U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT

ON

LAKE LYNN

MONONGALIA COUNTY

WEST VIRGINIA

EPA REGION III

WORKING PAPER No. 468

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

REPORT
ON
LAKE LYNN
MONONGALIA COUNTY
WEST VIRGINIA
EPA REGION III
WORKING PAPER No. 468

WITH THE COOPERATION OF THE
WEST VIRGINIA DEPARTMENT OF NATURAL RESOURCES
AND THE
WEST VIRGINIA NATIONAL GUARD
JUNE, 1975

CONTENTS

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 nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

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

Ira S. Latimer, Jr., Director of the Department of Natural Resources; and John H. Hall, Chief of the Water Resources Division; and the Water Resources Division staff 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.

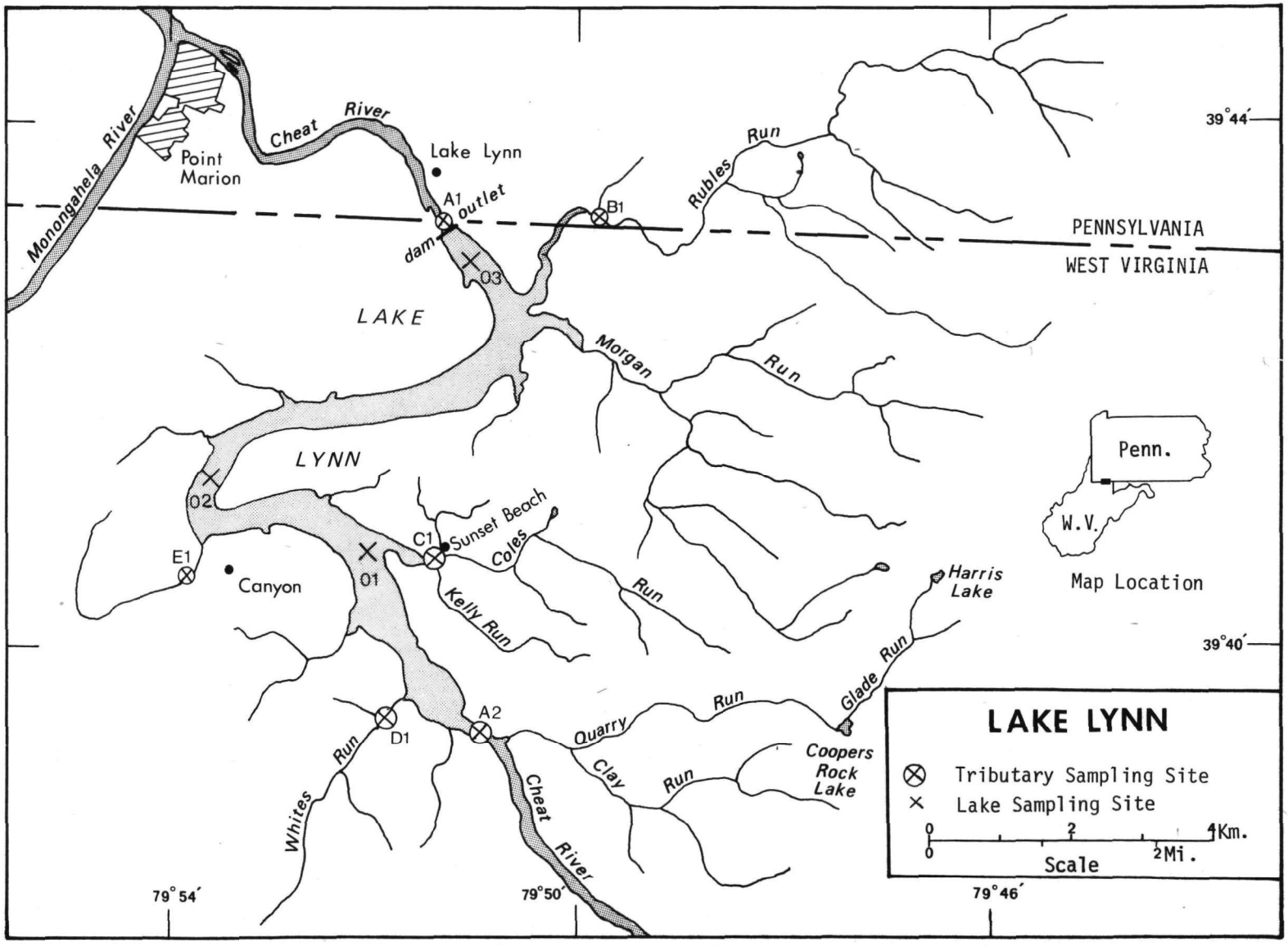
Major General Jack W. Blair, the Adjutant General of West Virginia, and Project Officer Major Manuel G. Goble, who directed the volunteer efforts of the West Virginia National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

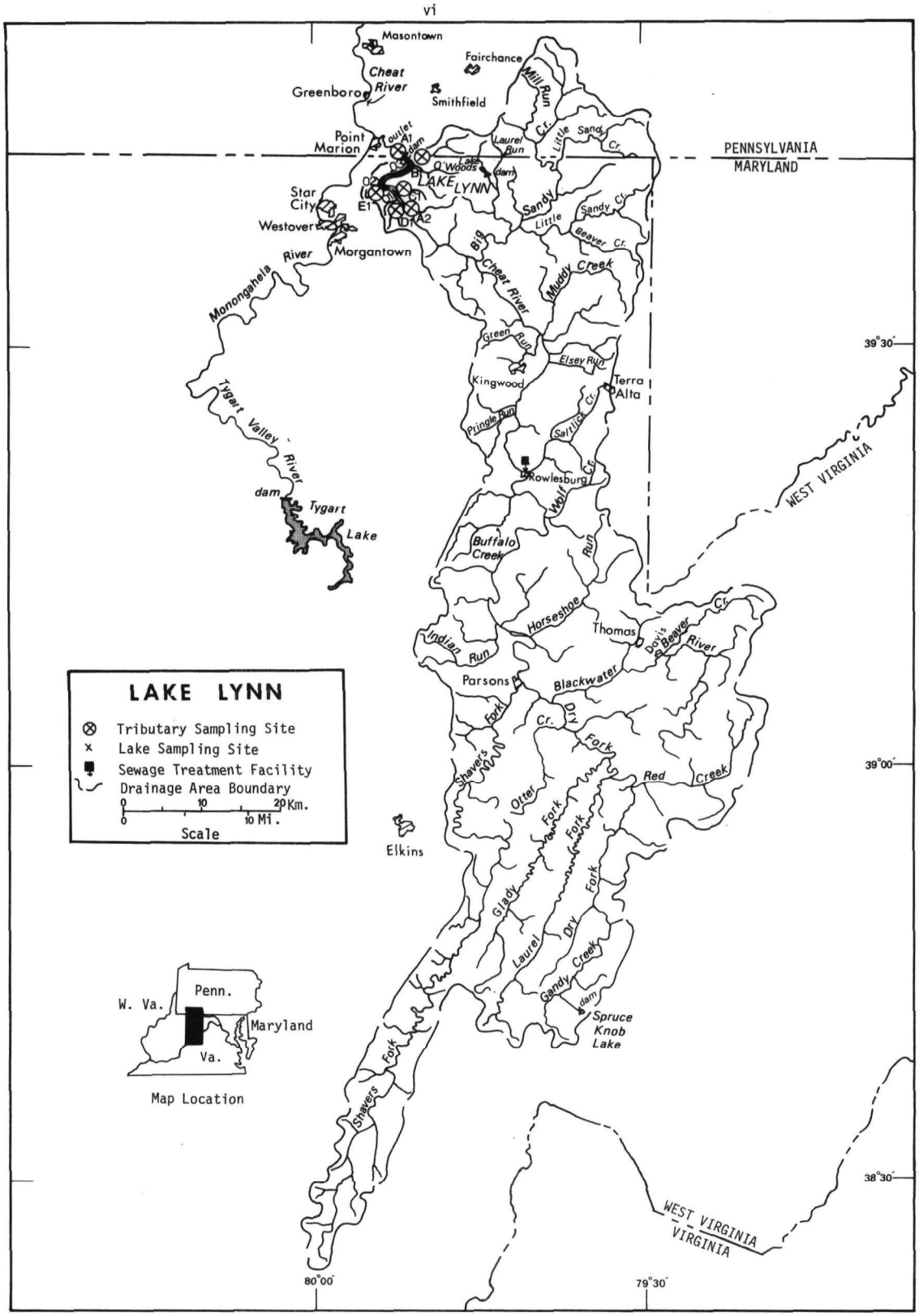
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF WEST VIRGINIA

LAKE NAME	COUNTY
Bluestone	Mercer, Monroe, Summers, WV; Giles, VA
Lynn	Monongalia
Summersville	Nicholas
Tygart	Barbour, Taylor


Monongahela River
Cheat River
Point Marion
Lake Lynn
A1
outlet
dam
B1
Rubles Run
39°44´
PENNSYLVANIA
WEST VIRGINIA
LAKE
LYNN
O3
O2
O1
Morgan Run
Penn.
W.V.
Map Location
E1
Canyon
C1
Sunset Beach
Coles Run
Kelly Run
Harris Lake
39°40´
Glade Run
Quarry Run
A2
D1
Whites Run
Clay Run
Coopers Rock Lake
Cheat River
79°54´
79°50´
79°46´
LAKE LYNN
Tributary Sampling Site
Lake Sampling Site
0 2 4Km.
0 2Mi.
Scale


Masontown
Fairchance
Cheat River
Greenboro
Smithfield
Mill Run
Point Marion
Laurel Run
Little Sandy Cr.
PENNSYLVANIA
MARYLAND
Q'woods
dam
LAKE LYNN
Star City
Sandy Cr.
Little Sandy Cr.
Westover
Beaver Cr.
Morgantown
Big Cheat River
Muddy Creek
Monongahela River
Green Run
Elsey Run
39°30'
Kingwood
Terra Alta
Tygart Valley River
Pringle Run
Salt Lick Cr.
dam
Tygart Lake
Rowlesburg
Wolf Run
WEST VIRGINIA
Buffalo Creek
Horseshoe Run
Thomas
Davis
Beaver Cr.
River
Indian Run
Parsons
Blackwater Fork
Dry Fork Cr.
Shavers Fork
Otter Fork
Red Creek
39°00'
Elkins
Glady Fork
Laurel Dry Fork
Gandy Creek
dam
Spruce Knob Lake
Shavers Fork
38°30'
WEST VIRGINIA
VIRGINIA
80°00'
79°30'
LAKE LYNN
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Drainage Area Boundary
0 10 20 Km.
0 10 Mi.
Scale
W. Va.
Penn.
Maryland
Va.
Map Location

LAKE LYNN

STORET NO. 5402

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Lake Lynn is mesotrophic. It ranked second in overall trophic quality when the four West Virginia lakes sampled in 1973 were compared using an index of six parameters*. None of the other lakes had less but one had the same total phosphorus, none had less median dissolved phosphorus, one had less inorganic nitrogen, one had less mean chlorophyll a, and two had greater mean Secchi disc transparency. Near-depletion of dissolved oxygen with depth occurred at station 3 in July and October.

The Lake Lynn drainage is impacted by acid mine wastes (Hall, 1975). The effect of these wastes on the trophic condition of the lake was not determined although evidenced by the rather low pH of the lake water. It is reported that a continuing supply of acid substances to certain lakes in Sweden causes oligotrophication of those waters (Grahn et al., 1974); conversely, some mid-Missouri strip mine lakes are reported to have become early eutrophic as the acid production of the stripped areas gradually diminished (King et al., 1974). The question of controllability of acid mine wastes was not addressed during the Survey.

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*. See Appendix A.

B. Rate-Limiting Nutrient:

The algal assay results indicate phosphorus limitation at the time the sample was taken (04/24/73). The lake data indicate phosphorus limitation at the other sampling times as well.

C. Nutrient Controllability:

1. Point sources--Known point sources accounted for only 0.2% of the total phosphorus load reaching Lake Lynn during the sampling year. These sources include the wastewater treatment plant at Rowlesburg and septic tanks serving dwellings near the lake.

The total phosphorus loading of 8.65 $g/m^2/yr$ is over twice that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 12). The combination of a mesotrophic condition and relatively high phosphorus loading is possible because Vollenweider's model probably is not applicable to lakes with short hydraulic retention times, and the mean hydraulic retention time of Lake Lynn is a short 12 days. In any case, it does not appear likely that point-source phosphorus control would result in any appreciable improvement in the trophic condition of the lake.

2. Non-point sources--It is calculated that non-point sources contributed over 99% of the total phosphorus load to the lake. The Cheat River contributed 93.7%; Rubles Run, 0.6%; Coles Run, less than 0.1%; Whites Run, 1.3%; Unnamed Stream E-1, 3.1%; and an estimated 0.9% was contributed by minor tribu-

taries and immediate drainage.

The phosphorus export rates of White Run and Unnamed Stream E-1 were very high, particularly the rate of the latter (see page 11). As far as is known, neither stream is impacted by a point source, and further study is needed to determine the cause of the high export rates.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 7.00 kilometers^2.
2. Mean depth: 12.8 meters.
3. Maximum depth: 26.8 meters.
4. Volume: 89.600 x 10^6 m^3.
5. Mean hydraulic retention time: 12 days.

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

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Cheat River	3,548.3	85.9
Rubles Run	32.1	0.7
Coles Run	4.2	0.1
Whites Run	7.8	0.2
Unnamed Stream E-1	4.0	0.1
Minor tributaries & immediate drainage -	51.1	1.4
Totals	3,647.5	88.4

2. Outlet -

Cheat River	3,654.5**	88.4**

C. Precipitation***:

1. Year of sampling: 131.8 centimeters.
2. Mean annual: 102.7 centimeters.

† Table of metric equivalents--Appendix B.
†† Robinson, 1974.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake; outlet flow adjusted to equal sum of inflows.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Lake Lynn 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 three stations on the lake and from a number of depths at each station (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 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 11.0 meters at station 1, 21.3 meters at station 2, and 23.5 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized below.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LAKE LYNN RESERVOIR
STORET CODE 5402

PARAMETER	1ST SAMPLING (4/24/73) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/28/73) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/ 5/73) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	11.1 - 16.3	14.6	15.2	13.2 - 26.6	24.4	26.0	15.2 - 22.7	21.0	21.4
DISS OXY (MG/L)	8.7 - 10.6	9.7	9.7	2.2 - 7.8	6.3	6.9	0.2 - 8.0	7.1	7.6
CNDCTVY (MCROMO)	60. - 110.	91.	95.	89. - 240.	173.	175.	85. - 168.	136.	150.
PH (STAND UNITS)	4.5 - 6.3	5.2	5.2	3.9 - 4.7	4.1	4.1	4.3 - 6.2	5.2	5.2
TOT ALK (MG/L)	10. - 10.	10.	10.	10. - 11.	10.	10.	10. - 10.	10.	10.
TOT P (MG/L)	0.004 - 0.010	0.006	0.005	0.004 - 0.009	0.005	0.005	0.006 - 0.044	0.015	0.010
ORTHO P (MG/L)	0.002 - 0.005	0.003	0.002	0.002 - 0.005	0.003	0.003	0.002 - 0.007	0.004	0.004
NO2+NO3 (MG/L)	0.450 - 0.520	0.487	0.500	0.220 - 0.420	0.314	0.320	0.030 - 0.380	0.297	0.305
AMMONIA (MG/L)	0.030 - 0.070	0.043	0.040	0.080 - 0.720	0.174	0.140	0.090 - 1.770	0.264	0.165
KJEL N (MG/L)	0.200 - 0.500	0.253	0.200	0.200 - 1.000	0.412	0.400	0.300 - 2.300	0.606	0.500
INORG N (MG/L)	0.490 - 0.570	0.530	0.540	0.400 - 0.940	0.488	0.440	0.400 - 1.800	0.561	0.465
TOTAL N (MG/L)	0.650 - 1.000	0.740	0.710	0.520 - 1.220	0.725	0.690	0.560 - 2.330	0.903	0.820
CHLRPYL A (UG/L)	0.5 - 0.5	0.5	0.5	8.1 - 15.9	12.0	11.9	1.4 - 2.2	1.7	1.6
SECCHI (METERS)	1.5 - 3.0	2.2	2.1	2.1 - 3.7	2.9	3.0	1.9 - 2.7	2.2	2.0

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/24/73	1. Flagellates	21
	2. *Pinnularia sp.*	10
	3. *Closterium sp.*	10
	4. *Euglena sp.*	10
	Total	52
07/28/73	1. *Glenodinium* (?) *sp.*	657
	Total	657
10/05/75	1. *Kirchneriella sp.*	441
	2. *Glenodinium* (?) *sp.*	286
	3. Flagellates	66
	4. *Navicula sp.*	11
	5. *Xanthidium* (?) *sp.*	11
	Total	815

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
04/24/73	01	0.5*
	02	0.5*
	03	0.5*
07/28/73	01	11.9
	02	15.9
	03	8.1
10/05/73	01	1.4
	02	2.2
	03	1.6

* Value known to be less than indicated.

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	0.005	0.495	0.1
0.050 P	0.055	0.495	1.3
0.050 P + 1.0 N	0.055	1.495	4.2
1.0 N	0.005	1.495	0.1

2. Discussion -

The control yield of the assay alga, Selenastrum Capricornutum, indicates that the potential primary productivity of Lake Lynn was low at the time the sample was collected. The yield increased with the addition of orthophosphorus alone but not with the addition of nitrogen alone. This indicates phosphorus was the limiting nutrient.

Further evidence of phosphorus limitation is provided by the mean lake inorganic nitrogen/orthophosphorus ratios of 176/1, 163/1, and 140/1 measured in April, August, and October, respectively.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the West Virginia National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), 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 June, 1974.

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

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

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

The operator of the Rowlesburg wastewater treatment plant provided monthly effluent samples and corresponding flow data.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Rowlesburg*	950	lagoon	302.8	Cheat River

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
Cheat River	56,755	93.7
Rubles Run	340	0.6
Coles Run	40	<0.1
Whites Run	800	1.3
Unnamed Stream E-1	1,860	3.1
b. Minor tributaries & immediate drainage (non-point load) -	535	0.9
c. Known municipal STP's -		
Rowlesburg	85	0.1
d. Septic tanks** -	35	<0.1
e. Known industrial - None	-	-
f. Direct precipitation*** -	125	0.2
Total	60,575	100.0

2. Outputs -

Lake outlet - Cheat River 24,250

3. Net annual P accumulation - 36,325 kg.

* Leon, 1973.
** Estimate based on 129 lakeshore dwellings; 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) -		
Cheat River	2,062,800	95.4
Rubles Run	29,150	1.3
Coles Run	3,860	0.2
Whites Run	7,720	0.4
Unnamed Stream E-1	2,210	0.1
b. Minor tributaries & immediate drainage (non-point load) -	46,680	2.2
c. Known municipal STP's -		
Rowlesburg	395	<0.1
d. Septic tanks* -	1,375	<0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	7,555	0.3
Total	2,161,745	100.0

2. Outputs -

Lake outlet - Cheat River 2,061,655

3. Net annual N accumulation - 100,090 kg.

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

Tributary	kg P/km^2/yr	kg N/km^2/yr
Cheat River	16	581
Rubles Run	11	908
Coles Run	10	919
Whites Run	103	990
Unnamed Stream E-1	465	552

* Estimate based on 129 lakeshore dwellings; see Working Paper No. 175.
** See Working Paper No. 175.

E. Yearly Loadings:

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	8.65	5.19	308.8	14.3

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

"Dangerous" (eutrophic loading)	3.70
"Permissible" (oligotrophic loading)	1.85

V. LITERATURE REVIEWED

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VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	5404	TYGART RESERVOIR	450
2	5402	LAKE LYNN RESERVOIR	350
3	5403	SUMMERSVILLE RESERVOIR	299
4	5401	BLUESTONE RESERVOIR	100

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
5401	BLUESTONE RESERVOIR	0.074	1.080	473.700	14.900	11.800	0.018
5402	LAKE LYNN RESERVOIR	0.006	0.490	403.222	4.733	14.800	0.003
5403	SUMMERSVILLE RESERVOIR	0.011	0.660	363.818	6.242	14.600	0.006
5404	TYGART RESERVOIR	0.006	0.430	378.667	1.178	14.700	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
5401	BLUESTONE RESERVOIR	0 (0)	0 (0)	0 (0)	0 (0)	100 (3)	0 (0)	100
5402	LAKE LYNN RESERVOIR	83 (2)	67 (2)	33 (1)	67 (2)	0 (0)	100 (3)	350
5403	SUMMERSVILLE RESERVOIR	33 (1)	33 (1)	100 (3)	33 (1)	67 (2)	33 (1)	299
5404	TYGART RESERVOIR	83 (2)	100 (3)	67 (2)	100 (3)	33 (1)	67 (2)	450

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 WEST VIRGINA 3/25/75

LAKE CODE 5402 LAKE LYNN

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 3654.5

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
5402A1	3654.5	129.41	142.72	170.75	136.49	106.47	64.00	44.17	44.17	24.64	38.51	59.47	104.49	88.52
5402A2	3548.3	125.44	138.47	165.65	132.52	103.36	62.01	42.76	42.76	23.79	37.38	57.77	101.37	85.86
5402B1	32.1	1.27	1.13	1.42	1.13	0.85	0.42	0.28	0.23	0.20	0.28	0.57	0.85	0.72
5402C1	4.2	0.17	0.17	0.20	0.14	0.11	0.08	0.06	0.03	0.03	0.06	0.06	0.11	0.10
5402D1	7.8	0.28	0.28	0.42	0.28	0.20	0.11	0.08	0.06	0.06	0.08	0.11	0.23	0.18
5402E1	4.0	0.17	0.14	0.17	0.14	0.11	0.06	0.03	0.03	0.03	0.03	0.06	0.11	0.09
5402ZZ	57.0	1.98	2.27	2.69	2.12	1.70	0.99	0.71	0.71	0.42	0.57	0.85	1.56	1.38

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 3654.5
SUM OF SUB-DRAINAGE AREAS = 3653.4
TOTAL FLOW IN = 1062.97
TOTAL FLOW OUT = 1065.28

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
5402A1	7	73	20.39	29	22.37				
	8	73	39.08	18	77.87				
	9	73	21.52	15	25.77				
	10	73	60.03	27	11.75				
	11	73	129.12	18	124.31				
	12	73	193.69	27	1141.17				
	1	74	220.59	12	682.44				
	2	74	119.78	3	83.82	28	83.25		
	3	74	147.81	14	119.21	30	54.37		
	4	74	131.39	30	37.66				
	5	74	95.14	20	71.64				
	6	74	205.01	22	348.30				
5402A2	7	73	19.54	29	15.01				
	8	73	37.66	18	75.32				
	9	73	20.95	15	24.92				
	10	73	58.33	27	11.38				
	11	73	125.16	18	120.35				
	12	73	187.74	27	1107.19				
	1	74	214.08	12	662.61				
	2	74	116.10	3	81.27	28	80.70		
	3	74	143.28	14	115.53	30	52.67		
	4	74	127.43	30	36.53				
	5	74	92.31	20	69.38				
	6	74	198.78	22	336.97				

TRIBUTARY FLOW INFORMATION FOR WEST VIRGINA 3/25/75

LAKE CODE 5402 LAKE LYNN

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
5402B1	7	73	0.19	29	0.10				
	8	73	0.23	18	0.25				
	9	73	0.11	25	0.23				
	10	73	0.31	27	0.06				
	11	73	1.02	18	1.08				
	12	73	1.56	27	6.34				
	1	74	2.04	12	5.72				
	2	74	0.62	3	0.71	28	0.65		
	3	74	1.13	14	0.82	30	0.51		
	4	74	1.02	30	0.26				
	5	74	1.08	20	1.22				
	6	74	1.27	22	1.44				
5402C1	7	73	0.03	29	0.01				
	8	73	0.03	18	0.03				
	9	73	0.01	15	0.03				
	10	73	0.04	27	0.01				
	11	73	0.14	18	0.14				
	12	73	0.21	27	0.82				
	1	74	0.27	12	0.76				
	2	74	0.08	3	0.09	28	0.08		
	3	74	0.15	14	0.11	30	0.07		
	4	74	0.14	30	0.03				
	5	74	0.14	20	0.16				
	6	74	0.17	22	0.19				
5402D1	7	73	0.05	29	0.03				
	8	73	0.05	18	0.06				
	9	73	0.03	15	0.06				
	10	73	0.07	27	0.01				
	11	73	0.25	18	0.26				
	12	73	0.37	27	1.53				
	1	74	0.48	12	1.39				
	2	74	0.15	3	0.17	28	0.16		
	3	74	0.27	14	0.20	30	0.12		
	4	74	0.25	30	0.06				
	5	74	0.26	20	0.28				
	6	74	0.31	22	0.34				
5402E1	7	73	0.02	29	0.01				
	8	73	0.03	18	0.03				
	9	73	0.01	15	0.03				
	10	73	0.04	27	0.01				
	11	73	0.13	18	0.13				
	12	73	0.20	27	0.79				
	1	74	0.25	12	0.71				
	2	74	0.08	3	0.09	28	0.08		
	3	74	0.14	14	0.10	30	0.06		
	4	74	0.13	30	0.03				
	5	74	0.13	20	0.15				
	6	74	0.16	22	0.18				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/03/25

540201
39 40 48.0 079 52 05.0
LAKE LYNN RESERVOIR
54061 WEST VIRGINIA

11EPALES 2111202
3 0018 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
73/04/24	09 05	0000	16.2		84	110	5.10	10K	0.050	0.200	0.450	0.004
	09 05	0006	15.9	9.2		110	5.10	10K	0.040	0.200K	0.450	0.004
	09 05	0014	15.9	9.3		105	5.20	10K	0.050	0.200K	0.460	0.003
73/07/28	13 45	0000	26.6		120	187	4.10	10K	0.140	0.500	0.310	0.003
	13 45	0005	26.5	7.8		181	4.10	10K	0.120	0.400	0.320	0.002
	13 45	0015	26.3	7.4		168	4.10	10K	0.100	0.300	0.320	0.003
	13 45	0025	25.7	7.0		189	4.30	10	0.130	0.300	0.330	0.002
	13 45	0036	24.6	5.5		175	4.30	11	0.130	0.400	0.330	0.003
73/10/05	10 05	0000	22.3		77	162	4.40	10K	0.260	0.900	0.300	0.004
	10 05	0005	22.3	7.6		162	4.70	10K	0.170	0.500	0.280	0.003
	10 05	0015	21.4	8.0		112	5.70	10K	0.200	0.500	0.360	0.004
	10 05	0021	20.7	7.8		85	6.00	10K	0.180	0.500	0.370	0.004

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/24	09 05	0000	0.005	0.5K
	09 05	0006	0.006	
	09 05	0014	0.005	
73/07/28	13 45	0000	0.005	11.9
	13 45	0005	0.005	
	13 45	0015	0.005	
	13 45	0025	0.005	
	13 45	0036	0.005	
73/10/05	10 05	0000	0.011	1.4
	10 05	0005	0.009	
	10 05	0015	0.011	
	10 05	0021	0.020	

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/03/25

540202
39 41 18.0 079 53 46.0
LAKE LYNN RESERVOIR
54061 WEST VIRGINIA

11EPALES 2111202
3 0058 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
73/04/24	09 40	0000	16.3		60	100	5.20	10K	0.050	0.200K	0.460	0.002K
	09 40	0006	16.3	9.1		85	5.20	10K	0.040	0.200K	0.460	0.002K
	09 40	0015	15.9	9.3		110	4.60	10K	0.040	0.200K	0.460	0.002K
	09 40	0022	14.9	10.2		90	4.90	10K	0.040	0.200K	0.490	0.002
	09 40	0030	14.0	10.2		95	4.80	10K	0.030	0.200K	0.510	0.003
	09 40	0042	11.7	10.2		100	4.60	10K	0.060	0.200K	0.510	0.004
	09 40	0054	11.2	10.2		110	4.50	10K	0.070	0.200K	0.500	0.005
73/07/28	13 05	0000	26.3		84	191	4.00	10K	0.150	0.500	0.290	0.004
	13 05	0005	26.4	7.5		198	4.00	10K	0.130	0.400	0.290	0.002
	13 05	0015	26.0	7.6		196	4.00	10K	0.140	0.300	0.290	0.003
	13 05	0025	25.7	6.8		240	3.90	10K	0.140	0.400	0.290	0.002K
	13 05	0045	22.7	6.3		160	3.90	10K	0.160	0.400	0.290	0.005
	13 05	0070	18.7	5.3		105	4.70	10	0.250	0.500	0.420	0.002
73/10/05	10 30	0000	22.3		74	166	4.30	10K	0.330	0.700	0.360	0.003
	10 30	0005	22.3	7.4		167	4.30	10K	0.190	0.600	0.290	0.003
	10 30	0015	22.3	7.4		166	4.90	10K	0.150	0.600	0.270	0.003
	10 30	0020	21.4	7.8		138	5.10	10K	0.120	0.700	0.290	0.002
	10 30	0040	19.9	8.0		100	6.20	10K	0.090	0.400	0.310	0.004
	10 30	0055	19.8	8.0		107	6.20	10K	0.090	0.300	0.310	0.005

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/03/25

540202
39 41 18.0 079 53 46.0
LAKE LYNN RESERVOIR
54061 WEST VIRGINIA

11EPALES 2111202
3 0058 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/24	09 40	0000	0.006	0.5K
	09 40	0006	0.005	
	09 40	0015	0.005	
	09 40	0022	0.006	
	09 40	0030	0.005	
	09 40	0042	0.007	
	09 40	0054	0.005	
73/07/28	13 05	0000	0.005	15.9
	13 05	0005	0.004	
	13 05	0015	0.006	
	13 05	0025	0.009	
	13 05	0045	0.005	
	13 05	0070	0.006	
73/10/05	10 30	0000	0.007	2.2
	10 30	0005	0.006	
	10 30	0015	0.007	
	10 30	0020	0.009	
	10 30	0040	0.026	
	10 30	0055	0.030	

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/03/25

540203
39 42 55.0 079 51 13.0
LAKE LYNN RESERVOIR
54061 WEST VIRGINIA

11EPALES
3

2111202
0055 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
73/04/24	10 20	0000	15.7		120	95	6.30	10K	0.040	0.300	0.500	0.002
	10 20	0006	15.6	9.5		95	5.50	10K	0.050	0.400	0.490	0.002K
	10 20	0015	15.2	9.8		80	5.50	10K	0.030	0.500	0.500	0.002K
	10 20	0022	15.1	9.7		70	5.40	10K	0.030	0.200K	0.510	0.002K
	10 20	0030	14.3	10.1		70	5.40	10K	0.040	0.200	0.520	0.002K
	10 20	0040	13.2	10.6		60	5.40	10K	0.030	0.200	0.510	0.002
	10 20	0051	11.1	8.7		60	5.30	10K	0.040	0.500	0.500	0.002
73/07/28	10 30	0000	26.6		144	161	4.10	10K	0.100	0.400	0.330	0.002K
	10 30	0005	26.5	7.6		162	4.10	10K	0.080	0.200	0.320	0.002K
	10 30	0015	26.5	7.6		162	4.00	10K	0.080	0.200K	0.330	0.004
	10 30	0025	25.2	4.6		211	3.90	10K	0.200	0.400	0.290	0.003
	10 30	0045	21.3	4.4		89	4.30	10K	0.190	0.400	0.360	0.003
	10 30	0077	13.2	2.2		159	3.90	10K	0.720	1.000	0.220	0.002
73/10/05	10 55	0000	22.7		108	167	4.40	10K	0.180	0.400	0.260	0.004
	10 55	0005	22.7	7.4		167	4.50	10K	0.160	0.300	0.260	0.003
	10 55	0020	21.3	7.2		121	5.40	10K	0.120	0.300	0.310	0.003
	10 55	0035	20.3	7.6		97	5.90	10K	0.110	0.300	0.380	0.005
	10 55	0055	19.8	7.6		95	5.90	10K	0.110	0.400	0.370	0.005
	10 55	0074	15.2	0.2		168	5.80	10K	1.770	2.300	0.030	0.007

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/03/25

540203
39 42 55.0 079 51 13.0
LAKE LYNN RESERVOIR
54061 WEST VIRGINIA

11EPALES 2111202
3 0055 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/24	10 20	0000	0.006	0.5K
	10 20	0006	0.005	
	10 20	0015	0.004	
	10 20	0022	0.010	
	10 20	0030	0.005	
	10 20	0040	0.006	
	10 20	0051	0.007	
73/07/28	10 30	0000	0.006	8.1
	10 30	0005	0.004	
	10 30	0015	0.004	
	10 30	0025	0.004	
	10 30	0045	0.009	
	10 30	0077	0.004	
73/10/05	10 55	0000	0.008	1.6
	10 55	0005	0.007	
	10 55	0020	0.009	
	10 55	0035	0.017	
	10 55	0055	0.019	
	10 55	0074	0.044	

K VALUE KNOWN TO BE
LESS THAN INDICATED

APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/03/25

5402A1
39 43 13.0 079 51 29.0
CHEAT RIVER
54089 7.5 LAKE LYNN
O/LAKE LYNN
BELO DAM .5 MI SSE OF VILLAGE OF LK LYNN
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
73/07/29	09	25	0.310	0.430	0.189	0.013	
73/08/18	10	13	0.350	0.240	0.154	0.005K	0.010
73/09/15	09	50	0.252	0.290	0.154	0.005K	0.010
73/10/27	09	40	0.220	0.300	0.110	0.014	
73/11/18	12	55	0.430	0.100K	0.040	0.005K	0.010
73/12/27	11	50	0.616	0.200	0.100	0.005K	0.010
74/01/12	10	20	0.588	0.500	0.068	0.005K	0.020
74/02/03	13	00	0.520	0.100K	0.035	0.005	0.005K
74/02/28	11	30	0.500	0.100K	0.030	0.005K	0.010
74/03/14	15	00	0.504	0.100	0.050	0.005K	0.005K
74/03/30	10	25	0.528	0.500	0.050	0.005K	0.005
74/04/30	12	50	0.440	0.400	0.065	0.005K	0.005
74/05/20	15	10	0.360	0.800	0.082	0.005K	0.005K
74/06/22	13	30	0.360	0.300	0.040	0.005K	

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/03/25

5402A2
39 39 28.0 079 50 58.0
CHEAT RIVER
54 7.5 LAKE LYNN
I/LAKE LYNN
BANK AT MONT CHATEAU STATE PARK
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
73/07/29	13 25		0.273	0.840	0.046	0.006	0.006
73/08/18	10 05		0.370	0.250	0.034	0.009	0.020
73/09/15	09 07		0.154	0.220	0.160	0.005K	0.010
73/10/27	10 40		0.180	0.900	0.110	0.012	
73/11/18	13 45		0.440	0.150	0.024	0.005K	0.025K
73/12/27	12 50		0.552	0.500	0.044	0.005K	0.090
74/01/12	11 10		0.520	0.700	0.052	0.005K	0.025
74/02/03	13 50		0.520	0.100K	0.025	0.005	0.005K
74/02/28	12 30		0.520	0.300	0.030	0.005K	0.030
74/03/14	15 45		0.450	0.100	0.020	0.005K	0.005K
74/03/30	14 05		0.490	0.200	0.055	0.005K	0.020
74/04/30	13 40		0.352	0.200	0.025	0.005K	0.010
74/05/20	15 50		0.368	0.400	0.075	0.005K	0.005K
74/06/22	14 30		0.320	0.200	0.030	0.005K	

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/03/25

540281
39 43 16.0 079 49 58.0
RUBLES RUN
54 7.5 LAKE LYNN
T/LAKE LYNN
BANK ALONG RD NEAR MOUTH 3 E OF LK LYNN
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
73/07/29	09 55		0.370	0.100K	0.005K	0.006	0.006
73/08/18	10 34		1.000	0.100K	0.009	0.007	0.025
73/09/15	09 00		0.840	0.230	0.015	0.005K	0.020
73/10/27	10 25		0.056	0.500	0.058	0.013	
73/11/18	13 13		1.200	0.100K	0.024	0.005K	0.010
73/12/27	12 00		1.520	0.400	0.020	0.005K	0.015
74/01/12	10 35		1.340	0.300	0.012	0.005K	0.020
74/02/03	11 00		0.860	0.200	0.010	0.010	0.010
74/02/28	11 50		0.900	0.600	0.030	0.005	0.015
74/03/14	15 00		0.990	0.100K	0.005	0.005K	0.005K
74/03/30	10 05		0.960	0.400	0.010	0.005K	0.005
74/04/30	13 05		0.460	2.000	0.035	0.005K	0.010
74/05/20	15 20		0.770	0.600	0.030	0.005K	0.015
74/06/22	13 50		0.730	0.100K	0.015	0.005K	0.040

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/03/25

5402C1
39 40 44.0 079 51 28.0
COLES RUN
54 7.5 LAKE LYNN
T/LAKE LYNN
SEC RD BRDG AT SUNSET BEACH
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
73/07/29	13 05		0.273	0.520	0.078	0.005K	0.010
73/08/18	09 50		0.231	0.230	0.107	0.006	0.010
73/09/15	08 50		0.500	0.360	0.132	0.005K	0.010
73/10/27	10 25		0.180	0.350	0.078	0.013	
73/11/18	14 00		0.470	0.200	0.056	0.005K	0.005
73/12/27	12 20		1.010	0.300	0.156	0.005K	0.015
74/01/12	13 00		0.980	0.500	0.168	0.005K	0.025
74/02/03	13 30		0.800	0.200	0.120	0.010	0.011
74/02/28	12 05		0.672	0.300	0.110	0.005	0.020
74/03/14	15 25		1.180	0.900	0.345	0.005K	0.005K
74/03/30	13 50		1.060	1.000	0.270	0.005K	0.010
74/04/30	13 25		0.680	0.600	0.210	0.005K	0.015
74/05/20	13 40		0.850	1.200	0.400	0.005K	0.010
74/06/22	14 05		0.660	0.400	0.370	0.005K	0.015

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/03/25

540201
39 39 30.0 079 51 55.0
WHITES RUN
54 7.5 LAKE LYNN
T/LAKE LYNN
SEC HWY BRDG .75 MI S OF ICES FERRY BRDG
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
73/07/29	13 45		0.780	0.620	0.025	0.052	0.090
73/08/18	10 15		0.890	0.170	0.038	0.100	0.175
73/09/15	09 25		1.160	0.420	0.054	0.110	0.180
73/10/27	16 00		1.120	0.300	0.033	0.390	0.680
73/11/18	13 30		0.970	0.500	0.040	0.060	0.095
73/12/27	11 15		1.120	0.100	0.020	0.009	0.040
74/01/12	13 20		1.360	0.800	0.072	0.024	0.040
74/02/03	13 45		0.520	0.100K	0.025	0.010	0.010
74/02/28	12 40		0.640	0.300	0.065	0.065	0.140
74/03/14	14 25		0.610	0.300	0.045	0.035	0.090
74/03/30	14 25		0.640	1.200	0.080	0.050	0.130
74/04/30	13 55		0.500	0.500	0.050	0.110	0.118
74/05/20	16 00		0.520	1.200	0.140	0.040	0.070
74/06/22	15 00		0.610	0.200	0.050	0.030	0.075

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/03/25

5402E1
39 40 35.0 079 53 47.0
UNNAMED STREAM
54 7.5 N MORGANTOWN
T/LAKE LYNN
SEC HWY BRDG .25 MI W OF CANYON
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
73/07/29	14 00			0.660	0.520	0.510	0.530
73/08/18	09 30			0.840	0.600	0.357	0.470
73/09/15	09 35			0.850	0.820	0.400	0.460
73/10/27	11 15		0.630	0.700	0.384	0.553	0.700
73/11/18	14 15		0.200	0.600	0.450	0.216	0.220
73/12/27	13 07		0.288	0.400	0.300	0.220	0.345
74/01/12	13 30		0.124	0.700	0.352	1.000	1.050
74/02/03	14 05		0.044	0.400	0.315	1.000	1.050
74/02/28	12 50			0.500	0.315	0.800	0.800
74/03/14	16 00		0.040	0.800	0.330	0.760	0.770
74/03/30	14 35		0.046	1.000	0.300	0.680	0.750
74/04/30	14 05		0.045	0.700	0.375	0.670	0.810
74/05/20	16 10		0.064	0.700	0.460	0.101	0.620
74/06/22	15 10		0.027	0.345	0.345	0.490	0.580

STORET RETRIEVAL DATE 75/03/25

5402AA PD5402AA P000950
39 22 00.0 079 40 30.0
ROWLESBERG
54089 PRESTON COUNTY
T/LAKE LYNN
CHEAT RIVER
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
73/09/12	15 00		0.015	8.600	0.140	0.830	1.600	0.080	
73/10/12	15 45		0.010K	6.650		1.400	3.200	0.080	
73/11/13	15 20		0.090	2.300	0.180	0.090	0.250	0.080	
73/12/18	15 00		0.740	1.300	0.110	0.170	0.220	0.080	
74/01/15	15 05		0.200	2.000	0.058	0.140	0.260	0.080	
74/02/13	15 40		0.080	1.000K	0.066	0.120	0.160	0.080	
74/03/12	15 30		0.040	1.000	0.050K	0.050K	0.260	0.080	
74/04/10	15 40		0.040	1.000K	0.110	0.057	0.320	0.080	
74/05/14	15 30		0.240	3.000	0.140	0.280	0.530	0.080	
74/06/11	15 40		0.040	5.100	0.130	0.180	0.450	0.080	
74/07/17	15 45		0.160	2.800	0.063	0.290	0.655		0.080
74/08/12	15 20		0.120	6.300	0.050K	0.056	1.300	0.080	

K VALUE KNOWN TO BE
LESS THAN INDICATED