# APPENDIX 4: MASS-BALANCE MODELING

## 1. INTRODUCTION

The development and structure of a mass-balance modeling framework for Onondaga Lake is described in previous lake monitoring reports (Ecologic, 2002). The framework facilitates computation and analysis of mass balances for nutrients and other water-quality components using hydrologic and water quality data collected in the Lake and its tributaries since 1986. Lake water and mass balances are formulated on yearly and seasonal (May-September) time scales. Results provide a basis for:

(1) Estimating the magnitude and precision of loads from each source;
(2) Assessing long-term trends in load and inflow concentration from each source and source category (point, nonpoint, total);
(3) Evaluating the adequacy of the monitoring program, based upon the precision of loads computed from concentration and flow data;
(4) Developing and periodic updating of an empirical nutrient loading model that predicts eutrophication-related water quality conditions (as measured by nutrient concentrations, chlorophyll-a, algal bloom frequency, transparency, and hypolimnetic oxygen depletion) as a function of yearly nutrient loads, inflows, and lake morphometry (Ecologic, 2001).
(5) Developing simple input/output models for other constituents; and
(6) Developing data summaries to support integration and interpretation of monitoring results in each yearly AMP report.

This appendix updates the mass-balance framework to include 2002 data. Recent mass balances for key water quality components are summarized. Long-term trends in total loads (point, nonpoint), inflow concentrations, and outflow concentrations are documented.

## 2. REFINEMENTS TO MASS-BALANCE FRAMEWORK

Estimates of historical flows and loads from Crucible and direct precipitation have been adjusted based upon recent information. Because of the small magnitude of these sources (~1% and ~2% of the total inflow after adjustment, respectively), the adjustments have relatively small impacts on the computed total flows and loads to the Lake, as well as on the outflow volumes computed by water balance.

Precipitation estimates have been updated for the entire period of record based upon data from the Hancock Airport weather station downloaded from the National Climatologic Data web site (www.ncdc.noaa.gov). Small differences were apparent relative to values used previously based upon Local Climatologic Data reports. Water budgets for the lake over the 1985-1996 period have been updated to reflect the updated precipitation record.

Throughout the 1985-2003 period, loads from Crucible have been computed using concentrations measured in samples that reflect a combination of the Crucible discharge and runoff from the Trib5A watershed. Between 1985 and 1999, flows were estimated from records provided by the industry which did not reflect the runoff component. Since 2000, the combined flows from Crucible and Trib5A have been measured directly. This change resulted in a significant increase in the average reported flows (from 0.6 cfs in 1985-1999 to 3.2 cfs in 2000-2003). The difference is presumably due to the Trib5A runoff component (averaging 2.6 cfs). To express the entire record on a consistent basis, the average flows for 1985-1999 have been increased by 2.6 cfs and the corresponding load estimates have been adjusted proportionately. Because of the sampling station location, it is not possible to separate the industrial and runoff loading components. Mass-balance results reported for Crucible therefore reflect the combined point and nonpoint inputs at this location.

## 2. LONG-TERM TRENDS

Yearly variations in precipitation and lake inflow volume are summarized in Figure 2. Over the 1986-2002 period, yearly runoff from the Onondaga Lake watershed varied from 30 to 73 cm and was strongly correlated with precipitation ($r^2 = 0.85$). The strength of this correlation suggests that year-to-year variations in the lake water budget can be simulated using a simple rainfall/runoff model. Runoff was 47 cm in 2002, as compared with a 17-year mean of 45 cm.

The following figures show trends in each water quality component over the entire period of record (1986-2002):

Figure 3 Total Inflow & Outflow Concentrations
Figure 4 Total Inflow & Outflow Loads
Figure 5 Total NonPoint & Total Metro Loads

Ten-year (1993-2002) trends in concentration and load for each mass-balance term and water quality component are summarized in Table 1. Trends are tested using a linear regression of flow-weighted-mean concentration or load against year. Trend slopes that are significantly different from zero ($p < .10$ for a two-tailed hypothesis or $p < 0.05$ for a one-tailed hypothesis) are listed. A ten-year rolling window has been consistently used for trend analysis in yearly AMP reports. With a longer period, results would be strongly influenced by historical data that are not representative of current conditions with respect to municipal and industrial wastewater inputs. With a shorter period, results would be increasingly influenced by short-term variations in hydrology and other random factors.

For total inflows, decreasing trends in concentration and/or load are indicated for alkalinity, BOD, chloride, calcium, ammonia nitrogen, Kjeldahl nitrogen, total nitrogen, total organic carbon, soluble reactive phosphorus, total phosphorus. Decreasing trends in nutrient species and BOD are apparent in Metro loads, but not in the nonpoint loads (with the exception of soluble reactive phosphorus). For the lake outflow, significant

decreasing trends in concentration and/or load are indicated for BOD, ammonia nitrogen, total Kjeldahl nitrogen, total nitrogen, total organic carbon, total inorganic carbon, soluble reactive phosphorus, and total phosphorus. Outflow trends are generally consistent with inflow trends and improving water quality conditions resulting primarily from Metro improvements over the 1993-2002 period.

Total inflow and outflow loads were significantly elevated in 1993 as a consequence of high runoff and Metro construction activities (Figures 3-5). For this reason, the 1993-2002 trends may be unrepresentative of true long-term trends. With the exception of outflow BOD, repeating the analysis for the 1994-2002 period has no effect on conclusions regarding the presence or absence of statistically significant trends in total inflow and outflow loads or concentrations, although the trend magnitudes are somewhat diminished.

## 3. MASS BALANCES

Five-year average (1998-2002) mass balances for the following constituents are summarized in the following tables:

| | |
|---|---|
| Table 2 | Chloride |
| Table 3 | Total Phosphorus |
| Table 4 | Soluble Reactive Phosphorus |
| Table 5 | Total Nitrogen |
| Table 6 | Ammonia Nitrogen |
| Table 7 | Total Phosphorus (May-September) |
| Table 8 | Soluble Reactive Phosphorus (May-September) |

Since chloride is expected to be conservative, the chloride balance provides a basis for testing the accuracy and completeness of the data and methods used to develop the mass balances. Outflow loads computed from 12-foot outlet samples exceeded inflow loads by

7% ± 3% or 12,200 ± 5,100 metric tons/year in 1998-2002 (Table 2). Excess loads in chloride and sodium load were fairly consistent from year to year (Figure 4).

Adjustment of historical estimates of chloride and sodium loads have been necessary to account for changes in the sampling strategy for Onondaga Creek. In previous annual reports, loads from Onondaga Creek have been computed using data from the Spencer and Kirkpatrick monitoring sites. In years when data from both stations were available, results have been averaged by sampling date. Between 1985 and mid 1998, only the Spencer station was sampled. Since that time, biweekly samples have been collected at Kirkpatrick and storm-event samples have been collected at Spencer. Biweekly grabs at Spencer were stopped in 1998 and resumed in 2000. These changes do not influence load computations for most parameters because concentrations measured at these two sites are not significantly different. Apparently because of the intervening salt springs, however, concentrations of sodium and chloride average 79% higher at Kirkpatrick as compared with Spencer. All historical load estimates have been adjusted to reflect the estimated load at Kirkpatrick by applying a 79% increase in years when only Spencer data were available and 28% increase in years when the Spencer and Kirkpatrick data were averaged. [The 28% factor comes from the math: if Kirkpatrick/Spencer = 1.79, then Kirkpatrick = 1.28 x the average of Kirkpatrick & Spencer]. This results in a substantial improvement in the accuracy of the loads for Onondaga Creek and better agreement between lake inflow and outflow loads. Under the existing sampling design, storm event samples are collected only at Spencer. Collection of storm event samples at Kirkpatrick would simplify and improve the accuracy of load estimates in future years. With this change, lake loads would be computed using data exclusively from Kirkpatrick.

As discussed in the 2001 annual report (Ecologic et al, 2002) excess loads of chloride and sodium may be attributed to application of road deicing salts in ungauged portions of the watershed and/or to salt springs contributing directly to the lake. The latter mechanism is not inconsistent with current understanding of the regional aquifer derived from ongoing research by the USGS (Kappel, 2003). Groundwater modeling being performed by the

USGS may provide independent estimates of salt loads from groundwater directly to the lake for comparison with those estimated here based upon mass balances.

Over the 1998-2002 period, the average total phosphorus load was 61,100 ± 2,000 kg/yr, 51% of which was attributed to Metro (Table 3). Decreasing trends in load and concentration are apparent within this period (Figures 3 & 4). The existing phosphorus balance model (Ecologic, 2002) provides a means for developing preliminary projections of water quality responses likely to result from control of specific phosphorus sources. The model is driven by the yearly total phosphorus load from all sources. One important limitation is that it does not directly account for seasonal variations or phosphorus speciation. Such effects are inherent in the empirical model calibration, which may need to be revised if there are significant changes in the seasonality and/or speciation of phosphorus loads from various sources.

As the Lake approaches a phosphorus-limited condition, inputs of soluble reactive phosphorus to the epilimnion during the summer would have the greatest potential impact on algal growth. The following table summarizes flow and phosphorus inputs from Metro (discharge + bypass) expressed as a percentage of the total lake inputs on a yearly and seasonal basis, as derived from Tables 3-8:

| 1998-2002 | Year | May-Sept |
|---|---|---|
| Flow | 21% | 25% |
| Total P Load | 51% | 57% |
| SRP Load | 63% | 73% |

The relative importance of the Metro discharges ranges from 51% (based upon annual total P loads) to 73% (based upon seasonal SRP loads). During this period, the TP concentration in the Metro discharge averaged 322 ± 3 ppb (Table 3). Further significant reductions in P load to the lake are expected when Metro discharges are reduced to <120 ppb with plant upgrades required by April 2006 and currently scheduled for completion by May 2004.

**REFERENCES**

Ecologic, LLC et al., “Onondaga Lake Monitoring Program, 2000 Annual Report”, prepared for Onondaga County, New York, November 2001.

Ecologic, LLC et al., “Onondaga Lake Monitoring Program, 2001 Annual Report”, prepared for Onondaga County, New York, October 2002.

Kappel, W., U.S. Geological Survey, Presentation to Onondaga Lake Advisors Meeting, April 2003.

# Mass Balance Appendix

## List of Figures



## List of Tables

# Figure 1

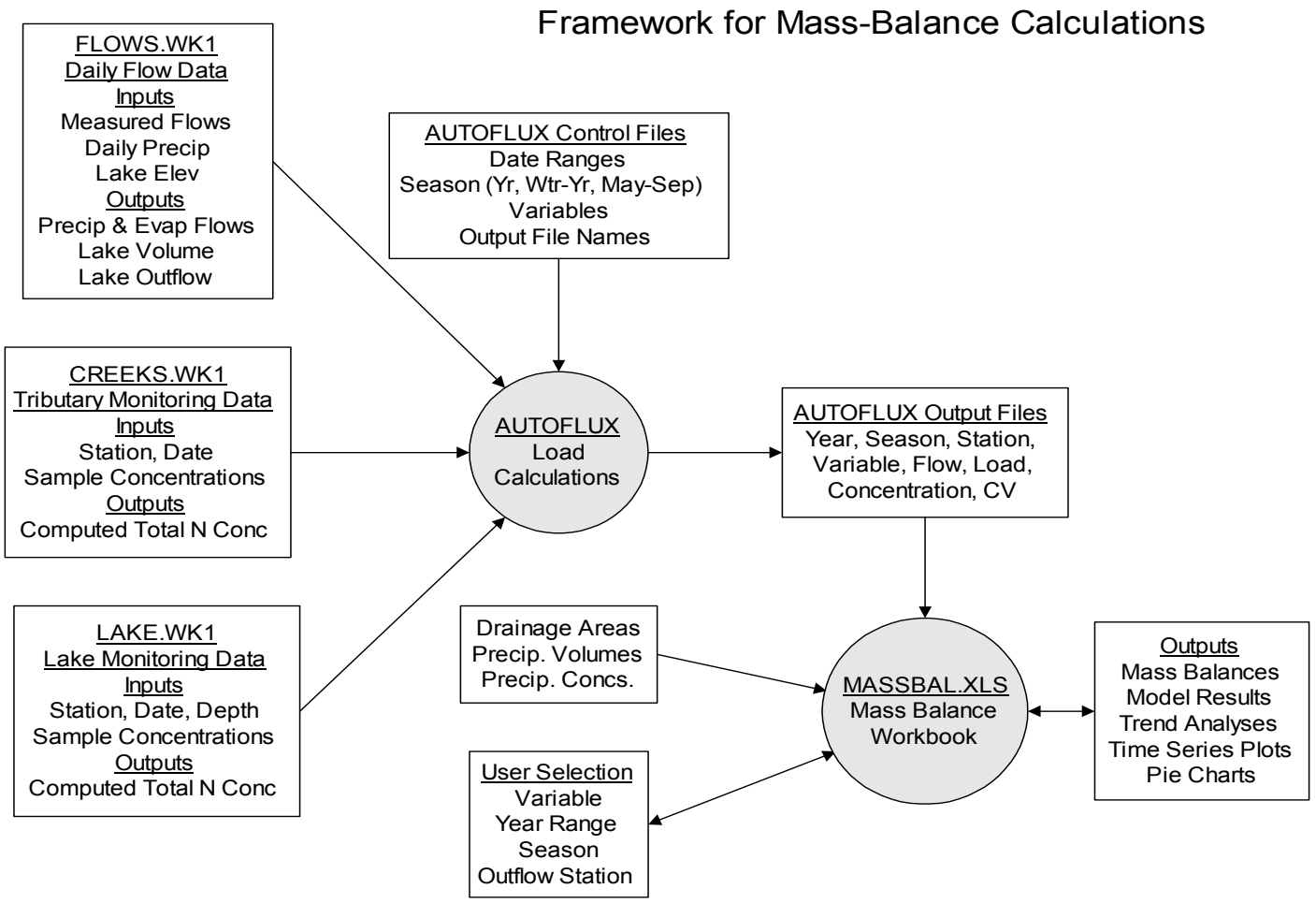
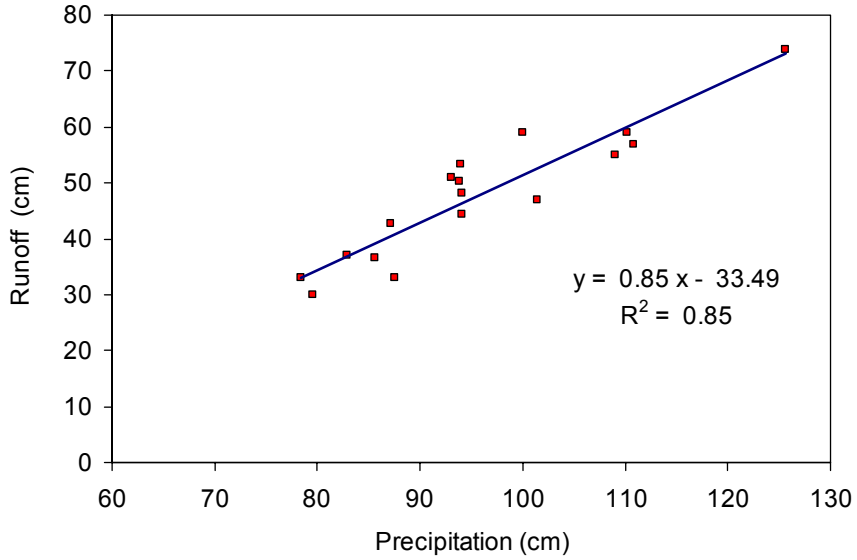
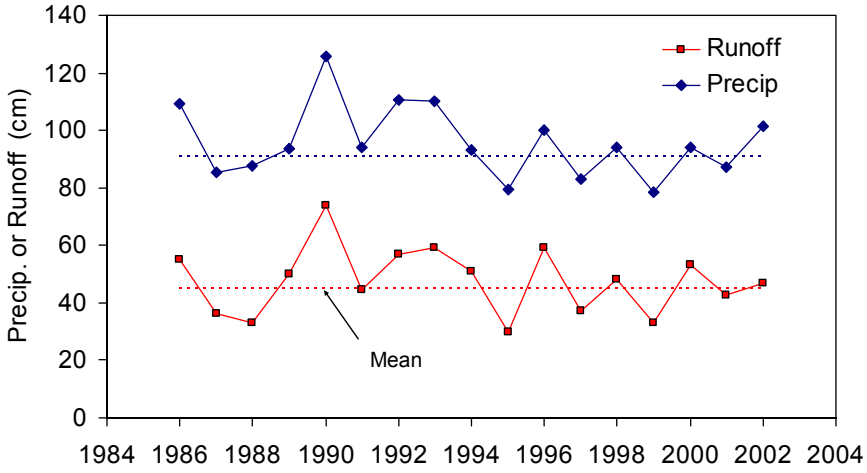
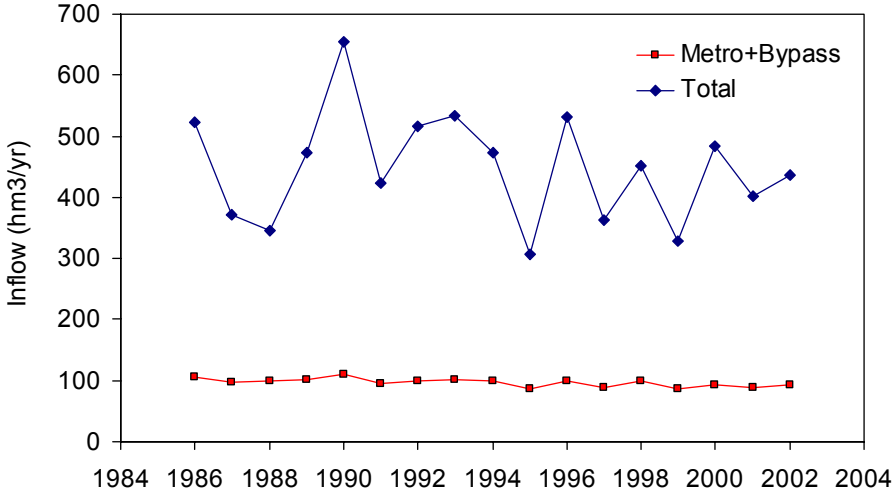

Framework for Mass-Balance Calculations
FLOWS.WK1
Daily Flow Data
Inputs
Measured Flows
Daily Precip
Lake Elev
Outputs
Precip & Evap Flows
Lake Volume
Lake Outflow
AUTOFLUX Control Files
Date Ranges
Season (Yr, Wtr-Yr, May-Sep)
Variables
Output File Names
CREEKS.WK1
Tributary Monitoring Data
Inputs
Station, Date
Sample Concentrations
Outputs
Computed Total N Conc
AUTOFLUX
Load
Calculations
AUTOFLUX Output Files
Year, Season, Station,
Variable, Flow, Load,
Concentration, CV
LAKE.WK1
Lake Monitoring Data
Inputs
Station, Date, Depth
Sample Concentrations
Outputs
Computed Total N Conc
Drainage Areas
Precip. Volumes
Precip. Concs.
MASSBAL.XLS
Mass Balance
Workbook
Outputs
Mass Balances
Model Results
Trend Analyses
Time Series Plots
Pie Charts
User Selection
Variable
Year Range
Season
Outflow Station

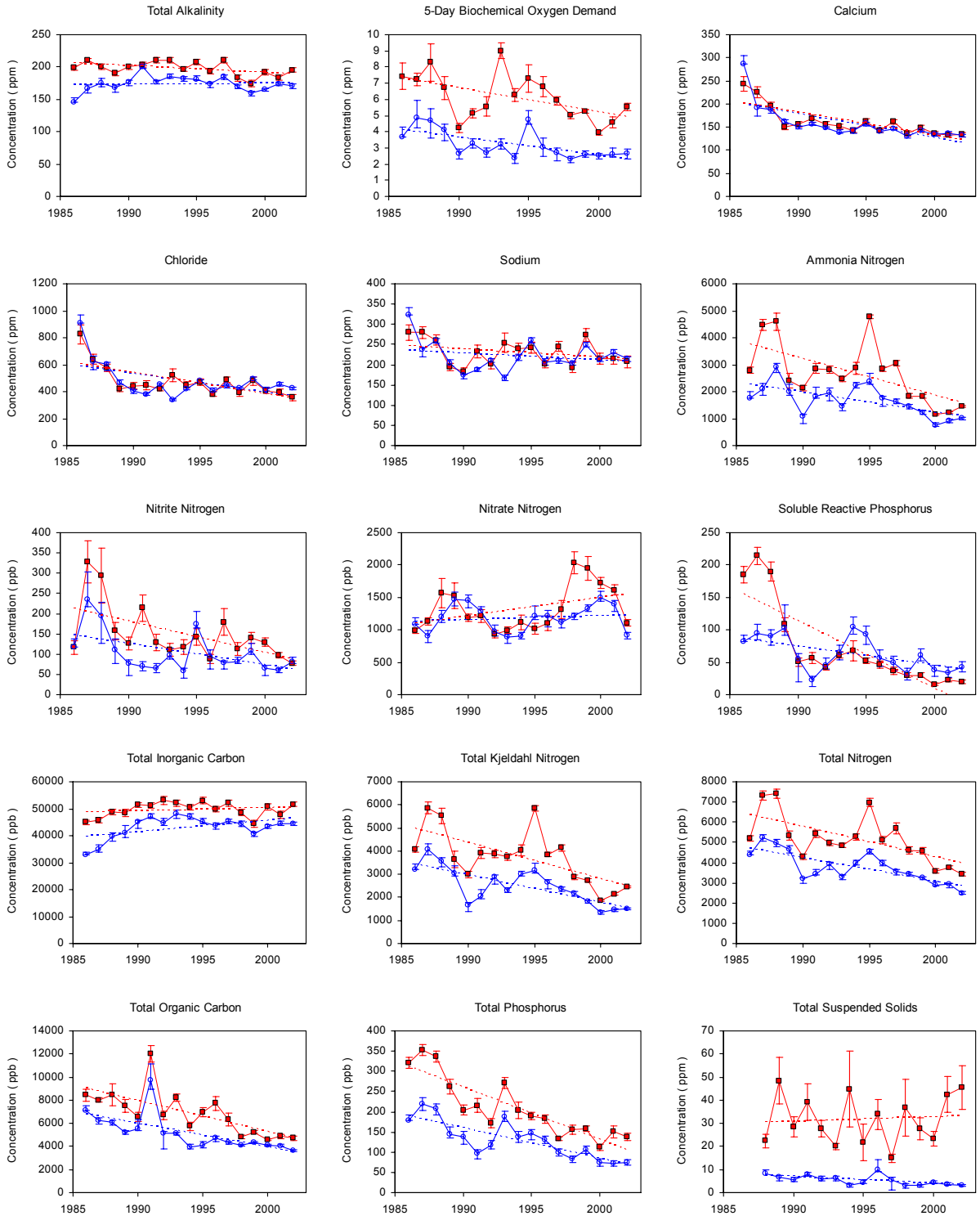
**Figure A4-2**
**Precipitation, Runoff, & Lake Inflow Volumes**



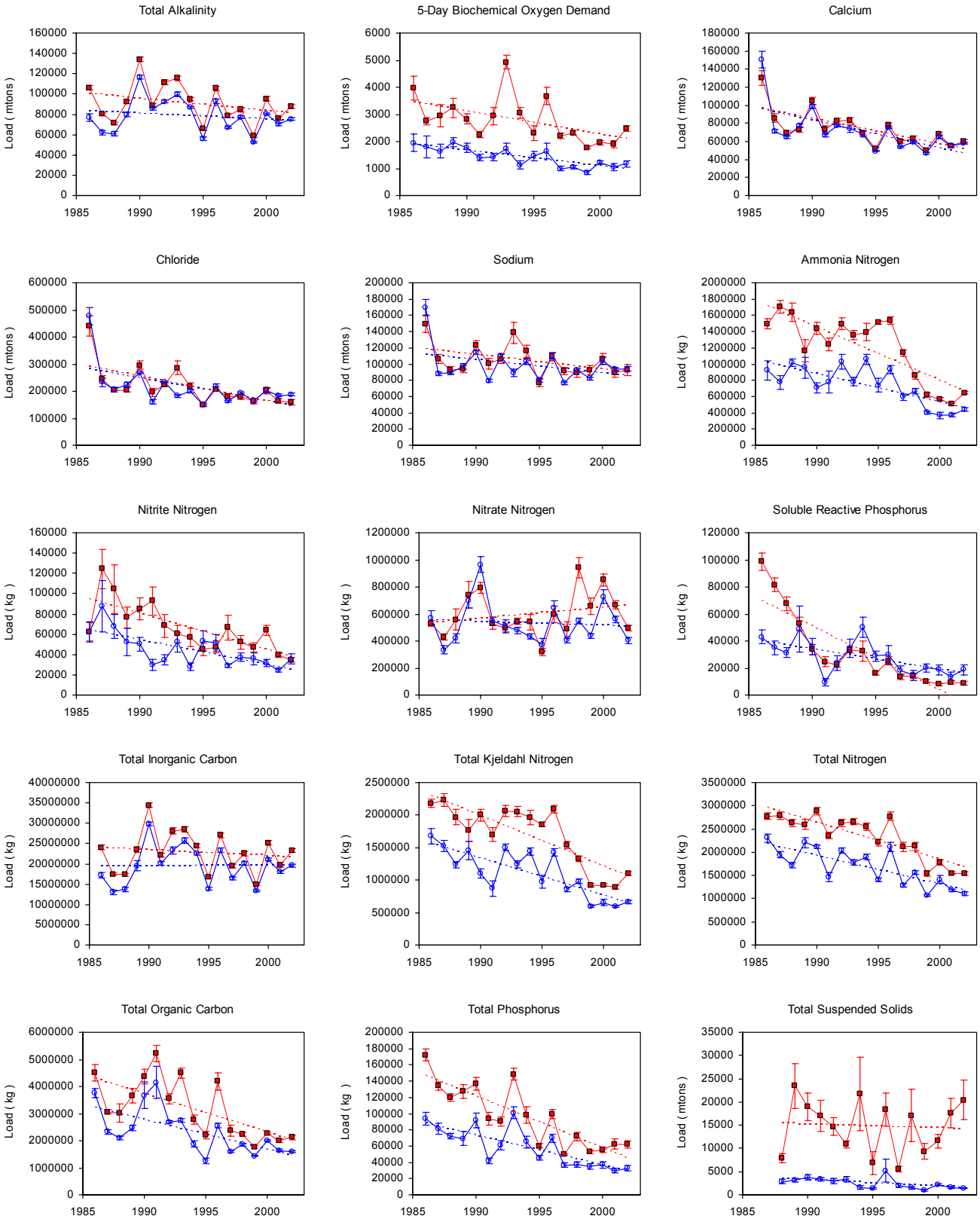



## Figure A4-3
## Long-Term Trends in Total Inflow & Outflow Concentrations



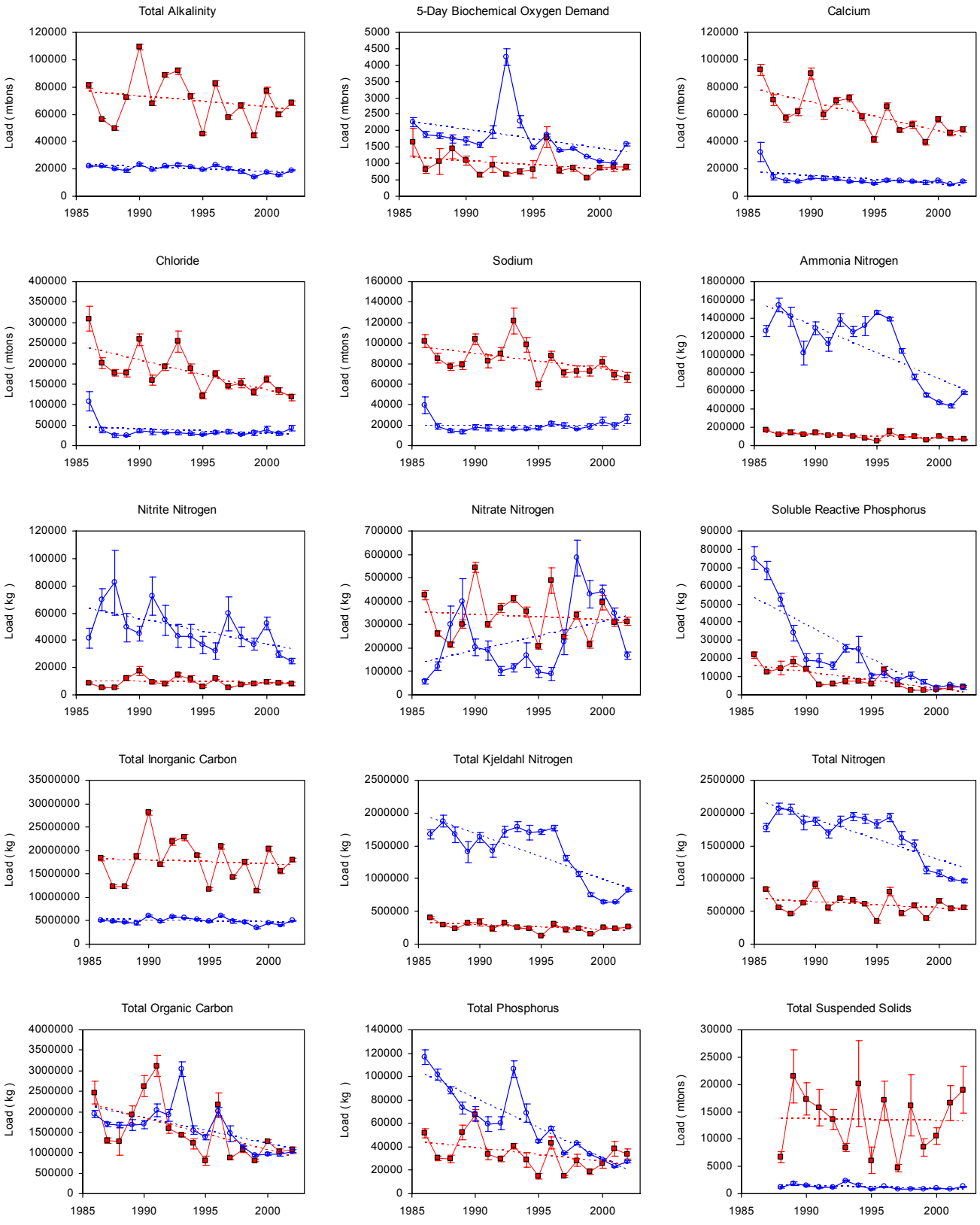

Squares = Inflow, Circles = Outflow  Error Bars = +/- 1 Standard Error  Dotted Lines = Linear Trends  X-Axis = Calendar Year

# Figure A4-4
# Long-Term Trends in Total Inflow & Outflow Loads




Squares = Inflow, Circles = Outflow  Error Bars = +/- 1 Standard Error  Dotted Lines = Linear Trends  X-Axis = Calendar Year

# Figure A4-5
# Long-Term Trends in NonPoint & Metro Loads




Squares = NonPoint, Circles = Metro+Bypass  Error Bars = +/- 1 Standard Error  Dotted Lines = Linear Trends  X-Axis = Calendar Year

# Table 1: 10-Year Trends in Load & Flow-Weighted-Mean Concentration

**Load Trends ( % / yr )** **Period: 1993 to 2002**

| Term | ALK | BOD5 | CA | CL | NA | NH3N | NO2N | NO3N | ORTHOP | TIC | TKN | TN | TOC | TP | TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metro | | -6% | | 4% | 5% | -12% | | | -16% | | -11% | -7% | -7% | -11% | |
| Bypass | | | | | | | | | -39% | | -36% | -35% | | -37% | |
| Allied | -5% | -7% | -7% | | | -16% | -12% | | -8% | -6% | -13% | -9% | -9% | -7% | |
| Crucible | | -6% | | | | | -12% | -7% | 22% | | | -6% | -5% | 13% | |
| Harbor/Hiawatha | | | | | | | | | | | | | | | |
| Ley/Park | | | | | | | | | | | | | | | |
| Ninemile/Rt48 | | | -5% | -7% | -5% | | -8% | | -9% | | | | | | |
| Onond./Kirkpatrick | | | | -6% | -6% | | | | -12% | | 5% | | | | |
| Harbor/Velasko | 9% | 18% | | 11% | 13% | | | 12% | | | 25% | 15% | 12% | | |
| Onondaga/Dorwin | | | | | | | | | -19% | | | | | | |
| Total Gauged | | -9% | | -4% | | -12% | | | -17% | | -10% | -7% | -8% | -10% | |
| NonPoint Gauged | | | | -6% | -5% | | | | -11% | | | | | | |
| Ungauged | | | | -6% | -5% | | | | -11% | | | | | | |
| Total NonPoint | | | | -6% | -5% | | | | -11% | | | | | | |
| Total Industrial | | -6% | | | | -10% | -12% | -7% | 10% | | -6% | -7% | -6% | 7% | |
| Total Municipal | -4% | -13% | | 3% | 4% | -13% | | | -20% | -3% | -12% | -9% | -12% | -15% | |
| Total External | | -9% | | -4% | | -12% | | | -17% | | -10% | -7% | -8% | -9% | |
| | | | | | | | | | | | | | | | |
| Total Inflow | | -9% | | -4% | | -12% | | | -17% | | -10% | -7% | -8% | -9% | |
| Total Outflow | | -4% | | | | -11% | -5% | | -12% | | -10% | -6% | | -13% | |
| Retention | | -12% | | | | -15% | | | | | -11% | -9% | -17% | | |
| Outlet2 | | -4% | | | | -9% | | | -9% | | -8% | -5% | | -11% | |
| Outlet12 | | -4% | | | | -11% | -5% | | -12% | | -10% | -6% | | -13% | |
| South Epil. | | -5% | | | | -11% | -6% | | -17% | | -10% | -6% | | -13% | |

**Concentration Trends ( % / yr )** **Period: 1993 to 2002**

| Term | ALK | BOD5 | CA | CL | NA | NH3N | NO2N | NO3N | ORTHOP | TIC | TKN | TN | TOC | TP | TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metro | -3% | -7% | | 4% | 5% | -12% | | | -16% | -2% | -11% | -7% | -7% | -11% | |
| Bypass | | -7% | | | 10% | -6% | | 18% | -15% | | -8% | -8% | -14% | -9% | |
| Allied | -3% | -4% | -5% | | | -15% | -10% | | -6% | -4% | -11% | -7% | -6% | -5% | 13% |
| Crucible | 2% | -5% | | | | | -11% | -7% | 23% | 2% | | -5% | -4% | 14% | |
| Harbor/Hiawatha | | 10% | | 5% | 5% | | | | | | | | | | |
| Ley/Park | | | | | 5% | | | | | | | | | | |
| Ninemile/Rt48 | -1% | | -3% | -5% | -3% | | -6% | | | | | | | | 7% |
| Onond./Kirkpatrick | | | | -5% | -5% | | | | -11% | | 6% | | | | |
| Harbor/Velasko | | 11% | | | | -10% | -31% | | -14% | | 16% | 5% | | | |
| Onondaga/Dorwin | | 6% | | | | | | | -18% | | 4% | | | | |
| Total Gauged | -1% | -7% | -2% | -3% | | -11% | | | -15% | | -9% | -6% | -6% | -7% | |
| NonPoint Gauged | | | -2% | -4% | -3% | | | | -9% | | 2% | | | | |
| Ungauged | | | -2% | -4% | -3% | | | | -9% | | 2% | | | | |
| Total NonPoint | | | -2% | -4% | -3% | | | | -9% | | 2% | | | | |
| Total Industrial | 1% | -5% | | 3% | | -9% | -11% | -6% | 12% | 1% | -5% | -6% | -5% | 8% | |
| Total Municipal | -3% | -11% | | 4% | 5% | -12% | | | -19% | | -11% | -8% | -10% | -14% | |
| Total External | -1% | -7% | -2% | -3% | | -11% | | | -15% | | -9% | -5% | -6% | -7% | |
| | | | | | | | | | | | | | | | |
| Total Inflow | -1% | -7% | -2% | -3% | | -11% | | | -15% | | -9% | -5% | -6% | -7% | |
| Total Outflow | -1% | | | | | -9% | | | -10% | -1% | -8% | -4% | -2% | -10% | |
| | | | | | | | | | | | | | | | |
| Outlet2 | | -3% | | 2% | | -8% | | | -8% | | -7% | -4% | -2% | -9% | |
| Outlet12 | -1% | | | | | -9% | | | -10% | -1% | -8% | -4% | -2% | -10% | |
| South Epil. | | | | | | -10% | | | -15% | | -8% | -5% | -2% | -11% | |

Trends Significant at $p < .10$ (2-tailed hypothesis), based upon linear regression of yearly values

# Table 2: Chloride Balance for 1998-2002

**Variable:** Chloride **Average for Years:** 1998 thru 2002 **Season:** Year

| Term | Flow 10^6 m3 | Load mtons | Std Error mtons | Conc ppm | RSE % | Percent of Total Inflow: Sampl per yr | Flow % | Load % | Error % | Drain. Area km2 | Runoff cm | Export mtons/ km2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metro Effluent | 89.35 | 32356 | 2475 | 362 | 8% | 29 | 21% | 19% | 31% | | | |
| Metro Bypass | 2.19 | 1099 | 175 | 502 | 16% | 5 | 1% | 1% | 0% | | | |
| East Flume | 0.50 | 226 | 9 | 456 | 4% | 28 | 0% | 0% | 0% | | | |
| Crucible | 2.82 | 1122 | 21 | 398 | 2% | 28 | 1% | 1% | 0% | | | |
| Harbor Brook | 8.56 | 2318 | 163 | 271 | 7% | 30 | 2% | 1% | 0% | 29.3 | 29.2 | 79.1 |
| Ley Creek | 34.40 | 10277 | 1028 | 299 | 10% | 31 | 8% | 6% | 5% | 77.5 | 44.4 | 132.6 |
| Ninemile Creek | 124.13 | 49272 | 1641 | 397 | 3% | 29 | 29% | 28% | 14% | 298.1 | 41.6 | 165.3 |
| Onondaga Creek | 142.49 | 69958 | 2954 | 491 | 4% | 31 | 33% | 40% | 45% | 285.1 | 50.0 | 245.4 |
| Nonpoint Gauged | 309.58 | 131824 | 3537 | 426 | 3% | 121 | 72% | 76% | 64% | 690.0 | 44.9 | 191.0 |
| Nonpoint Ungauged | 16.61 | 7075 | 974 | 426 | 14% | 0 | 4% | 4% | 5% | 37.0 | 44.9 | 191.0 |
| NonPoint Total | 326.19 | 138899 | 3668 | 426 | 3% | 121 | 76% | 80% | 69% | 727.0 | 44.9 | 191.0 |
| Industrial | 3.32 | 1349 | 23 | 407 | 2% | 56 | 1% | 1% | 0% | | | |
| Municipal | 91.54 | 33455 | 2481 | 365 | 7% | 34 | 21% | 19% | 31% | | | |
| Total External | 421.05 | 173703 | 4429 | 413 | 3% | 211 | 98% | 100% | 100% | 727.0 | 57.9 | 238.9 |
| Precipitation | 10.65 | 11 | 1 | 1 | 9% | 0 | 2% | 0% | 0% | 11.7 | 91.0 | 0.9 |
| Total Inflow | 431.70 | 173713 | 4429 | 402 | 3% | 211 | 100% | 100% | 100% | 738.7 | 58.4 | 235.1 |
| Evaporation | 8.86 | | | | | | 2% | | | 11.7 | 75.7 | |
| Outflow | 422.84 | 185917 | 2531 | 440 | 1% | | 98% | 107% | 33% | 738.7 | 57.2 | 251.7 |
| Retention | 0.00 | -12204 | 5101 | | 42% | | 0% | -7% | | | | |
| Alternative Estimates of Lake Output | | | | | | | | | | | | |
| Outlet 12 Feet | 422.84 | 185917 | 2531 | 440 | 1% | 26 | 98% | 107% | 33% | 738.7 | 57.2 | 251.7 |
| Outlet 2 Feet | 422.84 | 156991 | 3576 | 371 | 2% | 26 | 98% | 90% | 65% | 738.7 | 57.2 | 212.5 |
| Lake Epil | 422.84 | 180171 | 2174 | 426 | 1% | 21 | 98% | 104% | 24% | 738.7 | 57.2 | 243.9 |
| Upstream/Downstream Contrast- Harbor Brook | | | | | | | | | | | | |
| Upstream - Velasko | 8.03 | 1772 | 69 | 221 | 4% | 28 | 2% | 1% | 0% | 25.9 | 31.0 | 68.4 |
| Downstream - Hiawatha | 8.56 | 2318 | 163 | 271 | 7% | 30 | 2% | 1% | 0% | 29.3 | 29.2 | 79.1 |
| Local Inflow | 0.53 | 546 | 177 | 1037 | 32% | | 0% | 0% | 0% | 3.4 | 15.6 | 162.0 |
| Upstream/Downstream Contrast - Onondaga Creek | | | | | | | | | | | | |
| Upstream - Dorwin | 109.29 | 13337 | 544 | 122 | 4% | 31 | 25% | 8% | 2% | 229.4 | 47.6 | 58.1 |
| Downstream - Kirkpatrick | 142.49 | 69958 | 2954 | 491 | 4% | 31 | 33% | 40% | 45% | 285.1 | 50.0 | 245.4 |
| Local Inflow | 33.20 | 56620 | 3004 | 1705 | 5% | | 8% | 33% | 46% | 55.7 | 59.6 | 1016.0 |

| | | | |
|---|---|---|---|
| Lake Overflow Rate | 36.14 m/yr | Calib. Settling Rate | -2.4 m/yr |
| Lake Residence Time | 0.30 years | Calib. Retention Coef. | -7% |

RSE % = Relative Std. Error of Load & Inflow Conc. Estimates
Error % = Percent of Variance in Total Inflow Load Estimate

# Table 3: Total Phosphorus Balance for 1998-2002

**Variable:** **Total Phosphorus** **Average for Years:** **1998** **thru** **2002** **Season: Year**

| | | | | | | Percent of Total Inflow | | | | Drain. | | Export |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flow | Load | Std Error | Conc | RSE | Sampl | Flow | Load | Error | Area | Runoff | kg / |
| Term | 10^6 m3 | kg | kg | ppb | % | per yr | % | % | % | km2 | cm | km2 |
| Metro Effluent | 89.35 | 28745 | 281 | 322 | 1% | 365 | 21% | 47% | 2% | | | |
| Metro Bypass | 2.19 | 2568 | 77 | 1174 | 3% | 40 | 1% | 4% | 0% | | | |
| East Flume | 0.50 | 95 | 6 | 191 | 6% | 28 | 0% | 0% | 0% | | | |
| Crucible | 2.82 | 373 | 10 | 132 | 3% | 28 | 1% | 1% | 0% | | | |
| Harbor Brook | 8.56 | 704 | 118 | 82 | 17% | 30 | 2% | 1% | 0% | 29.3 | 29.2 | 24.0 |
| Ley Creek | 34.40 | 3965 | 330 | 115 | 8% | 30 | 8% | 6% | 3% | 77.5 | 44.4 | 51.2 |
| Ninemile Creek | 124.13 | 9149 | 963 | 74 | 11% | 29 | 29% | 15% | 24% | 298.1 | 41.6 | 30.7 |
| Onondaga Creek | 142.49 | 13688 | 1655 | 96 | 12% | 31 | 33% | 22% | 70% | 285.1 | 50.0 | 48.0 |
| | | | | | | | | | | | | |
| Nonpoint Gauged | 309.58 | 27506 | 1947 | 89 | 7% | 120 | 72% | 45% | 96% | 690.0 | 44.9 | 39.9 |
| Nonpoint Ungauged | 16.61 | 1476 | 229 | 89 | 15% | 0 | 4% | 2% | 1% | 37.0 | 44.9 | 39.9 |
| NonPoint Total | 326.19 | 28982 | 1960 | 89 | 7% | 120 | 76% | 47% | 98% | 727.0 | 44.9 | 39.9 |
| Industrial | 3.32 | 467 | 12 | 141 | 2% | 55 | 1% | 1% | 0% | | | |
| Municipal | 91.54 | 31313 | 291 | 342 | 1% | 405 | 21% | 51% | 2% | | | |
| Total External | 421.05 | 60762 | 1982 | 144 | 3% | 581 | 98% | 99% | 100% | 727.0 | 57.9 | 83.6 |
| Precipitation | 10.65 | 320 | 29 | 30 | 9% | 0 | 2% | 1% | 0% | 11.7 | 91.0 | 27.3 |
| Total Inflow | 431.70 | 61081 | 1982 | 141 | 3% | 581 | 100% | 100% | 100% | 738.7 | 58.4 | 82.7 |
| | | | | | | | | | | | | |
| Evaporation | 8.86 | | | | | | 2% | | | 11.7 | 75.7 | |
| Outflow | 422.84 | 34216 | 1483 | 81 | 4% | | 98% | 56% | 56% | 738.7 | 57.2 | 46.3 |
| Retention | 0.00 | 26865 | 2475 | | 9% | | 0% | 44% | | | | |
| | | | | | | | | | | | | |
| Alternative Estimates of Lake Output | | | | | | | | | | | | |
| Outlet 12 Feet | 422.84 | 34216 | 1483 | 81 | 4% | 26 | 98% | 56% | 56% | 738.7 | 57.2 | 46.3 |
| Outlet 2 Feet | 422.84 | 32232 | 1313 | 76 | 4% | 26 | 98% | 53% | 44% | 738.7 | 57.2 | 43.6 |
| Lake Epil | 422.84 | 31890 | 1368 | 75 | 4% | 22 | 98% | 52% | 48% | 738.7 | 57.2 | 43.2 |
| | | | | | | | | | | | | |
| Upstream/Downstream Contrast- Harbor Brook | | | | | | | | | | | | |
| Upstream - Velasko | 8.03 | 365 | 57 | 45 | 16% | 28 | 2% | 1% | 0% | 25.9 | 31.0 | 14.1 |
| Downstream - Hiawatha | 8.56 | 704 | 118 | 82 | 17% | 30 | 2% | 1% | 0% | 29.3 | 29.2 | 24.0 |
| Local Inflow | 0.53 | 339 | 131 | 643 | 39% | | 0% | 1% | 0% | 3.4 | 15.6 | 100.5 |
| | | | | | | | | | | | | |
| Upstream/Downstream Contrast - Onondaga Creek | | | | | | | | | | | | |
| Upstream - Dorwin | 109.29 | 7925 | 768 | 73 | 10% | 31 | 25% | 13% | 15% | 229.4 | 47.6 | 34.5 |
| Downstream - Kirkpatrick | 142.49 | 13688 | 1655 | 96 | 12% | 31 | 33% | 22% | 70% | 285.1 | 50.0 | 48.0 |
| Local Inflow | 33.20 | 5763 | 1824 | 174 | 32% | | 8% | 9% | 85% | 55.7 | 59.6 | 103.4 |

| | | | | |
|---|---|---|---|---|
| Lake Overflow Rate | 36.14 m/yr | Calib. Settling Rate | 28.4 m/yr | RSE % = Relative Std. Error of Load & Inflow Conc. Estimates |
| Lake Residence Time | 0.30 years | Calib. Retention Coef. | 44% | Error % = Percent of Variance in Total Inflow Load Estimate |

# Table 5: Total Nitrogen Balance for 1998-2002

**Variable:** **Total Nitrogen** **Average for Years:** **1998** **thru** **2002** **Season: Year**

| | | | | | | Percent of Total Inflow | | | | Drain. | | Export |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flow | Load | Std Error | Conc | RSE | Sampl | Flow | Load | Error | Area | Runoff | kg/ |
| Term | 10^6 m3 | kg | kg | ppb | % | per yr | % | % | % | km2 | cm | km2 |
| Metro Effluent | 89.35 | 1106076 | 22317 | 12379 | 2% | 50 | 21% | 65% | 74% | | | |
| Metro Bypass | 2.19 | 28838 | 1589 | 13179 | 6% | 5 | 1% | 2% | 0% | | | |
| East Flume | 0.50 | 3342 | 76 | 6735 | 2% | 28 | 0% | 0% | 0% | | | |
| Crucible | 2.82 | 5720 | 274 | 2029 | 5% | 28 | 1% | 0% | 0% | | | |
| Harbor Brook | 8.56 | 18201 | 717 | 2126 | 4% | 28 | 2% | 1% | 0% | 29.3 | 29.2 | 621.4 |
| Ley Creek | 34.40 | 50311 | 1509 | 1463 | 3% | 27 | 8% | 3% | 0% | 77.5 | 44.4 | 649.1 |
| Ninemile Creek | 124.13 | 219857 | 6926 | 1771 | 3% | 27 | 29% | 13% | 7% | 298.1 | 41.6 | 737.5 |
| Onondaga Creek | 142.49 | 230965 | 9976 | 1621 | 4% | 28 | 33% | 13% | 15% | 285.1 | 50.0 | 810.0 |
| | | | | | | | | | | | | |
| Nonpoint Gauged | 309.58 | 519334 | 12259 | 1678 | 2% | 110 | 72% | 30% | 22% | 690.0 | 44.9 | 752.6 |
| Nonpoint Ungauged | 16.61 | 27871 | 3846 | 1678 | 14% | 0 | 4% | 2% | 2% | 37.0 | 44.9 | 752.6 |
| NonPoint Total | 326.19 | 547206 | 12848 | 1678 | 2% | 110 | 76% | 32% | 25% | 727.0 | 44.9 | 752.6 |
| Industrial | 3.32 | 9062 | 284 | 2733 | 3% | 55 | 1% | 1% | 0% | | | |
| Municipal | 91.54 | 1134914 | 22374 | 12398 | 2% | 55 | 21% | 66% | 75% | | | |
| Total External | 421.05 | 1691181 | 25802 | 4017 | 2% | 220 | 98% | 99% | 100% | 727.0 | 57.9 | 2326.1 |
| Precipitation | 10.65 | 20237 | 1817 | 1900 | 9% | 0 | 2% | 1% | 0% | 11.7 | 91.0 | 1729.6 |
| Total Inflow | 431.70 | 1711418 | 25866 | 3964 | 2% | 220 | 100% | 100% | 100% | 738.7 | 58.4 | 2316.6 |
| | | | | | | | | | | | | |
| Evaporation | 8.86 | | | | | | 2% | | | 11.7 | 75.7 | |
| Outflow | 422.84 | 1267880 | 20938 | 2998 | 2% | | 98% | 74% | 66% | 738.7 | 57.2 | 1716.3 |
| Retention | 0.00 | 443538 | 33278 | | 8% | | 0% | 26% | | | | |
| | | | | | | | | | | | | |
| Alternative Estimates of Lake Output | | | | | | | | | | | | |
| Outlet 12 Feet | 422.84 | 1267880 | 20938 | 2998 | 2% | 26 | 98% | 74% | 66% | 738.7 | 57.2 | 1716.3 |
| Outlet 2 Feet | 422.84 | 1130010 | 23100 | 2672 | 2% | 26 | 98% | 66% | 80% | 738.7 | 57.2 | 1529.6 |
| Lake Epil | 422.84 | 1287685 | 16606 | 3045 | 1% | 23 | 98% | 75% | 41% | 738.7 | 57.2 | 1743.1 |
| | | | | | | | | | | | | |
| Upstream/Downstream Contrast- Harbor Brook | | | | | | | | | | | | |
| Upstream - Velasko | 8.03 | 17468 | 903 | 2174 | 5% | 28 | 2% | 1% | 0% | 25.9 | 31.0 | 673.9 |
| Downstream - Hiawatha | 8.56 | 18201 | 717 | 2126 | 4% | 28 | 2% | 1% | 0% | 29.3 | 29.2 | 621.4 |
| Local Inflow | 0.53 | 733 | 1153 | 1392 | 157% | | 0% | 0% | 0% | 3.4 | 15.6 | 217.6 |
| | | | | | | | | | | | | |
| Upstream/Downstream Contrast - Onondaga Creek | | | | | | | | | | | | |
| Upstream - Dorwin | 109.29 | 171774 | 8278 | 1572 | 5% | 27 | 25% | 10% | 10% | 229.4 | 47.6 | 748.8 |
| Downstream - Kirkpatrick | 142.49 | 230965 | 9976 | 1621 | 4% | 28 | 33% | 13% | 15% | 285.1 | 50.0 | 810.0 |
| Local Inflow | 33.20 | 59191 | 12963 | 1783 | 22% | | 8% | 3% | 25% | 55.7 | 59.6 | 1062.1 |

| | | | | |
|---|---|---|---|---|
| Lake Overflow Rate | 36.14 m/yr | Calib. Settling Rate | 12.6 m/yr | RSE % = Relative Std. Error of Load & Inflow Conc. Estimates |
| Lake Residence Time | 0.30 years | Calib. Retention Coef. | 26% | Error % = Percent of Variance in Total Inflow Load Estimate |

# Table 4: Soluble Reactive P Balance for 1998-2002

**Variable:** Soluble Reactive Phosphorus **Average for Years:** 1998 thru 2002 **Season:** Year

| Term | Flow 10^6 m3 | Load kg | Std Error kg | Conc ppb | RSE % | Sampl per yr | Percent of Total Inflow Flow % | Load % | Error % | Drain. Area km2 | Runoff cm | Export kg / km2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metro Effluent | 89.35 | 5912 | 491 | 66 | 8% | 28 | 21% | 59% | 72% | | | |
| Metro Bypass | 2.19 | 395 | 209 | 180 | 53% | 5 | 1% | 4% | 13% | | | |
| East Flume | 0.50 | 46 | 5 | 93 | 12% | 28 | 0% | 0% | 0% | | | |
| Crucible | 2.82 | 149 | 5 | 53 | 3% | 28 | 1% | 1% | 0% | | | |
| Harbor Brook | 8.56 | 181 | 24 | 21 | 13% | 30 | 2% | 2% | 0% | 29.3 | 29.2 | 6.2 |
| Ley Creek | 34.40 | 603 | 37 | 18 | 6% | 30 | 8% | 6% | 0% | 77.5 | 44.4 | 7.8 |
| Ninemile Creek | 124.13 | 1073 | 136 | 9 | 13% | 29 | 29% | 11% | 6% | 298.1 | 41.6 | 3.6 |
| Onondaga Creek | 142.49 | 1340 | 166 | 9 | 12% | 31 | 33% | 13% | 8% | 285.1 | 50.0 | 4.7 |
| | | | | | | | | | | | | |
| Nonpoint Gauged | 309.58 | 3197 | 219 | 10 | 7% | 120 | 72% | 32% | 14% | 690.0 | 44.9 | 4.6 |
| Nonpoint Ungauged | 16.61 | 172 | 26 | 10 | 15% | 0 | 4% | 2% | 0% | 37.0 | 44.9 | 4.6 |
| NonPoint Total | 326.19 | 3369 | 220 | 10 | 7% | 120 | 76% | 34% | 15% | 727.0 | 44.9 | 4.6 |
| Industrial | 3.32 | 195 | 7 | 59 | 4% | 55 | 1% | 2% | 0% | | | |
| Municipal | 91.54 | 6307 | 534 | 69 | 8% | 32 | 21% | 63% | 85% | | | |
| Total External | 421.05 | 9871 | 577 | 23 | 6% | 207 | 98% | 98% | 100% | 727.0 | 57.9 | 13.6 |
| Precipitation | 10.65 | 160 | 14 | 15 | 9% | 0 | 2% | 2% | 0% | 11.7 | 91.0 | 13.7 |
| Total Inflow | 431.70 | 10030 | 578 | 23 | 6% | 207 | 100% | 100% | 100% | 738.7 | 58.4 | 13.6 |
| | | | | | | | | | | | | |
| Evaporation | 8.86 | | | | | | 2% | | | 11.7 | 75.7 | |
| Outflow | 422.84 | 17236 | 1538 | 41 | 9% | | 98% | 172% | 709% | 738.7 | 57.2 | 23.3 |
| Retention | 0.00 | -7206 | 1643 | | 23% | | 0% | -72% | | | | |
| | | | | | | | | | | | | |
| Alternative Estimates of Lake Output | | | | | | | | | | | | |
| Outlet 12 Feet | 422.84 | 17236 | 1538 | 41 | 9% | 26 | 98% | 172% | 709% | 738.7 | 57.2 | 23.3 |
| Outlet 2 Feet | 422.84 | 14361 | 1222 | 34 | 9% | 26 | 98% | 143% | 448% | 738.7 | 57.2 | 19.4 |
| Lake Epil | 422.84 | 11499 | 1334 | 27 | 12% | 22 | 98% | 115% | 534% | 738.7 | 57.2 | 15.6 |
| | | | | | | | | | | | | |
| Upstream/Downstream Contrast- Harbor Brook | | | | | | | | | | | | |
| Upstream - Velasko | 8.03 | 64 | 7 | 8 | 11% | 28 | 2% | 1% | 0% | 25.9 | 31.0 | 2.5 |
| Downstream - Hiawatha | 8.56 | 181 | 24 | 21 | 13% | 30 | 2% | 2% | 0% | 29.3 | 29.2 | 6.2 |
| Local Inflow | 0.53 | 117 | 25 | 222 | 21% | | 0% | 1% | 0% | 3.4 | 15.6 | 34.7 |
| | | | | | | | | | | | | |
| Upstream/Downstream Contrast - Onondaga Creek | | | | | | | | | | | | |
| Upstream - Dorwin | 109.29 | 563 | 80 | 5 | 14% | 31 | 25% | 6% | 2% | 229.4 | 47.6 | 2.5 |
| Downstream - Kirkpatrick | 142.49 | 1340 | 166 | 9 | 12% | 31 | 33% | 13% | 8% | 285.1 | 50.0 | 4.7 |
| Local Inflow | 33.20 | 777 | 184 | 23 | 24% | | 8% | 8% | 10% | 55.7 | 59.6 | 13.9 |

Lake Overflow Rate 36.14 m/yr
Lake Residence Time 0.30 years
Calib. Settling Rate -15.1 m/yr
Calib. Retention Coef. -72%

RSE % = Relative Std. Error of Load & Inflow Conc. Estimates
Error % = Percent of Variance in Total Inflow Load Estimate

# Table 6: Ammonia Nitrogen Balance for 1998-2002

**Variable:** **Ammonia Nitrogen** **Average for Years:** **1998** **thru** **2002** **Season: Year**

| Term | Flow 10^6 m3 | Load kg | Std Error kg | Conc ppb | RSE % | Sampl per yr | Percent of Total Inflow Flow % | Load % | Error % | Drain. Area km2 | Runoff cm | Export kg/ km2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metro Effluent | 89.35 | 541605 | 9741 | 6061 | 2% | 365 | 21% | 85% | 86% | | | |
| Metro Bypass | 2.19 | 15847 | 838 | 7242 | 5% | 40 | 1% | 2% | 1% | | | |
| East Flume | 0.50 | 527 | 26 | 1063 | 5% | 28 | 0% | 0% | 0% | | | |
| Crucible | 2.82 | 478 | 18 | 169 | 4% | 28 | 1% | 0% | 0% | | | |
| Harbor Brook | 8.56 | 1368 | 136 | 160 | 10% | 28 | 2% | 0% | 0% | 29.3 | 29.2 | 46.7 |
| Ley Creek | 34.40 | 13543 | 614 | 394 | 5% | 27 | 8% | 2% | 0% | 77.5 | 44.4 | 174.7 |
| Ninemile Creek | 124.13 | 41393 | 3521 | 333 | 9% | 27 | 29% | 6% | 11% | 298.1 | 41.6 | 138.9 |
| Onondaga Creek | 142.49 | 18643 | 1020 | 131 | 5% | 28 | 33% | 3% | 1% | 285.1 | 50.0 | 65.4 |
| | | | | | | | | | | | | |
| Nonpoint Gauged | 309.58 | 74946 | 3719 | 242 | 5% | 110 | 72% | 12% | 13% | 690.0 | 44.9 | 108.6 |
| Nonpoint Ungauged | 16.61 | 4022 | 586 | 242 | 15% | 0 | 4% | 1% | 0% | 37.0 | 44.9 | 108.6 |
| NonPoint Total | 326.19 | 78968 | 3765 | 242 | 5% | 110 | 76% | 12% | 13% | 727.0 | 44.9 | 108.6 |
| Industrial | 3.32 | 1005 | 32 | 303 | 3% | 55 | 1% | 0% | 0% | | | |
| Municipal | 91.54 | 557452 | 9777 | 6090 | 2% | 404 | 21% | 87% | 87% | | | |
| Total External | 421.05 | 637425 | 10477 | 1514 | 2% | 570 | 98% | 100% | 100% | 727.0 | 57.9 | 876.7 |
| Precipitation | 10.65 | 1065 | 96 | 100 | 9% | 0 | 2% | 0% | 0% | 11.7 | 91.0 | 91.0 |
| Total Inflow | 431.70 | 638490 | 10478 | 1479 | 2% | 570 | 100% | 100% | 100% | 738.7 | 58.4 | 864.3 |
| | | | | | | | | | | | | |
| Evaporation | 8.86 | | | | | | 2% | | | 11.7 | 75.7 | |
| Outflow | 422.84 | 450957 | 12721 | 1066 | 3% | | 98% | 71% | 147% | 738.7 | 57.2 | 610.4 |
| Retention | 0.00 | 187533 | 16480 | | 9% | | 0% | 29% | | | | |
| | | | | | | | | | | | | |
| Alternative Estimates of Lake Output | | | | | | | | | | | | |
| Outlet 12 Feet | 422.84 | 450957 | 12721 | 1066 | 3% | 26 | 98% | 71% | 147% | 738.7 | 57.2 | 610.4 |
| Outlet 2 Feet | 422.84 | 386222 | 13761 | 913 | 4% | 26 | 98% | 60% | 173% | 738.7 | 57.2 | 522.8 |
| Lake Epil | 422.84 | 460654 | 15070 | 1089 | 3% | 23 | 98% | 72% | 207% | 738.7 | 57.2 | 623.6 |
| | | | | | | | | | | | | |
| Upstream/Downstream Contrast- Harbor Brook | | | | | | | | | | | | |
| Upstream - Velasko | 8.03 | 681 | 37 | 85 | 5% | 28 | 2% | 0% | 0% | 25.9 | 31.0 | 26.3 |
| Downstream - Hiawatha | 8.56 | 1368 | 136 | 160 | 10% | 28 | 2% | 0% | 0% | 29.3 | 29.2 | 46.7 |
| Local Inflow | 0.53 | 687 | 141 | 1305 | 20% | | 0% | 0% | 0% | 3.4 | 15.6 | 203.9 |
| | | | | | | | | | | | | |
| Upstream/Downstream Contrast - Onondaga Creek | | | | | | | | | | | | |
| Upstream - Dorwin | 109.29 | 9069 | 412 | 83 | 5% | 27 | 25% | 1% | 0% | 229.4 | 47.6 | 39.5 |
| Downstream - Kirkpatrick | 142.49 | 18643 | 1020 | 131 | 5% | 28 | 33% | 3% | 1% | 285.1 | 50.0 | 65.4 |
| Local Inflow | 33.20 | 9574 | 1100 | 288 | 11% | | 8% | 1% | 1% | 55.7 | 59.6 | 171.8 |

| | | | | |
|---|---|---|---|---|
| Lake Overflow Rate | 36.14 m/yr | Calib. Settling Rate | 15.0 m/yr | RSE % = Relative Std. Error of Load & Inflow Conc. Estimates |
| Lake Residence Time | 0.30 years | Calib. Retention Coef. | 29% | Error % = Percent of Variance in Total Inflow Load Estimate |

# Table 7: Total Phosphorus Balance for May-September, 1998-2002

**Variable:** **Total Phosphorus** **Average for Years:** **1998 thru 2002** **Season:** **MaySept**

| Term | Flow 10^6 m3 | Load kg | Std Error kg | Conc ppb | RSE % | Sampl per yr | Percent of Total Inflow Flow % | Load % | Error % | Drain. Area km2 | Runoff cm | Export kg / km2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metro Effluent | 34.81 | 11324 | 148 | 325 | 1% | 153 | 25% | 53% | 4% | | | |
| Metro Bypass | 0.69 | 813 | 243 | 1182 | 30% | 14 | 0% | 4% | 12% | | | |
| East Flume | 0.16 | 27 | 1 | 168 | 5% | 11 | 0% | 0% | 0% | | | |
| Crucible | 1.11 | 166 | 6 | 149 | 4% | 11 | 1% | 1% | 0% | | | |
| Harbor Brook | 2.95 | 214 | 31 | 72 | 14% | 12 | 2% | 1% | 0% | 29.3 | 10.1 | 7.3 |
| Ley Creek | 11.26 | 1531 | 107 | 136 | 7% | 13 | 8% | 7% | 2% | 77.5 | 14.5 | 19.8 |
| Ninemile Creek | 38.32 | 2833 | 203 | 74 | 7% | 12 | 27% | 13% | 8% | 298.1 | 12.9 | 9.5 |
| Onondaga Creek | 41.08 | 3713 | 593 | 90 | 16% | 13 | 29% | 18% | 71% | 285.1 | 14.4 | 13.0 |
| Nonpoint Gauged | 93.61 | 8292 | 636 | 89 | 8% | 51 | 67% | 39% | 82% | 690.0 | 13.6 | 12.0 |
| Nonpoint Ungauged | 5.02 | 445 | 74 | 89 | 17% | 0 | 4% | 2% | 1% | 37.0 | 13.6 | 12.0 |
| NonPoint Total | 98.64 | 8737 | 641 | 89 | 7% | 51 | 70% | 41% | 83% | 727.0 | 13.6 | 12.0 |
| Industrial | 1.27 | 193 | 6 | 151 | 3% | 22 | 1% | 1% | 0% | | | |
| Municipal | 35.50 | 12137 | 285 | 342 | 2% | 167 | 25% | 57% | 16% | | | |
| Total External | 135.41 | 21067 | 701 | 156 | 3% | 240 | 96% | 99% | 100% | 727.0 | 18.6 | 29.0 |
| Precipitation | 4.92 | 148 | 13 | 30 | 9% | 0 | 4% | 1% | 0% | 11.7 | 42.1 | 12.6 |
| Total Inflow | 140.33 | 21215 | 701 | 151 | 3% | 240 | 100% | 100% | 100% | 738.7 | 19.0 | 28.7 |
| Evaporation | 6.18 | | | | | | 4% | | | 11.7 | 52.8 | |
| Outflow | 134.15 | 6365 | 194 | 47 | 3% | | 96% | 30% | 8% | 738.7 | 18.2 | 8.6 |
| Retention | 0.00 | 14850 | 727 | | 5% | | 0% | 70% | | | | |
| Alternative Estimates of Lake Output | | | | | | | | | | | | |
| Outlet 12 Feet | 134.15 | 6365 | 194 | 47 | 3% | 11 | 96% | 30% | 8% | 738.7 | 18.2 | 8.6 |
| Outlet 2 Feet | 134.15 | 7341 | 373 | 55 | 5% | 11 | 96% | 35% | 28% | 738.7 | 18.2 | 9.9 |
| Lake Epil | 134.15 | 6559 | 247 | 49 | 4% | 11 | 96% | 31% | 12% | 738.7 | 18.2 | 8.9 |
| Upstream/Downstream Contrast- Harbor Brook | | | | | | | | | | | | |
| Upstream - Velasko | 2.70 | 74 | 11 | 28 | 15% | 11 | 2% | 0% | 0% | 25.9 | 10.4 | 2.9 |
| Downstream - Hiawatha | 2.95 | 214 | 31 | 72 | 14% | 12 | 2% | 1% | 0% | 29.3 | 10.1 | 7.3 |
| Local Inflow | 0.25 | 139 | 33 | 559 | 24% | | 0% | 1% | 0% | 3.4 | 7.4 | 41.4 |
| Upstream/Downstream Contrast - Onondaga Creek | | | | | | | | | | | | |
| Upstream - Dorwin | 28.66 | 2118 | 233 | 74 | 11% | 13 | 20% | 10% | 11% | 229.4 | 12.5 | 9.2 |
| Downstream - Kirkpatrick | 41.08 | 3713 | 593 | 90 | 16% | 13 | 29% | 18% | 71% | 285.1 | 14.4 | 13.0 |
| Local Inflow | 12.43 | 1595 | 637 | 128 | 40% | | 9% | 8% | 83% | 55.7 | 22.3 | 28.6 |

| | | | | |
|---|---|---|---|---|
| Lake Overflow Rate | 27.37 m/yr | Calib. Settling Rate | 63.9 m/yr | RSE % = Relative Std. Error of Load & Inflow Conc. Estimates |
| Lake Residence Time | 0.40 years | Calib. Retention Coef. | 70% | Error % = Percent of Variance in Total Inflow Load Estimate |

# Table 8: Soluble Reactive P Balance for May-September, 1998-2002

**Variable:** **Soluble Reactive Phosphorus** **Average for Years:** **1998 thru 2002** **Season:** **MaySept**

| Term | Flow 10^6 m3 | Load kg | Std Error kg | Conc ppb | RSE % | Sampl per yr | Percent of Total Inflow Flow % | Load % | Error % | Drain. Area km2 | Runoff cm | Export kg / km2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metro Effluent | 34.81 | 3442 | 310 | 99 | 9% | 11 | 25% | 72% | 69% | | | |
| Metro Bypass | 0.69 | 54 | 188 | 79 | 344% | 1 | 0% | 1% | 25% | | | |
| East Flume | 0.16 | 11 | 1 | 71 | 13% | 11 | 0% | 0% | 0% | | | |
| Crucible | 1.11 | 61 | 3 | 55 | 5% | 11 | 1% | 1% | 0% | | | |
| Harbor Brook | 2.95 | 64 | 6 | 22 | 9% | 12 | 2% | 1% | 0% | 29.3 | 10.1 | 2.2 |
| Ley Creek | 11.26 | 232 | 16 | 21 | 7% | 13 | 8% | 5% | 0% | 77.5 | 14.5 | 3.0 |
| Ninemile Creek | 38.32 | 344 | 44 | 9 | 13% | 12 | 27% | 7% | 1% | 298.1 | 12.9 | 1.2 |
| Onondaga Creek | 41.08 | 453 | 78 | 11 | 17% | 13 | 29% | 9% | 4% | 285.1 | 14.4 | 1.6 |
| | | | | | | | | | | | | |
| Nonpoint Gauged | 93.61 | 1094 | 91 | 12 | 8% | 51 | 67% | 23% | 6% | 690.0 | 13.6 | 1.6 |
| Nonpoint Ungauged | 5.02 | 59 | 10 | 12 | 17% | 0 | 4% | 1% | 0% | 37.0 | 13.6 | 1.6 |
| NonPoint Total | 98.64 | 1152 | 92 | 12 | 8% | 51 | 70% | 24% | 6% | 727.0 | 13.6 | 1.6 |
| Industrial | 1.27 | 73 | 4 | 57 | 5% | 22 | 1% | 2% | 0% | | | |
| Municipal | 35.50 | 3497 | 362 | 98 | 10% | 13 | 25% | 73% | 94% | | | |
| Total External | 135.41 | 4721 | 373 | 35 | 8% | 85 | 96% | 98% | 100% | 727.0 | 18.6 | 6.5 |
| Precipitation | 4.92 | 74 | 7 | 15 | 9% | 0 | 4% | 2% | 0% | 11.7 | 42.1 | 6.3 |
| Total Inflow | 140.33 | 4795 | 373 | 34 | 8% | 85 | 100% | 100% | 100% | 738.7 | 19.0 | 6.5 |
| | | | | | | | | | | | | |
| Evaporation | 6.18 | | | | | | 4% | | | 11.7 | 52.8 | |
| Outflow | 134.15 | 935 | 137 | 7 | 15% | | 96% | 19% | 14% | 738.7 | 18.2 | 1.3 |
| Retention | 0.00 | 3860 | 398 | | 10% | | 0% | 81% | | | | |
| | | | | | | | | | | | | |
| Alternative Estimates of Lake Output | | | | | | | | | | | | |
| Outlet 12 Feet | 134.15 | 935 | 137 | 7 | 15% | 11 | 96% | 19% | 14% | 738.7 | 18.2 | 1.3 |
| Outlet 2 Feet | 134.15 | 1429 | 143 | 11 | 10% | 11 | 96% | 30% | 15% | 738.7 | 18.2 | 1.9 |
| Lake Epil | 134.15 | 625 | 107 | 5 | 17% | 11 | 96% | 13% | 8% | 738.7 | 18.2 | 0.8 |
| | | | | | | | | | | | | |
| Upstream/Downstream Contrast- Harbor Brook | | | | | | | | | | | | |
| Upstream - Velasko | 2.70 | 16 | 3 | 6 | 19% | 11 | 2% | 0% | 0% | 25.9 | 10.4 | 0.6 |
| Downstream - Hiawatha | 2.95 | 64 | 6 | 22 | 9% | 12 | 2% | 1% | 0% | 29.3 | 10.1 | 2.2 |
| Local Inflow | 0.25 | 48 | 7 | 192 | 14% | | 0% | 1% | 0% | 3.4 | 7.4 | 14.2 |
| | | | | | | | | | | | | |
| Upstream/Downstream Contrast - Onondaga Creek | | | | | | | | | | | | |
| Upstream - Dorwin | 28.66 | 142 | 18 | 5 | 12% | 13 | 20% | 3% | 0% | 229.4 | 12.5 | 0.6 |
| Downstream - Kirkpatrick | 41.08 | 453 | 78 | 11 | 17% | 13 | 29% | 9% | 4% | 285.1 | 14.4 | 1.6 |
| Local Inflow | 12.43 | 311 | 80 | 25 | 26% | | 9% | 6% | 5% | 55.7 | 22.3 | 5.6 |

Lake Overflow Rate 27.37 m/yr Calib. Settling Rate 113.0 m/yr RSE % = Relative Std. Error of Load & Inflow Conc. Estimates

Lake Residence Time 0.40 years Calib. Retention Coef. 81% Error % = Percent of Variance in Total Inflow Load Estimate