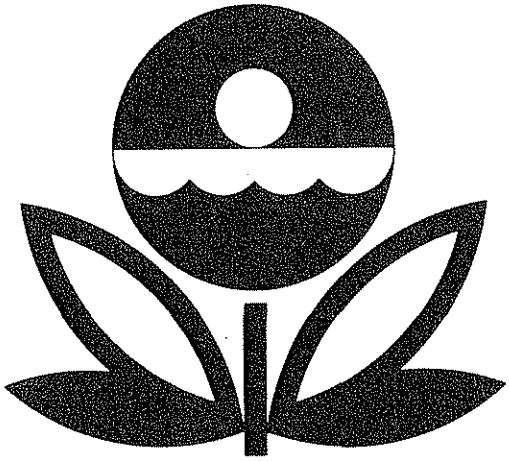
U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES



REPORT

ON

GRAND LAKE OF ST. MARYS

AUGLAIZE AND MERCER COUNTIES

OHIO

EPA REGION V

WORKING PAPER No. 411

PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

An Associate Laboratory of the

NATIONAL ENVIRONMENTAL RESEARCH CENTER - CORVALLIS, OREGON

and

NATIONAL ENVIRONMENTAL RESEARCH CENTER - LAS VEGAS, NEVADA

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WITH THE COOPERATION OF THE

OHIO ENVIRONMENTAL PROTECTION AGENCY

AND THE

OHIO NATIONAL GUARD

JUNE, 1975

CONTENTS

FOREWORD

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 Ohio Environmental Protection Agency for professional involvement, to the Ohio National Guard for conducting the tributary sampling phase of the Survey, and to those Ohio wastewater treatment plant operators who provided effluent samples and flow data.

Ned Williams, Director, and Tom Birch, Ken Carr, Larry Dietrick, Ron Havlice, Larry Korecko, Rod Mehlhop, Terry Wheeler, and John Youger, Ohio Environmental Protection Agency, 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.

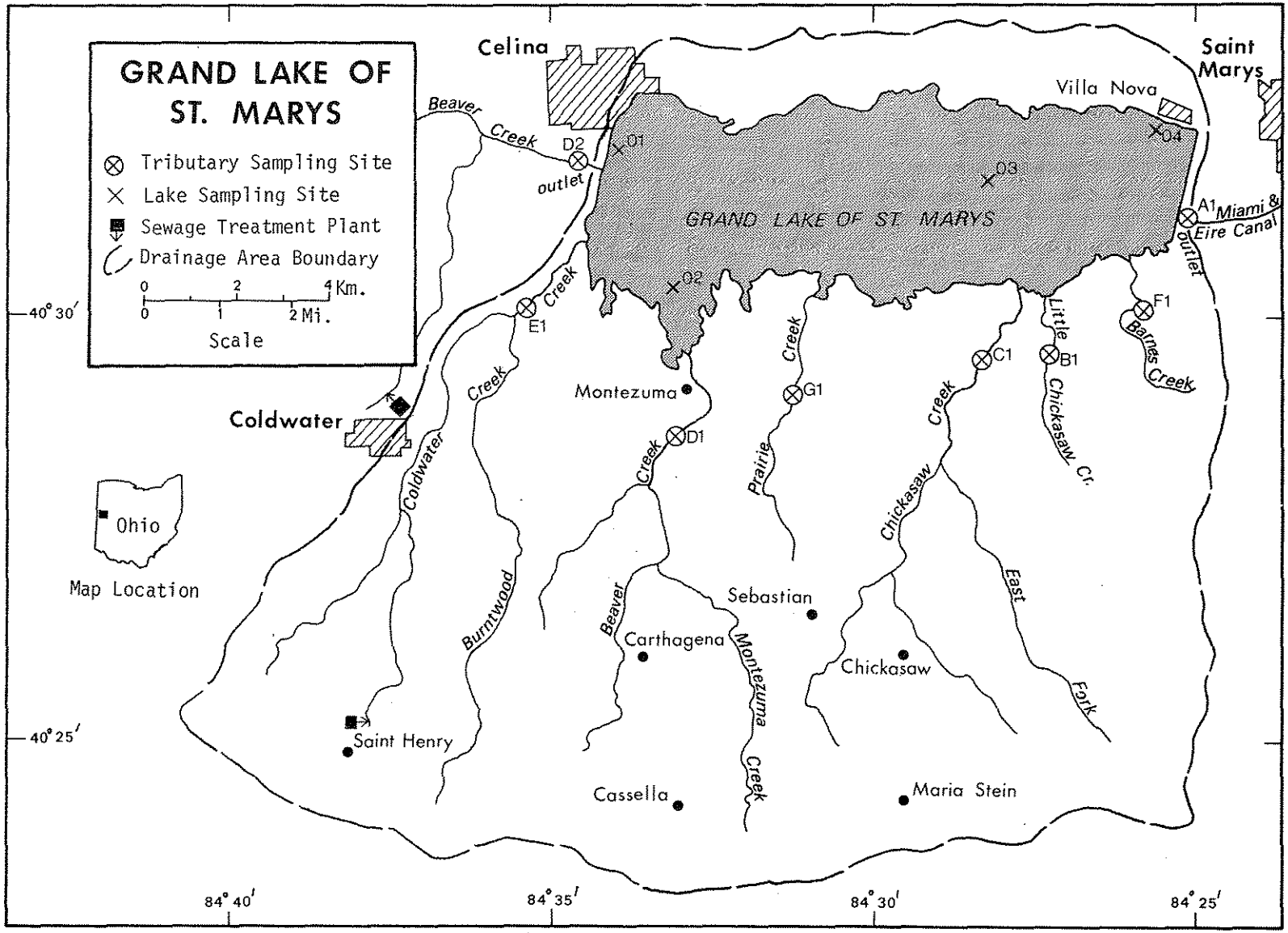
Major General Dana L. Stewart, then the Adjutant General of Ohio, and Project Officer Lt. Colonel Robert C. Timmons, who directed the volunteer efforts of the Ohio National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF OHIO

LAKE NAME	COUNTY
Atwood	Carroll, Tuscarawas
Beach City	Stark, Tuscarawas
Berlin	Mahoning, Portage, Stark
Buckeye	Fairfield, Licking, Perry
Charles Mill	Ashland, Richland
Deer Creek	Fayette, Pickaway
Delaware	Delaware
Dillon	Muskingum
Grand Lake of St. Marys	Auglaize, Mercer
Grant	Brown
Holiday	Huron
Hoover	Delaware, Franklin
Indian	Logan
Loramie	Auglaize, Shelby
Mosquito Creek	Trumbull
O'Shaughnessy	Delaware
Pymatuning	Ashtabula, OH; Crawford, PA
Pleasant Hill	Ashland, Richland
Rocky Fork	Highland
Shawnee	Greene
Tappan	Harrison


GRAND LAKE OF ST. MARYS
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Plant
Drainage Area Boundary
0 2 4 Km.
0 1 2 Mi.
Scale
Ohio
Map Location
Celina
Saint Marys
Villa Nova
Coldwater
Montezuma
Saint Henry
Carthagena
Sebastian
Chickasaw
Cassella
Maria Stein
Beaver Creek
outlet
Miami & Erie Canal
Coldwater Creek
Burntwood Creek
Prairie Creek
Chickasaw Creek
Little Chickasaw Cr.
Barnes Creek
East Fork
Montezuma Creek
O1
O2
O3
O4
D1
D2
E1
G1
C1
B1
A1
F1
40° 30′
40° 25′
84° 40′
84° 35′
84° 30′
84° 25′

GRAND LAKE OF ST. MARYS

STORET NO. 3927

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Grand Lake of St. Marys is eutrophic. It ranked seventh in overall trophic quality when the 20 Ohio lakes sampled in 1973 were compared using a combination of six parameters*. Fifteen of the lakes had less median total phosphorus, ten had less median dissolved phosphorus, one had less median inorganic nitrogen, 17 had less mean chlorophyll a, and 14 had greater mean Secchi disc transparency.

Survey limnologists reported heavy algal blooms at stations 2, 3, and 4 in May.

Almost continuous dredging of the lake is required to maintain satisfactory depths (Ketelle and Uttormark, 1971).

B. Rate-Limiting Nutrient:

The algal assay sample was lost in shipment. However, the lake data indicate phosphorus limitation at all sampling stations in May and at three of the four stations in August. The October data indicate nitrogen limitation at all stations.

C. Nutrient Controllability:

1. Point sources - During the sampling year, the phosphorus contribution of the listed point sources

* See Appendix A

amounted to only 8.0% of the input to Grand Lake of St. Marys. The wastewater treatment plant at St. Henry and septic tanks serving lakeshore dwellings were estimated to have accounted for 6.7% and 1.3% of the total, respectively.

The present phosphorus loading of 0.49 $g/m^2/yr$ is 1.8 times greater than that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 14). While even complete removal of phosphorus at the St. Henry treatment plant would not reduce the loading to the eutrophic level, the lake is phosphorus limited much of the time, and point-source phosphorus control should result in at least some improvement in the trophic condition of the lake, particularly if a significant portion of the phosphorus exports of two of the tributaries proves to be controllable (see below).

2. Non-point sources - It is estimated that phosphorus contribution of non-point sources accounted for 92% of the total load impacting Grand Lake of St. Marys during the sampling year. However the phosphorus export rates of several of the tributaries were high (see page 13) as compared to the 49 $kg/km^2/yr$ rate of Loramie Creek, a tributary of nearby Lake Loramie*. At least part of the higher export rates probably is due to agricultural runoff which is reported to be a problem in the lake

* Working Paper No. 405.

drainage basin (Youger, 1975). However, the 127 kg/km^2/yr rate of Coldwater Creek may have resulted from an unsampled point source (the Avco New Idea Company; see page 10), underestimation of the St. Henry wastewater treatment plant load, or both.

The high export rate of Prairie Creek (131 kg/km^2/yr) may have been due to discharges from the community of Sebastian. The National Guard tributary samplers reported that at times the waters of this creek were black and had an odor of raw sewage (Herfurth, 1973).

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 44.52 kilometers^2.
2. Mean depth: 3.0 meters.
3. Maximum depth: Unknown.
4. Volume: 133.560 x 10^6 m^3.
5. Mean hydraulic retention time: 1.6 years (based on outlet flow).

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

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Little Chickasaw Creek	18.2	0.2
Chickasaw Creek	47.7	0.5
Beaver Creek	52.8	0.5
Coldwater Creek	49.7	0.5
Barnes Creek	9.3	0.1
Prairie Creek	13.6	0.1
Minor tributaries & immediate drainage -	54.6	1.0
Totals	245.9	2.9

2. Outlet -

Beaver Creek (D-2)	171.5**	1.6
Miami & Erie Canal	118.9**	1.1
Total	290.4	2.7

C. Precipitation***:

1. Year of sampling: 114.7 centimeters.
2. Mean annual: 92.9 centimeters.

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† Youger, 1975.
* 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

Grand Lake of St. Marys 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 four stations on the lake and from one or more depths at each station (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and a similar sample was collected from each of the stations for chlorophyll a analysis. A sample was also collected for algal assays but was lost in shipment. The maximum depths sampled were 1.2 meters at station 1, 0.9 meters at station 2, 1.5 meters at station 3, and 0.9 meters at station 4.

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 LAKE SAINT MARYS
STORET CODE 3927

PARAMETER	1ST SAMPLING (5/ 4/73) 4 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (8/ 1/73) 4 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/11/73) 4 SITES RANGE	MEAN	MEDIAN
TEMP (C)	11.9 - 12.7	12.2	12.2	23.4 - 24.2	23.8	23.8	19.4 - 21.2	20.1	19.8
DISS OXY (MG/L)	8.6 - 9.4	8.9	8.9	6.8 - 8.2	7.5	7.6	7.8 - 11.0	9.4	9.4
CNDCTVY (MCROMO)	370. - 400.	389.	390.	338. - 350.	343.	342.	309. - 330.	318.	319.
PH (STAND UNITS)	7.2 - 8.2	7.9	8.1	8.6 - 9.1	8.8	8.8	8.8 - 9.2	9.0	9.1
TOT ALK (MG/L)	98. - 111.	105.	106.	88. - 96.	92.	93.	87. - 89.	88.	89.
TOT P (MG/L)	0.140 - 0.303	0.213	0.203	0.115 - 0.136	0.127	0.129	0.083 - 0.480	0.194	0.106
ORTHO P (MG/L)	0.011 - 0.018	0.013	0.012	0.010 - 0.018	0.013	0.012	0.023 - 0.041	0.032	0.032
NO2+NO3 (MG/L)	0.090 - 0.130	0.109	0.105	0.100 - 0.170	0.145	0.155	0.050 - 0.060	0.052	0.050
AMMONIA (MG/L)	0.090 - 0.130	0.105	0.110	0.090 - 0.130	0.107	0.105	0.070 - 0.100	0.082	0.080
KJEL N (MG/L)	2.000 - 3.400	2.612	2.550	2.000 - 2.200	2.100	2.100	1.200 - 1.700	1.375	1.300
INORG N (MG/L)	0.180 - 0.260	0.214	0.215	0.190 - 0.300	0.252	0.260	0.120 - 0.160	0.135	0.130
TOTAL N (MG/L)	2.100 - 3.500	2.721	2.665	2.150 - 2.360	2.245	2.235	1.250 - 1.750	1.427	1.355
CHLRPYL A (UG/L)	56.0 - 144.5	100.9	101.6	69.7 - 88.4	82.1	85.1	45.3 - 63.2	54.4	54.6
SECCHI (METERS)	0.1 - 0.3	0.1	0.1	0.4 - 0.5	0.4	0.5	0.2 - 1.0	0.6	0.7

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
05/04/73	1. Oscillatoria sp.	66,768
	2. Fragilaria sp.	15,396
	3. Flagellates	7,622
	4. Stephanodiscus sp.	6,707
	5. Scenedesmus sp.	3,506
	Other genera	16,464
	Total	116,463
08/01/73	1. Lyngbya sp.	19,563
	2. Anabaenopsis sp.	9,350
	3. Oscillatoria sp.	5,589
	4. Nitzschia sp.	3,049
	5. Stephanodiscus sp.	2,744
	Other genera	10,874
	Total	51,169
10/11/73	1. Lyngbya sp.	10,036
	2. Microcystis sp.	2,936
	3. Dactylococcopsis sp.	2,731
	4. Oscillatoria sp.	1,911
	5. Aphanizomenon sp.	1,638
	Other genera	7,099
	Total	26,351

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
05/04/73	01	56.0
	02	75.9
	03	144.5
	04	127.3
08/01/73	01	86.2
	02	84.1
	03	88.4
	04	69.7
10/11/73	01	61.8
	02	63.2
	03	45.3
	04	47.4

C. Limiting Nutrient Study:

The sample collected for algal assays was lost in shipment. The lake data indicate a combination of limiting nutrients. Following is a tabulation of the mean inorganic nitrogen to orthophosphorus ratios for each of the stations and sampling times with the indicated limiting nutrient in parenthesis.

Station	05/04/73	08/01/73	10/11/73
01	18/1 (P)	7/1 (N)	4/1 (N)
02	25/1 (P)	21/1 (P)	4/1 (N)
03	16/1 (P)	19/1 (P)	4/1 (N)
04	20/1 (P)	22/1 (P)	5/1 (N)

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Ohio 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 March and April when two samples were collected. Sampling was begun in May, 1973, and was completed in April, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Ohio 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 loads shown are those measured minus point-source loads, if any.

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

The community of St. Henry did not participate in the Survey, and nutrient loads were estimated at 1.134 kg P and 3.401 kg N/capita/year.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal* -

Name	Pop. Served**	Treatment	Mean Flow (m^3/d)***	Receiving Water
St. Henry	1,276	ext. aer.	483.0	Coldwater Creek

2. Known industrial† -

Name	Product	Treatment	(m^3/d)	Water
Avco New Idea	?	?	?	Coldwater Creek

* Treatment plant questionnaire.
** 1970 Census.
*** Estimated at 0.3785 m^3/capita/day.
† Youger, 1975.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
Little Chickasaw Creek	825	3.8
Chickasaw Creek	3,450	15.9
Beaver Creek	2,960	13.7
Coldwater Creek	6,430	29.7
Barnes Creek	635	2.9
Prairie Creek	1,785	8.2
b. Minor tributaries & immediate drainage (non-point load) -	3,085	14.2
c. Known municipal STP's -		
St. Henry	1,445	6.7
d. Septic tanks* -	275	1.3
e. Known industrial - Avco New Idea	?	?
f. Direct precipitation** -	780	3.6
Total	21,670	100.0

2. Outputs -

Lake outlet -	Beaver Creek	9,695
	Miami & Erie Canal	5,325
	Tot.	15,020

3. Net annual P accumulation - 6,650 kg.

* Estimate based on 500 permanent and 169 seasonal shoreline dwellings and one state park; 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) -		
Little Chickasaw Creek	27,335	6.7
Chickasaw Creek	61,085	15.0
Beaver Creek	58,905	17.0
Coldwater Creek	66,625	16.4
Barnes Creek	14,295	3.5
Prairie Creek	22,515	5.5
b. Minor tributaries & immediate drainage (non-point load) -	82,965	20.4
c. Known municipal STP's -		
St. Henry	4,340	1.1
d. Septic tanks* -	10,325	2.6
e. Known industrial - Avco New Idea	?	?
f. Direct precipitation** -	48,065	11.8
Total	406,455	100.0

2. Outputs -

Lake outlet -	Beaver Creek	141,490
	Miami & Erie Canal	96,345
	Tot.	237,835

3. Net annual N accumulation - 168,620 kg.

* Estimate based on 500 permanent and 169 seasonal shoreline dwellings and one state park; see Working Paper No. 175.
** See Working Paper No. 175.

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

Tributary	kg P/km^2/yr	kg N/km^2/yr
Little Chickasaw Creek	45	1,502
Chickasaw Creek	72	1,281
Beaver Creek	56	1,305
Coldwater Creek	129	1,340
Barnes Creek	68	1,537
Prairie Creek	131	1,656

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading 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/m^2/yr	0.49	0.15	9.1	3.8

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Grand Lake of St. Marys:

"Dangerous" (eutrophic loading)	0.28
"Permissible" (oligotrophic loading)	0.14

V. LITERATURE REVIEWED

Herfurth, Sgt., 1973, Personal communication (comments on tributary samples). Co. A(-) 1/148th Infantry, St. Marys.

Ketelle, Martha J. and Paul D. Uttormark, 1971. Problem lakes in the United States. EPA Water Poll. Contr. Res. Ser., Proj. #16010 EHR, Washington, DC.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

Youger, John, 1975. Personal communication (lake morphometry; review of preliminary report). OH Env. Prot. Agency, Columbus.

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
3901	BEACH CITY RESERVOIR	0.122	1.990	489.000	10.867	11.600	0.015
3902	BUCKEYE LAKE	0.179	0.380	490.000	186.567	9.600	0.020
3905	CHARLES MILL RESERVOIR	0.127	0.465	482.555	67.144	15.000	0.011
3906	DEER CREEK RESERVOIR	0.098	2.980	470.125	9.887	13.900	0.036
3907	DELAWARE RESERVOIR	0.086	2.340	484.111	10.856	14.500	0.024
3908	DILLION RESERVOIR	0.163	1.590	481.250	27.400	14.300	0.037
3912	GRANT LAKE	0.113	0.570	486.333	40.533	12.200	0.019
3914	HOOVER RESERVOIR	0.040	1.640	462.750	13.017	14.800	0.008
3915	INDIAN LAKE	0.120	0.380	485.222	76.855	14.200	0.012
3917	LORAMIE LAKE	0.185	1.380	494.000	104.100	8.200	0.019
3921	MOSQUITO CREEK RESERVOIR	0.058	0.150	465.333	36.267	11.600	0.006
3924	PLEASANT HILL LAKE	0.036	0.455	456.833	22.850	14.700	0.010
3927	LAKE SAINT MARYS	0.148	0.200	484.167	79.150	8.200	0.014
3928	ATWOOD RESERVOIR	0.031	0.205	462.000	16.442	14.700	0.005
3929	BERLIN RESERVOIR	0.042	0.900	465.435	15.496	13.600	0.006
3930	HOLIDAY LAKE	0.125	0.575	465.333	55.350	15.000	0.034
3931	O'SHAUGNESSY RESERVOIR	0.208	3.070	479.333	5.522	14.900	0.159
3932	ROCKY FORK LAKE	0.067	0.790	473.000	38.022	15.000	0.010
3933	SHAWNEE LAKE	0.069	2.380	474.333	39.567	15.000	0.009
3934	TAPPAN LAKE	0.040	0.280	466.111	37.711	15.000	0.007

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 NU
3901	BEACH CITY RESERVOIR	37 (7)	21 (4)	11 (2)	84 (16)	82 (15)	42 (8)	277
3902	BUCKEYE LAKE	11 (2)	76 (14)	5 (1)	0 (0)	89 (17)	26 (5)	207
3905	CHARLES MILL RESERVOIR	26 (5)	63 (12)	37 (7)	21 (4)	11 (0)	58 (11)	216
3906	DEER CREEK RESERVOIR	53 (10)	5 (1)	63 (12)	95 (18)	63 (12)	11 (2)	290
3907	DELAWARE RESERVOIR	58 (11)	16 (3)	32 (6)	89 (17)	47 (9)	21 (4)	263
3908	DILLION RESERVOIR	16 (3)	32 (6)	42 (8)	58 (11)	53 (10)	5 (1)	206
3912	GRANT LAKE	47 (9)	58 (11)	16 (3)	32 (6)	74 (14)	34 (6)	261
3914	HOOVER RESERVOIR	87 (16)	26 (5)	89 (17)	79 (15)	32 (6)	79 (15)	392
3915	INDIAN LAKE	42 (8)	76 (14)	21 (4)	16 (3)	58 (11)	53 (10)	266
3917	LORAMIE LAKE	5 (1)	37 (7)	0 (0)	5 (1)	97 (18)	34 (6)	178
3921	MOSQUITO CREEK RESERVOIR	74 (14)	100 (19)	82 (15)	53 (10)	82 (15)	92 (17)	483
3924	PLEASANT HILL LAKE	95 (18)	68 (13)	100 (19)	63 (12)	39 (7)	66 (12)	431
3927	LAKE SAINT MARYS	21 (4)	95 (18)	26 (5)	11 (2)	97 (18)	47 (9)	297
3928	ATWOOD RESERVOIR	100 (19)	89 (17)	95 (18)	68 (13)	39 (7)	100 (19)	491
3929	BERLIN RESERVOIR	79 (15)	42 (8)	74 (14)	74 (14)	68 (13)	92 (17)	429
3930	HOLIDAY LAKE	32 (6)	53 (10)	82 (15)	26 (5)	11 (0)	16 (3)	220
3931	O'SHAUGNESSY RESERVOIR	0 (0)	0 (0)	47 (9)	100 (19)	26 (5)	0 (0)	173
3932	ROCKY FORK LAKE	68 (13)	47 (9)	58 (11)	42 (8)	11 (0)	66 (12)	292
3933	SHAWNEE LAKE	63 (12)	11 (2)	53 (10)	37 (7)	11 (0)	74 (14)	249
3934	TAPPAN LAKE	87 (16)	84 (16)	68 (13)	47 (9)	11 (0)	84 (16)	381

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3926	ATWOOD RESERVOIR	491
2	3921	MOSQUITO CREEK RESERVOIR	483
3	3924	PLEASANT HILL LAKE	431
4	3929	BERLIN RESERVOIR	429
5	3914	HOOVER RESERVOIR	392
6	3934	TAPPAN LAKE	381
7	3927	LAKE SAINT MARYS	297
8	3932	ROCKY FORK LAKE	292
9	3906	DEER CREEK RESERVOIR	290
10	3901	BEACH CITY RESERVOIR	277
11	3915	INDIAN LAKE	266
12	3907	DELAWARE RESERVOIR	263
13	3912	GRANT LAKE	261
14	3933	SHAWNEE LAKE	249
15	3930	HOLIDAY LAKE	220
16	3905	CHARLES MILL RESERVOIR	216
17	3902	BUCKEYE LAKE	207
18	3908	DILLION RESERVOIR	206
19	3917	LORAMIE LAKE	178
20	3931	O'SHAUGNESSY RESERVOIR	173

APPENDIX B

CONVERSION 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 OHIO 1/27/75

LAKE CODE 3927 GRAND LAKE, ST. MARYS

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 290.1

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3927A1	118.9	1.70	2.04	2.94	2.38	1.36	0.76	0.51	0.24	0.18	0.22	0.45	0.96	1.14
3927B1	18.2	0.26	0.31	0.45	0.37	0.22	0.12	0.07	0.04	0.02	0.03	0.07	0.15	0.17
3927C1	47.7	0.68	0.82	1.19	0.96	0.54	0.31	0.20	0.10	0.07	0.09	0.18	0.40	0.46
3927D1	52.8	0.76	0.91	1.30	1.05	0.62	0.34	0.22	0.11	0.08	0.10	0.20	0.42	0.51
3927D2	171.5	2.44	2.92	4.19	3.40	1.98	1.10	0.71	0.34	0.25	0.31	0.65	1.42	1.64
3927E1	49.7	0.71	0.85	1.22	0.99	0.57	0.31	0.21	0.10	0.07	0.09	0.19	0.40	0.47
3927F1	9.3	0.13	0.16	0.24	0.20	0.11	0.06	0.04	0.02	0.01	0.02	0.03	0.07	0.09
3927G1	13.6	0.19	0.24	0.34	0.28	0.16	0.08	0.06	0.03	0.02	0.02	0.05	0.11	0.13
3927Z7	98.9	1.42	1.67	2.41	1.93	1.13	0.65	0.42	0.21	0.16	0.19	0.40	0.82	0.95

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 290.1
SUM OF SUB-DRAINAGE AREAS = 580.6
TOTAL FLOW IN = 66.99
TOTAL FLOW OUT = 0.0

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3927A1	5	73	0.74	6	0.42				
	6	73	2.29	9	1.22				
	7	73	0.48	15	0.25				
	8	73	0.54	12	0.54				
	9	73	0.54	9	0.54				
	10	73	0.57	13	0.57				
	11	73	0.54	11	0.54				
	12	73	0.51	8	0.51				
	1	74	0.51	12	0.51				
	2	74	0.51	17	0.51				
	3	74	0.51	3	0.51	19	0.51		
	4	74	0.51	2	0.51	21	0.51		
3927B1	5	73	0.12	6	0.07				
	6	73	0.34	9	0.18				
	7	73	0.07	15	0.04				
	8	73	0.17	12	0.09				
	9	73	0.10	9	0.10				
	10	73	0.03	13	0.03				
	11	73	0.12	11	0.05				
	12	73	0.15	8	0.03				
	1	74	0.74	12	0.06				
	2	74	0.15	17	0.07				
	3	74	0.31	3	0.24	19	0.16		
	4	74	0.31	2	0.13	21	0.06		

TRIBUTARY FLOW INFORMATION FOR OHIO 1/27/75

LAKE CODE 3927 GRAND LAKE, ST. MARYS

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
392701	5	73	0.28	6	0.16				
	6	73	0.93	9	0.51				
	7	73	0.29	15	0.12				
	8	73	0.45	12	1.59				
	9	73	0.01	9	0.01				
	10	73	0.08	13	0.08				
	11	73	0.31	11	0.13				
	12	73	0.40	8	0.08				
	1	74	1.95	12	0.16				
	2	74	0.42	17	0.17				
	3	74	0.85	3	0.62	19	0.45		
	4	74	0.85	2	0.37	21	0.16		
392701	5	73	0.34	6	0.19				
	6	73	1.02	9	0.54				
	7	73	0.22	15	0.13				
	8	73	0.51	12	1.76				
	9	73	0.00	9	0.00				
	10	73	0.09	13	0.09				
	11	73	0.34	11	0.14				
	12	73	0.42	8	0.08				
	1	74	2.21	12	0.18				
	2	74	0.48	17	0.19				
	3	74	0.93	3	0.71	19	0.48		
	4	74	0.91	2	0.40	21	0.17		
392702	5	73	1.10	6	0.62				
	6	73	3.31	9	1.76				
	7	73	0.71	15	0.42				
	8	73	1.59	12	0.54				
	9	73	1.76	9	2.63				
	10	73	0.03	13	0.03				
	11	73	0.42	11	0.03				
	12	73	2.76	8	2.76				
	1	74	5.27	12	5.13				
	2	74	5.49	17	5.32				
	3	74	3.57	3	5.27	19	5.21		
	4	74	1.42	2	0.67	21	0.54		
392701	5	73	0.31	6	0.19				
	6	73	0.93	9	0.51				
	7	73	0.29	15	0.12				
	8	73	0.48	12	1.67				
	9	73	0.02	9	0.02				
	10	73	0.08	13	0.08				
	11	73	0.34	11	0.14				
	12	73	0.40	8	0.08				
	1	74	2.04	12	0.16				
	2	74	0.45	17	0.18				
	3	74	0.85	3	0.62	19	0.45		
	4	74	0.85	2	0.37	21	0.16		

TRIBUTARY FLOW INFORMATION FOR OHIO 1/27/75

LAKE CODE 3927 GRAND LAKE, ST. MARYS

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3927F1	5	73	0.06	6	0.03				
	6	73	0.17	9	0.09				
	7	73	0.04	15	0.02				
	8	73	0.08	12	0.31				
	9	73	0.00	9	0.0				
	10	73	0.01	13	0.01				
	11	73	0.05	11	0.02				
	12	73	0.07	8	0.01				
	1	74	0.37	12	0.03				
	2	74	0.08	17	0.03				
	3	74	0.17	3	0.13	19	0.09		
	4	74	0.17	2	0.07	21	0.03		
3927G1	5	73	0.09	6	0.05				
	6	73	0.25	9	0.13				
	7	73	0.06	15	0.03				
	8	73	0.12	12	0.45				
	9	73	0.00						
	10	73	0.02	13	0.02				
	11	73	0.08	11	0.04				
	12	73	0.11	8	0.02				
	1	74	0.57	12	0.05				
	2	74	0.12	17	0.05				
	3	74	0.24	3	0.18	19	0.12		
	4	74	0.25	2	0.11	21	0.05		
3927ZZ	5	73	0.62						
	6	73	1.95						
	7	73	0.42						
	8	73	0.45						
	9	73	0.00						
	10	73	0.08						
	11	73	0.31						
	12	73	0.40						
	1	74	1.95						
	2	74	0.42						
	3	74	0.82						
	4	74	0.82						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/01/27

392701
40 32 07.0 084 34 11.0
LAKE SAINT MARYS
39107 OHIO

11EPALES
3

2111202
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
73/05/04	09 30	0000	12.7		10	400	7.20	98	0.110	2.000	0.100	0.012
	09 30	0004	12.7	8.6		380	7.70	99	0.110	2.200	0.110	0.012
73/08/01	12 00	0000	24.2	6.8	18	344	9.10	96	0.120	2.200	0.160	0.018
73/10/11	14 35	0000	20.4	7.8	8	330	9.10	88	0.100	1.200	0.060	0.041

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/04	09 30	0000	0.188	56.0
	09 30	0004	0.176	
73/08/01	12 00	0000	0.136	66.2
73/10/11	14 35	0000	0.480	61.8

STORET RETRIEVAL DATE 75/01/27

392702
40 30 34.0 084 33 12.0
LAKE SAINT MARYS
39107 OHIO

11EPALES
3

2111202
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
73/05/04	10 00	0000	11.9		3	400	8.00	107	0.090	2.200	0.090	0.012
	10 00	0003	12.2	9.0		400	8.10	108	0.090	2.400	0.100	0.018
73/08/01	11 40	0000	23.4	7.2	16	350	8.60	94	0.130	2.000	0.170	0.014
73/10/11	14 50	0000	19.4	8.0	16	319	8.80	89	0.080	1.700	0.050	0.033

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/04	10 00	0000	0.140	75.9
	10 00	0003	0.157	
73/08/01	11 40	0000	0.131	84.1
73/10/11	14 50	0000	0.123	63.2

STORET RETRIEVAL DATE 75/01/27

392703
40 31 38.0 084 28 18.0
LAKE SAINT MARYS
39107 OHIO

11EPALES 2111202
3 0007 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
73/05/04	10 30	0000	12.2		2	370	8.10	102	0.110	3.200	0.110	0.012
	10 30	0005	12.2	8.8		400	8.20	108	0.090	3.400	0.100	0.014
73/08/01	11 00	0000	23.7	8.0	18	338	8.80	88	0.090	2.200	0.100	0.010
73/10/11	15 10	0000	19.6	10.8	39	313	9.10	89	0.080	1.400	0.050	0.032
	15 10	0004	19.7			309						

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/04	10 30	0000	0.219	144.5
	10 30	0005	0.268	
73/08/01	11 00	0000	0.115	88.4
73/10/11	15 10	0000	0.089	45.3

STORET RETRIEVAL DATE 75/01/27

392704
40 32 29.0 084 25 39.0
LAKE SAINT MARYS
39011 OHIO

11EPALES
3

2111202
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
73/05/04	10 50	0000	12.0		3	380	8.10	105	0.110	2.800	0.130	0.014
	10 50	0003	12.1	9.4		380	8.10	111	0.130	2.700	0.130	0.011
73/08/01	11 00	0000	23.9	8.2	18	339	8.90	91	0.090	2.000	0.150	0.011
73/10/11	15 20	0000	21.2	11.0	39	321	9.20	87	0.070	1.200	0.050	0.023

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/04	10 50	0000	0.303	127.3
	10 50	0003	0.257	
73/08/01	11 00	0000	0.128	69.7
73/10/11	15 20	0000	0.083	47.4

APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/02/03

3927A1
40 31 16.0 084 25 17.0
MIAMI AND ERIE CANAL
39139 7.5 ST MARYS
O/GRAND LAKE OF ST MARYS
AT FLOODGATE NEAR BULKHEAD
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
73/05/06	07 45		0.010K	2.100	0.011	0.014	0.190
73/06/09	14 25		0.010K	1.260	0.128	0.017	0.115
73/07/15	14 15		0.027	2.500	0.045	0.028	0.125
73/08/12	09 15		0.022	1.800	0.019	0.017	0.115
73/09/09	13 40		0.015	1.800	0.021	0.010	0.123
73/10/13	10 25		0.038	1.850	0.052	0.012	0.135
73/11/11	11 00		0.056	0.900	0.028	0.015	0.102
73/12/08	10 00		0.440	1.100	0.036	0.024	0.095
74/01/13	10 40		0.430	1.800	0.140	0.010	0.065
74/02/17	10 30		1.260	1.600	0.090	0.015	0.145
74/03/03	11 15		1.500	2.100	0.050	0.035	0.280
74/03/19	19 40		1.180	2.000	0.020	0.055	0.200
74/04/02	17 45		1.440	2.500	0.030	0.075	0.240
74/04/21	11 30		0.284	2.400	0.027	0.035	0.190

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/03

392/81
40 29 40.0 084 27 25.0
LITTLE CHICKASAW CREEK
39 7.5 NEW BREMEN
T/GRAND LAKE OF ST MARYS
ST RT 703 BRDG NEAR COUNTY LINE JCT
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
73/05/06	08 20		2.500	1.260	0.060	0.042	0.080
73/06/09	14 55		4.800	1.900	0.126	0.088	0.152
73/07/15	14 40		2.600	1.470	0.154	0.120	0.220
73/08/12	09 50		6.000	3.900	0.230	0.405	1.050
73/09/09	13 50		0.410	1.260	0.110	0.019	0.090
73/10/13	11 10		0.010K	1.650	0.042	0.020	0.135
73/11/11	11 45		0.040	1.800	0.132	0.072	0.190
73/12/08	10 40		3.700	1.100	0.176	0.148	0.180
74/01/13	09 30		3.960	1.400	0.440	0.130	0.280
74/02/17	11 20		3.780	0.700	0.140	0.085	0.180
74/03/03	10 25		4.500	0.700	0.040	0.060	0.150
74/03/19	19 55		3.700	0.700	0.050	0.060	0.115
74/04/02	17 50		4.200	1.025	0.080	0.075	0.160
74/04/21	11 15		2.700	0.900	0.060	0.040	0.045

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/03

3927C1
40 29 40.0 084 28 25.0
CHICKASAW CREEK
39 7.5 NEW BREMEN
T/GRAND LAKE OF ST MARYS
ST RT 703 BRDG NEAR JCT WITH BEHM RD
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
73/05/06	08 30		2.200	1.200	0.052	0.084	0.150
73/06/09	15 10		0.074	1.300	0.024	0.023	0.230
73/07/15	14 55		0.990	1.760	0.120	0.031	0.145
73/08/12	10 10		3.900	4.100	0.260	0.460	1.330
73/09/09	14 05		0.056	1.760	0.025	0.044	0.220
73/10/13	11 20		0.020	2.100	0.120	0.069	0.325
73/11/11	12 05		0.560	2.400	0.690	0.240	0.375
73/12/04	11 00		3.060	1.400	0.430	0.270	0.339
74/01/13	09 50		3.200	1.500	0.600	0.260	0.345
74/02/17	11 45		3.700	1.400	0.240	0.135	0.210
74/03/03	10 05		3.900	1.100	0.120	0.120	0.250
74/03/19	20 05		3.700	0.700	0.115	0.125	0.195
74/04/02	15 15		3.700	1.200	0.090	0.120	0.220
74/04/21	11 00		2.400	1.000	0.025	0.090	0.120

STORET RETRIEVAL DATE 75/02/03

392701
40 28 46.0 084 33 02.0
BEAVER CREEK
39 7.5 MONTEZUMA
T/GRAND LAKE OF ST MARYS
GUADALUPE RD BRDG .5 MI S OF MONTEZU
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
73/05/06	09 00		1.100	1.400	0.035	0.048	0.115
73/06/09	15 55		3.300	1.760	0.220	0.120	0.200
73/07/15	15 00		0.115	1.320	0.160	0.033	0.135
73/08/12	09 35		5.500	5.100	0.540	0.450	1.450
73/09/09	14 30		0.040	1.260	0.071	0.072	0.240
73/10/13	12 45		0.010K	0.350	0.036	0.054	0.070
73/11/11	14 00		0.580	2.400	0.700	0.176	0.290
73/12/08	11 46		3.300	1.300	0.270	0.216	0.290
74/01/12	11 30		3.200	1.000	0.312	0.160	0.220
74/02/17	12 25		3.780	0.900	0.195	0.125	0.195
74/03/03	09 15		4.300	1.000	0.065	0.085	0.210
74/03/19	20 30		3.520	0.800	0.085	0.100	0.165
74/04/02	16 30		3.700	1.300	0.090	0.100	0.195
74/04/21	10 25		1.380	1.100	0.040	0.045	0.115

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/03

392702
40 32 05.0 084 34 40.0
BEAVER CREEK
39 7.5 CELINA
O/GRAND LAKE OF ST MARYS
US 127 BRDG S OF CELINA
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
73/05/05	09	20	0.086	2.730	0.094	0.016	0.180
73/06/09	16	40	0.200	2.400	0.120	0.019	0.125
73/07/15	14	14	0.027	2.250	0.027	0.023	0.150
73/08/12	10	10	0.094	1.100	0.039	0.022	0.135
73/09/04	14	55	0.010K	2.000	0.020	0.033	0.180
73/10/13	14	15	0.180	1.340	0.515	0.010	0.280
73/11/11	14	15	0.860	2.300	0.950	0.044	0.220
73/12/08	12	30	0.330	0.800	0.044	0.032	0.120
74/01/12	10	30	1.010	1.100	0.156	0.024	0.080
74/02/17	12	40	1.700	1.650	0.075	0.030	0.143
74/03/03	08	50	1.300	3.000	0.060	0.050	0.375
74/03/14	21	05	1.100	1.600	0.020	0.040	0.165
74/04/02	18	30	0.650	3.000	0.045	0.025	0.300
74/04/21	09	30	0.330	2.700	0.015	0.035	0.195

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/03

392761
40 30 15.0 084 35 30.0
COLDWATER CREEK
39 7.5 CELINA
1/GRAND LAKE OF ST MARYS
COLDWATER CREEK RD BRDG NW OF MONTEZUMA
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
73/05/06	09 10		1.200	1.150	0.037	0.200	0.270
73/06/09	16 20		3.000	1.900	0.189	0.252	0.340
73/07/15	14 21		0.640	2.300	0.115	0.042	0.230
73/08/12	09 55		6.700	4.600	0.460	0.360	1.200
73/09/09	14 45		0.086	1.980	0.180	0.220	0.450
73/10/13	13 45		0.066	3.200	0.490	0.970	1.100
73/11/11	13 55		0.760	1.880	0.645	1.440	1.600
73/12/06	12 05		3.700	2.000	0.570	0.480	0.600
74/01/12	11 00		3.360	1.100	0.470	0.224	0.300
74/02/17	13 10		3.700	0.800	0.175	0.145	0.210
74/03/03	08 30		4.300	1.200	0.100	0.165	0.330
74/03/19	20 55		3.780	0.800	0.060	0.140	0.235
74/04/02	18 00		3.800	1.200	0.090	0.160	0.250
74/04/21	09 15		1.400	1.200	0.045	0.240	0.330

STORET RETRIEVAL DATE 75/02/03

3927F1
40 30 15.0 084 26 00.0
BARNES CREEK
39 7.5 ST MARYS
T/GRAND LAKE OF ST MARYS
RT 364 BRDG 4 MI SW OF ST MARYS
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
73/05/06	08 10		3.300	1.470	0.056	0.033	0.115
73/06/09	14 40		0.010K	1.260	0.011	0.010	0.220
73/07/15	14 30		2.700	2.700	0.090	0.019	0.165
73/08/12	09 35		6.700	3.570	0.320	0.350	0.700
73/09/09	13 45		0.010K	2.520	0.046	0.040	0.310
73/10/13	10 45		0.015	3.500	0.060	0.042	0.490
73/11/11	11 25		0.750	1.950	0.216	0.024	0.140
73/12/08	10 25		3.300	0.800	0.152	0.124	0.180
74/01/12	10 15		3.900	1.000	0.132	0.116	0.165
74/02/17	11 00		4.100	0.600	0.085	0.060	0.105
74/03/03	10 50		4.600	0.700	0.025	0.045	0.120
74/03/19	19 50		3.900	0.700	0.030	0.065	0.115
74/04/02	18 05		4.100	1.000	0.065	0.060	0.185
74/04/21	11 20		2.800	1.100	0.035	0.050	0.150

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/03

392761
40 29 15.0 084 31 30.0
PRAIRIE CREEK
39 7.5 MONTEZUMA
I/GRAND LAKE OF ST MARYS
RT 219 1.5 MI E OF MONTEZUMA
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
73/05/06	08 45		2.700	2.100	0.110	0.176	0.250
73/06/09	15 35		6.450	1.380	0.088	0.016	0.240
73/07/15	14 50		0.290	0.990	0.048	0.240	0.360
73/08/12	09 10		5.600	3.700	0.240	0.620	1.000
73/09/09	14 20		0.720	1.700	0.180	0.700	1.050
73/10/13	11 50		0.010K		0.600	1.470	
73/12/08	11 20		2.940	1.800	0.400	0.400	0.590
74/01/12	12 20		3.300	1.300	0.390	0.288	0.380
74/02/17	12 05		3.900	1.100	0.180	0.150	0.320
74/03/03	09 40		4.500	0.900	0.050	0.092	0.195
74/03/19	20 15		3.780	0.800	0.060	0.135	0.270
74/04/02	17 15		4.300	1.000	0.085	0.150	0.240
74/04/21	10 50		2.500	1.700	0.075	0.220	0.320

K VALUE KNOWN TO BE
LESS THAN INDICATED