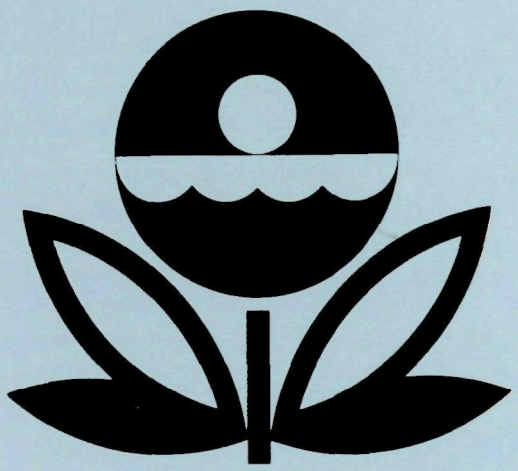
U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES



REPORT

ON

BOULDER LAKE

SUBLETTE COUNTY

WYOMING

EPA REGION VIII

WORKING PAPER No. 882

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

REPORT
ON
BOULDER LAKE
SUBLETTE COUNTY
WYOMING
EPA REGION VIII
WORKING PAPER No. 882

WITH THE COOPERATION OF THE
WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY
AND THE
WYOMING NATIONAL GUARD
JULY, 1977

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 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 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 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 Wyoming Department of Environmental Quality for professional involvement, to the Wyoming National Guard for conducting the tributary sampling phase of the Survey, and to those Wyoming wastewater treatment plant operators who voluntarily provided effluent samples.

The staff of the Water Quality Division 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.

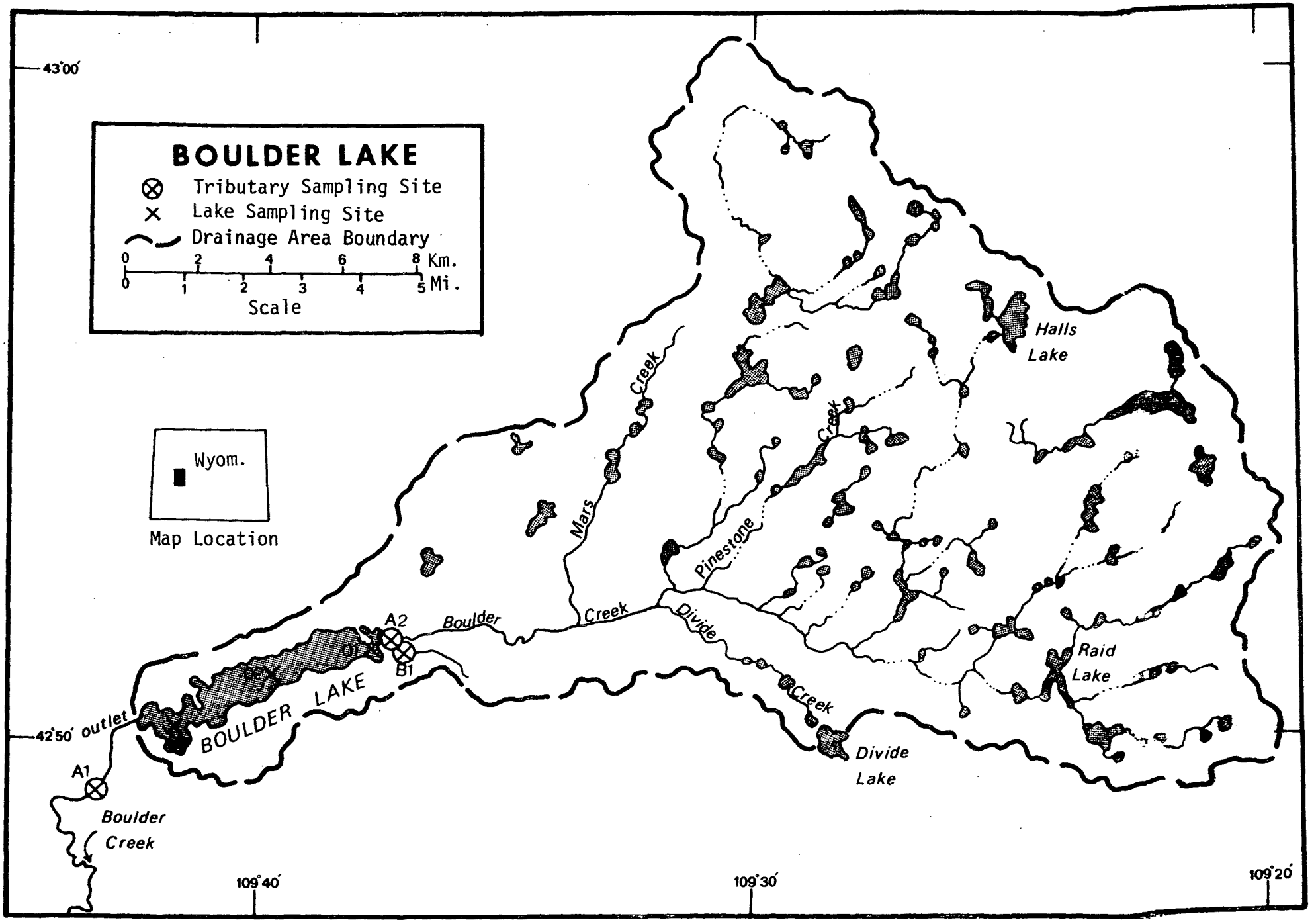
Brigadier General James L. Spence, The Adjutant General of Wyoming, and Project Officer Colonel Donald L. Boyer, who directed the volunteer efforts of the Wyoming National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY RESERVOIRS

State of Wyoming

NAME	COUNTY
Big Sandy	Sublette, Sweetwater
Boulder	Sublette
Boysen	Fremont
De Smet	Johnson
Flaming Gorge	Sweetwater, WY; Daggett, UT
Fremont	Sublette
Glendo	Converse, Platte
Keyhole	Crook
Ocean	Fremont
Seminoe	Carbon
Soda	Sublette
Viva Naughton	Lincoln
Woodruff Narrows	Uinta
Yellowtail	Bighorn, WY; Bighorn, Carbon, MT


BOULDER LAKE
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
0 2 4 6 8 Km.
0 1 2 3 4 5 Mi.
Scale
Wyom.
Map Location
43°00'
42°50'
109°40'
109°30'
109°20'
A1
A2
B1
Q1
Q2
outlet
BOULDER LAKE
Boulder Creek
Boulder Creek
Mars Creek
Pinestone Creek
Divide Creek
Halls Lake
Raid Lake
Divide Lake

BOULDER LAKE

STORET NO. 5602

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate Boulder Lake is oligotrophic. It ranked first in overall trophic quality when the 14 Wyoming lakes and reservoirs sampled in 1975 were compared using a combination of six parameters*. One of the water bodies had less median total phosphorus, none had less and one had the same median dissolved orthophosphorus, none had less and four had the same median inorganic nitrogen, none had less mean chlorophyll a, and one had greater mean Secchi disc transparency. No significant depression of dissolved oxygen occurred at depths as great as 53 meters.

B. Rate-Limiting Nutrient:

Due to significant changes in nutrient concentrations in the samples during shipment, the algal assay results are not considered representative of conditions in Boulder Lake at the times of sampling (08/28/75 and 10/17/75).

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

C. Nutrient Controllability:

1. Point sources--No known municipal or industrial point

* See Appendix A.

sources impacted Boulder Lake during the sampling year.

The septic tanks serving lakeshore dwellings and a recreational facility were estimated to have contributed less than 0.1% of the total phosphorus load, but a shoreline survey would have to be done to determine the significance of those sources.

The present phosphorus loading of 0.68 $g/m^2/yr$ is a little more than that proposed by Vollenweider (Vollenweider and Dillon, 1974) as an oligotrophic loading (see page 11). If the loading is not increased, the existing trophic quality of Boulder Lake should persist.

2. Non-point sources--Non-point sources, including precipitation, contributed essentially all of the total phosphorus load during the sampling year. Boulder Creek added 74.9% of the total; and the ungaged tributaries contributed an estimated 22.5%.

The phosphorus export rate of Boulder Creek was 12 kg/km^2 during the sampling year (see page 10). This rate was somewhat higher than that of an unimpacted tributary of nearby Fremont Lake (7 $kg/km^2/yr$)*.

* Working Paper No. 886.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 7.03 kilometers^2.
2. Mean depth: 12.2 meters.
3. Maximum depth: 69.8 meters.
4. Volume: 85.766 x 10^6 m^3.
5. Mean hydraulic retention time: 181 days (based on outflow).

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

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Boulder Creek	297.8	5.180
Minor tributaries & immediate drainage -	31.9	0.544
Totals	329.7	5.724

2. Outlet -

Boulder Creek	336.7**	5.470

C. Precipitation***:

1. Year of sampling: 25.7 centimeters.
2. Mean annual: 28.5 centimeters.

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† Table of metric conversions--Appendix B.
†† Prior, 1974; area planimetered on U.S.G.S. quad. maps.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Boulder Lake was sampled two times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from one or more depths at three stations on the lake (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during both visits, 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 near-surface at station 1, 53.3 meters at station 2, and 16.5 meters at station 3.

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 BOULDER LAKE
STORET CODE 5602

PARAMETER	1ST SAMPLING (8/28/75) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (10/17/75) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING 0 SITES RANGE	MEAN	MEDIAN
TEMP (C)	5.8 - 15.6	11.9	14.3	8.5 - 11.7	10.5	10.9	******	**********	
DISS OXY (MG/L)	6.6 - 9.6	8.0	7.8	7.6 - 8.8	8.4	8.4	******	**********	
CNDCTVY (MCROMO)	21. - 29.	25.	25.	1. - 3.	1.	1.	******	**********	
PH (STAND UNITS)	6.5 - 7.8	7.2	7.3	6.1 - 7.0	6.8	6.9	******	**********	
TOT ALK (MG/L)	10. - 22.	16.	16.	11. - 30.	18.	15.	******	**********	
TOT P (MG/L)	0.008 - 0.031	0.012	0.010	0.006 - 0.011	0.008	0.008	******	**********	
ORTHO P (MG/L)	0.002 - 0.012	0.004	0.003	0.002 - 0.004	0.003	0.002	******	**********	
NO2+NO3 (MG/L)	0.020 - 0.060	0.031	0.020	0.020 - 0.080	0.035	0.020	******	**********	
AMMONIA (MG/L)	0.020 - 0.040	0.022	0.020	0.020 - 0.020	0.020	0.020	******	**********	
KJEL N (MG/L)	0.200 - 0.600	0.318	0.300	0.200 - 0.200	0.200	0.200	******	**********	
INORG N (MG/L)	0.040 - 0.080	0.053	0.040	0.040 - 0.100	0.055	0.040	******	**********	
TOTAL N (MG/L)	0.220 - 0.660	0.349	0.320	0.220 - 0.280	0.235	0.220	******	**********	
CHLRPYL A (UG/L)	2.0 - 2.9	2.5	2.6	1.8 - 3.0	2.5	2.6	******	**********	
SECCHI (METERS)	2.5 - 4.1	3.3	3.3	1.2 - 6.1	3.6	3.6	******	**********	

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
08/28/75	1. Chlamydomonas (?) sp.	3,806
	2. Chroomonas (?) sp.	327
	3. Cryptomonas sp.	59
	4. Sphaerocystis sp.	30
	Total	4,222
10/17/75	1. Sphaerocystis sp.	104
	2. Aphanothece (?) sp.	78
	3. Elakatothrix sp.	52
	4. Cryptomonas sp.	26
	5. Chroomonas (?) sp.	26
	Total	286

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
08/28/75	1	2.9
	2	2.0
	3	2.6
10/17/75	1	1.8
	2	3.0
	3	2.6

C. Limiting Nutrient Study:

Because of significant nutrient changes in the samples during shipment from the field to the laboratory, the algal assay results are not considered representative of conditions in Boulder Lake at the times the samples were collected.

The lake data indicate borderline nitrogen limitation in August and phosphorus limitation in October. The mean inorganic nitrogen to orthophosphorus ratios were 13 to 1 in August and 18 to 1 in October. Nitrogen limitation would be expected at N to P ratios of 13 to 1 or less.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Wyoming National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the months of June and July when two samples were collected at two of the sites. Sampling was begun in October, 1974, and was completed in July, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Wyoming District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were calculated using mean annual concentrations and mean annual flows. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the mean concentrations in Unnamed Creek at station B-1 and the mean annual ZZ flow.

No known wastewater treatment plants impacted Boulder Lake during the sampling year.

A. Waste Sources:

1. Known municipal - None
2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
Boulder Creek	3,595	74.9
b. Minor tributaries & immediate drainage (non-point load) -	1,080	22.5
c. Known municipal STP's - None	-	-
d. Septic tanks* -	<5	<0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	125	2.6
Total	4,800	100.0

2. Outputs -

Lake outlet - Boulder Creek 3,105

3. Net annual P accumulation - 1,695 kg.

* Estimate based on two lakeshore dwellings and one campground; 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) -		
Boulder Creek	110,430	80.5
b. Minor tributaries & immediate drainage (non-point load) -	19,010	13.9
c. Known municipal STP's - None	-	-
d. Septic tanks* -	90	0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	7,590	5.5
Total	137,120	100.0

2. Outputs -

Lake outlet - Boulder Creek 176,470

3. Net annual N loss - 39,350 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Boulder Creek	12	371

E. Mean Nutrient Concentrations in Ungaged Stream:

Tributary	Mean Total P Conc. (mg/l)	Mean Total N Conc. (mg/l)
Unnamed Creek B-1	0.063	1.108

* Estimate based on two lakeshore dwellings and one campground; see Working Paper No. 175.
** See Working Paper No. 175.

F. 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	0.68	0.24	19.5	loss*

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

"Dangerous" (eutrophic loading)	0.96
"Permissible" (oligotrophic loading)	0.48

* There was an apparent loss of nitrogen during the sampling year. This may have been due to nitrogen fixation in the lake, solubilization of previously sedimented nitrogen, or underestimation of the minor tributary and immediate drainage load. Whatever the cause, a similar nitrogen loss has occurred at Shagawa Lake, Minnesota, which has been intensively studied by EPA's former National Eutrophication and Lake Restoration Branch (Malueg et al., 1975).

V. LITERATURE REVIEWED

Malueg, Kenneth W., D. Phillips Larsen, Donald W. Schults, and Howard T. Mercier; 1975. A six-year water, phosphorus, and nitrogen budget for Shagawa Lake, Minnesota. Jour. Environ. Qual., vol. 4, no. 2, pp. 236-242.

Prior, Roy E., 1974. Personal communication (lake morphometry). WY Dept. of Env. Qual., Cheyenne.

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 D	MEDIAN DISS ORTHO P
5601	BIG SANDY RESERVOIR	0.087	0.060	487.667	4.383	8.600	0.020
5602	BOULDER LAKE	0.004	0.040	361.600	2.483	8.400	0.002
5603	BOYSEN RESERVOIR	0.037	0.140	465.923	5.264	14.400	0.014
5604	LAKE DE SMET	0.033	0.040	409.000	11.167	9.400	0.006
5605	FLAMING GORGE RESERVOIR	0.014	0.605	366.461	5.611	12.200	0.003
5606	FREMONT LAKE	0.006	0.040	-22.000	3.783	7.400	0.002
5607	GLENDO RESERVOIR	0.045	0.315	459.182	8.473	12.600	0.014
5608	KEY HOLE RESERVOIR	0.028	0.050	454.583	7.792	14.000	0.004
5609	OCEAN LAKE	0.043	0.040	478.333	7.500	8.600	0.004
5610	SEMINOLE RESERVOIR	0.030	0.130	447.000	2.536	11.000	0.007
5611	SODA LAKE	0.063	0.040	387.500	5.575	15.000	0.014
5612	VIVA NAUGHTON RESERVOIR	0.065	0.120	430.000	25.067	13.200	0.024
5613	WOODRUFF NARROWS RESERVO	0.069	0.105	470.000	12.950	13.200	0.019
5614	YELLOWTAIL RESERVOIR	0.026	0.310	364.500	5.410	10.000	0.017

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
5601	BIG SANDY RESERVOIR	0 (0)	54 (7)	0 (0)	77 (10)	77 (10)	8 (1)	216
5602	BOULDER LAKE	92 (12)	92 (11)	92 (12)	100 (13)	92 (12)	92 (12)	560
5603	BOYSEN RESERVOIR	46 (6)	23 (3)	23 (3)	46 (6)	8 (1)	42 (5)	188
5604	LAKE DE SMET	54 (7)	73 (9)	62 (8)	15 (2)	69 (9)	62 (8)	335
5605	FLAMING GORGE RESERVOIR	85 (11)	0 (0)	77 (10)	54 (7)	46 (6)	85 (11)	347
5606	FREMONT LAKE	100 (13)	73 (9)	100 (13)	85 (11)	100 (13)	100 (13)	558
5607	GLENDO RESERVOIR	31 (4)	8 (1)	31 (4)	23 (3)	38 (5)	42 (5)	173
5608	KEY HOLE RESERVOIR	69 (9)	62 (8)	38 (5)	31 (4)	15 (2)	69 (9)	284
5609	OCEAN LAKE	38 (5)	92 (11)	8 (1)	38 (5)	85 (11)	77 (10)	338
5610	SEMINOLE RESERVOIR	62 (8)	31 (4)	46 (6)	92 (12)	54 (7)	54 (7)	339
5611	SODA LAKE	23 (3)	92 (11)	69 (9)	62 (8)	0 (0)	31 (4)	277
5612	VIVA NAUGHTON RESERVOIR	15 (2)	38 (5)	54 (7)	0 (0)	27 (3)	0 (0)	134
5613	WOODRUFF NARROWS RESERVO	8 (1)	46 (6)	15 (2)	8 (1)	27 (3)	15 (2)	119
5614	YELLOWTAIL RESERVOIR	77 (10)	15 (2)	85 (11)	69 (9)	62 (8)	23 (3)	331

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	5602	BOULDER LAKE	560
2	5606	FREMONT LAKE	558
3	5605	FLAMING GORGE RESERVOIR	347
4	5610	SEMINOLE RESERVOIR	339
5	5609	OCEAN LAKE	338
6	5604	LAKE DE SMET	335
7	5614	YELLOWTAIL RESERVOIR	331
8	5608	KEY HOLE RESERVOIR	284
9	5611	SODA LAKE	277
10	5601	BIG SANDY RESERVOIR	216
11	5603	BOYSEN RESERVOIR	188
12	5607	GLENDO RESERVOIR	173
13	5612	VIVA NAUGHTON RESERVOIR	134
14	5613	WOODRUFF NARROWS RESERVO	119

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 WYOMING 08/05/76

LAKE CODE 5602 BOULDER LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 336.7

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
5602A1	336.7	0.45	0.51	0.57	1.05	10.87	30.02	12.74	4.25	2.38	1.50	0.68	0.48	5.47
5602A2	297.8	0.45	0.45	0.62	1.78	17.47	26.62	8.78	1.78	1.64	1.02	0.76	0.65	5.18
5602ZZ	38.8	0.057	0.057	0.057	0.198	1.841	2.832	0.850	0.198	0.170	0.113	0.085	0.057	0.544

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 336.7
SUM OF SUB-DRAINAGE AREAS = 336.7
TOTAL FLOW IN = 68.55
TOTAL FLOW OUT = 65.50

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
5602A1	10	74	0.425	5	0.425				
	11	74	0.425	16	0.283				
	12	74	0.283	12	0.283				
	1	75	0.311	13	0.283				
	2	75	0.425						
	3	75	0.425						
	4	75	0.566						
	5	75	1.699	4	0.850	24	4.248		
	6	75	32.848	21	28.317				
	7	75	31.149	3	53.802	25	15.574		
	8	75	1.982						
	9	75	0.566						
5602A2	10	74	0.368	5	0.255				
	11	74	0.396	18	0.283				
	12	74	0.255	12	0.255				
	1	75	0.311						
	2	75	0.396						
	3	75	0.396						
	4	75	0.510						
	5	75	1.982	14	1.982				
	6	75	35.396	1	13.875	20	25.485		
	7	75	33.980	3	62.297	17	39.644		
	8	75	2.265						
	9	75	0.850						
5602ZZ	10	74	0.028						
	11	74	0.057						
	12	74	0.028						
	1	75	0.028						
	2	75	0.057						
	3	75	0.057						
	4	75	0.057						
	5	75	0.255						
	6	75	3.681						
	7	75	2.549						
	8	75	0.283						
	9	75	0.085						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/08/05

560201
42 51 22.0 109 37 23.0 3
BOULDER LAKE
56035 WYOMING

11EPALES 2111202
0003 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
75/08/28	11 40	0000	15.0	7.6		26	7.30	22	0.020	0.500	0.020K	0.009
75/10/17	11 30	0000	9.4	8.8	48	1K	7.05	18	0.020K	0.200K	0.020K	0.002K

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/08/28	11 40	0000	0.015	2.9	
75/10/17	11 30	0000	0.008	1.8	

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/08/05

560202
42 51 03.0 109 39 13.0 3
BOULDER LAKE
56035 WYOMING

11EPALES 2111202
0162 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
75/08/28	12 10	0000	14.8	7.6	162	29	7.50	16	0.020K	0.400	0.020K	0.004
	12 10	0005	14.7	7.6		25	7.30	19	0.020K	0.400	0.020K	0.003
	12 10	0025	14.2	8.0		22	7.00	15	0.020	0.300	0.020K	0.004
	12 10	0060	7.8	8.8		21	6.80	10K	0.020	0.300	0.040	0.002
	12 10	0110	6.1	8.4		21	6.65	10K	0.020K	0.200K	0.050	0.003
	12 10	0158	5.8	8.2		29	6.50	21	0.020	0.600	0.060	0.012
75/10/17	11 45	0000	11.7	8.2	240	1K	7.05	15	0.020K	0.200K	0.020K	0.003
	11 45	0005	11.6	8.6		1K	7.05	13	0.020K	0.200K	0.020K	0.002K
	11 45	0020	11.5	8.4		1K	6.80	19	0.020K	0.200K	0.020K	0.002
	11 45	0040	11.2	8.2		1K	7.00	13	0.020K	0.200K	0.020K	0.002K
	11 45	0065	10.9	8.3		1K	6.60	21	0.020	0.200K	0.060	0.003
	11 45	0105	8.9	8.4		1K	6.60	22	0.020K	0.200K	0.060	0.003
	11 45	0140	8.6	8.2		1K	6.15	30	0.020K	0.200K	0.080	0.004
	11 45	0175	8.5	8.0		1K	6.60	22	0.020K	0.200K	0.070	0.004

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/08/28	12 10	0000	0.010	2.0	
	12 10	0005	0.010		
	12 10	0025	0.010		
	12 10	0060	0.008		
	12 10	0110	0.012		
	12 10	0158			
75/10/17	11 45	0000	0.007	3.0	
	11 45	0005	0.006		
	11 45	0020	0.007		
	11 45	0040	0.007		
	11 45	0065	0.006		
	11 45	0105	0.006		
	11 45	0140	0.008		
	11 45	0175	0.008		

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

560203
42 50 08.0 109 41 34.0 3
BOULDER LAKE
56035 WYOMING

11EPALES 2111202
0058 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
75/08/28	12 45	0000	14.7	7.8	100	26	7.40	15	0.020K	0.200K	0.020K	0.002
	12 45	0005	14.5	9.6		26	7.80	16	0.020K	0.200K	0.020K	0.002K
	12 45	0020	14.3	7.8		23	7.55	16	0.040	0.200K	0.020K	0.002K
	12 45	0054	8.7	6.6		22	7.05	16	0.020	0.200K	0.050	0.005
75/10/17	12 10	0000	11.4	8.4	141	1K	6.80	15	0.020K	0.200K	0.020K	0.002
	12 10	0005	11.0	7.6		1K	7.00	14	0.020K	0.200K	0.020K	0.002
	12 10	0020	10.7	8.8		3	6.95	11	0.020K	0.200K	0.020K	0.002K
	12 10	0050	10.6	8.8		3	6.90	15	0.020K	0.200K	0.020K	0.002K

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/08/28	12 45	0000	0.031	2.6	
	12 45	0005	0.011		
	12 45	0020	0.008		
	12 45	0054	0.008		
75/10/17	12 10	0000	0.011	2.6	
	12 10	0005	0.009		
	12 10	0020	0.009		
	12 10	0050	0.010		

K VALUE KNOWN TO BE
LESS THAN INDICATED

APPENDIX E

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/08/05

560241
42 49 10.0 109 43 00.0 4
BOULDER CREEK
56 7.5 BOULDER LAKE
0/BOULDER LAKE 110691
GAGING STATION 1.2 MI SW OF BOULDER DAM
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
74/10/05	15	35	0.032	1.100	0.020	0.005	0.010
74/11/16	12	55	0.056	1.600	0.035	0.005	0.015
74/12/12	14	15	0.012	1.300	0.030	0.005K	0.010K
75/01/13	14	30	0.056	0.650	0.028	0.005K	0.010
75/05/04	14	00	0.060	1.450	0.035	0.005K	0.010K
75/05/24	11	40	0.045	1.300	0.045	0.005K	0.030
75/06/21	10	05	0.020	0.175	0.025	0.005K	0.020
75/07/03	14	30	0.030	0.300	0.025	0.005K	0.040

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

5602A2
42 51 25.0 109 37 00.0 4
BOULDER CREEK
56 7.5 SCAB CREEK
T/BOULDER LAKE 110691
FOOT BRDG ON NORTH FORK PACK TRAIL
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
74/10/05	14	45	0.064	0.300	0.040	0.005K	0.005K
74/11/18	11	40	0.008	0.400	0.020	0.005K	0.010K
74/12/12	15	15	0.064	0.700	0.030	0.005K	0.010K
75/05/14	13	15	0.090	0.450	0.055	0.005	0.050
75/06/01	15	15	0.035	0.150	0.005K	0.005K	0.010K
75/06/20	14	00	0.010	2.700	0.065	0.010	0.060
75/07/03	12	30	0.020	0.300	0.045	0.025	0.025
75/07/17	12	00	0.015	0.100	0.020	0.005K	0.010K

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

560281
42 51 30.0 109 36 22.0 4
UNNAMED CREEK
56 7.5 SCAB CREEK
T/BOULDER LAKE 110691
BRDG ON DIRT RD .3 MI E BOULDER LK CAMP
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
74/10/05	14	15	0.009	0.900	0.015	0.005	0.025
74/11/16	12	50	0.016	1.300	0.040	0.010	0.040
74/12/12	15	00	0.088	1.100	0.045	0.005K	0.010K
75/05/14	13	05	0.040	1.500	0.250	0.065	0.180
75/06/01	15	30	0.005	1.450	0.065	0.020	0.050
75/06/20	14	15	0.035	0.200	0.010	0.005K	0.020
75/07/03	13	30	0.005	1.250	0.035	0.155	0.090
75/07/17	12	15	0.015	0.950	0.040	0.035	0.090

K VALUE KNOWN TO BE
LESS THAN INDICATED