U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT

ON

BUDD LAKE

MORRIS COUNTY

NEW JERSEY

EPA REGION II

WORKING PAPER No. 364

PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

An Associate Laboratory of the

NATIONAL ENVIRONMENTAL RESEARCH CENTER - CORVALLIS, OREGON

and

NATIONAL ENVIRONMENTAL RESEARCH CENTER - LAS VEGAS, NEVADA

☆GPO—697-032

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WITH THE COOPERATION OF THE

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

AND THE

NEW JERSEY NATIONAL GUARD

MAY 1976

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 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 nonpoint 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 freshwater 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 the U.S. Environmental Protection Agency and to augment plans implementation by the states.

ACKNOWLEDGMENTS

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

Douglas Clark, Chief of the Bureau of Water Quality Planning and Management, Mr. Frank Takacs, New Jersey National Eutrophication Survey Coordinator, Principal Environmental Specialist, and Robert Kotch, Senior Environmental Engineer, 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.

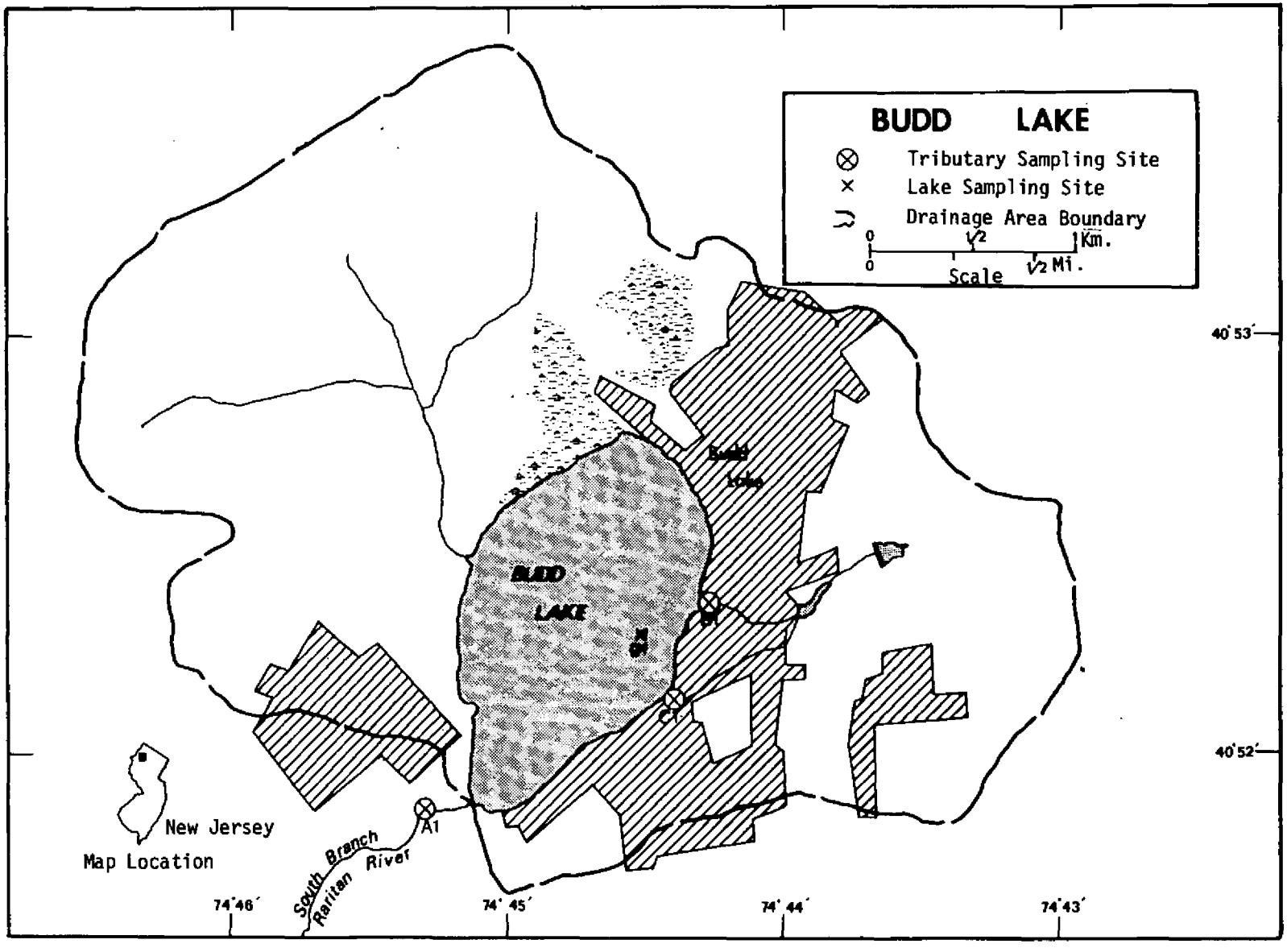
Major General William R. Sharp, Former Chief of Staff, Major General Wilfred G. Menard, Jr., Chief of Staff, and Project Officer Colonel Herbert D. Ruhlin, who directed the volunteer efforts of the New Jersey National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF NEW JERSEY

LAKE NAME	COUNTY
Budd Lake	Morris
Duhernal Lake	Middlesex
Farrington Lake	Middlesex
Greenwood Lake	Passaic, N.J.; Orange, N.Y.
Lake Hopatcong	Morris, Sussex
Lake Musconetcong	Morris, Sussex
Oradell Reservoir	Bergen
Paulinskill Lake	Sussex
Pinecliff Lake	Passaic
Pompton Lakes	Passaic
Spruce Run Reservoir	Hunterdon
Union Lake	Cumberland
Wanaque Reservoir	Passaic


BUDD LAKE
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
0 ½ 1 Km.
0 ½ Mi.
Scale
Budd Lake
BUDD LAKE
A1
New Jersey
Map Location
South Branch Raritan River
74°46'
74° 45'
74° 44'
74°43'
40°53'
40°52'

BUDD LAKE, NEW JERSEY

STORET NO. 3402

I. CONCLUSIONS

A. Trophic Condition:

Field observations and Survey data indicate Budd Lake is eutrophic. The lake is characterized by high chlorophyll a values, autumn algal blooms, and low Secchi disc transparency. Nutrient levels and potential for primary production as measured by algal assay control yield are high. Field limnologists reported abundant aquatic macrophytes in the lake.

Budd Lake has a past record of chemical weed controls, although none are currently being applied. Ketelle and Uttormark (1971) recommended partial to complete dredging, together with removal of nutrient contributions, for rehabilitation of the lake waters.

B. Rate-Limiting Nutrient:

There was a significant loss in nutrients in the algal assay sample between the time of collection and sample analysis, so the results are not considered representative of conditions in the lake at the time the sample was taken. However, lake data indicate

phosphorus limitation during spring and summer, and nitrogen limitation in the fall.

C. Nutrient Controllability:

The estimated phosphorus for Budd Lake of 0.29 $g/m^2/yr$ exceeds that proposed by Vollenweider (Vollenweider and Dillon, 1974) as "permissible" by 1.4 times, and it is 0.69 times the "dangerous" level.

There are no known point sources contributing to Budd Lake. Measured tributaries account for 19.1% of the total phosphorus load, and the ungaged drainage areas were estimated to contribute 74.2%.

Determination of surrounding land uses and unknown sources contributing loading is necessary before recommendations for lake improvement can be proposed.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake surface area and mean depth were provided by the State of New Jersey. Tributary flow data were provided by the New Jersey District Office of the U.S. Geological Survey (USGS) (outlet drainage area includes the lake surface area). Mean hydraulic retention time was obtained by dividing the lake volume by the mean flow of the outlet. Precipitation values were estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix A.

A. Lake Morphometry:

1. Surface area: 1.52 km^2.
2. Mean depth: 1.8 meters.
3. Maximum depth: 4.3 meters.
4. Volume: 2.736×10^6 m^3.
5. Mean hydraulic retention time: 144 days.

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

1. Tributaries -

Name	Drainage area(km^2)	Mean flow (m^3/sec)
B(1) Unnamed Creek	1.8	0.04
C(1) Unnamed Creek	0.5	0.01
Minor tributaries and immediate drainage -	8.3	0.18
Totals	10.6	0.23

2. Outlet - A(1) South Branch Raritan River 12.1 0.22

C. Precipitation:

1. Year of sampling: 163.1 cm.

2. Mean annual: 120.6 cm.

III. LAKE WATER QUALITY SUMMARY

Budd 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 one station on the lake and from a number of depths at that station (see map, page v). During each visit, depth-integrated samples were collected from the station for chlorophyll a analysis and phytoplankton identification and enumeration. During the first visit, a 18.9-liter depth-integrated sample was composited for algal assays. Maximum depth sampled was 2.4 meters at Station 1. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix C and are summarized in III A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll a determinations are included in III B. Results of the limiting nutrient study are presented in III C.

BUDD LAKE
STORET CODE 3402

PHYSICAL AND CHEMICAL CHARACTERISTICS

PARAMETER	(4/17/73) S*** = 1 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(7/23/73) S*** = 1 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(10/ 1/73) S*** = 1 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)
TEMPERATURE (DEG CENT)												
0.-1.5 M DEPTH	1	12.1- 12.1	12.1	0.0- 0.0	1	25.4- 25.4	25.4	0.0- 0.0	2	18.5- 19.1	18.8	0.0- 1.5
MAX DEPTH**	1	11.8- 11.8	11.8	2.4- 2.4	1	24.9- 24.9	24.9	1.8- 1.8	1	18.5- 18.5	18.5	1.5- 1.5
DISSOLVED OXYGEN (MG/L)												
0.-1.5 M DEPTH	0	*****-*****	*****	****-*****	0	*****-*****	*****	****-*****	1	10.8- 10.8	10.8	1.5- 1.5
MAX DEPTH**	1	11.8- 11.8	11.8	2.4- 2.4	1	7.6- 7.6	7.6	1.8- 1.8	1	10.8- 10.8	10.8	1.5- 1.5
CONDUCTIVITY (UMHOS)												
0.-1.5 M DEPTH	1	115.- 115.	115.	0.0- 0.0	1	120.- 120.	120.	0.0- 0.0	2	230.- 250.	240.	0.0- 1.5
MAX DEPTH**	1	110.- 110.	110.	2.4- 2.4	1	121.- 121.	121.	1.8- 1.8	1	230.- 230.	230.	1.5- 1.5
PH (STANDARD UNITS)												
0.-1.5 M DEPTH	1	7.8- 7.8	7.8	0.0- 0.0	1	8.6- 8.6	8.6	0.0- 0.0	2	8.5- 8.7	8.6	0.0- 1.5
MAX DEPTH**	1	7.9- 7.9	7.9	2.4- 2.4	1	7.2- 7.2	7.2	1.8- 1.8	1	8.5- 8.5	8.5	1.5- 1.5
TOTAL ALKALINITY (MG/L)												
0.-1.5 M DEPTH	1	19.- 19.	19.	0.0- 0.0	1	30.- 30.	30.	0.0- 0.0	2	20.- 23.	22.	0.0- 1.5
MAX DEPTH**	1	19.- 19.	19.	2.4- 2.4	1	29.- 29.	29.	1.8- 1.8	1	20.- 20.	20.	1.5- 1.5
TOTAL P (MG/L)												
0.-1.5 M DEPTH	1	0.047-0.047	0.047	0.0- 0.0	1	0.081-0.081	0.081	0.0- 0.0	2	0.102-0.110	0.106	0.0- 1.5
MAX DEPTH**	1	0.044-0.044	0.044	2.4- 2.4	1	0.083-0.083	0.083	1.8- 1.8	1	0.110-0.110	0.110	1.5- 1.5
DISSOLVED ORTHO P (MG/L)												
0.-1.5 M DEPTH	1	0.005-0.005	0.005	0.0- 0.0	1	0.013-0.013	0.013	0.0- 0.0	2	0.014-0.014	0.014	0.0- 1.5
MAX DEPTH**	1	0.007-0.007	0.007	2.4- 2.4	1	0.011-0.011	0.011	1.8- 1.8	1	0.014-0.014	0.014	1.5- 1.5
NO2+NO3 (MG/L)												
0.-1.5 M DEPTH	1	0.160-0.160	0.160	0.0- 0.0	1	0.120-0.120	0.120	0.0- 0.0	2	0.050-0.060	0.055	0.0- 1.5
MAX DEPTH**	1	0.130-0.130	0.130	2.4- 2.4	1	0.130-0.130	0.130	1.8- 1.8	1	0.050-0.050	0.050	1.5- 1.5
AMMONIA (MG/L)												
0.-1.5 M DEPTH	1	0.060-0.060	0.060	0.0- 0.0	1	0.130-0.130	0.130	0.0- 0.0	2	0.060-0.070	0.065	0.0- 1.5
MAX DEPTH**	1	0.060-0.060	0.060	2.4- 2.4	1	0.120-0.120	0.120	1.8- 1.8	1	0.060-0.060	0.060	1.5- 1.5
KJELDAHL N (MG/L)												
0.-1.5 M DEPTH	1	0.400-0.400	0.400	0.0- 0.0	1	1.800-1.800	1.800	0.0- 0.0	2	1.600-1.800	1.700	0.0- 1.5
MAX DEPTH**	1	0.600-0.600	0.600	2.4- 2.4	1	1.500-1.500	1.500	1.8- 1.8	1	1.600-1.600	1.600	1.5- 1.5
SECCHI DISC (METERS)	1	0.9- 0.9	0.9		1	0.6- 0.6	0.6		1	0.5- 0.5	0.5	

* N = NO. OF SAMPLES
** MAXIMUM DEPTH SAMPLED AT EACH SITE
*** S = NO. OF SITES SAMPLED ON THIS DATE

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera		Algal Units per ml
07/23/73	1.	Flagellates	1,750
	2.	Microcystis	996
	3.	Melosira	899
	4.	Stephanodiscus	535
	5.	Cyclotella	316
		Other genera	2,479
		Total	6,975
10/01/73	1.	Oscillatoria	3,404
	2.	Mougeotia	2,533
	3.	Microcystis	2,374
	4.	Melosira	1,306
	5.	Phormidium	752
		Other genera	3,997
		Total	14,366

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
04/17/73	1	33.4
07/23/73	1	57.5
10/01/73	1	54.6

C. Limiting Nutrient Study:

There was a significant loss of nutrients in the assay samples between the time of collection and the beginning of the assay, and the results are not indicative of conditions in the lake at the time the sample was taken. However, the levels of nutrients indicate that potentially Budd Lake had a high level of primary productivity.

The lake data indicate phosphorus limitation during spring and summer sampling times, with mean total inorganic nitrogen to mean orthophosphorus ratios (N/P) of 35/1 and 19/1, respectively. The N/P ratio of 10/1 during fall sampling indicates nitrogen limitation at that time.

IV. NUTRIENT LOADINGS
(See Appendix D for data)

For the determination of nutrient loadings, the New Jersey 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 July 1973, and was completed in July 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the New Jersey District Office of USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual concentrations in Unnamed Creeks at Stations B(1) and C(1) and mean annual ZZ flow.

A. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (nonpoint load) -		
B(1) Unnamed Creek	75	16.9
C(1) Unnamed Creek	10	2.2
b. Minor tributaries and immediate drainage (nonpoint load) -	330	74.2
c. Known municipal STP's - None		
d. Septic tanks* -	5	1.1
e. Known industrial - None		
f. Direct precipitation** -	25	5.6
Total	445	100.0

2. Output - A(1) South Branch Raritan River 375

3. Net annual P accumulation 70

*Estimate based on 20 lakeside residences.
**Estimated (see NES Working Paper No. 175).

B. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source		kg N/yr	% of total
a.	Tributaries (nonpoint load) -		
	B(1) Unnamed Creek	2,740	16.1
	C(1) Unnamed Creek	425	2.5
b.	Minor tributaries and immediate drainage (nonpoint load) -	12,025	70.5
c.	Known municipal STP's - None		
d.	Septic tanks* -	215	1.3
e.	Known industrial - None		
f.	Direct precipitation** -	1,640	9.6
	Total	17,045	100.0

2. Output - A(1) South Branch Raritan River 8,200

3. Net annual N accumulation 8,845

*Estimate based on 20 lakeside residences.
**Estimated (see NES Working Paper No. 175).

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

Tributary	kg P/km^2/yr	kg N/km^2/yr
B(1) Unnamed Creek	42	1,522
C(1) Unnamed Creek	20	850

D. 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 Yearly Phosphorus Loadings (g/m^2/yr)
Estimated loading for Budd Lake	0.29
Vollenweider's "dangerous" or eutrophic loading	0.42
Vollenweider's "permissible" or oligotrophic loading	0.21

V. LITERATURE REVIEWED

Ketelle, M. J. and P. D. Uttormark. 1971. Problem Lakes in the United States. U.S. Environmental Protection Agency Project #16010 EHR. University of Wisconsin, Madison, Wisconsin.

U.S. Environmental Protection Agency. 1975. National Eutrophication Survey Methods 1973-1976. Working Paper No. 175. Environmental Monitoring and Support Laboratory, Las Vegas, Nevada and Corvallis Environmental Research Laboratory, Corvallis, Oregon.

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

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 B

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NEW JERSEY 06/04/76

LAKE CODE 3402 BUDD LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 12.1

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3402A1	12.1	0.246	0.311	0.481	0.425	0.252	0.125	0.122	0.113	0.091	0.091	0.176	0.227	0.221
3402B1	1.8	0.040	0.048	0.076	0.068	0.042	0.023	0.022	0.021	0.017	0.017	0.031	0.037	0.037
3402C1	0.5	0.007	0.008	0.013	0.012	0.008	0.004	0.004	0.004	0.003	0.003	0.006	0.007	0.007
3402ZZ	9.8	0.200	0.255	0.392	0.345	0.202	0.098	0.095	0.088	0.070	0.070	0.139	0.183	0.178

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 12.1
SUM OF SUB-DRAINAGE AREAS = 12.1
TOTAL FLOW IN = 2.66
TOTAL FLOW OUT = 2.66

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3402A1	7	73	0.340	21	1.784				
	8	73	0.311	19	0.161				
	9	73	0.088	16	0.119				
	10	73	0.176	14	0.065				
	11	73	0.184	11	0.133				
	12	73	0.708	17	0.453				
	1	74	0.538	6	0.510				
	2	74	0.368	3	0.425	13	0.283		
	3	74	0.453	3	0.280	14	0.246		
	4	74	0.595	28	0.311				
	5	74	0.368	25	0.280				
	6	74	0.221	22	0.246				
3402B1	7	73	0.054	21	0.283				
	8	73	0.048	19	0.028				
	9	73	0.017	16	0.022				
	10	73	0.031	14	0.014				
	11	73	0.031	11	0.020				
	12	73	0.113	17	0.071				
	1	74	0.082	6	0.079				
	2	74	0.057	3	0.065	13	0.045		
	3	74	0.071	3	0.045	14	0.040		
	4	74	0.096	28	0.048				
	5	74	0.057	25	0.045				
	6	74	0.037	22	0.040				

TRIBUTARY FLOW INFORMATION FOR NEW JERSEY 06/04/76

LAKE CODE 3402 BUDD LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3402C1	7	73	0.010	21	0.048				
	8	73	0.009	19	0.005				
	9	73	0.003	16	0.004				
	10	73	0.006	14	0.003				
	11	73	0.006	11	0.004				
	12	73	0.020	17	0.012				
	1	74	0.014	6	0.014				
	2	74	0.010	3	0.011	13	0.008		
	3	74	0.012	3	0.008	14	0.007		
	4	74	0.017	28	0.009				
	5	74	0.010	25	0.008				
	6	74	0.007	22	0.007				
3402ZZ	7	73	0.276	21	1.453				
	8	73	0.255	19	0.128				
	9	73	0.068	16	0.093				
	10	73	0.139	14	0.049				
	11	73	0.147	11	0.108				
	12	73	0.575	17	0.370				
	1	74	0.442	6	0.417				
	2	74	0.301	3	0.348	13	0.230		
	3	74	0.370	3	0.227	14	0.200		
	4	74	0.481	28	0.255				
	5	74	0.301	25	0.227				
	6	74	0.178	22	0.199				

APPENDIX C

PHYSICAL AND CHEMICAL DATA

STORET RETRIEVAL DATE 76/06/04

340201
40 52 13.0 074 44 35.0 3
BUDD LAKE
34027 NEW JERSEY
013391

11EPALES 2111202
0008 FEET DEPTH CLASS 00

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
73/04/17	15	0000	12.1		36	115	7.80	19	0.060	0.400	0.160	0.005
	15	0008	11.8	11.8		110	7.90	19	0.060	0.600	0.130	0.007
73/07/23	15	0000	25.4		24	120	8.60	30	0.130	1.800	0.120	0.013
	15	0006	24.9	7.6		121	7.20	29	0.120	1.500	0.130	0.011
73/10/01	16	0000	19.1		18	250	8.70	23	0.070	1.800	0.060	0.014
	16	0005	18.5	10.8		230	8.50	20	0.060	1.600	0.050	0.014

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/17	15	0000	0.047	33.4
	15	0008	0.044	
73/07/23	15	0000	0.081	57.5
	15	0006	0.083	
73/10/01	16	0000	0.102	54.6
	16	0005	0.110	

APPENDIX D

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

3402A1
40 51 49.0 074 52 47.0 4
S BR RARITAN RIVER
34 7.5 HACKETTSTOWN
0/BUDD LAKE 020392
2NDRY RD BRDG 1000 FT BELO LAKE
11EPALES 2111204
0000 FEET DEPTH CLASS 00

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
73/07/21	12 00		0.010K	2.400	0.440	0.007	0.020
73/08/19	13 37		0.026	1.000	0.088	0.011	0.050
73/09/16	12 45		0.010K	1.600	0.132	0.009	0.080
73/10/14	12 45		0.026	0.750	0.030	0.015	0.095
73/11/11	14 15		0.010K	0.750	0.020	0.005K	0.080
73/12/17	15 00		0.064	0.350	0.024	0.005K	0.030
74/01/06	13 45		0.184	0.600	0.024	0.005K	0.025
74/02/03	13 30		0.336	0.400	0.055	0.015	0.015
74/02/13	15 15		2.500	0.400	0.055	0.015	0.020
74/03/03	09 30		0.420	0.500	0.030	0.005	0.063
74/03/14	16 30		0.290	0.600	0.085	0.035	0.060
74/04/28	13 00		0.012	0.400	0.030	0.010	0.025
74/05/25	14 15		0.016	0.700	0.030	0.010	0.075
74/06/22	13 20		0.336	1.100	0.160	0.050	0.085
74/07/13	13 35		0.480	0.800	0.080	0.045	0.120

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/06/04

340281
40 52 17.0 074 44 17.0 4
UNNAMED CREEK
34 7.5 CHESTER
T/BUDD LAKE 013391
CO RD 59 BRDG 0.2 MI N OF ST HWY 46 JCT
11EPALES 2111204
0000 FEET DEPTH CLASS 00

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
73/07/21	12	20	1.160	1.210	0.320	0.032	0.065
73/08/19	13	20	4.600	0.300	0.060	0.033	0.070
73/09/16	12	30	2.200	1.470	0.252	0.044	0.105
73/10/14	12	00	1.800	1.400	0.082	0.044	0.120
73/11/11	13	11	2.200	0.400	0.048	0.018	0.060
73/12/17	14	45	1.920	1.700	0.056	0.020	
74/01/06	14	00	2.200	0.500	0.048	0.020	0.025
74/02/03	13	15	0.336	0.400	0.055	0.015	0.020
74/02/13	15	00	2.500	0.400	0.055	0.010	0.020
74/03/03	09	50	0.410	0.500	0.010	0.005	0.060
74/03/14	16	45	0.280	0.700	0.090	0.035	0.080
74/04/28	13	20	0.024	0.400	0.025	0.010	0.030
74/05/25	14	30	0.016	0.600	0.030	0.010	0.070
74/06/22	13	40	0.330	0.900	0.175	0.050	0.085
74/07/13	13	55	0.480	0.700	0.110	0.045	0.120

STORET RETRIEVAL DATE 76/06/04

3402C1
40 52 05.0 074 44 25.0 4

34 MORRIS CO HWY MA
T/BUDD LAKE 013391
CO RD 59 BRDG JUST NOF ST HWY 46 JCT
11EPALES 2111204
0000 FEET DEPTH CLASS 00

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
73/07/21	12 30		0.560	1.540	0.230	0.017	0.065
73/08/19	13 30		0.077	1.050	0.110	0.015	0.040
73/09/16	12 15		2.020	0.900	0.170	0.037	0.060
73/10/14	12 18		0.890	1.250	0.062	0.018	0.135
73/11/11	13 40		0.580	0.750	0.072	0.010	0.065
73/12/17	14 50		3.600	0.500	0.150	0.020	0.030
74/01/06	13 30		4.200	1.000	0.124	0.016	0.025
74/02/03	13 45		0.336	0.600	0.060	0.015	0.020
74/02/13	15 25		2.500	0.500	0.055	0.015	0.025
74/03/03	09 15		0.410	0.500	0.010	0.005	0.060
74/03/14	17 00		0.252	0.500	0.095	0.030	0.040
74/04/24	13 35		0.004	0.600	0.020	0.005	0.030
74/05/25	14 00		0.028	1.300	0.190	0.010	0.065
74/06/22	13 30		0.330	0.600	0.140	0.050	0.085
74/07/13	14 05		0.500	1.300	0.100	0.055	0.080

APPENDIX E

PARAMETRIC RANKINGS OF LAKES SAMPLED BY NES IN 1973

STATE OF NEW JERSEY

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
3402	BUDD LAKE	0.082	0.205	474.000	48.500	7.400	0.012
3403	GREENWOOD LAKE	0.021	0.100	414.250	11.920	14.800	0.007
3406	ORADELL RESERVOIR	0.055	0.990	462.500	22.267	13.600	0.008
3409	PINECLIFF LAKE	0.070	0.175	465.500	38.960	11.000	0.011
3410	POMPTON LAKES	0.071	0.795	463.167	23.033	11.800	0.029
3412	DUHERNAL LAKE	0.082	1.420	466.667	6.800	8.600	0.010
3413	FARRINGTON LAKE	0.055	0.770	462.000	8.283	14.400	0.012
3415	LAKE HOPATCONG	0.022	0.120	416.333	13.627	14.900	0.007
3417	LAKE MUSCONETCONG	0.036	0.140	436.000	11.067	6.000	0.010
3419	PAULINS KILL LAKE	0.133	0.950	460.500	7.017	9.000	0.065
3420	SPRUCE RUN RESERVOIR	0.020	0.470	428.667	15.333	15.000	0.007
3422	UNION LAKE	0.063	1.150	463.200	22.080	12.800	0.018
3423	WANAQUE RESERVOIR	0.014	0.120	355.333	7.111	14.800	0.005

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
3402	BUDD LAKE	12 (1)	58 (7)	0 (0)	0 (0)	92 (11)	29 (3)	191
3403	GREENwOOD LAKE	83 (10)	100 (12)	92 (11)	58 (7)	21 (2)	83 (9)	437
3406	ORADELL RESERVOIR	54 (6)	17 (2)	42 (5)	25 (3)	42 (5)	67 (8)	247
3409	PINECLIFF LAKE	33 (4)	67 (8)	17 (2)	8 (1)	67 (8)	42 (5)	234
3410	POMPTON LAKES	25 (3)	33 (4)	33 (4)	17 (2)	58 (7)	8 (1)	174
3412	DUHERNAL LAKE	12 (1)	0 (0)	8 (1)	100 (12)	83 (10)	58 (7)	261
3413	FARRINGTON LAKE	54 (6)	42 (5)	50 (6)	75 (9)	33 (4)	29 (3)	283
3415	LAKE HOPATCONG	75 (9)	87 (10)	83 (10)	50 (6)	8 (1)	83 (9)	386
3417	LAKE MUSCONETCONG	67 (8)	75 (9)	67 (8)	67 (8)	100 (12)	50 (6)	426
3419	PAULINS KILL LAKE	0 (0)	25 (3)	58 (7)	92 (11)	75 (9)	0 (0)	250
3420	SPRUCE RUN RESERVOIR	92 (11)	50 (6)	75 (9)	42 (5)	0 (0)	83 (9)	342
3422	UNION LAKE	42 (5)	8 (1)	25 (3)	33 (4)	50 (6)	17 (2)	175
3423	WANAQUE RESERVOIR	100 (12)	87 (10)	100 (12)	83 (10)	21 (2)	100 (12)	491

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3423	WANAQUE RESERVOIR	491
2	3403	GREENWOOD LAKE	437
3	3417	LAKE MUSCONETCONG	426
4	3415	LAKE HOPATCONG	386
5	3420	SPRUCE RUN RESERVOIR	342
6	3413	FARRINGTON LAKE	283
7	3412	DUHERNAL LAKE	261
8	3419	PAULINS KILL LAKE	250
9	3406	ORADELL RESERVOIR	247
10	3409	PINECLIFF LAKE	234
11	3402	BUDD LAKE	191
12	3422	UNION LAKE	175
13	3410	POMPTON LAKES	174