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Great Lakes Connecting Channels

2005 Annual Data Report

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1. INTRODUCTION

Comprehensive, viable water quality monitoring programs are essential to providing the Michigan Department of Environmental Quality (MDEQ) a means by which to assess overall water quality throughout Michigan, and determine if water quality at a given station has improved, degraded or remained unchanged over time. Such programs provide the MDEQ with a sound basis for decision making and prioritizing its efforts as an agency. One such water quality monitoring program is the Michigan Water Chemistry Monitoring Project (WCMP).

In June 1998, the MDEQ, Water Bureau (WB), initiated the WCMP using part of a $500,000 appropriation by the state Legislature. This program was a first step towards improving water quality monitoring in Michigan since funding reductions imposed in the mid-1990s resulted in severely restricted monitoring capabilities. Technological advances in affordable, low-concentration analytical techniques then available to the WCMP also made it possible to assess Michigan's surface waters for key contaminants, such as mercury (Hg), at environmentally relevant levels.

The WCMP is an important component of the statewide surface water quality monitoring activities outlined in the January 1997 report prepared by the MDEQ-WB, and the MDEQ-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:

1. Assess the current status and condition of individual waters of the state and determine whether 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.

As initiated in 1998, the WCMP called for routine annual water chemistry monitoring at the Great Lakes Connecting Channels, Saginaw Bay, Grand Traverse Bay and selected Michigan streams tributary to the Great Lakes. With the November 1998 passage of the Clean Michigan Initiative, a substantial increase in annual funding became available for statewide surface water quality monitoring beginning in 2000. The study design of the WCMP was subsequently modified and expanded to help ensure implementation of statewide water chemistry monitoring activities capable of more fully realizing the goals set forth in the Strategy.

Michigan's Great Lakes Connecting Channels (i.e., the St. Marys, St. Clair and Detroit Rivers) are important locations for water chemistry monitoring efforts because they serve as conduits for direct water quality impacts between the Great Lakes. They also represent large watersheds subject to intense pressures from commercial and industrial activities. And as is true of many large watersheds, the Great Lakes Connecting Channels are affected by a variety of land uses, point and nonpoint sources of pollution, and geological and other natural influences. As part of the WCMP, a total of six stations - one at the headwaters and mouth of each of the Connecting Channels - are monitored monthly each year during the open-water season.

This report presents, summarizes and discusses results from water chemistry monitoring efforts undertaken at the Great Lakes Connecting Channels in 2005 as part of the WCMP. Data summaries include spatial comparisons, an evaluation of longitudinal profiles of estimated contaminant loading rates and comparisons of contaminant concentrations with Michigan Rule 57 water quality values. This report does not include trend analyses or summaries. A previous report summarizing trends in water quality data from 1992 through 2004 is available from MDEQ (GLEC, 2006). That trend report will be updated with 1992 through 2007 data when the 2007 monitoring data become available.

2. DESCRIPTION OF AVAILABLE DATA

Data from 2005 were provided by MDEQ and are the subject of this report. The parameters included in this report are: phosphorus (including total phosphorus and orthophosphorus), nitrogen (including total Kjeldahl nitrogen (TKN), nitrate and nitrite), total chloride, total suspended solids (TSS), total dissolved solids (TDS), water temperature, conductivity, dissolved oxygen (DO), pH, turbidity, alkalinity, total organic carbon (TOC), sulfate, hardness, calcium, magnesium, potassium and sodium. The metals data include: cadmium (Cd), copper (Cu), chromium (Cr), lead (Pb), mercury (Hg), nickel (Ni) and zinc (Zn).

For the purpose of this study, the data collected at the sampling stations listed below were used. The sampling station locations are shown in Figures 1 through 3.

Station 170139 – Upstream St. Marys River
Station 170140 – Downstream St. Marys River
Station 740376 – Upstream St. Clair River
Station 740016 – Downstream St. Clair River
Station 820414 – Upstream Detroit River
Station 820017 – Downstream Detroit River

The current structure of MDEQ's statewide water chemistry monitoring activities, including those performed on Michigan's Great Lakes Connecting Channels, is described in the Surface Water Quality Assessment Section's Procedure #58 (available upon request from MDEQ). Descriptions of the field procedures used to collect and handle the Connecting Channels water samples are provided in the document entitled "Water Chemistry Monitoring Project: Sample Collection and Handling Procedures for Selected Parameters" (available upon request from MDEQ). The methods of chemical analysis employed for analytes sampled at the Connecting Channels are described in a separate report (Aiello, 2006).

Samples were generally collected on a monthly basis from the St. Marys, St. Clair and Detroit Rivers during the period from April to November in 2005. However, due to equipment failure, no samples were collected from stations 170139, 740016, 740376, 820017 and 820414 in October, and from station 820414 in November.

Data below analytical quantification or detection levels (i.e., uncensored data), including negative values, were used directly in the analyses presented herein. Support for the use of uncensored data is provided by Porter et al. (1988) and Gilliom et al. (1984).

The 2005 flow data for all three rivers were obtained from the Army Corps of Engineers (ACOE). Pollutant loads for 2005 were calculated by the United States Geological Survey (USGS) and were provided by MDEQ. The loads were calculated using data from the sampling stations listed above and the available flow data, using Beale's Ratio Estimator.

3. RESULTS

3.1 SUMMARY OF FLOWS

The St. Marys River connects Lake Superior and Lake Huron and is the northernmost Connecting Channel in this study (Figure 1). St. Marys River flow is regulated by controlling works (hydropower plants, navigation locks and a dam) at Sault St. Marie. Figure 4 shows the flow in the St. Marys River in 2005, indicating significant flow variation, particularly between June and September. The mean flow for the year 2005 was approximately 2,204 m^3/s, and ranged from a minimum of 1,178 m^3/s to a maximum of 3,650 m^3/s.

The St. Clair River connects Lake Huron to Lake St. Clair (Figure 2). Figure 5 shows the flow in the St. Clair River in 2005. The mean flow for 2005 was approximately 4,624 m^3/s. Flows ranged from 2,832 to 5,495 m^3/s.

The Detroit River connects Lake St. Clair with Lake Erie and is the southernmost Connecting Channel in this study (Figure 3). The flow in the Detroit River is complex, due to numerous islands and channels, particularly in the lower half of the river. Flow is also affected by fluctuating water levels in Lake Erie. Figure 6 shows the complete flow record for 2005 in the Detroit River. Overall there was little relative variability in flow in the Detroit River in 2005; flows ranged between 4,581 and 5,684 m^3/s. The mean flow for 2005 was 5,070 m^3/s.

3.2 SUMMARY OF WATER QUALITY

Conventional water quality data collected in 2005 from the upstream and downstream stations in the St. Marys, St. Clair and Detroit Rivers are summarized in Tables 1 through 6. Also provided in these tables are summary statistics including data means, medians and standard deviations. Table 7 contains trace metals and Hg data from 2005, in addition to data means and waterbody-specific Rule 57 water quality values. Box plots for each water quality parameter are provided in Figures 7 through 35. Brief highlights from the results obtained are given below.

- Mean total chloride concentrations at the St. Marys River (2 mg/L) were just above the chloride quantification limit (QL) of 1 mg/L. Mean concentrations at the St. Clair and Detroit Rivers were slightly higher, ranging from 6 to 9 mg/L.

- Mean TKN, nitrate and phosphorus concentrations were relatively low at all locations, ranging from 0.14 to 0.26 mg/L for TKN (QL = 0.10 mg/L), 0.30 to 0.35 mg/L for nitrate (QL = 0.010 mg/L) and 0.007 to 0.025 mg/L for phosphorus (QL = 0.005 mg/L).

- Mean TSS concentrations were quite low at the St. Marys River and the St. Clair River upstream station (4 mg/L and 1 mg/L, respectively). Those measured at the St. Clair River downstream station and the Detroit River ranged from 6 to 12 mg/L (QL = 4 mg/L).

- At all locations, mean total Cd concentrations, and in fact nearly all individual Cd concentrations, were below the QL for Cd (0.037 ug/L).

- Mean total Cr concentrations were relatively low at all locations, ranging from 0.044 to 0.45 ug/L (QL = 0.19 ug/L).

- Mean total Cu, Pb and Zn concentrations were lowest at the St. Clair River upstream station (0.53 ug/L, 0.028 ug/L and 0.83 ug/L, respectively) and highest at the Detroit River downstream station (1.1 ug/L, 0.49 ug/L and 2.6 ug/L, respectively). (Copper QL = 0.1 ug/L; lead QL = 0.014 ug/L; zinc QL = 0.43 ug/L).

- Mean total Ni concentrations were lowest at the St. Marys River upstream station (0.38 ug/L) and highest at the Detroit River downstream station (1.4 ug/L). (QL = 0.31 ug/L).

- Mean total Hg concentrations at all St. Marys and St. Clair River monitoring stations were quite low (0.36 to 0.48 ng/L), whereas those at the Detroit River were relatively high (2.4 ng/L and 2.6 ng/L at the upstream and downstream stations, respectively). (QL = 0.45 ng/L).

4. LONGITUDINAL LOAD PROFILES

Loads for each river system were estimated by USGS using Beale's unbiased estimator method. Figures 36 to 47 show the calculated loads for all sampling locations for the year 2005, starting at the upstream end of the St. Marys River and progressing downstream to the mouth of the Detroit River. These plots can be used to identify where significant loading gains and/or losses occur in the Connecting Channels considered in this study.

Chloride

The longitudinal plot of the 2005 chloride load indicates a dramatic increase in the chloride content of Lake Huron as indicated by the increase in loading from the downstream station in the St. Marys River to the upstream station in the St. Clair River (Figure 36). Estimated loads continued to increase downstream, with the highest loads recorded at the downstream Detroit River station.

Total Kjeldahl Nitrogen

TKN loads in 2005 increased dramatically across Lake Huron (Figure 37). Little change was observed across Lake St. Clair; load estimates for the downstream St. Clair station and the upstream Detroit River station were similar. The largest TKN load was estimated at the downstream Detroit River station.

Nitrate

Nitrate loads increased dramatically across Lake Huron, whereas little change in the nitrate load was observed across Lake St. Clair (Figure 38). Load estimates were very similar between the upstream and downstream stations in the St. Marys River. Nitrate loads were also very similar between the upstream and downstream stations in the St. Clair and Detroit Rivers.

Total Phosphorus

Total phosphorus load estimates for 2005 indicate an increase between the upstream station in the St. Marys River and the upstream station in the St. Clair River (Figure 39). A similar increase was observed between the downstream station in the St. Clair River and the downstream station in the Detroit River. The largest estimated total phosphorus load was at the downstream station in the Detroit River.

Total Suspended Solids

Estimated TSS loads were relatively low between the upstream station in the St. Marys River and the upstream station in the St. Clair River (Figure 40). The loads increased across the St. Clair River and again across the Detroit River. The largest estimated TSS load was at the downstream location in the Detroit River.

Cadmium

Cd loads progressively increased from the upstream station in the St. Marys River to the downstream station in the Detroit River during 2005 (Figure 41). There was no dramatic increase in Cd loads across Lake Huron and Lake St. Clair; however, there was a substantial increase in the estimated Cd load across the St. Clair River, and an even more dramatic increase across the Detroit River.

Chromium

Estimated Cr loads generally increased from the St. Marys River to the Detroit River, however there was a reduction in the loads across Lake Huron (Figure 42). Loads increased between the upstream and downstream station in all three rivers. The largest estimated load was observed at the downstream station in the Detroit River, while the smallest load was at the upstream station in the St. Clair River.

Copper

Cu loads increased across the St. Marys River and decreased across the St. Clair and Detroit Rivers (Figure 43). There was also an increase in the estimated Cu load across Lake Huron and Lake St. Clair. The greatest Cu load was observed at the upstream station in the Detroit River.

Lead

Estimated Pb loads generally increased across the Connecting Channels, with the exception of the upstream station in the St. Clair River (Figure 44). For all three rivers, Pb loads increased from the upstream station to the downstream station. The greatest relative gain in Pb was observed in the Detroit River where Pb load more than doubled between the upstream and downstream stations.

Nickel

Ni loads increased from the upstream station in the St. Marys River to the downstream station in the Detroit River (Figure 45). Estimated loads also increased across all rivers. The largest estimated Ni load was observed at the downstream station in the Detroit River.

Zinc

Estimated Zn loads decreased between the upstream station in the St. Marys River and the upstream station in the St. Clair River (Figure 46). Conversely, loads increased between the downstream station in the St. Clair River and the downstream station in the Detroit River. Loads increased across the St. Clair and Detroit Rivers and decreased across the St. Marys River.

Mercury

Estimated Hg loads generally increased longitudinally across the Connecting Channels (Figure 47). A dramatic increase in the Hg load was observed across Lake St. Clair, and a slight load increase was noted across Lake Huron. Within a given river, the estimated Hg load showed relatively little change.

5. COMPARISON OF DATA WITH MICHIGAN RULE 57 WATER QUALITY VALUES

Data obtained for total Hg, Cd, Cr, Cu, Ni, Pb and Zn were compared with applicable Rule 57 water quality values. These values were developed in accordance with the Part 4 Michigan Water Quality Standards promulgated pursuant to Part 31 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

For total Hg, the applicable Rule 57 water quality value is the wildlife value (WV) and for total Cd, Cr, Cu, Ni, Pb and Zn, the applicable Rule 57 water quality value is the final chronic value (FCV). The FCVs for Cd, Cr, Cu, Ni, Pb and Zn are hardness dependent and were calculated for each Connecting Channel station using river-specific hardness data. Measured ambient Cd, Cr, Cu, Ni, Pb and Zn concentrations are for total metal, whereas the FCVs for these trace metals are expressed as dissolved metal. For this reason, a direct comparison between ambient Cd, Cr, Cu, Ni, Pb and Zn concentrations and Rule 57 water quality values cannot be made. This is not an important consideration when the ambient concentration meets the applicable Rule 57 water quality value; however, when it exceeds this value, the available data cannot show whether the ambient concentration of metal in the dissolved fraction exceeds the Rule 57 water quality value. More sophisticated monitoring would be necessary to resolve an ambiguity of this nature, and caution must be exercised when drawing conclusions from the available data.

Analytical results obtained for Cd, Cr, Cu, Pb, Ni, Hg and Zn are compared with applicable Rule 57 water quality values in Table 7. All sample results obtained for Cd, Cr, Cu, Pb, Ni and Zn met applicable Rule 57 water quality values. Total Hg exceeded the Hg Rule 57 water quality value of 1.3 ng/L in 12 of 42 samples analyzed in 2005. With the exception of one sample collected at the upstream station in the St. Clair River in April, all samples exceeding the Hg Rule 57 water quality value were collected from the Detroit River.

6. REFERENCES

Aiello, C. 2006. Michigan Water Chemistry Monitoring Great Lakes Tributaries 2004 Report. MDEQ, WB, Report # MI/DEQ/WB-06/045.

Gilliom, R.J., Hirsch, R.M., and E.J. Gilroy. 1984. Effect of Censoring Trace-Level Water-Quality Data on Trend-Detection Capability. Environ. Sci. Technol. 18(7): 530-535.

Great Lakes Environmental Center and Limno-Tech, Inc., 2006. Great Lakes Connecting Channels Data Evaluation and Trend Analysis Report. MDEQ Report # MI/DEQ/WB-06/092.

Porter, P.S., Ward, R.C., and H.F. Bell. 1988. The detection limit: water quality monitoring data are plagued with levels of chemicals that are too low to be measured precisely. Environ. Sci. Technol. 22(8): 856-861.

FIGURES


Station 170139
St. Mary's River
Sault Ste Marie
Sugar Island
Lake George
ONTARIO, CANADA
Lake Nicolet
Neebish Island
St Joseph Island
Munuscong Lake
St. Mary's River
28
129
I-75
80
N
Figure 1
St. Marys River
Sampling Location Map
Station 170140
Sample Location
0 1 2 3 4 5
Miles

Figure 2
St. Clair River
Sampling Location Map

Revision Date: 040302


Detroit
N
Station 820414
Belle Isle
I-75
I-96
I-94
River Rouge
Detroit River
Ecorse
Lincoln Park
Wyandotte
Riverview
ONTARIO
CANADA
I-75
Trenton
Grosse
Ile
Gibraltar
Figure 3
Detroit River
Sampling Location Map
Sample Location
0 1 2 3 4
Miles
Station 820017

Figure 4. St. Marys River Flow in 2005.

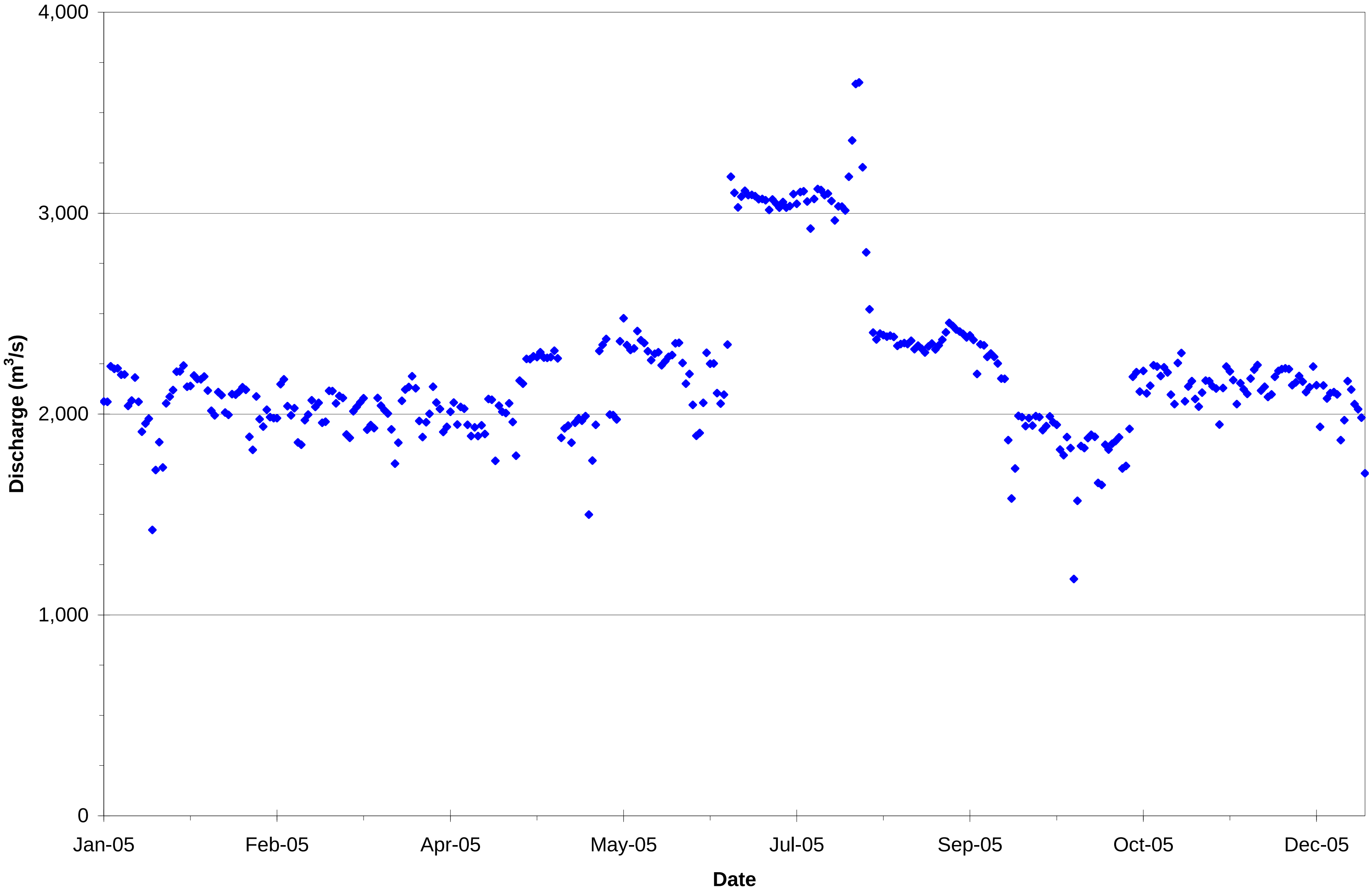


Figure 5. St. Clair River Flow in 2005.

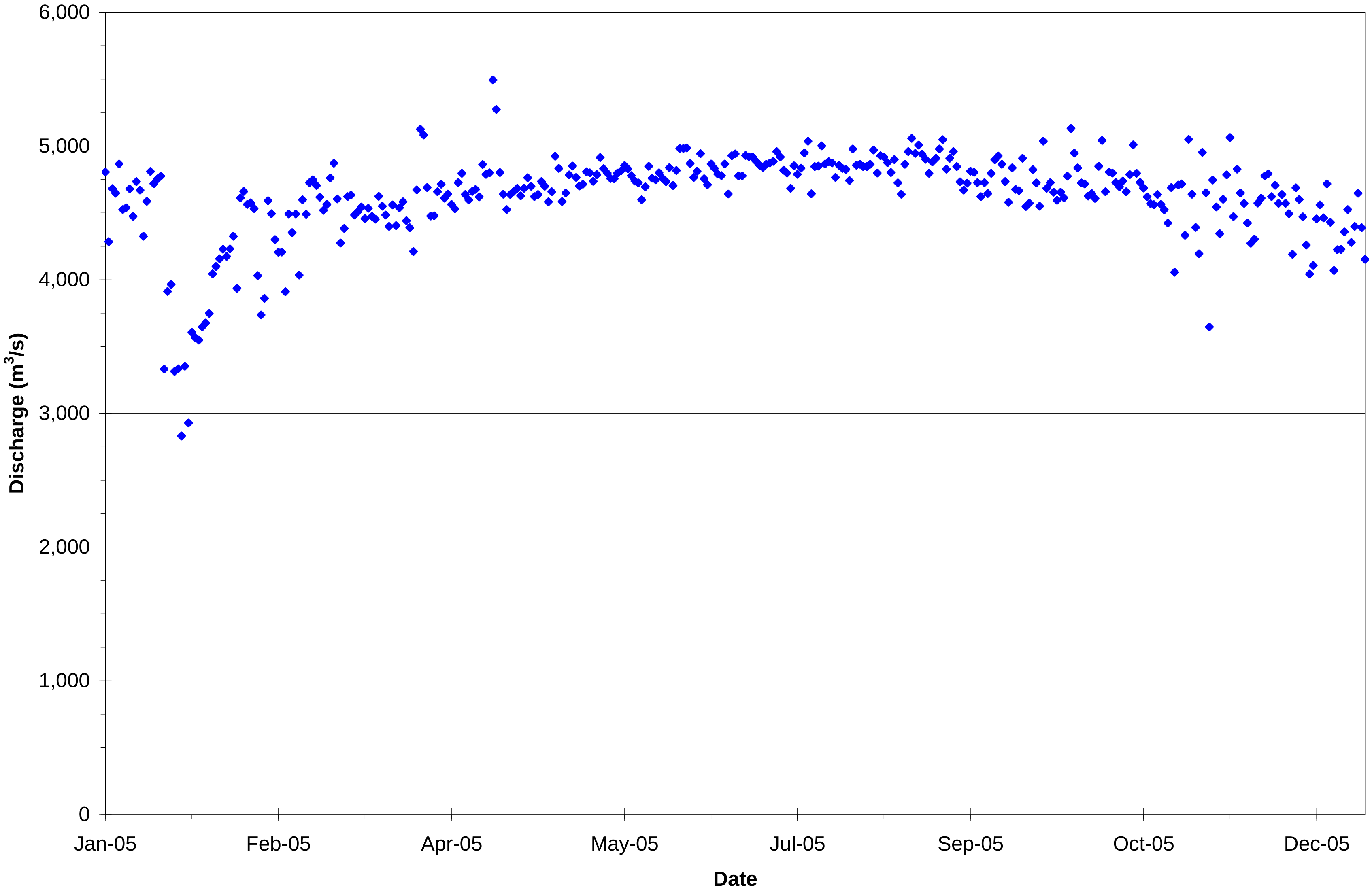


Figure 6. Detroit River Flow in 2005.

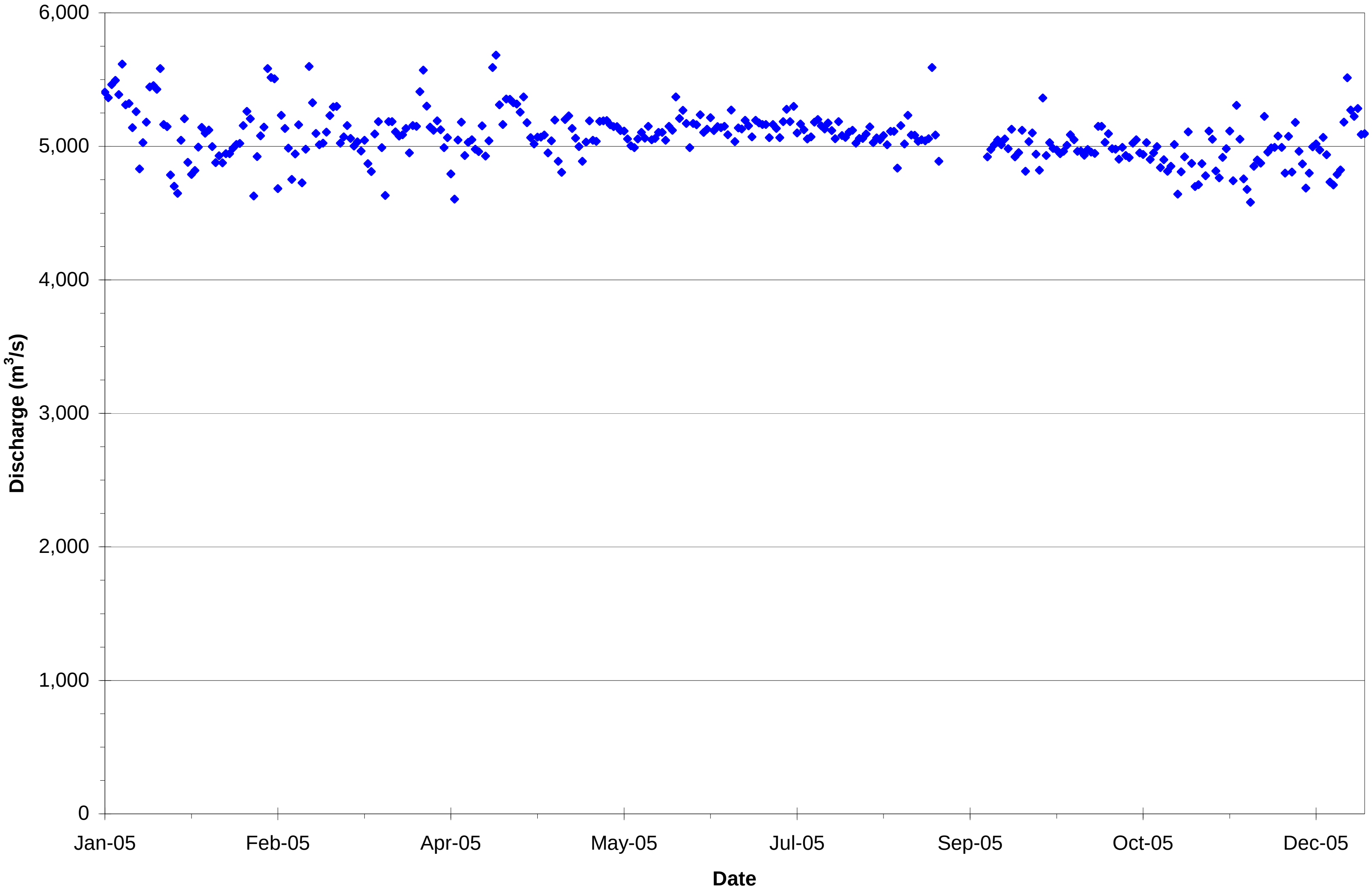


Figure 7. Box Plot of Specific Conductance (Conductivity) in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

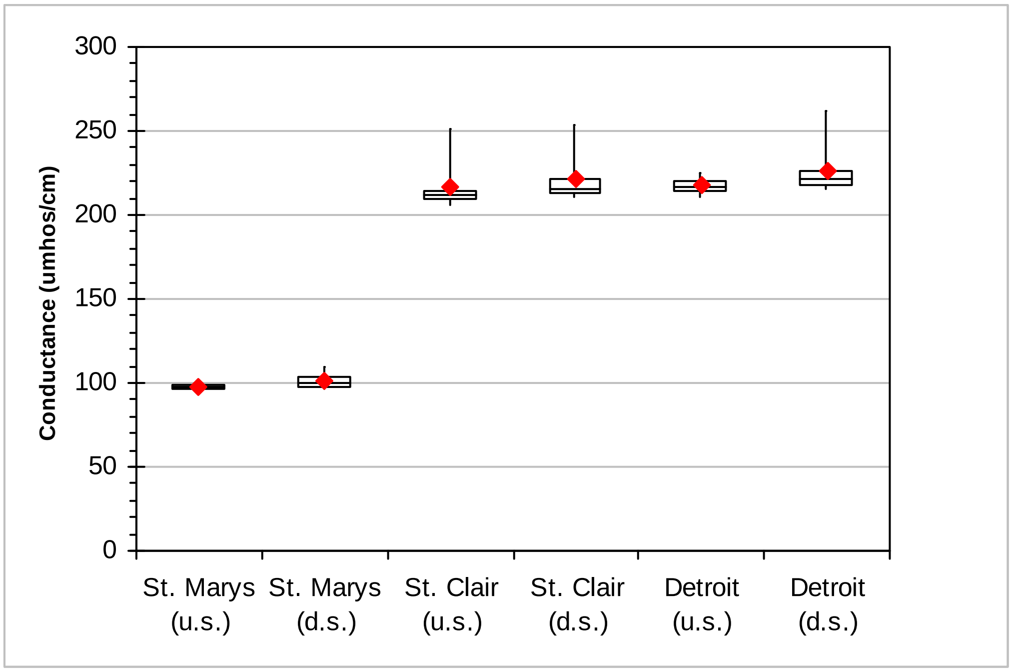


Figure 8. Box Plot of Dissolved Oxygen Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

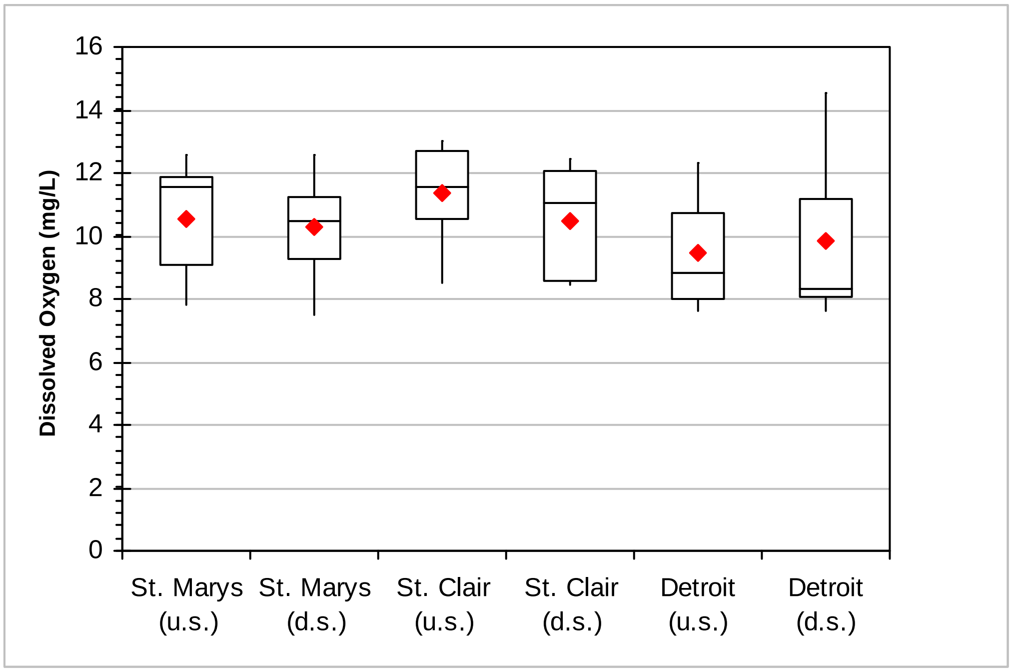


Figure 9. Box Plot of Hardness in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

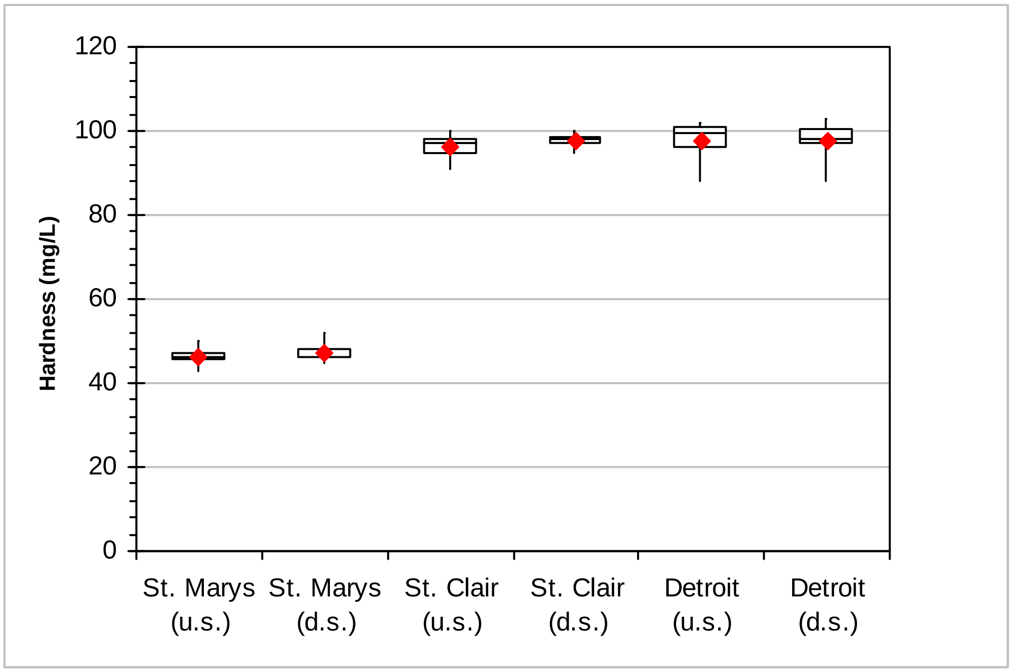


Figure 10. Box Plot of pH in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

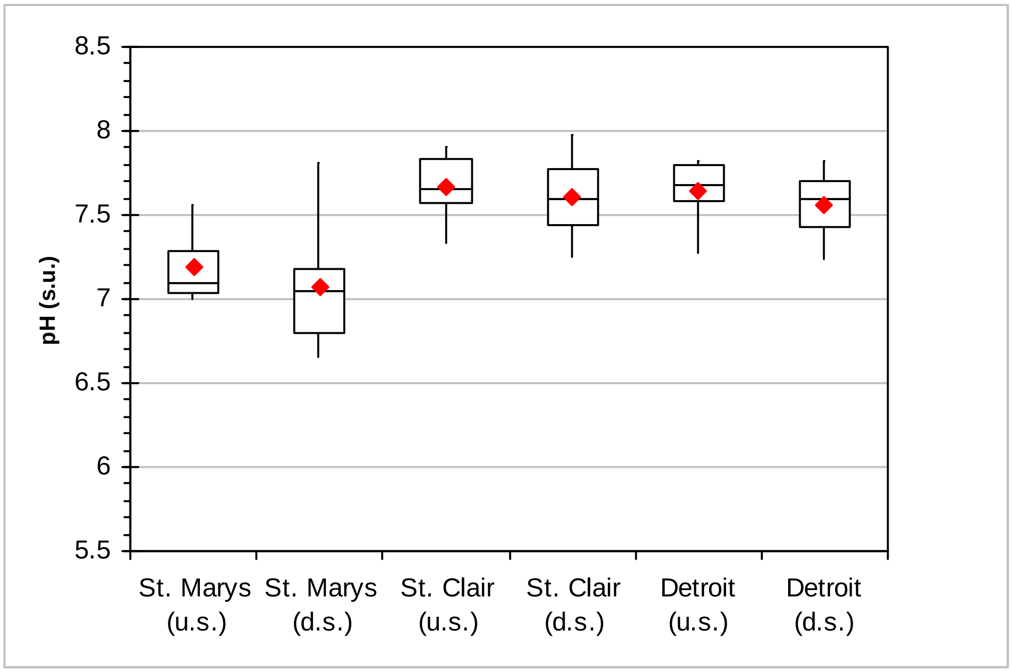


Figure 11. Box Plot of Water Temperature in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

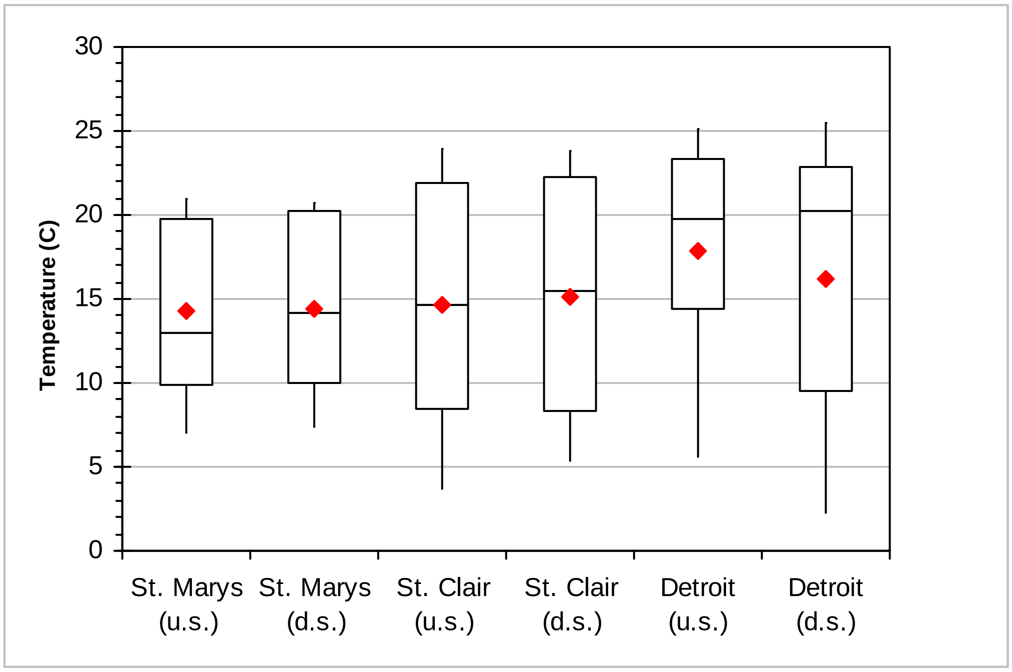


Figure 12. Box Plot of Alkalinity in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

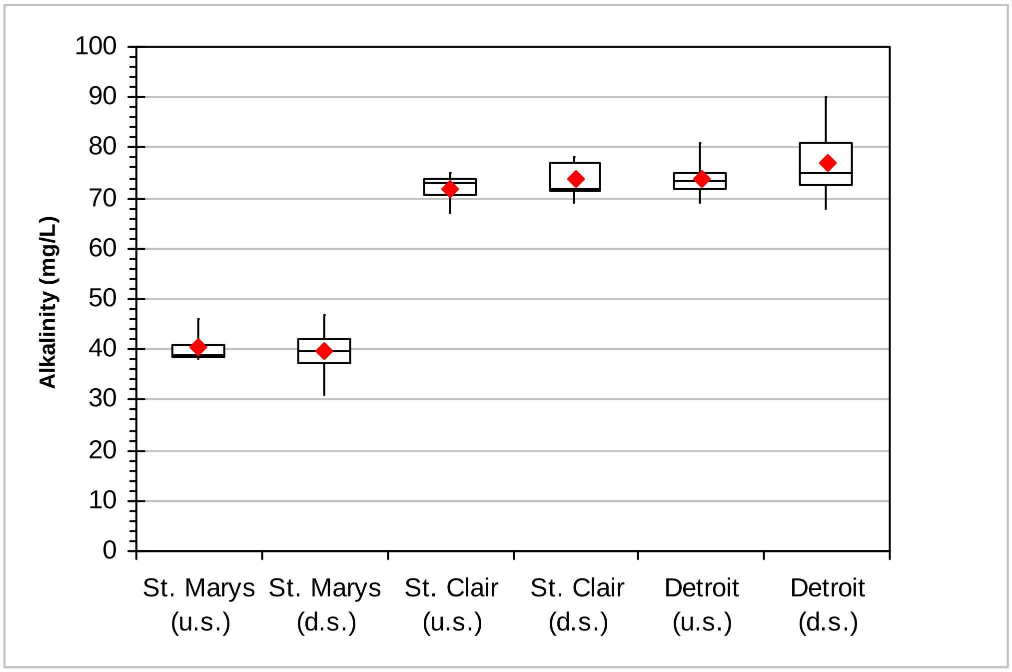


Figure 13. Box Plot of Total Ammonia Nitrogen Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

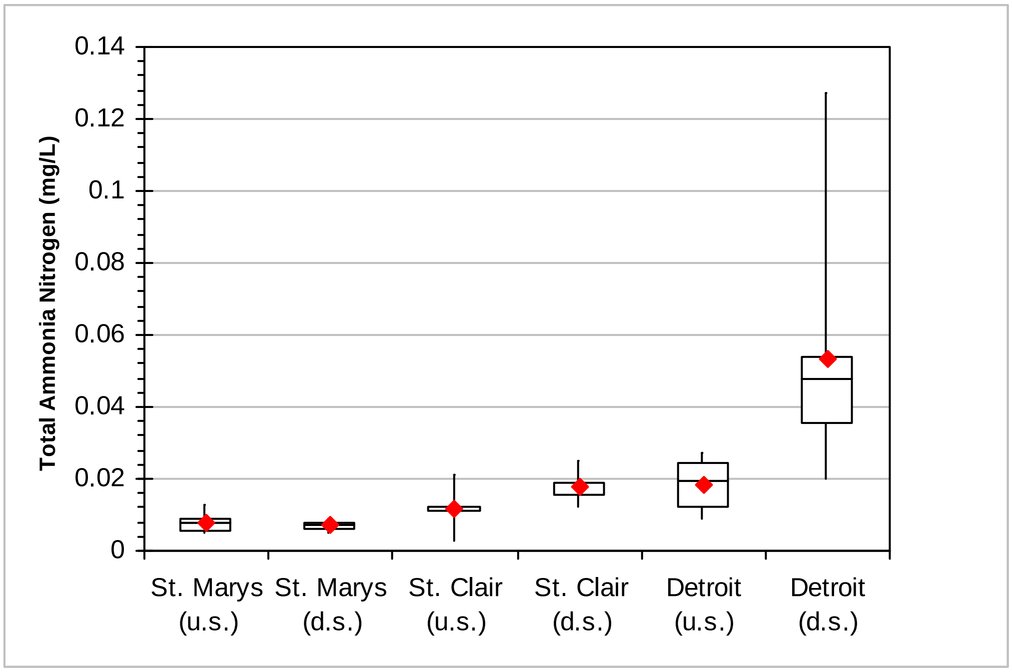


Figure 14. Box Plot of Calcium Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

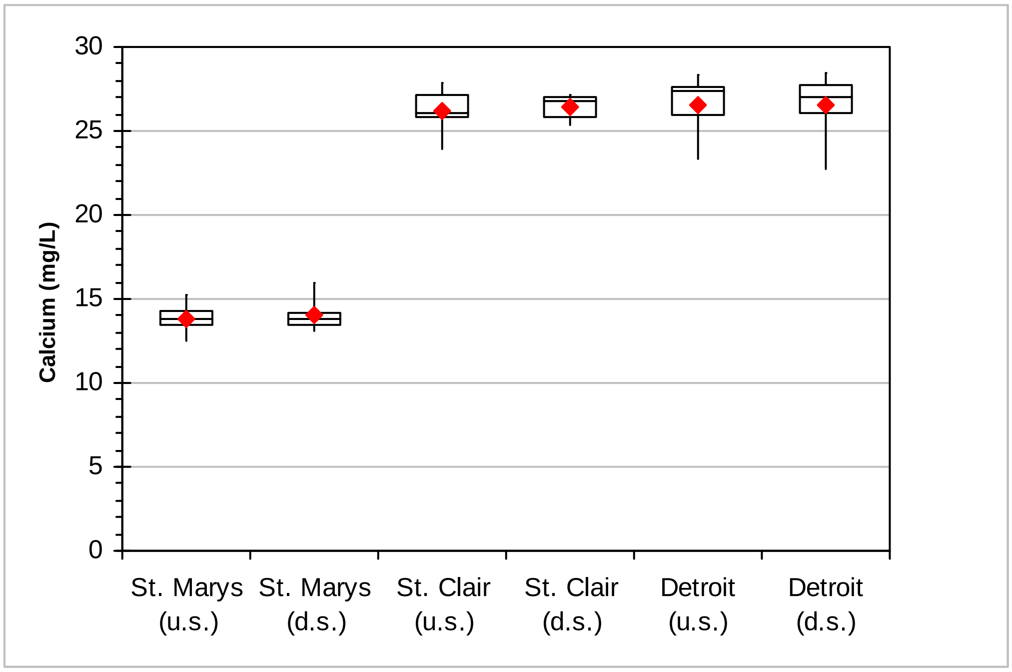


Figure 15. Box Plot of Chloride Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

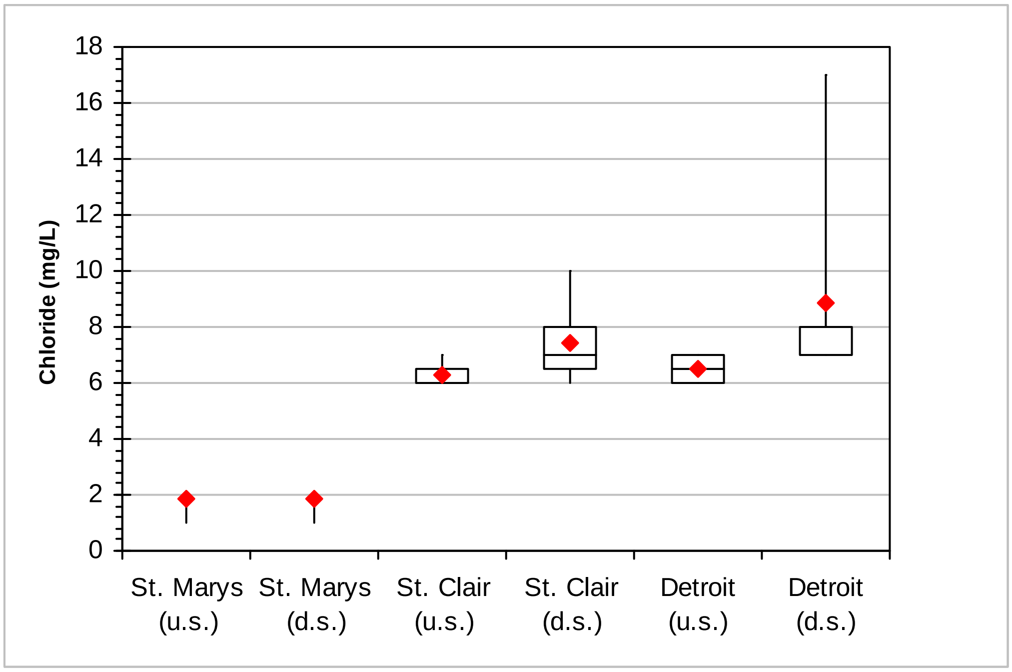


Figure 16. Box Plot of Total Dissolved Solids Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

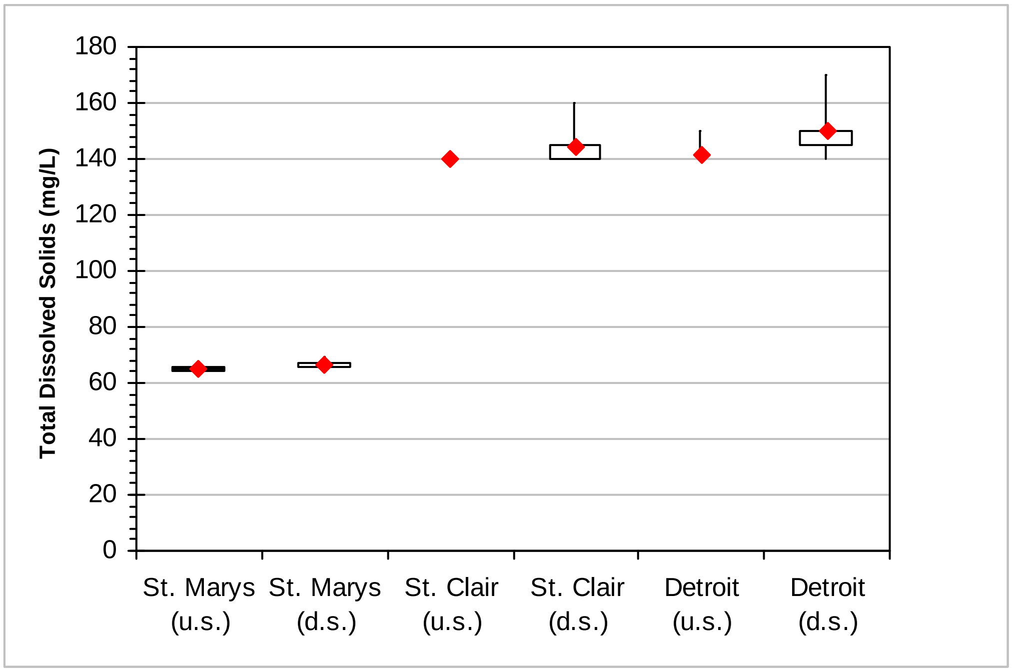


Figure 17. Box Plot of Total Kjeldahl Nitrogen Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

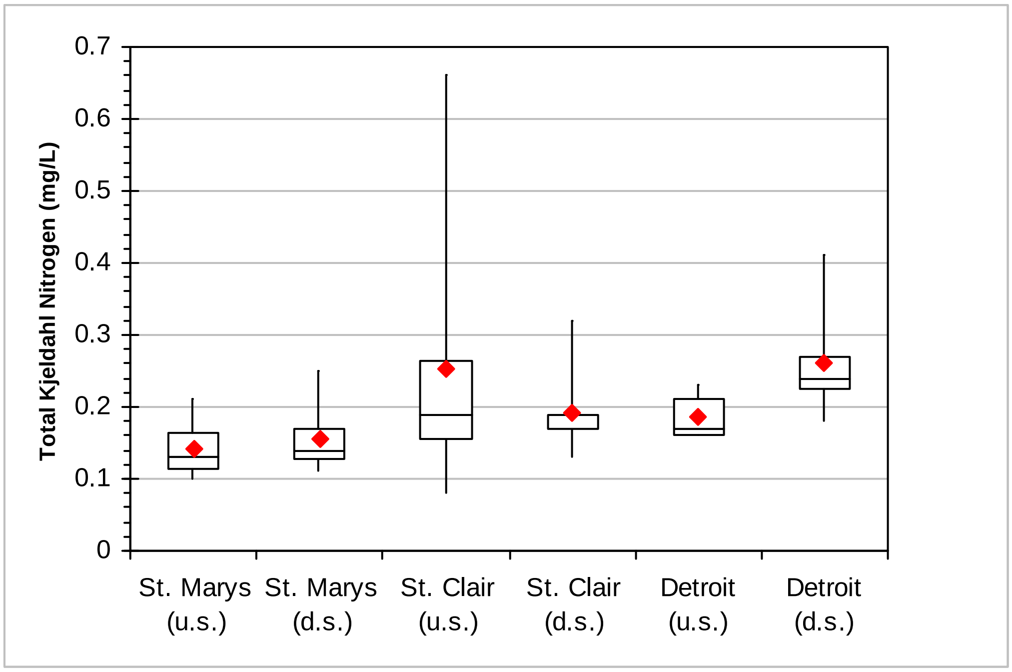


Figure 18. Box Plot of Magnesium Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

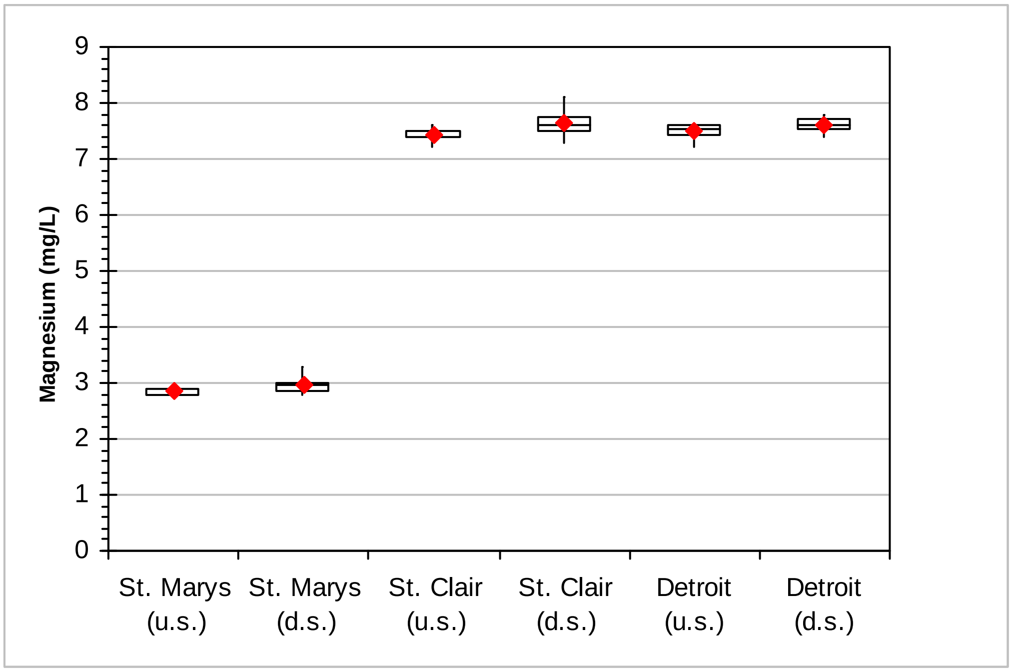


Figure 19. Box Plot of Nitrate Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

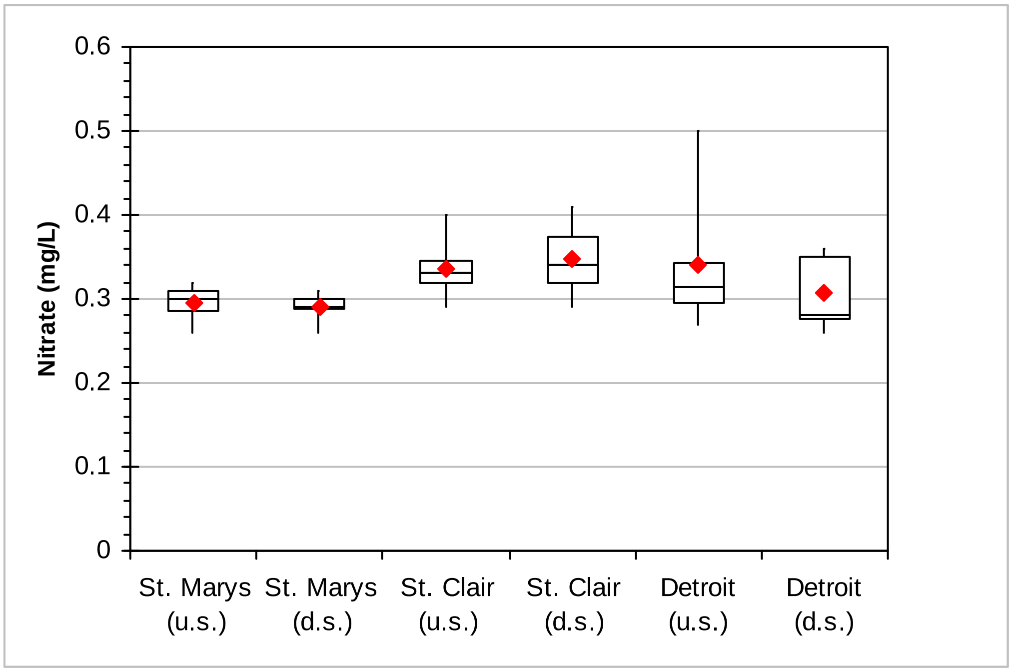


Figure 20. Box Plot of Nitrite Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

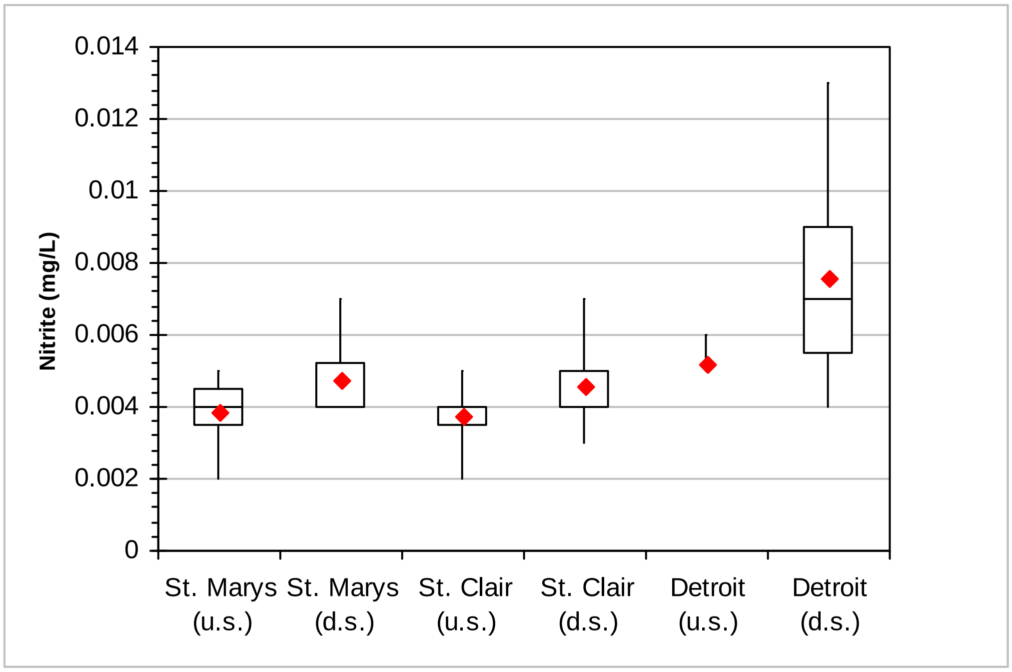


Figure 21. Box Plot of Total Organic Carbon Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

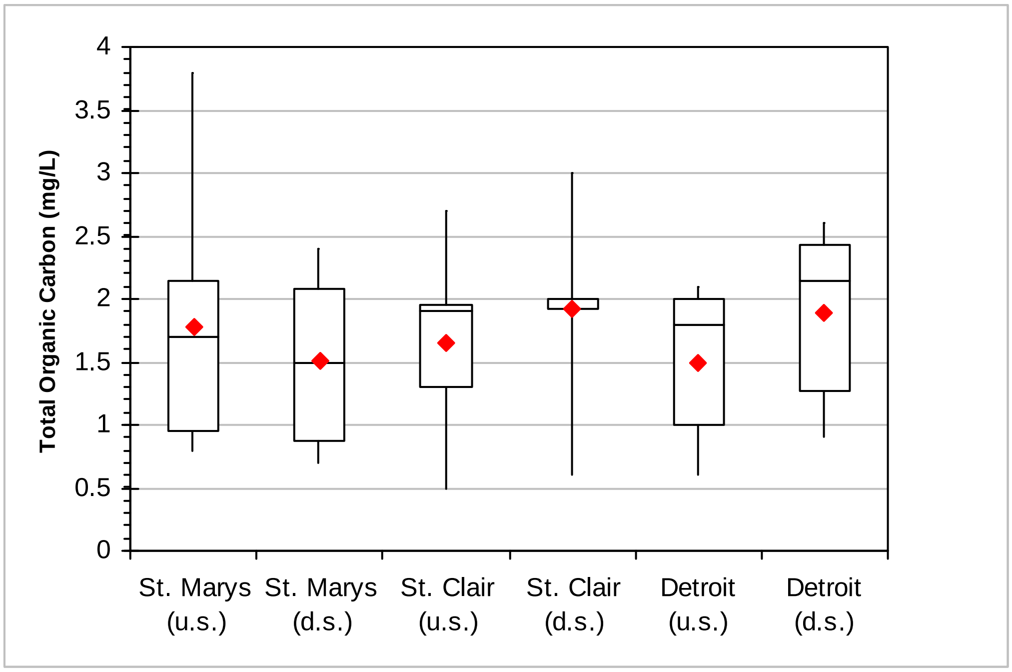


Figure 22. Box Plot of Orthophosphate Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

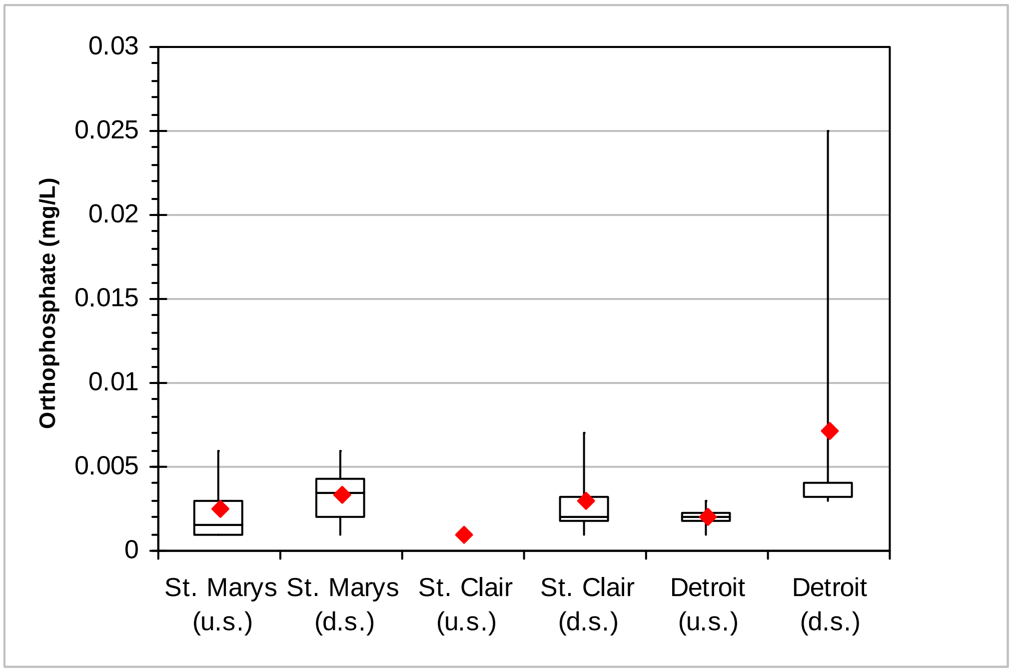


Figure 23. Box Plot of Total Phosphorus Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

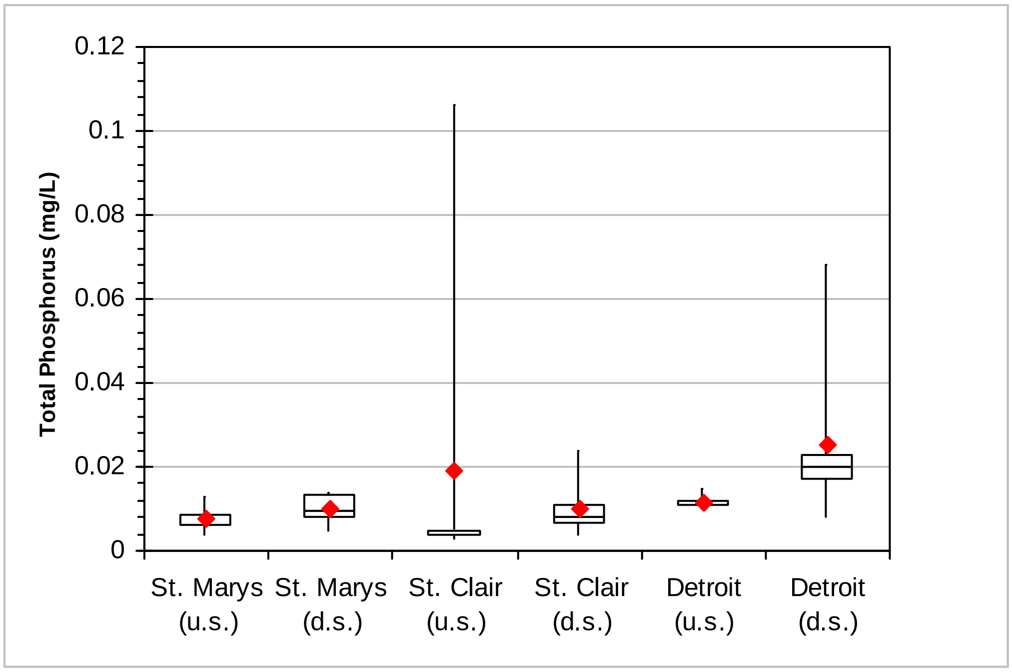


Figure 24. Box Plot of Potassium Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

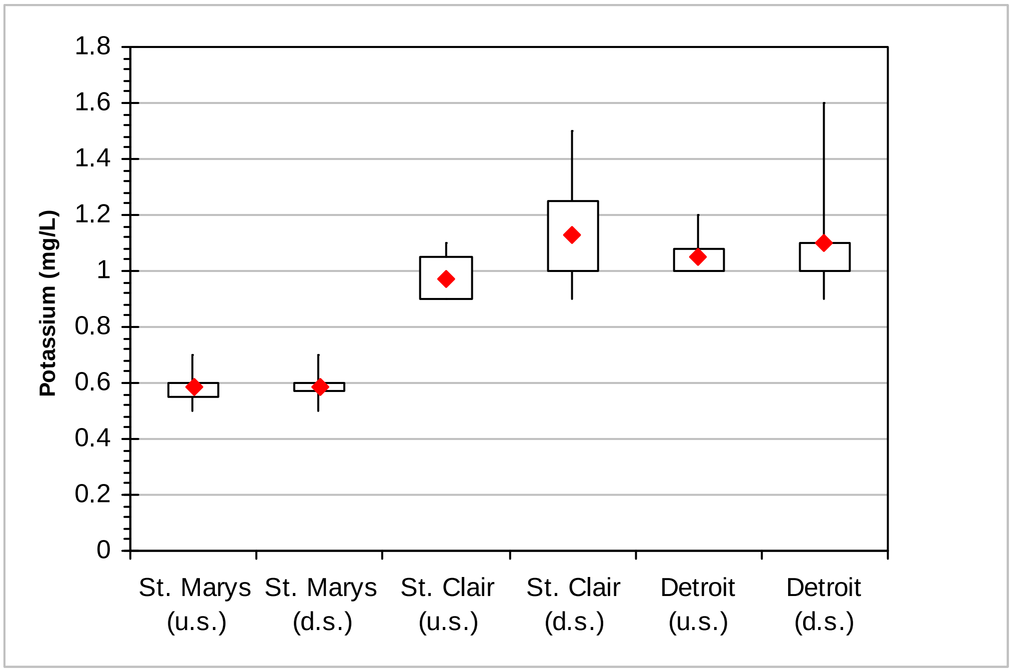


Figure 25. Box Plot of Sodium Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

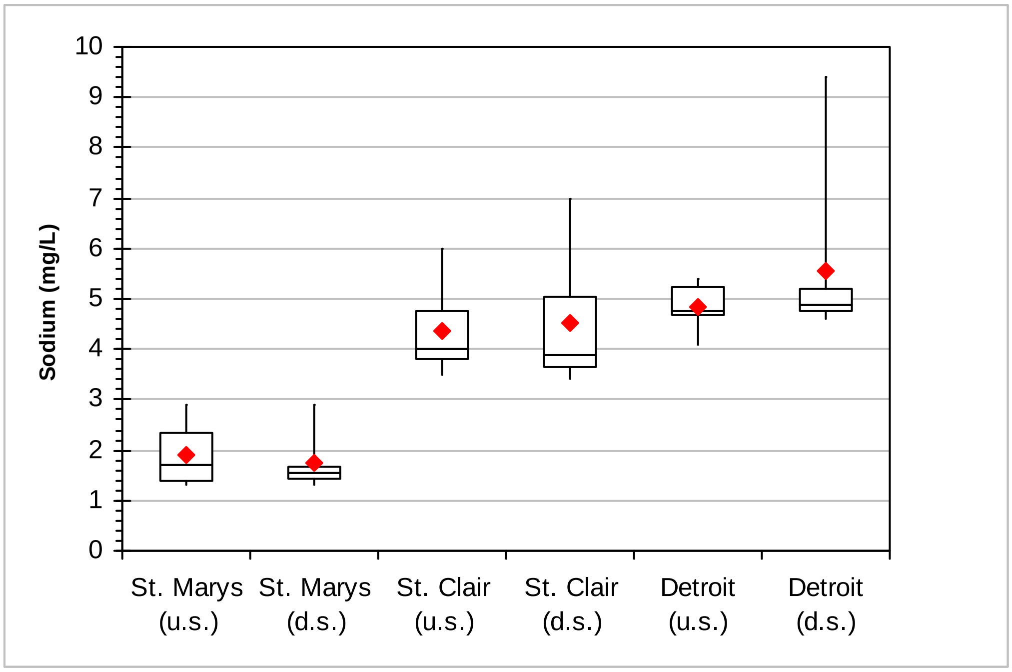


Figure 26. Box Plot of Sulfate Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

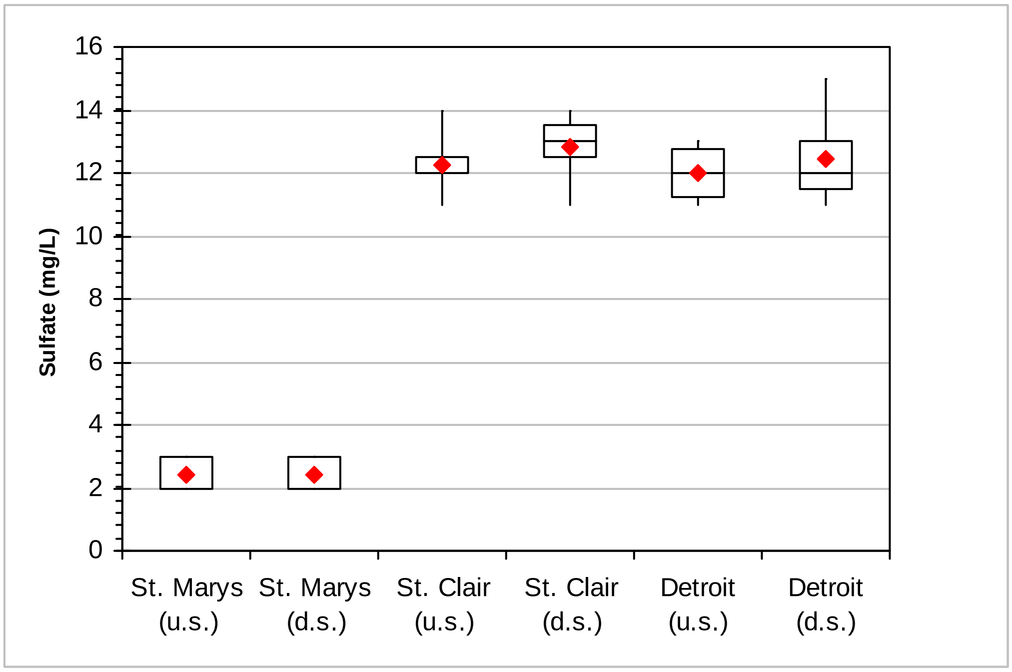


Figure 27. Box Plot of Total Suspended Solids Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

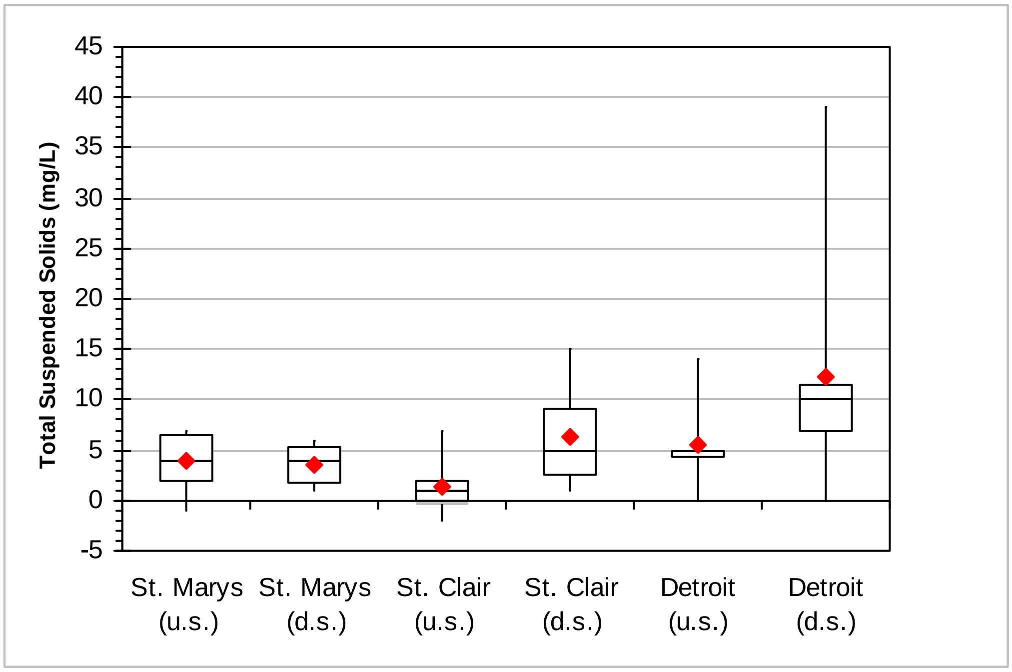


Figure 28. Box Plot of Turbidity in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

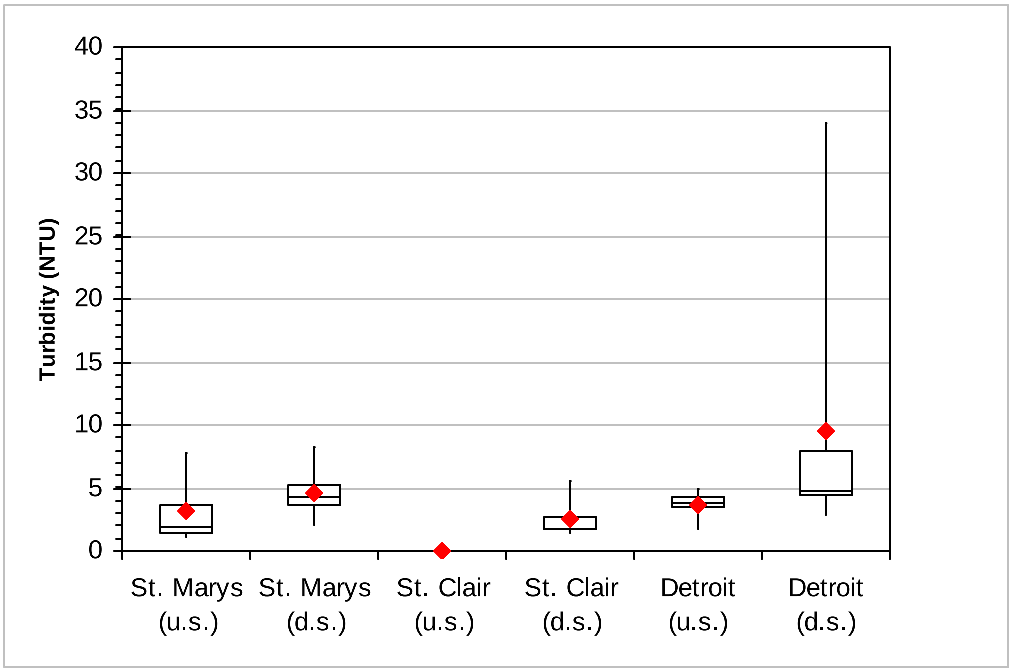


Figure 29. Box Plot of Cadmium Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

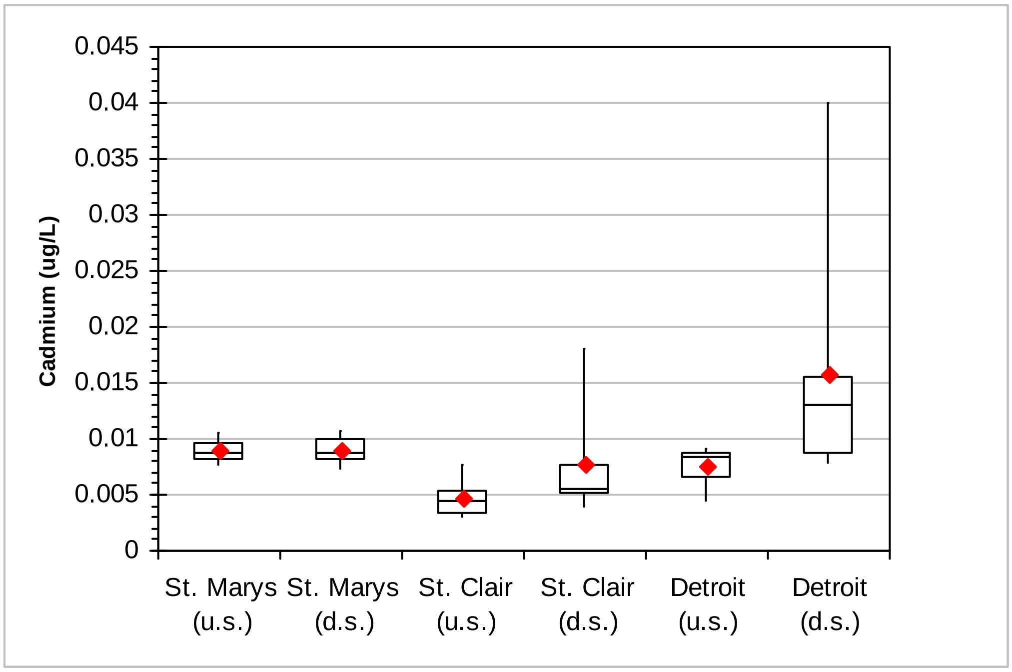


Figure 30. Box Plot of Chromium Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

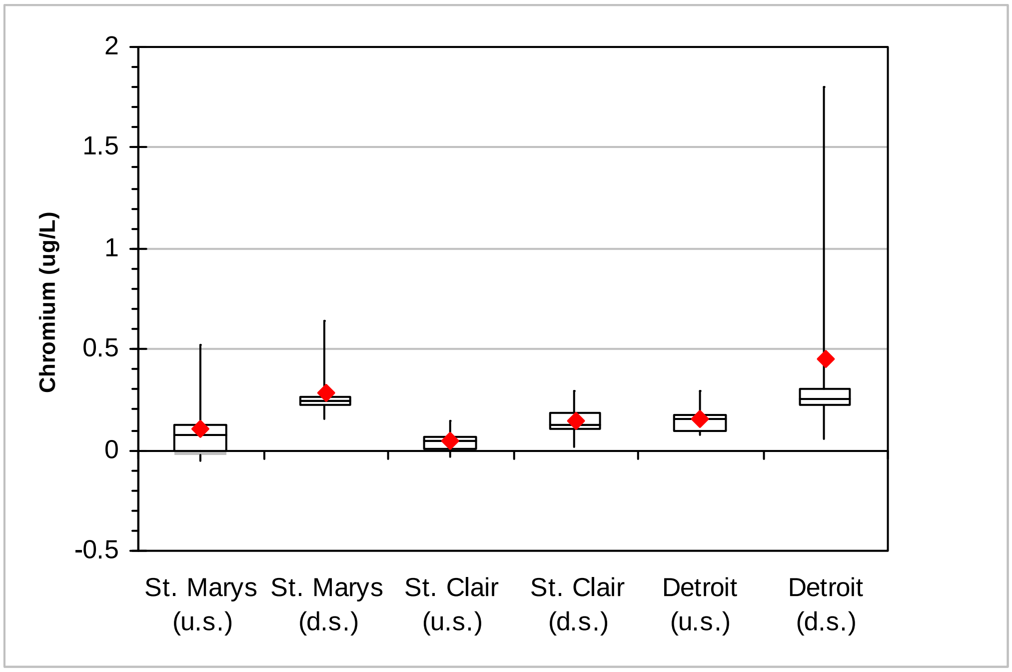


Figure 31. Box Plot of Copper Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

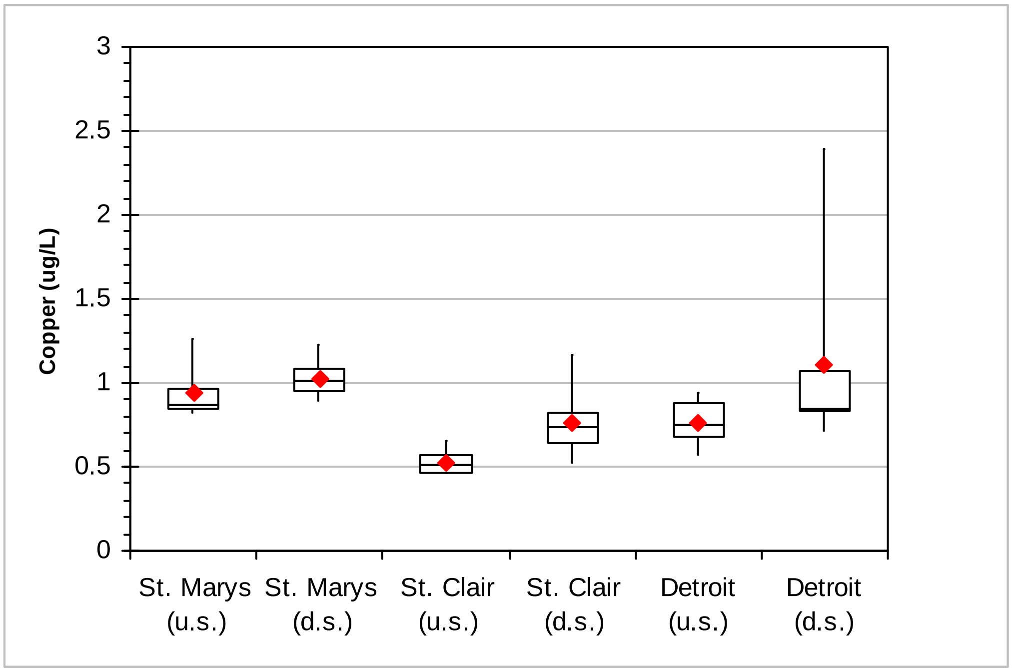


Figure 32. Box Plot of Lead Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

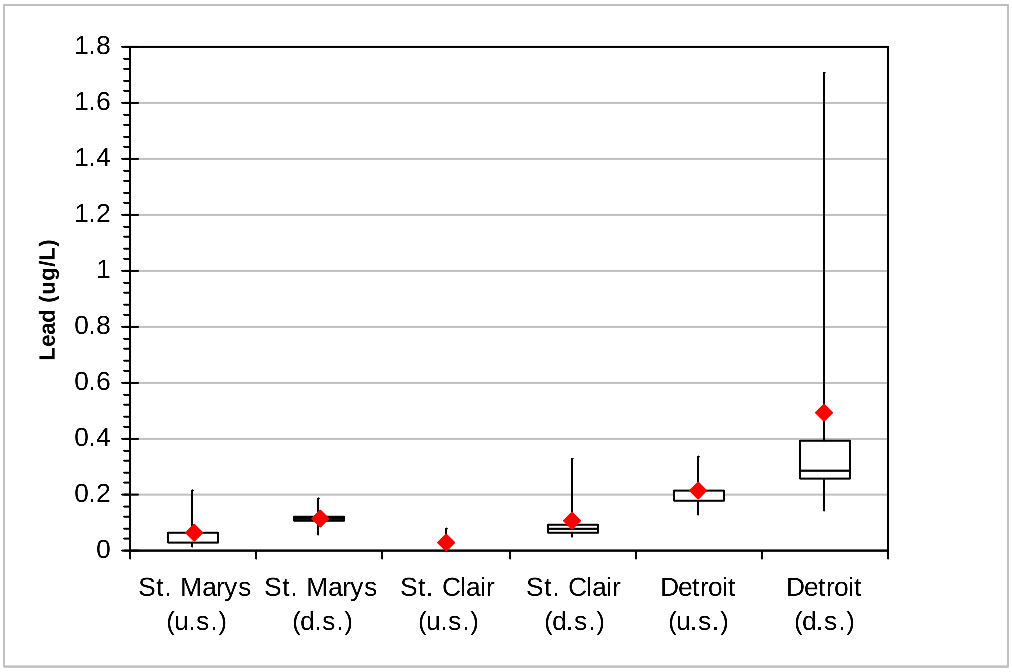


Figure 33. Box Plot of Nickel Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

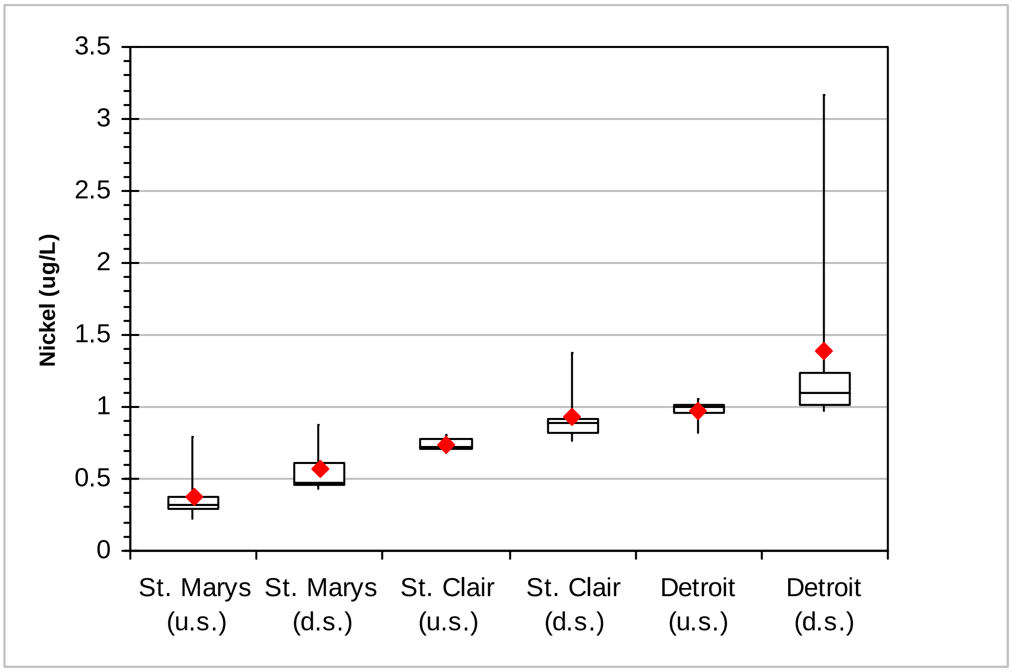


Figure 34. Box Plot of Zinc Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

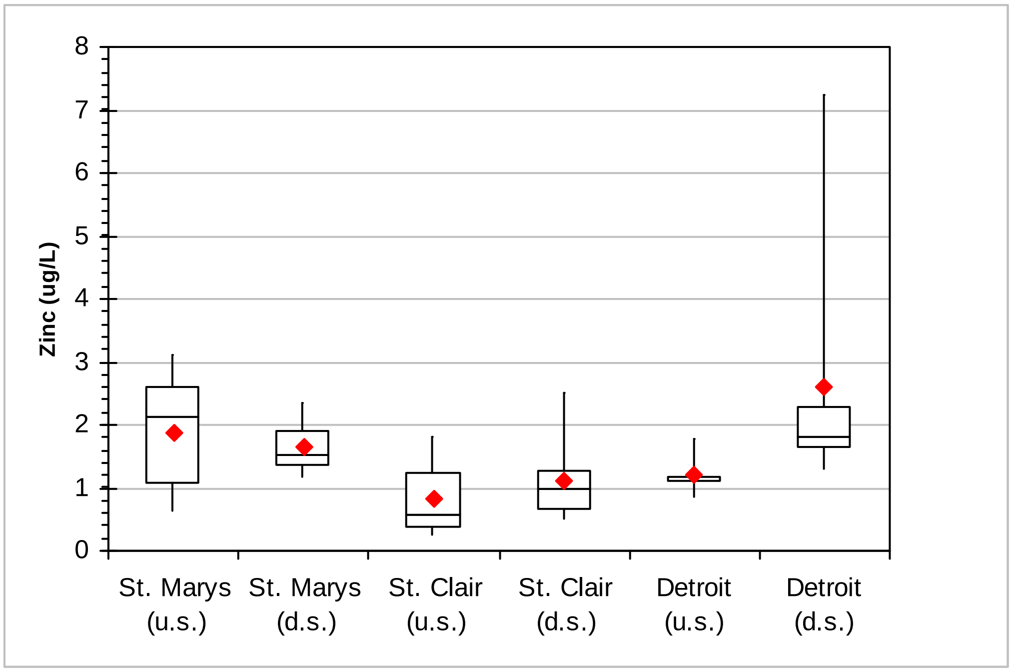


Figure 35. Box Plot of Mercury Concentrations in Michigan's Great Lakes Connecting Channels During 2005. Each Box Exhibits the Inner Quartiles, the Whiskers Exhibit the Outer Quartiles, the Median is Shown as a Solid Line and the Mean is Shown as a Diamond.

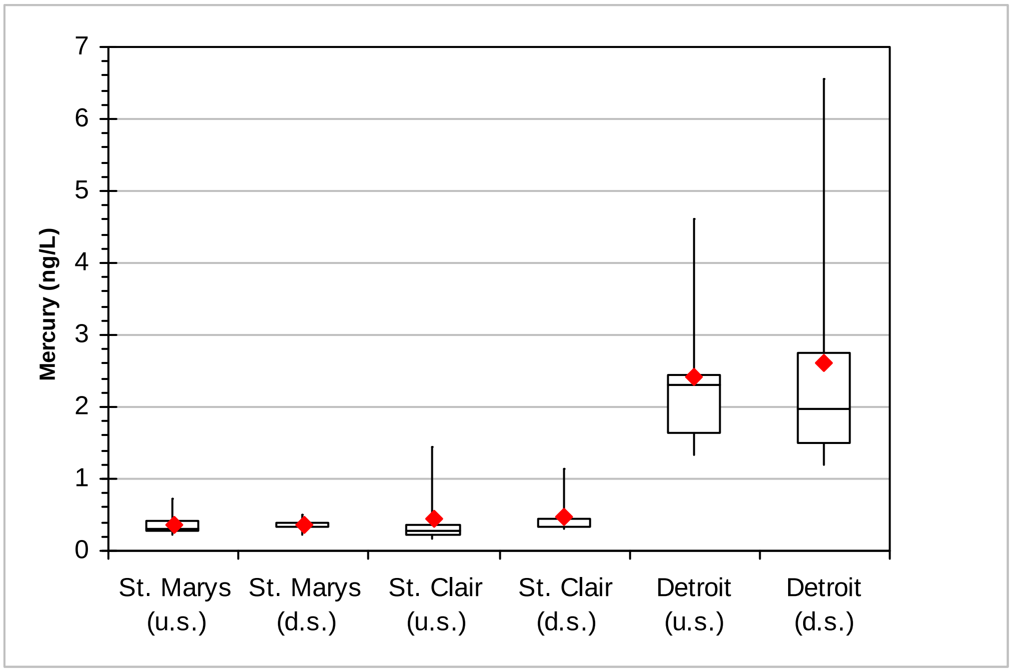


Figure 36. Longitudinal Profile of Chloride Load in 2005.

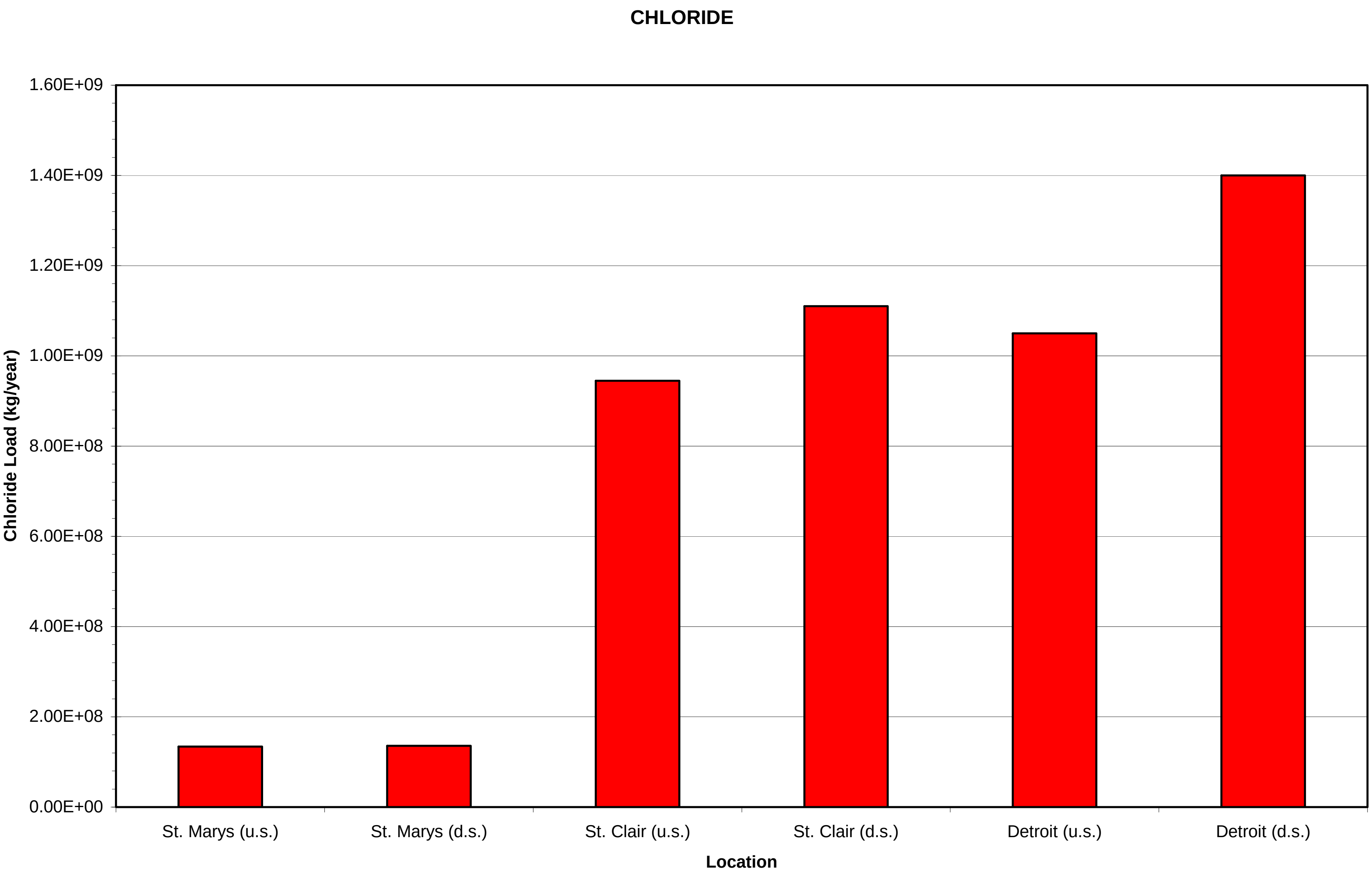


Figure 37. Longitudinal Profile of Total Kjeldahl Nitrogen Load in 2005.

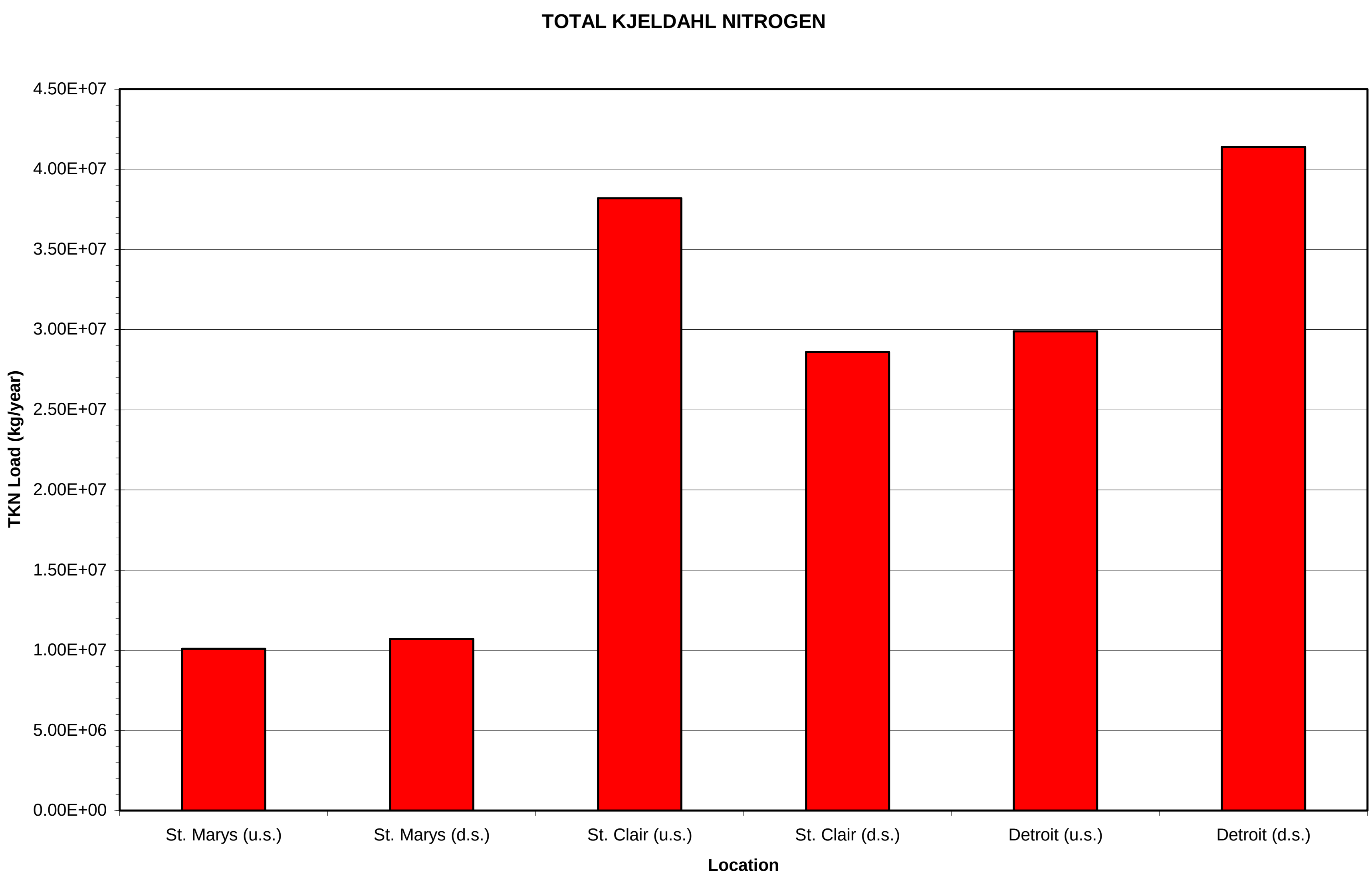


Figure 38. Longitudinal Profile of Nitrate Load in 2005.

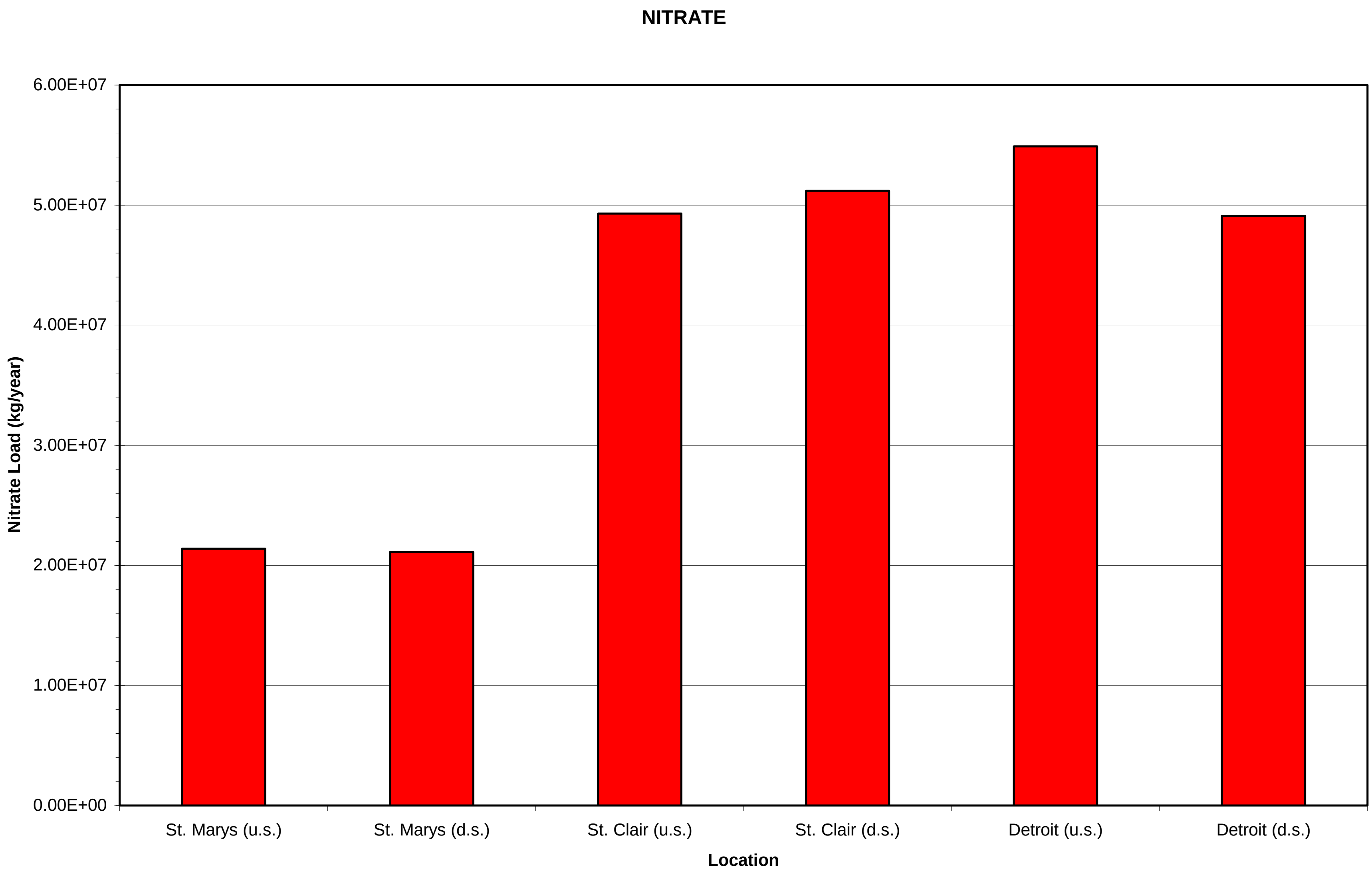


Figure 39. Longitudinal Profile of Total Phosphorus Load in 2005.

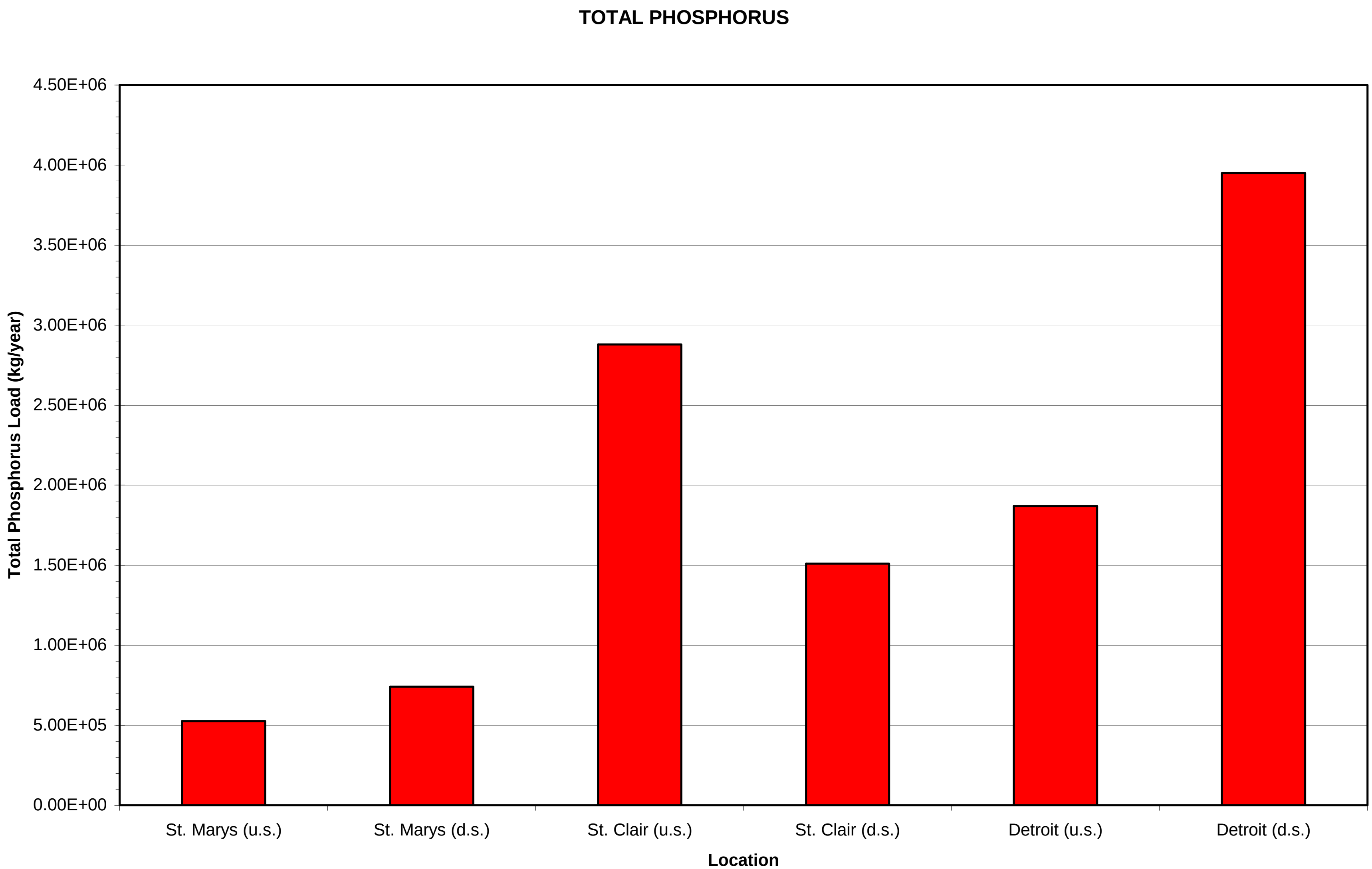


Figure 40. Longitudinal Profile of Total Suspended Solids Load in 2005.

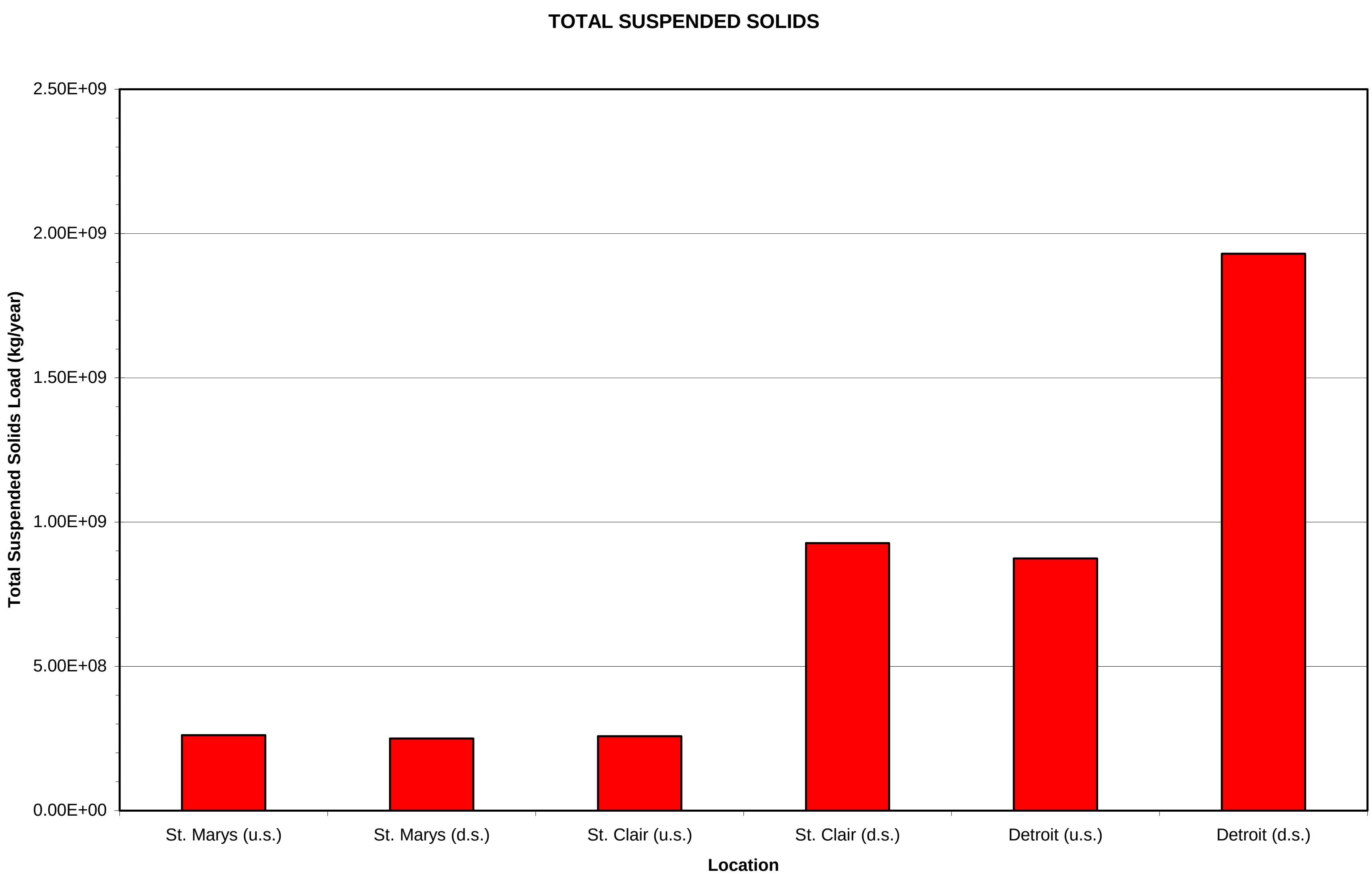


Figure 41. Longitudinal Profile of Cadmium Load in 2005.

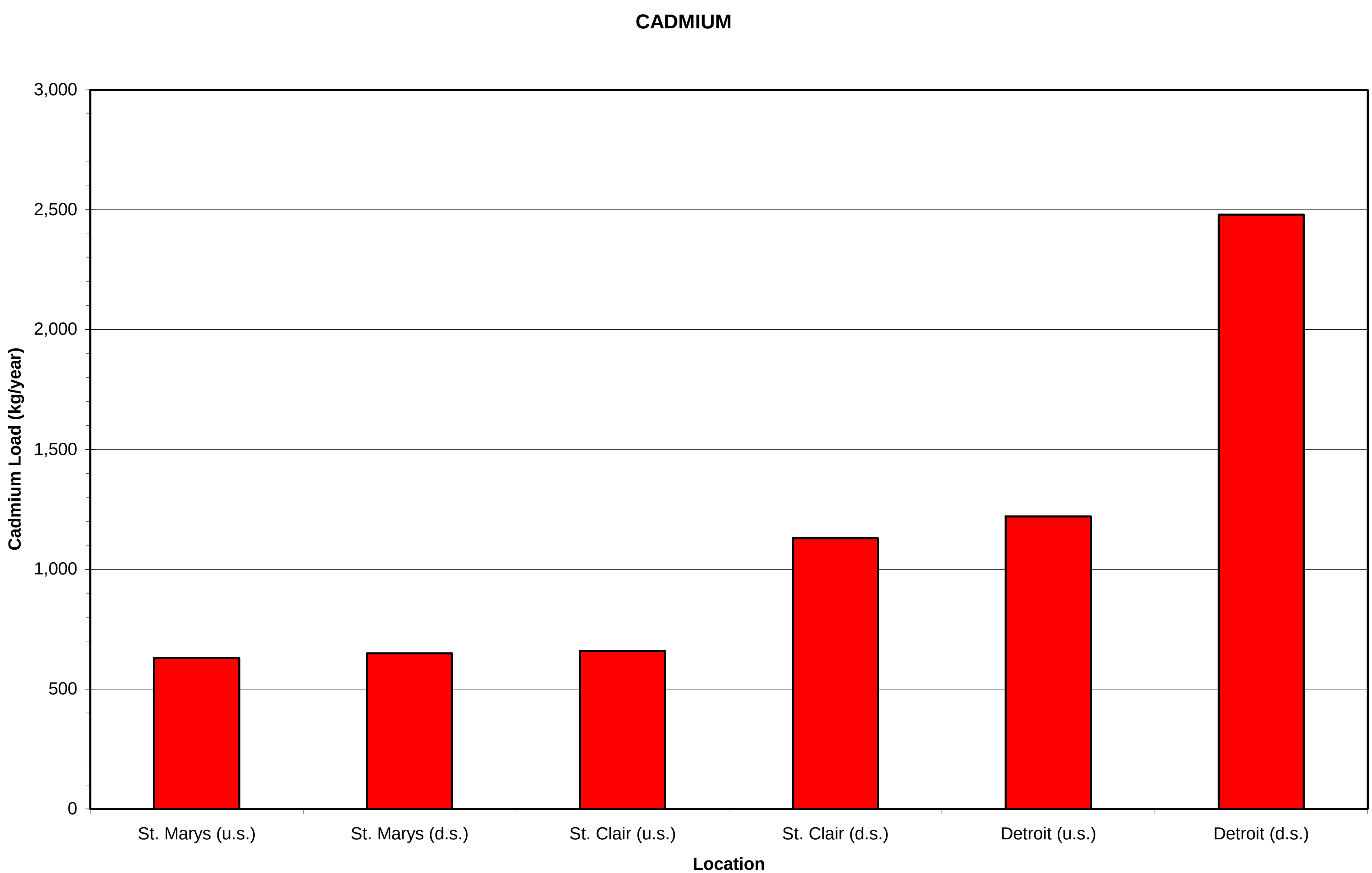


Figure 42. Longitudinal Profile of Chromium Load in 2005.

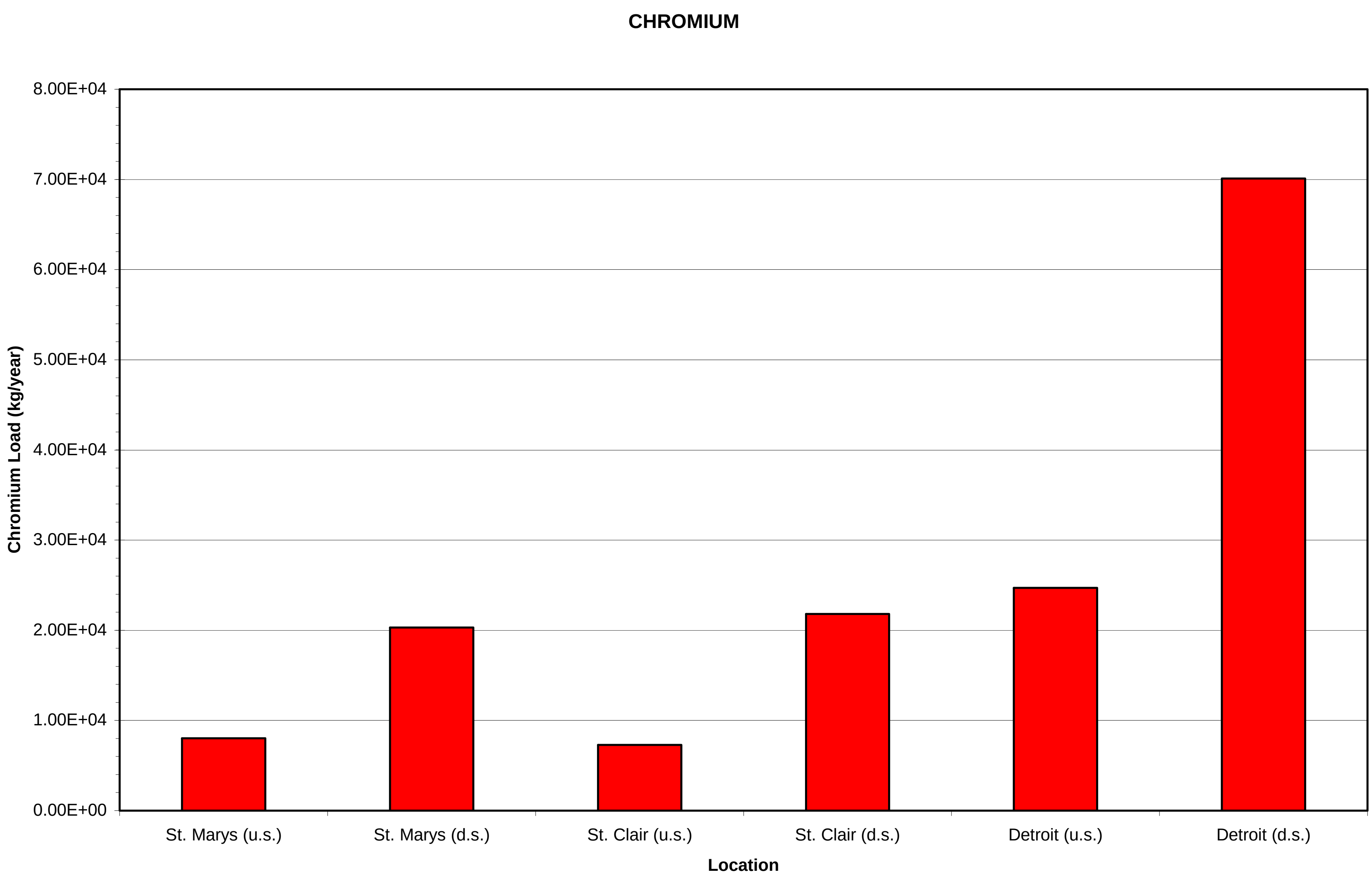


Figure 43. Longitudinal Profile of Copper Load in 2005.

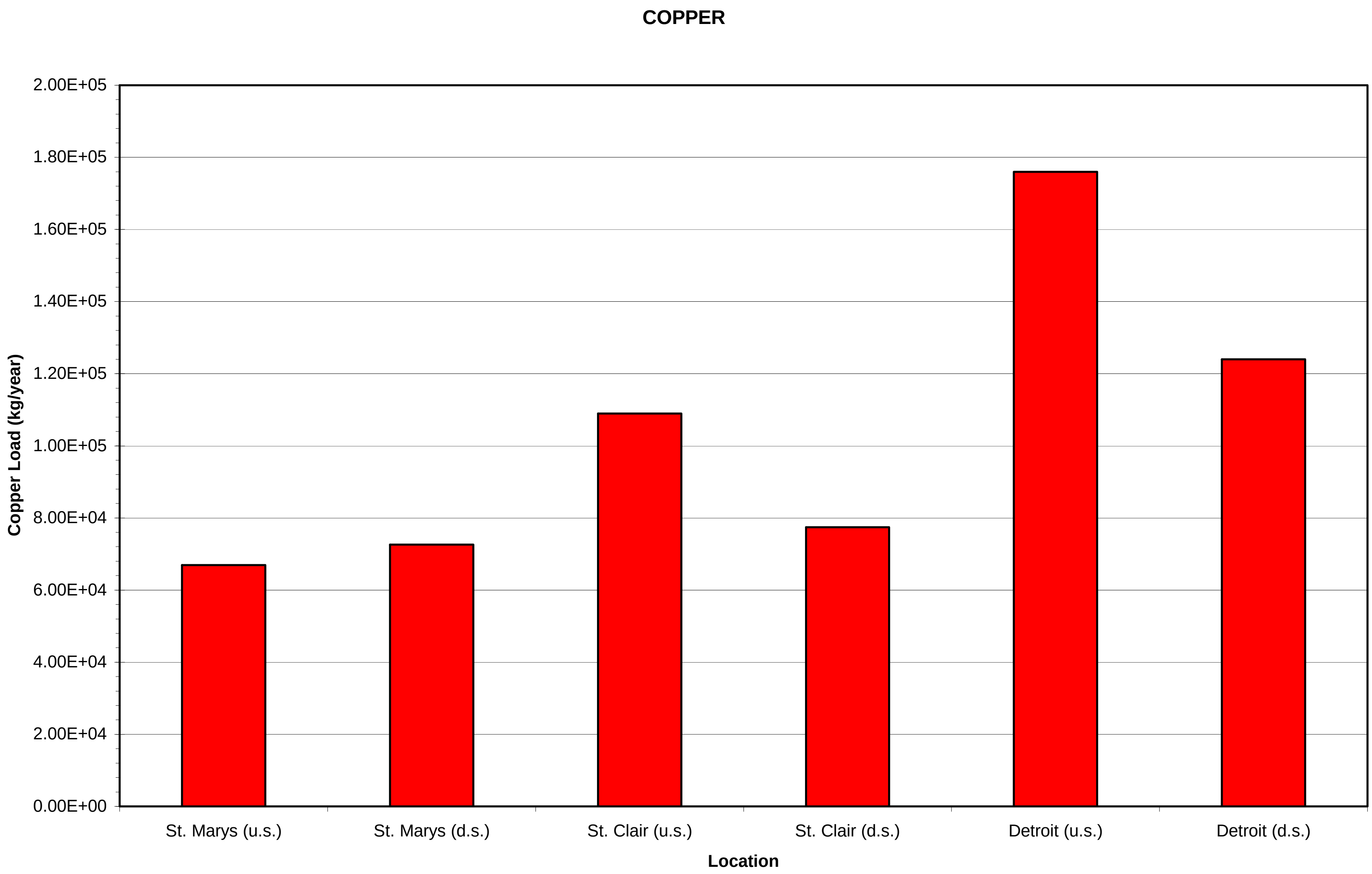


Figure 44. Longitudinal Profile of Lead Load in 2005.

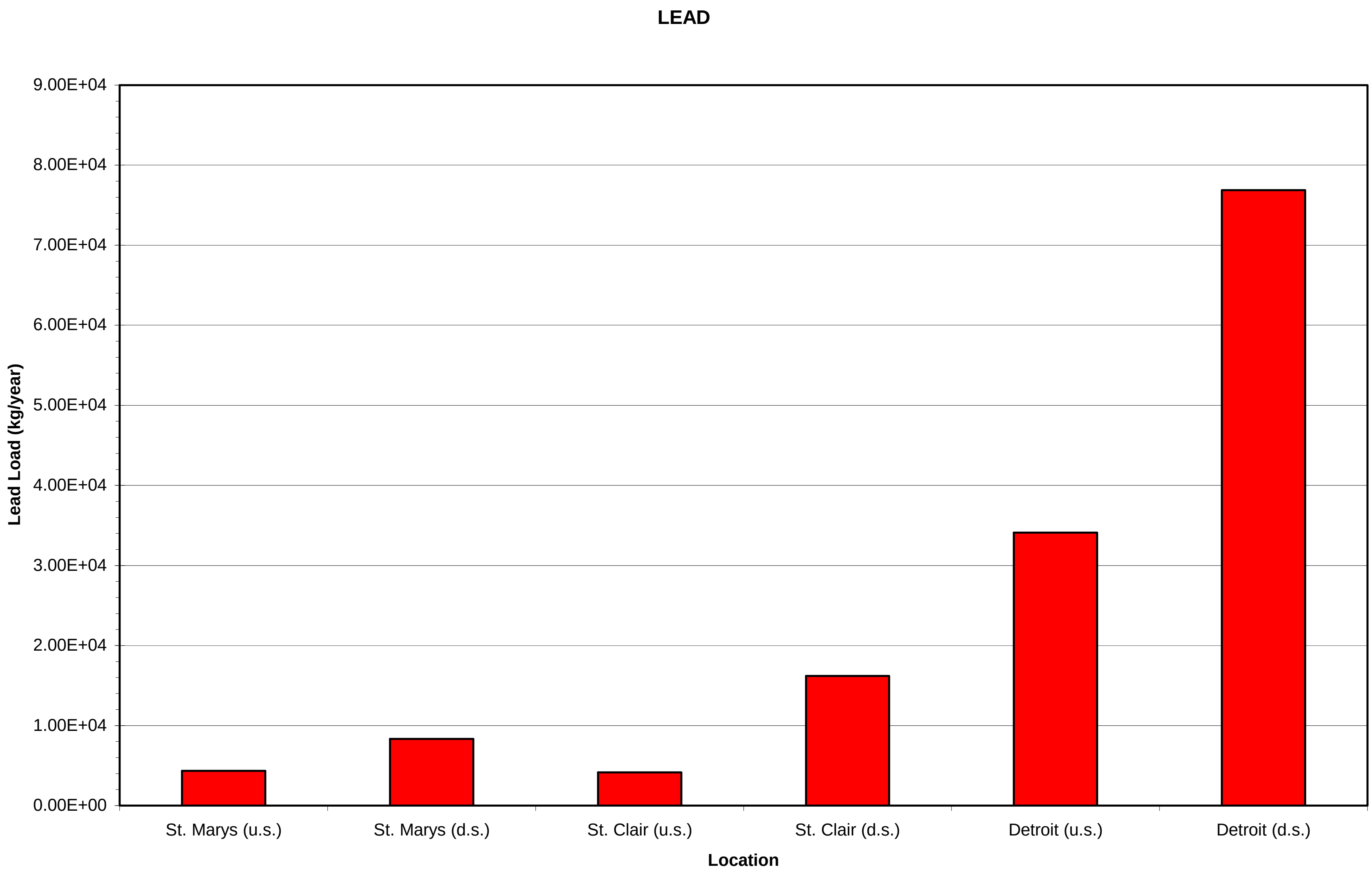


Figure 45. Longitudinal Profile of Nickel Load in 2005.

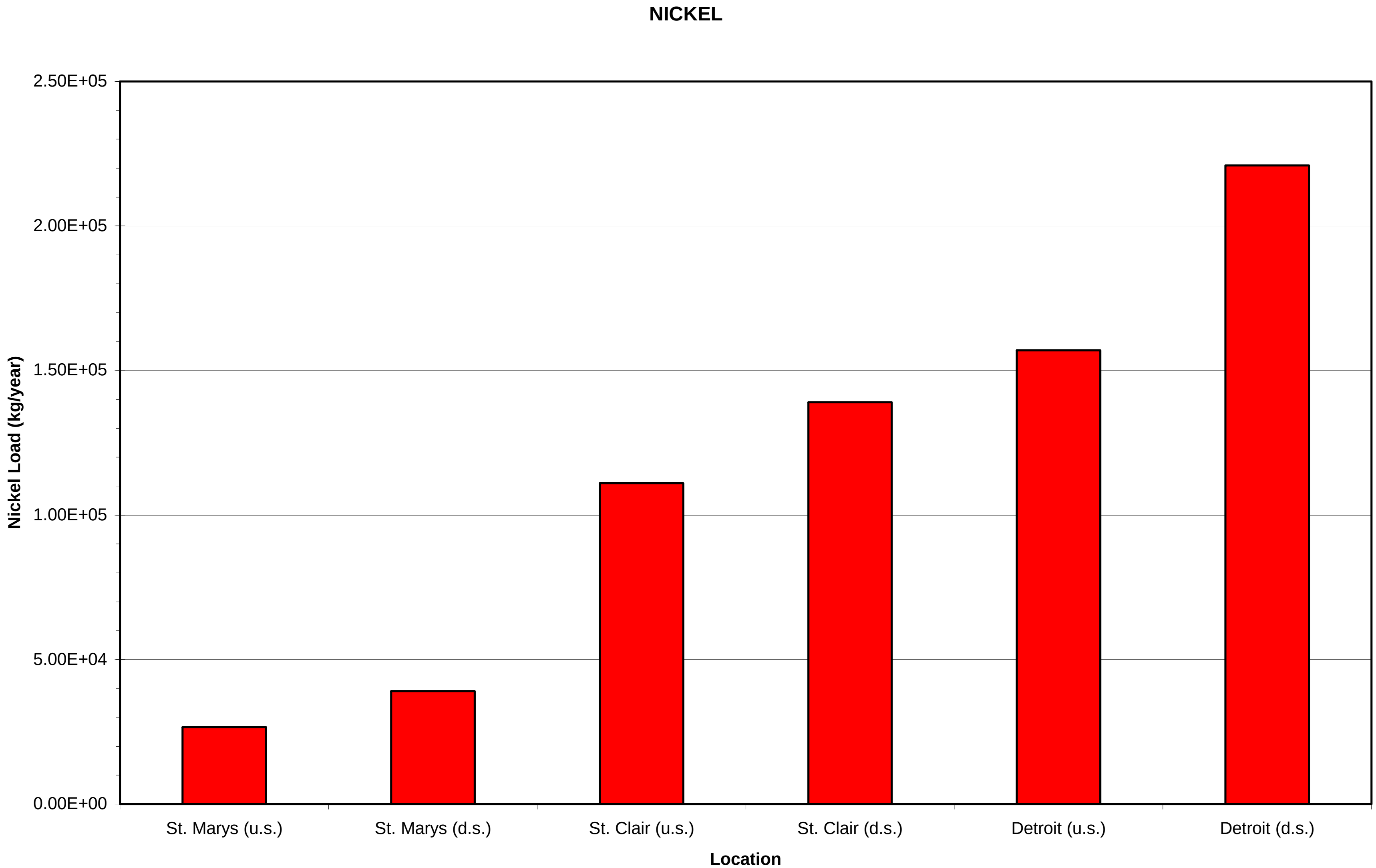


Figure 46. Longitudinal Profile of Zinc Load in 2005.

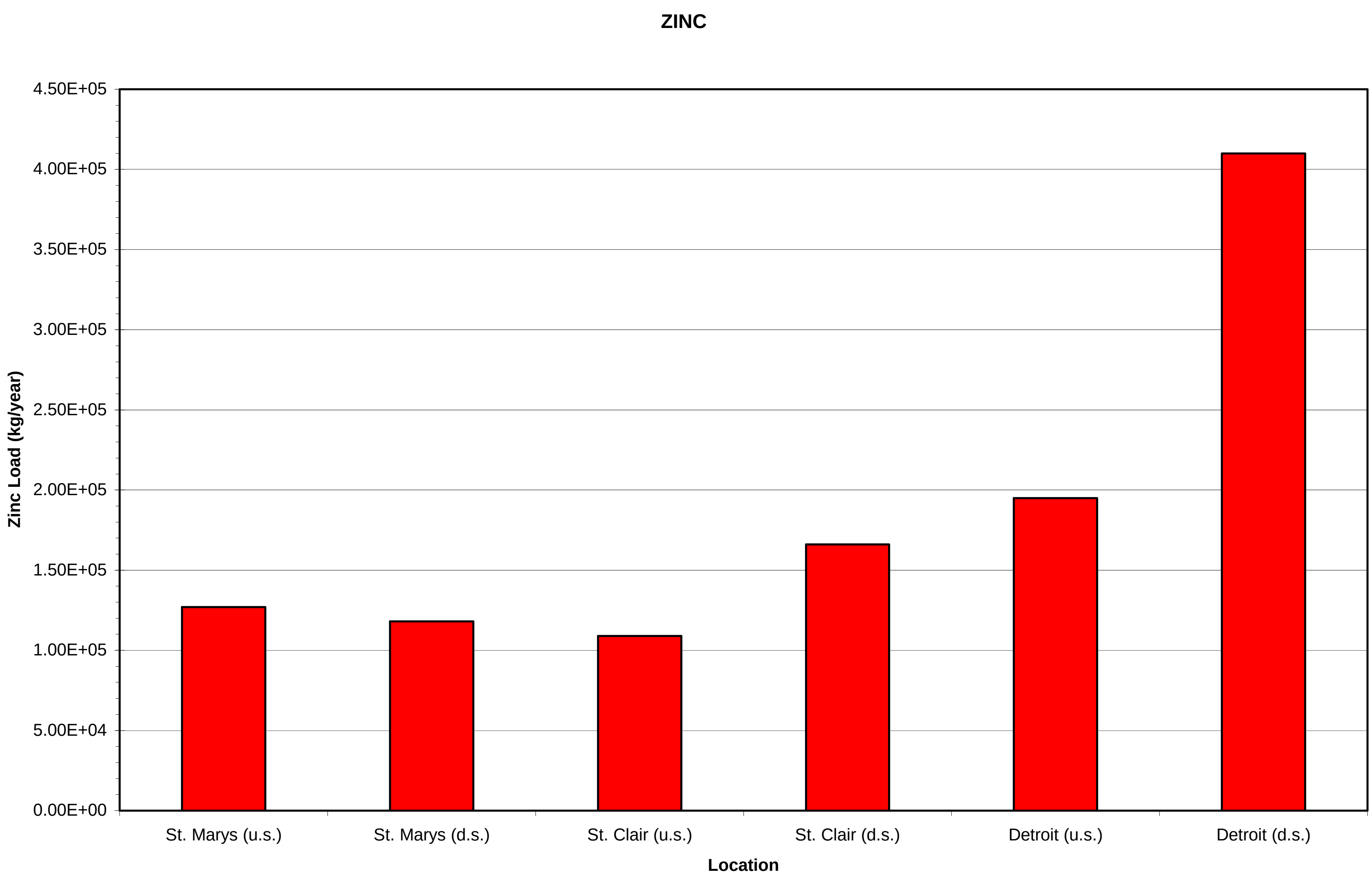
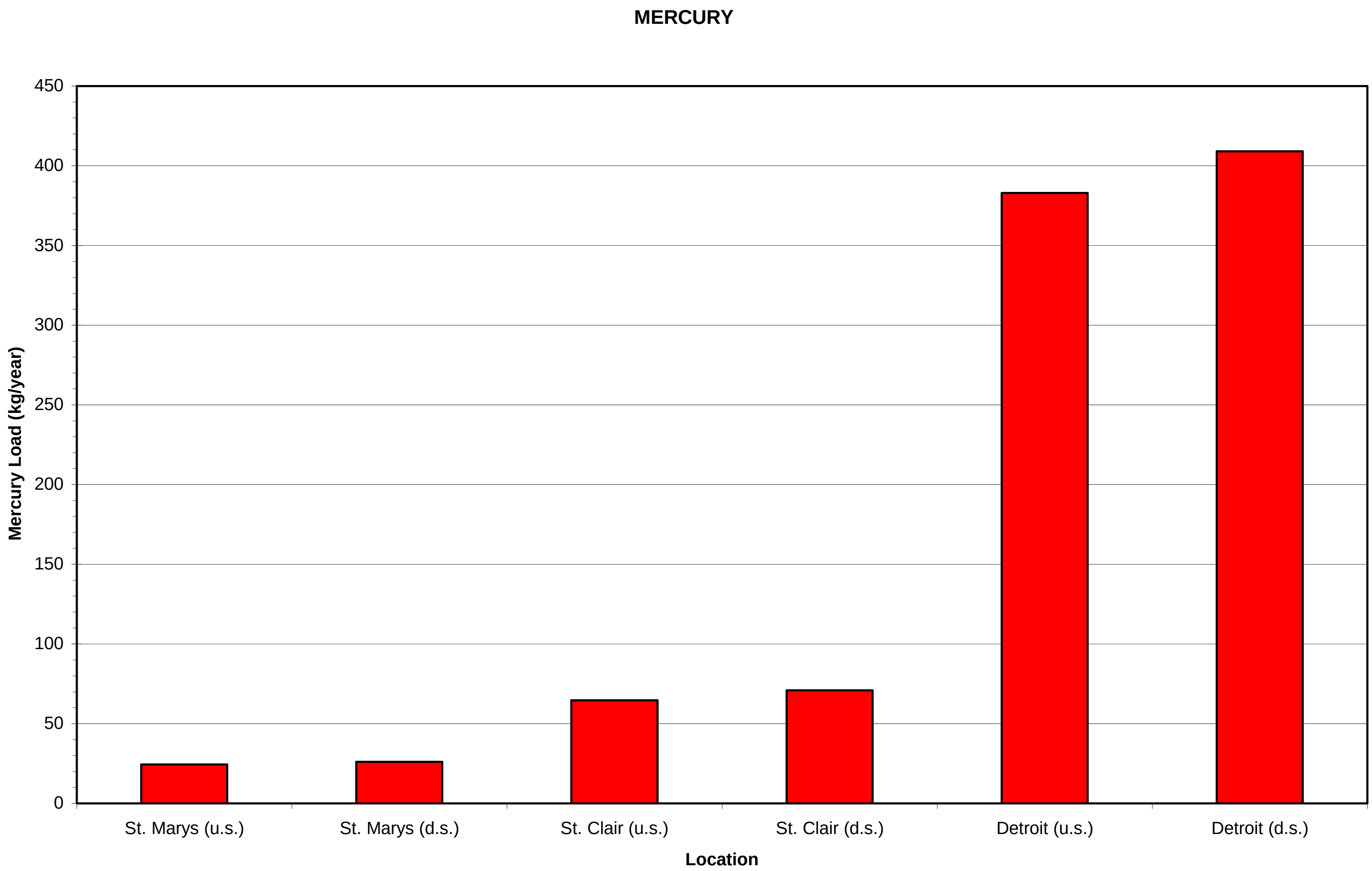


Figure 47. Longitudinal Profile of Mercury Load in 2005.



TABLES

Table 1. Summary of Water Quality in the St. Marys River Measured Upstream (Station 170139) in 2005.

PARAMETER	Units	4/21/2005	5/25/2005	6/13/2005	7/25/2005	8/15/2005	9/15/2005	11/8/2005	Mean	Median	Standard Deviation
Conductivity	umho/cm	100	98	99	97	95	97	98	98	98	2
Dissolved Oxygen	mg/L	12.60	11.55	12.07	8.84	9.38	7.84	11.71	10.57	11.55	1.85
Hardness ($CaCO_3$)	mg/L	50	45	47	47	46	43	46	46	46	2
pH	pH	7.02	7.06	7.56	7.18	7.10	7.39	7.00	7.19	7.10	0.21
Temperature	^oC	7.03	9.94	12.92	21.01	20.54	19.08	9.73	14.32	12.92	5.79
Total Alkalinity	mg/L	39	40	42	46	38	38	39	40	39	3
Total Ammonia	mg N/L	0.005 T	0.005 T	0.006 T	0.009 T	0.013	0.008 T	0.009 T	0.008	0.008	0.003
Total Calcium	mg/L	15.2	13.4	14.3	14.2	13.6	12.5	13.8	13.9	13.8	0.8
Total Chloride	mg/L	2	2	2	2	2	2	1	2	2	0
Total Dissolved Solids	mg/L	65	65	64	64	66	66	64	65	65	1
Total Kjeldahl Nitrogen	mg N/L	0.21	0.11	0.10	0.13	0.20	0.13	0.12	0.14	0.13	0.04
Total Magnesium	mg/L	2.9	2.8	2.8	2.9	2.9	2.8	2.9	2.9	2.9	0.1
Total Nitrate	mg N/L	0.30	0.32	0.32	0.29	0.28	0.26	0.30	0.30	0.30	0.02
Total Nitrite	mg N/L	0.005	0.003	0.004	0.004	0.005	0.004	0.002	0.004	0.004	0.001
Total Organic Carbon	mg/L	2.4	1.7	1.9	1.0	0.9	0.8	3.8	1.8	1.7	1.1
Total Ortho Phosphate	mg P/L	0.006	0.002 T	ND W	ND W	0.001 T	0.001 T	ND W	0.003	0.002	0.002
Total Phosphorus	mg P/L	0.013	0.006	0.006	0.008	0.009	0.006	0.004 T	0.007	0.006	0.003
Total Potassium	mg/L	0.6	0.6	0.5	0.7	0.6	0.6	0.5	0.6	0.6	0.1
Total Sodium	mg/L	2.5	2.9	ND	1.8	1.6	1.3	1.3	1.9	1.7	0.7
Total Sulfate	mg/L	3	2	2	3	2	2	3	2	2	1
Total Suspended Solids	mg/L	6	7	2 ND	4	7	-1 ND	2 ND	4	4	3
Turbidity	NTU	7.8	1.6	ND	1.1	2.3	ND	ND	3.2	2.0	3.1

+ = 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 2. Summary of Water Quality in the St. Marys River Measured Downstream (Station 170140) in 2005.

PARAMETER	Units	4/21/2005	5/25/2005	6/13/2005	7/25/2005	8/15/2005	9/15/2005	10/24/2005	11/8/2005	Mean	Median	Standard Deviation
Conductivity	umho/cm	103	109	101	99	96	98	98	103	101	100	4
Dissolved Oxygen	mg/L	12.57	10.70	10.28	8.88	9.44	7.50	11.01	11.86	10.28	10.49	1.64
Hardness ($CaCO_3$)	mg/L	46	46	49	46	45	46	52	48	47	46	2
pH	pH	6.83	6.65	7.81	7.12	6.98	7.31	6.72	7.13	7.07	7.05	0.37
Temperature	^oC	7.33	11.13	17.12	20.73	20.35	20.24	10.68	8.00	14.45	14.13	5.76
Total Alkalinity	mg/L	39	40	43	47	36	38	31	42	40	40	5
Total Ammonia	mg N/L	0.005 T	0.006 T	0.008 T	0.009 T	0.006 T	0.007 T	0.007 T	0.008 T	0.007	0.007	0.001
Total Calcium	mg/L	13.5	13.8	15.0	13.5	13.1	13.9	15.9	13.9	14.1	13.9	0.9
Total Chloride	mg/L	2	2	2	2	2	2	1	2	2	2	0
Total Dissolved Solids	mg/L	66	67	66	64	66	66	67	69	66	66	1
Total Kjeldahl Nitrogen	mg N/L	0.25	0.16	0.20	0.14	0.12	0.14	0.13	0.11	0.16	0.14	0.05
Total Magnesium	mg/L	3.0	2.9	2.8	2.9	3.0	2.8	3.0	3.3	3.0	3.0	0.2
Total Nitrate	mg N/L	0.31	0.30	0.30	0.29	0.29	0.26	0.28	0.29	0.29	0.29	0.02
Total Nitrite	mg N/L	0.004	0.004	0.004	0.004	0.005	0.004	0.007	0.006	0.005	0.004	0.001
Total Organic Carbon	mg/L	2.3	0.9	1.2	0.8	0.7	2.0	1.8	2.4	1.5	1.5	0.7
Total Ortho Phosphate	mg P/L	0.004	0.006	0.001 T	0.002 T	0.002 T	0.004	0.005	0.003	0.003	0.004	0.002
Total Phosphorus	mg P/L	0.014	0.014	0.005	0.010	0.008	0.009	0.008	0.013	0.010	0.010	0.003
Total Potassium	mg/L	0.6	0.5	0.6	0.7	0.6	0.6	0.5	0.6	0.6	0.6	0.1
Total Sodium	mg/L	2.9	1.7	1.6	ND	ND	1.4	1.3	1.5	1.7	1.6	0.6
Total Sulfate	mg/L	2	ND	2	3	2	2	3	3	2	2	1
Total Suspended Solids	mg/L	3 ND	2 ND	1 ND	6	5	1 ND	6	5	4	4	2
Turbidity	NTU	5.6	5.2	2.1	3.8	2.9	4.6	4.0	8.3	4.6	4.3	1.9

+ = 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 3. Summary of Water Quality in the St. Clair River Measured Upstream (Station 740376) in 2005.

PARAMETER	Units	4/27/2005	5/26/2005	6/15/2005	7/20/2005	8/17/2005	9/21/2005	11/30/2005	Mean	Median	Standard Deviation
Conductivity	umho/cm	251	212	216	212	208	206	210	216	212	16
Dissolved Oxygen	mg/L	13.00	12.40	11.57	10.43	8.49	10.62	13.00	11.36	11.57	1.64
Hardness ($CaCO_3$)	mg/L	91	97	100	99	97	94	96	96	97	3
pH	pH	7.49	7.66	7.80	7.65	7.90	7.87	7.33	7.67	7.66	0.21
Temperature	^oC	3.67	10.20	14.63	23.90	23.41	20.30	6.80	14.70	14.63	8.13
Total Alkalinity	mg/L	73	74	67	73	68	74	75	72	73	3
Total Ammonia	mg N/L	0.003 T	0.012	0.013	0.021	0.012	0.012	0.010	0.012	0.012	0.005
Total Calcium	mg/L	23.9	27.0	27.8	27.3	26.1	25.5	26.1	26.2	26.1	1.3
Total Chloride	mg/L	6	6	6	7	7	6	6	6	6	0
Total Dissolved Solids	mg/L	140	140	140	140	140	140	140	140	140	0
Total Kjeldahl Nitrogen	mg N/L	0.15	0.20	0.66	0.33	0.08 T	0.19	0.16	0.25	0.19	0.19
Total Magnesium	mg/L	7.5	7.2	7.4	7.5	7.6	7.4	7.4	7.4	7.4	0.1
Total Nitrate	mg N/L	0.35	0.34	0.40	0.33	0.33	0.29	0.31	0.34	0.33	0.03
Total Nitrite	mg N/L	0.003	0.004 H	0.005	0.004	0.004	0.004	0.002	0.004	0.004	0.001
Total Organic Carbon	mg/L	1.9	2.0	1.9	2.7	1.8	0.5	0.8	1.7	1.9	0.8
Total Ortho Phosphate	mg P/L	ND W	0.001 T H	ND W	0.001 T	0.001 T	ND W	0.001 T	0.001	0.001	0.000
Total Phosphorus	mg P/L	0.005	0.003 W	0.106	0.005	0.003 W	0.005	0.005	0.019	0.005	0.038
Total Potassium	mg/L	1.1	0.9	0.9	1.0	0.9	1.1	0.9	1.0	0.9	0.1
Total Sodium	mg/L	6.0	5.3	3.8	3.8	4.0	4.2	3.5	4.4	4.0	0.9
Total Sulfate	mg/L	12	12	14	12	11	13	12	12	12	1
Total Suspended Solids	mg/L	1 ND	-2 ND	1 ND	0 ND	3 ND	7	-1 ND	1	1	3
Turbidity	NTU	ND	ND	ND	ND	ND	ND	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.
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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 4. Summary of Water Quality in the St. Clair River Measured Downstream (Station 740016) in 2005.

PARAMETER	Units	4/27/2005	5/26/2005	6/15/2005	7/20/2005	8/17/2005	9/21/2005	11/30/2005	Mean	Median	Standard Deviation
Conductivity	umho/cm	253	226	218	216	211	214	212	221	216	15
Dissolved Oxygen	mg/L	12.24	11.95	11.03	8.48	8.44	8.67	12.45	10.47	11.03	1.87
Hardness ($CaCO_3$)	mg/L	97	100	99	95	97	98	98	98	98	2
pH	pH	7.41	7.60	7.74	7.48	7.81	7.98	7.25	7.61	7.60	0.25
Temperature	^oC	5.36	10.20	15.47	23.76	23.65	20.76	6.58	15.11	15.47	7.87
Total Alkalinity	mg/L	78	76	69	72	71	72	78	74	72	4
Total Ammonia	mg N/L	0.019	0.019	0.017	0.019	0.025	0.014	0.012	0.018	0.019	0.004
Total Calcium	mg/L	25.6	27.1	27.1	25.3	26.1	26.8	27.0	26.4	26.8	0.8
Total Chloride	mg/L	10	8	6	7	8	6	7	7	7	1
Total Dissolved Solids	mg/L	160	150	140	140	140	140	140	144	140	8
Total Kjeldahl Nitrogen	mg N/L	0.32	0.17	0.17	0.19	0.17	0.19	0.13	0.19	0.17	0.06
Total Magnesium	mg/L	8.1	7.8	7.5	7.6	7.7	7.5	7.3	7.6	7.6	0.3
Total Nitrate	mg N/L	0.41	0.35	0.40	0.33	0.34	0.29	0.31	0.35	0.34	0.04
Total Nitrite	mg N/L	0.007	0.004 H	0.004	0.005	0.005	0.004	0.003	0.005	0.004	0.001
Total Organic Carbon	mg/L	3.0	2.0	2.0	2.0	1.9	ND	0.6	1.9	2.0	0.8
Total Ortho Phosphate	mg P/L	0.007	ND W H	ND W	0.002 T	0.001 T	ND W	0.002 T	0.003	0.002	0.003
Total Phosphorus	mg P/L	0.024	0.010	0.005	0.012	0.008	0.008	0.004 T	0.010	0.008	0.007
Total Potassium	mg/L	1.4	1.0	0.9	1.0	1.0	1.1	1.5	1.1	1.0	0.2
Total Sodium	mg/L	7.0	5.2	3.7	4.9	3.4	3.6	3.9	4.5	3.9	1.3
Total Sulfate	mg/L	14	13	14	12	11	13	13	13	13	1
Total Suspended Solids	mg/L	15	1 ND	5	2 ND	3 ND	13	5	6	5	5
Turbidity	NTU	5.5	1.9	1.7	3.0	1.5	1.7	ND	2.6	1.8	1.5

+ = 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 5. Summary of Water Quality in the Detroit River Measured Upstream (Station 820414) in 2005.

PARAMETER	Units	4/27/2005	5/26/2005	6/15/2005	7/20/2005	8/17/2005	9/21/2005	Mean	Median	Standard Deviation
Conductivity	umho/cm	221	225	218	216	211	214	218	217	5
Dissolved Oxygen	mg/L	12.33	11.25	9.27	7.60	7.87	8.32	9.44	8.80	1.94
Hardness ($CaCO_3$)	mg/L	88	102	99	101	100	95	97	99	5
pH	pH	7.27	7.57	7.82	7.62	7.82	7.74	7.64	7.68	0.21
Temperature	^oC	5.63	12.80	19.15	25.12	24.30	20.39	17.90	19.77	7.45
Total Alkalinity	mg/L	75	75	69	72	81	72	74	74	4
Total Ammonia	mg N/L	0.009 T	0.011	0.016	0.025	0.027	0.023	0.019	0.020	0.008
Total Calcium	mg/L	23.3	28.3	27.4	27.7	27.4	25.5	26.6	27.4	1.9
Total Chloride	mg/L	6	7	7	7	6	6	7	7	1
Total Dissolved Solids	mg/L	140	150	140	140	140	140	142	140	4
Total Kjeldahl Nitrogen	mg N/L	0.23	0.16	0.16	0.22	0.18	0.16	0.19	0.17	0.03
Total Magnesium	mg/L	7.2	7.6	7.4	7.6	7.6	7.5	7.5	7.6	0.2
Total Nitrate	mg N/L	0.35	0.50	0.32	0.31	0.27	0.29	0.34	0.32	0.08
Total Nitrite	mg N/L	0.005	0.005 H	0.005	0.006	0.005	0.005	0.005	0.005	0.000
Total Organic Carbon	mg/L	2.1	1.8	0.6	2.0	1.0	ND	1.5	1.8	0.7
Total Ortho Phosphate	mg P/L	0.003	ND W H	ND W	0.001 T	0.002 T	0.002 T	0.002	0.002	0.001
Total Phosphorus	mg P/L	0.012	0.011	0.010	0.011	0.011	0.015	0.012	0.011	0.002
Total Potassium	mg/L	1.1	1.0	1.0	1.2	1.0	1.0	1.1	1.0	0.1
Total Sodium	mg/L	4.8	5.4	4.7	5.4	4.7	4.1	4.9	4.8	0.5
Total Sulfate	mg/L	12	12	13	11	11	13	12	12	1
Total Suspended Solids	mg/L	5	4	5	0 ND	5	14	6	5	5
Turbidity	NTU	3.5	4.9	4.0	1.8	3.4	4.4	3.7	3.8	1.1

+ = 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.
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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 6. Summary of Water Quality in the Detroit River Measured Downstream (Station 820017) in 2005.

PARAMETER	Units	4/27/2005	5/26/2005	6/15/2005	7/20/2005	8/17/2005	9/21/2005	11/30/2005	Mean	Median	Standard Deviation
Conductivity	umho/cm	226	222	226	217	216	218	262	227	222	16
Dissolved Oxygen	mg/L	11.80	10.60	8.34	7.63	8.07	8.07	14.53	9.86	8.34	2.58
Hardness ($CaCO_3$)	mg/L	88	98	100	97	97	101	103	98	98	5
pH	pH	7.24	7.54	7.82	7.69	7.72	7.60	7.31	7.56	7.60	0.21
Temperature	^oC	6.29	12.84	21.29	25.49	24.47	20.27	2.29	16.13	20.27	9.13
Total Alkalinity	mg/L	76	75	68	71	86	74	90	77	75	8
Total Ammonia	mg N/L	0.020	0.026	0.045	0.051	0.057	0.048	0.127	0.053	0.048	0.035
Total Calcium	mg/L	22.7	27.0	27.5	26.3	25.9	27.9	28.5	26.5	27.0	1.9
Total Chloride	mg/L	7	7	8	8	8	7	17	9	8	4
Total Dissolved Solids	mg/L	140	150	150	140	150	150	170	150	150	10
Total Kjeldahl Nitrogen	mg N/L	0.22	0.23	0.25	0.24	0.29	0.18	0.41	0.26	0.24	0.07
Total Magnesium	mg/L	7.5	7.4	7.6	7.6	7.8	7.6	7.8	7.6	7.6	0.1
Total Nitrate	mg N/L	0.35	0.35	0.27	0.28	0.26	0.28	0.36	0.31	0.28	0.04
Total Nitrite	mg N/L	0.005	0.004 H	0.006	0.009	0.009	0.007	0.013	0.008	0.007	0.003
Total Organic Carbon	mg/L	2.1	2.2	1.0	0.9	2.5	ND	2.6	1.9	2.2	0.7
Total Ortho Phosphate	mg P/L	0.004	ND W H	0.003	0.003	0.004	0.004	0.025	0.007	0.004	0.009
Total Phosphorus	mg P/L	0.015	0.008	0.019	0.024	0.020	0.022	0.068	0.025	0.020	0.020
Total Potassium	mg/L	1.0	0.9	1.0	1.0	1.1	1.1	1.6	1.1	1.0	0.2
Total Sodium	mg/L	5.3	4.8	4.6	4.9	5.1	4.7	9.4	5.5	4.9	1.7
Total Sulfate	mg/L	11	12	13	11	12	13	15	12	12	1
Total Suspended Solids	mg/L	10	0 ND	12	11	8	6	39	12	10	12
Turbidity	NTU	4.8	2.8	6.9	8.9	4.6	4.3	34.0	9.5	4.8	11.0

+ = 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.
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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 7. Concentrations of Trace Metals and Mercury Collected in 2005 and Corresponding Rule 57 Water Quality Values.

Station #170139	**21-Apr-05**	**25-May-05**		**13-Jun-05**	**25-Jul-05**	**15-Aug-05**	**15-Sep-05**		**24-Oct-05**	**8-Nov-05**	**MEAN**	**Rule 57 WQV**
Cadmium (ug/L)	0.01054	0.00824		0.00946	0.00971	0.00873	0.00818		NS	0.00775	0.0089	1.26
Chromium (ug/L)	0.52300	-0.05255		-0.01826	0.15300	-0.02917	0.09800	CCB	NS	0.07900	0.1076	39.2
Copper (ug/L)	1.26000	0.87000		0.96300	0.96800	0.85100	0.84200		NS	0.82000	0.9391	4.61
Lead (ug/L)	0.21400	0.02630		0.01440	0.09120	0.04010	0.02540		NS	0.02910	0.0629	4.38
Nickel (ug/L)	0.78900	0.22500		0.30700	0.41800	0.32100	0.28900		NS	0.31300	0.3803	27.0
Zinc (ug/L)	2.93000	2.28000		0.78000	3.11000	2.13000	1.35000		NS	0.62000	1.8857	61.2
Mercury (ng/L)	0.71000	0.31000	MSD	0.30000	0.48000	0.34000	0.21000		NS	0.24000	0.3700	1.3
Hardness (mg/L)	50	45		47	47	46	43		NS	46	46	
Station #170140	**21-Apr-05**	**25-May-05**		**13-Jun-05**	**25-Jul-05**	**15-Aug-05**	**15-Sep-05**		**24-Oct-05**	**8-Nov-05**	**MEAN**	**Rule 57 WQV**
Cadmium (ug/L)	0.01064	0.01041		0.00737	0.00864	0.00819	0.00980		0.00794	0.00877	0.0090	1.28
Chromium (ug/L)	0.23500	0.22800		0.15000	0.22100	0.25400	0.26700	CCB	0.27400	0.64000	0.2836	39.9
Copper (ug/L)	1.23000	1.08000		1.09000	0.97300	0.93400	0.96400		0.89500	1.05000	1.0270	4.70
Lead (ug/L)	0.11900	0.12200		0.05920	0.11700	0.09400	0.11300		0.11500	0.18900	0.1160	4.50
Nickel (ug/L)	0.53800	0.45700		0.42500	0.46300	0.48000	0.47800		0.88100	0.82900	0.5689	27.5
Zinc (ug/L)	1.57000	2.02000		1.42000	2.34000	1.88000	1.16000		1.20000	1.50000	1.6363	62.3
Mercury (ng/L)	0.51000	0.46000	LCQC	0.29000	0.34000	0.34000	0.34000		0.22000	0.36000	0.3575	1.3
Hardness (mg/L)	46	46		49	46	45	46		52	48	47	
Station #740376	**27-Apr-05**	**26-May-05**		**15-Jun-05**	**20-Jul-05**	**17-Aug-05**	**21-Sep-05**		**30-Nov-05**		**MEAN**	**Rule 57 WQV**
Cadmium (ug/L)	0.00770	0.00580		0.00479	0.00310	0.00331	0.00455		0.00365		0.0047	2.17
Chromium (ug/L)	0.00906	-0.03437		0.00792	0.05633	0.04197	0.14600	CCB	0.08100		0.0440	71.7
Copper (ug/L)	0.46800	0.61500		0.64900	0.52200	0.51300	0.46200		0.46300		0.5274	8.64
Lead (ug/L)	0.07760	0.02060		0.01000	0.01600	0.02370	0.02300		0.02600		0.0281	9.85
Nickel (ug/L)	0.81200	0.76900		0.77800	0.72700	0.71300	0.67800		0.71600		0.7419	50.2
Zinc (ug/L)	0.51000	1.46000		0.56000	1.81000	0.99000	0.28000		0.24000		0.8357	114.1
Mercury (ng/L)	1.45000	0.18000	MSD	0.27000	0.37000	0.34000	0.25000		0.21000		0.4386	1.3
Hardness (mg/L)	91	97		100	99	97	94		96		96	
Station #740016	**27-Apr-05**	**26-May-05**		**15-Jun-05**	**20-Jul-05**	**17-Aug-05**	**21-Sep-05**		**30-Nov-05**		**MEAN**	**Rule 57 WQV**
Cadmium (ug/L)	0.01800	0.00943		0.00559	0.00579	0.00528	0.00514		0.00399		0.0076	2.20
Chromium (ug/L)	0.29400	0.01245		0.13800	0.12800	0.10100	0.23600	CCB	0.11700		0.1466	72.9
Copper (ug/L)	1.17000	0.79000		0.85000	0.73300	0.64400	0.64700		0.52300		0.7653	8.80
Lead (ug/L)	0.33200	0.07910		0.04910	0.10600	0.06700	0.07870		0.05520		0.1096	10.1
Nickel (ug/L)	1.38000	0.92400		0.89100	0.91600	0.82000	0.83100		0.75700		0.9313	51.1
Zinc (ug/L)	2.50000	0.77000		1.29000	0.97000	0.55000	0.51000		1.24000		1.1186	116.1
Mercury (ng/L)	1.15000	0.33000	MSD	0.33000	0.49000	0.40000	0.34000		0.30000		0.4771	1.3
Hardness (mg/L)	97	100		99	95	97	98		98		98	

CCB = Continuing calibration blank exceded quality control criteria.
LCQC = Laboratory control exceeded quality control criteria.
MSD = Matrix spike duplicate exceeded quality control criteria.
NS = Not sampled.

Table 7 (cont'd). Concentrations of Trace Metals and Mercury Collected in 2005 and Corresponding Rule 57 Water Quality Values.

Station #820414	27-Apr-05	26-May-05		15-Jun-05	20-Jul-05	17-Aug-05	21-Sep-05		30-Nov-05	MEAN	Rule 57 WQV
Cadmium (ug/L)	0.00864	0.00877		0.00908	0.00453	0.00608	0.00801		NS	0.0075	2.19
Chromium (ug/L)	0.13900	0.07200		0.17600	0.08400	0.16500	0.28900	CCB	NS	0.1542	72.3
Copper (ug/L)	0.65500	0.94100		0.91200	0.57300	0.74100	0.76800		NS	0.7650	8.73
Lead (ug/L)	0.16700	0.21700		0.21400	0.13000	0.21700	0.33300		NS	0.2130	9.96
Nickel (ug/L)	0.98000	1.05000		1.02000	0.82400	0.95000	1.02000		NS	0.9740	50.7
Zinc (ug/L)	1.79000	1.17000		1.16000	1.08000	0.87000	1.17000		NS	1.2067	115.1
Mercury (ng/L)	1.32000	2.31000	MSD	2.28000	1.41000	2.50000	4.61000		NS	2.4050	1.3
Hardness (mg/L)	88	102		99	101	100	95		NS	98	
Station #820017	**27-Apr-05**	**26-May-05**		**15-Jun-05**	**20-Jul-05**	**17-Aug-05**	**21-Sep-05**		**30-Nov-05**	**MEAN**	**Rule 57 WQV**
Cadmium (ug/L)	0.01300	0.00793		0.01600	0.01500	0.00905	0.00862		0.04000	0.0157	2.20
Chromium (ug/L)	0.22900	0.05232		0.32400	0.25800	0.21500	0.27700	CCB	1.80000	0.4508	72.9
Copper (ug/L)	0.84600	0.83700		1.25000	0.88900	0.83800	0.72000		2.39000	1.1100	8.80
Lead (ug/L)	0.28400	0.14000		0.43100	0.36000	0.28500	0.22600		1.71000	0.4909	10.1
Nickel (ug/L)	1.16000	0.98800		1.32000	1.10000	1.05000	0.97900		3.16000	1.3939	51.1
Zinc (ug/L)	1.73000	1.60000		2.50000	2.05000	1.29000	1.80000		7.23000	2.6000	116.1
Mercury (ng/L)	1.19000	1.21000	MSD	2.69000	2.80000	1.79000	1.96000		6.55000	2.5986	1.3
Hardness (mg/L)	88	98		100	97	97	101		103	98	

CCB = Continuing calibration blank exceded quality control criteria.
LCQC = Laboratory control exceeded quality control criteria.
MSD = Matrix spike duplicate exceeded quality control criteria.
NS = Not sampled.