.87	8.83	8.28	8.25	8.469	8.280	0.313
pH (field)	pH	8.4	7.2	8.1	9.17		7.73		7.47	8.012	7.915	0.712
Temperature (field)	°C	9.2	10.45	18.03	23.29		17.7	9.12	5.5	13.327	10.450	6.387
Turbidity	NTU	2.9	0.5 K	1.9	3.4	7.4	2.9	14	4.1	4.638	3.150	4.272
Total Sodium	mg/L	16.1	6.1	13	8	6.2	6.5	5.2	6.1	8.400	6.350	3.962
Total Potassium	mg/L	2.2	1.1	1.8	1.2	1.1	1.1	1.1	1.3	1.363	1.150	0.414
Total Sulfide	mg/L	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.005 K	0.010	0.000
Total Alkalinity	mg/L	121	82	109	76	77	77	73	80	86.875	78.500	17.852
Secchi Disk reading	feet	5.3	10.2	7.8	6.5	3.3	5.3	3.5	5.1	5.875	5.300	2.278
Cyanide	mg/L	0.005 K								0.003 K		
VOA	ug/L				ND					0.000	0.000	
Base Neutrals	ug/L				ND					0.000	0.000	

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@ = Mean includes samples with concentration below level of quantification.
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V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A10.6 Water chemistry data collected in 2002 from Saginaw Bay (Station #320189).

PARAMETER	Units	5/21/2002	6/18/2002	7/24/2002	8/20/2002	9/25/2002	10/22/2002	11/12/2002	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.009 T	0.01	0.021	0.011	0.006 T	0.011	0.019	0.012	0.011	0.005
Total Nitrate	mg N/L	2 C	1.3 C PI	0.87 C	0.029 C	NAV	0.003 C T	0.125 C	0.721	0.498	0.818
Total Nitrite	mg N/L	0.019	0.015 PI	0.028	0.003	0.002	0.001 T	0.003	0.010	0.003	0.011
Total Kjeldahl Nitrogen	mg N/L	0.39	0.47	0.65	HT	0.57	0.52	0.34	0.490	0.495	0.115
Total Phosphorus	mg P/L	0.015	0.021	0.004 T	0.024	0.016	0.019	0.017	0.017	0.017	0.006
Total Ortho Phosphate	mg P/L	0.001 T	0.001 T	0.002 T	0.01	0.005	0.005	0.016	0.006	0.005	0.006
Total Sulfate	mg/L	32	33	32	26	20	25	16	26.286	26.000	6.550
Total Calcium	mg/L	47.5	43.3	28.9	23.3	25.7	26.7	31.3	32.386	28.900	9.314
Total Chloride	mg/L	27	33	51	31	25	24	16	29.571	27.000	10.922
Total Magnesium	mg/L	14.4	15.1	17	14.9	13.6	13	9.6	13.943	14.400	2.298
Total Organic Carbon	mg/L	4.2	4.7	6.6	6.1	4.8	5.2	2.8	4.914	4.800	1.250
Total Dissolved Solids	mg/L	270	270	250	200	200	200	180	224.286	200.000	37.796
Total Suspended Solids	mg/L	6	6	8	10	6	10	8	7.714	8.000	1.799
Hardness ($CaCO_3$)	mg/L	178	117	142	120	120	120	118	130.714	120.000	22.574
Chlorophyll a	ug/L	4	4	8	12	7	5	5	6.429	5.000	2.878
Conductivity (lab)	umho/cm	409	420	383	312	308	306	276	344.857	312.000	57.598
Conductivity (field)	umho/cm	433	409	374	304	301	287	244	336.000	304.000	69.876
Dissolved Oxygen (lab)	mg/L	10.9			8.72				9.810	9.810	1.541
Dissolved Oxygen (field)	mg/L	11.5	9.58	7.73	8.81	9.13	12.4	11.56	10.101	9.580	1.726
pH (lab)	pH	8.23	HT	8.7	9.03	8.64	8.19	8.2	8.498	8.435	0.346
pH (field)	pH	7.33	8.3	9.24	8.09	7.57		7.54	8.012	7.830	0.704
Temperature (field)	°C	10.66	17.45	23.37	22.42	16.02	6.97	6.05	14.706	16.020	7.012
Turbidity	NTU	4.1	3	4.4	4.1	5.4	4.9	4.8	4.386	4.400	0.769
Total Sodium	mg/L	12.6	14.8	15.9	14.3	13.1	11.2	6.3	12.600	13.100	3.176
Total Potassium	mg/L	1.9	2.1	2.6	2.8	1.6	1.7	5	2.529	2.100	1.177
Total Sulfide	mg/L	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.005 K	0.010	0.000
Total Alkalinity	mg/L	112	108	80	67	79	75	82	86.143	80.000	17.043
Secchi Disk reading	feet	3.8	4.2	3.4	4.4	3.3	3.5	3.7	3.757	3.700	0.412
Cyanide	mg/L	0.005 K							0.003 K		
VOA	ug/L				ND				0.000	0.000	
Base Neutrals	ug/L				ND				0.000	0.000	

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Table A10.7 Water chemistry data collected in 2002 from Saginaw Bay (Station #090252).

PARAMETER	Units	4/15/2002	5/21/2002	6/18/2002	7/24/2002	8/20/2002	9/25/2002	10/23/2002	11/12/2002	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.098	0.039	0.025	0.008 T	0.01	0.005 T	0.023	0.01	0.027	0.017	0.031
Total Nitrate	mg N/L	3.2 C	1.68 C	1.23 C PI	0.41 C	0.056 C	NAV	0.033 C	0.076 C	0.955	0.410	1.181
Total Nitrite	mg N/L	0.027	0.014	0.016 PI	0.009	0.003	0.001 T	0.002	0.001 T	0.009	0.006	0.009
Total Kjeldahl Nitrogen	mg N/L	0.76	0.48	0.46	0.48	HT	0.36	0.39	0.28	0.459	0.460	0.152
Total Phosphorus	mg P/L	0.044	0.021	0.026	0.023	0.037	0.012	0.029	0.015	0.026	0.025	0.011
Total Ortho Phosphate	mg P/L	0.018	0.001 T	0.002	0.002 T	0.009	0.004	0.006	0.005	0.006	0.005	0.006
Total Sulfate	mg/L	35	27	23	21	20	16	18	17	22.125	20.500	6.289
Total Calcium	mg/L	65.2	50.7	40.5	34.6	29.7	30.3	28.6	28.8	38.550	32.450	13.189
Total Chloride	mg/L	42	28	25	22	20	19	14	16	23.250	21.000	8.828
Total Magnesium	mg/L	17.4	14.6	12.5	11.9	10.9	10.7	9.6	9.5	12.138	11.400	2.698
Total Organic Carbon	mg/L	7.8	5.6	4.7	4.2	4.1	3.7	3.3	2.8	4.525	4.150	1.575
Total Dissolved Solids	mg/L	340	280	250	220	190	190	180	180	228.750	205.000	57.678
Total Suspended Solids	mg/L	4	2 K	2 K	8	10	2 K	10	4	4.875 K	4.000	3.536
Hardness ($CaCO_3$)	mg/L	235	187	109	135	119	120	111	111	140.875	119.500	45.883
Chlorophyll a	ug/L	2	2	5	14	18	7	6	4	7.250	5.500	5.776
Conductivity (lab)	umho/cm	529	424	377	332	295	290	272	278	349.625	313.500	89.811
Conductivity (field)	umho/cm	516	426	365	322	287	283	261	262	340.250	304.500	90.793
Dissolved Oxygen (lab)	mg/L	9.14								9.140	9.140	
Dissolved Oxygen (field)	mg/L	11.6	10.13	8.95	8.55	8.26	9.04	11.43	11.65	9.951	9.585	1.438
pH (lab)	pH	7.76	8.02	HT	8.69	8.77	8.7	8.32	8.27	8.361	8.320	0.383
pH (field)	pH	7.9	7.1	7.99	9.17	8.76	7.67		7.76	8.050	7.900	0.697
Temperature (field)	^{o}C	11.1	12.9	18.91	24.1	22.51	17.85	9.08	5.96	15.301	15.375	6.528
Turbidity	NTU	9.6	2.3	3.4	4.9	5.7	2.8	9.1	3.2	3.510 K	4.150	2.835
Total Sodium	mg/L	17.8	13.9	11.8	11.1	10.5	10.3	8	7.5	11.363	10.800	3.300
Total Potassium	mg/L	3.1	2	1.8	1.5	2	1.3	1.2	1.3	1.775	1.650	0.623
Total Sulfide	mg/L	0.01 K ST	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.01 K	0.005 K	0.010	0.000
Total Alkalinity	mg/L	145	131	109	87	82	86	81	84	100.625	86.500	24.985
Secchi Disk reading	feet	3.1	9.2	5.8	3.2	3.5	6.3	3.2	4.8	4.888	4.150	2.146
Cyanide	mg/L	0.005 K								0.003		
VOA	ug/L				ND					0.000	0.000	
bis(2-ethylhexyl)phthalate	ug/L				4.200					4.200	4.200	

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S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A11.1. Mean water chemistry data collected in 2003 from Saginaw Bay (Stations #060062 and #060078).

PARAMETER	Units	5/6/2003	6/2/2003	7/8/2003	8/13/2003	9/9/2003	10/23/2003	11/20/2003	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.017	0.011	0.017	0.013	0.004 T	0.006 T	0.018	0.012	0.013	0.006
Total Nitrate	mg N/L	0.038	0.95	0.336	0.14	0.049	0.24	0.27	0.289	0.240	0.312
Total Nitrite	mg N/L	0.006	0.009	0.004	0.005	0.004	0.002	0.003	0.005	0.004	0.002
Total Kjeldahl Nitrogen	mg N/L	0.23	0.43	0.2	0.43	0.3	0.22	0.19	0.29	0.230	0.105
Total Phosphorus	mg P/L	0.02	0.028	0.009	0.025	0.019	0.012	0.011	0.018	0.019	0.007
Total Ortho Phosphate	mg P/L	0.007	0.004	0.006	0.002	0.001 W	W ND	0.003 T	0.004	0.004	0.002
Total Sulfate	mg/L	17	24	16	13	15	13	14	16	15.000	3.830
Total Calcium	mg/L	31.2	39.6	28.9	29.1	26.2	27.3	26.2	29.8	28.900	4.681
Total Chloride	mg/L	12	22	13	10	9	9	7	12	10.000	4.957
Total Magnesium	mg/L	10	14	7.9	8.8	7.8	7.9	7.3	9.1	7.900	2.335
Total Organic Carbon	mg/L	2.1	3.5	2.8	2.9	2.4	2	1.9	2.5	2.400	0.581
Total Dissolved Solids	mg/L	170	220	155	160	150	150	140	164	155.000	26.570
Total Suspended Solids	mg/L	8	13	2	8	7	5	ND	7	7.500	3.656
Hardness ($CaCO_3$)	mg/L	115	144	107	108	97	101	67	106	107.000	22.934
Chlorophyll a	ug/L	3.3	12	1	9	9.6	4.8	2.2	6.0	4.800	4.206
Conductivity (lab)	umho/cm	260	332	242	241	230	231	219	251	241.000	38.051
Conductivity (field)	umho/cm	259	332	258	230	228	223	213	249	230.000	40.505
Dissolved Oxygen (lab)	mg/L										
Dissolved Oxygen (field)	mg/L	10.85	11.7	9.51	8.31	9.98	11.7	12.55	10.66	10.850	1.476
pH (lab)	pH	8.17	8.25	8.37	8.56	8.68	8.21	8.11	8.34	8.250	0.213
pH (field)	pH	7.95	8.13	8.12	8.21	8.3	7.68	7.43	7.97	8.120	0.314
Temperature (field)	^{o}C	9.06	14.52	20.72	22.74	20.72	9.14	5.95	14.69	14.520	6.788
Turbidity	NTU	4	9	ND	4.6	4.3	1.3	ND	4.6	4.300	2.770
Total Sodium	mg/L	7.1	10.9	6.1	7.1	4.9	4.6	3.8	6.4	6.100	2.365
Total Potassium	mg/L	1.2	1.7	1.2	1.2	1	1.1	1	1.200	1.200	0.238
Total Sulfide	mg/L	ND									
Total Alkalinity	mg/L	79	90	87	74	75	77	75	80	77.000	6.373
Secchi Disk reading	feet	4.2	2.9	18	4.7	6	8	13	8.1	6.000	5.481
Cyanide	mg/L	ND									
VOA	ug/L			ND							
Base/Neutral Organics	ug/L			ND							

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NA = Not analyzed.
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P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
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Q = Quantity of sample insufficient to perform analyses requested.
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R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A11.2. Water chemistry data collected in 2003 from Saginaw Bay (Station #060063).

PARAMETER	Units	5/6/2003	6/2/2003	7/8/2003	8/13/2003	9/9/2003	10/23/2003	11/20/2003	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.007 T	0.006 T	0.01	0.002 T	0.009 T	0.002 T		0.006	0.007	0.003
Total Nitrate	mg N/L	0.31	0.32	0.313	0.002 W	0.001 T	0.002 W		0.158	0.156	0.171
Total Nitrite	mg N/L	0.006	0.004	0.007	0.001 W	0.002	W ND		0.004	0.004	0.003
Total Kjeldahl Nitrogen	mg N/L	0.81	0.2	0.23	0.4	0.53	0.26		0.41	0.330	0.234
Total Phosphorus	mg P/L	0.026	0.009	0.012	0.012	0.021	0.012		0.015	0.012	0.007
Total Ortho Phosphate	mg P/L	0.011	0.001 T	0.002 T	0.001 T	0.001 W	W ND		0.003	0.001	0.004
Total Sulfate	mg/L	17	19	19	15	19	16		18	18.000	1.761
Total Calcium	mg/L	32.5	30.6	31.9	27.2	25.1	27.9		29.2	29.250	2.920
Total Chloride	mg/L	14	13	16	14	21	14		15	14.000	2.944
Total Magnesium	mg/L	9.2	8.9	9.5	9.1	10	8.8		9.3	9.150	0.442
Total Organic Carbon	mg/L	2.1	2.9	3.1	3.2	4.2	2.8		3.1	3.000	0.683
Total Dissolved Solids	mg/L	180	170	180	160	180	170		173	175.000	8.165
Total Suspended Solids	mg/L	4	ND	ND	6	9	ND		6	6.000	2.517
Hardness ($CaCO_3$)	mg/L	119	113	119	105	104	106		111	109.500	6.957
Chlorophyll a	ug/L	1	ND	1.6	6.7	5.3	1.5		3.2	1.600	2.596
Conductivity (lab)	umho/cm	271	260	277	250	276	258		265	265.500	10.948
Conductivity (field)	umho/cm	270	261	275	239	273	250		261	265.500	14.320
Dissolved Oxygen (lab)	mg/L										
Dissolved Oxygen (field)	mg/L	11.12	12.21	9.68	9.24	9.77	11.36		10.56	10.445	1.168
pH (lab)	pH	8.25	8.41	8.72	8.9 H	8.73	8.36		8.56	8.565	0.256
pH (field)	pH	8.17	8.41	8.38	8.43	8.41	8.18		8.33	8.395	0.121
Temperature (field)	^{o}C	9.95	15.17	24.18	23.3	20.01	8.41		16.84	17.590	6.738
Turbidity	NTU	1	ND	ND	4.7	4.4	ND		3.4	4.400	2.055
Total Sodium	mg/L	8.5	7	9.3	8.4	11.4	7.5		8.7	8.450	1.556
Total Potassium	mg/L	1.2	1.2	1.3	1.3	1.5	1.2		1.283	1.250	0.117
Total Sulfide	mg/L	ND									
Total Alkalinity	mg/L	81	81	78	70	76	81		78	79.500	4.355
Secchi Disk reading	feet	7.9	10	10	4.8	3.9	8.5		7.5	8.200	2.604
Cyanide	mg/L	ND									
VOA	ug/L			ND							
Base/Neutral Organics	ug/L			ND							

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
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R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A11.3. Water chemistry data collected in 2003 from Saginaw Bay (Station #090250).

PARAMETER	Units	5/6/2003	6/2/2003	7/8/2003	8/13/2003	9/9/2003	10/23/2003	11/20/2003	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.006 T	0.018	0.008 T	0.006 T	0.004 T	0.002 T		0.007	0.006	0.006
Total Nitrate	mg N/L	0.34	0.5	0.424	0.135	W ND	0.012		0.282	0.340	0.203
Total Nitrite	mg N/L	0.004	0.006	0.006 PI	0.005	0.002	0.001 T		0.004	0.005	0.002
Total Kjeldahl Nitrogen	mg N/L	0.37	0.32	0.19	0.39	0.36	0.35		0.33	0.355	0.072
Total Phosphorus	mg P/L	0.035	0.023	0.009	0.031	0.024	0.022		0.024	0.024	0.009
Total Ortho Phosphate	mg P/L	0.003	0.005	0.001 T	0.002	0.001 W	W ND		0.002	0.002	0.002
Total Sulfate	mg/L	21	24	17	14	18	16		18	17.500	3.615
Total Calcium	mg/L	33.8	35.5	31.9	31.6	28.7	34.4		32.7	32.850	2.440
Total Chloride	mg/L	19	19	15	13	18	16		17	17.000	2.422
Total Magnesium	mg/L	9.8	10.3	9.3	9.1	9.2	9.4		9.5	9.350	0.454
Total Organic Carbon	mg/L	2.6	3	2.7	2.9	3.6	3.1		3.0	2.950	0.354
Total Dissolved Solids	mg/L	190	200	180	170	180	170		182	180.000	11.690
Total Suspended Solids	mg/L	19	10	ND	8	5	5		9	8.000	5.771
Hardness ($CaCO_3$)	mg/L	125	131	118	116	110	125		121	121.500	7.574
Chlorophyll a	ug/L	8.8	4.6	3.4	16	9	10		8.6	8.900	4.471
Conductivity (lab)	umho/cm	299	310	278	264	275	268		282	276.500	18.206
Conductivity (field)	umho/cm	298	310	276	253	274	260		279	275.000	21.870
Dissolved Oxygen (lab)	mg/L										
Dissolved Oxygen (field)	mg/L	11.05	11.8	8.86	9.69	9.81	11.23		10.41	10.430	1.122
pH (lab)	pH	8.19	8.22	8.55	8.67 H	8.75	8.35		8.46	8.450	0.236
pH (field)	pH	8.1	8.19	8.29	8.27	8.45	8.16		8.24	8.230	0.123
Temperature (field)	°C	9.72	15.68	23.37	23.45	21.09	9.89		17.20	18.385	6.387
Turbidity	NTU	12	6.3	ND	5.4	4.6	4.3		6.5	5.400	3.160
Total Sodium	mg/L	11.1	8.6	8.3	6.9	8.8	6.7		8.4	8.450	1.590
Total Potassium	mg/L	1.4	1.4	1.3	1.3	1.4	1.4		1.367	1.400	0.052
Total Sulfide	mg/L	ND									
Total Alkalinity	mg/L	84	89	85	79	82	83		84	83.500	3.327
Secchi Disk reading	feet	2	2.3	15	4.7	3.6	4.8		5.4	4.150	4.846
Cyanide	mg/L	ND									
VOA	ug/L			ND							
Base/Neutral Organics	ug/L			ND							

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V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A11.4. Water chemistry data collected in 2003 from Saginaw Bay (Station #790134).

PARAMETER	Units	5/6/2003	6/2/2003	7/8/2003	8/13/2003	9/9/2003	10/23/2003	11/20/2003	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.021	0.003 T	0.014	0.002 T	0.003 T	0.004 T		0.008	0.004	0.008
Total Nitrate	mg N/L	0.49	0.3	0.414	0.003 T	W ND	0.009		0.243	0.300	0.227
Total Nitrite	mg N/L	0.003	0.003	0.006	0.001 W	0.001 T	0.001 T		0.003	0.002	0.002
Total Kjeldahl Nitrogen	mg N/L	0.27	0.17	0.23	0.45	0.48	0.48		0.35	0.360	0.139
Total Phosphorus	mg P/L	0.009	0.007	0.012	0.016	0.018	0.027		0.015	0.014	0.007
Total Ortho Phosphate	mg P/L	0.001 T	0.001 T	0.002 T	0.003	0.001 T	W ND		0.002	0.001	0.001
Total Sulfate	mg/L	17	17	19	18	20	18		18	18.000	1.169
Total Calcium	mg/L	34.8	29.4	32.6	24.8	25.6	30.7		29.7	30.050	3.907
Total Chloride	mg/L	18	10	17	19	26	21		19	18.500	5.244
Total Magnesium	mg/L	9.6	8.4	9.5	10.4	10.6	9.2		9.6	9.550	0.806
Total Organic Carbon	mg/L	2.4	1.8	3	3.9	4.2	2.9		3.0	2.950	0.900
Total Dissolved Solids	mg/L	190	150	190	170	190	190		180	190.000	16.733
Total Suspended Solids	mg/L	ND	ND	ND	9	7	16		11	9.000	4.726
Hardness ($CaCO_3$)	mg/L	127	108	121	105	108	115		114	111.500	8.626
Chlorophyll a	ug/L	ND	1	2.3	4.8	5.4	8		4.3	4.800	2.740
Conductivity (lab)	umho/cm	290	238	287	261	287	291		276	287.000	21.593
Conductivity (field)	umho/cm	291	239	285	250	286	284		273	284.500	22.098
Dissolved Oxygen (lab)	mg/L										
Dissolved Oxygen (field)	mg/L	10.94	12.2	8.78	8.99	9.74	11		10.28	10.340	1.330
pH (lab)	pH	8.2	8.31	8.65	8.79 H	8.79	8.38		8.52	8.515	0.256
pH (field)	pH	8.12	8.3	8.43	8.47	8.54	8.16		8.34	8.365	0.172
Temperature (field)	^{o}C	9.54	15.15	24.6	23.26	20.29	9.51		17.06	17.720	6.677
Turbidity	NTU	1.4	ND	ND	4.4	5.4	10		5.3	4.900	3.565
Total Sodium	mg/L	10.1	4.1	10	10.3	12.8	9.3		9.4	10.050	2.874
Total Potassium	mg/L	1.3	1.1	1.3	1.5	1.7	1.4		1.383	1.350	0.204
Total Sulfide	mg/L	ND									
Total Alkalinity	mg/L	81	78	84	64	74	87		78	79.500	8.222
Secchi Disk reading	feet	8.9	8.3	11	4.3	3.9	3		6.6	6.300	3.258
Cyanide	mg/L	ND									
VOA	ug/L			ND							
Base/Neutral Organics	ug/L			ND							

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V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A11.5. Water chemistry data collected in 2003 from Saginaw Bay (Station #320188).

PARAMETER	Units	5/6/2003	6/2/2003	7/8/2003	8/13/2003	9/9/2003	10/23/2003	11/20/2003	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.005 T	0.014	0.01	0.006 T	0.003 T	0.005 T	0.019	0.009	0.006	0.006
Total Nitrate	mg N/L	0.31	0.43	0.392	0.074	W ND	0.21	0.164	0.263	0.260	0.138
Total Nitrite	mg N/L	0.007	0.004	0.008	0.002	0.001 T	0.002	0.004	0.004	0.004	0.003
Total Kjeldahl Nitrogen	mg N/L	0.12	0.24	0.26	0.39	0.4	0.27	0.43	0.30	0.270	0.111
Total Phosphorus	mg P/L	0.005	0.007	0.01	0.013	0.013	0.018	0.034	0.014	0.013	0.010
Total Ortho Phosphate	mg P/L	0.001 T	0.001 T	0.011	0.003	0.002 T	W ND	0.005	0.004	0.003	0.004
Total Sulfate	mg/L	14	20	20	13	16	14	16	16	16.000	2.854
Total Calcium	mg/L	27.6	31.7	30.5	25.9	26.4	28	28	28.3	28.000	2.099
Total Chloride	mg/L	7	15	18	10	14	10	11	12	11.000	3.716
Total Magnesium	mg/L	7.9	9.4	9.8	8.2	8.8	8.1	8	8.6	8.200	0.751
Total Organic Carbon	mg/L	1.5	2.4	3.8	2.5	3.2	2.2	2.5	2.6	2.500	0.734
Total Dissolved Solids	mg/L	140	180	190	150	160	150	160	161	160.000	17.728
Total Suspended Solids	mg/L	ND	4	ND	8	10	10	19	10	10.000	5.495
Hardness ($CaCO_3$)	mg/L	102	118	117	99	102	103	103	106	103.000	7.783
Chlorophyll a	ug/L	ND	1	4	5	4.2	3.3	8.6	4.4	4.100	2.488
Conductivity (lab)	umho/cm	223	275	290	228	243	235	248	249	243.000	24.856
Conductivity (field)	umho/cm	222	277	287	220	242	228	244	246	242.000	26.575
Dissolved Oxygen (lab)	mg/L										
Dissolved Oxygen (field)	mg/L	11.25	12.61	8.68	9.4	9.51	11.7	14.28	11.06	11.250	2.002
pH (lab)	pH	8.18	8.28	8.73	8.75 H	8.64	8.26	8.19	8.43	8.280	0.261
pH (field)	pH	8.6	8.27	8.52	8.41	8.4	7.97	7.94	8.30	8.400	0.258
Temperature (field)	°C	9.7	14.42	24.78	22.67	20.04	8.47	5.64	15.10	14.420	7.511
Turbidity	NTU	ND	2.1	ND	2.4	4.1	5.7	16	6.1	4.100	5.741
Total Sodium	mg/L	4.2	7.2	8.9	6.4	6.9	4.3	5	6.1	6.400	1.724
Total Potassium	mg/L	0.9	1.2	1.4	1.1	1.2	1	1.1	1.129	1.100	0.160
Total Sulfide	mg/L	ND									
Total Alkalinity	mg/L	71	84	83	69	75	79	78	77	78.000	5.686
Secchi Disk reading	feet	10	6.9	10	6.6	4.1	5.8	2	6.5	6.600	2.920
Cyanide	mg/L	ND									
VOA	ug/L			ND							
Base/Neutral Organics	ug/L			ND							

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W = Reported value is less then the method detection limit.

Table A11.6. Water chemistry data collected in 2003 from Saginaw Bay (Station #320189).

PARAMETER	Units	5/6/2003	6/2/2003	7/8/2003	8/13/2003	9/9/2003	10/23/2003	11/20/2003	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.008 T	0.013	0.004 T	0.006 T	0.004 T	0.004 T	0.01	0.007	0.006	0.004
Total Nitrate	mg N/L	0.58	0.32	ND	0.003 T	W ND	W ND	0.018	0.230	0.169	0.275
Total Nitrite	mg N/L	0.007	0.005	0.001 T	0.001 T	0.003	0.001 T	0.003	0.003	0.003	0.002
Total Kjeldahl Nitrogen	mg N/L	0.18	0.34	0.38	0.39	0.47	0.73	0.43	0.42	0.390	0.166
Total Phosphorus	mg P/L	0.01	0.016	0.016	0.011	0.014	0.046	0.021	0.019	0.016	0.012
Total Ortho Phosphate	mg P/L	0.009	0.002 T	0.005	0.001 W	0.004	W ND	0.002 T	0.004	0.003	0.003
Total Sulfate	mg/L	16	18	19	18	20	20	20	19	19.000	1.496
Total Calcium	mg/L	31.2	31.6	17.2	20.2	14.9	30.9	31.5	25.4	30.900	7.573
Total Chloride	mg/L	9	9	11	18	18	25	24	16	18.000	6.775
Total Magnesium	mg/L	8.4	8.6	9	10.3	10.3	11.4	10.3	9.8	10.300	1.106
Total Organic Carbon	mg/L	1.8	2.4	3.6	3.7	4.8	4.6	3.7	3.5	3.700	1.087
Total Dissolved Solids	mg/L	160	160	130	150	140	200	210	164	160.000	29.921
Total Suspended Solids	mg/L	5	10	4	6	7	23	5	9	6.000	6.655
Hardness ($CaCO_3$)	mg/L	113	114	80	93	80	124	121	104	113.000	18.893
Chlorophyll a	ug/L	2.1	4.1	19	3.6	6.5	9.5	5.1	7.1	5.100	5.744
Conductivity (lab)	umho/cm	242	240	199	237	218	305	316	251	240.000	43.459
Conductivity (field)	umho/cm	240	241	197	227	219	296	312	247	240.000	41.621
Dissolved Oxygen (lab)	mg/L	10.1	9.56	8.24		9.96	10.3	11.6	9.96	10.030	1.090
Dissolved Oxygen (field)	mg/L	10.41	11.96	8.42	10.8	10.72	11	14.11	11.06	10.800	1.717
pH (lab)	pH	8.19	8.22	9.24	9.36	9.85	8.32	8.12	8.76	8.320	0.707
pH (field)	pH	8.16	8.21	9.02	9.01	9.54	8.04	7.75	8.53	8.210	0.656
Temperature (field)	°C	10.41	14.48	25.3	22.96	19.78	8.24	5.08	15.18	14.480	7.719
Turbidity	NTU	1.6	8.2	3	2.1	3.2	15	5.6	5.5	3.200	4.758
Total Sodium	mg/L	5.3	4.5	5.1	11.1	8.3	9.6	10.8	7.8	8.300	2.823
Total Potassium	mg/L	1.1	1.1	1	1.3	1.1	1.9	1.8	1.329	1.100	0.368
Total Sulfide	mg/L	ND									
Total Alkalinity	mg/L	76	78	51	51	47	86	88	68	76.000	17.827
Secchi Disk reading	feet	6.9	2.4	4	5.5	5	2.9	2.3	4.1	4.000	1.741
Cyanide	mg/L	ND									
VOA	ug/L			ND							
Base/Neutral Organics	ug/L			ND							

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A11.7. Water chemistry data collected in 2003 from Saginaw Bay (Station #090252).

PARAMETER	Units	5/6/2003	6/2/2003	7/8/2003	8/13/2003	9/9/2003	10/23/2003	11/20/2003	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.015	0.064	0.058	0.005 T	0.006 T	0.008 T		0.026	0.012	0.027
Total Nitrate	mg N/L	0.32	1.19	0.413	0.003 T	W ND	0.001 W		0.385	0.320	0.486
Total Nitrite	mg N/L	0.005	0.02	0.007	0.001 T	0.003	0.001 T		0.006	0.004	0.007
Total Kjeldahl Nitrogen	mg N/L	0.18	0.49	0.3	0.64	0.56	0.42		0.43	0.455	0.170
Total Phosphorus	mg P/L	0.009	0.014	0.019	0.028	0.032	0.029		0.022	0.024	0.009
Total Ortho Phosphate	mg P/L	0.003	0.002 T	0.003	0.005	0.005	W ND		0.004	0.003	0.001
Total Sulfate	mg/L	14	36	19	18	22	16		21	18.500	7.910
Total Calcium	mg/L	29.8	50.9	34.5	25.1	28.7	29.7		33.1	29.750	9.215
Total Chloride	mg/L	7	39	18	26	36	14		23	22.000	12.612
Total Magnesium	mg/L	8.1	15.3	9.9	10.7	11.4	8.7		10.7	10.300	2.571
Total Organic Carbon	mg/L	1.8	6	3.3	4	4.6	2.9		3.8	3.650	1.454
Total Dissolved Solids	mg/L	150	300	200	180	220	170		203	190.000	53.166
Total Suspended Solids	mg/L	ND	ND	ND	18	12	12		14	12.000	3.464
Hardness ($CaCO_3$)	mg/L	108	190	127	107	119	110		127	114.500	31.884
Chlorophyll a	ug/L	1	3.5	1	13	11	7		6.1	5.250	5.123
Conductivity (lab)	umho/cm	231	462	300	280	343	265		314	290.000	81.714
Conductivity (field)	umho/cm	229	465	298	271	345	258		311	284.500	85.058
Dissolved Oxygen (lab)	mg/L				7.96				7.96	7.960	#DIV/0!
Dissolved Oxygen (field)	mg/L	10.47	11.06	8.12	8.84	9.8	11.1		9.90	10.135	1.218
pH (lab)	pH	8.17	8.26	8.39	8.79 H	8.77	8.32		8.45	8.355	0.266
pH (field)	pH	8.13	8.18	8.17	8.43	8.49	8.12		8.25	8.175	0.163
Temperature (field)	°C	11.02	16.07	24.32	23	20.58	9.36		17.39	18.325	6.269
Turbidity	NTU	1.5	ND	ND	8.6	9.5	6.7		6.6	7.650	3.579
Total Sodium	mg/L	4.4	18.2	8.5	14.2	19.8	6.1		11.9	11.350	6.463
Total Potassium	mg/L	1	2.2	1.4	1.6	1.9	1.2		1.550	1.500	0.446
Total Sulfide	mg/L	ND									
Total Alkalinity	mg/L	73	127	90	64	83	86		87	84.500	21.683
Secchi Disk reading	feet	10	9.5	12	2.5	3	3.5		6.8	6.500	4.204
Cyanide	mg/L	ND									
VOA	ug/L			ND							
BaseNeutral Organics	ug/L			ND							

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A = Value reported is the mean of two or more determinations.
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Q = Quantity of sample insufficient to perform analyses requested.
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R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A12.1. Mean water chemistry data collected in 2004 from Saginaw Bay (Stations #060062 and #060078).

PARAMETER	Units	4/20/2004	5/11/2004	6/9/2004	7/6/2004	8/3/2004	9/27/2004	10/28/2004	11/9/2004	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.011	0.006 T	0.013	0.07 T	0.005	0.009 T	0.005 T	0.007 T	0.016	0.008	0.022
Total Nitrate	mg N/L	1.48	1.1	0.91	0.63	0.34	0.11	0.097	0.15	0.602	0.485	0.519
Total Nitrite	mg N/L	0.011	0.007	0.009	0.007	0.006	0.002	0.002 T	0.002	0.006	0.007	0.004
Total Kjeldahl Nitrogen	mg N/L	0.355	0.25 H	0.54	0.305	0.32	0.43	0.33	0.235	0.346	0.325	0.099
Total Phosphorus	mg P/L	0.0165	0.0105 H	0.017	0.013	0.012	0.0155	0.026	0.013	0.015	0.014	0.005
Total Ortho Phosphate	mg P/L	0.002 T	0.0015 ND W	0.001 T	0.0015 T	0.001 T W	0.0015 T	0.004	0.002 T	0.002	0.002	0.001
Total Sulfate	mg/L	20.5	21	21.5	16.5	16.5	16.5	13.5	14.5	17.563	16.500	3.052
Total Calcium	mg/L	37.4	36.8	38.1	31.3	29.6	29.4	30	28.9	32.688	30.650	4.004
Total Chloride	mg/L	26.5	20	19	14	12	13	12.5	10	15.875	13.500	5.508
Total Magnesium	mg/L	10.6	9.7	9.6	9.3	9	8.8	8.6	8.2	9.225	9.150	0.750
Total Organic Carbon	mg/L	3.6	3.2	5.6	3.7	3.8	3.6	3.1	2.6	3.650	3.600	0.882
Total Dissolved Solids	mg/L	220	210	210	180	170	165	170	160	185.625	175.000	23.820
Total Suspended Solids	mg/L	2 ND	2 ND	5.5	2 ND	2 ND	2 ND	11	2 ND	3.563	2.000	3.245
Hardness ($CaCO_3$)	mg/L	137	132	135	116	111	110	111	106	119.750	113.500	12.714
Chlorophyll a	ug/L	5.7	2.2	2.6	2.8	4.3	8.7	14	4.6	5.613	4.450	3.987
Conductivity (lab)	umho/cm	341.5	318	324.5	282.5	261.5	259.5	256.5	238.5	285.313	272.000	37.842
Conductivity (field)	umho/cm	339.5	313	328.5	274	255.5	260	259	239.5	283.625	267.000	37.785
Dissolved Oxygen (lab)	mg/L											
Dissolved Oxygen (field)	mg/L	12.625	11.64	9.175	9.525	8.94	8.745	11.64	11.48	10.471	10.503	1.525
pH (lab)	pH	8.41	8.3	8.36	8.405	8.725	8.585	8.28	8.22	8.411	8.383	0.168
pH (field)	pH	7.195	7.615	7.605	8.155	8.43	8.245	7.815	7.71	7.846	7.763	0.405
Temperature (field)	^{o}C	6.44	10.495	18.91	18.265	21.49	19.085	11.11	8.95	14.343	14.685	5.690
Turbidity	NTU	4.65	0.2 ND	2.7	0.2 ND	0.2 ND	2.85	5.8	2.4	2.375	2.550	2.119
Total Sodium	mg/L	12.4	9.75	8.85	6.9	6.35	7.85	6.65	5.5	8.031	7.375	2.241
Total Potassium	mg/L	2	1.6	1.7	1.4	1.3	2.05	1.2	1.15	1.550	1.500	0.347
Total Alkalinity	mg/L	92.5	86.5	104	90	82	78	91	75.5	87.438	88.250	9.112
Secchi Disk reading	feet	5.6	10.5	8	9.5	10	4.9	3.9	6	7.300	7.000	2.529
Cyanide	mg/L	ND										
VOA	ug/L				ND							
bis(2-ethylhexyl)phthalate	ug/L				4.100					4.100	4.100	

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T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A12.2. Water chemistry data collected in 2004 from Saginaw Bay (Station #060063).

PARAMETER	Units	4/20/2004		5/11/2004		7/19/2004		8/3/2004		9/27/2004		10/28/2004		11/9/2004		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.006	T	0.005	T	0.005	T	0.009	T	0.005	T	0.003	T	0.004	T	0.005	0.005	0.002
Total Nitrate	mg N/L	0.77		0.48		0.51		0.27		0.003	T	0.134		0.014		0.312	0.270	0.287
Total Nitrite	mg N/L	0.008		0.007		0.006		0.007		0.001	ND W	0.003		0.001	T	0.005	0.006	0.003
Total Kjeldahl Nitrogen	mg N/L	0.28		0.24	H	0.34		0.57		0.48		0.22		0.34		0.35	0.340	0.129
Total Phosphorus	mg P/L	0.006		0.007	H	0.01		0.017		0.023		0.012		0.012		0.012	0.012	0.006
Total Ortho Phosphate	mg P/L	0.0015	ND W	0.0015	ND W	0.002	T	0.0015	ND W	0.001	T	0.001	T	0.001	T	0.001	0.002	0.000
Total Sulfate	mg/L	20		21		21		22		20		12		17		19	20.000	3.464
Total Calcium	mg/L	33.7		33.4		35.4		31.4		31.9		29.1		32.5		32.5	32.500	1.991
Total Chloride	mg/L	20		18		16		22		27		10		16		18	18.000	5.350
Total Magnesium	mg/L	9.7		9.3		9.7		11.3		11.2		7.8		9.5		9.8	9.700	1.195
Total Organic Carbon	mg/L	2.8		3.4		3.6		5		4.7		2.6		3.5		3.7	3.500	0.898
Total Dissolved Solids	mg/L	200		200		190		200		220		150		180		191	200.000	21.931
Total Suspended Solids	mg/L	2	ND	2	ND	4	A	2	ND	6		8		2	ND	4	2.000	2.430
Hardness ($CaCO_3$)	mg/L	124		122		40		125		126		105		120		109	122.000	31.190
Chlorophyll a	ug/L	1.7			ND	4.8		9.1		5.7		2.4		2.3		4.3	3.600	2.815
Conductivity (lab)	umho/cm	305		301		288		304		335		236		280		293	301.000	30.374
Conductivity (field)	umho/cm	305		296		280		300		326		236		284		290	296.000	28.011
Dissolved Oxygen (lab)	mg/L																	
Dissolved Oxygen (field)	mg/L	11.05		11.47		8.7		9		8.89		11.55		11.32		10.28	11.050	1.340
pH (lab)	pH	8.56	H	8.59		8.7		9.04		8.76		8.35		8.33		8.62	8.590	0.246
pH (field)	pH	7.86		8.11		8.45		8.79		8.44		7.99		8.01		8.24	8.110	0.332
Temperature (field)	^{o}C	10.35		12.97		21.96		23.12		18.87		10.86		6.29		14.92	12.970	6.430
Turbidity	NTU	3.5		0.2	ND	0.2	ND	3.3		3.2		2.1		2		2.1	2.100	1.404
Total Sodium	mg/L	9.8		9.7		6.2		10.8		15.3		5		10.2		9.6	9.800	3.343
Total Potassium	mg/L	1.5		1.4		1.5		1.9		2.4		1.1		1.7		1.643	1.500	0.416
Total Alkalinity	mg/L	86		86		87		83		88		86		85		86	86.000	1.574
Secchi Disk reading	feet	5.2		8.2		8.2		4.7		4		8		9.2		6.8	8.000	2.079
Cyanide	mg/L		ND															
VOA	ug/L						ND											
Diethyl phthalate	ug/L					0.25										0.250	0.250	

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S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A12.3. Water chemistry data collected in 2004 from Saginaw Bay (Station #090250).

PARAMETER	Units	4/20/2004	5/11/2004	7/19/2004	8/3/2004	9/27/2004	10/28/2004	11/9/2004	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.007 T	0.001 W	0.004 T	0.01	0.01	0.006 T	0.009 T	0.007	0.007	0.003
Total Nitrate	mg N/L	0.71	1.2	0.61	0.32	0.026	0.008	0.17	0.435	0.320	0.433
Total Nitrite	mg N/L	0.007	0.008	0.007	0.008	0.001 T	0.003	0.002	0.005	0.007	0.003
Total Kjeldahl Nitrogen	mg N/L	0.3	0.29 H	0.45	0.42	0.4	0.44	0.3	0.37	0.400	0.072
Total Phosphorus	mg P/L	0.016	0.011 H	0.028	0.024	0.021	0.042	0.02	0.023	0.021	0.010
Total Ortho Phosphate	mg P/L	0.0015 ND W	0.001 T	0.004	0.0015 ND W	0.0015 ND W	0.008	0.001 T	0.003	0.002	0.003
Total Sulfate	mg/L	19	21	22	20	17	16	15	19	19.000	2.637
Total Calcium	mg/L	33.4	36	37.7	36.1	30.1	32.6	29.5	33.6	33.400	3.134
Total Chloride	mg/L	20	22	19	18	14	17	10	17	18.000	4.018
Total Magnesium	mg/L	9.5	9.9	10.3	10	8.7	9.6	8.2	9.5	9.600	0.750
Total Organic Carbon	mg/L	2.6	3.7	4.2	3.6	3.5	3.7	2.8	3.4	3.600	0.556
Total Dissolved Solids	mg/L	200	220	200	200	180	190	160	193	200.000	18.898
Total Suspended Solids	mg/L	6	2 ND	8	6	6	23	5	8	6.000	6.856
Hardness ($CaCO_3$)	mg/L	125	131	142	131	111	121	107	124	125.000	12.179
Chlorophyll a	ug/L	5.1	5.4	10	11	6.9	13	7.7	8.4	7.700	2.975
Conductivity (lab)	umho/cm	305	332	314	309	269	290	243	295	305.000	30.082
Conductivity (field)	umho/cm	303	327	307	305	260	293	246	292	303.000	28.518
Dissolved Oxygen (lab)	mg/L										
Dissolved Oxygen (field)	mg/L	12.09	12.04	8.13	8.16	8.12	11.5	10.9	10.13	10.900	1.910
pH (lab)	pH	8.45 H	8.52	8.57	8.63	8.69	8.23	8.2	8.47	8.520	0.190
pH (field)	pH	7.81	8.08	8.28	8.37	8.34	7.84	7.82	8.08	8.080	0.255
Temperature (field)	°C	8.26	10.85	22.17	22.63	19.6	10.89	8.14	14.65	10.890	6.539
Turbidity	NTU	7	2.4	3.4	5	3.9	15	3.8	5.8	3.900	4.314
Total Sodium	mg/L	9.8	10.4	9.8	9.9	7.6	9.1	5	8.8	9.800	1.904
Total Potassium	mg/L	1.4	1.6	1.7	1.6	1.9	1.4	1.2	1.543	1.600	0.230
Total Alkalinity	mg/L	88	90	94	96	80	96	78	89	90.000	7.381
Secchi Disk reading	feet	3.4	7	4.5	3.7	4.5	2	5.1	4.314	4.500	1.553
Cyanide	mg/L	ND									
VOA	ug/L			ND							
Diethyl phthalate	ug/L			0.2					0.200	0.200	

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T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A12.4. Water chemistry data collected in 2004 from Saginaw Bay (Station #790134).

PARAMETER	Units	4/20/2004	5/11/2004	6/9/2004	7/19/2004	8/3/2004	9/27/2004	10/28/2004	11/9/2004	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.007 T	0.008 T	0.02	0.008 T	0.008 T	0.006 T	0.002 T	0.005 T	0.009	0.008	0.005
Total Nitrate	mg N/L	0.35	0.84	1.79	1.16	0.44	0.003 T	0.09	0.004 T	0.655	0.440	0.654
Total Nitrite	mg N/L	0.004	0.008	0.04	0.014	0.008	0.001 ND W	0.002	0.002	0.011	0.008	0.014
Total Kjeldahl Nitrogen	mg N/L	0.18	0.22 H	0.67	0.66	0.51	0.57	0.27	0.47	0.47	0.510	0.198
Total Phosphorus	mg P/L	0.004 T	0.006 H	0.052	0.022	0.019	0.019	0.017	0.032	0.022	0.019	0.016
Total Ortho Phosphate	mg P/L	0.0015 ND W	0.001 T	0.001 T	0.004	0.0015 ND W	0.003	0.002 T	0.003	0.002	0.002	0.001
Total Sulfate	mg/L	14	19	21	25	21	21	12	18	20	21.000	3.388
Total Calcium	mg/L	28.7	32.8	44.6	44.4	36.1	29	27.4	32.1	35.4	32.800	6.704
Total Chloride	mg/L	9	14	28	27	19	24	10	22	20	22.000	6.949
Total Magnesium	mg/L	7.6	8.9	11.4	12.4	10.4	10.8	7.8	9.8	10.2	10.400	1.596
Total Organic Carbon	mg/L	1.8	2.9	7	7.4	4.2	5	2.6	4	4.6	4.200	2.042
Total Dissolved Solids	mg/L	150	180	260	240	200	200	150	200	204	200.000	36.450
Total Suspended Solids	mg/L	2 ND	2 ND	2 ND	5	2 ND	8	7	13	5	2.000	4.259
Hardness ($CaCO_3$)	mg/L	103	119	158	162	133	117	101	121	130	121.000	22.044
Chlorophyll a	ug/L	1	ND	8.7	8	11	6.7	5.1	7.1	7.1	7.550	3.345
Conductivity (lab)	umho/cm	227	283	393	372	313	304	232	302	313	304.000	55.344
Conductivity (field)	umho/cm	225	278	407	363	308	295	233	305	312	305.000	58.742
Dissolved Oxygen (lab)	mg/L											
Dissolved Oxygen (field)	mg/L	11.22	11.6	9.38	8.9	8.78	8.85	12.02	12.87	10.23	9.380	1.649
pH (lab)	pH	8.5 H	8.49	8.54	8.91	8.9	8.82	8.34	8.32	8.64	8.540	0.234
pH (field)	pH	7.62	8.07	7.71	8.79	8.66	8.51	7.96	7.98	8.19	8.070	0.465
Temperature (field)	°C	10.82	12.57	20.39	22.07	23.01	19.14	10.67	6.73	16.39	19.140	6.306
Turbidity	NTU	1.7	0.2 ND	3.6	2.4	3.8	6.1	3.2	8.4	3.7	3.600	2.763
Total Sodium	mg/L	4.1	6.8	12.5	12	10.5	12.7	5.7	11.2	10.0	11.200	3.273
Total Potassium	mg/L	1	1.3	2.3	2.3	1.7	2.3	1.1	1.6	1.786	1.700	0.530
Total Alkalinity	mg/L	74	82	114	108	92	79	90	84	90	84.000	15.164
Secchi Disk reading	feet	7.8	12	5.9	4.5	5.1	3.7	6.2	2.5	5.929	5.100	3.157
Cyanide	mg/L	ND										
VOA	ug/L				ND							
Diethyl phthalate	ug/L				0.180					0.180	0.180	

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
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M = The level of the method preparation blank is reported in the qualifier column.
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PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A12.5. Water chemistry data collected in 2004 from Saginaw Bay (Station #320188).

PARAMETER	Units	4/20/2004	5/11/2004	6/9/2004	7/19/2004	8/3/2004	9/27/2004	10/28/2004	11/9/2004	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.016	0.007 T	0.008 T	0.006 T	0.011	0.005 T	0.003 T	0.004 T	0.008	0.007	0.004
Total Nitrate	mg N/L	0.43	0.59	0.95	0.56	0.63	0.003 T	0.033	0.122	0.469	0.560	0.321
Total Nitrite	mg N/L	0.005	0.008	0.013	0.007	0.01	0.001 ND W	0.001 T	0.001 T	0.006	0.007	0.004
Total Kjeldahl Nitrogen	mg N/L	0.18	0.17 H	0.37	0.26	0.55	0.35	0.39	0.28	0.31	0.280	0.131
Total Phosphorus	mg P/L	0.009	0.006 H	0.013	0.009	0.014	0.015	0.021	0.017	0.012	0.013	0.004
Total Ortho Phosphate	mg P/L	0.001 T	0.001 T	0.0015 ND W	0.004	0.0015 ND W	0.001 T	0.002 T	0.003	0.002	0.002	0.001
Total Sulfate	mg/L	15	16	18	18	22	17	15	15	17	17.000	2.430
Total Calcium	mg/L	27.3	30.9	32.8	32	35.5	28	28.9	28	30.6	30.900	3.036
Total Chloride	mg/L	11	11	19	12	22	13	16	10	14	12.000	4.619
Total Magnesium	mg/L	8	8.1	9.6	8.9	11.3	8.6	9.6	7.9	8.9	8.600	1.210
Total Organic Carbon	mg/L	1.9	2.4	4.2	4.4	5.2	3.4	3.7	2.6	3.4	3.400	1.208
Total Dissolved Solids	mg/L	160	170	200	170	210	160	180	150	174	170.000	22.254
Total Suspended Solids	mg/L	2 ND	2 ND	2 ND	2 ND	5	6	12	7	4	2.000	2.215
Hardness ($CaCO_3$)	mg/L	101	111	122	117	135	105	112	103	113	111.000	12.191
Chlorophyll a	ug/L	1.6	1.3	1.2	2.2	7	4.7	5.3	4.6	3.2	2.200	2.229
Conductivity (lab)	umho/cm	242	257	312	264	322	254	274	234	269	257.000	34.170
Conductivity (field)	umho/cm	239	252	314	256	316	246	276	236	266	252.000	34.467
Dissolved Oxygen (lab)	mg/L											
Dissolved Oxygen (field)	mg/L	11.05	11.3	9.15	9.1	8.67	9.01	11.72	13.01	10.18	9.150	1.628
pH (lab)	pH	8.45 H	8.43	8.52	8.61	8.92	8.85	8.33	8.25	8.58	8.520	0.238
pH (field)	pH	7.5	8.01	7.71	8.48	8.67	8.55	7.84	7.83	8.11	8.010	0.459
Temperature (field)	^{o}C	9.87	12.85	21.13	20.99	23.22	19.02	10.59	6.32	16.20	19.020	6.499
Turbidity	NTU	3.7	0.2 ND	0.2 ND	0.2 ND	4.6	3.4	6.4	4.8	2.4	3.400	2.152
Total Sodium	mg/L	4.6	5.8	9.8	6.5	9.7	7.1	7.2	5.5	7.0	6.500	2.035
Total Potassium	mg/L	1.2	1.1	1.5	1.4	1.9	1.7	1.4	1.2	1.429	1.400	0.293
Total Alkalinity	mg/L	76	77	93	85	90	76	92	73	81	77.000	7.850
Secchi Disk reading	feet	5.5	11	11.5	11	4	6	3.60	5	7.7	6.000	3.290
Cyanide	mg/L	ND										
VOA	ug/L				ND							
Base/Neutral Organics	ug/L				0.180					0.180	0.180	

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
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M = The level of the method preparation blank is reported in the qualifier column.
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Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A12.6. Water chemistry data collected in 2004 from Saginaw Bay (Station #320189).

PARAMETER	Units	4/20/2004	5/11/2004	6/9/2004	7/19/2004	8/3/2004	9/27/2004	10/28/2004	11/9/2004	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.028	0.009 T	0.005 T	0.011	0.027	0.021	0.01	0.02	0.017	0.020	0.009
Total Nitrate	mg N/L	0.74	0.62	0.87	1.28	0.54	0.007 T	0.004 T	0.006 T	0.580	0.620	0.458
Total Nitrite	mg N/L	0.013	0.013	0.018	0.028	0.022	0.001 T	0.001 T	0.002	0.014	0.013	0.010
Total Kjeldahl Nitrogen	mg N/L	0.4	0.22 H	0.31	0.72	0.84	0.72	0.64	0.79	0.57	0.720	0.253
Total Phosphorus	mg P/L	0.026	0.01 H	0.015	0.021	0.024	0.018	0.028	0.034	0.021	0.021	0.008
Total Ortho Phosphate	mg P/L	0.002 T	0.0015 ND W	0.001 T	0.006	0.001 T	0.002 T	0.002 T	0.004	0.003	0.002	0.002
Total Sulfate	mg/L	17	19	19	27	25	26	19	21	22	21.000	3.958
Total Calcium	mg/L	31.6	35.1	30.3	36	26.3	27.8	34.4	35.1	31.7	31.600	3.828
Total Chloride	mg/L	13	12	13	33	29	37	27	28	24	28.000	10.612
Total Magnesium	mg/L	8.9	8.5	9.1	14.1	13.5	14.6	12.2	12.4	11.6	12.400	2.666
Total Organic Carbon	mg/L	2.3	2.7	3.4	7	7.1	7.5	5.5	5.3	5.0	5.300	2.231
Total Dissolved Solids	mg/L	180	180	170	240	210	240	220	220	206	210.000	29.358
Total Suspended Solids	mg/L	11	6	7	10	10	2 ND	18	21	10	10.000	5.912
Hardness ($CaCO_3$)	mg/L	116	123	113	148	121	130	136	139	127	123.000	12.668
Chlorophyll a	ug/L	6.1	4.8	3.2	9.8	16	17	16	9.4	9.5	9.400	5.353
Conductivity (lab)	umho/cm	276	278	267	364	317	369	333	346	317	317.000	43.695
Conductivity (field)	umho/cm	273	273	274	350	312	360	339	355	314	312.000	40.945
Dissolved Oxygen (lab)	mg/L	9.4 H		9.8 H	11.3 H	8.4	8.9	10.3	11.1	9.82	9.600	1.172
Dissolved Oxygen (field)	mg/L	10	10.85	9.11	10.26	8.15	8.1	10.7	12.65	9.87	10.000	1.609
pH (lab)	pH	8.35 H	8.37	8.92	8.98	8.97	8.76	8.27	8.19	8.65	8.760	0.336
pH (field)	pH	7.37	8	7.88	8.9	8.73	8.44	7.81	7.87	8.17	8.000	0.542
Temperature (field)	^{o}C	11.42	13.06	22.27	22.22	22.81	18.35	10.41	5.05	16.45	18.350	6.807
Turbidity	NTU	13	0.2 ND	0.2 ND	4.7	6	3.1	9.8	18	6.5	4.700	6.695
Total Sodium	mg/L	6.3	8.1	6.5	14.8	12.7	17.8	12.7	13.4	11.4	12.700	4.456
Total Potassium	mg/L	1.3	1.4	1.3	2.6	2.2	3.3	2.1	2.3	2.057	2.200	0.763
Total Alkalinity	mg/L	86	84	82	87	75	86	103	96	85	86.000	6.283
Secchi Disk reading	feet	1.7	5.8	6	3	2.7	4.1	4	2.1	3.629	3.000	1.726
Cyanide	mg/L	ND										
VOA	ug/L				ND							
Diethyl phthalate	ug/L				0.230					0.230	0.230	

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
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R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table A12.7. Water chemistry data collected in 2004 from Saginaw Bay (Station #090252).

PARAMETER	Units	4/20/2004	5/11/2004	6/9/2004	7/19/2004	8/3/2004	9/27/2004	10/28/2004	11/9/2004	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.005 ND D	0.13 D	0.07 D	0.008 T	0.014	0.021	0.003 T	0.009 T	0.037	0.014	0.047
Total Nitrate	mg N/L	2.78	7.58	2.46	1.25	0.53	0.004 T	0.003 T	0.011	2.088	1.250	2.664
Total Nitrite	mg N/L	0.017	0.12	0.04	0.012	0.011	0.001 T	0.001 T	0.002	0.029	0.012	0.042
Total Kjeldahl Nitrogen	mg N/L	0.55	1.22 H	0.78	0.82	0.84	0.45	0.43	0.35	0.72	0.780	0.293
Total Phosphorus	mg P/L	0.028	0.095 H	0.042	0.044	0.031	0.021	0.036	0.024	0.041	0.031	0.025
Total Ortho Phosphate	mg P/L	0.001 T	0.041	0.015	0.004	0.0015 ND W	0.003	0.001 T	0.003	0.010	0.003	0.015
Total Sulfate	mg/L	28	26	26	29	27	18	14	18	25	26.000	4.614
Total Calcium	mg/L	49.1	58.6	53.7	51.4	44.7	32.4	32.3	33.6	46.2	49.100	9.974
Total Chloride	mg/L	37	43	41	44	48	19	16	15	35	41.000	12.971
Total Magnesium	mg/L	13.1	15.3	14.3	15.3	15.9	9.8	9.3	9.4	13.3	14.300	2.685
Total Organic Carbon	mg/L	4.7	11	9.3	7.8	7.2	4	3.5	3.4	6.8	7.200	2.853
Total Dissolved Solids	mg/L	280	350	320	310	300	190	180	180	276	300.000	65.538
Total Suspended Solids	mg/L	6	13	2 ND	10	8	6	12	7	7	7.000	3.457
Hardness ($CaCO_3$)	mg/L	177	209	193	191	177	121	119	123	170	177.000	34.638
Chlorophyll a	ug/L	5.9	2.4	1.4	18	16	8	8.1	8.6	8.6	8.000	6.338
Conductivity (lab)	umho/cm	428	532	494	477	468	298	279	279	425	468.000	98.503
Conductivity (field)	umho/cm	431	529	507	467	462	290	281	282	424	462.000	99.479
Dissolved Oxygen (lab)	mg/L		8 H							8.00	8.000	
Dissolved Oxygen (field)	mg/L	11.12	8.51	7.88	8.7	9.05	8.33	11.7	12.29	9.41	8.700	1.642
pH (lab)	pH	8.5 H	7.8	8.19	8.74	8.94	8.56	8.37	8.27	8.43	8.500	0.378
pH (field)	pH	7.76	7.79	7.58	8.55	8.75	8.22	7.97	7.85	8.07	7.850	0.443
Temperature (field)	°C	10.09	15.13	22.19	22.44	22.85	18.95	10.9	7.26	16.99	18.950	6.333
Turbidity	NTU	7.7	22	1.2	6.5	5.6	5.4	8.3	5.4	7.7	5.600	6.623
Total Sodium	mg/L	16.3	16.9	16.8	20.7	25.4	10.9	9.6	7.8	16.4	16.800	5.833
Total Potassium	mg/L	2.5	3.7	3	2.8	2.8	2.1	1.4	1.4	2.614	2.800	0.724
Total Alkalinity	mg/L	105	130	143	134	124	85	96	86	115	124.000	23.422
Secchi Disk reading	feet	3	1.3	8	2.6	3.8	4.5	2.4	4.1	3.9	3.800	2.101
Cyanide	mg/L	ND										
VOA	ug/L				ND							
BaseNeutral Organics	ug/L				0.240					0.240	0.240	

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
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ND = Observed result was below the quantification level.
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PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

APPENDIX B

Grand Traverse Bay Water Chemistry Data

Table B1.1. Water Chemistry Data Collected in 1998 from Grand Traverse Bay Station #450132.

PARAMETER	Units	6/3/1998		7/28/1998		10/27/1998		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.006		0.006		0.003		0.005	0.006	0.002
Total Nitrate	mg N/L	0.220		0.186		0.200		0.202	0.200	0.017
Total Nitrite	mg N/L	0.002		0.002		0.003		0.002	0.002	0.001
Total Kjeldahl Nitrogen	mg N/L	0.18		0.15		0.23	Q	0.17	0.17	0.02
Total Phosphorus	mg P/L	0.006		0.013		0.003	T	0.007	0.006	0.005
Total Ortho Phosphate	mg P/L	0.001	T	0.001	T	0.001	W	0.001	0.001	0.000
Total Sulfate	mg/L	19		15		18		17	18	2
Total Calcium	mg/L	31.5		32.3		32.8		32.2	32.3	0.7
Total Chloride	mg/L	9		10		9		9	9	1
Total Magnesium	mg/L	10.9		11.5		11.0		11.1	11.0	0.3
Total Organic Carbon	mg/L	2.3		2.6		2.4		2.4	2.4	0.2
Total Dissolved Solids	mg/L	186		185		183		185	185	2
Total Suspended Solids	mg/L	4	K	4	K	4	K	2	2	0
Hardness ($CaCO_3$)	mg/L	124		128		127		126	127	2
Chlorophyll a	ug/L	1		1		3		2	1	1
Conductivity (lab)	umho/cm	286		284		281		284	284	3
Conductivity (field)	umho/cm	284				279		282	282	4
Dissolved Oxygen (field)	mg/L					10.5		10.5	10.5	
pH (lab)	pH	8.3	Q	8.5		8.3		8.4	8.4	0.1
pH (field)	pH	7.9				8.5		8.2	8.2	0.4
Temperature (field)	°C	11.4		23.0		12.7		15.7	12.7	6.4
Turbidity	NTU					0.3		0.3	0.3	
Secchi Disk reading	feet	29.0		41.0		20.0		30.0	29.0	10.5
Station Depth	feet	168		168		168				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
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G = Result and RL are estimated due to initial calibration standard criteria failure.
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NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B1.2. Water chemistry data collected in 1998 from Grand Traverse Bay station #450133.

PARAMETER	Units	6/3/1998		7/29/1998		10/27/1998		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.005		0.003		0.004		0.004	0.004	0.001
Total Nitrate	mg N/L	0.210		0.200		0.194		0.201	0.200	0.008
Total Nitrite	mg N/L	0.002		0.002		0.002		0.002	0.002	0.000
Total Kjeldahl Nitrogen	mg N/L	0.19		0.21		0.23	Q	0.20	0.20	0.01
Total Phosphorus	mg P/L	0.007		0.010		0.007	Q	0.009	0.009	0.002
Total Ortho Phosphate	mg P/L	0.001	W	0.001	T	0.003	Q	0.001	0.001	0.000
Total Sulfate	mg/L	19		16		17		17	17	2
Total Calcium	mg/L	30.9		32.4		32.8		32.0	32.4	1.0
Total Chloride	mg/L	8		10		9		9	9	1
Total Magnesium	mg/L	10.8		11.5		11.0		11.1	11.0	0.4
Total Organic Carbon	mg/L	1.8		2.4		1.7		2.0	1.8	0.4
Total Dissolved Solids	mg/L	185		185		185		185	185	0
Total Suspended Solids	mg/L	4	K	4	K	4	K	2	2	0
Hardness ($CaCO_3$)	mg/L	122		128		127		126	127	3
Chlorophyll a	ug/L			2		2		2	2	0
Conductivity (lab)	umho/cm	285		284		285		285	285	1
Conductivity (field)	umho/cm	282				275		279	279	5
Dissolved Oxygen (field)	mg/L	13.2				9.9		11.6	11.6	2.3
pH (lab)	pH	8.3	Q	8.5		8.3		8.4	8.4	0.1
pH (field)	pH	7.7				8.4		8.1	8.1	0.5
Temperature (field)	°C	10.8		22.0		13.2		15.3	13.2	5.9
Turbidity	NTU					0.2		0.2	0.2	
Secchi Disk reading	feet	23		23		38		28	23	9
Station Depth	feet	382		382		382				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B1.3. Water chemistry data collected in 1998 from Grand Traverse Bay station #280289.

PARAMETER	Units	6/3/1998		7/28/1998		10/27/1998		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.005		0.006		0.001		0.004	0.005	0.003
Total Nitrate	mg N/L	0.230		0.196		0.180		0.202	0.196	0.026
Total Nitrite	mg N/L	0.003		0.002		0.002		0.002	0.002	0.001
Total Kjeldahl Nitrogen	mg N/L	0.18		0.23		0.19	Q	0.21	0.21	0.04
Total Phosphorus	mg P/L	0.005		0.008				0.007	0.007	0.002
Total Ortho Phosphate	mg P/L	0.001	T	0.001	W	0.001	W	0.001	0.001	0.000
Total Sulfate	mg/L	19		16		17		17	17	2
Total Calcium	mg/L	30.9		32.4		32.5		31.9	32.4	0.9
Total Chloride	mg/L	8		10		9		9	9	1
Total Magnesium	mg/L	10.6		11.5		11.1		11.1	11.1	0.5
Total Organic Carbon	mg/L	2.4		2.5		2.2		2.4	2.4	0.2
Total Dissolved Solids	mg/L	187		183		184		185	184	2
Total Suspended Solids	mg/L	5		4	K	4	K	3	2	2
Hardness ($CaCO_3$)	mg/L	121		128		127		125	127	4
Chlorophyll a	ug/L	1		2		2		2	2	1
Conductivity (lab)	umho/cm	287		282		283		284	283	3
Conductivity (field)	umho/cm	283				275		279	279	6
Dissolved Oxygen (field)	mg/L					10		10	10	
pH (lab)	pH	8.3	Q	8.5		8.3		8.4	8.4	0.1
pH (field)	pH	7.96				8.30		8.13	8.13	0.24
Temperature (field)	°C	11.4		23		13.5		16.0	13.5	6.2
Turbidity	NTU					0.2		0.2	0.2	
Secchi Disk reading	feet	33		39		30		34	33	5
Station Depth	feet	580		580		580				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B1.4. Water chemistry data collected in 1998 from Grand Traverse Bay station #280288.

PARAMETER	Units	6/3/1998		7/28/1998		10/27/1998		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.005		0.008		0.005		0.006	0.005	0.002
Total Nitrate	mg N/L	0.220		0.186		0.183		0.196	0.186	0.021
Total Nitrite	mg N/L	0.003		0.002		0.002		0.002	0.002	0.001
Total Kjeldahl Nitrogen	mg N/L	0.15		0.19		0.21	Q	0.17	0.17	0.03
Total Phosphorus	mg P/L	0.006		0.005		0.001	T	0.004	0.005	0.003
Total Ortho Phosphate	mg P/L	0.001	WT	0.001	W	0.001	T	0.001	0.001	0.000
Total Sulfate	mg/L	19		16		16		17	16	2
Total Calcium	mg/L	31.1		31.9		32.5		31.8	31.9	0.7
Total Chloride	mg/L	9		9		9		9	9	0
Total Magnesium	mg/L	11.0		11.5		11.1		11.2	11.1	0.3
Total Organic Carbon	mg/L	2.3		2.3		2.3		2.3	2.3	0.0
Total Dissolved Solids	mg/L	186		183		184		184	184	2
Total Suspended Solids	mg/L	4	K	4	K	4	K	2	2	0
Hardness ($CaCO_3$)	mg/L	123		127		127		126	127	2
Chlorophyll a	ug/L	1	K	1	K	2		1	1	1
Conductivity (lab)	umho/cm	286		281		283		283	283	3
Conductivity (field)	umho/cm	284				275		280	280	6
Dissolved Oxygen (field)	mg/L									
pH (lab)	pH	8.3	Q	8.5		8.3		8.4	8.4	0.1
pH (field)	pH	7.9				8.4		8.2	8.2	0.4
Temperature (field)	°C	11.4		22.0		13.3		15.6	13.3	5.7
Turbidity	NTU					0.2		0.2	0.2	
Secchi Disk reading	feet	26		39.0		30		32	30	7
Station Depth	feet	160		160		160				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
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ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Figure B2.1 Water chemistry data collected in 1999 from the southern part of the western basin of Grand Traverse Bay (Station #450132).

PARAMETER	Units	6/8/1999		9/2/1999		9/2/1999 **Replicate		10/12/1999		10/12/1999 **Replicate		Mean		Median		Standard Deviation
Total Ammonia	mg N/L	0.004	T	0.007	T	0.022	ST	0.006	T	0.003	T	0.006		0.006		0.002
Total Nitrate	mg N/L	0.24	+	0.171	+	0.169	+ ST	0.193	+	0.192	+	0.201		0.193		0.035
Total Nitrite	mg N/L	0.001	T	0.003		0.003		0.003		0.003		0.002		0.003		0.001
Total Kjeldahl Nitrogen	mg N/L	0.18		0.18		0.24		0.22		0.23		0.193		0.180		0.023
Total Phosphorus	mg P/L	0.007		0.009		0.006		0.007		0.006		0.008		0.007		0.001
Total Ortho Phosphate	mg P/L	0.001	T	0.004		0.001	W	0.001	T	0.001	T	0.002		0.001		0.002
Total Sulfate	mg/L	12		16		14		18		20		15.333		16.000		3.055
Total Calcium	mg/L	34.7		32.6		31.6		34.1		33.8		33.800		34.100		1.082
Total Chloride	mg/L	9		10		10		9		9		9.333		9.000		0.577
Total Magnesium	mg/L	11.1		10.9		10.7		10.8		10.9		10.933		10.900		0.153
Total Organic Carbon	mg/L	1.9		2.3		3.4	ST	2.3		2.7		2.167		2.300		0.231
Total Dissolved Solids	mg/L	182	+	188	+	188	+	186	+	185	+	185.333		186.000		3.055
Total Suspended Solids	mg/L	4	K	4	K	4	K	4	K	4	K	2.000	@	4.000	K	0.000
Hardness ($CaCO_3$)	mg/L	132	+	126	+	123	+	130	+	129	+	129.333		130.000		3.055
Chlorophyll a	ug/L	2		3	+ Q	3	+ Q	3	HT	2	HT	2.667		3.000		0.577
Conductivity (lab)	umho/cm	281		289		289		286		284		285.333		286.000		4.041
Conductivity (field)	umho/cm	275		275		275		275		275		275.000		275.000		0.000
Dissolved Oxygen (lab)	mg/L	11.7		NA		NA		NA		NA		11.700		11.700		0.000
Dissolved Oxygen (field)	mg/L	14.13		10.24		10.24		11.6		11.6		11.990		11.600		1.974
pH (lab)	pH	8.21	HT	8.72		8.71		8.42		8.28		8.450		8.420		0.256
pH (field)	pH	7.79		6.55		6.55		8.6		8.6		7.647		7.790		1.032
Temperature (field)	^{o}C	10.14		22.5		22.5		13.71		13.71		15.450		13.710		6.361
Turbidity	NTU	0.4	K	0.4	K	0.4	K	0.4	K	0.4	K	0.200	@	0.400	K	0.000
Secchi Disk reading	feet	29.3		24		24		25		25		-		-		-
Station Depth	feet	168		169		169		168		168		-		-		-

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B2.2 Water chemistry data collected in 1999 from the northern part of the western basin of Grand Traverse Bay (Station # 450133).

PARAMETER	Units	6/8/1999		9/2/1999		10/7/1999		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.004	T	0.007	T	0.005	T	0.00533	0.005	0.002
Total Nitrate	mg N/L	0.24	+	0.173	+	0.191	+	0.20133	0.191	0.035
Total Nitrite	mg N/L	0.001	T	0.003		0.004		0.00267	0.003	0.002
Total Kjeldahl Nitrogen	mg N/L	0.19		0.17		0.17		0.17667	0.17	0.012
Total Phosphorus	mg P/L	0.006		0.008		0.005		0.00633	0.006	0.002
Total Ortho Phosphate	mg P/L	0.002	T	0.005		0.001	T	0.00267	0.002	0.002
Total Sulfate	mg/L	13		15		21		16.3333	15	4.163
Total Calcium	mg/L	34.4		32.9		34.4		33.9	34.4	0.866
Total Chloride	mg/L	9		10		9		9.33333	9	0.577
Total Magnesium	mg/L	10.8		10.9		10.9		10.8667	10.9	0.058
Total Organic Carbon	mg/L	1.9		2.6		2		2.16667	2	0.379
Total Dissolved Solids	mg/L	185	+	186	+	185	+	185.333	185	0.577
Total Suspended Solids	mg/L	4		4	K	4	K	2.66667 @	4 K	0.000
Hardness ($CaCO_3$)	mg/L	130	+	127	+	131	+	129.333	130	2.082
Chlorophyll a	ug/L	3		2	+ Q	2	HT	2.33333	2	0.577
Conductivity (lab)	umho/cm	284		286		285		285	285	1.000
Conductivity (field)	umho/cm	773		273		273		439.667	273	288.675
Dissolved Oxygen (lab)	mg/L	NA		NA		NA		NA	NA	NA
Dissolved Oxygen (field)	mg/L	14.9		10.2		10.8		11.9667	10.8	2.558
pH (lab)	pH	8.2	HT	8.7		8.36	HT	8.42	8.36	0.255
pH (field)	pH	7.75		6.52		8.18		7.48333	7.75	0.862
Temperature (field)	°C	9.8		22.5		14.19		15.4967	14.19	6.450
Turbidity	NTU	0.5		0.4	K	0.4	K	0.3 @	0.4 K	0.058
Secchi Disk reading	feet	29.3		27		26		-	-	-
Station Depth	feet	400		400		400		-	-	-

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
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ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B2.3 Water chemistry data collected in 1999 from the northern part of the eastern basin of Grand Traverse Bay (Station #280289).

PARAMETER	Units	6/8/1999		9/2/1999		10/7/1999		Mean+		Median		Standard Deviation
Total Ammonia	mg N/L	0.004	T	0.011		0.008	T	0.008		0.008		0.004
Total Nitrate	mg N/L	0.23	+	0.175	+	0.182	+	0.196		0.182		0.030
Total Nitrite	mg N/L	0.001	T	0.002		0.004		0.002		0.002		0.002
Total Kjeldahl Nitrogen	mg N/L	0.18		0.24		0.17		0.197		0.18		0.038
Total Phosphorus	mg P/L	0.006		0.008		0.007		0.007		0.007		0.001
Total Ortho Phosphate	mg P/L	0.002	T	0.001	W	0.001	W	0.001		0.001		0.001
Total Sulfate	mg/L	11		14		20		15.000		14		4.583
Total Calcium	mg/L	33.6		31.8		35.3		33.567		33.6		1.750
Total Chloride	mg/L	9		9		9		9.000		9		0.000
Total Magnesium	mg/L	11.1		11		11.2		11.100		11.1		0.100
Total Organic Carbon	mg/L	2		3		2.6		2.533		2.6		0.503
Total Dissolved Solids	mg/L	183	+	185	+	185	+	184.333		185		1.155
Total Suspended Solids	mg/L	4	K	4	K	4	K	2.000	@	4	K	0.000
Hardness ($CaCO_3$)	mg/L	130	+	125	+	134	+	129.667		130		4.509
Chlorophyll a	ug/L	1		1	+ Q	2	HT	1.333		1		0.577
Conductivity (lab)	umho/cm	282		285		285		284.000		285		1.732
Conductivity (field)	umho/cm	275		272		272		273.000		272		1.732
Dissolved Oxygen (lab)	mg/L	NA		NA		NA		NA		NA		NA
Dissolved Oxygen (field)	mg/L	12.6		10.19		10.63		11.140		10.63		1.283
pH (lab)	pH	8.21	HT	8.68		8.41	HT	8.433		8.41		0.236
pH (field)	pH	7.71		6.54		8.16		7.470		7.71		0.836
Temperature (field)	^{o}C	14.22		21.95		14.6		16.923		14.6		4.357
Turbidity	NTU	0.4	K	0.4	K	0.4	K	0.200	@	0.4	K	0.000
Secchi Disk reading	feet	23.4		30.3		28		-		-		-
Station Depth	feet	550		550		550		-		-		-

+ = Calculated value; not rounded to appropriate number of significant digits.

@ = Mean includes samples with concentration below level of quantification.

** = Not included in statistical calculations.

A = Value reported is the mean of two or more determinations.

C = Value caclulated from other independent parameters.

D and DL = Analyte value quantified from a dilution(s); reporting limit raised.

E = Result is estimated due to high recovery of batch QC.

G = Result and RL are estimated due to initial calibration standard criteria failure.

H and HT = Recommended laboratory holding time was exceeded.

I and DM = Dilution required due to matrix interference; reporting limit raised.

ID = Insufficient data for calculation.

J = Analyte was positively identified. Value is an estimate.

JC = Result is estimated since confirmation analysis did not meet acceptance criteria.

K = RL(s) raised due to matrix interferences.

M = The level of the method preparation blank is reported in the qualifier column.

NA = Not analyzed.

ND = Observed result was below the quantification level.

P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.

PI = Possible interference may have affetced the accuracy of the laboratory result.

Q = Quantity of sample insufficient to perform analyses requested.

QC = Quality control problems exist.

R = Result confiirmed by re-extraction and analysis.

S = Supernatant analyzed.

T = Reported value is less than the reporting limit. Result is estimated.

V = Value not available due to dilution.

W = Reported value is less then the method detection limit.

Table B2.4 Water chemistry data collected in 1999 from the sourthern part of the eastern basin of Grand Traverse Bay (Station #280288).

PARAMETER	Units	6/8/1999		6/8/1999 **Replicate		9/2/1999		10/7/1999		Mean		Median		Standard Deviation
Total Ammonia	mg N/L	0.002	T	0.004	T	0.01		0.012		0.008		0.01		0.005
Total Nitrate	mg N/L	0.23	+	0.23	+	0.172	+	0.187	+	0.19633		0.187		0.030
Total Nitrite	mg N/L	0.001	T	0.001	T	0.002		0.004		0.00233		0.002		0.002
Total Kjeldahl Nitrogen	mg N/L	0.18		0.19		0.21		0.2		0.19667		0.2		0.015
Total Phosphorus	mg P/L	0.006		0.006		0.004	T	0.007		0.00567		0.006		0.002
Total Ortho Phosphate	mg P/L	0.001	W	0.001	W	0.001	W	0.001	W	0.001		0.001		0.000
Total Sulfate	mg/L	11		13		14		20		15		14		4.583
Total Calcium	mg/L	31.8		32.9		30.7		33.9		32.1333		31.8		1.626
Total Chloride	mg/L	9		9		10		9		9.33333		9		0.577
Total Magnesium	mg/L	10.5		10.7		11.1		10.9		10.8333		10.9		0.306
Total Organic Carbon	mg/L	1.9		2		3.6		2.6		2.7		2.6		0.854
Total Dissolved Solids	mg/L	183	+	183	+	185	+	186	+	184.667		185		1.528
Total Suspended Solids	mg/L	4	K	4	K	4	K	10		4.66667	@	4		3.464
Hardness ($CaCO_3$)	mg/L	123	+	126	+	122	+	130	+	125		123		4.359
Chlorophyll a	ug/L	2		2		1	+ Q	1	HT	1.33333		1		0.577
Conductivity (lab)	umho/cm	282		282		285		286		284.333		285		2.082
Conductivity (field)	umho/cm	275		275		273		273		273.667		273		1.155
Dissolved Oxygen (lab)	mg/L	NA		NA		9.2		9.5		9.35		9.35		0.212
Dissolved Oxygen (field)	mg/L	14.8		14.8		10.16		10.7		11.8867		10.7		2.537
pH (lab)	pH	8.21	HT	8.21	HT	8.64		8.42	HT	8.42333		8.42		0.215
pH (field)	pH	7.7		7.7		6.53		8.15		7.46		7.7		0.836
Temperature (field)	°C	10.23		10.23		22.44		14.51		15.7267		14.51		6.195
Turbidity	NTU	0.4	K	0.4	K	0.4	K	0.4	K	0.2	@	0.4	K	0.000
Secchi Disk reading	feet	26.7		26.7		32.2		29		-		-		-
Station Depth	feet	170		170		170		172		-		-		-

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Figure B3.1 Water chemistry data collected* in 2000 from the southern part of the western basin of Grand Traverse Bay (Station #450132).

PARAMETER	Units	5/10/2000		8/9/2000		10/17/2000		Mean	Median		Standard Deviation
Total Ammonia	mg N/L	0.003	T	0.01	T	0.01	T HT	0.008	0.010		0.004
Total Nitrate	mg N/L	0.25	C	0.2	C	0.23	C HT	0.227	0.230		0.025
Total Nitrite	mg N/L	-0.001	T	0.003		0.003		0.002	0.003		0.002
Total Kjeldahl Nitrogen	mg N/L	0.15		0.23		0.16	HT	0.180	0.160		0.044
Total Phosphorus	mg P/L	0.004	T	0.01		0.01	HT	0.008	0.010		0.003
Total Ortho Phosphate	mg P/L	0.001	W	0.001	W	0.003		0.002	0.001		0.001
Total Sulfate	mg/L	16		19		18		17.667	18.000		1.528
Total Calcium	mg/L	33.7		33.6		32.9		33.400	33.600		0.436
Total Chloride	mg/L	9		10		10		9.667	10.000		0.577
Total Magnesium	mg/L	10.8		10.9		10.9		10.867	10.900		0.058
Total Organic Carbon	mg/L	2.4		2.5		2.1		2.333	2.400		0.208
Total Dissolved Solids	mg/L	187	+	190	+	190	+	189.000	190.000		1.732
Total Suspended Solids	mg/L	4	K	4	K	4	K	2.000	4.000	K	0.000
Hardness ($CaCO_3$)	mg/L	129	+	129	+	127	+	128.333	129.000		1.155
Chlorophyll a	ug/L	2		4		2		2.667	2.000		1.155
Conductivity (lab)	umho/cm	288		287		286		287.000	287.000		1.000
Conductivity (field)	umho/cm	297		303		307		302.333	303.000		5.033
Dissolved Oxygen (lab)	mg/L	NA		NA		NA		-	-		-
Dissolved Oxygen (field)	mg/L	10.3		8.99		9.8		9.697	9.800		0.661
pH (lab)	pH	8.19		8.48		8.32	HT	8.330	8.320		0.145
pH (field)	pH	8		8.21		8.1		8.103	8.100		0.105
Temperature (field)	°C	5.3		21.07		13.2		13.190	13.200		7.885
Turbidity	NTU	0.4	K	0.4	K	0.4	K	0.200	0.400	K	0.000
Secchi Disk reading	feet	37		25.4		26.5		-	-		-
Station Depth	feet	168		169		168		-	-		-

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B3.2 Water chemistry data collected in 2000 from the northern part of the western basin of Grand Traverse Bay (Station # 450133).

PARAMETER	Units	5/10/2000		8/8/2000		10/16/2000		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.002	T	0.01	T	0.01	T	0.00733	0.01	0.005
Total Nitrate	mg N/L	0.24	C	0.21	C HT	0.23	C HT	0.22667	0.23	0.015
Total Nitrite	mg N/L	0.001	W	0.003	HT	0.003		0.00233	0.003	0.001
Total Kjeldahl Nitrogen	mg N/L	0.18		0.16		0.15	HT	0.16333	0.16	0.015
Total Phosphorus	mg P/L	0.002	T	0.01		0.01	HT	0.00733	0.01	0.005
Total Ortho Phosphate	mg P/L	0.001	W	0.004	HT	0.002	T	0.00233	0.002	0.002
Total Sulfate	mg/L	16		17		18		17	17	1.000
Total Calcium	mg/L	33.4		34.7		33.3		33.8	33.4	0.781
Total Chloride	mg/L	9		10		10		9.66667	10	0.577
Total Magnesium	mg/L	10.9		10.4		10.8		10.7	10.8	0.265
Total Organic Carbon	mg/L	1.9		2.4		2.2		2.16667	2.2	0.252
Total Dissolved Solids	mg/L	186	+	190	+	190	+	188.667	190	2.309
Total Suspended Solids	mg/L	4		4	K	4	K	2.66667 @	4 K	0.000
Hardness ($CaCO_3$)	mg/L	128	+	130	+	128	+	128.667	128	1.155
Chlorophyll a	ug/L	1	K	3		2		2	2	1.000
Conductivity (lab)	umho/cm	286		288		285		286.333	286	1.528
Conductivity (field)	umho/cm	314		311		308		311	311	3.000
Dissolved Oxygen (lab)	mg/L	13		9		NA		10.85	10.85	2.616
Dissolved Oxygen (field)	mg/L	10.7		NA		10.7		10.7	10.7	0.000
pH (lab)	pH	8.21		8.51		8.32	HT	8.34667	8.32	0.152
pH (field)	pH	8.1				8		8.05	8.05	0.071
Temperature (field)	°C	6.4				13.4		9.9	9.9	4.950
Turbidity	NTU	0.4	K	0.4	K	0.4	K	0.26667 @	0.4 K	0.000
Secchi Disk reading	feet	45				36		21	40.5	6.364
Station Depth	feet	400		400		400		-	-	-

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B3.3 Water chemistry data collected in 2000 from the northern part of the eastern basin of Grand Traverse Bay (Station #280289).

PARAMETER	Units	5/10/2000		8/8/2000		10/16/2000		Mean+		Median		Standard Deviation
Total Ammonia	mg N/L	0.004	T	0.01	T	0.005	T HT	0.006		0.005		0.003
Total Nitrate	mg N/L	0.25	C	0.21	C HT	0.23	C HT	0.230		0.23		0.020
Total Nitrite	mg N/L	-0.001	T	0.003	HT	0.003		0.002		0.003		0.002
Total Kjeldahl Nitrogen	mg N/L	0.15		0.21		0.16	HT	0.173		0.16		0.032
Total Phosphorus	mg P/L	0.003	T	0.01		0.01	HT	0.008		0.01		0.004
Total Ortho Phosphate	mg P/L	0.001	W	0.001	T HT	0.002	T HT	0.001		0.001		0.001
Total Sulfate	mg/L	17		19		17		17.667		17		1.155
Total Calcium	mg/L	33.5		35		33.6		34.033		33.6		0.839
Total Chloride	mg/L	9		10		10		9.667		10		0.577
Total Magnesium	mg/L	10.7		11.6		10.7		11.000		10.7		0.520
Total Organic Carbon	mg/L	2.3		2.3		1.8		2.133		2.3		0.289
Total Dissolved Solids	mg/L	186	+	190	+	180	+	185.333		186		5.033
Total Suspended Solids	mg/L	4	K	4	K	4	K	2.000	@	4	K	0.000
Hardness ($CaCO_3$)	mg/L	128	+	135	+	128	+	130.333		128		4.041
Chlorophyll a	ug/L	1	K	3		2		2.000		2		1.000
Conductivity (lab)	umho/cm	286		287		284		285.667		286		1.528
Conductivity (field)	umho/cm	321		317		314		317.333		317		3.512
Dissolved Oxygen (lab)	mg/L	NA		NA		NA		NA		NA		NA
Dissolved Oxygen (field)	mg/L	10.4		NA		10		10.200		10.2		0.283
pH (lab)	pH	8.18		8.53		8.31	HT	8.340		8.31		0.177
pH (field)	pH	8.1		NA		7.9		8.000		8		0.141
Temperature (field)	°C	6.8		NA		13.4		10.100		10.1		4.667
Turbidity	NTU	0.4	K	0.4	K	0.4	K	0.200	@	0.4	K	0.000
Secchi Disk reading	feet	37		NA		30		-		-		-
Station Depth	feet	550		550		550		-		-		-

+ = Calculated value; not rounded to appropriate number of significant digits.

@ = Mean includes samples with concentration below level of quantification.

** = Not included in statistical calculations.

A = Value reported is the mean of two or more determinations.

C = Value caclulated from other independent parameters.

D and DL = Analyte value quantified from a dilution(s); reporting limit raised.

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JC = Result is estimated since confirmation analysis did not meet acceptance criteria.

K = RL(s) raised due to matrix interferences.

M = The level of the method preparation blank is reported in the qualifier column.

NA = Not analyzed.

ND = Observed result was below the quantification level.

P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estima

PI = Possible interference may have affetced the accuracy of the laboratory result.

Q = Quantity of sample insufficient to perform analyses requested.

QC = Quality control problems exist.

R = Result confiirmed by re-extraction and analysis.

S = Supernatant analyzed.

T = Reported value is less than the reporting limit. Result is estimated.

V = Value not available due to dilution.

W = Reported value is less then the method detection limit.

Table B3.4 Water chemistry data collected in 2000 from the sourthern part of the eastern basin of Grand Traverse Bay (Station #280288).

PARAMETER	Units	5/10/2000		8/9/2000		10/17/2000		Mean		Median		Standard Deviation
Total Ammonia	mg N/L	0.005	T	0.01		0.004	T HT	0.00633		0.005		0.003
Total Nitrate	mg N/L	0.25	C	0.2	C	0.22	C HT	0.22333		0.22		0.025
Total Nitrite	mg N/L	-0.001	T	0.002		0.003		0.00133		0.002		0.002
Total Kjeldahl Nitrogen	mg N/L	0.13		0.24		0.21	HT	0.19333		0.21		0.057
Total Phosphorus	mg P/L	0.01		0.01		0.01	HT	0.01		0.01		0.000
Total Ortho Phosphate	mg P/L	0.001	W	0.003		0.003	HT	0.00233		0.003		0.001
Total Sulfate	mg/L	18		17		18		17.6667		18		0.577
Total Calcium	mg/L	33		33.8		34		33.6		33.8		0.529
Total Chloride	mg/L	9		10		10		9.66667		10		0.577
Total Magnesium	mg/L	10.8		11.1		10.8		10.9		10.8		0.173
Total Organic Carbon	mg/L	2		2.2		2.2		2.13333		2.2		0.115
Total Dissolved Solids	mg/L	186	+	180	+	190	+	185.333		186		5.033
Total Suspended Solids	mg/L	4	K	4	K	10		4.66667	@	4		3.464
Hardness ($CaCO_3$)	mg/L	127	+	130	+	129	+	128.667		129		1.528
Chlorophyll a	ug/L	1		2		2		1.66667		2		0.577
Conductivity (lab)	umho/cm	286		284		285		285		285		1.000
Conductivity (field)	umho/cm	295		299		306		300		299		5.568
Dissolved Oxygen (lab)	mg/L	NA		NA		10		10		10		0.000
Dissolved Oxygen (field)	mg/L	10.5		8.9		9.8		9.73333		9.8		0.802
pH (lab)	pH	8.16	HT	8.47		8.35	HT	8.32667		8.35		0.156
pH (field)	pH	8		8.13		8		8.04333		8		0.075
Temperature (field)	°C	6.6		20.79		13.5		13.63		13.5		7.096
Turbidity	NTU	0.4	K	0.4	K	0.4	K	0.2	@	0.4	K	0.000
Secchi Disk reading	feet	44		37.7		33.5		-		-		-
Station Depth	feet	170		170		172		-		-		-

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
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K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
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ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estima
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Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B4.1 Water chemistry data collected in 2001 from the southern part of the western basin of Grand Traverse Bay (Station #450132).

PARAMETER	Units	4/19/2001		7/23/2001		10/22/2001		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.004	T	0.007	T	0.002	T	0.004	0.004	0.003
Total Nitrate	mg N/L	0.25	C	0.23	C	0.25	C	0.243	0.250	0.012
Total Nitrite	mg N/L	0.001	T	0.003		0.002		0.002	0.002	0.001
Total Kjeldahl Nitrogen	mg N/L	0.13		0.13		0.14		0.133	0.130	0.006
Total Phosphorus	mg P/L	0.003	T	0.007		0.005		0.005	0.005	0.002
Total Ortho Phosphate	mg P/L	0.001	W HT	0.005		0.004		0.003	0.004	0.002
Total Sulfate	mg/L	20		19		19		19.333	19.000	0.577
Total Calcium	mg/L	33.8		33.8		36.4		34.667	33.800	1.501
Total Chloride	mg/L	10		10		10		10.000	10.000	0.000
Total Magnesium	mg/L	11.2		11.1		11		11.100	11.100	0.100
Total Organic Carbon	mg/L	1.8		2.4		3		2.400	2.400	0.600
Total Dissolved Solids	mg/L	190		190		190		190.000	190.000	0.000
Total Suspended Solids	mg/L	4	K	4	K	4	K	2.000	4.000 K	0.000
Hardness ($CaCO_3$)	mg/L	131		130		136		132.333	131.000	3.215
Chlorophyll a	ug/L	2		1		3		2.000	2.000	1.000
Conductivity (lab)	umho/cm	289		290		286		288.333	289.000	2.082
Conductivity (field)	umho/cm	248						248.000	248.000	
Dissolved Oxygen (lab)	mg/L					10	HT	10.000	10.000	
Dissolved Oxygen (field)	mg/L	11.7						11.700	11.700	
pH (lab)	pH	8.16		8.45		8.15		8.253	8.160	0.170
pH (field)	pH	8.1						8.100	8.100	
Temperature (field)	^{o}C	2.4				10		6.200	6.200	5.374
Turbidity	NTU	0.4	K	0.4	K	0.4	K	0.200	0.400 K	0.000
Total Sodium	mg/L			4.5		5.5		5.000	5.000	0.707
Total Potassium	mg/L			1.2		1.2		1.200	1.200	0.000
Total Sulfide	mg/L	0.02	K	0.02	K	0.02	K	0.010	0.020 K	0.000
Total Alkalinity	mg/L	101		94		96		97	96	3.606
Secchi Disk reading	feet	29				24		27	27	3.536
Cyanide	mg/L	0.005	K					0.0025 K		
VOA	ug/L			ND				0.0000		
Base Neutrals	ug/L			ND				0.0000		

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B4.2 Water chemistry data collected in 2001 from the northern part of the western basin of Grand Traverse Bay (Station # 450133).

PARAMETER	Units	4/19/2001		7/23/2001		10/22/2001		Mean	Median		Standard Deviation
Total Ammonia	mg N/L	0.002	T	0.013		0.003	T	0.006	0.003		0.006
Total Nitrate	mg N/L	0.25	C	0.23	C	0.24	C	0.240	0.240		0.010
Total Nitrite	mg N/L	0.001	T	0.002		0.002		0.002	0.002		0.001
Total Kjeldahl Nitrogen	mg N/L	0.13		0.17		0.14		0.147	0.140		0.021
Total Phosphorus	mg P/L	0.005		0.007		0.002	T	0.005	0.005		0.003
Total Ortho Phosphate	mg P/L	0.001	W HT	0.004		0.004		0.003	0.004		0.002
Total Sulfate	mg/L	21		19		19		19.667	19.000		1.155
Total Calcium	mg/L	35		34.2		34.5		34.567	34.500		0.404
Total Chloride	mg/L	10		10		10		10.000	10.000		0.000
Total Magnesium	mg/L	11.3		11.1		10.8		11.067	11.100		0.252
Total Organic Carbon	mg/L	1.9		2.3		2		2.067	2.000		0.208
Total Dissolved Solids	mg/L	190		190		190		190.000	190.000		0.000
Total Suspended Solids	mg/L	5		4	K	4	K	3.000	4.000	K	0.577
Hardness ($CaCO_3$)	mg/L	134		131		131		132.000	131.000		1.732
Chlorophyll a	ug/L	2		1		3		2.000	2.000		1.000
Conductivity (lab)	umho/cm	290		289		286		288.333	289.000		2.082
Conductivity (field)	umho/cm	247				244		245.500	245.500		2.121
Dissolved Oxygen (lab)	mg/L					10	HT	10.000	10.000		
Dissolved Oxygen (field)	mg/L	12.1						12.100	12.100		
pH (lab)	pH	8.16		8.44		8.18		8.260	8.180		0.156
pH (field)	pH	8.1				7.9		8.000	8.000		0.141
Temperature (field)	^{o}C	2.5				11.3		6.900	6.900		6.223
Turbidity	NTU	0.4		0.4	K	0.4	K	0.270	0.400	K	0.000
Total Sodium	mg/L			5.3		4.8		5.050	5.050		0.354
Total Potassium	mg/L			1.2		1.2		1.200	1.200		0.000
Total Sulfide	mg/L	0.02	K	0.02	K	0.02	K	0.010	0.020	K	0.000
Total Alkalinity	mg/L	102		96		90		96	96		6.000
Secchi Disk reading	feet	33				34		34	34		0.707
Cyanide	mg/L	0.005	K					0.0025		K	
VOA	ug/L			ND				0.0000			
Base Neutrals	ug/L			ND				0.0000			

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
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H and HT = Recommended laboratory holding time was exceeded.
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Q = Quantity of sample insufficient to perform analyses requested.
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R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B4.3 Water chemistry data collected in 2001 from the northern part of the eastern basin of Grand Traverse Bay (Station #280289).

PARAMETER	Units	4/19/2001		7/23/2001		10/22/2001		Mean		Median		Standard Deviation
Total Ammonia	mg N/L	0.002	T	0.017		0.003	T	0.007		0.003		0.008
Total Nitrate	mg N/L	0.24	C	0.23	C	0.23	C	0.233		0.230		0.006
Total Nitrite	mg N/L	0.001	T	0.002		0.002		0.002		0.002		0.001
Total Kjeldahl Nitrogen	mg N/L	0.14		0.16		0.15		0.150		0.150		0.010
Total Phosphorus	mg P/L	0.004	T	0.005		0.002	T	0.004		0.004		0.002
Total Ortho Phosphate	mg P/L	0.001	T HT	0.004		0.004		0.003		0.004		0.002
Total Sulfate	mg/L	21		19		22		20.667		21.000		1.528
Total Calcium	mg/L	33.2		34.2		36.2		34.533		34.200		1.528
Total Chloride	mg/L	10		10		10		10.000		10.000		0.000
Total Magnesium	mg/L	11.2		11.1		11		11.100		11.100		0.100
Total Organic Carbon	mg/L	1.8		2.3		2		2.033		2.000		0.252
Total Dissolved Solids	mg/L	190		190		190		190.000		190.000		0.000
Total Suspended Solids	mg/L	4	K	4	K	4	K	2.000		4.000	K	0.000
Hardness ($CaCO_3$)	mg/L	129		131		136		132.000		131.000		3.606
Chlorophyll a	ug/L	2		1	K	3		1.833		2.000		1.000
Conductivity (lab)	umho/cm	289		287		285		287.000		287.000		2.000
Conductivity (field)	umho/cm	248				287		267.500		267.500		27.577
Dissolved Oxygen (lab)	mg/L											
Dissolved Oxygen (field)	mg/L	12.1				9.5		10.800		10.800		1.838
pH (lab)	pH	8.18		8.43		8.19		8.267		8.190		0.142
pH (field)	pH	8.1				7.9		8.000		8.000		0.141
Temperature (field)	^{o}C	2.2				11.1		6.650		6.650		6.293
Turbidity	NTU	0.4	K	0.4	K	0.4	K	0.200		0.400	K	0.000
Total Sodium	mg/L			5.5		4.8		5.150		5.150		0.495
Total Potassium	mg/L			1.2		1.2		1.200		1.200		0.000
Total Sulfide	mg/L	0.02	K	0.02	K	0.02	K	0.010		0.020	K	0.000
Total Alkalinity	mg/L	100		96		92		96		96		4.000
Secchi Disk reading	feet	41				34		38		38		4.950
Cyanide	mg/L	0.005	K					0.0025	K			
VOA	ug/L			ND				0.0000				
Base Neutrals	ug/L			ND				0.0000				

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@ = Mean includes samples with concentration below level of quantification.
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W = Reported value is less then the method detection limit.

Table B4.4 Water chemistry data collected in 2001 from the southern part of the eastern basin of Grand Traverse Bay (Station #280288).

PARAMETER	Units	4/19/2001		7/23/2001		10/23/2001		Mean		Median		Standard Deviation
Total Ammonia	mg N/L	0.003	T	0.021		0.002	T	0.009		0.003		0.011
Total Nitrate	mg N/L	0.25	C	0.194	C	0.23	C	0.225		0.230		0.028
Total Nitrite	mg N/L	0.001	T	0.002		0.002		0.002		0.002		0.001
Total Kjeldahl Nitrogen	mg N/L	0.11		0.16		0.16		0.143		0.160		0.029
Total Phosphorus	mg P/L	0.004	T	0.05**		0.005		0.005		0.005		0.001
Total Ortho Phosphate	mg P/L	0.001	T HT	0.006		0.004		0.004		0.004		0.003
Total Sulfate	mg/L	20		20		19		19.667		20.000		0.577
Total Calcium	mg/L	34.1		34.1		35.8		34.667		34.100		0.981
Total Chloride	mg/L	10		10		10		10.000		10.000		0.000
Total Magnesium	mg/L	11.3		11.1		11		11.133		11.100		0.153
Total Organic Carbon	mg/L	1.7		2.3		2.1		2.033		2.100		0.306
Total Dissolved Solids	mg/L	190		190		190		190.000		190.000		0.000
Total Suspended Solids	mg/L	4		4	K	4	K	2.666		4.000	K	0.000
Hardness ($CaCO_3$)	mg/L	132		131		135		132.667		132.000		2.082
Chlorophyll a	ug/L	2		1	K	3		1.833		2.000		1.000
Conductivity (lab)	umho/cm	289		286		285		286.667		286.000		2.082
Conductivity (field)	umho/cm	250				275		262.500		262.500		17.678
Dissolved Oxygen (lab)	mg/L	12.6		8.8		10		10.467		10.000		1.943
Dissolved Oxygen (field)	mg/L	11.9				10.1		11.000		11.000		1.273
pH (lab)	pH	8.15		8.4		8.22		8.257		8.220		0.129
pH (field)	pH	8.1				7.7		7.900		7.900		0.283
Temperature (field)	^{o}C	2.3				11.3		6.800		6.800		6.364
Turbidity	NTU	0.4	K	0.4	K	0.4	K	0.200		0.400	K	0.000
Total Sodium	mg/L			5.3		5.1		5.200		5.200		0.141
Total Potassium	mg/L			1.2		1.2		1.200		1.200		0.000
Total Sulfide	mg/L	0.02	K ST	0.02	K	0.02	K	0.010		0.020	K	0.000
Total Alkalinity	mg/L	100		94		90		95		94		5.033
Secchi Disk reading	feet	34				23		29		29		7.778
Cyanide	mg/L	0.005	K					0.0025	K			
VOA	ug/L			ND				0.0000				
Base Neutrals	ug/L			ND				0.0000				

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Table B5.1 Water chemistry data collected in 2002 from the southern part of the western basin of Grand Traverse Bay (Station #450132).

PARAMETER	Units	4/23/2002		7/31/2002		10/31/2002		Mean	Median		Standard Deviation
Total Ammonia	mg N/L	0.005	T	0.008	T	0.008	T	0.007	0.008		0.002
Total Nitrate	mg N/L	0.27	C	0.23	C	0.22	C	0.240	0.230		0.026
Total Nitrite	mg N/L	0.001	T	0.003		0.002		0.002	0.002		0.001
Total Kjeldahl Nitrogen	mg N/L	0.14		0.16		0.18		0.160	0.160		0.020
Total Phosphorus	mg P/L	0.005		0.006		0.006		0.006	0.006		0.001
Total Ortho Phosphate	mg P/L	0.001	W	0.001	W	0.007		0.003	0.001		0.003
Total Sulfate	mg/L	22		18		21		20.333	21.000		2.082
Total Calcium	mg/L	34.6		34.1		32.9		33.867	34.100		0.874
Total Chloride	mg/L	11		11		10		10.667	11.000		0.577
Total Magnesium	mg/L	11.3		10.8		11.6		11.233	11.300		0.404
Total Organic Carbon	mg/L	2.2		2		1.9		2.033	2.000		0.153
Total Dissolved Solids	mg/L	190		190		180		186.667	190.000		5.774
Total Suspended Solids	mg/L	4	K	5		4	K	3.000	4.000	K	0.577
Hardness ($CaCO_3$)	mg/L	133		130		130		131.000	130.000		1.732
Chlorophyll a	ug/L	1		1	K	2		1.333	1.000		0.577
Conductivity (lab)	umho/cm	291		290		283		288.000	290.000		4.359
Conductivity (field)	umho/cm	274		299		272		281.667	274.000		15.044
Dissolved Oxygen (lab)	mg/L			9.38	ST			9.380	9.380		
Dissolved Oxygen (field)	mg/L	13.1		9.22		11.6		11.307	11.600		1.957
pH (lab)	pH	8.08		8.37		8.3		8.250	8.300		0.151
pH (field)	pH	7.9		7.99		8.14		8.010	7.990		0.121
Temperature (field)	^{o}C	3		22.83		11.02		12.283	11.020		9.975
Turbidity	NTU	1	K	1	K	1	K	0.500	1.000	K	0.000
Total Sodium	mg/L	5.2		6.1		4.7		5.333	5.200		0.709
Total Potassium	mg/L	1.5		1.5		1.2		1.400	1.500		0.173
Total Sulfide	mg/L	0.02	K	0.02	K	0.02	K	0.010	0.020	K	0.000
Total Alkalinity	mg/L	99		99		98		99	99		0.577
Secchi Disk reading	feet	42.5		26		31		33	31		8.461
Cyanide	mg/L	0.005	K					0.0025	K		
VOA	ug/L			ND				0.0000			
Base Neutrals	ug/L			ND				0.0000			
bis(2-ethylhexyl)phthalate	ug/L			ND				0.0000			

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@ = Mean includes samples with concentration below level of quantification.
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V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B5.2 Water chemistry data collected in 2002 from the northern part of the western basin of Grand Traverse Bay (Station # 450133).

PARAMETER	Units	4/23/2002		7/31/2002		10/31/2002		Mean		Median		Standard Deviation
Total Ammonia	mg N/L	0.004	T	0.009	T	0.006	T	0.006		0.006		0.003
Total Nitrate	mg N/L	0.26	C	0.23	C	0.21	C	0.233		0.230		0.025
Total Nitrite	mg N/L	0.001	T	0.002		0.003		0.002		0.002		0.001
Total Kjeldahl Nitrogen	mg N/L	0.12		0.17		0.18		0.157		0.170		0.032
Total Phosphorus	mg P/L	0.001	T	0.001	W	0.007		0.003		0.001		0.003
Total Ortho Phosphate	mg P/L	0.001	W	0.001	W	0.026**		0.001		0.001		0.000
Total Sulfate	mg/L	21		18		21		20.000		21.000		1.732
Total Calcium	mg/L	33.4		34.3		33.4		33.700		33.400		0.520
Total Chloride	mg/L	10		10		10		10.000		10.000		0.000
Total Magnesium	mg/L	11.2		11.6		11.4		11.400		11.400		0.200
Total Organic Carbon	mg/L	1.9		2		2.2		2.033		2.000		0.153
Total Dissolved Solids	mg/L	190		190		180		186.667		190.000		5.774
Total Suspended Solids	mg/L	4	K	6		4	K	3.333		4.000	K	1.155
Hardness ($CaCO_3$)	mg/L	130		133		130		131.000		130.000		1.732
Chlorophyll a	ug/L	1		1		3		1.667		1.000		1.155
Conductivity (lab)	umho/cm	290		288		283		287.000		288.000		3.606
Conductivity (field)	umho/cm	275		294		271		280.000		275.000		12.288
Dissolved Oxygen (lab)	mg/L	13						13.000		13.000		
Dissolved Oxygen (field)	mg/L	12.9		9.16		11.5		11.187		11.500		1.890
pH (lab)	pH	8.09		8.38		8.28		8.250		8.280		0.147
pH (field)	pH	8.1		7.93		8.02		8.017		8.020		0.085
Temperature (field)	^{o}C	2.9		22.67		11.1		12.223		11.100		9.933
Turbidity	NTU	1	K	1	K	1	K	0.500		1.000	K	0.000
Total Sodium	mg/L	6.4		5.5		4.7		5.533		5.500		0.850
Total Potassium	mg/L	1.2		1.4		1.2		1.267		1.200		0.115
Total Sulfide	mg/L	0.02	K	0.02	K	0.02	K	0.010		0.020	K	0.000
Total Alkalinity	mg/L	93		96		96		95		96		1.732
Secchi Disk reading	feet	51.5		32		34.9		39		35		10.522
Cyanide	mg/L	0.005	K					0.0025	K			
VOA	ug/L			ND				0.0000				
Base Neutrals	ug/L			ND				0.0000				
bis(2-ethylhexyl)phthalate	ug/L			ND				0.0000				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
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Table B5.3 Water chemistry data collected in 2002 from the northern part of the eastern basin of Grand Traverse Bay (Station #280289).

PARAMETER	Units	4/23/2002		7/31/2002		10/31/2002		Mean		Median		Standard Deviation
Total Ammonia	mg N/L	0.007	T	0.009	T	0.008	T	0.008		0.008		0.001
Total Nitrate	mg N/L	0.26	C	0.22	C	0.21	C	0.230		0.220		0.026
Total Nitrite	mg N/L	0.001	T PI	0.002		0.003		0.002		0.002		0.001
Total Kjeldahl Nitrogen	mg N/L	0.19		0.17		0.16		0.173		0.170		0.015
Total Phosphorus	mg P/L	0.003	T	0.001	T	0.006		0.003		0.003		0.003
Total Ortho Phosphate	mg P/L	0.001	W	0.001	W	0.006		0.003		0.001		0.003
Total Sulfate	mg/L	19		19		21		19.667		19.000		1.155
Total Calcium	mg/L	33.4		32.8		33.3		33.167		33.300		0.321
Total Chloride	mg/L	10		11		11		10.667		11.000		0.577
Total Magnesium	mg/L	11.3		11.5		11.5		11.433		11.500		0.115
Total Organic Carbon	mg/L	2.1		2		1.9		2.000		2.000		0.100
Total Dissolved Solids	mg/L	190		190		180		186.667		190.000		5.774
Total Suspended Solids	mg/L	4	K	6		4	K	3.333		4.000	K	1.155
Hardness ($CaCO_3$)	mg/L	130		129		131		130.000		130.000		1.000
Chlorophyll a	ug/L	1		1	K	2		1.111		1.000		0.577
Conductivity (lab)	umho/cm	289		289		284		287.333		289.000		2.887
Conductivity (field)	umho/cm	274		296		269		279.667		274.000		14.364
Dissolved Oxygen (lab)	mg/L							-		-		-
Dissolved Oxygen (field)	mg/L	12.9		8.6		11.7		11.067		11.700		2.219
pH (lab)	pH	8.08		8.36		8.4		8.280		8.360		0.174
pH (field)	pH	7.9		8.02		8.22		8.047		8.020		0.162
Temperature (field)	^{o}C	3		23.66		11.04		12.567		11.040		10.414
Turbidity	NTU	1	K	1	K	1	K	0.500		1.000	K	0.000
Total Sodium	mg/L	5.1		6		5		5.367		5.100		0.551
Total Potassium	mg/L	1.2		2		1.7		1.633		1.700		0.404
Total Sulfide	mg/L	0.02	K	0.02	K	0.02	K	0.010		0.020	K	0.000
Total Alkalinity	mg/L	95		98		98		97		98		1.732
Secchi Disk reading	feet	49.3		33		36		39		36		8.675
Cyanide	mg/L	0.005	K					0.0025	K			
VOA	ug/L			ND				0.0000				
Base Neutrals	ug/L			ND				0.0000				
bis(2-ethylhexyl)phthalate	ug/L			4				4.0000				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B5.4 Water chemistry data collected in 2002 from the sourthern part of the eastern basin of Grand Traverse Bay (Station #280288).

PARAMETER	Units	4/23/2002		7/31/2002		10/31/2002		Mean		Median		Standard Deviation
Total Ammonia	mg N/L	0.004	T	0.013		0.008	T	0.008		0.008		0.005
Total Nitrate	mg N/L	0.26	C	0.21	C	0.21	C	0.227		0.210		0.029
Total Nitrite	mg N/L	0.001	T	0.003		0.002		0.002		0.002		0.001
Total Kjeldahl Nitrogen	mg N/L	0.15		0.17		0.15		0.157		0.150		0.012
Total Phosphorus	mg P/L	0.001	T	0.001	T	0.005		0.002		0.001		0.002
Total Ortho Phosphate	mg P/L	0.001	W	0.001	T	0.004		0.002		0.001		0.002
Total Sulfate	mg/L	21		18		20		19.667		20.000		1.528
Total Calcium	mg/L	34.4		33.9		32.5		33.600		33.900		0.985
Total Chloride	mg/L	10		10		10		10.000		10.000		0.000
Total Magnesium	mg/L	11.1		11.6		11.6		11.433		11.600		0.289
Total Organic Carbon	mg/L	2		1.9		1.9		1.933		1.900		0.058
Total Dissolved Solids	mg/L	190		190		180		186.667		190.000		5.774
Total Suspended Solids	mg/L	4	K	4		4	K	2.000		4.000	K	0.000
Hardness ($CaCO_3$)	mg/L	132		132		129		131.000		132.000		1.732
Chlorophyll a	ug/L	1		1	K	2		1.167		1.000		0.577
Conductivity (lab)	umho/cm	289		286		284		286.333		286.000		2.517
Conductivity (field)	umho/cm	275		294		269		279.333		275.000		13.051
Dissolved Oxygen (lab)	mg/L	13						13.000		13.000		
Dissolved Oxygen (field)	mg/L	12.1		9.02		11.8		10.973		11.800		1.698
pH (lab)	pH	8.08		8.35		8.28		8.237		8.280		0.140
pH (field)	pH	7.9		7.96		8.27		8.043		7.960		0.199
Temperature (field)	^{o}C	3.4		22.85		11.2		12.483		11.200		9.788
Turbidity	NTU	1	K	1	K	1	K	0.500		1.000	K	0.000
Total Sodium	mg/L	6.3		5.4		4.6		5.433		5.400		0.850
Total Potassium	mg/L	1.2		1.3		1.3		1.267		1.300		0.058
Total Sulfide	mg/L	0.02	K	0.02	K	0.02	K	0.010		0.020	K	0.000
Total Alkalinity	mg/L	97		101		96		98		97		2.646
Secchi Disk reading	feet	46.5		29		36.8		37		37		8.767
Cyanide	mg/L	0.005	K					0.0025	K			
VOA	ug/L			ND				0.0000				
Base Neutrals	ug/L			ND				0.0000				
bis(2-ethylhexyl)phthalate	ug/L			2.9				2.9000				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B6.1 Water chemistry data collected in 2003 from the southern part of the western basin of Grand Traverse Bay (Station #450132).

PARAMETER	Units	5/14/2003	7/14/2003	10/27/2003	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.011	0.008 T	0.005 T	0.008	0.008	0.003
Total Nitrate	mg N/L	0.25	0.21	0.194	0.218	0.210	0.029
Total Nitrite	mg N/L	0.002	0.004	0.006	0.004	0.004	0.002
Total Kjeldahl Nitrogen	mg N/L	0.13	0.16	0.18	0.157	0.160	0.025
Total Phosphorus	mg P/L	0.007	0.005	0.007	0.006	0.007	0.001
Total Ortho Phosphate	mg P/L	0.002 T	0.001 W	0.002 T	0.002	0.002	0.001
Total Sulfate	mg/L	19	16	18	17.667	18.000	1.528
Total Calcium	mg/L	34.3	33.4	33.2	33.633	33.400	0.586
Total Chloride	mg/L	10	10	11	10.333	10.000	0.577
Total Magnesium	mg/L	11.5	11.3	11.1	11.300	11.300	0.200
Total Organic Carbon	mg/L	1.3	2.7	2	2.000	2.000	0.700
Total Dissolved Solids	mg/L	180	190	190	186.667	190.000	5.774
Total Suspended Solids	mg/L	ND	ND	ND			
Hardness ($CaCO_3$)	mg/L	133	130	129	130.667	130.000	2.082
Chlorophyll a	ug/L	ND	ND	3.2	3.200	3.200	
Conductivity (lab)	umho/cm	284	286	286	285.333	286.000	1.155
Conductivity (field)	umho/cm	282	283	282	282.333	282.000	0.577
Dissolved Oxygen (lab)	mg/L	13.3		10	11.650	11.650	2.333
Dissolved Oxygen (field)	mg/L	17.23	10.08	11.01	12.773	11.010	3.887
pH (lab)	s.u	8.19	8.4	8.39	8.327	8.390	0.118
pH (field)	s.u.	8.09	8.22	7.83	8.047	8.090	0.199
Temperature (field)	^{o}C	3.3	19.11	11.79	11.400	11.790	7.912
Turbidity	NTU	ND	ND	ND			
Total Sodium	mg/L	5.7	5.2	6	5.633	5.700	0.404
Total Potassium	mg/L	1.2	1.4	1.3	1.300	1.300	0.100
Total Sulfide	mg/L	ND					
Total Alkalinity	mg/L	86	105	100	97.000	100	9.849
Secchi Disk reading	feet	54	30	27	37.000	30	14.799
Cyanide	mg/L	ND					
VOA	ug/L		ND				
Base/Neutral Organics	ug/L		ND				

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@ = Mean includes samples with concentration below level of quantification.
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A = Value reported is the mean of two or more determinations.
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JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B6.2. Water chemistry data collected in 2003 from the northern part of the western basin of Grand Traverse Bay (Station #450133).

PARAMETER	Units	5/14/2003		7/14/2003		10/27/2003		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.007	T	0.013		0.005	T	0.008	0.007	0.004
Total Nitrate	mg N/L	0.24		0.22		0.21		0.223	0.220	0.015
Total Nitrite	mg N/L	0.001	T	0.003		0.004		0.003	0.003	0.002
Total Kjeldahl Nitrogen	mg N/L	0.19		0.24		0.2		0.210	0.200	0.026
Total Phosphorus	mg P/L	0.008		0.006		0.009		0.008	0.008	0.002
Total Ortho Phosphate	mg P/L	0.001	T	0.001	W	0.002	T	0.001	0.001	0.001
Total Sulfate	mg/L	19		16		18		17.667	18.000	1.528
Total Calcium	mg/L	34.2		32.2		33.9		33.433	33.900	1.079
Total Chloride	mg/L	9		10		12		10.333	10.000	1.528
Total Magnesium	mg/L	11.5		11.3		11.1		11.300	11.300	0.200
Total Organic Carbon	mg/L	1.7		2.3		2		2.000	2.000	0.300
Total Dissolved Solids	mg/L	180		180		190		183.333	180.000	5.774
Total Suspended Solids	mg/L		ND		ND		ND			
Hardness ($CaCO_3$)	mg/L	133		127		130		130.000	130.000	3.000
Chlorophyll a	ug/L		ND		ND	2.2		2.200	2.200	
Conductivity (lab)	umho/cm	283		281		285		283.000	283.000	2.000
Conductivity (field)	umho/cm	282		279		281		280.667	281.000	1.528
Dissolved Oxygen (lab)	mg/L							#DIV/0!	#NUM!	#DIV/0!
Dissolved Oxygen (field)	mg/L	15.77		10.32		11.36		12.483	11.360	2.893
pH (lab)	s.u	8.18		8.41		8.35		8.313	8.350	0.119
pH (field)	s.u.	8.04		8.17		7.78		7.997	8.040	0.199
Temperature (field)	^{o}C	2.97		18.56		11.57		11.033	11.570	7.809
Turbidity	NTU		ND		ND		ND			
Total Sodium	mg/L	6.7		5.2		6.2		6.033	6.200	0.764
Total Potassium	mg/L	1.2		1.3		1.4		1.300	1.300	0.100
Total Sulfide	mg/L		ND							
Total Alkalinity	mg/L	89		99		99		95.667	99	5.774
Secchi Disk reading	feet	52		32.5		26		36.833	33	13.531
Cyanide	mg/L		ND							
VOA	ug/L			ND						
Base/Neutral Organics	ug/L			ND						

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
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D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
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H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B6.3. Water chemistry data collected in 2003 from the northern part of the eastern basin of Grand Traverse Bay (Station #280289).

PARAMETER	Units	5/14/2003		7/14/2003		10/27/2003		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.005	T	0.01		0.007	T	0.007	0.007	0.003
Total Nitrate	mg N/L	0.25		0.22		0.196		0.222	0.220	0.027
Total Nitrite	mg N/L	0.001	T	0.004		0.004		0.003	0.004	0.002
Total Kjeldahl Nitrogen	mg N/L	0.15		0.16		0.17		0.160	0.160	0.010
Total Phosphorus	mg P/L	0.007		0.003	W	0.006		0.005	0.006	0.002
Total Ortho Phosphate	mg P/L		ND	0.001	W	0.001	T	0.001	0.001	0.000
Total Sulfate	mg/L	19		20		18		19.000	19.000	1.000
Total Calcium	mg/L	34.8		32.8		33.5		33.700	33.500	1.015
Total Chloride	mg/L	10		10		11		10.333	10.000	0.577
Total Magnesium	mg/L	11.4		11.1		11.1		11.200	11.100	0.173
Total Organic Carbon	mg/L	1.6		2		2		1.867	2.000	0.231
Total Dissolved Solids	mg/L	180		180		190		183.333	180.000	5.774
Total Suspended Solids	mg/L		ND		ND		ND			
Hardness ($CaCO_3$)	mg/L	134		128		129		130.333	129.000	3.215
Chlorophyll a	ug/L	1			ND	2.2		1.600	1.600	
Conductivity (lab)	umho/cm	283		282		285		283.333	283.000	1.528
Conductivity (field)	umho/cm	281		278		281		280.000	281.000	1.732
Dissolved Oxygen (lab)	mg/L							#DIV/0!	#NUM!	#DIV/0!
Dissolved Oxygen (field)	mg/L	17		10.37		10.76		12.710	10.760	3.720
pH (lab)	s.u	8.18		8.42		8.37		8.323	8.370	0.127
pH (field)	s.u.	8.26		8.22		7.96		8.147	8.220	0.163
Temperature (field)	^{o}C	2.76		18.4		11.78		10.980	11.780	7.851
Turbidity	NTU		ND		ND		ND			
Total Sodium	mg/L	5.3		5.2		7.6		6.033	5.300	1.358
Total Potassium	mg/L	1.2		1.3		1.3		1.267	1.300	0.058
Total Sulfide	mg/L		ND							
Total Alkalinity	mg/L	91		95		101		95.667	95	5.033
Secchi Disk reading	feet	51		40		26		39.000	40	12.530
Cyanide	mg/L		ND							
VOA	ug/L			ND						
Base/Neutral Organics	ug/L			ND						

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B6.4. Water chemistry data collected in 2003 from the southern part of the eastern basin of Grand Traverse Bay (Station #280288).

PARAMETER	Units	5/14/2003	7/14/2003	10/27/2003	Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.012	0.011	0.007 T	0.010	0.011	0.003
Total Nitrate	mg N/L	0.24	0.21	0.197	0.216	0.210	0.022
Total Nitrite	mg N/L	0.001 T	0.003	0.003	0.002	0.003	0.001
Total Kjeldahl Nitrogen	mg N/L	0.16	0.17	0.18	0.170	0.170	0.010
Total Phosphorus	mg P/L	0.008	0.004 T	0.006	0.006	0.006	0.002
Total Ortho Phosphate	mg P/L	0.001 T	0.001 T	0.003	0.002	0.001	0.001
Total Sulfate	mg/L	18	17	17	17.333	17.000	0.577
Total Calcium	mg/L	34.2	31.7	32.8	32.900	32.800	1.253
Total Chloride	mg/L	10	10	19	13.000	10.000	5.196
Total Magnesium	mg/L	11.4	11.2	11.1	11.233	11.200	0.153
Total Organic Carbon	mg/L	1.7	2	2.2	1.967	2.000	0.252
Total Dissolved Solids	mg/L	180	180	190	183.333	180.000	5.774
Total Suspended Solids	mg/L	ND	ND	ND			
Hardness ($CaCO_3$)	mg/L	132	125	128	128.333	128.000	3.512
Chlorophyll a	ug/L	1.2	ND	2.6	1.900	1.900	
Conductivity (lab)	umho/cm	283	282	287	284.000	283.000	2.646
Conductivity (field)	umho/cm	282	279	282	281.000	282.000	1.732
Dissolved Oxygen (lab)	mg/L		9.3		9.300	9.300	
Dissolved Oxygen (field)	mg/L	15.83	10.25	10.61	12.230	10.610	3.123
pH (lab)	s.u	8.2	8.42	8.4	8.340	8.400	0.122
pH (field)	s.u.	8.14	8.25	8.05	8.147	8.140	0.100
Temperature (field)	^{o}C	3.18	19.26	11.95	11.463	11.950	8.051
Turbidity	NTU	ND	ND	ND			
Total Sodium	mg/L	6.2	5.7	6.5	6.133	6.200	0.404
Total Potassium	mg/L	1.2	1.3	2.1	1.533	1.300	0.493
Total Sulfide	mg/L	ND					
Total Alkalinity	mg/L	95	98	100	97.667	98	2.517
Secchi Disk reading	feet	45	29	28	34.000	29	9.539
Cyanide	mg/L	ND					
VOA	ug/L		ND				
Base/Neutral Organics	ug/L		ND				

+ = Calculated value; not rounded to appropriate number of significant digits.
@ = Mean includes samples with concentration below level of quantification.
** = Not included in statistical calculations.
A = Value reported is the mean of two or more determinations.
C = Value caclulated from other independent parameters.
D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
E = Result is estimated due to high recovery of batch QC.
G = Result and RL are estimated due to initial calibration standard criteria failure.
H and HT = Recommended laboratory holding time was exceeded.
I and DM = Dilution required due to matrix interference; reporting limit raised.
ID = Insufficient data for calculation.
J = Analyte was positively identified. Value is an estimate.
JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
M = The level of the method preparation blank is reported in the qualifier column.
NA = Not analyzed.
ND = Observed result was below the quantification level.
P and ST= Recommended sample collection/preservation technique not used; reported result(s) is an estimate.
PI = Possible interference may have affetced the accuracy of the laboratory result.
Q = Quantity of sample insufficient to perform analyses requested.
QC = Quality control problems exist.
R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B7.1 Water chemistry data collected in 2004 from the southern part of the western basin of Grand Traverse Bay (Station #450132).

PARAMETER	Units	4/14/2004		7/20/2004		10/21/2004		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.004	T	0.005	T	0.007	T	0.005	0.005	0.002
Total Nitrate	mg N/L	0.24		0.22		0.21		0.223	0.220	0.015
Total Nitrite	mg N/L	0.001	T	0.003		0.003		0.002	0.003	0.001
Total Kjeldahl Nitrogen	mg N/L	0.17		0.18		0.17		0.173	0.170	0.006
Total Phosphorus	mg P/L	0.005		0.005		0.006		0.005	0.005	0.001
Total Ortho Phosphate	mg P/L	0.002	T	0.0015	ND W	0.002	T	0.002	0.002	0.000
Total Sulfate	mg/L	18		19		18		18.333	18.000	0.577
Total Calcium	mg/L	34.5		36.8		33.8		35.033	34.500	1.570
Total Chloride	mg/L	11		10		11		10.667	11.000	0.577
Total Magnesium	mg/L	11.2		11.3		11.5		11.333	11.300	0.153
Total Organic Carbon	mg/L	1.9		2.5		2.1		2.167	2.100	0.306
Total Dissolved Solids	mg/L	180		190		190		186.667	190.000	5.774
Total Suspended Solids	mg/L	2	ND	2	ND	2	ND	2.000	2.000	0.000
Hardness ($CaCO_3$)	mg/L	132		139		132		134.333	132.000	4.041
Chlorophyll a	ug/L		ND		ND	2.4		2.400	2.400	
Conductivity (lab)	umho/cm	284		286		286		285.333	286.000	1.155
Conductivity (field)	umho/cm	288		276		288		284.000	288.000	6.928
Dissolved Oxygen (lab)	mg/L	13				9.8		11.400	11.400	2.263
Dissolved Oxygen (field)	mg/L	13.85		10.45		9.02		11.107	10.450	2.481
pH (lab)	s.u	8.21	H	8.38		8.35		8.313	8.350	0.091
pH (field)	s.u.	6.87		8.29		8.06		7.740	8.060	0.762
Temperature (field)	^{o}C	1.91		19.69		13.35		11.650	13.350	9.011
Turbidity	NTU	0.2	ND	0.2	ND	0.2	ND	0.200	0.200	0.000
Total Sodium	mg/L	5.6		6.2		5.9		5.900	5.900	0.300
Total Potassium	mg/L	1.4		1.3		1.6		1.433	1.400	0.153
Total Alkalinity	mg/L	101		92		105		99.333	101.000	6.658
Secchi Disk reading	feet	43		38		33		38.000	38.000	5.000
Cyanide	mg/L		ND							
VOA	ug/L				ND					
Di-n-butyl phthalate	ug/L			2.2				2.200	2.200	
Diethyl phthalate	ug/L			0.25				0.250	0.250	

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JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
K = RL(s) raised due to matrix interferences.
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Q = Quantity of sample insufficient to perform analyses requested.
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R = Result confiirmed by re-extraction and analysis.
S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B7.2. Water chemistry data collected in 2004 from the northern part of the western basin of Grand Traverse Bay (Station #450133).

PARAMETER	Units	4/14/2004		7/20/2004		10/21/2004		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.003	T	0.007	T	0.011		0.007	0.007	0.004
Total Nitrate	mg N/L	0.25		0.23		0.21		0.230	0.230	0.020
Total Nitrite	mg N/L	0.001	T	0.003		0.003		0.002	0.003	0.001
Total Kjeldahl Nitrogen	mg N/L	0.13		0.2		0.28		0.203	0.200	0.075
Total Phosphorus	mg P/L	0.007		0.003	W	0.006		0.005	0.006	0.002
Total Ortho Phosphate	mg P/L	0.001	T	0.0015	ND W	0.0015	ND W	0.001	0.002	0.000
Total Sulfate	mg/L	18		20		18		18.667	18.000	1.155
Total Calcium	mg/L	34.4		34.4		34		34.267	34.400	0.231
Total Chloride	mg/L	10		10		11		10.333	10.000	0.577
Total Magnesium	mg/L	11.1		11.3		11.2		11.200	11.200	0.100
Total Organic Carbon	mg/L	1.8		2.1		2.4		2.100	2.100	0.300
Total Dissolved Solids	mg/L	180		180		180		180.000	180.000	0.000
Total Suspended Solids	mg/L	2	ND	4		5		3.667	4.000	1.528
Hardness ($CaCO_3$)	mg/L	132		133		131		132.000	132.000	1.000
Chlorophyll a	ug/L	1.3			ND	2		1.650	1.650	0.495
Conductivity (lab)	umho/cm	283		285		285		284.333	285.000	1.155
Conductivity (field)	umho/cm	286		276		287		283.000	286.000	6.083
Dissolved Oxygen (lab)	mg/L									
Dissolved Oxygen (field)	mg/L	14.05		10.89		9.15		11.363	10.890	2.484
pH (lab)	s.u	8.2	H	8.41		8.34		8.317	8.340	0.107
pH (field)	s.u.	6.74		8.29		8.01		7.680	8.010	0.826
Temperature (field)	^{o}C	1.78		19.14		13.35		11.423	13.350	8.839
Turbidity	NTU	0.2	ND	0.2	ND	0.2	ND	0.200	0.200	0.000
Total Sodium	mg/L	5.3		5.6		6.9		5.933	5.600	0.850
Total Potassium	mg/L	1.3		1.3		1.3		1.300	1.300	0.000
Total Alkalinity	mg/L	99		94		123		105.333	99.000	15.503
Secchi Disk reading	feet	45		37.5		33		38.500	37.500	6.062
Cyanide	mg/L		ND							
VOA	ug/L				ND					
Di-n-butyl phthalate	ug/L			4.1				4.100	4.100	
Diethyl phthalate	ug/L			0.22				0.220	0.220	

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D and DL = Analyte value quantified from a dilution(s); reporting limit raised.
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T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B7.3. Water chemistry data collected in 2004 from the northern part of the eastern basin of Grand Traverse Bay (Station #280289).

PARAMETER	Units	4/14/2004		7/20/2004		10/21/2004		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.003	T	0.006	T	0.007	T	0.005	0.006	0.002
Total Nitrate	mg N/L	0.25		0.23		0.193		0.224	0.230	0.029
Total Nitrite	mg N/L	0.001	T	0.003		0.003		0.002	0.003	0.001
Total Kjeldahl Nitrogen	mg N/L	0.14		0.2		0.17		0.170	0.170	0.030
Total Phosphorus	mg P/L	0.0025	ND W	0.004	T	0.004	T	0.004	0.004	0.001
Total Ortho Phosphate	mg P/L	0.0015	ND W	0.0015	ND W	0.002	T	0.002	0.002	0.000
Total Sulfate	mg/L	18		19		18		18.333	18.000	0.577
Total Calcium	mg/L	33.5		33.9		32.4		33.267	33.500	0.777
Total Chloride	mg/L	10		10		10		10.000	10.000	0.000
Total Magnesium	mg/L	11.2		11.2		11.4		11.267	11.200	0.115
Total Organic Carbon	mg/L	1.7		3.3		2.2		2.400	2.200	0.819
Total Dissolved Solids	mg/L	180		180		180		180.000	180.000	0.000
Total Suspended Solids	mg/L	2	ND	2	ND	2	ND	2.000	2.000	0.000
Hardness ($CaCO_3$)	mg/L	130		131		128		129.667	130.000	1.528
Chlorophyll a	ug/L	1.5			ND	1.6		1.550	1.550	0.071
Conductivity (lab)	umho/cm	282		284		285		283.667	284.000	1.528
Conductivity (field)	umho/cm	285		275		288		282.667	285.000	6.807
Dissolved Oxygen (lab)	mg/L									
Dissolved Oxygen (field)	mg/L	13.83		10.9		9.07		11.267	10.900	2.401
pH (lab)	s.u	8.23	H	8.44		8.35		8.340	8.350	0.105
pH (field)	s.u.	7.05		8.32		8.15		7.840	8.150	0.689
Temperature (field)	^{o}C	1.91		19.68		13.74		11.777	13.740	9.046
Turbidity	NTU	0.2	ND	0.2	ND	0.2	ND	0.200	0.200	0.000
Total Sodium	mg/L	7.2		5.3		6.4		6.300	6.400	0.954
Total Potassium	mg/L	1.5		1.3		1.3		1.367	1.300	0.115
Total Alkalinity	mg/L	99		95		118		104.000	99	12.288
Secchi Disk reading	feet	47		39		30		38.667	39	8.505
Cyanide	mg/L		ND							
VOA	ug/L				ND					
Di-n-butyl phthalate	ug/L			2.9				2.900	3	
Diethyl phthalate	ug/L			0.24				0.240	0	

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H and HT = Recommended laboratory holding time was exceeded.
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JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
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M = The level of the method preparation blank is reported in the qualifier column.
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S = Supernatant analyzed.
T = Reported value is less than the reporting limit. Result is estimated.
V = Value not available due to dilution.
W = Reported value is less then the method detection limit.

Table B7.4. Water chemistry data collected in 2004 from the southern part of the eastern basin of Grand Traverse Bay (Station #280288).

PARAMETER	Units	4/14/2004		7/20/2004		10/21/2004		Mean	Median	Standard Deviation
Total Ammonia	mg N/L	0.003	T	0.007	T	0.008	T	0.006	0.007	0.003
Total Nitrate	mg N/L	0.24		0.197		0.197		0.211	0.197	0.025
Total Nitrite	mg N/L	0.002		0.003		0.003		0.003	0.003	0.001
Total Kjeldahl Nitrogen	mg N/L	0.14		0.16		0.17		0.157	0.160	0.015
Total Phosphorus	mg P/L	0.0025	ND W	0.003	W	0.005		0.004	0.003	0.001
Total Ortho Phosphate	mg P/L	0.0015	ND W	0.0015	ND W	0.002	T	0.002	0.002	0.000
Total Sulfate	mg/L	17		19		18		18.000	18.000	1.000
Total Calcium	mg/L	34.7		33.3		33.9		33.967	33.900	0.702
Total Chloride	mg/L	10		10		11		10.333	10.000	0.577
Total Magnesium	mg/L	11.2		11		11.4		11.200	11.200	0.200
Total Organic Carbon	mg/L	1.8		2.1		2.3		2.067	2.100	0.252
Total Dissolved Solids	mg/L	180		180		180		180.000	180.000	0.000
Total Suspended Solids	mg/L	2	ND	2	ND	2	ND	2.000	2.000	0.000
Hardness ($CaCO_3$)	mg/L	133		129		132		131.333	132.000	2.082
Chlorophyll a	ug/L	1.5			ND	2.1		1.800	1.800	0.424
Conductivity (lab)	umho/cm	283		282		284		283.000	283.000	1.000
Conductivity (field)	umho/cm	285		273		287		281.667	285.000	7.572
Dissolved Oxygen (lab)	mg/L			9.2	H			9.200	9.200	
Dissolved Oxygen (field)	mg/L	14.2		10.36		9.05		11.203	10.360	2.677
pH (lab)	s.u	8.23	H	8.43		8.4		8.353	8.400	0.108
pH (field)	s.u.	7.17		8.28		8.15		7.867	8.150	0.607
Temperature (field)	°C	2.08		21.11		13.82		12.337	13.820	9.601
Turbidity	NTU	0.2	ND	0.2	ND	0.2	ND	0.200	0.200	0.000
Total Sodium	mg/L	6.5		5.6		6.6		6.233	6.500	0.551
Total Potassium	mg/L	1.5		1.3		1.3		1.367	1.300	0.115
Total Alkalinity	mg/L	100		96		116		104.000	100.000	10.583
Secchi Disk reading	feet	41		37.5		38		38.833	38.000	1.893
Cyanide	mg/L	0.009						0.009	0.009	
VOA	ug/L				ND					
Di-n-butyl phthalate	ug/L			7.1				7.100	7.100	
Diethyl phthalate	ug/L			0.23				0.230	0.230	

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ID = Insufficient data for calculation.
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JC = Result is estimated since confirmation analysis did not meet acceptance criteria.
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