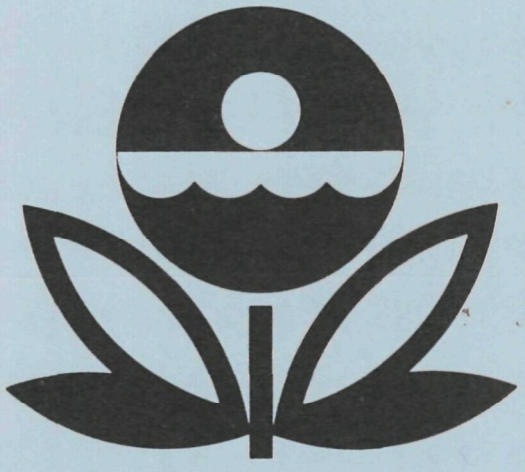
U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES



REPORT

ON

LAKE MUNSON

LEON COUNTY

FLORIDA

EPA REGION IV

WORKING PAPER No. 268

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

☆G.P.O. 699-440

REPORT
ON
LAKE MUNSON
LEON COUNTY
FLORIDA
EPA REGION IV
WORKING PAPER No. 268

WITH THE COOPERATION OF THE
FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
AND THE
FLORIDA NATIONAL GUARD

DECEMBER, 1977

CONTENTS

	Page
Foreword	ii
List of Florida Lakes	iv
Lake and Drainage Area Map	v
Sections	
I. Conclusions	1
II. Lake and Drainage Basin Characteristics	4
III. Lake Water Quality Summary	5
IV. Nutrient Loadings	9
V. Literature Reviewed	13
VI. Appendices	14

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater 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 Florida Department of Environmental Regulation for professional involvement and to the Florida National Guard for conducting the tributary sampling phase of the Survey.

Joseph W. Landers, Jr., Secretary of the Department of Environmental Regulation; John A Redmond, former Director of the Division of Planning, Technical Assistance, and Grants; and Dr. Tim S. Stuart, Chief of the Bureau of Water Quality, 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.

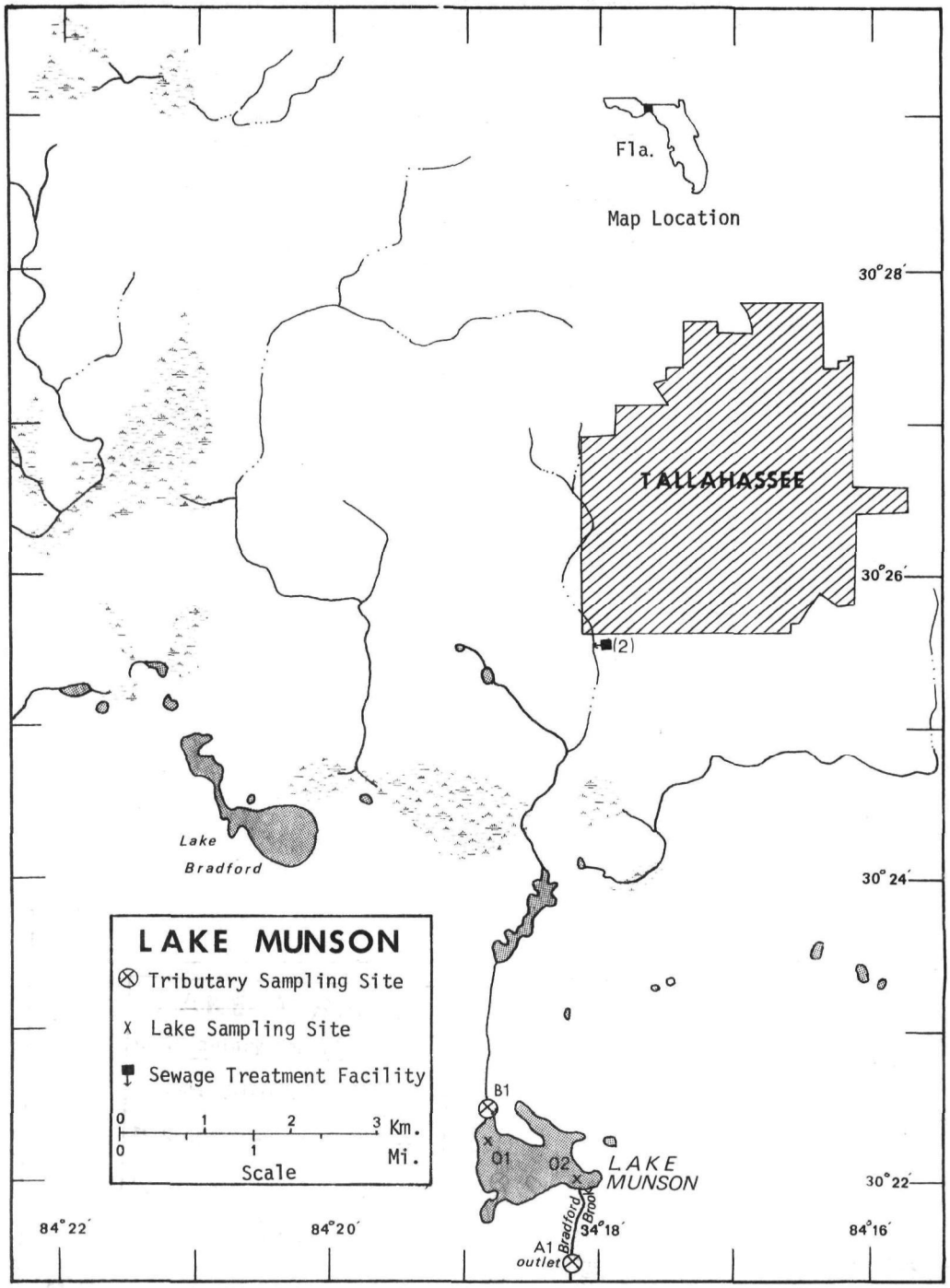
Major General Henry W. McMillan (Retired), then the Adjutant General of Florida, and Project Officer Colonel Hugo F. Windham, who directed the volunteer efforts of the Florida National Guard, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF FLORIDA

LAKE NAME	COUNTY
Alligator	Columbia
Apopka	Lake, Orange
Banana	Polk
Crescent	Flagler, Putnam
Doctors	Clay
Dora	Lake
East Tohopekaliga	Osceola
Effie	Polk
Eloise	Polk
George	Putnam, Volusia
Gibson	Polk
Glenada	Highlands
Griffin	Lake
Haines	Polk
Hancock	Polk
Horseshoe	Seminole
Howell	Orange, Seminole
Istokpoga	Highlands
Jessie	Polk
Jessup	Seminole
Kissimmee	Osceola
Lawne	Orange
Lulu	Polk
Marion	Polk
Minnehaha	Orange
Minneola	Lake
Monroe	Seminole, Volusia
Munson	Leon
Okeechobee	Glades, Hendry, Martin, Okeechobee, Palm Beach
Poinsett	Brevard, Orange, Osceola
Reedy	Polk
Seminole	Jackson, FL; Decatur, Seminole, GA
Seminole	Pinellas
South	Brevard
Talquin	Gadsden, Leon
Tarpon	Pinellas
Thonotosassa	Hillsborough
Tohopekaliga	Osceola
Trout	Lake
Weohyakapka	Polk
Yale	Lake


Fla.
Map Location
30°28´
TALLAHASSEE
30°26´
(2)
Lake
Bradford
30°24´
LAKE MUNSON
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
0 1 2 3 Km.
0 1 Mi.
Scale
B1
01
02
LAKE
MUNSON
30°22´
84°22´
84°20´
34°18´
84°16´
A1
outlet
Bradford
Brook

LAKE MUNSON

STORET NO. 1247

I. CONCLUSIONS

A. Trophic Condition:

Survey data and a report by others (Ketelle and Uttormark, 1971) indicate that Lake Munson is hypereutrophic. It ranked 39th in overall trophic quality when the 41 Florida lakes sampled in 1973 were compared using a combination of six lake parameters*. Thirty-seven of the lakes had less median total phosphorus and mean chlorophyll a, 35 had less median dissolved phosphorus, 38 had less median inorganic nitrogen, and 37 had greater mean Secchi disc transparency.

The limited Survey data indicate diurnal fluctuation of dissolved oxygen (D.O.) may be a problem in this lake. The early-to mid-afternoon near-surface D.O. concentrations ranged from about 175% to nearly 220% of saturation in June and August, but similar samples taken at mid-morning in November ranged from 30% of saturation at station 2 to 73% at station 1. More intensive sampling is needed to determine whether nocturnal depression of D.O. is significant.

Survey limnologists noted emergent and floating vegetation at all stations in June and August and at station 2 in November. Also, phytoplankton blooms were noted at both stations in August, and clumps of filamentous blue-green algae were observed at station

* See Appendix A.

1 in November.

B. Rate-Limiting Nutrient:

Algal assay results indicate the lake was nitrogen limited at the time the sample was collected (06/20/73). The lake data indicate nitrogen limitation at all sampling stations and times.

C. Nutrient Controllability:

1. Point sources--The apparent loss of both phosphorus and nitrogen during the sampling year (pages 10 and 11) indicates the non-point nutrient contributions were underestimated; e.g., because of presumed insignificant runoff from the immediate drainage (Mann, 1975), nutrient contributions from that source were considered to be negligible (page 9). However, assuming the total nutrient inputs were at least equal to the loads leaving the lake, it is estimated the two Tallahassee wastewater treatment plants contributed about 46% of the total phosphorus and 44% of the total nitrogen inputs to the lake.

Based on the outlet load, the sampling year phosphorus loading was nearly 102 g/m^2, or about 74 times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic rate (see page 12). However, Vollenweider's model probably is not applicable to water bodies with short hydraulic retention times, and the estimated mean hydraulic retention time of Lake Munson is only 11 days.

Even complete removal of phosphorus at the Tallahassee plants would still leave an estimated loading of 55 $g/m^2/yr$; and, regard-

less of the applicability of the model, it is not likely that the reduction of phosphorus inputs attainable by municipal point-source control alone would result in a significant change in the trophic condition of the lake.

The very high in-lake concentrations of inorganic nitrogen (mean = 1.740 mg/l) and orthophosphorus (mean = 0.907 mg/l) during Survey sampling indicate major reductions of both nutrients would be necessary to improve the trophic condition of Lake Munson.

2. Non-point sources--On the basis of the outlet loads, it is estimated that non-point sources contributed about 54% of the total phosphorus and 56% of the total nitrogen inputs to Lake Munson. The 1972 U.S.G.S. Lake Munson and Tallahassee quadrangle maps indicate urban runoff from the City of Tallahassee probably contributes nutrients to the lake.

The phosphorus export of Unnamed Stream B-1 was a high 193 kg/km^2 during the sampling year. The high rate may have resulted from underestimation of the Tallahassee loads (0.78 kg P/capita/yr at the plants), urban drainage, or both.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 1.03 kilometers^2.
2. Mean depth: 1.5 meters.
3. Maximum depth: 2.0 meters.
4. Volume: 1.545 x 10^6 m^3.
5. Mean hydraulic retention time: 11 days (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)†††
Unnamed Creek B-1	158.0	1.75
Minor tributaries & immediate drainage -	8.1	0.00*
Totals	166.1	1.75

2. Outlet -

Bradford Brook	167.1**	1.67

C. Precipitation***:

1. Year of sampling: 208.0 centimeters.
2. Mean annual: 144.4 centimeters.

† Table of metric conversions--Appendix B.
†† No bathymetric map available. Surface area from FL Game & Fresh Water Fish Comm. (Anonymous, 1971); depths estimated from soundings reported in Appendix D.
††† For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
* Runoff assumed to be insignificant; lake is in a sink area (Mann, 1975).
** Includes area of lake.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Lake Munson was sampled three times in 1973 by means of a pontoon-equipped Huey helicopter. Each time, near-surface samples for physical and chemical parameters were collected from two stations on the lake and, the third time, from one additional depth 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 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 0.6 meters at station 1 and 0.3 meters at station 2.

The 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 MUNSON
STORET CODE 1247

PARAMETER	1ST SAMPLING (6/20/73) 2 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (8/30/73) 2 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (11/ 5/73) 2 SITES RANGE	MEAN	MEDIAN
TEMP (C)	28.2 - 29.1	28.6	28.6	29.2 - 31.2	30.2	30.2	19.3 - 20.5	19.9	19.9
DISS OXY (MG/L)	13.8 - 17.1	15.4	15.4	16.0 - 16.0	16.0	16.0	2.8 - 6.6	4.7	4.7
CNDCTVY (MCROMO)	135. - 145.	140.	140.	202. - 204.	203.	203.	325. - 349.	337.	337.
PH (STAND UNITS)	9.1 - 9.4	9.2	9.2	10.1 - 10.5	10.3	10.3	8.2 - 8.7	8.4	8.4
TOT ALK (MG/L)	36. - 43.	40.	40.	44. - 48.	46.	46.	102. - 112.	107.	107.
TOT P (MG/L)	1.140 - 1.180	1.160	1.160	1.470 - 1.480	1.475	1.475	2.060 - 4.110	3.085	3.085
ORTHO P (MG/L)	0.820 - 0.885	0.852	0.852	0.600 - 0.620	0.610	0.610	1.930 - 2.090	2.010	2.010
NO2+NO3 (MG/L)	0.280 - 0.380	0.330	0.330	0.300 - 0.320	0.310	0.310	0.760 - 0.860	0.810	0.810
AMMONIA (MG/L)	0.200 - 0.850	0.525	0.525	0.140 - 0.300	0.220	0.220	2.250 - 3.800	3.025	3.025
KJEL N (MG/L)	2.800 - 3.100	2.950	2.950	3.600 - 3.800	3.700	3.700	6.800 - 9.600	8.200	8.200
INORG N (MG/L)	0.480 - 1.230	0.855	0.855	0.440 - 0.620	0.530	0.530	3.010 - 4.660	3.835	3.835
TOTAL N (MG/L)	3.080 - 3.480	3.280	3.280	3.900 - 4.120	4.010	4.010	7.560 -10.460	9.010	9.010
CHLRPYL A (UG/L)	108.6 - 184.9	146.7	146.7	115.6 - 179.2	147.4	147.4	125.0 - 128.6	126.8	126.8
SECCHI (METERS)	0.3 - 0.5	0.4	0.4	0.4 - 0.4	0.4	0.4	0.3 - 0.3	0.3	0.3

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
06/20/73	1. Flagellates	4,021
	2. Cryptomonas sp.	3,251
	3. Cyclotella sp.	2,823
	4. Microcystis sp.	1,540
	5. Kirchneriella sp.	1,112
	Other genera	5,818
	Total	18,565
08/30/73	1. Anabaena sp.	4,033
	2. Microcystis sp.	1,589
	3. Scenedesmus sp.	1,589
	4. Raphidiopsis sp.	1,344
	5. Merismopedia sp.	1,059
	Other genera	2,361
	Total	11,975
11/05/73	1. Anabaena sp.	40,425
	2. Flagellates	21,432
	3. Chrysococcus sp.	12,448
	4. Chlamydomonas sp.	11,422
	5. Cyclotella sp.	6,288
	Other genera	12,702
	Total	104,717

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/20/73	1	108.6
	2	184.9
08/30/73	1	179.2
	2	115.6
11/05/73	1	125.0
	2	128.6

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.780	1.565	42.1
0.050 P	0.830	1.565	41.5
0.050 P + 1.0 N	0.830	2.565	62.9
1.0 N	0.780	2.565	67.7

2. Filtered and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.710	1.510	42.7
0.050 P	0.760	1.510	38.3
0.050 P + 1.0 N	0.760	2.510	59.9
1.0 N	0.710	2.510	69.7

3. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential primary productivity of Lake Munson was very high at the time the assay sample was collected (06/20/73). The lack of yield response with increased levels of orthophosphorus, until nitrogen was also added, indicates that the lake was limited by nitrogen at that time. Note that the addition of nitrogen alone resulted in a yield greater than that of the control.

The mean lake inorganic nitrogen to orthophosphorus ratios are further evidence of nitrogen limitation (2 to 1 or less at all sampling stations and times).

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Florida National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v). Sampling was begun in March, 1973, and was completed in February, 1974.

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

Estimates of nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were not made because the lake essentially is a sink at or just above the water table most of the time (Mann, 1975).

The operators of the Tallahassee wastewater treatment plants (Dale Mabry Field and Lake Bradford Road) provided monthly effluent samples and corresponding flow data.

---

* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal* -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Tallahassee -				
Lake Bradford Road	50,400	act. sludge	19,665.2	Unnamed Creek B-1
Dale Mabry Field	11,500	act. sludge	3,410.0	Unnamed Creek B-1

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Unnamed Creek B-1	30,440	38.8
b. Minor tributaries & immediate drainage (non-point load) -	none	-
c. Known municipal STP's -		
Lake Bradford Road	37,795	48.1
Dale Mabry Field	10,220	13.0
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation** -	45	0.1
Total	78,500	100.0

2. Outputs -

Lake outlet - Bradford Brook 104,735

3. Net annual P loss - 26,235 kg.

* Treatment plant questionnaires.
** Brezonik and Shannon, 1971.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Unnamed Creek B-1	81,545	38.2
b. Minor tributaries & immediate drainage (non-point load) -	none	-
c. Known municipal STP's -		
Lake Bradford Road	107,505	50.3
Dale Mabry Field	24,010	11.2
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	595	0.3
Total	213,655	100.0

2. Outputs -

Lake outlet - Bradford Brook 296,815

3. Net annual N loss - 83,160 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Unnamed Creek B-1	193	516

* Brezonik and Shannon, 1971.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Note, however, that Florida lakes may be able to assimilate phosphorus at a somewhat higher level than that suggested by Vollenweider (Shannon and Brezonik, 1972).

Essentially, Vollenweider's "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".

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	76.21	loss*	207.4	loss*

Vollenweider phosphorus loadings ($g/m^2/yr$) based on estimated mean depth and hydraulic retention time of Lake Munson:

"Dangerous" (eutrophic loading)	1.38
"Permissible" (oligotrophic loading)	0.69

* There was an apparent loss of nutrients during the sampling year. This may have been due to nutrient fixation in the lake, solubilization of previously sedimented nutrients, significant contributions from the immediate drainage, or (probably) insufficient outlet sampling in relation to the short hydraulic retention time of the lake.

V. LITERATURE REVIEWED

Anonymous, 1971. Water quality investigations - 1970-71 annual progress report. Fed. Aid in Fish Restor., Dingell-Johnson Proj. No. F-21-5, FL Game & Fresh Water Fish Comm., Tallahassee.

Brezonik, Patrick L. and Earl E. Shannon, 1971. Trophic state of lakes in north central Florida. Publ. No. 13, FL Water Resources Res. Ctr., U. of FL, Gainesville.

Ketelle, Martha J., and Paul D. Uttormark, 1971. Problem lakes in the United States. EPA Water Poll. Contr. Res. Ser., Proj. No. 16010 EHR, Wash., DC.

Mann, William, 1975. Personal communication ("ZZ" flows; subsurface seepage). U.S. Geol. Surv., Tallahassee.

Shannon, Earl E., and Patrick L. Brezonik, 1972. Relationships between lake trophic state and nitrogen and phosphorus loading rates. Env. Sci. & Techn. 6 (8): 719-725.

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.

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
1201	ALLIGATOR LAKE	0.620	0.260	474.000	87.733	13.100	0.386
1202	LAKE APOPKA	0.102	0.230	484.176	46.611	8.200	0.019
1203	LAKE BANANA	0.660	0.260	482.667	208.600	3.600	0.293
1206	LAKE CRESCENT	0.065	0.130	473.889	10.211	10.200	0.033
1207	DOCTORS LAKE	0.084	0.120	465.555	27.100	10.600	0.028
1208	LAKE DORA	0.102	0.240	482.889	54.978	7.400	0.022
1209	LAKE EFFIE	1.480	0.410	489.000	261.433	15.000	0.950
1210	LAKE GEORGE	0.129	0.165	469.308	35.000	11.000	0.063
1211	LAKE GIBSON	0.167	0.115	470.000	19.675	10.200	0.069
1212	GLENADA LAKE	0.134	0.165	454.167	27.667	14.700	0.072
1214	LAKE GRIFFIN	0.119	0.260	481.333	66.855	6.600	0.038
1215	LAKE HAINES	0.063	0.115	462.667	26.567	10.600	0.014
1217	LAKE HANCOCK	0.772	0.195	483.500	97.900	5.600	0.158
1219	LAKE HORSESHOE	0.034	0.130	459.000	12.067	11.500	0.023
1220	LAKE HOWELL	1.260	0.285	464.000	54.117	9.000	1.175
1221	LAKE ISTOKPOGA	0.039	0.120	464.222	6.594	8.600	0.010
1223	LAKE JESSUP	0.492	0.290	487.000	76.550	7.600	0.288
1224	LAKE KISSIMMEE	0.034	0.145	463.667	24.142	8.800	0.007
1227	LAKE LULU	1.490	1.065	483.000	276.566	14.300	1.030
1228	LAKE MARION	0.044	0.260	468.833	29.967	7.600	0.016
1229	LAKE MINNEHAHA	0.038	0.080	435.000	8.733	7.700	0.012
1230	LAKE MINNEOLA	0.018	0.070	406.333	3.333	7.400	0.009
1231	LAKE MONROE	0.188	0.300	474.555	14.225	10.800	0.128
1232	LAKE OKEECHOBEE	0.063	0.185	472.366	14.524	9.800	0.010
1234	LAKE POINSETT	0.085	0.150	469.000	6.500	10.600	0.051
1236	LAKE PEEDY	0.033	0.330	468.500	34.837	10.600	0.008
1238	LAKE SOUTH	0.074	0.130	464.000	23.167	9.000	0.028
1239	LAKE TALQUIN	0.085	0.290	462.167	9.483	14.400	0.031

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
1240	LAKE THONOTOSASSA	0.695	0.095	466.167	37.700	10.200	0.565
1241	LAKE TOHOPEKALIGA	0.246	0.200	472.917	30.633	10.500	0.152
1242	TROUT LAKE	1.110	0.650	472.000	76.967	12.900	0.970
1243	LAKE WEOHYAKAPKA	0.047	0.080	458.667	7.767	8.200	0.011
1246	LAKE YALE	0.027	0.160	441.000	25.367	7.600	0.014
1247	LAKE MUNSON	1.475	0.925	486.667	140.317	12.200	0.852
1248	LAKE SEMINOLE	0.234	0.175	473.833	102.000	8.600	0.026
1249	LAKE LAWNE	2.560	1.350	494.667	84.900	10.400	0.117
1250	LAKE TARPON	0.041	0.070	400.889	6.867	9.000	0.027
1252	LAKE ELOISE	0.486	0.170	465.333	70.233	12.200	0.339
1258	LAKE JESSIE	0.051	0.090	452.667	26.300	10.800	0.011
1261	EAST LAKE TOHOPEKALIGA	0.042	0.070	440.833	5.167	9.400	0.007
1264	PAYNE'S PRAIRIE LAKE (NO	1.260	0.140	476.000	88.200	7.400	1.210

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
1201	ALLIGATOR LAKE	25 (10)	29 (10)	30 (12)	18 (7)	10 (4)	18 (7)	130
1202	LAKE APOPKA	50 (20)	38 (15)	10 (4)	38 (15)	74 (29)	70 (28)	280
1203	LAKE BANANA	23 (9)	29 (10)	20 (8)	5 (2)	100 (40)	23 (9)	200
1206	LAKE CRESCENT	65 (26)	70 (27)	33 (13)	80 (32)	48 (18)	50 (20)	346
1207	DOCTORS LAKE	60 (24)	76 (30)	60 (24)	55 (22)	34 (12)	56 (22)	341
1208	LAKE DORA	53 (21)	35 (14)	18 (7)	33 (13)	90 (35)	68 (27)	297
1209	LAKE EFFIE	5 (2)	10 (4)	3 (1)	3 (1)	0 (0)	10 (4)	31
1210	LAKE GEORGE	45 (18)	54 (21)	48 (19)	43 (17)	23 (9)	43 (17)	256
1211	LAKE GIBSON	40 (16)	81 (32)	45 (18)	70 (28)	48 (18)	40 (16)	324
1212	GLENADA LAKE	43 (17)	54 (21)	85 (34)	53 (21)	3 (1)	38 (15)	276
1214	LAKE GRIFFIN	48 (19)	29 (10)	23 (9)	30 (12)	95 (38)	48 (19)	273
1215	LAKE HAINES	70 (28)	81 (32)	75 (30)	58 (23)	34 (12)	78 (31)	396
1217	LAKE HANCOCK	18 (7)	43 (17)	13 (5)	13 (5)	98 (39)	28 (11)	213
1219	LAKE HORSESHOE	93 (37)	70 (27)	80 (32)	78 (31)	20 (8)	65 (26)	406
1220	LAKE HOWELL	11 (4)	23 (9)	69 (27)	35 (14)	60 (23)	3 (1)	201
1221	LAKE ISTOKPOGA	85 (34)	76 (30)	65 (26)	93 (37)	69 (27)	89 (35)	477
1223	LAKE JESSUP	28 (11)	18 (7)	5 (2)	25 (10)	83 (32)	25 (10)	184
1224	LAKE KISSIMMEE	90 (36)	63 (25)	73 (29)	65 (26)	65 (26)	99 (39)	455
1227	LAKE LULU	3 (1)	3 (1)	15 (6)	0 (0)	8 (3)	5 (2)	34
1228	LAKE MARION	78 (31)	29 (10)	53 (21)	50 (20)	83 (32)	73 (29)	366
1229	LAKE MINNEHAHA	88 (35)	91 (36)	95 (38)	85 (34)	78 (31)	80 (32)	517
1230	LAKE MINNEOLA	100 (40)	98 (38)	98 (39)	100 (40)	90 (35)	93 (37)	579
1231	LAKE MONROE	38 (15)	15 (6)	28 (11)	75 (30)	26 (10)	33 (13)	215
1232	LAKE OKEECHOBEE	68 (27)	45 (18)	40 (16)	73 (29)	53 (21)	89 (35)	368
1234	LAKE POINSETT	58 (23)	60 (24)	50 (20)	95 (38)	34 (12)	45 (18)	342
1236	LAKE REEDY	95 (38)	13 (5)	55 (22)	45 (18)	34 (12)	95 (38)	337
1238	LAKE SOUTH	63 (25)	70 (27)	69 (27)	68 (27)	60 (23)	56 (22)	386
1239	LAKE TALQUIN	55 (22)	20 (8)	78 (31)	83 (33)	5 (2)	53 (21)	294

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
1240	LAKE THONOTOSASSA	20 (8)	85 (34)	58 (23)	40 (16)	48 (18)	15 (6)	266
1241	LAKE TOHOPEKALIGA	33 (13)	40 (16)	38 (15)	48 (19)	40 (16)	30 (12)	229
1242	TROUT LAKE	15 (6)	8 (3)	43 (17)	23 (9)	13 (5)	8 (3)	110
1243	LAKE WEOHYAKAPKA	75 (30)	91 (36)	83 (33)	88 (35)	74 (29)	84 (33)	495
1246	LAKE YALE	98 (39)	58 (23)	90 (36)	63 (25)	83 (32)	75 (30)	467
1247	LAKE MUNSON	8 (3)	5 (2)	8 (3)	8 (3)	16 (6)	13 (5)	58
1248	LAKE SEMINOLE	35 (14)	48 (19)	35 (14)	10 (4)	69 (27)	63 (25)	260
1249	LAKE LAWNE	0 (0)	0 (0)	0 (0)	20 (8)	43 (17)	35 (14)	98
1250	LAKE TARPON	83 (33)	98 (38)	100 (40)	90 (36)	60 (23)	60 (24)	491
1252	LAKE ELOISE	30 (12)	50 (20)	63 (25)	28 (11)	16 (6)	20 (8)	207
1258	LAKE JESSIE	73 (29)	88 (35)	88 (35)	60 (24)	26 (10)	84 (33)	419
1261	EAST LAKE TOHOPEKALIGA	80 (32)	98 (38)	93 (37)	98 (39)	55 (22)	99 (39)	523
1264	PAYNE'S PRAIRIE LAKE (NO	11 (4)	65 (26)	25 (10)	15 (6)	90 (35)	0 (0)	206

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1230	LAKE MINNEOLA	579
2	1261	EAST LAKE TOHOPEKALIGA	523
3	1229	LAKE MINNEHAHA	517
4	1243	LAKE WEOHYAKAPKA	495
5	1250	LAKE TARPON	491
6	1221	LAKE ISTOKPOGA	477
7	1246	LAKE YALE	467
8	1224	LAKE KISSIMMEE	455
9	1258	LAKE JESSIE	419
10	1219	LAKE HORSESHOE	406
11	1215	LAKE HAINES	396
12	1238	LAKE SOUTH	386
13	1232	LAKE OKEECHOBEE	368
14	1228	LAKE MARION	366
15	1206	LAKE CRESCENT	346
16	1234	LAKE POINSETT	342
17	1207	DOCTORS LAKE	341
18	1236	LAKE REEDY	337
19	1211	LAKE GIBSON	324
20	1208	LAKE DORA	297
21	1239	LAKE TALQUIN	294
22	1202	LAKE APOPKA	280
23	1212	GLENADA LAKE	276
24	1214	LAKE GRIFFIN	273
25	1240	LAKE THONOTOSASSA	266
26	1248	LAKE SEMINOLE	260
27	1210	LAKE GEORGE	256
28	1241	LAKE TOHOPEKALIGA	229

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
29	1231	LAKE MONROE	215
30	1217	LAKE HANCOCK	213
31	1252	LAKE ELOISE	207
32	1264	PAYNE'S PRAIRIE LAKE (NO	206
33	1220	LAKE HOWELL	201
34	1203	LAKE BANANA	200
35	1223	LAKE JESSUP	184
36	1201	ALLIGATOR LAKE	130
37	1242	TROUT LAKE	110
38	1249	LAKE LAWNE	98
39	1247	LAKE MUNSON	58
40	1227	LAKE LULU	34
41	1209	LAKE EFFIE	31

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 FLORIDA 10/23/75

LAKE CODE 1247 LAKE MUNSON

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 167.1

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1247A1	167.1	1.73	2.15	2.61	2.63	1.50	1.30	1.42	1.56	1.42	1.25	1.10	1.42	1.67
1247B1	158.0	1.81	2.24	2.69	2.72	1.59	1.39	1.50	1.64	1.50	1.33	1.19	1.50	1.75
1247ZZ	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 167.1 TOTAL FLOW IN = 21.10
SUM OF SUB-DRAINAGE AREAS = 166.0 TOTAL FLOW OUT = 20.08

NOTE *** LAKE IS IN A SINK AREA AT OR ABOVE THE WATER TABLE MOST OF THE TIME

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1247A1	3	73	3.94	17	2.63				
	4	73	8.66	13	3.54				
	5	73	2.63	17	1.39				
	6	73	1.95	15	2.35				
	7	73	0.93	13	0.79				
	8	73	1.59	17	2.21				
	9	73	1.73	14	1.08				
	10	73	0.65	12	0.57				
	11	73	1.05	16	0.71				
	12	73	0.99	14	0.62				
	1	74	2.10	18	1.13				
	2	74	2.12	15	1.30				
1247B1	3	73	4.02	17	2.72				
	4	73	8.75	13	3.62				
	5	73	2.72	17	1.47				
	6	73	2.04	15	2.44				
	7	73	1.02	13	0.88				
	8	73	1.67	17	2.29				
	9	73	1.81	14	1.19				
	10	73	0.74	12	0.65				
	11	73	1.13	16	0.79				
	12	73	1.08	14	0.71				
	1	74	2.18	18	1.22				
	2	74	2.21	15	1.39				

TRIBUTARY FLOW INFORMATION FOR FLORIDA 10/23/75

LAKE CODE 1247 LAKE MUNSON

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1247ZZ	3	73	0.0	17	0.0				
	4	73	0.0	13	0.0				
	5	73	0.0	17	0.0				
	6	73	0.0	15	0.0				
	7	73	0.0	13	0.0				
	8	73	0.0	17	0.0				
	9	73	0.0	14	0.0				
	10	73	0.0	12	0.0				
	11	73	0.0	16	0.0				
	12	73	0.0	14	0.0				
	1	74	0.0	18	0.0				
	2	74	0.0	15	0.0				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/08/25

124701
30 22 14.0 084 18 47.0
LAKE MUNSON
12073 FLORIDA

11EPALES 2111202
3 0005 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
73/06/20	13 30	0000	29.1	13.8	10	145	9.10	43	0.850	3.100	0.380	0.885
73/08/30	16 15	0000	31.2		15	204	10.50	44	0.140	3.600	0.300	0.620
73/11/05	09 47	0000	20.5		10	349	8.70	112	3.800	9.600	0.860	2.090
	09 47	0002	20.5	6.6		349						

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/06/20	13 30	0000	1.180	108.6
73/08/30	16 15	0000	1.480	179.2
73/11/05	09 47	0000	4.110	125.0

STORET RETRIEVAL DATE 75/08/25

124702
30 21 58.0 084 18 08.0
LAKE MUNSON
12073 FLORIDA

11EPALES 2111202
3 0005 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
73/06/20	13 50	0000	28.2	17.1	18	135	9.40	36	0.200	2.800	0.280	0.820
73/08/30	16 25	0000	29.2	16.0	15	202	10.10	48	0.300	3.800	0.320	0.600
73/11/05	09 34	0000	19.3		12	325	8.20	102	2.250	6.800	0.760	1.930
	09 34	0001	19.3	2.8		325						

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/06/20	13 50	0000	1.140	184.9
73/08/30	16 25	0000	1.470	115.6
73/11/05	09 34	0000	2.060	128.6

APPENDIX E

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/08/25

1247A1
30 21 30.0 084 18 00.0
BRADFORD BROOK
12069 15 TALLAHASSEE
O/LAKE MUNSON
ST HWY 61 BRDG S OF LAKE
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
73/03/17	08 30		0.880	5.700	2.400	1.580	2.400
73/04/13	14 10		0.084	2.200	0.790	0.540	0.830
73/05/17	16 00		0.160	4.400	0.170	0.850	1.300
73/06/15	09 10		0.430	10.500	1.000	0.585	0.880
73/07/13	09 10		0.052	4.500	1.580	1.700	2.300
73/08/17	08 43		0.310	3.000	0.920	1.100	1.400
73/09/14	09 45		0.280	2.520	1.160	1.040	1.350
73/10/12	08 45		0.860	3.150	0.910	1.700	1.720
73/11/16	08 50		1.200	5.250	2.760	2.700	3.200
73/12/14	10 00		1.700	6.600	2.640	2.400	2.700
74/01/18	12 10		1.260	4.600	2.100	2.000	2.900
74/02/15	11 19		1.760	6.000	1.250	2.100	2.800

STORET RETRIEVAL DATE 75/08/25

124781
30 22 30.0 084 19 00.0
UNNAMED STREAM
12 15 TALLAHASSEE
I/LAKE MUNSON
DIRT RD BRDG JUST N OF LAKE
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
73/03/17	08 45		0.780	4.600	1.600	1.700	2.100
73/04/13	14 20		0.014	1.380	0.084	0.800	0.880
73/05/17	16 20		0.060	6.800	0.330	1.060	1.150
73/06/15	08 21		0.027	4.200	0.280	0.840	0.980
73/07/13	09 20		0.011	1.150	0.037	0.450	0.635
73/08/17	08 49		0.040	2.800	1.020	0.530	0.710
73/09/14	09 55		0.017	4.900	3.300	1.000	1.250
73/10/12	09 00		0.200	1.550	0.490	0.900	1.050
73/11/16	09 05		1.430	3.750	1.160	2.200	2.450
73/12/14	10 10		1.600	3.850	1.520	1.840	2.400
74/01/18	12 00		0.040	1.400	0.135	0.290	0.650
74/02/15	11 09		0.650	4.800	0.360	1.400	2.700

STORET RETRIEVAL DATE 75/08/25

12478A AS12478A P050400
30 25 30.0 084 18 00.0
TALLAHASSEE (LK BEDFORD PLANT)
12069 15 TALLAHASSEE
T/LAKE MUNSON
UNNAMED STREAM
11EPALES 2141204
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	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/04/09	08 00								
CP(T)-			0.810	14.700	5.000	2.600	4.400	5.890	5.260
73/04/09	24 00								
73/05/09	00 00								
CP(T)-			9.600	6.600	0.650	3.500	4.100	5.700	5.760
73/05/09	16 00								
73/06/26	00 00								
CP(T)-			3.800	9.400	1.400	4.300	4.900	5.450	5.550
73/06/26	16 00								
73/07/24	08 00								
CP(T)-			1.100	11.500	3.700	3.100	5.200	5.450	5.580
73/07/24	24 00								
73/08/21	08 00								
CP(T)-			5.000	4.975	0.084	4.420	5.000	5.060	5.400
73/08/21	12 00								
73/09/25	08 00								
CP(T)-			2.730	12.000	2.730	4.500	5.100	5.630	5.070
73/09/25	24 00								
73/11/07	08 00								
CP(T)-			8.000	9.100	0.245	5.000	6.400	4.950	5.300
73/11/07	12 00								
73/12/04	08 00								
CP(T)-			5.000	12.000	2.500	5.300	6.300	5.220	5.700
73/12/04	24 00								
74/02/05	08 00								
CP(T)-								4.710	4.330
74/02/05	24 00								
74/03/05	08 00								
CP(T)-			1.920	16.000	6.600	4.700	5.500	5.110	4.630
74/03/05	24 00								
74/04/02	08 00								
CP(T)-			0.200	10.000	8.200	4.600	5.600	5.280	4.670
74/04/02	24 00								
74/05/14	08 00								
CP(T)-			0.120	17.000	9.700	4.600	5.500	4.520	4.670
74/05/14	24 00								

STORET RETRIEVAL DATE 75/08/25

1247BA AS1247BA P050400
30 25 30.0 084 18 00.0
TALLAHASSEE (LK BEDFORD PLANT)
12069 15 TALLAHASSEE
T/LAKE MUNSON
UNNAMED STREAM
11EPALES 2141204
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	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
74/06/03	08	00							
CP(T)-			2.500	16.000	7.190	4.500	5.500	5.200	4.750
74/06/03	24	00							

STORET RETRIEVAL DATE 75/08/25

124788 AS124788 P011500
30 25 30.0 084 18 00.0
DALE MABRY PLANT)
12 15 TALLAHASSEE
T/LAKE MUNSON
UNNAMED STREAM TALLAHASSEE (
11EPALES 2141204
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	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/04/19 00 00									
CP(T)-			0.103	17.000	6.400	5.880	6.700	1.150	1.110
73/04/19 16 00									
73/05/09 00 00									
CP(T)-			0.120	18.900	8.500	5.700	6.400	1.200	1.160
73/05/09 16 00									
73/06/26 00 00									
CP(T)-			0.280	13.800	4.900	6.600	7.100	0.930	1.070
73/06/26 16 00									
73/07/24 08 00									
CP(T)-			0.190	17.600	3.400	5.300	8.500	0.720	0.920
73/07/24 24 00									
73/08/21 08 00									
CP(T)-			0.770	14.000	3.680	6.000	7.600	0.850	0.860
73/08/21 12 00									
73/09/25 08 00									
CP(T)-			0.230	18.900	8.900	8.900	9.650	0.840	0.860
73/09/25 24 00									
73/11/07 08 00									
CP(T)-			0.250	22.000	10.000	8.500	9.800	0.840	0.860
73/11/07 12 00									
73/12/04 08 00									
CP(T)-			0.650	23.000	15.000	9.100	9.900	0.700	0.850
73/12/04 24 00									
74/02/05 08 00									
CP(T)-								0.720	0.790
74/02/05 24 00									
74/03/05 08 00									
CP(T)-			1.200	24.000	16.000	9.400	10.000	0.800	0.770
74/03/05 24 00									
74/04/02 08 00									
CP(T)-			1.360	13.000	9.650	6.150	8.000	0.840	0.770
74/04/02 24 00									
74/05/14 08 00									
CP(T)-			1.200	20.000	10.500	7.600	8.500	0.810	0.780
74/05/14 24 00									

STORET RETRIEVAL DATE 75/08/25

12478B AS12478B P011500
30 25 30.0 084 18 00.0
DALE MABRY PLANT)
12 15 TALLAHASSEE
T/LAKE MUNSON
UNNAMED STREAM TALLAHASSEE (
11EPALES 2141204
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	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
74/06/03	08 00								
CP(T)-			0.156	25.000	13.000	6.950	8.200	0.850	0.800
74/06/03	20 00								