

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
NATIONAL EUTROPHICATION SURVEY**

**WORKING PAPER SERIES**



REPORT  
ON  
ROUND LAKE  
WAUPACA COUNTY  
WISCONSIN  
EPA REGION V  
WORKING PAPER No. 65

**PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY**

**An Associate Laboratory of the**

**NATIONAL ENVIRONMENTAL RESEARCH CENTER - CORVALLIS, OREGON**

**and**

**NATIONAL ENVIRONMENTAL RESEARCH CENTER - LAS VEGAS, NEVADA**

REPORT  
ON  
ROUND LAKE  
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WISCONSIN  
EPA REGION V  
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WITH THE COOPERATION OF THE  
WISCONSIN DEPARTMENT OF NATURAL RESOURCES  
AND THE  
WISCONSIN 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 nation-wide 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.

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\* The lake discussed in this report was included in the National Eutrophication Survey as a water body of interest to the Wisconsin Department of Natural Resources. This report relates only to the data obtained from lake sampling.

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 Wisconsin Department of Natural Resources for professional involvement and to the Wisconsin National Guard for conducting the tributary sampling phase of the Survey.

Francis H. Schraufnagel, Acting Assistant Director, and Joseph R. Ball of the Bureau of Water Quality, and Donald R. Winter, Lake Rehabilitation Program, provided invaluable lake documentation and counsel during the Survey. Central Office and District Office personnel of the Department of Natural Resources reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper series.

Major General James J. Lison, Jr., the Adjutant General of Wisconsin, and Project Officer CW-4 Donald D. Erickson, who directed the volunteer efforts of the Wisconsin National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

## NATIONAL EUTROPHICATION SURVEY

## STUDY LAKES

STATE OF WISCONSIN

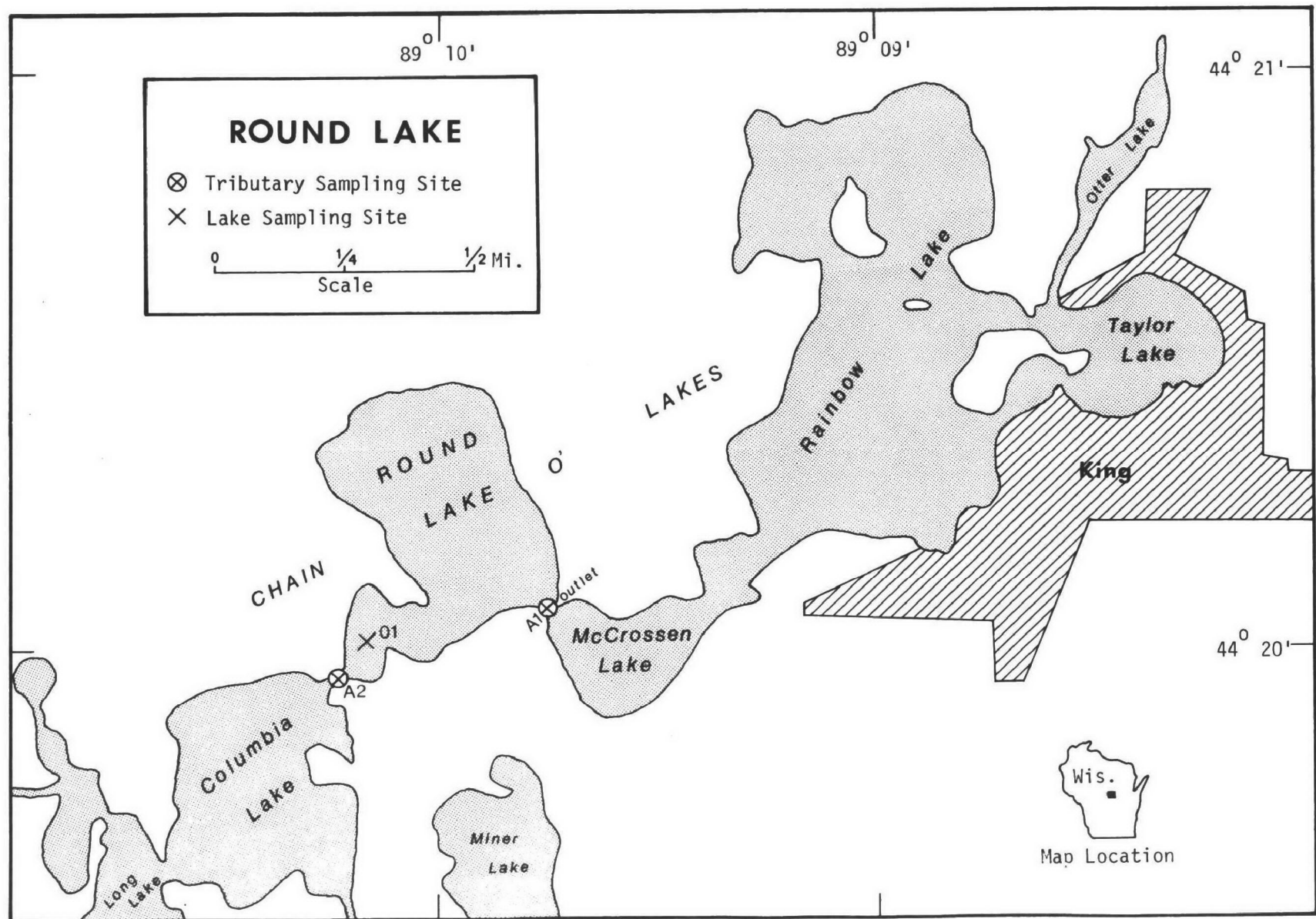
<u>LAKE NAME</u>	<u>COUNTY</u>
Altoona	Eau Claire
Beaver Dam	Barron
Beaver Dam	Dodge
Big Eau Pleine	Marathon
Browns	Racine
Butte des Morts	Winnebago
Butternut	Price, Ashland
Castle Rock Flowage	Juneau
Como	Walworth
Crystal	Vilas
Delavan	Walworth
Eau Claire	Eau Claire
Geneva	Walworth
Grand	Green Lake
Green	Green Lake
Kegonsa	Dane
Koshkonong	Jefferson, Rock, Dane
Lac La Belle	Waukesha
Middle	Walworth
Nagawicka	Waukesha
Oconomowoc	Waukesha
Okauchee	Waukesha
Petenwell Flowage	Juneau
Pewaukee	Waukesha
Pigeon	Waupaca
Pine	Waukesha
Poygan	Winnebago, Waushara
Rock	Jefferson
Rome Pond	Jefferson, Waukesha
Round	Waupaca
Shawano	Shawano
Sinnissippi	Dodge

LAKE NAME

Swan  
Tainter  
Tichigan  
Townline  
Trout  
Wapogasset  
Wausau  
Willow  
Winnebago  
  
Wisconsin  
Wissota  
Yellow

COUNTY

Columbia  
Dunn  
Racine  
Oneida  
Vilas  
Polk  
Marathon  
Oneida  
Winnebago, Fond Du Lac,  
Calumet  
Columbia  
Chippewa  
Burnett





## ROUND LAKE

STORET NO. 5566

### I. INTRODUCTION

Round Lake was included in the National Eutrophication Survey as a water body of interest to the Wisconsin Department of Natural Resources. The inlet and outlet of the lake were sampled (Appendix B), but no wastewater treatment plants impact the lake. Therefore, this report relates only to the lake sampling data.

Round Lake is one of the 22 Waupaca County Chain-O-Lakes which range in area from three to 116 acres (Anonymous, 1972).

### II. CONCLUSIONS

#### A. Trophic Condition:

Survey data and a report by others (Lueschow, et al., 1970) indicate Round Lake is meso-eutrophic. Of the 46 Wisconsin lakes sampled, seven had less mean total phosphorus, six had less mean dissolved phosphorus, 43 had less mean inorganic nitrogen, four had less mean chlorophyll a, and four had greater mean Secchi disc transparency.

Dissolved oxygen was nearly depleted at the 45-foot depth in June and was depleted at the 53-foot depth in August, 1972.

#### B. Rate-Limiting Nutrient:

The algal assay results indicate Round Lake was phosphorus limited at the time the sample was taken (11/08/72). The lake data indicate phosphorus limitation at the other sampling times as well.

### III. LAKE CHARACTERISTICS

#### A. Lake Morphometry\*:

1. Surface area: 80 acres.
2. Mean depth: 30.4 feet.
3. Maximum depth: 67 feet.
4. Volume: 2,426 acre-feet.

#### B. Precipitation\*\*:

1. Year of sampling: 37.1 inches.
2. Mean annual: 30.4 inches.

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\* Schraufnager, 1975.

\*\* See Working Paper No. 1, "Survey Methods, 1972".

#### IV. LAKE WATER QUALITY SUMMARY

Round Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at a single station on the lake (see map, page vi). During each visit, a single depth-integrated (15 feet to surface) sample was collected for phytoplankton identification and enumeration, and a similar sample was collected for chlorophyll a analysis. During the last visit, a single five-gallon depth-integrated sample was taken for algal assays. The maximum depth sampled was 56 feet.

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

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

## A. Physical and chemical characteristics:

<u>FALL VALUES</u>				
<u>Parameter</u>	<u>Minimum</u>	<u>Mean</u>	<u>Median</u>	<u>Maximum</u>
Temperature (Cent.)	7.5	7.5	7.5	7.5
Dissolved oxygen (mg/l)	9.0	9.3	9.4	9.6
Conductivity ( $\mu$ mhos)	320	323	322	330
pH (units)	7.9	7.9	7.9	8.0
Alkalinity (mg/l)	130	146	149	149
Total P (mg/l)	0.009	0.010	0.010	0.012
Dissolved P (mg/l)	0.005	0.006	0.006	0.007
NO <sub>2</sub> + NO <sub>3</sub> (mg/l)	0.610	0.615	0.615	0.620
Ammonia (mg/l)	0.240	0.260	0.260	0.270
<u>ALL VALUES</u>				
Secchi disc (inches)	130	134	135	136

## B. Biological characteristics:

## 1. Phytoplankton -

<u>Sampling Date</u>	<u>Dominant Genera</u>	<u>Number per ml</u>
06/23/72	1. Fragilaria	673
	2. Cyclotella	152
	3. Chroococcus	141
	4. Oocystis	83
	5. Dinobryon	54
	Other genera	<u>177</u>
	Total	1,280
08/22/72	1. Cyclotella	2,717
	2. Microcystis	1,739
	3. Chroococcus	1,196
	4. Dinobryon	652
	5. Rhabdoderma	507
	Other genera	<u>617</u>
	Total	7,428
11/08/72	1. Microcystis	438
	2. Dinobryon	195
	3. Fragilaria	32
	4. Flagellates	22
	Other genera	<u>152</u>
	Total	839

2. Chlorophyll a -

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

<u>Sampling Date</u>	<u>Station Number</u>	<u>Chlorophyll <u>a</u> (<math>\mu</math>g/l)</u>
06/23/72	01	2.5
08/22/72	01	3.4
11/08/72	01	4.7

## C. Limiting Nutrient Study:

## 1. Autoclaved, filtered, and nutrient spiked -

<u>Spike (mg/l)</u>	<u>Ortho P Conc. (mg/l)</u>	<u>Inorganic N Conc. (mg/l)</u>	<u>Maximum yield (mg/l-dry wt.)</u>
Control	0.005	0.780	0.2
0.006 P	0.011	0.780	0.5
0.012 P	0.017	0.780	3.0
0.024 P	0.029	0.780	9.6
0.060 P	0.065	0.780	19.8
0.060 P + 10.0 N	0.065	10.780	26.5
10.0 N	0.005	10.780	0.2

## 2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Round Lake was relatively low at the time of sample collection (11/08/72). Also, the increased yields with increased levels of orthophosphorus show the lake was phosphorus limited at that time (note the lack of yield response when only nitrogen was added).

The lake data indicate phosphorus limitation at the other sampling times as well; i.e., the mean N/P ratios were 40/1 and greater, and phosphorus limitation would be expected.

## V. LITERATURE REVIEWED

Anonymous, 1972. Wisconsin lakes. Publ. 218-72, WI Dept. Nat. Resources, Madison.

Fassbender, Ronald L., and John J. Weber, 1971. Surface water resources of Waupaca County. WI Dept. Nat. Resources, Madison.

Lueschow, Lloyd A., James M. Helm, Donald R. Winter, and Gary W. Karl; 1970. Trophic nature of selected Wisconsin lakes. Trans. Wisc. Acad. Sci., Arts & Ltrs., vol. 58, pp. 237-264.

Schraufnager, Francis H., 1975. Personal communication (lake morphometry). WI Dept. Nat. Resources, Madison.

## VI. APPENDICES

### APPENDIX A

#### PHYSICAL and CHEMICAL DATA



STORET RETRIEVAL DATE 74/09/30

556601  
44 20 00.0 089 00 00.0  
ROUND LAKE  
55 WISCONSIN

11EPALES 2111202  
6 0050 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CONDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CAC03 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/23	13 25	0000	20.0	11.0	136	300	8.30	139	0.500	0.050	0.042	0.041
	13 25	0015	19.0	10.8		360	7.30	170	1.200	0.310	0.053	0.042
	13 25	0045	6.0	0.6		360	7.30	173	1.100	0.290	0.015	0.005
72/08/22	14 14	0000			135	275	8.30	132	0.380	0.080	0.007	0.004
	14 14	0004	23.6	8.6		280	8.35	129	0.380	0.070	0.006	0.003
	14 14	0015	20.2	10.5		275	8.40	133	0.440	0.110	0.005	0.004
	14 14	0025	10.8	14.9		315	8.30	158	1.450	0.130	0.010	0.005
	14 14	0035	7.5	13.4		320	8.30	165	1.450	0.070	0.019	0.006
	14 14	0047	5.6	0.2		348	7.40	175	0.750	0.680	0.023	0.006
	14 14	0050	5.4	0.4		338	7.35	175	0.450	0.870	0.023	0.006
	14 14	0053	5.1	0.0		360	7.30	178	0.130	1.400	0.033	0.008
	14 14	0056	4.9	0.0		340	7.30	182	0.100	2.570	0.019	0.006
72/11/08	08 30	0000			130	320	7.90	149	0.620	0.270	0.010	0.005
	08 30	0004	7.5	9.6		320	7.90	149	0.610	0.260	0.010	0.006
	08 30	0015	7.5	9.4		320	7.90	130	0.610	0.260	0.010	0.006
	08 30	0025	7.5	9.0		325	7.90	148	0.610	0.250	0.010	0.006
	08 30	0035	7.5	9.3		325	8.00	149	0.620	0.270	0.012	0.007
	08 30	0046	7.5	9.4		330	8.00	149	0.620	0.240	0.009	0.006

32217  
DATE TIME DEPTH CHLRPHYL  
FROM OF A  
TO DAY FEET UG/L

72/06/23 13 25 0000 2.5J  
72/08/22 14 14 0000 3.4J  
72/11/08 08 30 0000 4.7J

J VALUE KNOWN TO BE IN ERROR

## APPENDIX B

### TRIBUTARY DATA

STORET RETRIEVAL DATE 74/10/02

554641 15556641  
 44 20 00.0 049 10 00.0  
 ROUND LAKE OUTLET  
 55 15 WAUPAUKA  
 0/ROUND LAKE  
 END OF RD OFF CO HWY 0 4 MISW WAUPAUKA  
 11FPALES 2111204  
 4 0000 FEET DEPTH

DATE	TIME	DEPTH	00630 NO <sub>3</sub> -N N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH <sub>3</sub> -N TOTAL MG/L	00671 PHOS-DIS ORTHOP MG/L P	00665 PHOS-TOT MG/L P
FROM	OF	FEET					
TO	DAY						
72/03/23	12	35	0.249	0.675	0.094	0.005K	0.012
72/10/14	09	45	0.249	0.550	0.056	0.005K	0.010
72/11/11	09	00	0.310	0.820	0.120	0.005K	0.016
72/12/09	09	05	0.315	1.050	0.134	0.005K	0.016
73/01/06	09	30	0.370	0.860	0.260	0.005K	0.019
73/03/17	09	35	0.126	0.220	0.149	0.009	0.040
73/04/02	19	10	0.860	0.600	0.105	0.006	0.010
73/04/19	19	30	0.510	0.640	0.150	0.005K	0.020
73/05/20	14	10	0.730	0.520	0.018	0.005K	0.010
73/05/31	15	10	0.770	0.800	0.036	0.005K	0.015
73/06/16	10	35	0.580	0.440	0.032	0.007	0.015
73/07/16	11	35	0.380	0.500	0.033	0.005K	0.010
73/03/31	10	30	0.250	0.520	0.120	0.008	0.020

K VALUE KNOWN TO BE LESS  
 THAN INDICATED

STORET RETRIEVAL DATE 74/10/02

556681 LS556681  
 44 20 00.0 089 10 30.0  
 ROUND LAKE INLET  
 55 15 WAUPAUC  
 1/ROUND LAKE  
 CO HWY 0 RDG 1.5 MI WSW OF KING  
 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
72/09/23	12 01		0.345	0.700	0.102	0.005K	0.008
72/10/14	09 30		0.420	0.750	0.076	0.005K	0.010
72/11/11	08 45		0.570	0.600	0.147	0.005K	0.010
72/12/09	09 00		0.630	3.000	0.100	0.005K	0.020
73/01/06	09 05		0.700	1.320	0.210	0.012	0.140
73/02/10	09 15		0.730	0.720	0.220	0.009	
73/04/02	19 00		0.680	0.610	0.120	0.005K	0.080
73/04/19	19 30		0.990	1.180	0.110	0.005K	0.020
73/05/20	14 00		0.750	0.560	0.026	0.005K	0.015
73/05/31	14 10		0.750	1.700	0.075	0.005K	0.015
73/06/16	10 30		0.620	0.560	0.034	0.005K	0.017
73/07/16	11 30		0.440	0.440	0.029	0.005K	0.010
73/09/31	10 25		0.357	1.380	0.072	0.005K	0.022

K VALUE KNOWN TO BE LESS  
 THAN INDICATED