U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT

ON

CRAB ORCHARD LAKE

JACKSON AND WILLIAMSON COUNTIES

ILLINOIS

EPA REGION V

WORKING PAPER No. 301

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

☆G.P.O. 699-440

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WITH THE COOPERATION OF THE

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

AND THE

ILLINOIS NATIONAL GUARD

JUNE, 1975

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F O R 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 Illinois Environmental Protection Agency for professional involvement and to the Illinois National Guard for conducting the tributary sampling phase of the Survey.

Dr. Richard H. Briceland, Director of the Illinois Environmental Protection Agency; and Ronald M. Barganz, State Survey Coordinator, and John J. Forneris, Manager of Region III, Field Operations Section of the Division of Water Pollution Control, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

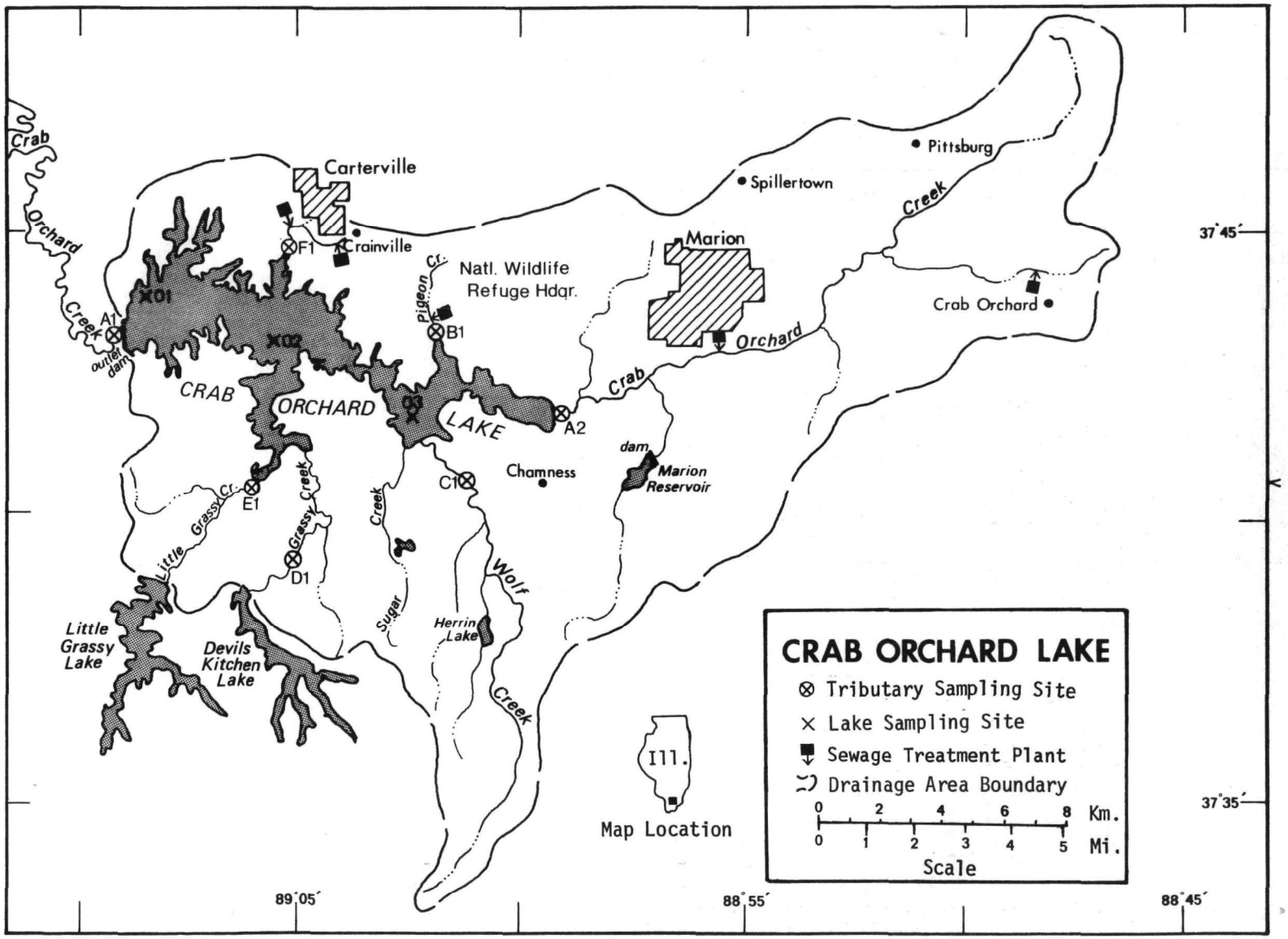
Major General Harold R. Patton, the Adjutant General of Illinois, and Project Officer Colonel Daniel L. Fane, who directed the volunteer efforts of the Illinois National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF ILLINOIS

LAKE NAME	COUNTY
Baldwin	Randolph
Bloomington	McLean
Carlyle	Bond, Clinton, Fayette
Cedar	Lake
Charleston	Coles
Coffeen	Montgomery
Crab Orchard	Jackson, Williamson
Decatur	Macon
DePue	Bureau
East Loon	Lake
Fox	Lake
Grass	Lake
Highland Silver	Madison
Holiday	LaSalle
Horseshoe	Madison
Long	Lake
Lou Yaeger	Montgomery
Marie	Lake
Old Ben Mine	Franklin
Pistakee	Lake, McHenry
Raccoon	Marion
Rend	Franklin, Jefferson
Sangchris	Christian
Shelbyville	Moultrie, Shelby
Slocum	Lake
Springfield	Sangamon
Storey	Knox
Vandalia	Fayette
Vermilion	Vermilion
Wee Ma Tuk	Fulton
Wonder	McHenry


CRAB ORCHARD LAKE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Plant
Drainage Area Boundary
0 2 4 6 8 Km.
0 1 2 3 4 5 Mi.
Scale
Carterville
Crainville
Natl. Wildlife Refuge Hdqr.
Marion
Spillertown
Pittsburg
Crab Orchard
Chamness
Marion Reservoir
dam
Little Grassy Lake
Devils Kitchen Lake
Herrin Lake
Ill.
Map Location
Crab Orchard Creek
Pigeon Cr.
Little Grassy Cr.
Grassy Creek
Sugar Creek
Wolf Creek
outlet dam
A1
A2
B1
C1
D1
E1
F1
X01
X02
X03
37°45′
37°35′
89°05′
88°55′
88°45′

CRAB ORCHARD LAKE

STORET NO. 1712

I. CONCLUSIONS

A. Trophic Condition:

Survey data show that Crab Orchard Lake is eutrophic. It ranked eighth in overall trophic quality when the 31 Illinois lakes sampled in 1973 were compared using a combination of six lake parameters*. Ten of the lakes had less median total phosphorus, four had less and one had the same median dissolved phosphorus, two had less and one had the same median inorganic nitrogen, 24 had less mean chlorophyll a, and 17 had greater mean Secchi disc transparency. Marked depression of dissolved oxygen with depth occurred at sampling station 1 in August, 1973.

Survey limnologists reported a blue-green algal bloom in progress in August and noted the occurrence of submergent and emergent aquatic macrophytes in the shoreline shallows near all three sampling stations.

B. Rate-Limiting Nutrient:

A significant change in primary nutrients occurred in the assay sample between the time of collection and the beginning of the assay, and the results are not representative of conditions in the lake at the time the sample was taken (05/08/73).

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* See Appendix A.

The lake data indicate phosphorus limitation in May but nitrogen limitation in August and October.

C. Nutrient Controllability:

1. Point sources--The estimated phosphorus contribution of point sources amounted to 26.3% of the total load reaching the lake during the sampling year. The City of Marion was estimated to have contributed 20.3% and the other four point sources 6.0% of the total load.

The Crab Orchard National Wildlife Refuge provides a wintering area for a large segment of the Mississippi flyway Canada goose flock as well as many flyway ducks, and it is estimated that ducks and geese contributed 7.9% of the total phosphorus load to Crab Orchard Lake during the sampling year (see page 10).

The present phosphorus loading rate of 2.82 $g/m^2/yr$ is over seven times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic rate (see page 14). Even complete removal of phosphorus at the point sources would only reduce the loading rate to 2.07 $g/m^2/yr$ (still over five times the dangerous rate). However, Crab Orchard Lake is phosphorus limited part of the time, and it is likely that a high degree of phosphorus control at the point sources would result in

persistent phosphorus limitation and a reduction in the incidence and severity of nuisance algal blooms, particularly if a significant portion of the phosphorus export of Crab Orchard Creek proves to be controllable (see below).

2. Non-point sources--It is estimated that non-point sources accounted for 65.8% of the total phosphorus load reaching Crab Orchard Lake during the sampling year. However, Crab Orchard Creek had a very high phosphorus export rate of 221 $kg/km^2/yr$ (see page 14).

It is unlikely that the high rate resulted solely from underestimation of the phosphorus loads from the City of Marion and the Crab Orchard School; e.g., the phosphorus load for Marion would have to be nearly three times greater than the estimated load to lower the Crab Orchard Creek export rate to that of Wolf Creek (16 $kg/km^2/yr$). Therefore, it appears that either there are other point sources in the Crab Orchard Creek drainage or land-use practices result in an unusually high phosphorus export. In either case, a need for further study of the drainage is indicated.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 28.19 kilometers^2.
2. Mean depth: 3.0 meters.
3. Maximum depth: >6.1 meters.
4. Volume: 84.570 x 10^6 m^3.
5. Mean hydraulic retention time: 288 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Crab Orchard Creek	213.9	1.4
Pigeon Creek	10.3	0.1
Wolf Creek	33.2	0.2
Pin Oak Creek	4.6	<0.1
Minor tributaries & immediate drainage -	230.4	1.7
Totals	492.4	3.4

2. Outlet -

Crab Orchard Creek	520.6**	3.4

C. Precipitation***:

1. Year of sampling: 124.0 centimeters.
2. Mean annual: 112.3 centimeters.

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† Table of metric conversions--Appendix B.
†† Forneris, 1973.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Crab Orchard Lake was sampled three times during the open-water season of 1973 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 usually from two or more depths at each station (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter 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 6.1 meters at station 1, 3.0 meters at station 2, and 1.2 meters at station 3.

The lake sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR CRAB ORCHARD LAKE
STORET CODE 1712

	1ST SAMPLING (5/ 8/73) 3 SITES			2ND SAMPLING (8/ 8/73) 3 SITES			3RD SAMPLING (10/19/73) 3 SITES		
PARAMETER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN
TEMP (C)	17.6 - 18.4	18.2	18.3	27.1 - 30.3	28.9	29.0	18.5 - 20.6	20.0	20.2
DISS OXY (MG/L)	7.8 - 8.8	8.3	8.2	1.2 - 14.0	6.6	7.2	5.6 - 9.4	7.4	7.3
CNDCTVY (MCROMC	200. - 300.	253.	240.	265. - 290.	274.	272.	222. - 294.	235.	224.
PH (STAND UNITS	8.1 - 8.3	8.2	8.1	7.1 - 9.0	8.2	8.2	7.5 - 8.4	7.8	7.7
TOT ALK (MG/L)	30. - 39.	37.	38.	54. - 66.	58.	56.	48. - 65.	54.	53.
TOT P (MG/L)	0.053 - 0.227	0.106	0.081	0.051 - 0.424	0.155	0.084	0.071 - 0.257	0.114	0.092
ORTHO P (MG/L)	0.006 - 0.022	0.012	0.011	0.007 - 0.115	0.035	0.012	0.007 - 0.047	0.020	0.016
NO2+NO3 (MG/L)	0.060 - 0.220	0.109	0.100	0.070 - 0.200	0.116	0.100	0.040 - 0.220	0.130	0.135
AMMONIA (MG/L)	0.080 - 0.140	0.100	0.100	0.090 - 0.320	0.156	0.135	0.040 - 0.070	0.057	0.060
KJEL N (MG/L)	0.600 - 1.100	0.733	0.700	1.500 - 3.600	2.150	1.800	0.600 - 1.900	0.900	0.750
INORG N (MG/L)	0.160 - 0.360	0.209	0.200	0.160 - 0.400	0.272	0.260	0.080 - 0.290	0.187	0.190
TOTAL N (MG/L)	0.660 - 1.220	0.842	0.790	1.570 - 3.800	2.266	1.900	0.800 - 1.970	1.030	0.840
CHLRPYL A (UG/L	3.4 - 58.5	26.1	16.4	24.6 - 225.4	106.8	70.4	29.4 - 77.6	46.7	33.1
SECCHI (METERS)	0.1 - 0.6	0.4	0.5	0.3 - 0.8	0.6	0.7	0.3 - 0.4	0.4	0.4

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal units per ml
05/08/73	1. *Cyclotella sp.*	12,226
	2. *Melosira sp.*	7,763
	3. Coccoid Chrysophyta	2,474
	4. *Dactylococcopsis sp.*	776
	5. *Cryptomonas sp.*	679
	Other genera	3,105
	Total	27,023
08/08/73	1. *Oscillatoria sp.*	30,614
	2. *Dactylococcopsis sp.*	21,930
	3. Coccoid cells	10,350
	4. *Cyclotella sp.*	7,281
	5. Pennate diatoms	7,281
	Other genera	32,806
	Total	110,262
10/19/73	1. Coccoid cells	33,481
	2. *Dactylococcopsis sp.*	8,830
	3. *Oscillatoria sp.*	7,358
	4. Pennate diatoms	4,139
	5. *Microcystis sp.*	4,047
	Other genera	11,588
	Total	69,444

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (μg/l)
05/08/73	01	3.4
	02	16.4
	03	58.5
08/08/73	01	24.6
	02	70.4
	03	225.4
10/19/73	01	29.4
	02	33.1
	03	77.6

C. Limiting Nutrient Study:

A 15% loss of inorganic nitrogen and a 150% gain in orthophosphorus occurred in the assay sample between the time of collection and the beginning of the assay, and the limiting nutrient was shifted from phosphorus in the lake (the mean inorganic nitrogen/orthophosphorus ratio was 17/1) to nitrogen limitation in the assay sample (N/P = 6/1). Consequently, the assay results are not representative of conditions in the lake at the time the sample was taken (05/08/73).

As noted above, the lake data indicate phosphorus limitation in May; however, nitrogen limitation is indicated in August (N/P = 8/1) and October (N/P = 9/1).

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Illinois National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of February and March when two samples were collected. Sampling was begun in June, 1973, and was completed in May, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Illinois 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*.

Except for Pin Oak Creek and Pigeon Creek, nutrient loads shown are those measured minus point-source loads, if any. However, the combined estimated nutrient loads for Carterville and Crainville exceeded those measured in Pin Oak Creek, and the estimated Refuge Headquarters loads exceeded the loads measured in Pigeon Creek. Therefore, the background loads for these two streams were estimated using the nutrient loads, in $kg/km^2/yr$, in Wolf Creek at station C-1 and multiplying by the Pin Oak Creek and Pigeon Creek drainage areas in km^2.

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* See Working Paper No. 175.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads, in $kg/km^2/year$, at station C-1 and multiplying by the ZZ area in km^2.

The City of Marion, the villages of Carterville and Crainville, and the Crab Orchard School did not participate in the sampling program, and nutrient loads were estimated at 1.134 kg P and 3.401 kg N/capita/year.

Estimates of nutrient contributions by wild ducks and geese utilizing Crab Orchard National Wildlife Refuge were based on 50,000 over-wintering geese reported by the Fish and Wildlife Service (Anonymous, 1969) and the following assumptions:

1. One-half as many ducks as geese over-winter.
2. Winter resident waterfowl are at the lake for five months.
3. Each wild duck contributes 0.20 kg total phosphorus and 0.45 kg total nitrogen per year (Paloumpis and Starrett, 1960).
4. Each wild goose contributes the same amount of phosphorus and nitrogen as one wild duck since geese typically feed in fields away from the lake several hours each day.

A. Waste Sources:

1. Known muncipal† -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)*	Receiving Water
Marion	14,180	trickling filter	5,367.1	Crab Orchard Creek
Carterville	1,600	act. sludge	605.6	Pin Oak Creek
Crab Orchard School	80	trickling filter	30.3	Crab Orchard Creek
Crab Orchard Refuge Hdq.	2,000	act. sludge	757.0	Pigeon Creek
Crainville	549**	aer. ponds	207.8	Pin Oak Creek

2. Industrial - In 1969, some 26 firms in the Crab Orchard Lake drainage produce hardware for the space program, explosives, office supplies, chemicals, solvents, and a variety of other products (Anonymous, 1969). The current status and nutrient significance of these industries is not known.

† Anonymous, 1972.
* Estimated at 0.3785 m^3/capita/day.
** 1970 Census.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Crab Orchard Creek	47,270	59.5
Pigeon Creek	165	0.2
Wolf Creek	520	0.7
Pin Oak Creek	75	0.1
b. Minor tributaries & immediate drainage (non-point load) -	3,685	4.6
c. Known municipal STP's -		
Marion	16,080	20.3
Carterville	1,815	2.3
Crab Orchard School	90	0.1
Crab Orchard Refuge Hdq.	2,270	2.9
Crainville	625	0.8
d. Septic tanks* -	15	<0.1
e. Industrial - Unknown	?	-
f. Ducks and geese -	6,250	7.9
g. Direct precipitation** -	495	0.6
Total	79,355	100.0

2. Outputs -

Lake outlet - Crab Orchard Creek 16,160

3. Net annual P accumulation - 63,195 kg.

* Estimate based on two marinas and five campgrounds; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/ yr	% of total
a. Tributaries (non-point load) -		
Crab Orchard Creek	131,295	35.8
Pigeon Creek	4,740	1.3
Wolf Creek	15,265	4.2
Pin Oak Creek	2,115	0.6
b. Minor tributaries & immediate drainage (non-point load) -	105,985	28.9
c. Known municipal STP's -		
Marion	48,225	13.1
Carterville	5,440	1.5
Crab Orchard School	270	<0.1
Crab Orchard Refuge Hdq.	6,800	1.9
Crainville	1,865	0.5
d. Septic tanks* -	570	0.2
e. Industrial - Unknown	?	-
f. Ducks and geese -	14,065	3.8
g. Direct precipitation** -	30,435	8.2
Total	367,070	100.0

2. Outputs -

Lake outlet - Crab Orchard Creek 164,625

3. Net annual N accumulation - 202,445 kg.

* Estimate based on two marinas and five campgrounds; see Working Paper No. 175.
** See Working Paper No. 175.

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

Tributary	kg P/km²/yr	kg N/km²/yr	N/P Ratio
Crab Orchard Creek	221*	614	3/1
Wolf Creek	16	460	29/1

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" rate is the rate at which the receiving water would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry 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 short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m²/yr	2.82	2.2	13.0	7.2

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

"Dangerous" (eutrophic rate)	0.38
"Permissible" (oligotrophic rate)	0.19

* Unusually high export rate probably is indicative of unmeasured point-source influence.

V. LITERATURE REVIEWED

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VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS ORTHO P
1703	LAKE BLOOMINGTON	0.050	5.730	464.667	26.200	14.800	0.020
1706	LAKE CARLYLE	0.084	1.270	477.889	17.367	11.000	0.032
1708	LAKE CHARLESTON	0.160	4.680	490.667	12.000	8.400	0.065
1711	COFFEEN LAKE	0.032	0.260	456.222	7.700	14.900	0.012
1712	CRAB ORCHARD LAKE	0.082	0.200	482.222	59.867	13.800	0.013
1714	LAKE DECATUR	0.129	3.750	479.571	43.000	14.500	0.062
1725	LONG LAKE	0.704	1.190	482.667	49.333	8.800	0.398
1726	LAKE LOU YAEGER	0.186	1.600	489.583	10.662	11.400	0.076
1727	LAKE MARIE	0.098	0.370	467.667	39.533	14.700	0.057
1733	PISTAKEE LAKE	0.203	0.370	485.667	75.867	7.000	0.062
1735	REND LAKE	0.071	0.210	471.500	23.533	12.700	0.012
1739	LAKE SHELBYVILLE	0.062	3.290	461.333	17.161	14.800	0.019
1740	SILVER LAKE (HIGHLAND)	0.226	0.970	489.500	5.822	14.800	0.057
1742	LAKE SPRINGFIELD	0.108	3.265	483.385	13.013	10.800	0.059
1748	VERMILION LAKE	0.109	4.695	481.500	31.150	14.200	0.050
1750	WONDER LAKE	0.426	0.890	486.000	98.533	7.800	0.132
1751	LAKE STORY	0.072	2.510	459.333	17.250	14.800	0.021
1752	DEPUE LAKE	0.438	4.050	490.000	58.833	7.600	0.276
1753	LAKE SANGCHRIS	0.050	1.970	475.417	19.292	14.500	0.009
1754	LAKE HOLIDAY	0.167	3.135	485.167	51.217	7.200	0.046
1755	FOX LAKE	0.219	0.375	486.167	63.850	8.800	0.083
1756	GRASS LAKE	0.301	0.820	481.000	83.500	5.900	0.093
1757	EAST LOON LAKE	0.076	0.120	450.000	22.300	14.900	0.018
1758	SLOCUM LAKE	0.865	0.200	487.333	221.100	5.800	0.362
1759	CEDAR LAKE	0.029	0.170	400.333	5.767	12.800	0.013
1761	LAKE WEMATUK	0.069	1.770	466.333	7.967	14.500	0.031
1762	RACCOON LAKE	0.106	0.310	484.333	19.217	13.800	0.020
1763	BALDWIN LAKE	0.044	0.140	461.167	11.333	13.200	0.007

VI. APPENDICES

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LAKE RANKINGS

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1727	LAKE MARIE	0.098	0.370	467.667	39.533	14.700	0.057
1733	PISTAKEE LAKE	0.203	0.370	485.667	75.867	7.000	0.062
1735	REND LAKE	0.071	0.210	471.500	23.533	12.700	0.012
1739	LAKE SHELBYVILLE	0.062	3.290	461.333	17.161	14.800	0.019
1740	SILVER LAKE (HIGHLAND)	0.226	0.970	489.500	5.822	14.800	0.057
1742	LAKE SPRINGFIELD	0.108	3.265	483.385	13.013	10.800	0.059
1748	VERMILION LAKE	0.109	4.695	481.500	31.150	14.200	0.050
1750	WONDER LAKE	0.426	0.890	486.000	98.533	7.800	0.132
1751	LAKE STORY	0.072	2.510	459.333	17.250	14.800	0.021
1752	DEPUE LAKE	0.438	4.050	490.000	58.833	7.600	0.276
1753	LAKE SANGCHRIS	0.050	1.970	475.417	19.292	14.500	0.009
1754	LAKE HOLIDAY	0.167	3.135	485.167	51.217	7.200	0.046
1755	FOX LAKE	0.219	0.375	486.167	63.850	8.800	0.083
1756	GRASS LAKE	0.301	0.820	481.000	83.500	5.900	0.093
1757	EAST LOON LAKE	0.076	0.120	450.000	22.300	14.900	0.018
1758	SLOCUM LAKE	0.865	0.200	487.333	221.100	5.800	0.362
1759	CEDAR LAKE	0.029	0.170	400.333	5.767	12.800	0.013
1761	LAKE WEMATUK	0.069	1.770	466.333	7.967	14.500	0.031
1762	RACCOON LAKE	0.106	0.310	484.333	19.217	13.800	0.020
1763	BALDWIN LAKE	0.044	0.140	461.167	11.333	13.200	0.007

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS ORTHO P
1703	LAKE BLOOMINGTON	0.050	5.730	464.667	26.200	14.800	0.020
1706	LAKE CARLYLE	0.084	1.270	477.889	17.367	11.000	0.032
1708	LAKE CHARLESTON	0.160	4.680	490.667	12.000	8.400	0.065
1711	COFFEEN LAKE	0.032	0.260	456.222	7.700	14.900	0.012
1712	CRAB ORCHARD LAKE	0.082	0.200	482.222	59.867	13.800	0.013
1714	LAKE DECATUR	0.129	3.750	479.571	43.000	14.500	0.062
1725	LONG LAKE	0.704	1.190	482.667	49.333	8.800	0.398
1726	LAKE LOU YAEGER	0.186	1.600	489.583	10.662	11.400	0.076
1727	LAKE MARIE	0.098	0.370	467.667	39.533	14.700	0.057
1733	PISTAKEE LAKE	0.203	0.370	485.667	75.867	7.000	0.062
1735	REND LAKE	0.071	0.210	471.500	23.533	12.700	0.012
1739	LAKE SHELBYVILLE	0.062	3.290	461.333	17.161	14.800	0.019
1740	SILVER LAKE (HIGHLAND)	0.226	0.970	489.500	5.822	14.800	0.057
1742	LAKE SPRINGFIELD	0.108	3.265	483.385	13.013	10.800	0.059
1748	VERMILION LAKE	0.109	4.695	481.500	31.150	14.200	0.050
1750	WONDER LAKE	0.426	0.890	486.000	98.533	7.800	0.132
1751	LAKE STORY	0.072	2.510	459.333	17.250	14.800	0.021
1752	DEPUE LAKE	0.438	4.050	490.000	58.833	7.600	0.276
1753	LAKE SANGCHRIS	0.050	1.970	475.417	19.292	14.500	0.009
1754	LAKE HOLIDAY	0.167	3.135	485.167	51.217	7.200	0.046
1755	FOX LAKE	0.219	0.375	486.167	63.850	8.800	0.083
1756	GRASS LAKE	0.301	0.820	481.000	83.500	5.900	0.093
1757	EAST LOON LAKE	0.076	0.120	450.000	22.300	14.900	0.018
1758	SLOCUM LAKE	0.865	0.200	487.333	221.100	5.800	0.362
1759	CEDAR LAKE	0.029	0.170	400.333	5.767	12.800	0.013
1761	LAKE WEMATUK	0.069	1.770	466.333	7.967	14.500	0.031
1762	RACCOON LAKE	0.106	0.310	484.333	19.217	13.800	0.020
1763	BALDWIN LAKE	0.044	0.140	461.167	11.333	13.200	0.007

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1703	LAKE BLOOMINGTON	0.050	5.730	464.667	26.200	14.800	0.020
1706	LAKE CARLYLE	0.084	1.270	477.889	17.367	11.000	0.032
1708	LAKE CHARLESTON	0.160	4.680	490.667	12.000	8.400	0.065
1711	COFFEEN LAKE	0.032	0.260	456.222	7.700	14.900	0.012
1712	CRAB ORCHARD LAKE	0.082	0.200	482.222	59.867	13.800	0.013
1714	LAKE DECATUR	0.129	3.750	479.571	43.000	14.500	0.062
1725	LONG LAKE	0.704	1.190	482.667	49.333	8.800	0.398
1726	LAKE LOU YAEGER	0.186	1.600	489.583	10.662	11.400	0.076
1727	LAKE MARIE	0.098	0.370	467.667	39.533	14.700	0.057
1733	PISTAKEE LAKE	0.203	0.370	485.667	75.867	7.000	0.062
1735	REND LAKE	0.071	0.210	471.500	23.533	12.700	0.012
1739	LAKE SHELBYVILLE	0.062	3.290	461.333	17.161	14.800	0.019
1740	SILVER LAKE (HIGHLAND)	0.226	0.970	489.500	5.822	14.800	0.057
1742	LAKE SPRINGFIELD	0.108	3.265	483.385	13.013	10.800	0.059
1748	VERMILION LAKE	0.109	4.695	481.500	31.150	14.200	0.050
1750	WONDER LAKE	0.426	0.890	486.000	98.533	7.800	0.132
1751	LAKE STORY	0.072	2.510	459.333	17.250	14.800	0.021
1752	DEPUE LAKE	0.438	4.050	490.000	58.833	7.600	0.276
1753	LAKE SANGCHRIS	0.050	1.970	475.417	19.292	14.500	0.009
1754	LAKE HOLIDAY	0.167	3.135	485.167	51.217	7.200	0.046
1755	FOX LAKE	0.219	0.375	486.167	63.850	8.800	0.083
1756	GRASS LAKE	0.301	0.820	481.000	83.500	5.900	0.093
1757	EAST LOON LAKE	0.076	0.120	450.000	22.300	14.900	0.018
1758	SLOCUM LAKE	0.865	0.200	487.333	221.100	5.800	0.362
1759	CEDAR LAKE	0.029	0.170	400.333	5.767	12.800	0.013
1761	LAKE WEMATUK	0.069	1.770	466.333	7.967	14.500	0.031
1762	RACCOON LAKE	0.106	0.310	484.333	19.217	13.800	0.020
1763	BALDWIN LAKE	0.044	0.140	461.167	11.333	13.200	0.007

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS ORTHO P
1764	LAKE VANDALIA	0.116	0.480	478.111	11.278	14.800	0.023
1765	OLD BEN MINE RESERVOIR	0.930	0.205	478.333	31.433	11.200	0.575
1766	HORSESHOE LAKE	0.127	0.705	482.833	182.250	6.800	0.018

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1703	LAKE BLOOMINGTON	88 (26)	0 (0)	80 (24)	47 (14)	13 (2)	68 (20)	296
1706	LAKE CARLYLE	63 (19)	40 (12)	63 (19)	63 (19)	63 (19)	53 (16)	345
1708	LAKE CHARLESTON	37 (11)	7 (2)	0 (0)	77 (23)	77 (23)	27 (8)	225
1711	COFFEEN LAKE	97 (29)	77 (23)	93 (28)	93 (28)	2 (0)	92 (27)	454
1712	CRAB ORCHARD LAKE	67 (20)	90 (27)	43 (13)	20 (6)	42 (12)	85 (25)	347
1714	LAKE DECATUR	40 (12)	13 (4)	53 (16)	33 (10)	30 (8)	32 (9)	201
1725	LONG LAKE	7 (2)	43 (13)	40 (12)	30 (9)	72 (21)	3 (1)	195
1726	LAKE LOU YAEGER	30 (9)	37 (11)	7 (2)	87 (26)	57 (17)	23 (7)	241
1727	LAKE MARIE	60 (18)	68 (20)	73 (22)	37 (11)	23 (7)	42 (12)	303
1733	PISTAKEE LAKE	27 (8)	68 (20)	23 (7)	13 (4)	90 (27)	32 (9)	253
1735	REND LAKE	77 (23)	80 (24)	70 (21)	50 (15)	53 (16)	92 (27)	422
1739	LAKE SHELBYVILLE	83 (25)	17 (5)	83 (25)	70 (21)	13 (2)	73 (22)	339
1740	SILVER LAKE (HIGHLAND)	20 (6)	47 (14)	10 (3)	97 (29)	13 (2)	42 (12)	229
1742	LAKE SPRINGFIELD	53 (16)	20 (6)	33 (10)	73 (22)	67 (20)	37 (11)	283
1748	VERMILION LAKE	50 (15)	3 (1)	47 (14)	43 (13)	37 (11)	47 (14)	227
1750	WONDER LAKE	13 (4)	50 (15)	20 (6)	7 (2)	80 (24)	13 (4)	183
1751	LAKE STORY	73 (22)	27 (8)	90 (27)	67 (20)	13 (2)	63 (19)	333
1752	DEPUE LAKE	10 (3)	10 (3)	3 (1)	23 (7)	83 (25)	10 (3)	139
1753	LAKE SANGCHRIS	88 (26)	30 (9)	67 (20)	57 (17)	30 (8)	97 (29)	369
1754	LAKE HOLIDAY	33 (10)	23 (7)	27 (8)	27 (8)	87 (26)	50 (15)	247
1755	FOX LAKE	23 (7)	63 (19)	17 (5)	17 (5)	72 (21)	20 (6)	212
1756	GRASS LAKE	17 (5)	53 (16)	50 (15)	10 (3)	97 (29)	17 (5)	244
1757	EAST LOON LAKE	70 (21)	100 (30)	97 (29)	53 (16)	2 (0)	77 (23)	399
1758	SLOCUM LAKE	3 (1)	87 (26)	13 (4)	0 (0)	100 (30)	7 (2)	210
1759	CEDAR LAKE	100 (30)	93 (28)	100 (30)	100 (30)	50 (15)	85 (25)	528
1761	LAKE WEWATUK	80 (24)	33 (10)	77 (23)	90 (27)	30 (8)	57 (17)	367
1762	RACCOON LAKE	57 (17)	73 (22)	30 (9)	60 (18)	42 (12)	68 (20)	330
1763	BALDWIN LAKE	93 (28)	97 (29)	87 (26)	80 (24)	47 (14)	100 (30)	504

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1764	LAKE VANDALIA	47 (14)	60 (18)	60 (18)	83 (25)	13 (2)	60 (.18)	323
1765	OLD BEN MINE RESERVOIR	0 (0)	83 (25)	57 (17)	40 (12)	60 (18)	0 (0)	240
1766	HORSESHOE LAKE	43 (13)	57 (17)	37 (11)	3 (1)	93 (28)	80 (24)	313

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1759	CEDAR LAKE	528
2	1763	BALDWIN LAKE	504
3	1711	COFFEEN LAKE	454
4	1735	REND LAKE	422
5	1757	EAST LOON LAKE	399
6	1753	LAKE SANGCHRIS	369
7	1761	LAKE WEMATUK	367
8	1712	CRAB ORCHARD LAKE	347
9	1706	LAKE CARLYLE	345
10	1739	LAKE SHELBYVILLE	339
11	1751	LAKE STORY	333
12	1762	RACCOON LAKE	330
13	1764	LAKE VANDALIA	323
14	1766	HORSESHOE LAKE	313
15	1727	LAKE MARIE	303
16	1703	LAKE BLOOMINGTON	296
17	1742	LAKE SPRINGFIELD	283
18	1733	PISTAKEE LAKE	253
19	1754	LAKE HOLIDAY	247
20	1756	GRASS LAKE	244
21	1726	LAKE LOU YAEGER	241
22	1765	OLD BEN MINE RESERVOIR	240
23	1740	SILVER LAKE (HIGHLAND)	229
24	1748	VERMILION LAKE	227
25	1708	LAKE CHARLESTON	225
26	1755	FOX LAKE	212
27	1758	SLOCUM LAKE	210
28	1714	LAKE DECATUR	201

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
29	1725	LONG LAKE	195
30	1750	WONDER LAKE	183
31	1752	DEPUE LAKE	139

APPENDIX B

CONVERSIONS FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR ILLINOIS 10/23/75

LAKE CODE 1712 CRAB ORCHARD LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 520.6

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1712A1	520.6	3.57	5.04	6.40	6.63	5.24	4.28	2.66	1.40	1.03	1.19	1.66	1.94	3.41
1712A2	213.9	1.41	2.08	2.60	2.68	2.11	1.75	1.07	0.56	0.40	0.45	0.65	0.76	1.37
1712B1	10.3	0.06	0.10	0.12	0.12	0.10	0.08	0.05	0.02	0.02	0.02	0.03	0.03	0.06
1712C1	33.2	0.20	0.33	0.39	0.40	0.31	0.27	0.16	0.08	0.05	0.06	0.09	0.11	0.20
1712F1	4.6	0.03	0.05	0.05	0.05	0.04	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.03
1712ZZ	259.0	1.86	2.49	3.23	3.37	2.68	2.13	1.37	0.73	0.56	0.67	0.89	1.03	1.74

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 520.6 TOTAL FLOW IN = 41.05
SUM OF SUB-DRAINAGE AREAS = 521.1 TOTAL FLOW OUT = 41.05

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1712A1	6	73	2.01	3	3.79				
	7	73	0.0	8	0.0				
	8	73	0.0	4	0.0				
	9	73	0.0	2	0.0				
	10	73	0.0	7	0.0				
	11	73	9.74	4	0.0				
	12	73	9.80	2	2.92				
	1	74	11.07	6	0.91				
	2	74	2.15	3	3.51	16	0.0		
	3	74	11.47	2	1.13	17	12.37		
	4	74	3.37	5	2.46				
	5	74	1.47	4	2.46				
1712A2	6	73	1.02	3	1.81				
	7	73	0.07	7	0.13				
	8	73	0.00	4	0.01				
	9	73	0.06	2	0.00				
	10	73	0.03	7	0.01				
	11	73	5.10	4	0.03				
	12	73	5.83	2	0.34				
	1	74	6.74	6	1.98				
	2	74	1.59	3	0.62	16	0.27		
	3	74	4.64	2	0.48	17	5.07		
	4	74	1.33	5	1.08				
	5	74	0.96	4	0.48				

LAKE CODE 1712 CRAB ORCHARD LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1712B1	6	73	0.05	3	0.09				
	7	73	0.00	7	0.01				
	8	73	0.0	4	0.0				
	9	73	0.00	2	0.0				
	10	73	0.0	7	0.0				
	11	73	0.20	4	0.0				
	12	73	0.24	2	0.01				
	1	74	0.28	6	0.08				
	2	74	0.08	3	0.03	16	0.01		
	3	74	0.22	2	0.02	17	0.24		
	4	74	0.06	5	0.05				
	5	74	0.04	4	0.02				
1712C1	6	73	0.16	3	0.28				
	7	73	0.01	8	0.02				
	8	73	0.0	4	0.0				
	9	73	0.01	2	0.0				
	10	73	0.00	7	0.0				
	11	73	0.71	4	0.00				
	12	73	0.82	2	0.05				
	1	74	0.96	6	0.28				
	2	74	0.25	3	0.10	16	0.04		
	3	74	0.68	2	0.07	17	0.76		
	4	74	0.20	5	0.16				
	5	74	0.14	4	0.07				
1712F1	6	73	0.02	3	0.04				
	7	73	0.0	7	0.00				
	8	73	0.0	4	0.0				
	9	73	0.0	2	0.0				
	10	73	0.0	7	0.0				
	11	73	0.08	4	0.0				
	12	73	0.10	2	0.06				
	1	74	0.13	6	0.04				
	2	74	0.03	3	0.01	16	0.01		
	3	74	0.10	2	0.01	17	0.10		
	4	74	0.03	6	0.02				
	5	74	0.02	4	0.01				
1712ZZ	6	73	1.22	3	2.24				
	7	73	0.08	8	0.16				
	8	73	0.00	4	0.01				
	9	73	0.27	2	0.01				
	10	73	0.04	7	0.01				
	11	73	6.23	4	0.03				
	12	73	7.16	2	0.40				
	1	74	8.21	6	2.41				
	2	74	2.61	3	0.76	16	0.34		
	3	74	5.97	2	0.68	17	6.34		
	4	74	1.59	5	1.30				
	5	74	1.16	4	0.59				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/10/23

171201
37 43 50.0 089 08 30.0
CRAB ORCHARD LAKE
17199 ILLINOIS

11EPALES 2111202
3 0023 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/05/08	13 40	0000	18.4		20	275	8.30	39	0.080	0.800	0.150	0.013
	13 40	0004	18.4	8.3		270	8.10	38	0.080	0.700	0.080	0.006
	13 40	0015	18.3	8.1		220	8.10	38	0.100	0.700	0.060	0.011
	13 40	0020	18.2	7.8		300	8.10	39	0.110	0.600	0.060	0.013
73/08/08	15 40	0000	28.1		30	265	8.20	56	0.100	2.100	0.080	0.012
	15 40	0005	28.2	2.6		265	7.80	56	0.120	1.500	0.070	0.013
	15 40	0019	27.1	1.2		265	7.10	60	0.320	1.500	0.080	0.015
73/10/19	11 10	0000	20.6		15	225	7.70	53	0.070	0.700	0.210	0.018
	11 10	0005	20.5	6.4		223	7.60	53	0.040	0.600	0.200	0.013
	11 10	0014	20.4	5.6		224	7.50	54	0.070	0.600	0.220	0.014

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/08	13 40	0000	0.076	3.4
	13 40	0004	0.073	
	13 40	0015	0.053	
	13 40	0020	0.081	
73/08/08	15 40	0000	0.051	24.6
	15 40	0005	0.056	
	15 40	0019	0.051	
73/10/19	11 10	0000	0.071	29.4
	11 10	0005	0.076	
	11 10	0014	0.094	

STORET RETRIEVAL DATE 75/10/23

171202
37 43 10.0 089 05 25.0
CRAB ORCHARD LAKE
17199 ILLINOIS

11EPALES 2111202
3 0014 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/05/08	14 10	0000	18.3		24	240	8.20	37	0.100	0.700	0.090	0.006
	14 10	0004	18.3	8.8		240	8.20	36	0.100	0.800	0.100	0.008
	14 10	0010	18.3	8.7		240	8.20	34	0.100	0.600	0.100	0.010
73/08/08	16 10	0000	29.2		28	271	8.50	54	0.090	1.800	0.070	0.007
	16 10	0005	29.1	7.8		273	8.20	54	0.120	1.600	0.120	0.010
	16 10	0010	29.0	7.2		272	7.90	55	0.150	1.800	0.130	0.012
73/10/19	11 30	0000	20.1		16	222	7.90	51	0.040	0.800	0.040	0.007
	11 30	0006	19.9	8.2		223	7.80	48	0.050	0.800	0.040	0.022

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/08	14 10	0000	0.082	16.4
	14 10	0004	0.082	
	14 10	0010	0.080	
73/08/08	16 10	0000	0.084	70.4
	16 10	0005	0.085	
	16 10	0010	0.087	
73/10/19	11 30	0000	0.091	33.1
	11 30	0006	0.098	

STORET RETRIEVAL DATE 75/10/23

171203
37 41 45.0 089 02 20.0
CRAB ORCHARD LAKE
17199 ILLINOIS

11EPALES 2111202
3 0006 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/05/08	14 35	0000	17.9		5	290	8.10	38	0.090	1.100	0.120	0.022
	14 35	0004	17.6	8.0		200	8.10	30	0.140	0.600	0.220	0.018
73/08/08	16 25	0000	30.2		10	290J	9.00	66	0.170	3.300	0.180	0.115
	16 25	0002	30.3	14.0		290J	8.80	65	0.180	3.600	0.200	0.098
73/10/19	11 40	0000	18.5	9.4	12	294	8.40	65	0.070	1.900	0.070	0.047

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/08	14 35	0000	0.198	58.5
	14 35	0004	0.227	
73/08/08	16 25	0000	0.424	225.4
	16 25	0002	0.400	
73/10/19	11 40	0000	0.257	77.6

J VALUE KNOWN TO BE IN ERROR

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 75/10/23

1712A1
37 43 14.0 089 09 10.0
CRAB ORCHARD CREEK
17135 7.5 CARBONDALE
O/CRAB ORCHARD LAKE
ST RD 1901 BRDG BELO DAM AT OUTLET
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 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
73/06/03	08 30		0.067	1.760	0.420	0.042	0.120
73/07/08	09 11		0.250	2.600	0.650	0.046	0.095
73/08/04	10 30		0.220	1.800	0.294	0.040	0.190
73/09/02	10 21		0.230	1.200	0.131	0.024	0.110
73/10/07	08 55		0.357	0.800	0.090	0.020	0.105
73/11/04	08 25		0.260	0.850	0.066	0.029	0.080
73/12/02	08 20		0.680	0.700	0.062	0.040	0.115
74/01/06	09 05		0.232	1.800	0.116	0.024	0.090
74/02/03	08 45		0.192	0.900	0.100	0.030	0.125
74/02/16	08 30		0.060	1.400		0.025	0.215
74/03/02	11 15		0.028	1.600		0.025	0.200
74/03/17	10 50		0.046	1.600		0.030	0.210
74/04/05	09 40		0.038	2.300	0.075	0.020	0.150
74/05/04	08 10		0.024	1.000	0.145	0.025	0.145

STORET RETRIEVAL DATE 75/10/23

1712A2
37 41 48.0 088 59 16.0
CRAB ORCHARD CREEK
17 7.5 MARION
I/CRAB ORCHARD LAKE
RD BRDG 3 MI SW OF MARION
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 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
73/06/03	10 45		0.590	2.385	0.660	0.310	0.590
73/07/07	10 45		0.250	6.300	1.900	1.200	1.250
73/08/04	11 40		0.132	6.700	1.890	0.990	1.100
73/09/02	13 00		0.180	2.300	0.860	1.800	2.100
73/10/07	14 35		0.031	9.250	5.000	4.200	9.100
73/11/04	09 10		0.850	4.750	2.500		5.200
73/12/02	09 45		0.580	1.600	0.410	0.312	0.600
74/01/06	10 15		0.630	1.600	0.660	0.200	0.670
74/02/03	09 30		0.430	1.100	0.390	0.095	0.345
74/02/16	09 30		0.270	1.800	0.445	0.153	0.460
74/03/02	12 15		0.288	2.400	0.105	0.065	0.800
74/03/17	12 00		0.252	1.800	0.166	0.075	0.410
74/04/05	10 45		0.504	1.700	0.530	0.100	0.330
74/05/04	10 00		0.184	2.300	0.735	0.095	0.400

STORET RETRIEVAL DATE 75/10/23

1712B1
37 43 14.0 089 02 00.0
PIGEON CREEK
17 7.5 CRAB ORCHARD
T/CRAB ORCHARD LAKE
RD BRDG .75 MI WSW OF REFUGE HEADQUARTER
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 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
73/06/03	10 30		1.100	3.500	0.830	0.440	0.700
73/07/07	10 24		0.260	2.810		0.260	0.550
73/08/04	12 10		0.132	4.700	0.400	0.285	0.540
73/09/02	12 00		0.078	2.000	0.300	0.370	0.620
73/10/07	11 55		0.670	3.800	2.100	1.370	1.800
73/11/04	09 20		0.330	2.400	0.168	0.410	0.760
73/12/02	10 20		2.600	1.700	0.240	0.460	0.690
74/02/03	09 45		0.480	2.200	1.100	0.185	0.430
74/02/16	09 30		1.180	1.900	0.220	0.660	0.980
74/03/02	11 56		0.276	1.800	0.085	0.075	0.330
74/03/17	11 20		0.252	1.500	0.085	0.080	0.330
74/04/05	10 25		0.390	1.400	0.185	0.125	0.345
74/05/04	09 48		0.500	1.700	0.345	0.175	0.540

STORET RETRIEVAL DATE 75/10/23

1712C1
37 40 40.0 089 01 20.0
WOLF CREEK
17 7.5 CRAB ORCHARD
T/CRAB ORCHARD LAKE
RD BRDG 7 MI SW OF MARION
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 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
73/06/03	09 50		0.540	0.900	0.054	0.026	0.060
73/07/08	09 48		0.340	2.700		0.010	0.060
73/08/04	11 15		2.220	1.050	0.061	0.032	0.095
73/09/02	11 40		4.200	1.470	0.168	0.027	0.070
73/10/07	11 45		4.300	1.400	0.105	0.021	0.105
73/12/02	09 05		0.480	0.300	0.068	0.020	0.045
74/01/06	09 50		0.820	0.700	0.136	0.024	0.035
74/02/03	09 15		0.830	0.200	0.065	0.015	0.035
74/02/16	09 20		1.010	0.400	0.065	0.010	0.035
74/03/02	11 40		0.216	1.200	0.045	0.030	0.280
74/03/17	11 35		0.208	1.200	0.050	0.035	0.260
74/04/05	10 15		0.588	0.900	0.095	0.005	0.020
74/05/04	09 30		0.300	0.600	0.120	0.020	0.060

STORET RETRIEVAL DATE 75/10/23

1712D1
39 39 15.0 089 05 05.0
GRASSY CREEK
17 7.5 CRAB ORCHARD
T/CRAB ORCHARD LAKE
BRDG 1. MI E OF COTTAGE HOME CHURCH
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 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
73/06/03	09 29		0.016	1.980		0.013	0.035
73/07/07	10 03			4.600	0.460	0.009	0.045
73/08/04	11 00		0.016	2.700	0.086	0.010	0.060
73/09/02	11 30		0.035	1.320	0.058	0.014	0.110
73/10/07	09 15		0.046	1.400	0.110	0.022	0.080
73/11/04	08 50		0.020	1.225	0.044	0.033	0.065
73/12/02	08 55		0.040	0.400	0.028	0.008	0.025
74/01/06	09 30		0.108	0.800	0.096	0.008	0.020
74/02/03	09 15		0.176	0.700	0.065	0.010	0.025
74/02/16	08 55		0.192	0.300	0.025	0.010	0.030
74/03/02	11 22		0.148	0.750	0.020	0.010	0.050
74/03/17	11 20		0.136	0.600	0.030	0.010	0.040
74/04/05	10 00		0.136	0.700	0.072	0.005	0.020
74/05/04	09 15		0.092	0.500	0.050	0.010	0.030

STORET RETRIEVAL DATE 75/10/23

1712E1
37 40 35.0 089 05 58.0
LITTLE GRASSY CREEK
17 7.5 CRAB ORCHARD
T/CRAB ORCHARD LAKE
RD BRDG BELO CONFLU WITH LOST BRANCH
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 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
73/06/03	09 00		0.033	1.100	0.032	0.012	0.055
73/07/08	09 32		0.069	4.500	0.147	0.014	0.060
73/08/04	10 45		0.038	2.310	0.053	0.011	0.100
73/09/02	10 45		0.037	0.890	0.060	0.015	0.105
73/10/07	09 05		0.058	1.100	0.068	0.021	0.080
73/11/04	08 35		0.012	0.800	0.044	0.033	0.085
73/12/02	08 45		0.100	0.300	0.056	0.012	0.030
74/01/06	09 15		0.192	1.400	0.056	0.008	0.020
74/02/03	09 00		0.184	0.600	0.040	0.010	0.027
74/02/16	08 25		0.160	0.300	0.030	0.010	0.040
74/03/02	11 05		0.156	1.200	0.030	0.020	0.115
74/03/17	11 00		0.144	0.700	0.040	0.020	0.110
74/04/05	09 55		0.128	0.400	0.045	0.010	0.010
74/05/04	08 50		0.108	0.400	0.050	0.010	0.040

STORET RETRIEVAL DATE 75/10/23

1712F1
37 44 50.0 089 05 05.0
PIN OAK CREEK
17 7.5 CRAB ORCHARD
T/CRAB ORCHARD LAKE
HWY 13 BRDG .5 MI WSW OF CARTERVILLE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 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
73/06/03	11 13		0.294	7.800	0.720	0.690	1.200
73/07/07	11 40		0.086	10.000	2.400	1.100	1.800
73/08/04	12 25		0.930	15.000	2.900	1.000	1.100
73/09/02	12 15		0.063	12.600	6.850	4.200	5.000
73/10/07	12 10		0.120	27.000	17.000	14.000	14.000
73/11/04	09 40		0.540	16.000	9.300		10.500
73/12/02	10 30		0.116	3.850	1.800	1.200	1.720
74/02/03	10 45		0.860	4.400	0.970	1.250	2.400
74/02/16	09 55		0.440	6.000	2.200	1.500	2.300
74/03/02	12 45		0.380	2.100	0.315	0.308	0.790
74/03/17	12 20		0.360	2.200	0.320	0.330	0.840
74/04/06	15 00		0.240	1.900	0.200	0.340	0.500
74/05/04	10 40		0.690	4.300	1.350	1.000	2.630