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Report

LAKE McCARRONS WETLAND TREATMENT SYSTEM -- PHASE III STUDY REPORT

METROPOLITAN COUNCIL ENVIRONMENTAL SERVICES

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LAKE McCARRONS WETLAND TREATMENT SYSTEM PHASE III STUDY REPORT

METROPOLITAN COUNCIL
ENVIRONMENTAL SERVICES

SEPTEMBER 1997

Project Funded Through Participation of:
U.S. Environmental Protection Agency - Clean Lakes Program
Minnesota Pollution Control Agency
Metropolitan Council
City of Roseville, Minnesota

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EXECUTIVE SUMMARY

The McCarrons Wetland Treatment System (MWTS) has been operational since 1985. The city of Roseville's system is comprised of a headwater detention pond, followed in line by five small wetland chambers. An additional small detention pond also contributes inflow to the last wetland chamber. The MWTS was designed to improve the water quality of Lake McCarrons, also in Roseville.

This study (Phase III, Clean Lakes Grant) was undertaken to evaluate the difference in pollutant removal performance of the system relative to the performance when the system was new (Phase II, Clean Lakes Grant). Notable degradation in the physical character of the system has occurred as the system aged and the city introduced new drainage directly to the wetland chambers.

Rainfall and snowmelt runoff events, and baseflow were monitored at six sites for solids, nutrients, oxygen demand and select metals from March 1995 through November 1996. Sediment samples were also collected throughout the system at the beginning of the study (November 1994) and at the end (November 1996). Lake McCarrons was simultaneously sampled for water quality. Runoff quantity was also characterized, with runoff coefficients for the six monitoring sites varying from 0.13 to 0.29.

Flow-weighted mean concentrations entering the MWTS and moving through the headwaters detention pond were substantially lower in Phase III than Phase II, while outflow concentrations leaving the MWTS were quite similar in the two studies. Pollutant removal efficiencies for most pollutants are dramatically reduced now (Phase III) compared to the new system (Phase II). The lower inflow concentrations partly explain the loss of efficiency; that is, it is easier to show improvement in a highly polluted inflow than in one that is relatively cleaner. However, a load analysis shows that other factors also contribute to the performance reduction, including potential phosphorus saturation of the wetland soils, re-establishment of channels through the wetland chambers, berm failure and culvert by-passing, introduction of 100 additional acres of drainage directly to the system, and partial dredging of the outlet wetland. Most of the benefit accruing from the MWTS occurs in the headwater detention pond, where solids settling reduces many of the pollutants of concern. Very little additional pollutant removal, with the exception of nitrogen, occurs in the wetland chambers. Pollutant removal is especially poor during snowmelt when processes within the MWTS are minimized due to ice formation and vegetative inactivity.

Temperature data collected during part of the study at both an inflow site and the outflow to the lake show that water is warmed as it moves through the MWTS. During warm months, this results in outflow into the reduced volume of the lake above the thermocline. This appears to contribute to the continuing degradation of the lake's quality even though the MWTS reduces some pollutant input.

Lake McCarrons is eutrophic with abundant densities of macrophyte growth around its shore and occasional dense algal blooms. The lake is strongly stratified, and becomes anoxic early in the summer, at times remaining so throughout the following winter. The Metropolitan Council has sampled the water quality of Lake McCarrons since 1984. An intensive study was done concurrently with the 1995-1996 MWTS sampling.

Data collected on the lake indicates slight degradation in water quality, indicated by increasing phosphorus and decreasing transparency. Chlorophyll-a levels have remained fairly constant. Year-to-year variability in precipitation and temperature could account for some of this appearance of degradation. Very high levels of TP in the hypolimnion become available to the entire lake at fall and spring overturn.

Spring and early summer phytoplankton populations are small, consisting of a mixture of green algae, diatoms and dinoflagellates. Blue-green algae dominates from mid summer through the winter. Zooplankton grazing on algae would likely be enhanced by introducing oxygen into the hypolimnion. Macrophyte occurrence has remained fairly stable since 1983. There is no evidence that the distribution or species composition of the lake's macrophyte community are related to nutrient concentrations in the water. Lake McCarrons has an abundant panfish population. Bass, muskellunge (Tiger), walleye pike and northern pike have all been caught in the lake recently.

Runoff and water quality entering the lake were directly monitored for about 90% of the watershed draining to the lake via the MWTS. During this period of study, approximately 45% of the lake's TP load came in the summer, 35% in the spring and snowmelt, and 15% in the autumn. The lake's summertime phosphorus concentrations appear to be insensitive to inputs of phosphorus prior to mid May, when the lake is not stratified. Inputs become far more important after stratification in the late spring. To achieve a desirable summertime mean TP of 30-35 μg/l, a 50-60% reduction in the lake's current summertime epilimnetic load is needed. The lake continues to degrade, possibly the result of warming the inflow as noted previously. Yearly precipitation and air temperature variation could also be responsible for lake quality variation because of water temperature and dilution dynamics in the epilimnion.

Suggestions for managing the MWTS focus on restoration and maintenance. Continued dredging of debris from the detention ponds, as was done in 1993, is essential to their proper operation. The berms at each wetland chamber are badly in need of repair, or more preferably, replacement with stable spillways in place of culverts. Inputs to the outlet wetland from the hockey rink pond and the culvert from McCarrons Boulevard should be corrected by restructuring the detention pond outlet and reorienting the culvert to discharge elsewhere into the wetland.

Re-establishing the original configuration of the wetland chambers and removing some of the possibly phosphorus-saturated soils would be a major engineering and regulatory endeavor, but one that will most likely be needed to increase system performance. Installation of permanent floatable skimmers or baffle weirs at the pond and outlet wetland outflows will help keep material in the system and will reduce trash rack maintenance. The temporary silt curtains used during the study did appear to effectively accomplish this task, but they disintegrated during the study and need a more permanent replacement.

Channel erosion is evident at two inflows to the headwater detention pond. Replacement of the lattice material under the main footbridge (site D) and stabilization of the channel from the west (site C) are needed.

A public education program aimed at household habits could help reduce some of the pollution reaching the MWTS and eventually the lake. A program should focus on leaf, litter and grass clipping cleanup, household wastes (particularly oil), lawn fertilizer and erosion control. Metropolitan Council staff would be available to help the city with a package of educational materials.

Because of the amount of polluting material discharged to the lake over the past decades, lake improvement will be difficult and expensive. The MWTS has been helpful over the past 12 years in reducing net inputs to the lake, but this study has shown that the system is decreasing in effectiveness and may be directing inflow to a limited volume of the lake above the thermocline. Possible approaches to lake improvement include chemical treatment of the lake and/or inflows; rerouting inflow below the thermocline; whole or partial lake mixing; and attention to the management changes noted above for the MWTS to improve performance.

ABOUT THIS REPORT

This report was prepared to present the findings of a Phase III Clean Lakes (Section 314, Water Pollution Control Act of 1972) study of the McCarrons Wetland Treatment System (MWTS) in Roseville, Minnesota. Phase III studies are intended to evaluate long-term performance of management practices used to improve lake water quality. The MWTS was built in 1985-86, and studied initially with a Phase II Clean Lakes grant. Local cost-share requirements have been met in both studies by the city of Roseville and the Metropolitan Council.

Also included in this report is an assessment of the condition of Lake McCarrons. Although not a part of the Clean Lakes grant, this analysis was undertaken by the Council to determine the effect of the MWTS on the lake.

The MWTS section of this report was prepared by Gary Oberts (Senior Environmental Planner), Judy Sventek (Environmental Planner) and Mike Perniel (Associate Environmental Planner), all from the Metropolitan Council's Environmental Services Division, Environmental Planning and Evaluation Department. The lake analysis was done by Randy Anhorn, of the same Council unit.

State management of this project was through the Minnesota Pollution Control Agency. The state Project Manager was Shannon Lotthammer of the MPCA's Watershed Assistance Section, Water Quality Division. Mark Evenson of the same Division provided technical support on much of the study equipment.

Copies of this report can be obtained from the Metropolitan Council's Regional Data Center (602-1140 or TTY 291-0904). This report is Council Publication No. 32-97-026.

PART 1: WETLAND TREATMENT SYSTEM

INTRODUCTION

In 1985, the city of Roseville undertook a wetland treatment project to reduce overall phosphorus loads to Lake McCarrons to achieve mesotrophic conditions in the lake. A Phase II Clean Lakes Project (Water Pollution Control Act of 1972, Section 314) was undertaken by the Metropolitan Council and the City of Roseville upon completion of system construction in the fall of 1986. The 21 month monitoring project was designed to collect data on the wetland system's effectiveness in improving water quality. Data were collected on runoff into and through the wetland treatment system, on Lake McCarrons, and on two large sumps that were installed adjacent to the lake to capture large-grained sediment.

Water quality monitoring of the McCarrons Wetland Treatment System (MWTS) showed that the system was very effective in the removal of solids associated pollutants and moderately effective in removing soluble nutrients. Most of the reduction in pollutants occurred in the detention pond because of the highly concentrated manner in which runoff enters; that is, it was easier to show good percentage reductions in dirty tributary water than it was in cleaner, presettled water.

Based on the short-term performance of the MWTS, some improvements in Lake McCarrons' water quality were expected. However, this was not observed in data collected for several years after the project was implemented. Possible reasons for the failure to see improvement include year-to-year variability in the lake that masks any changes, lake/watershed dynamics that continue pollutant input, and decreased effectiveness of the MWTS.

A Phase III study was begun in 1995 to evaluate the MWTS further in light of the above findings. The objectives of this study are to determine if a wetland treatment system performs as well several years after being built as it did when new, and to see if proper maintenance of the system can maintain long-term treatment effectiveness. The system has been operational for over ten years. Prior to initiation of the Phase III system monitoring, the detention pond was dredged (January 1993) to its original configuration and the amount of material removed documented. The detention portion of the system has accumulated a tremendous amount of sediment and the wetland portions have been exposed to high urban runoff loads of particulate and dissolved pollutants.

This report was prepared to fulfill the contractual agreement with the U.S. Environmental Protection Agency. The purposes of the report are to present findings on the effectiveness of the wetland treatment system after years of service, and to evaluate its impact on the quality of Lake McCarrons. Recommendations will be made on the improved operation and maintenance of wetland treatment systems in order to achieve long-term water quality improvement.

BACKGROUND

HISTORY OF THE PROJECT

The MWTS was built by the city of Roseville and has been evaluated by the Metropolitan Council under two separate federal Clean Lakes studies. Clean Lakes projects in the state of Minnesota are administered through the Minnesota Pollution Control Agency (MPCA).

The following history of the project was supplied by the city of Roseville and supplemented by the Metropolitan Council.

- June 1977: Roseville City Council approves submittal of application for federal funds to improve Lake McCarrons

- September 1977: Application for grant sent to EPA

- March 1978: EPA rejects grant application, citing lack of limnologic and hydrologic data

- July 1980: EPA awards grant to city for diagnostic/feasibility study of lake

- April 1981: Diagnostic/feasibility study begins with Donohue and Associates as consulting engineers

- Late 1982: Phase I diagnostic/feasibility study completed

- November 1983: Revised Phase I submitted after EPA rejection of first study due to deficiencies

- June 1984: Phase II grant received from EPA to initiate a lake improvement project

- February 1985: Construction contract awarded

- April 1985: Construction begins

- September 1985: Substantial completion of wetland grading and detention pond berm

- November 1985: substantial completion of detention pond

- April 1986: Heavy rains add to damage caused to berms during snowmelt of March, 1986

- July 1986: System deemed stable enough for sampling to begin in fall

- September 1986: Water sampling of wetland system under Phase II by Metropolitan Council begins

- November 1986: After many problems caused by wet weather and poor soil conditions, construction repair completed

- June 1988: Water sampling under Phase II ends

- July 1988: Study of the effectiveness of the system complete and report prepared by the Metropolitan Council

- January 1993: Detention pond dredged to original configuration

- September 1994: Phase III grant approved by MPCA and EPA

- November 1994: Sediment sampling completed in wetland system

- March 1995: Water sampling of wetland system by Metropolitan Council begins

- November 1996: Final sediment sampling completed and water sampling ends

SYSTEM DESCRIPTION

The MWTS drains a total area of 736.1 acres (298.1 hectares - ha) within the city of Roseville. Figure 1 shows the area draining to the system and the land cover of the drainage basin, while Figure 2 displays the general configuration of the MWTS. Figure 3 is a generalized cross-section of the system from the inlet at the headwaters detention pond to the outlet of the system at Lake McCarrons. Note in Figure 1 that subwatersheds C2, H2 and H3 do not contribute flow to Lake McCarrons under less than extreme conditions. Subwatershed H1 drains directly to the lake, thus avoiding the MWTS. Outflow from subwatershed C1 (Alameda Pond) is intermittent, depending upon the amount of runoff the pond receives.

The headwaters detention pond is 2.4 acres (0.97 ha) in area, and contains an approximate design permanent storage volume below the minimum outlet weir elevation of 6.6 acre-feet (8,141 m^3), which is substantially more than the final Phase II storage volume of 2.8 acre-feet (3,454 m^3) due to the January 1993 removal of material from the pond to establish the original design condition. An additional 6.5 acre-feet (8,018 m^3) of water quality storage exists between the weir outflow elevation and the emergency spillway overflow elevation. The hockey rink detention pond was added after the Phase II study; it is 0.45 acres (0.18 ha) in size, with a permanent design storage of 1.25 acre-feet (1,542 m^3) and approximately 1.0 acre-feet (1,233 m^3) in water quality storage. The actual area of chambered wetlands in the MWTS, not including the volume available in either of the two detention ponds, is 6.2 acres (2.5 ha). Storage within the wetland chambers is temporary, since the culverts are designed to slow the water to allow temporary contact with wetland vegetation rather than detain it for long periods of time. Maximum storage in the wetland chambers is approximately 12 acre-feet (14,801 m^3).

Table 1 contains a basic description of the watershed components draining to the MWTS. Figures are presented with and without Alameda pond because of the intermittent nature of the outflow from subwatershed C1.

Table 2 summarizes data on land cover contributing to the MWTS. Details on the land cover and imperviousness associated with it are also presented in Appendix A.

Figure 1. Lake McCarrons Watershed, 1996 Land Cover and Subwatershed Designations

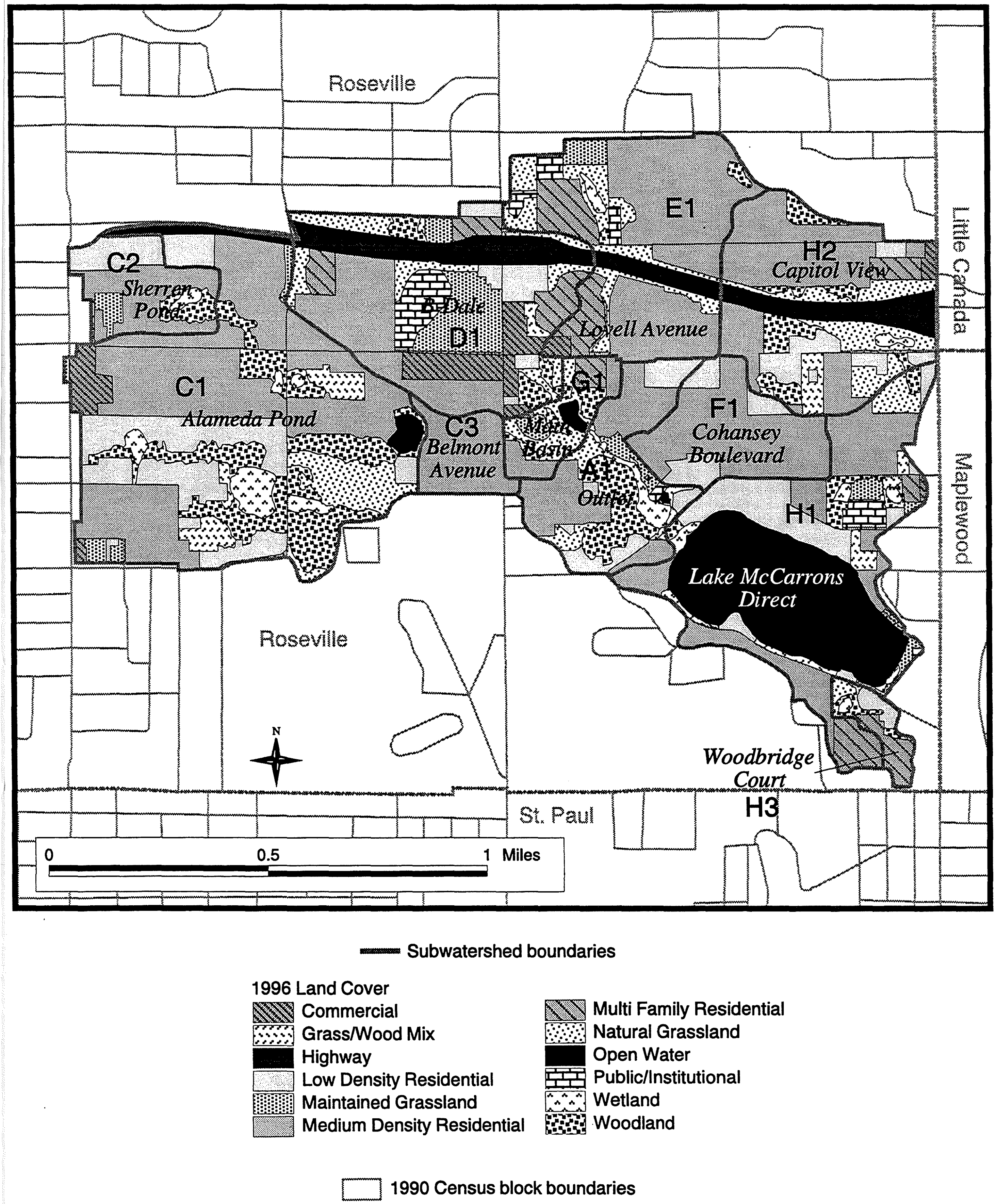


Figure 2. Locations of Wetland System Monitoring Stations

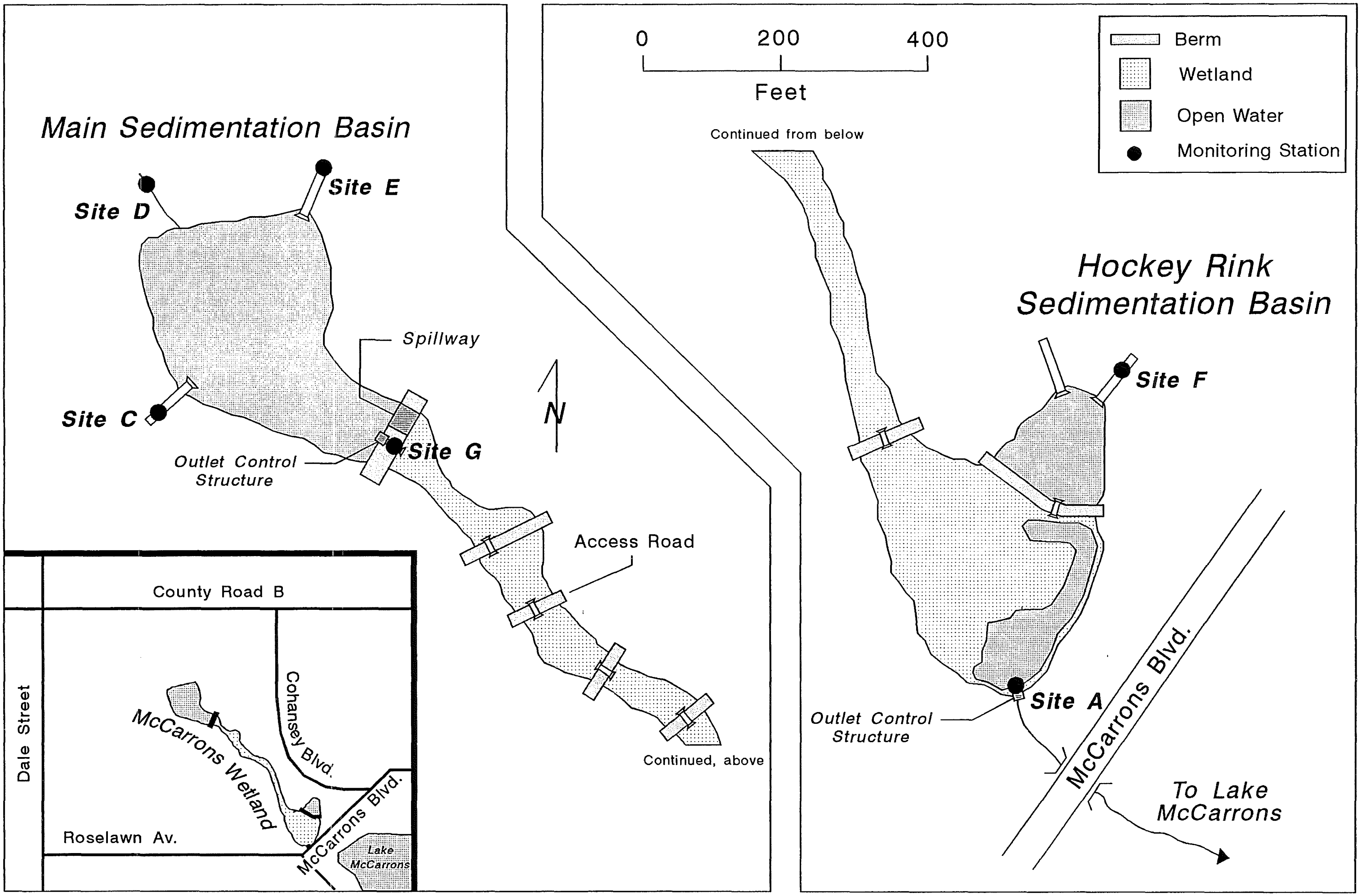
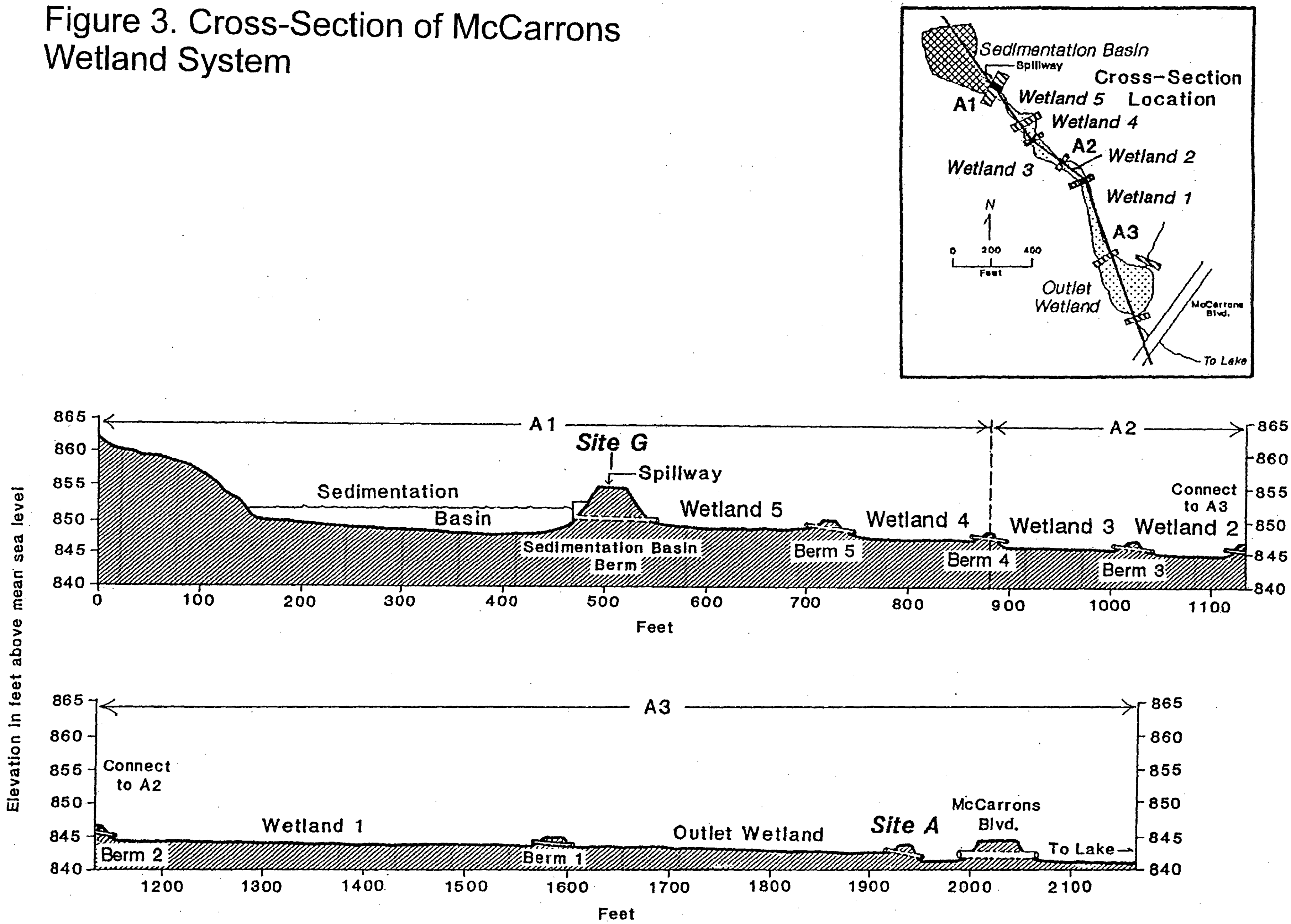


Figure 3. Cross-Section of McCarrons Wetland System



Vertical exaggeration approximately 7x

Table 1. Description of McCarrons Wetland Treatment System Sampling Sites

Site	Drainage Area, acres (hectares) [without Alameda*]	Description
A	736.1 (298.1) [463.9 (187.9)]	Treatment system outflow through box culvert, manhole and 12" CMP outflow pipe; site located at North McCarrons Boulevard; stage continuously recorded, sampling automated.
G	612.3 (248.0) [340.1 (137.7)]	Detention pond outflow through box culvert, manhole and 12" CMP outflow pipe; site located in Villa Park off of Cohansey Boulevard; stage continuously recorded and sampling automated.
C	295.9 (119.8) [23.7 (9.6)]	Concrete arch pipe (36" x 58.5") storm sewer inflow gauged at broad-crested weir before inflow to detention pond from the west (B-Dale Men's Club); contributions from Alameda Pond subwatershed dependent upon level before event; stage continuously recorded and sampling automated.
D	157.5 (63.8)	Open channel inflow at broad-crested weir before inflow to detention pond from northwest; channel originates at terminus of storm sewer near intersection of County Road B and Dale St.; stage continuously recorded and sampling automated.
E	132.8 (53.8)	54" corrugated storm sewer inflow to detention pond from north near Villa Park condominiums; extremely fast response to rainfall events; stage continuously recorded and sampling automated.
F	54.1 (21.9)	Concrete arch pipe (22.5" x 36.5") storm sewer inflow to detention pond that outlets to wetland upstream of Site A; drainage from Cohansey Boulevard; stage continuously recorded and sampling automated.
AI	69.8 (28.3)	Unmonitored, overland flow and atmospheric input to treatment system below headwaters detention basin.
GI	26.1 (10.6)	Unmonitored, overland flow and atmospheric input to headwaters detention pond.

*Subtract 272.2 acres (110.2 hectares) if Alameda Pond does not contribute.

Table 2. Land Cover of Subwatershed Draining to the MWTS.

SUBWATERSHED [See Fig.1]	Low Density Residential	Med. Density Residential	Multi-Family Residential	Commercial	Public and Institutional	Open Water	Wetland	Grassland	Woodland	Highway	Impervious %
	LAND COVER TYPE IN ACRES* (% of subwatershed)										
C with Alameda [C1 + C3] (295.9 acres - 119.8ha)	50.2 (17.0)	137.6 (46.5)	--	8.1 (2.7)	--	3.3 (1.1)	10.6 (3.6)	27.0 (9.1)	53.5 (18.1)	5.6 (1.9)	20.3
C without Alameda [C3 only] (23.7 acres - 9.6ha)	--	23.7 (100)	--	--	--	--	--	--	--	--	36.8
D [D1] (157.5 acres - 63.8ha)	10.3 (6.5)	36.6 (23.2)	14.0 (8.9)	16.9 (10.7)	9.8 (6.2)	--	--	39.0 (24.8)	6.9 (4.4)	24.0 (15.2)	34.1
E [E1] (132.8 acres - 53.8ha)	--	72.6 (54.7)	18.1 (13.6)	1.8 (1.4)	5.1 (3.8)	--	1.3 (1.0)	24.2 (18.2)	2.6 (2.0)	7.1 (5.3)	36.1
G indirect [G1] (26.1 acres - 10.6ha)	--	6.2 (23.8)	3.2 (12.3)	0.3 (1.1)	--	1.8 (6.9)	--	10.0 (38.3)	4.6 (17.6)	--	11.7
G with Alameda [C1,C3,G1,D1,E1] (612.3 acres - 248.0ha)	60.5 (9.9)	253.0 (41.3)	35.2 (5.7)	27.0 (4.4)	15.0 (2.4)	5.1 (0.8)	12.0 (2.0)	100.3 (16.4)	67.7 (11.0)	36.6 (6.0)	26.9
G without Alameda [C3,G1,D1,E1] (340.1 acres - 137.7ha)	10.3 (3.0)	139.0 (40.9)	35.2 (10.4)	18.9 (5.6)	15.0 (4.4)	1.8 (0.5)	1.3 (0.4)	73.3 (21.6)	14.1 (4.1)	31.0 (9.1)	33.4
F [F1] (54.1 acres - 21.9ha)	10.4 (19.2)	43.7 (80.8)	--	--	--	--	--	--	--	--	34.9
A indirect [A1] (69.8 acres - 28.3ha)	11.7 (16.7)	29.9 (42.8)	--	--	0.8 (1.1)	0.3 (0.4)	4.0 (5.7)	8.8 (12.6)	14.4 (20.6)	--	17.6
A with Alameda [C1,C3,G1,D1,E1,F1,A1] (736.1 acres - 298.1ha)	82.6 (11.2)	326.5 (44.4)	35.2 (4.8)	27.0 (3.7)	15.7 (2.1)	5.4 (0.7)	16.0 (2.2)	109.0 (14.8)	82.0 (11.1)	36.6 (5.0)	26.6

Table 2. Land Cover of Subwatershed Draining to the MWTS (continued).

SUBWATERSHED [See Fig.1]	LAND COVER TYPE IN ACRES* (% of subwatershed) Low Density Residential	Med. Density Residential	Multi-Family Residential	Commercial	Public and Institutional	Open Water	Wetland	Grassland	Woodland	Highway	Impervious %
A without Alameda [C3,G1,D1,E1,F1,A1] (463.9 acres - 187.9ha)	32.5 (7.0)	212.6 (45.8)	35.2 (7.6)	18.9 (4.1)	15.7 (3.4)	2.1 (0.5)	5.4 (1.2)	82.1 (17.7)	28.5 (6.1)	31.0 (6.7)	31.2

STUDY METHODS

RUNOFF AND BASEFLOW SAMPLING

Monitoring of the MWTS began on March 10, 1995, with a snowmelt event and ended on November 4, 1996, with a 0.28 inch (0.71 cm) rainfall event. A total of 35 events were sampled (Table 3), in addition to quarterly baseflow sampling. Figure 4 illustrates the occurrence of rainfall events versus those events that were sampled (see also later section on Climatological Conditions). Clearly, the focus was on events over 0.25 inches (0.64 cm); every event over 1.0 inch (2.54 cm) was sampled. Appendix B contains precipitation specifics for the period of study, showing the variation between high and low precipitation periods as the study progressed.

Sampling efforts focused on the collection of runoff from rainfall and snowmelt events in order to assess system performance during periods of high loading. Flow was recorded continuously at all six sites and automatically sampled during runoff events. There were brief periods at each site when continuous flow data was not recorded due to instrumentation failure. Automatic flow data was not recorded at Site F for 1995 due to instrument installation problems. When recorded data were not available, hydrologic modeling was used to fill in information.

Flow depth was continually recorded with either Keller or Druck pressure transducers. A Lundahl ultrasonic sensor was used at Site A early on in the study and was transferred to Site E for several weeks before it was replaced with a Keller pressure transducer. The ultrasonic sensor did not work well in the high humidity and small confined spaces of the storm sewers. The pressure transducers were connected to CR-10 Campbell Scientific dataloggers that recorded date, time, head readings, and discharge (cfs). Continuous readings were recorded at 15 minute intervals except during events when flow levels were recorded at either 5 or 10 minute intervals for sites C, D, E, and F. Readings were recorded at 30 minute intervals at sites A and G. The head readings were routinely checked by field staff to verify their accuracy. Winter baseflow was manually recorded weekly.

All electronic dataloggers were stored in air tight boxes containing desiccant. The instrumentation was secured in 0.75 inch (1.90 cm) thick treated plywood boxes with metal tops. PVC plastic or galvanized pipe was used to protect the wiring leading from the boxes to the stream or culvert. The pressure transducers were secured to either the cement storm sewer wall or to a metal stake driven in the streambed.

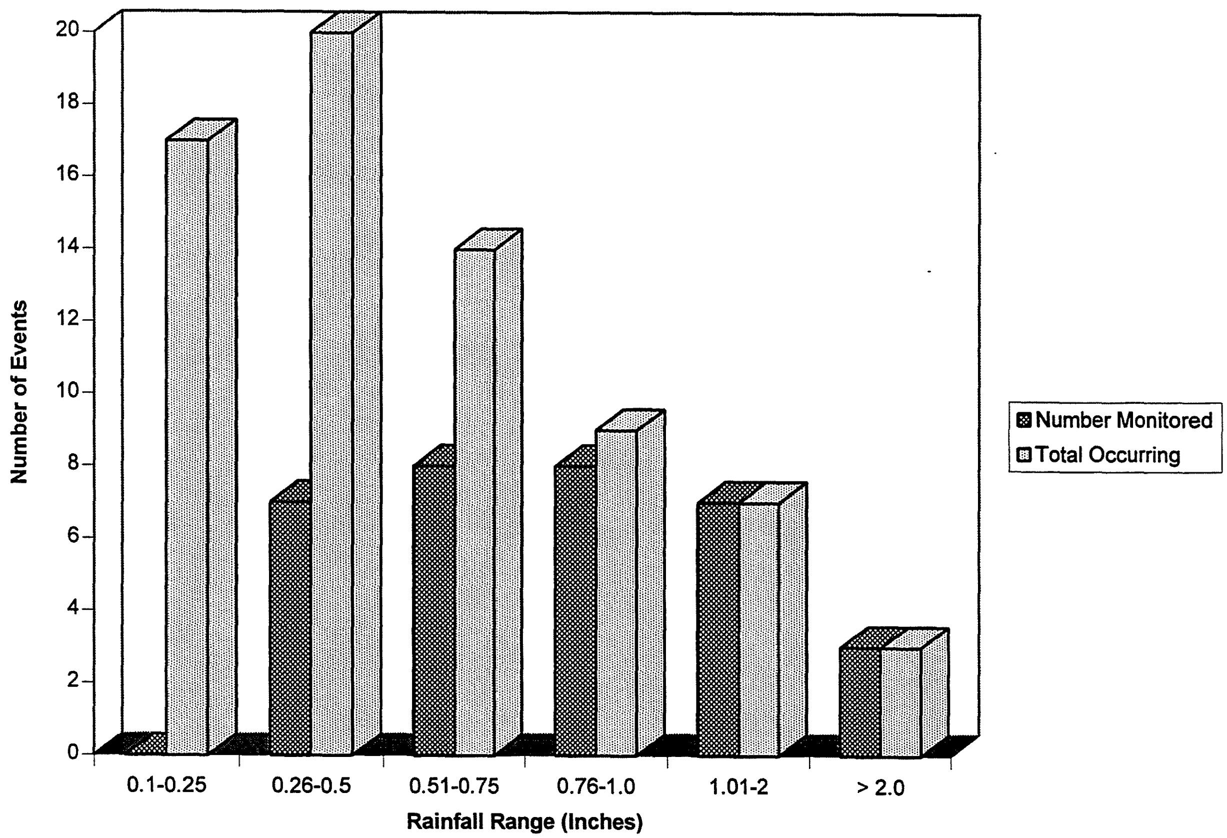
Water temperatures were measured with a Campbell Scientific 107B thermistor probe and a Campbell Scientific 247 combination thermistor and conductivity probe, at sites A and D respectively. Thermistor probes were checked in the field with a Fisher digital thermometer. Water temperature data at the wetland outlet (Site A) was collected from mid summer 1995 to fall 1996. Water temperature at one of the tributary sites (Site D) was collected from July 1996 to fall 1996. The temperature probes were removed before late fall freeze-up and reinstalled shortly before snowmelt.

Rainfall was continually collected in a Sierra tipping bucket rain gauge. The gauge tipped with every 0.01 inch (0.025 cm) of rain and was recorded on the datalogger mentioned previously. Two wedge rain gauges were installed as a back-up to the Sierra tipping bucket rain gauge, one next to the tipping bucket and one near sampling site G.

Table 3. Sampling History of McCarrons Wetland Treatment System

Date	Precipitation, inches (cm)	Site Monitored
1994 November 15	Sediment	10 Sites
1995 March 11-16	Melt	All
March 19-20	0.30 (0.76)	All
March 25-26	0.76 (1.93)	A,C,G
April 18	0.89 (2.26)	All
May 13	0.64 (1.63)	All
May 19	Baseflow	A,D,E,G
May 27-28	2.03 (5.16)	All
June 5-6	1.49 (3.78)	All
June 26-27	0.84 (2.13)	All
July 4-6	1.87 (4.75)	A,C,D,F,G
July 11	Baseflow	A,C,D,E,G
July 14-15	3.29 (8.36)	A,C,D,F,G
August 6	0.80 (2.03)	All
August 11	0.56 (1.42)	A,C,D,F,G
August 13	0.72 (1.83)	A,C,D,E,G
September 5	Baseflow	A,C,D,E,G
September 29-October 1	1.30 (3.30)	All
October 2	0.44 (1.12)	All
October 5-6	0.92 (3.36)	All
October 23	1.68 (4.27)	All
1996 January 23	Baseflow	A,D,E,G
February 24	Melt	All
March 11-14	Melt	All
April 23	Baseflow	A,C,D,E,G
May 2	0.60 (1.52)	A,C,D,E,G
May 18-19	1.48 (3.76)	All
June 6	2.12 (5.38)	All
June 16-17	1.62 (4.11)	All
June 21	1.40 (3.56)	All
July 2	Baseflow	A,C,D,E,G
July 6	0.48 (1.22)	A,D,F,G
July 27-28	0.58 (1.47)	All
August 5-6	0.62 (1.52)	A,D,E,G
August 6-7	0.76 (1.93)	A,D,E,F,G
August 22	0.34 (0.86)	All
September 20	0.34 (0.86)	A,D,F,G
September 25-27	0.44 (1.12)	A,D,E,F,G
October 16	Baseflow	A,D,E,G
October 16-17	1.42 (3.61)	A,E,F,G
October 22-24	0.74 (1.88)	All
October 29-30	0.96 (2.44)	All
November 4	0.28 (0.71)	All
November 7	Sediment	10 Sites

Figure 4. Monitored Events Compared To Total Events



Water samples were collected with ISCO or Sigma, 24-bottle automatic samplers. The samplers were installed in the plywood boxes and set-up using Tygon tubing. The ISCO and Sigma samplers contained 500 and 1000 ml bottles, respectively. To prevent plugging, all samplers used plastic strainers at the termination of the Tygon tubing in the stream or storm sewer. All samplers were triggered by changes in water depth (flow), and were calibrated and programmed for a single rinse and purge cycle before sampling the stormwater. The samples were collected on a flow basis and flow-composited.

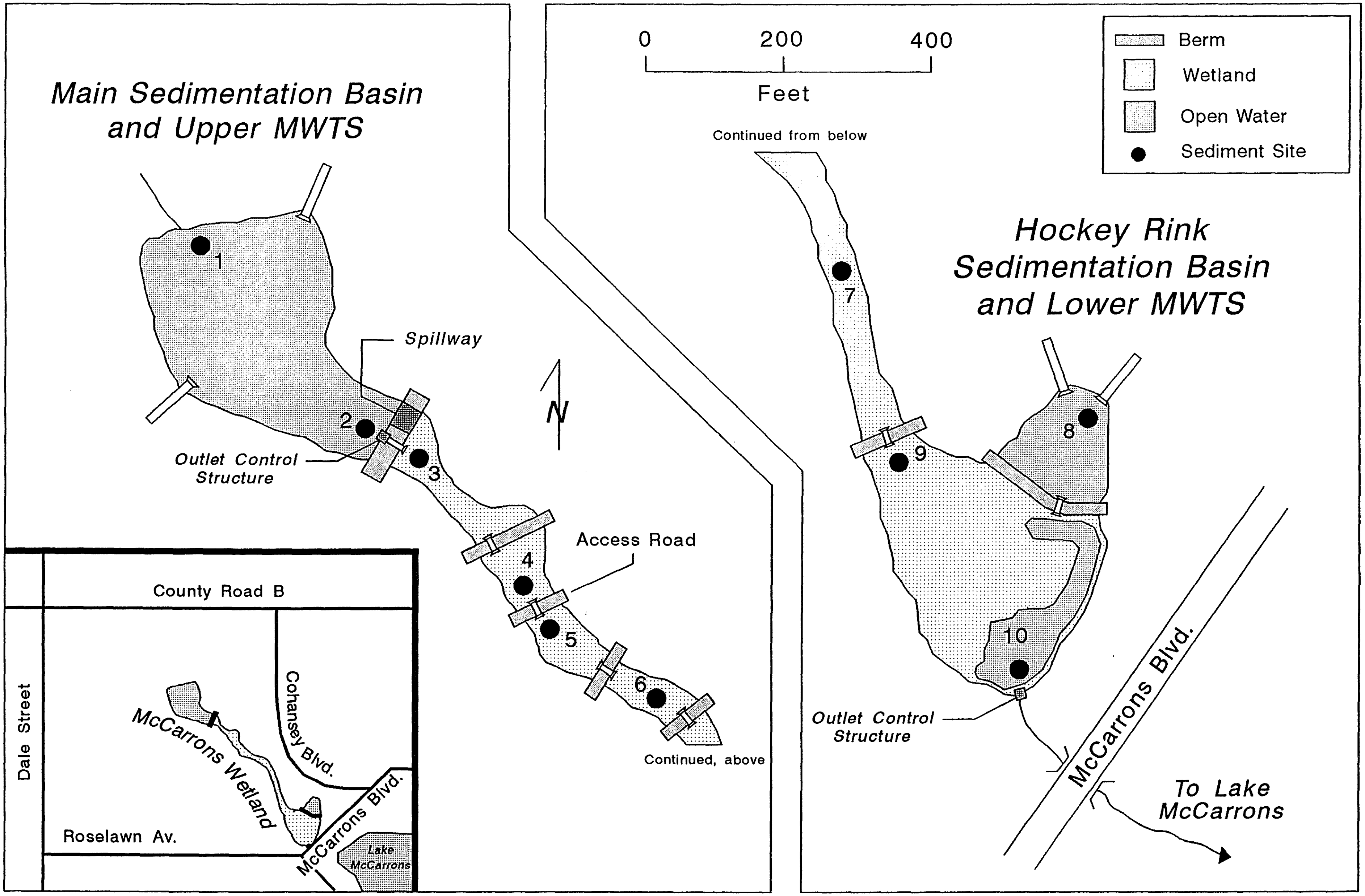
Baseflow samples were manually collected quarterly and processed according to the same methods as event samples.

SEDIMENT SAMPLING

Sediment samples from 10 sites were collected on two different occasions. Sediment samples were collected throughout the wetland system to determine sedimentation rates, as well as various physical and chemical parameters. Bathymetry on both the headwater and the hockey rink detention ponds was recorded on October 14, 1994 and November 7, 1996 (results presented in later section). Soils samples were collected at the 10 sites noted in Figure 5 at the beginning and end of the study on November 15, 1994 and November 7, 1996, respectively. Samples were collected with either a ponar dredge or by directly scooping the sediment into the container. Appendix C contains descriptions of each site in more detail.

Sediment samples were placed into one-liter plastic containers and put on ice until they were delivered to the laboratory for analysis.

Figure 5. MWTS Sediment Sampling Sites, November 1996



LABORATORY PROCESSING

Following each sampled event, the sample bottles were labeled, numbered and collected in iced coolers and subsequently transported to the Metropolitan Council Environmental Services (MCES) laboratory located at the Metropolitan Wastewater Treatment Plant. The flow data was downloaded from the dataloggers with a laptop computer using the Campbell interface software GT through an RS 232 port. Once in the laboratory, the raw data were entered into a Lotus spreadsheet, where the proportional flow composite volumes from the discrete field samples were determined. Samples were then flow-composited; that is, placed proportionately in a single sample based on flow rate at the time of sampling. The samples were then split into the appropriate bottles and submitted for analysis. All empty sample bottles were washed at the lab using phosphorus-free detergent.

Quarterly baseflow samples were handled by taking one grab sample (2000 ml) and recording the stage. The sample was split into the appropriate bottles at the lab and submitted for analysis.

For quality control and assurance, field standards containing pre-determined concentrations of total phosphorus were submitted on several occasions. For 1995, several of the total phosphorus (TP) and dissolved phosphorus (TDP) concentration results had to be re-run because some of the blind standards results were not within acceptable error ranges. In 1996, extra blind samples were submitted and the results were all within the accepted limits.

Sample processing at the MCES laboratory includes homogenous subsampling and pre-filtering for dissolved parameters. Analysis and preservation was done by laboratory staff. The methods of analysis used by the MCES laboratory are all U.S. EPA approved methods, which follow Standard Methods or ASTM guidelines. The laboratory also has its QA Manual on file with the Minnesota Department of Health, which is the state entity that certifies NPDES permit related laboratories.

After a final composite of 2000 ml for each sampled site is prepared, the following analysis were completed:

Parameter	Volume ml.	Preservation
-Total suspended solids(TSS) and volatile suspended solids (VSS)	1000+	Cool to 4 C.
-Total phosphorus (TP)	150	0.2 ml conc. H2SO4
-Dissolved phosphorus, (TDP)	150 (filtered)	0.2 ml conc. H2SO4
-Chemical oxygen demand (COD)	50	0.2 ml conc. H2SO4
-Total Kjeldahl nitrogen (TKN)	50	0.2 ml conc. H2SO4
-Nitrate (NO3), Nitrite (NO2)	20	0.2 ml. Chloroform
-Ammonia (NH3)	20	0.1 ml. 30% H2SO4
-Total copper (TCu), Total zinc (TZn), Total Lead (TPb)	250	1.0 ml conc. HNO3

Total nitrogen (TN) is reported as the sum of total Kjeldahl nitrogen (TKN), nitrates and nitrites. TKN is the sum of organic nitrogen (ORG-N) plus ammonia (NH3). ORG-N is, therefore, reported as the difference between TKN and NH3. NO2+3 is reported as the sum of nitrites and nitrates.

Some adjustments were made in laboratory procedures during the course of the study. To aid in laboratory detection of phosphorus, it was resolved after the first year that a larger aliquot of 150 ml for both parameters (TDP and TP) would be submitted to the lab in 1996. TCu was analyzed in 1995, but was rarely detected. As a result, it was replaced in 1996 with TPb. TZn was collected throughout the duration of the study.

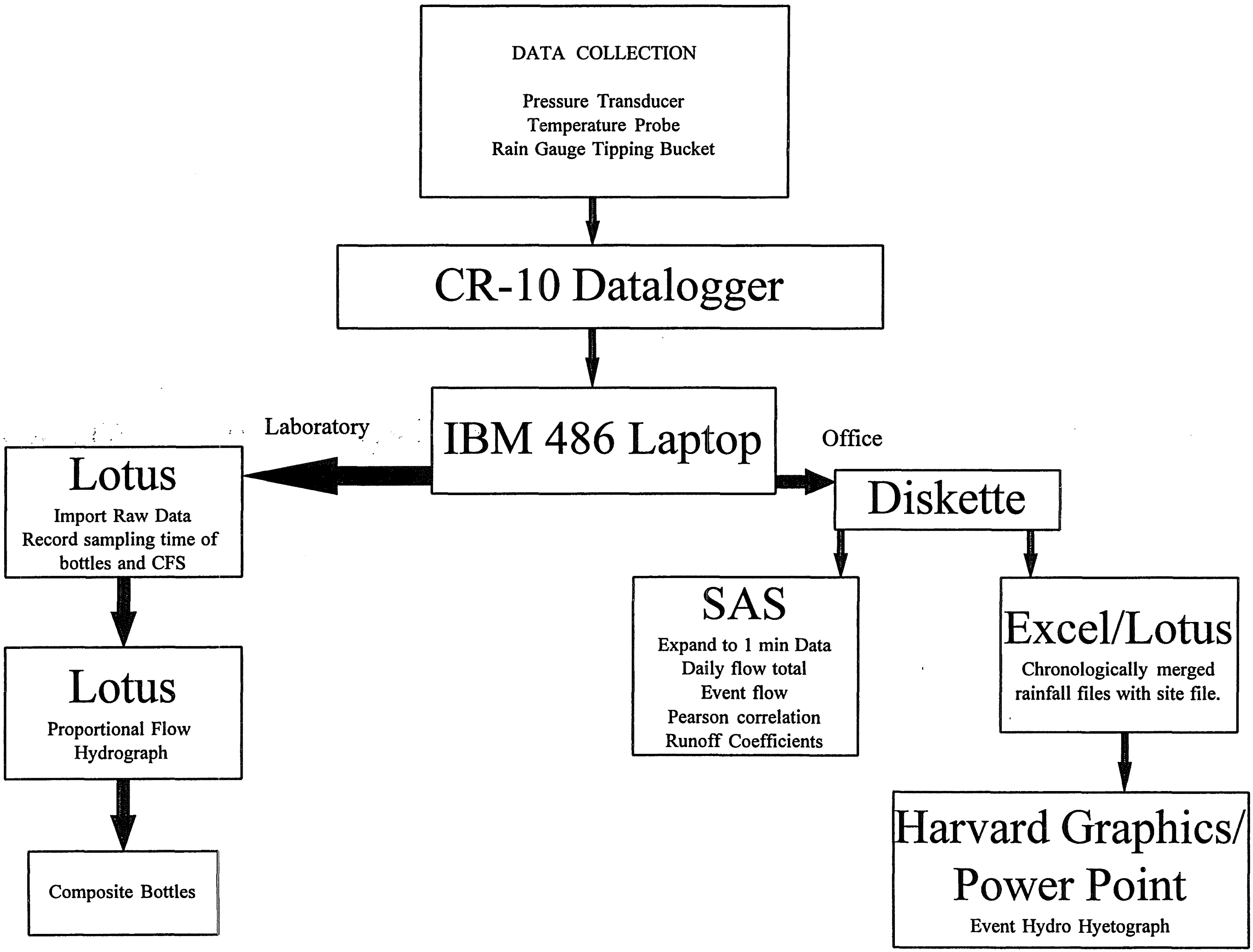
Nitrite and nitrate laboratory testing detection limits changed from 1995 to 1996. The laboratory changed the detection limits for nitrates and nitrites June 1, 1996. Reported nitrate "less than" values changed from <0.02 to <0.05 mg/l, and reported nitrite "less than" values changed from <0.01 to <0.03 mg/l. There was no change in the test procedures, only a minimum reporting level change as the test was incorporated into a LIMS (Laboratory Information Management System) computer system. The laboratory no longer uses the detection limit of the test for the reported "less than" value.

DATA MANAGEMENT

As previously described, all sites were equipped with Campbell Scientific dataloggers that recorded date, time, water level, and discharge rates; in addition, temperature data was collected at sites A and D. Raw water level data was recorded every one minute, then stored as five, ten, fifteen, or thirty minute averages. Continuous readings for sites C, D, E, and F were recorded at 15 minute intervals except during events when flow levels were recorded at either 5 or 10 minute intervals. Sites A and G were recorded at 30 minute intervals, with events recorded at 15 minute intervals. The water level records are continuous with a few gaps during periods when the equipment was not working correctly. Rainfall data was continuously recorded during periods of rain; the datalogger recorded each 0.01inch (0.025 cm). Temperature data was continuous for a somewhat shorter time period, as noted previously.

The raw data were initially downloaded, stored and transported on the laptop computer. The data were later transferred to diskette and imported into SAS (Statistical Analysis System, Statistics Institute Inc., Version 6) as a permanent continuous database where the data set was expanded into one minute averages. The summation of flow totals for events as well as daily flow totals were completed and stored in SAS. Some statistical analysis was completed in SAS, but most of the statistical analysis was completed in Microsoft Excel. Daily flow and event flow totals data were transferred from SAS into Excel for this analysis. Excel was used extensively for data graphing and statistical analysis. Figure 6 graphically portrays the data handling system.

Figure 6. McCarrons Wetland Project Data Flow Chart.



CLIMATOLOGICAL CONDITIONS

The yearly precipitation totals for both 1995 and 1996 were above the normal yearly precipitation total at the Minneapolis-St. Paul International Airport. Appendix B summarizes by month the amount of rain and snow (water equivalent) that fell during the study and shows graphically the individual rainfall events that occurred during the period of study. The appendix also contains actual daily rainfall data and a comparison of the precipitation with normal conditions at the Minneapolis-St. Paul International Airport as complied by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), Environmental Data and Information Service, National Climatic Center. The long-term average monthly rainfall is based on data collected at or near the airport site since 1891, and the snowfall equivalent data is from 1939 to present.

Precipitation conditions in 1995 were characterized by very high months of rain in July, August, and October, and low months of precipitation in January, February, September, and November. In 1996, precipitation conditions were below normal during the months of February, April, July, August, and September, but above normal during the months of May, June, October, November and December. The largest single event of the period of study occurred on July 14-15, 1995, when a total of 3.28 inches (8.33 cm) of rain fell over a two-day period. The most intense part of this rainfall event occurred on July 14, when 2.63 inches (6.68) fell over a four hour period. This amount of rain caused large amounts of flow to overtop the spillways and berms at Sites A and G.

The winter of 1995 was very mild with little snowfall. The entire seasonal snowfall was only 23.20 inches (58.93 cm), far below the long-term average of 49.9 inches (126.75 cm). The winter of 1996 was close to normal with 45.9 inches (116.59 cm). The differences in snowmelt between these markedly different years will be discussed later in the report.

For purposes of this study, a rainfall "event" was defined as more than 0.10 inches (0.25 cm) of rain, based on field observations of initial abstraction. Zero runoff generally occurred at rainfalls less than 0.10 inches. The number of rainfall events over 0.10 inches (0.25cm) during the study was 70. Figure 4 previously showed the distribution of events that occurred during the sampling period and the number of each range that were sampled. A variety of events of different magnitude were sampled; the sampling objective was not to sample at the same frequency as occurrence, rather to collect a wide range of events with emphasis on those that are likely to contribute substantial loads. This was accomplished.

RESULTS

HYDROLOGIC RESPONSE

Continuous instantaneous flow (1 minute intervals) was monitored at all sites during the period of study with some exceptions. Difficulties with backwater were experienced at Site F during 1995. This problem was overcome in 1996 with the placement of the flow sensor further upgradient. Periods of sensor or recorder malfunction also led to occasional loss of flow data. When flow data were absent, hydrologic models (P8, Walker) or flow balance methods were used to fill in missing data.

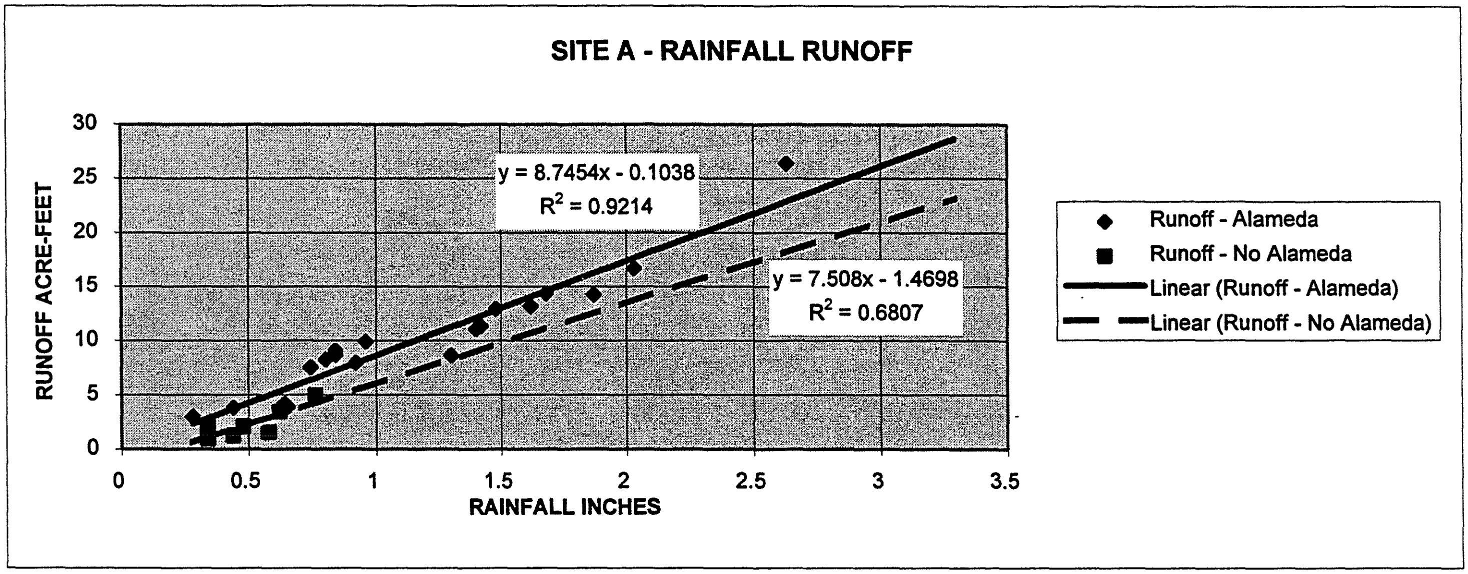
Figures 7a and 7b illustrate the rainfall-runoff relationships seen at each monitored site. Figure 7a contains those subwatersheds affected by outflow from Alameda Pond, while Figure 7b shows those that are not influenced by Alameda outflows. Only confidently recorded flows are included in the figures to attain accuracy. Daily flow plots using all monitored and modeled data are included in Appendix D. Note that an initial abstraction of about 0.10" (0.25 cm) occurs at each site except F, where scattered data resulted in a poorer fit.

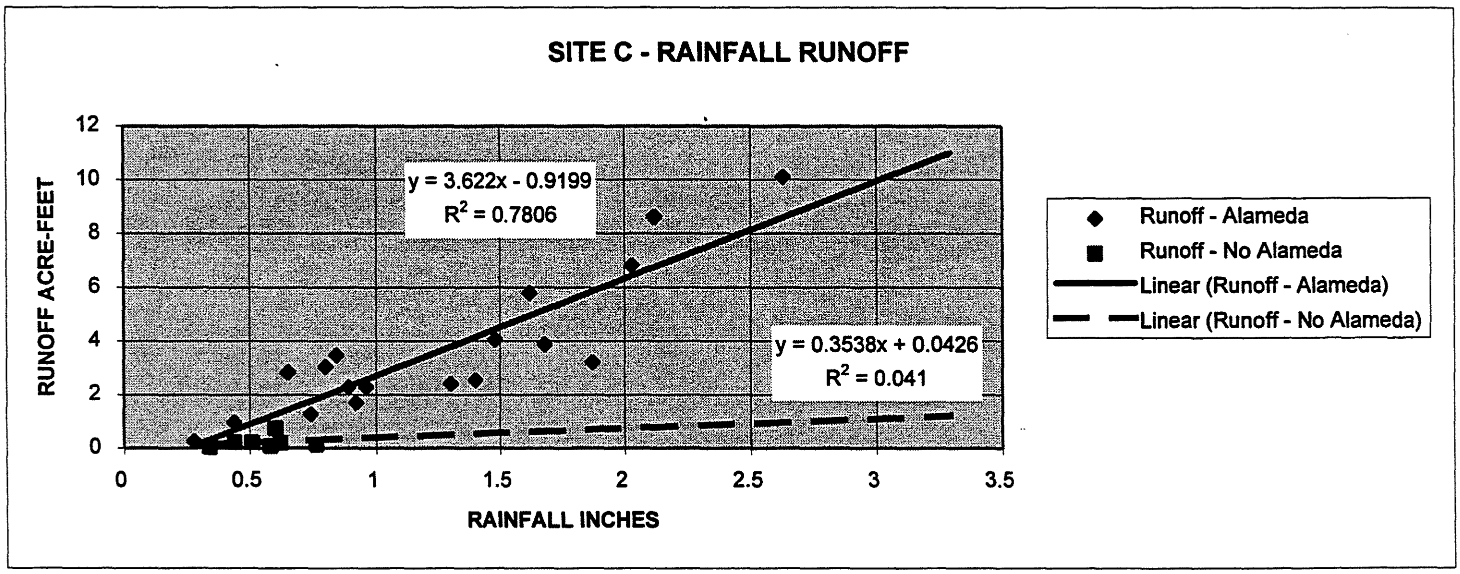
Following is a list of the overall runoff coefficients tabulated at each site.

	RUNOFF COEFFICIENT		
SITE	Overall	W/Alameda	No Alameda
A	0.14	0.15	0.14
C	0.13	1.11	0.22
D	0.17	--	--
E	0.29	--	--
F	0.13	--	--
G	0.15	0.16	0.13

The data presented above were somewhat difficult to generate because of the unique situation at Alameda Pond in the subwatershed draining directly to Site C, then through sites A and G. The problem is that Alameda Pond starts out dry for most events and must fill prior to contributing to flow at Site C. Once Alameda flows, another 272 acres (101.2 ha) contribute to a site that previously drained only 24 acres (9.7 ha). Flow from the outlet of Alameda Pond was not electronically monitored during the event, therefore, exact time of contribution, if ever, was not recorded. Similarly, total volume contribution specifically from Alameda Pond and its subwatershed was not documented. In putting together the data, the maximum subwatershed area was used whenever Alameda Pond flow was known to contribute any flow whatsoever to Site C. The result is that the runoff coefficient given above will be slightly lower than might be actually seen because the runoff volume is spread over a larger area than contributed for the entire event. Therefore, some caution should be used in the interpretation of runoff coefficients from Sites C, G and A, which are all influenced by the flow volumes from Alameda Pond.

ɟure 7a. Rainfall-Runoff Relationships for Monitored Sites Influenced by Alameda Pond.





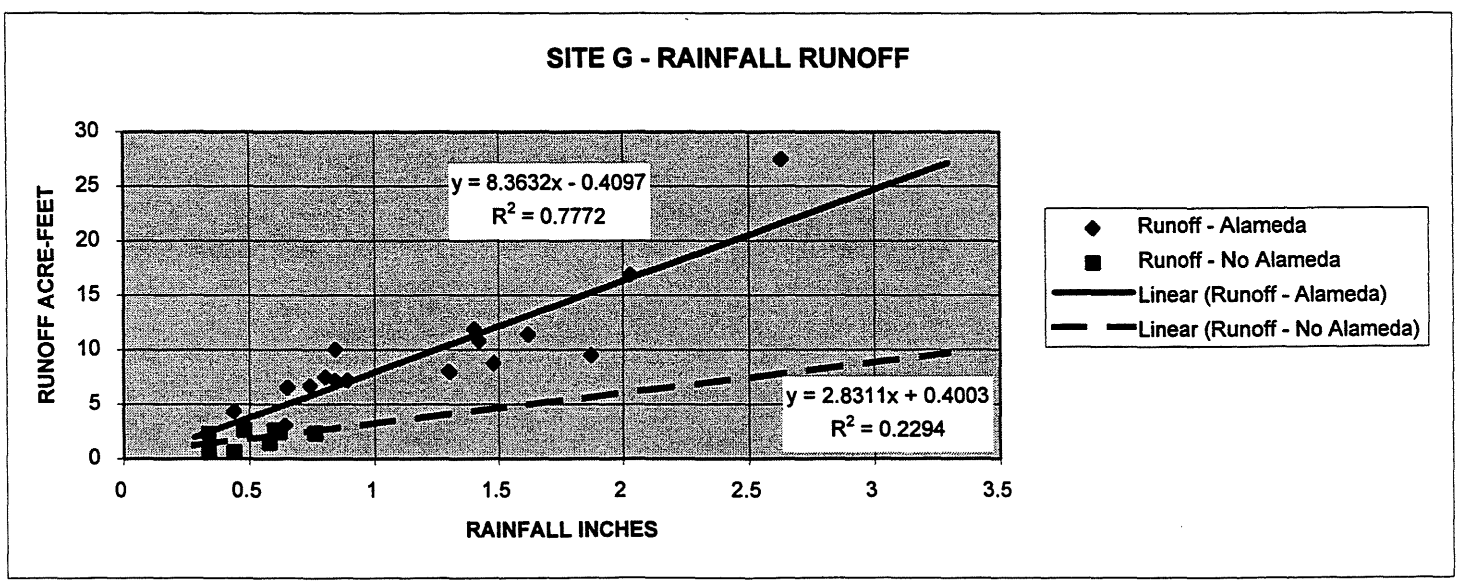
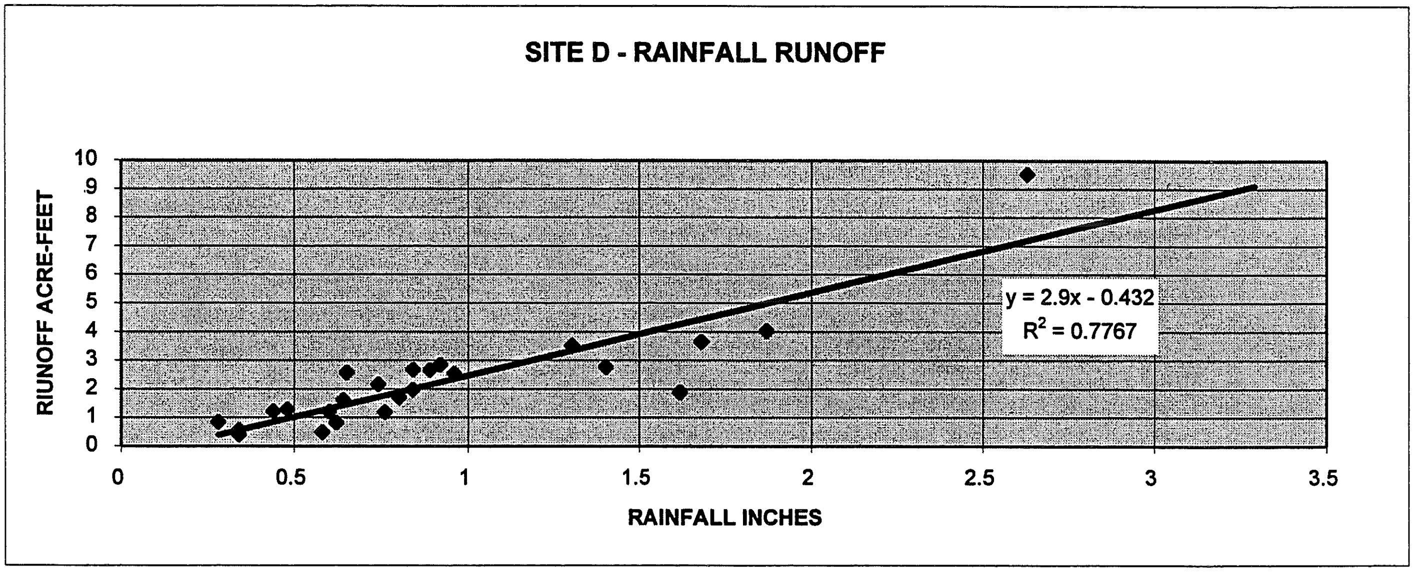
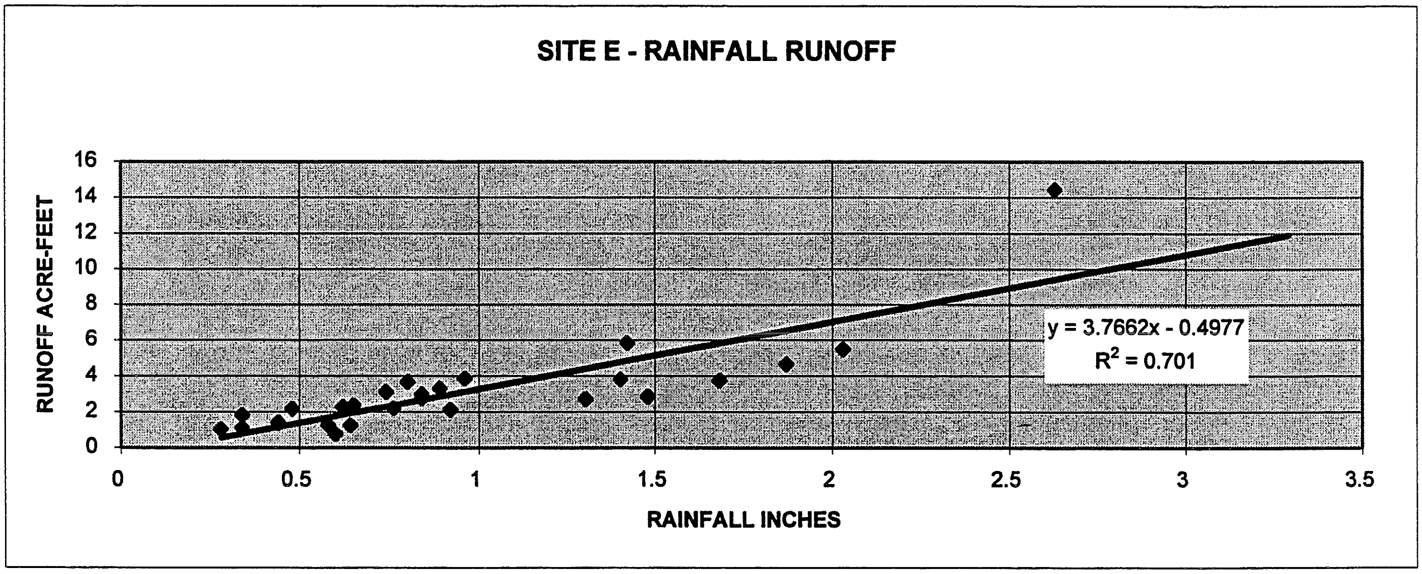
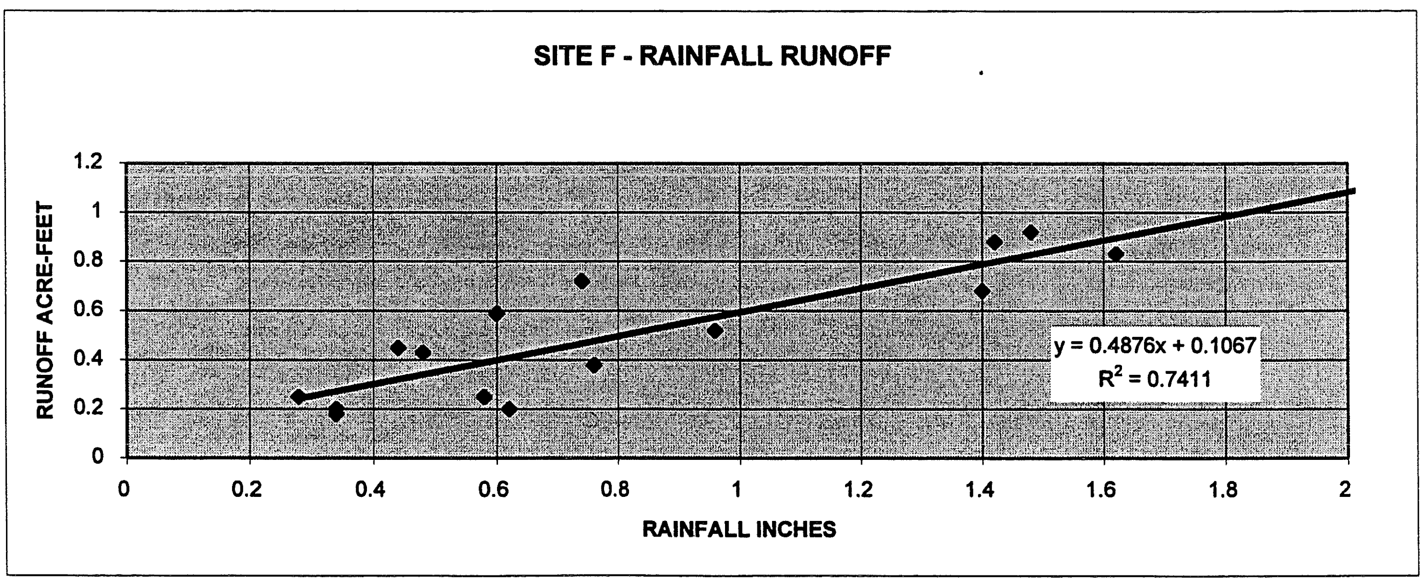


Figure 7b. Rainfall-Runoff Relationships for Monitored Sites Not Influenced by Alameda Pond.







WATER QUALITY

Event Concentration data

A total compilation of event mean concentrations (EMC) for each monitored site is contained in Appendix H. An "event mean concentration" is derived by compositing measured increments of sampled runoff based on the amount of flow that occurred when the sample was taken; that is, the higher the flow, the larger incremental volume added to the composite. This gives an "average" value for the event concentration.

Table 4 uses the EMCs as input to determine the "flow-weighted mean" (FWM) concentrations for all monitored events at each site. The FWM concentration is the total load of a particular contaminant for the entire study period divided by the total flow, thus averaging high flows with low flows to determine a single mean value for the period of study. Also included in Table 4 are the mean values for all of the event mean concentrations (EMCs) of the monitored events. The FWM and mean of the EMCs merely give different interpretations of the "average" concentration. Note that the FWM and mean EMC values are nearly equal in most instances.

Samples were analyzed for total copper (TCu) during all of 1995 and the spring of 1996, and for total lead (TPb) for all of 1996. Summaries of these metals are not contained in the discussion because of the large number of results with levels "less than" the minimum reportable concentration. This a dramatic change from earlier (1980s) Metropolitan Council and nationwide runoff studies in which relatively high levels of lead were also observed. For example, the Phase II McCarrons study (Oberts and Osgood, 1988) showed runoff site FWM values for TPb to range from 0.076-0.137 mg/l, whereas few Phase III measured above the detectable level of 0.050 mg/l. Levels for other early 1980s studies were similarly high, with the Nationwide Urban Runoff Program (NURP) median value for urban areas ranging from 0.104-0.144 mg/l (U.S. EPA, 1983), and a Minnesota Department of Transportation study (MnDOT, 1981) study showing a median highway level of TPb at 0.475 mg/l. The change away from lead in gasoline has had a very noticeable affect on the environment. Copper levels were not monitored in the previous Metropolitan Council studies, but it does not appear to be present at noticeable levels at this time.

Figures 8a-c illustrate the variability of pollutant concentration at each site for the solid, phosphorus and nitrogen related parameters, respectively, via box plots. Figures 9a-c similarly illustrate the difference in FWM concentrations with flow through the system, and the differences between the phase II data and the Phase III data. The order of presentation in each graphic represents the manner in which water flows into and through the system. That is, the three tributaries (C, D, E) flow into G, whose outflow is joined by tributary F as inflow to site A (see also Figure 2). The figures portray the general trend seen in most events of high tributary concentrations, and relatively low outflow concentrations from the detention pond (site G) and the MWTS (site A). The figures also show the high relative concentrations in Phase II relative to Phase III. Variability in the load behavior through the system will be covered later in this report.

Table 4. Flow-Weighted Mean Concentrations for Monitored Events.

Flow-Weighted Mean Concentration (mg/l) [(Total load/total flow) * k]
Minimum
Maximum
Events
[Mean of all event mean concentrations (EMCs)]

SITE	TSS	VSS	TP	TDP	COD	TKN	ORG-N	NH3	NO2+3	TN	TZn
A	22.6	8.6	0.25	0.13	36.8	1.42	1.11	0.31	0.27	1.69	0.009
	6	3	0.09	0.01	21	0.53	0.24	<0.02	<0.06	<0.86	<0.005
	73	34	0.66	0.50	90	3.70	3.59	1.50	1.19	4.23	0.050
	40	40	40	40	40	40	40	40	40	40	40
	[20.8]	[8.7]	[0.26]	[0.11]	[41.2]	[1.39]	[1.06]	[0.33]	[0.31]	[1.70]	[0.010]
C	48.0	20.6	0.30	0.10	61.4	2.32	2.04	0.28	0.29	2.52	0.015
	13	6	0.09	<0.01	27	0.76	0.50	<0.02	<0.07	<1.11	<0.005
	650	275	2.20	0.41	218	8.30	8.09	1.30	1.65	8.60	0.170
	32	32	32	31	32	32	32	32	32	32	32
	[86.2]	[36.8]	[0.43]	[0.13]	[80.9]	[2.40]	[2.02]	[0.38]	[0.34]	[2.74]	[0.028]
D	92.3	26.7	0.32	0.16	65.6	1.40	1.01	0.40	0.47	1.88	0.037
	13	5	0.12	0.02	28	0.21	0.03	<0.02	<0.22	<0.43	<0.005
	490	102	0.90	0.69	162	4.60	2.97	1.90	1.44	6.04	0.140
	36	36	36	36	36	36	36	36	36	36	36
	[84.2]	[25.7]	[0.33]	[0.15]	[70.2]	[1.47]	[1.02]	[0.46]	[0.52]	[1.99]	[0.041]
E	50.8	13.0	0.33	0.20	46.4	1.45	0.99	0.46	0.62	2.07	0.016
	6	3	0.08	0.03	22	0.32	0.09	0.12	<0.17	<0.60	<0.005
	210	42	0.98	0.83	110	4.40	2.70	1.70	1.40	5.80	0.080
	32	32	32	30	32	32	32	32	32	32	32
	[53.7]	[13.7]	[0.29]	[0.18]	[49.4]	[1.39]	[0.91]	[0.49]	[0.46]	[1.85]	[0.020]
F	130.1	26.1	0.61	0.38	69.5	2.08	1.51	0.59	0.46	2.54	0.016
	7	4	0.11	0.05	23	0.61	0.47	<0.02	<0.10	<0.81	<0.005
	1520	139	3.00	1.40	167	7.67	5.27	2.40	1.50	8.27	0.070
	34	34	33	33	34	33	33	34	33	33	34
	[128.5]	[29.8]	[0.62]	[0.33]	[77.3]	[2.04]	[1.48]	[0.55]	[0.51]	[2.54]	[0.019]
G	23.8	11.0	0.26	0.11	40.1	1.81	1.48	0.33	0.27	2.08	0.010
	4	3	0.04	<0.01	24	0.58	0.20	<0.02	<0.06	<0.69	<0.005
	214	110	0.80	0.53	87	7.00	6.91	1.60	1.08	7.21	0.050
	38	39	39	37	39	39	39	39	39	39	39
	[25.3]	[12.3]	[0.26]	[0.10]	[42.7]	[1.69]	[1.37]	[0.33]	[0.30]	[1.99]	[0.011]

Figure 8a. Solids Related Event Concentration Box Plots.

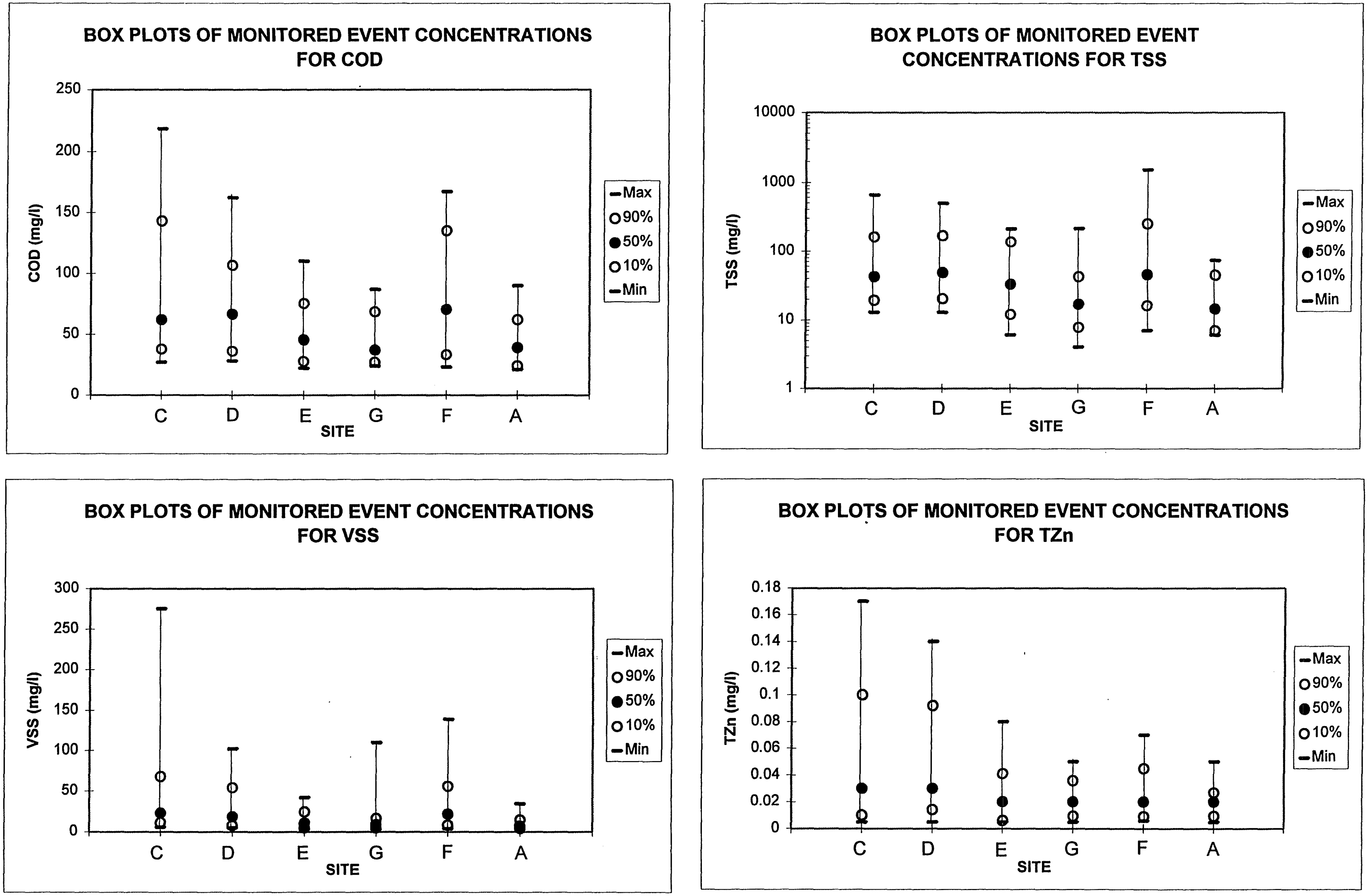
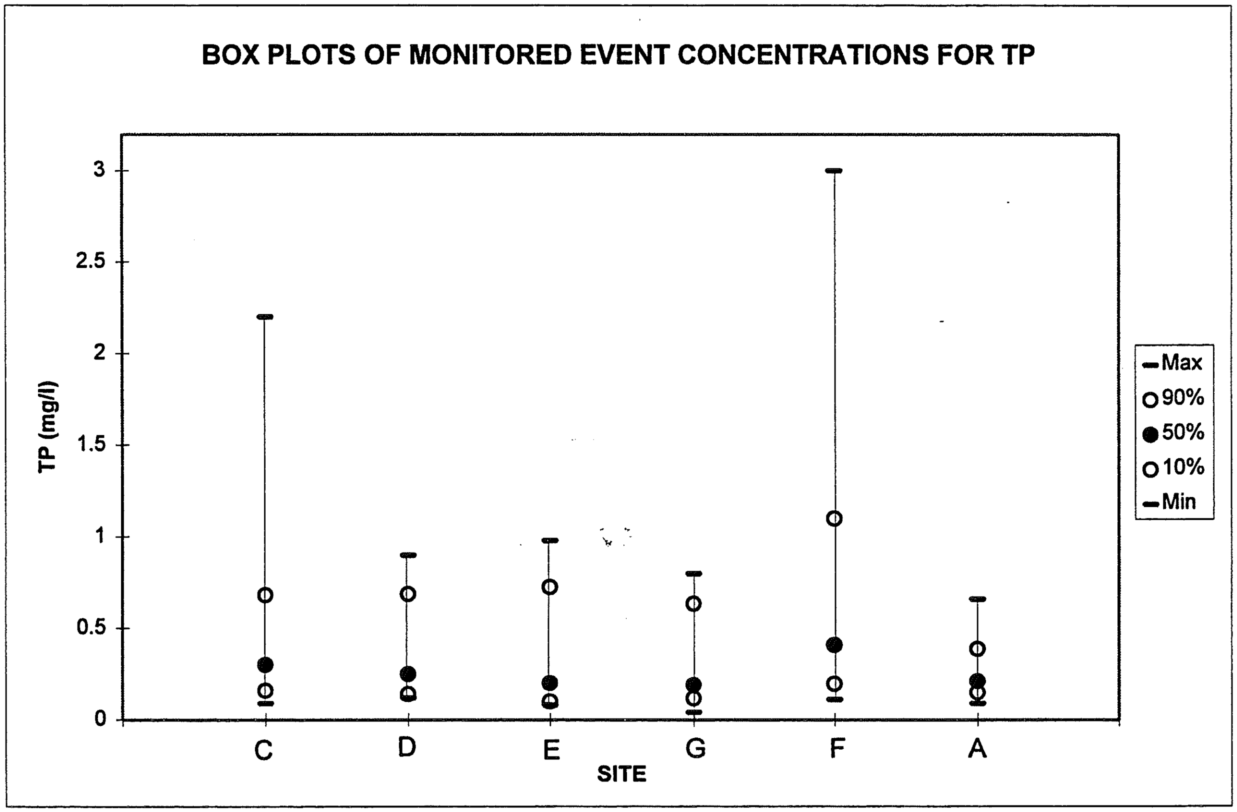


Figure 8b. Phosphorus Related Event Concentration Box Plots.



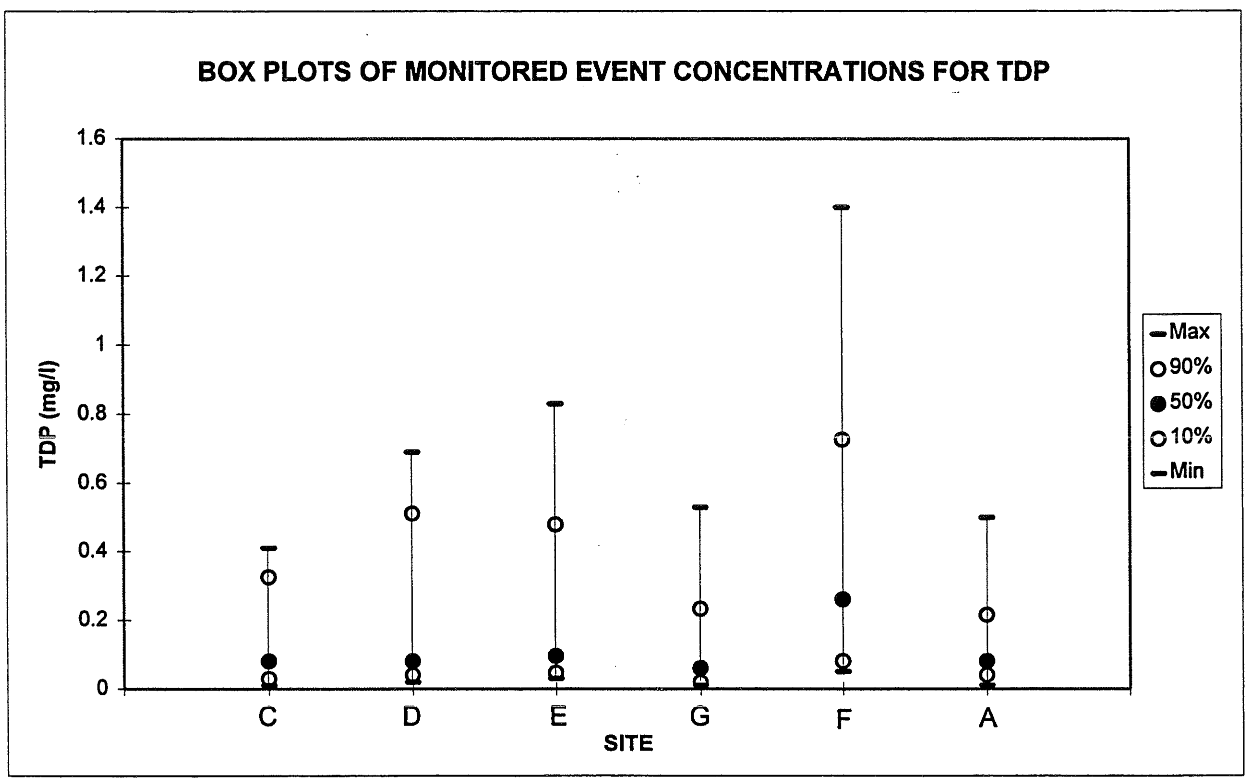


Figure 8c. Nitrogen Related Event Concentration Box Plots.

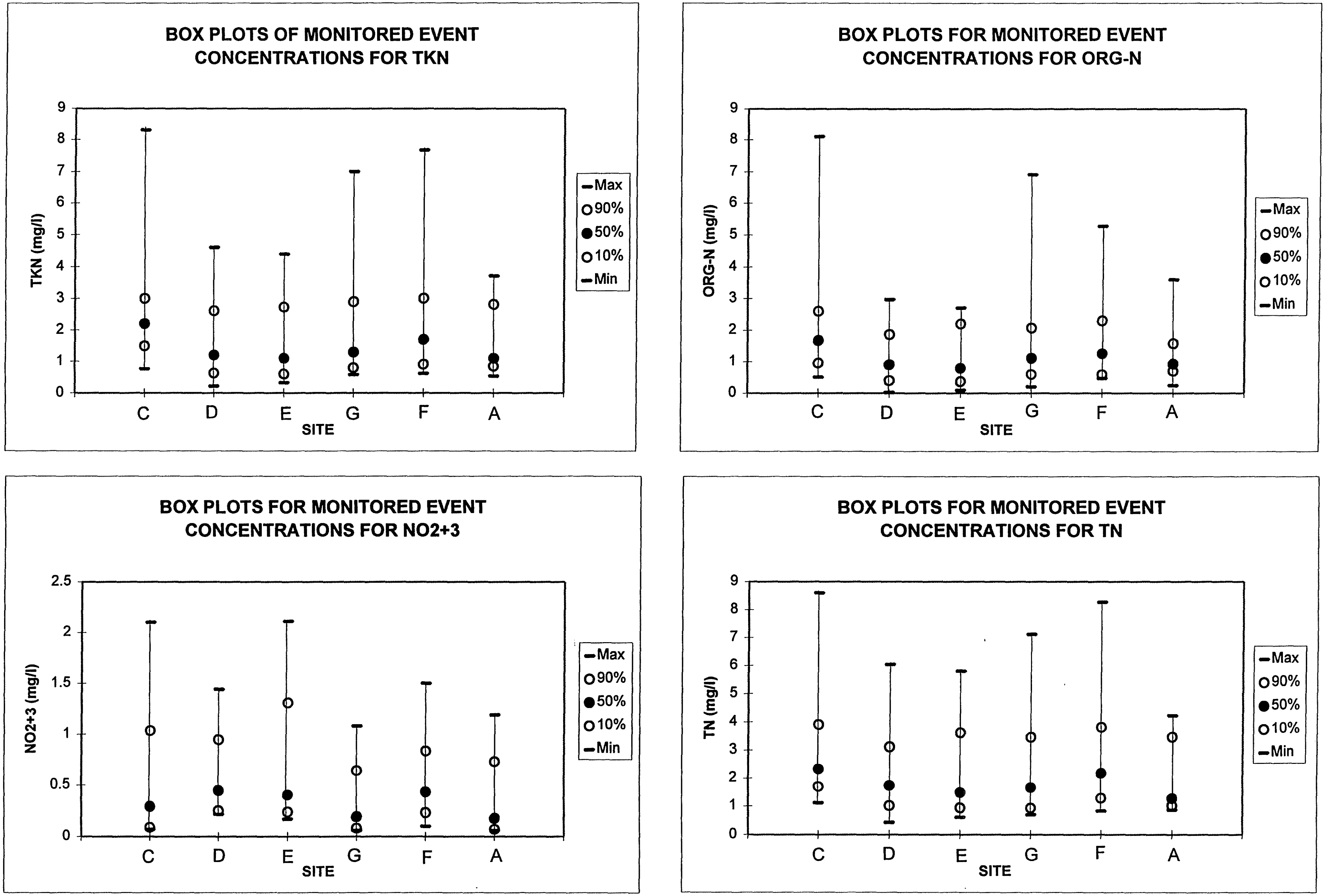


Figure 9a. Flow-Weighted Mean Concentrations for COD, TSS, VSS and TZn -- Phase II vs. Phase III.

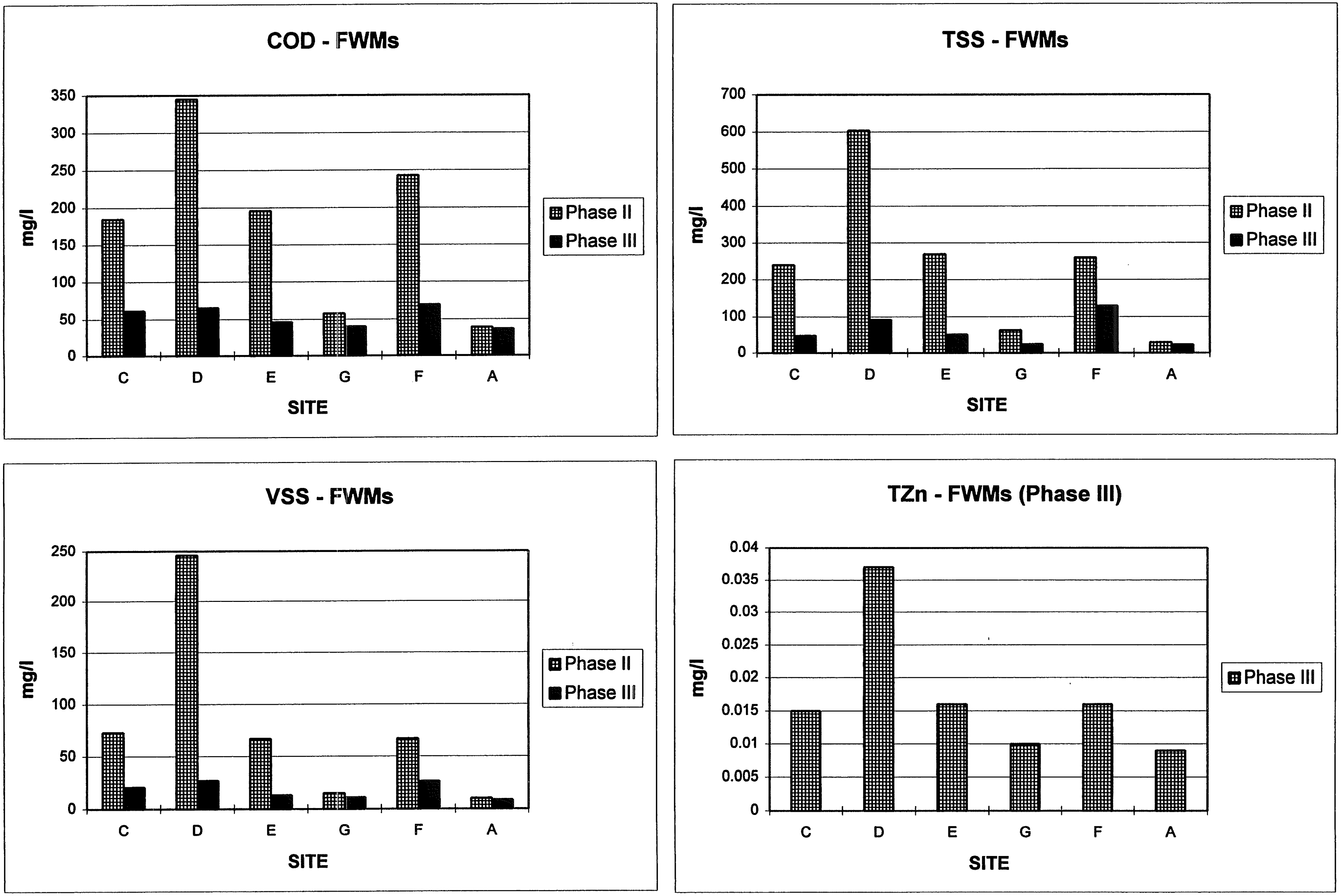
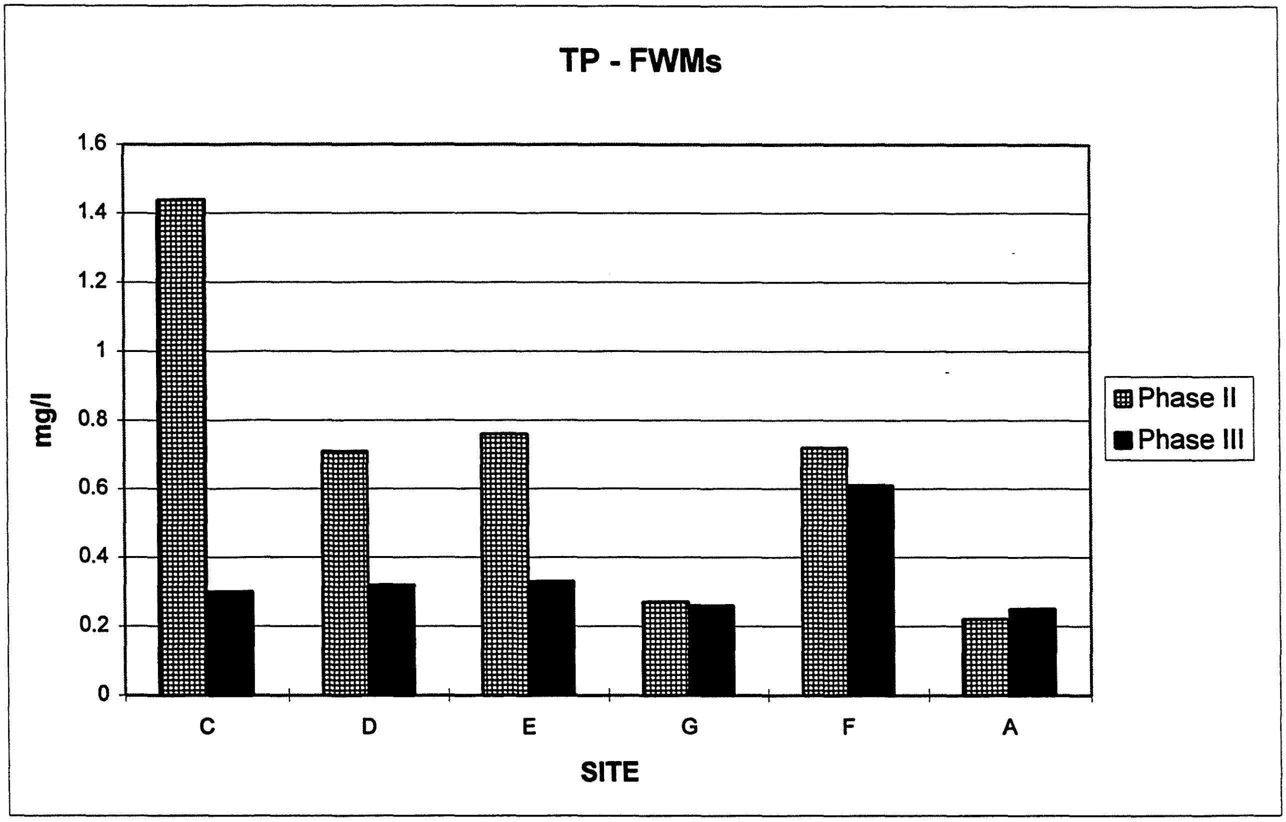


Figure 9b. Flow-Weighted Mean Concentrations for TDP and TP -- Phase II vs. Phase III.



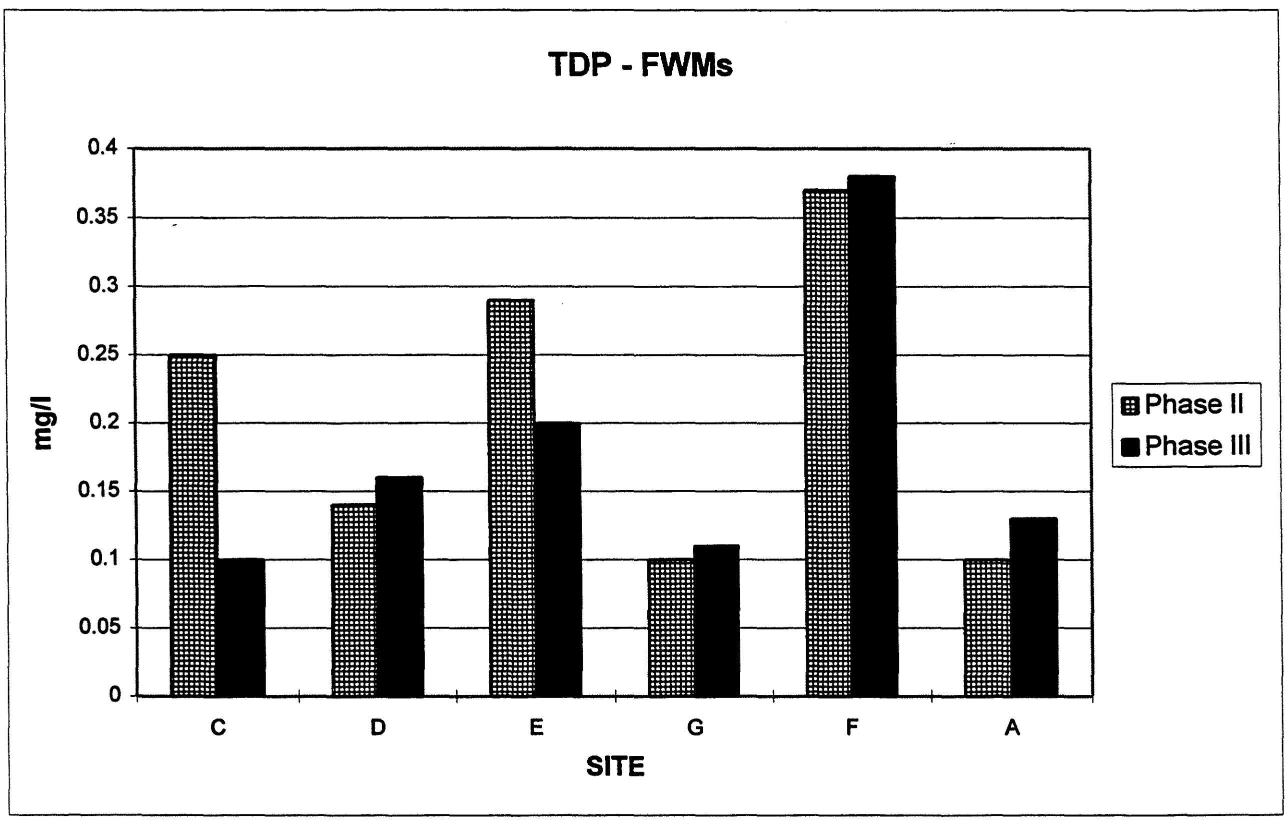
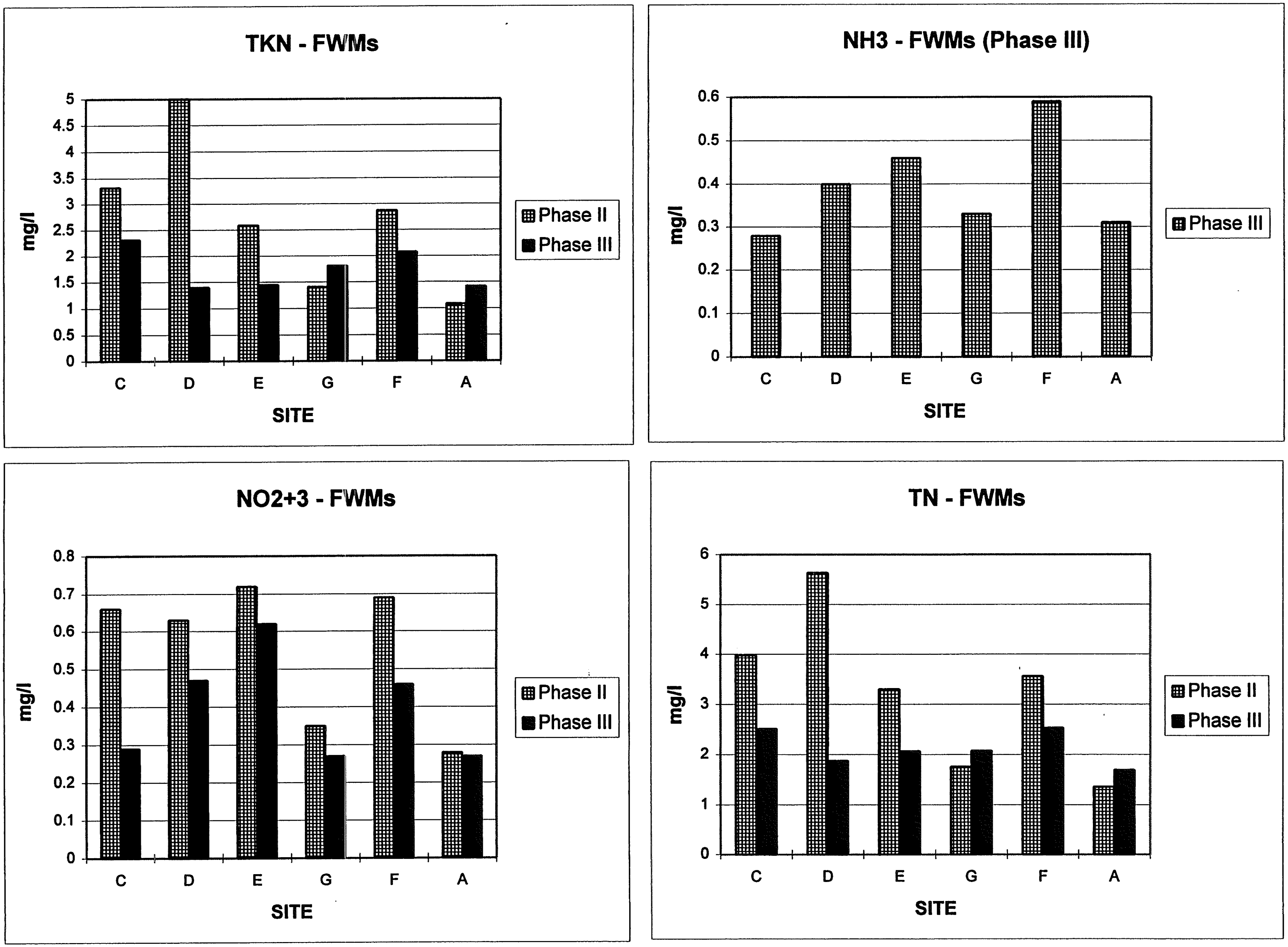


Figure 9c. Flow-Weighted Mean Concentrations for TKN, NH3, NO2+3 and TN -- Phase II and Phase III.



Baseflow Data

Table 5 summarizes baseflow concentration data for each of the monitored sites. Appendix E contains the detailed baseflow concentration data collected throughout the study. A total of seven baseflow samples were taken for each site, provided flow occurred at the time of sampling. Note that site F never flowed unless there was an event and that site C was dry on three of the baseflow sampling dates. However, because site C was not dry for all of the quarter, the average of all sampling dates was applied to determine baseflow loads from this subwatershed.

Of particular note in the baseflow values in Table 5 is the proportionately high values at sites A and G relative to the tributary inputs at sites C, D and E. The importance of this will be evident when the total loads are discussed later in the report.

Baseflow through the MWTS is supported by groundwater discharge. A discussion of groundwater movement in the McCarrons Lake vicinity is contained in Appendix E. This discussion was copied from the Phase II report.

Table 5. Baseflow Concentration Summary.

Mean Concentration (mg/l)
Minimum
Maximum
# of Samples

SITE	TSS	VSS	TP	TDP	COD	TKN	ORG-N	NH3	NO2+3	TN	TZn
A	14	6.7	0.32	0.08	37	1.47	1.03	<0.43	<0.21	<1.68	<0.009
	7	4	0.11	0.01	24	0.48	.0.30	<0.02	<0.06	<0.54	<0.005
	24	12	0.49	0.16	53	2.00	1.51	1.2	0.90	2.60	0.030
	7	7	6	7	7	7	7	7	7	7	7
C	6.5	3.2	0.10	0.05	27.5	1.33	0.73	0.66	2.06	3.44	<0.005
	5	2	0.08	0.04	13	0.80	0.37	0.43	0.49	1.29	<0.005
	9	5	0.12	0.06	47	1.80	0.95	0.85	3.00	4.80	<0.005
	4	4	4	4	4	3	4	4	4	4	4
D	5.4	<2.6	0.12	0.03	25.3	0.98	0.83	0.16	<0.56	<1.64	<0.007
	4	<2	0.07	0.02	11	0.44	0.14	0.05	<0.31	<0.75	<0.005
	8	3	0.19	0.04	61	3.00	2.82	0.33	0.82	3.29	0.020
	7	7	7	7	7	7	7	7	7	7	7
E	3.6	<2.6	0.09	0.03	26.3	1.15	0.85	0.31	1.64	2.79	<0.006
	2	<2	0.05	0.01	14	0.50	0.18	0.23	1.23	1.73	<0.005
	8	4	0.13	0.07	48	1.90	1.57	0.42	2.25	3.75	0.010
	7	7	7	7	7	7	7	7	7	7	7
F	No Baseflow										
G	20.7	15.4	0.25	0.04	51	2.09	1.98	<0.12	<0.27	<2.37	<0.009
	6	4	0.08	0.01	27	0.96	0.67	<0.02	<0.06	<1.04	<0.005
	88	70	0.86	0.09	113	3.70	3.68	0.63	1.05	3.48	0.030
	7	7	7	7	7	7	7	7	7	7	7

SEDIMENT SAMPLES

The location (Figure 5) and timing of sediment samples taken from the MWTS was discussed in a previous section. The results of the sampling effort are summarized and compared to the Phase II data in Table 6. Appendix C contains detailed soil descriptions at the sampled sites, as well as a graphic depicting the results of a sieve analysis.

Figures 10 and 11, respectively, show the contours of the headwater detention pond (site G) and the hockey rink detention pond (site F). The headwater pond was dredged to its original contours in January 1993 at a cost of $55,000. Very little accumulation of material appears between the October 1994 sampling date and the November 1996 follow-up. This is in stark contrast to the first eight years (1986-1993) of the pond's existence, when it nearly filled with sediment; a total of 0.5 acre-feet (616.7 m^3) of sediment accumulated during the 21-month Phase II study period. The primary reason for the decrease in accumulation is the stabilization of the channel flowing into the pond from site D. The hockey rink pond (Figure 11) did show signs of sediment accumulation, but with some erosion of the bottom material also evident along the longitudinal axis from inlet to outlet. Approximately 17% (0.21 acre-feet; 259.0m^3) of the storage volume in the hockey rink was lost during the Phase III study period.

The soils in the MWTS can be characterized as organic sapric and humic (peaty) muck, but containing a fair amount of grit and sand. Typically, the soils in the wetland chambers are sapric peats mixed with sand that has entered the chambers during runoff events. Most evidence of sand and grit occurs logically in the headwater and the hockey rink detention ponds. Decomposed cattails were evident in most of the wetland samples.

The data presented in Table 6 show that Fe (iron) and Al (aluminum) have markedly decreased from the Phase II to the Phase III study. The net result is that there is likely even less sorptive capacity available to adsorb phosphorus than the already limited peaty and sandy mix of soils offer. This is one explanation for the decreased removal of phosphorus that will be discussed in a later section. The lack of a clear trend in the TP content of the soil samples detracts from the ability to make a definitive statement about phosphorus uptake, but it does appear that the soils in the system could be saturated and unable to adsorb more phosphorus.

Other observations related to the data in Table 6 concern the continued drop in lead (TPb) seen from 1986 to 1997, and the increase in total organic carbon (TOC) from the first Phase III sample to the second sample. The lead parallels the decrease of lead in automotive fuel. This decrease is consistent with most current environmental monitoring. TOC data were not collected in Phase II so a comparison with Phase III TOC levels cannot occur. The marked increase in TOC from November 1994 to October 1996 is most likely due to the greater abundance of vegetative debris at the end of the growing season (early October) versus well after senescence (mid November). The abundance of carbon assists the microbial denitrification process important to nitrogen removal in the system.

Table 6. McCarrons Wetland Treatment System Sediment Analysis.

SITE (Phase II study)	DATE	TOTAL SOLIDS %	VOLATILE SOLIDS %	TAl* mg/Kg*	TFe* mg/Kg	TOC* mg/Kg	TP* mg/Kg	TPb* mg/Kg
1 (Pond A)	860904	15.7	10.4	2898	5025	ns*	185	14.5
	880615	29.2	7.4	2193	4715	ns	227	45.7
	941115	9.4	4.4	360	1067	75200	153	3.4
	961004	57.9	4.2	629	3657	120000	620	12.3
2 (Pond B)	860904	36.0	11.2	4339	8928	ns	800	34.5
	880615	39.2	8.8	2696	4804	ns	409	36.8
	941115	42.6	4.1	2718	5554	45400	780	18.7
	961004	20.2	6.6	1353	4507	120000	540	13.0
3 (Wetland 4)	860904	50.7	9.2	11000	19024	ns	435	69.6
	880615	ns	ns	ns	ns	ns	ns	ns
	941115	35.0	4.2	2131	4228	46900	263	24.7
	961004	52.5	2.6	378	1366	110000	500	5.4
4 (Wetland 3)	860904	20.2	11.2	5020	5519	ns	305	24.6
	880615	ns	ns	ns	ns	ns	ns	ns
	941115	24.5	4.4	2778	5442	64100	353	24.7
	961004	23.9	6.1	1512	3534	120000	830	17.2
5 (New)	941115	32.3	16.6	2483	4789	33700	184	16.8
	961004	44.0	4.1	1998	4365	61000	534	13.9
6 (Wetland 2)	860904	62.1	5.1	8052	14863	ns	390	117.0
	880615	ns	ns	ns	ns	ns	ns	ns
	941115	30.5	3.1	2873	5959	37000	239	22.7
	961004	35.9	4.0	1124	2857	79000	580	11.0
7 (Wetland 1A)	860904	47.1	8.7	18195	24968	ns	640	138.0
	880615	ns	ns	ns	ns	ns	ns	ns
	941115	25.3	4.3	3623	7805	68200	370	35.7
	961004	49.3	1.8	1063	3674	85000	910	10.8
8 (New)	941115	17.3	3.6	2300	4869	61300	172	9.1
	961004	59.5	3.4	342	893	89000	380	1.4
9 (Outlet A)	860904	32.3	8.1	14263	20464	ns	575	98.1
	880615	ns	ns	ns	ns	ns	ns	ns
	941115	23.0	3.4	3763	6255	46200	391	49.4
	961004	47.8	3.3	1005	2694	95000	540	13.2

Table 6. McCarrons Wetland Treatment System Sediment Analysis (continued).

SITE (Previous study)	DATE	TOTAL SOLIDS %	VOLATILE SOLIDS %	TAI mg/Kg	TFe mg/Kg	TOC mg/Kg	TP mg/Kg	TPb mg/Kg
10 (Outlet C)	860904	31.2	9.1	11147	23529	ns	550	57.5
	880615	ns	ns	ns	ns	ns	ns	ns
	941115	25.0	2.5	3810	7197	42100	364	20.7
	961004	22.0	4.5	702	1685	98000	390	6.6
Not Sampled in Phase III study:								
(Wetl.1B)	860904	50.5	7.2	13075	23109	ns	560	134.0
(Outlet B)	860904	41.2	7.2	11867	15136	ns	555	60.6

*Abbreviations: TAI = total aluminum
TFe = total iron
TOC = total organic carbon
TP = total phosphorus
TPb = total lead
mg/Kg = milligrams per kilogram, or parts per million (solids)
ns = not sampled

Figure 10. MWTS Headwater Detention Basin Bathymetric Maps

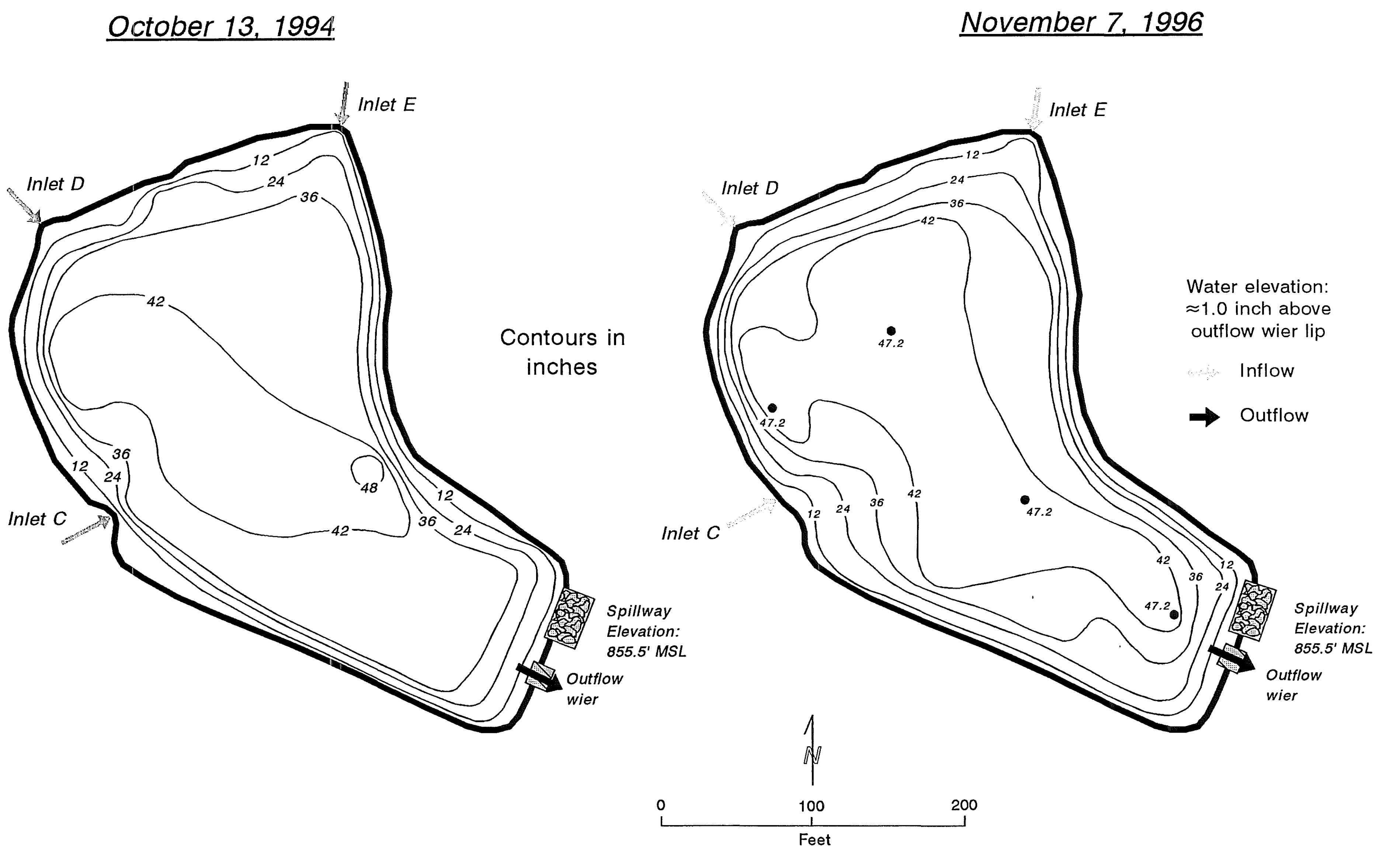
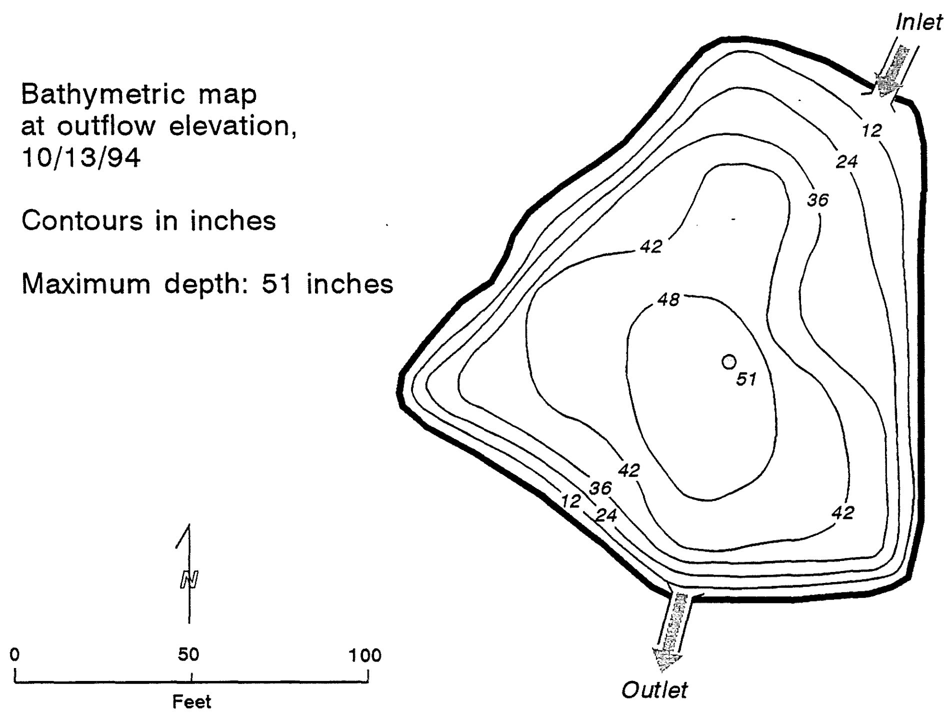


Figure 11. MWTS Hockey Rink Detention Pond Bathymetric Maps

Bathymetric map
at outflow elevation,
10/13/94

Contours in inches

Maximum depth: 51 inches

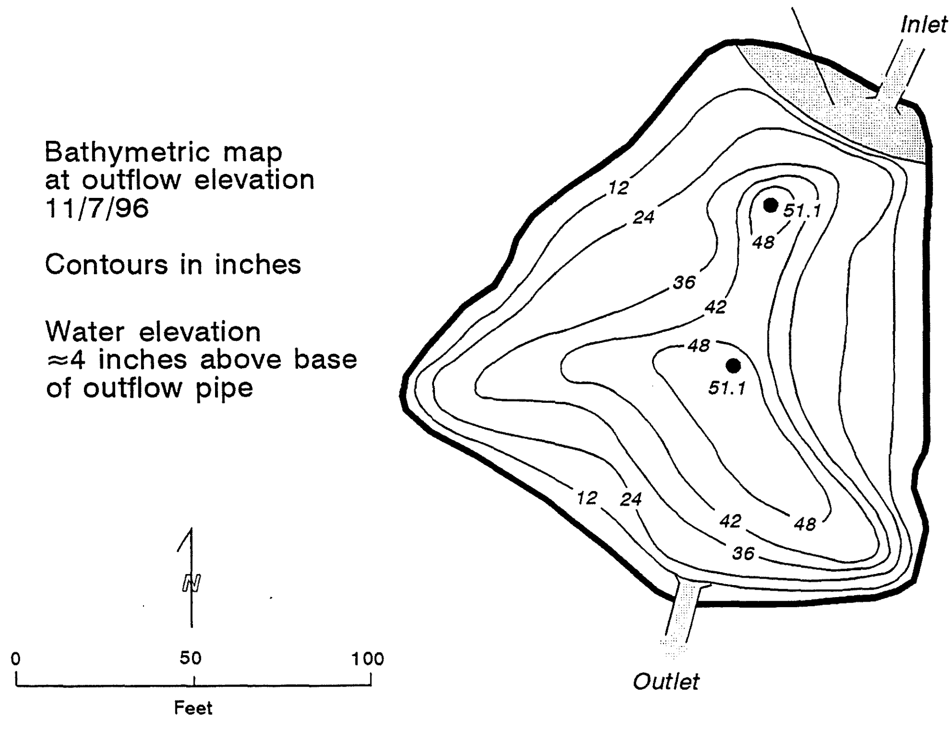


Approximate extent
of exposed bottom
at outflow elevation

Bathymetric map
at outflow elevation
11/7/96

Contours in inches

Water elevation
≈4 inches above base
of outflow pipe



BIOLOGICAL SURVEY

A noticeable shift has occurred in much of the vegetation comprising the MWTS since it was constructed in 1985. Most noticeable is the proliferation of cattails over the past several years. A biological survey was conducted to document the changes from Phase II to Phase III, and to again document conditions at a point in time for future comparisons.

A biologist (Jack Mauritz) was retained to conduct the survey during the summer of 1995. The results of the Mauritz survey and the field sketches accompanying the survey are contained in Appendix G. An elaborate and expensive planting was done in 1985 to introduce desirable wetland species to the MWTS. Unfortunately, only wild iris, water lilies and some bulrushes remain from the initial planting. Although most of the original plants did become established, the shift to cattails and reed canary grass has been prolific. Although the wetland system maintains its appeal as an urban wetland, there is a definite shift away from the diverse ecosystem that was envisioned, to a cattail monoculture with reed canary grass edges.

DISCUSSION

RUNOFF TREATMENT SYSTEM

The MWTS is a surface water management facility consisting of a detention pond followed by six "chambered" wetlands and a second tributary detention pond, all of which discharge to the northwest end of Lake McCarrons. The system was constructed to improve the quality of surface water draining from an urban watershed. Many changes have been made to the system since the 1988 Phase II study was completed. Some of these changes are suspected of decreasing the effectiveness of the MWTS.

While the original system drained a total of 636 acres (257.6 ha) when Alameda Pond flowed, the current system now drains a 736 acre (306.2 ha) watershed. The city of Roseville diverted another 100 acres (40.5 ha) in the MWTS during the seven years between the Phase II and III studies. Most of the additional input came via subwatersheds C (Alameda Pond), AI (direct inflow to a wetland chamber below the detention pond outlet), and E, with the addition of 55.9 acres (22.6 ha), 37.4 acres (15.1 ha) and 17.8 acres (7.2 ha), respectively. One of the new inlets was particularly damaging to the wetland. A new storm sewer draining McCarrons Boulevard south of Site A was directed into the final wetland about 20 feet (6.1 m) away from the MWTS outlet at site A, and positioned such that flow was directed straight at the outlet. After the movement of sediment-laden runoff was noted flowing directly to the outlet, a 15-foot (4.6 m) long boulder berm was constructed by the city in 1995 in an attempt to divert flow out into the wetland. This had marginal success, since flow merely "turned the corner" and again flowed straight to the outlet. Reconstruction of McCarrons Boulevard might offer the chance to re-route this storm sewer outlet to another location.

One of the Phase II recommendations was for the city to construct a detention pond at the site of the current hockey rink pond, which was obviously done. However, to foster flow from the hockey rink outlet, an arc in the final outlet wetland was dredged from the pond outlet to the system outlet at site A. Again, this allows for short-circuiting of flow, by-passing the additional treatment that might be afforded by vegetative contact in the final wetland.

Another change in the MWTS came not as a result of city construction, but rather as a result of aging. Several of the berms have experienced erosion and several of the culverts are either plugged or by-passed through erosion cuts in the berms. The net results of this are less detention of water in the wetland chambers during events and semi-dry conditions (with mudflats) between events when water drains out of the chambers.

Finally, permanent channels have begun to again erode their way back into the wetland system. Essentially every one of the wetland chambers have reestablished channels that carry water directly from one culvert to the next. This undoubtedly causes some of the reduction in baseflow removal efficiency discussed later in the report. The primary cause for channel re-establishment appears to be concentrated flow from one culvert to the next, with some fill in side channel areas during events; that is, as the chambers have filled over the years, water has sought the easiest flowpath from culvert to culvert.

Separately, any one of these conditions could explain some of the reduction in treatment efficiency seen in the MWTS. Collectively, they have all contributed to a system that no longer performs as it did in the first years after construction.

LOADING ANALYSIS

Event loading tables from each of the monitored events from the Phase III study are contained in Appendix H. Each table contains all of the data used to prepare the loading analysis that follows. Appendix I contains all of the unmonitored events that were similarly used; these events were modeled to fill in gaps for events that were small or intentionally not sampled.

The purpose of this analysis is to document the current efficiency of the MWTS, as well as changes in the efficiencies between Phase II and Phase III. The change has been rather dramatic, leading to some interesting conclusions on the longevity of wetland treatment systems.

Treatment Efficiencies

The primary objective of a Phase III Clean Lakes study is to compare the effectiveness of the management practice being evaluated over a long term. In the case of the MWTS, the system has been operational for about 12 years. The Phase III study provides an opportunity to see how well this wetland treatment system works as compared to the Phase II study of the new (1986) system.

Although "treatment efficiency" or percent removal is used for ease of discussion and comparison, the real important factor is how much load is reduced. That is, a highly loaded system could remove a tremendous amount of material, yet show a low percent removal, whereas a system with little load entering could show high removal yet take out substantially less load. The reporting that follows attempts to discuss both factors, but readers should judge the system by load removed, since what ultimately matters is the amount of polluting material reaching the lake.

Table 7 presents the findings from Phase II relative to treatment efficiency covering both events and baseflow, and Table 8 does the same for Phase III. The data are graphically portrayed in Figures 12a-d, with the percentage reductions noted above the graphs.

The comparison data presented for the early system (Phase II, 1986-88) versus the 12-year old system (Phase III, 1995-96) clearly show a current system that no longer performs as it did when new. In fact, loading to the lake from the MWTS actually increased in phosphorus from the first study to the second even though inflow load for the second study period was less (see Figure 12b). Every pollutant studied, with the exception of nitrite/nitrate (NO2+3) had dramatically lower load reduction effectiveness in the latter study. Particularly evident is the poor performance of the system relative to phosphorus, where reduction for TP went from 69.6% (about 0.9 pounds, or 0.4 kg, per day reduction) to only 4.0% (0.03 pound, or 0.01 kg, per day reduction).

A noticeable difference in water transmitted through the MWTS is evident in Figure 12d. The Phase III study showed about 200 more acre-feet (246,698 m^3) of inflow to the system, and close to 285 more acre-feet (351,545 m^3) of outflow than was seen in the Phase II study, which occurred during a dry period. These differences translate into overall flow reductions of 28.9% for Phase II, but only 9.5% for Phase III. This increase in passage of water through the MWTS undoubtedly contributes to the reduced performance of the system.

Examining the various components (events and baseflow) that make up the loading tables will give some indication of where major reductions occur or do not occur within the system.

Table 7. Overall Load Reductions for Period of Study (9/1/95 - 8/31/96) (365 days)
- Phase II

	INFLOW, pounds (kg)			OUTFLOW, pounds (kg)			Percent Overall Reduction	Pounds per Day (Kg per Day) Reduction
	Events	Baseflow	Total	Events	Baseflow	Total		
TSS	510,076	6,684	516,760	17,462	3,250	20,712	96.0	779.9
	(231,575)	(3,035)	(234,609)	(7,928)	(1,476)	(9,403)		(354.1)
VSS	159,494	2,704	162,198	7,150	1,690	8,840	94.5	241.1
	(72,410)	(1,228)	(73,638)	(3,246)	(767)	(4,013)		(109.5)
TP	752.3	57.1	809.4	189.6	56.7	246.3	69.6	0.89
	(341.5)	(25.9)	(367.5)	(86.1)	(25.7)	(111.8)		(0.40)
TDP	163.9	38.5	202.4	85.3	26.3	111.6	44.9	0.14
	(74.4)	(17.5)	(91.9)	(38.7)	(11.9)	(50.7)		(0.06)
COD	227,313	16,123	243,436	30,612	17,055	47,667	80.4	307.8
	(103,200)	(7,320)	(110,520)	(13,898)	(7,743)	(21,641)		(139.7)
TKN	2,809	534	3,343	858	634	1,492	55.4	2.91
	(1,275)	(242)	(1,518)	(390)	(288)	(677)		(1.32)
ORG-N	Not separately analyzed							
NO2+3	585	621	1,206	182	262	444	63.2	1.20
	(266)	(282)	(548)	(82.6)	(119)	(202)		(0.54)
NH3	Not separately analyzed							
TN	3,398	1,155	4,553	1,040	896	1,936	57.5	4.11
	(1,543)	(524)	(2,067)	(472)	(407)	(879)		(1.87)
TPb	77.94	2.35	80.29	4.68	0.78	5.46	93.2	0.118
	(35.37)	(1.07)	(36.45)	(2.12)	(0.35)	(2.48)		(0.05)
ACRE-FT	310.5	218.3	528.8	175.4	200.7	376.1	28.9	0.24 A-F/Day
(m^3)	(382,999)	(269,271)	(652,270)	(216,254)	(247,561)	(463,156)		(296 m^3/Day)

Table 8. Overall Load Reductions for Period of Study (3/11/95 - 11/5/96) (604 days) -- Phase III

	INFLOW, pounds (kg)				OUTFLOW, pounds (kg)					
	Monitored Events	Unmonitored Events	Baseflow	Total	Monitored Events	Unmonitored Events	Baseflow	Total	Percent Overall Reduction	Lbs. per Day (Kg per Day) Reduction
TSS	75,069	17,070	2,944	95,083	22,084	2,832	7,342	32,258	66.1	104.0
	(34,081)	(7,750)	(1,337)	(43,168)	(10,026)	(1,286)	(3,333)	(14,645)		(47.2)
VSS	22,151	6,020	1,559	29,730	8,358	1,415	3,294	13,067	56.0	27.6
	(10,057)	(2,733)	(708)	(13,497)	(3,795)	(642)	(1,495)	(5,932)		(12.5)
TP	375.7	80.4	59.1	515.2	245.4	46.2	202.8	494.4	4.0	0.03
	(170.6)	(36.5)	(26.8)	(233.9)	(111.4)	(21.0)	(92.1)	(224.5)		(0.01)
TDP	190.8	20.4	21.7	232.9	122.8	13.7	43.3	179.8	22.8	0.09
	(41.2)	(9.3)	(9.9)	(105.7)	(55.8)	(6.2)	(19.7)	(81.6)	(10.4)	(0.04)
COD	63,377	17,500	15,472	96,349	35,962	7,300	22,540	65,802	31.7	50.6
	(28,773)	(7,945)	(7,024)	(43,742)	(16,327)	(3,314)	(10,233)	(29,874)		(23.0)
TKN	1,956	395	637	2,988	1,388	224	820	2,432	18.6	0.92
	(888)	(179)	(289)	(1,357)	(630)	(102)	(372)	(1,104)		(0.42)
ORG-N	1,483	308	443	2,233	1,081	195	630	1,907	14.6	0.54
	(673)	(140)	(201)	(1,014)	(491)	(89)	(286)	(866)		(0.25)
NO2+3	582	119	721	1,423	264	53.0	146	462	67.5	1.59
	(264)	(54)	(327)	(646)	(120)	(24.1)	(66)	(210)		(0.72)
NH3	393	73.3	194	660	307	28.3	190	525	20.4	0.22
	(178)	(33.3)	(88)	(300)	(139)	(12.8)	(86)	(238)		(0.10)
TN	2,460	514	1,359	4,333	1,652	277	965	2,894	33.2	2.38
	(1,117)	(233)	(617)	(1,967)	(750)	(126)	(438)	(1,314)		(1.08)
TZn	23.4	5.77	8.76	37.9	8.67	1.08	13.7	23.4	38.1	0.021
	(10.6)	(2.62)	(3.98)	(17.2)	(3.94)	(0.49)	(6.2)	(10.6)		(0.010)
ACRE-FT	420.1	102.5	206.7	729.4	359.9	79.7	220.8	660.4	9.5	0.11 A-F/day
(m^3)	(518,189)	(126,433)	(254,962)	(899,708)	(443,933)	(98,309)	272,355)	(814,597)		(141 m^3/day)

Figure 12a-d. Load Reduction Comparison Between Phase II and III, with Percentage Reduction Noted.

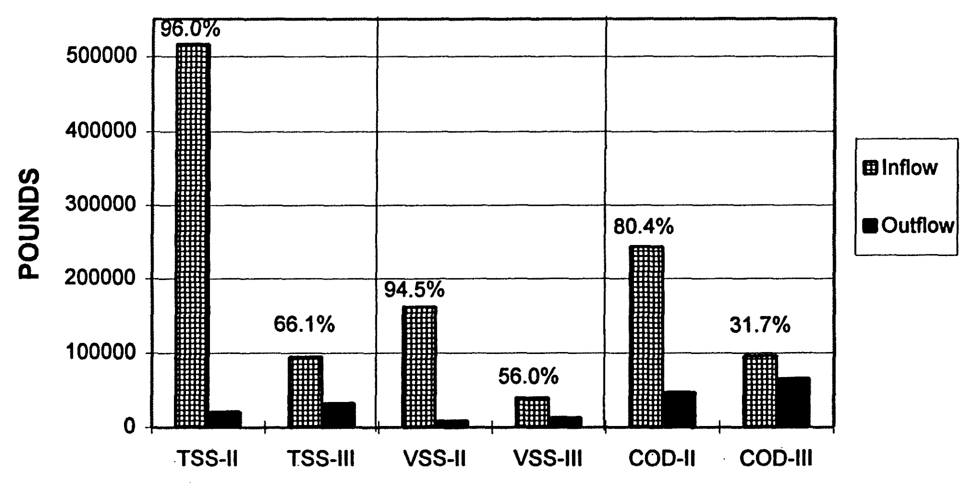


FIGURE 12a. Load Reduction Comparison - TSS, VSS, COD

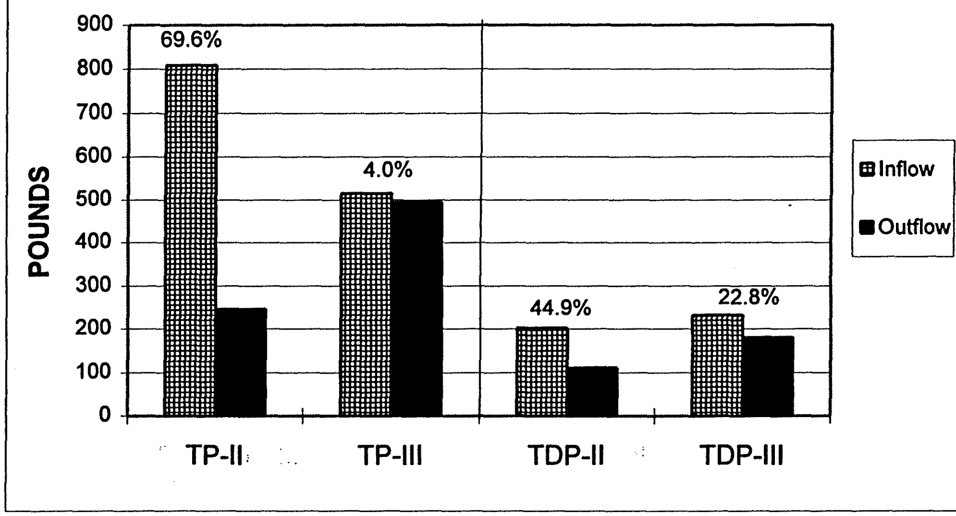


Figure 12b. Load Reduction Comparison - TP, TDP

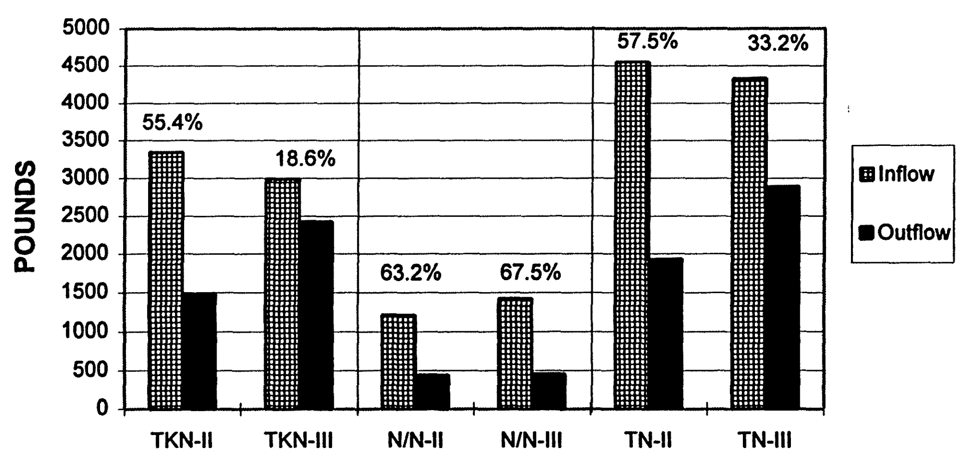


Figure 12c. Load Reduction Comparison - TKN, N/N, TN

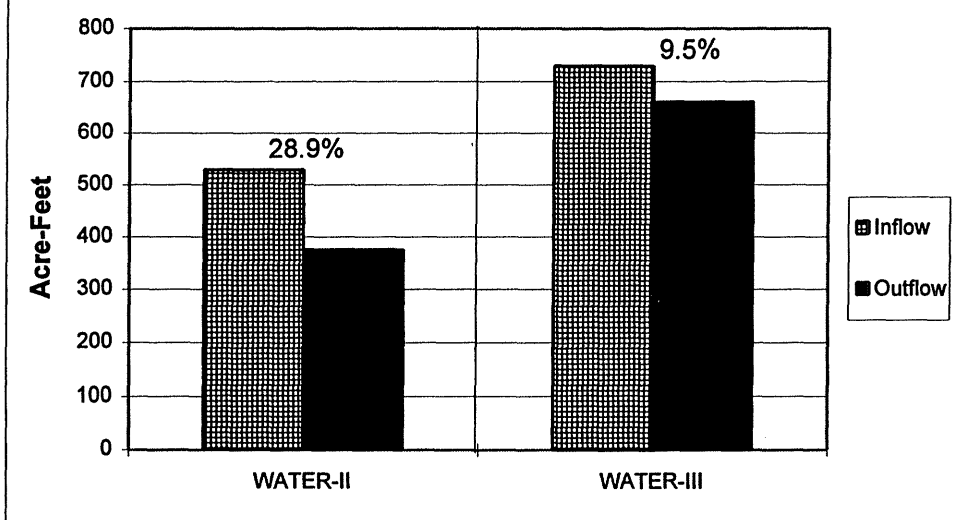


Figure 12d. Water Reduction Comparison

Event Loading

Table 9 provides event-only details on the pond, wetland and total system performance of the MWTS for both rain-only and rain plus snowmelt events. The table presents percent pollutant removal effectiveness data both from a "graphic" analysis that plots the slope of the inflow-outflow load line, as well as the total load reduction for the period of study (in parenthesis). The graphic or regression efficiency line technique is suggested by Martin and Smoot (1986) to minimize the influence of single events. The technique uses the slope of the best fit line determined from all of the event inflow loads plotted against event outflow loads, with the intercept passing through the origin. Note that additional inputs occur within the wetland, so the numbers in the table are not additive.

Figure 13 graphically portrays the results in Table 9. Several observations about pollutant reduction in the MWTS during events can be made. First, with few exceptions, the reductions are substantially less than those seen in Phase II. Figures 12a-c gave a first indication that the MWTS was not operating at its original capability. Figure 13 shows that less pollutant reduction during events is partly responsible.

The headwater detention pond is responsible for most of the treatment of solids related pollutants (TSS, VSS, COD) and phosphorus (TP, TDP). However, this trend is reversed for the nitrogen species (ORG-N, NH3, NO2+3), wherein the wetland part of the system is responsible for most improvement. The settling of solids material in the pond during events means that the pond is generally doing the job for which it was built. Although not enough material was collected to make a visible difference in the pond's bathymetry (Figure 10), the water quality data do show that some solids are dropping out in the pond. At the total solids content shown in Table 9, an approximate range of 25-150 cubic yards (19-105 m^3) per year are settling into the headwaters detention pond. At this rate, the pond will take just over ten years to fill to a point where three feet of quiescent storage is unavailable in portions of the pond. An annual inspection is recommended, however, because of unusual events that could fill the pond faster and because of unmonitored bedload that also contributes solids load to the pond.

Phosphorus reduction shows the same general behavior as the solids. However, the addition of snowmelt to the rainfall events narrows the margin between inflow and outflow in the pond and the wetland components, likely because of wash-out from the frozen wetland during snowmelt.

The nitrogen species behave quite different from the solids and phosphorus because of the dynamics of microbial activity in wetlands. That is, organic wetland soils and dense vegetation provide an opportunity for nitrification/denitrification by microbes. Under this process, soluble forms of nitrogen are taken up by the microbes and turned to nitrogen gas, which is released to the atmosphere. The total organic carbon (TOC) content in the wetland soils (Table 6) provides the carbon fuel needed for the nitrification/dnitrification process. The level of organic nitrogen (ORG-N) actually increases in the pond with algal uptake in the highly eutrophic pond. Reductions in this form of nitrogen occur when it converts via the nitrification/denitrification process in the wetland to ammonia, nitrite/nitrate and then to nitrogen gas. Some limited plant uptake also occurs.

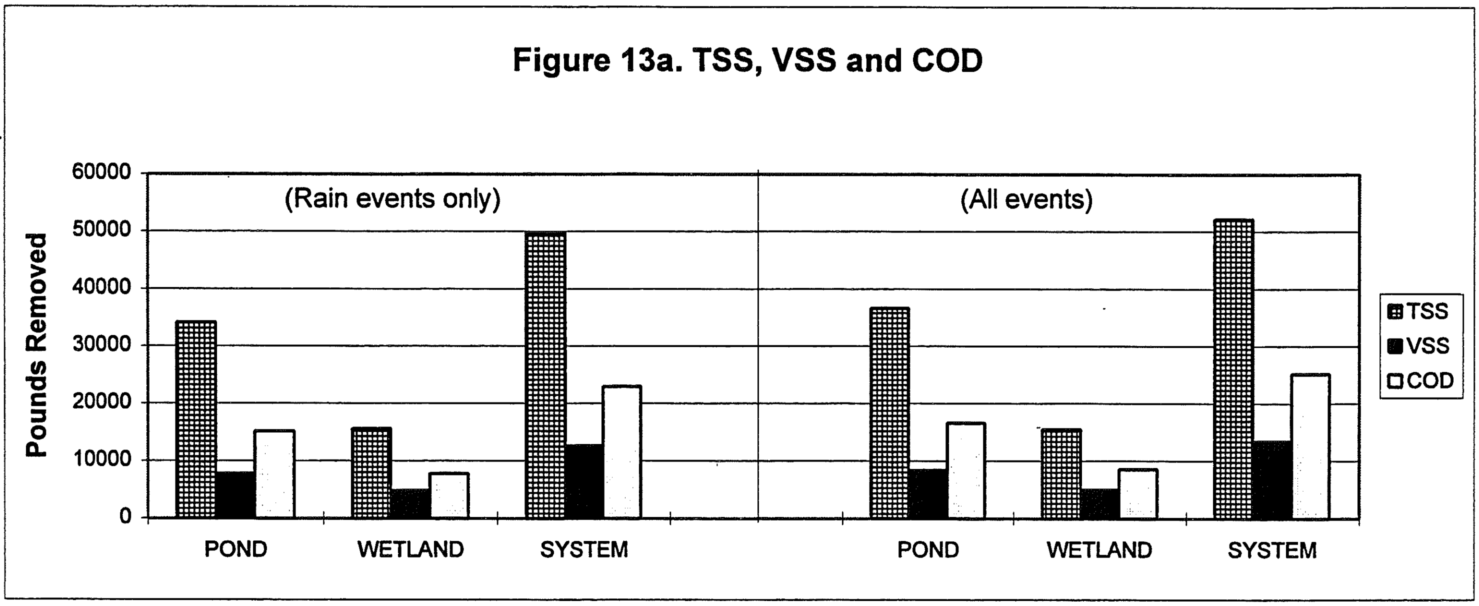
Inflow versus outflow loads for all of the sampled events can be graphed to display behavior throughout the period of study. Figures 14a-c represent the total set of monitored events for TSS, TP and TN, respectively. Similar plots for the other constituents evaluated are contained in Appendix J.

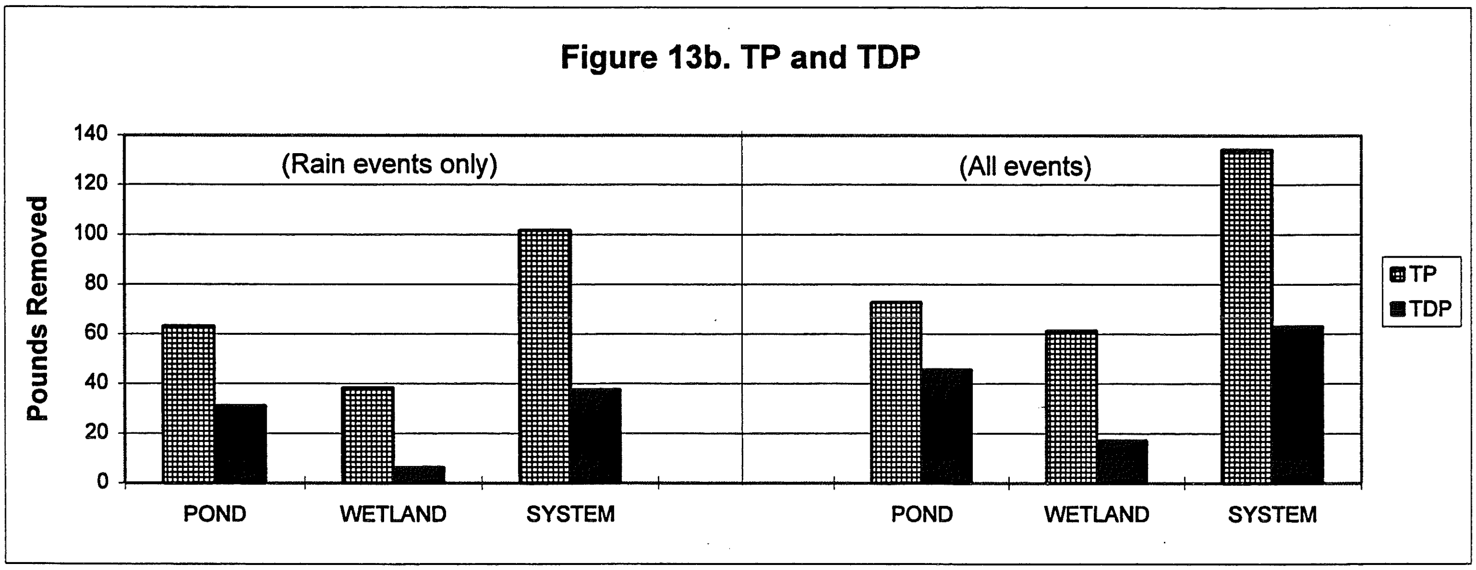
Table 9. Summary of event treatment efficiencies - Phase III study for all events.

Pollutant Removals - % Removed (mass determination)

POLLUTANT	RAIN ONLY POND	RAIN ONLY WETLAND	RAIN ONLY SYSTEM	W/SNOW POND	W/SNOW WETLAND	W/SNOW SYSTEM
TSS	69	53	78	68	49	76
	(67)	(47)	(74)	(65)	(42)	(71)
VSS	53	45	67	50	39	63
	(50)	(43)	(66)	(47)	(38)	(62)
TP	32	22	38	20	24	35
	(32)	(18)	(35)	(25)	(20)	(34)
TDP	48	24	52	26	18	36
	(45)	(9)	(36)	(33)	(13)	(34)
COD	40	23	48	33	18	42
	(40)	(22)	(47)	(36)	(20)	(43)
TKN	-13	48	39	-5	34	26
	(-1)	(36)	(36)	(1)	(28)	(29)
ORG-N	-17	56	38	-11	49	31
	(-7)	(41)	(32)	(-4)	(35)	(28)
NH3	47	15	56	8	9	16
	(39)	(22)	(46)	(21)	(14)	(29)
NO2+3	59	15	60	49	7	48
	(56)	(24)	(60)	(48)	(18)	(51)
TN	4	44	42	5	29	29
	(13)	(34)	(41)	(12)	(27)	(34)
TZn	70	8	68	52	38	64
	(68)	(14)	(66)	(58)	(27)	(64)

Figure 13. Phase III Event Load Reduction Comparison of System Components.





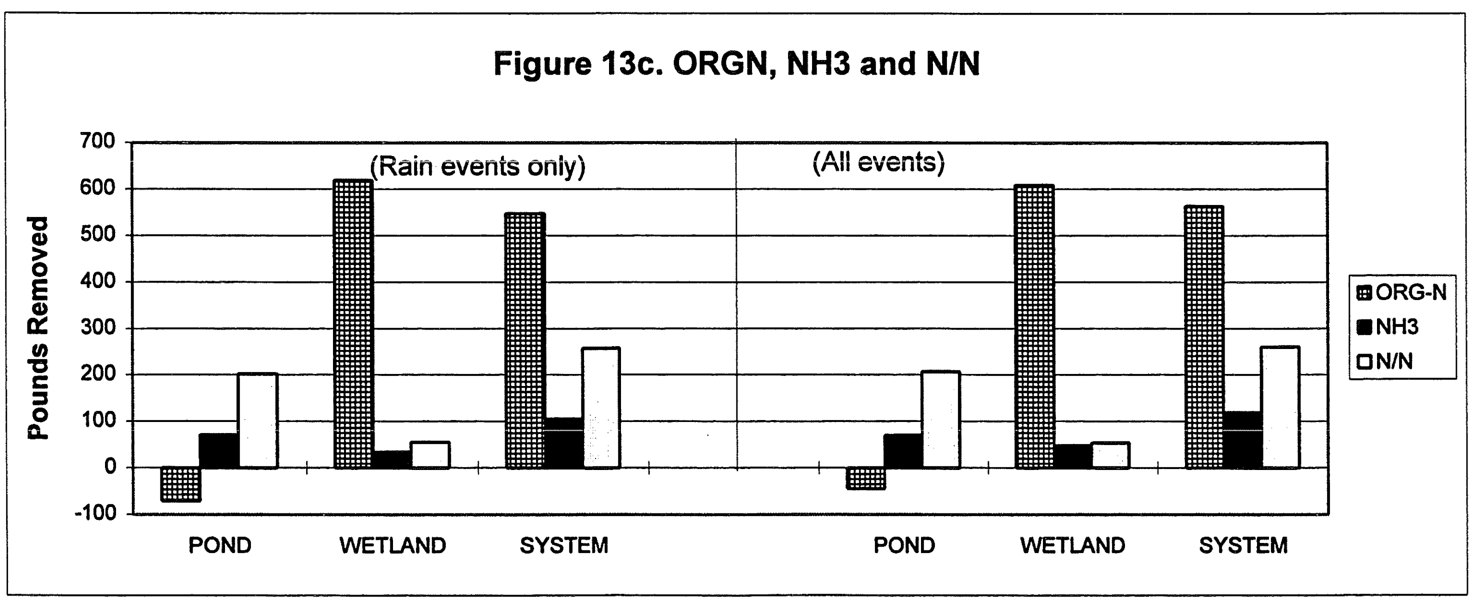
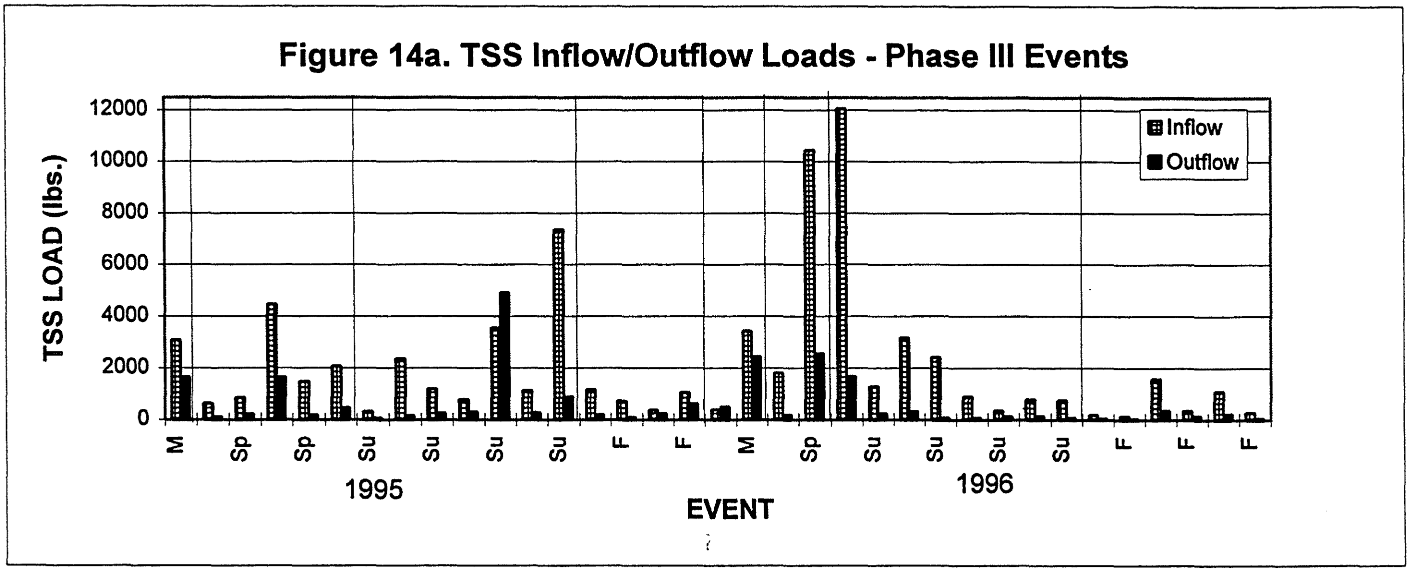
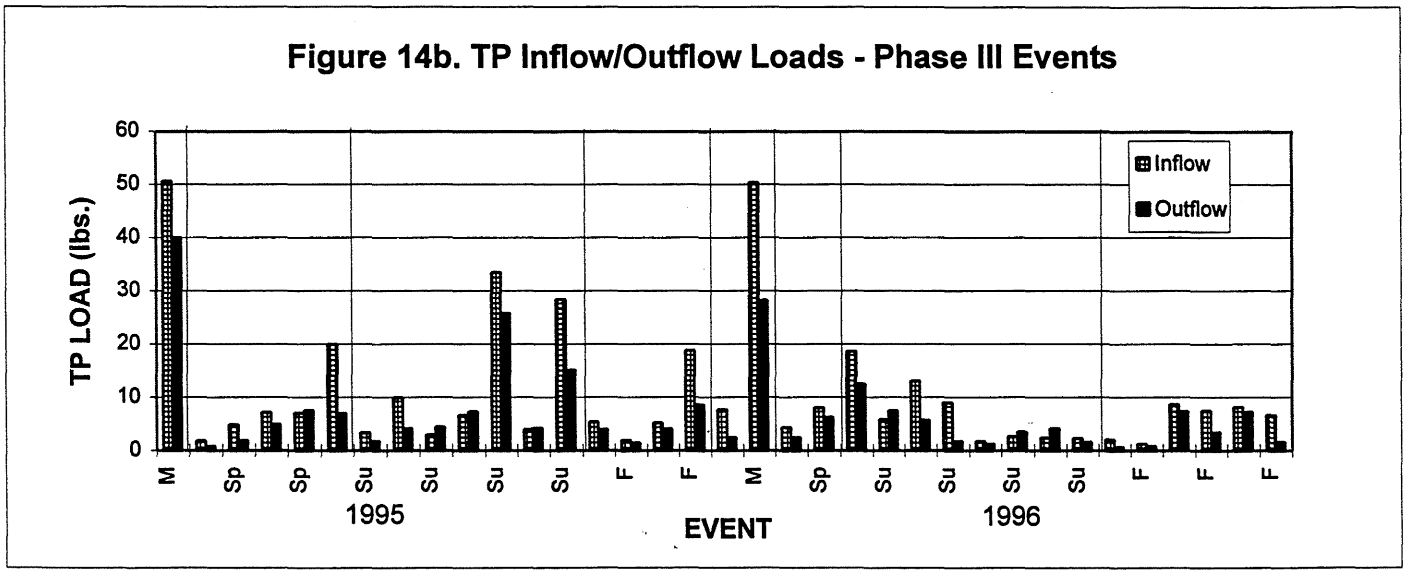


Figure 14a-c. Inflow/Outflow Load Compariosns - Phase III Events





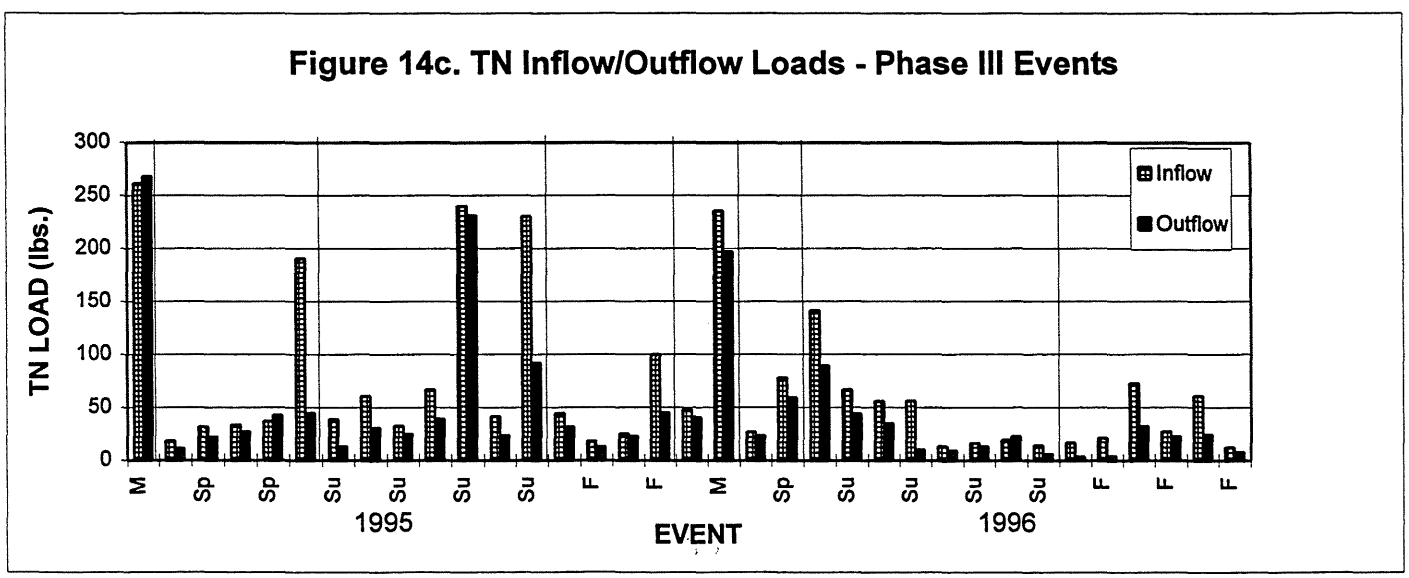


Figure 14a shows a relatively consistent pattern of TSS removal throughout the study, with the exception of a 3.29" rainfall (8.36 cm) event in July 1995 that washed some solids out of the system. Several smaller rainfall amounts contributed higher solids and resulted in very good solids removal, mostly in the detention pond.

Figure 14b shows a mixed bag of behavior for TP during the monitored events. Seven events spread throughout the spring and summer rainfall seasons of 1995 and 1996 displayed a load reversal in which TP is higher leaving the system than entering. This is somewhat contrary to conventional thinking that phosphorus outflow increases with the decomposition of vegetation at the on-set of fall senescence. However, reference to Appendix J shows that TDP in fact does show this reversal for at least two fall events. Some enrichment of the dissolved phosphorus phase relative to the particulate during senescence likely causes this behavior.

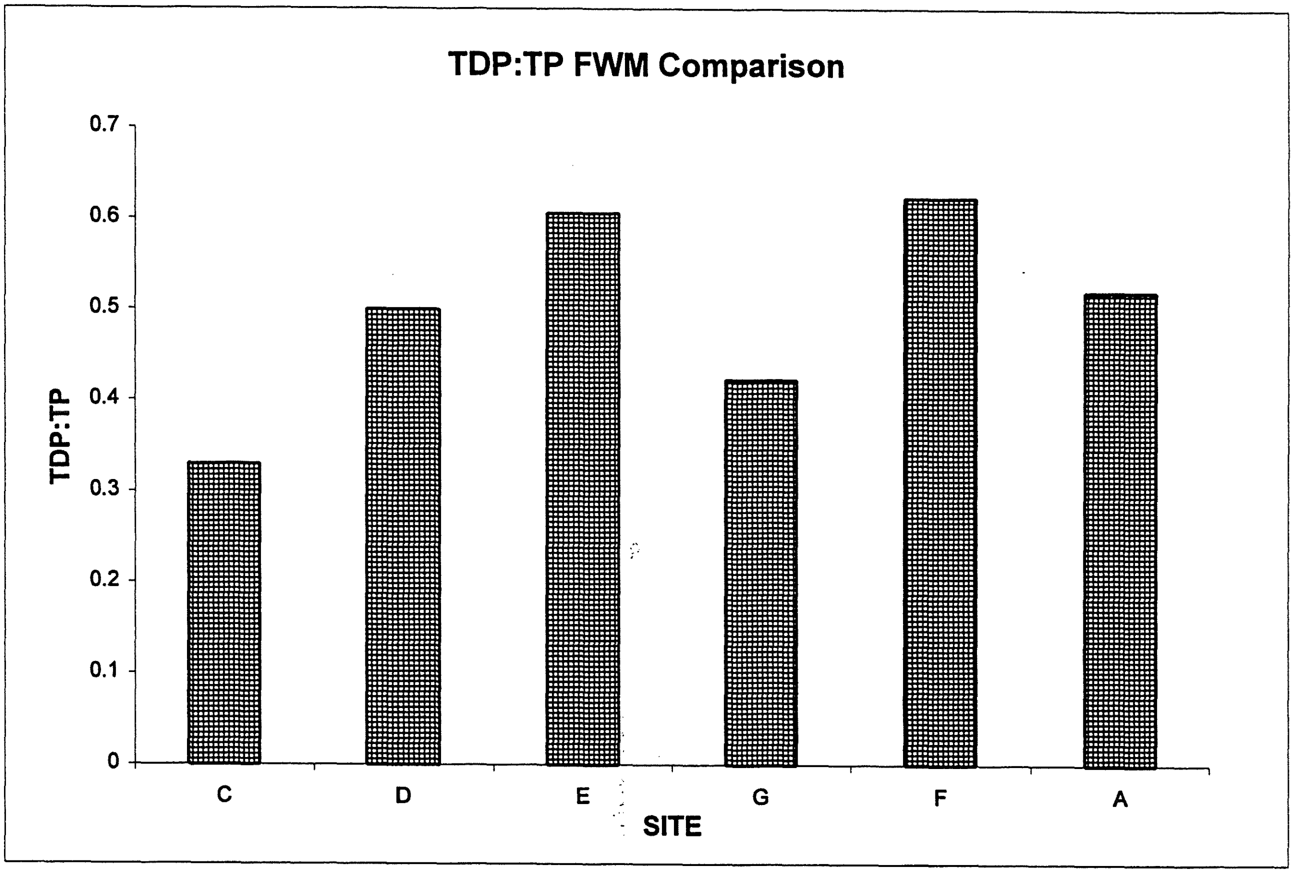
Finally, Figure 14c shows something different again with three of the largest loading events exhibiting little or no overall pollutant removal, while three other large events remove nitrogen rather well. Reference to Appendix J shows that both ORG-N and NH3 display both positive and negative removals throughout the study, while NO2+3 generally reduces levels, although some reversals occur. COD and TZn show generally good reductions year-round, with few exceptions.

The behavior of TDP relative to TP, and VSS relative to TSS provide some insight to system behavior and its ability to treat water during the year. That is, a high TDP:TP ratio means that a high percentage of the phosphorus moving through the system is dissolved, and therefore difficult to remove. Conversely, a high particulate percentage could mean easier removal, at least initially before subsequent bio-physio-chemical processes change the form. A high percentage of VSS relative to TSS means that much of the solids are organic in nature and subject to biological degradation once settled from the water column. Non-organic particulates will settle and remain in place until they are removed from the system entirely or resuspended and deposited elsewhere.

Figure 15 illustrates the TDP:TP and VSS:TSS concentration ratios based on the overall flow-weighted means at each monitored site. Generally, the graphic shows that the detention pond (site G) moderates the TDP it receives from tributaries, but puts out a higher percentage of volatile solids than it receives. During much of the year, the detention pond is a highly eutrophic system that allows algae to uptake phosphorus and migrate out into the wetland. The wetland component of the system, as reflected in site A, moderates this inflow to some degree but raises the percentage of TDP relative to TP.

The variable dynamics of TDP:TP and VSS:TSS concentration behavior can be seen in the event-by-event ratio tabulations in Appendix K. Table 10 summarizes some of the overall and melt-specific statistics from the Appendix K event traces. The TDP:TP graphics uniformly show a much higher ratio of dissolved to total phosphorus in the melt than the rest of the year. Very high TDP is typical of melt runoff because the energy of flow is not sufficient to wash heavier particles from the urban surfaces; however, organic material that has accumulated all winter and broken down to fine-grained or dissolved fractions are moved and show up in the monitoring data. Wash-off from the spring events generally shows a lower percentage of dissolved material because the runoff energy from the rainfall is now sufficient to mobilize larger particulate material. The detention pond (site G) and the wetland system (site A) moderate the tributary inflow slightly, but generally pass through most of the phosphorus in the same ratios as they receive.

Figure 15. FWM Ratios for TDP:TP and VSS:TSS.



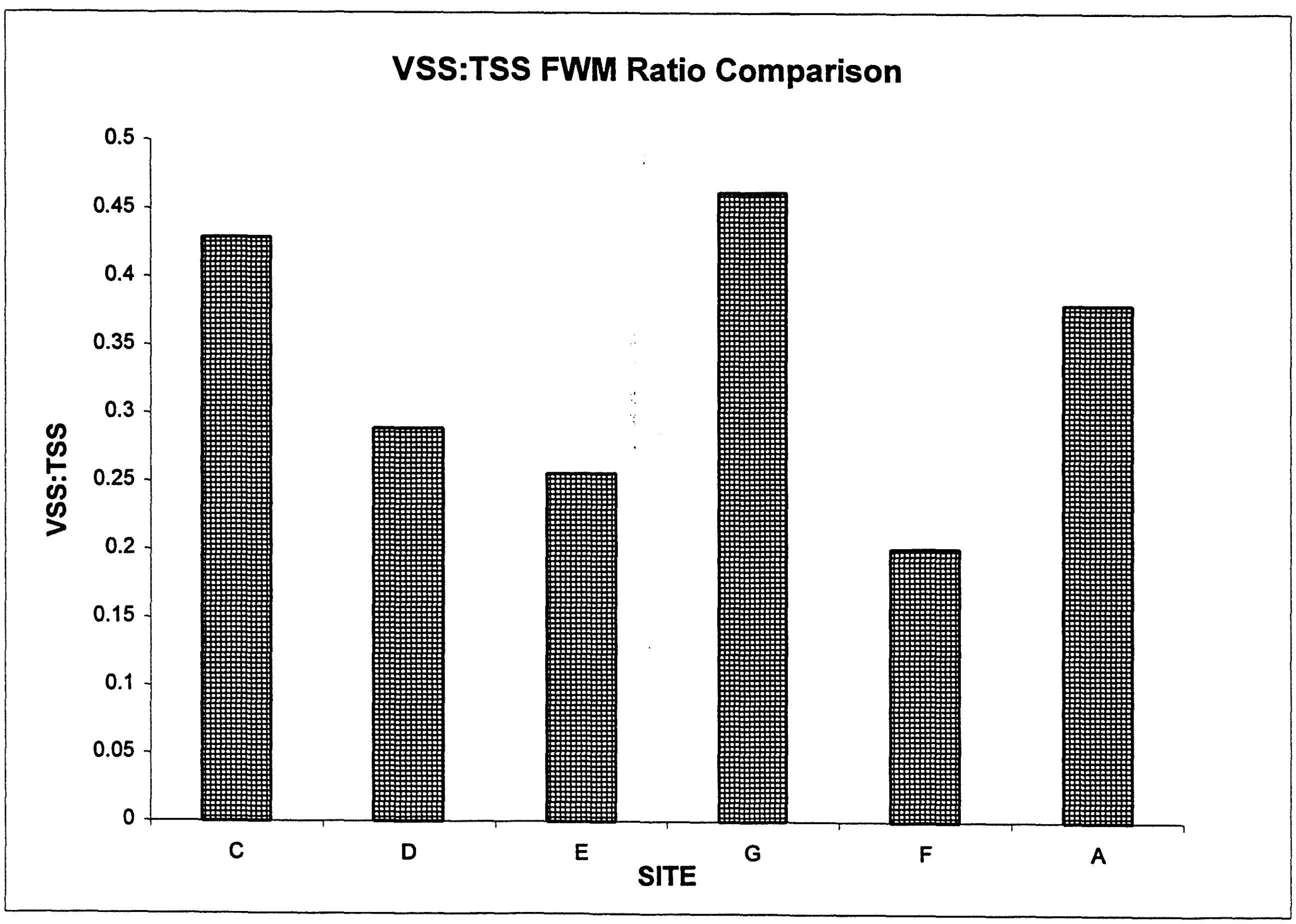


Table 10. Summary Statistics for TDP:TP and VSS:TSS Concentration Ratios.

STATISTIC	A	C	D	E	F	G
TDP:TP						
- Mean all	0.41	0.30	0.41	0.52	0.57	0.34
- Stnd.Dev.	0.21	0.23	0.25	0.23	0.23	0.24
- Mean melt	0.64	0.66	0.77	0.81	0.77	0.58
VSS:TSS						
- Mean all	0.49	0.48	0.36	0.33	0.42	0.55
- Stnd.Dev.	0.17	0.16	0.08	0.12	0.19	0.15
- Mean melt	0.37	0.39	0.40	0.41	0.35	0.47

The volatile or organic fraction of the TSS comprises from one-third to one-half of the total. The VSS fraction behaves differently than phosphorus in the melt in that it is generally lower, with the exception of tributary sites D and E. The lack of biological activity over the winter and the preponderance of inorganic solids (sand and grit) applied to urban surfaces increase the proportion of the non-volatile fraction. Appendix K also contains plots of TSS concentration versus the VSS:TSS ratio for four sites (A, D, E and F). These plots show rather clearly that the VSS:TSS ratio drops as TSS concentration rises; that is, the more TSS in the sample the higher the likelihood that much of it is not organic material, but rather non-organic particulate material such as sand, clay or litter. The other two sites (C and G) are highly influenced by Alameda Pond the headwater detention pond, respectively, and have settled the material from the runoff prior to samples being collected. Similar plots for the TDP:TP ratios did not yield any significant relationships.

Baseflow Loading

It is clear from Tables 7 and 8 that baseflow played a different role relative to total loading during Phase III than it did during Phase II. Table 11 compares the relative inflow and outflow baseflow ratios of Phases II and III. Although Phase III lasted about 34 days longer than Phase II, a relative comparison gives some insight to system behavior over the two study periods. Baseflow accounted for all of the inflow on 474 of the days during the Phase III study, and for 582 of the days during the Phase II study, which was a rather dry period.

Table 11. Phase II Vs. Phase III Inflow and Outflow Baseflow Loading Ratios.

POLLUTANT	II INFLOW:III INFLOW	II OUTFLOW:III OUTFLOW
TSS	2.27	0.44
VSS	1.73	0.51
TP	0.97	0.28
TDP	1.80	0.61
COD	1.04	0.76
TKN	0.84	0.77
NO2+3	0.86	1.80
TN	0.85	0.93
WATER	1.06	0.91

For TSS, VSS, and TDP reflected in Table 11, the baseflow entering the MWTS in Phase II was much larger than the baseflow in Phase III. TP and COD were about the same, and the nitrogen species were about 85% as high. However, the baseflow leaving the system and entering Lake McCarrons was substantially higher in Phase III relative to Phase II for all of the parameters except NO2+3 and TN.

This finding further explains some of the reduction in treatment efficiency seen in the system. That is, for baseflow loading for the solids related parameters and TDP, less loading occurred in Phase III but a larger percentage of it flowed out, thus reducing overall system performance. For TP, about the same flowed into the system, but substantially more flowed out in Phase III. TKN's outflow ratio went down slightly, while NO2+3's system reduction substantially increased, thus slightly increasing overall TN reduction in the latter study.

Graphic portrayals of the Table 11 data are contained in Appendix L. These graphics illustrate the movement of the MWTS away from a well performing treatment system to one that works only moderately well for solids and nitrogen, but not well for phosphorus. Note in Appendix L that TSS and VSS are plotted on a logarithmic scale.

Snowmelt Effects

A discussion of loading behavior in Minnesota cannot occur without some reflection on the role of snowmelt. Previous findings reported in the Phase II report indicated the relative importance of snowmelt runoff to the annual loading picture in cold climates, and to much reduced treatment efficiency in the MWTS. The Phase III findings are consistent with the Phase II findings.

Figure 16 displays the type of flow behavior seen in both the 1995 and 1996 melt events; these events are typical of snowmelt behavior. At the first stages of melt, the water conveyance system is frozen very solid. Culverts and outlets are constricted and water can easily build and pond behind them. In the case of the MWTS, both the detention ponds (headwater and hockey rink) and the wetland chambers are frozen.

The thick layer of ice (generally over 2 feet or 0.6 m thick) that forms in the detention ponds greatly reduces the effectiveness of the ponds in reducing pollutant load, as shown in Figure 17. Initially, melt water flows under the thick ice layer in a pressurized flow that can resuspend loosely aggregated, fine-grained particles previously settled on the bottom. Once the capacity of the sub-ice volume is exceeded, water begins to flow over the surface of the ice. In both over- and under-ice flow situations, treatment by settling is essentially non-existent for all but very coarse-grain solids. The wetland situation is not much different than the ponds at this stage of melt. That is, there is a layer of ice built-up in the wetland chambers. The ice layer in this case, however, sits almost directly on top of the soil, thus preventing any real contact between the runoff water and the wetland soils. Runoff piles up on top of the wetland and awaits release through an outlet that might be constricted by ice. As with the ponds, very little, if any, treatment results.

As the melt proceeds, more runoff water is moved through the system. The conveyance system begins to release some of the water that has built up as temperatures begin to melt the thick constrictive ice. This stage is seen particularly in the "Mid" level flow on 1995 in Figure 16. Finally, the system melts completely and all of the material that was held-up by the ice constrictions is released.

Figure 16. Snowmelt Volume Through Melt Progression

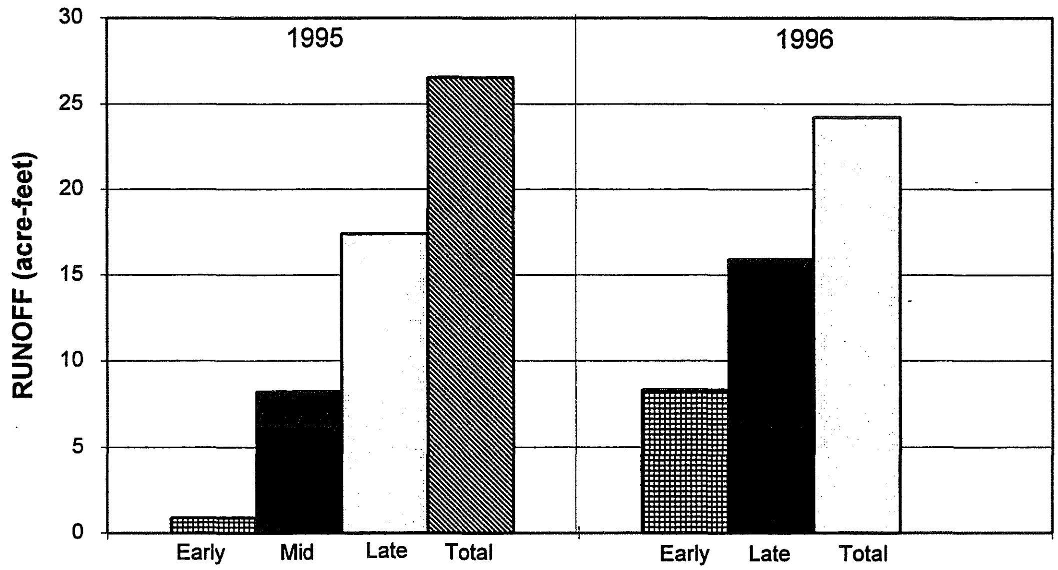
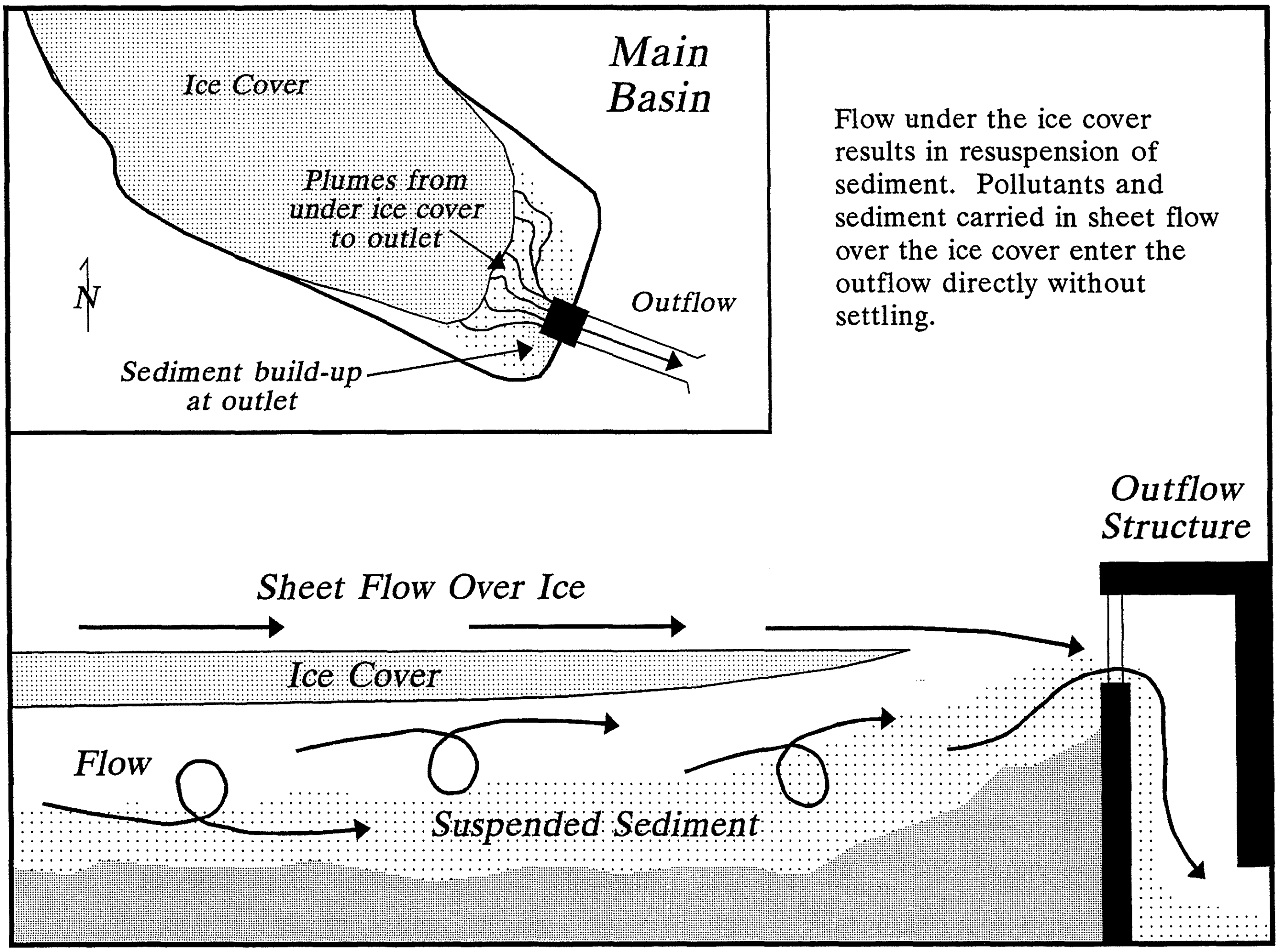


Figure 17

Schematic of Flow Created Under Partial Ice Cover, MWTS Headwater Detention Basin



Pollutant removal behavior reflects the flow dynamics at play in the MWTS. Figures 18-21 graphically portray pollutant removal percentages at each component of the MWTS for the stages of melt progression shown in Figure 16. Figures 18a-c show the solids related pollutants for the 1995 melt; Figures 19a-c show the nutrients for 1995; Figures 20a-c and 21a-c show the same sequence for the 1996 melt.

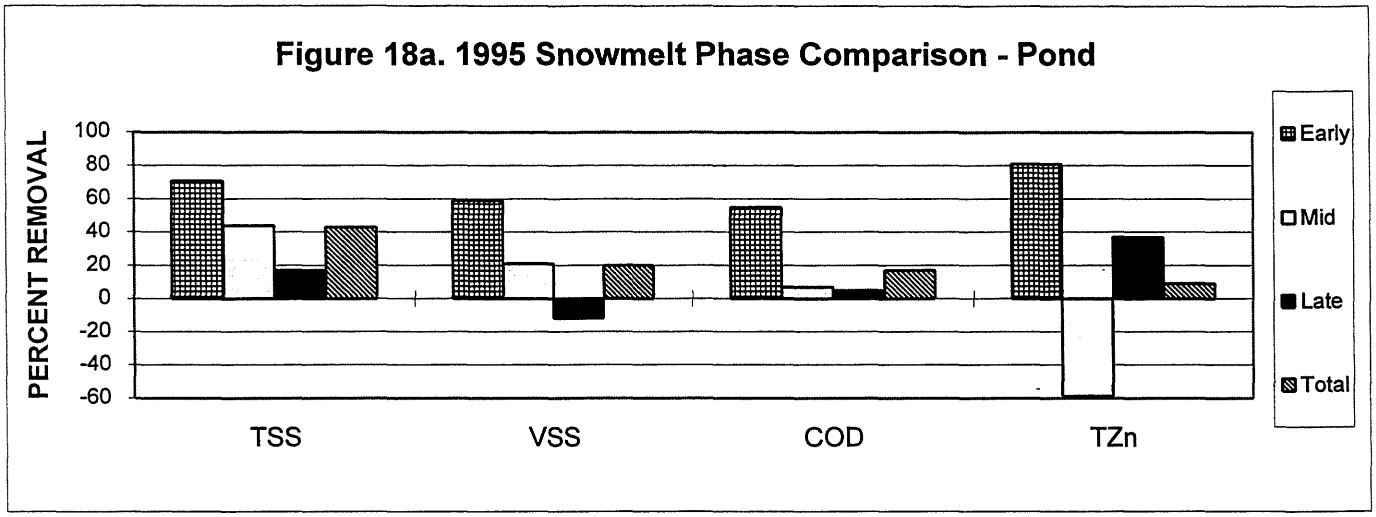
The pond did a fair job of coarse solids settling (TSS, VSS, COD, TZn) in both years, but latter phases of melt in the wetland led to very poor overall removals, mostly in the 20-40% range. Nutrient behavior was more sporadic, with generally poor performance for phosphorus particularly in the wetland in 1995 and the pond in 1996. Nitrogen removals were also quite poor, with net wash-out of ORG-N in both the wetland and overall components in 1995, and late event wash-out of other nitrogen species in most elements examined.

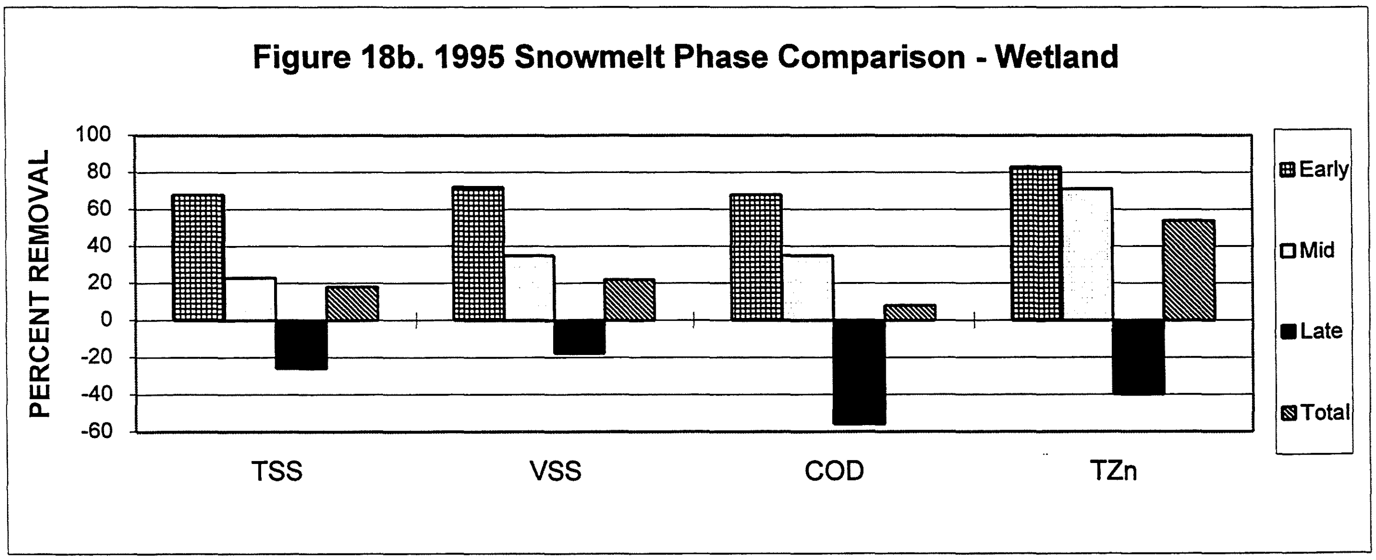
In advance of the 1996 melt, a small (one foot) flashboard was installed at both the headwater detention pond and the outlet wetland in an attempt to establish some detention volume in each storage area. As evident in Figures 18-21, there was no obvious positive benefit seen in the pond, most likely because of the relatively small volume added by only one foot of storage.

Permanent changes to the wetland to enhance treatment during snowmelt would be very difficult beyond the addition of a small flashboard. Although hard to attribute simply to the flashboard, there did appear to be somewhat better performance in the wetland following addition of the one foot board before the 1996 event. The creation of any standing water in the outlet wetland might result in just enough dissipation of runoff energy to drop some particulate matter and make a small difference in overall melt load. Insertion of a flashboard prior to melt would involve an active management program by the city of Roseville to watch for the onset of melt and respond accordingly.

Improving performance of the MWTS for pollutant removal during melt events would be very difficult to achieve, given the frozen nature of the various system components. The primary improvement would be the lowering of water levels in the ponds in the fall to avoid establishing a thick layer of ice. Dropping water levels, however, would necessitate the establishment of some kind of mechanism to allow baseflow to move through. The solution to this could be a sub-ice inlet that draws from near the bottom, below whatever ice layer forms. This approach would require some reconstruction at the headwater detention pond, but the configuration is possible. The hockey rink pond would be very difficult to reconfigure because outflow occurs at about the same elevation as standing water in the outlet wetland. Perhaps a small diameter sub-ice pipe from the detention pond to the wetland would suffice for the very small amount of baseflow entering the hockey rink pond.

Figure 18a-c. 1995 Snowmelt Phase Comparison for Pond, Wetland and System (TSS, VSS, COD, TZn)





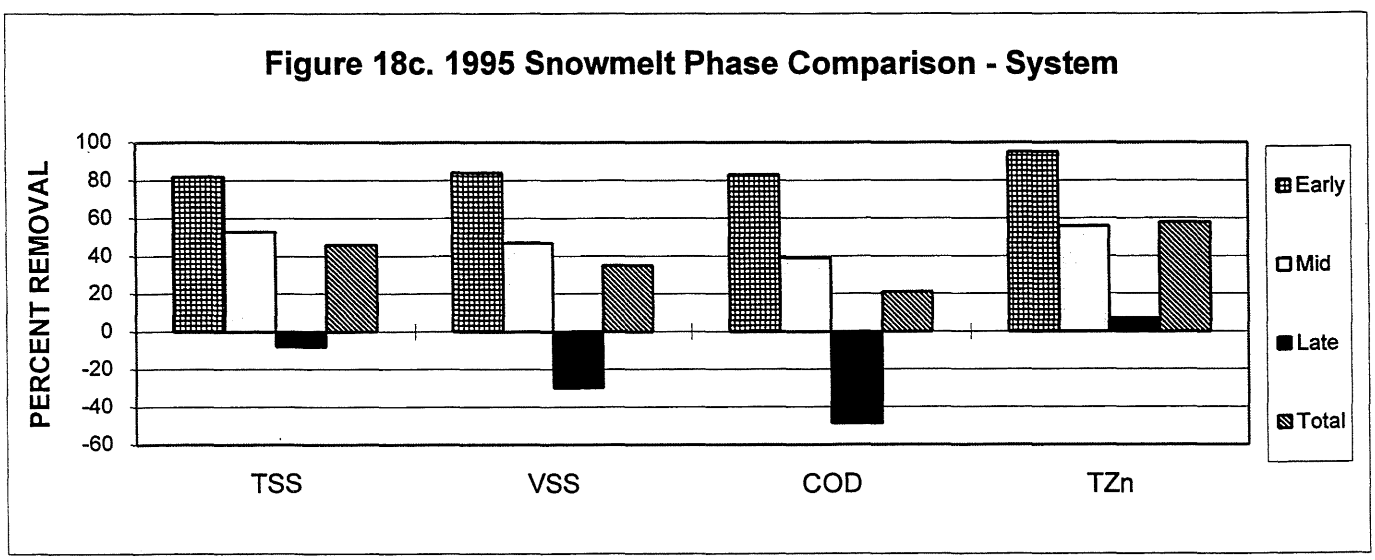
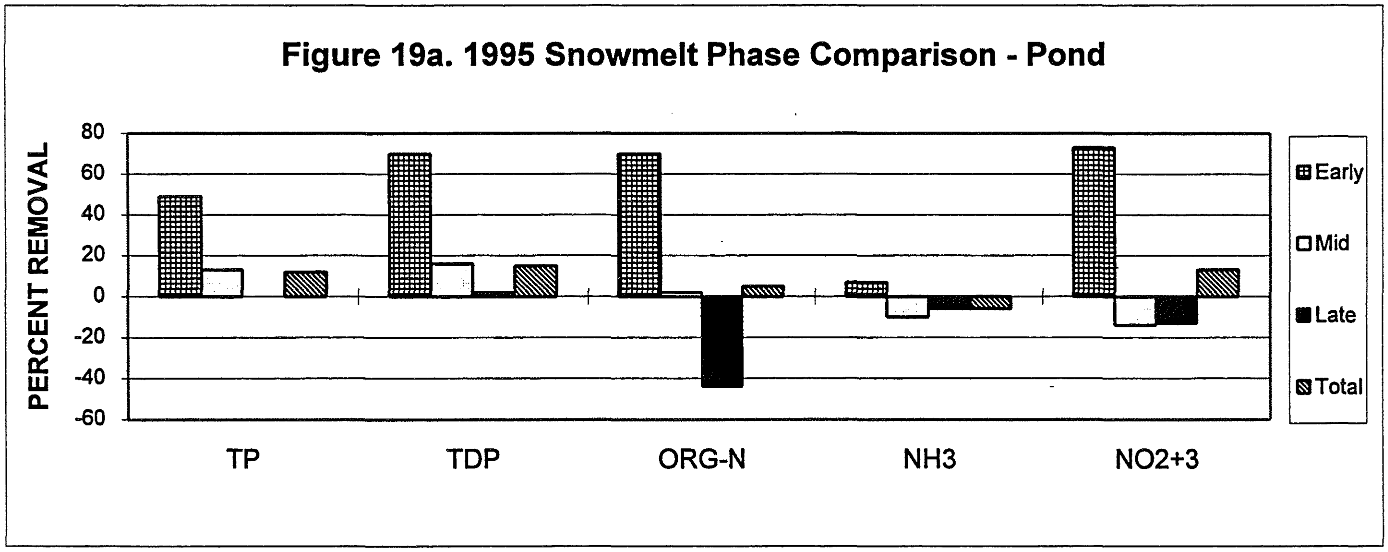
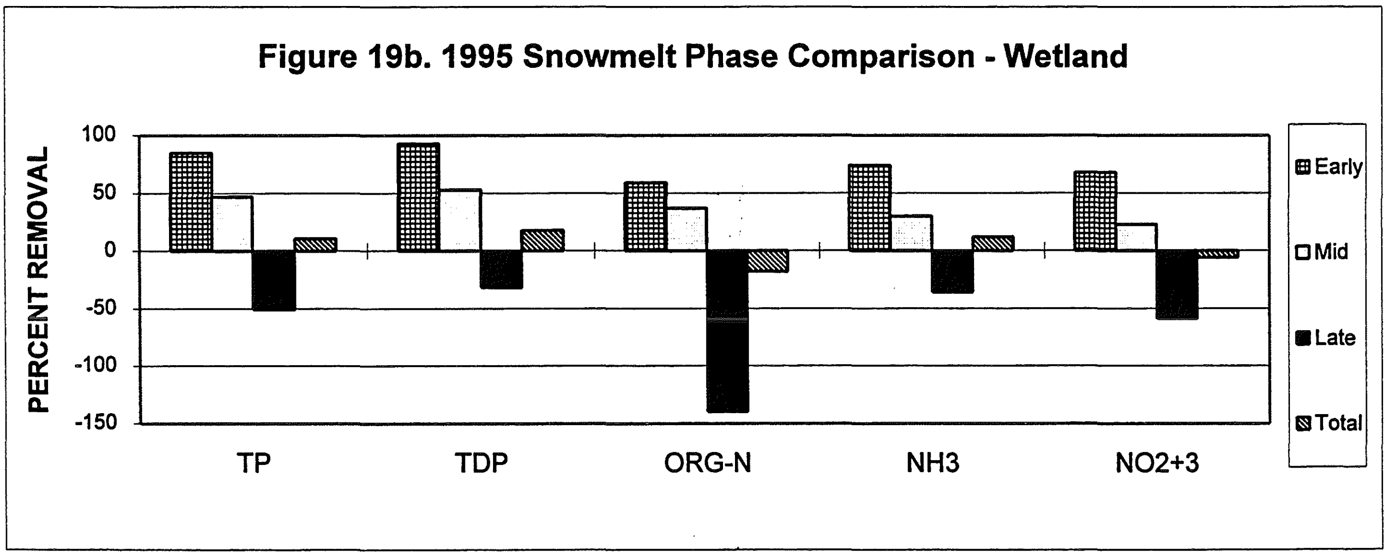


Figure 19a-c. 1995 Snowmelt Phase Comparison for Pond, Wetland and System (TP, TDP, ORG-N, NH3, NO2+3)





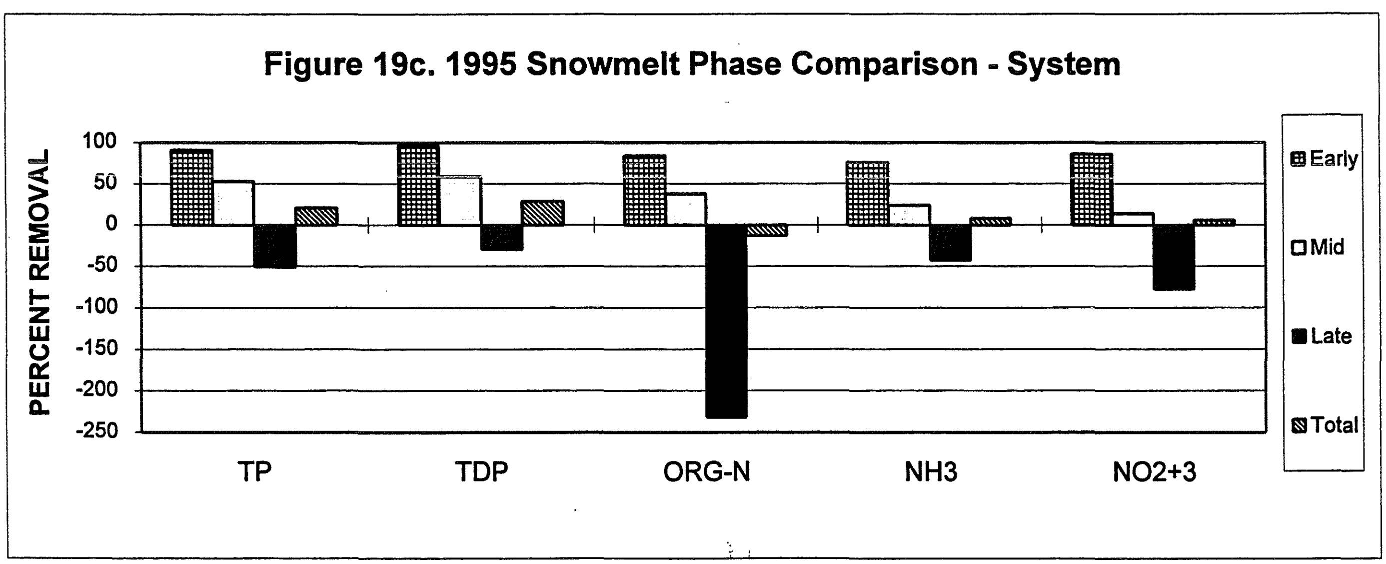
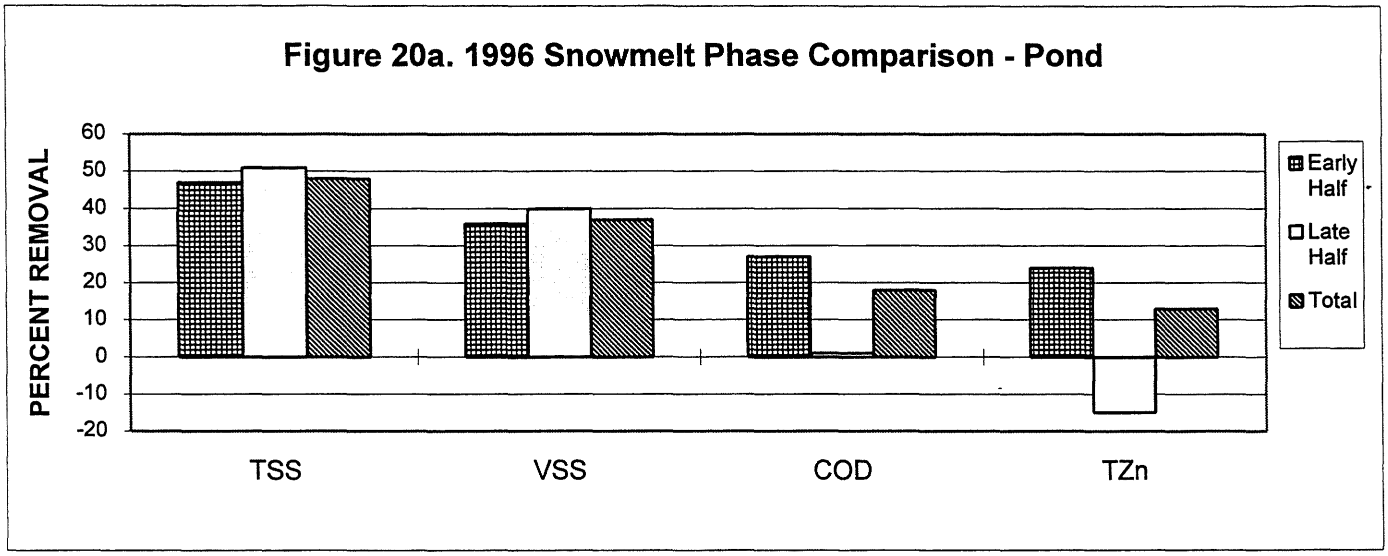
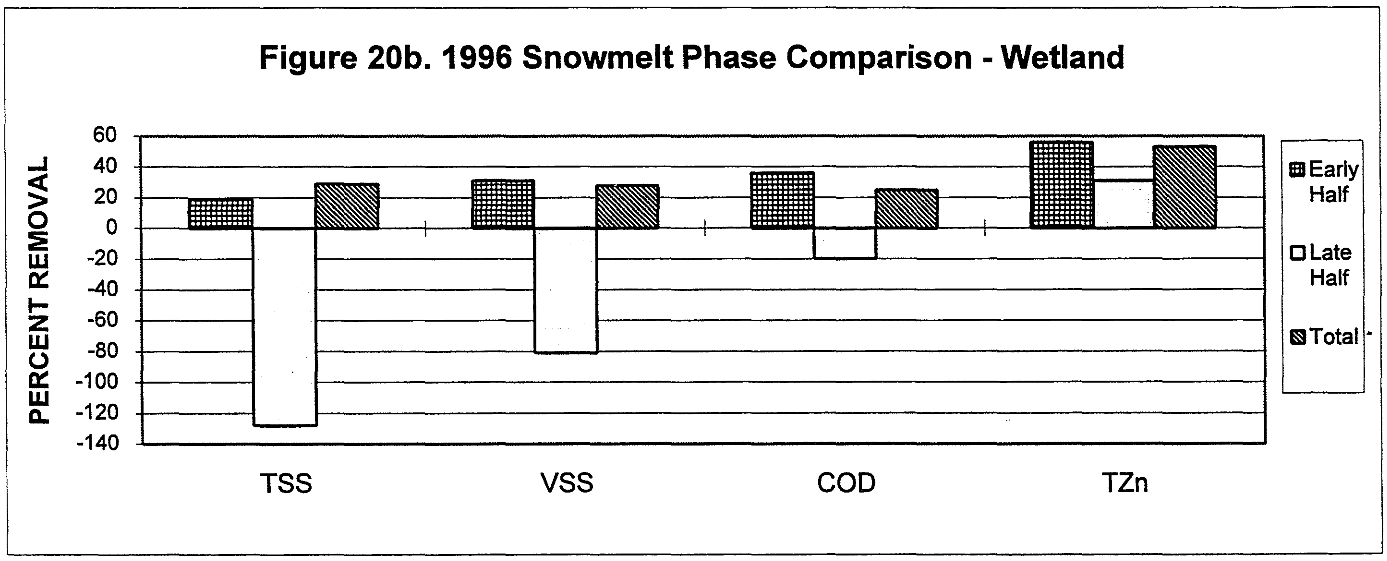


Figure 20a-c. 1996 Snowmelt Phase Comparison For Pond, Wetland and System (TSS, VSS, COD, TZn)





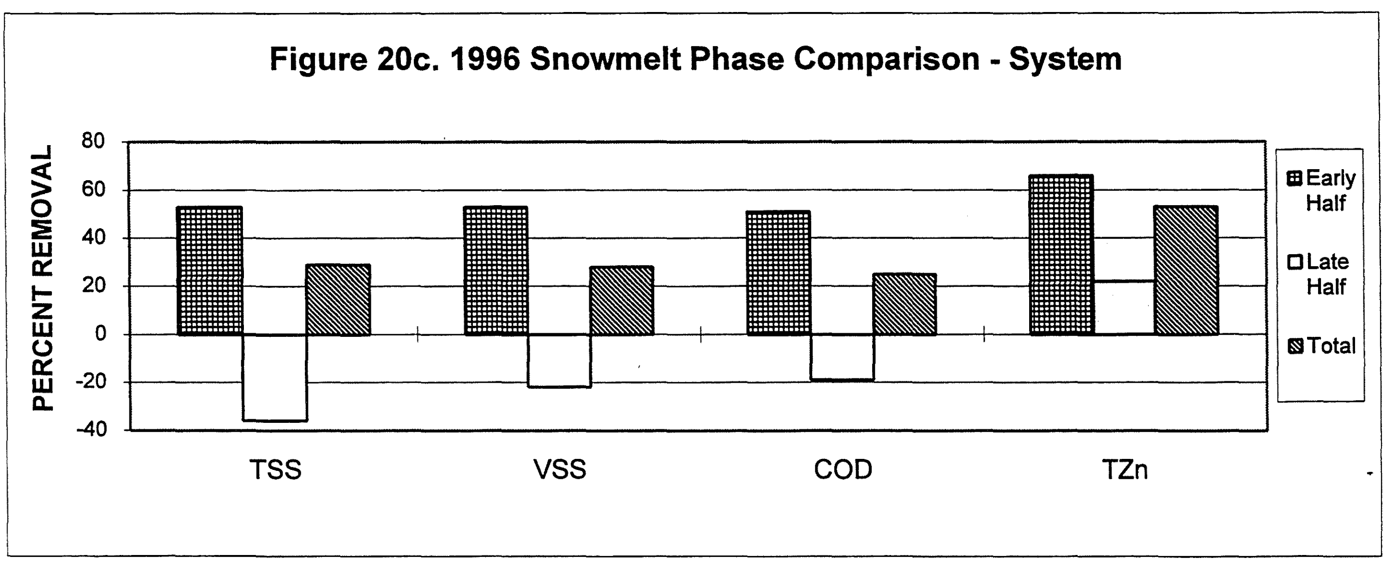
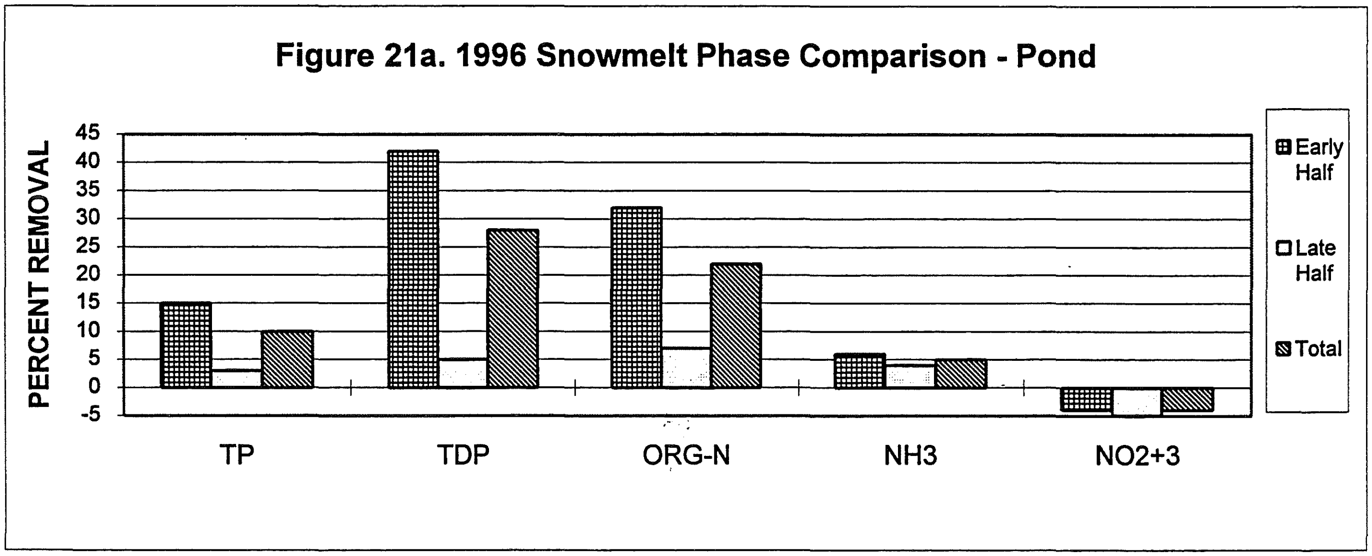
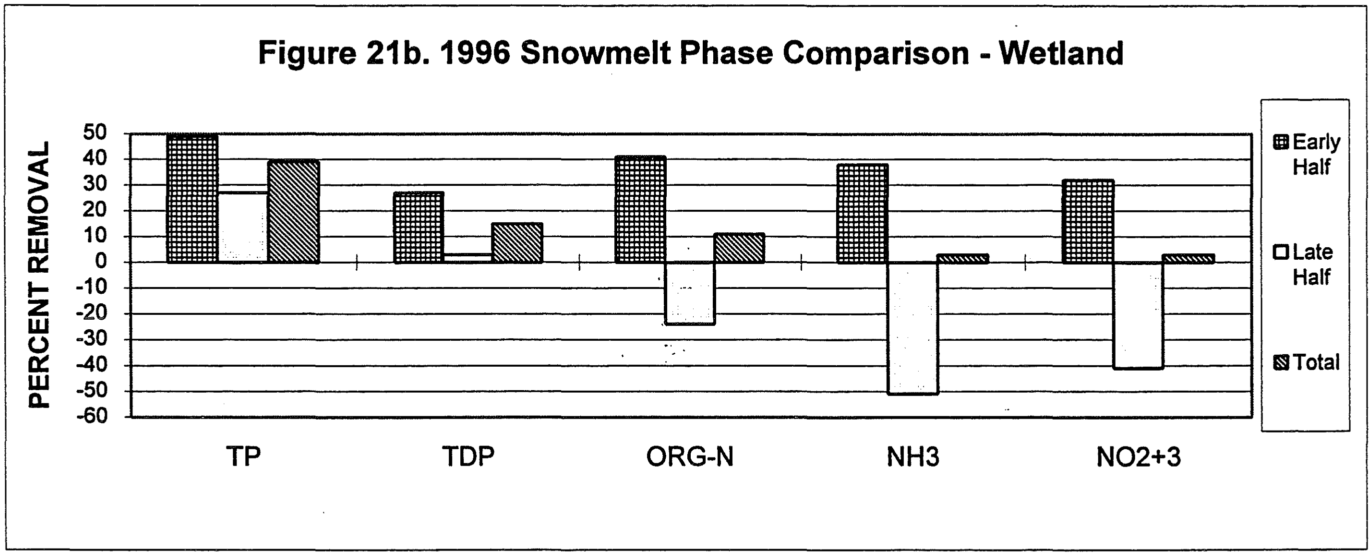
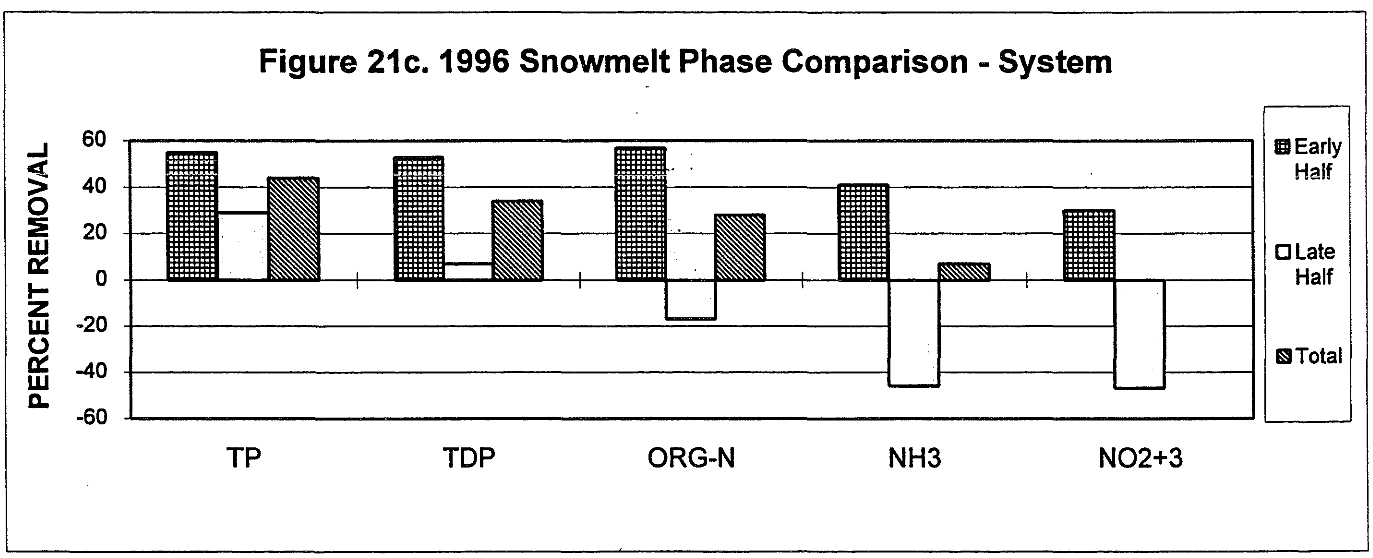


Figure 21a-c. 1996 Snowmelt Phase Comparison For Pond, Wetland and System (TP, TDP, ORG-N, NH3, NO2+3)







TEMPERATURE DATA

Physical observations during the previous study indicated the possibility that water was heated as it moved through the MWTS. However, data were needed to quantify the exact nature of this suspected warming effect. Thermistors were installed at an inflow monitoring station (site D) and at the system outflow (site A) to continually record water temperature. Outflow temperatures into Lake McCarrons were recorded from May 30, 1995 through the end of the study (November 12, 1996). The inflow site was only recorded from July 9, 1996 through the end of the study.

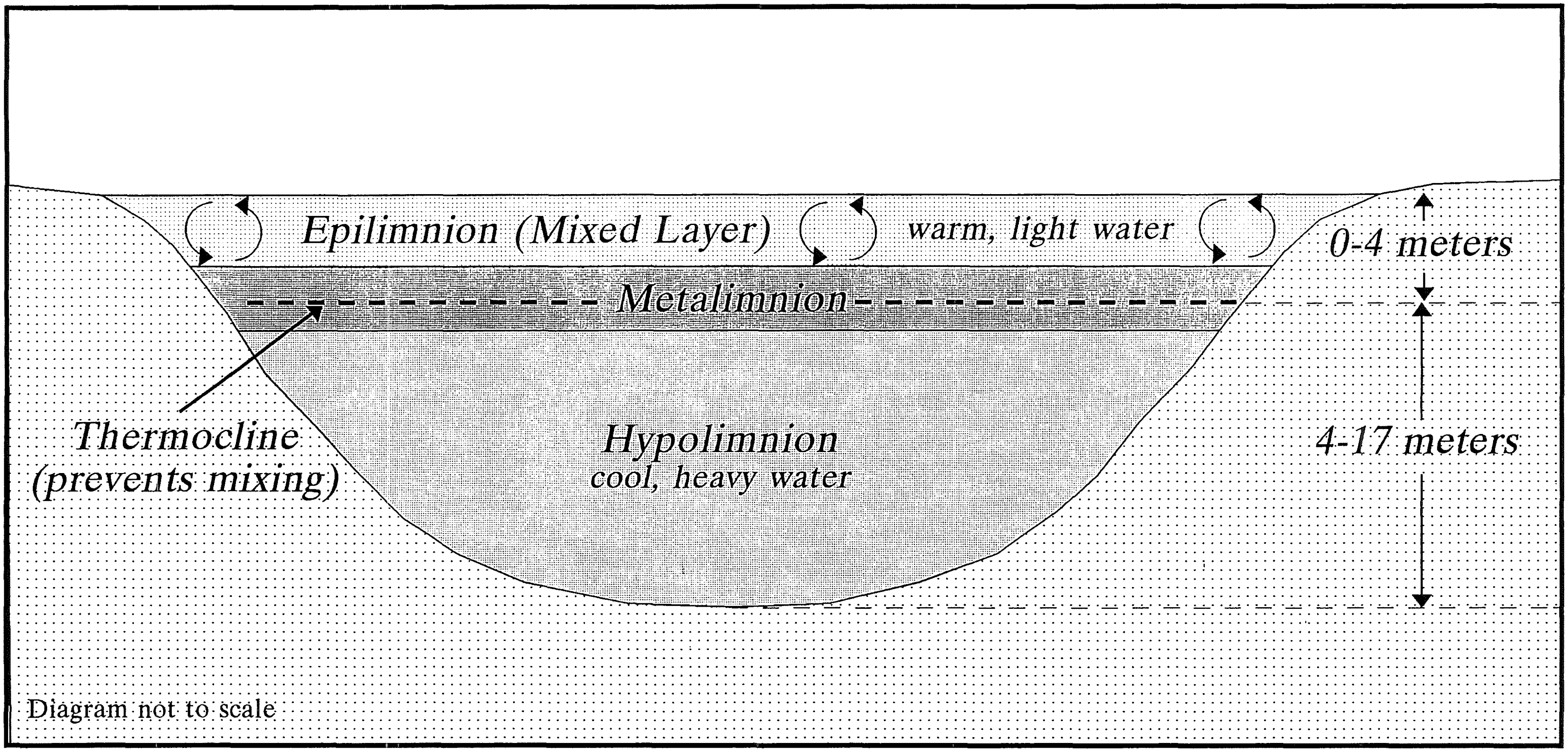
The temperature data yielded some very valuable information. All of the recorded temperature data from the MWTS, as well as the location of the lake's thermocline are included in Appendix M. Data recorded in the 1996 growing season showed a fairly consistent warming of both baseflow and event flow water by approximately 5°C (9°F) between the MWTS inflow and outflow. This increase is enough to create a temperature differential that is sufficient to maintain the discharge from the MWTS above the thermocline, resulting in confinement of inflow to the epilimnion, or near surface waters above the thermocline. As a result, mixing of the inflow will be limited to the volume of the thermocline rather than the entire volume of the lake or the volume of the much larger hypolimnion. This is especially critical in a densely stratified lake like McCarrons, which sets up the thermocline early in the spring and maintains well defined layers well into the fall. Figure 22 graphically portrays this result. Limiting the volume available for mixing likely results in higher concentrations of phosphorus in the lake's epilimnion where biological growth in the form of algal blooms leads to degraded water quality in the lake. This temperature phenomenon likely contributes to the lake's poor response to the pollution reductions seen since the installation of the MWTS. Further discussion of lake impact occurs in the Part 2 evaluation of the lake.

Although temperature data were not recorded for the entire period of study at the inflow, it is apparent from the 1996 data that heating in the system occurs during warm weather months. This creates a dilemma for use of this type of urban runoff treatment system when it is tributary to a lake. That is, installation of the detention/wetland system exposes the runoff water to heating. Before the system was installed, the wetland was deeply channelized and flow moved quickly through from inflow to outflow. It is, therefore, assumed that this runoff water entered the lake close to the inflow temperatures recorded during the Phase III study, perhaps a bit cooler because of groundwater seepage that was visible in the deep channels. Since the inflow temperature is usually cooler than the lake thermocline, the inflow likely sunk beneath the thermocline and mixed with a much larger volume, thus eliminating the inflow from being immediately available to surface biota and diluting the effect of the highly concentrated urban runoff. Now, the MWTS is expected to reduce the phosphorus load to the lake; however, the system itself has become essentially ineffective relative to phosphorus, and it heats the outflowing water so that it sits on top of the thermocline.

Further analysis of the thermodynamics and internal loading of the Lake McCarrons situation is beyond the scope of this report. However, solving the inflow temperature dilemma might be the key to improving the lake. Options to consider include: outlet of the inflowing water beneath the thermocline via pipes; chemical treatment (alum or ferric chloride) of inflow to tie-up phosphorus prior to discharge to the lake; whole or partial lake mixing to disrupt formation of the thermocline; and/or further work on the MWTS to return phosphorus reductions to those of the initial system. Some relief in warming might be obtainable by planting vegetation that could provide some shade to the water as it moves through the wetland part of the system. Eliminating channelized flow in favor of spread-out sheet flow that can flow under vegetation, and the elimination of standing water in the wetland chambers could reduce warming. Each of these solutions has benefits, problems and costs that must be evaluated by lake managers before any attempt is made to proceed.

Figure 22. Lake McCarrons Generalized Ecosystem

(Summertime Average Conditions)



PART 2: LAKE McCARRONS

BACKGROUND

LAKE DESCRIPTION

Lake McCarrons and its 821 acre (332 ha) contributing watershed (excluding the lake) lie within the City of Roseville in Ramsey County, Minnesota. The lake itself has a surface area of about 81 acres (32.9 hectares) and has mean and maximum depths of 7.7 and 17.3 meters (25.0 and 57.0 feet), respectively. The resulting water volume of the lake is 2.52×10^6 m^3 (roughly 6.7 billion gallons). Lake McCarrons is classified ecologically by the Minnesota Department of Natural Resources (MDNR) as a roughfish-gamefish lake.

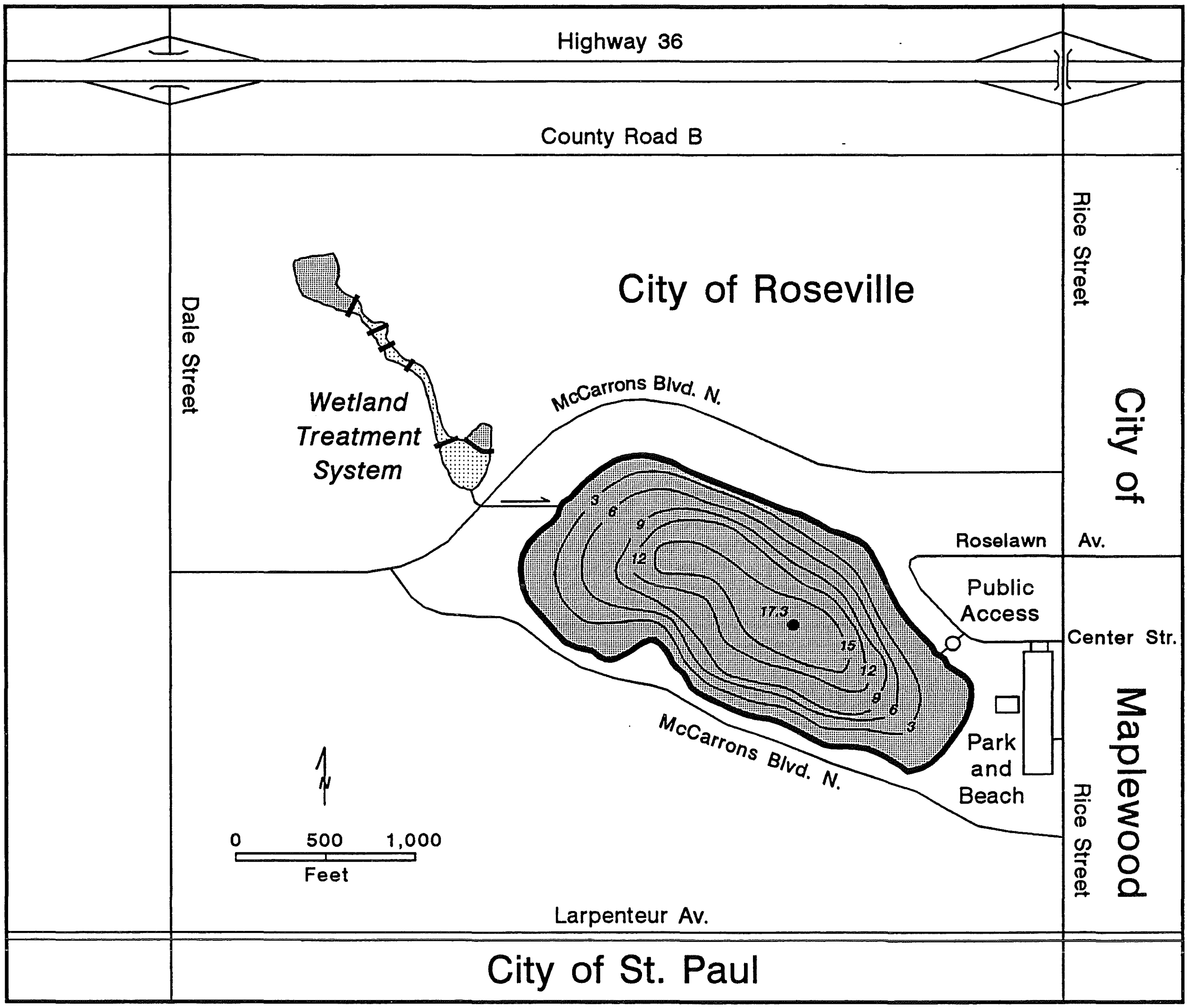
The primary lake uses include swimming at the county beach, pleasure boating (small boats), and fishing. The lake's size normally restricts the use of larger or faster boats. The lake is eutrophic with abundant densities of macrophyte growth around its shore (to a maximum depth of 3.2 m [10.5 feet]) and occasional algal blooms. The lake is strongly dimictic and the hypolimnion becomes anoxic early in the summer and, depending on the extent of the fall overturn, may remain anoxic through the winter. These anoxic conditions have in fact resulted in some partial winterkills on the lake in past years. These current lake conditions will be further discussed in the following pages.

PUBLIC ACCESS AND TRANSPORTATION

There is one public access to the lake. The concrete boat ramp located on the south eastern end of the lake provides good accessibility for use of the lake (Figure 23). The access and associated park are administered by Ramsey County.

Road access to the Lake McCarrons area is good, with Highway 36 running along the north side of the lake, and Rice Street along the east side of the lake leading to Center Street which ends at the lake's public access.

Figure 23. Lake McCarrons Location Map



Lake ID: 620054

WMO: Central Ramsey

● Sampling site
44°59'54"N
93°06'43"W

Lake contours in meters

LIMNOLOGICAL ASSESSMENT

The limnological assessment for this project includes a review of historical water quality data and data collected in a 19-month long lake monitoring program (April 1995-October 1996). Data analyses were conducted based on the summation of these data, not solely on the data collected during the 1995 or 1996 monitoring program.

HISTORICAL DATA

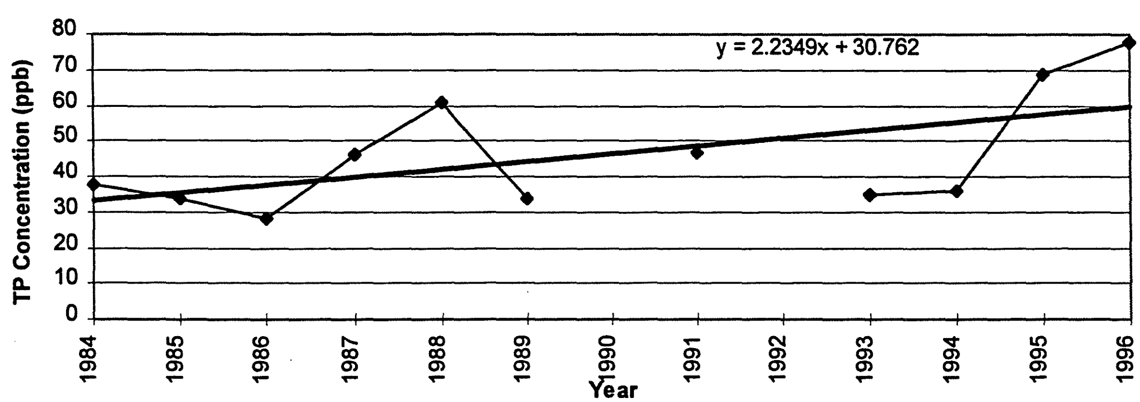
The lake has a rather extensive historical database. Historic data are provided in Appendix N. The historical data (1984-1994) on Lake McCarrons is summarized in this section. The 1995-1996 data is summarized later in this report.

A compilation of selected summer water quality parameter means (May-September) are provided in Table 12. For the purpose of this report, the earliest nutrient data used was in May, 1984. Numbers of samples per season are also indicated on the table. All sampling locations were within two meters (m) of the surface.

Phosphorus

The database contains phosphorus concentrations during the summers of 1984-1989 (while the lake was monitored in 1990 the entire year of phosphorus data was thrown out due to laboratory error), 1991, and 1993-1996 (Table 12). The mean total phosphorus (TP) concentration during these periods ranged from 28.0 micrograms per liter (μg/l) [μg/l is also equivalent to parts per billion (ppb) as shown on the representative graphs] in 1986 to 78.0 μg/l in 1996. The mean of all 11 summertime means is 46.0 μg/l. When completing a trendline (regression analysis) on the 11 summertime means a slight degrading trend is apparent (Figure 24).

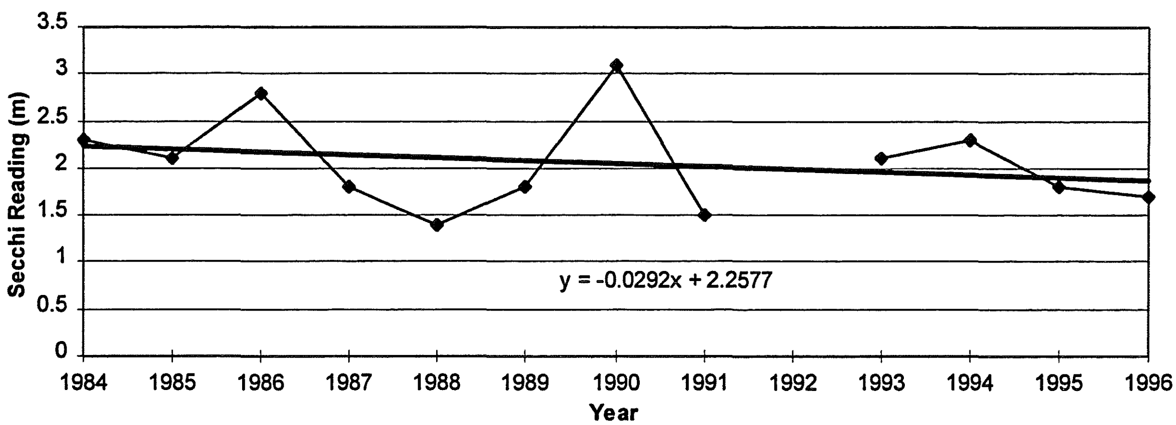
Figure 24. Lake McCarrons Summer Mean TP Concentrations



Chlorophyll and Secchi Transparency

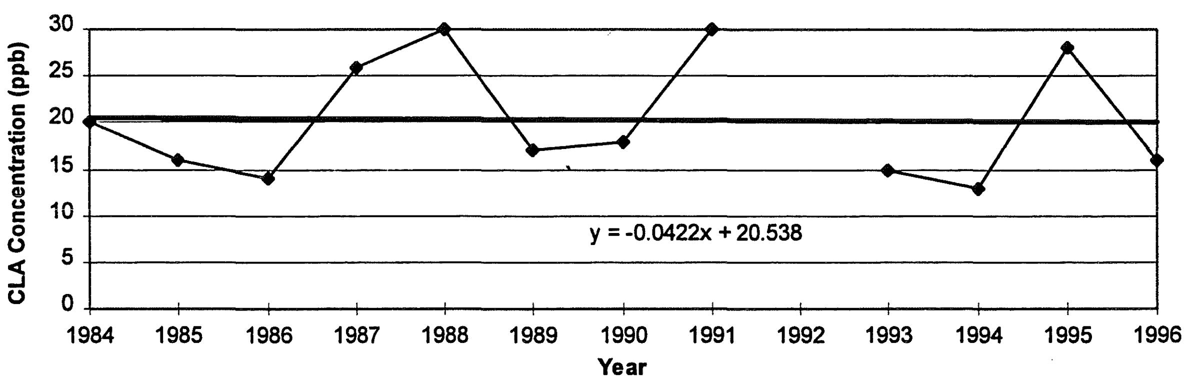
Secchi transparency readings were taken during each of the summers of 1984-1991, and 1993-1996. Summertime mean transparencies ranged from a high of 3.1 m (10.2 feet) in 1990 to a low of 1.4 m (4.5 feet) in 1989. The overall average for all 12 summertime means shown on Table 12, is 2.1 m (just under 7.0 feet). Figure 25, graphs the 12 summertime mean Secchi readings for Lake McCarrons and a regression analysis on the plotted data reveals a slight degrading trendline for the data.

Figure 25. Lake McCarrons Summer Mean Secchi Readings



Similarly to Secchi readings, chlorophyll-a (CLA) data were collected in 1984-1991, and 1993-1996. Mean annual CLA concentrations ranged from a high of 30.0 μg/l in 1988 and 1991 to a low of 13.0 μg/l in 1994. The mean of the 12 CLA means is 20.3 μg/l. Figure 26 reveals that no apparent trends can be determined from the summertime mean database.

Figure 26. Lake McCarrons Summer Mean CLA Concentrations



For the years for which Secchi transparency and CLA data are present, Secchi transparency and CLA concentrations seem to be related to one another. That is, an increase or decrease in a lake's CLA concentration results in an opposite reaction in Secchi transparency. When looking at the lake's summertime CLA and Secchi means it further becomes apparent that for the most part, when the lake has a higher summertime mean CLA concentration the lake will have a lower mean Secchi transparency, and visa versa. This CLA/Secchi relationship is common to most lakes in the area.

Nitrogen

Total Kjeldahl nitrogen (TKN) concentrations were recorded during the 1984-1991, and 1993-1996 monitoring years. Table 12 shows the maximum mean TKN concentration, 2.38 milligrams per liter (mg/l), was recorded during 1980, while the lowest mean TKN concentration other than that recorded in 1993 was 1.91 mg/l in 1984. The average of the 12 summertime mean TKN concentrations is 1.10 mg/l). Similar to that shown on the TP and Secchi transparency graphs (Figure 24 and 25), There is a slight degrading trend in the in-lake summertime mean TKN concentrations.

Dissolved Oxygen

The lake's water column has also been measured for dissolved oxygen (DO) levels in the past. Similarly to the nutrient and Secchi data, DO levels were measured during the summers of 1984-1991, and 1993-1996. Concentrations ranged from <5.0 - >10.0 mg/l in the lake's surface waters, and annually became anoxic (> 2.0 mg/l) in the lakes hypolimnion throughout the summer and winter months. Because the lake is so strongly stratified during the summer months, the hypolimnion (and resulting anoxic conditions) in mid-summer generally ranged from 4.0 meters to 17.0 meters.

Table 12. Summary of Selected Summer Quality Means for Lake McCarrons Surface Waters

Year	Total Phosphorus (μg/l)	n	Chlorophyll-a (μg/l)	n	Secchi transparency (m)	n	Kjeldahl Nitrogen (mg/l)	n
1984	38	10	20	10	2.3	10	1.08	10
1985	34	15	16	15	2.1	15	0.97	15
1986	28	11	14	11	2.8	11	0.82	11
1987	46	11	26	11	1.8	11	1.11	11
1988	61	11	30	11	1.4	11	1.38	11
1989	34	11	17	11	1.8	11	1.01	11
1990			18	10	3.1	10	1.10	10
1991	47	11	30	11	1.5	11	1.22	11
1992								
1993	35	10	15	10	2.1	10	0.90	10
1994	36	10	13	10	2.3	10	0.90	10
1995	69	11	28	11	1.8	11	1.41	11
1996	78	10	16	10	1.7	10	1.28	10
Mean	**46.0**	**11**	**20.3**	**12**	**2.1**	**12**	**1.10**	**12**

n = number of monitoring events

CURRENT DATA

A 19-month lake monitoring program was conducted as part of this project. The monitoring occurred between April 1995 and October 1996.

Lake Monitoring Methods

Lake McCarrons was sampled at two-week intervals from mid-April through mid-October 1995, monthly from November 1995 through March 1996, and biweekly again from mid-April 1996 through October 1996. The lake was normally visited between 8:00 a.m. and noon on the sampling days. Samples were collected from one station located over the deepest spot near the center of the lake (Figure 23).

A hand-held Global Positioning System (GPS) was used to lock in sampling location coordinates (shown as latitude and longitude), and to aid in relocating sampling locations during each ensuing monitoring event. Time, surf and weather conditions, and station depth were recorded upon anchoring at the site. Temperature and dissolved oxygen were measured at one-meter intervals (temperature at half-meter intervals near the thermocline) using a Yellow Springs, Inc. (model 50) field oxygen/temperature meter. Water transparency was measured using a 20 cm black-and-white Secchi disk.

Water was collected from the lake's surface (0-2 m) using a two-meter PVC pipe that held two liters of water. Two or three such samples were mixed in an 8-liter plastic jug. All water samples were transported on ice in a dark cooler and processed and preserved within six hours of collection. Water from the surface jug was withdrawn for the following chemical analyses: total phosphorus (TP), total dissolved phosphorus (TDP), total Kjeldahl nitrogen (TKN), ammonia (NH3) [quarterly in 1995-1996], nitrate-nitrite (NO2+3) [quarterly in 1995-1996], chlorophyll-a (CLA), alkalinity (ALK) [quarterly in 1995-1996], pH and specific conductance (COND). Subsurface water samples were also drawn using a 2-liter Van Dorn and analyzed for TP, TDP, and TKN. Subsurface sampling once the lake stratified generally included a sample just above the thermocline, just below the thermocline, and a half meter off the bottom.

In addition, phytoplankton and zooplankton samples were taken from Lake McCarrons from April 1995 through March 1996. Phytoplankton samples were withdrawn from the surface jug and preserved in the field in 1 percent acid Lugol's solution. Zooplankton were collected by vertically towing a 80 μm mesh Wisconsin-type net through the entire water column and preserved in 4 percent formaldehyde. Plankton and zooplankton data are not reported in this report because further analysis is pending.

The routine chemical analyses were performed at the Metropolitan Council Environmental Services - Environmental Planning and Evaluation Department (MCES-EPE) laboratory [referred to as MCES lab] following U.S. EPA approved methods. Surface and subsurface water samples in Lake McCarrons were analyzed for TDP (filtered through a 0.45 μm membrane filter) and for TP. Water samples tested for phosphorus (TP and TDP) and TKN were digested with the sulfates of hydrogen, potassium and mercury (H_2SO4, K_2SO_4 and $HgSO_4$). Following digestion, phosphorus was analyzed using a modified ascorbic acid reduction method (APHA 1992). Samples tested for TKN were chemically reduced the same way as the total phosphorus samples, then were color-intensified with sodium nitroprusside and assayed for ammonia colorimetrically. TKN and TP from the surface were periodically analyzed in duplicate to determine accuracy, at which time their average values were reported.

Samples that were analyzed for ammonia were first filtered through a 0.45 μm glass-fiber filter. The filtered NH3 samples were then color-intensified with sodium nitroprusside and tested for ammonia colorimetrically. Nitrate-nitrite nitrogen was measured by reducing nitrate to nitrite, then diazotizing the nitrite and assaying colorimetrically.

Water samples to be analyzed for CLA were filtered onto a 0.45 μm glass-fiber-filter, saturated with magnesium carbonate, and stored frozen in the dark until analyzed (within 30 days). CLA was extracted from the filters by homogenization in 90 percent aqueous acetone. The optical density of the extract was measured spectrophotometrically at 630, 647, 664 and 750 nm. CLA was calculated from a trichromatic equation that corrects for turbidity (APHA 1992).

A 10-ml sample for ALK (g $CaCO_3 /m^3$) was decanted from the field surface jug and then titrated with 0.02N HCl to an electrometrically determined end point of pH 4.5.

Specific conductance and pH were measured in the laboratory using one of several available lab meters that were calibrated daily.

RESULTS

LAKE CHEMISTRY

The chemistry of Lake McCarrons was assessed through this project. The chemistry is discussed in relation to four major components: phosphorus, oxygen, chlorophyll, and Secchi transparency, and several minor components. Table 12 summarizes the information on surface water phosphorus, CLA, Secchi transparency, and total Kjeldahl nitrogen collected during this project and Figures 27-38 present the 1995-1996 data in graphical form. 1995-1996 raw water quality data are presented in Appendix N.

While the lake's 1995 and 1996 summertime TP and Secchi transparency means presented on Table 12 are worse than the majority of pre-1993 summertime means, this does not necessarily mean that the overall quality of the lake is degrading. In fact, degraded water quality conditions were found on many of the lakes monitored by the Council in 1995 when compared to their water quality in 1993 and 1994. Metro lakes experienced very similar water quality in 1996 to that recorded in 1995. This degradation in local lake quality more than likely is attributed to the summer of 1995 being warmer than normal and the late-summer and early-autumn months being wetter than normal (overall the summer of 1995 was drier than normal). The warmer conditions (17 days > 90 degrees Fahrenheit including eight days in a row in June and five days in a row in July) coupled with what seemed to be a calm summer, likely promoted algal growth, thus raising CLA conditions and lowering water clarity. The summer of 1996, on the other hand was cooler and dryer then normal. The previous years of higher than normal annual precipitation (1993-1995) however, have resulted in the soils in some watersheds becoming saturated. Thus rainfall runs off more quickly lessening infiltration, increasing nutrient and sediment loads to the lakes and exacerbating current high lake levels.

It is important to note that any perceived degradation in lake quality should be viewed with caution. While it would be distressing to translate the poorer water quality of Lake McCarrons in 1995 and 1996 to the decreased overall quality of the lake, this may not be the case. Other factors such as annual temperature and precipitation conditions play a large role in the lake's actual water quality from year to year.

Phosphorus

Phosphorus is a primary concern of Lake McCarrons because historical evidence has shown that it is the limiting nutrient for primary productivity. Improvements in water quality relating to algal growth will have to come from reducing phosphorus availability during the growing season (May-September).

The seasonal trends in in-lake phosphorus concentrations are summarized in the figures that accompany the following text. During the winter months, there was a fairly steady decline in phosphorus concentration (both total and dissolved), in the water near the lake's bottom. The winter months also showed an increase in total and dissolved phosphorus in the lake's surface water.

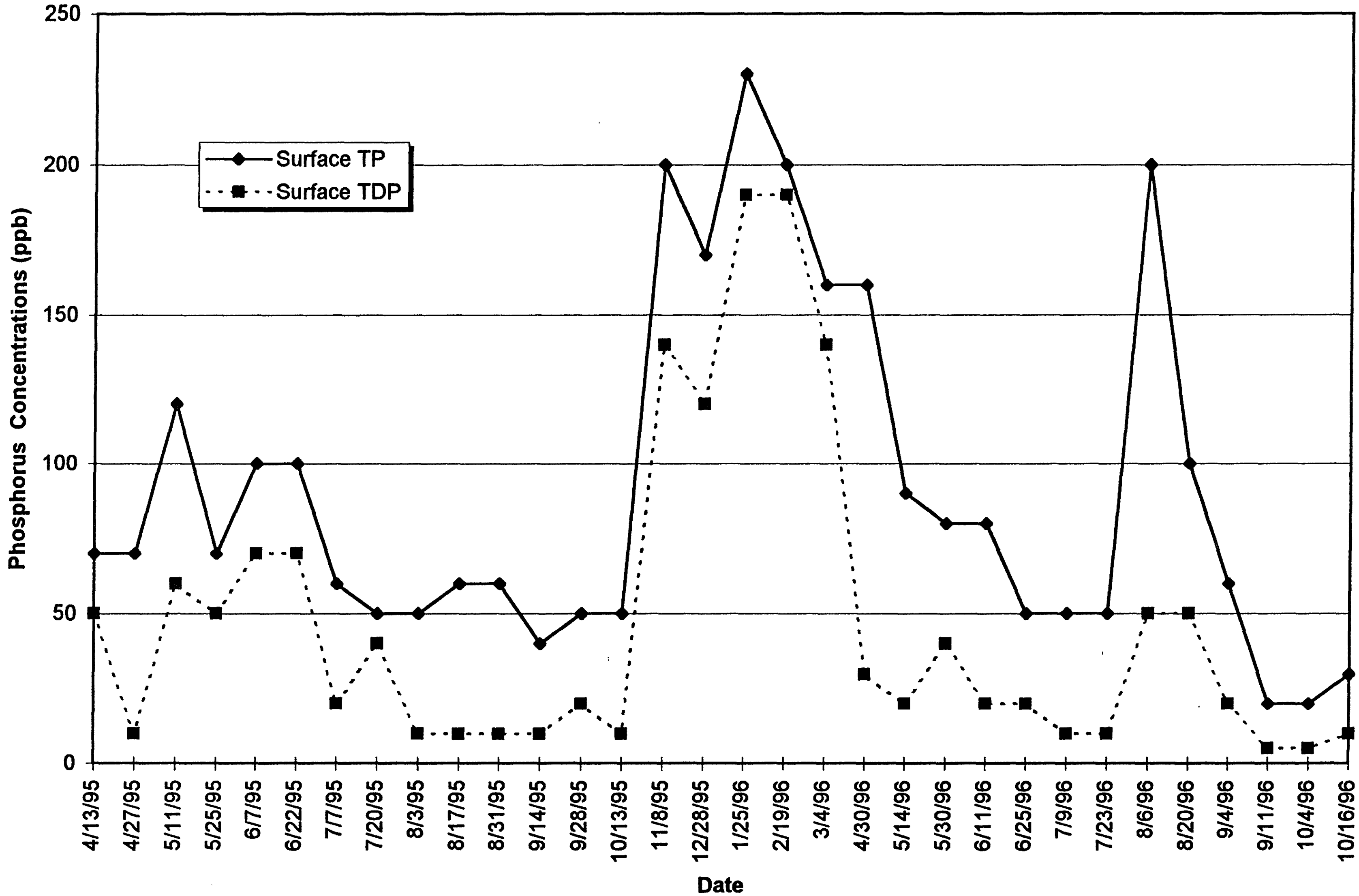
The surface and bottom samples on most occasions exhibited a significant difference in phosphorus concentrations. This disparity narrowed from November to mid-May when the lake was un-stratified and TP concentrations of the lake's surface water was at times actually greater than that of the bottom water. These periods relate to spring and fall turnover of the lake. However, it is significant to note that although phosphorus levels in the lake's hypolimnion increased throughout the summer months (some 8-12 fold of that in the spring), the surface concentrations actually decreased in the early-summer from that observed throughout the winter. In fact, except for a few dates where TP was greater than 100.0 μg/l and once when the surface TP reached 200.0 μg/l, the TP of the lake's surface water for the most part remained consistently between 40.0 and 80.0 μg/l .

The summertime mean total phosphorus concentration of the lake's surface water was 69.0 μg/l in 1995 and 78.0 μg/l in 1996 (the 1996 summertime mean is less than the 85.0 μg/l reported in the 1996 Council report entitled *1996 Study of the Water Quality in 66 Metropolitan Area Lakes*, because of an error in data input). If the August 6, 1996 surface TP of 200.0 μg/l would be excluded from the dataset, the 1996 summertime mean would have been 64.4 μg/l. The summer mean surface TDP in 1995 was 33.6 μg/l (49% of the surface TP) while the summertime mean in 1996 was 24.5 μg/l (31% of the surface TP). At 0.5 m off the bottom, the summertime mean TP concentration was 756.0 μg/l in 1995 and 852.0 g/l in 1996. The summertime mean TDP concentrations were 644.0 μg/l (85% of the bottom TP) in 1995 and 708.0 μg/l (83% of the bottom TP) in 1996. Therefore, the overwhelming majority of the phosphorus in the lake's bottom water is in a dissolved form.

Surface TP and TDP concentrations (Figure 27), were at their greatest levels in early-summer 1995, winter 1995-1996 and late-summer 1996. The maximum summer surface TP concentration was experienced on August 6, 1996 (200.0 μg/l), while the maximum summer surface TDP concentration was recorded in June 1995 (70.0 μg/l). The maximum surface TP and TDP concentrations over the winter months were recorded on January 25, 1996 (230.0 μg/l and 190.0 μg/l, respectively).

A look at the current and historic surface phosphorus data reveals a slightly different scenario in 1996 than was seen in the past. For the most part surface phosphorus in Lake McCarrons in the past has started out high in the spring after turnover and slowly reduces throughout the summer before increasing again in late fall after fall turnover. This same scenario is common among other strongly stratified lakes in the region. Surface phosphorus in 1996, however, started out high in spring, declined through July, but then dramatically increased in August before decreasing again through early autumn. This two-to-four fold increase in August dramatically impacted the lake's overall summertime mean. While the cause of this dramatic increase is uncertain, one possible explanation could be the result of the very dry July and August experienced in 1996. This drier than normal (-1.43 inches [-3.63 cm] from the monthly norm in July and -2.19 inches [5.56 cm] in August) probably resulted in either the lengthening of the lake's retention time or a loss of any flushing altogether. In fact, there was no recorded outflow from the lake between July and mid-November, 1996. Therefore the lake's epilimnetic zone would be unable to purge itself of its associated phosphorus while baseflow from the wetland treatment system continually added to the load.

Figure 27. Surface Phosphorus Concentrations



Hypolimnetic TP and TDP concentrations throughout the study period (shown in Figure 28) were at their greatest levels during the summer months and at their minimum throughout the winter months. The greatest TP and TDP concentration in the lake's hypolimnion (collected 0.5 m off the lake bottom) was on August 6, 1996 (1,700.0 μg/l and 1,400.0 μg/l, respectively). Throughout the summer months the TP concentrations near the lake's bottom started around 150.0 μg/l and then increased to a range of 800.0 μg/l to 1,700.0 μg/l. These high summer concentrations of phosphorus in the lake's hypolimnion become available to the lake's surface waters in the fall of the year when the lake turns over (Figure 29 show how phosphorus concentrations at the lake's 6 m and 12 m depth reacts similarly [although a bit delayed] as the near-bottom depth). After turnover, phosphorus concentrations throughout the lake's water column become similar (resulting in increased concentrations at the surface and decreased concentrations in the sub-surface samples as compared to summer). The high summer concentrations; however, have little effect on surface concentrations throughout the summer months due to the strong stratification of the lake (preventing the mixing of the lake's epilimnion and hypolimnion).

The dramatic increase in the lake's hypolimnetic TP levels from May through November in 1995 and 1996 indicates an influx (or release) of phosphorus into the system. Figure 30 shows that this period of phosphorus increase corresponds to the period of anoxia in the lake's hypolimnion.

Figures 28-30 reveal that extremely high TP concentrations were recorded at all four sampling depths (surface, 6 m, 12 m, and 16 m) on August 6, 1996. The concentrations on this date were actually the study's summer maximums for surface, 6 m and 16 m samples. The 12 m TP concentration on August 6, was the second highest summer concentration recorded over the two years of the study.

The reason for the elevated TP concentrations on August 6, 1996 is not entirely known. There were no abnormally elevated phosphorus concentrations recorded on other metro area lakes monitored that same day by the Council (which could have indicated possible contamination problems). Climatological conditions for early- to mid-August 1996 indicate that high winds were recorded on August 3, 4, and 6 with five-second and 2-minute maximums of 30 mph and 25 mph on August 3 and 4, and 49 mph and 31 mph on August 6. Additionally, nearly one inch of rain was recorded between August 5 and 6 and the maximum air temperature on August 6 (94 degrees F) was 10 (+) degrees warmer then the days prior or after.

A potential explanation for the elevated surface TP levels on August 6, 1996 could be that the wind conditions along with the high air temperature could cause some mixing between the epilimnion and lower depths. Because each sampling depth experienced elevated TP, and the lake's temperature and dissolved oxygen profiles and thermocline depth on August 6 were similar to those for sampling dates immediately prior and after, the wind and air temperature conditions in early- to mid- August may not have factored into the elevated TP scenario at all. Thus, the reason for the elevated TP concentrations on August 6, 1996 are not presently known.

Figure 28. Surface and Near-Bottom Total and Dissolved Phosphorus Concentrations

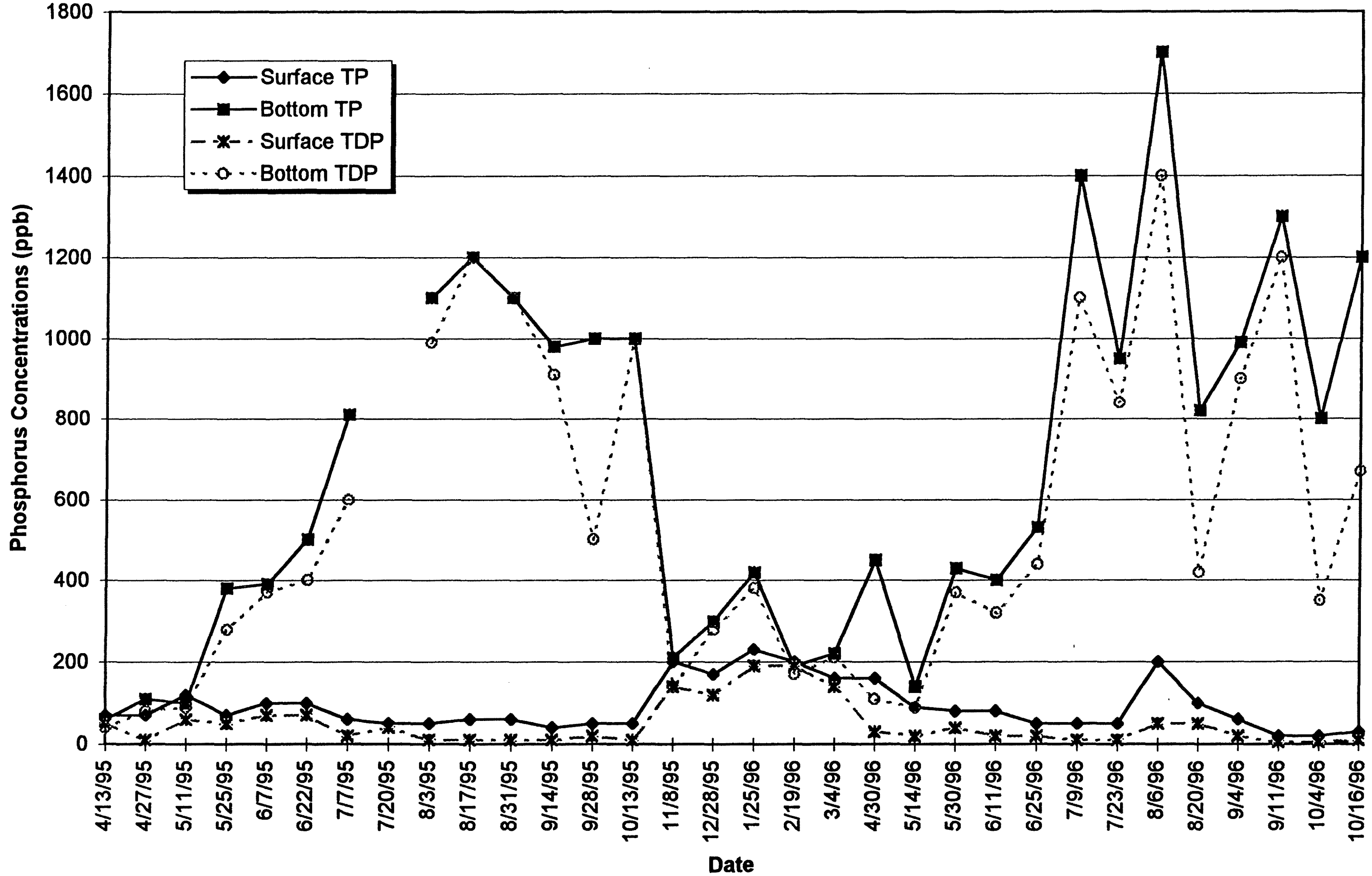


Figure 29. 6- Meter and 12-Meter Total and Dissolved Phosphorus Concentrations

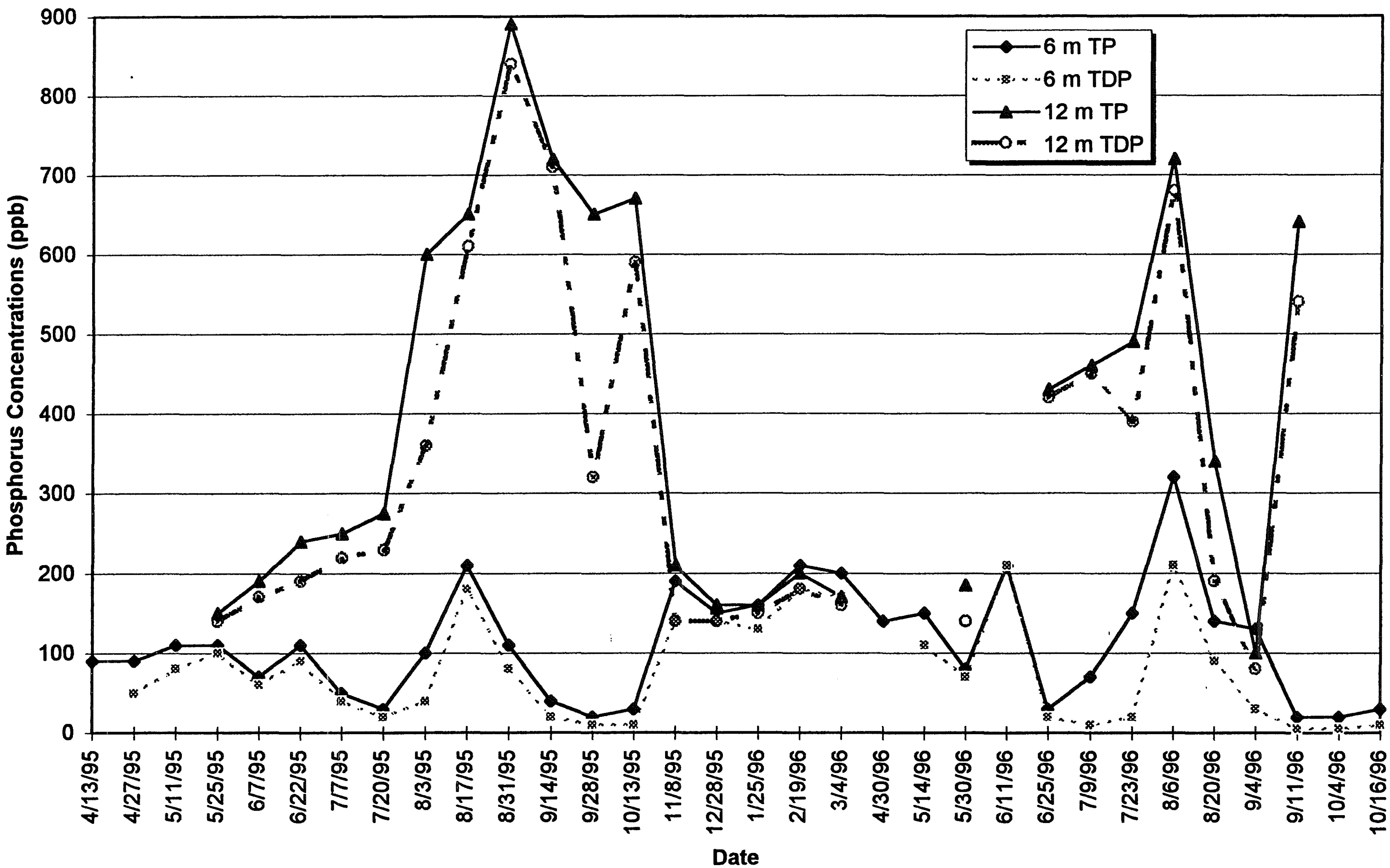
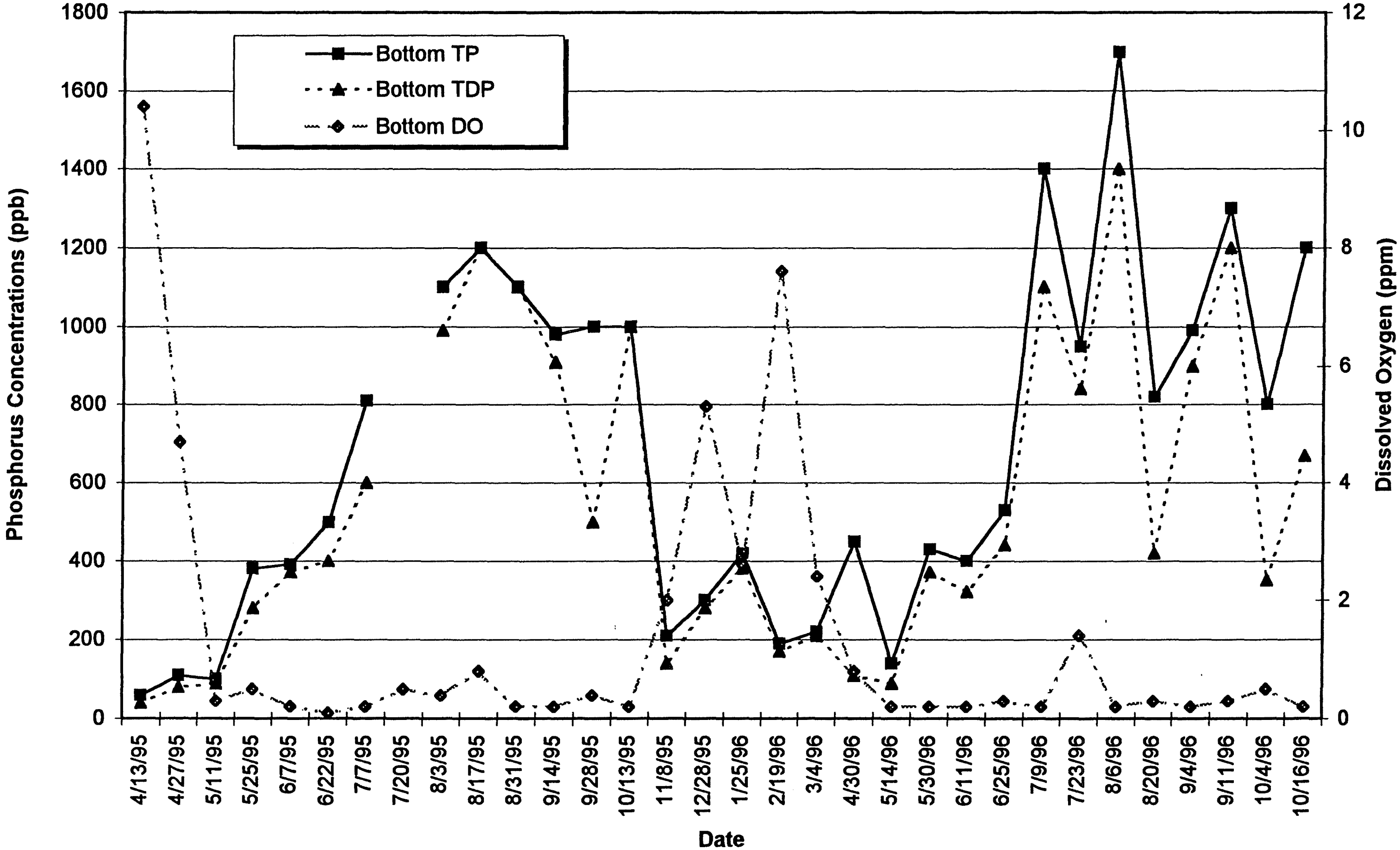


Figure 30. Near-Bottom (16m) Phosphorus Concentrations vs. Near-Bottom Dissolved Oxygen Levels



Figures 31 and 32 show the lake's approximate TP and TDP load throughout the water column during each monitoring event. These figures show the increase of TP and TDP in the lake's hypolimnion throughout the summer months and how fall turnover increases the amount of TP and TDP at the lake's surface.

Generally, in the surface, sub-surface, and near-bottom samples, TP and TDP concentration trends mirrored one another. That is, as TP concentrations (phosphorus in particulate form + phosphorus in dissolved form) either increased or decreased, TDP concentrations for the most part followed. This means that the percentage of phosphorus which was in the dissolved form (the form of phosphorus which is most readily available for algal growth) remained constant throughout the year. Furthermore, the TDP:TP relationship may substantiate the problem of phosphorus release from the lake's sediments (internal loading). The reason being that the lake's phosphorus concentration seemed to be dictated by the levels of TDP (the form of which phosphorus is released from a lake's sediments) not particulate phosphorus (which makes up the majority of surface runoff).

TP concentrations are used to estimate the overall trophic status of a lake. A TP concentration of 20-50 μg/l is considered eutrophic, and a concentration greater than 50.0 μg/l is considered borderline eutrophic-hypereutrophic for lakes in northern temperate regions (Reckhow et al. 1980). Therefore, Lake McCarrons mean TP concentration, of 69.0 μg/l in 1995 and 78.0 μg/l in 1996, puts the lake in the hypereutrophic classification.

Figure 31. Total Phosphorus Content in Lake McCarrons

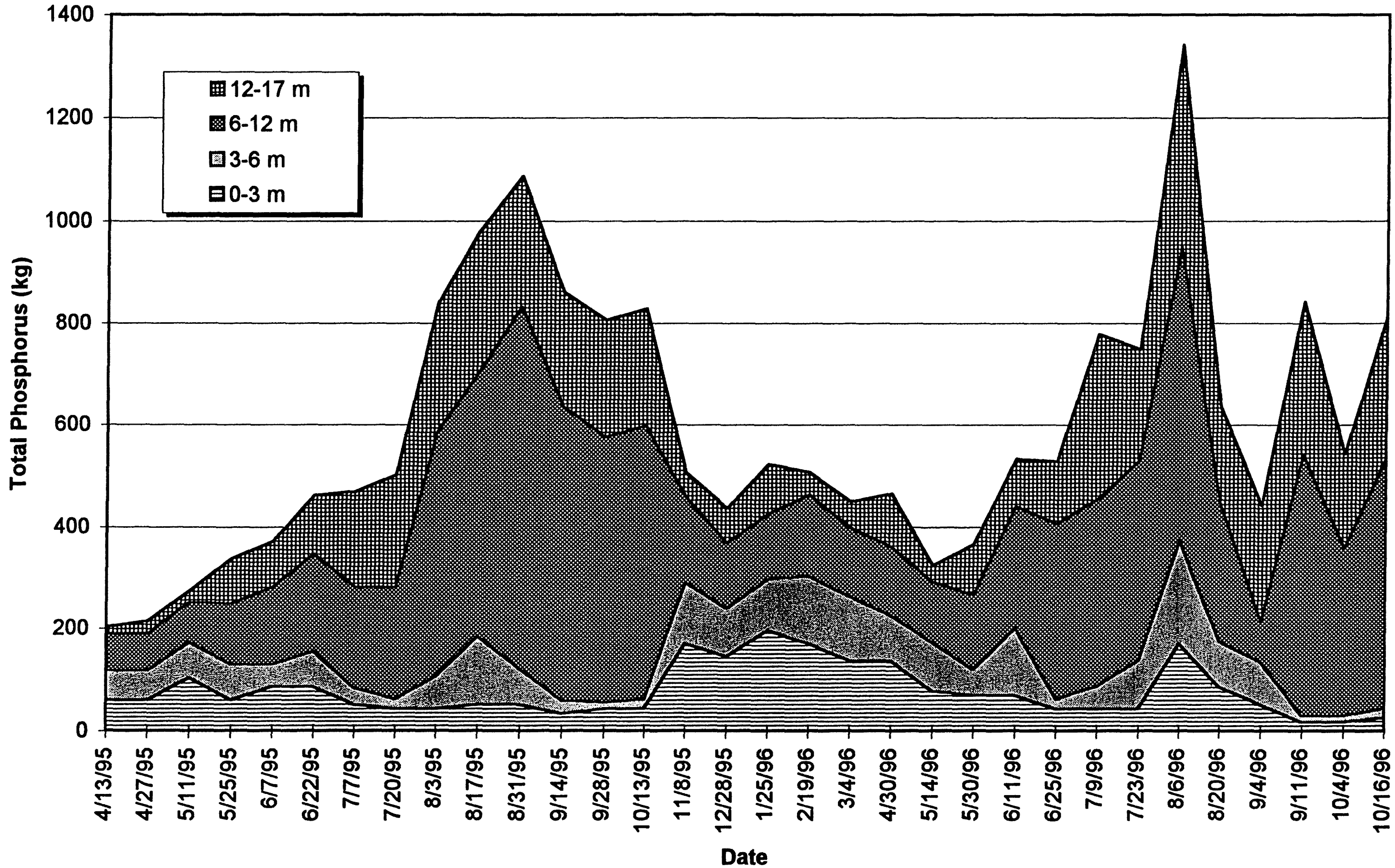
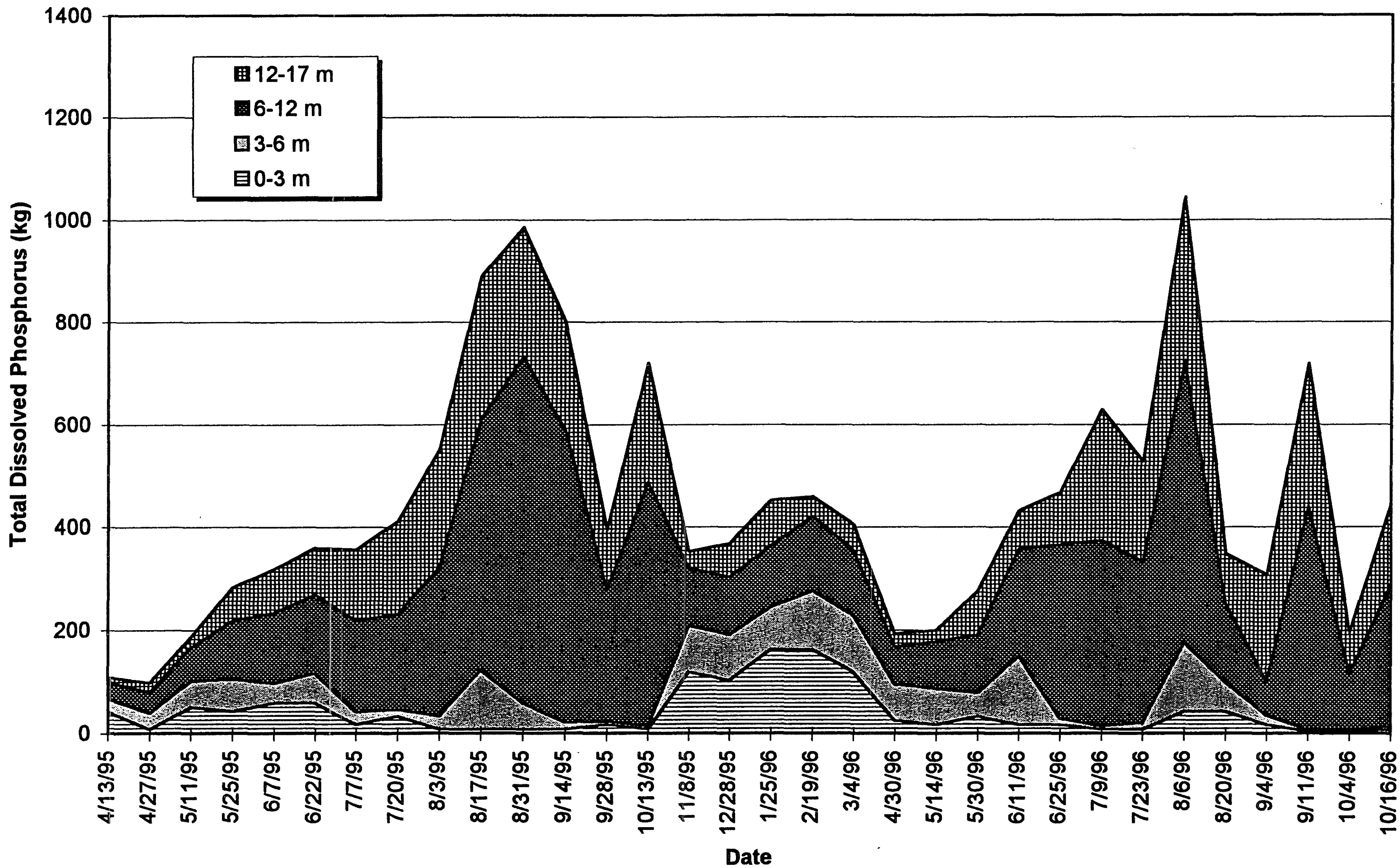


Figure 32. Total Dissolved Phoshorus Content in Lake McCarrons



Chlorophyll-a

CLA measurements, used as an index to total algal mass, were made on composite samples of the top 0-2 meters of the lake's surface. The CLA concentration values for each monitoring date are shown in Appendix N.

The mean summertime CLA concentration for Lake McCarrons in 1995 was 28.0 μg/l and in 1996 was 16.0 μg/l. Concentrations ranged from 2.4 μg/l in late-May 1995 to 132.0 μg/l in late-April 1996 (Figure 33). The period of the greatest increase was from 4.9 μg/l on March 3, 1996 to 132.0 μg/l on April 30, 1996.

As it is possible to estimate lake trophic status by its TP concentration, the same is true for CLA data. According to Walker (1985), a CLA concentration exceeding 15.0 μg/l places the lake in a eutrophic category. The 16.0 μg/l and 24.0 μg/l mean chlorophyll concentrations for Lake McCarrons in 1996 and 1995 classifies it as eutrophic.

Secchi Transparency

Secchi disk transparencies over the study period ranged from 4.4 m in late-May 1995 to 0.6 m in August 1995 (Figure 33). The summertime mean Secchi reading for Lake McCarrons in 1995 was 1.8 m and in 1996 was 1.7 m. Overall, the best transparencies were recorded in May and early-June 1995, early-July 1995, early-November 1995, late-winter 1996, May 1996, late-June 1996, and early-October 1996. On these occasions transparency was 2.0 m or more. The worst transparencies, on the other hand, were recorded in April 1995 and 1996, and August 1995. During these monitoring events Secchi transparency was 0.8 m or less.

Throughout the course of the 1995-1996 study, chlorophyll concentration and Secchi transparency trends proved to be very strongly related (Figure 33). For the most part Figure 33 reveals that an increase or decrease in the lake's chlorophyll concentration resulted in the opposite Secchi transparency trend. For example, as the lake's transparency dropped from a high in late-May 1995 to a near low in late-June 1995, chlorophyll concentrations rose from a near low to the fourth highest concentration

Dissolved Oxygen

Dissolved oxygen levels were measured at the lake's surface and at one-meter intervals (half-meter intervals around the lake's thermocline) to the bottom.

Oxygen is of importance to the working of a lake ecosystem, not only as a necessary element for life, but also as an element which influences the fate of other chemicals. For example, under anoxic conditions (which is the norm rather than an anomaly), phosphorus can be released more readily from lake sediments, as was observed in Lake McCarrons.

Surface concentrations (Figure 34) ranged from a high of 13.2 mg/l on April 27, 1995 to a low of 6.8 mg/l on April 30, 1996. Bottom concentrations ranged from 10.4 mg/l (mid-April 1995),to a low of 0.2 mg/l (numerous occasions). In fact, of the 32 monitoring events over the study period, the lake had bottom dissolved oxygen levels below 1.0 mg/l 24 times (75 percent). Figure 34 shows that the lake's bottom was anoxic from May through November in 1995 and May through October in 1996.

Figure 33. Secchi Transparencies vs. Chlorophyll-a Concentrations

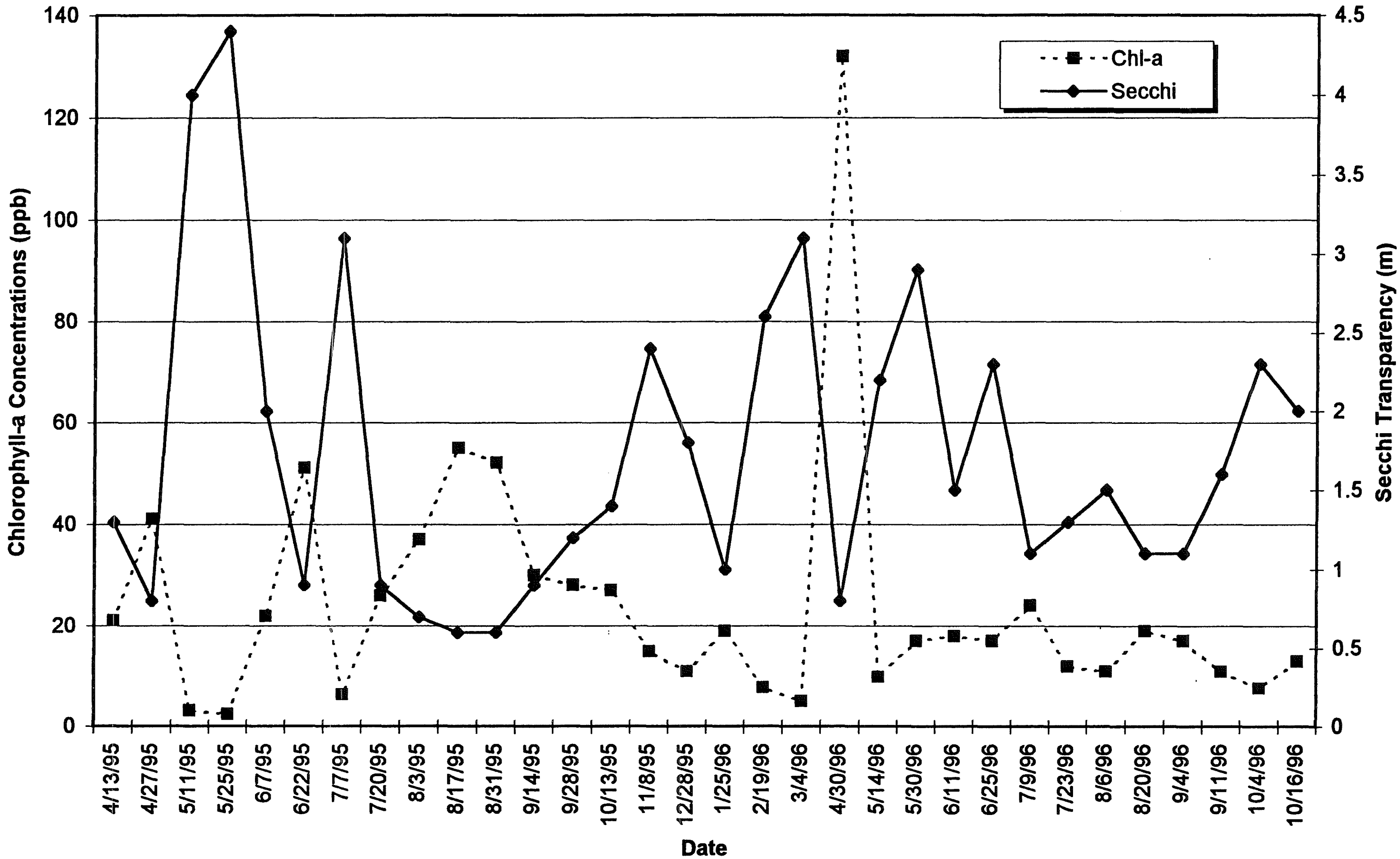


Figure 34. Surface and Near-Bottom Dissolved Oxygen Levels

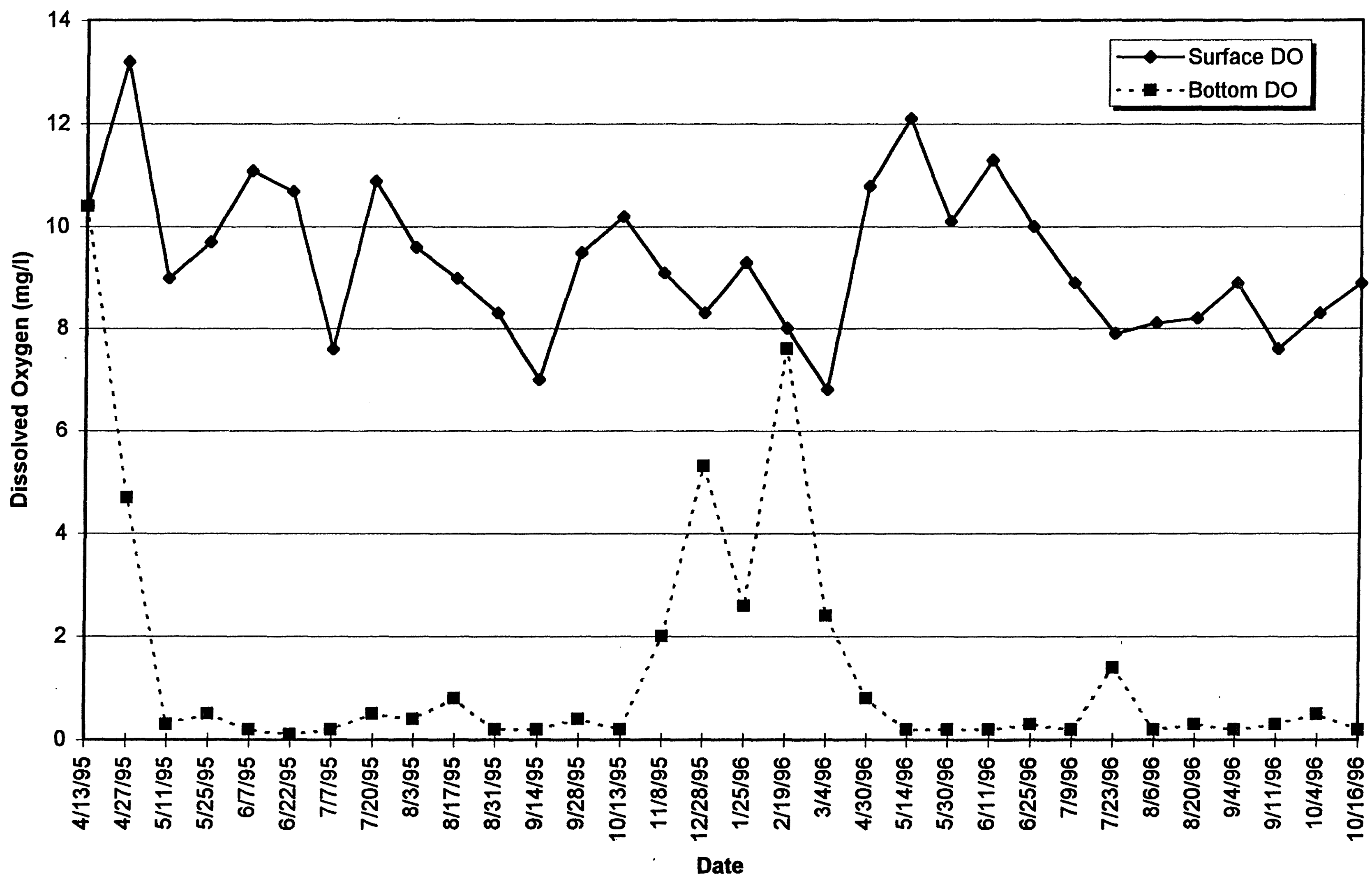


Figure 35 shows dissolved oxygen levels at 6 m and 12 m throughout the monitoring period. The graph reveals that the lake's anoxic zone raises to the 12 m depth from June through October in 1995 and mid-May through October in 1996. At the lake's 6 m depth, the anoxic zone is evident from mid-July through late-September 1995 and early-July through mid-September 1996. Therefore, below the thermocline, the lake's hypolimnion became anoxic very quickly after ice-off and remained anoxic throughout the summer and fall until turnover in late fall. As was the case in the 1988 Lake McCarrons study (Oberts and Osgood 1988), the hypolimnion depletion occurs so quickly that it is not possible to calculate depletion rates with existing biweekly monitoring data. Figure 36 shows the depth at which the lake's DO level dropped below 1.0 mg/l throughout the study period.

Similar to that reported in the 1988 study where summer anoxia was normally found from three to five meters below the surface in 1984-1988, summer anoxia during 1995 and 1996 was found from 3-5.5 m. Therefore, as was calculated in the 1988 report, 49-66% of the lake's volume goes anaerobic during the summer months, which in turn exposes approximately 61-73% of the lake's bottom area to anoxic waters (Oberts and Osgood 1988).

Total Kjeldahl Nitrogen

Total Kjeldahl nitrogen (TKN) is the sum of organic nitrogen and ammonia nitrogen, and is the largest contributor (minus nitrate + nitrite) to total nitrogen. Concentrations of TKN at the lake's surface ranged from 0.72 mg/l in late-August 1996 to 2.40 mg/l (or 720-2,400 μg/l) throughout the study (Figure 37). Temporally, lake-wide TKN was highest in late-April and late August 1995, and late-January and late-May 1996 and lowest in mid-July 1995, and August and October 1996. The overall summer mean TKN concentration for Lake McCarrons in 1995 was 1.41 mg/l and in 1996 was 1.28 mg/l.

Additionally three nitrate-nitrite (N02+3) samples were analyzed throughout the study. The N02+3 levels (shown on Figure 37) ranged from 0.03 mg/l to 0.38 mg/l).

The mean surface TN:TP ratio over the entire study period was 28.3. The mean TN:TP ratio for the 1995 and 1996 summertime data was 22.2. This complements historical data which indicates that the lake is phosphorus limiting.

Figure 35. 6-Meter and 12-Meter Dissolved Oxygen Levels

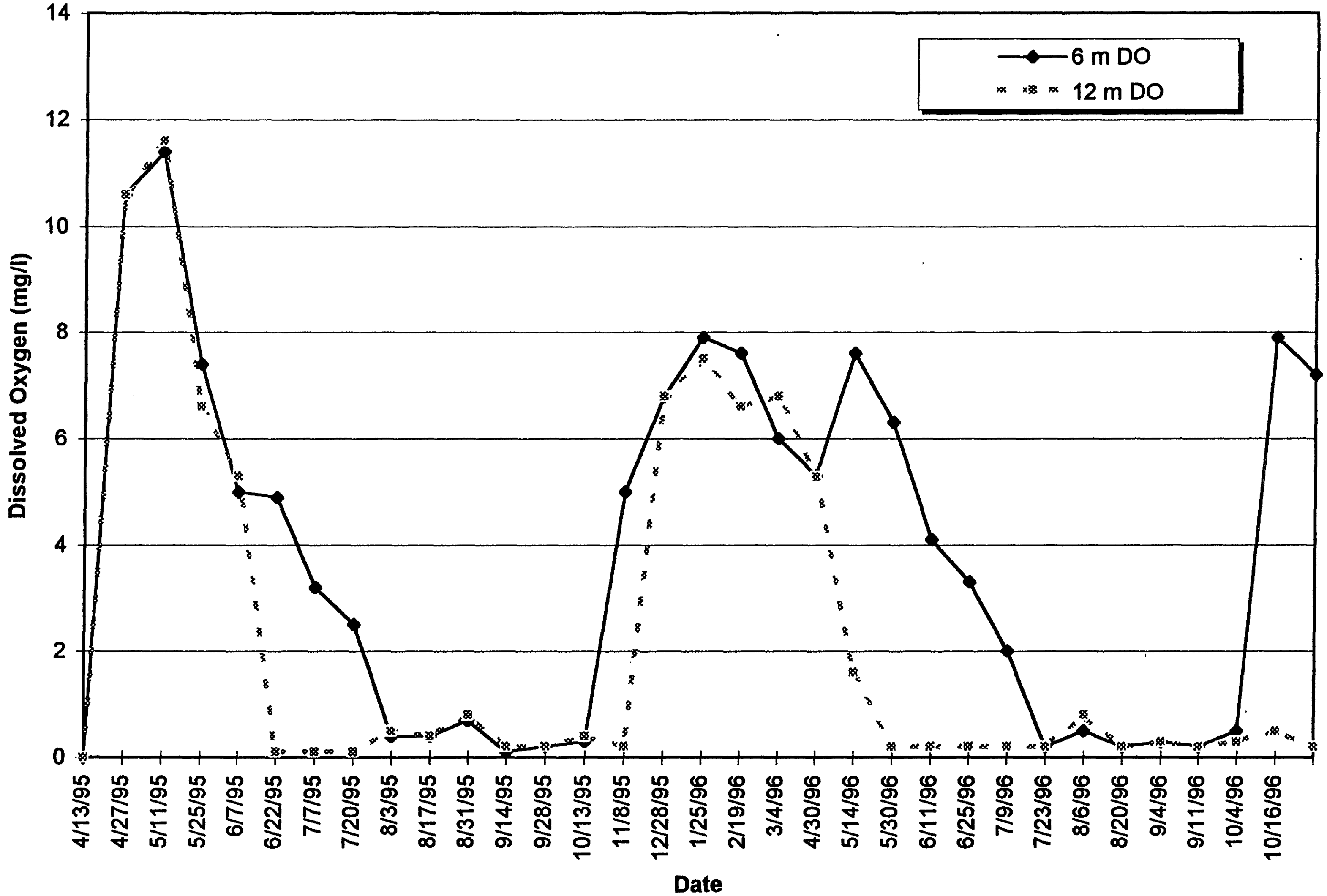


Figure 36. Depth at which Dissolved Oxygen Level < 1.0 mg/l

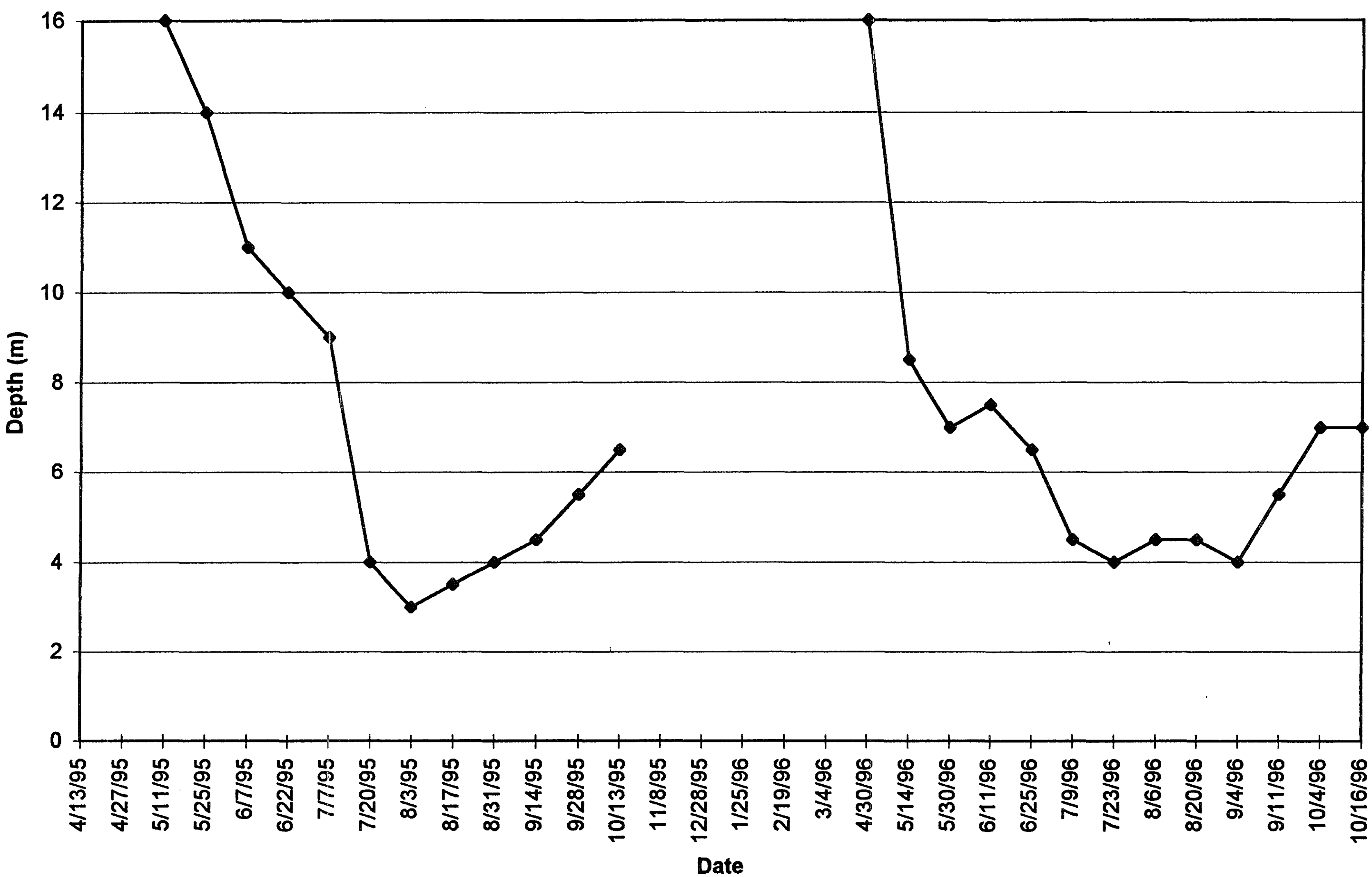
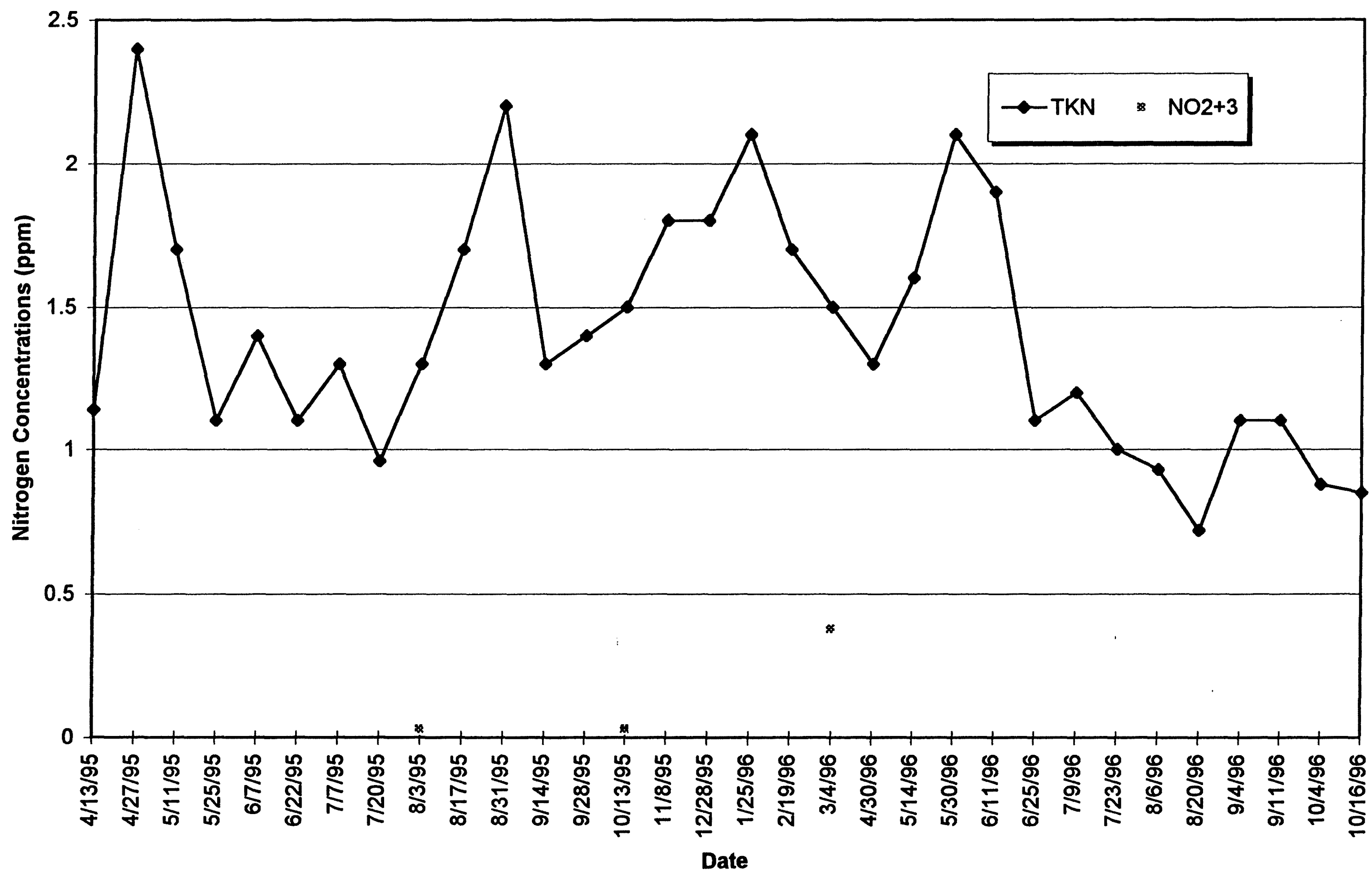


Figure 37. Surface TKN and Nitrate/Nitrite Concentrations



Temperature Gradients

Temperatures were measured at the lake's surface and at one-meter intervals (half-meter intervals around the thermocline) to the bottom.

The lake heated rather slowly, at the same approximate rate as other lakes in the area, reaching 20.0 °C at the lake's surface around early-June (1995 and 1996). Surface temperatures then continued to increase until reaching its maximum of 25.5 °C on both August 17, 1995 and 24.7 °C on September 4, 1996. Temperature then declined there after.

The lake developed a thermocline in early-May 1995 and 1996. The lake then becomes strongly stratified from late-May through October. From mid-May through mid-September in 1995 and 1996 the thermocline generally set-up between 3-5 m below the lake's surface. Just below the thermocline the lake quickly became anoxic throughout the summer months (see Dissolved Oxygen). Figure 38 shows the temperature of the lake's surface water and the approximate upper depth of the lake's thermocline throughout the study period.

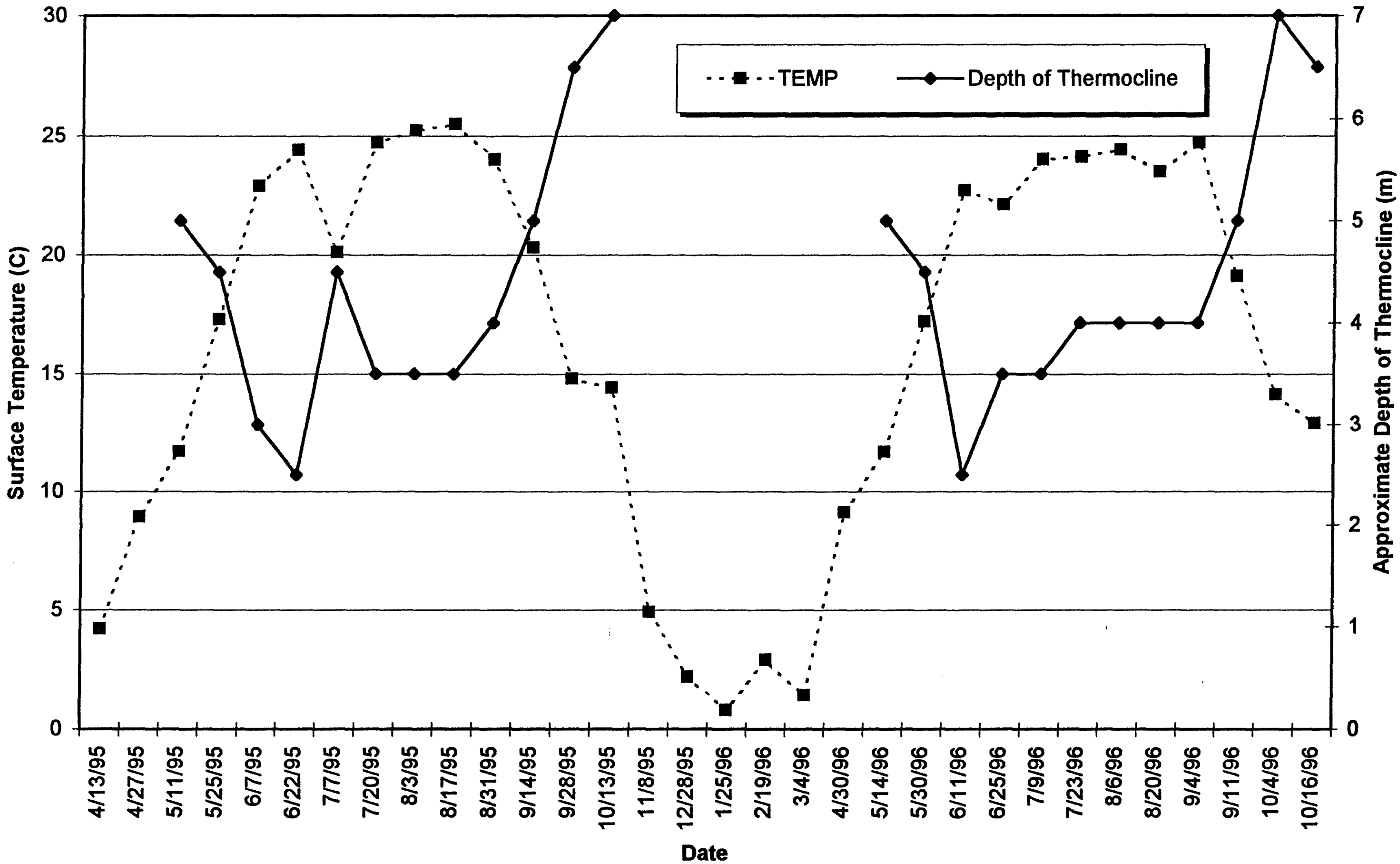
In November 1995 the fall turnover occurred eliminating the thermocline, and as expected the lake experienced inverse stratification beneath the ice.

Conductivity

Specific conductance measures the electrical current that passes through a solution. Since electrical current is carried by charged particles (ions), this is an indirect measure of the number of ions in solution, mostly as inorganic substances. Soft water lakes have few dissolved ions, resulting in a specific conductance of less than 100 microhms per centimeter (μmho/cm); hard water lakes often have a conductivity exceeding 300 μmhos/cm. The conductivity should remain fairly constant for a given lake throughout the year; any significant changes over a short period of time may indicate a significant amount of precipitation or erosion that may impact the water quality.

Conductivity on Lake McCarrons ranged from 329-538 μmhos/cm at the lake's surface and 423-701 μmhos/cm at the lake's bottom. The maximum conductivities at the lake's surface and bottom waters were recorded in early-March and early-August 1996, while the minimum values for the surface and bottom samples were both recorded in late-September 1995. Generally, the conductivity readings in both the surface and bottom waters ranged from 390-450 μmhos/cm. The summertime mean surface and bottom conductivities throughout the monitoring period were 429 and 578 μmhos/cm, respectively. The summertime mean conductivities can further be broken down to surface means of 431 μmhos/cm in 1995 and 427 μmhos/cm in 1996. 1995 and 1996 bottom conductivity means were 536 and 625 μmhos/cm.

Figure 38. Surface Temperature and Approximate Depth of Thermocline



pH

Pure water consists of an equal number of hydrogen (H^+) and hydroxide (OH^-) ions. pH is a measure of the number of hydrogen ions in solution. At pH of 7.0, the number of hydrogen and hydroxide ions are equal. At a pH below 7.0, the number of hydrogen ions exceeds the number of hydroxide ions, and the lake is 'acidic'; at a pH above 7.0 the lake is 'basic'. A difference in one pH unit corresponds to a ten-fold difference in the number of hydrogen (and hydroxide) ions. Most lakes fall within a pH range of 6.0-9.0, an acceptable range for most aquatic organisms.

The pH values ranged from 6.8 (March 1996) to 8.8 (September 1995) in the lake's surface waters, and 6.7 (September 1996) to 8.2 (May 1995) in the lake's bottom waters. The summertime mean surface and bottom pH values for 1995 were 8.4 and 7.3, respectively. The summertime mean surface and bottom pH values for 1996 were 8.2 and 7.1, respectively. When combining the 1995 and 1996 summertime data the surface and bottom pH means were 8.3 and 7.2.

Lake Quality Report Card

The lake quality report card was developed following the 1989 survey (Osgood 1989). The idea is simply that lake water quality characteristics can be ranked by comparing measured values to those of other Metro Area lakes. In this way technical information, which in the past had required professional analysis, can more easily be used by a less technical audience to visualize their lakes' water quality related to other area lakes. The grading curve represents percentile ranges for three water quality indicators - the summertime (May - September) average values for total phosphorus, CLA, and Secchi disk. These percentiles use ranked data from 119 lakes sampled from 1980-1988:

GRADE	PERCENTILE	TP(μg/l)	CLA(μg/l)	SD(m)
A	<10	<23	<10	>3.0
B	10-30	23-32	10-20	2.2-3.0
C	30-70	32-68	20-48	1.2-2.2
D	70-90	68-152	48-77	0.7-1.2
F	>90	>152	>77	<0.7

The three variables used in the grading system strongly relate to open-water nuisance aspects of a lake (i.e. algal blooms), which can indicate accelerated aging (cultural eutrophication). For example, lake phosphorus concentration has been related to increased algal abundance, increased frequency of algal blooms, and to the increased abundance of blue-green algae (Osgood 1988). CLA, which is a pigment in plants (including algae) essential in the photosynthesis process, is used to estimate the algal abundance of a lake. And finally, Secchi transparency relates to the appearance of a lake (generally the less algae, the better the transparency of a lake). TKN concentration was not included in the grading process because most lake nuisances in the area are related to the lakes' phosphorus concentration (Osgood, 1988). These water quality grades; however, only characterize the open-water quality of lakes. Other nuisances, such as the abundance of aquatic macrophytes are not indicated with these grades.

The percentile curve can be used to assign grades to the monitored lakes. Therefore, a lake having a mean summertime Secchi transparency of 1.7 m would receive a C grade, or be considered average as compared to other area lakes. Also, grades can generally correspond to descriptive rankings (and recreational use-impairments) of lakes. Lakes receiving an A grade (<10 percentile) can be deemed exceptional as compared to other area lakes (and as having no recreational use impairments). A B lake is considered to have very good water quality (and some recreational use impairment), while lakes receiving a C grade are considered to have average water quality (and are recreationally impaired). A D grade lake translates to a very poor ranking (severely impaired), and a lake having an F grade would mean extremely poor quality compared to other area lakes and indicates no possible recreational use.

The 1995 and 1996 summertime water quality data for Lake McCarrons translates to a C grade (average water quality and recreationally impaired). Past water quality data reveals that the lake's water quality grade has remained fairly constant over the past decade and a half (Table 13).

Table 13. Lake McCarrons Water Quality Grades Based on Summertime Means

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
TP	C	C	B	C	C	C		C		C	C	D	D
CLA	B	B	B	C	C	B	B	C		B	B	C	B
Secchi	B	C	B	C	C	C	B	C		C	B	C	C
Overall	**B**	**C**	**B**	**C**	**C**	**C**	**B**	**C**		**C**	**B**	**C**	**C**

Trophic Status

Trophic State Indices (TSI) provide a basis for comparing biological productivity of lakes. These indices were developed by Carlson (1977) using TP, Secchi transparency, and CLA data. Table 14 presents the 1995 and 1996 TSI for Lake McCarrons.

According to Heiskary (1985), lakes with TSIs of 0 to 40 are oligotrophic, 41 to 50 are mesotrophic, 51 to 70 are eutrophic, and greater than 70 are hypereutrophic. Using this classification, Lake McCarrons is eutrophic. Eutrophic lakes have a high nutrient content and high productivity.

Table 14. 1995 and 1996 Trophic Status Indices for Lake McCarrons

Parameter	1995 TSI	1996 TSI
Total Phosphorus	65	67
Chlorophyll-a	63	58
Secchi Transparency	52	52
Average	**60**	**59**

Trophic State Indices can also be used to determine suitability for recreation uses. The Minnesota Pollution Control Agency [MPCA] (1990) classifies lakes as fully, partially, or non-supporting swimming. According to the MPCA, lakes in the North-Central Hardwood Forests Ecoregion need a TSI equal to or below 59 to fully support swimming, while a TSI between 60 and 65 classifies a lake as partially supporting swimming. In 1996 Lake McCarrons, with an average TSI of 59, would barely stay within the supporting swimming classification. Furthermore, average annual TSIs determined from the lake's historical Secchi, TP, and chlorophyll database (1984 = 55, 1985 = 54, 1986 = 51, 1987 = 58, 1988 = 61, 1989 = 55, 1990 = 51, 1991 = 59, 1993 = 54 , 1994 = 53, 1995 = 60) reveal that the lake has always either supported or partially supported swimming over the past decade and a half. Lakes only partially supporting swimming generally exhibit impaired swimming conditions 26 to 50 percent of the time (MPCA 1990). Because changes in TSI of up to ten units normally occurs from year -to-year within lakes (Osgood 1988), it seems that the lake's trophic status has not changed since 1984. However, if a trend line is calculated for the annual (1984-1996) combined mean TSIs (Figure 39), a definite degradation trend is seen.

LAKE BIOLOGY

Phytoplankton

The phytoplankton community of Lake McCarrons was examined between April 1995 and March 1996. Phytoplankton samples were withdrawn from the surface water sample and preserved in the field in 1% acid Lugol's solution. The goal was to determine the genera of algae present as well as their relative amounts within the entire population. The total algal biovolume was also calculated. Results of these examinations are presented in Appendix O.

A total of 33 different genera were identified. The most common are shown in Table 15. On most occasions, seven or more genera, with as many as 15, were observed (Appendix O).

Figure 39. Lake McCarrons Combined Mean TSI Trend

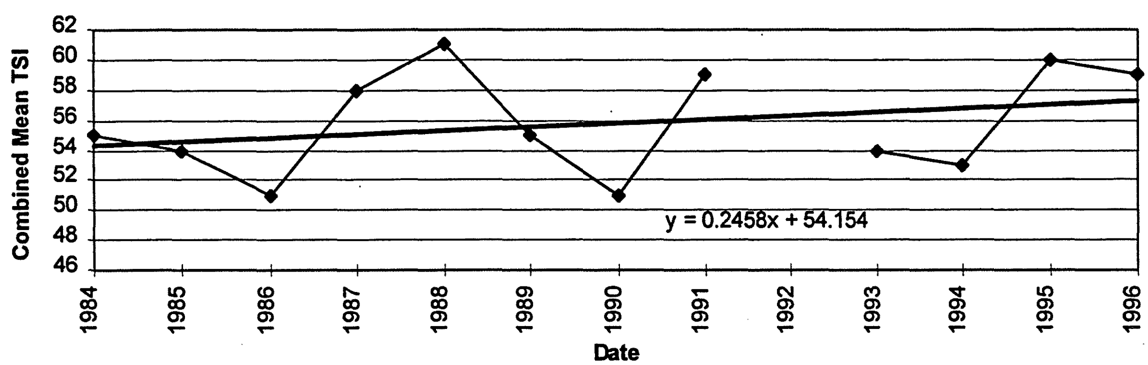


Table 15. Phytoplankton Generally Observed in Lake McCarrons

Bacillariophyceae	Chlorophyceae	Cryptophyceae	Cyanophyta	Dinophyceae
Asteroionella sp.	*Ankistrodesmus sp.*	*Chroomonas sp.*	*Anabaena sp.*	*Ceratium sp.*
Fragilaria sp.	*Carteria sp.*	*Cryptomonas sp.*	*Aphanizomenon sp.*	*Gymnodinium sp.*
Navicula sp.	*Closterium sp.*		*Coelosphaerium sp.*	
	Coelastrum sp.		*Gomphosphaerium sp.*	
	Cosmarium sp.		*Lyngbya sp.*	
	Crugingenia sp.		*Microcystis sp.*	
	Dictyosphaerium sp.		*Oscillatoria sp.*	
	Elactrothrix sp.		*Raphidiopsis sp.*	
	Eudorina sp.			
	Oocystis sp.			
	Pediastrum sp.			
	Schroderia sp.			

In the spring and early-summer, the phytoplankton population was small and consisted of a mixture of green algae (e.g. *Chlorochromonas* and *Cryptomonas*) and diatoms (e.g. *Fragilaria*) and dinoflagellates (e.g. *Gymnodinium*). The spring bloom was short-lived the diatoms and green flagellates succeeded in mid-summer by filamentous blue-greens. Blue-green dominance was observed from late-summer through winter. The most commonly occurring blue-green algae were *Anabaena*, *Aphanizomenon*, and *Microcystis*.

The algal biovolume started out low in April and May 1995, increased to a peak in late-June 1995, decreased in early-July 1995 and then fluctuated to three more peaks (late-August 1995, mid-October 1995, and late-January 1996) (Figure 40). The algal biovolume peaks correspond to the previously mentioned blue-green algae bloom.

Zooplankton

During each lake monitoring event zooplankton samples were taken with a 80 μm mesh Wisconsin-type plankton net. The net, which raised through the water column was rinsed down and the contents poured into a bottle and preserved with 4 percent formaldehyde. Counts of the zooplankton organisms were completed with the use of a microscope by an outside consultant. The results are shown in Appendix O and graphed in Figure 41.

The lake's zooplankton population consisted mainly of cladocerans, copepods, and nauplii. Some cladocerans were further classified as *Daphnia*, *Bosmina*, and *Chydorus*. The most abundant daphnids were *Daphnia pulicaria*, *Daphnia galeata mendotae*, and *Daphnia retrocurva* (important to the lake because of their phytoplankton grazing tendencies). Generally, whenever the *D. pulicaria* and *D. galeata mendotae* populations were thriving, however, the other cladocerans were less abundant. The lake's *Daphnia* population was at its lowest in early-spring and late-summer and peaked in early-summer.

As was mentioned in Oberts and Osgood 1988, there is a inverse correlation between the abundance of daphnids in the Metro Area lakes and the abundance of algae. While too few data exist for such statistical correlation's in Lake McCarrons, it is reasonable to assume that this occurs. This can be seen visually during the springtime clear water phase, when daphnids are sparse; as *D. galeata mendotae* and *D. pulicaria* become abundant in May 1995, the abundance of algae (as CLA) decreases (Figures 33 and 40) (Oberts and Osgood 1988) and resulting Secchi transparencies increase. Similar to what was reported in the 1988 report, *Daphnia* in 1993 and 1995 are only abundant until early-summer. The loss of hypolimnetic oxygen again undoubtedly forces the *Daphnia* into the epilimnion and their numbers are reduced by planktivorous fish (Oberts and Osgood 1988). As was first mentioned in the 1988 report, supplying oxygen to the summertime hypolimnion might allow *Daphnia* to remain abundant and reduce the abundance of algae.

Figure 40. Phytoplankton Community Biovolume

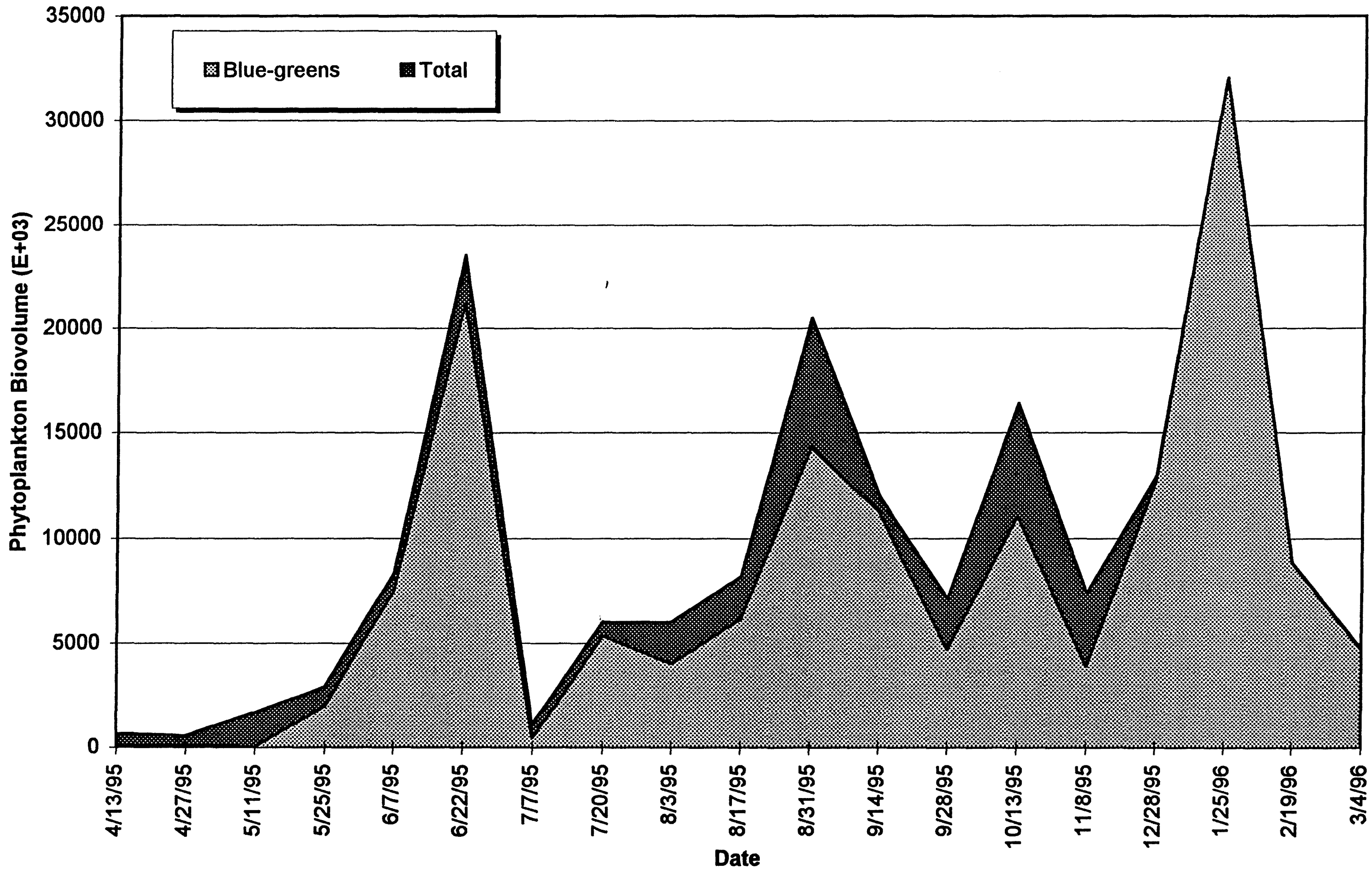
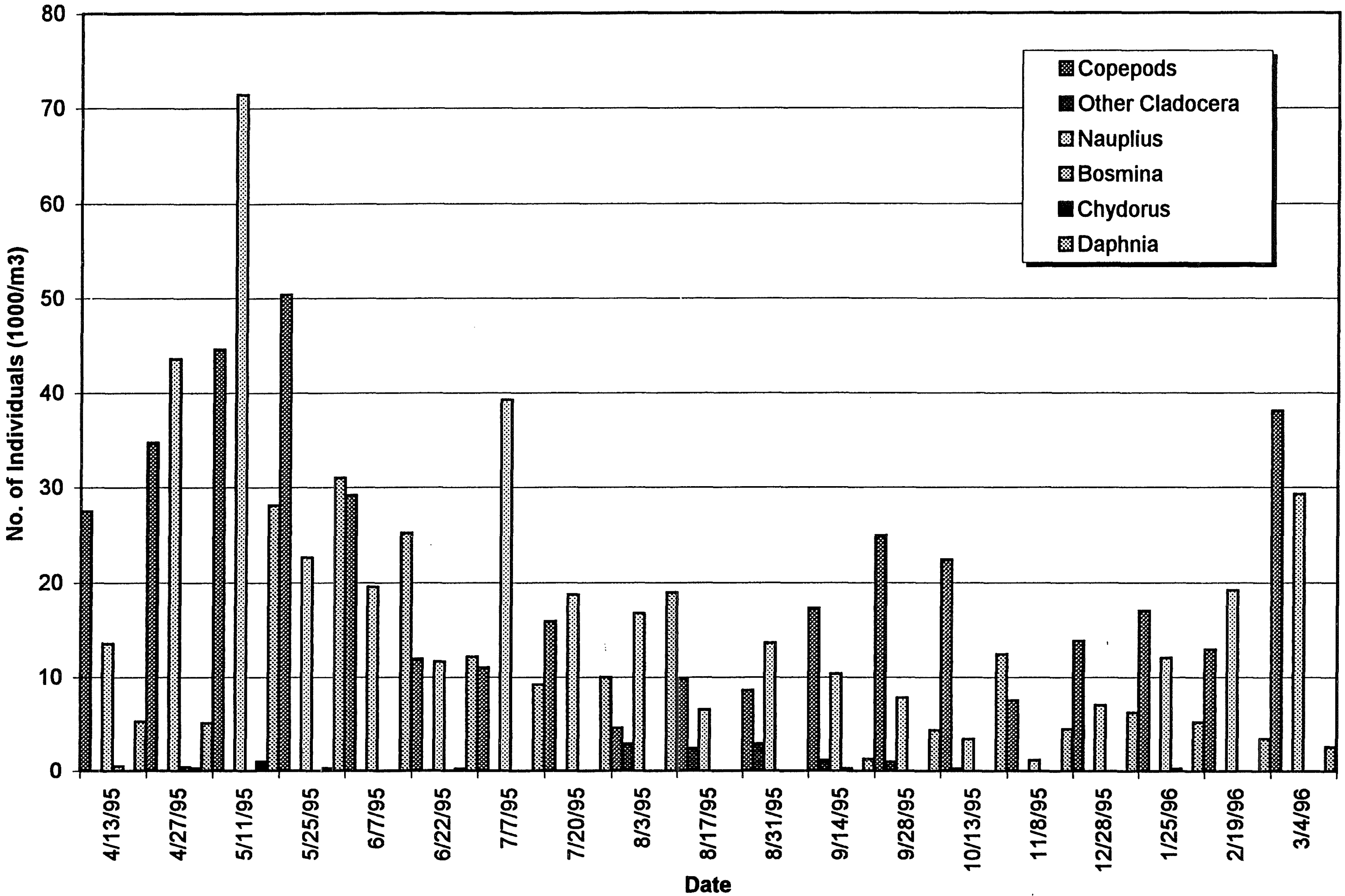


Figure 41. Zooplankton Community



Aquatic Macrophytes

Aquatic macrophytes were collected and mapped from numerous sites around the lakeshore on June 22, and August 14, 1995. The extent of macrophyte growth did not change between the two sampling dates, nor did it change much from similar surveys in 1985, 1987, and 1993. The aquatic plants on both sampling occasions in 1995 were found in waters generally 2 m or less; however, plants were found at a maximum depth of 3.2 m. Twelve species of macrophytes were found during the 1995 studies (Table 16).

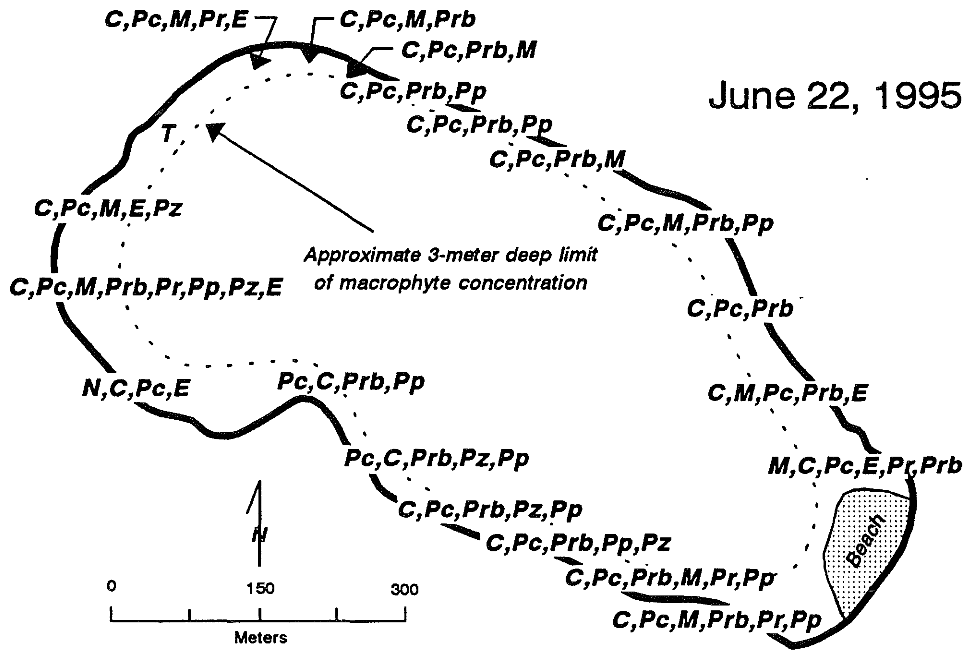
Figure 42 shows the distribution of the species during each monitoring event. As can be seen by the survey map, the dominant macrophyte was Ceratophyllum demersum followed by Myriophyllum excalbescens and Potamogeton crispus. The most abundant emergent form, Typha , was found in the bay area on the northwest end of the lake near the inlet (Figure 42). The composition of the macrophyte community did not change much between the two monitoring dates. The main difference was the decrease in the abundance of P. crispus during the August 14 survey. Additionally, there is no evidence that the distribution or species composition of the lake's macrophyte community are related to the nutrient concentrations in the water.

Table 16. Macrophytes Observed During Two Collections in 1995

Scientific Name (Common Name)	Scientific Name (Common Name)
Ceratophyllum demersum (coontail)	Potamogeton crispus (curly pondweed)
Chara *sp.* (muskgrass)	Potamogeton pectinatus (sago pondweed)
Elodea canadensis (canada waterweed)	Potamogeton richardsonii (clasping pondweed)
Lemna trisulca (duckweed)	Potamogeton robinsii (robins pondweed)
Myriophyllum exalbescens (northern milfoil)	Potamogeton zostteriformis (flatstem pondweed)
Nuphar *sp.* (Spatterdock)	Typha latifolia (cattail)

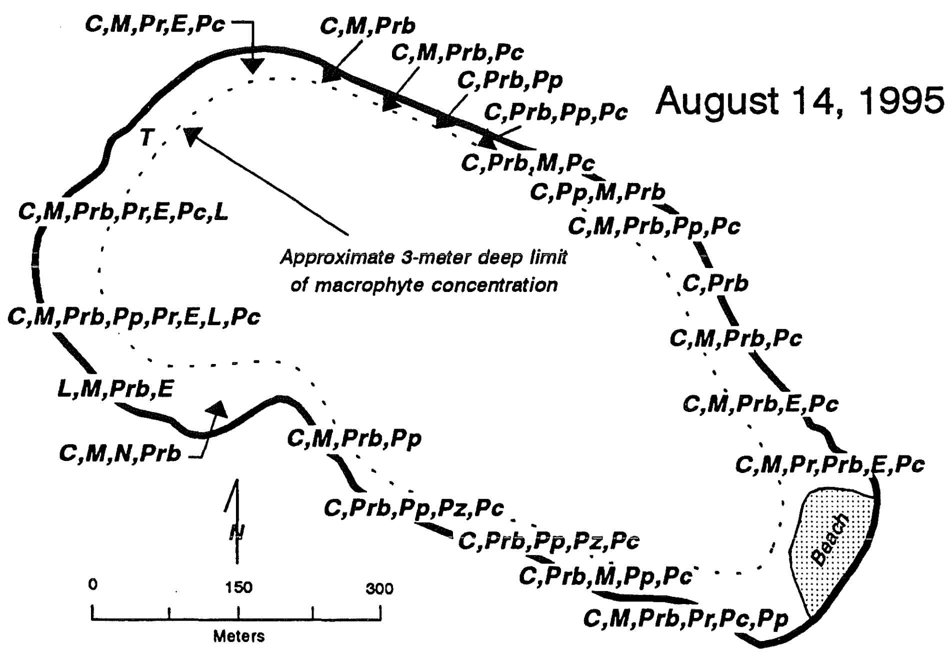
Macrophytes are known to pump nutrients into lake water. Although this internal loading process was not specifically examined either here or in the diagnostic study, it is possible that the lake's macrophytes are a significant internal source of nutrients, at least during certain times of the year (see phosphorus budget). If this occurs to any significant extent, then a management technique such as macrophyte harvesting could appropriately address both the internal nutrient loading and the nuisance associated with the presence of the macrophytes.

Figure 42. Lake McCarrons Macrophyte Surveys, 1995



General species dominance in order of representation

C	Ceratophyllum demersum (coontail)	Pc	Potamogeton crispis (Curly leaf pondweed)
ch	Chara	Pp	Potamogeton pectinatus (Sago pondweed)
E	Elodea canadensis (Canada waterweed)	Pr	Potamogeton richardsonii (Clasping pondweed)
L	Lemna	Prb	Potamogeton Robinsii (Robbins pondweed)
M	Myriophyllum (milfoil)	Pz	Potamogeton zosteriformis
N	Nuphar	T	Typha (cattail)



Fish

A fisheries survey of Lake McCarrons by the MDNR during June 1993 suggested that the lake was moderately productive with respect to fish (MDNR 1993). A list of the species reported in the report are shown in Table 17. The following was listed as the status of the lake's fishery in the 1993 survey: McCarrons Lake has an abundant panfish population. Bluegill catches were high. Size structure of the sampled bluegill was good for area lakes. Bluegill ranged in length from 3.9 to 7.9 inches, with an average length of 6.4 inches. Black crappie, largemouth bass, pumpkinseed, and yellow perch were abundant, but average size of the sampled fish was small. Northern pike catches were low, but average length and weight were good. Few walleye and muskellunge were sampled all of which were good sized and corresponded to past stockings (stocking was discontinued in 1992 due to occasional winterkills). Black bullhead and yellow bullhead catches were low, but, average size was large (MDNR 1993).

A recent fisheries management plan for the lake was adopted by the MDNR in 1995. The goal of the plan is to provide a fish population that will support 70 angler hours per acre of fishing.

Table 17. 1993 Reported Fish Species

Black Bullhead	Muskellunge (Tiger)
Black Crappie	Northern Pike
Bluegill	Pumpkinseed Sunfish
Green Sunfish	Walleye
Hybrid Sunfish	White Sucker
Carp	Yellow Bullhead
Largemouth Bass	Yellow Perch

HYDROLOGIC BUDGET

The hydrologic budget for Lake McCarrons is an accounting of the sources and losses of water to the lake. This budget is important because it can affect the current water quality of the lake and also affect how rapidly water quality improvements may be evident if, for example, phosphorus loading to the lake was reduced. The hydrologic budget was considered separately for water inflow and water losses.

Water inflows to the lake are considered to fall into two primary groups: surface inflows (Runoff, determined through monitoring and modeling), and direct precipitation on the lake itself (taken as a mean of Ramsey County measuring stations). Water losses, on the other hand, generally are the result of evaporation (calculated in the 1988 report to be 236 x 10^3 m^3/yr) and surface outflow through the lake's outlet (determined through the regression of 1981-1987 monitored precipitation and corresponding 1981-1987 former Metropolitan Waste Control Commission (MWCC) daily measured outflow).

The calculation of the lake's outflow proved to be rather difficult. During the period of study covered in the 1988 Lake McCarrons report, outflow from the lake was monitored by the then Metropolitan Waste Control Commission (MWCC) in order to determine the volume of water that was entering the Trout Brook interceptor. The monitoring of Lake McCarron's outflow volumes ended in 1988, however. Therefore, in order to determine lake outflow in 1995 and 1996, lake level data collected two-five times a month by Ramsey County were used to calculate daily and monthly flows from the known specifications of the lake outlet weir. Lake levels for unrecorded dates were determined by interpolating between dates of known levels.

The calculation the lake's summer and fall outflow volumes resulted in reasonable numbers. A problem arose; however, in the calculation of winter (December, January, February and March) flow. Lake level data suggested extremely large outflow volumes (December, January and February outflows represented 80-87% of total outflow volume in 1995 and 1996). These high volumes of outflow were determined to be erroneous because there generally is little or no flow from the lake during the winter months due to freezing at the outlet. On the other hand, an assumption of no outflow during December, January, February, and March could not be made either, because some outflow obviously exists during winter and spring thaw conditions. In fact, spring melt conditions were recorded in February and March of 1995 and 1996.

The difficulty in calculating the overall outflow from the lake was that the lake's over-winter water levels (which were determined bi-weekly by surveying the water level at a hole cut in the lake's ice from a point of known elevation along the lakeshore), continually increased throughout most of the winter months. Levels generally increased from below the weir elevation of 841.00 feet in late-November and December, to a high of 0.62 feet above the weir in mid-February 1996. These high lake levels translated to high outflows up to a calculated 10.6 million gallons a day (calculated flows generally were between 2.7 and 6.0 million gallons a day). All this while the lake was not overflowing its outlet. As mentioned earlier, because the outlet normally freezes over-winter and the lake does not overflow, these large outflow volumes were determined to be false readings. The only time where it was assumed that the lake actually did outlet was when the lake's over-wintering levels began to fall (mid-March in 1996 and mid-January and late-February 1996), thus the backed-up water behind the frozen outlet structure began to flow, lowering the surveyed level of the lake. At this point daily outlet was determined by subtracting the earlier days level from the current day's level (daily lake levels were interpolated between each day of surveyed data).

Generally, the input of precipitation directly on the lake is balanced by evaporation and the input by surface inflow (Runoff) is balanced by the outflow from the lake. During the monitoring period of the study (1995 and 1996) the inflows account for 17-22% of the lake's total volume each year (whole lake retention time of 4.6-5.9 years [mean of 5.25 years]). The difference between the inflow and outflow represents the residual or unaccounted volume of water each year. A positive residual represents a net accumulation while a negative number represents a net loss.

Similar to the 1988 Lake McCarrons report, groundwater influence on the lake's hydrologic budget (either adding to or subtracting from the lake's volume) was not accounted for. Groundwater inflow or infiltration may account for the residuals listed in Table 18. Contrary to that reported in the 1987 report, the annual water budgets reveal annual water gains in 1995 and 1996 (a total of 629 x 10^3 m^3 or approximately 25% of the lake's total volume) while lake levels stayed fairly normal. During 1984-1987 period of study, a water loss of 721 x 10^3 m^3 was reported indicating that there may have been some groundwater inflow into the lake in order to maintain the lake's level. The water gain in 1995-1996, on the other hand, now indicate a reversed scenario where lake water drained out of the lake into the groundwater rather than the other way around.

Table 18. Approximate Hydrologic Budgets for Lake McCarrons (10^3 m^3)

	1995	1996
Direct Precipitation	293	238
Runoff (Inflow)	561	419
Evaporation	236	236
Outflow	290	120
Residual (in-out)	+328	+301

The water gains in 1995 and 1996 rather than water losses in 1984-1987 are the result of a decrease in lake outflow, and an increase in the quantity of flow from the wetland into the lake (Table 12d) (roughly a 75% increase in wetland inflow into the lake in 1995-1996 as compared to 1986-1988). The lake outflow in 1995 and 1996 was as much as eight times less than that reported in the 1988 report (951 x 10^3 m^3 in 1986 versus 120 x 10^3 m^3 in 1996). The major reason for the decrease in lake outflow is due to the re-construction of the lake outlet structure during the summer of 1991 and water moving from the lake into the surrounding groundwater. The elevation of the new outlet weir is 841.00 which is slightly higher (1.8 inches) than that of the weir in the mid- to late-1980's when the weir elevation was 840.85. The higher elevation allows less water to pass over the weir.

Lake McCarrons annual water budgets broken down into seasonal components are shown in Table 19. Similar to what was reported in the earlier Council report, roughly 50% of the lake's water load inputs normally occurred during the "summer months" (June-August). Approximately 20% of the lake's water loads occurred during each of the "spring" (March-May) and "autumn" (September-November) months.

Table 19. Approximate Seasonal Hydrologic Budgets for Lake McCarrons (10^3 m^3)

Year	Winter (D,J,F)	Spring (M,A,M)	Summer (J,J,A)	Autumn (S,O,N)	Total
1995					
Precipitation*	11	72	135	54	272
Runoff**	43	138	271	109	561
Evaporation	0	-54	-147	-35	-236
Outflow	-0	-74	-111	-105	-290
1996					
Precipitation*	29	49	65	87	230
Runoff**	54	120	144	101	419
Evaporation	0	-54	-147	-35	-236
Outflow	-35	-38	-22	-25	-120
Norm. Budget					
Precipitation*	24	64	93	54	235
Runoff**	35	64	206	73	378
Evaporation	0	-54	-147	-35	-236
Outflow +	-59	-74	-152	-92	-377

* Direct precipitation on the lake's surface

** Runoff directly to the lake

*** 70 percent of normal pan evaporation

\+ Computed as a residual assuming no net groundwater movement for the normal budget

PHOSPHORUS BUDGET

The phosphorus budget for Lake McCarrons is an accounting of the sources and losses of phosphorus from the lake. The chronic problem of blue-green algae blooms discussed earlier is likely due to excessive phosphorus concentrations in the lake. Therefore, the phosphorus budget is important in identifying the sources of phosphorus around the lake and their relative contribution. Sources considered under current conditions fell into three categories: surface runoff (Runoff), atmospheric fallout (ATM, used the same loading rate as in the Council's 1988 study on Lake McCarrons), and macrophytes (Macro, also used the same phosphorus release rate as in the 1988 report). The phosphorus leaving the system through the lake's outlet is expressed as "Outflow" and the difference between the inflow phosphorus and outflow phosphorus, which is retained in the lake itself, is expressed as "residual" and as a fraction of the inflow phosphorus (% Retained).

Surface Runoff

As was mentioned earlier in this report, the Lake McCarrons' watershed consists of 821.3 acres of direct drainage area to the lake. Runoff (and resulting phosphorus input) from 736.1 of the 821.3 acres drains through the wetland treatment system before it enters the lake and was monitored with the use of automatic sampling equipment. Phosphorus input from the remaining watershed was calculated using export coefficients determined from the 1988 McCarrons report. The resulting surface water phosphorus loads to Lake McCarrons were calculated and results are shown in Table 20.

The 1988 McCarrons report included pre-wetland treatment system (1984-1986) runoff TP loads of 365-500 kg. After the construction and stabilization of the of the wetland system, the 1987 runoff load to the lake was estimated to be 173 kg which is roughly the mean of the 1995 and 1996 estimated runoff load.

Atmospheric Fallout

This value was estimated using measurements by Osgood (1983), on Spring Lake (Scott County). With the use of bulk samplers atmospheric loading to Spring Lake was determined to be 0.22 kg/ha/yr. While other atmospheric fallout coefficients exist which arguably could be more valid, atmospheric impact to the lake would prove to be small no matter the coefficient used. Therefore, since the Spring Lake coefficient was used in the 1988 report, and in an effort to maintain some compatibility between the two reports, the annual atmospheric loading to Lake McCarrons was estimated using the Spring Lake coefficient (0.22 kg/ha/yr). This resulted in an annual atmospheric load on the lake of approximately 7.0 kg/yr (Table 20).

Table 20. Estimated* Annual Phosphorus Budget (kg) for Lake McCarrons

	1995	1996
ATM**	7	7
Macro	15	15
Runoff (Inflow)	208	136
Outflow	-27	-18
Residual	203	140
% Retained	88%	89%

* Groundwater excluded

** Direct precipitation and dustfall

Macrophytes

The exact phosphorus release from macrophytes in Lake McCarrons was not examined as part of this study. There is; however, no question that they do play some role in adding phosphorus. That is, when plants die and begin to decay, the phosphorus the plants had previously taken up is released increasing the amount available for algal growth. Because the results from the 1995 and 1988 lake macrophyte surveys were similar in their genera and species composition and overall area of growth, the estimated macrophyte release was taken from the Council's 1988 report on the lake which was calculated from Carpenter, 1980.

Similar to the Lake McCarrons water budgets, the lake's annual phosphorus budgets were further broken down into seasonal components and are shown in Tables 21 and 22. Roughly 45% of the lake's phosphorus load inputs normally occurred during the "summer months" (June-August). Approximately 35% of the lake's phosphorus loads occurred during "spring" (March-May) and 15% occurred during the "autumn" (September-November) months.

One area not accounted for in this report is the internal phosphorus load (phosphorus release from the sediments) to the lake. Due to the fact that such a large portion of the incoming phosphorus is retained in the lake each year (Table 20) depositing to the lake's sediments, and the resulting high concentrations of near-bottom phosphorus throughout the summer (Figure 28), internal phosphorus is a definite source of phosphorus to the lakes epilimnion during spring and fall turnover. This remnant source of recycled phosphorus in the spring can have an adverse affect on the lake's summertime mean TP concentrations by producing high starting concentrations (Osgood 1996). The influence of phosphorus recycled from the lake sediments during the summer months, however, has little if any affect on the lake's summertime mean surface TP concentrations because the lake is so well stratified as to prevent the mixing of phosphorus-laden water to the surface (Osgood 1996).

Table 21. Approximate Seasonal TP Loads to Lake McCarrons (kg)

Year	Winter (D,J,F)	Spring (M,A,M)	Summer (J,J,A)	Autumn (S,O,N)	Total
1995	9 (4%)	60 (29%)	105 (51%)	34 (16%)	208
1996	11 (8%)	37 (27%)	53 (39%)	35 (26%)	136
Normal	14 (9%)	51 (33%)	67 (43%)	24 (15%)	156

Table 22. Approximate Seasonal TDP Loads to Lake McCarrons (kg)

Year	Winter (D,J,F)	Spring (M,A,M)	Summer (J,J,A)	Autumn (S,O,N)	Total
1995	2 (3%)	21 (35%)	26 (43%)	11 (18%)	60
1996	4 (8%)	17 (35%)	14 (29%)	13 (27%)	48
Normal	4 (8%)	17 (33%)	21 (42%)	8 (16%)	50

As mentioned earlier, the 1995 and 1996 estimated TP loads to the lake are similar to the post-wetland load reported in the 1988 report. Similarly, the 60 kg and 48 kg TDP load estimated for 1995 and 1996 are comparable the post-wetland load of 49 kg included in the 1988 report. Post-wetland TDP loads included in the 1988 report ranged from 82-99 kg.

DISCUSSION

WATER QUALITY ASSESSMENT

Under this section, an assessment is made of the water quality of Lake McCarrons.

As mentioned earlier in this report, phosphorus is the primary concern of Lake McCarrons because historical evidence has shown that it is the limiting nutrient for primary productivity. And any attempt to manage the frequency and severity of blue-green algal blooms (the dominant algal taxa in Lake McCarrons) will rely on the ability to manage the lake's phosphorus load. Thus, the majority of the following discussion will focus on the lake's phosphorus load.

Seasonal in-lake phosphorus conditions in 1995 and 1996 remained similar to those discussed in the 1988 report. That is, the lake's summertime phosphorus concentrations appear to be insensitive to inputs of phosphorus prior to mid-May. Prior to mid-May, when the lake is un-stratified, phosphorus concentrations are high (150.0-200.0 μg/l) throughout the water column. When the lake does stratify (generally by mid-May) epilimnetic phosphorus concentrations start to decrease to lows around 50.0 μg/l (higher than was found in the mid-1980's) while the lake's hypolimnion phosphorus concentrations start to increase to concentrations commonly exceeding 1,000.0 μg/l during the summer. Thus, similar to that reported in 1988, the lake's elevated epilimnetic phosphorus concentrations in spring (prior to stratification) are no doubt due to residual internal phosphorus that had accumulated from the previous summer rather than external sources (Oberts and Osgood 1988). However, because the epilimnetic phosphorus concentration generally does decline from spring to early-summer, neither the internal load nor spring time external load appears to have much of an impact on the lake's summer surface phosphorus concentration (Oberts and Osgood 1988).

The 1988 report mentioned the above scenario as a reason that their steady state phosphorus models predicted higher than monitored phosphorus concentrations for the lake. While this may be the case, those same models now predict lower than monitored phosphorus concentrations. Why is this? A possible explanation may be found in a comparison of the lake's epilimnetic phosphorus loads and thermodynamics.

Summertime epilimnetic TP loads during each monitoring event in the 1980's were generally between 10.0 and 20.0 kg, while the epilimnetic TP load in 1995 and 1996 ranged from 26.0 kg to a high of 213.0 kg (the epilimnetic zone volume used in the 1988 report was 8.53 x 10^3 m^3 while the average epilimnetic zone calculated from data recorded during each monitoring date in 1995 and 1996 was 10.06 x 10^3 m^3). The lake's average summer epilimnetic TP loads in 1995 and 1996 were 73.5 and 82.0 kg, respectively. For the lake to maintain a summertime TP mean of 30.0-35.0 μg/l (shown as the approximate MINLEAP modeled "expected" TP concentration for the lake discussed later in this report) a mean summer load within the lake's epilimnion (with the same approximate volume experienced in 1995 and 1996) would need to be approximately 32.0-38.0 kg. Thus, an approximate 50-60% reduction in the lake's current summertime epilimnetic load would be necessary to reach MINLEAP "expected" TP concentrations..

An explanation which makes some sense for this increase in TP load to the epilimnion while the total external load in Phase III conditions actually decreases from the pre-wetland (pre-Phase II) conditions, has to do with the wetland system uncharacteristically warming the lake's inflow. By detaining the runoff in the wetland system and increasing the amount of time that the runoff takes to reach the lake, the runoff is warmed and it, along with its associated phosphorus load, enters and remains in the lake's epilimnetic zone rather than plunging into the hypolimnetic zone. Prior to the construction and stabilization of the wetland treatment system there was no detention areas to catch the runoff from the surrounding watershed before it entered the lake. Thus, the runoff simply followed a channelized area to the lake allowing for a swift trip to the lake without detention time allowing the inflow to warm up. The inflow was cool enough that during the period of lake stratification it would enter the lake and plunge below the established thermocline into the hypolimnion and the associated nutrients would become unavailable to the epilimnion as long as the thermocline was in place. When the wetland system was constructed; however, the watershed runoff was pooled and allowed to warm. Thus, the resulting inflow, highly concentrated in phosphorus relative to epilimnetic levels, generally entered the lake at temperatures warmer than the thermocline and mixed with the epilimnion where the nutrients would be available to the epilimnion (Appendix M).

In 1995, the first year where temperature data were collected for the wetland treatment system, a monitoring location was set-up at the treatment system outfall (lake inlet) only. The recorded information along with the top of the lake's associated thermocline (above which would be considered epilimnetic zone) are presented in graphs in Appendix M. This information reveals that from early-June (when monitoring began) to September, the majority of the inflow does actually enter the lake at temperatures above the established thermocline. In order to estimate what pre-wetland system temperature conditions were, additional temperature monitoring stations were set-up above the treatment system in 1996 to monitor the temperature of the un-pooled inflow (conditions similar to pre-construction). The graphs reveal that while the temperature of the runoff leaving the treatment system was again generally above that of the lake's thermocline, the temperature of the runoff prior to detention in the wetland system was below the temperature of the thermocline. Thus, it is concluded that the temperature of the runoff entering the lake prior to the treatment system would have allowed the water to plunge below the thermocline and its associated phosphorus would be entrained in the lake's hypolimnion rather than available to its epilimnion as it is now.

Furthermore, analysis of all the available water quality data collected by the Council from 1984-1996 indicates a decline in the overall water quality in Lake McCarrons from pre-Phase II conditions (1984-1986) to current conditions (1995-1996). Why is this? The lake's water quality was supposed to improve after the addition of the wetland treatment system by detaining the majority of the overland runoff before it enters the lake, allowing sediments and phosphorus to settle out. While Figure 12b does show that the TP load entering the lake from the wetland system during Phase III roughly doubled that recorded during the Phase II study (as shown in Figure 12b as approximately 500 lbs to 250 lbs), the load from Phase III is less that of pre-Phase II. However, graphs depicting the annual 1984-1996 summertime epilimnetic TP, CLA, and Secchi transparency means (Figures 24 through 26), and their associated calculated trend lines, indicate a decreasing trend in the lake's water quality from pre-Phase II conditions to the present.

Recent (1995 and 1996) in-lake conditions exceed projected conditions for the lake as determined by the MPCA database program, MINLEAP. This database is segregated into four ecoregions for the State. Lake McCarrons lies in the Central Hardwood Forests (CHF) ecoregion. The MINLEAP computer program was run for Lake McCarrons to evaluate its results based on the CHF ecoregion (Table 23).

The MINLEAP program, which estimates the water quality concentrations of a lake by comparing it to others in the same ecoregion, greatly under estimates the total TP load to the lake. As a result the lake's actual water quality numbers are quite a bit worse then the MINLEAP expected numbers for a lake and surrounding watershed of McCarrons size in the CHF.

Table 23. MINLEAP Model Results

Parameter	Current	Predicted (+95 % CI)
Total Phosphorus (μg/l)	69-78	31 (+12)
Chlorophyll-a (μg/l)	16-28	10 (+7)
Secchi Transparency (m)	1.7-1.8	2.0 (+0.9)

In the past, the lake has approached these MINLEAP numbers. This, even though past TP loads reported in the 1987 study (Oberts and Osgood 1988) for the lake were quite a bit over those estimated by MINLEAP. The 1995 and 1996 total TP loads, on the other hand, were only 2.6 and 1.8 times greater than that projected in MINLEAP, yet the in-lake water quality is not only worse than that projected by MINLEAP, but worse then historic water quality. The current water quality is even worse than that experienced in the early- to mid-1980's prior to the construction of the wetland treatment system when total TP loads were dramatically worse. What is the cause of this? At this point there are a few theories, but no real answers.

One possible explanation discussed earlier has to do with the treatment system actually warming the inflow so that it remains above the thermocline and its nutrients become available in the lake's epilimnion rather than plunging into the lake's hypolimnion where it is unavailable to the lake's upper waters.

Another possible partial explanation or added influence to the other theories is the effect of the yearly climatological conditions on the system. A look at the yearly summer (May-September) temperature and precipitation data seems to show that the years where greater then normal temperature and less then normal precipitation were realized, the lake experienced worse water quality. This scenario is also connected to the above thermodynamic discussion. The combination of lower then normal precipitation (which increases the retention time of the wetland system) and above average temperature, leads to the additional warming of the water before it enters the lake. This results in the majority of the water and associated phosphorus load to enter directly into the lake's epilimnion rather then dropping to the cooler hypolimnion where the phosphorus would become unavailable to the epilimnion due to the strong stratification of the lake. There was one exception to this scenario, however. Climatological conditions experienced in 1996, which were dryer and cooler than normal, still resulted in worse than normal lake water quality conditions.

When discussing the decreased removal efficiencies of the MWTS and lack of expected water quality improvements of Lake McCarrons we must not overlook inadequacies in the system's initial design, and subsequent maintenance and changes ("retrofits"). The treatment system's 2.4 acre (0.97 ha) detention basin, which has a mean depth of roughly three feet (0.3 m), is only one-third of a percent of the size of the 736.1 acre (298.1 ha) watershed draining to it. Nationwide Urban Runoff Program (NURP) design recommendations suggest a permanent pool volume equal to one percent of the drainage area and a mean depth of at least three feet. To meet these recommendations, the detention basin for a 736.1 acre watershed should actually be 7.4 acres (3.0 ha), or nearly three times its current size. Additionally, the current arrangement of the berm culverts separating the six wetland chambers, allows for the channelization of flow through the chambers. These design limitations along with the lack of wetland chamber maintenance and added "retrofits" have resulted in the MWTS unable to work as efficiently as it once did. In fact, after years of accumulating phosphorus, allowing it to drop out of the water column before it enters the lake, portions of the wetland treatment system are now so channelized and phosphorus-laden that they may at times actually act as a phosphorus pump rather than a phosphorus sink. For the period of study of Phase III, phosphorus outflow from the wetland treatment system approximated its inflow.

The problems facing Lake McCarrons are more than likely a combination of the above mentioned theories. The design limitations, aging, and degradation of the wetland treatment system along with the warming of the pooled runoff more than likely result in excess phosphorus loading into the lake's epilimnetic zone where it results in higher phosphorus concentrations, more frequent algal blooms and lower Secchi transparencies. This along with ever changing climatological conditions make for the fluctuating decrease in the water quality on the lake.

CONCLUSIONS

1) The Phase III study successfully accomplished the objective of evaluating the McCarrons Wetland Treatment System (MWTS) ten years after its construction. The data collected do allow for comparison with the Phase II data from the newly constructed system.

2) Several changes have occurred in the MWTS and its drainage basin that affect the ability of the system to treat runoff. These changes include:

- Addition of 100 acres (40.5 ha) to the drainage area of the system;
- Direction of runoff via storm sewer from McCarrons Boulevard to near the outlet of the MWTS, with the storm sewer outlet oriented directly toward the outlet structure;
- Addition of a new detention pond near the hockey rink (positive action);
- Dredging of the outlet wetland from the hockey rink detention pond to the wetland outlet to increase flow but eliminate contact time with the wetland;
- Erosion of several wetland chamber berms and culverts. leading to dewatering of some wetland standing water; and
- Re-establishment (by loss of pools) of channels migrating through the entire system.

3) The MWTS no longer removes pollutants from runoff at the same levels it did when the system was new. Removal efficiencies dropped by about 20% to 65% for all pollutants evaluated, except NO2+3 which actually increased in removal efficiency. The translation of removal percentage decrease to actual load removal is shown in Tables 7a and 7b.

4) The detention ponds are responsible for the removal of most of the solids removed by the system, whereas the wetland plays a similar role for the nitrogen species. The system did not effectively remove phosphorus during the Phase III period of study.

5) The percentage of total loading that is contributed by baseflow has increased since the system was first studied. Channelization of baseflow between events contributes to this reduction in removal efficiency.

6) The effectiveness of the MWTS under winter conditions and snowmelt is greatly reduced because of conveyance freeze-up and the establishment of ice covers over the wetlands and detention ponds. Dropping water levels in the detention ponds in the fall in anticipation of ice formation and allowing baseflow to pass beneath ice layers could improve overall treatment efficiency of the snowmelt. This approach, however, requires re-configuration of the existing MWTS outlet structures.

7) The MWTS warms runoff water as it moves through during warm weather months. The increased temperature places inflow water above the well established thermocline in Lake McCarrons, and thereby limits the highly concentrated inflows to the thin epilimnion where it is most available to nuisance biota. Prior to installation of the MWTS, cooler inflow most likely sunk below the thermocline and mixed with the larger volume in the hypolimnion. Although some vegetative shading of the MWTS could reduce warming to a limited extent, realistic solutions to the temperature problem include addition of alum or ferric chloride to runoff to create settleable flocs, circulation of all or part of the lake, and/or release of water to deeper parts of the lake via pipe.

8) Lake McCarrons is a highly eutrophic lake typified by substantial algal blooms in the summer months. Phosphorus in the epilimnion provides the major nutrient input driving these blooms.

9) The lake becomes strongly stratified in the spring and its hypolimnion turns anoxic early in the summer, remaining so well into or through the following winter. Spring and fall overturns allow highly concentrated hypolimnetic waters to enter the entire water column.

10) Internal phosphorus available to the epilimnion during spring turnover can have an adverse affect on the lake's summertime mean TP concentrations by producing high starting concentrations. The influence of phosphorus recycled from the lake sediments during the summer months, however, has little if any affect on the lake's summertime mean surface TP concentrations because the lake is so well stratified as to prevent the mixing of phosphorus-laden water to the surface.

11) In order to meet a lake TP concentration goal of 30.0-35.0 μg/l (if this indeed would actually be the goal), an approximate 50-60% reduction in the lake's current epilimnetic phosphorus load to roughly 32.0-38.0 kg would need to occur.

SYSTEM AND LAKE MANAGEMENT RECOMMENDATIONS

The discussion on system loading leads to several management activities that should be taken by the city, watershed management organization and/or county. Clearly, active maintenance of the system is essential. The near filling of the headwater detention pond in just eight years of operation indicates the level of attention needed. A five-year schedule for removal of material from both detention ponds is recommended based upon the average rate of accumulation since installation. An annual inspection is suggested in the event unusual circumstances lead to accelerated accumulation. On a related note, the debris removed from the headwater pond in 1993 was trucked to a residential area and spread as fill. Although the level of contaminants in the sediment is not deemed "hazardous", some caution on disposal is warranted. It is recommended that disposal occur well away from areas where children could be exposed to accidental ingestion of dust or contact with skin. Fill and covering is a recommended practice for this type of sediment.

Maintenance of the berms at each of the wetland chambers should not be neglected. The several years of operation have taken their toll on the berms, causing many to be breached by even minor flow and many to leak because of erosion around the culverts. Other culverts have periodically plugged, either with flow debris (primarily pieces of wood) or rocks intentionally placed by vandals. Unfortunately, a small amount of corrective maintenance will not likely suffice to bring the berms back to structural stability. It is recommended that total restructuring of the berms occur, with the culverts replaced by broad "spillways" that spread flow over a wider area. The spillways should be structurally secured against erosion through the use of geotextile material and rock, and be installed at opposite sides of each successive berm. Artificial rock outcropping has been used successfully in an artificial stream Mears Park in St. Paul and in the spillway of Normandale Lake in Bloomington, creating an aesthetically pleasing appearance with structural integrity. Spreading the water out will also help prevent re-establishment of channels within the wetlands. Although this will be a continual struggle because of nature's insistence on concentrated flow, anything that can be done to spread it out will certainly help. Reconfiguring the flow crescent from the hockey rink outlet to the wetland outlet is also recommended to eliminate the short-circuiting that now occurs for flow from the pond.

The above change should also be made for the outlet of the hockey rink detention pond. The current connection via culvert hydraulically connects the outlet wetland and the detention pond, but really does nothing to assist water quality. Eliminating the culvert and installing a broad spillway above the level of the existing culvert would segregate the pond from the wetland. That is, the only connection will then be by spillway overflow during events. Since essentially no baseflow currently exists at site F draining to the hockey rink pond, the quality of the pond water will not be any worse because of the segregation.

Perhaps the most sensitive recommendation is for the city to re-establish the wetland chambers back to their original configuration. The years have both filled and cut through the chambers to the extent that several stretches of completely channelized flow are obvious. The chamber immediately adjacent to Villa Park is a mud-flat most of the year. This recommendation is sensitive because of the regulatory framework within which such an improvement must occur. Meeting with the regulatory agencies (MDNR, Army Corps of Engineers, watershed management organization) and crafting a joint proposal for restoration would certainly benefit the project. Some select planting during restoration would help delay (not control) the movement toward a mono-culture of cattails in the wetland part of the system. Removal of soil that is likely saturated with phosphorus should also return some of the system's pollutant reduction capability.

The installation of permanent floatable skimmers (baffle weirs) at both the headwater detention pond (site G) and the wetland outlet (site A) is needed. The temporary, experimental skimmers that were installed visibly held back much floating material that otherwise would have ventured downstream. The skimmers also dramatically reduced the maintenance demand by almost eliminating the need to clean the intake screens on the two outlet boxes noted above.

Some recommendations for eliminating ice build-up in the headwater detention pond were made in the snowmelt section of the report. Although re-building the existing outlet culverts is not recommended at this time, any reconstruction in the future should include installation of drawdown control valves and/or piping to allow for dewatering from beneath an ice layer.

The storm sewer outflow from McCarrons Boulevard immediately southwest of the wetland outflow (site A) should be redirected away from the outlet. The temporary rip-rap berm installed during the study works only marginally to divert the flow; the inflow should be redirected well up the southern side of the outlet wetland.

The main channel draining into the headwater detention pond (site D) is badly in need of repair, and the channel from site C to the detention pond has also been eroded. Geotextile and structurally secure material will be needed because of the high flows and fast velocities experienced at both sites. At site D, perhaps an artificial rock drop structure or falls would serve a triple benefit of aeration and erosion control, while introducing an aesthetically pleasing asset for the park.

The new outlet structures installed at sites A and G appear to have reduced the rate at which water drains from the wetland and detention pond. Although the intent of the entire system is to detain water, the outlet wetland and the detention pond seem to drain so slowly as to cause frequent overtopping of the berm at A and occasional by-pass over the spillway at G, even during relatively small events. This is probably not of any consequence at the detention pond, but it could result in berm erosion and less than desirable detention times at the outlet wetland. Maintaining the current outlet and raising the berm by about one foot could address the problem at site A; however, water levels in the hockey rink detention pond will raise whenever levels at site A go up.

A public education program that gives citizens information on things they can do to control nonpoint source pollution is another management tool the city could use to keep the flow of contaminants into the wetland treatment system at a minimum. Flyers and news items in city newspapers can address such practices as lawn care, leaf and grass disposal, auto maintenance, pet control and erosion control. Similar efforts can be undertaken to introduce people to the MWTS and tell them about the numerous benefits derived from this approach. This also gives the people who pay the bills a visible example of what their money is buying. Information about the system could also be provided on-site, with informational placards or kiosks located at select spots along the pedestrian trails.

The public education program noted above could also be used to promote the proper use of the city's leaf collection program, which picks up leaves raked to the curbside in the fall. Although the program is directed at curbside pickup, many Roseville residents have come to expect city clean up of leaves placed in the street. Unless city crews arrive immediately after leaves are put there, the possibility exists that rain and or snowmelt/plowing will move leaves into the storm sewer system, and ultimately to the lake. Leaves contain a very high phosphorus content that is detrimental to the lake. Flyers or water bill stuffers sent directly to homeowners could reduce the amount of leaves placed into the street.

While all of the above suggestions address improvement of the MWTS, a parallel set of recommendations can also be made to positively impact the lake. A series of recommendations on how to deal with the warm water problem was made in the previous discussion.

Another approach would involve increasing the whole lake flushing rate during the spring to flush the lake's spring epilimnetic zone of residual phosphorus. The majority of the epilimnetic phosphorus is the result of the accumulation of phosphorus throughout the winter months when the lake is un-stratified. The phosphorus which is not allowed to migrate up into the epilimnetic zone during the summer when the lake is stratified becomes available throughout the lake's water column during the winter and remains available in the epilimnetic zone as the lake stratifies again in early-summer. The lake's epilimnetic zone currently experiences loads exceeding 100 kg during spring monitoring events. In order to successfully lower the summer epilimnetic zone phosphorus load to desired levels, the residual phosphorus should be flushed out of the system as soon as possible. The current estimated eplimnetic flushing rate of one year (Oberts and Osgood 1988) allows this elevated phosphorus load to linger in the system masking any potential good remedial efforts may be doing. Thus, by increasing the whole lake flushing rate, the lake's epilimnetic flushing rate would also increase, shortening the time the excess spring phosphorus is available within the epilimnion. This could potentially be accomplished by using a controlled outlet structure and/or an external water supply to allow for the flushing of the lake's phosphorus rich waters in the spring of the year.

Inflow water treatment with alum (aluminum sulfate) or ferric chloride could be used to bind phosphorus to flocculants, which are then settled-out. The state of Minnesota currently is in an experimental phase with alum in lakes to see if any adverse effects occur in lake biota. Ferric chloride addition has occurred successfully for many years at the inflows to the St. Paul Water Utility's Vadnais Chain of Lakes. Although chemical injection is an expensive remedial measure, its ability to remove phosphorus from the water column is genuine. In addition to high initial capital costs, this approach would mandate a very active management program to regulate the influx of chemical to the lake. Injection could occur at either the MWTS outflow, with settling in the lake, or at the headwaters detention pond, with settling in the pond and subsequent wetland chambers.

A whole lake alum treatment could be used to directly address the lake's internal phosphorus loading problem. This technique could be used to remove the phosphorus from the water column and seal the bound phosphorus in the sediments rendering it inactive for release to the overlying water. Specifics on feasibility and design of either alum treatment mentioned above are well beyond the scope of this study, but the city is urged to explore this further as a viable treatment option.

Wetland system improvements and maintenance could improve the quality of inflow to the lake. All of the MWTS improvement options listed previously should result in better water quality exiting the treatment system into the lake. Exact levels of pollutant reduction cannot be determined until a series of improvements are made by the city and the quality of outflow monitored.

Reconfiguration of the MWTS outlet (lake inlet) such that the outflow pipe extends into the hypolimnion would allow the warmed discharge to cool enough to stay entrained in hypolimnion. This option would involve the construction of an overflow collection box at the MWTS outflow and the extension of a 12-inch or larger pipe far enough into the lake to reach well below the normal thermocline. One thousand feet (305 m) of pipe would allow for discharge at approximately a 40-foot (12 m) depth, far enough below the thermocline (4 m or 13') to allow the discharge to cool and remain in the hypolimnion. Although this option does not remove phosphorus from the lake, it addresses the need to keep phosphorus concentrated inflows away from the epilimnion during the critical summer months.

Whatever entity assumes responsibility for the quality of the lake must undertake an aggressive implementation program for the lake to see improvement. It has become clear from this study that improvement in the lake will not occur unless something is done to reduce phosphorus in the wetland outflow, direct the outflow deeper into the lake, or mix the water in some portions of the lake. Any of these approaches will be costly, but improvement is not likely without them.

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APPENDIX A
LAKE McCARRONS WATERSHED CONTRIBUTING LAND COVER

Lake McCarrons Watershed Contributing Land Cover, 1996

Site A1: Exclusive		
1996 Land Cover Name	Count	Area Acres
Grass/Wood Mix	1	1.05
Low Density Residential	5	11.71
Maintained Grassland	1	2.83
Medium Density Residential	3	29.86
Natural Grassland	4	5.41
Open Water	1	0.29
Public/Institutional	2	0.75
Wetland	1	4.05
Woodland	2	13.83
	Total	69.78

Site C1: Exclusive		
1996 Land Cover Name	Count	Area Acres
Commercial	2	8.09
Grass/Wood Mix	3	10.11
Highway	1	5.56
Low Density Residential	8	50.16
Maintained Grassland	4	4.46
Medium Density Residential	6	113.95
Natural Grassland	2	17.46
Open Water	1	3.29
Wetland	5	10.64
Woodland	10	48.49
	Total	272.21

Site D1: Exclusive		
1996 Land Cover Name	Count	Area Acres
Commercial	4	16.88
Grass/Wood Mix	1	1.58
Highway	1	23.96
Low Density Residential	5	10.33
Maintained Grassland	2	20.08
Medium Density Residential	2	36.58
Multi Family Residential	3	13.96
Natural Grassland	8	18.18
Public/Institutional	1	9.84
Woodland	3	6.15
	Total	157.54

Lake McCarrons Watershed Contributing Land Cover, 1996

Site E1: Exclusive		
1996 Land Cover Name	Count	Area Acres
Commercial	1	1.77
Highway	1	7.06
Maintained Grassland	1	3.71
Medium Density Residential	3	72.62
Multi Family Residential	2	18.07
Natural Grassland	6	20.52
Public/Institutional	3	5.11
Wetland	1	1.32
Woodland	3	2.59
	Total	132.77

Site F1: Exclusive		
1996 Land Cover Name	Count	Area Acres
Low Density Residential	3	10.42
Medium Density Residential	1	43.67
	Total	54.09

Site G1: Exclusive		
1996 Land Cover Name	Count	Area Acres
Commercial	1	0.29
Maintained Grassland	1	2.06
Medium Density Residential	2	6.17
Multi Family Residential	1	3.21
Natural Grassland	1	7.97
Open Water	1	1.77
Woodland	4	4.61
	Total	26.08

Site H1: Exclusive		
1996 Land Cover Name	Count	Area Acres
Commercial	1	0.55
Grass/Wood Mix	6	6.94
Low Density Residential	6	24.36
Maintained Grassland	4	5.20
Medium Density Residential	5	41.89
Multi Family Residential	2	8.65
Natural Grassland	1	4.54
Open Water	1	75.42
Public/Institutional	2	4.44
Wetland	3	2.68
Woodland	5	5.80
	Total	180.47

Lake McCarrons Watershed Contributing Land Cover, 1996

Site C3: Exclusive		
1996 Land Cover Name	Count	Area Acres
Medium Density Residential	1	23.66
	Total	23.66
Site C3: Inclusive (includes C1, C3)		
1996 Land Cover Name	Count	Area Acres
Commercial	2	8.09
Grass/Wood Mix	3	10.11
Highway	1	5.56
Low Density Residential	8	50.16
Maintained Grassland	4	4.46
Medium Density Residential	7	137.61
Natural Grassland	2	17.46
Open Water	1	3.29
Wetland	5	10.64
Woodland	10	48.49
	Total	295.87
Site G1: Inclusive (Includes C1, C3, D1, E1, G1)		
1996 Land Cover Name	Count	Area Acres
Commercial	8	27.03
Grass/Wood Mix	4	11.69
Highway	3	36.58
Low Density Residential	13	60.49
Maintained Grassland	8	30.31
Medium Density Residential	14	252.98
Multi Family Residential	6	35.24
Natural Grassland	17	64.13
Open Water	2	5.06
Public/Institutional	4	14.95
Wetland	6	11.96
Woodland	20	61.84
	Total	612.26

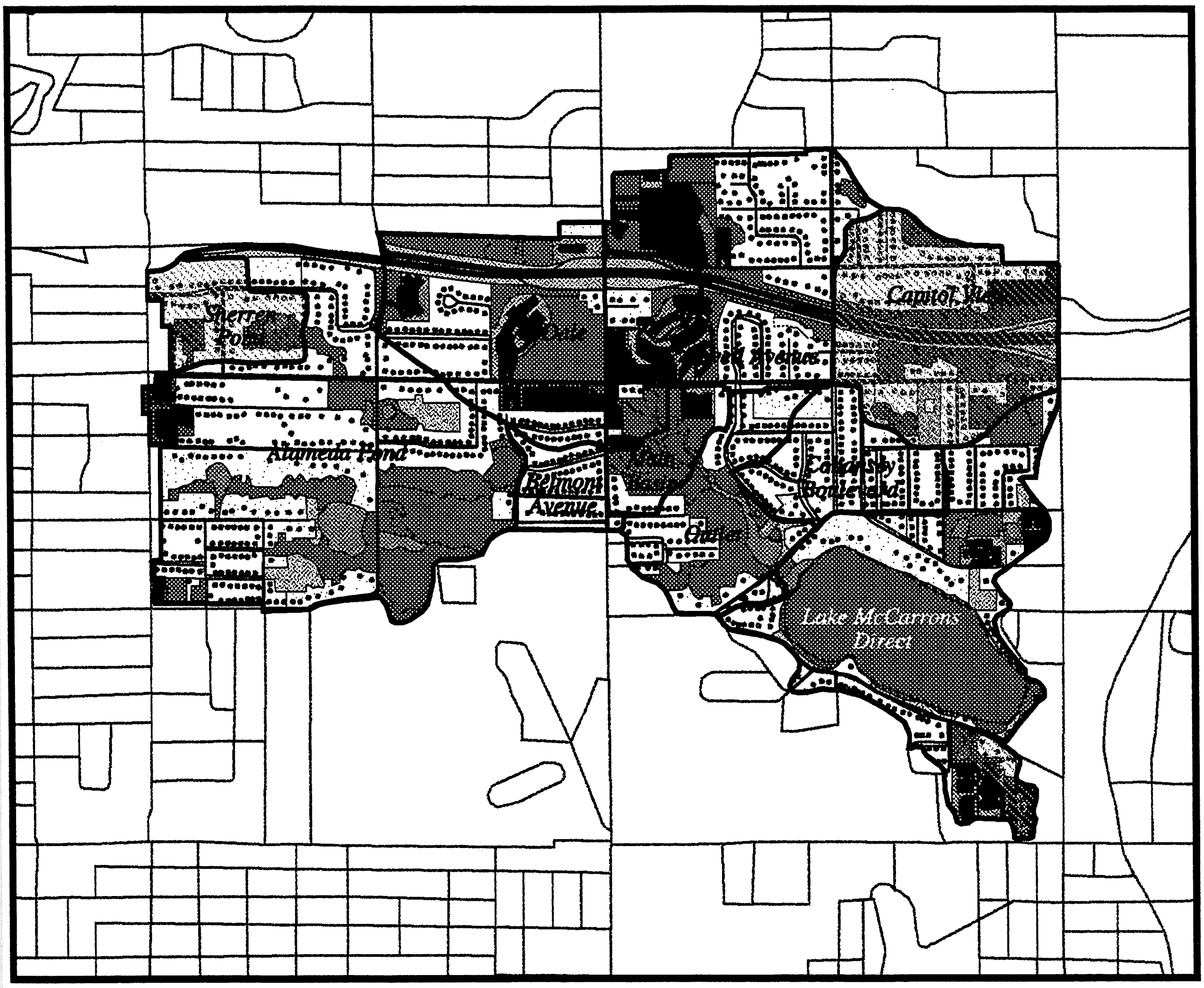
Lake McCarrons Watershed Contributing Land Cover, 1996

Site A1: Inclusive (Includes A1, C1, C3, D1, E1, F1, G1)		
1996 Land Cover Name	Count	Area Acres
Commercial	8	27.03
Grass/Wood Mix	5	12.74
Highway	3	36.58
Low Density Residential	21	82.62
Maintained Grassland	9	33.14
Medium Density Residential	18	326.51
Multi Family Residential	6	35.24
Natural Grassland	21	69.54
Open Water	3	5.35
Public/Institutional	6	15.70
Wetland	7	16.01
Woodland	22	75.67
	Total	736.13
Site H1: Inclusive (Includes A1, C1, C3, D1, E1, F1, G1, H1)		
1996 Land Cover Name	Count	Area Acres
Commercial	9	27.58
Grass/Wood Mix	11	19.68
Highway	3	36.58
Low Density Residential	27	106.98
Maintained Grassland	13	38.34
Medium Density Residential	23	368.40
Multi Family Residential	8	43.89
Natural Grassland	22	74.08
Open Water	4	80.77
Public/Institutional	8	20.14
Wetland	10	18.69
Woodland	27	81.47
	Total	916.60

Lake McCarrons Watershed Non-Contributing Land Cover, 1996

Site C2 (Sherren Pond)		
1996 Land Cover Name	Count	Area Acres
Commercial	1	0.25
Low Density Residential	1	9.39
Maintained Grassland	1	2.78
Medium Density Residential	2	21.05
Multi Family Residential	1	0.30
Wetland	1	1.30
Woodland	1	4.02
	Total	39.09
Site H2 (Capitol View)		
1996 Land Cover Name	Count	Area Acres
Commercial	1	1.75
Grass/Wood Mix	2	4.50
Highway	1	16.33
Low Density Residential	5	11.63
Medium Density Residential	6	52.19
Multi Family Residential	1	3.76
Natural Grassland	4	19.64
Wetland	1	1.13
Woodland	7	12.89
	Total	123.82
Site H3 (Woodbridge Court)		
1996 Land Cover Name	Count	Area Acres
Low Density Residential	1	2.79
Multi Family Residential	1	5.78
Natural Grassland	1	1.31
Wetland	1	0.48
Woodland	2	2.45
	Total	12.81

Impervious Surfaces in the Lake McCarrons Watershed



N

0 0.5 1 Miles

McCarrons subwatersheds

- Contributing
- Non-contributing

Road impervious classes based on average width

- Highway ramp
- Two-lane highway
- Two-lane residential
- Two-lane throroughfare
- Four-lane thoroughfare
- Single Family House
- Other impervious structures

Background shading denotes 1996 land cover.

Methodology: Impervious areas were calculated for a random sampling of 43 single family structures, and the average value was assigned to all items in this class. A sampling of roadway widths was calculated, and the average values for each class were assigned to all items within that class. Areas for all other structures (multi family, commercial, institutional and parking areas) were calculated individually.

McCarrons Watershed, 1996 Impervious Areas

Impervious Areas from Single Family:

Site Code	Count	Area in Acres
A1	90	7.47
C1	299	24.82
C2	43	3.57
C3	53	4.40
D1	100	8.30
E1	160	13.28
F1	131	10.87
G1	11	0.91
H1	148	12.28
H2	136	11.29
H3	6	0.50
Totals	1,177	97.69

G1 Cummulative = 54.37 acres
A1 Cummulative = 73.62 acres
H1 Cummulative = 97.69 acres

Impervious Areas from Other Structures:

Site Code	Count	Area in Acres
A1	0	0
C1	5	4.65
C2	2	0.54
C3	0	0
D1	20	21.99
E1	11	16.90
F1	0	0
G1	2	2.15
H1	18	6.39
H2	3	3.91
H3	11	2.64
Totals	72	59.17

G1 Cummulative = 46.23 acres
A1 Cummulative = 46.23 acres
H1 Cummulative = 59.17 acres

Impervious Areas from Roadways:				
Site Code	Count	Area in Acres		
A1	8	4.79		
C1	19	21.93		
C2	2	1.43		
C3	5	4.30		
D1	17	23.39		
E1	19	17.81		
F1	11	7.99		
G1	0	0		
H1	16	10.84		
H2	15	18.41		
H3	1	0.35		
Totals	113	111.24		
G1 Cummulative = 68.86 acres				
A1 Cummulative = 81.64 acres				
H1 Cummulative = 111.24 acres				

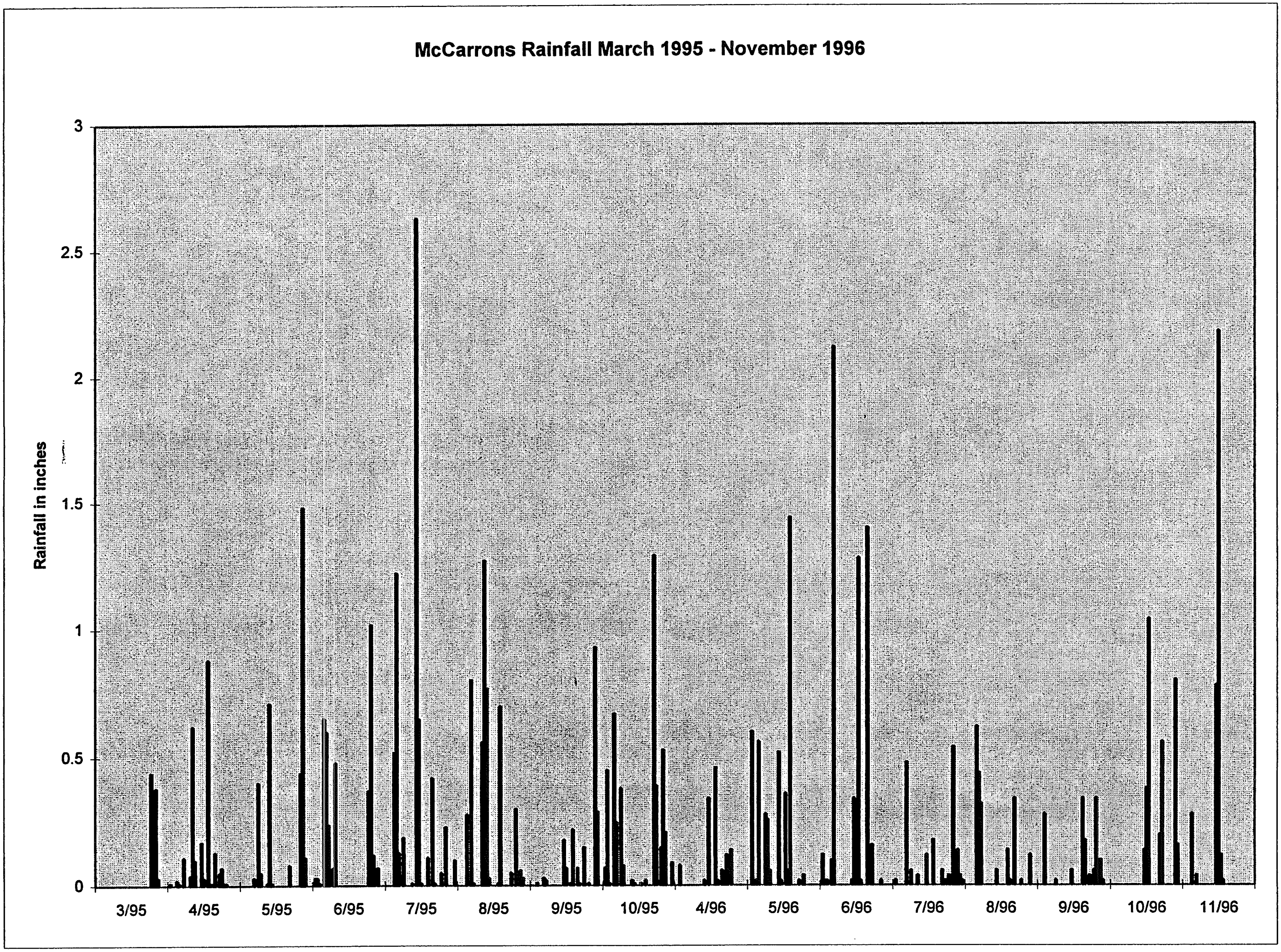
Sum: All Impervious Areas:				
Site Code	Count	Area in Acres	Total Area	Impervious
A1	N/A	12.26	69.78	0.18
C1	N/A	51.40	272.21	0.19
C2	N/A	5.54	39.09	0.14
C3	N/A	8.70	23.66	0.37
D1	N/A	53.68	157.54	0.34
E1	N/A	47.99	132.77	0.36
F1	N/A	18.86	54.09	0.35
G1	N/A	3.06	26.08	0.12
H1	N/A	29.51	180.47	0.16
H2	N/A	33.61	123.82	0.27
H3	N/A	3.49	12.81	0.27
Totals		268.10	1,092.32	0.25
G1 Cummulative = 170.37 acres/26% impervious				
A1 Cummulative = 201.49 acres/26% impervious				
H1 Cummulative = 268.10 acres/25% impervious				

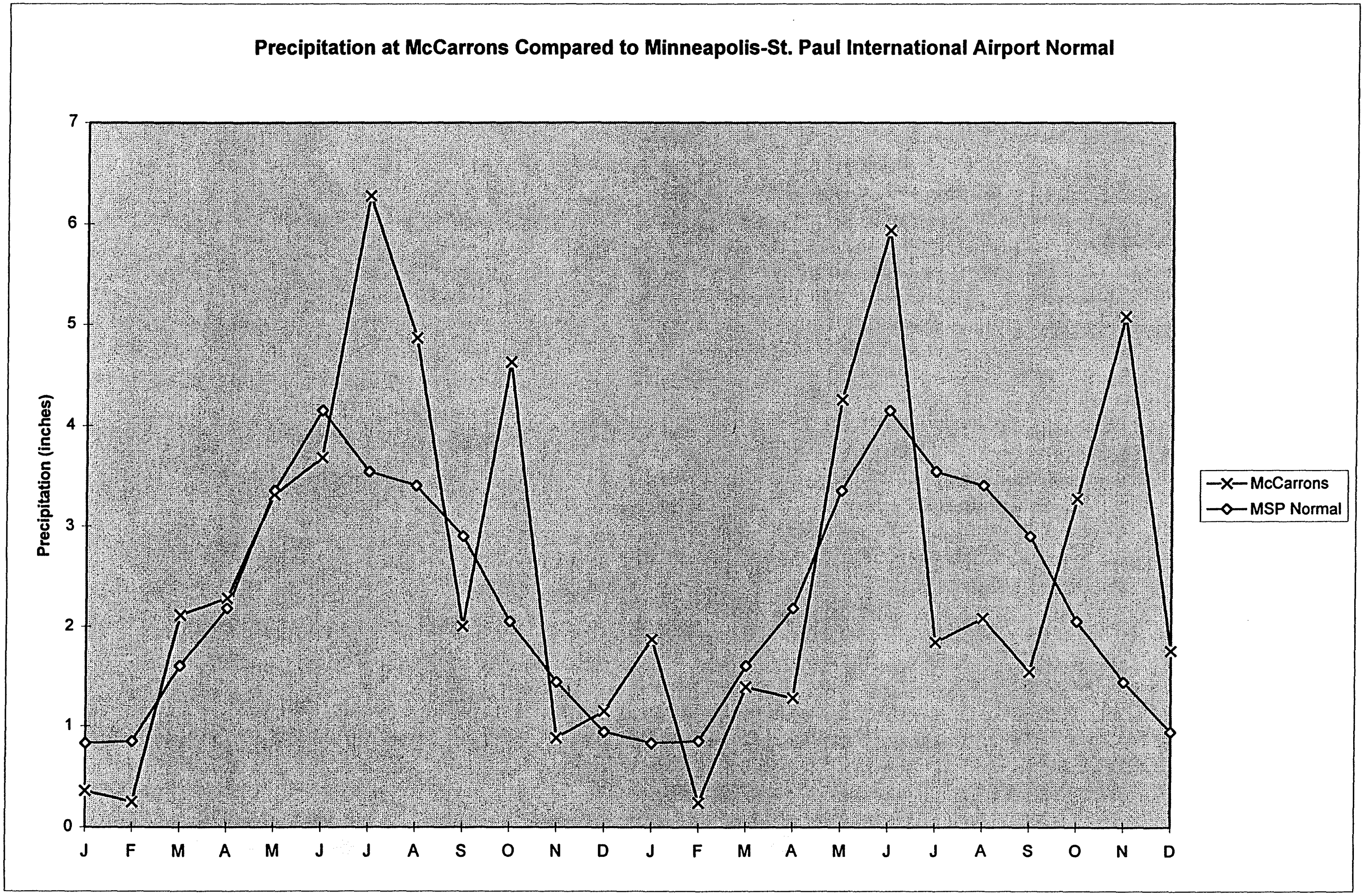
APPENDIX B
WATERSHED AND AIRPORT PRECIPITATION DATA

Appendix B.
Monthly Precipitation Totals for McCarrons Treatment System Gauge, inches.

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Total
1995	0.36* 4.2**	0.25* 2.1**	2.11* 10.4**	2.28	3.32	3.69	6.28	4.87	2	4.63	0.88* 6.6**	1.15* 16.1**	31.82*
1996	1.87* 14.5**	0.24* 1.2**	1.39* 14.1**	1.28	4.26	5.94	1.84	2.08	1.54	3.28	5.08* 15.3**	1.75* 23.7**	30.55*
Normal (MSP)***	0.83	0.85	1.6	2.18	3.36	4.15	3.55	3.41	2.9	2.05	1.44	0.94	27.26

* includes airport data
** inches of snowfall included in monthly total precipitation
*** mean for 1966-1995


McCarrons Rainfall March 1995 - November 1996
Rainfall in inches
3
2.5
2
1.5
1
0.5
0
3/95
4/95
5/95
6/95
7/95
8/95
9/95
10/95
4/96
5/96
6/96
7/96
8/96
9/96
10/96
11/96

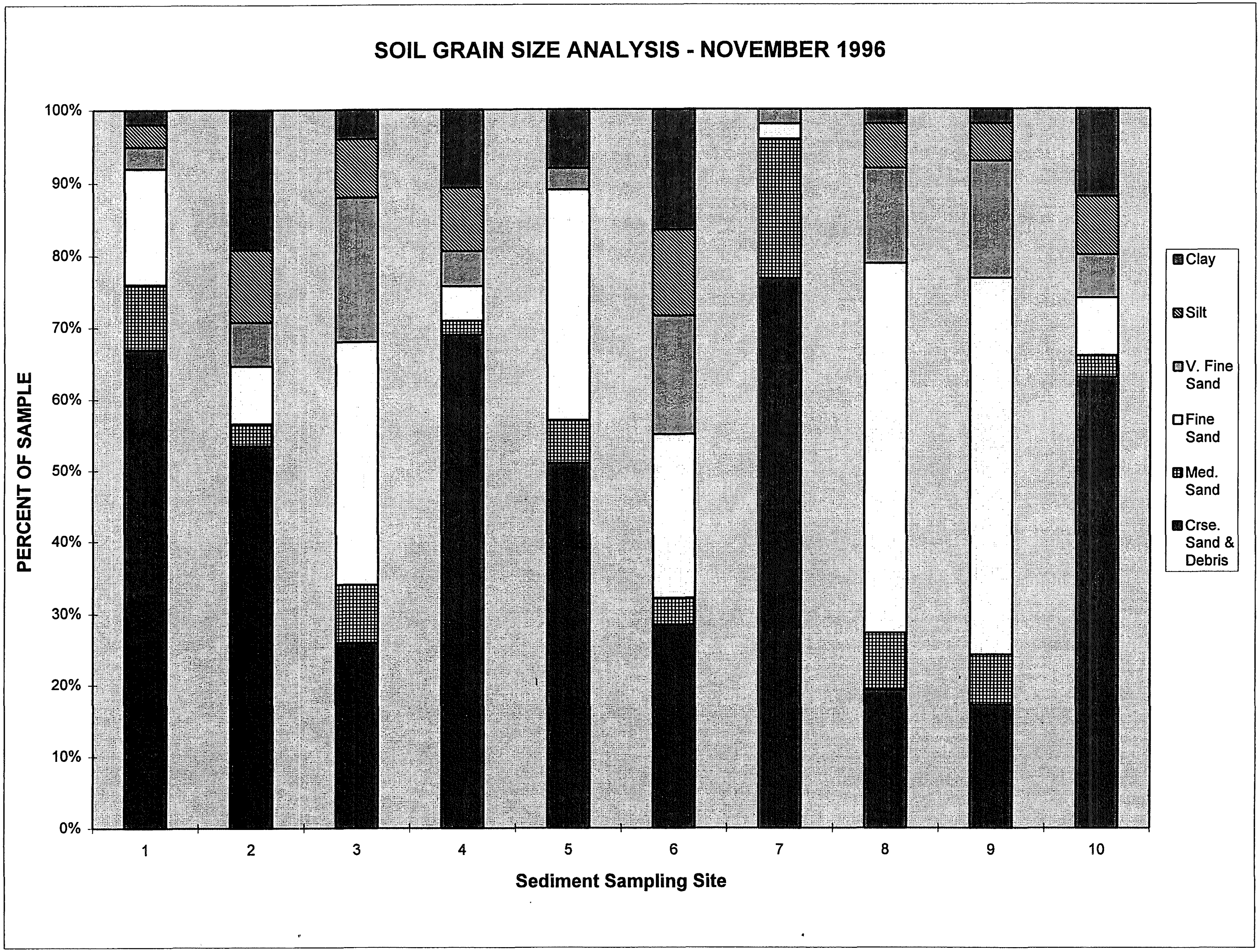

Precipitation at McCarrons Compared to Minneapolis-St. Paul International Airport Normal
Precipitation (inches)
0
1
2
3
4
5
6
7
J
F
M
A
M
J
J
A
S
O
N
D
J
F
M
A
M
J
J
A
S
O
N
D
McCarrons
MSP Normal

APPENDIX B.

McCarrons Rainfall Data (does not include snowmelt equivalent), inches.

DAY/MONTH	3/95	4/95	5/95	6/95	7/95	8/95	9/95	10/95	4/96	5/96	6/96	7/96	8/96	9/96	10/96	11/96
1		0.01	0	0.03	0	0	0	0.07	0	0	0.12	0.02	0	0	0	0
2		0	0	0.03	0	0	0	0.45	0.08	0.6	0.02	0	0	0	0	0
3		0	0	0.01	0	0	0.01	0.01	0	0.02	0.02	0	0	0.28	0	0
4		0.02	0	0	0.52	0.28	0	0	0	0.02	0	0	0	0	0	0.28
5		0.01	0	0.65	1.22	0	0	0.67	0	0.56	0.1	0	0.62	0	0	0
6		0	0.03	0.6	0.13	0.8	0.03	0.25	0	0	2.12	0.48	0.44	0	0	0.04
7		0.11	0	0.24	0	0.01	0.02	0	0	0	0	0	0.32	0	0	0
8		0	0.4	0	0.19	0	0	0.38	0	0.28	0	0.06	0	0.02	0	0
9		0	0.05	0.07	0	0	0	0.08	0	0.26	0	0	0	0	0	0
10		0.04	0	0.48	0	0	0	0	0	0.06	0	0	0	0	0	0
11		0.62	0	0	0	0.56	0	0	0	0	0	0.04	0	0	0	0
12		0.1	0.01	0	0.01	1.27	0	0	0	0	0	0	0	0	0	0
13		0	0.71	0	0	0.77	0	0.02	0.02	0	0	0	0	0	0	0
14		0	0.01	0	2.63	0.03	0	0.01	0	0.52	0.02	0	0.06	0	0	0
15		0.17	0	0	0.65	0	0.18	0	0.34	0.02	0.34	0.12	0	0.06	0.14	0.78
16		0.03	0	0	0.01	0	0.07	0	0	0	0.32	0	0	0	0.38	2.18
17		0	0	0	0	0	0	0.01	0	0.36	1.28	0	0	0	1.04	0.12
18		0.88	0	0	0	0.01	0.01	0	0.46	0.06	0.02	0.18	0	0	0	0.02
19		0.01	0	0	0.11	0.7	0.22	0.02	0.02	1.44	0	0	0.14	0	0	
20		0.01	0	0	0	0	0	0	0	0	0	0	0.02	0.34	0	
21		0.13	0	0	0.42	0	0.07	0	0.06	0	1.4	0	0	0.18	0	
22		0	0.08	0	0.01	0	0.01	0	0.04	0	0	0.06	0.34	0	0.2	
23		0.05	0	0	0	0	0	1.29	0.12	0.02	0.16	0.02	0	0.04	0.56	
24		0.07	0	0	0	0.05	0.15	0.39	0	0	0	0.02	0	0	0	
25	0.44	0.01	0	0.37	0.05	0	0	0	0.14	0.04	0	0.04	0.02	0.06	0	
26	0.32	0.01	0	1.02	0	0.3	0.01	0.15	0	0	0	0.02	0	0.34	0	
27	0.38	0	0.44	0.12	0.23	0	0	0.53	0	0	0.02	0.54	0	0.1	0	
28	0.03	0	1.48	0	0	0.06	0	0.21	0	0	0	0.04	0	0.1	0	
29	0	0	0.11	0.07	0	0.03	0.93	0	0	0	0	0.14	0.12	0.02	0.8	
30	0	0	0	0	0	0	0.29	0	0	0	0	0.04	0	0	0.16	
31	0	-	0	-	0.1	0	-	0.09	-	0	-	0.02	0	-	0	
Total	1.17	2.28	3.32	3.69	6.28	4.87	2	4.63	1.28	4.26	5.94	1.84	2.08	1.54	3.28	3.42

APPENDIX C
SEDIMENT SAMPLING STATION DATA



SOIL GRAIN SIZE ANALYSIS - NOVEMBER 1996
PERCENT OF SAMPLE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1
2
3
4
5
6
7
8
9
10
Sediment Sampling Site
Clay
Silt
V. Fine Sand
Fine Sand
Med. Sand
Crse. Sand & Debris

I) Notes from Sediment Sampling on November 7, 1996

A) Main Detention Pond

Sampling Site #1 **(Pond A sample from Phase II)**

0-4" - Predominantly black peat (sapric), organic, leaves in sample, sandy, gritty, lots of organic matter.
- Sample collected 10 feet east of inlet D and 8 feet from shore with Eckman dredge.

Sampling Site #2 **(Pond B sample from Phase II)**

0-4" - Dark black peat (sapric), fine grain, with some twigs and leaves.
- Sample collected 8 feet west of the outlet structure and 6 feet from shore with Eckman dredge.

B) Wetlands

Sampling Site #3 **(Wetland 4 sample from Phase II)**

0-4" - Sapric, black, smelly, gritty, lots of organics (cattails).
- Sample was collected in the middle of the chamber, between inlet and cattails with Eckman dredge.

Sampling Site #4 **(Wetland 3 sample from Phase II)**

0-4" - Black, highly organic (sapric), very fine, smelly.
- Sample was collected 6 feet east of the outlet and 3 feet from shore with Eckman dredge.

Sampling Site #5 **(No sample from Phase II taken)**

0-4" - Black, silt loam mixed with sand, sulfur smell.
- Sample was collected about 3 feet south of the inlet with Eckman dredge.

Sampling Site #6 **(Wetland 2 sample from Phase II)**

0-3" - All cattail fibers, black.
- Sample collected 20 feet off berm toward outlet by scooping sample into the sample container.

Sampling Site #7 **(Wetland 1A sample from Phase II)**

0-4" - Sandy, gritty, black loam, very little organics.
- Sample was collected at head of the pooled water where velocity begins to decrease approximately mid-way through the chamber with Eckman dredge.

C) **Hockey Rink Detention Pond**

Sampling Site #8 (No sample from Phase II taken)

0-4" - Lots of leaves, organics, very gritty, smelly, gray and black.
- Sample was collected on the southeast side of the inlet about 4 feet from shore with Eckman dredge.

D) **Outlet A**

Sampling Site #9 (Outlet A sample from Phase II)

0-4" - Sand, organic mix, black, lots of cattail debris.
- Sample was collected in pooled area before the cattails south of the inlet berm by scooping sample into the sample container.

E) **Outlet C**

Sampling Site #10 (Outlet C sample from Phase II)

0-4" - Fine organic, no smell, black peat (sapric), decomposed cattails.
- Sample was collected 3 feet in front of pond outlet with Eckman dredge.

II) Notes from Sediment Sampling on November 15, 1994

A) **Main Detention Pond**

Sampling Site #1 (Pond A sample from Phase II)

0-4" - Predominantly black peat (sapric), organic, leaves in sample.
- Sample collected 10 feet east of inlet D and 8 feet from shore with Eckman dredge.

Sampling Site #2 (Pond B sample from Phase II)

0-4" - Black peat (sapric), gritty with some sand and leaves.
- Sample collected 8 feet west of the outlet structure and 6 feet from shore with Eckman dredge.

B) **Wetlands**

Sampling Site #3 (Wetland 4 sample from Phase II)

0-4" - Sapric, interbedded with hemic and sapric. 2-3 inches of sand interbedded with peat.
- Sample was collected in the middle of the chamber, between inlet and cattails by scooping sample into the sample container.

Sampling Site #4 **(Wetland 3 sample from Phase II)**

0-4" - Organic silt loam, black peat (sapric), small amount of sand.
- Sample was collected 6 feet east of the outlet and 3 feet from shore with Eckman dredge.

Sampling Site #5 **(No sample from Phase II taken)**

0-4" - Organic, silt loam with small amount of sand. Sulfur smell.
- Sample was collected about 3 feet south of the inlet with Eckman dredge.

Sampling Site #6 **(Wetland 2 sample from Phase II)**

0-3" - First 3 inches very organic, next 1 inch of sand. Most of sample was from top 3 inches of sediment. Tightly compacted sand from the next inch.
- Sample collected 20 feet off berm toward outlet by scooping sample into the sample container.

Sampling Site #7 **(Wetland 1A sample from Phase II)**

0-4" - Sandy, gritty, black loam. Same as site #6.
- Sample was collected at head of the pooled water where velocity begins to decrease approximately mid-way through the chamber by scooping sample into the sample container.

C) Hockey Rink Detention Pond

Sampling Site #8 **(No sample from Phase II taken)**

0-4" - Organic muck. Oil slick came to surface when grabbed sample.
- Sample was collected on the southeast side of the inlet about 4 feet from shore with Eckman dredge.

D) Outlet A

Sampling Site #9 **(Outlet A sample from Phase II)**

0-4" - Very fibrous, predominantly black peat (sapric).
- Sample was collected in pooled area before the cattails south of the inlet berm by scooping sample into the sample container.

E) Outlet C

Sampling Site #10 **(Outlet C sample from Phase II)**

0-4" - Black peat (sapric). Evidence of gray silty clay-loam at about 1-2", not very fibrous.
- Sample was collected 3 feet in front of pond outlet with Eckman dredge.

III) Notes from Sediment Sampling 1988

A) Main Detention Pond

Subsample 1 (chemical sample Pond B):

0-30" - Predominantly black peat (sapric) with evidence of alteration seen in bands of black and gray mineral strata within the organic matrix; note suspect alteration by construction and not naturally (mineral soils quite compacted).

Subsample 2 (chemical sample Pond A):

0-42" - Mixed black peat (sapric) and dark brown peat (hemic).

B) Wetland No. 4

Subsample 1:

0-8" - Black loam
8"-12" - Very dark gray, sandy loam
12"-18" - Gray coarse sand
18"-30" - Stratified gray sand and black silty clay-loam

Subsample 2: (chemical sample Wetland 4):

0-8" - Black loam with strata of black peat (sapric)
8"-24" - Very dark gray, highly organic silt-loam with strata of decayed vegetation; note likely backwater area with some layered strata of mixed organic and mineral soils.

C) Wetland No. 3

Subsample 1:

0-1" - Gray, fine sand
1"-8" - Stratified very dark gray, silty clay loam; one-half inch bands of black peat (sapric); thin bands of gray, coarse sand; layers of decayed vegetation between strata.

Subsample 2 (chemical sample Wetland 3):

0-7" - Black peat (sapric)
7"-10" - Mixed black peat (sapric) and dark brown peat (hemic)
10"-48" - Peat (hemic); note this area of wetland catchment different than subsample no. 1 and probably represents backwater area; no mineral soils found; upper peats highly decomposed and lower peats somewhat decomposed.

D) Wetland No. 2

<u>Subsample 1:</u>

0-6" - Olive gray, loamy sand
6"-9" - Very dark gray, silt-clay-loam
9"-15" - Gray, very fine sandy loam
15"-18" - Dark gray, silty clay-loam
18"-30" - Peat (sapric)

<u>Subsample 2 (chemical sample Wetland 2):</u>

0-3" - Black, fine sandy loam
3"-6" - Gray, medium sand
6"-11" - Black, silty clay-loam
11"-17" - Black peat (sapric)
17"-? - Very dark gray, silty loam; note highly stratified soils indicative of variable water levels; relative lack of organic soils probably indicative of little historic ponding at this point.

E) Wetland No. 1

<u>Subsample 1 (chemical sample Wetland 1A):</u>

0-3" - Black peat (sapric)
3"-24" - Highly organic silt-loam with thick seams of black organic matter
24"-30" - Dark gray silty clay-loam with numerous strata of dead vegetation; note situation typical of water level changes between free flowing and slack waters.

F) Outlet Wetland

<u>Subsample 1 (chemical sample Outlet A):</u>

0-30" - Predominantly black peat (sapric) with variable strata of dark gray silt-loam; very fibrous with many decayed plant residues; note basin more historically indicative of floodway than wetland, reflecting variable water level changes.

<u>Subsample 2 (chemical Outlet C):</u>

0-6" - Black peat (sapric)
6"-30" - Mixed black sapric peat with very dark gray silt-loam at 50-50 mixture; note again basin indicative of historic fluctuating water levels creating mixed organic and mineral strata typical of floodway.

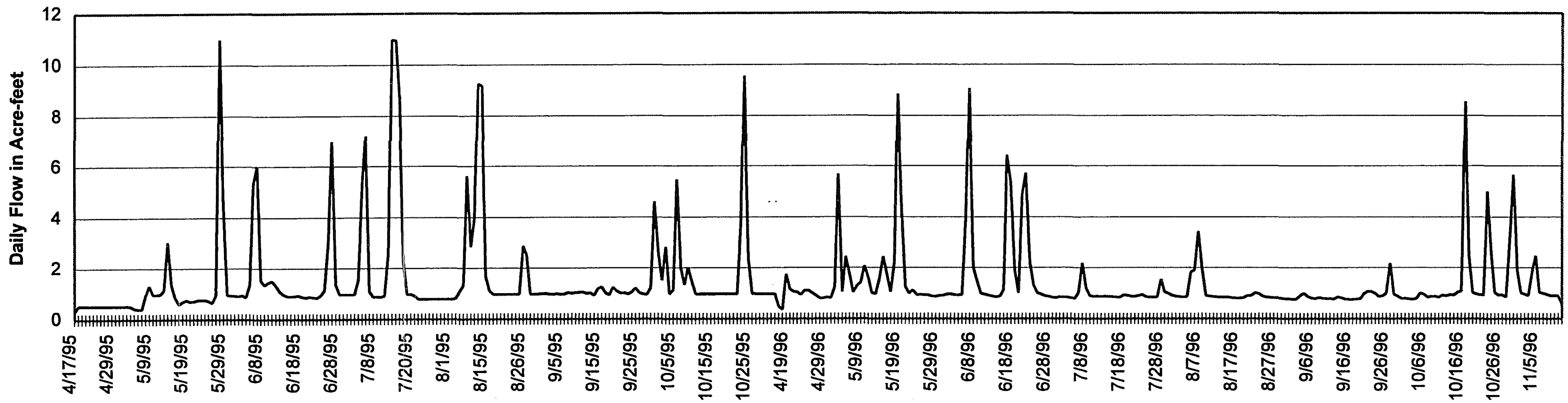
<u>Subsample 3 (chemical Outlet B):</u>

0-5" - Black peat (sapric); numerous decayed plants
5"-24" - Dark gray silty clay-loam
24"-30" - Mixed black peat (sapric) and dark gray silt-clay-loam.

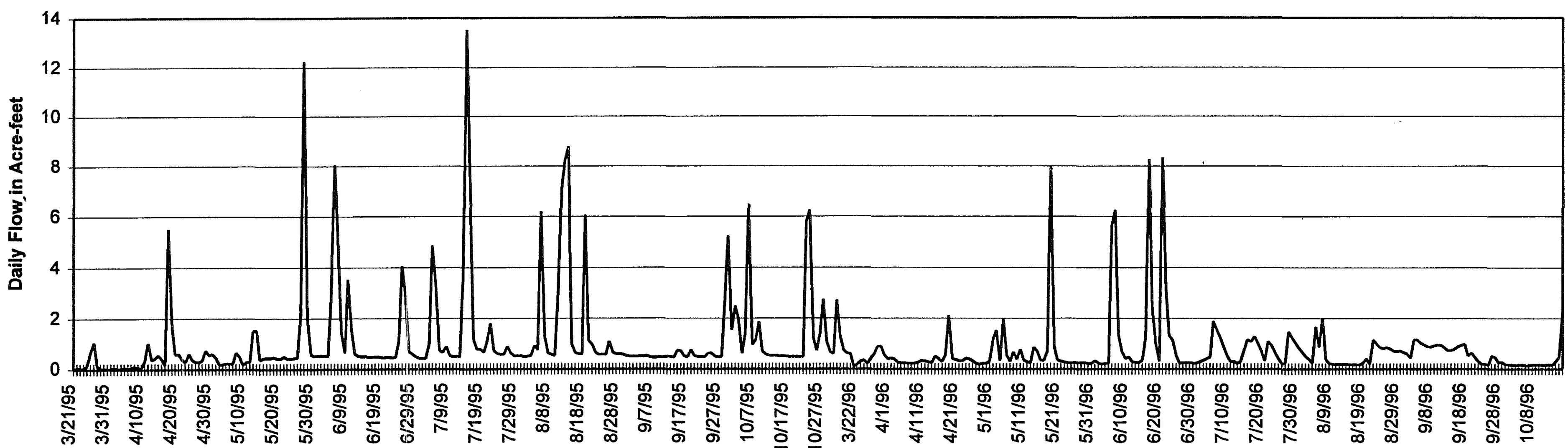
APPENDIX D
MWTS DAILY FLOW GRAPHICS

Daily Flow Plots - Sites A and G.

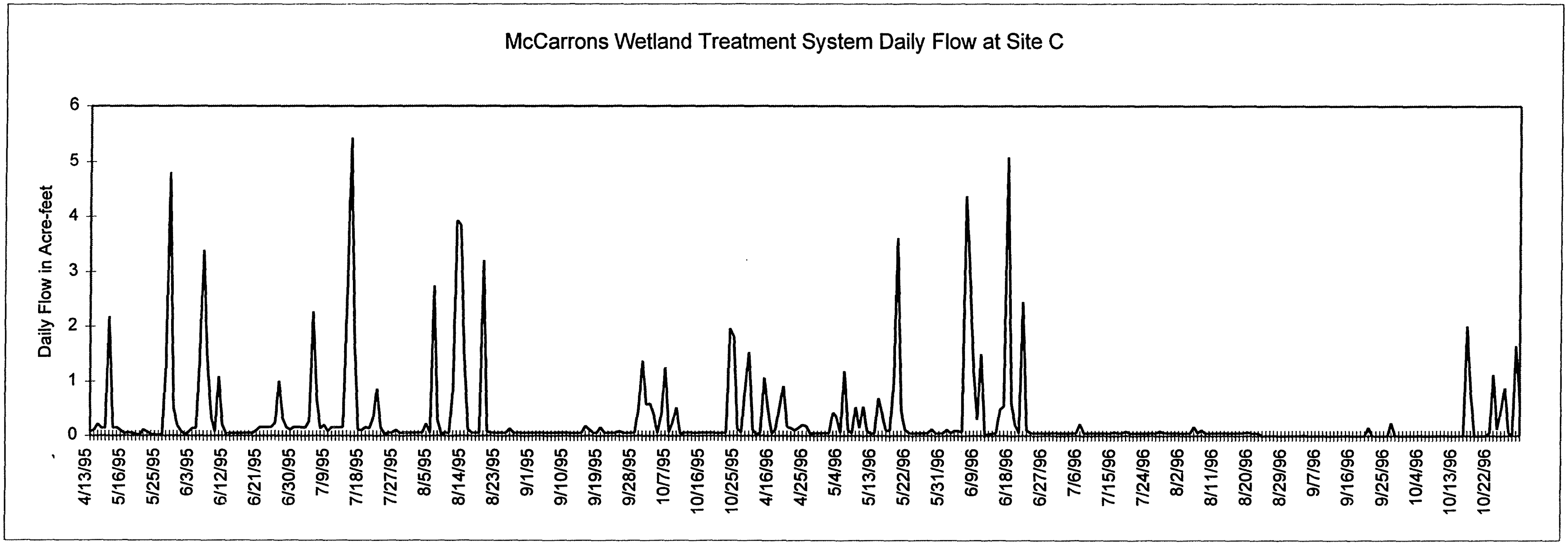
McCarrons Wetland Treatment System Daily Flow at Site A

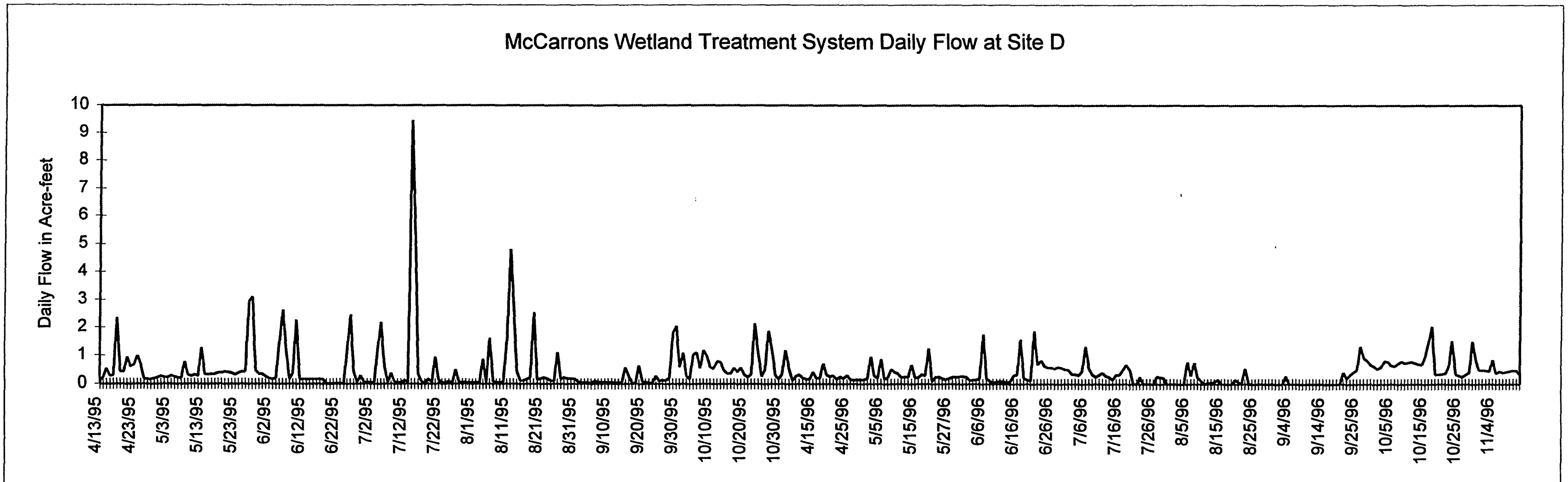


McCarrons Wetland Treatment System Daily Flow at Site G

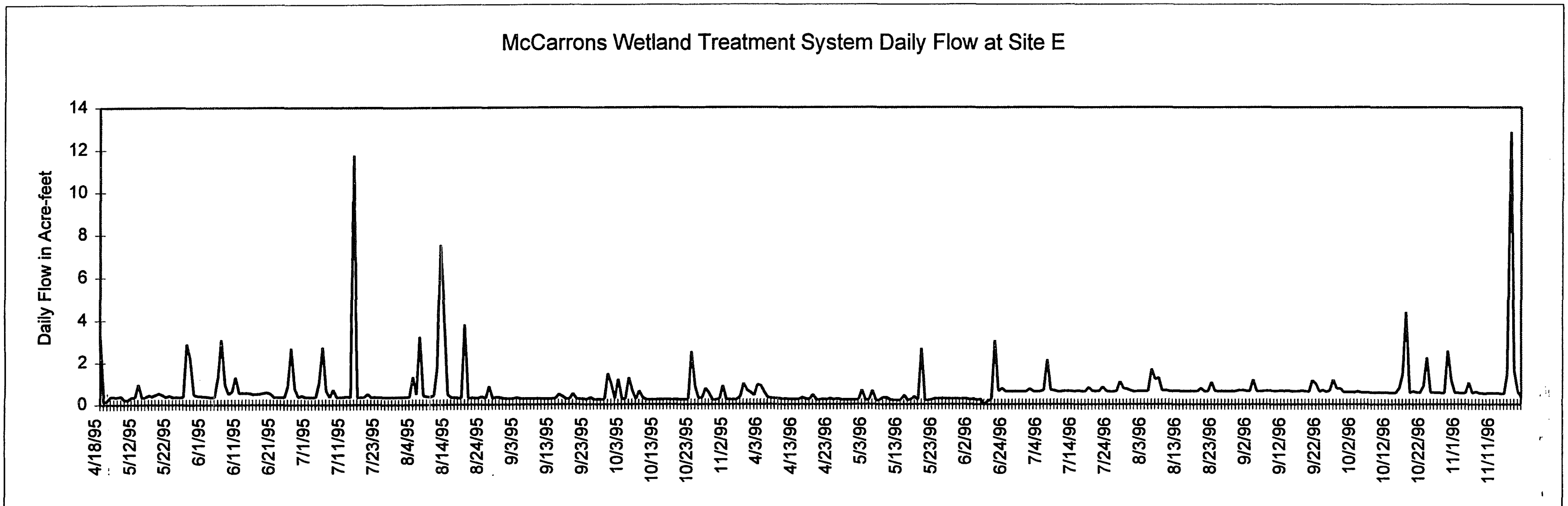


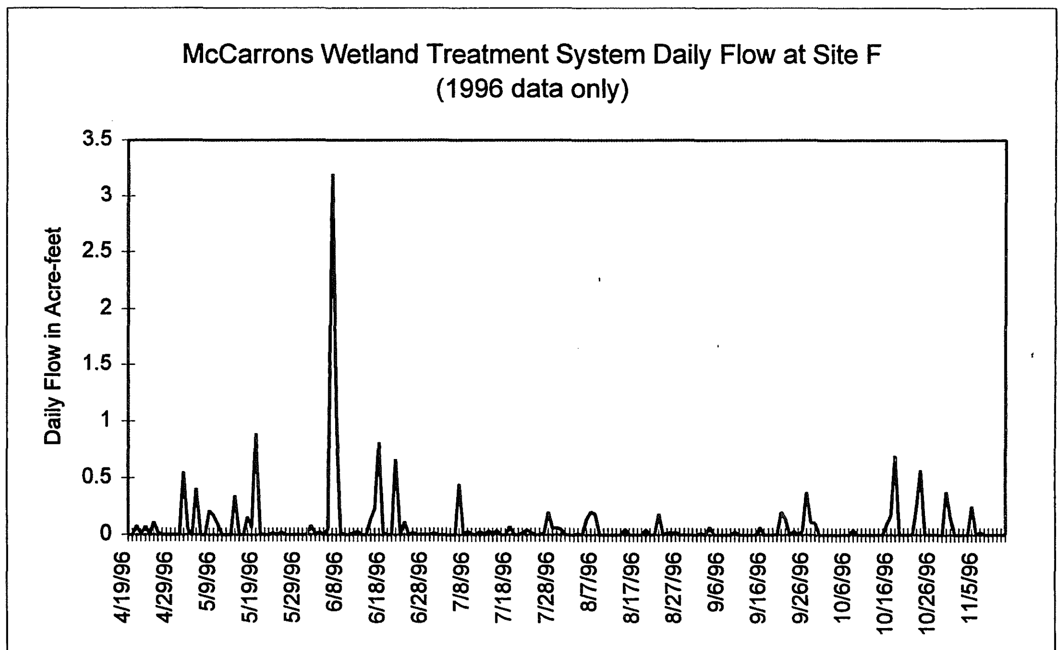
Daily Flow Plots - Sites C and D.





Daily Flow Plots - Sites E and F.





APPENDIX E
GROUNDWATER AND BASEFLOW

Appendix E. Groundwater and Baseflow

Groundwater discharges steadily into the McCarrons Wetland Treatment System. There is a fairly uniform 0.05-0.2 cubic feet per second (cfs) baseflow through the wetland maintained by groundwater.

In order to confirm the direction of groundwater flow through the wetland system and in the general vicinity of the lake, the Minnesota Geological Survey's (MGS) well logs for the area were searched to supplement the data collected as part of the feasibility study (Donohue, 1983). All of the MGS documented wells in the McCarrons area were researched for ground surface elevation, static water level. and aquifer within which the well is contained. Equipotential maps for the upper three aquifer units (Quaternary undifferentiated, Platteville Limestone and St. Peter Sandstone) are contained in this appendix.

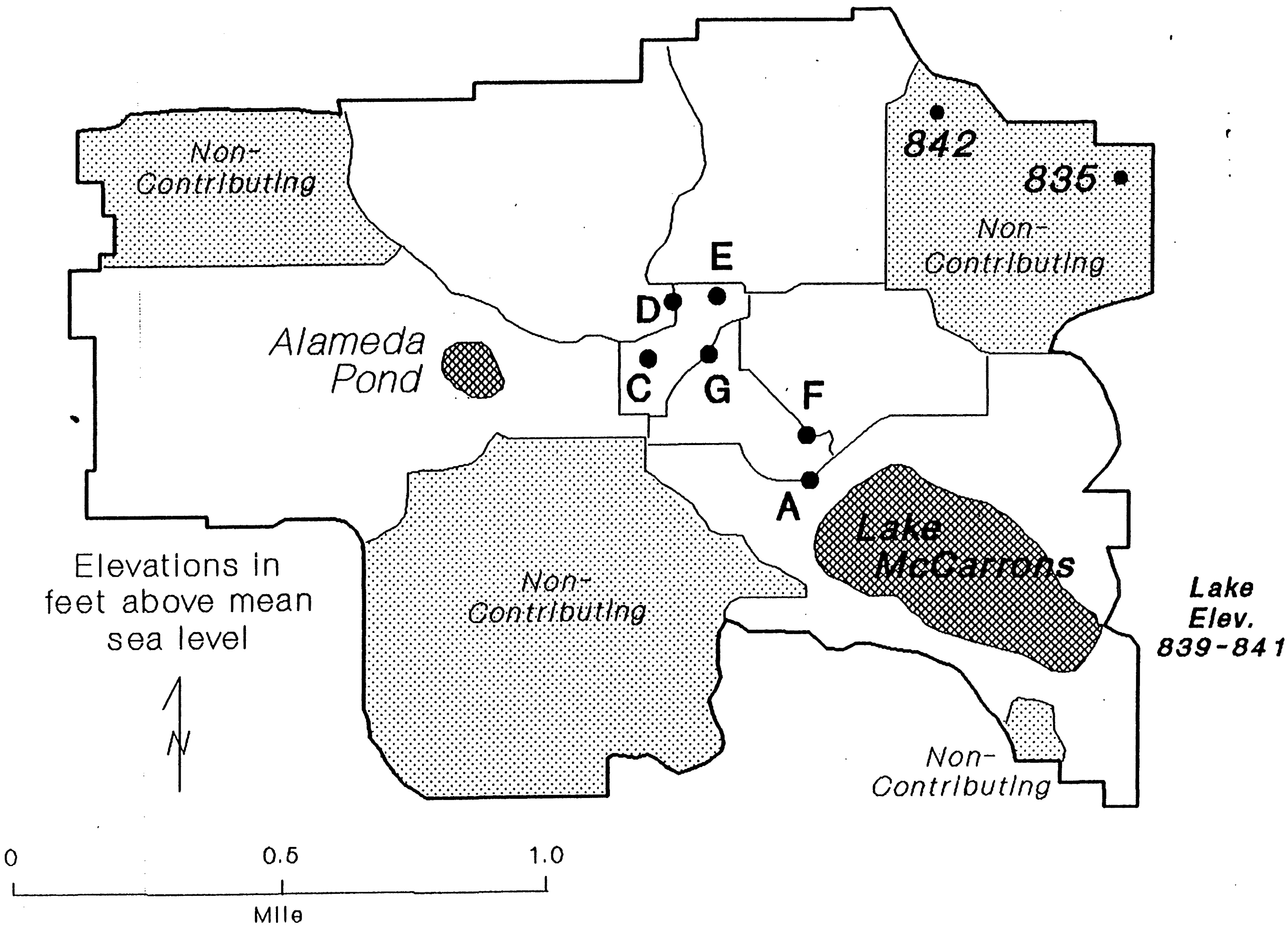
The well log data were plotted by cross-section, but essentially no patterns of continuity were noted. Rather, the underlying material can be best characterized as undifferentiated glacial till, with many layers of intermixed sand, gravel, clay and hardpan. Most of the wells for which there were logs terminated in a sand and gravel layer from which water is undoubtedly drawn. The lake appears to overlay a mixed series of hardpan and sand layers to the northwest, and a fairly uniform sand and gravel layer to the southeast.

Water levels in the four wells terminating in the St. Peter Sandstone indicate a drop from above the surface level of the lake to the north to below the level of the lake to the southwest. This pattern is reflective of the regional St. Peter flow (northeast to southwest) through this part of the Metropolitan Area.

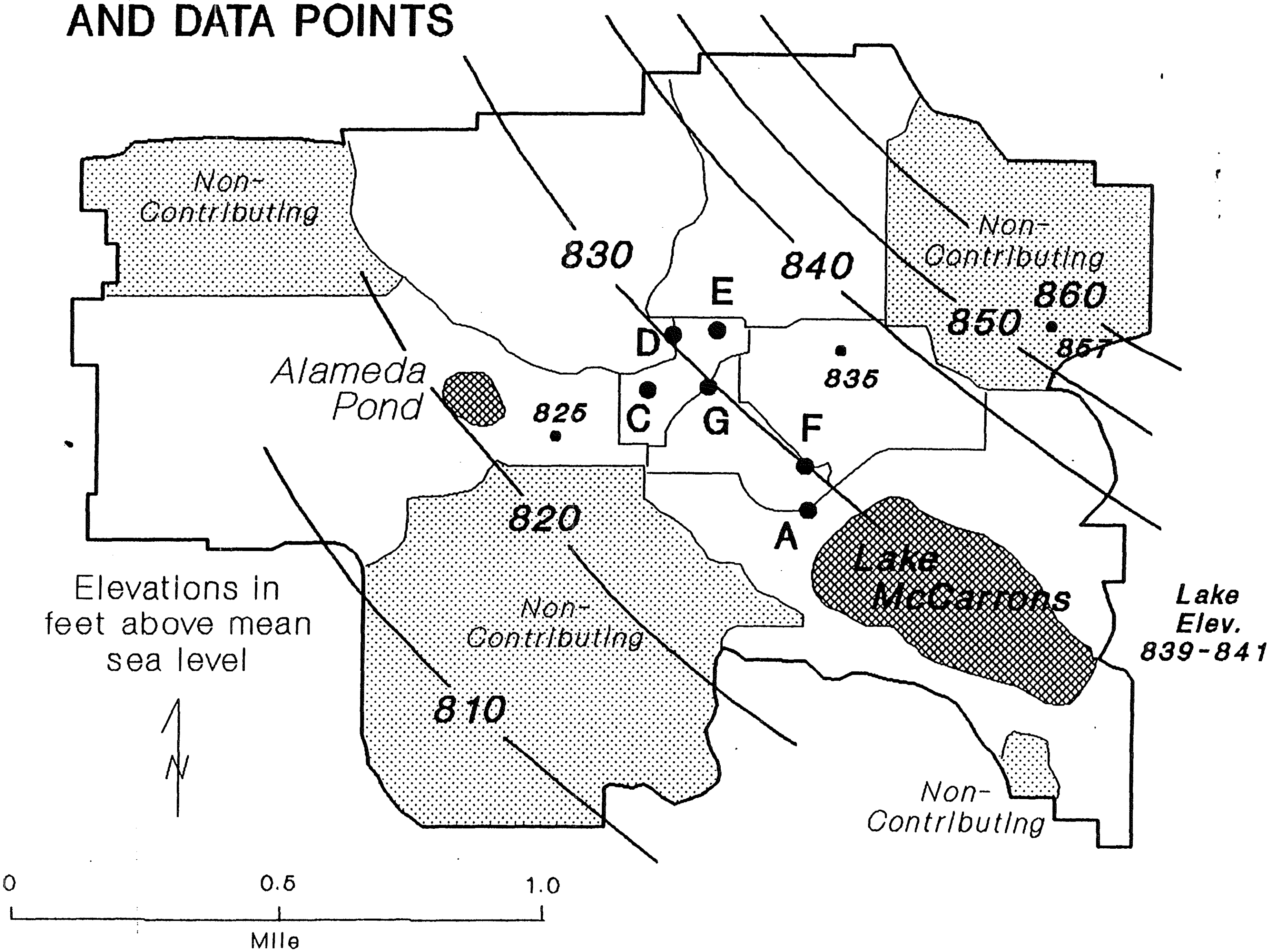
Only two Platteville Limestone wells were found, both of these to the north of the lake. The Platteville is discontinuous throughout this part of the Metropolitan Area.

The best database available for shallow groundwater in the McCarrons area is for Quaternary undifferentiated glacial till. The data presented in the feasibility report show that water levels can vary several feet within a short period of time. The flow pattern shown for the surficial layer is based on the best estimation of the average water level in the wells for which data were analyzed. The equipotential lines indicate a general flow of water in the surficial material from northwest to southeast, almost at a right angle to the shallow bedrock flow in the area. The gradient is rather small, as evidenced by the small amount of flow into Appendix G - Jack Mauritz Field Survey - Summer 1995

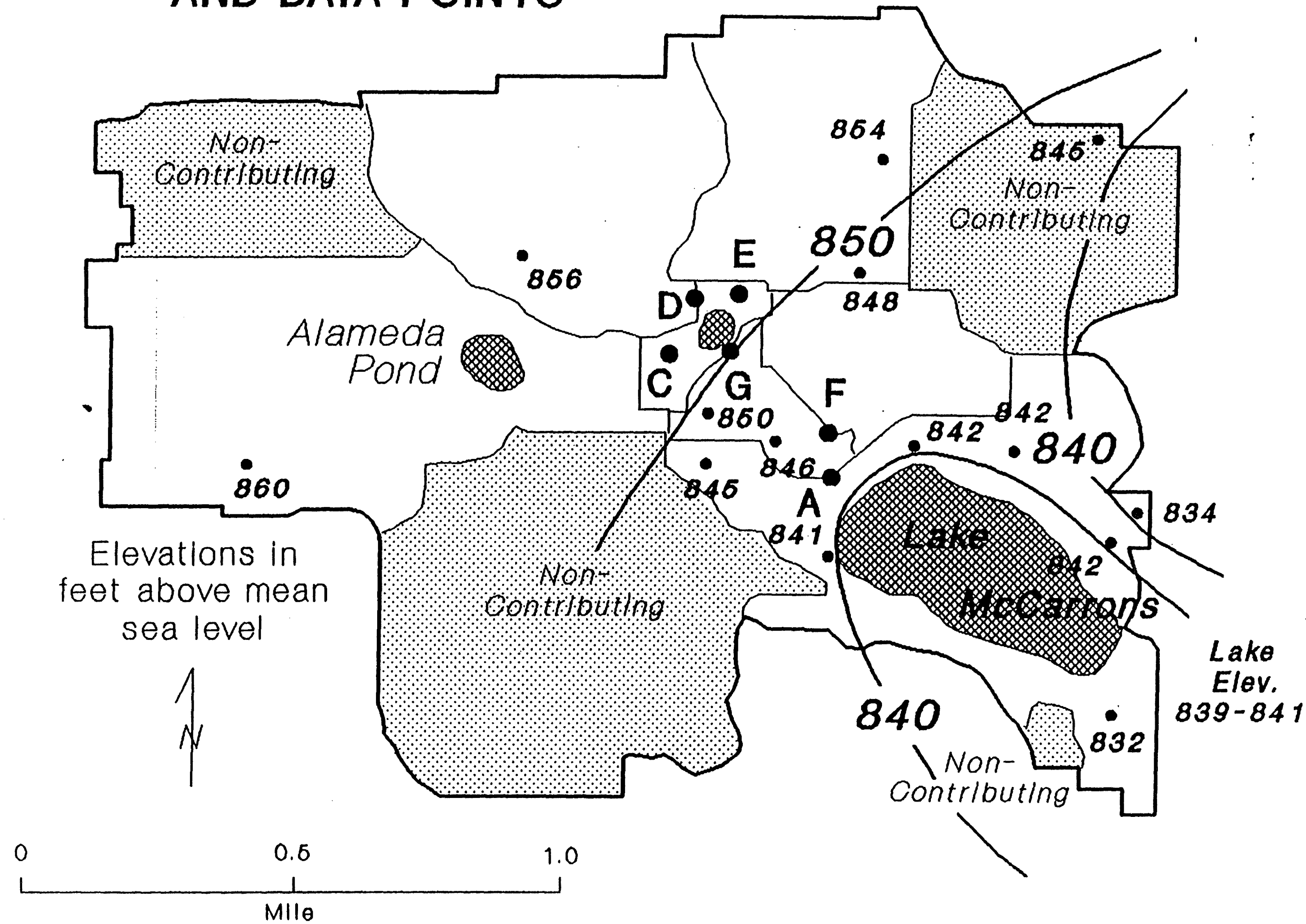
PLATTEVILLE LIMESTONE DATA POINTS



ST. PETER SANDSTONE EQUIPOTENTIAL LINES AND DATA POINTS



QUATERNARY UNDIFFERENTIATED EQUIPOTENTIAL LINES AND DATA POINTS



APPENDIX F.
MONITORED BASEFLOW LOADING TABLES

McCarrons 1995 Load Totals

Baseflow - Portion of 1st quarter 1995

Period covers 3/11/95 - 3/31/95

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	6	3	0.11	0.05	32	1.33	0.67	0.31	1.73	2.04	0.66	3.37	0.01	0.02	2.97
D	5	3	0.08	0.03	11	0.47	0.14	0.03	0.79	0.82	0.33	1.29	0.01	0.020	2.93
E	3	3	0.10	0.02	21	0.60	0.37	0.04	2.14	2.18	0.23	2.78	0.01	0.010	1.49
G Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
G	6	6	0.08	0.04	44	1.30	0.67	0.06	0.99	1.05	0.63	2.35	0.01	0.030	4.76
F (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A	18	6	0.11	0.01	24	1.70	0.85	0.04	0.86	0.90	0.85	2.60	0.01	0.030	5.66

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	49	24	0.89	0.40	259	10.75	5.42	2.51	13.99	16.49	5.34	27.25	0.081	0.162	2.97
D	40	24	0.64	0.24	88	3.75	1.12	0.24	6.30	6.54	2.63	10.29	0.080	0.160	2.93
E	12	12	0.40	0.08	85	2.43	1.50	0.16	8.65	8.81	0.93	11.24	0.040	0.040	1.49
G Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
G Inflow	101	60	1.93	0.72	431	16.93	8.03	2.91	28.94	31.85	8.90	48.78	0.201	0.362	7.39
G	78	78	1.04	0.52	570	16.83	8.67	0.78	12.81	13.59	8.15	30.42	0.129	0.388	4.76
Pond Reduction	23	-17	0.90	0.21	-138	0.10	-0.64	2.13	16.13	18.26	0.74	18.36	0.072	-0.027	2.63
(%)	23	-29	46	29	-32	1	-8	73	56	57	8	38	36	-7	36
F	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Inflow	78	78	1.04	0.52	570	16.83	8.67	0.78	12.81	13.59	8.15	30.42	0.129	0.388	4.76
A	277	92	1.69	0.15	369	26.17	13.09	0.62	13.24	13.85	13.09	40.02	0.154	0.462	5.66
Wetland Reduction	-199	-15	-0.66	0.36	200	-9.34	-4.41	0.16	-0.42	-0.26	-4.93	-9.61	-0.025	-0.074	-0.90
(%)	-257	-19	-64	70	35	-56	-51	21	-3	-2	-60	-32	-19	-19	-19
System Reduction	-177	-32	0.24	0.57	62	-9.24	-5.06	2.29	15.70	17.99	-4.19	8.75	0.047	-0.100	1.73
(%)	-176	-53	12	79	14	-55	-63	79	54	56	-47	18	23	-28	23

Note: baseflow samples not taken; apply 1996 1st quarter values for D, E, G and A; average baseflow value for C

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McCarrons 1995 Load Totals

Baseflow - 2nd quarter 1995

Period covers 4/1/95 - 6/30/95

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	6	3	0.11	0.05	32	1.33	0.67	0.31	1.73	2.04	0.66	3.37	0.01	0.020	12.54
D	8	3	0.19	0.02	18	3.00	2.82	0.01	0.28	0.29	0.18	3.29	0.01	0.005	15.90
E	2	2	0.07	0.07	14	0.50	0.18	0.02	1.21	1.23	0.32	1.73	0.01	0.005	10.72
G Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
G	11	8	0.14	0.01	27	2.80	2.77	0.01	0.06	0.07	0.03	2.87	0.01	0.006	26.85
F (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A	7	4	0.57	0.04	29	0.48	0.30	0.01	0.05	0.06	0.18	0.54	0.01	0.005	37.09

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	205	102	3.76	1.71	1093	45.42	22.88	10.59	59.08	69.66	22.54	115.08	0.341	0.683	12.54
D	346	130	8.23	0.87	779	129.88	122.09	0.43	12.12	12.56	7.79	142.44	0.433	0.216	15.90
E	58	58	2.04	2.04	408	14.58	5.25	0.58	35.29	35.88	9.33	50.46	0.292	0.146	10.72
G Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
G Inflow	610	291	14.02	4.62	2280	189.88	150.22	11.60	106.49	118.09	39.66	307.98	1.066	1.045	39.16
G	804	585	10.23	0.73	1973	204.65	202.46	0.73	4.39	5.12	2.19	209.77	0.731	0.439	26.85
Pond Reduction	-194	-294	3.79	3.88	307	-14.77	-52.24	10.87	102.11	112.98	37.47	98.21	0.335	0.607	12.31
(%)	-32	-101	27	84	13	-8	-35	94	96	96	94	32	31	58	31
F	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Inflow	804	585	10.23	0.73	1973	204.65	202.46	0.73	4.39	5.12	2.19	209.77	0.731	0.439	26.85
A	707	404	57.56	4.04	2928	48.47	30.29	1.01	5.05	6.06	18.18	54.53	1.010	0.505	37.09
Wetland Reduction	97	181	-47.32	-3.31	-955	156.18	172.16	-0.28	-0.66	-0.94	-15.98	155.24	-0.279	-0.066	-10.24
(%)	12	31	-462	-453	-48	76	85	-38	-15	-18	-729	74	-38	-15	-38
System Reduction	-97	-113	-43.53	0.58	-648	141.42	119.93	10.59	101.44	112.04	21.49	253.45	0.056	0.540	2.07
(%)	-16	-39	-310	12	-28	74	80	91	95	95	54	82	5	52	5

Note: samples collected 5/19/95; average baseflow concentrations applied to C

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McCarrons 1995 Load Totals

Baseflow - 3rd quarter 1995

Period covers 7/1/95 - 9/30/95

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	5	2	0.10	0.06	21	1.40	0.69	0.30	2.34	2.64	0.71	4.04	0.01	0.005	12.20
D	8	3	0.12	0.03	23	0.65	0.49	0.04	0.47	0.51	0.16	1.16	0.01	0.005	12.07
E	3	2	0.08	0.03	26	1.60	1.28	0.07	1.33	1.40	0.32	3.00	0.01	0.005	8.15
G Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
G	10	7	0.19	0.06	37	1.40	1.36	0.01	0.08	0.09	0.04	1.49	0.01	0.005	26.11
F (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A	23	12	0.49	0.16	44	1.70	1.51	0.01	0.08	0.09	0.19	1.79	0.01	0.005	30.93

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	166	66	3.32	1.99	698	46.51	22.92	9.97	77.73	87.70	23.59	134.21	0.332	0.166	12.20
D	263	99	3.94	0.99	756	21.36	16.10	1.31	15.45	16.76	5.26	38.12	0.329	0.164	12.07
E	67	44	1.77	0.67	577	35.48	28.38	1.55	29.49	31.05	7.10	66.53	0.222	0.111	8.15
G Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
G Inflow	496	209	9.04	3.64	2030	103.35	67.41	12.83	122.67	135.50	35.94	238.85	0.883	0.441	32.42
G	711	498	13.51	4.27	2630	99.52	96.68	0.71	5.69	6.40	2.84	105.92	0.711	0.355	26.11
Pond Red.	-215	-288	-4.47	-0.62	-600	3.83	-29.27	12.12	116.98	129.11	33.10	132.94	0.172	0.086	6.31
(%)	-43	-138	-49	-17	-30	4	-43	94	95	95	92	56	19	19	19
F	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Inflow	711	498	13.51	4.27	2630	99.52	96.68	0.71	5.69	6.40	2.84	105.92	0.711	0.355	26.11
A	1937	1010	41.26	13.47	3705	143.14	127.14	0.84	6.74	7.58	16.00	150.72	0.842	0.421	30.93
Wet. Red.	-1226	-513	-27.75	-9.21	-1075	-43.62	-30.46	-0.13	-1.05	-1.18	-13.15	-44.80	-0.131	-0.066	-4.82
(%)	-172	-103	-205	-216	-41	-44	-32	-18	-18	-18	-463	-42	-18	-18	-18
Syst. Red.	-1441	-801	-32.22	-9.83	-1675	-39.79	-59.73	11.99	115.94	127.93	19.94	88.14	0.041	0.020	1.49
(%)	-291	-383	-356	-270	-82	-39	-89	93	95	94	55	37	5	5	5

Note: samples collected 7/11/95

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McCarrons 1995 Load Totals

Baseflow - 4th quarter 1995

Period covers 10/1/95 - 12/31/95

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	6	3	0.11	0.05	32	1.33	0.67	0.31	1.73	2.04	0.66	3.37	0.01	0.020	3.96
D	4	2	0.07	0.03	18	0.44	0.39	0.03	0.28	0.31	0.05	0.75	0.01	0.050	9.97
E	2	2	0.11	0.05	27	0.86	0.58	0.07	1.48	1.55	0.28	2.41	0.01	0.050	7.86
G Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
G	9	4	0.10	0.03	36	0.96	0.94	0.03	0.03	0.06	0.02	1.02	0.01	0.050	27.03
F (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A	11	4	0.32	0.10	43	1.20	1.08	0.03	0.05	0.08	0.12	1.28	0.01	0.050	33.11

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	65	32	1.19	0.54	345	14.33	7.22	3.34	18.64	21.98	7.11	36.31	0.108	0.215	3.96
D	109	54	1.90	0.81	488	11.94	10.58	0.81	7.60	8.41	1.36	20.35	0.136	1.357	9.97
E	43	43	2.35	1.07	578	18.41	12.41	1.50	31.68	33.17	5.99	51.58	0.107	1.070	7.86
G Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
G Inflow	216	129	5.44	2.42	1411	44.67	30.21	5.65	57.91	63.56	14.46	108.24	0.350	2.642	21.79
G	662	294	7.36	2.21	2649	70.65	69.17	2.21	2.21	4.42	1.47	75.06	0.368	3.679	27.03
Pond Reduction	-446	-165	-1.92	0.22	-1238	-25.97	-38.96	3.44	55.70	59.15	12.99	33.18	-0.018	-1.037	-5.25
(%)	-207	-127	-35	9	-88	-58	-129	61	96	93	90	31	-5	-39	-24
F	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Inflow	662	294	7.36	2.21	2649	70.65	69.17	2.21	2.21	4.42	1.47	75.06	0.368	3.679	27.03
A	991	360	28.84	9.01	3875	108.15	97.33	2.70	4.51	7.21	10.81	115.36	0.451	4.506	33.11
Wetland Reduction	-329	-66	-21.48	-6.80	-1226	-37.50	-28.16	-0.50	-2.30	-2.79	-9.34	-40.29	-0.083	-0.827	-6.07
(%)	-50	-22	-292	-308	-46	-53	-41	-22	-104	-63	-635	-54	-22	-22	-22
System Reduction	-775	-231	-23.40	-6.59	-2464	-63.47	-67.12	2.95	53.41	56.35	3.65	-7.12	-0.100	-1.864	-11.32
(%)	-359	-179	-430	-272	-175	-142	-222	52	92	89	25	-7	-29	-71	-52

Note: used 1996 4th quarter baseflow samples; average baseflow values for C

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McCarrons 1996 Load Totals

Baseflow - first quarter, 1996

Period covers 1/1/96 - 3/31/96

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	6	3	0.11	0.05	32	1.33	0.67	0.31	1.73	2.04	0.66	3.37	0.020	0.05	7.14
D	5	3	0.08	0.03	11	0.47	0.14	0.03	0.79	0.82	0.33	1.29	0.020	0.05	17.06
E	3	3	0.10	0.02	21	0.60	0.37	0.04	2.14	2.18	0.23	2.78	0.010	0.06	15.41
G Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
G	6	4	0.08	0.04	44	1.30	0.67	0.06	0.99	1.05	0.63	2.35	0.030	0.05	28.54
F (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A	18	6	0.11	0.01	24	1.70	0.85	0.04	0.86	0.90	0.85	2.60	0.030	0.05	34.36

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	117	58	2.14	0.97	622	25.85	13.02	6.03	33.63	39.66	12.83	65.51	0.389	0.972	7.14
D	232	139	3.71	1.39	511	21.82	6.50	1.39	36.68	38.08	15.32	59.90	0.929	2.322	17.06
E	126	126	4.19	0.84	881	25.17	15.52	1.68	89.77	91.44	9.65	116.61	0.419	2.517	15.41
G Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
G Inflow	475	323	10.05	3.20	2014	72.85	35.05	9.10	160.08	169.18	37.80	242.02	1.737	5.811	39.61
G	466	311	6.22	3.11	3418	101.00	52.05	4.66	76.92	81.58	48.95	182.58	2.331	3.885	28.54
Pond Reduction	9	13	3.83	0.10	-1405	-28.15	-17.01	4.44	83.17	87.60	-11.14	59.45	-0.594	1.926	11.07
(%)	2	4	38	3	-70	-39	-49	49	52	52	-29	25	-34	33	28
F	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Inflow	466	311	6.22	3.11	3418	101.00	52.05	4.66	76.92	81.58	48.95	182.58	2.331	3.885	28.54
A	1684	561	10.29	0.94	2245	159.01	79.51	3.74	80.44	84.18	79.51	243.19	2.806	4.677	34.36
Wetland Reduction	-1217	-250	-4.07	2.17	1174	-58.01	-27.45	0.92	-3.53	-2.61	-30.56	-60.62	-0.475	-0.792	-5.82
(%)	-261	-81	-66	70	34	-57	-53	20	-5	-3	-62	-33	-20	-20	-20
System Reduction	-1209	-238	-0.24	2.27	-231	-86.16	-44.46	5.36	79.64	85.00	-41.70	-1.17	-1.069	1.134	5.25
(%)	-255	-74	-2	71	-11	-118	-127	59	50	50	-110	0	-62	20	13

Note: samples collected 1/23/96; average baseflow values for C

9601qtr.xls

McCarrons 1996 Load Totals

Baseflow - 2nd quarter 1996

Period covers 4/1/96 - 6/30/96

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	9	5	0.12	0.06	47	0.80	0.37	0.05	0.44	0.49	0.43	1.29	0.050	0.05	13.10
D	5	2	0.09	0.04	61	1.00	0.83	0.05	0.67	0.72	0.17	1.72	0.005	0.05	12.45
E	3	2	0.13	0.02	48	1.50	1.08	0.06	2.19	2.25	0.42	3.75	0.005	0.05	8.04
G Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
G	12	8	0.15	0.02	60	3.10	3.08	0.04	0.34	0.38	0.02	3.48	0.005	0.05	20.69
F (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A	7	4	0.26	0.02	53	1.50	1.48	0.04	0.08	0.12	0.02	1.62	0.050	0.05	31.97

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	321	178	4.28	2.14	1676	28.54	13.20	1.78	15.69	17.48	15.34	46.01	1.783	1.783	13.10
D	170	68	3.05	1.36	2068	33.90	28.14	1.70	22.71	24.41	5.76	58.31	0.170	1.695	12.45
E	66	44	2.84	0.44	1050	32.82	23.63	1.31	47.91	49.23	9.19	82.04	0.109	1.094	8.04
G Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
G Inflow	556	290	10.18	3.93	4795	95.26	64.97	4.79	86.32	91.11	30.29	186.37	2.062	4.573	33.59
G	676	451	8.45	1.13	3380	174.63	173.50	2.25	19.15	21.41	1.13	196.03	0.282	2.817	20.69
Pond Reduction	-120	-161	1.73	2.81	1415	-79.37	-108.53	2.54	67.17	69.71	29.16	-9.66	1.781	1.756	12.90
(%)	-22	-55	17	71	30	-83	-167	53	78	77	96	-5	86	38	38
F	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Inflow	676	451	8.45	1.13	3380	174.63	173.50	2.25	19.15	21.41	1.13	196.03	0.282	2.817	20.69
A	609	348	22.63	1.74	4613	130.56	128.82	3.48	6.96	10.44	1.74	141.00	4.352	4.352	31.97
Wetland Reduction	67	102	-14.18	-0.61	-1233	44.07	44.68	-1.23	12.19	10.96	-0.61	55.03	-4.070	-1.535	-11.28
(%)	10	23	-168	-55	-36	25	26	-55	64	51	-55	28	-1445	-55	-55
System Reduction	-53	-58	-12.45	2.19	182	-35.30	-63.85	1.31	79.36	80.67	28.55	45.37	-2.290	0.221	1.62
(%)	-10	-20	-122	56	4	-37	-98	27	92	89	94	24	-111	5	5

Note: samples collected 4/23/96

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McCarrons 1996 Load Totals

Baseflow - 3rd quarter 1996

Period covers 7/1/96 - 9/30/96

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	5	3	0.10	0.04	29	1.80	0.95	0.58	2.42	3.00	0.85	4.80	<u>0.005</u>	<u>0.05</u>	4.66
D	4	2	0.10	0.04	31	0.78	0.66	0.09	0.58	0.67	0.12	1.45	<u>0.005</u>	<u>0.05</u>	6.19
E	8	4	0.10	0.03	32	1.90	1.57	0.19	1.11	1.30	0.33	3.20	<u>0.005</u>	<u>0.05</u>	11.92
G Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
G	9	7	0.20	0.09	40	1.40	1.33	0.05	0.13	0.18	0.07	1.58	<u>0.005</u>	<u>0.05</u>	28.31
F (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A	8	4	0.31	0.11	35	1.70	1.22	0.05	0.09	0.14	0.48	1.84	<u>0.005</u>	<u>0.05</u>	35.55

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	63	38	1.27	0.51	368	22.84	12.06	7.36	30.71	38.07	10.79	60.92	0.063	0.635	4.66
D	67	34	1.69	0.67	523	13.15	11.13	1.52	9.78	11.30	2.02	24.45	0.084	0.843	6.19
E	260	130	3.25	0.97	1038	61.66	50.95	6.17	36.02	42.19	10.71	103.85	0.162	1.623	11.92
G Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
G Inflow	391	202	6.20	2.16	1929	97.65	74.13	15.04	76.51	91.56	23.52	189.21	0.310	3.100	22.78
G	694	540	15.42	6.94	3083	107.91	102.51	3.85	10.02	13.87	5.40	121.78	0.385	3.854	28.31
Pond Reduction	-303	-338	-9.22	-4.78	-1154	-10.26	-28.38	11.19	66.49	77.68	18.12	67.43	-0.075	-0.754	-5.54
(%)	-78	-168	-149	-222	-60	-11	-38	74	87	85	77	36	-24	-24	-24
F	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Inflow	694	540	15.42	6.94	3083	107.91	102.51	3.85	10.02	13.87	5.40	121.78	0.385	3.854	28.31
A	774	387	30.00	10.65	3388	164.54	118.08	4.84	8.71	13.55	46.46	178.09	0.484	4.839	35.55
Wetland Reduction	-81	152	-14.59	-3.71	-304	-56.63	-15.57	-0.99	1.31	0.32	-41.06	-56.30	-0.099	-0.985	-7.24
(%)	-12	28	-95	-53	-10	-52	-15	-26	13	2	-761	-46	-26	-26	-26
System Reduction	-384	-186	-23.80	-8.49	-1458	-66.88	-43.95	10.20	67.80	78.01	-22.94	11.12	-0.174	-1.739	-12.78
(%)	-98	-92	-384	-394	-76	-68	-59	68	89	85	-98	6	-56	-56	-56

Note: samples collected 7/2/96

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McCarrons 1996 Load Totals

Baseflow - Portion of 4th quarter 1996

Period covers 10/1/96 - 11/5/96

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	6	3	0.11	0.05	32	1.33	0.67	0.31	1.73	2.04	0.33	3.37	0.020	0.05	0.78
D	4	2	0.07	0.03	18	0.44	0.39	0.03	0.28	0.31	0.05	0.75	0.005	0.05	6.75
E	2	2	0.11	0.05	27	0.86	0.58	0.07	1.48	1.55	0.28	2.41	0.005	0.05	2.48
G Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
G	9	4	0.10	0.03	36	0.96	0.94	0.03	0.03	0.06	0.02	1.02	0.005	0.05	7.93
F (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A Overland (dry)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0
A	11	4	0.32	0.10	43	1.20	1.08	0.03	0.05	0.08	0.12	1.28	0.005	0.05	12.11

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	13	6	0.23	0.11	68	2.84	1.43	0.66	3.69	4.35	0.70	7.19	0.043	0.107	0.78
D	73	37	1.29	0.55	331	8.08	7.16	0.55	5.14	5.69	0.92	13.77	0.092	0.918	6.75
E	13	13	0.74	0.34	182	5.80	3.91	0.47	9.99	10.46	1.89	16.26	0.034	0.337	2.48
G Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
G Inflow	100	57	2.26	0.99	581	16.72	12.50	1.68	18.82	20.51	3.51	37.23	0.168	1.362	10.01
G	194	86	2.16	0.65	777	20.73	20.30	0.65	0.65	1.30	0.43	22.03	0.108	1.080	7.93
Pond Reduction	-95	-30	0.10	0.35	-196	-4.01	-7.79	1.04	18.17	19.21	3.08	15.20	0.060	0.282	2.08
(%)	-95	-53	5	35	-34	-24	-62	62	97	94	88	41	36	21	21
F	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Overland + Atmos.	0	0	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00
A Inflow	194	86	2.16	0.65	777	20.73	20.30	0.65	0.65	1.30	0.43	22.03	0.108	1.080	7.93
A	363	132	10.55	3.30	1417	39.56	35.60	0.99	1.65	2.64	3.96	42.19	0.165	1.648	12.11
Wetland Reduction	-168	-45	-8.39	-2.65	-640	-18.82	-15.30	-0.34	-1.00	-1.34	-3.52	-20.17	-0.057	-0.568	-4.18
(%)	-87	-53	-388	-409	-82	-91	-75	-53	-154	-104	-816	-92	-53	-53	-53
System Reduction	-263	-75	-8.29	-2.30	-836	-22.83	-23.10	0.70	17.17	17.87	-0.44	-4.97	0.003	-0.286	-2.10
(%)	-264	-133	-366	-231	-144	-137	-185	41	91	87	-13	-13	2	-21	-21

Note: samples collected 10/16/96; average baseflow values for C

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APPENDIX G.
1995 BIOLOGICAL SURVEY BY JACK MAURITZ

August 23, 1995

Report

1995 Biological Field Survey
McCarron's Lake Wetland Project

Submitted to: Mr. Gary Oberts,
Metropolitan Council of the Twin Cities
Mears Park Centre
230 E. Fifth Street
St. Paul MN 55101

Submitted by: John Godfrey (Jack) Mauritz
Consulting Naturalist and Recreation Planner
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Chanhassen, MN 55317
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Metropolitan Council Contract Number C - 95 - 68

mcclkcvr

08.23.95

This report describes plants (and animals) observed within Rose Villa Park, in Roseville, Ramsey County, Minnesota, during visits made in June, July and August of 1995. The survey's purpose was to prepare a revised vegetation list for the Wetland Project, which had last been surveyed in 1988. The report also contains macro vertebrate and invertebrate animal observations made incidental to the plant survey.

Field maps of the approximate boundaries of cattail-dominated (Typha spp.)stands are appended. The purpose is to establish a baseline for future studies of change in the boundaries of cattail-dominated and other vegetative communities.

The report is organized to coincide with the report from an October 5, 1988, field survey prepared by Mr. Paul Burke with the assistance of Mr. Steve Eggers. Site descriptions in the 1988 report will not be reiterated, supplementary comments have been added to some. Wetland unit names in the 1988 report were retained. Nomenclature used for plant species has been made consistent with that in Eggers and Reed, 1987, Wetland Plants of Wisconsin and Minnesota ... etc in all cases where the species is named in that publication.

Wetland Unit 5:

Palustrine- occurring in Aquatic Bed, (i.e. in open water)

Coontail	Ceratophylum demersum L.
Lesser Duckweed	Lemna minor L.
Pondweed (Narrow Leafed)	Potamageton sp.
Filamentous Green Algae	

Palustrine- occurring in the Riparian Border,

Depending upon water levels, some may be emergents in the border of the pond, most of the season these were found up-slope from waters edge to trailside. Area varies from frequently flooded to seasonally flooded to flooded only at highest water level. Soils may be permanently, to seasonally, to very briefly saturated.

Woody-stemmed Plants, (trees and shrubs), include:

Alder-leafed Buckthorn	Rhamnus alnifolia L'Her.
Common Buckthorn	Rhamnus cathartica L.
Silver Maple	Acer saccharinum L.
Box Elder	Acer negundo L.
Eastern Cottonwood	Populus deltoides Marsh.
Black Willow	Salix nigra Marsh.
Sandbar Willow	Salix exigua Nutt.
Red-osier Dogwood	Cornus stolonifera Michaux
Grey Dogwood	Cornus racemosa L.

Common Elderberry	Sambucus canadensis L.
Elm (presumed to be hybrid)	Ulmus sp. X

Broad-leafed Herbaceous Plants:

Stinging Nettle (Tall N.)	Urtica dioica ssp. gracilis (Ait.) Selander
Dock	Rumex sp. (cf. R. Mexicanus)
Giant Ragweed	Ambrosia trifida L.
Common Ragweed	Ambrosia artemisiifolia L.
Common Mint	Mentha arvensis L.
Bugleweed	Lycopus sp.
Jewelweed	Impatiens capensis Mierb.
European Nightshade	Solanum Dulcamara L.
Blue Vervain	Verbena hastata L.
Burdock	Arctium minus (Hill) Bernh.
Wild Cucumber	Echinocystis lobata (Michx.) T&G.
Canada Thistle	Cirsium arvense (L.) Scop.
Birds-foot Trefoil	Lotus corniculata L.
Aster	Aster spp.
Plantain	Plantago sp
Boneset	Eupatorium perfoliatum L.
Cinquefoil	Potentilla sp.
Daisy Fleabane	Erigeron sp.
Sorrel	Oxalis stricta L.
Mustard (Yellow Rocket)	Barbarea vulgaris R. Br.
Penny Cress	Thlaspi arvense L.
Mullein	Verbascum Thapsus L.
Sow Thistle	Sonchus arvensis L.
Marsh Skullcap	Scutellaria galericulata L.
Marsh Milkweed	Asclepias incarnata L.
Old Field Milkweed	Asclepias syriaca L.

Linear-leafed Herbaceous Plants; Grasses, Rushes and Sedges:

Canada Bluejoint	Calamagrostis canadensis Michaux Beauv.
Manna Grass	Glyceria sp.
Reed Canary Grass	Phalaris arundinacea L.
Bent Grass	Agrostis sp.
Foxtail Grass	Setaria sp.
Kentucky Bluegrass	Poa pratensis L.
Canada Bluegrass	Poa compressa L.
Green Bullrush	Scirpus atrovirens Willd.
Rush	Juncus spp.
Bottlebrush Sedge	Carex sp. (cf. comosa or hystericina) (in the Pseudo-Cyperae group)
Sedge (Clumped)	Carex sp. (cf. stipata) (in vulpinae group)
Hummock Sedge	Carex stricta Lam.

Observed Animal Life, includes observed signs such as prints, scat, etc.:

Mallard
Great Egret
Barn Swallow
Great Blue Heron
Grackle
Catbird
Cardinal
Redwinged Blackbird
Robin
Blue Jay
Common Crow
Raccoon (track & scat)
Green Frog
Leopard Frog
Tadpoles (immature frogs of more than one spp.)
Water Striders
Whirligig (Water) Beetle
Backswimmers
Dragonfly
Damselfly

Small fish, presumed to include:
- Topminnows
- Shiners
- Black Bullhead
(none of these captured for ID)

Wetland Unit 4

Palustrine- occuring in the inundated area of emergent plants, from Channel edge to base of slope of higher ground:

Blue-flag, Wild Iris	*Iris versicolor* L.
Broad-leaved Cattail (dominant spp.)	*Typha latifolia* L.
Narrow-leaved Cattail (sparse-sctd.)	*Typha angustifolia* L.
Purple Loosestrife	*Lythrum salicaria* L.
European Nightshade	
Jewelweed	
Giant Ragweed	
Duckweed	
Reed Canary Grass	

Palustrine- occuring in inlet Pond and channel, in flowing water & back-eddy:

Pondweed, (narrow leaf)	*Potamogeton* spp.
Duckweed	

Palustrine- occuring in the riparian west side including trail edge & slope to inundated (Cattail-dominated) edge:

Cottonwood	
Black Willow	
Box Elder	
Sandbar Willow	
Red-osier Dogwood	
Grey Dogwood	
Tatarian Honeysuckle	*Lonicera tatarica* L.
Reed Canary Grass	
Vetch	*Vicia americana* L.

See also, species listed for Riparian Border in Unit 5

Palustrine- occuring in the riparian east side from channel below inlet to trail and to tree edge:

Reed Canary Grass
Black Willow
Sandbar Willow
Red-osier Dogwood
Grey Dogwood
See also, spp. listed for Unit 5

Observed animals:

Green Heron
Cardinal
Rose-breasted Grosbeak
Dragonfly ("Tenspot")
Damselfly
Small fish: (presumed to be Shiner Minnows, no capture for identification)

Wetland Unit 3

Palustrine - occurring in the upper pond:

Floating in open water:

Pondweed (narrow-leaf) Potamogeton sp.

Emergent, in all quadrants of the pond:

Yellow Water Lily, (dominant emergent sp.) Nuphar variegata Durand
White Water Lily, Nymphaea odorata Aiton
Duckweed (floating in pond) L. minor

Palustrine- occurring in the lower pond:

In open water of pond:

emergent:

Broad-leaved Cattail (dominates E. qdrt.)
Green Bullrush (sparse, at E. edge) Scirpus atrovirens Willd.
Pondweed, (narrow leaf)
Yellow Water Lily, (scattered in S & W quadrants of pond)
White Water Lily, (few)
Arrowhead (sparse-scattered at edges) Sagittaria latifolia Willd.
Water Plantain Alisma Plantago-aquatica (Pursh.) Farw.

Palustrine- occurring in the riparian border of both upper and lower basins, on berm(s) and trail edge:

Sandbar Willow
Reed Canary Grass
See also Riparian Border spp. listed for Units 5 & 4.

Animals observed:

Wood Duck (broods in upper and lower basins)
Leopard Frog
Tadpoles, several spp.
American Toad

Wetland Unit 2

Palustrine- occurring in the pool and channel at upper end, below berm:

emergent:

Broad-leaved Cattail (very abund. & dominant)
Jewelweed

Palustrine- occurring in the lower end of basin:

emergent:

Broad-leaved Cattail
River Bullrush

Palustrine- occurring in the riparian border on the West side, 2nd & 3rd quarters from North to South, from channel to treeline:

Rice Grass?	
Bottlebrush Sedge (cespitose, sctd.)	Carex sp.
Sedge (sctd. clumps)	C. stipata
Water Plantain (wide sctd.)	Alisma Plantago-aquatica L.
River Bulrush	Scirpus fluviatilis (Torrey) Gray

Palustrine- occurring in the riparian border on the West side, in wooded area:

High-bush Cranberry	Viburnum trilobum
Alder-leaved Buckthorn	Rhamnus alnifolia
Gooseberry	Ribes sp.

Also see "Woody-stemmed" list from Unit 5:

Wetland Unit 1

Palustrine- occurring in the riparian border along the channel, on both sides and extending to treeline:

Reed Canary Grass, (abundant, in scattered clumps)
Cattail (scattered, at channel edges)
River Bulrush (one lg clump, several scattered small clumps)
Wild Grape (in Reed Canary Grass, below berm, E side)

Palustrine- occuring at the riparian border on both sides:

See also Woody Plants listed for Units 5, etc.

Outlet Pond

Palustrine- occurring in the entire pond and channels:

emergent:

Broad-leaved Cattail (estimate pond surface to be 85% Cattail dominated)
Reed Canary Grass (sctd. clumps, most along entry channels, just below berm)

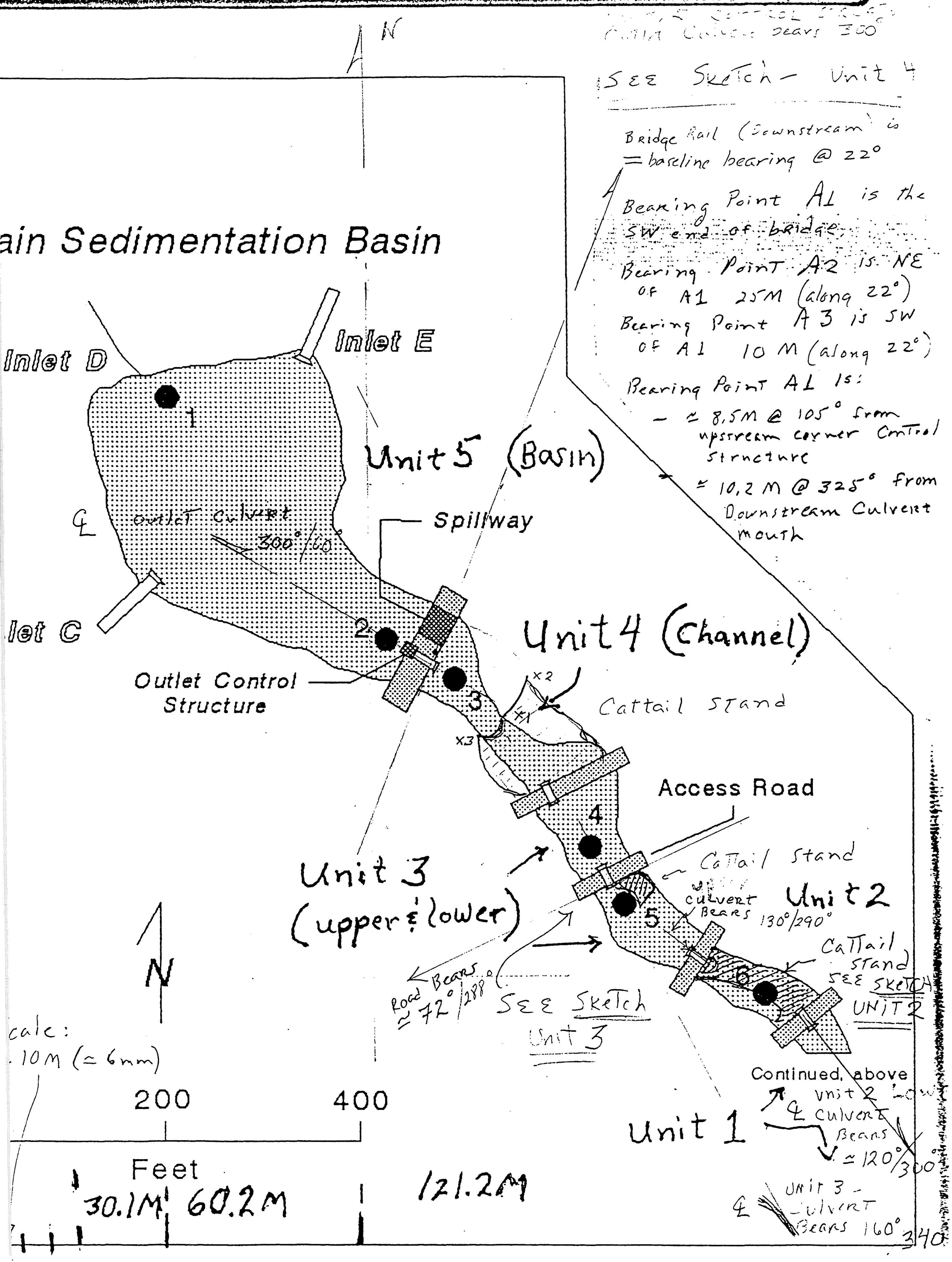
floating in the open water of channels and in the pool at outlet structure:

Pondweed (narrow-leaved)	Potamogeton sp.
Coontail	
Smartweed/Pinkweed	Polygonum sp.

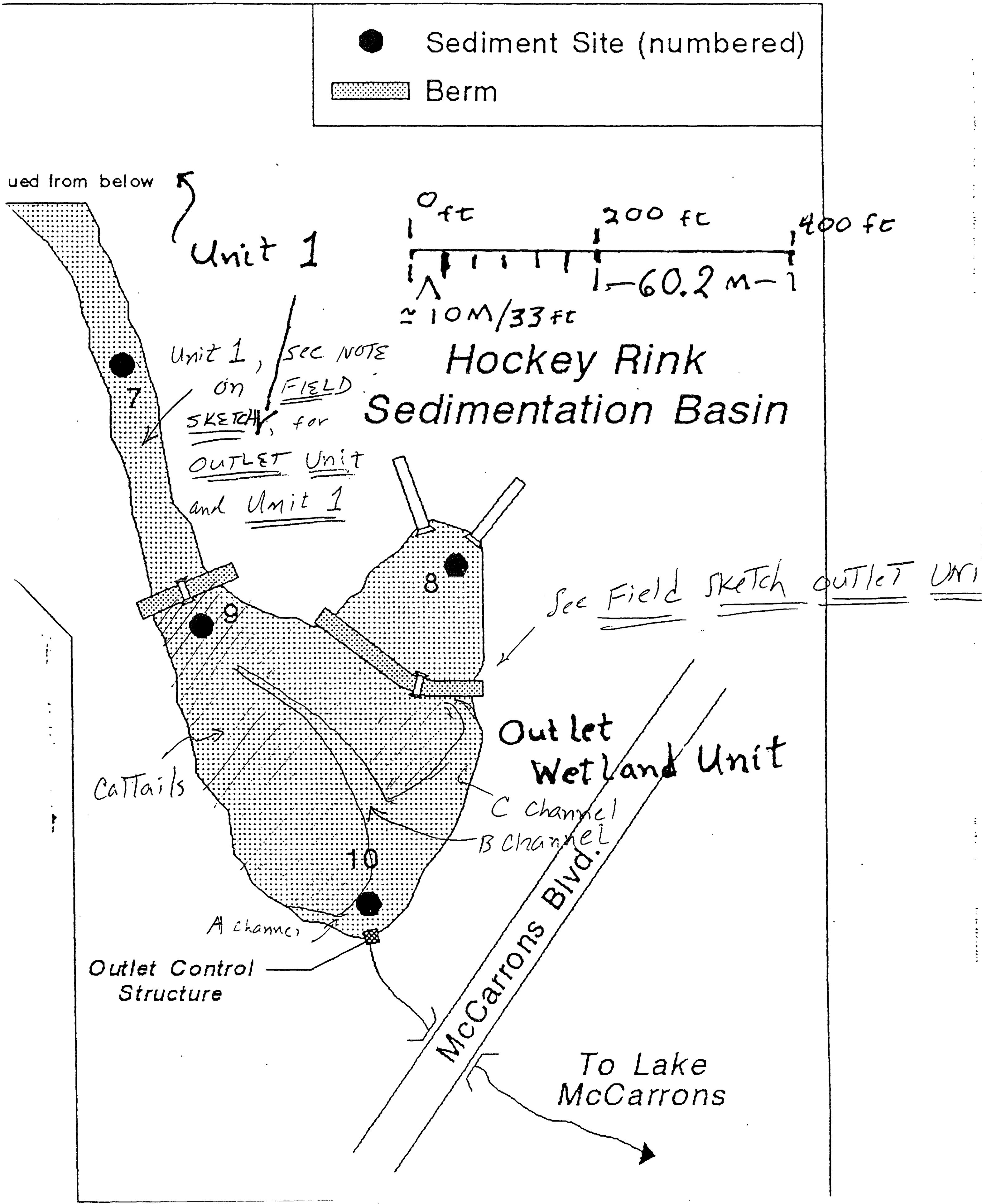
Observed animals:

Mallard (multiple broods)
Green Frog
Leopard Frog
Green Heron
Muskrat

end: mcclkrpt 08.23.94



Culvert bears 300°
SEE Sketch - Unit 4
Bridge Rail (Downstream) is = baseline bearing @ 22°
Bearing Point A1 is the SW end of bridge.
Bearing Point A2 is NE of A1 25M (along 22°)
Bearing Point A3 is SW of A1 10 M (along 22°)
Bearing Point A1 is:
- ≃ 8.5M @ 105° from upstream corner Control structure
- ≃ 10.2 M @ 325° from Downstream Culvert mouth
N
ain Sedimentation Basin
Inlet D
Inlet E
Inlet C
1
Unit 5 (Basin)
Outlet Culvert 300°/60°
Spillway
2
3
Outlet Control Structure
Unit 4 (Channel)
x2
x1
x3
Cattail Stand
Access Road
4
Unit 3 (upper & lower)
Cattail Stand
Culvert Bears 130°/290°
Unit 2
5
Cattail Stand
SEE SKETCH UNIT 2
6
Road Bears ≃ 72°/288°
SEE Sketch Unit 3
N
cale:
10M (≃ 6mm)
200
400
Feet
30.1M
60.2M
121.2M
Continued above
Unit 1
Unit 2 Lower Culvert Bears ≃ 120°/300°
Unit 3 - Culvert Bears 160°


Sediment Site (numbered)
Berm
ued from below
Unit 1
0 ft
200 ft
400 ft
60.2 M
≃ 10M/33 ft
Hockey Rink
Sedimentation Basin
Unit 1, see NOTE on FIELD SKETCH, for OUTLET Unit and Unit 1
7
8
9
10
See Field Sketch OUTLET UNI
Outlet Wetland Unit
Cattails
C channel
B channel
A channel
Outlet Control Structure
McCarrons Blvd.
To Lake McCarrons

FIELD SKETCH Unit 4

...earings taken by Brunton ...mpass ("Pocket Transit") ...justed by 2.5° E declination

Established Points show upstream Boundary of Cattail dominated Area in Unit 4

...oint A1 is SW end of bridge @ Downstream Railing

≈ 8.5 M @ 105° from upstream end of control structure

≈ 10.2 M @ 325° from Downstream mouth of Culvert from Control Structure

Point X3 is furthest NORT Cattails along TREELINE

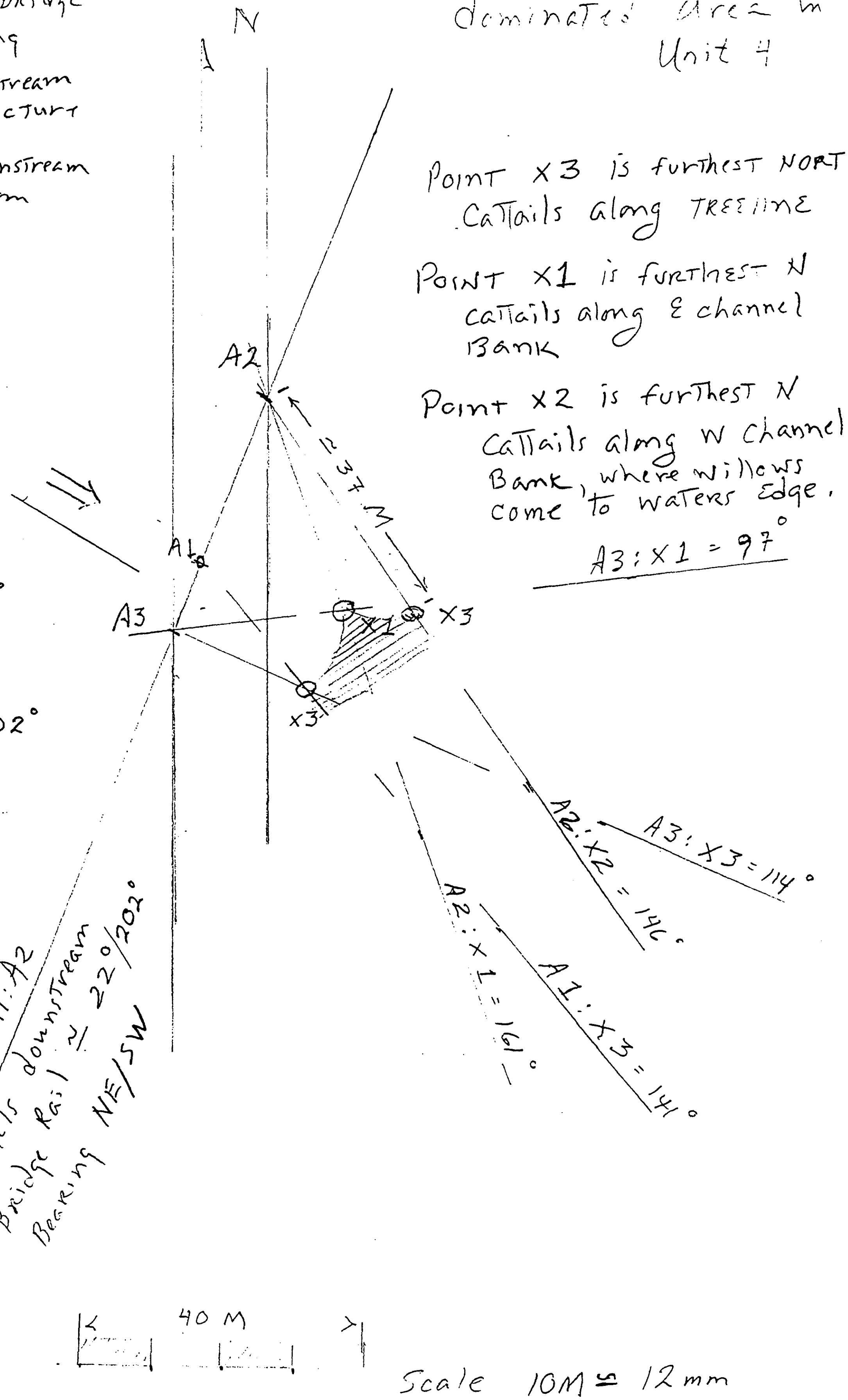
Point X1 is furthest N cattails along E channel Bank

Point X2 is furthest N Cattails along W Channel Bank, where willows come to waters Edge.

...tlet Culvert Bearing @ ≈ 300°

Point A2 is 25M ...E of A1, Bearing 22°/202°

Point A3 is 10M SW of A1, Bearing 22°/202°



Scale 10M ≈ 12mm

FIELD SKETCH UNIT

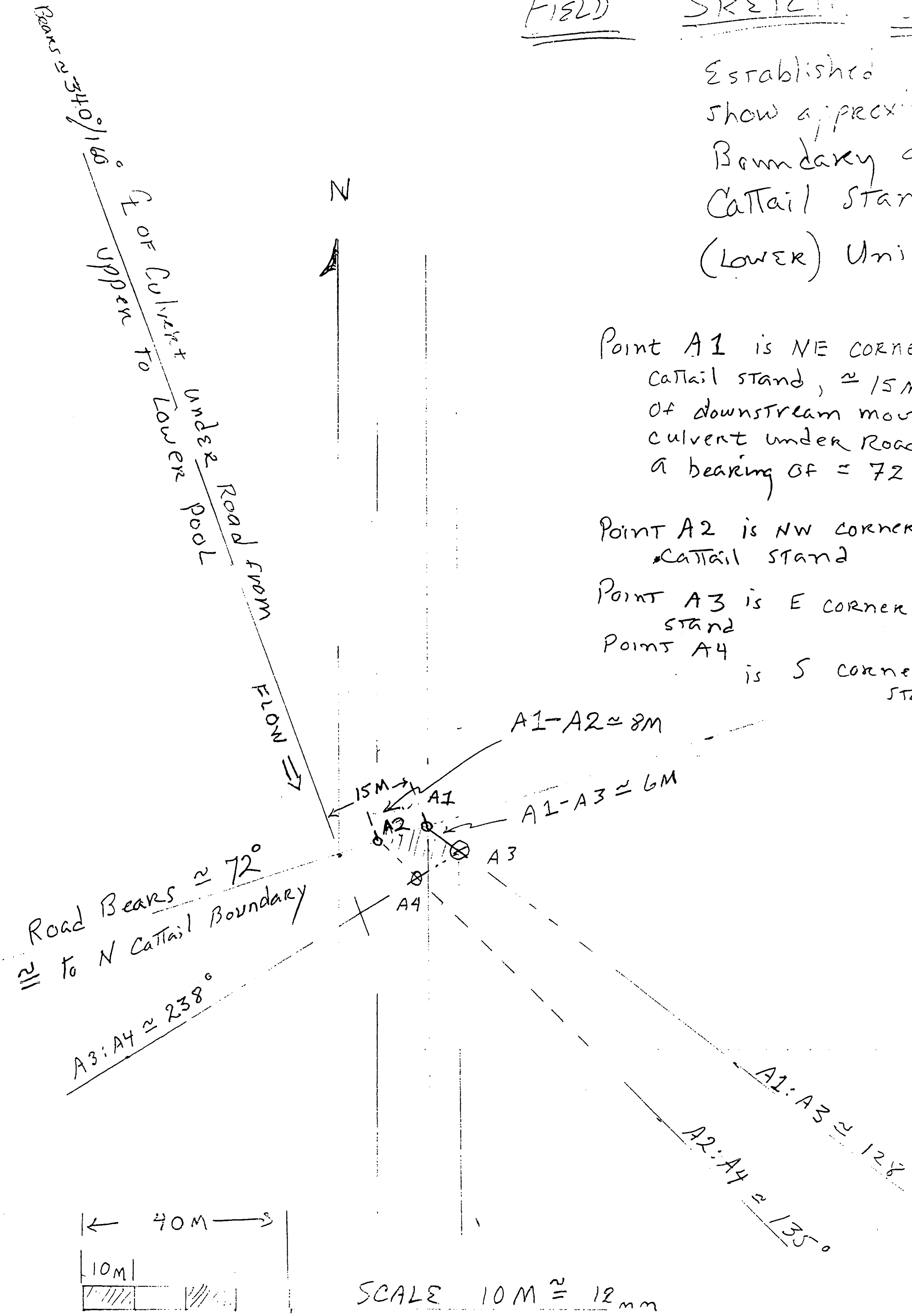
Established Points show approximate Boundary of Cattail Stand in (LOWER) Unit 3

Point A1 is NE CORNER of Cattail stand, ≃ 15M NE of downstream mouth of culvert under Road, on a bearing of ≃ 72°

Point A2 is NW CORNER of Cattail stand

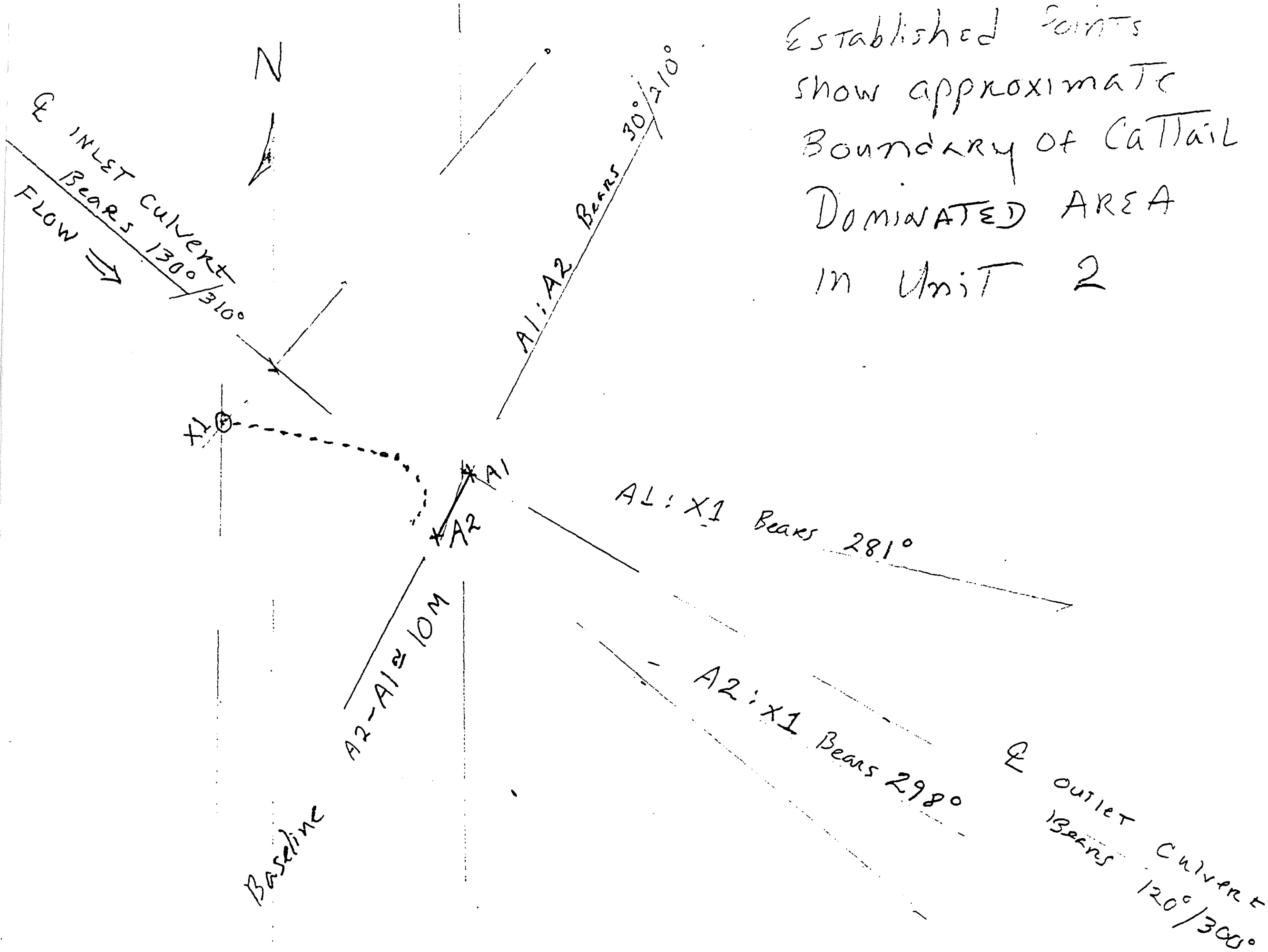
Point A3 is E CORNER of stand

Point A4 is S CORNER of stand



FIELD SKETCH UNIT 2

Established Points show approximate Boundary of Cattail Dominated Area in Unit 2



In this Basin:

- SEDGE MEADOW EXTENDS FROM Pt X1 down stream to approximately 5M above point A2, which is on BERM, Bounded on SW by TREELINE, Roughly Line A2:X1
- Cattail Boundary is Line A1:X1, plus the Recurving Line sketched upstream from about 10M above A1 to 5M above A2. It is approximately equal to dotted Line in This sketch. All of the basin N & E of this Line is cattail community except the small pool just below inlet.

Notes Accompanying Field Sketches for Unit 1 and Outlet Unit:

Re: Unit 1 - Most of the unit is covered in a mixture of sedge meadow, cattail and reed canary grass clumps, none of which cover an area greater than ~$10m^2$. In other words, no single species has achieved dominance in a "stand" within the basin; rather, small clumps of the above plant groups have established where conditions favor. These appear to be based on elevation/duration of soil saturation, thus deepest small "pockets" contain clumps of cattail, others may be patches of rushes/sedges. The highest elevations are grassy.

Re: Outlet Unit - This basin is filled with cattail, with the exception of three open channels, located as follows:

"A channel" - extends west along wooded edge for approximately 25m, bearing ~285° from outlet control

"B channel" - extends toward the inlet from Unit 1 with the channel <5m width curving to the west of a bearing 335° - 340° from outlet

"C channel" - extends in an arc north and east toward the hockey rink pond; the mouth of the channel bears between 40° - 50° from the outlet structure

The maximum width of open water, at the juncture of B & C channels, is (estimated) 30m from the shoreline.

the wetland.

Samples of groundwater were not analyzed for quality because the baseflow samples were thought to represent groundwater adequately. The reason for this is that the baseflow at the tributary sites (D, E, and C when flowing) was visibly fed by groundwater seeping from storm sewer joints or from springs in the sides of the channel. Baseflow concentrations are found in Table 5 of the text.

APPENDIX H.
MONITORED EVENT LOADING TABLES

McCarrons 1995 Load Totals

Event: Summary - Snowmelt 3/11-16/95

Load in Pounds - three part melt

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	535	230	11.32	8.88	1205	45.97	22.80	1.00	12.66	13.66	23.16	59.63	0.234	0.328	8.32
D	1030	384	12.82	9.35	1612	54.34	34.12	1.00	10.43	11.43	20.22	65.77	0.329	1.045	5.90
E	840	266	18.08	15.17	1747	75.97	45.14	1.64	16.22	17.86	30.81	93.83	0.319	0.519	8.83
G Overland	125	45	1.79	1.31	206	7.60	4.65	0.14	1.77	1.91	2.95	9.51	0.040	0.111	0.91
G Inflow	2530	925	44.01	34.71	4770	183.88	106.71	3.78	41.08	44.86	77.14	228.74	0.922	2.003	23.96
G	1452	741	38.59	29.45	3982	183.04	101.54	2.90	36.21	39.11	81.50	222.15	0.945	1.821	23.98
Pond Reduction	1078	184	5.42	5.26	788	0.84	5.17	0.88	4.87	5.75	-4.36	6.59	-0.023	0.182	-0.02
(%)	43	20	12	15	17	0	5	23	12	13	-6	3	-2	9	0
F	338	100	3.86	3.51	436	14.74	8.48	0.31	4.44	4.75	7.27	19.49	0.066	0.152	2.04
A Overland	233	75	2.71	2.10	323	10.81	5.92	0.24	2.34	2.58	4.90	13.39	0.055	0.136	1.55
A Inflow	2023	916	45.16	35.06	4741	208.59	115.94	3.45	42.99	46.44	93.67	255.03	1.066	2.109	27.57
A	1667	712	40.07	28.75	4373	219.00	136.54	3.39	45.85	49.24	82.43	268.24	0.723	0.971	26.54
Wetland Reduction	356	204	5.09	6.31	368	-10.41	-20.60	0.06	-2.86	-2.80	11.24	-13.21	0.343	1.138	1.03
(%)	18	22	11	18	8	-5	-18	2	-7	-6	12	-5	32	54	4
System Reduction	1434	388	10.51	11.57	1156	-9.57	-15.43	0.94	2.01	2.95	6.88	-6.62	0.320	1.320	1.01
(%)	46	35	21	29	21	-5	-13	22	4	6	8	-3	31	58	4

McCarrons 1995 Load Totals

Event: Snow Melt 3/11/95

First part of 3/11 - 3/16/95 snowmelt

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	150	44	0.66	0.19	151	3.30	2.50	0.13	1.38	1.51	0.80	4.81	0.03	0.130	0.13
D	113	39	0.68	0.33	162	4.60	2.70	0.13	1.31	1.44	1.90	6.04	0.04	0.140	1.09
E	25	11	0.61	0.47	110	4.40	2.70	0.10	1.30	1.40	1.70	5.80	0.03	0.080	1.45
G Overland [Avg of C+D+E]	96	31	0.65	0.33	141	4.10	2.63	0.12	1.33	1.45	1.47	5.55	0.03	0.117	0.16
G	20	10	0.33	0.12	60	2.40	0.80	0.04	0.35	0.39	1.60	2.79	0.01	0.020	2.83
F	166	38	0.48	0.32	120	2.70	1.70	0.10	1.40	1.50	1.00	4.20	0.02	0.060	0.38
A Overland [Avg of G+F]	158	41	0.57	0.26	136	3.00	2.10	0.12	1.39	1.51	0.90	4.51	0.03	0.095	0.29
A	59	17	0.21	0.04	90	3.10	1.60	0.06	0.70	0.76	1.50	3.86	0.01	0.020	0.90

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	53	16	0.23	0.07	53	1.17	0.88	0.05	0.49	0.53	0.28	1.70	0.011	0.046	0.13
D	335	116	2.02	0.98	481	13.65	8.01	0.39	3.89	4.27	5.64	17.92	0.119	0.415	1.09
E	99	43	2.41	1.86	434	17.37	10.66	0.39	5.13	5.53	6.71	22.89	0.118	0.316	1.45
G Overland + Atmos.	42	14	0.28	0.14	61	1.78	1.15	0.05	0.58	0.63	0.64	2.42	0.015	0.051	0.16
G Inflow	529	188	4.94	3.05	1030	33.97	20.70	0.88	10.09	10.96	13.27	44.93	0.262	0.828	2.83
G	154	77	2.54	0.92	462	18.49	6.16	0.31	2.70	3.00	12.33	21.49	0.077	0.154	2.83
Pond Reduction	375	111	2.40	2.12	568	15.48	14.54	0.57	7.39	7.96	0.94	23.44	0.185	0.674	0.00
(%)	71	59	49	70	55	46	70	65	73	73	7	52	71	81	0
F	172	39	0.50	0.33	124	2.79	1.76	0.10	1.45	1.55	1.03	4.34	0.021	0.062	0.38
A Overland + Atmos.	125	32	0.45	0.20	107	2.37	1.66	0.09	1.10	1.19	0.71	3.55	0.020	0.075	0.29
A Inflow	451	149	3.49	1.46	693	23.65	9.58	0.50	5.24	5.74	14.07	29.39	0.117	0.291	3.50
A	145	42	0.51	0.10	221	7.60	3.92	0.15	1.72	1.86	3.68	9.46	0.025	0.049	0.90
Wetland Reduction	306	107	2.97	1.36	473	16.05	5.66	0.36	3.53	3.88	10.40	19.94	0.093	0.242	2.60
(%)	68	72	85	93	68	68	59	71	67	68	74	68	79	83	74
System Reduction	681	218	5.37	3.48	1040	31.53	20.20	0.93	10.92	11.84	11.34	43.37	0.278	0.916	2.60
(%)	82	84	91	97	83	81	84	86	86	86	76	82	92	95	74

Precip. = Snowmelt (Part 1)

* The following data in this table were modeled:

- A overland & G overland flow
- F flow

McCarrons 1995 Load Totals

Event: Snow Melt 3/12/95

Second part of 3/11 - 3/16/95 snowmelt

Concentrations in mg/l (underlined values indicate "less than")

Site		TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C		32	14	0.66	0.41	62	2.60	1.50	0.05	0.76	0.81	1.10	3.41	0.01	0.020	2.14
D		70	26	0.90	0.69	95	3.70	2.50	0.05	0.57	0.62	1.20	4.32	0.02	0.060	2.91
E		39	12	0.81	0.69	69	3.40	2.20	0.05	0.64	0.69	1.20	4.09	0.01	0.020	5.15
G Overland	[Avg of C+D+E]	47	17	0.79	0.60	75	3.23	2.07	0.05	0.66	0.71	1.17	3.94	0.01	0.033	0.53
G		26	13	0.70	0.53	70	3.40	2.10	0.05	0.74	0.79	1.30	4.19	0.02	0.050	10.73
F		37	14	0.68	0.68	69	2.80	1.30	0.05	0.77	0.82	1.50	3.62	0.01	0.020	1.01
A Overland	[Avg of G+F]	35	14	0.67	0.55	66	2.70	1.40	0.05	0.77	0.82	1.30	3.52	0.01	0.020	0.76
A		32	13	0.56	0.39	69	3.30	1.90	0.06	0.87	0.93	1.40	4.23	0.01	0.020	8.22

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	186	82	3.84	2.39	361	15.15	8.74	0.29	4.43	4.72	6.41	19.87	0.058	0.117	2.14
D	555	206	7.13	5.47	753	29.31	19.80	0.40	4.52	4.91	9.51	34.22	0.158	0.475	2.91
E	547	168	11.36	9.67	967	47.67	30.84	0.70	8.97	9.67	16.82	57.34	0.140	0.280	5.15
G Overland + Atmos.	68	25	1.14	0.86	109	4.66	2.98	0.07	0.95	1.02	1.68	5.68	0.019	0.048	0.53
G Inflow	1355	481	23.47	18.39	2190	96.78	62.37	1.46	18.86	20.32	34.42	117.11	0.376	0.920	10.73
G	759	380	20.45	15.48	2045	99.31	61.34	1.46	21.61	23.08	37.97	122.39	0.584	1.460	10.73
Pond Reduction	596	101	3.02	2.91	145	-2.53	1.03	0.00	-2.75	-2.75	-3.55	-5.28	-0.208	-0.540	0.00
(%)	44	21	13	16	7	-3	2	0	-15	-14	-10	-5	-55	-59	0
F	102	38	1.87	1.87	190	7.70	3.57	0.14	2.12	2.25	4.12	9.95	0.027	0.055	1.01
A Overland + Atmos.	71	29	1.39	1.13	136	5.58	2.90	0.10	1.58	1.68	2.69	7.27	0.021	0.041	0.76
A Inflow	933	447	23.70	18.48	2370	112.59	67.81	1.70	25.31	27.01	44.79	139.61	0.632	1.557	12.50
A	716	291	12.53	8.73	1544	73.84	42.52	1.34	19.47	20.81	31.33	94.65	0.224	0.448	8.22
Wetland Reduction	216	156	11.17	9.75	826	38.75	25.29	0.36	5.85	6.20	13.46	44.95	0.409	1.109	4.28
(%)	23	35	47	53	35	34	37	21	23	23	30	32	65	71	34
System Reduction	813	257	14.19	12.66	971	36.22	26.32	0.36	3.09	3.45	9.91	39.67	0.201	0.569	4.28
(%)	53	47	53	59	39	33	38	21	14	14	24	30	47	56	34

Precip. = Snowmelt (Part 2)

* The following data in this table were modeled:
- A overland & G overland flow
- F flow

McCarrons 1995 Load Totals

Event: Snow Melt 3/14/95

Third part of 3/11 - 3/16/95 snowmelt

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	18	8	0.44	0.39	48	1.80	0.80	0.04	0.47	0.51	1.00	2.31	0.01	0.010	6.05
D	27	12	0.71	0.56	73	2.20	1.22	0.04	0.39	0.43	0.98	2.63	0.01	0.030	1.90
E	32	9	0.71	0.60	57	1.80	0.60	0.04	0.35	0.39	1.20	2.19	0.01	0.020	2.23
G Overland [Avg of C+D+E]	26	10	0.62	0.52	59	1.93	0.87	0.04	0.40	0.44	1.06	2.38	0.01	0.020	0.22
G	19	10	0.55	0.46	52	2.30	1.20	0.04	0.49	0.53	1.10	2.83	0.01	0.010	10.42
F	36	13	0.84	0.74	69	2.40	1.20	0.04	0.49	0.53	1.20	2.93	0.01	0.020	0.65
A Overland [Avg of C+F]	27	11	0.64	0.57	59	2.10	1.00	0.04	0.48	0.52	1.10	2.62	0.01	0.015	0.50
A	17	8	0.57	0.42	55	2.90	1.90	0.04	0.52	0.56	1.00	3.46	0.01	0.010	17.42

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	296	132	7.25	6.42	791	29.65	13.18	0.66	7.74	8.40	16.47	38.04	0.165	0.165	6.05
D	140	62	3.67	2.90	378	11.38	6.31	0.21	2.02	2.22	5.07	13.60	0.052	0.155	1.90
E	194	55	4.31	3.64	346	10.93	3.64	0.24	2.12	2.37	7.28	13.29	0.061	0.121	2.23
G Overland + Atmos.	15	6	0.37	0.31	36	1.16	0.52	0.02	0.24	0.27	0.63	1.42	0.006	0.012	0.22
G Inflow	646	254	15.60	13.27	1550	53.11	23.65	1.13	12.12	13.26	29.46	66.36	0.283	0.453	10.40
G	539	284	15.60	13.05	1475	65.24	34.04	1.13	13.90	15.03	31.20	80.27	0.284	0.284	10.42
Pond Reduction	107	-29	0.00	0.22	75	-12.13	-10.39	0.00	-1.78	-1.78	-1.74	-13.91	-0.001	0.170	-0.02
(%)	17	-12	0	2	5	-23	-44	0	-15	-13	-6	-21	0	37	0
F	64	23	1.49	1.31	122	4.25	2.12	0.07	0.87	0.94	2.12	5.18	0.018	0.035	0.65
A Overland + Atmos.	37	14	0.87	0.77	80	2.86	1.36	0.05	0.65	0.71	1.50	3.56	0.014	0.020	0.50
A Inflow	639	321	17.96	15.13	1677	72.34	37.52	1.26	15.42	16.68	34.82	89.02	0.315	0.339	11.57
A	806	379	27.03	19.92	2608	137.52	90.10	1.90	24.66	26.56	47.42	164.08	0.474	0.474	17.42
Wetland Reduction	-167	-58	-9.07	-4.79	-931	-65.18	-52.58	-0.64	-9.24	-9.88	-12.60	-75.05	-0.159	-0.135	-5.85
(%)	-26	-18	-51	-32	-56	-90	-140	-51	-60	-59	-36	-84	-51	-40	-51
System Reduction	-60	-88	-9.07	-4.57	-857	-77.31	-62.96	-0.64	-11.02	-11.65	-14.34	-88.97	-0.160	0.035	-5.87
(%)	-8	-30	-51	-30	-49	-128	-232	-51	-81	-78	-43	-118	-51	7	-51

Precip. = Snowmelt
(Part 3)

* The following data in this table were modeled:
- A overland & G overland flow
- F flow

McCarrons 1995 Load Totals

Event: 3/19-20/95

Precipitation Inches: 0.30

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	43	17	0.32	0.11	48	1.70	0.98	0.02	0.35	0.37	0.72	2.07	0.01	0.020	0.50
D	36	14	0.17	0.04	57	1.40	0.55	0.07	1.24	1.31	0.85	2.71	0.02	0.060	0.40
E	66	14	0.17	0.06	52	1.10	0.31	0.04	1.02	1.06	0.79	2.16	0.01	0.040	1.50
G Overland [Avg of C+D+E]	48	15	0.22	0.07	52	1.40	0.61	0.04	0.87	0.91	0.79	2.31	0.01	0.040	0.05
G	21	7	0.17	0.04	34	1.00	0.51	0.04	0.59	0.63	0.49	1.63	0.01	0.005	2.40
F	282	77	0.38	0.11	110	1.80	1.00	0.06	1.05	1.11	0.80	2.91	0.02	0.040	0.19
A Overland [Avg of G+F]	163	47	0.35	0.11	79	1.75	0.99	0.04	0.70	0.74	0.76	2.49	0.02	0.030	0.27
A	18	6	0.12	0.05	25	1.10	0.24	0.04	0.50	0.54	0.86	1.64	0.01	0.005	2.55

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	59	23	0.44	0.15	65	2.31	1.33	0.03	0.48	0.50	0.98	2.82	0.014	0.027	0.50
D	39	15	0.19	0.04	62	1.52	0.60	0.08	1.35	1.43	0.93	2.95	0.022	0.065	0.40
E	270	57	0.69	0.25	212	4.49	1.27	0.16	4.17	4.33	3.23	8.82	0.041	0.163	1.50
G Overland + Atmos.	7	2	0.04	0.01	7	0.29	0.08	0.01	0.18	0.18	0.11	0.40	0.002	0.005	0.11
G Inflow	374	98	1.35	0.45	347	8.62	3.28	0.27	6.17	6.44	5.24	14.99	0.078	0.261	2.51
G	137	46	1.11	0.26	222	6.53	3.33	0.26	3.85	4.12	3.20	10.65	0.065	0.033	2.40
Pond Reduction	237	52	0.24	0.19	125	2.09	-0.05	0.01	2.31	2.33	2.04	4.34	0.013	0.229	0.11
(%)	63	53	18	42	36	24	-2	5	38	36	39	29	16	88	4
F	146	40	0.20	0.06	57	0.93	0.52	0.03	0.54	0.57	0.41	1.51	0.010	0.021	0.19
A Overland + Atmos.	119	35	0.27	0.10	58	1.56	0.73	0.03	0.67	0.70	0.56	2.12	0.011	0.022	0.43
A Inflow	402	120	1.58	0.41	337	9.03	4.58	0.33	5.07	5.39	4.17	14.28	0.087	0.075	3.02
A	125	42	0.83	0.35	174	7.64	1.67	0.28	3.47	3.75	5.97	11.38	0.069	0.035	2.55
Wetland Reduction	278	78	0.75	0.07	164	1.39	2.91	0.05	1.60	1.65	-1.80	2.89	0.017	0.041	0.47
(%)	69	65	47	16	49	15	64	15	32	31	-43	20	20	54	15
System Reduction	514	130	0.99	0.26	288	3.48	2.86	0.06	3.91	3.97	0.24	7.23	0.030	0.269	0.57
(%)	80	76	54	43	62	31	63	18	53	51	4	39	30	89	18

Precip. = 0.30 "
Duration = 17 hrs.
Intensity = 0.018 in./hr.
Last Precip. = 32 hrs.

Pond inflow (A'/hr.) = 0.15
Hydr. Resid. (hr.) = 68.47

* The following data in this table were modeled:
- All flow levels

McCarrons 1995 Load Totals

Event: Rain 3/25-26/95

Precipitation Inches: 0.76

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	57	28	0.37	0.11	66	1.60	1.39	0.02	0.32	0.34	0.21	1.94	0.01	0.040	1.26
D	79	24	0.25	0.05	89	1.27	0.87	0.06	0.60	0.66	0.40	1.93	<u>0.01</u>	0.054	0.90
E	41	10	0.20	0.11	62	2.70	2.26	0.04	0.47	0.51	0.44	3.21	<u>0.01</u>	0.029	1.05
G Overland [Avg of C+D+E]	59	21	0.27	0.09	72	1.86	1.51	0.04	0.46	0.50	0.35	2.36	0.01	0.041	0.16
G	25	10	0.20	0.02	51	1.30	1.00	0.03	0.46	0.49	0.30	1.79	<u>0.01</u>	0.040	3.37
F	96	25	0.67	0.33	78	1.87	1.47	0.05	0.45	0.50	0.40	2.37	0.02	0.027	0.50
A Overland [Avg of C+F]	77	27	0.52	0.22	72	1.74	1.43	0.04	0.39	0.42	0.31	2.16	0.02	0.034	0.94
A	18	6	0.15	0.06	57	1.20	0.76	0.04	0.46	0.50	0.44	1.70	<u>0.01</u>	0.050	4.81

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	196	96	1.27	0.38	226	5.49	4.77	0.07	1.10	1.17	0.72	6.65	0.034	0.137	1.26
D	194	59	0.61	0.12	218	3.11	2.13	0.15	1.47	1.62	0.98	4.73	0.025	0.132	0.90
E	117	29	0.57	0.31	177	7.72	6.46	0.11	1.34	1.46	1.26	9.18	0.029	0.083	1.05
G Overland + Atmos.	26	9	0.13	0.05	32	1.07	0.66	0.02	0.35	0.37	0.15	1.44	0.004	0.018	0.31
G Inflow	532	192	2.59	0.87	653	17.39	14.02	0.35	4.26	4.61	3.11	22.00	0.092	0.370	3.52
G	229	92	1.83	0.18	468	11.93	9.17	0.28	4.22	4.50	2.75	16.42	0.092	0.367	3.37
Pond Reduction	303	101	0.75	0.68	185	5.46	4.84	0.08	0.04	0.12	0.36	5.58	0.000	0.003	0.15
(%)	57	52	29	79	28	31	35	22	1	3	12	25	0	1	4
F	131	34	0.91	0.45	106	2.55	2.00	0.07	0.61	0.68	0.54	3.23	0.027	0.037	0.50
A Overland + Atmos.	196	68	1.37	0.60	184	5.14	3.66	0.10	1.38	1.48	0.78	6.62	0.038	0.086	1.33
A Inflow	556	194	4.11	1.23	758	19.61	14.83	0.44	6.21	6.66	4.08	26.27	0.157	0.489	5.20
A	236	79	1.96	0.79	746	15.71	9.95	0.52	6.02	6.55	5.76	22.26	0.131	0.655	4.81
Wetland Reduction	320	115	2.15	0.45	12	3.90	4.88	-0.08	0.19	0.11	-1.68	4.01	0.026	-0.165	0.39
(%)	58	59	52	36	2	20	33	-18	3	2	-41	15	17	-34	8
System Reduction	623	216	2.90	1.13	197	9.36	9.72	0.00	0.23	0.22	-1.33	9.58	0.026	-0.162	0.54
(%)	73	73	60	59	21	37	49	-1	4	3	-30	30	17	-33	10

Precip. = 0.76 "
Duration = 22.5 hrs.
Intensity = 0.03 inch/hr.
Last Precip. = 117 hrs.

Pond inflow (A'/hr.) = 0.16
Hydr. Resid. (hr.) = 64.64

* The following data in this table were modeled:
A, G -flow (balance)
C,D, E, F -flow (P-8)
D, E, F - water quality
A & G overland flow.

McCarrons 1995 Load Totals

Event: Rain 4/18/95

Precipitation Inches: 0.89

Concentrations in mg/l (underlined values indicate "less than")

Site		TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C		101	27	0.22	0.01	71	0.97	0.77	0.01	0.13	0.14	0.20	1.11	0.02	0.040	2.27
D		156	50	0.32	0.04	105	1.10	0.78	0.01	0.43	0.44	0.32	1.54	0.02	0.100	2.66
E		210	42	0.26	0.05	81	0.82	0.50	0.01	0.26	0.27	0.32	1.09	0.02	0.070	3.30
G Overland	[Avg of C+D+E]	156	40	0.27	0.03	86	0.96	0.68	0.01	0.27	0.28	0.28	1.25	0.02	0.070	0.13
G		25	8	0.12	0.01	35	0.58	0.43	0.01	0.18	0.19	0.15	0.77	0.02	0.020	7.22
F		325	53	0.41	0.08	88	0.95	0.58	0.02	0.31	0.33	0.37	1.28	0.02	0.070	0.43
A Overland	[Avg of G+F]	213	40	0.32	0.05	80	0.96	0.68	0.02	0.22	0.24	0.29	1.20	0.02	0.055	0.70
A		70	17	0.21	0.04	42	0.89	0.74	0.02	0.25	0.27	0.15	1.16	0.01	0.030	8.66

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	624	167	1.36	0.06	439	5.99	4.76	0.06	0.80	0.87	1.24	6.86	0.124	0.247	2.27
D	1130	362	2.32	0.29	760	7.97	5.65	0.07	3.11	3.19	2.32	11.15	0.145	0.724	2.66
E	1887	377	2.34	0.45	728	7.37	4.49	0.09	2.34	2.43	2.87	9.79	0.180	0.629	3.30
G Overland + Atmos.	55	14	0.11	0.03	30	0.65	0.24	0.01	0.27	0.28	0.10	0.92	0.007	0.025	0.30
G Inflow	3695	920	6.12	0.83	1957	21.97	15.14	0.23	6.52	6.75	6.53	28.73	0.455	1.625	8.53
G	491	157	2.36	0.20	688	11.40	8.45	0.20	3.54	3.73	2.95	15.13	0.393	0.393	7.22
Pond Reduction	3204	763	3.76	0.63	1269	10.57	6.69	0.04	2.98	3.02	3.58	13.59	0.062	1.232	1.31
(%)	87	83	61	76	65	48	44	15	46	45	55	47	14	76	15
F	380	62	0.48	0.09	103	1.11	0.68	0.02	0.36	0.39	0.43	1.50	0.023	0.082	0.43
A Overland + Atmos.	406	76	0.64	0.13	151	2.65	1.29	0.04	0.88	0.92	0.54	3.58	0.038	0.105	1.16
A Inflow	1278	295	3.48	0.42	942	15.16	10.42	0.26	4.78	5.04	3.92	20.21	0.455	0.580	8.81
A	1650	401	4.95	0.94	990	20.98	17.45	0.47	5.89	6.37	3.54	27.35	0.236	0.707	8.66
Wetland Reduction	-373	-105	-1.47	-0.52	-48	-5.82	-7.03	-0.21	-1.11	-1.32	0.39	-7.14	0.219	-0.127	0.15
(%)	-29	-36	-42	-125	-5	-38	-67	-81	-23	-26	10	-35	48	-22	2
System Reduction	2831	658	2.30	0.11	1221	4.76	-0.34	-0.17	1.87	1.70	3.97	6.45	0.281	1.104	1.46
(%)	63	62	32	10	55	18	-2	-59	24	21	53	19	54	61	14

Precip. = 0.89 "
Duration = 12 hrs.
Intensity = 0.07 in/hr.
Last Precip. = 62 hrs.

Pond inflow (A'/hr.) = 0.71
Hydr. Resid. (hr.) = 14.21

* The following data in this table were modeled:
- A -flow (balance)
- A & G overland flow.
- F flow

McCarrons 1995 Load Totals

Event: Rain 5/13/95

Precipitation Inches: 0.64

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	155	68	1.31	0.07	140	7.60	7.26	0.01	0.15	0.16	0.34	7.76	0.02	0.100	0.92
D	70	22	0.28	0.07	52	0.48	0.04	0.02	0.31	0.33	0.44	0.81	0.02	0.060	1.61
E	71	17	0.19	0.06	39	0.58	0.37	0.02	0.30	0.32	0.21	0.90	0.02	0.040	1.26
G Overland [Avg of C+D+E]	99	36	0.59	0.07	77	2.89	2.56	0.02	0.25	0.27	0.33	3.16	0.02	0.067	0.11
G	4	3	0.08	0.02	28	0.63	0.26	0.01	0.05	0.06	0.37	0.69	0.01	0.010	3.04
F	238	46	0.41	0.32	70	1.41	1.09	0.04	0.35	0.39	0.32	1.80	0.02	0.050	0.34
A Overland [Avg of C+F]	197	57	0.86	0.20	105	4.51	4.18	0.03	0.25	0.28	0.33	4.78	0.02	0.075	0.56
A	18	6	0.66	0.01	23	3.70	3.59	0.01	0.06	0.07	0.11	3.77	0.01	0.010	4.20

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	388	170	3.28	0.18	351	19.03	18.18	0.03	0.38	0.40	0.85	19.43	0.050	0.250	0.92
D	307	96	1.23	0.31	228	2.10	0.18	0.09	1.36	1.45	1.93	3.55	0.088	0.263	1.61
E	244	58	0.65	0.21	134	1.99	1.27	0.07	1.03	1.10	0.72	3.09	0.069	0.137	1.26
G Overland + Atmos.	30	11	0.19	0.03	23	1.08	0.77	0.01	0.20	0.21	0.10	1.29	0.006	0.020	0.23
G Inflow	968	336	5.35	0.72	735	24.21	20.39	0.19	2.96	3.15	3.60	27.36	0.212	0.671	4.02
G	33	25	0.66	0.17	232	5.21	2.15	0.08	0.41	0.50	3.06	5.71	0.083	0.083	3.04
Pond Reduction	935	311	4.69	0.55	504	19.00	18.24	0.11	2.55	2.66	0.54	21.65	0.130	0.588	0.98
(%)	97	93	88	77	68	78	89	56	86	84	15	79	61	88	24
F	220	43	0.38	0.30	65	1.31	1.01	0.04	0.32	0.36	0.30	1.67	0.019	0.046	0.34
A Overland + Atmos.	300	87	1.34	0.33	160	7.46	6.36	0.05	0.71	0.76	0.50	8.22	0.030	0.114	0.89
A Inflow	553	154	2.38	0.79	457	13.97	9.53	0.17	1.45	1.62	3.86	15.59	0.132	0.243	4.27
A	206	69	7.55	0.11	263	42.30	41.05	0.11	0.69	0.80	1.26	43.10	0.114	0.114	4.20
Wetland Reduction	347	86	-5.16	0.68	194	-28.33	-31.52	0.05	0.77	0.82	2.60	-27.51	0.017	0.129	0.07
(%)	63	56	-217	86	42	-203	-331	31	53	51	67	-176	13	53	2
System Reduction	1282	397	-0.48	1.23	697	-9.33	-13.28	0.16	3.31	3.47	3.14	-5.86	0.147	0.717	1.05
(%)	86	85	-7	91	73	-28	-48	58	83	81	71	-16	56	86	20

Precip. = 0.64 "
Duration = 12.25 hrs.
Intensity = 0.05 in/hr.
Last Precip. = 112 hrs.

Pond inflow (A'/hr.) = 0.33
Hydr. Resid. (hr.) = 30.76

* The following data in this table were modeled:
C, F - flow
A & G overland flow.

McCarrons 1995 Load Totals

Event: Summary - 2.03" Rainfall Event 5/27-29/95

Load in Pounds - two part rainfall event

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	767	306	9.14	1.76	793	119.70	116.11	0.24	4.87	5.11	3.56	124.81	0.185	0.685	6.81
D	673	249	4.76	0.62	621	15.20	12.31	0.21	6.44	6.65	2.92	21.85	0.176	0.643	6.45
E	323	100	2.61	0.87	406	10.18	7.70	0.19	3.61	3.80	2.48	13.98	0.150	0.423	5.48
G Overland	28	10	0.28	0.09	29	2.87	2.02	0.02	0.63	0.65	0.15	3.52	0.008	0.026	0.69
G Inflow	1791	665	16.79	3.34	1849	147.95	138.14	0.66	15.55	16.21	9.11	164.16	0.519	1.777	19.43
G	527	274	9.08	3.63	1127	175.50	171.60	0.46	5.30	5.76	3.91	181.26	0.460	0.920	16.91
Pond Reduction	1264	391	7.71	-0.29	722	-27.55	-33.46	0.20	10.25	10.45	5.20	-17.10	0.059	0.857	2.52
(%)	71	59	46	-9	39	-19	-24	30	66	64	57	-10	11	48	13
F	107	45	1.15	0.45	126	3.87	2.83	0.07	1.02	1.09	1.03	4.96	0.027	0.027	0.99
A Overland	178	74	2.09	0.67	196	18.72	15.60	0.11	2.46	2.57	1.25	21.29	0.044	0.102	2.66
A Inflow	812	393	12.32	4.75	1449	198.09	190.03	0.64	8.78	9.42	6.19	207.51	0.531	1.049	20.56
A	472	268	7.06	4.13	1255	39.77	23.37	0.45	4.53	4.98	16.40	44.75	0.590	0.910	16.70
Wetland Reduction	340	125	5.26	0.62	194	158.32	166.66	0.19	4.25	4.44	-10.21	162.76	-0.059	0.139	3.86
(%)	42	32	43	13	13	80	88	30	48	47	-165	78	-11	13	19
System Reduction	1604	516	12.97	0.33	916	130.77	133.20	0.39	14.50	14.89	-5.01	145.66	0.000	0.996	6.38
(%)	77	66	65	7	42	77	85	46	76	75	-44	76	0	52	28

McCarrons 1995 Load Totals

Event: Rain 5/27-28/95 (part 1 of 2 part event)

Precipitation Inches: 1.36

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	42	15	0.62	0.11	44	8.30	8.09	0.01	0.29	0.30	0.21	8.60	0.01	0.040	4.75
D	36	14	0.29	0.03	34	0.80	0.64	0.01	0.36	0.37	0.16	1.17	0.01	0.040	5.36
E	21	6	0.17	0.06	27	0.60	0.44	0.01	0.23	0.24	0.16	0.84	0.01	0.030	4.58
G Overland [Avg of C+D+E]	33	12	0.36	0.07	35	3.23	3.06	0.01	0.29	0.30	0.18	3.54	0.01	0.037	0.20
G	13	7	0.28	0.11	25	7.00	6.91	0.01	0.11	0.12	0.09	7.12	0.01	0.020	8.16
F	22	13	0.39	0.15	40	1.40	0.95	0.02	0.42	0.44	0.45	1.84	0.01	0.010	0.66
A Overland [Avg of C+F]	32	14	0.51	0.13	42	4.85	4.52	0.02	0.36	0.37	0.33	5.22	0.01	0.025	1.07
A	16	8	0.31	0.14	29	1.10	0.69	0.01	0.17	0.18	0.41	1.28	0.02	0.020	4.95

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	543	194	8.02	1.42	569	107.32	104.61	0.13	3.75	3.88	2.72	111.20	0.129	0.517	4.75
D	525	204	4.23	0.44	496	11.67	9.34	0.15	5.25	5.40	2.33	17.07	0.146	0.584	5.36
E	262	75	2.12	0.75	337	7.48	5.49	0.12	2.87	2.99	1.99	10.47	0.125	0.374	4.58
G Overland + Atmos.	18	6	0.22	0.06	19	2.23	1.66	0.01	0.42	0.43	0.10	2.66	0.005	0.020	0.46
G Inflow	1348	479	14.59	2.67	1421	128.70	121.10	0.41	12.29	12.70	7.14	141.41	0.405	1.495	15.15
G	289	155	6.22	2.44	555	155.49	153.49	0.22	2.44	2.67	2.00	158.16	0.222	0.444	8.16
Pond Reduction	1059	324	8.37	0.23	865	-26.79	-32.40	0.19	9.85	10.04	5.14	-16.75	0.183	1.051	6.99
(%)	79	68	57	8	61	-21	-27	46	80	79	72	-12	45	70	46
F	40	23	0.70	0.27	72	2.52	1.71	0.04	0.75	0.79	0.81	3.31	0.018	0.018	0.66
A Overland + Atmos.	93	41	1.54	0.45	122	15.38	13.17	0.06	1.74	1.80	0.96	17.18	0.029	0.073	1.77
A Inflow	422	220	8.46	3.16	750	173.39	168.37	0.32	4.94	5.26	3.77	178.64	0.269	0.535	10.59
A	216	108	4.18	1.89	391	14.82	9.30	0.13	2.29	2.43	5.52	17.25	0.270	0.270	4.95
Wetland Reduction	206	112	4.28	1.27	359	158.56	159.07	0.19	2.65	2.83	-1.76	161.40	0.000	0.266	5.64
(%)	49	51	51	40	48	91	94	58	54	54	-47	90	0	50	53
System Reduction	1265	436	12.65	1.50	1224	131.77	126.67	0.38	12.50	12.87	3.39	144.65	0.183	1.316	12.63
(%)	85	80	75	44	76	90	93	74	85	84	38	89	40	83	72

Precip. = 1.36 "
Duration = 19.5 hrs.
Intensity = 0.07 in/hr.
Last Precip. = 328 hrs.

Pond inflow (A'/hr.) = 0.78
Hydr. Resid. (hr.) = 13.00

* The following data in this table were modeled:
A & G overland flow.
D, F - flow

McCarrons 1995 Load Totals

Event: Rain 5/28-29/95 (part 2 of 2 part event)

Precipitation Inches: 0.67

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	40	20	0.20	0.06	40	2.20	2.05	0.02	0.20	0.22	0.15	2.42	0.01	0.030	2.06
D	50	15	0.18	0.06	42	1.20	1.00	0.02	0.40	0.42	0.20	1.62	0.01	0.020	1.09
E	25	10	0.20	0.05	28	1.10	0.90	0.03	0.30	0.33	0.20	1.43	0.01	0.020	0.90
G Overland [Avg of C+D+E]	38	15	0.19	0.06	37	1.50	1.32	0.02	0.30	0.32	0.18	1.82	0.01	0.023	0.10
G	10	5	0.12	0.05	24	0.84	0.76	0.01	0.12	0.13	0.08	0.97	0.01	0.020	8.75
F	75	25	0.50	0.20	60	1.50	1.25	0.03	0.30	0.33	0.25	1.83	0.01	0.010	0.33
A Overland [Avg of C+F]	58	23	0.35	0.13	50	1.85	1.65	0.03	0.25	0.28	0.20	2.13	0.01	0.020	0.54
A	8	5	0.09	0.07	27	0.78	0.44	0.01	0.07	0.08	0.34	0.86	0.01	0.020	11.75

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	224	112	1.12	0.34	224	12.34	11.50	0.11	1.12	1.23	0.84	13.57	0.056	0.168	2.06
D	148	45	0.53	0.18	125	3.56	2.97	0.06	1.19	1.25	0.59	4.81	0.030	0.059	1.09
E	61	25	0.49	0.12	69	2.70	2.21	0.07	0.74	0.81	0.49	3.50	0.025	0.049	0.90
G Overland + Atmos.	10	4	0.06	0.03	10	0.64	0.36	0.01	0.21	0.22	0.05	0.86	0.003	0.006	0.23
G Inflow	444	185	2.21	0.66	428	19.23	17.03	0.25	3.25	3.51	1.97	22.74	0.113	0.283	4.28
G	238	119	2.86	1.19	572	20.01	18.10	0.24	2.86	3.10	1.91	23.10	0.238	0.476	8.75
Pond Reduction	206	66	-0.65	-0.53	-144	-0.78	-1.08	0.02	0.40	0.41	0.07	-0.36	-0.125	-0.193	-4.47
(%)	46	36	-29	-79	-34	-4	-6	7	12	12	3	-2	-111	-68	-105
F	67	22	0.45	0.18	54	1.35	1.12	0.03	0.27	0.30	0.22	1.64	0.009	0.009	0.33
A Overland + Atmos.	85	33	0.55	0.22	74	3.34	2.43	0.05	0.72	0.76	0.29	4.10	0.015	0.029	0.89
A Inflow	390	175	3.85	1.59	699	24.69	21.65	0.31	3.84	4.15	2.42	28.85	0.262	0.515	9.97
A	256	160	2.88	2.24	864	24.95	14.07	0.32	2.24	2.56	10.88	27.51	0.320	0.640	11.75
Wetland Reduction	134	15	0.98	-0.64	-165	-0.25	7.58	-0.01	1.60	1.60	-8.45	1.34	-0.058	-0.125	-1.78
(%)	34	8	25	-40	-24	-1	35	-3	42	38	-349	5	-22	-24	-18
System Reduction	340	81	0.33	-1.17	-309	-1.03	6.50	0.01	2.00	2.01	-8.38	0.98	-0.183	-0.318	-6.26
(%)	57	34	10	-110	-56	-4	32	2	47	44	-336	3	-134	-99	-114

Precip. = 0.67 "
Duration = 27 hrs.
Intensity = 0.02 in/hr.
Last Precip. = 0.25 hrs.

Pond inflow (A'/hr.) = 0.16
Hydr. Resid. (hr.) = 63.74

* The following data in this table were modeled:
A & G overland flow.
F - flow
C, D, E, F - water quality

McCarrons 1995 Load Totals

Event: Rain 6/05-06/95

Precipitation Inches: 0.65

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	14	6	0.17	0.04	27	1.50	1.38	0.02	0.18	0.20	0.12	1.70	0.01	0.005	2.84
D	22	7	0.12	0.04	28	1.20	0.96	0.04	0.37	0.41	0.24	1.61	0.01	0.020	2.57
E	6	3	0.10	0.03	22	1.10	0.89	0.04	0.33	0.37	0.21	1.47	0.01	0.008	2.35
G Overland [Avg of C+D+E]	14	5	0.13	0.04	26	1.27	1.08	0.03	0.29	0.33	0.19	1.59	0.01	0.011	0.09
G	9	5	0.04	0.03	30	1.30	1.20	0.02	0.12	0.14	0.10	1.44	0.01	0.005	6.53
F	7	5	0.27	0.17	35	1.70	1.47	0.04	0.31	0.35	0.23	2.05	0.01	0.005	0.31
A Overland [Avg of C+F]	11	6	0.22	0.11	31	1.60	1.43	0.03	0.25	0.28	0.18	1.88	0.01	0.005	0.50
A	7	4	0.17	0.07	23	1.20	1.09	0.01	0.05	0.06	0.11	1.26	0.01	0.005	3.92

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	108	46	1.31	0.31	209	11.60	10.67	0.15	1.39	1.55	0.93	13.14	0.077	0.039	2.84
D	154	49	0.84	0.28	196	8.40	6.72	0.28	2.59	2.87	1.68	11.26	0.070	0.140	2.57
E	38	19	0.64	0.19	141	7.04	5.69	0.26	2.11	2.37	1.34	9.40	0.064	0.051	2.35
G Overland + Atmos.	3	1	0.04	0.02	6	0.53	0.26	0.01	0.20	0.21	0.05	0.58	0.002	0.003	0.21
G Inflow	304	116	2.84	0.80	552	27.56	23.34	0.70	6.29	6.99	4.00	34.39	0.214	0.232	7.97
G	160	89	0.71	0.53	533	23.11	21.33	0.36	2.13	2.49	1.78	25.60	0.178	0.089	6.53
Pond Reduction	144	27	2.13	0.27	18	4.45	2.01	0.35	4.16	4.50	2.22	8.79	0.036	0.144	1.44
(%)	47	23	75	33	3	16	9	49	66	64	56	26	17	62	18
F	6	4	0.23	0.14	30	1.43	1.24	0.03	0.26	0.30	0.19	1.73	0.008	0.004	0.31
A Overland + Atmos.	14	7	0.33	0.17	42	2.78	1.94	0.05	0.67	0.72	0.24	3.02	0.014	0.007	0.84
A Inflow	180	101	1.27	0.85	605	27.32	24.51	0.44	3.07	3.51	2.21	30.34	0.200	0.100	7.68
A	75	43	1.81	0.75	245	12.81	11.63	0.11	0.53	0.64	1.17	13.45	0.107	0.053	3.92
Wetland Reduction	105	58	-0.54	0.10	360	14.52	12.88	0.33	2.53	2.86	1.04	16.90	0.093	0.047	3.76
(%)	59	58	-43	12	59	53	53	76	83	82	47	56	47	47	49
System Reduction	249	85	1.58	0.37	378	18.97	14.89	0.68	6.69	7.37	3.26	25.69	0.129	0.190	5.20
(%)	77	67	47	33	61	60	56	86	93	92	73	66	55	78	57

NOTE: second event follows in 8 hours

Precip. = 0.65 "
Duration = 29 hrs.
Intensity = 0.02 in./hr.
Last Precip. = 136 hrs.

Pond inflow (A'/hr.) = 0.27
Hydr. Resid. (hr.) = 36.73

* The following data in this table were modeled:
A & G overland flow.
F - flow

McCarrons 1995 Load Totals

Event: Rain 6/26-27/95

Precipitation Inches: 0.84

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	NH3	N/N	TN	Copper	Zinc	Q Water, A'
C	64	36	0.16	0.05	134	1.60	1.46	0.03	0.28	0.14	0.31	1.91	0.01	0.005	2.20
D	93	37	0.14	0.04	33	0.67	0.45	0.06	0.40	0.22	0.46	1.13	0.01	0.005	1.97
E	28	18	0.08	0.03	24	0.79	0.41	0.03	0.41	0.38	0.44	1.23	0.01	0.005	2.76
G Overland [Avg of C+D+E]	62	30	0.13	0.04	64	1.02	0.77	0.04	0.36	0.25	0.40	1.42	0.01	0.005	0.13
G	8	8	0.09	0.09	33	0.86	0.71	0.04	0.22	0.15	0.26	1.12	0.01	0.005	7.18
F	12	8	0.19	0.15	29	0.80	0.58	0.05	0.37	0.22	0.42	1.22	0.01	0.005	0.40
A Overland [Avg of C+F]	38	22	0.18	0.10	82	1.20	1.02	0.04	0.33	0.18	0.37	1.57	0.01	0.005	0.66
A	11	10	0.19	0.07	51	0.92	0.77	0.04	0.11	0.15	0.15	1.07	0.01	0.005	8.66

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	NH3	N/N	TN	Copper	Zinc	Total Water, A'
C	383	216	0.96	0.30	803	9.58	8.74	0.18	1.68	0.84	1.86	11.44	0.060	0.030	2.20
D	499	198	0.75	0.21	177	3.59	2.41	0.32	2.15	1.18	2.47	6.06	0.054	0.027	1.97
E	210	135	0.60	0.23	180	5.94	3.08	0.23	3.08	2.86	3.31	9.24	0.075	0.038	2.76
G Overland + Atmos.	22	11	0.06	0.03	23	0.65	0.27	0.02	0.29	0.25	0.31	0.96	0.004	0.002	0.29
G Inflow	1114	560	2.37	0.77	1182	19.76	14.51	0.75	7.19	5.13	7.94	27.70	0.192	0.096	7.22
G	156	156	1.76	1.76	645	16.81	13.88	0.78	4.30	2.93	5.08	21.89	0.195	0.098	7.18
Pond Reduction	958	404	0.61	-0.99	537	2.95	0.63	-0.04	2.89	2.20	2.86	5.81	-0.003	-0.002	0.04
(%)	86	72	26	-129	45	15	4	-5	40	43	36	21	-2	-2	1
F	13	9	0.21	0.16	32	0.87	0.63	0.05	0.40	0.24	0.46	1.33	0.011	0.005	0.40
A Overland + Atmos.	68	40	0.36	0.22	146	2.93	1.83	0.08	1.02	0.77	1.10	4.04	0.018	0.009	1.09
A Inflow	238	205	2.32	2.14	823	20.61	16.34	0.92	5.72	3.94	6.64	27.26	0.224	0.112	8.67
A	259	236	4.48	1.65	1202	21.69	18.15	0.94	2.59	3.54	3.54	25.22	0.236	0.118	8.66
Wetland Reduction	-22	-31	-2.16	0.49	-379	-1.07	-1.81	-0.02	3.13	0.41	3.11	2.03	-0.011	-0.006	0.01
(%)	-9	-15	-93	23	-46	-5	-11	-3	55	10	47	7	-5	-5	0
System Reduction	936	372	-1.55	-0.50	158	1.88	-1.18	-0.06	6.02	2.60	5.96	7.84	-0.015	-0.007	0.05
(%)	78	61	-53	-43	12	8	-7	-7	70	42	63	24	-7	-7	1

Precip. = 0.84 "
Duration = 28.25 hrs.
Intensity = 0.03 in/hr.
Last Precip. = 9 hrs.

Pond inflow (A'/hr.) = 0.26
Hydr. Resid. (hr.) = 39.51

* The following data in this table were modeled:
C, F -flow
A & G overland flow.

McCarrons 1995 Load Totals

Event: Rain 6/06-07/95

Precipitation Inches: 0.84

Concentrations in mg/l (underlined values indicate "less than")

Site		TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C		110	50	0.49	0.09	85	2.20	1.95	0.05	0.60	0.65	0.25	2.85	0.01	0.035	4.87
D		70	25	0.25	0.07	70	1.20	0.88	0.05	0.50	0.55	0.32	1.75	0.01	0.039	3.84
E		60	15	0.21	0.08	50	1.10	0.78	0.04	0.45	0.49	0.32	1.59	0.01	0.022	3.91
G Overland	[Avg of C+D+E]	80	30	0.32	0.08	68	1.50	1.20	0.04	0.52	0.56	0.30	2.06	0.01	0.032	0.12
G		30	16	0.22	0.05	45	1.40	1.26	0.03	0.26	0.29	0.14	1.69	0.01	0.007	15.39
F		105	35	0.60	0.25	85	1.90	1.50	0.04	0.45	0.49	0.40	2.39	0.01	0.020	0.40
A Overland	[Avg of C+F]	108	43	0.55	0.17	85	2.05	1.73	0.05	0.53	0.57	0.33	2.62	0.01	0.028	0.63
A		7	4	0.17	0.07	23	1.20	1.09	0.01	0.05	0.06	0.11	1.26	0.01	0.005	15.06

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	1458	663	6.50	1.19	1127	29.17	25.85	0.66	7.95	8.62	3.31	37.78	0.133	0.464	4.87
D	732	261	2.61	0.73	732	12.54	9.20	0.47	5.23	5.70	3.35	18.24	0.105	0.408	3.84
E	639	160	2.24	0.85	532	11.71	8.30	0.40	4.79	5.19	3.41	16.90	0.106	0.234	3.91
G Overland + Atmos.	26	10	0.12	0.04	22	0.78	0.39	0.02	0.33	0.35	0.10	0.88	0.003	0.010	0.28
G Inflow	2855	1094	11.46	2.82	2413	54.20	43.75	1.56	18.30	19.86	10.16	73.80	0.347	1.116	12.90
G	1257	670	9.22	2.09	1885	58.65	52.79	1.26	10.89	12.15	5.87	70.80	0.419	0.293	15.39
Pond Reduction	1598	423	2.25	0.72	528	-4.46	-9.04	0.30	7.41	7.71	4.30	3.00	-0.072	0.823	-2.49
(%)	56	39	20	26	22	-8	-21	19	40	39	42	4	-21	74	-19
F	114	38	0.65	0.27	93	2.07	1.63	0.04	0.49	0.53	0.44	2.60	0.011	0.022	0.40
A Overland + Atmos.	184	73	0.98	0.33	146	4.29	2.96	0.09	1.34	1.43	0.56	4.85	0.017	0.047	1.06
A Inflow	1556	781	10.85	2.70	2124	65.01	57.38	1.39	12.72	14.11	6.86	78.25	0.447	0.362	16.85
A	287	164	6.97	2.87	943	49.20	44.69	0.41	2.05	2.46	4.51	51.66	0.410	0.205	15.06
Wetland Reduction	1269	617	3.88	-0.17	1181	15.82	12.69	0.98	10.67	11.65	2.35	26.60	0.037	0.157	1.79
(%)	82	79	36	-6	56	24	22	70	84	83	34	34	8	43	11
System Reduction	2866	1041	6.12	0.55	1709	11.36	3.65	1.28	18.08	19.36	6.65	29.60	-0.035	0.980	-0.70
(%)	91	86	47	16	64	19	8	76	90	89	60	36	-9	83	-5

Precip. = 0.84 "
Duration = 24 hrs.
Intensity = 0.035 in./hr.
Last Precip. = 7 hrs.

Pond inflow (A'/hr.) = 0.54
Hydr. Resid. (hr.) = 18.79

* The following data in this table were modeled:
A & G overland flow.
F - flow
C, D, E, F, G water quality

McCarrons 1995 Load Totals

Event: Rain 7/04-06/95

Precipitation Inches: 1.87

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	13	9	0.12	0.05	34	1.30	1.28	0.01	0.06	0.07	0.02	1.37	<u>0.01</u>	0.005	3.21
D	24	13	0.14	0.06	37	0.77	0.69	0.03	0.19	0.22	0.08	0.99	<u>0.01</u>	0.005	4.03
E	25	9	0.19	0.09	31	0.92	0.79	0.10	1.17	1.27	0.13	2.19	<u>0.01</u>	0.005	4.65
G Overland [Avg of C+D+E]	21	10	0.15	0.07	34	1.00	0.92	0.05	0.47	0.52	0.08	1.52	0.01	0.005	0.29
G	11	7	0.13	0.07	27	0.79	0.74	0.01	0.07	0.08	0.05	0.87	<u>0.01</u>	0.005	9.51
F	8	4	0.20	0.14	27	1.20	1.09	0.03	0.21	0.24	0.11	1.44	<u>0.01</u>	0.005	1.32
A Overland [Avg of G+F]	11	7	0.16	0.10	31	1.25	1.19	0.02	0.14	0.16	0.07	1.41	0.01	0.005	1.65
A	8	4	0.19	0.10	21	0.96	0.94	0.01	0.05	0.06	0.02	1.02	<u>0.01</u>	0.005	14.22

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	114	79	1.05	0.44	297	11.36	11.19	0.09	0.52	0.61	0.17	11.97	0.087	0.044	3.21
D	263	143	1.54	0.66	406	8.45	7.57	0.33	2.08	2.41	0.88	10.86	0.110	0.055	4.03
E	316	114	2.41	1.14	392	11.65	10.00	1.27	14.81	16.08	1.65	27.72	0.127	0.063	4.65
G Overland + Atmos.	16	8	0.15	0.09	27	1.43	0.73	0.05	0.73	0.78	0.06	2.21	0.008	0.004	0.65
G Inflow	710	343	5.14	2.32	1122	32.88	29.48	1.73	18.15	19.88	2.76	52.76	0.332	0.166	12.54
G	285	181	3.37	1.81	699	20.45	19.16	0.26	1.81	2.07	1.29	22.52	0.259	0.129	9.51
Pond Reduction	425	162	1.78	0.51	423	12.43	10.32	1.47	16.34	17.81	1.46	30.24	0.073	0.036	3.03
(%)	60	47	35	22	38	38	35	85	90	90	53	57	22	22	24
F	29	14	0.72	0.50	97	4.31	3.92	0.11	0.75	0.86	0.40	5.17	0.036	0.018	1.32
A Overland + Atmos.	47	29	0.81	0.52	137	7.34	5.32	0.12	1.58	1.69	0.29	9.04	0.045	0.022	2.62
A Inflow	361	225	4.89	2.83	933	32.11	28.40	0.48	4.15	4.63	1.98	36.74	0.340	0.170	13.45
A	310	155	7.35	3.87	813	37.16	36.39	0.39	1.94	2.32	0.77	39.48	0.387	0.194	14.22
Wetland Reduction	51	70	-2.46	-1.04	120	-5.05	-7.99	0.10	2.21	2.31	1.21	-2.75	-0.047	-0.024	-0.77
(%)	14	31	-50	-37	13	-16	-28	20	53	50	61	-7	-14	-14	-6
System Reduction	476	232	-0.68	-0.53	543	7.38	2.33	1.57	18.55	20.12	2.67	27.49	0.025	0.013	2.25
(%)	61	60	-10	-16	40	17	6	80	91	90	78	41	6	6	14

Precip. = 1.87 "
Duration = 43.5 hrs.
Intensity = 0.04 in/hr.
Last Precip. = 158 hrs.

Pond inflow (A'/hr.) = 0.29
Hydr. Resid. (hr.) = 35.04

* The following data in this table were modeled:
- E - water quality
- F -flow
- A & G overland flow.

McCarrons 1995 Load Totals

Event: Rain 7/14-15/95

Precipitation Inches: 3.29

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	33	12	0.16	0.05	38	1.60	1.51	0.01	0.20	0.21	0.09	1.81	0.01	0.005	16.07
D	32	11	0.37	0.24	39	1.10	0.98	0.02	0.53	0.55	0.12	1.65	0.01	0.010	10.93
E	29	8	0.40	0.29	32	1.19	1.02	0.11	1.32	1.43	0.17	2.62	0.01	0.005	10.26
G Overland [Avg of C+D+E]	31	10	0.31	0.19	36	1.30	1.17	0.05	0.68	0.73	0.13	2.03	0.01	0.007	0.51
G	24	7	0.22	0.09	25	1.40	1.16	0.02	0.30	0.32	0.24	1.72	0.01	0.005	37.00
F	18	5	0.29	0.26	23	1.50	1.34	0.02	0.55	0.57	0.16	2.07	0.01	0.005	2.40
A Overland [Avg of C+F]	26	9	0.23	0.16	31	1.55	1.43	0.02	0.38	0.39	0.13	1.94	0.01	0.005	2.95
A	42	8	0.22	0.06	26	1.60	1.31	0.03	0.34	0.37	0.29	1.97	0.01	0.005	43.10

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	1444	525	7.00	2.19	1662	69.99	66.06	0.44	8.75	9.19	3.94	79.18	0.437	0.219	16.07
D	952	327	11.01	7.14	1160	32.73	29.16	0.60	15.77	16.36	3.57	49.09	0.298	0.298	10.93
E	810	223	11.17	8.10	894	33.24	28.49	3.07	36.87	39.94	4.75	73.18	0.279	0.140	10.26
G Overland + Atmos.	43	14	0.49	0.33	50	2.93	1.62	0.08	1.58	1.66	0.18	4.60	0.014	0.009	1.14
G Inflow	3249	1090	29.67	17.76	3767	138.89	125.33	4.19	62.97	67.16	12.43	206.05	1.028	0.665	38.40
G	2417	705	22.16	9.07	2518	141.01	116.84	2.01	30.22	32.23	24.17	173.24	1.007	0.504	37.00
Pond Reduction	832	385	7.51	8.69	1249	-2.12	8.49	2.17	32.75	34.92	-11.74	32.80	0.021	0.162	1.40
(%)	26	35	25	49	33	-2	7	52	52	52	-94	16	2	24	4
F	118	33	1.89	1.70	150	9.80	8.75	0.13	3.59	3.72	1.05	13.52	0.065	0.033	2.40
A Overland + Atmos.	205	68	1.97	1.41	245	15.49	11.44	0.17	4.72	4.89	1.00	20.38	0.080	0.040	4.65
A Inflow	2740	806	26.02	12.17	2913	166.30	137.04	2.31	38.53	40.84	26.22	207.14	1.153	0.576	44.05
A	4928	939	25.81	7.04	3051	187.72	153.70	3.52	39.89	43.41	34.03	231.14	1.173	0.587	43.10
Wetland Reduction	-2188	-133	0.21	5.13	-137	-21.42	-16.66	-1.21	-1.36	-2.57	-7.80	-23.99	-0.020	-0.010	0.95
(%)	-80	-16	1	42	-5	-13	-12	-52	-4	-6	-30	-12	-2	-2	2
System Reduction	-1356	252	7.72	13.82	1112	-23.55	-8.17	0.96	31.39	32.35	-19.54	8.81	0.001	0.151	2.35
(%)	-38	21	23	66	27	-14	-6	22	44	43	-135	4	0	21	5

NOTE: some water lost over berms at A & G

Precip. = 3.29 "
Duration = 23 hrs.
Intensity = 0.14 in/hr.
Last Precip. = 140 hrs.

Pond inflow (A'/hr.) = 1.67
Hydr. Resid. (hr.) = 6.05

* The following data in this table were modeled:
A, G -flow (balance) E - water quality
C, D, E, F - flow (P-8)
A & G overland flow.

McCarrons 1995 Load Totals

Event: Rain 8/06/95

Precipitation Inches: 0.80

Concentrations in mg/l (underlined values indicate "less than")

Site		TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C		21	21	0.19	0.05	50	2.50	2.39	0.01	0.20	0.21	0.11	2.71	<u>0.01</u>	0.005	3.04
D		44	16	0.14	0.03	34	0.75	0.56	0.01	0.25	0.26	0.19	1.01	<u>0.01</u>	0.020	1.70
E		67	13	0.13	0.05	26	0.66	0.54	0.01	0.22	0.23	0.12	0.89	<u>0.01</u>	0.020	3.67
G Overland	[Avg of C+D+E]	44	17	0.15	0.04	37	1.30	1.16	0.01	0.22	0.23	0.14	1.54	0.01	0.015	0.12
G		19	13	0.19	0.01	37	1.30	1.17	0.01	0.05	0.06	0.13	1.36	<u>0.01</u>	0.005	7.52
F		28	8	0.11	0.05	23	0.61	0.47	0.01	0.20	0.21	0.14	0.82	<u>0.01</u>	0.005	0.39
A Overland	[Avg of G+F]	25	15	0.15	0.05	37	1.56	1.43	0.01	0.20	0.21	0.13	1.77	0.01	0.005	0.63
A		13	8	0.19	0.04	35	1.00	0.97	0.01	0.05	0.06	0.03	1.06	<u>0.01</u>	0.005	8.25

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	174	174	1.57	0.41	414	20.69	19.78	0.08	1.66	1.74	0.91	22.43	0.083	0.041	3.04
D	204	74	0.65	0.14	157	3.47	2.59	0.05	1.16	1.20	0.88	4.67	0.046	0.093	1.70
E	669	130	1.30	0.50	260	6.59	5.39	0.10	2.20	2.30	1.20	8.89	0.100	0.200	3.67
G Overland + Atmos.	14	5	0.06	0.03	12	0.70	0.38	0.01	0.23	0.23	0.05	0.94	0.003	0.005	0.27
G Inflow	1061	383	3.58	1.08	843	31.45	28.15	0.24	5.24	5.47	3.03	36.93	0.232	0.339	8.68
G	389	266	3.89	0.20	757	26.61	23.95	0.20	1.02	1.23	2.66	27.84	0.205	0.102	7.52
Pond Reduction	672	117	-0.31	0.88	85	4.84	4.19	0.03	4.21	4.25	0.37	9.09	0.027	0.236	1.16
(%)	63	31	-9	81	10	15	15	13	80	78	12	25	12	70	13
F	30	8	0.12	0.05	24	0.65	0.50	0.01	0.21	0.22	0.15	0.87	0.011	0.005	0.39
A Overland + Atmos.	42	25	0.30	0.13	63	3.41	2.45	0.03	0.76	0.79	0.21	4.19	0.017	0.009	1.04
A Inflow	461	299	4.30	0.38	844	30.67	26.90	0.24	1.99	2.24	3.02	32.91	0.232	0.116	8.95
A	292	180	4.27	0.90	786	22.46	21.78	0.22	1.12	1.35	0.67	23.81	0.225	0.112	8.25
Wetland Reduction	169	120	0.04	-0.52	58	8.21	5.12	0.02	0.87	0.89	2.35	9.10	0.008	0.004	0.70
(%)	37	40	1	-135	7	27	19	8	44	40	78	28	3	3	8
System Reduction	841	237	-0.27	0.36	144	13.05	9.31	0.05	5.09	5.14	2.72	18.19	0.035	0.240	1.87
(%)	74	57	-7	29	15	37	30	18	82	79	80	43	14	68	18

Precip. = 0.80 "
Duration = 16 hrs.
Intensity = 0.05 in/hr.
Last Precip. = 37 hrs.

Pond inflow (A'/hr.) = 0.54
Hydr. Resid. (hr.) = 18.61

* The following data in this table were modeled:
- F - flow
- A & G overland flow.

McCarrons 1995 Load Totals

Event: Summary - Rainfall Event 8/11-15/95

Load in Pounds - three part rainfall event

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	1924	860	8.53	1.82	2064	64.94	54.60	5.48	7.81	13.29	10.35	78.23	0.275	0.452	10.10
D	2477	650	6.36	2.39	1673	33.20	20.66	6.12	10.02	16.14	12.54	49.34	0.259	0.696	9.51
E	2157	513	9.22	4.30	1762	44.04	28.55	11.33	20.31	31.64	15.49	75.68	0.393	0.441	14.44
G Overland	84	27	0.32	0.13	67	2.14	1.26	0.05	0.71	0.76	0.45	2.90	0.010	0.023	0.64
G Inflow	6642	2050	24.43	8.64	5566	144.32	105.07	22.98	38.85	61.83	38.83	206.15	0.937	1.612	34.69
G	1432	982	14.68	4.39	3581	217.68	202.39	1.65	19.39	21.04	15.30	238.72	0.748	0.435	27.48
Pond Reduction	5210	1068	9.75	4.25	1985	-73.36	-97.32	21.33	19.46	40.79	23.53	-32.57	0.189	1.177	7.21
(%)	78	52	40	49	36	-51	-93	93	50	66	61	-16	20	73	21
F	267	96	1.62	0.85	228	6.41	3.86	0.11	1.41	1.52	2.55	7.93	0.035	0.043	1.26
A Overland	466	183	2.37	0.99	411	13.22	9.00	0.20	2.72	2.92	3.06	16.14	0.056	0.094	2.71
A Inflow	2165	1261	18.67	6.23	4220	237.31	215.25	1.96	23.52	25.48	20.91	262.79	0.839	0.572	31.45
A	883	494	15.16	6.83	2843	75.18	65.15	1.54	15.41	16.95	10.03	92.13	0.718	0.449	26.37
Wetland Reduction	1282	767	3.51	-0.60	1377	162.13	150.10	0.42	8.11	8.53	10.88	170.66	0.121	0.123	5.08
(%)	59	61	19	-10	33	68	70	21	34	33	52	65	14	22	16
System Reduction	6492	1835	13.26	3.65	3362	88.77	52.78	21.75	27.57	49.32	34.41	138.09	0.310	1.300	12.29
(%)	88	79	47	35	54	54	45	93	64	74	77	60	30	74	32

McCarrons 1995 Load Totals

Event: Rain 8/11-12/95

Precipitation Inches: 0.56 (Part 1 of 8/11-8/15/95 2.63" event)

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	179	68	0.56	0.16	109	2.90	2.55	0.03	0.48	0.51	0.35	3.41	<u>0.01</u>	0.040	0.95
D	45	15	0.24	0.14	68	0.99	0.25	0.02	0.54	0.56	0.74	1.55	<u>0.01</u>	0.030	1.53
E	34	9	0.28	0.18	48	1.10	0.35	0.12	1.41	1.53	0.75	2.63	<u>0.01</u>	0.007	1.72
G Overland [Avg of C+D+E]	86	31	0.36	0.16	75	1.66	1.05	0.06	0.81	0.87	0.61	2.53	0.01	0.026	0.08
G	24	12	0.29	0.10	68	1.90	1.46	0.02	0.55	0.57	0.44	2.47	<u>0.01</u>	0.005	3.26
F	59	19	0.25	0.16	57	1.70	0.92	0.02	0.67	0.69	0.78	2.39	<u>0.01</u>	0.008	0.26
A Overland [Avg of C+F]	119	44	0.41	0.16	83	2.30	1.74	0.03	0.58	0.60	0.57	2.90	0.01	0.024	0.43
A	14	7	0.27	0.07	52	1.10	0.75	0.01	0.12	0.13	0.35	1.23	<u>0.01</u>	0.005	1.43

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	463	176	1.45	0.41	282	7.50	6.59	0.08	1.24	1.32	0.91	8.82	0.026	0.103	0.95
D	187	62	1.00	0.58	283	4.12	1.04	0.08	2.25	2.33	3.08	6.46	0.042	0.125	1.53
E	159	42	1.31	0.84	225	5.15	1.64	0.56	6.60	7.16	3.51	12.31	0.047	0.033	1.72
G Overland + Atmos.	19	7	0.09	0.05	16	0.55	0.23	0.02	0.28	0.30	0.13	0.85	0.002	0.006	0.19
G Inflow	828	287	3.85	1.88	806	17.33	9.50	0.74	10.38	11.11	7.63	28.44	0.117	0.267	4.39
G	213	106	2.57	0.89	603	16.86	12.96	0.18	4.88	5.06	3.90	21.92	0.089	0.044	3.26
Pond Reduction	615	181	1.27	1.00	203	0.47	-3.45	0.56	5.50	6.06	3.73	6.52	0.028	0.222	1.13
(%)	74	63	33	53	25	3	-36	76	53	54	49	23	24	83	26
F	42	13	0.18	0.11	40	1.20	0.65	0.01	0.47	0.49	0.55	1.69	0.007	0.006	0.26
A Overland + Atmos.	139	51	0.50	0.21	97	3.21	2.03	0.04	0.96	1.00	0.66	4.21	0.012	0.028	0.72
A Inflow	394	171	3.25	1.22	741	21.27	15.64	0.23	6.32	6.55	5.12	27.82	0.108	0.078	4.24
A	54	27	1.05	0.27	202	4.28	2.92	0.04	0.47	0.51	1.36	4.79	0.039	0.019	1.43
Wetland Reduction	340	144	2.20	0.94	539	16.99	12.72	0.19	5.85	6.04	3.76	23.03	0.069	0.059	2.81
(%)	86	84	68	78	73	80	81	83	93	92	73	83	64	75	66
System Reduction	955	324	3.47	1.94	741	17.46	9.27	0.75	11.35	12.10	7.48	29.56	0.096	0.281	3.94
(%)	95	92	77	88	79	80	76	95	96	96	85	86	71	94	73

Precip. = 0.56 "
Duration = 3 hrs.
Intensity = 0.19 in/hr.
Last Precip. = 105 hrs.

Pond inflow (A'/hr.) = 1.46
Hydr. Resid. (hr.) = 6.91

* The following data in this table were modeled:
E - water quality
F -flow
A & G overland flow.

McCarrons 1995 Load Totals

Event: Rain 8/13-15/95

Precipitation Inches: 0.72 (Part 3 of 8/11-8/15/95 2.63" event)

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	29	19	0.21	0.03	62	2.20	1.71	0.01	0.11	0.12	0.49	2.32	0.01	0.005	4.30
D	125	29	0.24	0.09	62	1.60	1.06	0.01	0.24	0.25	0.54	1.85	0.01	0.030	2.77
E	62	13	0.21	0.10	45	1.00	0.82	0.01	0.23	0.24	0.18	1.24	0.01	0.005	4.90
G Overland [Avg of C+D+E]	72	20	0.22	0.07	56	1.60	1.20	0.01	0.19	0.20	0.40	1.80	0.01	0.013	0.11
G	13	11	0.17	0.06	47	4.10	3.95	0.02	0.20	0.22	0.15	4.32	0.01	0.005	13.12
F	50	31	0.49	0.22	67	1.94	1.24	0.03	0.21	0.24	0.70	2.18	0.01	0.009	0.35
A Overland [Avg of G+F]	40	25	0.35	0.13	65	2.07	1.48	0.02	0.16	0.18	0.60	2.25	0.01	0.007	0.56
A	6	6	0.19	0.11	42	0.92	0.81	0.02	0.22	0.24	0.11	1.16	0.01	0.005	13.86

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	339	222	2.46	0.35	726	25.75	20.02	0.12	1.29	1.40	5.74	27.16	0.117	0.059	4.30
D	943	219	1.81	0.68	468	12.06	7.99	0.08	1.81	1.89	4.07	13.95	0.075	0.226	2.77
E	827	173	2.80	1.33	600	13.34	10.94	0.13	3.07	3.20	2.40	16.54	0.133	0.067	4.90
G Overland + Atmos.	22	6	0.08	0.04	17	0.73	0.36	0.01	0.20	0.20	0.12	0.93	0.003	0.004	0.25
G Inflow	2131	621	7.15	2.40	1810	51.88	39.31	0.33	6.36	6.69	12.33	58.58	0.329	0.355	12.22
G	464	393	6.07	2.14	1679	146.43	141.08	0.71	7.14	7.86	5.36	154.29	0.357	0.179	13.12
Pond Reduction	1666	228	1.08	0.26	132	-94.55	-101.77	-0.38	-0.78	-1.16	6.97	-95.71	-0.028	0.177	-0.90
(%)	78	37	15	11	7	-182	-259	-115	-12	-17	57	-163	-9	50	-7
F	48	30	0.47	0.21	64	1.85	1.18	0.03	0.20	0.23	0.67	2.08	0.010	0.009	0.35
A Overland + Atmos.	60	38	0.57	0.23	98	3.82	2.25	0.04	0.62	0.66	0.91	4.48	0.015	0.011	0.93
A Inflow	572	461	7.11	2.58	1841	152.10	144.51	0.78	7.96	8.74	6.93	160.85	0.382	0.198	14.40
A	226	226	7.17	4.15	1585	34.71	30.56	0.75	8.30	9.06	4.15	43.77	0.377	0.189	13.86
Wetland Reduction	346	234	-0.06	-1.57	256	117.39	113.95	0.03	-0.34	-0.31	2.78	117.08	0.005	0.009	0.54
(%)	60	51	-1	-61	14	77	79	4	-4	-4	40	73	1	5	4
System Reduction	2012	462	1.01	-1.32	388	22.84	12.17	-0.35	-1.12	-1.47	9.75	21.37	-0.024	0.186	-0.36
(%)	90	67	12	-46	20	40	28	-88	-16	-19	70	33	-7	50	-3

Precip. = 0.72 "
Duration = 6.5 hrs.
Intensity = 0.11 in/hr.
Last Precip. = 14 hrs.

Pond inflow (A'/hr.) = 1.88
Hydr. Resid. (hr.) = 5.37

* The following data in this table were modeled:
F -flow P-8, all water quality parameters.
A & G overland flow.

McCarrons 1995 Load Totals

Event: Rain 8/12-13/95

Precipitation Inches: 1.35" (Part 2 of 8/11-8/15/95 2.63" event)

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	85	35	0.35	0.08	80	2.40	2.12	0.04	0.40	0.44	0.28	2.84	0.01	0.022	4.85
D	95	26	0.25	0.08	65	1.20	0.82	0.04	0.42	0.46	0.38	1.66	0.01	0.035	5.21
E	55	14	0.24	0.10	44	1.20	0.75	0.05	0.50	0.55	0.45	1.75	0.01	0.016	7.82
G Overland [Avg of C+D+E]	78	25	0.28	0.09	63	1.60	1.23	0.04	0.44	0.48	0.37	2.08	0.01	0.024	0.20
G	25	16	0.20	0.05	43	1.80	1.60	0.03	0.22	0.25	0.20	2.05	0.01	0.007	11.10
F	100	30	0.55	0.30	70	1.90	1.15	0.04	0.40	0.44	0.75	2.34	0.01	0.016	0.65
A Overland [Avg of C+F]	93	33	0.45	0.19	75	2.15	1.64	0.04	0.40	0.44	0.52	2.59	0.01	0.019	1.06
A	20	8	0.23	0.08	35	1.20	1.05	0.03	0.22	0.25	0.15	1.45	0.01	0.008	11.08

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	1122	462	4.62	1.06	1056	31.69	27.99	0.53	5.28	5.81	3.70	37.50	0.132	0.290	4.85
D	1347	369	3.55	1.13	922	17.02	11.63	0.50	5.96	6.45	5.39	23.47	0.142	0.496	5.21
E	1171	298	5.11	2.13	937	25.55	15.97	0.96	10.64	11.60	9.58	37.15	0.213	0.341	7.82
G Overland + Atmos.	43	14	0.15	0.05	34	0.87	0.67	0.02	0.24	0.26	0.20	1.13	0.005	0.013	0.20
G Inflow	3683	1142	13.43	4.37	2949	75.12	56.26	2.00	22.12	24.13	18.87	99.25	0.492	1.141	18.08
G	755	483	6.04	1.36	1299	54.39	48.35	0.76	6.65	7.40	6.04	61.79	0.302	0.212	11.10
Pond Reduction	2928	659	7.38	3.01	1650	20.73	7.91	1.25	15.47	16.72	12.82	37.45	0.190	0.929	6.98
(%)	79	58	55	69	56	28	14	62	70	69	68	38	39	81	39
F	177	53	0.97	0.53	124	3.36	2.03	0.07	0.71	0.78	1.33	4.14	0.018	0.028	0.65
A Overland + Atmos.	267	94	1.30	0.55	216	6.20	4.72	0.12	1.15	1.27	1.49	7.47	0.029	0.055	1.06
A Inflow	1199	630	8.31	2.44	1640	63.95	55.10	0.94	8.51	9.45	8.86	73.40	0.349	0.295	12.81
A	603	241	6.94	2.41	1056	36.19	31.67	0.75	6.64	7.39	4.52	43.58	0.302	0.241	11.08
Wetland Reduction	596	389	1.38	0.03	584	27.76	23.43	0.19	1.87	2.06	4.33	29.82	0.047	0.053	1.73
(%)	50	62	17	1	36	43	43	20	22	22	49	41	14	18	14
System Reduction	3524	1048	8.76	3.03	2234	48.49	31.34	1.44	17.35	18.78	17.16	67.27	0.237	0.983	8.71
(%)	85	81	56	56	68	57	50	66	72	72	79	61	44	80	44

Precip. = 1.35 "
Duration = 18 hrs.
Intensity = 0.08 in./hr.
Last Precip. = 22 hrs.

Pond inflow (A'/hr.) = 1.00
Hydr. Resid. (hr.) = 10.06

* The following data in this table were modeled:
All sites water quality
F -flow
A & G overland flow.

McCarrons 1995 Load Totals

Event: Rain 9/29-10/1/95

Precipitation Inches: 1.30

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	41	27	0.09	0.01	218	0.76	0.50	0.02	0.33	0.35	0.26	1.11	0.01	0.009	2.40
D	48	17	0.20	0.02	90	0.91	0.68	0.02	0.44	0.46	0.23	1.37	0.01	0.020	3.52
E	23	9	0.19	0.04	59	1.40	1.21	0.01	0.30	0.31	0.19	1.71	0.01	0.005	2.72
G Overland [Avg of C+D+E]	37	18	0.16	0.02	122	1.02	0.80	0.02	0.36	0.37	0.23	1.40	0.01	0.011	0.19
G	25	12	0.17	0.02	38	1.50	1.45	0.01	0.11	0.12	0.05	1.62	0.01	0.005	8.00
F	67	40	0.39	0.30	36	1.70	1.30	0.06	0.48	0.54	0.40	2.24	0.01	0.005	0.61
A Overland [Avg of C+F]	54	34	0.24	0.16	127	1.23	0.90	0.04	0.41	0.45	0.33	1.68	0.01	0.007	0.99
A	9	5	0.17	0.03	24	1.20	1.14	0.01	0.14	0.15	0.06	1.35	0.01	0.005	8.64

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	268	176	0.59	0.07	1424	4.97	3.27	0.13	2.16	2.29	1.70	7.25	0.065	0.059	2.40
D	460	163	1.92	0.19	862	8.72	6.52	0.19	4.22	4.41	2.20	13.13	0.096	0.192	3.52
E	170	67	1.41	0.30	437	10.37	8.96	0.07	2.22	2.30	1.41	12.66	0.074	0.037	2.72
G Overland + Atmos.	19	9	0.11	0.04	63	0.98	0.41	0.02	0.44	0.45	0.12	1.43	0.005	0.006	0.44
G Inflow	917	415	4.02	0.59	2787	25.03	19.15	0.41	9.03	9.44	5.43	34.47	0.240	0.293	9.08
G	544	261	3.70	0.44	828	32.67	31.58	0.22	2.40	2.61	1.09	35.28	0.218	0.109	8.00
Pond Reduction	373	154	0.32	0.15	1959	-7.64	-12.42	0.19	6.63	6.83	4.34	-0.81	0.023	0.184	1.08
(%)	41	37	8	26	70	-31	-65	47	73	72	80	-2	9	63	12
F	111	66	0.65	0.50	60	2.82	2.16	0.10	0.80	0.90	0.66	3.72	0.017	0.008	0.61
A Overland + Atmos.	146	90	0.71	0.48	342	4.52	2.43	0.13	1.77	1.89	0.89	6.41	0.027	0.019	1.66
A Inflow	801	418	5.06	1.42	1230	40.01	36.16	0.44	4.96	5.40	2.64	45.41	0.261	0.136	10.27
A	212	118	4.00	0.71	564	28.22	26.81	0.24	3.29	3.53	1.41	31.75	0.235	0.118	8.64
Wetland Reduction	590	300	1.06	0.71	665	11.78	9.35	0.21	1.67	1.87	1.23	13.66	0.026	0.018	1.63
(%)	74	72	21	50	54	29	26	47	34	35	47	30	10	14	16
System Reduction	963	454	1.38	0.86	2624	4.14	-3.07	0.40	8.30	8.70	5.57	12.85	0.049	0.203	2.71
(%)	82	79	26	55	82	13	-13	63	72	71	80	29	17	63	24

Precip. = 1.30 "
Duration = 43 hrs.
Intensity = 0.03 in/hr.
Last Precip. = 116 hrs.

Pond inflow (A'/hr.) = 0.21
Hydr. Resid. (hr.) = 47.83

* The following data in this table were modeled:
F- flow P-8.
A & G overland flow.

McCarrons 1995 Load Totals

Event: Rain 10/02/95

Precipitation Inches: 0.44

Concentrations in mg/l (underlined values indicate "less than")

Site		TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C		34	25	0.16	0.02	51	2.20	2.18	0.01	0.06	0.07	0.02	2.27	0.01	0.005	0.96
D		76	25	0.19	0.05	50	0.98	0.71	0.01	0.22	0.23	0.27	1.21	0.01	0.030	1.22
E		60	19	0.12	0.05	28	1.00	0.72	0.01	0.16	0.17	0.28	1.17	0.01	0.008	1.44
G Overland	[Avg of C+D+E]	57	23	0.16	0.04	43	1.39	1.20	0.01	0.15	0.16	0.19	1.55	0.01	0.014	0.06
G		16	11	0.14	0.01	29	1.30	1.23	0.01	0.22	0.23	0.07	1.53	0.01	0.005	4.34
F		116	54	0.29	0.16	71	1.30	1.12	0.01	0.10	0.11	0.18	1.41	0.01	0.020	0.21
A Overland	[Avg of C+F]	75	40	0.23	0.09	61	1.75	1.65	0.01	0.08	0.09	0.10	1.84	0.01	0.013	0.34
A		11	7	0.14	0.06	24	0.96	0.92	0.01	0.28	0.29	0.04	1.25	0.01	0.005	3.84

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	89	65	0.42	0.05	133	5.75	5.70	0.03	0.16	0.18	0.05	5.93	0.026	0.013	0.96
D	252	83	0.63	0.17	166	3.25	2.36	0.03	0.73	0.76	0.90	4.02	0.033	0.100	1.22
E	235	74	0.47	0.20	110	3.92	2.82	0.04	0.63	0.67	1.10	4.59	0.039	0.031	1.44
G Overland + Atmos.	9	4	0.03	0.01	7	0.38	0.20	0.00	0.11	0.11	0.03	0.49	0.002	0.002	0.14
G Inflow	586	227	1.55	0.43	416	13.30	11.07	0.10	1.62	1.73	2.08	15.03	0.100	0.146	3.76
G	189	130	1.65	0.12	343	15.36	14.53	0.12	2.60	2.72	0.83	18.08	0.118	0.059	4.34
Pond Reduction	397	97	-0.10	0.31	73	-2.06	-3.46	-0.02	-0.98	-0.99	1.25	-3.05	-0.018	0.087	-0.58
(%)	68	43	-6	72	18	-15	-31	-15	-60	-57	60	-20	-18	60	-15
F	66	31	0.17	0.09	41	0.74	0.64	0.01	0.06	0.06	0.10	0.81	0.006	0.011	0.21
A Overland + Atmos.	69	37	0.23	0.10	56	2.03	1.53	0.02	0.30	0.32	0.09	2.34	0.009	0.012	0.57
A Inflow	325	197	2.05	0.31	440	18.13	16.70	0.14	2.96	3.10	1.02	21.23	0.133	0.082	5.12
A	115	73	1.46	0.63	251	10.04	9.62	0.10	2.93	3.03	0.42	13.07	0.105	0.052	3.84
Wetland Reduction	210	124	0.59	-0.31	189	8.09	7.08	0.03	0.03	0.07	0.60	8.16	0.029	0.030	1.28
(%)	65	63	29	-99	43	45	42	25	1	2	59	38	21	36	25
System Reduction	606	221	0.49	0.00	262	6.04	3.62	0.02	-0.94	-0.92	1.85	5.11	0.011	0.117	0.70
(%)	84	75	25	0	51	38	27	15	-48	-44	82	28	9	69	15

NOTE: G outflow high because of grate cleaning during event

Precip. = 0.44 "
Duration = 1.75 hrs.
Intensity = 0.25 in/hr.
Last Precip. = 32 hrs.

Pond inflow (A'/hr.) = 2.15
Hydr. Resid. (hr.) = 4.70

* The following data in this table were modeled:
A -flow (balance)
F- flow (P-8)
A & G overland flow.

McCarrons 1995 Load Totals

Event: Rain 10/05/95

Precipitation Inches: 0.92

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	20	16	0.20	0.03	63	1.60	1.55	0.01	0.08	0.09	0.05	1.69	0.01	0.005	1.69
D	14	6	0.12	0.06	42	0.21	0.03	0.01	0.21	0.22	0.18	0.43	0.01	0.005	2.84
E	13	5	0.11	0.07	38	0.42	0.16	0.01	0.17	0.18	0.26	0.60	0.01	0.005	2.12
G Overland [Avg of C+D+E]	16	9	0.14	0.05	48	0.74	0.58	0.01	0.15	0.16	0.16	0.91	0.01	0.005	0.14
G	20	11	0.18	0.02	51	1.20	1.05	0.01	0.13	0.14	0.15	1.34	0.01	0.005	6.79
F	40	23	1.10	0.51	116	3.00	2.96	0.02	0.08	0.10	0.04	3.10	0.01	0.005	0.45
A Overland [Avg of C+F]	30	20	0.65	0.27	90	2.30	2.26	0.02	0.08	0.10	0.05	2.40	0.01	0.005	0.73
A	12	6	0.19	0.04	46	1.00	0.86	0.01	0.05	0.06	0.14	1.06	0.01	0.005	7.97

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	92	74	0.92	0.14	290	7.36	7.13	0.05	0.37	0.41	0.23	7.77	0.046	0.023	1.69
D	108	46	0.93	0.46	325	1.62	0.23	0.08	1.62	1.70	1.39	3.32	0.077	0.039	2.84
E	75	29	0.63	0.40	219	2.42	0.92	0.06	0.98	1.04	1.50	3.46	0.058	0.029	2.12
G Overland + Atmos.	6	3	0.07	0.04	18	0.60	0.22	0.01	0.24	0.24	0.06	0.84	0.004	0.002	0.32
G Inflow	281	152	2.55	1.04	852	12.01	8.51	0.19	3.21	3.40	3.18	15.41	0.185	0.092	6.97
G	370	203	3.33	0.37	943	22.18	19.41	0.18	2.40	2.59	2.77	24.77	0.185	0.092	6.79
Pond Reduction	-88	-51	-0.77	0.67	-91	-10.17	-10.90	0.00	0.81	0.81	0.41	-9.36	0.000	0.000	0.18
(%)	-31	-34	-30	65	-11	-85	-128	3	25	24	13	-61	0	0	3
F	49	28	1.35	0.62	142	3.68	3.63	0.02	0.10	0.12	0.05	3.80	0.012	0.006	0.45
A Overland + Atmos.	60	39	1.34	0.58	178	5.42	4.48	0.04	0.64	0.68	0.09	6.10	0.020	0.010	1.21
A Inflow	478	270	6.01	1.58	1263	31.28	27.52	0.25	3.14	3.39	2.91	34.67	0.217	0.108	8.45
A	260	130	4.12	0.87	998	21.70	18.66	0.22	1.08	1.30	3.04	23.00	0.217	0.108	7.97
Wetland Reduction	218	140	1.89	0.71	265	9.58	8.86	0.04	2.05	2.09	-0.13	11.67	0.000	0.000	0.48
(%)	46	52	31	45	21	31	32	14	65	62	-4	34	0	0	6
System Reduction	130	89	1.12	1.38	174	-0.59	-2.04	0.04	2.86	2.90	0.29	2.31	0.000	0.000	0.65
(%)	33	41	21	61	15	-3	-12	16	72	69	9	9	0	0	8

Precip. = 0.92 "
Duration = 16 hrs.
Intensity = 0.06 in/hr.
Last Precip. = 73 hrs.

Pond inflow (A'/hr.) = 0.44
Hydr. Resid. (hr.) = 23.20

* The following data in this table were modeled:
A, G - flow
F - flow
A & G overland flow.

McCarrons 1996 Load Totals

Event: **Snowmelt 2/24/96**

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	18	8	0.24	0.07	38	2.20	0.90	0.03	0.10	0.13	1.30	2.33	<u>0.005</u>	<u>0.05</u>	0.85
D	17	8	0.51	0.49	56	2.00	0.70	0.07	0.76	0.83	1.30	2.83	0.020	<u>0.05</u>	1.37
E	23	10	0.51	0.46	60	2.70	1.30	0.07	0.64	0.71	1.40	3.41	0.020	<u>0.05</u>	2.65
G Overland [Avg of C+D+E]	19	9	0.42	0.34	51	2.30	0.97	0.06	0.50	0.56	1.33	2.86	0.015	0.05	0.21
G	42	14	0.80	0.17	68	1.60	0.20	0.08	0.61	0.69	1.40	2.29	0.030	<u>0.05</u>	5.08
F	63	23	0.67	0.32	96	2.10	0.50	0.11	0.57	0.68	1.60	2.78	0.030	<u>0.05</u>	0.47
A Overland [Avg of C+F]	41	16	0.46	0.20	67	2.15	0.70	0.07	0.34	0.41	1.45	2.56	0.018	0.05	0.36
A	44	13	0.21	0.08	63	2.60	1.20	0.11	0.79	0.90	1.40	3.50	0.020	<u>0.05</u>	4.31

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	42	19	0.56	0.16	88	5.09	2.08	0.07	0.23	0.30	3.01	5.39	0.012	0.116	0.85
D	63	30	1.90	1.83	209	7.46	2.61	0.26	2.83	3.10	4.85	10.55	0.075	0.186	1.37
E	166	72	3.68	3.32	433	19.48	9.38	0.50	4.62	5.12	10.10	24.60	0.144	0.361	2.65
G Overland	11	5	0.24	0.19	29	1.31	0.55	0.03	0.29	0.32	0.76	1.63	0.009	0.029	0.21
G Inflow	282	125	6.38	5.50	759	33.34	14.62	0.87	7.97	8.84	18.72	42.18	0.239	0.691	5.08
G	581	194	11.06	2.35	940	22.13	2.77	1.11	8.44	9.54	19.36	31.67	0.415	0.691	5.08
Pond Reduction	-299	-68	-4.69	3.15	-181	11.22	11.86	-0.24	-0.47	-0.71	-0.64	10.51	-0.176	0.000	0.00
(%)	-106	-54	-73	57	-24	34	81	-27	-6	-8	-3	25	-74	0	0
F	81	29	0.86	0.41	123	2.69	0.64	0.14	0.73	0.87	2.05	3.56	0.038	0.064	0.47
A Overland	40	15	0.45	0.19	66	2.11	0.69	0.07	0.33	0.40	1.42	2.50	0.017	0.049	0.36
A Inflow	701	238	12.37	2.95	1129	26.92	4.09	1.32	9.49	10.81	22.83	37.73	0.470	0.804	5.91
A	516	153	2.46	0.94	739	30.51	14.08	1.29	9.27	10.56	16.43	41.06	0.235	0.587	4.31
Wetland Reduction	185	86	9.90	2.01	390	-3.59	-9.99	0.03	0.22	0.25	6.40	-3.34	0.236	0.218	1.60
(%)	26	36	80	68	35	-13	-244	2	2	2	28	-9	50	27	27
System Reduction	-114	18	5.22	5.16	208	7.63	1.87	-0.21	-0.24	-0.46	5.76	7.17	0.060	0.218	1.60
(%)	-28	10	68	85	22	20	12	-20	-3	-5	26	15	20	27	27

Precip. = Snowmelt

* The following data in this table were modeled:
- A overland & G overland water quality and flow
- F flow

McCarrons 1995 Load Totals

Event: Rain 10/23/95

Precipitation Inches: 1.68

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Q Water, A'
C	25	18	0.43	0.14	89	3.00	2.83	0.01	0.13	0.14	0.17	3.14	0.01	0.005	3.88
D	44	19	0.41	0.15	74	1.40	0.97	0.03	0.41	0.44	0.43	1.84	0.01	0.030	3.66
E	12	5	0.21	0.13	46	1.00	0.67	0.02	0.28	0.30	0.33	1.30	0.01	0.006	3.76
G Overland [Avg of C+D+E]	27	14	0.35	0.14	70	1.80	1.49	0.02	0.27	0.29	0.31	2.09	0.01	0.014	0.25
G	17	12	0.18	0.04	34	1.10	1.01	0.01	0.21	0.22	0.09	1.32	0.01	0.005	11.55
F	34	15	1.40	1.40	140	4.70	3.60	0.04	0.28	0.32	1.10	5.02	0.01	0.020	1.14
A Overland [Avg of G+F]	30	17	0.92	0.77	115	3.85	3.22	0.03	0.21	0.23	0.64	4.08	0.01	0.013	1.35
A	16	9	0.22	0.12	28	0.90	0.81	0.01	0.25	0.26	0.09	1.16	0.01	0.005	14.34

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Copper	Zinc	Total Water, A'
C	264	190	4.54	1.48	940	31.69	29.89	0.11	1.37	1.48	1.80	33.17	0.106	0.053	3.88
D	438	189	4.08	1.49	737	13.95	9.66	0.30	4.08	4.38	4.28	18.33	0.100	0.299	3.66
E	123	51	2.15	1.33	471	10.24	6.86	0.20	2.87	3.07	3.38	13.31	0.102	0.061	3.76
G Overland + Atmos.	18	10	0.27	0.13	47	1.80	1.01	0.02	0.51	0.53	0.21	2.33	0.007	0.009	0.57
G Inflow	844	440	11.04	4.43	2196	57.67	47.43	0.63	8.83	9.47	9.67	67.14	0.314	0.422	11.87
G	535	377	5.66	1.26	1069	34.59	31.76	0.31	6.60	6.92	2.83	41.50	0.314	0.157	11.55
Pond Reduction	309	63	5.39	3.17	1127	23.09	15.67	0.32	2.23	2.55	6.84	25.64	0.000	0.265	0.32
(%)	37	14	49	72	51	40	33	50	25	27	71	38	0	63	3
F	106	47	4.34	4.34	434	14.59	11.17	0.12	0.87	0.99	3.41	15.58	0.031	0.062	1.14
A Overland + Atmos.	108	61	3.44	2.91	421	15.70	11.82	0.12	1.63	1.74	2.33	17.44	0.037	0.046	2.22
A Inflow	748	484	13.45	8.51	1924	64.87	54.74	0.55	9.10	9.65	8.58	74.52	0.382	0.265	14.91
A	625	351	8.59	4.68	1093	35.13	31.62	0.39	9.76	10.15	3.51	45.28	0.390	0.195	14.34
Wetland Reduction	124	133	4.86	3.83	831	29.73	23.12	0.16	-0.66	-0.50	5.06	29.24	-0.008	0.070	0.57
(%)	17	27	36	45	43	46	42	30	-7	-5	59	39	-2	26	4
System Reduction	433	196	10.24	7.00	1958	52.82	38.79	0.48	1.57	2.05	11.90	54.87	-0.008	0.335	0.89
(%)	41	36	54	60	64	60	55	55	14	17	77	55	-2	63	6

Precip. = 1.68 "
Duration = 26.25 hrs.
Intensity = 0.06 in/hr.
Last Precip. = 340 hrs.

Pond inflow (A'/hr.) = 0.45
Hydr. Resid. (hr.) = 22.33

* The following data in this table were modeled:
A, G-flow
F- flow
A & G overland flow.

McCarrons 1996 Load Totals

Event: Summary - Snowmelt 3/11-14/96

Load in Pounds - both parts of melt

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	565	211	4.69	4.34	607	29.42	15.28	0.49	3.40	3.89	14.14	33.31	0.341	0.561	4.17
D	1361	468	11.32	9.19	1268	45.20	24.12	0.81	5.94	6.75	21.08	51.95	0.835	0.794	5.84
E	948	380	24.37	18.73	1502	92.17	51.73	1.25	11.95	13.20	40.46	105.37	0.415	1.365	10.03
G Overland	140	52	1.64	1.33	155	7.19	3.89	0.11	0.91	1.02	3.31	8.21	0.080	0.123	0.90
G Inflow	3014	1111	42.02	33.59	3532	173.98	95.02	2.66	22.20	24.86	78.99	198.84	1.671	2.843	20.94
G	1562	700	37.89	24.31	2893	149.04	74.10	2.59	23.28	25.87	74.94	174.91	1.446	2.851	20.94
Pond Reduction	1452	411	4.13	9.28	639	24.94	20.92	0.07	-1.08	-1.01	4.05	23.93	0.225	-0.008	0.00
(%)	48	37	10	28	18	14	22	3	-5	-4	5	12	13	0	0
F	229	99	5.39	4.31	383	18.89	10.80	0.36	2.60	2.96	8.10	21.85	0.110	0.275	2.02
A Overland	196	79	2.93	2.45	262	12.75	7.00	0.22	1.63	1.85	5.75	14.60	0.105	0.211	1.55
A Inflow	1987	878	46.21	31.07	3538	180.68	91.90	3.17	27.51	30.68	88.79	211.36	1.661	3.337	24.51
A	2454	928	28.27	26.48	3130	167.37	81.41	3.53	26.26	29.79	85.94	197.16	0.886	3.525	24.23
Wetland Reduction	-467	-50	17.94	4.59	408	13.31	10.49	-0.36	1.25	0.89	2.85	14.20	0.775	-0.188	0.28
(%)	-24	-6	39	15	12	7	11	-11	5	3	3	7	47	-6	1
System Reduction	985	361	22.07	13.87	1047	38.25	31.41	-0.29	0.17	-0.12	6.90	38.13	1.000	-0.196	0.28
(%)	29	28	44	34	25	19	28	-9	1	0	7	16	53	-6	1

McCarrons 1996 Load Totals

Event: Snowmelt 3/11-12/96

First part of 3/11-3/14 snowmelt

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	60	24	0.38	0.35	61	2.70	1.40	0.03	0.31	0.34	1.30	3.04	0.030	<u>0.05</u>	1.92
D	124	39	0.68	0.56	104	3.30	1.70	0.06	0.41	0.47	1.60	3.77	0.080	<u>0.05</u>	3.17
E	50	17	0.98	0.83	62	3.90	2.20	0.05	0.49	0.54	1.70	4.44	0.020	<u>0.05</u>	5.65
G Overland [Avg of C+D+E]	78	27	0.68	0.58	76	3.30	1.77	0.05	0.40	0.45	1.53	3.75	0.043	0.05	0.49
G	39	16	0.66	0.38	54	2.80	1.30	0.05	0.45	0.50	1.50	3.30	0.030	<u>0.05</u>	11.23
F	38	18	1.00	0.82	65	3.80	2.10	0.07	0.59	0.66	1.70	4.46	0.020	<u>0.05</u>	1.10
A Overland [Avg of C+F]	49	21	0.69	0.59	63	3.25	1.75	0.05	0.45	0.50	1.50	3.75	0.025	0.05	0.84
A	51	18	0.56	0.50	56	2.80	1.30	0.06	0.49	0.55	1.50	3.35	0.020	0.06	8.32

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	314	125	1.99	1.83	319	14.11	7.32	0.16	1.62	1.78	6.79	15.89	0.157	0.261	1.92
D	1070	337	5.87	4.83	897	28.48	14.67	0.52	3.54	4.06	13.81	32.53	0.690	0.431	3.17
E	769	261	15.07	12.77	954	59.98	33.84	0.77	7.54	8.31	26.15	68.29	0.308	0.769	5.65
G Overland	104	36	0.91	0.77	101	4.40	2.36	0.06	0.54	0.60	2.05	5.00	0.058	0.067	0.49
G Inflow	2257	759	23.83	20.20	2271	106.98	58.18	1.51	13.23	14.74	48.79	121.71	1.213	1.529	11.23
G	1192	489	20.18	11.62	1651	85.60	39.74	1.53	13.76	15.29	45.86	100.88	0.917	1.529	11.23
Pond Reduction	1064	270	3.66	8.58	620	21.38	18.44	-0.02	-0.52	-0.55	2.94	20.83	0.295	0.000	0.00
(%)	47	36	15	42	27	20	32	-2	-4	-4	6	17	24	0	0
F	114	54	2.99	2.46	195	11.38	6.29	0.21	1.77	1.98	5.09	13.36	0.060	0.150	1.10
A Overland	112	48	1.58	1.34	144	7.43	4.00	0.11	1.03	1.14	3.43	8.58	0.057	0.114	0.84
A Inflow	1418	591	24.75	15.41	1990	104.41	50.03	1.85	16.55	18.40	54.38	122.81	1.034	1.793	13.17
A	1155	408	12.68	11.32	1268	63.42	29.44	1.36	11.10	12.46	33.97	75.87	0.453	1.359	8.32
Wetland Reduction	263	183	12.07	4.09	721	40.99	20.59	0.49	5.45	5.95	20.40	46.94	0.581	0.434	4.85
(%)	19	31	49	27	36	39	41	27	33	32	38	38	56	24	37
System Reduction	1327	453	15.72	12.67	1341	62.37	39.03	0.47	4.93	5.40	23.34	67.77	0.877	0.434	4.85
(%)	53	53	55	53	51	50	57	26	31	30	41	47	66	24	37

Precip. = Snowmelt (Part 1)

* The following data in this table were modeled:

- A overland and G overland water quality and flow
- F flow

McCarrons 1996 Load Totals

Event: Snowmelt 3/13-14/96

Second part of 3/11-3/14 snowmelt

Concentrations in mg/l (underlined values indicate "less than")

Site		TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C		41	14	0.44	0.41	47	2.50	1.30	0.05	0.29	0.34	1.20	2.84	0.030	0.05	2.25
D		40	18	0.75	0.60	51	2.30	1.30	0.04	0.33	0.37	1.00	2.67	0.020	0.05	2.67
E		15	10	0.78	0.50	46	2.70	1.50	0.04	0.37	0.41	1.20	3.11	0.009	0.05	4.38
G Overland	[Avg of C+D+E]	32	14	0.66	0.50	48	2.50	1.37	0.04	0.33	0.37	1.13	2.87	0.020	0.05	0.41
G		14	8	0.67	0.48	47	2.40	1.30	0.04	0.36	0.40	1.10	2.80	0.020	0.05	9.71
F		46	18	0.96	0.74	75	3.00	1.80	0.06	0.33	0.39	1.20	3.39	0.020	0.05	0.92
A Overland	[Avg of G+F]	44	16	0.70	0.58	61	2.75	1.55	0.06	0.31	0.37	1.20	3.12	0.025	0.05	0.71
A		30	12	0.36	0.35	43	2.40	1.20	0.05	0.35	0.40	1.20	2.80	0.010	0.05	15.91

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	251	86	2.70	2.51	288	15.31	7.96	0.31	1.78	2.08	7.35	17.40	0.184	0.306	2.25
D	291	131	5.45	4.36	371	16.72	9.45	0.29	2.40	2.69	7.27	19.41	0.145	0.363	2.67
E	179	119	9.30	5.96	548	32.19	17.89	0.48	4.41	4.89	14.31	37.08	0.107	0.596	4.38
G Overland	36	16	0.73	0.56	54	2.79	1.53	0.05	0.37	0.42	1.26	3.21	0.022	0.056	0.41
G Inflow	756	351	18.18	13.40	1261	67.01	36.82	1.12	8.95	10.08	30.19	77.09	0.458	1.322	9.71
G	370	211	17.71	12.69	1242	63.44	34.36	1.06	9.52	10.57	29.08	74.01	0.529	1.322	9.71
Pond Reduction	386	140	0.47	0.71	18	3.57	2.46	0.06	-0.56	-0.50	1.12	3.08	-0.070	0.000	0.00
(%)	51	40	3	5	1	5	7	6	-6	-5	4	4	-15	0	0
F	115	45	2.40	1.85	188	7.51	4.51	0.15	0.83	0.98	3.01	8.49	0.050	0.125	0.92
A Overland	84	31	1.35	1.11	118	5.32	3.00	0.11	0.60	0.71	2.32	6.02	0.048	0.097	0.71
A Inflow	569	287	21.47	15.65	1548	76.27	41.87	1.31	10.94	12.26	34.40	88.52	0.627	1.544	11.34
A	1299	520	15.59	15.16	1862	103.95	51.97	2.17	15.16	17.32	51.97	121.27	0.433	2.166	15.91
Wetland Reduction	-730	-232	5.88	0.49	-314	-27.68	-10.11	-0.85	-4.22	-5.07	-17.57	-32.75	0.194	-0.622	-4.57
(%)	-128	-81	27	3	-20	-36	-24	-65	-39	-41	-51	-37	31	-40	-40
System Reduction	-344	-92	6.34	1.20	-296	-24.10	-7.65	-0.79	-4.78	-5.56	-16.46	-29.67	0.124	-0.622	-4.57
(%)	-36	-22	29	7	-19	-30	-17	-57	-46	-47	-46	-32	22	-40	-40

Precip. = Snowmelt (Part 2)

* The following data in this table were modeled:
- A overland and G overland water quality and flow
- F flow

McCarrons 1996 Load Totals

Event: **Rain 5/02/96**

Precipitation Inches: 0.60

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	281	77	0.69	0.07	129	3.00	2.71	0.02	0.18	0.20	0.29	3.20	0.020	0.05	0.75
D	194	64	0.25	0.08	125	1.70	1.09	0.06	0.44	0.50	0.61	2.20	0.080	0.05	1.21
E	134	28	0.17	0.09	85	1.40	0.88	0.03	0.40	0.43	0.52	1.83	0.020	0.05	0.78
G Overland [Avg of C+D+E]	203	56	0.37	0.08	113	2.03	1.56	0.04	0.34	0.38	0.47	2.41	0.040	0.05	0.09
G	23	10	0.16	0.04	41	1.30	1.28	0.02	0.10	0.12	0.02	1.42	0.005	0.05	2.59
F	37	20	0.55	0.28	100	1.99	1.50	0.05	0.43	0.48	0.49	2.47	0.021	0.05	0.59
A Overland [Avg of C+F]	159	49	0.62	0.18	115	2.50	2.11	0.04	0.31	0.34	0.39	2.84	0.021	0.05	0.47
A	11	6	0.14	0.04	54	1.20	1.18	0.01	0.13	0.14	0.02	1.34	0.005	0.05	4.00

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	574	157	1.41	0.14	263	6.13	5.53	0.04	0.37	0.41	0.59	6.53	0.041	0.102	0.75
D	639	211	0.82	0.26	412	5.60	3.59	0.20	1.45	1.65	2.01	7.25	0.264	0.165	1.21
E	285	59	0.36	0.19	180	2.97	1.87	0.06	0.85	0.91	1.10	3.89	0.042	0.106	0.78
G Overland + Atmos.	50	14	0.10	0.03	28	0.70	0.38	0.01	0.20	0.21	0.12	0.92	0.010	0.012	0.21
G Inflow	1547	441	2.69	0.63	883	15.40	11.37	0.31	2.87	3.18	3.82	18.58	0.357	0.385	2.95
G	162	71	1.13	0.28	289	9.17	9.02	0.14	0.71	0.85	0.14	10.01	0.035	0.353	2.59
Pond Reduction	1385	371	1.57	0.35	594	6.24	2.35	0.17	2.16	2.33	3.68	8.57	0.321	0.033	0.36
(%)	90	84	58	55	67	40	21	55	75	73	96	46	90	8	12
F	59	32	0.88	0.45	161	3.20	2.41	0.08	0.69	0.77	0.79	3.97	0.034	0.080	0.59
A Overland + Atmos.	203	62	0.82	0.25	146	3.75	2.69	0.05	0.70	0.76	0.50	4.50	0.026	0.064	0.78
A Inflow	425	165	2.83	0.98	596	16.11	14.13	0.27	2.10	2.37	1.43	18.48	0.095	0.497	3.96
A	120	65	1.52	0.44	588	13.07	12.85	0.11	1.42	1.52	0.22	14.59	0.054	0.544	4.00
Wetland Reduction	305	99	1.31	0.55	8	3.04	1.28	0.17	0.68	0.85	1.21	3.89	0.041	-0.048	-0.04
(%)	72	60	46	56	1	19	9	60	33	36	85	21	43	-10	-1
System Reduction	1690	470	2.88	0.90	602	9.28	3.63	0.34	2.84	3.18	4.89	12.46	0.362	-0.015	0.32
(%)	93	88	65	67	51	42	22	76	67	68	96	46	87	-3	7

NOTE: grate unplugged at Site A during event leading to excess outflow

Precip. = 0.60 "
Duration = 10 hrs.
Intensity = 0.06 in/hr.
Last Precip. = 157 hrs.

Pond inflow (A'/hr.) = 0.29
Hydr. Resid. (hr.) = 34.30

* The following data in this table were modeled:
F -all water quality parameters.
A & G overland flow.
A Flow

McCarrons 1996 Load Totals

Event: Rain 5/18-19/96

Precipitation Inches: 1.48

Concentrations in mg/l (underlined values indicate "less than")

Site		TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C		58	17	0.16	0.01	32	2.00	1.98	0.01	0.08	0.09	0.02	2.09	0.005	0.05	4.05
D		287	72	0.29	0.06	80	2.40	2.26	0.02	0.30	0.32	0.14	2.72	0.120	0.06	2.60
E		168	29	0.29	0.07	34	2.40	2.18	0.02	0.26	0.28	0.22	2.68	0.030	0.05	2.86
G Overland	[Avg of C+D+E]	171	39	0.25	0.05	49	2.27	2.14	0.02	0.21	0.23	0.13	2.50	0.052	0.05	0.22
G		29	9	0.15	0.01	29	1.80	1.72	0.01	0.18	0.19	0.08	1.99	0.005	0.05	8.76
F		1520	139	0.36	0.10	41	1.50	1.32	0.03	0.23	0.26	0.18	1.76	0.020	0.05	0.92
A Overland	[Avg of C+F]	789	78	0.26	0.06	37	1.75	1.65	0.02	0.16	0.18	0.10	1.93	0.013	0.05	1.19
A		73	34	0.18	0.05	28	1.60	1.58	0.01	0.09	0.10	0.02	1.70	0.005	0.05	12.92

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	639	187	1.76	0.11	353	22.05	21.83	0.11	0.88	0.99	0.22	23.04	0.055	0.551	4.05
D	2031	510	2.05	0.42	566	16.99	16.00	0.14	2.12	2.26	0.99	19.25	0.849	0.425	2.60
E	1308	226	2.26	0.54	265	18.69	16.97	0.16	2.02	2.18	1.71	20.87	0.234	0.389	2.86
G Overland + Atmos.	102	24	0.17	0.05	29	1.87	1.28	0.02	0.41	0.43	0.08	2.30	0.031	0.032	0.50
G Inflow	4081	946	6.25	1.13	1213	59.59	56.08	0.43	5.44	5.87	3.00	65.46	1.169	1.397	10.01
G	692	215	3.58	0.24	692	42.92	41.02	0.24	4.29	4.53	1.91	47.45	0.119	1.192	8.76
Pond Reduction	3390	732	2.67	0.90	521	16.66	15.06	0.19	1.15	1.34	1.09	18.00	1.050	0.205	1.25
(%)	83	77	43	79	43	28	27	44	21	23	36	28	90	15	13
F	3807	348	0.90	0.25	103	3.76	3.31	0.08	0.58	0.65	0.45	4.41	0.050	0.125	0.92
A Overland + Atmos.	2556	253	0.91	0.25	118	7.04	5.35	0.09	1.27	1.36	0.32	8.39	0.040	0.162	1.95
A Inflow	7054	815	5.39	0.74	912	53.72	49.67	0.40	6.14	6.54	2.68	60.26	0.210	1.480	11.63
A	2567	1196	6.33	1.76	985	56.27	55.57	0.35	3.17	3.52	0.70	59.79	0.176	1.759	12.92
Wetland Reduction	4487	-380	-0.94	-1.02	-72	-2.56	-5.90	0.05	2.97	3.02	1.98	0.47	0.034	-0.279	-1.29
(%)	64	-47	-17	-138	-8	-5	-12	12	48	46	74	1	16	-19	-11
System Reduction	7876	351	1.73	-0.12	449	14.11	9.16	0.23	4.12	4.36	3.07	18.47	1.084	-0.074	-0.03
(%)	75	23	22	-7	31	20	14	40	57	55	81	24	86	-4	0

Precip. = 1.48 "
Duration = 7 hrs.
Intensity = 0.21 in/hr.
Last Precip. = 23.5 hrs.

Pond inflow (A'/hr.) = 1.43
Hydr. Resid. (hr.) = 7.06

* The following data in this table were modeled:
- A & G overland flow.
- D flow

McCarrons 1996 Load Totals

Event: Rain 6/06/96

Precipitation Inches: 2.12

Concentrations in mg/l (underlined values indicate "less than")

Site		TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C		33	12	0.18	0.08	44	2.10	2.04	0.03	0.12	0.15	0.06	2.25	0.005	0.05	8.61
D		490	102	0.23	0.13	110	1.80	1.42	0.03	0.22	0.25	0.38	2.05	0.080	0.05	5.50
E		148	23	0.56	0.11	41	1.80	1.36	0.10	0.35	0.45	0.44	2.25	0.006	0.05	5.36
G Overland	[Avg of C+D+E]	224	46	0.32	0.11	65	1.90	1.61	0.05	0.23	0.28	0.29	2.18	0.030	0.05	0.32
G		65	19	0.27	0.05	44	2.20	2.07	0.03	0.05	0.08	0.13	2.28	0.005	0.05	19.79
F		237	29	0.31	0.20	48	2.00	1.40	0.03	0.12	0.15	0.60	2.15	0.005	0.05	1.50
A Overland	[Avg of C+F]	135	21	0.25	0.14	46	2.05	1.72	0.03	0.12	0.15	0.33	2.20	0.005	0.05	1.71
A		27	8	0.20	0.06	39	1.30	1.19	0.03	0.10	0.13	0.11	1.43	0.005	0.05	23.00

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	773	281	4.22	1.88	1031	49.22	47.81	0.70	2.81	3.52	1.41	52.74	0.117	1.172	8.61
D	7336	1527	3.44	1.95	1647	26.95	21.26	0.45	3.29	3.74	5.69	30.69	1.198	0.749	5.50
E	2159	336	8.17	1.61	598	26.26	19.84	1.46	5.11	6.57	6.42	32.83	0.088	0.730	5.36
G Overland + Atmos.	195	40	0.32	0.13	57	2.38	1.40	0.06	0.61	0.67	0.26	3.05	0.026	0.044	0.73
G Inflow	10464	2184	16.15	5.56	3333	104.82	90.32	2.67	11.82	14.49	13.77	119.31	1.429	2.694	20.20
G	3502	1024	14.55	2.69	2370	118.52	111.52	1.62	2.69	4.31	7.00	122.83	0.269	2.694	19.79
Pond Reduction	6962	1160	1.61	2.86	963	-13.70	-21.20	1.05	9.13	10.18	6.77	-3.52	1.160	0.000	0.41
(%)	67	53	10	52	29	-13	-23	39	77	70	49	-3	81	0	2
F	968	118	1.27	0.82	196	8.17	5.72	0.12	0.49	0.61	2.45	8.78	0.020	0.204	1.50
A Overland + Atmos.	628	95	1.24	0.76	214	11.50	8.01	0.17	1.66	1.83	1.54	13.33	0.023	0.233	2.81
A Inflow	5098	1237	17.06	4.27	2781	138.19	125.24	1.91	4.84	6.75	10.99	144.94	0.313	3.131	24.10
A	1691	501	12.52	3.76	2442	81.39	74.51	1.88	6.26	8.14	6.89	89.53	0.313	3.131	23.00
Wetland Reduction	3407	737	4.53	0.51	339	56.79	50.73	0.03	-1.42	-1.39	4.10	55.41	0.000	0.000	1.10
(%)	67	60	27	12	12	41	41	2	-29	-21	37	38	0	0	5
System Reduction	10370	1897	6.14	3.37	1301	43.09	29.53	1.08	7.71	8.79	10.87	51.89	1.160	0.000	1.50
(%)	86	79	33	47	35	35	28	37	55	52	61	37	79	0	6

NOTE: flow lost over berms at A & G

Precip. = 2.12 "

Duration = 3.75 hrs.

Intensity = 0.565 in/hr.

Last Precip. = 16 hrs.

Pond inflow (A'/hr.) = 5.39

Hydr. Resid. (hr.) = 1.88

* The following data in this table were modeled:

E, D, F - flow - A, G flow (balance)

A & G overland flow.

McCarrons 1996 Load Totals

Event: **Rain 6/16-17/96**

Precipitation Inches: 1.62

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	29	15	0.17	0.02	53	2.20	2.18	0.04	0.05	0.09	0.02	2.29	0.005	0.05	5.79
D	33	10	0.18	0.08	51	0.86	0.78	0.06	0.26	0.32	0.08	1.18	0.005	0.05	1.88
E	25	9	0.10	0.04	42	0.80	0.60	0.07	0.24	0.31	0.20	1.11	0.005	0.05	3.76
G Overland [Avg of C+D+E]	29	11	0.15	0.05	49	1.29	1.19	0.06	0.18	0.24	0.10	1.53	0.005	0.05	0.24
G	12	7	0.21	0.06	46	1.80	1.55	0.07	0.12	0.19	0.25	1.99	0.005	0.05	11.39
F	86	14	0.18	0.06	48	0.81	0.74	0.05	0.40	0.45	0.07	1.26	0.005	0.05	0.83
A Overland [Avg of C+F]	58	15	0.18	0.04	51	1.51	1.46	0.05	0.23	0.27	0.05	1.78	0.005	0.05	1.28
A	7	3	0.21	0.11	39	1.10	0.92	0.05	0.08	0.13	0.18	1.23	0.005	0.05	13.19

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	457	236	2.68	0.32	835	34.68	34.36	0.63	0.79	1.42	0.32	36.09	0.079	0.788	5.79
D	169	51	0.92	0.41	261	4.40	3.99	0.31	1.33	1.64	0.41	6.04	0.026	0.256	1.88
E	256	92	1.02	0.41	430	8.19	6.14	0.72	2.46	3.17	2.05	11.36	0.051	0.512	3.76
G Overland + Atmos.	19	7	0.13	0.06	32	1.40	0.78	0.05	0.43	0.48	0.07	1.87	0.003	0.033	0.55
G Inflow	901	387	4.75	1.19	1558	48.66	45.27	1.70	5.01	6.71	2.84	55.37	0.159	1.588	11.98
G	372	217	6.51	1.86	1426	55.81	48.06	2.17	3.72	5.89	7.75	61.70	0.155	1.550	11.39
Pond Reduction	529	170	-1.76	-0.67	132	-7.15	-2.79	-0.47	1.29	0.82	-4.91	-6.33	0.004	0.038	0.59
(%)	59	44	-37	-56	8	-15	-6	-28	26	12	-173	-11	2	2	5
F	194	32	0.41	0.14	108	1.83	1.67	0.11	0.90	1.02	0.16	2.85	0.011	0.113	0.83
A Overland + Atmos.	200	51	0.69	0.22	176	6.74	5.09	0.18	1.63	1.81	0.16	8.55	0.017	0.174	2.12
A Inflow	767	299	7.61	2.21	1711	64.38	54.82	2.46	6.25	8.71	8.07	73.10	0.184	1.838	14.34
A	251	108	7.54	3.95	1400	39.50	33.03	1.80	2.87	4.67	6.46	44.16	0.180	1.795	13.19
Wetland Reduction	515	191	0.07	-1.73	310	24.89	21.79	0.67	3.38	4.05	1.60	28.93	0.004	0.042	1.15
(%)	67	64	1	-78	18	39	40	27	54	46	20	40	2	2	8
System Reduction	1044	362	-1.69	-2.40	442	17.74	18.99	0.20	4.66	4.86	-3.31	22.60	0.008	0.080	1.74
(%)	81	77	-29	-155	24	31	37	10	62	51	-105	34	4	4	12

Precip. = 1.62 "
Duration = 28.25 hrs.
Intensity = 0.06 in/hr.
Last Precip. = 15.75 hrs.

Pond inflow (A'/hr.) = 0.42
Hydr. Resid. (hr.) = 23.82

* The following data in this table were modeled:
E -flow total.
A & G overland flow.

McCarrons 1996 Load Totals

Event: Rain 6/21/96

Precipitation Inches: 1.40

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	100	35	0.38	0.08	59	1.90	1.63	0.03	0.25	0.28	0.27	2.18	0.010	0.05	2.54
D	88	24	0.24	0.08	62	1.30	0.93	0.03	0.43	0.46	0.37	1.76	0.040	0.05	2.77
E	52	12	0.17	0.08	43	1.10	0.75	0.03	0.23	0.26	0.35	1.36	0.007	0.05	3.82
G Overland [Avg of C+D+E]	80	24	0.26	0.08	55	1.43	1.10	0.03	0.30	0.33	0.33	1.77	0.019	0.05	0.23
G	10	7	0.22	0.04	31	1.50	1.11	0.03	0.21	0.24	0.39	1.74	0.005	0.05	11.90
F	281	34	2.50	0.53	74	1.10	0.65	0.03	0.39	0.42	0.45	1.52	0.020	0.05	0.68
A Overland [Avg of C+F]	191	35	0.53	0.31	67	1.50	1.14	0.03	0.32	0.35	0.36	1.85	0.015	0.05	1.37
A	11	5	0.19	0.08	34	0.99	0.81	0.03	0.15	0.18	0.18	1.17	0.005	0.05	11.08

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	691	242	2.63	0.55	408	13.14	11.27	0.21	1.73	1.94	1.87	15.07	0.069	0.346	2.54
D	664	181	1.81	0.60	468	9.80	7.01	0.23	3.24	3.47	2.79	13.27	0.302	0.377	2.77
E	541	125	1.77	0.83	447	11.44	7.80	0.31	2.39	2.70	3.64	14.14	0.073	0.520	3.82
G Overland + Atmos.	50	15	0.19	0.08	34	1.38	0.69	0.03	0.46	0.49	0.21	1.86	0.012	0.031	0.50
G Inflow	1946	563	6.40	2.06	1357	35.76	26.77	0.77	7.82	8.59	8.50	44.35	0.455	1.274	9.63
G	324	227	7.13	1.30	1004	48.59	35.96	0.97	6.80	7.77	12.63	56.37	0.162	1.620	11.90
Pond Reduction	1622	336	-0.73	0.77	353	-12.83	-9.18	-0.20	1.02	0.82	-4.13	-12.01	0.293	-0.346	-2.27
(%)	83	60	-11	37	26	-36	-34	-26	13	10	-49	-27	64	-27	-24
F	520	63	4.63	0.98	137	2.04	1.20	0.06	0.72	0.78	0.83	2.81	0.037	0.093	0.68
A Overland + Atmos.	710	129	2.04	1.21	248	6.89	4.25	0.13	1.92	2.05	1.34	8.94	0.056	0.186	2.09
A Inflow	1555	418	13.80	3.48	1389	57.52	41.41	1.16	9.45	10.60	14.81	68.12	0.255	1.899	14.67
A	332	151	5.73	2.41	1026	29.86	24.43	0.90	4.52	5.43	5.43	35.29	0.151	1.508	11.08
Wetland Reduction	1223	268	8.07	1.07	364	27.66	16.98	0.25	4.92	5.17	9.38	32.83	0.104	0.391	3.59
(%)	79	64	58	31	26	48	41	22	52	49	63	48	41	21	24
System Reduction	2845	603	7.34	1.84	716	14.82	7.80	0.05	5.94	5.99	5.25	20.82	0.398	0.045	1.32
(%)	90	80	56	43	41	33	24	6	57	52	49	37	73	3	11

Precip. = 1.40 "
Duration = 5 hrs.
Intensity = 0.28 in/hr.
Last Precip. = 86.5 hrs.

Pond inflow (A'/hr.) = 1.93
Hydr. Resid. (hr.) = 5.24

* The following data in this table were modeled:
A & G overland flow.

McCarrons 1996 Load Totals

Event: **Rain 7/06/96**

Precipitation Inches: 0.48

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	124	50	0.57	0.08	134	2.40	2.25	0.41	1.69	2.10	0.15	4.50	0.037	0.05	0.22
D	314	81	0.79	0.09	148	3.10	2.97	0.18	0.88	1.06	0.13	4.16	0.120	0.05	1.29
E	142	30	0.77	0.12	92	2.80	2.63	0.17	1.94	2.11	0.17	4.91	0.030	0.05	2.16
G Overland [Avg of C+D+E]	193	54	0.71	0.10	125	2.77	2.62	0.25	1.50	1.76	0.15	4.52	0.062	0.05	0.07
G	214	110	0.46	0.07	87	3.30	3.05	0.12	0.66	0.78	0.25	4.08	0.009	0.05	2.65
F	185	60	0.56	0.19	155	2.80	2.78	0.13	0.72	0.85	0.02	3.65	0.030	0.05	0.43
A Overland [Avg of C+F]	155	55	0.57	0.14	145	2.60	2.52	0.27	1.21	1.48	0.09	4.08	0.034	0.05	0.37
A	16	8	0.31	0.09	48	1.20	1.17	0.04	0.57	0.61	0.03	1.81	0.005	0.05	3.20

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	74	30	0.34	0.05	80	1.44	1.35	0.25	1.01	1.26	0.09	2.70	0.022	0.030	0.22
D	1103	284	2.77	0.32	520	10.89	10.43	0.63	3.09	3.72	0.46	14.61	0.421	0.176	1.29
E	835	176	4.53	0.71	541	16.46	15.46	1.00	11.41	12.41	1.00	28.87	0.176	0.294	2.16
G Overland + Atmos.	37	10	0.14	0.03	24	0.69	0.50	0.05	0.38	0.43	0.03	1.12	0.012	0.010	0.16
G Inflow	2049	501	7.79	1.10	1165	29.48	27.74	1.93	15.89	17.82	1.57	47.30	0.632	0.509	3.83
G	1544	794	3.32	0.50	628	23.81	22.00	0.87	4.76	5.63	1.80	29.43	0.065	0.361	2.65
Pond Reduction	505	-293	4.47	0.59	537	5.67	5.74	1.06	11.13	12.19	-0.23	17.86	0.567	0.148	1.18
(%)	25	-58	57	54	46	19	21	55	70	68	-15	38	90	29	31
F	217	70	0.66	0.22	181	3.28	3.25	0.15	0.84	0.99	0.02	4.27	0.035	0.059	0.43
A Overland + Atmos.	156	55	0.59	0.16	146	3.06	2.53	0.28	1.46	1.74	0.09	4.80	0.034	0.050	0.62
A Inflow	1916	919	4.57	0.89	955	30.15	27.79	1.30	7.07	8.36	1.91	38.51	0.134	0.470	3.70
A	139	70	2.70	0.78	418	10.45	10.19	0.35	4.97	5.31	0.26	15.77	0.044	0.436	3.20
Wetland Reduction	1777	849	1.87	0.10	536	19.69	17.60	0.95	2.10	3.05	1.65	22.74	0.090	0.034	0.50
(%)	93	92	41	12	56	65	63	73	30	36	86	59	67	7	13
System Reduction	2281	557	6.33	0.69	1074	25.37	23.34	2.01	13.23	15.24	1.42	40.60	0.657	0.182	1.68
(%)	94	89	70	47	72	71	70	85	73	74	84	72	94	30	34

Precip. = 0.48 "
Duration = 1.25 hrs.
Intensity = 0.38 in/hr.
Last Precip. = 318 hrs.

Pond inflow (A'/hr.) = 3.07
Hydr. Resid. (hr.) = 3.29

* The following data in this table were modeled:
C -all water quality parameters.
E -all water quality parameters.
A & G overland flow.

McCarrons 1996 Load Totals

Event: Rain 7/27-28/96

Precipitation Inches: 0.58

Concentrations in mg/l (underlined values indicate "less than")

Site		TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C		307	157	0.19	0.14	171	2.10	2.00	0.07	0.75	0.82	0.10	2.92	0.100	0.05	0.09
D		58	21	0.29	0.04	90	1.20	1.18	0.05	0.49	0.54	0.02	1.74	0.040	0.05	0.48
E		117	22	0.22	0.05	73	0.98	0.81	0.04	0.46	0.50	0.17	1.48	0.040	0.05	1.25
G Overland	[Avg of C+D+E]	161	67	0.23	0.08	111	1.43	1.33	0.05	0.57	0.62	0.10	2.05	0.060	0.05	0.09
G		45	25	0.27	0.15	72	1.90	1.87	0.03	0.15	0.18	0.03	2.08	0.010	0.05	1.48
F		88	46	0.26	0.08	118	1.20	1.18	0.03	0.26	0.29	0.02	1.49	0.030	0.05	0.25
A Overland	[Avg of C+F]	198	102	0.23	0.11	145	1.65	1.59	0.05	0.51	0.56	0.06	2.21	0.065	0.05	0.46
A		21	11	0.30	0.05	62	1.00	0.98	0.03	1.16	1.19	0.02	2.19	0.009	0.05	1.56

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	75	38	0.05	0.03	42	0.51	0.49	0.02	0.18	0.20	0.02	0.72	0.025	0.012	0.09
D	76	27	0.38	0.05	118	1.57	1.54	0.07	0.64	0.71	0.03	2.27	0.052	0.065	0.48
E	398	75	0.75	0.17	248	3.33	2.76	0.14	1.57	1.70	0.58	5.04	0.136	0.170	1.25
G Overland + Atmos.	39	16	0.07	0.03	27	0.55	0.33	0.02	0.25	0.27	0.02	0.82	0.015	0.012	0.20
G Inflow	588	157	1.24	0.29	435	5.97	5.11	0.23	2.64	2.87	0.65	8.84	0.228	0.260	2.02
G	181	101	1.09	0.60	290	7.65	7.53	0.12	0.60	0.73	0.12	8.38	0.040	0.201	1.48
Pond Reduction	407	56	0.15	-0.32	145	-1.69	-2.42	0.11	2.04	2.15	0.53	0.46	0.187	0.059	0.54
(%)	69	36	12	-111	33	-28	-47	48	77	75	81	5	82	23	27
F	60	31	0.18	0.05	80	0.82	0.80	0.02	0.18	0.20	0.01	1.01	0.020	0.034	0.25
A Overland + Atmos.	247	127	0.31	0.17	181	2.60	1.99	0.07	0.93	1.00	0.08	3.61	0.081	0.063	0.76
A Inflow	489	259	1.57	0.82	551	11.07	10.33	0.21	1.71	1.93	0.21	13.00	0.142	0.298	2.49
A	89	47	1.27	0.21	263	4.25	4.16	0.13	4.93	5.05	0.08	9.30	0.038	0.212	1.56
Wetland Reduction	399	212	0.30	0.61	288	6.83	6.17	0.08	-3.21	-3.13	0.12	3.70	0.104	0.086	0.93
(%)	82	82	19	74	52	62	60	40	-187	-162	59	28	73	29	37
System Reduction	806	269	0.45	0.29	433	5.14	3.75	0.20	-1.18	-0.98	0.66	4.16	0.291	0.144	1.47
(%)	90	85	26	58	62	55	47	61	-31	-24	89	31	88	40	49

Precip. = 0.58 "
Duration = 2.25 hrs.
Intensity = 0.26 in/hr.
Last Precip. = 234 hrs.

Pond inflow (A'/hr.) = 0.90
Hydr. Resid. (hr.) = 11.24

* The following data in this table were modeled:
A & G overland flow.

McCarrons 1996 Load Totals

Event: Rain 8/05/96

Precipitation Inches: 0.62

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	34	13	0.34	0.07	89	2.40	2.22	0.03	0.39	0.42	0.18	2.82	0.005	0.05	0.20
D	71	20	0.35	0.07	80	1.10	1.01	0.03	0.28	0.31	0.09	1.41	0.006	0.05	0.82
E	12	4	0.10	0.06	37	0.59	0.47	0.03	0.32	0.35	0.12	0.94	0.005	0.05	2.28
G Overland [Avg of C+D+E]	39	12	0.26	0.07	69	1.36	1.23	0.03	0.33	0.36	0.13	1.72	0.005	0.05	0.09
G	17	12	0.33	0.09	46	1.80	1.77	0.03	0.05	0.08	0.03	1.88	0.005	0.05	2.45
F	69	13	0.63	0.26	60	1.64	1.28	0.03	0.26	0.29	0.36	1.93	0.009	0.05	0.20
A Overland [Avg of C+F]	52	13	0.49	0.17	75	2.02	1.75	0.03	0.33	0.36	0.27	2.38	0.007	0.05	0.49
A	15	9	0.37	0.08	44	1.30	1.22	0.03	0.07	0.10	0.08	1.40	0.005	0.05	3.48

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	19	7	0.19	0.04	48	1.31	1.21	0.02	0.21	0.23	0.10	1.54	0.003	0.027	0.20
D	158	45	0.78	0.16	179	2.46	2.25	0.07	0.63	0.69	0.20	3.15	0.013	0.112	0.82
E	74	25	0.62	0.37	230	3.66	2.92	0.19	1.99	2.17	0.74	5.83	0.031	0.310	2.28
G Overland + Atmos.	10	3	0.08	0.03	17	0.55	0.30	0.01	0.20	0.21	0.03	0.76	0.001	0.012	0.21
G Inflow	261	80	1.66	0.59	474	7.97	6.68	0.28	3.02	3.30	1.08	11.28	0.048	0.461	3.51
G	113	80	2.20	0.60	307	12.01	11.80	0.20	0.33	0.53	0.20	12.54	0.033	0.333	2.45
Pond Reduction	148	0	-0.54	-0.01	167	-4.03	-5.12	0.08	2.69	2.77	0.88	-1.26	0.015	0.128	1.06
(%)	57	-1	-32	-1	35	-51	-77	29	89	84	81	-11	31	28	30
F	38	7	0.34	0.14	33	0.89	0.70	0.02	0.14	0.16	0.20	1.05	0.005	0.027	0.20
A Overland + Atmos.	69	17	0.68	0.25	99	3.27	2.33	0.05	0.76	0.80	0.36	4.07	0.009	0.067	0.81
A Inflow	220	104	3.22	0.99	439	16.17	14.84	0.27	1.23	1.50	0.76	17.66	0.048	0.427	3.46
A	142	85	3.51	0.76	417	12.32	11.56	0.28	0.66	0.95	0.76	13.26	0.047	0.474	3.48
Wetland Reduction	78	19	-0.28	0.23	22	3.85	3.28	-0.02	0.57	0.55	0.00	4.40	0.000	-0.046	-0.02
(%)	35	18	-9	24	5	24	22	-7	46	37	0	25	0	-11	-1
System Reduction	225	19	-0.82	0.23	189	-0.18	-1.84	0.06	3.26	3.32	0.87	3.13	0.015	0.082	1.04
(%)	61	18	-31	23	31	-2	-19	18	83	78	54	19	24	15	23

Precip. = 0.62 "
Duration = 3.75 hrs.
Intensity = 0.16 in./hr.
Last Precip. = 144 hrs.

Pond inflow (A'/hr.) = 0.94
Hydr. Resid. (hr.) = 10.79

* The following data in this table were modeled:
C -all water quality parameters.
F -all water quality parameters.
A & G overland flow.

McCarrons 1996 Load Totals

Event: Rain 8/6-7/96

Precipitation Inches: 0.76

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	76	33	0.25	0.05	62	2.40	2.22	0.03	0.41	0.44	0.18	2.84	0.024	<u>0.05</u>	0.13
D	56	16	0.18	0.04	53	0.80	0.71	0.03	0.39	0.42	0.09	1.22	0.020	<u>0.05</u>	1.18
E	73	18	0.20	0.08	48	0.97	0.84	0.03	0.35	0.38	0.13	1.35	0.020	<u>0.05</u>	2.21
G Overland [Avg of C+D+E]	68	22	0.21	0.06	54	1.39	1.26	0.03	0.38	0.41	0.13	1.80	0.021	0.05	0.11
G	14	8	0.21	0.08	33	1.10	1.08	0.03	1.05	1.08	0.02	2.18	<u>0.005</u>	<u>0.05</u>	2.33
F	34	12	0.13	0.06	40	0.72	0.60	0.03	0.32	0.35	0.12	1.07	<u>0.005</u>	<u>0.05</u>	0.38
A Overland [Avg of C+F]	55	23	0.19	0.06	51	1.56	1.41	0.03	0.37	0.40	0.15	1.96	0.015	0.05	0.60
A	11	5	0.31	0.11	44	0.97	0.89	0.03	0.70	0.73	0.08	1.70	<u>0.005</u>	<u>0.05</u>	4.94

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	27	12	0.09	0.02	22	0.85	0.79	0.01	0.15	0.16	0.06	1.01	0.008	0.018	0.13
D	180	51	0.58	0.13	170	2.57	2.28	0.10	1.25	1.35	0.29	3.92	0.064	0.161	1.18
E	439	108	1.20	0.48	289	5.84	5.05	0.18	2.11	2.29	0.78	8.12	0.120	0.301	2.21
G Overland + Atmos.	20	7	0.08	0.03	16	0.68	0.38	0.01	0.26	0.27	0.04	0.95	0.006	0.015	0.26
G Inflow	666	178	1.95	0.66	497	9.93	8.50	0.30	3.76	4.07	1.17	14.00	0.199	0.494	3.78
G	89	51	1.33	0.51	209	6.98	6.85	0.19	6.66	6.85	0.13	13.83	0.032	0.317	2.33
Pond Reduction	578	127	0.61	0.15	288	2.96	1.65	0.11	-2.90	-2.79	1.05	0.17	0.168	0.177	1.45
(%)	87	72	32	23	58	30	19	37	-77	-69	89	1	84	36	38
F	35	12	0.13	0.06	41	0.74	0.62	0.03	0.33	0.36	0.12	1.11	0.005	0.052	0.38
A Overland + Atmos.	90	37	0.35	0.13	83	3.25	2.30	0.06	0.99	1.05	0.25	4.30	0.024	0.082	0.99
A Inflow	214	100	1.81	0.70	334	10.97	9.77	0.28	7.98	8.26	0.50	19.24	0.061	0.451	3.70
A	148	67	4.17	1.48	592	13.04	11.97	0.40	9.41	9.82	1.08	22.86	0.067	0.672	4.94
Wetland Reduction	66	33	-2.35	-0.78	-258	-2.07	-2.19	-0.12	-1.43	-1.55	-0.58	-3.63	-0.007	-0.222	-1.24
(%)	31	33	-130	-112	-77	-19	-22	-44	-18	-19	-117	-19	-11	-49	-33
System Reduction	643	160	-1.74	-0.63	30	0.88	-0.55	-0.01	-4.33	-4.34	0.47	-3.46	0.161	-0.045	0.21
(%)	81	70	-72	-75	5	6	-5	-3	-85	-79	30	-18	71	-7	4

Precip. = 0.76 "
Duration = 11 hrs.
Intensity = 0.07 in/hr.
Last Precip. = 37.5 hrs.

Pond inflow (A'/hr.) = 0.34
Hydr. Resid. (hr.) = 29.43

* The following data in this table were modeled:
C - all water quality parameters.
A & G overland flow.

McCarrons 1996 Load Totals

Event: Rain 8/22/96

Precipitation Inches: 0.34

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	650	275	0.68	0.10	175	2.00	1.24	0.11	1.54	1.65	0.76	3.65	0.170	0.05	0.04
D	31	11	0.15	0.08	78	0.46	0.38	0.03	1.03	1.06	0.08	1.52	0.030	0.05	0.55
E	64	20	0.29	0.19	73	0.32	0.09	0.04	1.04	1.08	0.23	1.40	0.050	0.05	1.79
G Overland [Avg of C+D+E]	248	102	0.37	0.12	109	0.93	0.57	0.06	1.20	1.26	0.36	2.19	0.083	0.05	0.05
G	48	28	0.63	0.09	77	1.10	1.08	0.03	0.53	0.56	0.02	1.66	0.005	0.05	2.29
F	34	23	0.27	0.10	80	1.80	1.78	0.03	0.88	0.91	0.02	2.71	0.005	0.05	0.18
A Overland [Avg of G+F]	342	149	0.48	0.10	128	1.90	1.51	0.07	1.21	1.28	0.39	3.18	0.088	0.05	0.29
A	16	10	0.28	0.10	36	0.53	0.29	0.03	0.56	0.59	0.24	1.12	0.005	0.05	2.14

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	71	30	0.07	0.01	19	0.22	0.14	0.01	0.17	0.18	0.08	0.40	0.019	0.005	0.04
D	46	16	0.22	0.12	117	0.69	0.57	0.04	1.54	1.59	0.12	2.28	0.045	0.075	0.55
E	312	97	1.41	0.93	356	1.56	0.44	0.19	5.07	5.26	1.12	6.82	0.244	0.244	1.79
G Overland + Atmos.	34	14	0.06	0.02	15	0.24	0.08	0.01	0.23	0.24	0.05	0.48	0.011	0.007	0.12
G Inflow	463	158	1.77	1.08	506	2.71	1.22	0.26	7.01	7.27	1.37	9.98	0.318	0.331	2.50
G	299	175	3.93	0.56	480	6.86	6.73	0.19	3.30	3.49	0.12	10.35	0.031	0.312	2.29
Pond Reduction	164	-17	-2.16	0.52	26	-4.15	-5.51	0.07	3.70	3.78	1.25	-0.37	0.287	0.019	0.21
(%)	35	-11	-122	48	5	-153	-452	29	53	52	91	-4	90	6	8
F	17	11	0.13	0.05	39	0.88	0.87	0.01	0.43	0.45	0.01	1.33	0.002	0.025	0.18
A Overland + Atmos.	270	118	0.39	0.10	101	1.81	1.19	0.06	1.13	1.19	0.31	3.01	0.069	0.039	0.47
A Inflow	586	303	4.45	0.71	620	9.55	8.80	0.26	4.87	5.13	0.44	14.68	0.103	0.376	2.94
A	93	58	1.63	0.58	210	3.09	1.69	0.17	3.26	3.44	1.40	6.52	0.029	0.291	2.14
Wetland Reduction	493	245	2.82	0.12	410	6.47	7.11	0.09	1.60	1.69	-0.96	8.16	0.074	0.084	0.80
(%)	84	81	63	17	66	68	81	33	33	33	-216	56	72	22	27
System Reduction	656	228	0.66	0.64	436	2.32	1.59	0.16	5.31	5.47	0.29	7.79	0.361	0.103	1.00
(%)	88	80	29	52	68	43	49	48	62	61	17	54	93	26	32

Precip. = 0.34 "
Duration = 6.75 hrs.
Intensity = 0.05 in/hr.
Last Precip. = 52.25 hrs.

Pond inflow (A'/hr.) = 0.37
Hydr. Resid. (hr.) = 27.32

* The following data in this table were modeled:
A & G overland flow.

McCarrons 1996 Load Totals

Event: Rain 9/20/96

Precipitation Inches: 0.34

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	61	26	0.34	0.08	80	2.40	2.17	0.03	0.97	1.00	0.23	3.40	0.030	<u>0.05</u>	0.15
D	22	11	0.32	0.10	73	1.60	1.26	0.03	0.73	0.76	0.34	2.36	0.050	<u>0.05</u>	0.40
E	26	9	0.34	0.14	52	1.60	1.22	0.03	1.00	1.03	0.38	2.63	0.040	<u>0.05</u>	1.10
G Overland [Avg of C+D+E]	36	15	0.33	0.11	68	1.87	1.55	0.03	0.90	0.93	0.32	2.80	0.040	0.05	0.05
G	6	3	0.12	0.06	35	0.90	0.85	0.03	0.05	0.08	0.05	0.98	0.010	<u>0.05</u>	0.61
F	45	23	0.39	0.33	92	2.20	1.95	0.03	0.80	0.83	0.25	3.03	0.040	<u>0.05</u>	0.20
A Overland [Avg of C+F]	53	25	0.37	0.21	86	2.30	2.06	0.03	0.89	0.92	0.24	3.22	0.035	0.05	0.26
A	23	10	0.26	0.05	42	1.30	1.17	0.03	0.06	0.09	0.13	1.39	0.020	<u>0.05</u>	0.94

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	25	11	0.14	0.03	33	0.98	0.89	0.01	0.40	0.41	0.09	1.39	0.012	0.020	0.15
D	24	12	0.35	0.11	79	1.74	1.37	0.03	0.79	0.83	0.37	2.57	0.054	0.054	0.40
E	78	27	1.02	0.42	156	4.79	3.65	0.09	2.99	3.08	1.14	7.88	0.120	0.150	1.10
G Overland + Atmos.	5	2	0.05	0.02	9	0.37	0.21	0.01	0.19	0.19	0.04	0.56	0.005	0.007	0.12
G Inflow	132	52	1.56	0.58	277	7.88	6.12	0.14	4.37	4.51	1.65	12.40	0.192	0.231	1.77
G	10	5	0.20	0.10	58	1.49	1.41	0.05	0.08	0.13	0.08	1.63	0.017	0.083	0.61
Pond Reduction	122	47	1.36	0.48	219	6.39	4.71	0.09	4.29	4.38	1.56	10.77	0.175	0.148	1.16
(%)	92	90	87	83	79	81	77	65	98	97	95	87	91	64	65
F	25	13	0.21	0.18	50	1.20	1.06	0.02	0.44	0.45	0.14	1.65	0.022	0.027	0.20
A Overland + Atmos.	38	17	0.27	0.16	61	1.94	1.46	0.03	0.80	0.83	0.17	2.77	0.025	0.035	0.44
A Inflow	72	35	0.69	0.44	169	4.63	3.93	0.09	1.32	1.41	0.39	6.05	0.063	0.146	1.25
A	59	26	0.67	0.13	107	3.33	2.99	0.08	0.15	0.23	0.33	3.56	0.051	0.128	0.94
Wetland Reduction	13	9	0.02	0.31	62	1.31	0.94	0.02	1.17	1.18	0.06	2.49	0.012	0.018	0.31
(%)	18	27	3	71	36	28	24	17	88	84	14	41	19	12	25
System Reduction	135	56	1.38	0.79	281	7.70	5.65	0.11	5.46	5.56	1.62	13.26	0.187	0.166	1.46
(%)	70	69	67	86	72	70	65	58	97	96	83	79	79	56	61

Precip. = 0.34 "
Duration = 3.25 hrs.
Intensity = 0.10 in/hr.
Last Precip. = 390

Pond inflow (A'/hr.) = 0.54
Hydr. Resid. (hr.) = 18.60

* The following data in this table were modeled:
C -all water quality parameters and flow — D - flow
E -all water quality parameters. — A&G overland flow

McCarrons 1996 Load Totals

Event: Rain 9/25-27/96

Precipitation Inches: 0.44

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	48	25	0.24	0.09	60	2.38	2.17	0.11	1.00	1.11	0.21	3.49	0.010	0.05	0.23
D	13	5	0.12	0.12	47	1.10	0.76	0.08	0.82	0.90	0.34	2.00	0.020	0.05	0.61
E	9	4	0.10	0.10	34	1.20	0.79	0.06	1.03	1.09	0.41	2.29	0.009	0.05	1.36
G Overland [Avg of C+D+E]	23*	11	0.15	0.10	47	1.56	1.24	0.08	0.95	1.03	0.32	2.59	0.013	0.05	0.07
G	5	3	0.12	0.02	26	0.89	0.79	0.03	0.08	0.11	0.10	1.00	0.005	0.05	0.58
F	20	13	0.21	0.10	35	1.40	1.04	0.03	0.75	0.78	0.36	2.18	0.006	0.05	0.45
A Overland [Avg of C+F]	34	19	0.23	0.10	48	1.89	1.61	0.07	0.88	0.95	0.29	2.84	0.008	0.05	0.40
A	13	5	0.24	0.10	34	1.10	1.01	0.03	0.09	0.12	0.09	1.22	0.005	0.05	1.28

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	30	16	0.15	0.06	38	1.49	1.36	0.07	0.63	0.69	0.13	2.19	0.006	0.031	0.23
D	22	8	0.20	0.20	78	1.83	1.26	0.13	1.36	1.49	0.56	3.32	0.033	0.083	0.61
E	33	15	0.37	0.37	126	4.44	2.92	0.22	3.81	4.04	1.52	8.48	0.033	0.185	1.36
G Overland + Atmos.	4	2	0.04	0.03	9	0.45	0.24	0.02	0.27	0.28	0.06	0.73	0.002	0.010	0.15
G Inflow	89	41	0.76	0.65	250	8.21	5.78	0.44	6.07	6.51	2.27	14.72	0.075	0.309	2.35
G	8	5	0.19	0.03	41	1.41	1.25	0.05	0.13	0.17	0.16	1.58	0.008	0.079	0.58
Pond Reduction	82	36	0.57	0.62	209	6.80	4.53	0.39	5.94	6.34	2.12	13.14	0.067	0.230	1.77
(%)	91	88	75	95	84	83	78	89	98	97	93	89	90	74	75
F	25	16	0.26	0.12	43	1.72	1.27	0.04	0.92	0.96	0.44	2.67	0.007	0.061	0.45
A Overland + Atmos.	37	21	0.27	0.13	52	2.46	1.75	0.08	1.18	1.26	0.31	3.73	0.009	0.054	0.63
A Inflow	69	41	0.71	0.28	136	5.58	4.27	0.17	2.23	2.39	0.91	7.98	0.024	0.195	1.66
A	45	17	0.84	0.35	118	3.83	3.52	0.10	0.31	0.42	0.31	4.25	0.017	0.174	1.28
Wetland Reduction	24	24	-0.12	-0.07	17	1.75	0.75	0.06	1.91	1.97	0.60	3.73	0.007	0.020	0.38
(%)	35	58	-17	-25	13	31	18	37	86	83	66	47	27	10	23
System Reduction	106	60	0.44	0.55	227	8.55	5.28	0.46	7.85	8.31	2.71	16.86	0.074	0.250	2.15
(%)	70	78	35	61	66	69	60	81	96	95	90	80	81	59	63

Precip.	= 0.44 "	Pond inflow (A'/hr.) =	0.09
Duration	= 26.75 hrs.	Hydr. Resid. (hr.) =	114.76
Intensity	= 0.016 in/hr.		
Last Precip.	= 99.5 hrs.		

* The following data in this table were modeled:

C -all water quality parameters	D - flow
A, E, G - dissolved phosphorus	A & G overland flow.

McCarrons 1996 Load Totals

Event: Rain 10/16-17/96

Precipitation Inches: 1.42

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	64	26	0.28	0.07	74	2.38	2.22	0.03	0.47	0.50	0.16	2.88	0.027	0.05	2.80
D	49	17	0.19	0.07	65	1.08	0.93	0.03	0.42	0.45	0.15	1.53	0.037	0.05	3.10
E	30	10	0.16	0.10	43	0.99	0.57	0.03	0.40	0.43	0.42	1.42	0.020	0.05	5.85
G Overland (Avg of C+D+E)	48	18	0.21	0.08	61	1.48	1.24	0.03	0.43	0.46	0.24	1.94	0.028	0.05	0.21
G	8	5	0.11	0.04	40	0.80	0.78	0.03	0.11	0.14	0.02	0.94	0.005	0.05	10.79
F	23	13	0.45	0.30	79	1.40	1.24	0.04	0.41	0.45	0.16	1.85	0.009	0.05	0.88
A Overland (Avg of C+F)	44	20	0.37	0.19	77	1.89	1.73	0.04	0.44	0.48	0.16	2.37	0.018	0.05	1.10
A	12	6	0.24	0.15	41	0.93	0.91	0.03	0.09	0.12	0.02	1.05	0.005	0.05	11.35

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	al Water, A'
C	488	198	2.13	0.53	564	18.14	16.92	0.23	3.58	3.81	1.22	21.95	0.206	0.381	2.80
D	414	143	1.60	0.59	549	9.11	7.85	0.25	3.54	3.80	1.27	12.91	0.312	0.422	3.10
E	478	159	2.55	1.59	685	15.77	9.08	0.48	6.37	6.85	6.69	22.61	0.319	0.796	5.85
G Overland + Atmos.	27	10	0.15	0.07	35	1.34	0.71	0.02	0.52	0.54	0.14	1.88	0.016	0.029	0.48
G Inflow	1406	511	6.43	2.79	1832	44.36	34.56	0.98	14.02	15.00	9.31	59.36	0.853	1.628	12.23
G	235	147	3.23	1.17	1175	23.50	22.91	0.88	3.23	4.11	0.59	27.61	0.147	1.469	10.79
Pond Reduction	1171	364	3.20	1.61	657	20.86	11.64	0.10	10.79	10.89	8.73	31.75	0.706	0.159	1.44
(%)	83	71	50	58	36	47	34	10	77	73	94	53	83	10	12
F	55	31	1.08	0.72	189	3.35	2.97	0.10	0.98	1.08	0.38	4.43	0.022	0.120	0.88
A Overland + Atmos.	130	58	1.16	0.62	229	6.97	5.18	0.12	2.05	2.18	0.48	9.15	0.054	0.150	1.83
A Inflow	420	236	5.47	2.52	1593	33.82	31.06	1.10	6.27	7.37	1.45	41.19	0.222	1.738	13.50
A	371	185	7.42	4.63	1267	28.73	28.12	0.93	2.78	3.71	0.62	32.44	0.154	1.545	11.35
Wetland Reduction	50	51	-1.94	-2.12	326	5.09	2.95	0.17	3.49	3.66	0.83	8.75	0.068	0.193	2.15
(%)	12	22	-36	-84	20	15	9	16	56	50	57	21	31	11	16
System Reduction	1221	415	1.26	-0.50	984	25.95	14.59	0.28	14.27	14.55	9.56	40.50	0.774	0.353	3.60
(%)	77	69	14	-12	44	47	34	23	84	80	94	56	83	19	24

Precip. = 1.42 "
Duration = 9.75 hrs.
Intensity = 0.14 in/hr.
Last Precip. = 41.25 hrs.

Pond inflow (A'/hr.) = 1.25
Hydr. Resid. (hr.) = 8.05

* The following data in this table were modeled:
C -all water quality and flow parameters
D -all water quality and flow parameters
A & G overland flow.

McCarrons 1996 Load Totals

Event: Rain 10/22-24/96

Precipitation Inches: 0.74

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	38	22	0.74	0.26	106	1.50	1.36	0.03	0.16	0.19	0.14	1.69	0.020	0.05	1.29
D	14	7	0.15	0.10	44	0.51	0.41	0.03	0.31	0.34	0.10	0.85	0.010	0.05	2.16
E	9	5	0.19	0.19	44	0.79	0.64	0.03	0.25	0.28	0.15	1.07	0.007	0.05	3.11
G Overland [Avg of C+D+E]	20	11	0.36	0.18	65	0.93	0.80	0.03	0.24	0.27	0.13	1.20	0.012	0.05	0.11
G	7	4	0.12	0.06	32	0.64	0.62	0.03	0.13	0.16	0.02	0.80	0.005	0.05	6.67
F	11	8	0.60	0.57	133	1.18	1.08	0.03	0.27	0.30	0.10	1.48	0.010	0.05	0.72
A Overland [Avg of C+F]	25	15	0.67	0.42	120	1.34	1.22	0.03	0.22	0.25	0.12	1.59	0.015	0.05	0.60
A	8	4	0.17	0.11	30	0.80	0.78	0.06	0.25	0.31	0.02	1.11	0.005	0.05	7.53

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	133	77	2.60	0.91	372	5.27	4.78	0.11	0.56	0.67	0.49	5.93	0.070	0.176	1.29
D	82	41	0.88	0.59	259	3.00	2.41	0.18	1.82	2.00	0.59	5.00	0.059	0.294	2.16
E	76	42	1.61	1.61	373	6.69	5.42	0.25	2.12	2.37	1.27	9.06	0.059	0.423	3.11
G Overland + Atmos.	6	3	0.12	0.07	19	0.53	0.24	0.01	0.21	0.23	0.04	0.76	0.004	0.015	0.25
G Inflow	298	164	5.21	3.18	1023	15.49	12.85	0.55	4.72	5.26	2.39	20.75	0.192	0.908	6.81
G	127	73	2.18	1.09	581	11.62	11.26	0.54	2.36	2.91	0.36	14.53	0.091	0.908	6.67
Pond Reduction	171	92	3.03	2.09	442	3.87	1.59	0.00	2.36	2.36	2.03	6.23	0.101	0.000	0.14
(%)	57	56	58	66	43	25	12	1	50	45	85	30	53	0	2
F	22	16	1.18	1.12	261	2.31	2.12	0.06	0.53	0.59	0.20	2.90	0.020	0.098	0.72
A Overland + Atmos.	40	25	1.13	0.71	195	2.87	1.99	0.06	0.74	0.80	0.20	3.67	0.025	0.082	0.98
A Inflow	189	113	4.48	2.92	1037	16.81	15.37	0.66	3.63	4.29	0.76	21.09	0.135	1.088	8.37
A	164	82	3.48	2.25	615	16.40	15.99	1.23	5.12	6.35	0.41	22.75	0.102	1.025	7.53
Wetland Reduction	25	31	1.00	0.67	422	0.41	-0.62	-0.57	-1.50	-2.07	0.35	-1.66	0.032	0.063	0.84
(%)	13	27	22	23	41	2	-4	-86	-41	-48	46	-8	24	6	10
System Reduction	196	122	4.03	2.75	864	4.28	0.97	-0.56	0.86	0.29	2.37	4.57	0.134	0.063	0.98
(%)	54	60	54	55	58	21	6	-84	14	4	85	17	57	6	12

Precip. = 0.74"
Duration = 23 hrs.
Intensity = 0.03 in./hr.
Last Precip. = 118 hrs.

Pond inflow (A'/hr.) = 0.30
Hydr. Resid. (hr.) = 34.10

* The following data in this table were modeled:
- A overland and G overland flow

McCarrons 1996 Load Totals

Event: Rain 10/29-30/96

Precipitation Inches: 0.96

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	30	16	0.26	0.07	54	1.80	1.58	0.03	0.12	0.15	0.22	1.95	0.005	0.05	2.28
D	58	24	0.29	0.06	70	1.30	1.14	0.03	0.46	0.49	0.16	1.79	0.020	0.05	2.54
E	15	7	0.14	0.07	38	0.74	0.62	0.03	0.36	0.39	0.12	1.13	0.005	0.05	3.84
G Overland [Avg of C+D+B]	34	16	0.23	0.07	54	1.28	1.11	0.03	0.31	0.34	0.17	1.62	0.010	0.05	0.14
G	9	5	0.14	0.05	29	0.81	0.79	0.03	0.15	0.18	0.02	0.99	0.005	0.05	8.80
F	128	83	1.10	0.63	167	7.67	5.27	0.04	0.56	0.60	2.40	8.27	0.030	0.05	0.52
A Overland [Avg of C+F]	79	50	0.68	0.35	111	4.74	3.43	0.04	0.34	0.38	1.31	5.11	0.018	0.05	0.76
A	9	5	0.27	0.20	30	0.77	0.75	0.03	0.11	0.14	0.02	0.91	0.005	0.05	9.93

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	186	99	1.61	0.43	335	11.17	9.81	0.19	0.74	0.93	1.37	12.10	0.031	0.310	2.28
D	401	166	2.01	0.41	484	8.99	7.88	0.21	3.18	3.39	1.11	12.38	0.138	0.346	2.54
E	157	73	1.46	0.73	397	7.74	6.48	0.31	3.76	4.08	1.25	11.81	0.052	0.523	3.84
G Overland + Atmos.	13	6	0.11	0.04	21	0.82	0.42	0.02	0.30	0.32	0.06	1.14	0.004	0.019	0.32
G Inflow	757	344	5.19	1.62	1237	28.71	24.59	0.72	7.99	8.72	3.79	37.43	0.225	1.198	8.98
G	216	120	3.35	1.20	695	19.40	18.92	0.72	3.59	4.31	0.48	23.72	0.120	1.198	8.80
Pond Reduction	542	225	1.83	0.43	542	9.31	5.67	0.00	4.40	4.40	3.31	13.71	0.106	0.000	0.18
(%)	72	65	35	26	44	32	23	1	55	51	87	37	47	0	2
F	181	117	1.56	0.89	236	10.86	7.46	0.06	0.79	0.85	3.40	11.71	0.042	0.071	0.52
A Overland + Atmos.	163	102	1.45	0.77	229	10.68	7.09	0.09	1.20	1.29	2.71	11.97	0.036	0.103	1.26
A Inflow	560	340	6.36	2.86	1160	40.94	33.47	0.86	5.59	6.45	6.59	47.39	0.198	1.372	10.58
A	243	135	7.30	5.41	811	20.81	20.27	0.81	2.97	3.78	0.54	24.60	0.135	1.352	9.93
Wetland Reduction	317	205	-0.93	-2.55	349	20.13	13.20	0.05	2.61	2.66	6.05	22.79	0.063	0.020	0.65
(%)	57	60	-15	-89	30	49	39	6	47	41	92	48	32	1	6
System Reduction	858	429	0.90	-2.12	891	29.44	18.87	0.06	7.01	7.07	9.36	36.51	0.169	0.020	0.83
(%)	78	76	11	-65	52	59	48	6	70	65	95	60	56	1	8

Precip.	= 0.96 "	Pond inflow (A'/hr.) =	0.45	* The following data in this table were modeled:
Duration	= 20 hrs.	Hydr. Resid. (hr.) =	22.48	A & G overland flow, G flow
Intensity	= 0.05 in/hr.			
Last Precip.	= 136 hrs.			

McCarrons 1996 Load Totals

Event: Rain 11/4/96

Precipitation Inches: 0.28

Concentrations in mg/l (underlined values indicate "less than")

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Q Water, A'
C	44	27	2.20	0.30	116	1.70	1.53	0.03	0.13	0.16	0.17	1.86	0.005	0.05	0.25
D	48	19	0.32	0.10	70	1.40	0.89	0.06	0.26	0.32	0.51	1.72	0.020	0.05	0.83
E	38	15	0.28	0.15	56	1.10	0.82	0.03	0.16	0.19	0.28	1.29	0.005	0.05	1.02
G Overland [Avg of C+D+E]	43	20	0.93	0.18	81	1.40	1.08	0.04	0.18	0.22	0.32	1.62	0.010	0.05	0.04
G	12	6	0.23	0.06	31	1.20	1.05	0.03	0.06	0.09	0.15	1.29	0.005	0.05	2.14
F	34	23	3.00	0.72	158	2.40	1.85	0.07	0.20	0.27	0.55	2.67	0.005	0.05	0.25
A Overland [Avg of C+F]	39	25	2.60	0.51	137	2.05	1.69	0.05	0.17	0.22	0.36	2.27	0.005	0.05	0.21
A	7	4	0.20	0.08	30	0.92	0.84	0.03	0.05	0.08	0.08	1.00	0.005	0.05	2.99

Load in Pounds

Site	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Lead	Total Water, A'
C	30	18	1.50	0.20	79	1.16	1.04	0.02	0.09	0.11	0.12	1.27	0.003	0.034	0.25
D	108	43	0.72	0.23	158	3.16	2.01	0.14	0.59	0.72	1.15	3.89	0.045	0.113	0.83
E	106	42	0.78	0.42	155	3.05	2.28	0.08	0.44	0.53	0.78	3.58	0.014	0.139	1.02
G Overland + Atmos.	5	2	0.11	0.03	9	0.25	0.12	0.01	0.07	0.08	0.03	0.33	0.001	0.005	0.09
G Inflow	249	105	3.10	0.87	401	7.62	5.45	0.25	1.19	1.44	2.08	9.06	0.064	0.291	2.19
G	70	35	1.34	0.35	181	6.99	6.12	0.17	0.35	0.52	0.87	7.51	0.029	0.291	2.14
Pond Reduction	179	70	1.76	0.52	221	0.63	-0.67	0.07	0.84	0.91	1.21	1.55	0.034	0.000	0.05
(%)	72	67	57	60	55	8	-12	29	71	64	58	17	54	0	2
F	23	16	2.04	0.49	108	1.63	1.26	0.05	0.14	0.18	0.37	1.82	0.003	0.034	0.25
A Overland + Atmos.	22	14	1.50	0.31	78	1.43	0.97	0.03	0.24	0.27	0.21	1.70	0.003	0.029	0.35
A Inflow	115	65	4.88	1.14	366	10.05	8.34	0.25	0.73	0.98	1.45	11.04	0.035	0.354	2.74
A	57	33	1.63	0.65	244	7.49	6.84	0.24	0.41	0.65	0.65	8.14	0.041	0.407	2.99
Wetland Reduction	58	32	3.25	0.49	122	2.57	1.50	0.01	0.32	0.33	0.80	2.90	-0.005	-0.053	-0.25
(%)	51	50	67	43	33	26	18	4	44	34	55	26	-15	-15	-9
System Reduction	237	103	5.02	1.02	343	3.20	0.83	0.08	1.16	1.24	2.01	4.44	0.029	-0.053	-0.19
(%)	81	76	76	61	58	30	11	25	74	66	76	35	42	-15	-7

Precip.	= 0.28 "	Pond inflow (A'/hr.) =	0.31	* The following data in this table were modeled:
Duration	= 7 hrs.	Hydr. Resid. (hr.) =	32.23	A & G overland flow, G flow
Intensity	= 0.04 in/hr.			
Last Precip.	= 130 hrs.			

APPENDIX I.
UNMONITORED (MODELED) EVENT LOADING TABLES

Appendix I. Unmoitored (Modeled) Data Tables															
Site	Date	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Water, A'
A	950327	114.3	57.2	1.63	0.57	245.0	8.98	7.76	0.16	1.63	1.80	1.23	10.78	0.041	3.00
	950411	64.9	28.4	1.01	0.28	142.0	4.46	3.85	0.10	1.01	1.12	0.61	5.58	0.020	1.49
	950508	54.2	31.6	1.13	0.32	171.7	4.97	4.52	0.09	1.13	1.22	0.45	6.19	0.023	1.66
	950609	271.5	126.7	4.34	1.27	687.9	21.72	19.01	0.36	4.53	4.89	2.72	26.61	0.091	6.65
	950625	37.2	21.7	0.62	0.19	93.1	3.10	2.64	0.06	0.93	0.99	0.47	4.10	0.016	1.14
	950626	55.5	32.4	0.93	0.28	138.8	4.63	3.93	0.09	1.39	1.48	0.69	6.11	0.023	1.70
	950708	33.1	16.6	0.62	0.21	115.9	3.31	2.94	0.08	0.41	0.50	0.37	3.81	0.021	1.52
	950721	131.6	76.8	2.74	0.77	416.9	12.07	10.97	0.22	2.74	2.96	1.10	15.03	0.055	4.03
	950727	30.5	15.2	0.57	0.19	106.7	3.05	2.71	0.08	0.38	0.46	0.34	3.51	0.019	1.40
	950804	50.0	29.2	0.83	0.25	125.0	4.17	3.54	0.08	1.25	1.33	0.62	5.50	0.021	1.53
	950819	479.1	209.6	7.49	2.10	1048.1	32.94	28.45	0.75	7.49	8.23	4.49	41.17	0.150	11.00
	950826	81.7	47.6	1.36	0.41	204.2	6.81	5.78	0.14	2.04	2.18	1.02	8.98	0.034	2.50
	950915	25.7	12.8	0.48	0.16	89.9	2.57	2.28	0.06	0.32	0.39	0.29	2.96	0.016	1.18
	950918	26.6	13.3	0.50	0.17	93.0	2.66	2.36	0.07	0.33	0.40	0.30	3.06	0.017	1.22
	950924	24.6	12.3	0.46	0.15	86.1	2.46	2.18	0.06	0.31	0.37	0.28	2.83	0.015	1.13
	951008	115.0	67.1	2.40	0.67	364.1	10.54	9.58	0.19	2.40	2.59	0.96	13.13	0.048	3.52
	951026	392.0	174.2	4.36	1.31	784.0	21.78	18.51	0.44	4.36	4.79	3.27	26.57	0.109	8.00
	960415	40.2	23.4	0.67	0.20	100.5	3.35	2.85	0.07	1.00	1.07	0.50	4.42	0.017	1.23
	960418	106.2	61.9	2.21	0.62	336.2	9.73	8.85	0.18	2.21	2.39	0.88	12.12	0.044	3.25
	960423	23.7	11.9	0.45	0.15	83.1	2.37	2.11	0.06	0.30	0.36	0.27	2.73	0.015	1.09
	960504	147.8	69.0	2.37	0.69	374.5	11.83	10.35	0.20	2.46	2.66	1.48	14.49	0.049	3.62
	960508	41.5	24.2	0.69	0.21	103.7	3.46	2.94	0.07	1.04	1.11	0.52	4.56	0.017	1.27
	960509	81.7	47.6	1.36	0.41	204.2	6.81	5.78	0.14	2.04	2.18	1.02	8.98	0.034	2.50
	960514	142.9	66.7	2.29	0.67	362.1	11.43	10.00	0.19	2.38	2.57	1.43	14.01	0.048	3.50
	960517	22.9	11.4	0.43	0.14	80.0	2.29	2.03	0.06	0.29	0.34	0.26	2.63	0.014	1.05
	960518	58.8	34.3	0.98	0.29	147.0	4.90	4.17	0.10	1.47	1.57	0.74	6.47	0.025	1.80
	960615	30.7	17.9	0.51	0.15	76.8	2.56	2.18	0.05	0.77	0.82	0.38	3.38	0.013	0.94
	960715	19.6	9.8	0.37	0.12	68.6	1.96	1.74	0.05	0.25	0.29	0.22	2.25	0.012	0.90
	960718	22.2	11.1	0.42	0.14	77.7	2.22	1.97	0.06	0.28	0.33	0.25	2.55	0.014	1.02
	960729	29.0	14.5	0.54	0.18	101.4	2.90	2.57	0.07	0.36	0.43	0.33	3.33	0.018	1.33
	960903	36.2	18.1	0.68	0.23	126.5	3.62	3.21	0.09	0.45	0.54	0.41	4.16	0.023	1.66
	960921	10.7	5.3	0.20	0.07	37.3	1.07	0.95	0.03	0.13	0.16	0.12	1.23	0.007	0.49
	961015	30.9	15.5	0.58	0.19	108.2	3.09	2.74	0.08	0.39	0.46	0.35	3.56	0.019	1.42
	TOTAL	2832.5	1415.4	46.21	13.74	7300.1	223.79	195.44	4.51	48.47	52.98	28.35	276.76	1.085	79.74

Site	Date	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Water, A'
C	950327	104.8	62.9	0.84	0.21	188.7	4.19	3.77	0.06	1.26	1.32	0.42	5.51	0.042	0.77
	950411	47.9	18.0	0.30	0.05	47.9	1.32	1.23	0.02	0.24	0.26	0.09	1.58	0.012	0.22
	950508	86.8	39.5	0.39	0.07	75.0	1.82	1.66	0.04	0.39	0.43	0.16	2.25	0.024	0.29
	950609	407.0	176.9	1.77	0.32	336.2	8.49	7.79	0.18	1.77	1.95	0.71	10.44	0.124	1.3
	950625	32.7	16.3	0.26	0.07	52.3	1.18	1.05	0.02	0.33	0.35	0.13	1.52	0.013	0.24
	950626	17.7	8.8	0.14	0.04	28.3	0.64	0.57	0.01	0.18	0.19	0.07	0.82	0.007	0.13
	950708	20.4	8.2	0.16	0.02	20.4	0.69	0.62	0.01	0.04	0.05	0.07	0.75	0.002	0.15
	950721	401.3	182.4	1.82	0.33	346.5	8.39	7.66	0.18	1.82	2.01	0.73	10.40	0.109	1.34
	950727	13.6	5.4	0.11	0.01	13.6	0.46	0.41	0.01	0.03	0.04	0.05	0.50	0.001	0.1
	950804	31.3	15.7	0.25	0.06	50.1	1.13	1.00	0.02	0.31	0.33	0.13	1.46	0.013	0.23
	950819	718.7	269.5	4.49	0.81	718.7	19.76	18.42	0.27	3.59	3.86	1.35	23.63	0.180	3.3
	950826	25.9	12.9	0.21	0.05	41.4	0.93	0.83	0.02	0.26	0.27	0.10	1.21	0.010	0.19
	950915	24.5	9.8	0.20	0.02	24.5	0.83	0.74	0.01	0.05	0.06	0.09	0.90	0.002	0.18
	950918	20.4	8.2	0.16	0.02	20.4	0.69	0.62	0.01	0.04	0.05	0.07	0.75	0.002	0.15
	950924	28.6	11.4	0.23	0.03	28.6	0.97	0.87	0.02	0.06	0.07	0.10	1.05	0.003	0.21
	951008	227.6	103.4	1.03	0.19	196.5	4.76	4.34	0.10	1.03	1.14	0.41	5.90	0.062	0.76
	951026	632.1	175.6	2.11	0.56	526.8	14.05	12.64	0.21	1.76	1.97	1.40	16.01	0.176	2.58
	960415	20.4	10.2	0.16	0.04	32.7	0.74	0.65	0.01	0.20	0.22	0.08	0.95	0.008	0.15
	960418	476.1	216.4	2.16	0.39	411.2	9.96	9.09	0.22	2.16	2.38	0.87	12.34	0.130	1.59
	960423	46.3	18.5	0.37	0.05	46.3	1.57	1.41	0.03	0.09	0.12	0.17	1.69	0.005	0.34
	960504	403.8	175.6	1.76	0.32	333.6	8.43	7.73	0.18	1.76	1.93	0.70	10.36	0.123	1.29
	960508	70.8	35.4	0.57	0.14	113.2	2.55	2.26	0.04	0.71	0.75	0.28	3.30	0.028	0.52
	960509	93.9	47.0	0.75	0.19	150.3	3.38	3.01	0.06	0.94	1.00	0.38	4.38	0.038	0.69
	960514	366.3	159.3	1.59	0.29	302.6	7.64	7.01	0.16	1.59	1.75	0.64	9.40	0.111	1.17
	960517	13.6	5.4	0.11	0.01	13.6	0.46	0.41	0.01	0.03	0.04	0.05	0.50	0.001	0.10
	960518	134.8	67.4	1.08	0.27	215.6	4.85	4.31	0.08	1.35	1.43	0.54	6.28	0.054	0.99
	960615	65.3	32.7	0.52	0.13	104.5	2.35	2.09	0.04	0.65	0.69	0.26	3.04	0.026	0.48
	960715	9.5	3.8	0.08	0.01	9.5	0.32	0.29	0.01	0.02	0.02	0.03	0.35	0.001	0.07
	960718	10.9	4.4	0.09	0.01	10.9	0.37	0.33	0.01	0.02	0.03	0.04	0.40	0.001	0.08
	960729	9.5	3.8	0.08	0.01	9.5	0.32	0.29	0.01	0.02	0.02	0.03	0.35	0.001	0.07
	960903	16.3	6.5	0.13	0.02	16.3	0.56	0.50	0.01	0.03	0.04	0.06	0.60	0.002	0.12
	960921	10.9	4.4	0.09	0.01	10.9	0.37	0.33	0.01	0.02	0.03	0.04	0.40	0.001	0.08
	961015	8.2	3.3	0.07	0.01	8.2	0.28	0.25	0.00	0.02	0.02	0.03	0.30	0.001	0.06
	TOTAL	4597.8	1918.9	24.1	4.7	4504.7	114.5	104.2	2.0	22.8	24.8	10.3	139.3	1.313	19.9

Site	Date	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Water, A'
D	950327	166.6	50.0	0.56	0.14	194.4	3.05	2.22	0.11	1.39	1.50	0.83	4.55	0.111	1.02
	950411	81.0	23.8	0.24	0.05	61.9	0.95	0.67	0.04	0.29	0.32	0.29	1.28	0.029	0.35
	950508	194.0	51.7	0.65	0.16	181.0	3.10	2.20	0.13	1.29	1.42	0.91	4.53	0.103	0.95
	950609	539.0	179.7	1.72	0.43	503.1	8.62	6.32	0.29	3.59	3.88	2.30	12.50	0.287	2.64
	950625	152.4	61.0	0.76	0.15	213.4	4.27	3.20	0.18	1.22	1.40	1.07	5.67	0.061	1.12
	950626	129.3	51.7	0.65	0.13	181.0	3.62	2.72	0.16	1.03	1.19	0.91	4.81	0.052	0.95
	950708	41.4	18.6	0.26	0.04	62.1	1.24	0.88	0.04	0.26	0.30	0.36	1.54	0.021	0.38
	950721	226.6	60.4	0.76	0.18	211.5	3.63	2.57	0.15	1.51	1.66	1.06	5.29	0.121	1.11
	950727	52.3	23.5	0.33	0.05	78.4	1.57	1.11	0.05	0.33	0.38	0.46	1.95	0.026	0.48
	950804	118.4	47.4	0.59	0.12	165.8	3.32	2.49	0.14	0.95	1.09	0.83	4.41	0.047	0.87
	950819	629.4	185.1	1.85	0.37	481.3	7.40	5.18	0.30	2.22	2.52	2.22	9.92	0.222	2.72
	950826	172.9	69.1	0.86	0.17	242.0	4.84	3.63	0.21	1.38	1.59	1.21	6.43	0.069	1.27
	950915	61.0	27.4	0.38	0.06	91.5	1.83	1.30	0.06	0.38	0.44	0.53	2.27	0.030	0.56
	950918	68.6	30.9	0.43	0.07	102.9	2.06	1.46	0.07	0.43	0.50	0.60	2.56	0.034	0.63
	950924	39.2	17.6	0.25	0.04	58.8	1.18	0.83	0.04	0.25	0.28	0.34	1.46	0.020	0.36
	951008	475.7	126.9	1.59	0.38	444.0	7.61	5.39	0.32	3.17	3.49	2.22	11.10	0.254	2.33
	951026	544.4	149.7	1.70	0.41	476.4	6.81	5.10	0.20	2.72	2.93	1.70	9.73	0.204	2.50
	960415	84.4	33.8	0.42	0.08	118.1	2.36	1.77	0.10	0.68	0.78	0.59	3.14	0.034	0.62
	960418	261.3	69.7	0.87	0.21	243.9	4.18	2.96	0.17	1.74	1.92	1.22	6.10	0.139	1.28
	960423	47.9	21.6	0.30	0.05	71.9	1.44	1.02	0.05	0.30	0.35	0.42	1.78	0.024	0.44
	960504	214.4	71.5	0.69	0.17	200.1	3.43	2.52	0.11	1.43	1.54	0.91	4.97	0.114	1.05
	960508	68.1	27.2	0.34	0.07	95.3	1.91	1.43	0.08	0.54	0.63	0.48	2.53	0.027	0.5
	960509	103.4	41.4	0.52	0.10	144.8	2.90	2.17	0.12	0.83	0.95	0.72	3.85	0.041	0.76
	960514	230.7	76.9	0.74	0.18	215.3	3.69	2.71	0.12	1.54	1.66	0.98	5.35	0.123	1.13
	960517	35.9	16.2	0.22	0.04	53.9	1.08	0.76	0.04	0.22	0.26	0.31	1.34	0.018	0.33
	960518	39.5	15.8	0.20	0.04	55.3	1.11	0.83	0.05	0.32	0.36	0.28	1.47	0.016	0.29
	960615	40.8	16.3	0.20	0.04	57.2	1.14	0.86	0.05	0.33	0.38	0.29	1.52	0.016	0.3
	960715	38.1	17.2	0.24	0.04	57.2	1.14	0.81	0.04	0.24	0.28	0.33	1.42	0.019	0.35
	960718	78.4	35.3	0.49	0.08	117.6	2.35	1.67	0.08	0.49	0.57	0.69	2.92	0.039	0.72
	960729	24.0	10.8	0.15	0.02	35.9	0.72	0.51	0.02	0.15	0.17	0.21	0.89	0.012	0.22
	960903	30.5	13.7	0.19	0.03	45.7	0.91	0.65	0.03	0.19	0.22	0.27	1.14	0.015	0.28
	960921	35.9	16.2	0.22	0.04	53.9	1.08	0.76	0.04	0.22	0.26	0.31	1.34	0.018	0.33
	961015	107.8	48.5	0.67	0.11	161.7	3.23	2.29	0.11	0.67	0.78	0.94	4.02	0.054	0.99
	TOTAL	5133.3	1706.5	20.0	4.2	5477.2	97.8	71.0	3.7	32.3	36.0	26.8	133.8	2.402	29.8

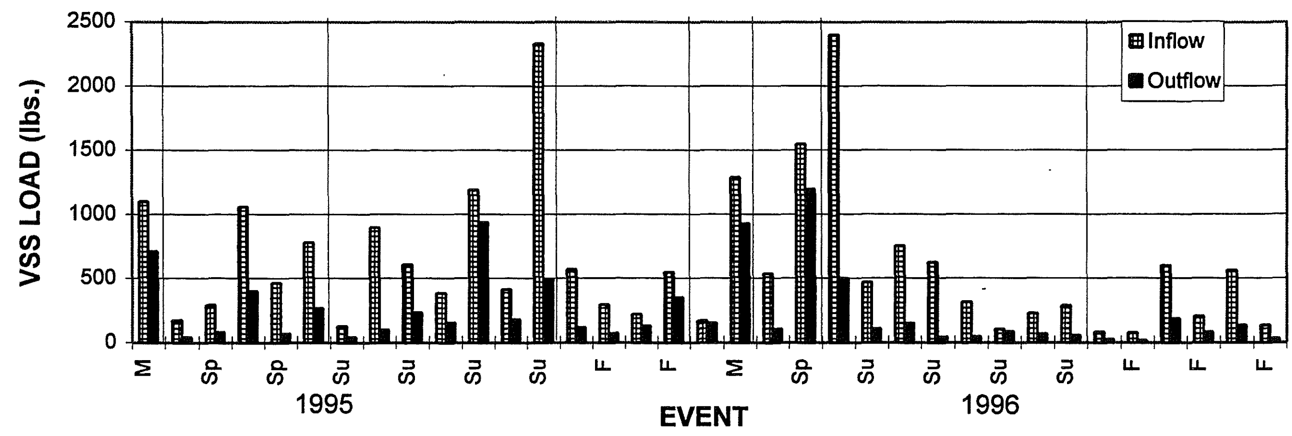
Site	Date	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Water, A'
E	950327	130.7	39.2	0.52	0.18	130.7	2.61	1.83	0.08	1.05	1.12	0.78	3.74	0.052	0.96
	950411	45.7	11.4	0.17	0.07	34.3	0.84	0.61	0.03	0.30	0.34	0.23	1.17	0.015	0.28
	950508	81.7	20.4	0.27	0.11	70.8	1.50	1.09	0.04	0.68	0.72	0.41	2.22	0.034	0.50
	950609	290.5	79.2	1.06	0.42	264.1	5.81	4.22	0.16	2.64	2.80	1.58	8.61	0.132	1.94
	950625	92.6	34.7	0.46	0.14	125.0	2.55	1.85	0.07	1.16	1.23	0.69	3.77	0.046	0.85
	950626	79.5	29.8	0.40	0.12	107.3	2.19	1.59	0.06	0.99	1.05	0.60	3.24	0.040	0.73
	950708	80.6	30.2	0.40	0.10	110.8	2.22	1.81	0.06	0.40	0.46	0.40	2.68	0.010	0.74
	950721	165.0	41.2	0.55	0.22	143.0	3.02	2.20	0.08	1.37	1.46	0.82	4.48	0.069	1.01
	950727	58.8	22.1	0.29	0.07	80.9	1.62	1.32	0.04	0.29	0.34	0.29	1.96	0.007	0.54
	950804	151.4	56.8	0.76	0.23	204.3	4.16	3.03	0.11	1.89	2.01	1.14	6.17	0.076	1.39
	950819	694.2	173.5	2.55	1.04	520.6	12.73	9.26	0.46	4.63	5.09	3.47	17.82	0.231	4.25
	950826	124.1	46.6	0.62	0.19	167.6	3.41	2.48	0.09	1.55	1.64	0.93	5.06	0.062	1.14
	950915	52.3	19.6	0.26	0.07	71.9	1.44	1.18	0.04	0.26	0.30	0.26	1.74	0.007	0.48
	950918	54.4	20.4	0.27	0.07	74.9	1.50	1.23	0.04	0.27	0.31	0.27	1.81	0.007	0.50
	950924	61.0	22.9	0.30	0.08	83.8	1.68	1.37	0.05	0.30	0.35	0.30	2.03	0.008	0.56
	951008	156.8	39.2	0.52	0.21	135.9	2.87	2.09	0.08	1.31	1.39	0.78	4.26	0.065	0.96
	951026	247.7	59.5	1.09	0.35	223.0	5.45	3.96	0.15	1.98	2.13	1.49	7.58	0.050	1.82
	960415	62.1	23.3	0.31	0.09	83.8	1.71	1.24	0.05	0.78	0.82	0.47	2.53	0.031	0.57
	960418	147.0	36.8	0.49	0.20	127.4	2.70	1.96	0.07	1.23	1.30	0.74	3.99	0.061	0.9
	960423	54.4	20.4	0.27	0.07	74.9	1.50	1.23	0.04	0.27	0.31	0.27	1.81	0.007	0.5
	960504	124.3	33.9	0.45	0.18	113.0	2.49	1.81	0.07	1.13	1.20	0.68	3.68	0.056	0.83
	960508	34.8	13.1	0.17	0.05	47.0	0.96	0.70	0.03	0.44	0.46	0.26	1.42	0.017	0.32
	960509	57.7	21.6	0.29	0.09	77.9	1.59	1.15	0.04	0.72	0.76	0.43	2.35	0.029	0.53
	960514	125.8	34.3	0.46	0.18	114.3	2.52	1.83	0.07	1.14	1.21	0.69	3.73	0.057	0.84
	960517	40.3	15.1	0.20	0.05	55.4	1.11	0.91	0.03	0.20	0.23	0.20	1.34	0.005	0.37
	960518	22.9	8.6	0.11	0.03	30.9	0.63	0.46	0.02	0.29	0.30	0.17	0.93	0.011	0.21
	960615	82.8	31.0	0.41	0.12	111.7	2.28	1.66	0.06	1.03	1.10	0.62	3.37	0.041	0.76
	960715	71.9	27.0	0.36	0.09	98.8	1.98	1.62	0.05	0.36	0.41	0.36	2.39	0.009	0.66
	960718	92.6	34.7	0.46	0.12	127.3	2.55	2.08	0.07	0.46	0.53	0.46	3.08	0.012	0.85
	960729	98.0	36.8	0.49	0.12	134.8	2.70	2.21	0.07	0.49	0.56	0.49	3.26	0.012	0.9
	960903	173.1	64.9	0.87	0.22	238.1	4.76	3.90	0.13	0.87	1.00	0.87	5.76	0.022	1.59
	960921	65.3	24.5	0.33	0.08	89.8	1.80	1.47	0.05	0.33	0.38	0.33	2.17	0.008	0.6
	961015	83.8	31.4	0.42	0.10	115.3	2.31	1.89	0.06	0.42	0.48	0.42	2.79	0.010	0.77
	TOTAL	3903.5	1204.0	16.6	5.5	4188.9	89.1	67.2	2.6	31.2	33.8	21.9	122.9	1.301	29.9

Site	Date	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Water, A'
F	950327	49.0	12.3	0.15	0.05	39.2	0.93	0.74	0.02	0.20	0.22	0.20	1.15	0.005	0.18
	950411	14.3	4.1	0.08	0.03	10.9	0.27	0.21	0.01	0.05	0.05	0.05	0.32	0.003	0.05
	950508	27.2	9.5	0.16	0.05	24.5	0.52	0.41	0.01	0.12	0.13	0.11	0.65	0.005	0.10
	950609	72.2	24.8	0.42	0.14	62.3	1.42	1.13	0.03	0.32	0.35	0.28	1.76	0.014	0.26
	950625	46.3	10.2	0.19	0.05	41.7	0.93	0.69	0.02	0.14	0.16	0.23	1.08	0.009	0.17
	950626	38.1	8.4	0.15	0.04	34.3	0.76	0.57	0.02	0.11	0.13	0.19	0.89	0.008	0.14
	950708	7.6	4.8	0.09	0.02	15.2	0.44	0.35	0.01	0.04	0.05	0.09	0.49	0.001	0.08
	950721	51.7	18.1	0.31	0.09	46.6	0.98	0.78	0.02	0.23	0.25	0.21	1.24	0.010	0.19
	950727	9.5	6.0	0.11	0.03	19.1	0.54	0.44	0.01	0.05	0.07	0.11	0.61	0.001	0.10
	950804	35.4	7.8	0.14	0.04	31.9	0.71	0.53	0.01	0.11	0.12	0.18	0.83	0.007	0.13
	950819	208.7	59.6	1.19	0.40	159.0	3.88	3.08	0.08	0.70	0.78	0.79	4.65	0.040	0.73
	950826	38.1	8.4	0.15	0.04	34.3	0.76	0.57	0.02	0.11	0.13	0.19	0.89	0.008	0.14
	950915	7.6	4.8	0.09	0.02	15.2	0.44	0.35	0.01	0.04	0.05	0.09	0.49	0.001	0.08
	950918	8.6	5.4	0.10	0.02	17.2	0.49	0.39	0.01	0.05	0.06	0.10	0.55	0.001	0.09
	950924	5.7	3.6	0.07	0.02	11.4	0.33	0.26	0.01	0.03	0.04	0.07	0.37	0.001	0.06
	951008	59.9	21.0	0.36	0.11	53.9	1.14	0.90	0.02	0.27	0.29	0.24	1.43	0.012	0.22
	951026	131.5	37.6	0.63	0.25	100.2	2.38	2.00	0.05	0.38	0.43	0.38	2.80	0.019	0.46
	960415	43.6	9.6	0.17	0.04	39.2	0.87	0.65	0.02	0.13	0.15	0.22	1.02	0.009	0.16
	960418	62.6	21.9	0.38	0.11	56.4	1.19	0.94	0.03	0.28	0.31	0.25	1.50	0.013	0.23
	960423	7.6	4.8	0.09	0.02	15.2	0.44	0.35	0.01	0.04	0.05	0.09	0.49	0.001	0.08
	960504	111.1	38.1	0.65	0.22	95.8	2.18	1.74	0.04	0.49	0.53	0.44	2.71	0.022	0.4
	960508	57.2	12.6	0.23	0.06	51.5	1.14	0.86	0.02	0.17	0.19	0.29	1.34	0.011	0.21
	960509	70.8	15.6	0.28	0.07	63.7	1.42	1.06	0.03	0.21	0.24	0.35	1.66	0.014	0.26
	960514	94.4	32.4	0.56	0.19	81.4	1.85	1.48	0.04	0.42	0.45	0.37	2.30	0.019	0.34
	960517	15.2	9.6	0.17	0.04	30.5	0.87	0.70	0.02	0.09	0.10	0.17	0.98	0.002	0.16
	960518	16.3	3.6	0.07	0.02	14.7	0.33	0.25	0.01	0.05	0.06	0.08	0.38	0.003	0.06
	960615	38.1	8.4	0.15	0.04	34.3	0.76	0.57	0.02	0.11	0.13	0.19	0.89	0.008	0.14
	960715	2.9	1.8	0.03	0.01	5.7	0.16	0.13	0.00	0.02	0.02	0.03	0.18	0.000	0.03
	960718	6.7	4.2	0.08	0.02	13.3	0.38	0.30	0.01	0.04	0.05	0.08	0.43	0.001	0.07
	960729	6.7	4.2	0.08	0.02	13.3	0.38	0.30	0.01	0.04	0.05	0.08	0.43	0.001	0.07
	960903	5.7	3.6	0.07	0.02	11.4	0.33	0.26	0.01	0.03	0.04	0.07	0.37	0.001	0.06
	960921	13.3	8.4	0.15	0.04	26.7	0.76	0.61	0.02	0.08	0.09	0.15	0.85	0.002	0.14
	961015	8.6	5.4	0.10	0.02	17.2	0.49	0.39	0.01	0.05	0.06	0.10	0.55	0.001	0.09
	TOTAL	1372.1	430.2	7.6	2.3	1287.1	30.4	24.0	0.6	5.2	5.8	6.4	36.3	0.253	5.68

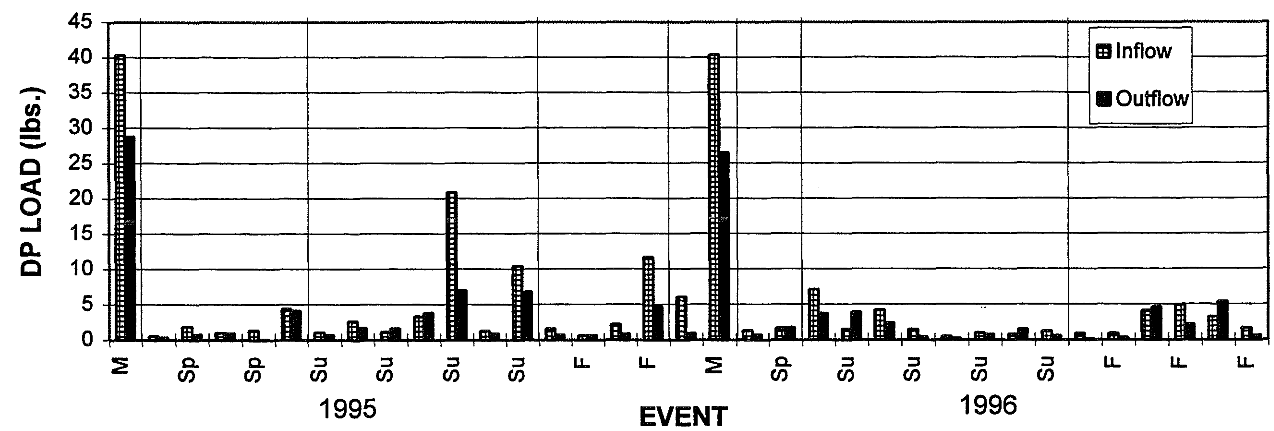
Site	Date	TSS	VSS	TP	DP	COD	TKN	Org N	Nitrite	Nitrate	N/N	NH3	TN	Zinc	Water, A'
G	950327	191.2	76.5	1.15	0.38	267.7	7.65	6.58	0.23	1.53	1.76	1.07	9.41	0.038	2.81
	950411	109.4	65.7	0.73	0.18	164.2	5.11	4.56	0.11	0.91	1.02	0.55	6.13	0.018	1.34
	950508	88.5	60.2	0.71	0.14	159.3	4.25	3.75	0.11	0.88	0.99	0.50	5.24	0.028	1.30
	950609	343.7	220.0	2.75	0.69	618.6	19.25	17.32	0.41	2.75	3.16	1.92	22.41	0.069	5.05
	950625	58.8	14.7	0.59	0.15	88.2	2.94	2.50	0.09	0.29	0.38	0.44	3.32	0.015	1.08
	950626	65.3	16.3	0.65	0.16	98.0	3.27	2.78	0.10	0.33	0.42	0.49	3.69	0.016	1.20
	950708	28.6	22.9	0.43	0.17	85.8	2.86	2.57	0.09	0.29	0.37	0.29	3.23	0.014	1.05
	950721	244.3	166.1	1.95	0.39	439.8	11.73	10.36	0.29	2.44	2.74	1.37	14.46	0.078	3.59
	950727	25.0	20.0	0.38	0.15	75.1	2.50	2.25	0.08	0.25	0.33	0.25	2.83	0.013	0.92
	950804	90.9	22.7	0.91	0.23	136.4	4.55	3.86	0.14	0.45	0.59	0.68	5.14	0.023	1.67
	950819	716.2	429.7	4.77	1.19	1074.3	33.42	29.84	0.72	5.97	6.68	3.58	40.11	0.119	8.77
	950826	94.2	23.5	0.94	0.24	141.3	4.71	4.00	0.14	0.47	0.61	0.71	5.32	0.024	1.73
	950915	19.9	15.9	0.30	0.12	59.6	1.99	1.79	0.06	0.20	0.26	0.20	2.25	0.010	0.73
	950918	20.1	16.1	0.30	0.12	60.4	2.01	1.81	0.06	0.20	0.26	0.20	2.28	0.010	0.74
	950924	19.9	15.9	0.30	0.12	59.6	1.99	1.79	0.06	0.20	0.26	0.20	2.25	0.010	0.73
	951008	211.0	143.5	1.69	0.34	379.8	10.13	8.95	0.25	2.11	2.36	1.18	12.49	0.068	3.10
	951026	322.9	161.4	2.42	0.81	613.4	16.14	13.72	0.32	2.91	3.23	2.42	19.37	0.081	5.93
	960415	48.5	12.1	0.48	0.12	72.7	2.42	2.06	0.07	0.24	0.31	0.36	2.74	0.012	0.89
	960418	208.3	141.6	1.67	0.33	374.9	10.00	8.83	0.25	2.08	2.33	1.17	12.33	0.067	3.06
	960423	19.9	15.9	0.30	0.12	59.6	1.99	1.79	0.06	0.20	0.26	0.20	2.25	0.010	0.73
	960504	169.5	108.5	1.36	0.34	305.0	9.49	8.54	0.20	1.36	1.56	0.95	11.05	0.034	2.49
	960508	35.9	9.0	0.36	0.09	53.9	1.80	1.53	0.05	0.18	0.23	0.27	2.03	0.009	0.66
	960509	62.6	15.7	0.63	0.16	93.9	3.13	2.66	0.09	0.31	0.41	0.47	3.54	0.016	1.15
	960514	128.6	82.3	1.03	0.26	231.5	7.20	6.48	0.15	1.03	1.18	0.72	8.39	0.026	1.89
	960517	9.0	7.2	0.13	0.05	27.0	0.90	0.81	0.03	0.09	0.12	0.09	1.02	0.004	0.33
	960518	38.1	9.5	0.38	0.10	57.2	1.91	1.62	0.06	0.19	0.25	0.29	2.15	0.010	0.70
	960615	55.0	13.7	0.55	0.14	82.5	2.75	2.34	0.08	0.27	0.36	0.41	3.11	0.014	1.01
	960715	31.6	25.3	0.47	0.19	94.7	3.16	2.84	0.09	0.32	0.41	0.32	3.57	0.016	1.16
	960718	38.4	30.7	0.58	0.23	115.2	3.84	3.45	0.12	0.38	0.50	0.38	4.34	0.019	1.41
	960729	42.5	34.0	0.64	0.25	127.4	4.25	3.82	0.13	0.42	0.55	0.42	4.80	0.021	1.56
	960903	59.1	47.3	0.89	0.35	177.2	5.91	5.32	0.18	0.59	0.77	0.59	6.68	0.030	2.17
	960921	20.4	16.3	0.31	0.12	61.3	2.04	1.84	0.06	0.20	0.27	0.20	2.31	0.010	0.75
	961015	15.8	12.6	0.24	0.09	47.4	1.58	1.42	0.05	0.16	0.21	0.16	1.78	0.008	0.58
	TOTAL	3632.9	2072.8	30.97	8.53	6502.7	196.83	173.79	4.92	30.22	35.14	23.05	231.98	0.938	62.28

APPENDIX J.
INFLOW/OUTFLOW LOAD GRAPHS

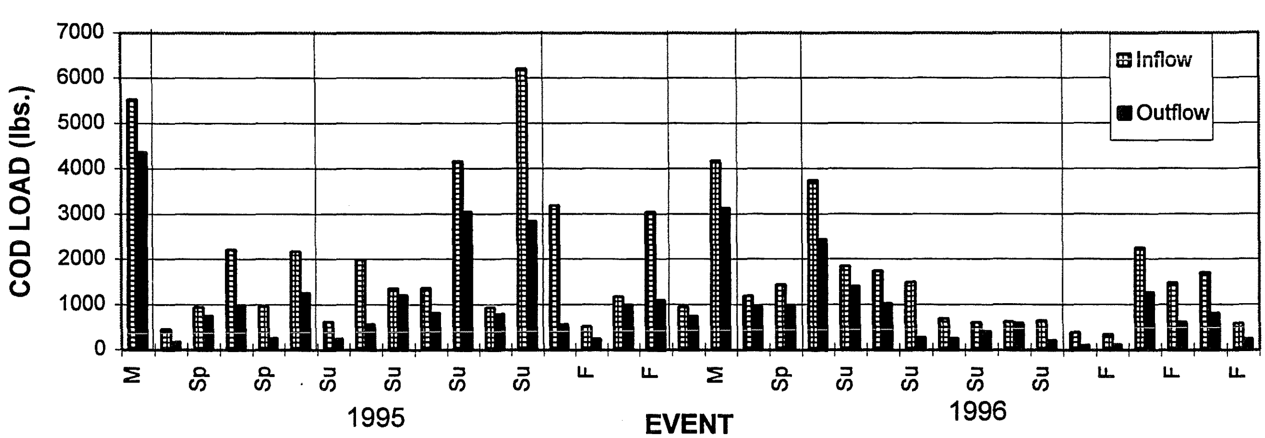
VSS Inflow/Outflow Load - Phase III Events



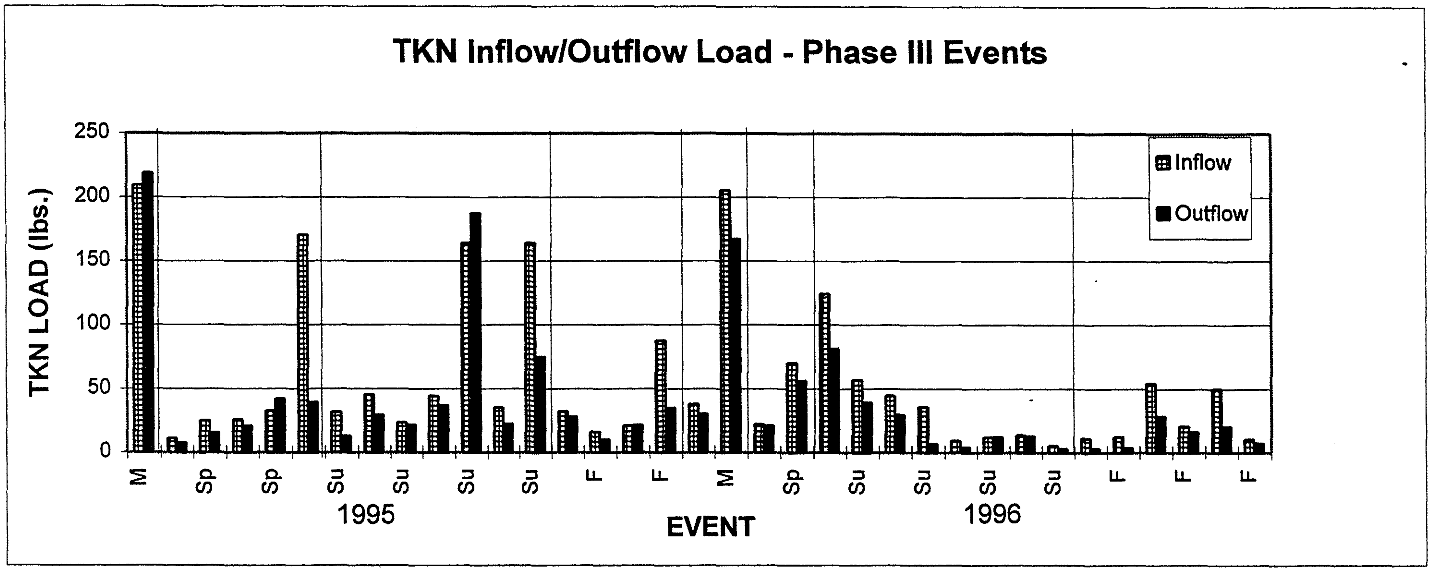
DP Inflow/Outflow Load - Phase III Events

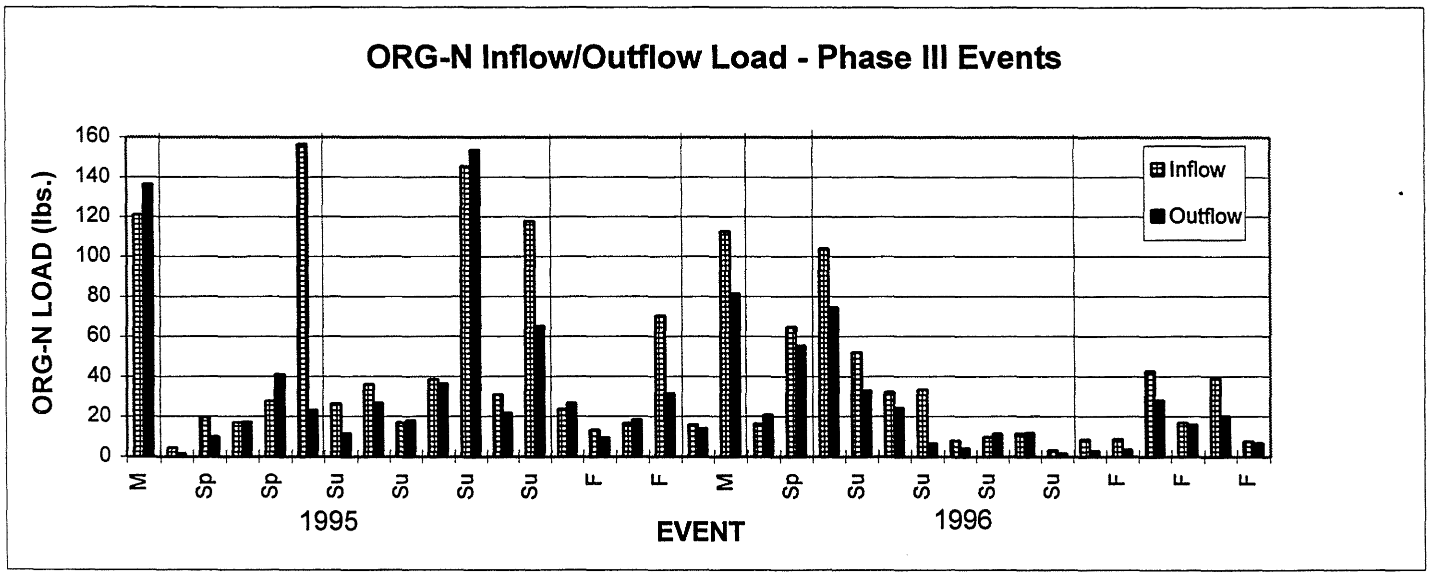


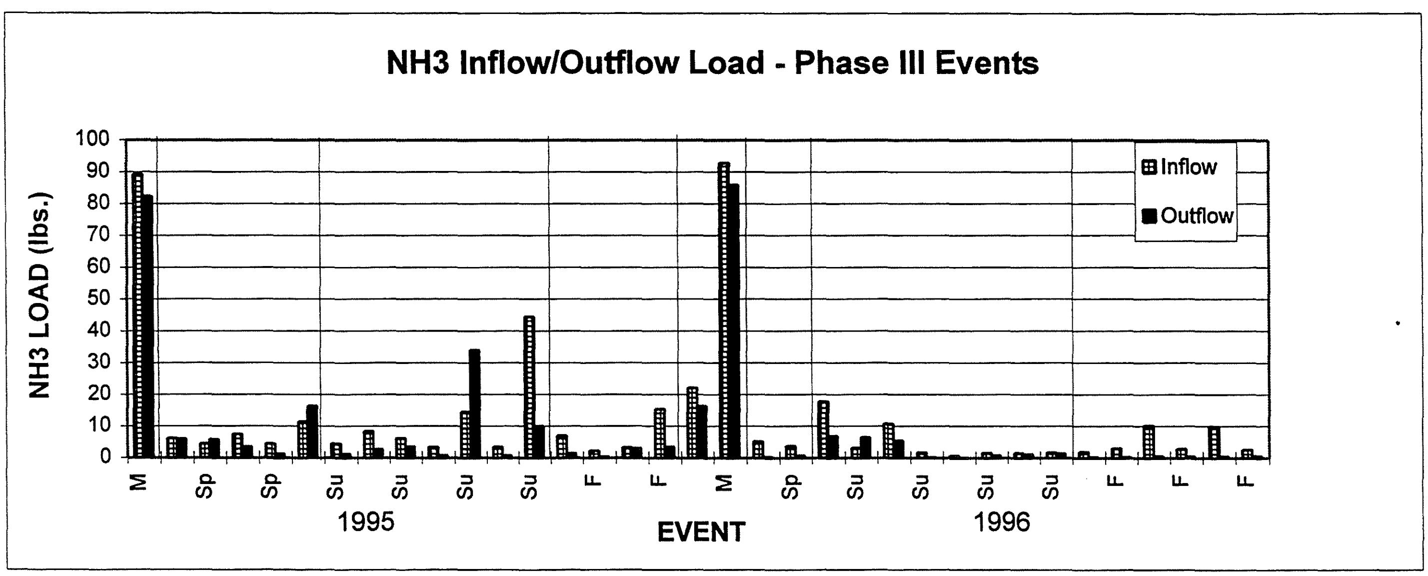
COD Inflow/Outflow Load - Phase III Events

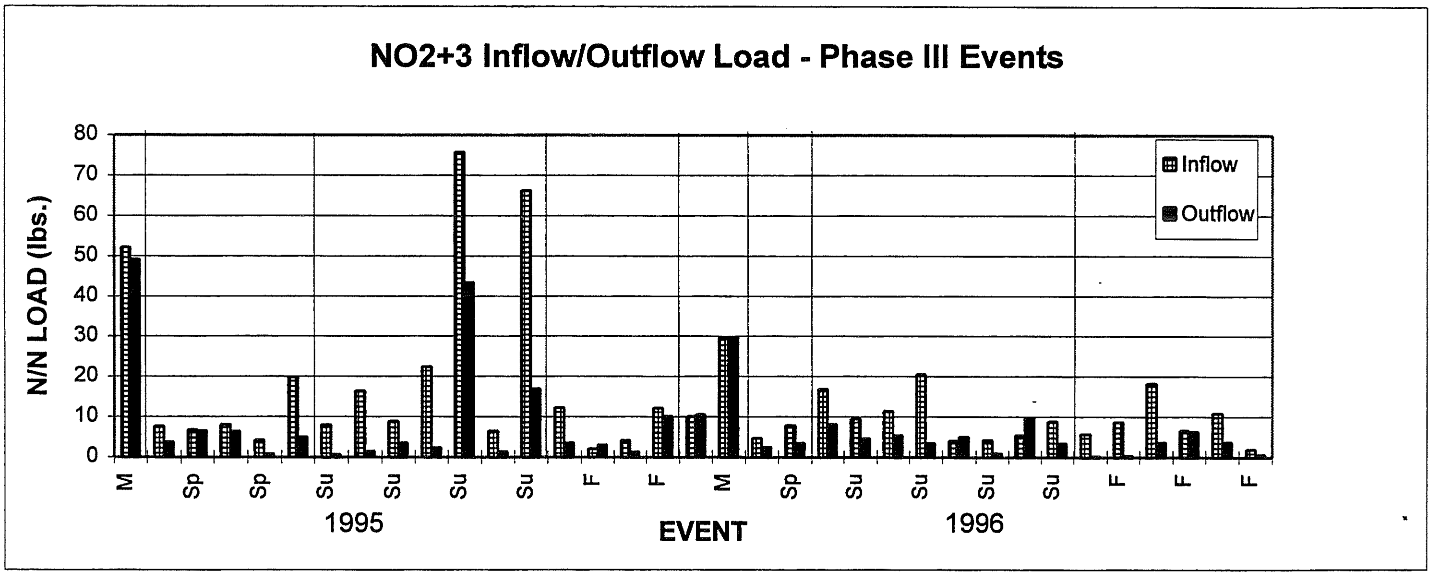


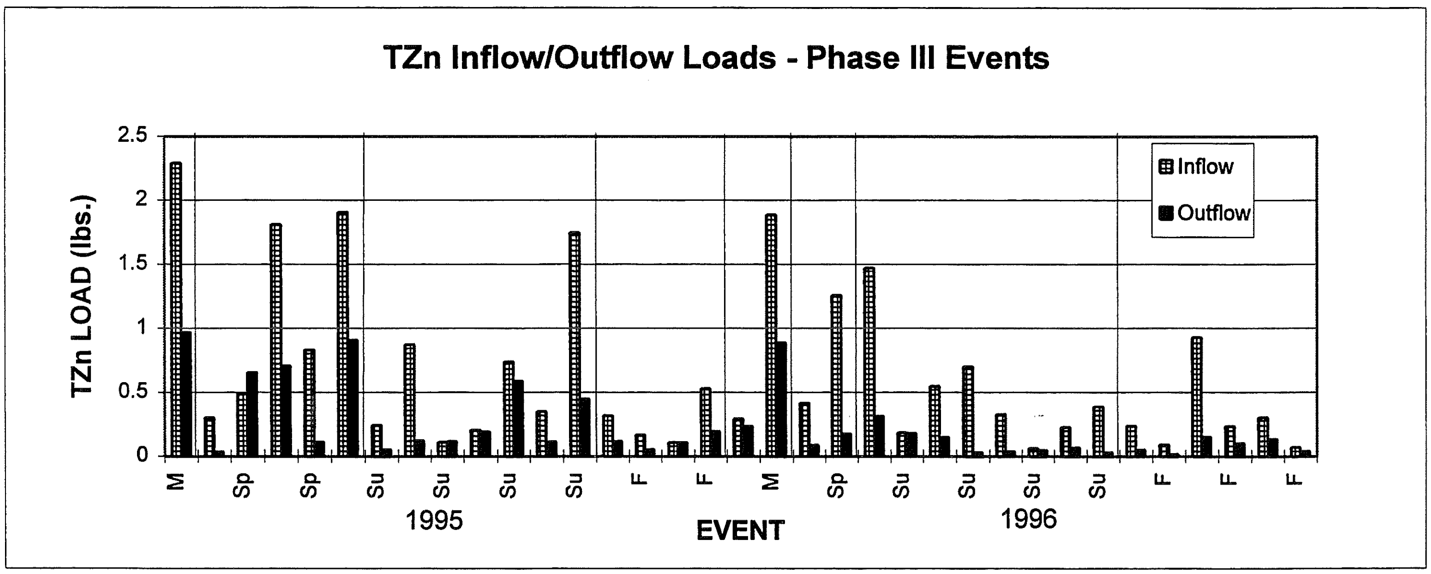
Appendix J. Inflow/Outflow Loads - Phase III Events





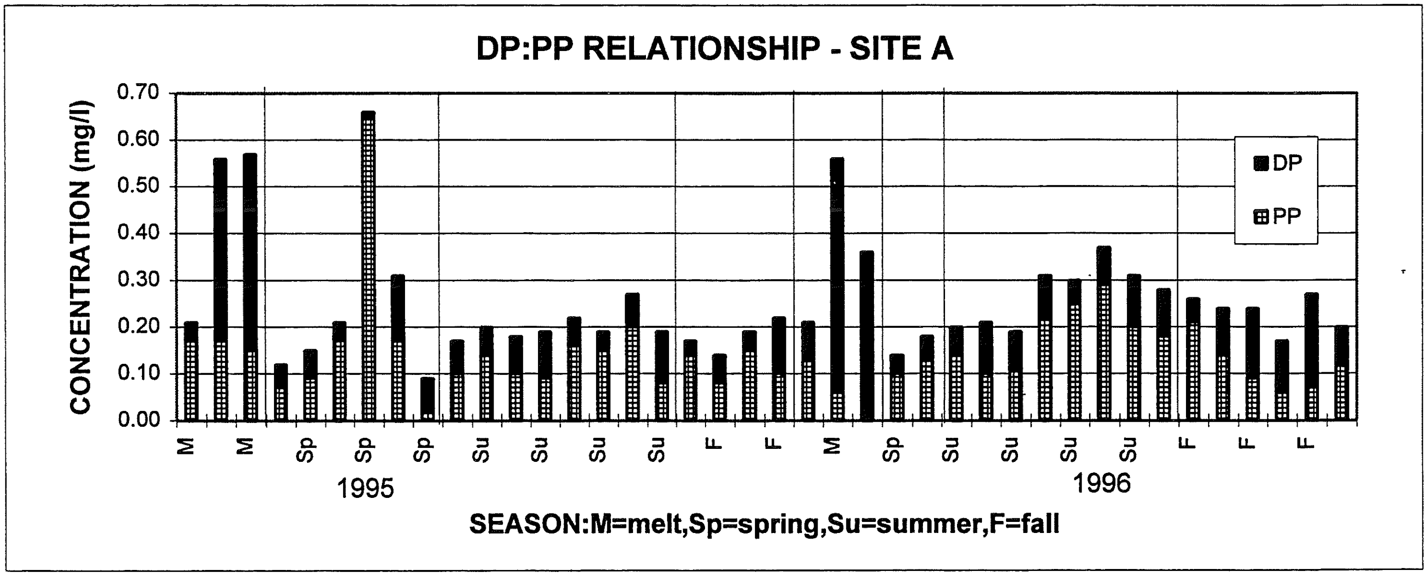


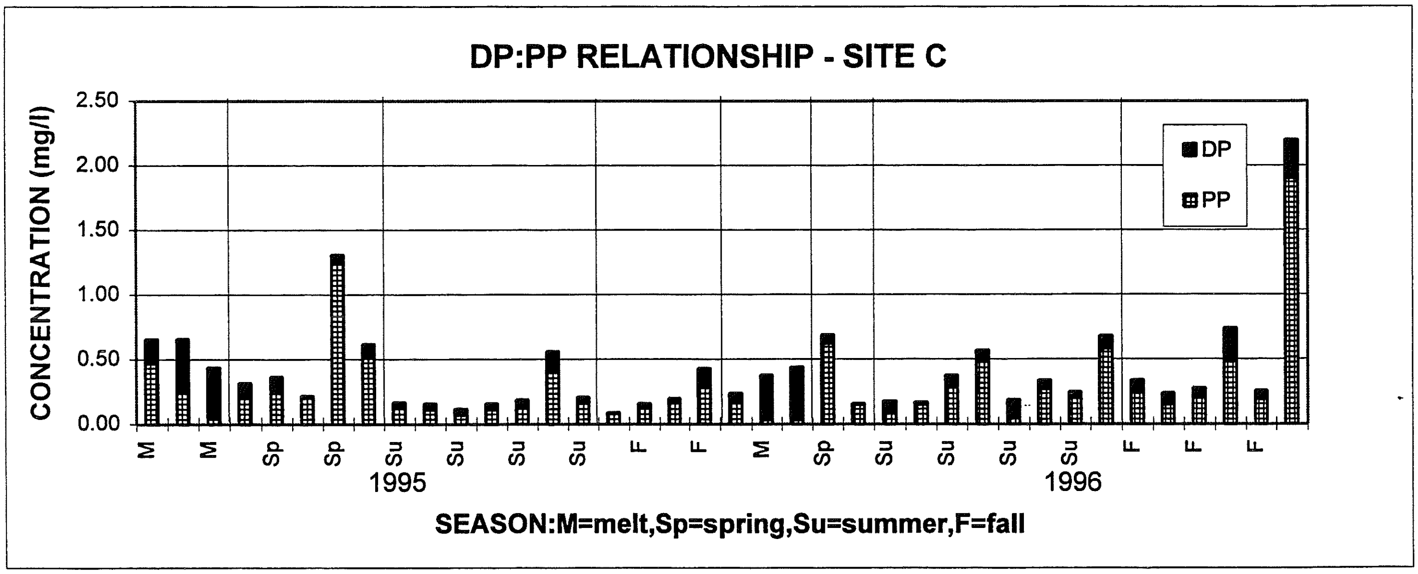

NO2+3 Inflow/Outflow Load - Phase III Events
N/N LOAD (lbs.)
80
70
60
50
40
30
20
10
0
Inflow
Outflow
M
Sp
Sp
Su
Su
Su
Su
F
F
M
Sp
Su
Su
Su
Su
F
F
F
1995
EVENT
1996

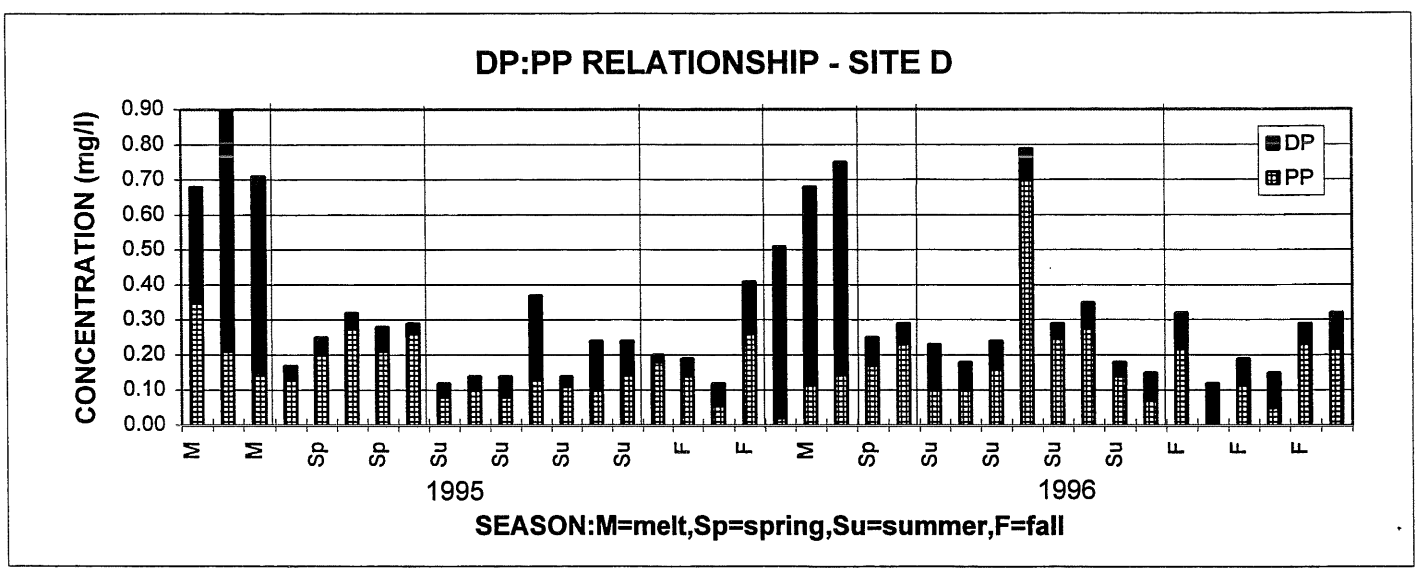

TZn Inflow/Outflow Loads - Phase III Events
TZn LOAD (lbs.)
2.5
2
1.5
1
0.5
0
Inflow
Outflow
M
Sp
Sp
Su
Su
Su
Su
F
F
M
Sp
Su
Su
Su
Su
F
F
F
1995
EVENT
1996

APPENDIX K.
TDP:PP AND VSS:NVSS PLOTS

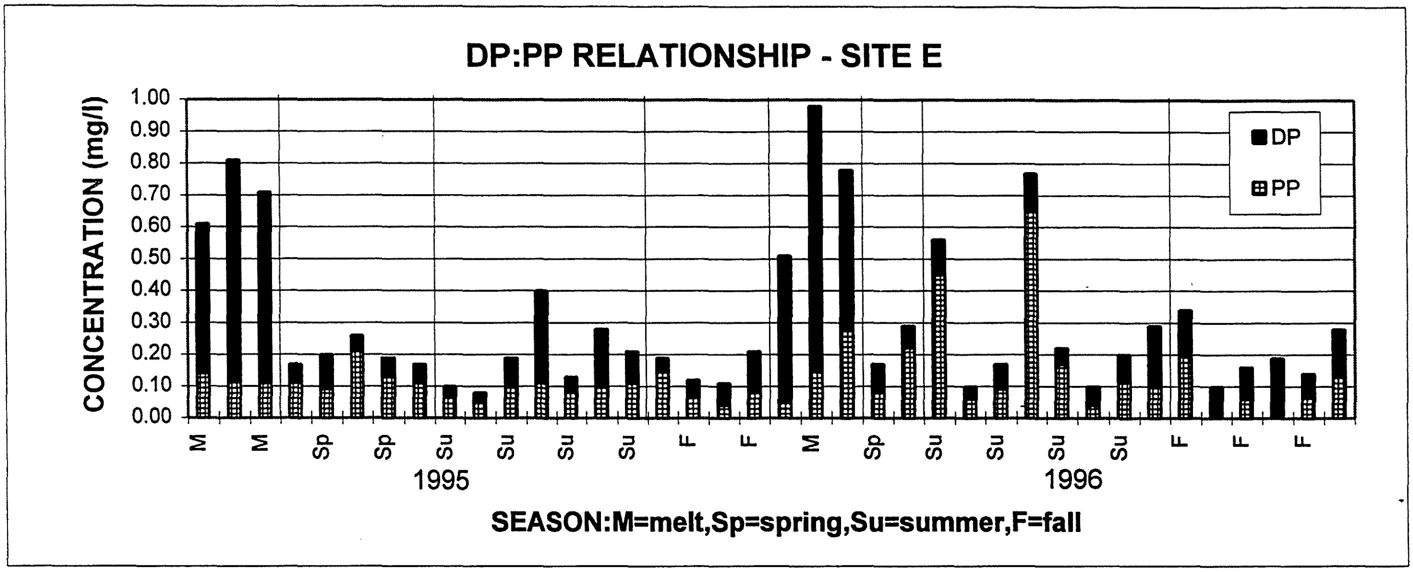
Appendix K. DP:PP (particulate phosphorus) Plots.

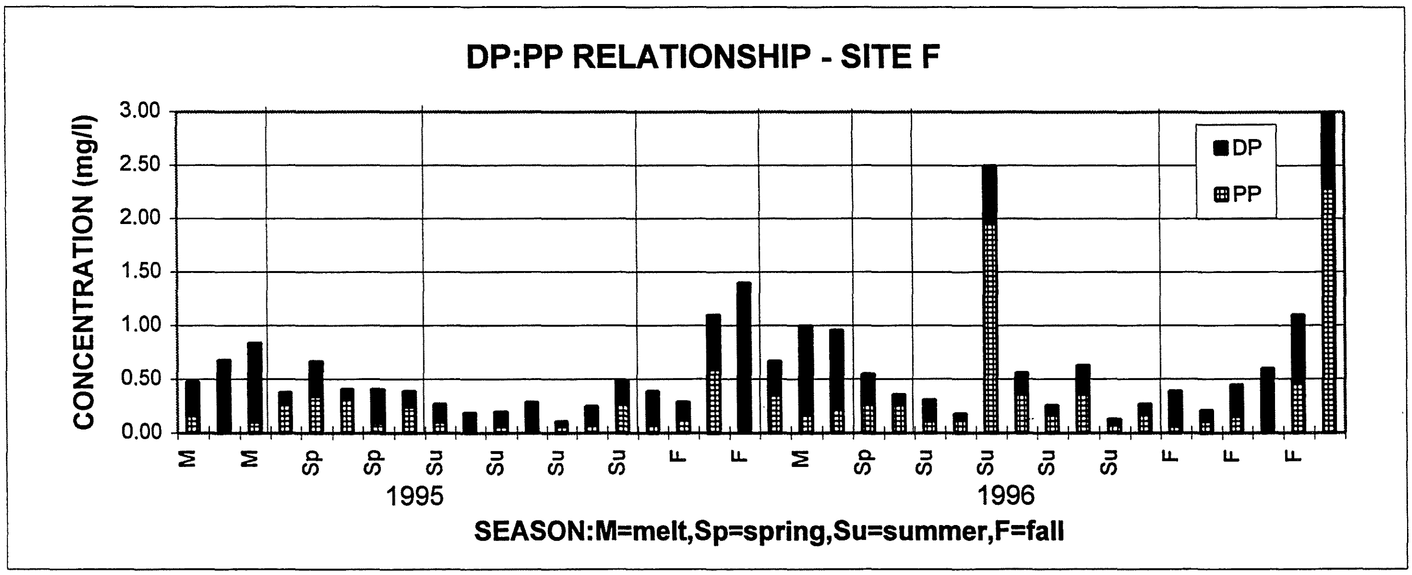


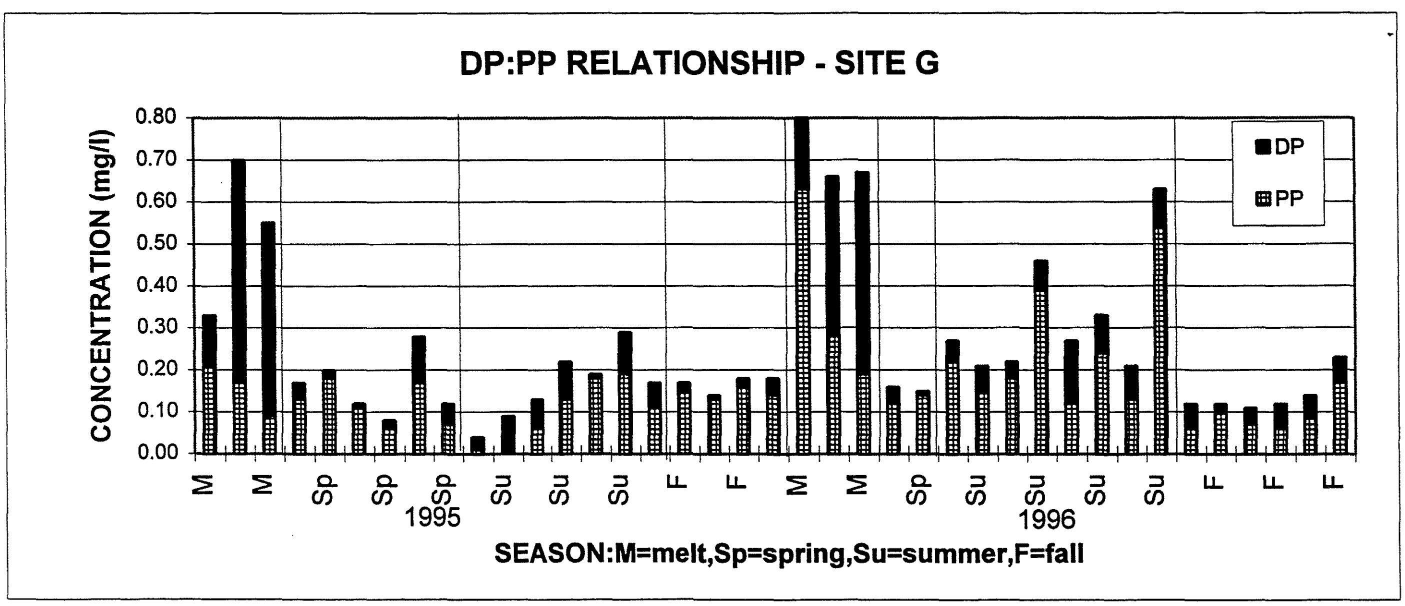




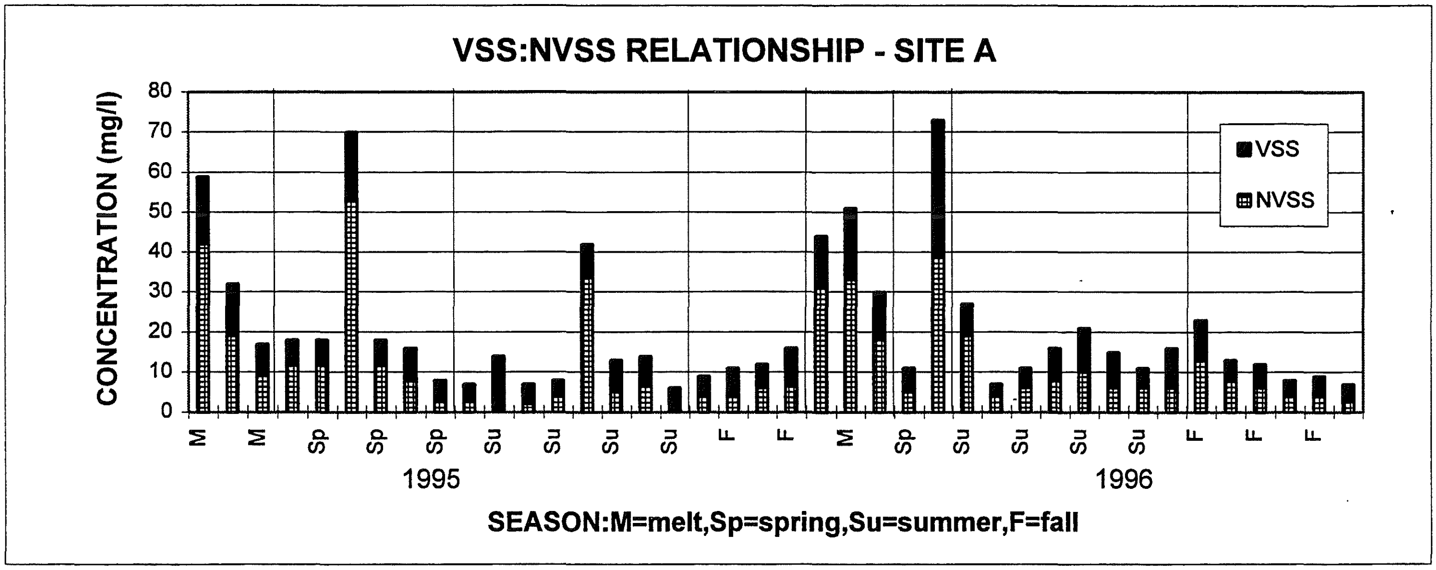
Appendix K. DP:PP (particulate phosphorus) Plots.

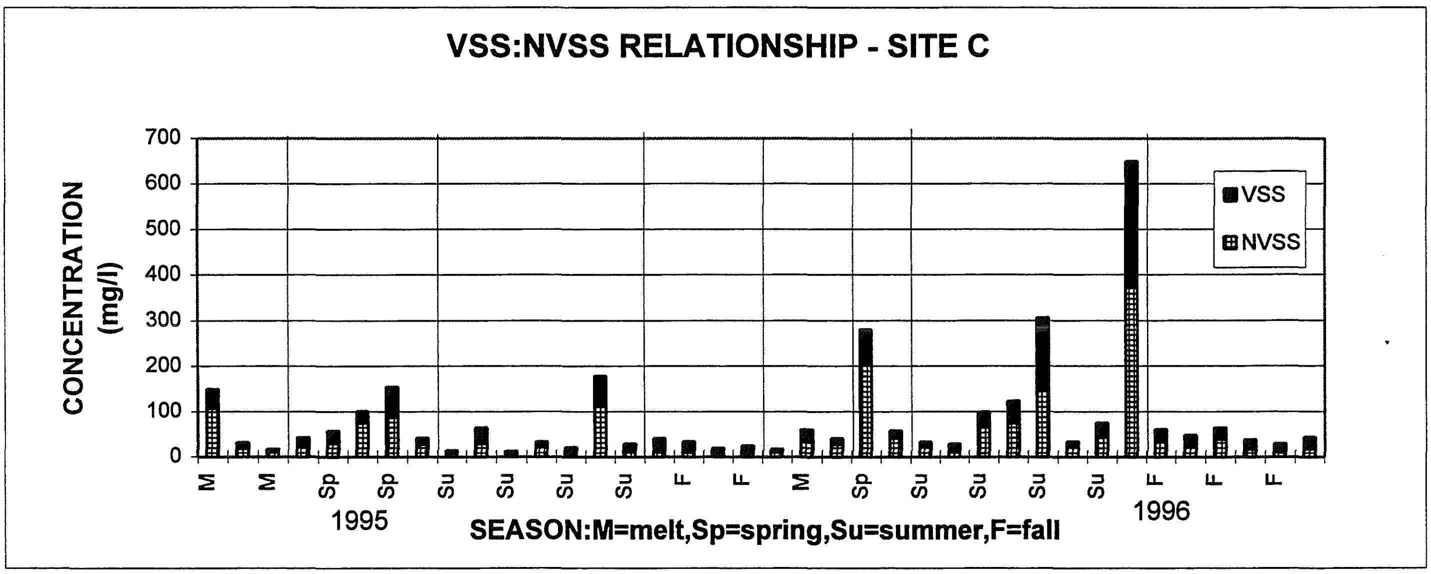


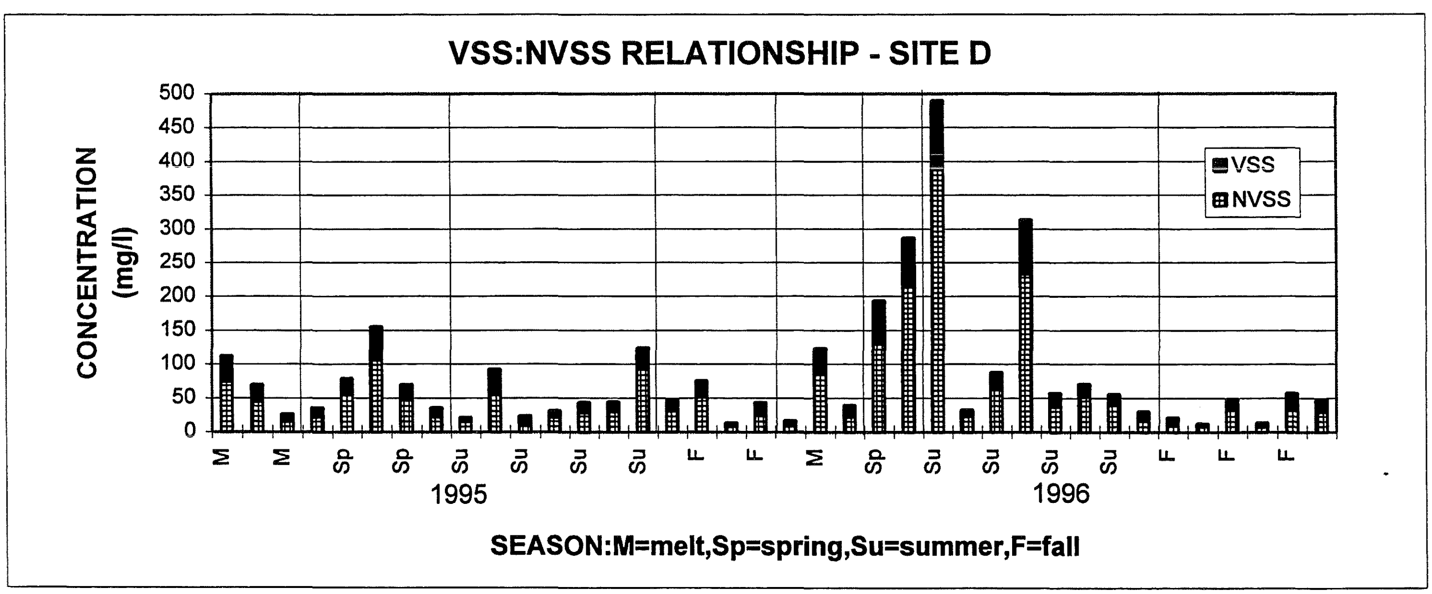




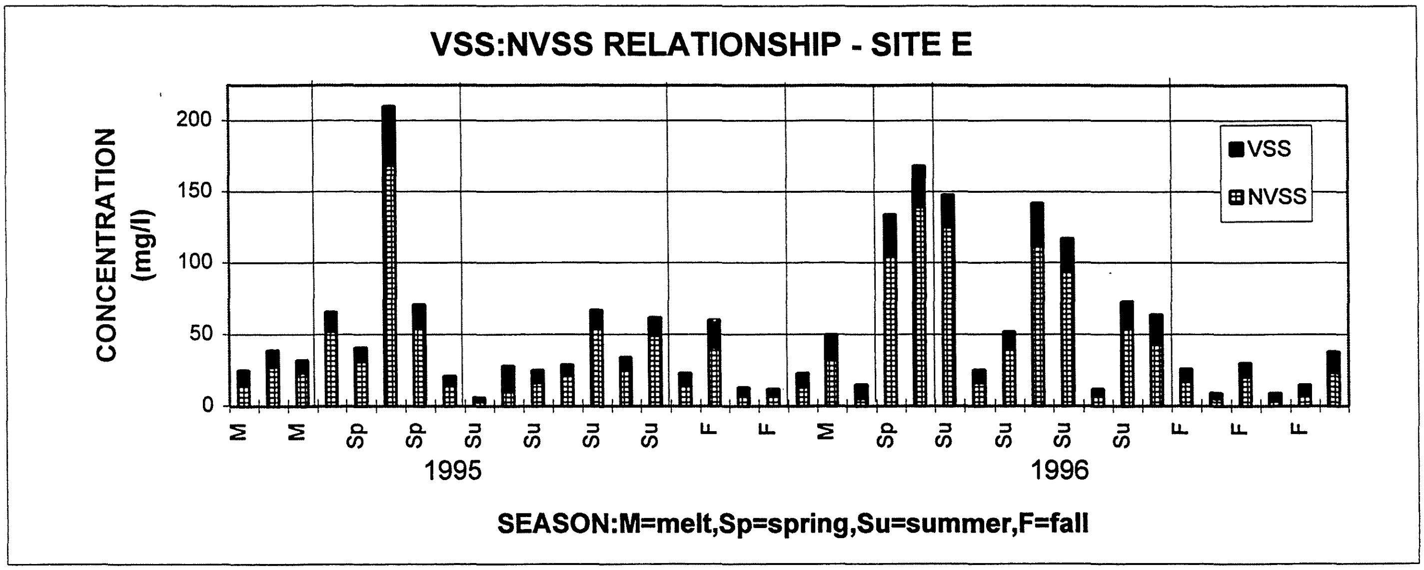
Appendix K. VSS:NVSS (non-volatile suspended solids) Plots.

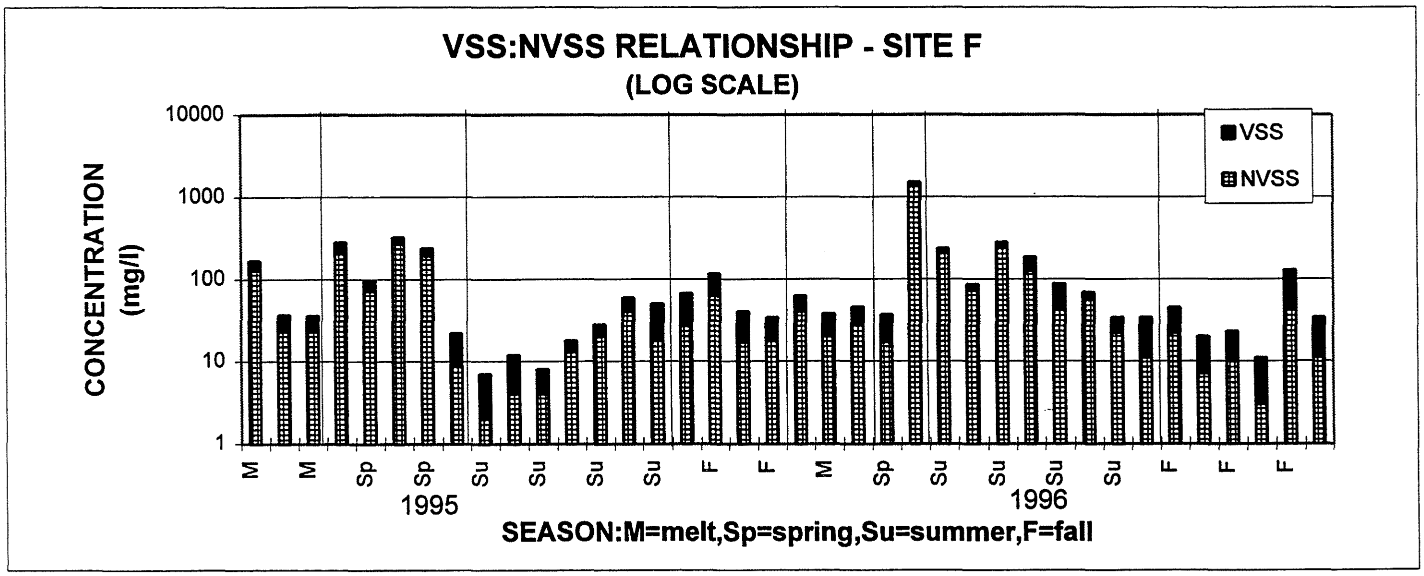


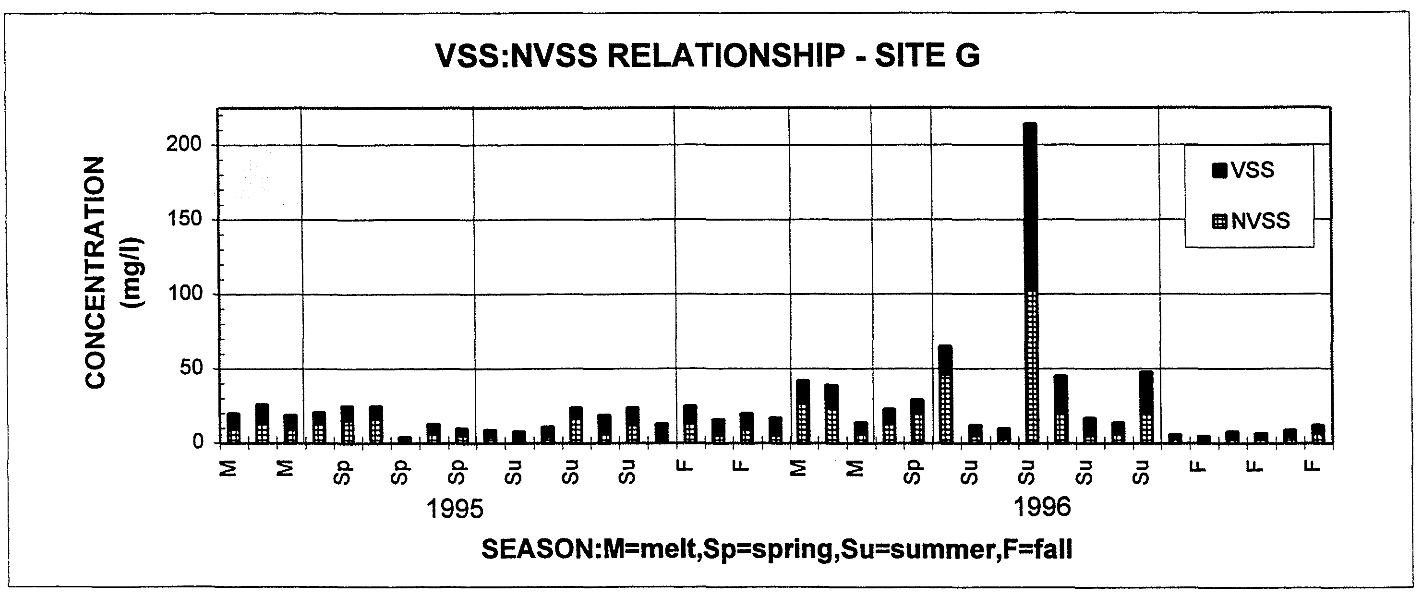




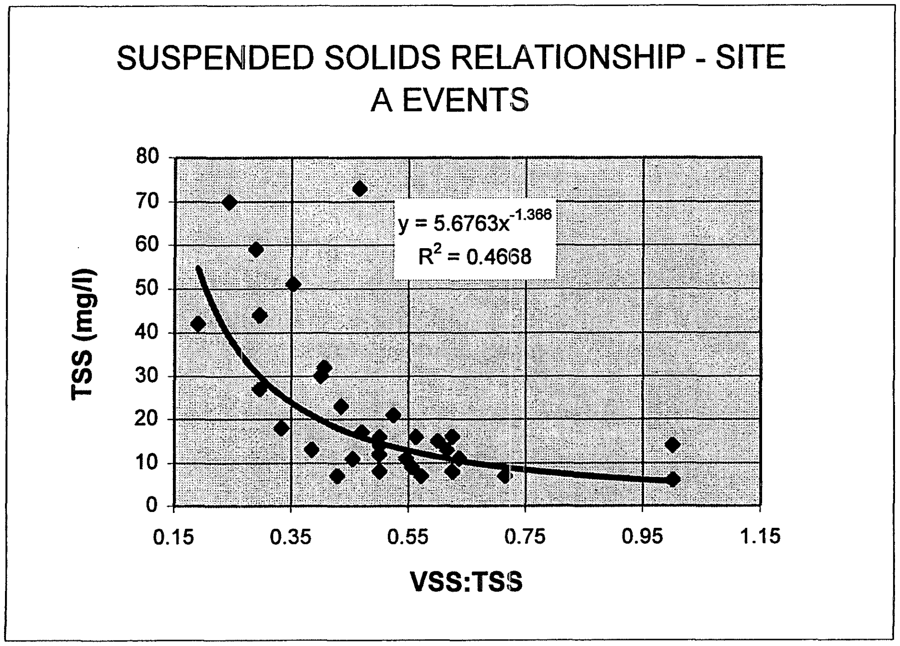
Appendix K. VSS:NVSS (non-volatile suspended solids) Plots.

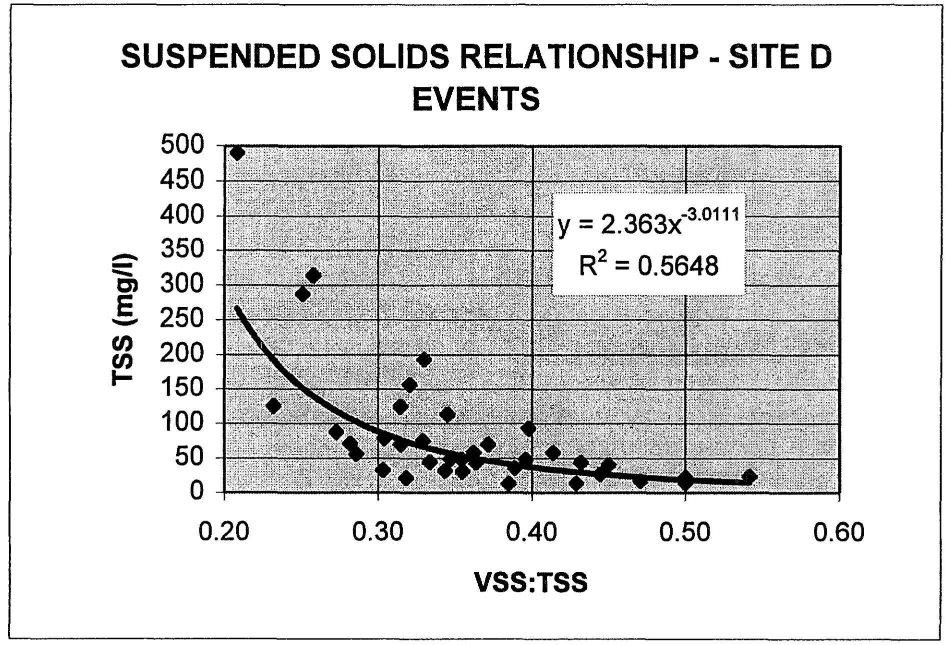


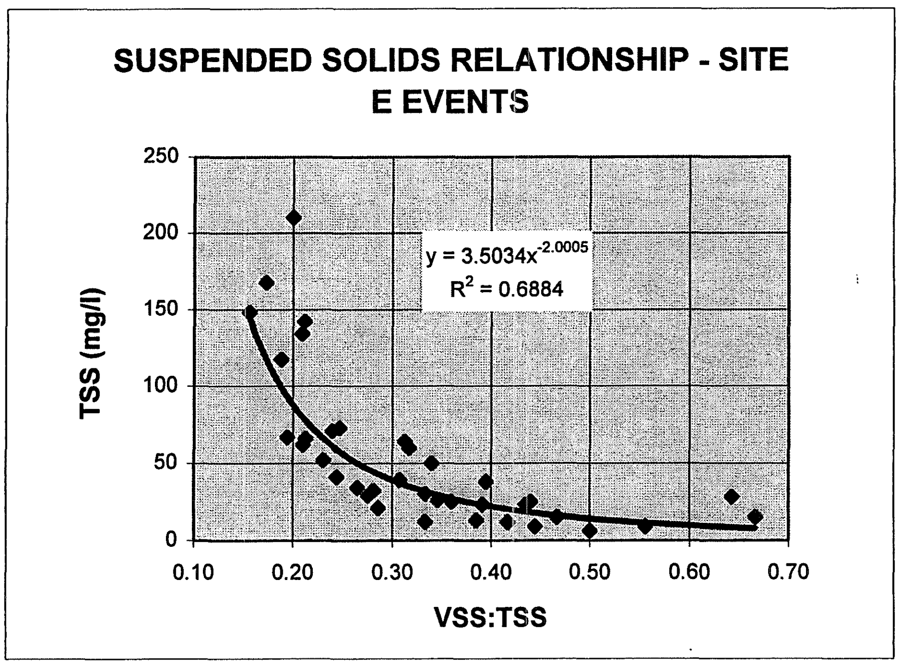


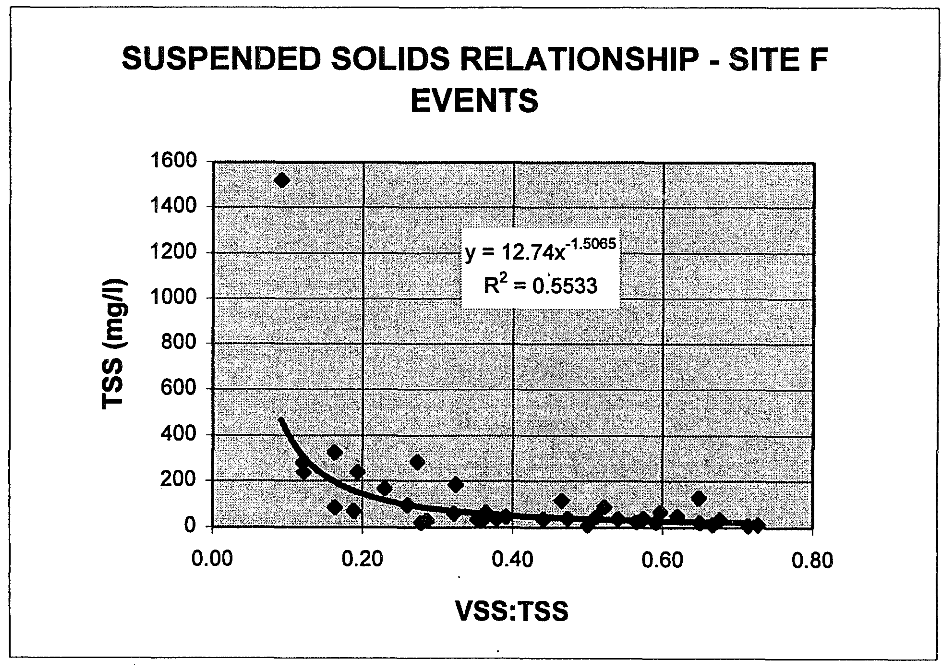


Appendix K. TSS versus VSS:TSS Plots.



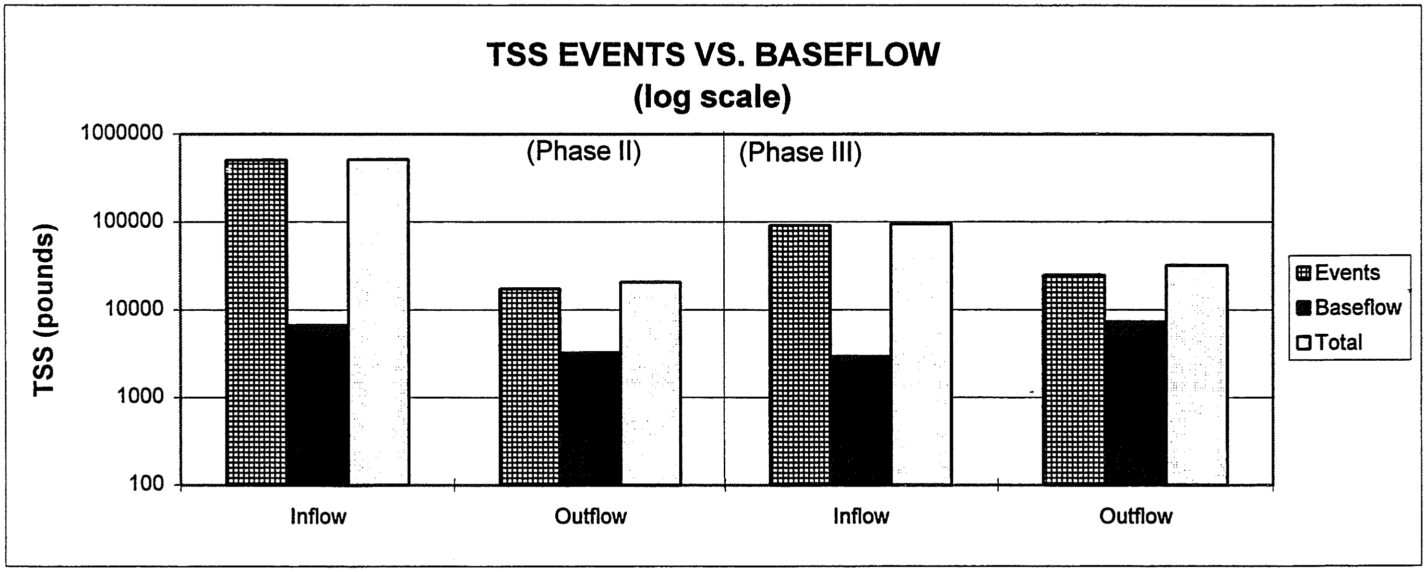


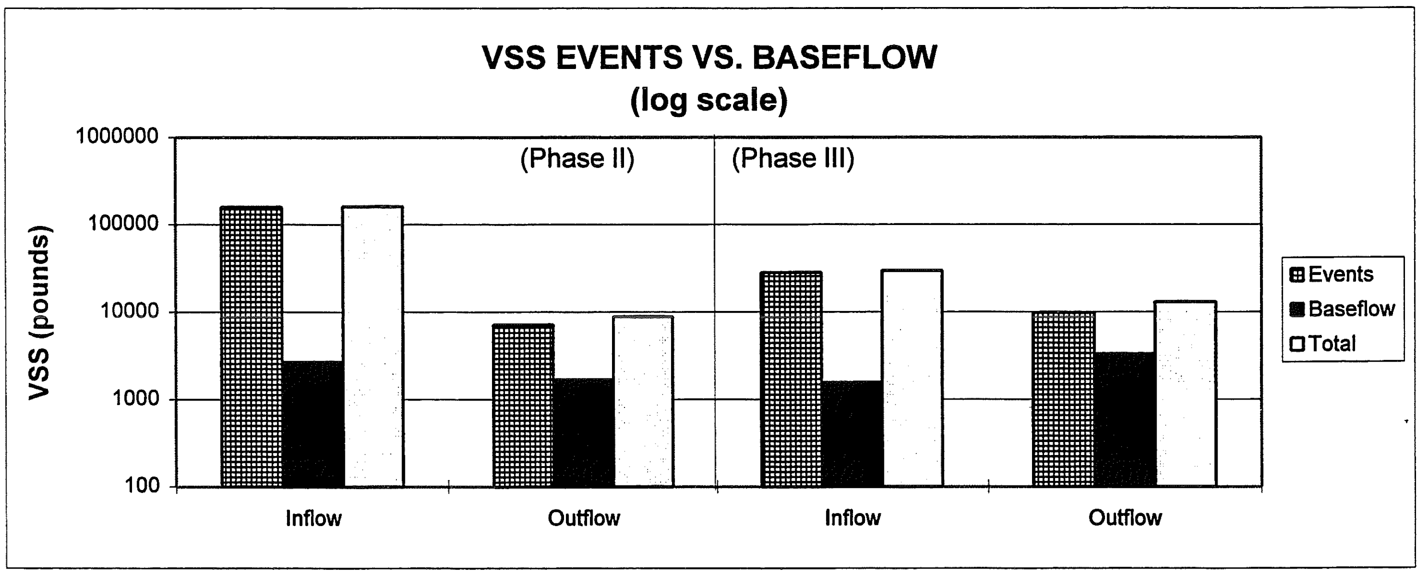


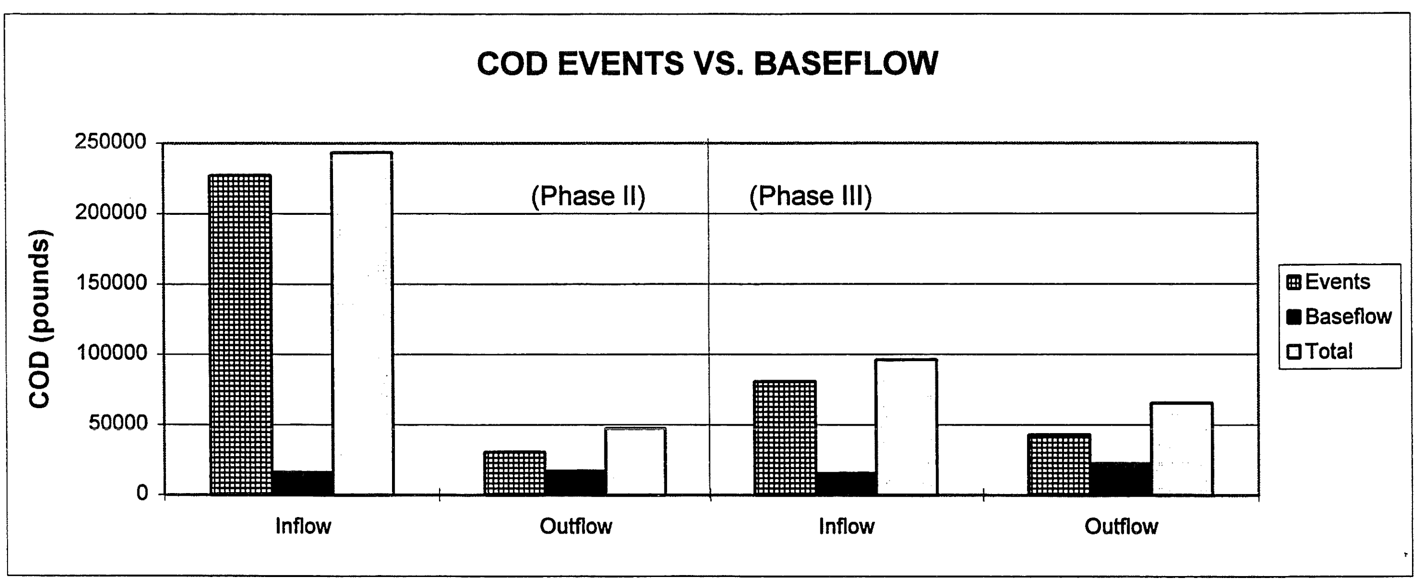


APPENDIX L.
EVENT VS. BASEFLOW LOADING PLOTS

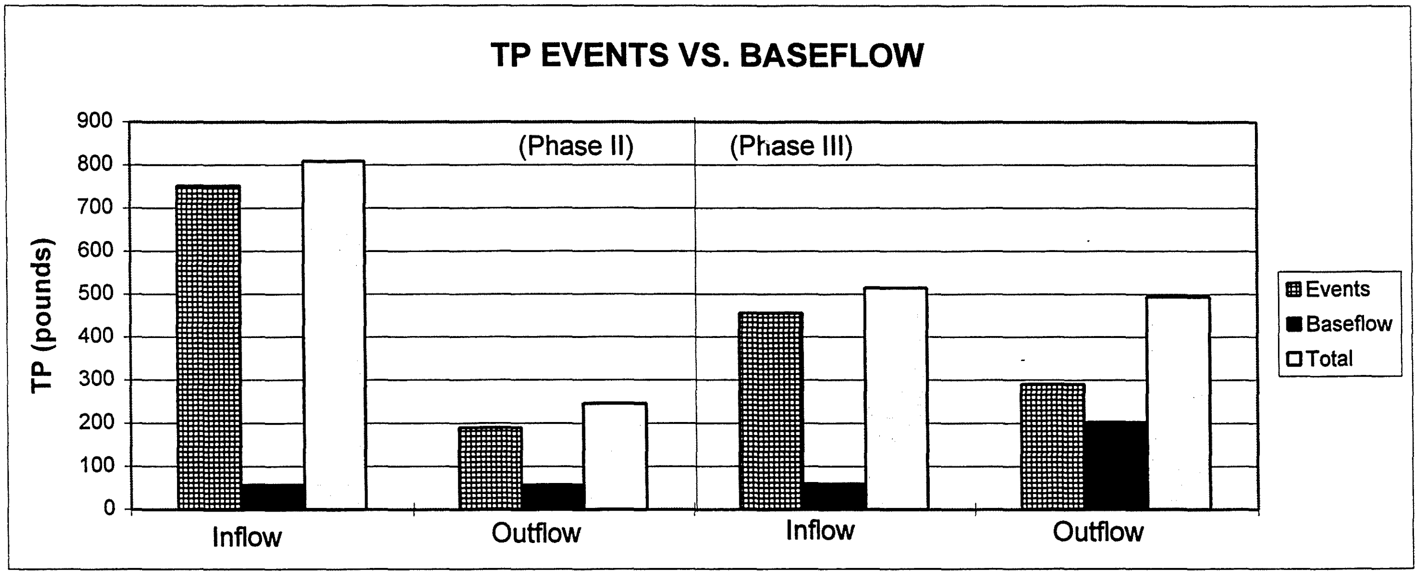
Appendix L. Event vs. Baseflow Comparisons.

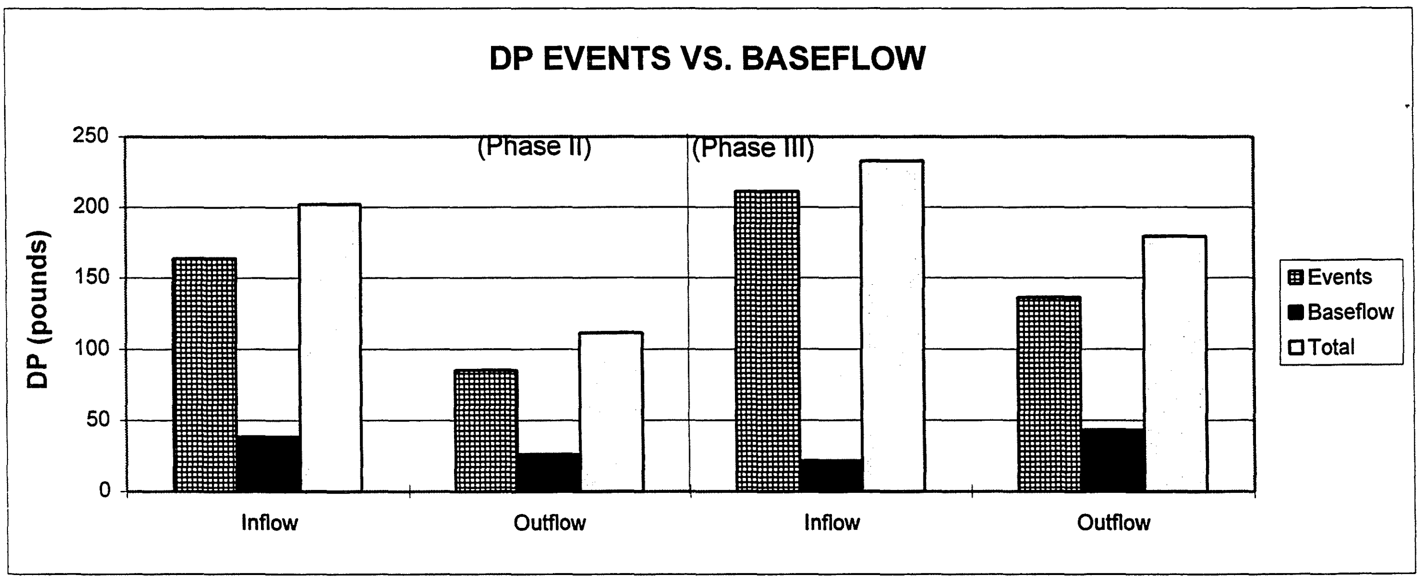




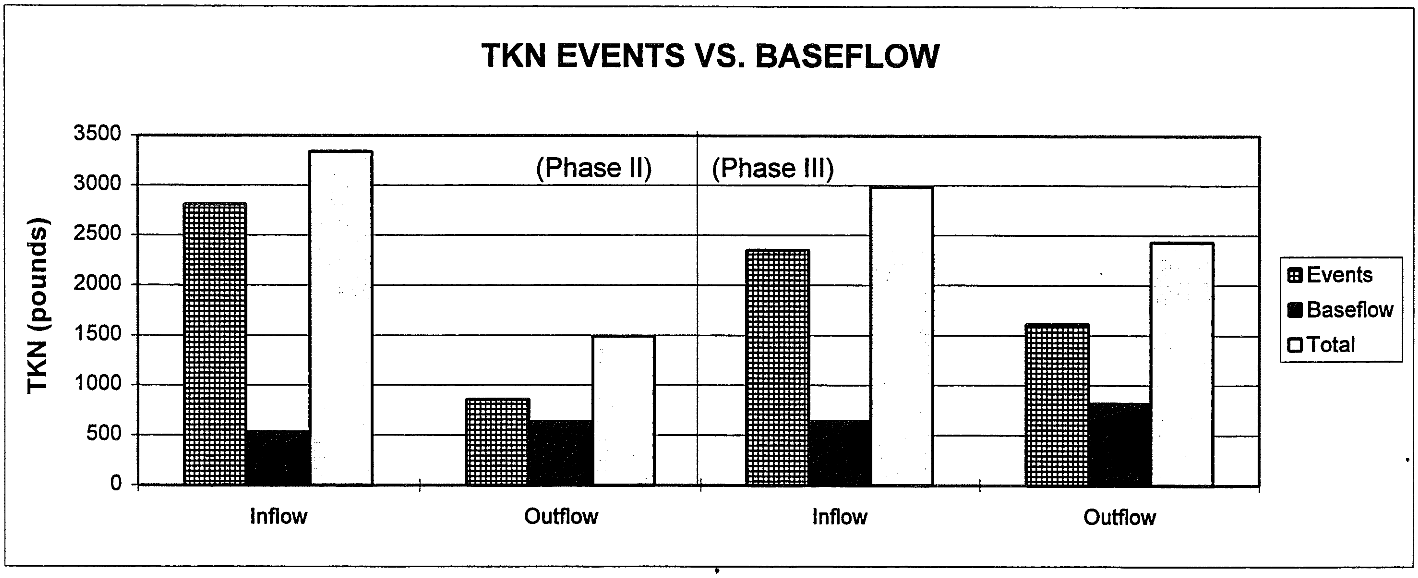


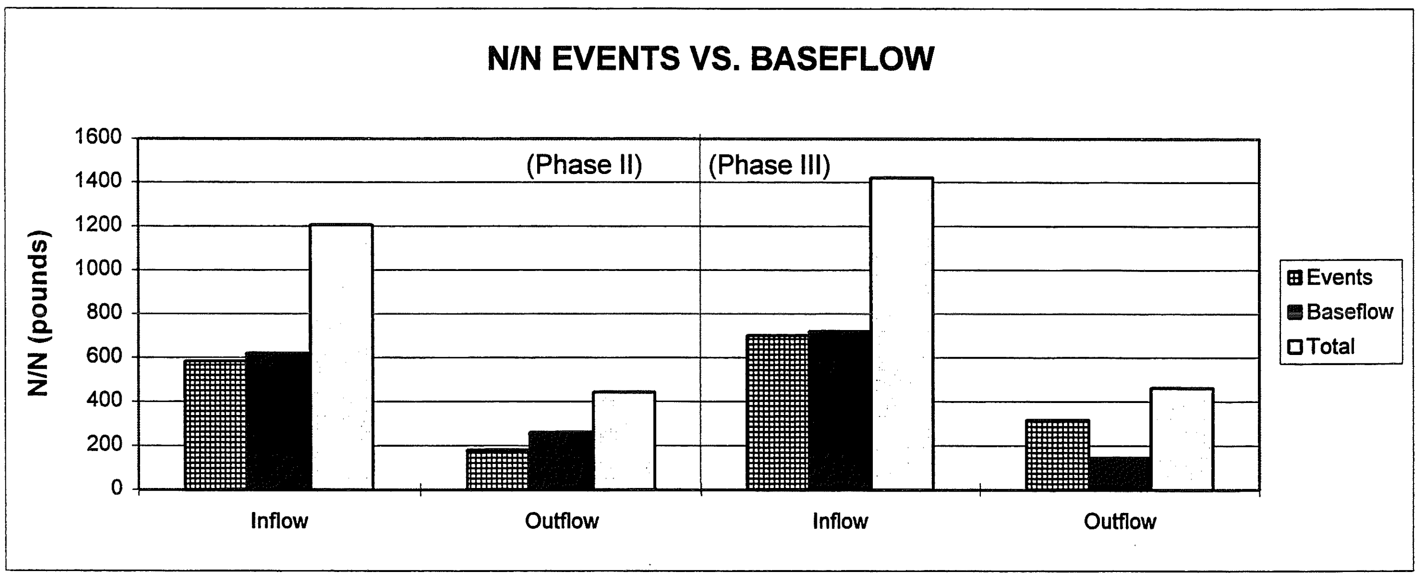
Appendix L. Event vs. Baseflow Comparisons.

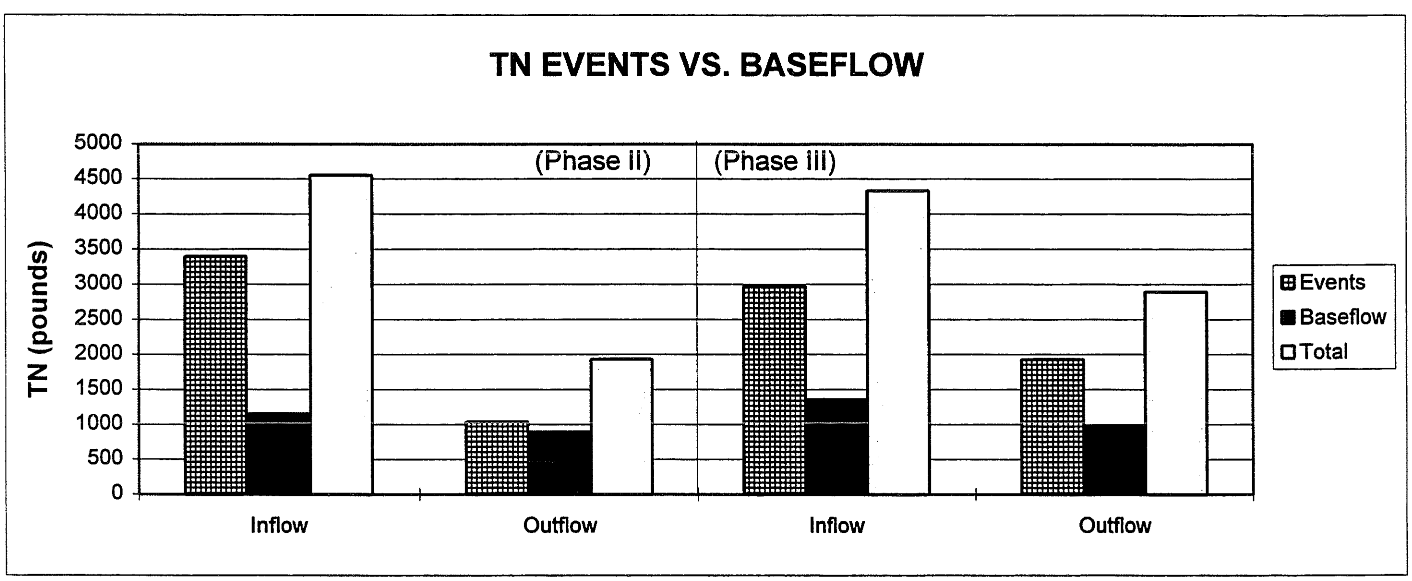




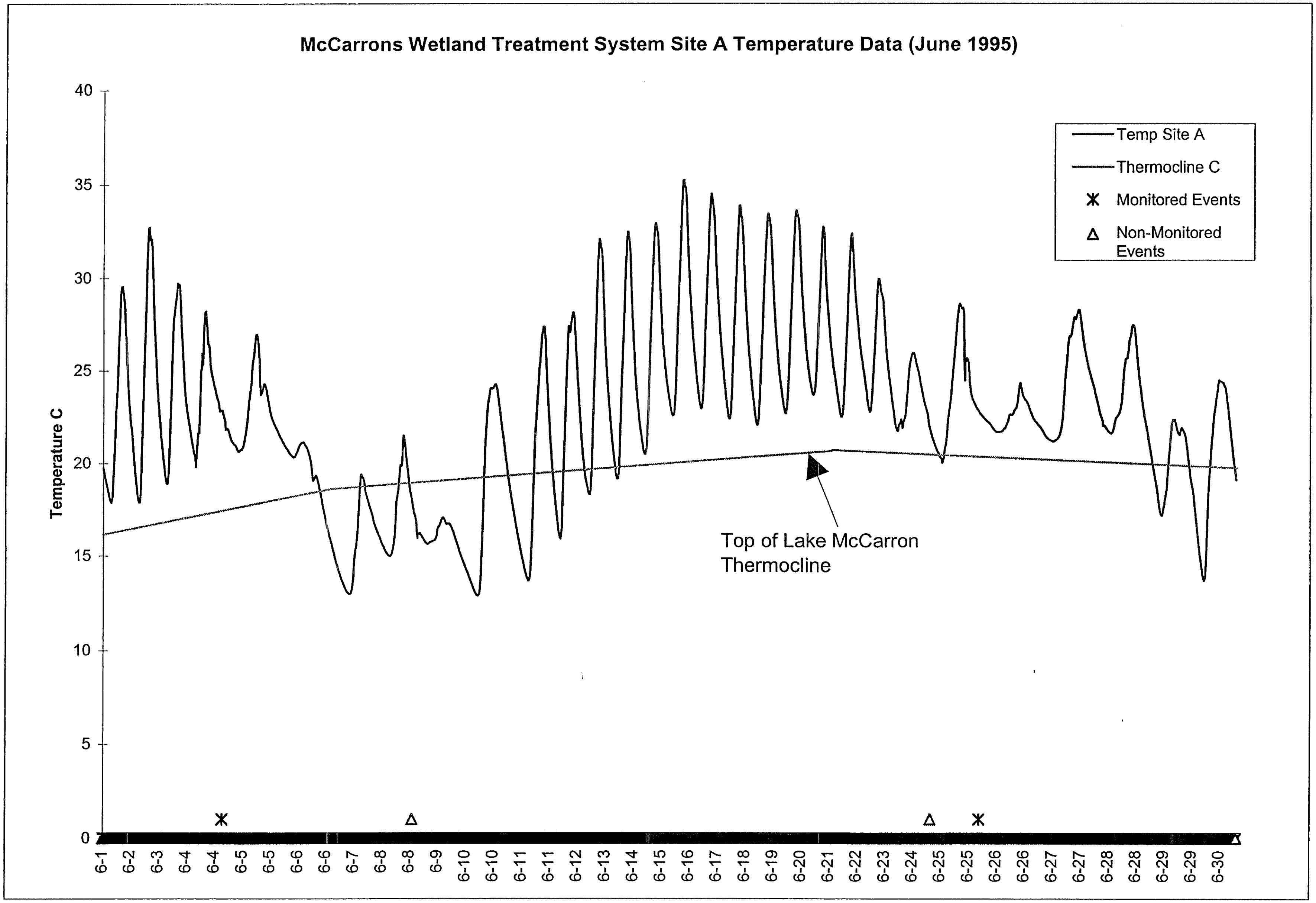
Appendix L. Event vs. Baseflow Comparisons.







APPENDIX M.
MWTS TEMPERATURE DATA


McCarrons Wetland Treatment System Site A Temperature Data (June 1995)
Temperature C
40
35
30
25
20
15
10
5
0
Temp Site A
Thermocline C
Monitored Events
Non-Monitored Events
Top of Lake McCarron Thermocline
6-1
6-2
6-3
6-4
6-4
6-5
6-5
6-6
6-6
6-7
6-8
6-8
6-9
6-10
6-10
6-11
6-11
6-12
6-13
6-14
6-15
6-16
6-17
6-18
6-19
6-20
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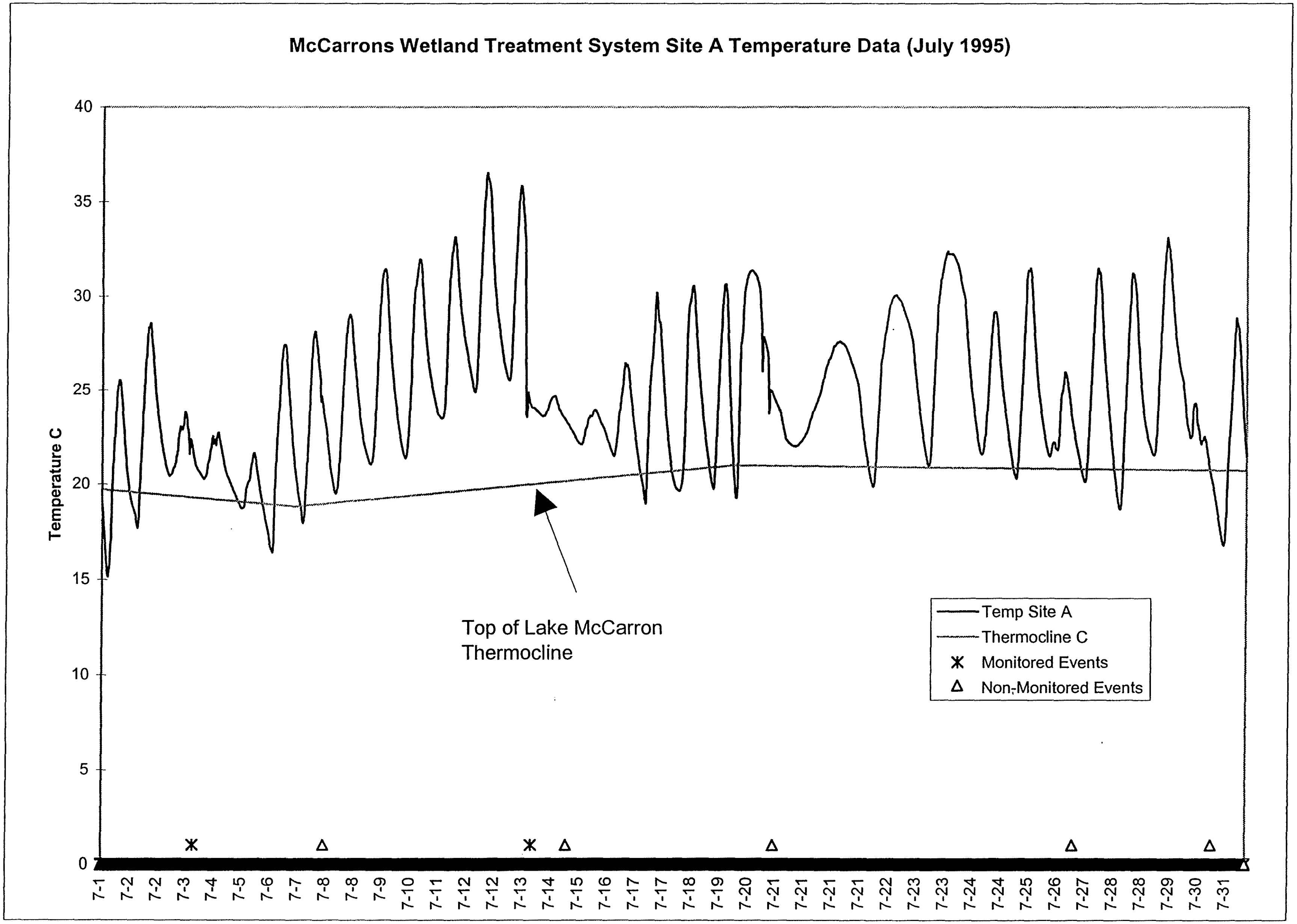
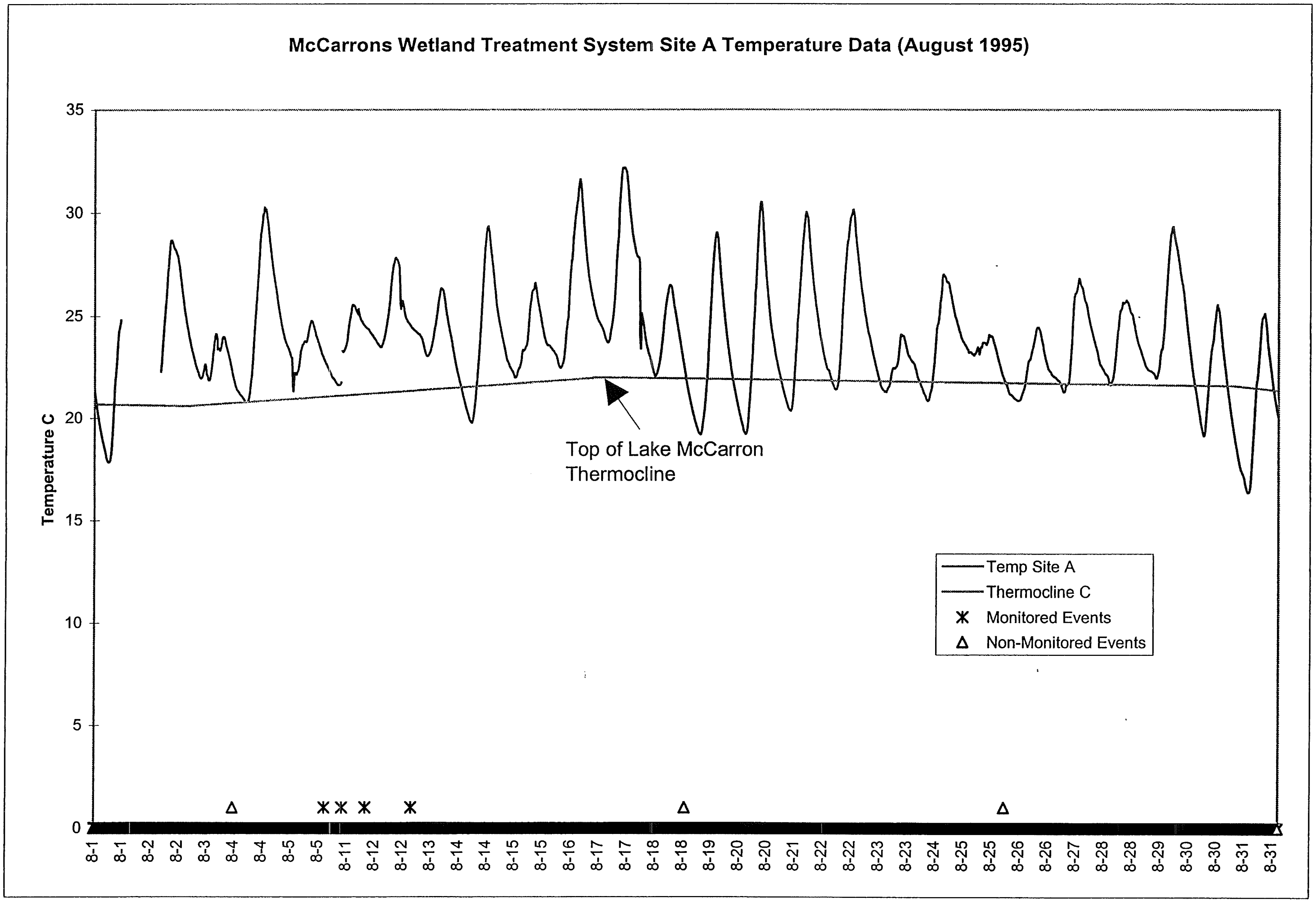
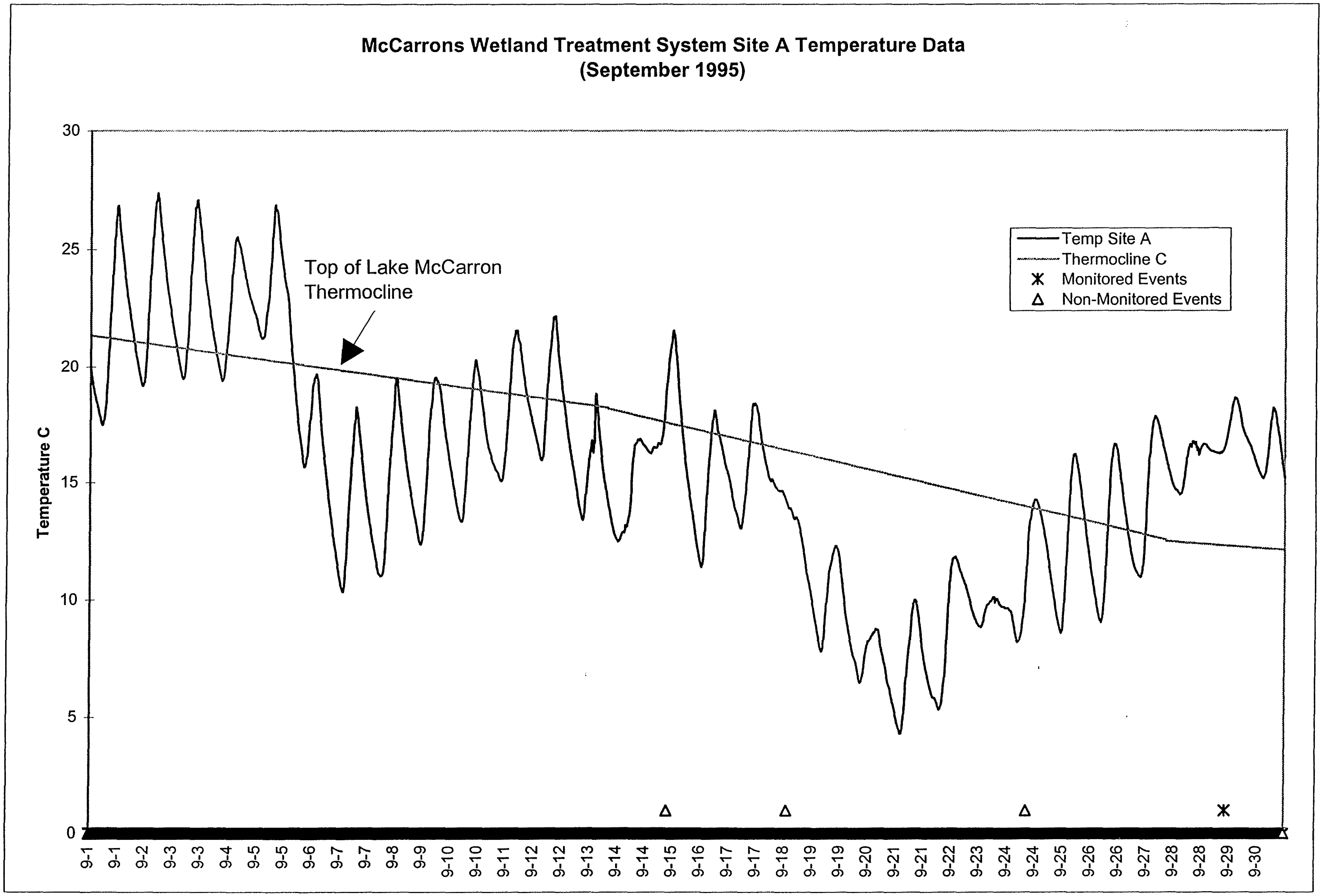
6-29
6-29
6-30


McCarrons Wetland Treatment System Site A Temperature Data (July 1995)
Temperature C
40
35
30
25
20
15
10
5
0
7-1
7-2
7-2
7-2
7-3
7-4
7-5
7-6
7-7
7-8
7-8
7-9
7-10
7-11
7-12
7-12
7-13
7-14
7-15
7-16
7-17
7-17
7-18
7-19
7-20
7-21
7-21
7-21
7-21
7-22
7-23
7-23
7-24
7-24
7-25
7-26
7-27
7-28
7-28
7-29
7-30
7-31
Top of Lake McCarron
Thermocline
Temp Site A
Thermocline C
Monitored Events
Non-Monitored Events


McCarrons Wetland Treatment System Site A Temperature Data (August 1995)
Temperature C
35
30
25
20
15
10
5
0
Top of Lake McCarron Thermocline
Temp Site A
Thermocline C
Monitored Events
Non-Monitored Events
8-1
8-1
8-2
8-2
8-3
8-4
8-4
8-5
8-5
8-11
8-12
8-12
8-13
8-14
8-14
8-15
8-15
8-16
8-17
8-17
8-18
8-18
8-19
8-20
8-20
8-21
8-22
8-22
8-23
8-23
8-24
8-25
8-25
8-26
8-26
8-27
8-28
8-28
8-29
8-30
8-30
8-31
8-31


McCarrons Wetland Treatment System Site A Temperature Data
(September 1995)
Temperature C
30
25
20
15
10
5
0
Top of Lake McCarron
Thermocline
Temp Site A
Thermocline C
Monitored Events
Non-Monitored Events
9-1
9-1
9-2
9-3
9-3
9-4
9-5
9-5
9-6
9-7
9-7
9-8
9-9
9-10
9-10
9-11
9-12
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9-13
9-14
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9-16
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9-21
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9-23
9-24
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9-25
9-26
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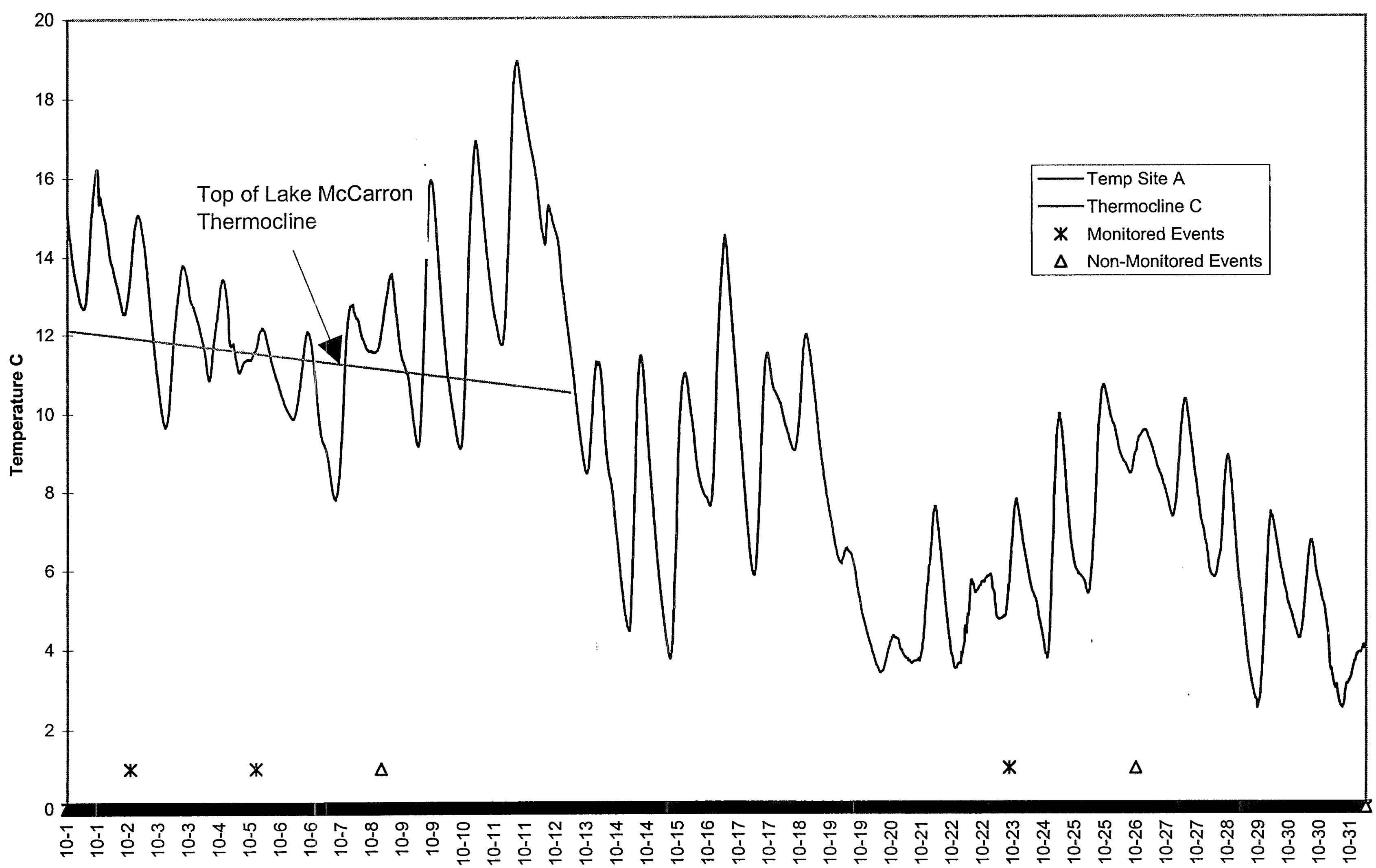
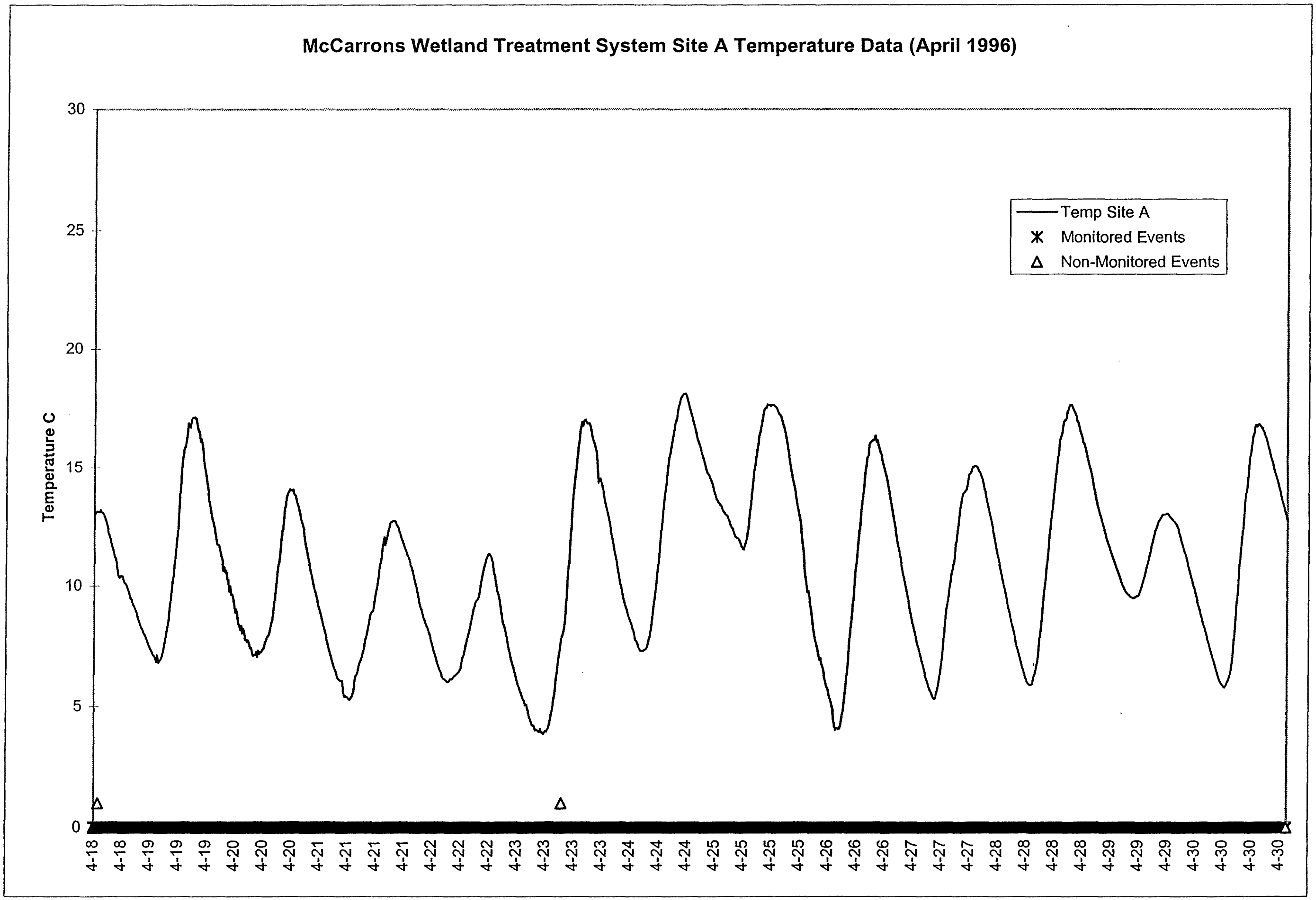
9-27
9-28
9-28
9-29
9-30

McCarrons Wetland Treatment System Site A Temperature Data (October 1995)




McCarrons Wetland Treatment System Site A Temperature Data (April 1996)
Temperature C
30
25
20
15
10
5
0
Temp Site A
Monitored Events
Non-Monitored Events
4-18
4-18
4-19
4-19
4-19
4-20
4-20
4-20
4-21
4-21
4-21
4-21
4-22
4-22
4-22
4-23
4-23
4-23
4-23
4-24
4-24
4-24
4-25
4-25
4-25
4-25
4-26
4-26
4-26
4-27
4-27
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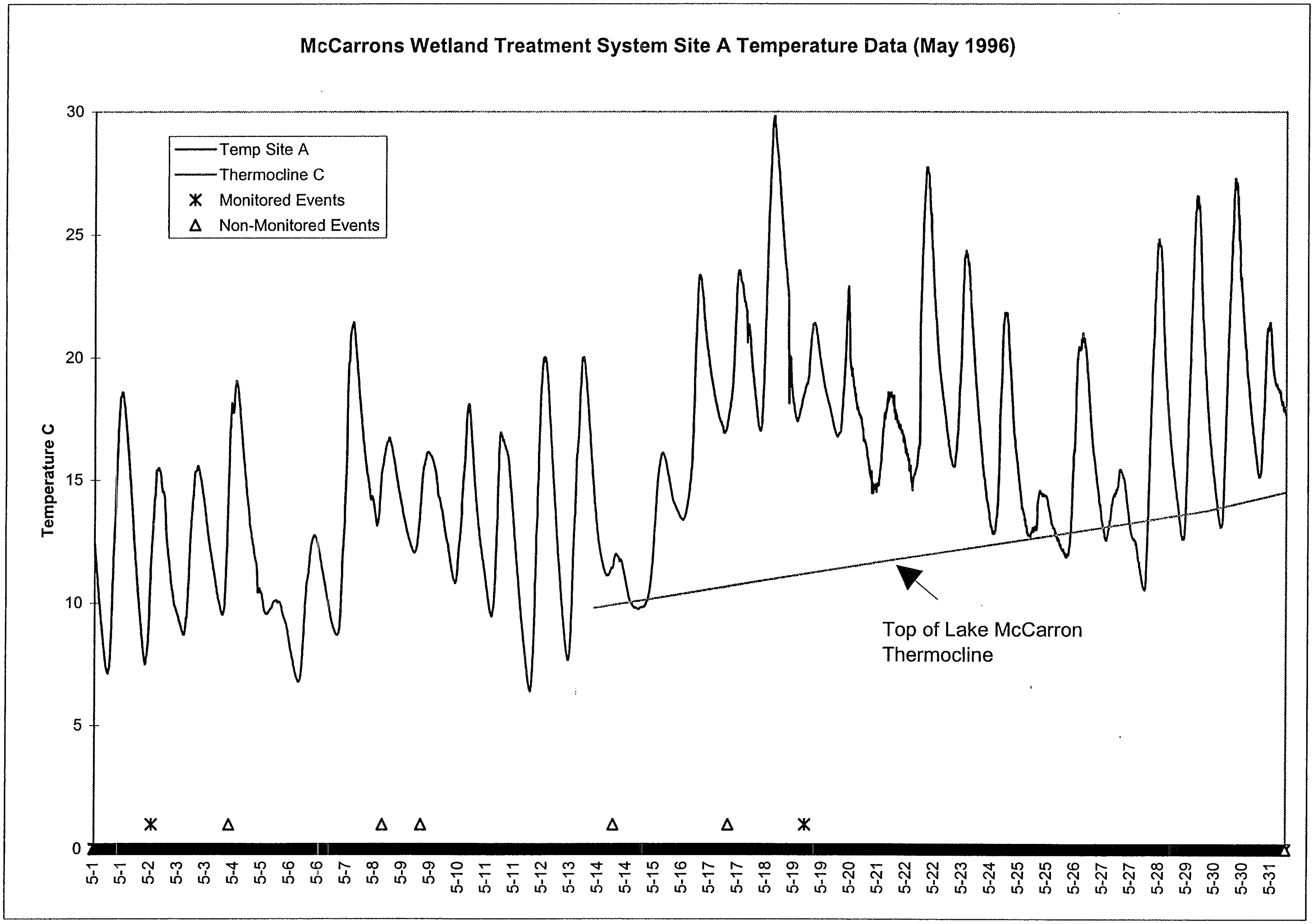
4-29
4-29
4-30
4-30
4-30
4-30


McCarrons Wetland Treatment System Site A Temperature Data (May 1996)
Temperature C
Temp Site A
Thermocline C
Monitored Events
Non-Monitored Events
Top of Lake McCarron Thermocline
30
25
20
15
10
5
0
5-1
5-1
5-2
5-3
5-3
5-4
5-5
5-6
5-6
5-7
5-8
5-9
5-9
5-10
5-11
5-11
5-12
5-13
5-14
5-14
5-15
5-16
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5-20
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5-23
5-24
5-25
5-25
5-26
5-27
5-27
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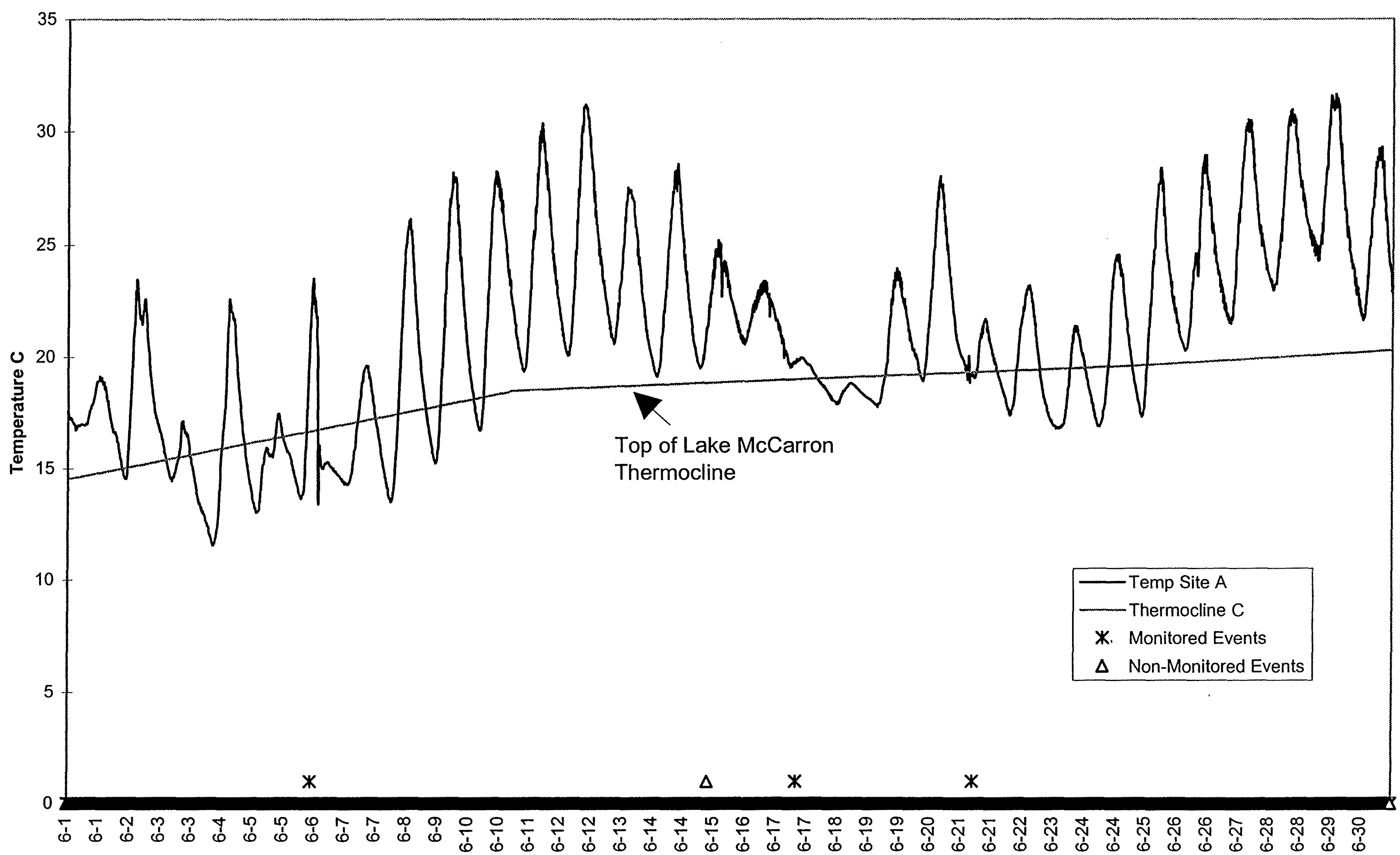
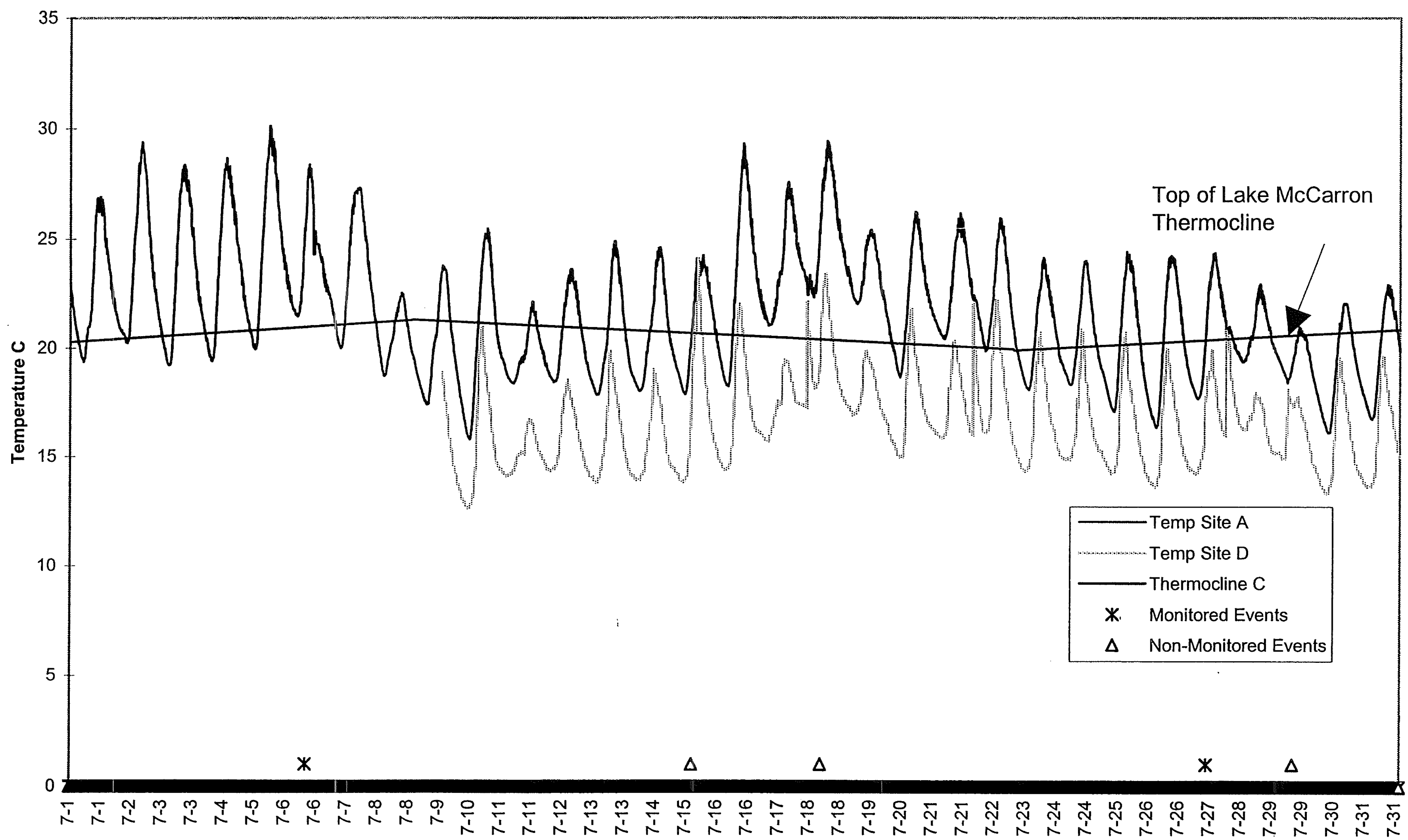
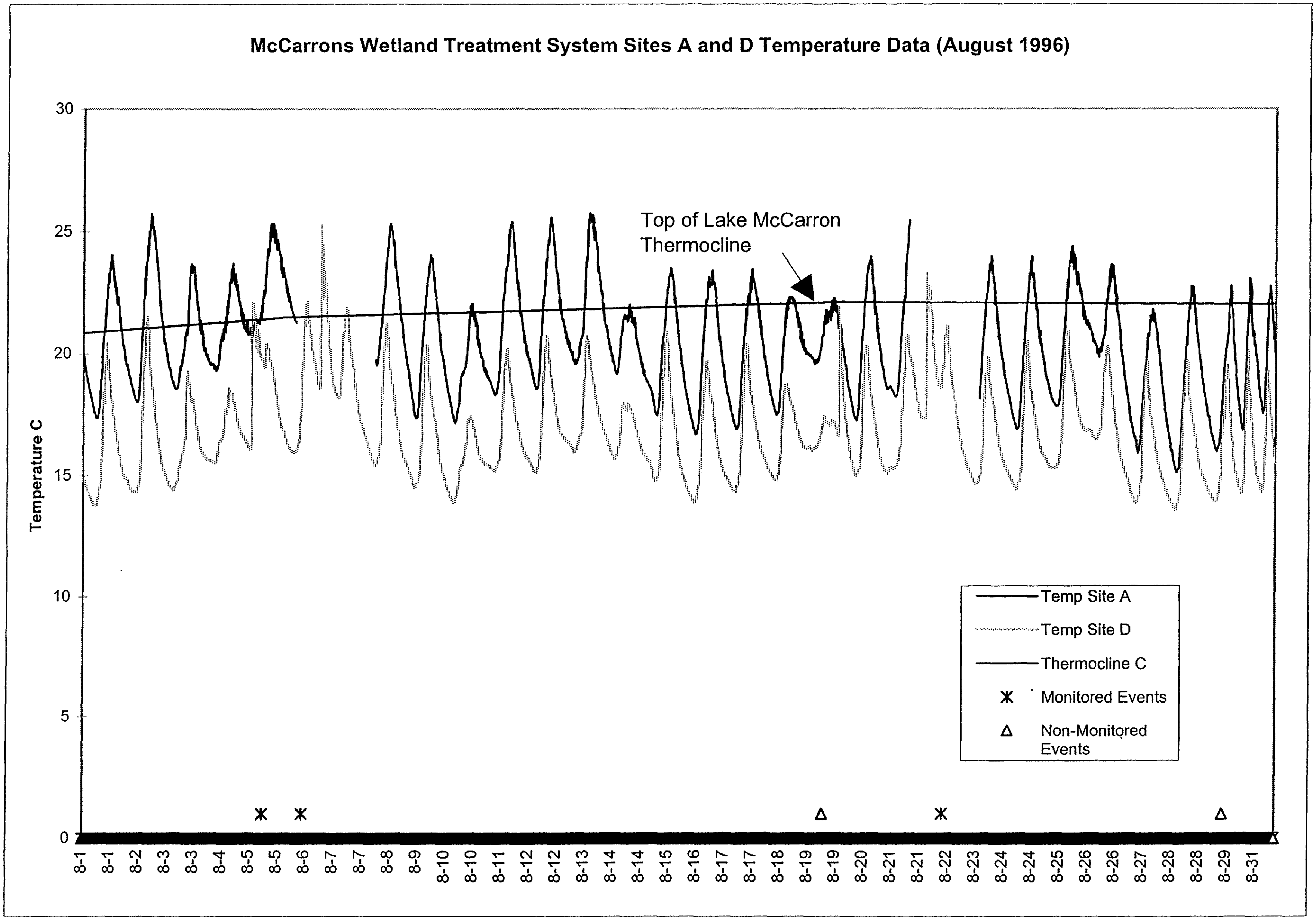
5-29
5-30
5-30
5-31

McCarrons Wetland Treatment System Site A Temperature Data (June 1996)



McCarrons Wetland Treatment System Sites A and D Temperature Data (July 1996)





McCarrons Wetland Treatment System Sites A and D Temperature Data (August 1996)
Temperature C
30
25
20
15
10
5
0
Top of Lake McCarron Thermocline
Temp Site A
Temp Site D
Thermocline C
Monitored Events
Non-Monitored Events
8-1
8-1
8-2
8-3
8-3
8-4
8-5
8-5
8-6
8-7
8-7
8-8
8-9
8-10
8-10
8-11
8-12
8-12
8-13
8-14
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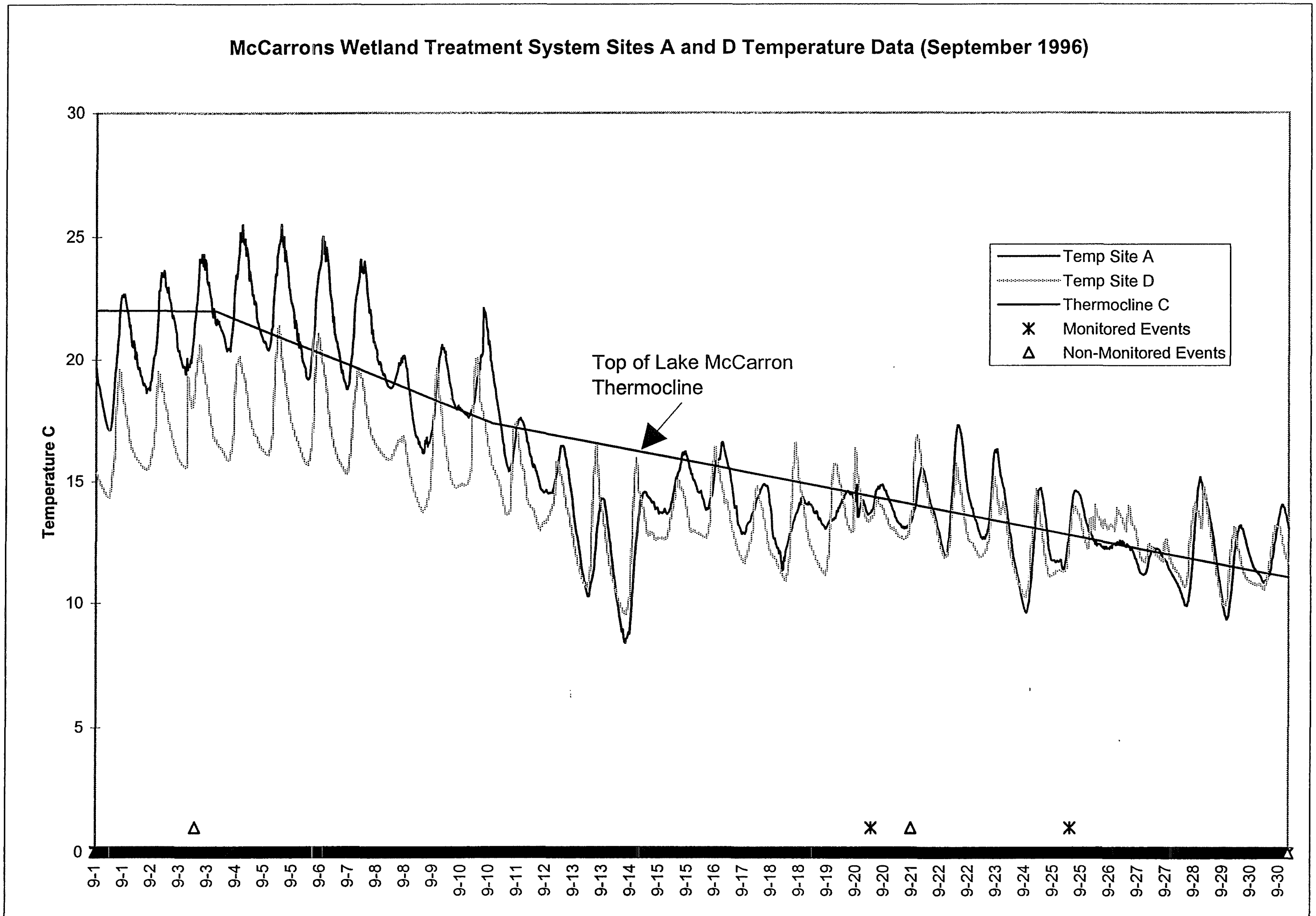
8-31


McCarrons Wetland Treatment System Sites A and D Temperature Data (September 1996)
Temperature C
30
25
20
15
10
5
0
Temp Site A
Temp Site D
Thermocline C
Monitored Events
Non-Monitored Events
Top of Lake McCarron Thermocline
9-1
9-1
9-2
9-3
9-3
9-4
9-5
9-5
9-6
9-7
9-8
9-8
9-9
9-10
9-10
9-11
9-12
9-13
9-13
9-14
9-15
9-15
9-16
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9-25
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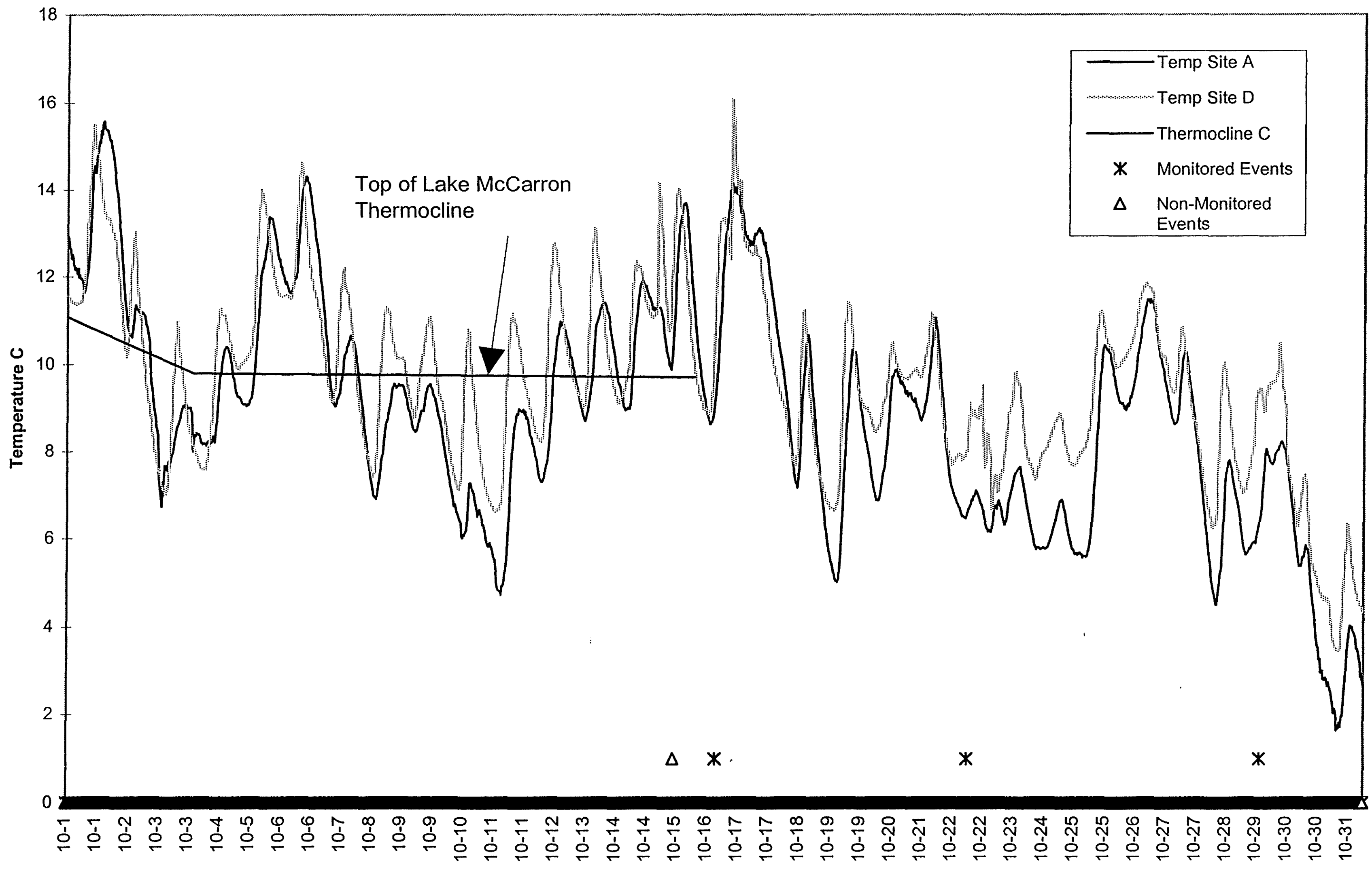
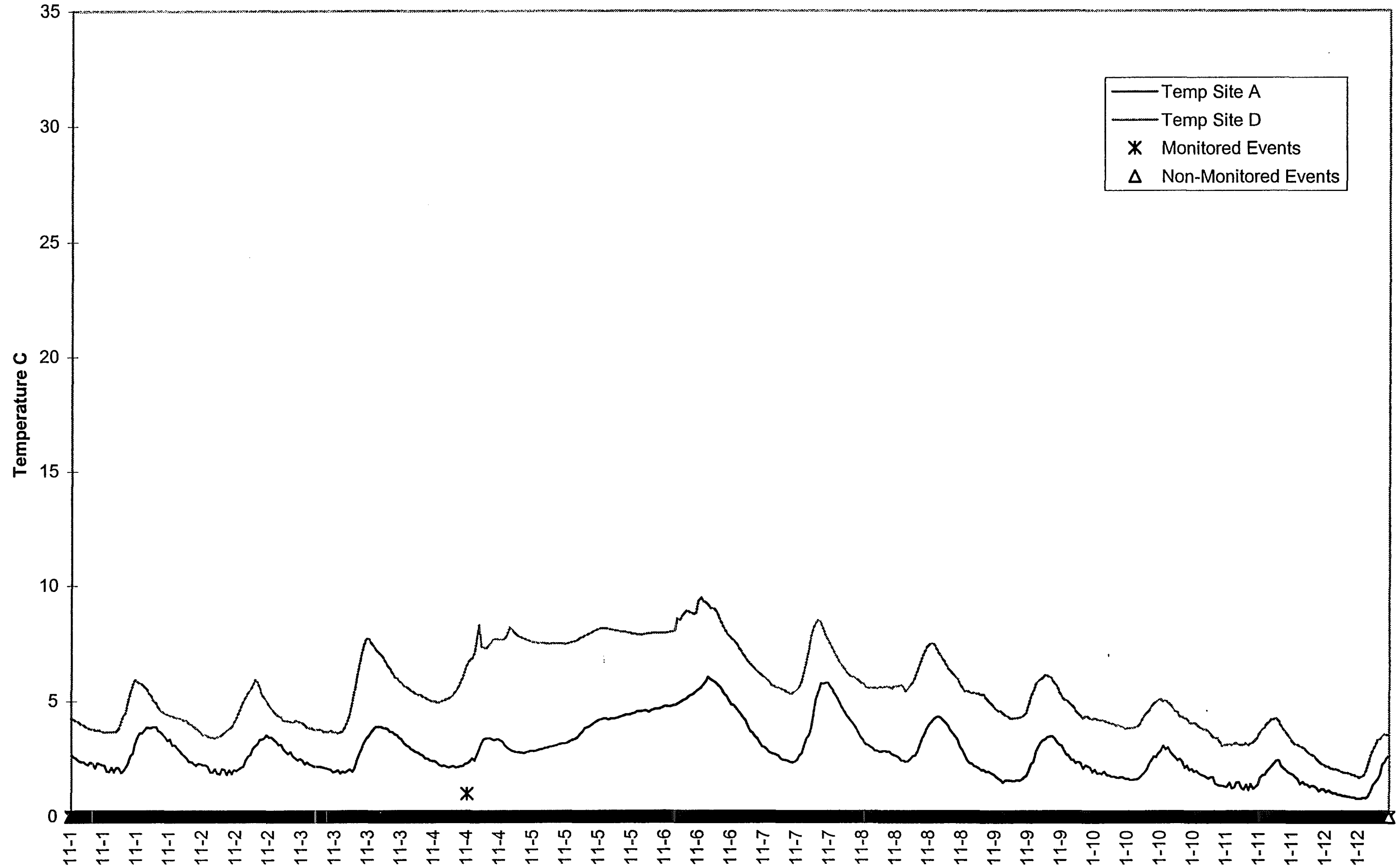
9-29
9-30
9-30

McCarrons Wetland Treatment System Sites A and D Temperature Data (October 1996)



McCarrons Wetland Treatment System Sites A and D Temperature Data (November 1996)



APPENDIX N.
LAKE WATER QUALITY DATA

Physical/Chemical Data

Parameter Code	Parameter	Detection Limit*	Units
DM	Depth	--	m
TC	Temperature	--	^0C
DO	Dissolved Oxygen	--	mg/l ($g \bullet m^{-3}$)
TP	Total Phosphorus	10	$\mu g/l$ ($mg \bullet m^{-3}$)
TDP	Total Dissolved Phosphorus	10	$\mu g/l$ ($mg \bullet m^{-3}$)
TKN	Total Kjeldahl Nitrogen	0.20	mg/l ($g \bullet m^{-3}$)
NO2+NO3	Nitrate + Nitrite	50/10	$\mu g/l$ ($mg \bullet m^{-3}$)
NH3	Ammonia	20	$\mu g/l$ ($mg \bullet m^{-3}$)
CLA	Chlorophyll a (uncorrected)	1.0	$\mu g/l$ ($mg \bullet m^{-3}$)
SDM	Secchi Disk	--	m (=3.2808 ft)
COND	Specific Conductance	--	μmho/cm
PHL	pH	--	standard units
ALK	Alkalinity	20	$g\ CaCO_3 \cdot m^{-3}$
PC	Physical Condition	--	1 to 5 ranking
SR	Suitability for Recreation	--	1 to 5 ranking

* Below detection-limit values are reported here as half the detection limit

Definition of Measurement Units

Celsius (^0C) - The basic metric unit of temperature; [(9/5)x(^0C)] + 32 = fahrenheit.
Centimeter (cm) - One one-thousandth of a meter; roughly equivalent to two-fifths of an inch.
Gram (g) - One one-thousandth of a kilogram.
Kilogram (kg) - The basic metric unit of mass; equivalent to 1000 grams of approximately 2.2 pounds.
Liter (l) - The basic metric unit of volume; roughly equivalent to 1 quart or 0.25 gallons.
Meter (m) - The basic metric unit of length; equivalent to 3.2808 feet.
Microgram (μg) - One one-millionth of a gram.
Micrograms per liter ($\mu g/l$) - An expression for concentration usually in reference to a liquid; roughly equivalent to parts per billion.
Microhms per centimeter (μmho/cm) - A unit of measure used to determine the concentration of dissolved minerals in the water.
Milligram (mg) - One one-thousandth of a gram.
Milligrams per liter (mg/l) - An expression for concentration usually in reference to a liquid; roughly equivalent to parts per million.
Standard units - Used to measure the acidity or pH of the water on a 1 to 14 scale (6.5 to 9.0 is desirable). A pH of 7 is considered neutral, while below 7 is considered acidic and above 7 is basic.

LAKENAME=MCCARRONS YEAR=1995

OBS	LAKEID	DATE	DM	TC	DO	TP	TDP	TKN	N23	CLA	SDM	COND	PHL	ALK
1	62-0054	950413	0.0	4.2	10.70	70	50	1.140	.	21.0	1.3	483	7.34	.
2	62-0054	950413	1.0	4.2	10.70	.	.	.	.	.	.	.	.	.
3	62-0054	950413	2.0	4.2	10.70	.	.	.	.	.	.	.	.	.
4	62-0054	950413	3.0	4.1	10.70	.	.	.	.	.	.	.	.	.
5	62-0054	950413	4.0	4.1	10.70	.	.	.	.	.	.	.	.	.
6	62-0054	950413	5.0	4.1	10.70	.	.	.	.	.	.	.	.	.
7	62-0054	950413	6.0	4.1	10.60	.	.	.	.	.	.	.	.	.
8	62-0054	950413	7.0	4.1	10.60	.	.	.	.	.	.	.	.	.
9	62-0054	950413	8.0	4.1	10.60	90	.	.	.	.	.	.	.	.
10	62-0054	950413	9.0	4.1	10.60	.	.	.	.	.	.	.	.	.
11	62-0054	950413	10.0	4.1	10.60	.	.	.	.	.	.	.	.	.
12	62-0054	950413	11.0	4.1	10.60	.	.	.	.	.	.	.	.	.
13	62-0054	950413	12.0	4.1	10.60	.	.	.	.	.	.	.	.	.
14	62-0054	950413	13.0	4.1	10.60	.	.	.	.	.	.	.	.	.
15	62-0054	950413	14.0	4.1	10.60	.	.	.	.	.	.	.	.	.
16	62-0054	950413	15.0	4.1	10.50	.	.	.	.	.	.	.	.	.
17	62-0054	950413	16.0	4.1	10.40	60	40	.	.	.	.	450	7.47	.
18	62-0054	950427	0.0	8.9	13.20	70	10	2.400	.	41.0	0.8	474	8.53	.
19	62-0054	950427	1.0	8.8	14.20	.	.	.	.	.	.	.	.	.
20	62-0054	950427	2.0	8.1	14.20	.	.	.	.	.	.	.	.	.
21	62-0054	950427	3.0	8.3	13.40	.	.	.	.	.	.	.	.	.
22	62-0054	950427	4.0	7.6	11.90	.	.	.	.	.	.	.	.	.
23	62-0054	950427	5.0	6.8	11.60	.	.	.	.	.	.	.	.	.
24	62-0054	950427	6.0	6.3	11.40	.	.	.	.	.	.	.	.	.
25	62-0054	950427	7.0	6.3	11.30	.	.	.	.	.	.	.	.	.
26	62-0054	950427	8.0	6.0	11.40	.	.	.	.	.	.	.	.	.
27	62-0054	950427	9.0	5.9	11.50	90	50	.	.	.	.	504	7.92	.
28	62-0054	950427	10.0	5.9	11.90	.	.	.	.	.	.	.	.	.
29	62-0054	950427	11.0	5.9	11.80	.	.	.	.	.	.	.	.	.
30	62-0054	950427	12.0	5.7	11.60	.	.	.	.	.	.	.	.	.
31	62-0054	950427	13.0	5.7	11.50	.	.	.	.	.	.	.	.	.
32	62-0054	950427	14.0	5.6	11.30	.	.	.	.	.	.	.	.	.
33	62-0054	950427	15.0	5.5	11.50	.	.	.	.	.	.	.	.	.
34	62-0054	950427	16.0	5.5	8.60	.	.	.	.	.	.	.	.	.
35	62-0054	950427	17.0	5.4	4.70	110	80	.	.	.	.	489	7.74	.
36	62-0054	950511	0.0	11.7	9.00	120	60	1.700	.	3.1	4.0	535	8.50	.
37	62-0054	950511	1.0	11.7	8.90	.	.	.	.	.	.	.	.	.
38	62-0054	950511	2.0	11.7	8.70	.	.	.	.	.	.	.	.	.
39	62-0054	950511	3.0	11.7	8.50	.	.	.	.	.	.	.	.	.
40	62-0054	950511	4.0	11.2	7.50	.	.	.	.	.	.	.	.	.
41	62-0054	950511	4.5	10.3	7.10	.	.	.	.	.	.	.	.	.
42	62-0054	950511	5.0	9.4	6.20	.	.	.	.	.	.	.	.	.
43	62-0054	950511	5.5	8.0	7.10	.	.	.	.	.	.	.	.	.
44	62-0054	950511	6.0	7.5	7.40	.	.	.	.	.	.	.	.	.
45	62-0054	950511	6.5	7.2	7.70	.	.	.	.	.	.	.	.	.
46	62-0054	950511	7.0	6.9	8.30	.	.	.	.	.	.	.	.	.
47	62-0054	950511	7.5	6.7	8.20	.	.	.	.	.	.	.	.	.
48	62-0054	950511	8.0	6.5	8.00	110	80	.	.	.	.	554	8.00	.

-- LAKENAME=MCCARRONS YEAR=1995 --
(continued)

OBS	LAKEID	DATE	DM	TC	DO	TP	TDP	TKN	N23	CLA	SDM	COND	PHL	ALK
49	62-0054	950511	9.0	6.3	7.90	.	.	.	.	.	.	.	.	.
50	62-0054	950511	10.0	6.1	7.90	.	.	.	.	.	.	.	.	.
51	62-0054	950511	11.0	6.0	7.00	.	.	.	.	.	.	.	.	.
52	62-0054	950511	12.0	6.0	6.60	.	.	.	.	.	.	.	.	.
53	62-0054	950511	13.0	5.9	5.80	.	.	.	.	.	.	.	.	.
54	62-0054	950511	14.0	5.8	4.30	.	.	.	.	.	.	.	.	.
55	62-0054	950511	15.0	5.8	2.80	.	.	.	.	.	.	.	.	.
56	62-0054	950511	16.0	5.7	0.20	.	.	.	.	.	.	.	.	.
57	62-0054	950511	17.0	5.7	0.30	110	90	.	.	.	.	601	8.20	.
58	62-0054	950525	0.0	17.3	9.70	70	50	1.100	0.150	2.4	4.4	531	7.41	120
59	62-0054	950525	1.0	16.9	9.60	.	.	.	.	.	.	.	.	.
60	62-0054	950525	2.0	16.7	9.60	.	.	.	.	.	.	.	.	.
61	62-0054	950525	3.0	16.5	9.70	.	.	.	.	.	.	.	.	.
62	62-0054	950525	4.0	16.2	9.20	.	.	.	.	.	.	.	.	.
63	62-0054	950525	4.5	13.7	6.20	.	.	.	.	.	.	.	.	.
64	62-0054	950525	5.0	13.3	5.30	110	100	.	.	.	.	556	7.41	.
65	62-0054	950525	5.5	10.9	5.10	.	.	.	.	.	.	.	.	.
66	62-0054	950525	6.0	10.1	5.00	.	.	.	.	.	.	.	.	.
67	62-0054	950525	6.5	9.3	5.50	.	.	.	.	.	.	.	.	.
68	62-0054	950525	7.0	8.0	5.50	.	.	.	.	.	.	.	.	.
69	62-0054	950525	7.5	7.8	5.60	.	.	.	.	.	.	.	.	.
70	62-0054	950525	8.0	7.2	5.80	.	.	.	.	.	.	.	.	.
71	62-0054	950525	8.5	6.9	5.80	.	.	.	.	.	.	.	.	.
72	62-0054	950525	9.0	6.7	5.80	.	.	.	.	.	.	.	.	.
73	62-0054	950525	10.0	6.4	5.70	.	.	.	.	.	.	.	.	.
74	62-0054	950525	11.0	6.1	5.50	150	140	.	.	.	.	561	7.38	.
75	62-0054	950525	12.0	5.9	5.30	.	.	.	.	.	.	.	.	.
76	62-0054	950525	13.0	5.8	2.80	.	.	.	.	.	.	.	.	.
77	62-0054	950525	14.0	5.7	0.50	.	.	.	.	.	.	.	.	.
78	62-0054	950525	15.0	5.7	0.50	.	.	.	.	.	.	.	.	.
79	62-0054	950525	16.0	5.6	0.50	.	.	.	.	.	.	.	.	.
80	62-0054	950525	17.0	5.6	0.50	380	280	.	.	.	.	574	7.34	.
81	62-0054	950607	0.0	22.9	11.10	100	70	1.400	.	22.0	2.0	454	8.15	.
82	62-0054	950607	1.0	23.0	11.10	.	.	.	.	.	.	.	.	.
83	62-0054	950607	2.0	22.8	10.60	.	.	.	.	.	.	.	.	.
84	62-0054	950607	2.5	20.0	9.90	.	.	.	.	.	.	.	.	.
85	62-0054	950607	3.0	18.6	8.90	.	.	.	.	.	.	.	.	.
86	62-0054	950607	3.5	17.5	8.70	.	.	.	.	.	.	.	.	.
87	62-0054	950607	4.0	16.9	8.30	.	.	.	.	.	.	.	.	.
88	62-0054	950607	4.5	15.8	7.10	.	.	.	.	.	.	.	.	.
89	62-0054	950607	5.0	14.1	5.20	70	60	.	.	.	.	481	7.83	.
90	62-0054	950607	5.5	11.3	4.90	.	.	.	.	.	.	.	.	.
91	62-0054	950607	6.0	10.4	4.90	.	.	.	.	.	.	.	.	.
92	62-0054	950607	6.5	9.6	5.20	.	.	.	.	.	.	.	.	.
93	62-0054	950607	7.0	8.7	5.30	.	.	.	.	.	.	.	.	.
94	62-0054	950607	7.5	8.1	5.30	.	.	.	.	.	.	.	.	.
95	62-0054	950607	8.0	7.7	5.40	.	.	.	.	.	.	.	.	.

LAKENAME=MCCARRONS YEAR=1995
(continued)

OBS	LAKEID	DATE	DM	TC	DO	TP	TDP	TKN	N23	CLA	SDM	COND	PHL	ALK
96	62-0054	950607	8.5	7.3	5.70	.	.	.	.	.	.	.	.	.
97	62-0054	950607	9.0	7.1	4.90	.	.	.	.	.	.	.	.	.
98	62-0054	950607	10.0	6.6	4.50	190	170	.	.	.	.	508	7.52	.
99	62-0054	950607	11.0	6.2	0.10	.	.	.	.	.	.	.	.	.
100	62-0054	950607	12.0	6.1	0.10	.	.	.	.	.	.	.	.	.
101	62-0054	950607	13.0	6.0	0.10	.	.	.	.	.	.	.	.	.
102	62-0054	950607	14.0	5.9	0.10	.	.	.	.	.	.	.	.	.
103	62-0054	950607	15.0	5.9	0.20	.	.	.	.	.	.	.	.	.
104	62-0054	950607	16.0	5.9	0.20	390	370	.	.	.	.	519	7.34	.
105	62-0054	950622	0.0	29.4	10.70	100	70	1.100	.	51.0	0.9	427	8.81	.
106	62-0054	950622	1.0	29.0	10.70	.	.	.	.	.	.	.	.	.
107	62-0054	950622	1.5	28.5	12.60	.	.	.	.	.	.	.	.	.
108	62-0054	950622	2.0	23.8	5.50	.	.	.	.	.	.	.	.	.
109	62-0054	950622	2.5	20.7	6.20	.	.	.	.	.	.	.	.	.
110	62-0054	950622	3.0	18.2	4.50	.	.	.	.	.	.	.	.	.
111	62-0054	950622	3.5	16.8	3.40	.	.	.	.	.	.	.	.	.
112	62-0054	950622	4.0	15.4	3.30	.	.	.	.	.	.	.	.	.
113	62-0054	950622	4.5	14.3	3.10	.	.	.	.	.	.	.	.	.
114	62-0054	950622	5.0	12.9	2.90	110	90	.	.	.	.	485	7.68	.
115	62-0054	950622	5.5	11.3	2.90	.	.	.	.	.	.	.	.	.
116	62-0054	950622	6.0	9.9	3.20	.	.	.	.	.	.	.	.	.
117	62-0054	950622	6.5	8.8	3.90	.	.	.	.	.	.	.	.	.
118	62-0054	950622	7.0	8.0	4.40	.	.	.	.	.	.	.	.	.
119	62-0054	950622	7.5	7.1	4.60	.	.	.	.	.	.	.	.	.
120	62-0054	950622	8.0	6.8	4.50	.	.	.	.	.	.	.	.	.
121	62-0054	950622	9.0	6.4	3.70	.	.	.	.	.	.	.	.	.
122	62-0054	950622	10.0	6.1	0.10	.	.	.	.	.	.	.	.	.
123	62-0054	950622	11.0	5.9	0.10	240	190	.	.	.	.	514	7.44	.
124	62-0054	950622	12.0	5.8	0.10	.	.	.	.	.	.	.	.	.
125	62-0054	950622	13.0	5.7	0.10	.	.	.	.	.	.	.	.	.
126	62-0054	950622	14.0	5.7	0.10	.	.	.	.	.	.	.	.	.
127	62-0054	950622	15.0	5.7	0.10	.	.	.	.	.	.	.	.	.
128	62-0054	950622	16.0	5.6	0.10	.	.	.	.	.	.	.	.	.
129	62-0054	950622	17.0	5.6	0.10	500	400	.	.	.	.	532	7.23	.
130	62-0054	950707	0.0	20.1	7.60	60	20	1.300	.	6.3	3.1	430	7.92	.
131	62-0054	950707	1.0	20.1	7.60	.	.	.	.	.	.	.	.	.
132	62-0054	950707	2.0	20.2	7.60	.	.	.	.	.	.	.	.	.
133	62-0054	950707	3.0	20.2	7.50	.	.	.	.	.	.	.	.	.
134	62-0054	950707	3.5	19.4	7.40	.	.	.	.	.	.	.	.	.
135	62-0054	950707	4.0	18.8	3.10	.	.	.	.	.	.	.	.	.
136	62-0054	950707	4.5	15.4	2.30	.	.	.	.	.	.	.	.	.
137	62-0054	950707	5.0	14.1	2.30	50	40	.	.	.	.	463	7.48	.
138	62-0054	950707	5.5	12.2	2.50	.	.	.	.	.	.	.	.	.
139	62-0054	950707	6.0	11.0	2.50	.	.	.	.	.	.	.	.	.
140	62-0054	950707	6.5	9.8	2.70	.	.	.	.	.	.	.	.	.
141	62-0054	950707	7.0	8.6	3.40	.	.	.	.	.	.	.	.	.
142	62-0054	950707	7.5	7.7	3.30	.	.	.	.	.	.	.	.	.

LAKENAME=MCCARRONS YEAR=1995
(continued)

OBS	LAKEID	DATE	DM	TC	DO	TP	TDP	TKN	N23	CLA	SDM	COND	PHL	ALK
143	62-0054	950707	8.0	7.2	2.70	.	.	.	.	.	.	.	.	.
144	62-0054	950707	8.5	6.9	2.10	.	.	.	.	.	.	.	.	.
145	62-0054	950707	9.0	6.6	0.10	.	.	.	.	.	.	.	.	.
146	62-0054	950707	9.5	6.4	0.10	.	.	.	.	.	.	.	.	.
147	62-0054	950707	10.0	6.3	0.10	250	220	.	.	.	.	471	7.38	.
148	62-0054	950707	11.0	6.1	0.10	.	.	.	.	.	.	.	.	.
149	62-0054	950707	12.0	6.0	0.10	.	.	.	.	.	.	.	.	.
150	62-0054	950707	13.0	5.9	0.10	.	.	.	.	.	.	.	.	.
151	62-0054	950707	14.0	5.8	0.20	.	.	.	.	.	.	.	.	.
152	62-0054	950707	15.0	5.7	0.20	.	.	.	.	.	.	.	.	.
153	62-0054	950707	16.0	5.7	0.20	.	.	.	.	.	.	.	.	.
154	62-0054	950707	17.0	5.7	0.20	810	600	.	.	.	.	519	7.15	.
155	62-0054	950720	0.0	24.7	10.90	50	40	0.960	.	26.0	0.9	435	8.80	.
156	62-0054	950720	1.0	24.8	10.80	.	.	.	.	.	.	.	.	.
157	62-0054	950720	2.0	24.8	10.60	.	.	.	.	.	.	.	.	.
158	62-0054	950720	2.5	24.1	6.70	.	.	.	.	.	.	.	.	.
159	62-0054	950720	3.0	22.9	3.00	.	.	.	.	.	.	.	.	.
160	62-0054	950720	3.5	21.0	1.20	.	.	.	.	.	.	.	.	.
161	62-0054	950720	4.0	18.3	0.30	.	.	.	.	.	.	.	.	.
162	62-0054	950720	4.5	15.9	0.20	.	.	.	.	.	.	.	.	.
163	62-0054	950720	5.0	13.4	0.30	30	20	.	.	.	.	472	7.74	.
164	62-0054	950720	5.5	12.0	0.40	.	.	.	.	.	.	.	.	.
165	62-0054	950720	6.0	11.1	0.40	.	.	.	.	.	.	.	.	.
166	62-0054	950720	6.5	10.0	0.40	.	.	.	.	.	.	.	.	.
167	62-0054	950720	7.0	8.5	0.50	.	.	.	.	.	.	.	.	.
168	62-0054	950720	7.5	7.9	0.50	.	.	.	.	.	.	.	.	.
169	62-0054	950720	8.0	7.5	0.50	.	.	.	.	.	.	.	.	.
170	62-0054	950720	9.0	6.9	0.50	.	.	.	.	.	.	.	.	.
171	62-0054	950720	10.0	6.4	0.50	.	.	.	.	.	.	.	.	.
172	62-0054	950720	11.0	6.2	0.40	280	230	.	.	.	.	490	7.45	.
173	62-0054	950720	12.0	5.9	0.50	.	.	.	.	.	.	.	.	.
174	62-0054	950720	13.0	5.9	0.50	.	.	.	.	.	.	.	.	.
175	62-0054	950720	14.0	5.7	0.50	.	.	.	.	.	.	.	.	.
176	62-0054	950720	15.0	5.7	0.50	.	.	.	.	.	.	.	.	.
177	62-0054	950720	16.0	5.7	0.50	.	.	.	.	.	.	.	.	.
178	62-0054	950720	17.0	5.7	0.50	.	.	.	.	.	.	520	7.17	.
179	62-0054	950803	0.0	25.2	9.60	50	10	1.300	0.030	37.0	0.7	401	8.84	70
180	62-0054	950803	1.0	25.4	9.50	.	.	.	.	.	.	.	.	.
181	62-0054	950803	2.0	25.4	9.50	.	.	.	.	.	.	.	.	.
182	62-0054	950803	3.0	23.7	5.50	.	.	.	.	.	.	.	.	.
183	62-0054	950803	3.5	20.6	0.30	.	.	.	.	.	.	.	.	.
184	62-0054	950803	4.0	18.1	0.30	.	.	.	.	.	.	.	.	.
185	62-0054	950803	4.5	16.8	0.30	.	.	.	.	.	.	.	.	.
186	62-0054	950803	5.0	15.3	0.30	.	.	.	.	.	.	.	.	.
187	62-0054	950803	5.5	13.2	0.40	.	.	.	.	.	.	.	.	.
188	62-0054	950803	6.0	11.8	0.40	100	40	.	.	.	.	483	7.91	.
189	62-0054	950803	6.5	10.7	0.40	.	.	.	.	.	.	.	.	.

LAKENAME=MCCARRONS YEAR=1995
(continued)

OBS	LAKEID	DATE	DM	TC	DO	TP	TDP	TKN	N23	CLA	SDM	COND	PHL	ALK
190	62-0054	950803	7.0	9.6	0.40	.	.	.	.	.	.	.	.	.
191	62-0054	950803	7.5	9.0	0.40	.	.	.	.	.	.	.	.	.
192	62-0054	950803	8.0	8.5	0.40	.	.	.	.	.	.	.	.	.
193	62-0054	950803	8.5	7.8	0.40	.	.	.	.	.	.	.	.	.
194	62-0054	950803	9.0	7.5	0.40	.	.	.	.	.	.	.	.	.
195	62-0054	950803	9.5	6.9	0.40	.	.	.	.	.	.	.	.	.
196	62-0054	950803	10.0	6.7	0.40	.	.	.	.	.	.	.	.	.
197	62-0054	950803	11.0	6.3	0.40	.	.	.	.	.	.	.	.	.
198	62-0054	950803	12.0	6.1	0.40	600	360	.	.	.	.	555	7.32	.
199	62-0054	950803	13.0	6.0	0.40	.	.	.	.	.	.	.	.	.
200	62-0054	950803	14.0	5.9	0.40	.	.	.	.	.	.	.	.	.
201	62-0054	950803	15.0	5.8	0.40	.	.	.	.	.	.	.	.	.
202	62-0054	950803	16.0	5.8	0.40	.	.	.	.	.	.	.	.	.
203	62-0054	950803	17.0	5.8	0.40	1100	990	.	.	.	.	586	7.12	.
204	62-0054	950817	0.0	25.5	9.00	60	10	1.700	.	55.0	0.6	394	8.77	.
205	62-0054	950817	1.0	25.6	8.90	.	.	.	.	.	.	.	.	.
206	62-0054	950817	2.0	.	.	.	.	.	.	.	.	.	.	.
207	62-0054	950817	2.5	25.0	5.00	.	.	.	.	.	.	.	.	.
208	62-0054	950817	3.0	24.5	2.10	.	.	.	.	.	.	.	.	.
209	62-0054	950817	3.5	22.0	0.30	.	.	.	.	.	.	.	.	.
210	62-0054	950817	4.0	19.0	0.40	.	.	.	.	.	.	.	.	.
211	62-0054	950817	4.5	16.6	0.40	.	.	.	.	.	.	.	.	.
212	62-0054	950817	5.0	14.7	0.60	.	.	.	.	.	.	.	.	.
213	62-0054	950817	5.5	12.7	0.60	.	.	.	.	.	.	.	.	.
214	62-0054	950817	6.0	10.6	0.70	210	180	.	.	.	.	513	7.52	.
215	62-0054	950817	6.5	9.6	0.70	.	.	.	.	.	.	.	.	.
216	62-0054	950817	7.0	8.9	0.70	.	.	.	.	.	.	.	.	.
217	62-0054	950817	7.5	8.1	0.70	.	.	.	.	.	.	.	.	.
218	62-0054	950817	8.0	7.6	0.70	.	.	.	.	.	.	.	.	.
219	62-0054	950817	8.5	7.3	0.70	.	.	.	.	.	.	.	.	.
220	62-0054	950817	9.0	7.0	0.70	.	.	.	.	.	.	.	.	.
221	62-0054	950817	9.5	6.8	0.70	.	.	.	.	.	.	.	.	.
222	62-0054	950817	10.0	6.6	0.70	.	.	.	.	.	.	.	.	.
223	62-0054	950817	11.0	6.3	0.80	.	.	.	.	.	.	.	.	.
224	62-0054	950817	12.0	6.0	0.80	650	610	.	.	.	.	529	7.27	.
225	62-0054	950817	13.0	5.9	0.80	.	.	.	.	.	.	.	.	.
226	62-0054	950817	14.0	5.8	0.80	.	.	.	.	.	.	.	.	.
227	62-0054	950817	15.0	5.8	0.80	.	.	.	.	.	.	.	.	.
228	62-0054	950817	16.0	5.7	0.80	.	.	.	.	.	.	.	.	.
229	62-0054	950817	17.0	5.7	0.80	1200	1200	8.000	.	.	.	543	7.13	.
230	62-0054	950831	0.0	24.0	8.30	60	10	2.200	.	52.0	0.6	369	8.67	.
231	62-0054	950831	1.0	24.1	8.30	.	.	.	.	.	.	.	.	.
232	62-0054	950831	2.0	24.3	8.20	.	.	.	.	.	.	.	.	.
233	62-0054	950831	3.0	24.0	3.00	.	.	.	.	.	.	.	.	.
234	62-0054	950831	3.5	23.3	1.30	.	.	.	.	.	.	.	.	.
235	62-0054	950831	4.0	21.6	0.10	.	.	.	.	.	.	.	.	.
236	62-0054	950831	4.5	18.5	0.10	.	.	.	.	.	.	.	.	.

LAKENAME=MCCARRONS YEAR=1995
(continued)

OBS	LAKEID	DATE	DM	TC	DO	TP	TDP	TKN	N23	CLA	SDM	COND	PHL	ALK
237	62-0054	950831	5.0	16.1	0.10	.	.	.	.	.	.	.	.	.
238	62-0054	950831	5.5	13.6	0.10	.	.	.	.	.	.	.	.	.
239	62-0054	950831	6.0	11.8	0.10	110	80	.	.	.	.	488	7.83	.
240	62-0054	950831	6.5	10.1	0.10	.	.	.	.	.	.	.	.	.
241	62-0054	950831	7.0	9.6	0.10	.	.	.	.	.	.	.	.	.
242	62-0054	950831	7.5	8.2	0.10	.	.	.	.	.	.	.	.	.
243	62-0054	950831	8.0	7.8	0.10	.	.	.	.	.	.	.	.	.
244	62-0054	950831	9.0	7.2	0.20	.	.	.	.	.	.	.	.	.
245	62-0054	950831	10.0	6.8	0.20	.	.	.	.	.	.	.	.	.
246	62-0054	950831	11.0	6.3	0.20	.	.	.	.	.	.	.	.	.
247	62-0054	950831	12.0	6.2	0.20	890	840	.	.	.	.	500	7.40	.
248	62-0054	950831	13.0	6.0	0.20	.	.	.	.	.	.	.	.	.
249	62-0054	950831	14.0	5.9	0.20	.	.	.	.	.	.	.	.	.
250	62-0054	950831	15.0	5.8	0.20	.	.	.	.	.	.	.	.	.
251	62-0054	950831	16.0	5.8	0.20	.	.	.	.	.	.	.	.	.
252	62-0054	950831	17.0	5.8	0.20	1100	1100	.	.	.	.	543	7.17	.
253	62-0054	950914	0.0	20.3	7.00	40	10	1.300	.	30.0	0.9	.	8.54	.
254	62-0054	950914	1.0	20.3	7.00	.	.	.	.	.	.	.	.	.
255	62-0054	950914	2.0	20.6	7.00	.	.	.	.	.	.	.	.	.
256	62-0054	950914	3.0	20.7	7.00	.	.	.	.	.	.	.	.	.
257	62-0054	950914	4.0	20.7	6.50	.	.	.	.	.	.	.	.	.
258	62-0054	950914	4.5	18.2	0.20	.	.	.	.	.	.	.	.	.
259	62-0054	950914	5.0	15.4	0.20	.	.	.	.	.	.	.	.	.
260	62-0054	950914	5.5	12.9	0.20	.	.	.	.	.	.	.	.	.
261	62-0054	950914	6.0	11.5	0.20	40	20	.	.	.	.	.	7.62	.
262	62-0054	950914	6.5	10.4	0.20	.	.	.	.	.	.	.	.	.
263	62-0054	950914	7.0	9.7	0.20	.	.	.	.	.	.	.	.	.
264	62-0054	950914	7.5	8.6	0.20	.	.	.	.	.	.	.	.	.
265	62-0054	950914	8.0	8.2	0.20	.	.	.	.	.	.	.	.	.
266	62-0054	950914	8.5	7.8	0.20	.	.	.	.	.	.	.	.	.
267	62-0054	950914	9.0	7.1	0.20	.	.	.	.	.	.	.	.	.
268	62-0054	950914	9.5	7.0	0.20	.	.	.	.	.	.	.	.	.
269	62-0054	950914	10.0	6.8	0.20	.	.	.	.	.	.	.	.	.
270	62-0054	950914	11.0	6.3	0.20	.	.	.	.	.	.	.	.	.
271	62-0054	950914	12.0	6.2	0.20	720	710	.	.	.	.	.	7.16	.
272	62-0054	950914	13.0	6.1	0.20	.	.	.	.	.	.	.	.	.
273	62-0054	950914	14.0	6.0	0.20	.	.	.	.	.	.	.	.	.
274	62-0054	950914	15.0	5.9	0.20	.	.	.	.	.	.	.	.	.
275	62-0054	950914	16.0	5.9	0.20	.	.	.	.	.	.	.	.	.
276	62-0054	950914	17.0	5.9	0.20	980	910	.	.	.	.	.	7.11	.
277	62-0054	950928	0.0	14.8	9.50	50	20	1.400	.	28.0	1.2	329	8.43	.
278	62-0054	950928	1.0	14.8	9.50	.	.	.	.	.	.	.	.	.
279	62-0054	950928	2.0	14.8	9.20	.	.	.	.	.	.	.	.	.
280	62-0054	950928	3.0	14.1	6.50	.	.	.	.	.	.	.	.	.
281	62-0054	950928	4.0	13.9	5.80	.	.	.	.	.	.	.	.	.
282	62-0054	950928	5.0	13.8	5.10	.	.	.	.	.	.	.	.	.
283	62-0054	950928	5.5	13.5	0.30	.	.	.	.	.	.	.	.	.

LAKENAME=MCCARRONS YEAR=1995
(continued)

OBS	LAKEID	DATE	DM	TC	DO	TP	TDP	TKN	N23	CLA	SDM	COND	PHL	ALK
284	62-0054	950928	6.0	12.5	0.30	20	10	.	.	.	.	337	7.97	.
285	62-0054	950928	6.5	10.6	0.40	.	.	.	.	.	.	.	.	.
286	62-0054	950928	7.0	9.5	0.40	.	.	.	.	.	.	.	.	.
287	62-0054	950928	7.5	8.7	0.40	.	.	.	.	.	.	.	.	.
288	62-0054	950928	8.0	8.0	0.40	.	.	.	.	.	.	.	.	.
289	62-0054	950928	8.5	7.5	0.40	.	.	.	.	.	.	.	.	.
290	62-0054	950928	9.0	7.3	0.40	.	.	.	.	.	.	.	.	.
291	62-0054	950928	9.5	7.0	0.40	.	.	.	.	.	.	.	.	.
292	62-0054	950928	10.0	6.8	0.40	.	.	.	.	.	.	.	.	.
293	62-0054	950928	11.0	6.3	0.40	.	.	.	.	.	.	.	.	.
294	62-0054	950928	12.0	6.1	0.40	650	320	.	.	.	.	403	7.31	.
295	62-0054	950928	13.0	6.0	0.40	.	.	.	.	.	.	.	.	.
296	62-0054	950928	14.0	5.9	0.40	.	.	.	.	.	.	.	.	.
297	62-0054	950928	15.0	5.8	0.40	.	.	.	.	.	.	.	.	.
298	62-0054	950928	16.0	5.8	0.40	.	.	.	.	.	.	.	.	.
299	62-0054	950928	17.0	5.8	0.40	1000	500	4.800	.	.	.	423	7.18	.
300	62-0054	951012	0.0	14.4	10.20	50	10	1.500	0.030	27.0	1.4	365	8.60	91
301	62-0054	951012	1.0	14.5	10.20	.	.	.	.	.	.	.	.	.
302	62-0054	951012	2.0	13.5	9.20	.	.	.	.	.	.	.	.	.
303	62-0054	951012	3.0	13.2	8.20	.	.	.	.	.	.	.	.	.
304	62-0054	951012	4.0	13.0	6.80	.	.	.	.	.	.	.	.	.
305	62-0054	951012	5.0	13.0	6.80	.	.	.	.	.	.	.	.	.
306	62-0054	951012	6.0	12.8	5.00	30	10	.	.	.	.	378	8.10	.
307	62-0054	951012	6.5	11.8	0.20	.	.	.	.	.	.	.	.	.
308	62-0054	951012	7.0	10.5	0.20	.	.	.	.	.	.	.	.	.
309	62-0054	951012	7.5	9.0	0.20	.	.	.	.	.	.	.	.	.
310	62-0054	951012	8.0	8.8	0.20	.	.	.	.	.	.	.	.	.
311	62-0054	951012	8.5	8.1	0.20	.	.	.	.	.	.	.	.	.
312	62-0054	951012	9.0	7.8	0.20	.	.	.	.	.	.	.	.	.
313	62-0054	951012	9.5	7.6	0.20	.	.	.	.	.	.	.	.	.
314	62-0054	951012	10.0	7.1	0.20	.	.	.	.	.	.	.	.	.
315	62-0054	951012	11.0	6.6	0.20	.	.	.	.	.	.	.	.	.
316	62-0054	951012	12.0	6.4	0.20	670	590	.	.	.	.	462	7.30	.
317	62-0054	951012	13.0	6.2	0.20	.	.	.	.	.	.	.	.	.
318	62-0054	951012	14.0	6.1	0.20	.	.	.	.	.	.	.	.	.
319	62-0054	951012	15.0	5.9	0.20	.	.	.	.	.	.	.	.	.
320	62-0054	951012	16.0	5.9	0.20	.	.	.	.	.	.	.	.	.
321	62-0054	951012	17.0	5.9	0.20	1000	1000	.	.	.	.	498	7.20	.
322	62-0054	951108	0.0	4.9	9.10	200	140	1.800	.	15.0	2.4	478	7.37	.
323	62-0054	951108	1.0	4.9	7.30	.	.	.	.	.	.	.	.	.
324	62-0054	951108	2.0	4.9	6.80	.	.	.	.	.	.	.	.	.
325	62-0054	951108	3.0	4.9	6.80	.	.	.	.	.	.	.	.	.
326	62-0054	951108	4.0	4.9	6.80	.	.	.	.	.	.	.	.	.
327	62-0054	951108	5.0	4.9	6.80	.	.	.	.	.	.	.	.	.
328	62-0054	951108	6.0	4.9	6.80	190	140	.	.	.	.	440	7.34	.
329	62-0054	951108	7.0	4.9	6.70	.	.	.	.	.	.	.	.	.
330	62-0054	951108	8.0	4.9	6.70	.	.	.	.	.	.	.	.	.

-- LAKENAME=MCCARRONS YEAR=1995 --
(continued)

OBS	LAKEID	DATE	DM	TC	DO	TP	TDP	TKN	N23	CLA	SDM	COND	PHL	ALK
331	62-0054	951108	9.0	4.9	7.00	.	.	.	.	.	.	.	.	.
332	62-0054	951108	10.0	4.9	6.80	.	.	.	.	.	.	.	.	.
333	62-0054	951108	11.0	4.9	6.70	.	.	.	.	.	.	.	.	.
334	62-0054	951108	12.0	4.9	6.80	190	140	.	.	.	.	432	7.42	.
335	62-0054	951108	13.0	4.8	6.80	.	.	.	.	.	.	.	.	.
336	62-0054	951108	14.0	4.8	6.80	.	.	.	.	.	.	.	.	.
337	62-0054	951108	15.0	4.8	6.70	.	.	.	.	.	.	.	.	.
338	62-0054	951108	16.0	4.9	5.30	.	.	.	.	.	.	.	.	.
339	62-0054	951108	17.0	4.9	2.00	210	140	.	.	.	.	446	7.43	.
340	62-0054	951228	0.0	.	.	170	120	1.800	.	11.0	1.8	.	.	.
341	62-0054	951228	1.0	2.2	8.30	.	.	.	.	.	.	486	7.46	.
342	62-0054	951228	5.0	2.7	7.90	150	140	.	.	.	.	475	7.58	.
343	62-0054	951228	10.0	2.8	7.50	160	140	.	.	.	.	465	7.39	.
344	62-0054	951228	15.0	3.2	5.30	300	280	.	.	.	.	483	7.34	.

LAKENAME=MCCARRONS YEAR=1996

OBS	LAKEID	DATE	DM	TC	DO	TP	TDP	TKN	N23	CLA	SDM	COND	PHL	ALK
345	62-0054	960125	0.0	.	.	230	190	2.100	.	19.0	1.0	.	.	.
346	62-0054	960125	1.0	0.8	9.30	.	.	.	.	.	.	462	7.35	.
347	62-0054	960125	5.0	2.2	7.60	160	130	.	.	.	.	451	7.48	.
348	62-0054	960125	10.0	2.5	6.60	160	150	.	.	.	.	475	7.46	.
349	62-0054	960125	16.0	2.6	2.60	420	380	.	.	.	.	524	7.31	.
350	62-0054	960219	0.0	.	.	200	190	1.750	.	7.7	2.6	.	.	.
351	62-0054	960219	1.0	2.9	8.00	.	.	.	.	.	.	512	7.30	.
352	62-0054	960219	5.0	2.9	6.00	210	180	.	.	.	.	510	7.44	.
353	62-0054	960219	10.0	2.8	6.10	200	180	.	.	.	.	517	7.54	.
354	62-0054	960219	16.0	2.7	7.60	190	170	.	.	.	.	522	7.54	.
355	62-0054	960304	0.0	.	.	165	150	1.450	0.380	4.9	3.1	.	.	118
356	62-0054	960304	1.0	1.4	6.80	.	.	.	.	.	.	539	6.77	.
357	62-0054	960304	5.0	1.8	5.30	200	170	.	.	.	.	512	6.88	.
358	62-0054	960304	10.0	1.5	5.20	170	160	.	.	.	.	546	6.96	.
359	62-0054	960304	15.0	2.0	2.40	220	210	.	.	.	.	628	6.95	.
360	62-0054	960430	0.0	9.1	10.80	160	30	1.300	.	132.0	0.8	.	8.54	.
361	62-0054	960430	1.0	9.0	10.80	.	.	.	.	.	.	.	.	.
362	62-0054	960430	2.0	9.0	10.80	.	.	.	.	.	.	.	.	.
363	62-0054	960430	3.0	8.9	10.80	.	.	.	.	.	.	.	.	.
364	62-0054	960430	3.5	8.1	10.80	.	.	.	.	.	.	.	.	.
365	62-0054	960430	4.0	7.9	10.30	.	.	.	.	.	.	.	.	.
366	62-0054	960430	5.0	7.5	8.90	.	.	.	.	.	.	.	.	.
367	62-0054	960430	6.0	7.2	7.60	.	.	.	.	.	.	.	.	.
368	62-0054	960430	7.0	6.8	6.70	.	.	.	.	.	.	.	.	.
369	62-0054	960430	8.0	5.8	3.50	140	.	1.900	.	.	.	.	8.05	.
370	62-0054	960430	9.0	4.0	1.10	.	.	.	.	.	.	.	.	.
371	62-0054	960430	10.0	3.6	1.10	.	.	.	.	.	.	.	.	.
372	62-0054	960430	11.0	3.4	1.60	.	.	.	.	.	.	.	.	.
373	62-0054	960430	12.0	3.4	1.60	.	.	.	.	.	.	.	.	.
374	62-0054	960430	13.0	3.4	1.50	.	.	.	.	.	.	.	.	.
375	62-0054	960430	14.0	3.4	1.40	.	.	.	.	.	.	.	.	.
376	62-0054	960430	15.0	3.4	1.30	.	.	.	.	.	.	.	.	.
377	62-0054	960430	16.0	3.4	0.80	.	.	.	.	.	.	.	.	.
378	62-0054	960430	17.0	3.4	0.80	450	110	.	.	.	.	.	7.12	.
379	62-0054	960514	0.0	11.7	12.10	90	20	1.600	.	9.8	2.2	422	8.40	.
380	62-0054	960514	1.0	11.7	12.10	.	.	.	.	.	.	.	.	.
381	62-0054	960514	2.0	11.7	11.70	.	.	.	.	.	.	.	.	.
382	62-0054	960514	3.0	11.6	11.40	.	.	.	.	.	.	.	.	.
383	62-0054	960514	3.5	11.3	11.40	.	.	.	.	.	.	.	.	.
384	62-0054	960514	4.0	10.8	11.40	.	.	.	.	.	.	.	.	.
385	62-0054	960514	4.5	9.8	10.10	.	.	.	.	.	.	.	.	.
386	62-0054	960514	5.0	9.4	9.90	.	.	.	.	.	.	.	.	.
387	62-0054	960514	5.5	8.3	8.30	.	.	.	.	.	.	.	.	.
388	62-0054	960514	6.0	7.9	6.30	.	.	.	.	.	.	.	.	.
389	62-0054	960514	6.5	7.2	5.00	.	.	.	.	.	.	.	.	.
390	62-0054	960514	7.0	6.6	4.30	.	.	.	.	.	.	.	.	.
391	62-0054	960514	7.5	6.2	2.50	.	.	.	.	.	.	.	.	.
392	62-0054	960514	8.0	5.3	1.40	150	110	.	.	.	.	472	7.60	.

LAKENAME=MCCARRONS YEAR=1996
(continued)

OBS	LAKEID	DATE	DM	TC	DO	TP	TDP	TKN	N23	CLA	SDM	COND	PHL	ALK
393	62-0054	960514	8.5	4.9	0.20	.	.	.	.	.	.	.	.	.
394	62-0054	960514	9.0	4.4	0.20	.	.	.	.	.	.	.	.	.
395	62-0054	960514	10.0	4.0	0.20	.	.	.	.	.	.	.	.	.
396	62-0054	960514	11.0	3.7	0.20	.	.	.	.	.	.	.	.	.
397	62-0054	960514	12.0	3.6	0.20	.	.	.	.	.	.	.	.	.
398	62-0054	960514	13.0	3.6	0.20	.	.	.	.	.	.	.	.	.
399	62-0054	960514	14.0	3.5	0.20	.	.	.	.	.	.	.	.	.
400	62-0054	960514	15.0	3.5	0.20	.	.	.	.	.	.	.	.	.
401	62-0054	960514	16.0	3.5	0.20	.	.	.	.	.	.	.	.	.
402	62-0054	960514	17.0	3.5	0.20	140	90	.	.	.	.	476	7.71	.
403	62-0054	960530	0.0	17.2	10.10	80	40	2.100	.	17.0	2.9	443	8.41	.
404	62-0054	960530	1.0	17.2	10.30	.	.	.	.	.	.	.	.	.
405	62-0054	960530	2.0	16.5	9.50	.	.	.	.	.	.	.	.	.
406	62-0054	960530	3.0	16.2	9.10	.	.	.	.	.	.	.	.	.
407	62-0054	960530	4.0	15.6	8.20	.	.	.	.	.	.	.	.	.
408	62-0054	960530	4.5	13.8	7.20	.	.	.	.	.	.	.	.	.
409	62-0054	960530	5.0	11.8	6.40	80	70	.	.	.	.	460	7.83	.
410	62-0054	960530	5.5	10.1	5.30	.	.	.	.	.	.	.	.	.
411	62-0054	960530	6.0	8.4	4.10	.	.	.	.	.	.	.	.	.
412	62-0054	960530	6.5	7.7	3.00	.	.	.	.	.	.	.	.	.
413	62-0054	960530	7.0	7.3	0.20	.	.	.	.	.	.	.	.	.
414	62-0054	960530	7.5	6.4	0.20	.	.	.	.	.	.	.	.	.
415	62-0054	960530	8.0	5.9	0.20	.	.	.	.	.	.	.	.	.
416	62-0054	960530	8.5	5.2	0.20	.	.	.	.	.	.	.	.	.
417	62-0054	960530	9.0	4.8	0.20	.	.	.	.	.	.	.	.	.
418	62-0054	960530	9.5	4.7	0.20	.	.	.	.	.	.	.	.	.
419	62-0054	960530	10.0	4.5	0.20	.	.	.	.	.	.	.	.	.
420	62-0054	960530	11.0	4.2	0.20	.	.	.	.	.	.	.	.	.
421	62-0054	960530	12.0	4.0	0.20	180	140	.	.	.	.	608	7.22	.
422	62-0054	960530	13.0	3.9	0.20	.	.	.	.	.	.	.	.	.
423	62-0054	960530	14.0	3.8	0.20	.	.	.	.	.	.	.	.	.
424	62-0054	960530	15.0	3.8	0.20	.	.	.	.	.	.	.	.	.
425	62-0054	960530	16.0	3.7	0.20	.	.	.	.	.	.	.	.	.
426	62-0054	960530	17.0	3.7	0.20	430	370	.	.	.	.	633	7.19	.
427	62-0054	960611	0.0	22.7	11.30	80	20	1.900	.	18.0	1.5	428	8.30	.
428	62-0054	960611	1.0	22.5	11.10	.	.	.	.	.	.	.	.	.
429	62-0054	960611	1.5	21.5	11.30	.	.	.	.	.	.	.	.	.
430	62-0054	960611	2.0	20.4	11.40	.	.	.	.	.	.	.	.	.
431	62-0054	960611	2.5	18.5	11.60	.	.	.	.	.	.	.	.	.
432	62-0054	960611	3.0	17.7	11.40	.	.	.	.	.	.	.	.	.
433	62-0054	960611	3.5	17.0	11.20	.	.	.	.	.	.	.	.	.
434	62-0054	960611	4.0	15.8	9.40	.	.	.	.	.	.	.	.	.
435	62-0054	960611	4.5	14.7	7.20	.	.	.	.	.	.	.	.	.
436	62-0054	960611	5.0	13.6	5.50	.	.	.	.	.	.	.	.	.
437	62-0054	960611	5.5	12.7	5.10	.	.	.	.	.	.	.	.	.
438	62-0054	960611	6.0	9.6	3.30	.	.	.	.	.	.	.	.	.
439	62-0054	960611	6.5	8.6	2.80	.	.	.	.	.	.	.	.	.

LAKENAME=MCCARRONS YEAR=1996
(continued)

OBS	LAKEID	DATE	DM	TC	DO	TP	TDP	TKN	N23	CLA	SDM	COND	PHL	ALK
440	62-0054	960611	7.0	7.8	1.30	.	.	.	.	.	.	.	.	.
441	62-0054	960611	7.5	7.1	0.30	.	.	.	.	.	.	.	.	.
442	62-0054	960611	8.0	6.4	0.30	210	210	.	.	.	.	495	7.40	.
443	62-0054	960611	8.5	6.0	0.30	.	.	.	.	.	.	.	.	.
444	62-0054	960611	10.0	4.9	0.20	.	.	.	.	.	.	.	.	.
445	62-0054	960611	11.0	4.3	0.20	.	.	.	.	.	.	.	.	.
446	62-0054	960611	12.0	4.3	0.20	.	.	.	.	.	.	.	.	.
447	62-0054	960611	13.0	4.2	0.30	.	.	.	.	.	.	.	.	.
448	62-0054	960611	14.0	4.0	0.30	.	.	.	.	.	.	.	.	.
449	62-0054	960611	15.0	3.9	0.20	.	.	.	.	.	.	.	.	.
450	62-0054	960611	16.0	3.9	0.20	.	.	.	.	.	.	.	.	.
451	62-0054	960611	17.0	3.9	0.20	400	320	.	.	.	.	587	7.10	.
452	62-0054	960618	9.0	5.6	0.30	.	.	.	.	.	.	.	.	.
453	62-0054	960625	0.0	22.1	10.00	50	20	1.100	.	17.0	2.3	411	8.50	.
454	62-0054	960625	1.0	22.1	10.10	.	.	.	.	.	.	.	.	.
455	62-0054	960625	2.0	21.7	9.90	.	.	.	.	.	.	.	.	.
456	62-0054	960625	2.5	21.0	8.20	.	.	.	.	.	.	.	.	.
457	62-0054	960625	3.0	19.6	8.80	.	.	.	.	.	.	.	.	.
458	62-0054	960625	3.5	17.6	6.40	.	.	.	.	.	.	.	.	.
459	62-0054	960625	4.0	16.1	3.40	.	.	.	.	.	.	.	.	.
460	62-0054	960625	4.5	14.2	2.90	.	.	.	.	.	.	.	.	.
461	62-0054	960625	5.0	12.8	2.50	.	.	.	.	.	.	.	.	.
462	62-0054	960625	5.5	11.1	2.40	.	.	.	.	.	.	.	.	.
463	62-0054	960625	6.0	10.0	2.00	30	20	.	.	.	.	470	7.50	.
464	62-0054	960625	6.5	8.5	0.20	.	.	.	.	.	.	.	.	.
465	62-0054	960625	7.0	7.5	0.20	.	.	.	.	.	.	.	.	.
466	62-0054	960625	7.5	6.7	0.20	.	.	.	.	.	.	.	.	.
467	62-0054	960625	8.0	6.3	0.20	.	.	.	.	.	.	.	.	.
468	62-0054	960625	8.5	5.8	0.20	.	.	.	.	.	.	.	.	.
469	62-0054	960625	9.0	5.3	0.20	.	.	.	.	.	.	.	.	.
470	62-0054	960625	9.5	4.8	0.20	.	.	.	.	.	.	.	.	.
471	62-0054	960625	10.0	4.6	0.20	.	.	.	.	.	.	.	.	.
472	62-0054	960625	11.0	4.3	0.20	.	.	.	.	.	.	.	.	.
473	62-0054	960625	12.0	4.2	0.20	430	420	.	.	.	.	614	7.20	.
474	62-0054	960625	13.0	4.0	0.20	.	.	.	.	.	.	.	.	.
475	62-0054	960625	14.0	3.9	0.20	.	.	.	.	.	.	.	.	.
476	62-0054	960625	15.0	3.9	0.20	.	.	.	.	.	.	.	.	.
477	62-0054	960625	16.0	3.9	0.20	.	.	.	.	.	.	.	.	.
478	62-0054	960625	17.0	3.9	0.20	530	440	.	.	.	.	596	7.30	.
479	62-0054	960709	0.0	24.0	8.90	50	10	1.200	.	24.0	1.1	407	7.80	.
480	62-0054	960709	1.0	24.0	8.80	.	.	.	.	.	.	.	.	.
481	62-0054	960709	2.0	24.0	8.80	.	.	.	.	.	.	.	.	.
482	62-0054	960709	3.0	24.0	8.40	.	.	.	.	.	.	.	.	.
483	62-0054	960709	3.5	21.3	7.40	.	.	.	.	.	.	.	.	.
484	62-0054	960709	4.0	17.7	4.40	.	.	.	.	.	.	.	.	.
485	62-0054	960709	4.5	14.8	0.20	.	.	.	.	.	.	.	.	.
486	62-0054	960709	5.0	13.3	0.40	70	10	.	.	.	.	439	7.50	.

LAKENAME=MCCARRONS YEAR=1996
(continued)

OBS	LAKEID	DATE	DM	TC	DO	TP	TDP	TKN	N23	CLA	SDM	COND	PHL	ALK
487	62-0054	960709	5.5	10.8	0.20	.	.	.	.	.	.	.	.	.
488	62-0054	960709	6.0	9.8	0.20	.	.	.	.	.	.	.	.	.
489	62-0054	960709	6.5	8.4	0.20	.	.	.	.	.	.	.	.	.
490	62-0054	960709	7.0	7.7	0.20	.	.	.	.	.	.	.	.	.
491	62-0054	960709	7.5	6.8	0.20	.	.	.	.	.	.	.	.	.
492	62-0054	960709	8.0	6.3	0.20	.	.	.	.	.	.	.	.	.
493	62-0054	960709	8.5	5.5	0.20	.	.	.	.	.	.	.	.	.
494	62-0054	960709	9.0	5.3	0.20	.	.	.	.	.	.	.	.	.
495	62-0054	960709	10.0	4.8	0.20	.	.	.	.	.	.	.	.	.
496	62-0054	960709	11.0	4.4	0.20	.	.	.	.	.	.	.	.	.
497	62-0054	960709	12.0	4.2	0.20	460	450	.	.	.	.	598	7.20	.
498	62-0054	960709	13.0	4.1	0.20	.	.	.	.	.	.	.	.	.
499	62-0054	960709	14.0	4.0	0.20	.	.	.	.	.	.	.	.	.
500	62-0054	960709	15.0	4.0	0.20	.	.	.	.	.	.	.	.	.
501	62-0054	960709	16.0	4.0	0.20	.	.	.	.	.	.	.	.	.
502	62-0054	960709	17.0	4.0	0.20	1400	1100	.	.	.	.	640	7.10	.
503	62-0054	960723	0.0	24.1	7.90	50	10	1.000	.	12.0	1.3	.	8.30	.
504	62-0054	960723	1.0	24.2	7.90	.	.	.	.	.	.	.	.	.
505	62-0054	960723	2.0	24.2	7.90	.	.	.	.	.	.	.	.	.
506	62-0054	960723	3.0	24.2	7.60	.	.	.	.	.	.	.	.	.
507	62-0054	960723	3.5	23.3	3.40	.	.	.	.	.	.	.	.	.
508	62-0054	960723	4.0	19.9	0.60	.	.	.	.	.	.	.	.	.
509	62-0054	960723	4.5	15.4	0.40	.	.	.	.	.	.	.	.	.
510	62-0054	960723	5.0	13.2	0.40	.	.	.	.	.	.	.	.	.
511	62-0054	960723	5.5	12.0	0.40	.	.	.	.	.	.	.	.	.
512	62-0054	960723	6.0	10.5	0.50	150	20	.	.	.	.	.	7.49	.
513	62-0054	960723	6.5	8.9	0.50	.	.	.	.	.	.	.	.	.
514	62-0054	960723	7.0	8.5	0.60	.	.	.	.	.	.	.	.	.
515	62-0054	960723	7.5	7.4	0.60	.	.	.	.	.	.	.	.	.
516	62-0054	960723	8.0	6.8	0.60	.	.	.	.	.	.	.	.	.
517	62-0054	960723	8.5	6.1	0.60	.	.	.	.	.	.	.	.	.
518	62-0054	960723	9.0	5.6	0.60	.	.	.	.	.	.	.	.	.
519	62-0054	960723	10.0	5.1	0.60	.	.	.	.	.	.	.	.	.
520	62-0054	960723	11.0	4.7	0.60	.	.	.	.	.	.	.	.	.
521	62-0054	960723	12.0	4.4	0.60	490	390	.	.	.	.	.	7.18	.
522	62-0054	960723	13.0	4.2	0.60	.	.	.	.	.	.	.	.	.
523	62-0054	960723	14.0	4.2	0.60	.	.	.	.	.	.	.	.	.
524	62-0054	960723	15.0	4.1	0.60	.	.	.	.	.	.	.	.	.
525	62-0054	960723	16.0	4.1	0.60	.	.	.	.	.	.	.	.	.
526	62-0054	960723	17.0	4.1	0.60	950	840	.	.	.	.	.	7.01	.
527	62-0054	960806	0.0	24.4	8.10	200	50	0.930	.	11.0	1.5	443	8.33	.
528	62-0054	960806	1.0	24.4	7.90	.	.	.	.	.	.	.	.	.
529	62-0054	960806	2.0	24.4	7.70	.	.	.	.	.	.	.	.	.
530	62-0054	960806	2.5	23.7	7.50	.	.	.	.	.	.	.	.	.
531	62-0054	960806	3.0	23.6	7.00	.	.	.	.	.	.	.	.	.
532	62-0054	960806	3.5	23.0	5.40	.	.	.	.	.	.	.	.	.
533	62-0054	960806	4.0	21.5	1.90	.	.	.	.	.	.	.	.	.

LAKENAME=MCCARRONS YEAR=1996
(continued)

OBS	LAKEID	DATE	DM	TC	DO	TP	TDP	TKN	N23	CLA	SDM	COND	PHL	ALK
534	62-0054	960806	4.5	19.7	0.20	.	.	.	.	.	.	.	.	.
535	62-0054	960806	5.0	15.0	0.20	.	.	.	.	.	.	.	.	.
536	62-0054	960806	5.5	13.0	0.20	.	.	.	.	.	.	.	.	.
537	62-0054	960806	6.0	11.3	0.20	320	210	.	.	.	.	476	7.68	.
538	62-0054	960806	6.5	9.5	0.20	.	.	.	.	.	.	.	.	.
539	62-0054	960806	7.0	8.6	0.20	.	.	.	.	.	.	.	.	.
540	62-0054	960806	7.5	7.8	0.20	.	.	.	.	.	.	.	.	.
541	62-0054	960806	8.0	7.2	0.20	.	.	.	.	.	.	.	.	.
542	62-0054	960806	8.5	6.4	0.20	.	.	.	.	.	.	.	.	.
543	62-0054	960806	9.0	5.6	0.20	.	.	.	.	.	.	.	.	.
544	62-0054	960806	10.0	4.9	0.20	.	.	.	.	.	.	.	.	.
545	62-0054	960806	11.0	4.5	0.20	.	.	.	.	.	.	.	.	.
546	62-0054	960806	12.0	4.3	0.20	720	680	.	.	.	.	620	7.13	.
547	62-0054	960806	13.0	4.3	0.20	.	.	.	.	.	.	.	.	.
548	62-0054	960806	14.0	4.2	0.20	.	.	.	.	.	.	.	.	.
549	62-0054	960806	15.0	4.2	0.20	.	.	.	.	.	.	.	.	.
550	62-0054	960806	16.0	4.2	0.20	.	.	.	.	.	.	.	.	.
551	62-0054	960806	17.0	4.2	0.20	1700	1400	.	.	.	.	701	6.95	.
552	62-0054	960820	0.0	23.5	8.20	100	50	0.720	.	19.0	1.1	436	8.54	.
553	62-0054	960820	1.0	23.6	8.10	.	.	.	.	.	.	.	.	.
554	62-0054	960820	2.0	23.6	8.00	.	.	.	.	.	.	.	.	.
555	62-0054	960820	3.0	23.6	8.00	.	.	.	.	.	.	.	.	.
556	62-0054	960820	3.5	23.5	6.60	.	.	.	.	.	.	.	.	.
557	62-0054	960820	4.0	22.1	1.50	.	.	.	.	.	.	.	.	.
558	62-0054	960820	4.5	19.7	0.30	.	.	.	.	.	.	.	.	.
559	62-0054	960820	5.0	16.3	0.30	.	.	.	.	.	.	.	.	.
560	62-0054	960820	5.5	13.3	0.30	.	.	.	.	.	.	.	.	.
561	62-0054	960820	6.0	11.9	0.30	140	90	.	.	.	.	482	7.63	.
562	62-0054	960820	6.5	9.9	0.30	.	.	.	.	.	.	.	.	.
563	62-0054	960820	7.0	8.6	0.30	.	.	.	.	.	.	.	.	.
564	62-0054	960820	7.5	7.8	0.30	.	.	.	.	.	.	.	.	.
565	62-0054	960820	8.0	7.1	0.30	.	.	.	.	.	.	.	.	.
566	62-0054	960820	9.0	5.8	0.30	.	.	.	.	.	.	.	.	.
567	62-0054	960820	10.0	5.3	0.30	.	.	.	.	.	.	.	.	.
568	62-0054	960820	11.0	4.8	0.30	.	.	.	.	.	.	.	.	.
569	62-0054	960820	12.0	4.6	0.30	340	190	.	.	.	.	608	7.16	.
570	62-0054	960820	13.0	4.4	0.30	.	.	.	.	.	.	.	.	.
571	62-0054	960820	14.0	4.3	0.30	.	.	.	.	.	.	.	.	.
572	62-0054	960820	15.0	4.3	0.30	.	.	.	.	.	.	.	.	.
573	62-0054	960820	16.0	4.3	0.30	.	.	.	.	.	.	.	.	.
574	62-0054	960820	17.0	4.2	0.30	820	420	.	.	.	.	665	7.01	.
575	62-0054	960904	0.0	24.7	8.90	60	20	1.100	.	17.0	1.1	425	7.80	.
576	62-0054	960904	1.0	24.7	8.80	.	.	.	.	.	.	.	.	.
577	62-0054	960904	2.0	24.6	8.80	.	.	.	.	.	.	.	.	.
578	62-0054	960904	3.0	24.1	8.80	.	.	.	.	.	.	.	.	.
579	62-0054	960904	3.5	23.5	7.60	.	.	.	.	.	.	.	.	.
580	62-0054	960904	4.0	22.0	0.80	.	.	.	.	.	.	.	.	.

LAKENAME=MCCARRONS YEAR=1996
(continued)

OBS	LAKEID	DATE	DM	TC	DO	TP	TDP	TKN	N23	CLA	SDM	COND	PHL	ALK
581	62-0054	960904	4.5	19.1	0.80	.	.	.	.	.	.	.	.	.
582	62-0054	960904	5.0	16.5	0.80	.	.	.	.	.	.	.	.	.
583	62-0054	960904	5.5	13.9	0.20	.	.	.	.	.	.	.	.	.
584	62-0054	960904	6.0	12.2	0.20	130	30	.	.	.	.	490	7.20	.
585	62-0054	960904	6.5	9.7	0.20	.	.	.	.	.	.	.	.	.
586	62-0054	960904	7.0	8.2	0.20	.	.	.	.	.	.	.	.	.
587	62-0054	960904	7.5	7.3	0.20	.	.	.	.	.	.	.	.	.
588	62-0054	960904	8.0	6.8	0.20	.	.	.	.	.	.	.	.	.
589	62-0054	960904	8.5	6.2	0.20	.	.	.	.	.	.	.	.	.
590	62-0054	960904	9.0	5.6	0.60	.	.	.	.	.	.	.	.	.
591	62-0054	960904	10.0	4.9	0.20	.	.	.	.	.	.	.	.	.
592	62-0054	960904	11.0	4.6	0.20	.	.	.	.	.	.	.	.	.
593	62-0054	960904	12.0	4.4	0.20	400	280	.	.	.	.	618	6.78	.
594	62-0054	960904	13.0	4.3	0.20	.	.	.	.	.	.	.	.	.
595	62-0054	960904	14.0	4.3	0.20	.	.	.	.	.	.	.	.	.
596	62-0054	960904	15.0	4.2	0.20	.	.	.	.	.	.	.	.	.
597	62-0054	960904	16.0	4.2	0.20	990	900	.	.	.	.	663	6.65	.
598	62-0054	960917	0.0	19.1	7.60	20	5	1.100	.	11.0	1.6	425	7.83	.
599	62-0054	960917	1.0	19.3	7.60	.	.	.	.	.	.	.	.	.
600	62-0054	960917	2.0	19.3	7.60	.	.	.	.	.	.	.	.	.
601	62-0054	960917	3.0	19.3	7.60	.	.	.	.	.	.	.	.	.
602	62-0054	960917	4.0	19.3	7.50	.	.	.	.	.	.	.	.	.
603	62-0054	960917	4.5	19.1	6.20	.	.	.	.	.	.	.	.	.
604	62-0054	960917	5.0	17.4	2.40	.	.	.	.	.	.	.	.	.
605	62-0054	960917	5.5	14.2	0.60	.	.	.	.	.	.	.	.	.
606	62-0054	960917	6.0	12.3	0.50	20	5	.	.	.	.	468	7.08	.
607	62-0054	960917	6.5	10.2	0.40	.	.	.	.	.	.	.	.	.
608	62-0054	960917	7.0	8.8	0.40	.	.	.	.	.	.	.	.	.
609	62-0054	960917	7.5	8.0	0.30	.	.	.	.	.	.	.	.	.
610	62-0054	960917	8.0	6.8	0.30	.	.	.	.	.	.	.	.	.
611	62-0054	960917	9.0	5.7	0.30	.	.	.	.	.	.	.	.	.
612	62-0054	960917	10.0	5.2	0.30	.	.	.	.	.	.	.	.	.
613	62-0054	960917	11.0	4.7	0.30	.	.	.	.	.	.	.	.	.
614	62-0054	960917	12.0	4.5	0.30	640	540	.	.	.	.	601	6.52	.
615	62-0054	960917	13.0	4.4	0.30	.	.	.	.	.	.	.	.	.
616	62-0054	960917	14.0	4.3	0.30	.	.	.	.	.	.	.	.	.
617	62-0054	960917	15.0	4.3	0.30	.	.	.	.	.	.	.	.	.
618	62-0054	960917	16.0	4.3	0.30	.	.	.	.	.	.	.	.	.
619	62-0054	960917	17.0	4.3	0.30	1300	1200	.	.	.	.	662	6.53	.
620	62-0054	961004	0.0	14.1	8.30	20	5	0.880	.	7.6	2.3	444	7.28	.
621	62-0054	961004	1.0	14.2	8.20	.	.	.	.	.	.	.	.	.
622	62-0054	961004	2.0	14.2	8.10	.	.	.	.	.	.	.	.	.
623	62-0054	961004	3.0	14.2	8.10	.	.	.	.	.	.	.	.	.
624	62-0054	961004	4.0	14.2	8.10	.	.	.	.	.	.	.	.	.
625	62-0054	961004	5.0	14.2	8.00	.	.	.	.	.	.	.	.	.
626	62-0054	961004	6.0	14.2	7.90	.	.	.	.	.	.	.	.	.
627	62-0054	961004	6.5	13.7	4.30	.	.	.	.	.	.	.	.	.

LAKENAME=MCCARRONS YEAR=1996
(continued)

OBS	LAKEID	DATE	DM	TC	DO	TP	TDP	TKN	N23	CLA	SDM	COND	PHL	ALK
628	62-0054	961004	7.0	9.8	0.70	.	.	.	.	.	.	.	.	.
629	62-0054	961004	8.0	7.3	0.60	.	.	.	.	.	.	.	.	.
630	62-0054	961004	9.0	6.0	0.50	20	5	.	.	.	.	555	6.58	.
631	62-0054	961004	10.0	5.4	0.50	.	.	.	.	.	.	.	.	.
632	62-0054	961004	11.0	4.9	0.50	.	.	.	.	.	.	.	.	.
633	62-0054	961004	12.0	4.7	0.50	.	.	.	.	.	.	.	.	.
634	62-0054	961004	13.0	4.5	0.50	.	.	.	.	.	.	.	.	.
635	62-0054	961004	14.0	4.4	0.50	.	.	.	.	.	.	.	.	.
636	62-0054	961004	15.0	4.4	0.50	.	.	.	.	.	.	.	.	.
637	62-0054	961004	16.0	4.3	0.50	.	.	.	.	.	.	.	.	.
638	62-0054	961004	17.0	4.3	0.50	800	350	.	.	.	.	678	6.25	.
639	62-0054	961016	0.0	12.9	8.90	30	10	0.850	.	13.0	2.0	440	7.30	.
640	62-0054	961016	1.0	12.9	8.70	.	.	.	.	.	.	.	.	.
641	62-0054	961016	2.0	12.7	8.70	.	.	.	.	.	.	.	.	.
642	62-0054	961016	3.0	12.5	8.70	.	.	.	.	.	.	.	.	.
643	62-0054	961016	4.0	12.3	8.40	.	.	.	.	.	.	.	.	.
644	62-0054	961016	5.0	11.7	7.70	.	.	.	.	.	.	.	.	.
645	62-0054	961016	6.0	10.9	7.20	.	.	.	.	.	.	.	.	.
646	62-0054	961016	7.0	9.1	0.20	.	.	.	.	.	.	.	.	.
647	62-0054	961016	8.0	8.6	0.20	.	.	.	.	.	.	.	.	.
648	62-0054	961016	9.0	7.9	0.20	30	10	.	.	.	.	570	6.72	.
649	62-0054	961016	10.0	7.5	0.20	.	.	.	.	.	.	.	.	.
650	62-0054	961016	11.0	7.1	0.20	.	.	.	.	.	.	.	.	.
651	62-0054	961016	12.0	6.7	0.20	.	.	.	.	.	.	.	.	.
652	62-0054	961016	13.0	6.5	0.20	.	.	.	.	.	.	.	.	.
653	62-0054	961016	14.0	6.3	0.20	.	.	.	.	.	.	.	.	.
654	62-0054	961016	15.0	6.1	0.20	.	.	.	.	.	.	.	.	.
655	62-0054	961016	16.0	5.9	0.20	.	.	.	.	.	.	.	.	.
656	62-0054	961016	17.0	5.7	0.20	1200	670	.	.	.	.	640	6.45	.

APPENDIX O.
LAKE PLANKTON DATA

1995 PHYTOPLANKTON DATA

	LAKE	DATE	TAXON	CELLCON PERML	CELLVOL CUMICRO	BIOVCONC E+03	GENERA	CLASS	ORDER
1	MCCR	950413	APHN	517	84	43	APHANIZOMENON	CYAN	HORM
2	MCCR	950413	CHRO	517	90	47	CHROOMONAS	CRYP	CRYP
3	MCCR	950413	CHLO	389	78	30	CHLOROCHROMONA	CHRY	HETR
4	MCCR	950413	CRYP	716	410	294	CRYPTOMONAS SM	CRYP	CRYP
5	MCCR	950413	GYMN	40	1150	46	GYMNODINIUM	PYRR	PYRR
6	MCCR	950413	MIFL	3579	50	179	MICROFLAGELLATES		
7	MCCR	950413	SPCH	1909	30	57	SPHERICAL CHLO	CHLO	
8	MCCR	950427	APHN	915	75	69	APHANIZOMENON	CYAN	HORM
9	MCCR	950427	CHLO	716	78	56	CHLOROCHROMONA	CHRY	HETR
10	MCCR	950427	CHRO	119	90	11	CHROOMONAS	CRYP	CRYP
11	MCCR	950427	CRYP	278	1460	406	CRYPTOMONAS LG	CRYP	CRYP
12	MCCR	950427	FRAG	4	780	3	FRAGILARIA	DIAT	PENN
13	MCCR	950427	MIFL	119	25	3	MICROFLAGELLATES		
14	MCCR	950427	SPCH	239	45	11	SPHERICAL CHLO	CHLO	
15	MCCR	950511	APHN	398	70	28	APHANIZOMENON	CYAN	HORM
16	MCCR	950511	CHLO	1909	78	149	CHLOROCHROMONA	CHRY	HETR
17	MCCR	950511	CHRO	2028	90	183	CHROOMONAS	CRYP	CRYP
18	MCCR	950511	CRYP	2187	400	875	CRYPTOMONADS S	CRYP	CRYP
19	MCCR	950511	GYMN	199	1300	259	GYMNODIMIUN	PYRR	PYRR
20	MCCR	950511	MIFL	2386	20	48	MICROFLAGELLATES		
21	MCCR	950511	SPCH	3818	45	172	SPHERICAL CHLO	CHLO	
22	MCCR	950525	ANKI	159	90	14	ANKISTRODESMUS	CHLO	CHLO
23	MCCR	950525	APHN	29190	68	1985	APHANIZOMENON	CYAN	HORM
24	MCCR	950525	CHLO	3778	78	295	CHLOROCHROMONA	CHRY	HETR
25	MCCR	950525	CRYP	199	420	84	CRYPTOMONADS S	CRYP	CRYP
26	MCCR	950525	CRYP	358	1500	537	CRYPTOMONS LG	CRYP	CRYP
27	MCCR	950525	FRAG	8	900	7	FRAGILARIA	DIAT	PENN
28	MCCR	950525	SPCH	159	40	6	SPHERICAL CHLO	CHLO	
29	MCCR	950607	APHN	98425	76	7480	APHANIZOMENON	CYAN	PYRR
30	MCCR	950607	CERA	6	45000	270	CERATIUM	PYRR	PYRR
31	MCCR	950607	CHLO	358	78	28	CHLOROCHROMONA	CHRY	HETR
32	MCCR	950607	CHRO	795	96	76	CHROOMONAS	CRYP	CRYP
33	MCCR	950607	CRYP	278	1300	361	CRYPTOMONAS LG	CRYP	CRYP
34	MCCR	950607	FRAG	4	860	3	FRAGILARIA	DIAT	PENN
35	MCCR	950607	MIFL	437	24	10	MICROFLAGELLATES		
36	MCCR	950607	PLAN	5	360	2	PLANKTOSPHERIA	CHLO	CHLO
37	MCCR	950607	SPCH	1591	44	70	SPHERICAL CHLO	CHLO	
38	MCCR	950607	STAU	5	1250	6	STAURASTRUM	CHLO	ZYGN
39	MCCR	950622	APHN	286328	74	21188	APHANIZOMENON	CYAN	HORM
40	MCCR	950622	CERA	40	35000	1400	CERATIUM	PYRR	PYRR
41	MCCR	950622	CHRO	40	98	4	CHROOMONAS	CRYP	CRYP
42	MCCR	950622	COEL	795	680	541	COELASTRUM	CHLO	CHLO

1995 PHYTOPLANKTON DATA

	LAKE	DATE	TAXON	CELLCON PERML	CELLVOL CUMICRO	BIOVCONC E+03	GENERA	CLASS	ORDER
43	MCCR	950622	CRYP	40	420	17	CRYPTOMONAS SM	CRYP	CRYP
44	MCCR	950622	EUDO	1273	250	318	EUDORINA	CHLO	VOLV
45	MCCR	950622	MICR	795	14	11	MICROCYSTIS	CYAN	CHRO
46	MCCR	950622	MIFL	80	20	2	MICROFLAGELLATES		
47	MCCR	950622	NAVI	40	580	23	NAVICULA	DIAT	PENN
48	MCCR	950622	SCHR	40	120	5	SCHRODERIA	CHLO	CHLO
49	MCCR	950622	SPCH	119	38	5	SHPERICAL CHLO	CHLO	
50	MCCR	950706	APHN	5965	75	447	APHANIZOMENON	CYAN	HORM
51	MCCR	950706	CERA	6	34000	204	CERATIUM	PYRR	PYRR
52	MCCR	950706	CHRO	646	95	61	CHROOMONAS	CRYP	CRYP
53	MCCR	950706	COEL	4	650	3	COELASTRUM	CHLO	CHLO
54	MCCR	950706	COSM	5	1680	8	COSMARIUM	CHLO	ZYGN
55	MCCR	950706	CRYP	199	420	84	CRYPTOMONAS SM	CRYP	CRYP
56	MCCR	950706	MICR	159	14	2	MICROCYSTIS	CYAN	CHRO
57	MCCR	950706	MIFL	1511	20	30	MICROFLAGELLATES		
58	MCCR	950706	OOCY	5	250	1	OOCYSTIS	CHLO	CHLO
59	MCCR	950706	SCHR	1591	120	191	SCHRODERIA	CHLO	CHLO
60	MCCR	950706	SPCH	2545	44	112	SPHERICAL CHLO	CHLO	
61	MCCR	950706	STAU	5	1200	6	STAURASTRUM	CHLO	ZYGN
62	MCCR	950720	OOCY	12885	240	3092	ANABAENA	CHLO	HORM
63	MCCR	950720	APHN	27241	70	1907	APHANIZOMENON	CYAN	HORM
64	MCCR	950720	CERA	4	35000	140	CERATIUM	PYRR	PYRR
65	MCCR	950720	CHRO	159	96	15	CHROOMONAS	CRYP	CRYP
66	MCCR	950720	COEL	795	19	15	COELOSPHAERIUM	CYAN	CHRO
67	MCCR	950720	COSM	40	1800	72	COSMARIUM	CHLO	ZYGN
68	MCCR	950720	CRUC	477	26	12	CRUCIGENIA	CHLO	CHLO
69	MCCR	950720	DICT	795	160	127	DICTYOSPHAERIU	CHLO	CHLO
70	MCCR	950720	MICR	27837	12	334	MICROCYSTIS	CYAN	CHRO
71	MCCR	950720	MIFL	636	20	13	MICROFLAGELLATES		
72	MCCR	950720	OOCY	159	220	35	OOCYSTIS	CHLO	CHLO
73	MCCR	950720	PEDI	1273	170	216	PEDIASTRUM	CHLO	CHLO
74	MCCR	950720	SCHR	40	120	5	SCHRODERIA	CHLO	CHLO
75	MCCR	950720	SPCH	1432	40	57	SPHERICAL CHLO	CHLO	
76	MCCR	950803	ANAB	12408	250	3102	ANABAENA	CYAN	HORM
77	MCCR	950803	APHN	6164	70	431	APHANIZOMENON	CYAN	HORM
78	MCCR	950803	CERA	40	44000	1760	CERATIUM	PYRR	PYRR
79	MCCR	950803	COEL	9544	20	191	COELOSPHAERIUM	CYAN	CHRO
80	MCCR	950803	DICT	795	160	127	DICTYOSPHAERIU	CHLO	CHLO
81	MCCR	950803	GOMP	1193	18	21	GOMPHOSPHAERIA	CYAN	CHRO
82	MCCR	950803	MICR	21872	12	262	MICROCYSTIS	CYAN	CHRO
83	MCCR	950803	SPCH	80	38	3	SPHERICAL CHLO	CHLO	
84	MCCR	950803	TRAC	40	3200	128	TRACHELOMONAS	EUGL	EUGL

1995 PHYTOPLANKTON DATA

	LAKE	DATE	TAXON	CELLCON PERML	CELLVOL CUMICRO	BIOVCONC E+O3	GENERA	CLASS	ORDER
85	MCCR	950817	CRYP	20958	240	5030	ANABAENA	CYAN	HORM
86	MCCR	950817	APHN	12328	70	863	APHANIZOMENON	CYAN	HORM
87	MCCR	950817	CERA	40	46000	1840	CERATIUM	PYRR	PYRR
88	MCCR	950817	CLOS	5	450	2	CLOSTERIUM	CHLO	ZYGN
89	MCCR	950817	COEL	9544	20	191	COELOSPHAERIUM	CYAN	CHRO
90	MCCR	950817	EUDO	636	250	159	EUDORINA	CHLO	VOLV
91	MCCR	950817	GOMPH	1591	20	32	GOMPHOSPHAERIA	CYAN	CHRO
92	MCCR	950817	MICR	3977	12	48	MICRICYCTIS	CYAN	CHRO
93	MCCR	950817	RAPH	80	50	4	RAPHIDIOPSIS	CYAN	HORM
94	MCCR	950817	SPCH	676	40	27	SHPERICAL CHLO	CHLO	
95	MCCR	950831	ANAB	46396	220	10207	ANABAENA	CYAN	HORM
96	MCCR	950831	APHN	55675	65	3619	APHANIZOMENON	CYAN	HORM
97	MCCR	950831	CERA	133	46000	6118	CERATIUM	PYRR	PYRR
98	MCCR	950831	COEL	6628	20	133	COELOSPHAERIUM	CYAN	CHRO
99	MCCR	950831	MICR	16570	12	199	MICROCYSTIS	CYAN	CHRO
100	MCCR	950831	OSCI	7954	20	159	OSCILLATORIA	CYAN	HORM
101	MCCR	950831	SPCH	1193	40	48	SPHAERICAL CHL	CHLO	CHRO
102	MCCR	950914	ANAB	25531	240	6127	ANABAENA	CYAN	HORM
103	MCCR	950914	APHN	58061	74	4297	APHANIZOMENON	CYAN	HORM
104	MCCR	950914	CART	159	1250	199	CARTERIA	CHLO	VOLV
105	MCCR	950914	CHRO	318	96	31	CHROOMONAS	CRYP	CRYP
106	MCCR	950914	COEL	16	650	10	COELASTRUM	CHLO	CHLO
107	MCCR	950914	COEL	80	20	2	COELOSPHAERIUM	CYAN	CHRO
108	MCCR	950914	CRYP	80	420	34	CRYPTOMONAS SM	CRYP	CRYP
109	MCCR	950914	CRYP	159	1600	254	CRYPTOMONAS LG	CRYP	CRYP
110	MCCR	950914	LYNG	1591	24	38	LYNGBYA	CYAN	HORM
111	MCCR	950914	MALL	80	1200	96	MALLOMONAS	CHRY	CHRY
112	MCCR	950914	RAPH	15907	49	779	RAPHIDIOPSIS	CYAN	HORM
113	MCCR	950914	SPCH	716	40	29	SPHERICAL CHLO	CHLO	
114	MCCR	950914	ELAC	636	160	102	ELACTROTHRIX	CHLO	CHLO
115	MCCR	950928	ANAB	3844	250	961	ANABAENA	CYAN	HORM
116	MCCR	950928	APHN	42684	74	3159	APHANIZOMENON	CYAN	HORM
117	MCCR	950928	CART	331	1250	414	CARTERIA	CHLO	VOLV
118	MCCR	950928	CHRO	133	96	13	CHROOMONAS	CRYP	CRYP
119	MCCR	950928	COEL	13	20	0	COELSPHAERIUM	CYAN	CHRO
120	MCCR	950928	CRYP	133	420	56	CRYPTOMONAS SM	CRYP	CRYP
121	MCCR	950928	CRYP	597	1500	896	CRYPTOMONAS LG	CRYP	CRYP
122	MCCR	950928	FRAG	199	760	151	FRAGILARIA	DIAT	PENN
123	MCCR	950928	LYNG	3977	25	99	LYNGBYA	CYAN	HORM
124	MCCR	950928	MALL	331	1200	397	MALLOMONAS	CHRY	CHRY
125	MCCR	950928	MICR	3314	12	40	MICROCYSTIS	CYAN	CHRO
126	MCCR	950928	RAPH	9743	45	438	RAPHIDIOPSIS	CYAN	HORM

1995 PHYTOPLANKTON DATA

	LAKE	DATE	TAXON	CELLCON PERML	CELLVOL CUMICRO	BIOVCONC E+03	GENERA	CLASS	ORDER
127	MCCR	950928	SHCH	398	39	16	SPHERICAL CHLO	CHLO	
128	MCCR	950928	CERA	13	37000	481	CERATIUM	PYRR	PYRR
129	MCCR	951013	MIFL	398	220	88	ANABAENA	CYAN	HORM
130	MCCR	951013	ANAB	143164	75	10737	APHANIZOMENON	CYAN	HORM
131	MCCR	951013	APHN	80	1250	100	CARTERIA	CHLO	VOLV
132	MCCR	951013	CART	80	56000	4480	CERATIUM	PYRR	PYRR
133	MCCR	951013	CERA	80	400	32	CRYPTOMONAS SM	CRYP	CRYP
134	MCCR	951013	CRYP	557	1300	724	CRYPTOMONAS LG	CRYP	CRYP
135	MCCR	951013	CRYP	16	450	7	FRAGILARIA	DIAT	PENN
136	MCCR	951013	FRAG	12248	20	245	LYNGBYA	CYAN	HORM
137	MCCR	951013	LYNG	398	12	5	MICROCYSTIS	CYAN	CHRO
138	MCCR	951013	MICR	159	34	5	SPHERICAL CHLO	CHLO	
139	MCCR	951108	AULA	239	820	196	AULACOSERIA	DIAT	CENT
140	MCCR	951108	ANAB	239	200	48	ANABAENA	CYAN	HORM
141	MCCR	951108	APHN	52493	70	3675	APHANIZOMENON	CYAN	HORM
142	MCCR	951108	CART	398	1100	438	CARTERIA	CHLO	VOLV
143	MCCR	951108	CERA	8	44000	352	CERATIUM	PYRR	PYRR
144	MCCR	951108	CHRO	398	96	38	CHROOMONAS	CRYP	CRYP
145	MCCR	951108	CLOS	80	450	36	CLOSTERIUM	CHLO	ZYGN
146	MCCR	951108	COEL	7954	20	159	COELOPHAERIUM	CYAN	CHRO
147	MCCR	951108	CRYP	239	450	108	CRYPTOMONAS SM	CRYP	CRYP
148	MCCR	951108	CRYP	80	1350	108	CRYPTOMONAS LG	CRYP	CRYP
149	MCCR	951108	FRAG	16	480	8	FRAGILARIA	DIAT	PENN
150	MCCR	951108	MICR	159	13	2	MICROCYSTIS	CYAN	CHRO
151	MCCR	951108	SCHR	24	110	3	SCHRODERIA	CHLO	CHLO
152	MCCR	951108	SPCH	1909	34	65	SPHERICAL CHLO	CHLO	
153	MCCR	951108	STEP	32	68000	2176	STEPHANODISCUS	DIAT	CENT
154	MCCR	951228	APHN	57995	220	12759	APHANIZOMENON	CYAN	HORM
155	MCCR	951228	ASTE	133	310	41	ASTEROIONELLA	DIAT	PENN
156	MCCR	951228	CRYP	66	350	23	CRYPTOMONAS SM	CRYP	CRYP
157	MCCR	951228	CRYP	66	1400	92	CRYPTOMONAS LG	CRYP	CRYP
158	MCCR	951228	SPCH	464	44	20	SPHERICAL CHLO	CHLO	
159	MCCR	960125	APHN	410933	78	32053	APHANIZOMENON	CYAN	HORM
160	MCCR	960125	COEL	133	19	3	COELOSPHAERIUM	CYAN	CHRO
161	MCCR	960125	MICR	1326	12	16	MICROCYSTIS	CYAN	CHRO
162	MCCR	960125	MIFL	265	24	6	MICROFLAGELLATES		
163	MCCR	960125	SPCH	398	35	14	SPHERICAL CHLO	CHLO	
164	MCCR	960213	APHN	119303	74	8828	APHANIZOMENON	CYAN	HORM
165	MCCR	960213	SPCH	477	40	19	SPHERICAL CHLO	CHLO	
166	MCCR	960304	APHN	64026	74	4738	APHANIZOMENON	CYAN	HROM
167	MCCR	960304	SPCH	80	45	4	SPHERICAL CHLO	CHLO	

1995 ZOOPLANKTON DATA

OBS	LAKE	DATE YMD	TAXON	PERLITER	THOUANIM	EGGPRFEM	GENERA	ORDER
1	MCCR	950413	CYCL	21.11	21.1		CYCLOPS	COPEPODA
2	MCCR	950413	MESO	1.64	1.6		MESOCYCLOPS	COPEPODA
3	MCCR	950413	COPE	4.02	4.0		COPEPODIDS	COPEPODA
4	MCCR	950413	NAUP	13.52	13.5		NAUPLII	COPEPODA
5	MCCR	950413	DIAP	0.82	0.8		DIAPTOMUS	COPEPODA
6	MCCR	950413	DPUL	5.3	5.3	6	DAPHNIA PULICARIA	CLADOCERA
7	MCCR	950413	BOSM	0.54	0.5		BOSMINA	CLADOCERA
8	MCCR	950427	CYCL	19.61	19.6		CYCLOPS	COPEPODA
9	MCCR	950427	MESO	6.11	6.1	60	MESOCYCLOPS	COPEPODA
10	MCCR	950427	COPE	8.25	8.3		COPEPODIDS	COPEPODA
11	MCCR	950427	NAUP	43.63	43.6		NAUPLII	COPEPODA
12	MCCR	950427	DIAP	0.75	0.8		DIAPTOMUS	COPEPODA
13	MCCR	950427	CHYD	0.32	0.3		CHYDORUS	CLADOCERA
14	MCCR	950427	DPUL	5.14	5.1	6	DAPHNIA PULICARIA	CLADOCERA
15	MCCR	950427	BOSM	0.42	0.4		BOSMINA	CLADOCERA
16	MCCR	950511	CYCL	17.33	17.3		CYCLOPS	COPEPODA
17	MCCR	950511	MESO	9.24	9.2		MESOCYCLOPS	COPEPODA
18	MCCR	950511	COPE	17.07	17.1		COPEPODIDS	COPEPODA
19	MCCR	950511	NAUP	71.41	71.4		NAUPLII	COPEPODA
20	MCCR	950511	DIAP	0.97	1.0		DIAPTOUMS	COPEPODA
21	MCCR	950511	CHYD	0.97	1.0		CHYDORUS	CLADOCERA
22	MCCR	950511	DGAL	17.33	17.3		DAPHNIA GALEATA MENDOTAE	CLADOCERA
23	MCCR	950511	DPUL	10.75	10.8	5	DAPHNIA PULICARIA	CLADOCERA
24	MCCR	950525	CYCL	32.3	32.3		CYCLOPS	COPEPODA
25	MCCR	950525	MESO	2.65	2.7	32	MESOCYCLOPS	COPEPODA
26	MCCR	950525	COPE	13.83	13.8		COPEPODIDS	COPEPODA
27	MCCR	950525	NAUP	22.64	22.6		NAUPLII	COPEPODA
28	MCCR	950525	DIAP	1.61	1.6		DIAPTOMUS	COPEPODA
29	MCCR	950525	CHYD	0.28	0.3		CHYDORUS	CLADOCERA
30	MCCR	950525	DGAL	16.38	16.4		DAPHNIA GALEATA MENDOTAE	CLADOCERA
31	MCCR	950525	DPUL	14.58	14.6	3	DAPHNIA PULICARIA	CLADOCERA
32	MCCR	950607	CYCL	17.5	17.5		CYCLOPS	COPEPODA
33	MCCR	950607	MESO	1.25	1.3	24	MESOCYCLOPS	COPEPODA
34	MCCR	950607	COPE	6.19	6.2		COPEPODIDS	COPEPODA
35	MCCR	950607	NAUP	19.47	19.5		NAUPLII	COPEPODA
36	MCCR	950607	DIAP	4.21	4.2	20	DIAPTOUMS	COPEPODA

1995 ZOOPLANKTON DATA

OBS	LAKE	DATE YMD	TAXON	PERLITER	THOUANIM	EGGPRFEM	GENERA	ORDER
37	MCCR	950607	DGAL	15.25	15.3		DAPHNIA GALEATA MENDOTAE	CLADOCERA
38	MCCR	950607	DPUL	9.87	9.9	4	DAPHNIA PULICARIA	CLADOCERA
39	MCCR	950622	CYCL	5.51	5.5	28	CYCLOPS	COPEPODA
40	MCCR	950622	MESO	0.23	0.2		MESOCYCLOPS	COPEPODA
41	MCCR	950622	COPE	1.35	1.4		COPEPODIDS	COPEPODA
42	MCCR	950622	NAUP	11.64	11.6		NAUPLII	COPEPODA
43	MCCR	950622	DIAP	4.78	4.8	18	DIAPTOMUS	COPEPODA
44	MCCR	950622	CHYD	0.24	0.2		CHYDORUS	COPEPODA
45	MCCR	950622	DGAL	9.17	9.2	2	DAPHNIA GALEATA MENDOTAE	CLADOCERA
46	MCCR	950622	DPUL	2.87	2.9		DAPHNIA PULICARIA	CLADOCERA
47	MCCR	950706	CYCL	4.24	4.2		CYCLOPS	COPEPODA
48	MCCR	950706	MESO	0.19	0.2		MESOCYCLOPS	COPEPODA
49	MCCR	950706	COPE	3.66	3.7		COPEPODIDS	COPEPODA
50	MCCR	950706	NAUP	39.23	39.2		NAUPLII	COPEPODA
51	MCCR	950706	DIAP	2.89	2.9		DIAPTOMUS	COPEPODA
52	MCCR	950706	DGAL	7.9	7.9	2	DAPHNIA GALEATA MENDOTAE	CLADOCERA
53	MCCR	950706	DPUL	1.34	1.3	4	DAPHNIA PULICARIA	CLADOCERA
54	MCCR	950720	CYCL	6.38	6.4	24	CYCLOPS	COPEPODA
55	MCCR	950720	MESO	1.11	1.1		MESOCYCLOPS	COPEPODA
56	MCCR	950720	COPE	1.99	2.0		COPEPODIDS	COPEPODA
57	MCCR	950720	NAUP	18.66	18.7		NAUPLII	COPEPODA
58	MCCR	950720	DIAP	6.38	6.4	30	DIAPTOMUS	COPEPODA
59	MCCR	950720	DGAL	4.14	4.1	3	DAPHNIA GALEATA MENDOTAE	CLADOCERA
60	MCCR	950720	DPUX	0.63	0.6		DAPHNIA PULEX	CLADOCERA
61	MCCR	950720	DPUL	5.26	5.3	2	DAPHNIA PULICARIA	CLADOCERA
62	MCCR	950803	CYCL	2.21	2.2		CYCLOPS	COPEPODA
63	MCCR	950803	MESO	1.93	1.9	16	MESOCYCLOPS	COPEPODA
64	MCCR	950803	COPE	0.52	0.5		COPEPODIDS	COPEPODA
65	MCCR	950803	NAUP	16.73	16.7		NAUPLII	COPEPODA
66	MCCR	950803	DIAP	9.68	9.7		DIAPTOMUS	COPEPODA
67	MCCR	950803	DIPS	2.91	2.9		DIAPHANOSOMA	CLADOCERA
68	MCCR	950803	DGAL	0.44	0.4		DAPHNIA GALEATA MENDOTAE	CLADOCERA
69	MCCR	950803	DPUX	18	18.0		DAPHNIA PULEX	CLADOCERA
70	MCCR	950803	DPUL	0.53	0.5		DAPHNIA PULICARIA	CLADOCERA
71	MCCR	950817	CYCL	2.37	2.4	16	CYCLOPS	COPEPODA
72	MCCR	950817	MESO	0.53	0.5	30	MESOCYCLOPS	COPEPODA

1995 ZOOPLANKTON DATA

OBS	LAKE	DATE YMD	TAXON	PERLITER	THOUANIM	EGGPRFEM	GENERA	ORDER
73	MCCR	950817	NAUP	6.52	6.5		NAUPLII	COPEPODA
74	MCCR	950817	DIAP	7.04	7.0	4	DIAPTOMUS	COPEPODA
75	MCCR	950817	DIPS	2.37	2.4		DIAPHANOSOMA	CLADOCERA
67	MCCR	950803	COPE	2.21	2.2		CYCLOPS	COPEPODA
76	MCCR	950831	CYCL	0.52	0.5		CYCLOPS	COPEPODA
77	MCCR	950831	MESO	0.82	0.8	24	MESOCYCLOPS	COPEPODA
78	MCCR	950831	COPE	0.21	0.2		COPEPODIDS	COPEPODA
79	MCCR	950831	NAUP	13.61	13.6		NAUPLII	COPEPODA
80	MCCR	950831	DIAP	7.11	7.1	6	DIAPTOMUS	COPEPODA
81	MCCR	950831	DIPS	2.88	2.9	1	DIAPHANOSOMA	CLADOCERA
82	MCCR	950914	CYCL	2.49	2.5		CYCLOPS	COPEPODA
83	MCCR	950914	MESO	1.16	1.2	28	MESOCYCLOPS	COPEPODA
84	MCCR	950914	COPE	0.66	0.7		COPEPODIDS	COPEPODA
85	MCCR	950914	NAUP	10.3	10.3		NAUPLII	COPEPODA
86	MCCR	950914	DIAP	12.3	12.3	8	DIAPTOUMS	COPEPODA
87	MCCR	950914	DIPS	1.16	1.2		DIAPHANOSOMA	CLADOCERA
88	MCCR	950914	DRET	0.5	0.5		DAPHNIA RETROCURVA	CLADOCERA
89	MCCR	950914	DGAL	0.25	0.3		DAPHNIA GALEATA MENDOTAE	CLADOCERA
90	MCCR	950914	DPUL	0.5	0.5		DAPHNIA PULICARIA	CLADOCERA
91	MCCR	950914	BOSM	0.25	0.3		BOSMINA	COPEPODA
92	MCCR	950928	CYCL	2.64	2.6		CYCLOPS	COPEPODA
93	MCCR	950928	COPE	0.7	0.7		COPEPODIDS	COPEPODA
94	MCCR	950928	NAUP	7.75	7.8		NAUPLII	COPEPODA
95	MCCR	950928	DIAP	21.58	21.6		DIAPTOUMS	COPEPODA
96	MCCR	950928	DIPS	0.96	1.0		DIAPHANOSOMA	CLADOCERA
97	MCCR	950928	DRET	1.49	1.5	6	DAPHNIA RETROCURVA	CLADOCERA
98	MCCR	950928	DGAL	2.2	2.2		DAPHNIA GALEATA MENDOTAE	CLADOCERA
99	MCCR	950928	DPUL	0.71	0.7	8	DAPHNIA PULICARIA	CLADOCERA
100	MCCR	951013	CYCL	3.41	3.4		CYCLOPS	COPEPODA
101	MCCR	951013	MESO	1.32	1.3		MESOCYCLOPS	COPEPODA

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OBS	LAKE	DATE YMD	TAXON	PERLITER	THOUANIM	EGGPRFEM	GENERA	ORDER
102	MCCR	951013	COPE	1.32	1.3		COPEPODIDS	COPEPODA
103	MCCR	951013	NAUP	3.41	3.4		NAUPLII	COPEPODA
104	MCCR	951013	DIAP	16.4	16.4		DIAPTOMUS	COPEPODA
105	MCCR	951013	DIPS	0.28	0.3		DIAPHANOSOMA	CLADOCERA
106	MCCR	951013	DRET	8.05	8.1	6	DAPHNIA RETROCURVA	CLADOCERA
107	MCCR	951013	DGAL	2.84	2.8		DAPHNIA GALEATA MENDOTAE	CLADOCERA
108	MCCR	951013	DPUL	1.51	1.5	5	DAPHNIA PULICARIA	CLADOCERA
109	MCCR	951108	CYCL	2.61	2.6		CYCLOPS	COPEPODA
110	MCCR	951108	MESO	0.32	0.3		MESOCYCLOPS	COPEPODA
111	MCCR	951108	COPE	0.84	0.8		COPEPODIDS	COPEPODA
112	MCCR	951108	NAUP	1.15	1.2		NAUPLII	COPEPODA
113	MCCR	951108	DIAP	3.76	3.8		DIAPTOMUS	COPEPODA
114	MCCR	951108	DGAL	1.67	1.7		DAPHNIA GALEATA MENDOTAE	CLADOCERA
115	MCCR	951108	DPUL	2.82	2.8		DAPHNIA PULICARIA	CLADOCERA
116	MCCR	951228	CYCL	1.81	1.8		CYCLOPS	COPEPODA
117	MCCR	951228	COPE	0.32	0.3		COPEPODIDS	COPEPODA
118	MCCR	951228	NAUP	7.02	7.0		NAUPLII	COPEPODA
119	MCCR	951228	DIAP	11.7	11.7		DIAPTOMUS	COPEPODA
120	MCCR	951228	DGAL	0.32	0.3		DAPHNIA GALEATA MENDOTAE	CLADOCERA
121	MCCR	951228	DPUL	5.85	5.9		DAPHNIA PULICARIA	CLADOCERA
122	MCCR	960125	CYCL	4.02	4.0		CYCLOPS	COPEPODA
123	MCCR	960125	MESO	0.67	0.7		MESOCYCLOPS	COPEPODA
124	MCCR	960125	COPE	0.89	0.9		COPEPODIDS	COPEPODA
125	MCCR	960125	NAUP	11.97	12.0		NAUPLII	COPEPODA
126	MCCR	960125	DIAP	11.41	11.4		DIAPTOMUS	COPEPODA
127	MCCR	960125	DGAL	0.34	0.3		DAPHNIA GALEATA MENDOTAE	CLADOCERA
128	MCCR	960125	DPUL	4.92	4.9		DAPHNIA PULICARIA	CLADOCERA
129	MCCR	960125	BOSM	0.34	0.3		BOSMINA	CLADOCERA
130	MCCR	960213	CYCL	3.71	3.7		CYCLOPS	COPEPODA
131	MCCR	960213	MESO	2.53	2.5		MESOCYCLOPS	COPEPODA
132	MCCR	960213	COPE	0.54	0.5		COPEPODIDS	COPEPODA
133	MCCR	960213	NAUP	19.19	19.2		NAUPLII	COPEPODA
134	MCCR	960213	DIAP	6.24	6.2		DIAPTOMUS	COPEPODA
135	MCCR	960213	DPUL	3.53	3.5		DAPHNIA PULICARIA	CLADOCERA
136	MCCR	960304	CYCL	14.77	14.8		CYCLOPS	COPEPODA
137	MCCR	960304	MESO	5.2	5.2	32	MESOCYCLOPS	COPEPODA

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OBS	LAKE	DATE YMD	TAXON	PERLITER	THOUANIM	EGGPRFEM	GENERA	ORDER
138	MCCR	960304	COPE	1.77	1.8		COPEPODIDS	COPEPODA
139	MCCR	960304	NAUP	29.3	29.3		NAUPLII	COPEPODA
140	MCCR	960304	DIAP	16.3	16.3		DIAPTOMUS	COPEPODA
141	MCCR	960304	DPUL	2.6	2.6	3	DAPHNIA PULICARIA	CLADOCERA

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