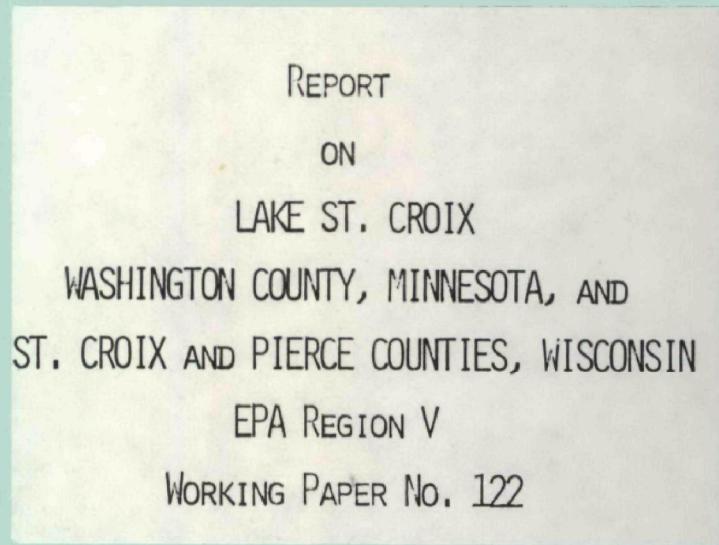


**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY
WORKING PAPER SERIES**



PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

An Associate Laboratory of the

NATIONAL ENVIRONMENTAL RESEARCH CENTER - CORVALLIS, OREGON

and

NATIONAL ENVIRONMENTAL RESEARCH CENTER - LAS VEGAS, NEVADA

REPORT
ON
LAKE ST. CROIX
WASHINGTON COUNTY, MINNESOTA, AND
ST. CROIX AND PIERCE COUNTIES, WISCONSIN
EPA REGION V
WORKING PAPER No. 122

WITH THE COOPERATION OF THE
MINNESOTA POLLUTION CONTROL AGENCY
AND THE
MINNESOTA NATIONAL GUARD
JANUARY, 1975

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FOR E W O R D

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

- a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.
- b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.
- c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Minnesota Pollution Control Agency for professional involvement and to the Minnesota National Guard for conducting the tributary sampling phase of the Survey.

Grant J. Merritt, Director of the Minnesota Pollution Control Agency, John F. McGuire, Chief, and Joel G. Schilling, Biologist, of the Section of Surface and Groundwater, Division of Water Quality, provided invaluable lake documentation and counsel during the course of the Survey; and the staff of the Section of Municipal Works, Division of Water Quality, were most helpful in identifying point sources and soliciting municipal participation in the Survey.

Major General Chester J. Moeglein, the Adjutant General of Minnesota, and Project Officer Major Adrian Beltrand, who directed the volunteer efforts of the Minnesota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

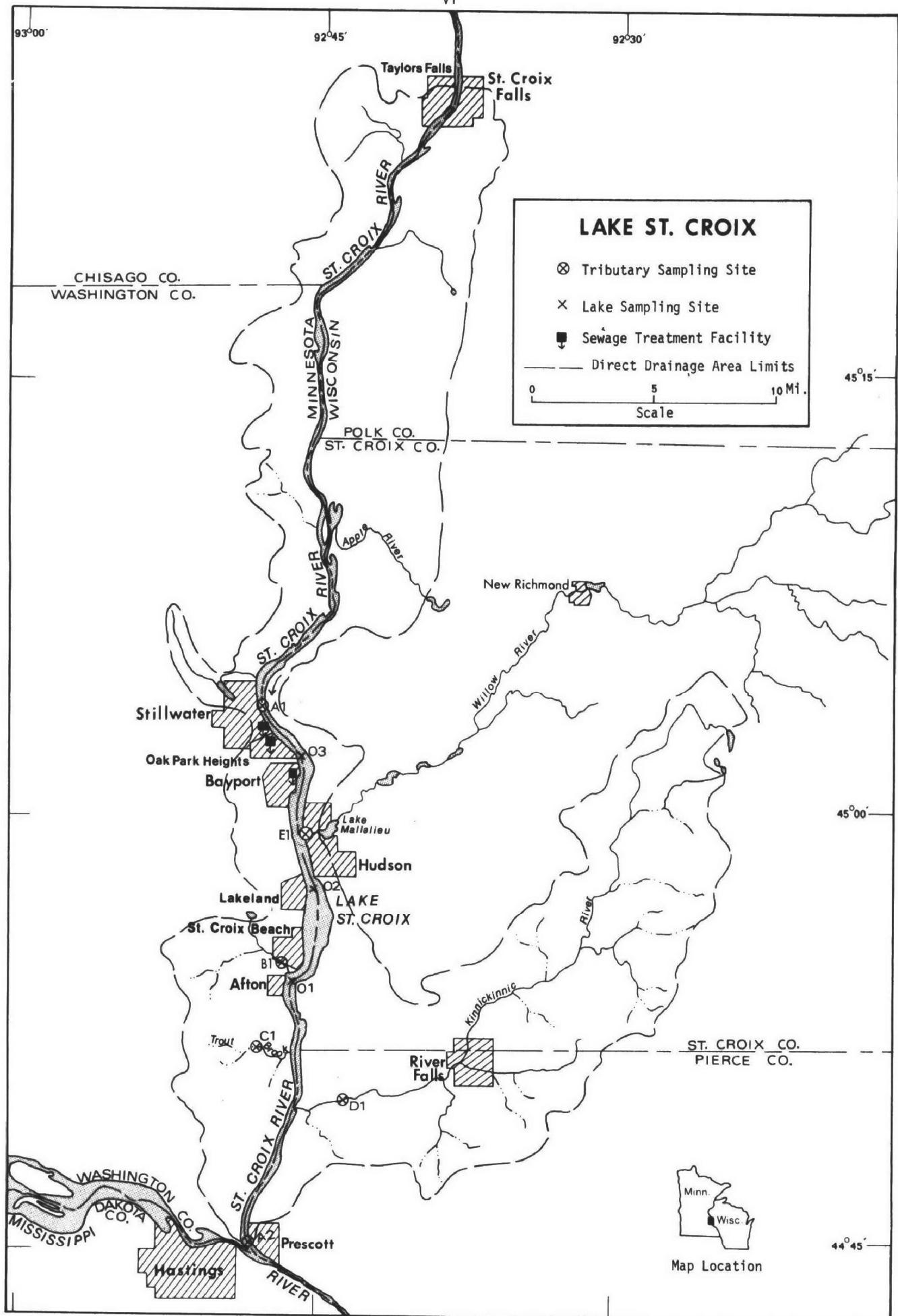
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MINNESOTA

| <u>LAKE NAME</u> | <u>COUNTY</u> |
|------------------|--------------------------------------|
| Albert Lea | Freeborn |
| Andrusia | Beltrami |
| Badger | Polk |
| Bartlett | Koochiching |
| Bear | Freeborn |
| Bemidji | Beltrami |
| Big | Stearns |
| Big Stone | Big Stone, MN; Roberts, Grant, SD |
| Birch | Cass |
| Blackduck | Beltrami |
| Blackhoof | Crow Wing |
| Budd | Martin |
| Buffalo | Wright |
| Calhoun | Hennepin |
| Carlos | Douglas |
| Carrigan | Wright |
| Cass | Beltrami, Cass |
| Clearwater | Wright, Stearns |
| Cokato | Wright |
| Cranberry | Crow Wing |
| Darling | Douglas |
| Elbow | St. Louis |
| Embarass | St. Louis |
| Fall | Lake |
| Forest | Washington |
| Green | Kandiyohi |
| Gull | Cass |
| Heron | Jackson |
| Leech | Cass |
| Le Homme Dieu | Douglas |
| Lily | Blue Earth |
| Little | Grant |
| Lost | St. Louis |

| <u>LAKE NAME</u> | <u>COUNTY</u> |
|------------------|--|
| Madison | Blue Earth |
| Malmedal | Pope |
| Mashkenode | St. Louis |
| McQuade | St. Louis |
| Minnetonka | Hennepin |
| Minnewaska | Pope |
| Mud | Itasca |
| Nest | Kandiyohi |
| Pelican | St. Louis |
| Pepin | Goodhue, Wabasha, MN; Pierce, Pepin, WI |
| Rabbit | Crow Wing |
| Sakatah | Le Sueur |
| Shagawa | St. Louis |
| Silver | McLeod |
| Six Mile | St. Louis |
| Spring | Washington, Dakota |
| St. Croix | Washington, MN; St. Croix, Pierce, WI |
| St. Louis Bay | St. Louis, MN; Douglas, WI |
| Superior Bay | St. Louis, MN; Douglas, WI |
| Swan | Itasca |
| Trace | Todd |
| Trout | Itasca |
| Wagonga | Kandiyohi |
| Wallmark | Chisago |
| White Bear | Washington |
| Winona | Douglas |
| Wolf | Beltrami, Hubbard |
| Woodcock | Kandiyohi |
| Zumbro | Olmstead, Wabasha |



LAKE ST. CROIX*

STORET NO. 27A7

I. CONCLUSIONS

A. Trophic Condition:

Survey data show that Lake St. Croix is eutrophic. Of the 60 Minnesota lakes sampled in the fall of 1972, when essentially all were well-mixed, 14 had less mean total phosphorus, 13 had less mean dissolved phosphorus, and 35 had less mean inorganic nitrogen. Of all 80 Minnesota lakes sampled, 45 had greater mean chlorophyll a, and 36 had greater Secchi disc transparency.

Reportedly, no particular aquatic nuisance problems are indicated for Lake St. Croix, although an algae bloom occurred in the summer of 1974 (Schilling, 1974).

B. Rate-Limiting Nutrient:

There was a loss of nitrogen in the assay sample and the results of the algal assay are not indicative of conditions in the lake at the time of sampling. However, the lake data indicate nitrogen limitation in June and August and phosphorus limitation in November.

C. Nutrient Controllability:

1. Point sources--During the sampling year, Lake St. Croix received a total phosphorus load at a rate of 79 lbs/acre/yr

* In this report, Lake St. Croix is considered to extend from the St. Croix River bridge at Stillwater, Minnesota, to the U.S. 10 highway bridge just upstream from the confluence of the St. Croix River with the Mississippi River.

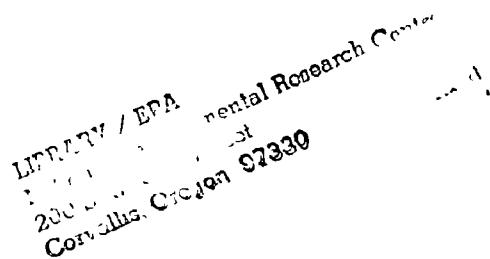
($8.9 \text{ g/m}^2/\text{yr}$) or more than four times that proposed by Vollenweider (in press) as "dangerous"; i.e., a eutrophic rate (see page 14). Now, Vollenweider's model may not be applicable to water bodies with very short hydraulic retention times, and Lake St. Croix has a relatively short mean retention time of 23 days. However, the lake retained (accumulated) about 33% of the applied phosphorus load during the sampling year, and it is likely that the Vollenweider loading rates have some significance in this case.

The Minnesota Pollution Control Agency regulations require phosphorus control at point sources that directly or indirectly contribute to lakes or reservoirs. It is calculated that even complete removal of phosphorus at the point sources considered in this study would still leave a loading rate of nearly $7.9 \text{ g/m}^2/\text{yr}$ (about $3\frac{1}{2}$ times the eutrophic rate).

While a high level of point-source phosphorus control would be expected to result in at least some improvement in the trophic condition of Lake St. Croix, it appears that attention will have to be given to non-point sources as well if an optimal level of phosphorus reduction is to be achieved (see below).

2. Non-point sources--It is estimated that about 88% of the total phosphorus load during the sampling year was contributed

by non-point sources. The mean non-point phosphorus exports of the various subdrainages do not appear to be excessive (see page 14), but the rather high drainage area to lake area ratio of 600 to 1 ensures a significant loading rate from non-point sources alone. Note that even the low phosphorus export of unimpacted Trout Brook (22 lbs P/mi²/yr), if applied to the entire drainage, would result in a lake loading rate of about 21 lbs/acre/yr or 2.3 g/m²/yr.



II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry[†]:

1. Surface area: 8,209 acres.
2. Mean depth: 28.8 feet.
3. Maximum depth: 78 feet.
4. Volume: 236,419 acre/feet.
5. Mean hydraulic retention time: 23 days.

B. Tributary and Outlet:

(See Appendix A for flow data)

1. Tributaries -

| <u>Name</u> | <u>Drainage area*</u> | <u>Mean flow*</u> |
|--|-------------------------|-------------------|
| St. Croix River | 6,550.0 mi ² | 4,472.7 cfs |
| Valley Branch Stream (B-1) | 13.0 mi ² | 9.7 cfs |
| Trout Brook | 11.0 mi ² | 2.6 cfs |
| Kinnickinnic River | 167.0 mi ² | 95.3 cfs |
| Willow River | 263.0 mi ² | 41.0 cfs |
| Minor tributaries & immediate drainage - | 683.2 mi ² | 471.7 cfs |
| Totals | 7,687.2 mi ² | 5,093.0 cfs |

2. Outlet -

| | | |
|-----------------|----------------------------|-------------|
| St. Croix River | 7,700.0 mi ² ** | 5,093.0 cfs |
|-----------------|----------------------------|-------------|

C. Precipitation***:

1. Year of sampling: 31.4 inches.
2. Mean annual: 30.9 inches.

[†] DNR lake survey map (1970); mean depth by random-dot method.

* Drainage areas are accurate within $\pm 5\%$; mean daily flows are accurate within $\pm 10\%$; and ungaged flows are accurate within ± 10 to 25% for drainage areas greater than 10 mi^2 .

** Includes area of lake.

*** See Working Paper No. 1, "Survey Methods".

III. LAKE WATER QUALITY SUMMARY

Lake St. Croix was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from two or more depths at each station (see map, page vi). During each visit, a single depth-integrated (15 feet or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 15 feet at station 1, 71 feet at station 2, and 28 feet at station 3.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake essentially was well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

| <u>Parameter</u> | <u>Minimum</u> | <u>Mean</u> | <u>Median</u> | <u>Maximum</u> |
|------------------------------------|----------------|-------------|---------------|----------------|
| Temperature (Cent.) | 5.0 | 6.2 | 6.4 | 7.0 |
| Dissolved oxygen (mg/l) | 10.0 | 10.5 | 10.5 | 10.8 |
| Conductivity (μmhos) | 203 | 209 | 210 | 215 |
| pH (units) | 7.5 | 7.5 | 7.5 | 7.6 |
| Alkalinity (mg/l) | 74 | 76 | 76 | 78 |
| Total P (mg/l) | 0.027 | 0.031 | 0.030 | 0.038 |
| Dissolved P (mg/l) | 0.014 | 0.017 | 0.017 | 0.022 |
| $\text{NO}_2 + \text{NO}_3$ (mg/l) | 0.190 | 0.212 | 0.200 | 0.250 |
| Ammonia (mg/l) | 0.050 | 0.080 | 0.080 | 0.110 |
| <u>ALL VALUES</u> | | | | |
| Secchi disc (inches) | 36 | 44 | 36 | 60 |

B. Biological characteristics:

1. Phytoplankton -

| <u>Sampling Date</u> | <u>Dominant Genera</u> | <u>Number per ml</u> |
|----------------------|---|---|
| 06/28/72 | 1. Melosira 2. Achnanthes 3. Dinobryon 4. Stephanodiscus 5. Flagellates Other genera | 1,039 783 693 437 376 <u>1,582</u> |
| | Total | 4,910 |
| 08/26/72 | 1. Dinobryon 2. Cyclotella 3. Chroococcus 4. Melosira 5. Pediastrum Other genera | 2,532 1,338 524 289 271 <u>1,086</u> |
| | Total | 6,040 |
| 11/04/72 | 1. Cyclotella 2. Dinobryon 3. Flagellates 4. Melosira 5. Asterionella Other genera | 2,264 1,396 1,057 1,057 830 <u>2,830</u> |
| | Total | 9,434 |

2. Chlorophyll a -

(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

| <u>Sampling Date</u> | <u>Station Number</u> | <u>Chlorophyll a ($\mu\text{g/l}$)</u> |
|----------------------|-----------------------|---|
| 06/28/72 | 01 | 16.1 |
| | 02 | 32.3 |
| | 03 | 20.0 |
| 08/26/72 | 01 | 2.7 |
| | 02 | 3.7 |
| | 03 | 2.3 |
| 11/04/72 | 01 | 5.5 |
| | 02 | 5.7 |
| | 03 | 3.9 |

C. Limiting Nutrient Study:

Because of a loss of about 20% of the inorganic nitrogen in the assay sample between the time of collection and the beginning of the assay, the results are not indicative of lake conditions at the time of sampling. The lake data indicate that phosphorus was limiting in November (N/P ratio = 17/1), and nitrogen was limiting in June (N/P = 7/1) and August (N/P = 9/1).

IV. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Minnesota National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), except for May when extra samples were collected. Sampling was begun in October, 1972, and was completed in September, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Minnesota District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated by using the means of the nutrient loads, in $\text{lbs}/\text{mi}^2/\text{year}$, at stations B-1 and C-1 and multiplying the means by the ZZ area in mi^2 .

The operators of the Stillwater, Bayport, and Oak Park Heights, Minnesota, wastewater treatment plants provided monthly effluent samples and corresponding flow data. However, the communities of Taylors Falls, Minnesota, and St. Croix Falls, Hudson, New Richmond, and River Falls, Wisconsin, did not participate in the Survey, and nutrient loads from these sources were estimated at 2.5 lbs P and 7.5 lbs N/capita/year.

* See Working Paper No. 1.

In the following loading tables, the nutrient loads attributed to the St. Croix River are those measured at station A-1 minus the Taylors Falls and St. Croix Falls estimated loads; and the loads given for the Kinnickinnic River are those measured at station D-1 minus the estimated River Falls loads.

However, the estimated phosphorus load from the New Richmond treatment plant (9,250 lbs P/yr) was over twice that measured at the outlet station (E-1) of the Willow River (4,480 lbs P/yr), indicating a rather high degree of phosphorus sedimentation and/or biological assimilation in the river and in Lake Mallalieu. Therefore, in this report, it is assumed that one-half of the load measured at E-1 is attributable to New Richmond and the rest is due to non-point sources. Note, however, nitrogen loads were not likewise adjusted; the nitrogen load attributed to the Willow River is that measured at E-1 minus the estimated New Richmond load.

The septic tank loads were estimated on the basis of the combined populations of Lakeland, St. Croix Beach, and Afton (1970 Census) at 0.25 lbs P and 9.4 lbs N/capita/year.

A. Waste Sources:

1. Known Minnesota municipal[†] -

| <u>Name</u> | <u>Pop. Served</u> | <u>Treatment</u> | <u>Mean Flow (mgd)</u> | <u>Receiving Water</u> |
|---------------|------------------------|------------------|----------------------------|----------------------------|
| Taylors Falls | 587 | trickling filter | 0.059* | St. Croix River |
| Stillwater | 11,205 | act. sludge | 1.825 | Lake St. Croix |
| Oak Park Hts. | 1,238 | act. sludge | 0.470 | Lake St. Croix |
| Bayport | 3,110 | act. sludge | 0.420 | Lake St. Croix |

2. Known Wisconsin municipal** -

| <u>Name</u> | <u>Pop. Served</u> | <u>Treatment</u> | <u>Mean Flow (mgd)</u> | <u>Receiving Water</u> |
|-----------------|------------------------|------------------|----------------------------|----------------------------|
| St. Croix Falls | 1,425 | trickling filter | 0.271 | St. Croix River |
| New Richmond | 3,700 | trickling filter | 0.356 | Willow River |
| Hudson | 6,590 | trickling filter | 0.400 | Lake St. Croix |
| River Falls | 7,230 | trickling filter | 0.695 | Kinnickinnic River |

3. Industrial - Unknown

[†] Anonymous, 1974.

* Estimated at 100 gal/capita/day.

** Wisconsin STP data from McKersie, et al., 1972.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

| <u>Source</u> | <u>lbs P/ yr</u> | <u>% of total</u> |
|--|----------------------|-----------------------|
| a. Tributaries (non-point load) - | | |
| St. Croix River | 530,160 | 81.4 |
| Valley Branch Stream (B-1) | 600 | <0.1 |
| Trout Brook | 240 | <0.1 |
| Kinnickinnic River | 17,440 | 2.7 |
| Willow River | 2,240 | 0.3 |
| b. Minor tributaries & immediate drainage (non-point load) - | | 23,230 |
| | | 3.6 |
| c. Known municipal STP's - | | |
| Taylors Falls | 1,470 | 0.2 |
| Stillwater | 14,030 | 2.2 |
| Oak Park Heights | 13,020 | 2.0 |
| Bayport | 6,590 | 1.0 |
| St. Croix Falls | 3,560 | 0.5 |
| New Richmond | 2,240 | 0.3 |
| Hudson | 16,480 | 2.5 |
| River Falls | 18,080 | 2.8 |
| d. Septic tanks* - | 580 | <0.1 |
| e. Industrial - Unknown | - | - |
| f. Direct precipitation** - | <u>1,280</u> | <u>0.2</u> |
| Total | 651,240 | 100.0 |

2. Outputs -

Lake outlet - St. Croix River 439,130

3. Net annual P accumulation - 212,110 pounds

* Estimated 2,320 contributing population (see page 9).

** See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

| <u>Source</u> | <u>lbs N/ yr</u> | <u>% of total</u> |
|--|----------------------|-----------------------|
| a. Tributaries (non-point load) - | | |
| St. Croix River | 10,101,250 | 80.5 |
| Valley Branch Stream (B-1) | 45,550 | 0.4 |
| Trout Brook | 8,820 | <0.1 |
| Kinnickinnic River | 449,860 | 3.6 |
| Willow River | 110,880 | 0.9 |
| b. Minor tributaries & immediate drainage (non-point load) - | 1,470,930 | 11.7 |
| c. Known municipal STP's - | | |
| Taylors Falls | 4,400 | <0.1 |
| Stillwater | 71,530 | 0.6 |
| Oak Park Heights | 25,870 | 0.2 |
| Bayport | 21,100 | 0.2 |
| St. Croix Falls | 10,690 | <0.1 |
| New Richmond | 27,750 | 0.2 |
| Hudson | 49,420 | 0.4 |
| River Falls | 54,220 | 0.4 |
| d. Septic tanks* - | 21,810 | 0.2 |
| e. Industrial - Unknown | - | - |
| f. Direct precipitation** - | <u>79,090</u> | <u>0.6</u> |
| Total | 12,553,170 | 100.0 |

2. Outputs -

Lake outlet - St. Croix River 12,399,580

3. Net annual N accumulation - 153,590 pounds

* Estimated 2,320 contributing population (see page 9).

** See Working Paper No. 1.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

| <u>Tributary</u> | <u>lbs P/mi²/yr</u> | <u>lbs N/mi²/yr</u> |
|----------------------------|--------------------------------|--------------------------------|
| St. Croix River | 81 | 1,542 |
| Valley Branch Stream (B-1) | 46 | 3,504 |
| Trout Brook | 22 | 802 |
| Kinnickinnic River | 104 | 2,694 |

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphology permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with very short hydraulic retention times.

| <u>Units</u> | <u>Total Phosphorus</u> | | <u>Total Nitrogen</u> | |
|--------------------------|-------------------------|--------------------|-----------------------|--------------------|
| | <u>Total</u> | <u>Accumulated</u> | <u>Total</u> | <u>Accumulated</u> |
| lbs/acre/yr | 79.3 | 25.8 | 1,529.2 | 18.7 |
| grams/m ² /yr | 8.89 | 2.90 | 171.4 | 2.1 |

Vollenweider loading rates for phosphorus (g/m²/yr) based on mean depth and mean hydraulic retention time of Lake St. Croix:

| | |
|-----------------------------------|------|
| "Dangerous" (eutrophic rate) | 2.20 |
| "Permissible" (oligotrophic rate) | 1.10 |

V. LITERATURE REVIEWED

- Anonymous, 1965. Report on application for waste disposal permit, Allen S. King Plant, Northern States Power Company, Oak Park Heights, Minnesota. MN Dept. of Health, Minneapolis.
- Anonymous, 1974. Wastewater disposal facilities inventory. MPCA, Minneapolis.
- McKersie, Jerome R., Robert M. Krill, Charles Kozel, Thomas E. DeWitt, and Danny J. Ryan; 1972. St. Croix River pollution investigation survey. WI Dept. of Nat. Resources, Madison.
- Schilling, Joel, 1974. Personal communication (summary of information on Minnesota lakes). MPCA, Minneapolis.
- Vollenweider, Richard A., (in press). Input-output models. Schweiz Z. Hydrol.

VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MINNESOTA

10/30/74

LAKE CODE 27A7 ST. CROIX LAKE

TOTAL DRAINAGE AREA OF LAKE 7700.00

| TRIBUTARY | SUH-DRAINAGE AREA | NORMALIZED FLOWS | | | | | | | | | | | | MEAN |
|-----------|----------------------|------------------|--------|--------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | |
| 27A7A1 | 6450.00 | 2144.0 | 2154.0 | 4247.0 | 10300.0 | 812.0 | 5431.0 | 4210.0 | 2971.0 | 3598.0 | 3536.0 | 3272.0 | 2539.0 | 4472.6 |
| 27A7A2 | 7700.00 | 3124.1 | 3043.1 | 4444.1 | 12565.6 | 10107.0 | 7766.4 | 3916.2 | 3280.6 | 3584.8 | 3003.7 | 3501.3 | 3244.7 | 5093.0 |
| 27A7B1 | 13.00 | 4.00 | 8.20 | 11.00 | 12.00 | 10.00 | 11.50 | 10.00 | 9.50 | 9.00 | 9.50 | 9.00 | 8.50 | 9.69 |
| 27A7C1 | 11.00 | 0.24 | 0.24 | 1.50 | 11.00 | 6.50 | 5.50 | 1.75 | 1.00 | 2.00 | 1.50 | 0.27 | 0.26 | 2.64 |
| 27A7D1 | 167.00 | 69.10 | 67.50 | 256.00 | 93.40 | 93.40 | 119.00 | 69.20 | 70.60 | 70.00 | 74.60 | 85.90 | 80.70 | 95.29 |
| 27A7E1 | 263.00 | 24.70 | 20.70 | 110.00 | 40.40 | 36.00 | 51.20 | 29.80 | 30.40 | 30.10 | 32.00 | 36.90 | 34.70 | 40.96 |
| 27A7F1 | 696.00 | 280.00 | 286.10 | 412.00 | 1154.00 | 936.00 | 682.00 | 363.00 | 304.00 | 332.00 | 278.00 | 324.00 | 301.00 | 471.68 |

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 7700.00
SUM OF SUH-DRAINAGE AREAS = 7700.00TOTAL FLOW IN = 61072.54
TOTAL FLOW OUT = 61136.59

MEAN MONTHLY FLOWS AND DAILY FLOWS

| TRIBUTARY | MONTH | YEAR | MEAN FLOW | FLOW DAY | | FLOW | DAY | FLOW | DAY |
|-----------|-------|------|-----------|----------|----------|------|---------|------|---------|
| | | | | DAY | FLOW | | | | |
| 27A7A1 | 10 | 72 | 5145.0 | 14 | 5800.00 | | | | |
| | 11 | 72 | 6767.00 | 5 | 4600.00 | | | | |
| | 12 | 72 | 3016.00 | ? | 3200.00 | | | | |
| | 1 | 73 | 3220.00 | | | | | | |
| | 2 | 73 | 2970.00 | 4 | 3100.00 | | | | |
| | 3 | 73 | 12110.00 | 4 | 2900.00 | | | | |
| | 4 | 73 | 7763.00 | 5 | 7400.00 | | | | |
| | 5 | 73 | 8347.00 | 2 | 5900.00 | 20 | 5300.00 | | |
| | 6 | 73 | 5947.00 | 0 | 7100.00 | | | | |
| | 7 | 73 | 2710.00 | 18 | 2400.00 | | | | |
| | 8 | 73 | 4150.00 | 12 | 5200.00 | | | | |
| | 9 | 73 | 3900.00 | 29 | 4200.00 | | | | |
| 27A7A2 | 10 | 72 | 6648.00 | 14 | 7540.00 | | | | |
| | 11 | 72 | 8747.00 | 5 | 12500.00 | | | | |
| | 12 | 72 | 3921.00 | ? | 4160.00 | | | | |
| | 1 | 73 | 4120.00 | | | | | | |
| | 2 | 73 | 3450.00 | 3 | 4010.00 | | | | |
| | 3 | 73 | 15700.00 | 4 | 65500.00 | | | | |
| | 4 | 73 | 9200.00 | 8 | 3740.00 | | | | |
| | 5 | 73 | 9400.00 | 2 | 6860.00 | 19 | 6170.00 | 20 | 6170.00 |
| | 6 | 73 | 7000.00 | 9 | 2330.00 | | | | |
| | 7 | 73 | 3100.00 | 18 | 2900.00 | | | | |
| | 8 | 73 | 4700.00 | 12 | 5900.00 | | | | |
| | 9 | 73 | 4400.00 | 29 | 4700.00 | | | | |

TRIBUTARY FLOW INFORMATION FOR MINNESOTA

10/30/74

LAKE CODE 27A7 ST. CROIX LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS

| TRIBUTARY | MONTH | YEAR | MEAN FLOW | DAY | FLOW | DAY | FLOW | DAY | FLOW |
|-----------|-------|------|-----------|-----|---------|-----|-------|-----|------|
| 27A7B1 | 10 | 72 | 9.25 | 14 | 8.90 | | | | |
| | 11 | 72 | 9.80 | 5 | 12.00 | | | | |
| | 12 | 72 | 9.00 | 2 | 9.00 | | | | |
| | 1 | 73 | 9.40 | | | | | | |
| | 2 | 73 | 9.30 | 3 | 9.20 | | | | |
| | 3 | 73 | 10.60 | 4 | 9.50 | | | | |
| | 4 | 73 | 10.10 | 8 | 10.00 | | | | |
| | 5 | 73 | 10.70 | 2 | 13.00 | 20 | 9.30 | | |
| | 6 | 73 | 9.10 | 9 | 8.60 | | | | |
| | 7 | 73 | 9.00 | 18 | 9.10 | | | | |
| | 8 | 73 | 12.00 | 12 | 0.0 | | | | |
| | 9 | 73 | 14.00 | 29 | 20.00 | | | | |
| 27A7C1 | 10 | 72 | 0.78 | 14 | 0.60 | | | | |
| | 11 | 72 | 0.31 | 5 | 0.70 | | | | |
| | 12 | 72 | 0.28 | 2 | 0.30 | | | | |
| | 1 | 73 | 0.63 | | | | | | |
| | 2 | 73 | 0.30 | 3 | 0.30 | | | | |
| | 3 | 73 | 1.52 | 4 | 0.80 | | | | |
| | 4 | 73 | 26.50 | 8 | 21.00 | | | | |
| | 5 | 73 | 6.63 | 2 | 16.00 | 20 | 2.60 | | |
| | 6 | 73 | 1.87 | 9 | 1.40 | | | | |
| | 7 | 73 | 1.60 | 28 | 1.60 | | | | |
| | 8 | 73 | 1.30 | 12 | 1.10 | | | | |
| | 9 | 73 | 3.00 | 29 | 4.50 | | | | |
| 27A7D1 | 10 | 72 | 108.00 | 14 | 123.00 | | | | |
| | 11 | 72 | 178.00 | 5 | 252.00 | | | | |
| | 12 | 72 | 96.00 | 2 | 102.00 | | | | |
| | 1 | 73 | 102.00 | | | | | | |
| | 2 | 73 | 93.20 | 3 | 97.00 | | | | |
| | 3 | 73 | 727.00 | 4 | 3030.00 | | | | |
| | 4 | 73 | 70.40 | | | | | | |
| | 5 | 73 | 86.40 | 2 | 49.00 | 20 | 54.00 | | |
| | 6 | 73 | 109.00 | 9 | 130.00 | | | | |
| | 7 | 73 | 44.30 | 18 | 39.40 | | | | |
| | 8 | 73 | 97.40 | 12 | 124.00 | | | | |
| | 9 | 73 | 75.60 | 29 | 80.90 | | | | |
| 27A7E1 | 10 | 72 | 46.40 | 14 | 53.00 | | | | |
| | 11 | 72 | 76.50 | 5 | 108.00 | | | | |
| | 12 | 72 | 41.30 | 2 | 44.00 | | | | |
| | 1 | 73 | 43.90 | | | | | | |
| | 2 | 73 | 40.10 | 3 | 42.00 | | | | |
| | 3 | 73 | 313.00 | 4 | 1303.00 | | | | |
| | 4 | 73 | 30.30 | 8 | 29.00 | | | | |
| | 5 | 73 | 37.20 | 2 | 26.00 | 20 | 23.00 | | |
| | 6 | 73 | 46.90 | 9 | 56.00 | | | | |
| | 7 | 73 | 19.00 | 18 | 16.90 | | | | |
| | 8 | 73 | 41.90 | 12 | 53.30 | | | | |
| | 9 | 73 | 32.50 | 29 | 34.80 | | | | |

TRIBUTARY FLOW INFORMATION FOR MINNESOTA

10/30/74

LAKE CODE 27A7 ST. CROIX LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS

| TRIBUTARY | MONTH | YEAR | MEAN FLOW | DAY | FLOW | DAY | FLOW | DAY | FLOW |
|-----------|-------|------|-----------|-----|--------|-----|--------|-----|--------|
| 27A7Z7 | 10 | 72 | 463.00 | 14 | 522.00 | | | | |
| | 11 | 72 | 609.00 | 5 | 864.00 | | | | |
| | 12 | 72 | 271.00 | 2 | 288.00 | | | | |
| | 1 | 73 | 240.00 | | | | | | |
| | 2 | 73 | 267.00 | 3 | 279.00 | | | | |
| | 3 | 73 | 1090.00 | 4 | 261.00 | | | | |
| | 4 | 73 | 700.00 | 8 | 666.00 | | | | |
| | 5 | 73 | 750.00 | 2 | 531.00 | 19 | 477.00 | 20 | 477.00 |
| | 6 | 73 | 530.00 | 9 | 634.00 | | | | |
| | 7 | 73 | 243.00 | 18 | 216.00 | 28 | 468.00 | | |
| | 8 | 73 | 369.00 | 12 | 378.00 | | | | |
| | 9 | 73 | 351.00 | | | | | | |

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/10/30

27A701
44 54 00.0 092 46 25.0
ST CROIX LAKE
27 MINNESOTA

| DATE FROM TO | TIME OF DAY | DEPTH FEET | WATFR TEMP CENT | 00010 00 MG/L | 00300 00 MG/L | 00077 SECCHI INCHES | 00094 CNDUCTVY FIELD MICROMHO | 00400 PH SU | 00410 TALK CACO3 MG/L | 00630 NO2&NO3 N-TOTAL MG/L | 00610 NH3-N TOTAL MG/L | 00665 PHOS-TOT MG/L P | 00666 PHOS-DIS MG/L P |
|--------------------|-------------------|---------------|-----------------------|---------------------|---------------------|---------------------------|--|-------------------|--------------------------------|-------------------------------------|---------------------------------|-----------------------------|-----------------------------|
| | | | | | | | | | | | | | |
| 72/06/28 | 17 30 | 0000 | ??. | 10.2 | 60 | 165 | 7.63 | 82 | 0.060 | 0.050 | 0.032 | 0.020 | |
| | 17 30 | 0015 | ??. | 7.7 | | 150 | 7.37 | 81 | 0.130 | 0.110 | 0.036 | 0.025 | |
| 72/08/26 | 14 30 | 0000 | | | 36 | 143 | 7.00 | 61 | 0.230 | 0.200 | 0.066 | 0.063 | |
| | 14 30 | 0004 | 21.0 | 5.3 | | 140 | 7.10 | | | | | | |
| | 14 30 | 0015 | 21.0 | 5.4 | | 140 | 7.10 | 60 | 0.250 | 0.210 | 0.061 | 0.049 | |
| 72/11/04 | 14 30 | 0000 | | | 48 | 215 | 7.50 | 76 | 0.240 | 0.110 | 0.034 | 0.020 | |
| | 14 30 | 0004 | 6.5 | 10.4 | | 205 | 7.50 | 78 | 0.250 | 0.110 | 0.038 | 0.021 | |
| | 14 30 | 0008 | 6.5 | 10.4 | | 210 | 7.50 | 78 | 0.240 | 0.100 | 0.038 | 0.022 | |

32217
DATE TIME DEPTH CHLRPHYL
FROM OF A
TO DAY FEET ug/l

| | | | |
|----------|-------|------|-------|
| 72/06/28 | 17 30 | 0000 | 16.1J |
| 72/08/26 | 14 30 | 0000 | 2.7J |
| 72/11/04 | 14 30 | 0000 | 5.5J |

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/10/30

27A702
44 57 20.0 092 45 30.0
ST CROIX LAKE
27 MINNESOTA

11EPALES
3 2111202
0075 FEET DEPTH

| DATE | TIME | DEPTH | WATER OF TO | 00010 00 | 00300 MG/L | 00077 TRANSP SECCHI | 00094 CNDUCTVY FIELD | 00400 PH SU | 00410 ALK CACO ₃ | 00630 NO ₂ &NO ₃ N-TOTAL | 00610 NH ₃ -N TOTAL | 00665 PHOS-TOT | 00666 PHOS-DIS |
|----------|-------|-------|-------------------|-------------|---------------|---------------------------|----------------------------|-------------------|-----------------------------------|--|--------------------------------------|-------------------|-------------------|
| FROM | DAY | FEET | CFTN | MG/L | INCHES | MICROMHO | | MG/L | MG/L | MG/L | MG/L | MG/L P | MG/L P |
| 72/06/28 | 17 50 | 0000 | 22.9 | 9.2 | 36 | 145 | 7.28 | 71 | 0.040 | 0.050 | 0.046 | 0.026 | |
| | 17 50 | 0015 | 20.4 | 7.7 | | 145 | | | | | | | |
| | 17 50 | 0125 | 19.8 | 6.1 | | 150 | 7.20 | 79 | 0.190 | 0.130 | 0.046 | 0.034 | |
| 72/08/26 | 14 50 | 0000 | | | 36 | 130 | 7.15 | 56 | 0.230 | 0.200 | 0.074 | 0.047 | |
| | 14 50 | 0004 | 20.0 | 5.3 | | 128 | 7.20 | 56 | 0.230 | 0.180 | 0.075 | 0.043 | |
| | 14 50 | 0015 | 19.9 | 5.3 | | 125 | 7.20 | 55 | 0.230 | 0.190 | 0.072 | 0.044 | |
| | 14 50 | 0021 | 19.9 | 4.6 | | 121 | 7.20 | 52 | 0.230 | 0.180 | 0.070 | 0.038 | |
| | 14 50 | 0031 | 19.8 | 5.4 | | 121 | 7.20 | 53 | 0.240 | 0.180 | 0.069 | 0.042 | |
| | 14 50 | 0041 | 19.9 | 5.4 | | 123 | 7.20 | 53 | 0.240 | 0.190 | 0.071 | 0.043 | |
| | 14 50 | 0051 | 19.8 | 5.4 | | 120 | 7.20 | 53 | 0.240 | 0.170 | 0.071 | 0.040 | |
| | 14 50 | 0061 | 19.8 | 5.6 | | 120 | 7.20 | 52 | 0.240 | 0.170 | 0.069 | 0.042 | |
| | 14 50 | 0071 | 19.1 | 5.6 | | 120 | 7.20 | 51 | 0.240 | 0.170 | 0.068 | 0.042 | |
| 72/11/04 | 14 45 | 0000 | | | 58 | 210 | 7.60 | 78 | 0.210 | 0.080 | 0.030 | 0.017 | |
| | 14 45 | 0004 | 6.5 | 10.6 | | 210 | 7.60 | 77 | 0.210 | 0.080 | 0.034 | 0.017 | |
| | 14 45 | 0015 | 6.4 | 10.4 | | 208 | 7.50 | 76 | 0.200 | 0.070 | 0.030 | 0.016 | |
| | 14 45 | 0025 | 6.4 | 10.2 | | 208 | 7.50 | 76 | 0.200 | 0.080 | 0.031 | 0.019 | |
| | 14 45 | 0045 | 6.4 | 10.0 | | 212 | 7.50 | 77 | 0.210 | 0.080 | 0.030 | 0.015 | |
| | 14 45 | 0068 | 6.4 | 10.8 | | 210 | 7.50 | 77 | 0.200 | 0.070 | 0.031 | 0.018 | |

32217

| DATE | TIME | DEPTH | CHLRPHYL |
|----------|-------|-------|----------|
| FROM | OF | A | |
| TO | DAY | FEET | UG/L |
| 72/06/28 | 17 50 | 0000 | 32.3J |
| 72/08/26 | 14 50 | 0000 | 3.7J |
| 72/11/04 | 14 45 | 0000 | 5.7J |

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/10/30

27A703
45 01 52.0 092 46 07.0
ST CROIX LAKE
27 MINNESOTA

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00010 WATER TEMP CENT | | 00300 DO | | 00077 TRANSP SECCHI | | 00094 CNDUCTVY FIELD | | 00400 PH | | 00410 T ALK CACO ₃ | | 00630 NO ₂ &NO ₃ N-TOTAL | | 00610 NH ₃ -N TOTAL | | 00665 PHOS-TOT MG/L P | | 00666 PHOS-DIS MG/L P | |
|--------------------|-------------------|---------------|--------------------------------|-------------|---------------------------|----------------------------|---------------------------|-------------------------------------|--|--------------------------------------|-----------------------------|-----------------------------|-------------------------------------|--|--|--|--------------------------------------|--|-----------------------------|--|-----------------------------|--|
| | | | 00010 WATER TEMP CENT | 00300 DO | 00077 TRANSP SECCHI | 00094 CNDUCTVY FIELD | 00400 PH | 00410 T ALK CACO ₃ | 00630 NO ₂ &NO ₃ N-TOTAL | 00610 NH ₃ -N TOTAL | 00665 PHOS-TOT MG/L P | 00666 PHOS-DIS MG/L P | | | | | | | | | | |
| 72/06/28 | 18 15 | 0000 | 26.0 | 8.0 | 36 | 140 | 7.23 | 72 | 0.060 | 0.120 | 0.060 | 0.036 | | | | | | | | | | |
| | 18 15 | 0015 | 21.4 | 7.4 | | 135 | 7.28 | 71 | 0.080 | 0.130 | 0.055 | 0.036 | | | | | | | | | | |
| 72/08/26 | 15 40 | 0000 | | | 36 | 120 | 7.30 | 50 | 0.250 | 0.140 | 0.087 | 0.054 | | | | | | | | | | |
| | 15 40 | 0004 | 19.4 | 6.5 | | 120 | 7.20 | 49 | 0.240 | 0.130 | 0.084 | 0.052 | | | | | | | | | | |
| | 15 40 | 0015 | 18.3 | 6.2 | | 120 | 7.20 | 49 | 0.250 | 0.140 | 0.080 | 0.054 | | | | | | | | | | |
| | 15 40 | 0021 | 18.2 | 6.3 | | 120 | 7.20 | 48 | 0.240 | 0.140 | 0.087 | 0.052 | | | | | | | | | | |
| | 15 40 | 0028 | 18.1 | 6.1 | | 120 | 7.20 | 55 | 0.250 | 0.160 | 0.092 | 0.055 | | | | | | | | | | |
| 72/11/04 | 15 15 | 0000 | | | 47 | 215 | 7.50 | 74 | 0.200 | 0.090 | 0.029 | 0.015 | | | | | | | | | | |
| | 15 15 | 0004 | 7.0 | 10.6 | | 208 | 7.50 | 75 | 0.190 | 0.060 | 0.027 | 0.017 | | | | | | | | | | |
| | 15 15 | 0015 | 5.0 | 10.6 | | 203 | 7.50 | 76 | 0.200 | 0.050 | 0.028 | 0.014 | | | | | | | | | | |
| | 15 15 | 0026 | 5.0 | 10.6 | | 205 | 7.50 | 76 | 0.200 | 0.060 | 0.029 | 0.014 | | | | | | | | | | |

32217

| DATE FROM TO | TIME OF DAY | DEPTH FEET | CHLRPHYL | |
|--------------------|-------------------|---------------|----------|------|
| | | | A | UG/L |
| 72/06/28 | 18 15 | 0000 | 20.0J | |
| 72/08/26 | 15 40 | 0000 | 2.3J | |
| 72/11/04 | 15 15 | 0000 | 3.9J | |

J VALUE KNOWN TO BE IN ERROR

APPENDIX C

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 74/10/30

27A7A1 LS27A7A1
 45 03 30.0 092 48 00.0
 ST CROIX RIVER
 27 7.5 STILLWATER
 I/LAKE ST CROIX
 AT INT BRDG BETW STILLWATER & HOUTON
 11EPALES 2111204
 4 0000 FEET DEPTH

| DATE FROM TO | TIME OF DAY | DEPTH FFET | 00630 N-TOTAL MG/L | 00625 TOT KJFL MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS URTHO MG/L P | 00665 PHOS-TOT MG/L P |
|--------------------|-------------------|---------------|--------------------------|---------------------------|---------------------------------|--------------------------------------|-----------------------------|
| | | | | | | | |
| 72/10/14 | 14 30 | | 0.140 | 0.700 | 0.062 | 0.014 | 0.050 |
| 72/11/05 | 12 30 | | 0.234 | 0.660 | 0.138 | 0.017 | 0.056 |
| 73/04/04 | 10 00 | | 0.690 | 1.540 | 0.013 | 0.012 | 0.040 |
| 73/05/02 | 20 15 | | 0.070 | 0.670 | 0.010 | 0.006 | 0.050 |
| 73/05/20 | 14 00 | | 0.051 | 1.100 | 0.005K | 0.011 | 0.050 |
| 73/06/09 | 14 00 | | 0.075 | 1.300 | 0.016 | 0.012 | 0.057 |
| 73/07/14 | 17 00 | | 0.010K | 0.720 | 0.013 | 0.013 | 0.055 |
| 73/08/12 | 11 45 | | 0.010K | 1.260 | 0.021 | 0.014 | 0.057 |
| 73/09/29 | 09 00 | | 0.140 | 0.840 | 0.049 | 0.026 | 0.085 |

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORER RETRIEVAL DATE 74/10/30

27A7A2 27A4E1
 44 46 00.0 092 49 00.0
 ST CROIX RIVER
 27 7.5 PRESCOT/HAST
 0/LAKE ST CROIX
 US 10 BRDG E PRESCOTT WI
 11FPALES 2111204
 4 0000 FEET DEPTH

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 N02&N03 N-TOTAL MG/L | 00625 TOT KJFL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|--------------------|-------------------|---------------|-------------------------------------|--------------------------------|---------------------------------|--------------------------------------|-----------------------------|
| 72/10/14 | | | 0.424 | 0.950 | 0.079 | 0.038 | 0.075 |
| 72/11/05 | 13 30 | | 0.310 | 0.720 | 0.115 | 0.025 | 0.050 |
| 72/12/02 | 15 25 | | 0.294 | 0.680 | 0.046 | 0.019 | 0.044 |
| 73/01/14 | 13 00 | | 0.560 | 1.260 | 0.130 | 0.024 | 0.035 |
| 73/02/03 | 13 40 | | 0.600 | 1.600 | 0.088 | 0.027 | 0.035 |
| 73/03/04 | 13 30 | | 0.670 | 1.540 | 0.058 | 0.021 | 0.035 |
| 73/04/02 | 11 00 | | 0.280 | 0.750 | 0.054 | 0.020 | 0.050 |
| 73/05/02 | 19 30 | | 0.033 | 0.740 | 0.060 | 0.007 | 0.050 |
| 73/05/19 | 10 40 | | 0.019K | 0.540 | 0.005K | 0.005K | 0.045 |
| 73/05/20 | 15 10 | | 0.065 | 1.200 | 0.010 | 0.007 | 0.035 |
| 73/06/09 | 15 00 | | 0.350 | 1.100 | 0.132 | 0.019 | 0.040 |
| 73/07/18 | 17 45 | | 0.126 | 0.640 | 0.022 | 0.005K | 0.015 |
| 73/08/12 | 10 30 | | 0.010K | 1.000 | 0.010 | 0.011 | 0.040 |
| 73/09/29 | 09 45 | | 0.340 | 0.360 | 0.027 | 0.031 | 0.055 |

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

27A7B1 LS27A7B1
 44 54 30.0 092 46 00.0
 VALLEY BRANCH STREAM
 27 7.5 HUDSON
 T/LAKE ST CROIX
 ST HWY 95 BRDG RETW AFTON SST MARYS PT
 11EPALES 2111204
 4 0000 FEET DEPTH

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 N- TOTAL MG/L | 00625 TOT KJFL MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|--------------------|-------------------|---------------|------------------------------|------------------------------|---------------------------------|--------------------------------------|-----------------------------|
| 72/10/14 | 15 30 | | 0.380 | 0.100K | 0.043 | 0.013 | 0.028 |
| 72/11/05 | 13 20 | | 0.640 | 0.100K | 0.018 | 0.016 | 0.026 |
| 72/12/02 | 14 45 | | 2.400 | 0.100K | 0.025 | 0.012 | 0.021 |
| 73/01/14 | 12 20 | | 2.700 | 0.100K | 0.021 | 0.015 | 0.020 |
| 73/02/03 | 13 00 | | 2.500 | 0.580 | 0.053 | 0.010 | 0.020 |
| 73/03/04 | 12 45 | | 2.500 | 2.750 | 0.320 | 0.060 | 0.030 |
| 73/04/08 | 10 30 | | 2.200 | 0.100K | 0.007 | 0.008 | 0.015 |
| 73/05/02 | 19 00 | | 1.650 | 0.520 | 0.011 | 0.005K | 0.030 |
| 73/05/20 | 14 30 | | 1.900 | 0.630 | 0.035 | 0.014 | 0.040 |
| 73/06/09 | 14 30 | | 1.040 | 1.100 | 0.052 | 0.032 | 0.040 |
| 73/07/18 | 17 15 | | 2.040 | 0.340 | 0.013 | 0.013 | 0.025 |
| 73/08/12 | 09 45 | | 2.040 | 0.100K | 0.016 | 0.016 | 0.025 |
| 73/09/29 | 09 15 | | 2.120 | 0.170 | 0.014 | 0.019 | 0.035 |

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

27A7C1 LS27A7C1
 44 51 30.0 092 46 30.0
 TROUT BROOK
 27 7.5 PRESCOTT
 T/LAKE ST CROIX
 CO HWY 21 2.5 MI S OF AFTON
 11 EPALES 2111204
 4 0000 FEET DEPTH

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 N02&N03 N-TOTAL MG/L | 00625 TUT KJFL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS URTHO MG/L P | 00665 PHOS-TOT MG/L P |
|--------------------|-------------------|---------------|-------------------------------------|--------------------------------|---------------------------------|--------------------------------------|-----------------------------|
| 72/10/14 | 15 | 55 | 0.280 | 1.350 | 0.050 | 0.034 | 0.072 |
| 72/11/05 | 13 | 15 | 0.420 | 0.210 | 0.021 | 0.029 | 0.046 |
| 72/12/02 | 15 | 00 | 1.950 | 0.100K | 0.008 | 0.033 | 0.056 |
| 73/01/14 | 12 | 40 | 1.960 | 0.100K | 0.016 | 0.024 | 0.025 |
| 73/02/03 | 13 | 20 | 1.960 | 0.600 | 0.024 | 0.027 | 0.030 |
| 73/04/08 | 10 | 45 | 1.660 | 0.110 | 0.007 | 0.021 | 0.025 |
| 73/05/02 | 19 | 15 | 1.440 | 0.530 | 0.026 | 0.074 | 0.160 |
| 73/05/20 | 14 | 45 | 1.030 | 1.100 | 0.010 | 0.017 | 0.035 |
| 73/06/09 | 14 | 45 | 0.810 | 1.000 | 0.040 | 0.019 | 0.035 |
| 73/07/28 | 17 | 30 | 1.220 | 0.160 | 0.024 | 0.026 | 0.045 |
| 73/08/12 | 10 | 15 | 1.420 | 0.130 | 0.009 | 0.027 | 0.040 |
| 73/09/29 | 09 | 30 | 1.640 | 0.400 | 0.012 | 0.038 | 0.065 |

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

27A7D1 LS27A7D1
44 46 30.0 092 44 00.0
KINNICKINNIC RIVER
27 PIERCE CO MAP
T/LAKE ST CROIX
CO HWY F BRDG NNE PRESCOT 5MI WSW R FALS
11EPALES 2111204
4 0000 FEET DEPTH

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 N028N03 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|--------------------|-------------------|---------------|-------------------------------------|--------------------------------|---------------------------------|--------------------------------------|-----------------------------|
| 72/10/14 | 16 | 50 | 0.480 | 0.100K | 0.082 | 0.170 | 0.210 |
| 72/11/05 | 14 | 00 | 0.730 | 0.280 | 0.061 | 0.128 | 0.170 |
| 72/12/02 | 15 | 30 | 2.900 | 0.176 | 0.176 | 0.180 | 0.220 |
| 73/01/14 | 13 | 20 | 3.400 | 0.290 | 0.096 | 0.115 | 0.150 |
| 73/02/03 | 14 | 00 | 3.100 | 0.260 | 0.147 | 0.126 | 0.155 |
| 73/03/04 | 13 | 45 | 2.900 | 2.400 | 0.399 | 0.180 | 0.240 |
| 73/05/02 | 19 | 45 | 1.740 | 1.700 | 0.160 | 0.132 | 0.345 |
| 73/07/18 | 20 | 00 | 2.300 | 0.100K | 0.010 | 0.094 | 0.130 |
| 73/08/12 | 10 | 45 | 2.700 | 0.110 | 0.007 | 0.076 | 0.105 |
| 73/09/29 | 10 | 00 | 0.945 | 0.120 | 0.017 | 0.120 | 0.150 |

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

27A7E1 LS27A7E1
 44 59 00.0 092 45 30.0
 LAKE MALLALIFU
 27 7.5 HUDSON
 T/LAKE ST CROIX
 AT HUDSON CITY BRDG
 11EPALES 2111204
 4 0000 FEET DEPTH

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00636 N02NN03 N-TOTAL | 00625 TOT KJEL N | 00610 NH3-N TOTAL | 00671 PHOS-DIS ORTHO | 00665 PHOS-TOT MG/L P |
|--------------------|-------------------|---------------|-----------------------------|------------------------|-------------------------|----------------------------|-----------------------------|
| | | | MG/L | MG/L | MG/L | MG/L P | MG/L P |
| 72/10/14 | 15 00 | | 0.042 | 1.250 | 0.044 | 0.008 | 0.069 |
| 72/11/05 | 12 45 | | 0.450 | 1.260 | 0.027 | 0.007 | 0.054 |
| 72/12/02 | 14 25 | | 1.200 | 0.560 | 0.013 | 0.010 | 0.056 |
| 73/01/14 | 12 00 | | 2.060 | 0.180 | 0.094 | 0.035 | 0.040 |
| 73/02/03 | 14 20 | | 2.000 | 1.470 | 0.096 | 0.038 | 0.045 |
| 73/03/04 | 12 30 | | 2.000 | 0.960 | 0.102 | 0.032 | 0.040 |
| 73/04/08 | 10 15 | | 0.096 | 0.660 | 0.010 | 0.012 | 0.040 |
| 73/05/02 | 20 00 | | 1.180 | 1.150 | 0.013 | 0.008 | 0.070 |
| 73/05/20 | 14 15 | | 0.430 | 1.680 | 0.036 | 0.006 | 0.060 |
| 73/06/04 | 14 15 | | 0.400 | 1.150 | 0.022 | 0.005K | 0.065 |
| 73/07/18 | 20 15 | | 0.040 | 1.100 | 0.006 | 0.013 | 0.070 |
| 73/08/12 | 11 00 | | 0.010K | 0.750 | 0.005K | 0.013 | 0.050 |
| 73/09/29 | 10 15 | | 0.480 | 0.760 | 0.027 | 0.013 | 0.060 |

K VALUE KNOWN TO BE LESS
 THAN INDICATED .

STORED RETRIEVAL DATE 74/10/30

27A751 P027A751 P010191
45 02 25.0 092 47 30.0
STILLWATER
27 7.5 STILLWATER
D/LAKE ST CROIX
LAKE ST CROIX
11EPALES 2141204
4 0000 FEET DEPTH

STORED RETRIEVAL DATE 7-10-80

P027A752 P0029A7
45 01 00.0 092 46 30.0
HAYPORT
27 7.5 STILLWATER
9/LAKE ST CROIX
LAKE ST CROIX
11EPALES 2141204
4 0000 FEET DEPTH

STOPED RETRIEVAL DATE 74/10/30

274753 AS27A753 P001238
45 02 00.0 092 47 30.0
OAK PARK HIGHTS
27 7.5 STILLWATER
DLAKE ST CROIX
LAKE ST CROIX
11EPALES 2141204
4 0000 FEET DEPTH