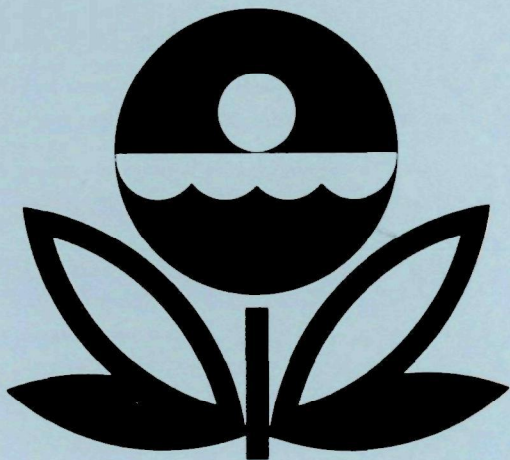


**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY
WORKING PAPER SERIES**



REPORT
ON
CANYON FERRY RESERVOIR
BROADWATER AND LEWIS & CLARK COUNTIES
MONTANA
EPA REGION VIII
WORKING PAPER No. 790

**CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON
and
ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA**

REPORT
ON
CANYON FERRY RESERVOIR
BROADWATER AND LEWIS & CLARK COUNTIES
MONTANA
EPA REGION VIII
WORKING PAPER No. 790

WITH THE COOPERATION OF THE
MONTANA DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES
AND THE
MONTANA NATIONAL GUARD
MAY, 1977

CONTENTS

	<u>Page</u>
<u>Foreword</u>	ii
List of Montana Lakes and Reservoirs	iv
Lake and Drainage Area Map	v
<u>Sections</u>	
I. Conclusions	1
II. Lake and Drainage Basin Characteristics	4
III. Lake Water Quality Summary	5
IV. Nutrient Loadings	12
V. Literature Reviewed	17
VI. Appendices	18

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 freshwater lakes and reservoirs.

OBJECTIVES

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

ANALYTIC APPROACH

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

- a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.
- b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.
- c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

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

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

ACKNOWLEDGEMENT

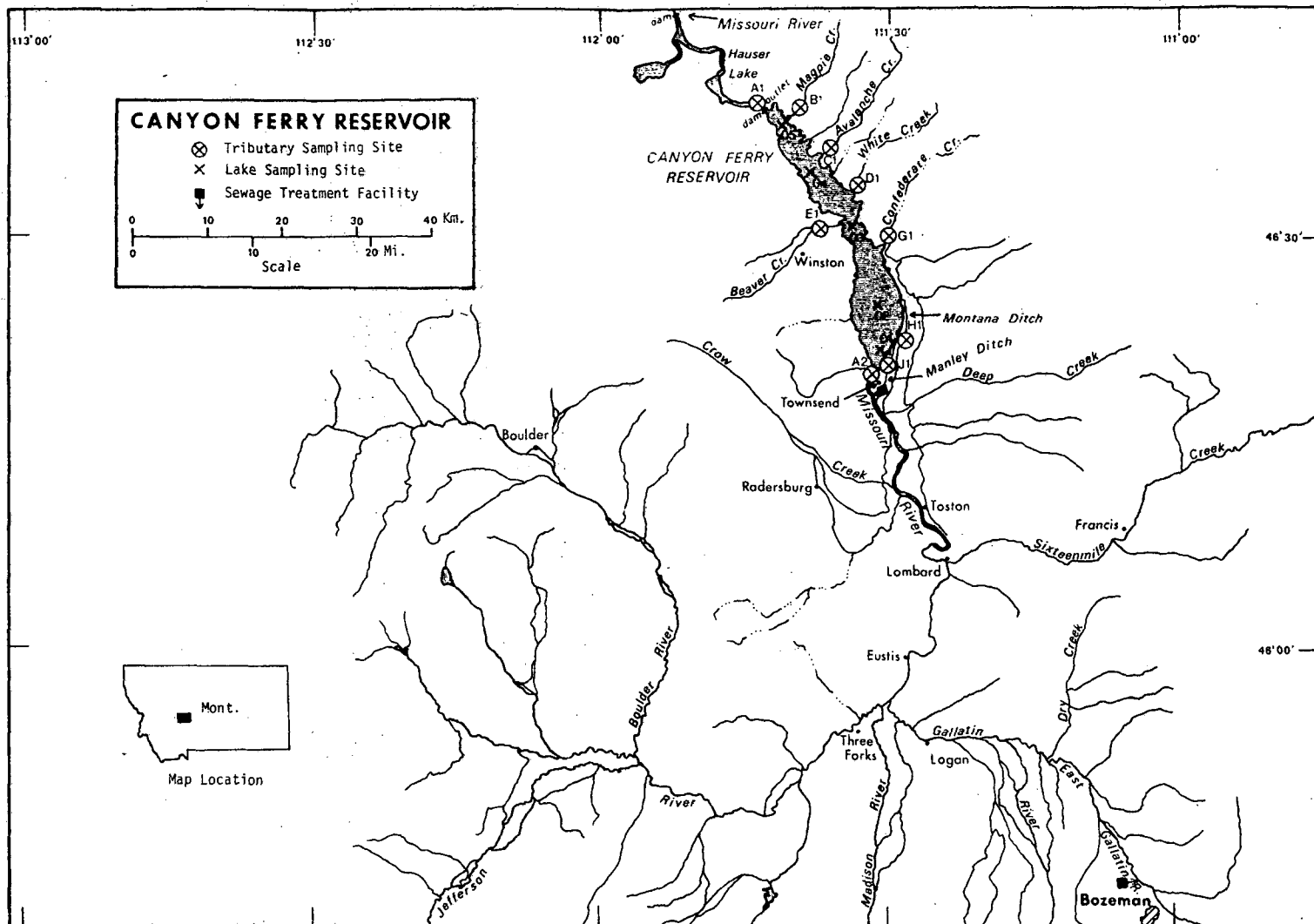
The staff of the National Eutrophication Survey (Office of Research & Development, U.S. Environmental Protection Agency) express sincere appreciation to the Montana Department of Health and Environmental Sciences for professional involvement, to the Montana National Guard for conducting the tributary sampling phase of the Survey, and to those Montana wastewater treatment plant operators who voluntarily provided effluent samples.

The staff of the Water Quality Bureau 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 John J. Womack, the Adjutant General of Montana, and Project Officer Major William Yeager, who directed the volunteer efforts of the Montana National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY
STUDY LAKES AND RESERVOIRS
STATE OF MONTANA

<u>LAKE NAME</u>	<u>COUNTY</u>
Canyon Ferry	Broadwater, Lewis and Clark
Clark Canyon	Beaverhead
Flathead	Flathead, Lake
Georgetown	Deer Lodge, Granite
Hebgen	Gallatin
Koocanusa	Lincoln, MT; British Columbia, Can.
Mary Ronan	Lake
McDonald	Flathead
Nelson	Phillips
Seeley	Missoula
Swan	Lake
Tally	Flathead
Tiber	Liberty, Toole
Tongue River	Big Horn
Whitefish	Flathead
Yellowtail	Carbon, Bighorn, MT; Bighorn, WY



CANYON FERRY RESERVOIR

STORET NO. 3001

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Canyon Ferry Reservoir is eutrophic. It ranked last in overall trophic quality when the 15 Montana lakes and reservoirs sampled in 1975 were compared using a combination of six water quality parameters*. Twelve of the water bodies had less median total phosphorus, 13 had less median dissolved orthophosphorus, 12 had less median inorganic nitrogen, 11 had less mean chlorophyll a, and 11 had greater mean Secchi disc transparency. Depression of dissolved oxygen with depth occurred at stations 2 and 3 in July and at station 4 in September.

Survey limnologists noted a bloom of filamentous algae at stations 2, 3, 4, and 5 during the July sampling and submerged macrophytes at station 1 in September. The periodic dominance of blue-green algae in late summer has been noted in reports of limnological investigations of the reservoir (Wright, 1958; 1959; 1960; 1961; 1965).

B. Rate-Limiting Nutrient:

The algal assay results indicate that Canyon Ferry Reservoir was nitrogen limited at the times the samples were collected (09/04/75 and 10/22/75). The reservoir data indicate nitrogen limitation at all sampling stations and times except for station 1 in September.

* See Appendix A.

C. Nutrient Controllability:

1. Point sources--During the sampling year, point sources contributed less than 0.5% of the total phosphorus load to Canyon Ferry Reservoir. The wastewater treatment plant at Townsend contributed 0.4%, and septic tanks serving shoreline dwellings and campgrounds were estimated to have contributed less than 0.1%. In addition, a wastewater treatment plant of unknown significance at Bozeman was not included as a point source since it is beyond the 40-kilometer limit of the Survey* (see map, page v).

The present phosphorus loading of $2.27 \text{ g/m}^2/\text{year}$ is twice that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 16). The phosphorus loadings of $2.85 \text{ g/m}^2/\text{yr}$ and $2.44 \text{ g/m}^2/\text{yr}$, derived from the 1971 and 1972 phosphorus budgets prepared by Wright et al. (1974), support the Survey findings and indicate the need for nutrient control to establish a more persistent phosphorus-limited condition and slow the present rate of eutrophication of the reservoir.

2. Non-point sources--Non-point sources contributed over 99% of the total phosphorus load during the sampling year. The Missouri River contributed 97.8%, Beaver Creek contributed 0.2%, and Confederate Creek contributed 0.1%. The ungaged minor tributaries and immediate drainage contributed an estimated 0.7%.

* See Working Paper No. 175, "...Survey Methods, 1973-1976".

As noted above, part of the phosphorus load in the Missouri River may be due to the Bozeman wastewater treatment plant effluent rather than non-point sources. In addition, irrigation in the drainage basin also may be significant. An additional study is needed to determine the contribution and significance of all point and non-point sources impacting the Missouri River and its tributaries upstream from the reservoir.

II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS[†]A. Morphometry^{††}:

1. Surface area: 142.45 kilometers².
2. Mean depth: 17.4 meters.
3. Maximum depth: 68.6 meters.
4. Volume: 2,478.630 x 10⁶ m³.
5. Mean hydraulic retention time: 186 days.

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

1. Tributaries -

<u>Name</u>	<u>Drainage area (km²)*</u>	<u>Mean flow (m³/sec)*</u>
Missouri River	39,738.4	150.450
Magpie Creek	63.4	0.105
Beaver Creek	148.7	0.222
Confederate Creek	149.2	0.440
Minor tributaries & immediate drainage -	<u>949.2</u>	<u>4.276</u>
Totals	41,048.9	155.493**

2. Outlet -

Missouri River	41,191.3***	153.840
----------------	-------------	---------

C. Precipitation****:

1. Year of sampling: 44.7 centimeters.
2. Mean annual: 29.3 centimeters.

† Table of metric conversions--Appendix B.

†† Horpestad, 1975.

* For limits of accuracy, see Working Paper No. 175.

** Sum of inflows adjusted to equal outflow plus evaporation.

*** Includes area of reservoir.

**** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Canyon Ferry Reservoir was sampled four times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from one or more depths at five stations on the reservoir (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 September and October 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 1.5 meters at station 1, 13.7 meters at station 2, 24.1 meters at station 3, 34.4 meters at station 4, and 50.3 meters at station 5.

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 CANYON FERRY RESERVOIR
STORET CODE 3001

PARAMETER	1ST SAMPLING (5/28/75)				2ND SAMPLING (7/31/75)				3RD SAMPLING (9/ 4/75)			
	5 SITES				5 SITES				5 SITES			
	RANGE	MEAN	MEDIAN		RANGE	MEAN	MEDIAN		RANGE	MEAN	MEDIAN	
TEMP (C)	4.8 - 10.5	7.6	7.1		5.4 - 17.3	14.1	16.3		10.4 - 19.1	17.4	18.4	
DISS OXY (MG/L)	8.4 - 11.6	10.1	10.4		2.2 - 8.6	6.3	6.6		0.6 - 9.4	6.2	7.0	
CNDCTVY (MCROMO)	225. - 270.	249.	250.		208. - 289.	231.	228.		226. - 380.	262.	250.	
PH (STAND UNITS)	7.2 - 8.4	7.9	7.9		7.8 - 8.6	8.3	8.2		7.5 - 8.4	8.1	8.2	
TOT ALK (MG/L)	122. - 161.	143.	143.		94. - 136.	106.	100.		108. - 162.	121.	123.	
TOT P (MG/L)	0.028 - 0.247	0.064	0.057		0.033 - 0.160	0.061	0.042		0.026 - 0.282	0.056	0.038	
ORTHO P (MG/L)	0.014 - 0.073	0.033	0.026		0.009 - 0.063	0.030	0.022		0.004 - 0.063	0.029	0.024	
NO2+NO3 (MG/L)	0.150 - 0.340	0.209	0.210		0.030 - 0.360	0.129	0.090		0.040 - 0.330	0.125	0.090	
AMMONIA (MG/L)	0.030 - 0.100	0.057	0.050		0.020 - 0.140	0.032	0.020		0.020 - 0.100	0.026	0.020	
KJEL N (MG/L)	0.400 - 0.900	0.548	0.500		0.200 - 0.600	0.352	0.300		0.200 - 0.700	0.261	0.200	
INORG N (MG/L)	0.180 - 0.400	0.266	0.250		0.060 - 0.500	0.161	0.110		0.060 - 0.430	0.151	0.110	
TOTAL N (MG/L)	0.580 - 1.240	0.757	0.720		0.230 - 0.960	0.481	0.450		0.260 - 1.030	0.386	0.320	
CHLRPYL A (UG/L)	3.4 - 9.5	6.3	7.3		2.6 - 13.2	7.9	9.2		2.9 - 9.2	5.7	5.3	
SECCHI (METERS)	0.2 - 4.1	1.2	0.5		1.1 - 3.0	1.9	2.0		0.9 - 2.5	1.5	1.0	

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR CANYON FERRY RESERVOIR
STORET CODE 3001

4TH SAMPLING (10/22/75)

PARAMETER	5 SITES		
	RANGE	MEAN	MEDIAN
TEMP. (C)	9.9 - 14.4	13.2	13.7
DISS OXY (MG/L)	0.6 - 10.7	8.2	8.4
CNDCTVY (MCROMO)	219. - 243.	226.	222.
PH (STAND UNITS)	7.7 - 8.3	8.1	8.2
TOT ALK (MG/L)	125. - 157.	134.	132.
TOT P (MG/L)	0.039 - 0.244	0.065	0.050
ORTHO P (MG/L)	0.012 - 0.074	0.032	0.031
NO2+NO3 (MG/L)	0.040 - 0.160	0.133	0.140
AMMONIA (MG/L)	0.020 - 0.070	0.029	0.020
KJEL N (MG/L)	0.200 - 0.600	0.271	0.200
INORG N (MG/L)	0.080 - 0.190	0.162	0.165
TOTAL N (MG/L)	0.310 - 0.640	0.404	0.360
CHLRPYL A (UG/L)	1.2 - 7.7	3.3	1.5
SECCHI (METERS)	0.9 - 1.5	1.2	1.1

B. Biological Characteristics:

1. Phytoplankton -

<u>Sampling Date</u>	<u>Dominant Genera</u>	<u>Algal Units per ml</u>
05/28/75	1. <u>Chroomonas sp.</u>	411
	2. <u>Melosira sp.</u>	376
	3. <u>Fragilaria sp.</u>	274
	4. <u>Diatoma sp.</u>	205
	5. <u>Cymbella sp.</u>	137
	Other genera	<u>753</u>
	Total	2,156
07/31/75	1. <u>Fragilaria sp.</u>	2,667
	2. <u>Aphanizomenon sp.</u>	1,731
	3. <u>Nitzschia sp.</u>	187
	4. <u>Chroomonas sp.</u>	187
	5. <u>Synedra sp.</u>	140
	Other genera	<u>94</u>
	Total	5,006
09/04/75	1. <u>Fragilaria sp.</u>	389
	2. <u>Melosira sp.</u>	389
	3. <u>Chroomonas sp.</u>	311
	4. <u>Asterionella sp.</u>	78
	5. <u>Stephanodiscus sp.</u>	39
	Other genera	<u>116</u>
	Total	1,322
10/22/75	1. <u>Aphanizomenon sp.</u>	265
	2. <u>Chroomonas sp.</u>	144
	3. <u>Melosira sp.</u>	120
	4. <u>Navicula sp.</u>	96
	5. <u>Cymbella sp.</u>	48
	Other genera	<u>145</u>
	Total	818

2. Chlorophyll a -

<u>Sampling Date</u>	<u>Station Number</u>	<u>Chlorophyll <u>a</u> ($\mu\text{g/l}$)</u>
05/28/75	1	9.5
	2	3.4
	3	3.8
	4	7.7
	5	7.3
07/31/75	1	3.3
	2	11.4
	3	9.2
	4	13.2
	5	2.6
09/04/75	1	-
	2	9.2
	3	6.4
	4	4.3
	5	2.9
10/22/75	1	4.6
	2	7.7
	3	1.2
	4	1.5
	5	1.3

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. September sample; stations 1 through 5 -

<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	0.025	0.195	5.2
0.050 P	0.075	0.195	5.1
0.050 P + 1.0 N	0.075	1.195	28.9
1.0 N	0.025	1.195	8.0

b. October sample; stations 1, 2, and 3 -

<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	0.025	0.150	5.7
0.050 P	0.075	0.150	5.8
0.050 P + 1.0 N	0.075	1.150	25.5
1.0 N	0.025	1.150	8.4

c. October sample; stations 4 and 5 -

<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	0.035	0.182	7.4
0.050 P	0.085	0.182	8.5
0.050 P + 1.0 N	0.085	1.182	25.9
1.0 N	0.035	1.182	16.3

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential primary productivity of Canyon Ferry Reservoir was relatively high at the times the samples were collected (09/04/75 and 10/22/75). Also, in all three assays, the lack of growth response with the addition of phosphorus alone until nitrogen was also added indicates that the reservoir was limited by nitrogen at those times. Note that the addition of nitrogen alone resulted in yields significantly greater than those of the controls in all assays.

The reservoir data indicate nitrogen limitation at all stations with the exception of station 1 in September; i.e., the mean inorganic nitrogen/orthophosphorus ratios were 12/1

or less and nitrogen limitation would be expected. However, the September N/P ratio at station 1 was 15/1, and phosphorus limitation would be expected there.

Nitrogen limitation, as indicated by the algal assay or by in-reservoir nitrogen to phosphorus ratios, does not necessarily mean that the trophic condition of the reservoir can be improved by controlling nitrogen inputs. In many cases, the apparent condition of nitrogen-limitation results from excessive phosphorus input from point sources and is often accompanied by a corresponding increase in primary production. In such cases, the reversal of the enriched condition depends upon phosphorus control, not nitrogen control.

IV. NUTRIENT LOADINGS (See Appendix E for data)

For the determination of nutrient loadings, the Montana National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v). Sampling was begun in October, 1974, and was completed in September, 1975.

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

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/km²/year, at stations B-1, E-1, and G-1 and multiplying the means by the ZZ area in km².

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

* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal* -

<u>Name</u>	<u>Pop. Served</u>	<u>Treatment</u>	<u>Mean Flow (m³/d)</u>	<u>Receiving Water</u>
Townsend	1,300	stab. pond	4,294.3	Missouri River

2. Known industrial - None

* Treatment plant questionnaire.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

<u>Source</u>	<u>kg P/ yr</u>	<u>% of total</u>
a. Tributaries (non-point load) -		
Missouri River	322,140	97.8
Magpie Creek	85	<0.1
Beaver Creek	625	0.2
Confederate Creek	370	0.1
b. Minor tributaries & immediate drainage (non-point load) -	2,185	0.7
c. Known municipal STP's -		
Townsend	1,305	0.4
d. Septic tanks* -	105	<0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	<u>2,495</u>	<u>0.8</u>
Total	329,310	100.0

2. Outputs -

Reservoir outlet - Missouri River 183,030

3. Net annual P accumulation - 146,280, kg.

* Estimate based on 89 seasonal and 169 permanent shoreline residences and 1 campground; see Working Paper No. 175.

** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

<u>Source</u>	<u>kg N/ yr</u>	<u>% of total</u>
a. Tributaries (non-point load) -		
Missouri River	3,972,710	94.9
Magpie Creek	1,370	<0.1
Beaver Creek	4,090	0.1
Confederate Creek	9,825	0.2
b. Minor tributaries & immediate drainage (non-point load) -	36,730	0.9
c. Known municipal STP's -		
Townsend	4,485	0.1
d. Septic tanks* -	3,900	0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	<u>153,790</u>	<u>3.7</u>
Total	4,186,900	100.0

2. Outputs -

Reservoir outlet - Missouri River
3,857,500

3. Net annual N accumulation - 329,400 kg.

D. Non-point Nutrient Export by Subdrainage Area:

<u>Tributary</u>	<u>kg P/km²/yr</u>	<u>kg N/km²/yr</u>
Missouri River	8	100
Magpie Creek	1	22
Beaver Creek	4	28
Confederate Creek	2	66

* Estimate based on 89 seasonal and 169 permanent shoreline residences and 1 campground; see Working Paper No. 175.

** See Working Paper No. 175.

E. Mean Nutrient Concentrations in Ungaged Streams:

<u>Tributary</u>	<u>Mean Total P Conc. (mg/l)</u>	<u>Mean Total N Conc. (mg/l)</u>
Avalanche Creek	0.086	0.650
White Creek	0.050	0.330
Manley Ditch*	0.240	0.715

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.

	<u>Total Phosphorus</u>		<u>Total Nitrogen</u>	
	<u>Total</u>	<u>Accumulated</u>	<u>Total</u>	<u>Accumulated</u>
grams/m ² /yr	2.27	1.03	29.4	2.3

Vollenweider phosphorus loadings
(g/m²/yr) based on mean depth and mean
hydraulic retention time of Canyon Ferry Reservoir:

"Dangerous" (eutrophic loading)	1.12
"Permissible" (oligotrophic loading)	0.56

* Only two samples.

V. LITERATURE REVIEWED

Horpestad, Abe, 1975. Personal communication (reservoir morphometry).
MT Dept. of Health & Env. Sci., Helena.

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.

Wright, John C., 1958. The limnology of Canyon Ferry Reservoir. I.
Phytoplankton - zooplankton relationships in the euphotic zone
during September and October 1956. *Limn. & Oceanog.*, 3:150-159.

_____, 1959. The limnology of Canyon Ferry Reservoir. II.
Phytoplankton standing crop and primary production, *Limn. &
Oceanog.*, 4:235-245.

_____, 1960. The limnology of Canyon Ferry Reservoir. III.
Some observations on the density dependance of photosynthesis and
its cause. *Limn. & Oceanog.*, 5:356-361.

_____, 1961. The limnology of Canyon Ferry Reservoir. IV.
The estimation of primary production from physical limnological
data. *Limn. & Oceanog.*, 6:330-337.

_____, 1965. The population dynamics and production of
Daphnia in Canyon Ferry Reservoir, Montana. *Limn. & Oceanog.*,
10:583-590.

Wright, John C., Ronald Rada, and Chadwick Martin, 1974. An investi-
gation into the extent and cause of eutrophication in Canyon
Ferry Reservoir, Montana. Proj. A-055 Mont, MT U. Joint Water
Resources Res. Ctr., Bozeman.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INCHES N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS ORTHO P
3001	CANYON FERRY RESERVOIR	0.047	0.178	442.800	5.816	14.400	0.029
3002	CLARK CANYON RESERVOIR	0.044	0.160	398.750	2.375	12.000	0.027
3003	FLATHEAD LAKE	0.008	0.050	267.833	1.273	9.000	0.004
3004	GEORGETOWN RESERVOIR	0.022	0.040	367.333	6.983	10.200	0.011
3005	HEBGEN RESERVOIR	0.022	0.040	367.700	4.083	13.800	0.020
3006	KOOCANUSA RESERVOIR	0.045	0.100	337.643	2.669	10.400	0.044
3007	MARY RONAN LAKE	0.020	0.040	371.091	4.673	14.200	0.006
3008	MC DONALD LAKE	0.006	0.180	190.667	0.467	6.400	0.002
3009	NELSON RESERVOIR	0.029	0.075	456.750	7.233	11.400	0.007
3010	SEELEY LAKE	0.015	0.040	362.857	2.171	13.200	0.010
3011	SWAN LAKE	0.010	0.050	282.750	3.289	9.600	0.004
3012	TALLY LAKE	0.011	0.050	339.167	2.083	9.200	0.004
3013	TIBER RESERVOIR	0.018	0.180	448.555	2.806	9.600	0.004
3014	TONGUE RIVER RESERVOIR	0.051	0.050	474.111	16.878	13.600	0.008
3016	WHITEFISH LAKE (LOWER)	0.003	0.040	290.000	1.400	7.000	0.003

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
3001	CANYON FERRY RESERVOIR	14 (2)	14 (2)	21 (3)	21 (3)	0 (0)	7 (1)	77
3002	CLARK CANYON RESERVOIR	7 (1)	21 (3)	29 (4)	64 (4)	36 (5)	14 (2)	171
3003	FLATHEAD LAKE	89 (12)	61 (8)	93 (13)	93 (13)	86 (12)	75 (9)	497
3004	GEORGETOWN RESERVOIR	39 (5)	79 (10)	50 (7)	14 (2)	57 (8)	29 (4)	268
3005	HERGEN RESERVOIR	39 (5)	79 (10)	43 (6)	36 (5)	14 (2)	21 (3)	232
3006	KOOCANUSA RESERVOIR	21 (3)	29 (4)	71 (10)	57 (8)	50 (7)	0 (0)	228
3007	MARY RONAN LAKE	50 (7)	96 (13)	36 (5)	29 (4)	7 (1)	57 (8)	275
3008	MC DONALD LAKE	100 (14)	4 (0)	100 (14)	100 (14)	100 (14)	100 (14)	504
3009	NELSON RESERVOIR	29 (4)	36 (5)	7 (1)	7 (1)	43 (6)	50 (7)	172
3010	SEELEY LAKE	64 (9)	96 (13)	57 (8)	71 (10)	29 (4)	36 (5)	353
3011	SWAN LAKE	79 (11)	46 (6)	86 (12)	43 (6)	68 (9)	75 (9)	397
3012	TALLY LAKE	71 (10)	61 (8)	64 (9)	79 (11)	79 (11)	75 (9)	429
3013	TIBER RESERVOIR	57 (8)	4 (0)	14 (2)	50 (7)	68 (9)	75 (9)	268
3014	TONGUE RIVER RESERVOIR	0 (0)	46 (6)	0 (0)	0 (0)	21 (3)	43 (6)	110
3016	WHITEFISH LAKE (LOWER)	89 (12)	79 (10)	79 (11)	86 (12)	93 (13)	93 (13)	519

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3016	WHITEFISH LAKE (LOWER)	519
2	3008	MC DONALD LAKE	504
3	3003	FLATHEAD LAKE	497
4	3012	TALLY LAKE	429
5	3011	SWAN LAKE	397
6	3010	SEELEY LAKE	353
7	3007	MARY RONAN LAKE	275
8	3013	TIBER RESERVOIR	268
9	3004	GEORGETOWN RESERVOIR	268
10	3005	HEBGEN RESERVOIR	232
11	3006	KOOCANUSA RESERVOIR	228
12	3009	NELSON RESERVOIR	172
13	3002	CLARK CANYON RESERVOIR	171
14	3014	TONGUE RIVER RESERVOIR	110
15	3001	CANYON FERRY RESERVOIR	77

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 MONTANA

12/0376

LAKE CODE 3001 CANYON FERRY LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 41191.3

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS)												
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3001A1	41191.3	138.75	137.34	141.58	162.82	209.54	266.18	158.57	111.85	114.40	127.14	135.92	142.43	153.84
3001A2	39738.4	96.28	107.60	114.68	164.24	254.85	368.12	155.74	73.62	99.11	127.43	135.92	109.02	150.45
3001B1	63.4	0.057	0.057	0.057	0.042	0.142	0.283	0.142	0.113	0.113	0.085	0.085	0.085	0.105
3001E1	148.7	0.006	0.006	0.006	0.142	1.416	0.566	0.227	0.113	0.057	0.042	0.042	0.014	0.222
3001G1	149.2	0.20	0.17	0.17	0.28	1.70	0.99	0.42	0.28	0.28	0.23	0.25	0.23	0.44
3001ZZ	1105.9	0.0	0.0	0.028	0.142	0.283	1.416	0.085	0.057	0.0	0.0	0.0	0.0	0.166

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 41191.3
SUM OF SUB-DRAINAGE AREAS = 41205.5

TOTAL FLOW IN = 1817.72
TOTAL FLOW OUT = 1846.54

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3001A1	10	74	135.355	5	141.584				
	11	74	127.709	3	101.091				
	12	74	118.081	8	124.028				
	1	75	96.560	18	165.654				
	2	75	100.808	9	142.434				
	3	75	116.099	9	167.069				
	4	75	138.469	6	168.768				
	5	75	281.186	4	167.353				
	6	75	532.357	8	180.945				
3001A2	7	75	404.931						
	8	75	165.654	29	154.044				
	9	75	136.487	5	152.911	18	151.212		
	10	74	123.348	5	101.941				
	11	74	100.780	3	133.089				
	12	74	142.915	8	165.937				
	1	75	163.926	19	131.390				
	2	75	155.969	9	74.473	23	0.0		
	3	75	169.420	9	130.257				
	4	75	167.749	6	124.594				
	5	75	176.018	4	189.157				
	6	75	328.475	8	580.495	25	696.594		
	7	75	451.087	16	390.772	31	182.927		
	8	75	183.635	29	157.442				
	9	75	152.458						

TRIBUTARY FLOW INFORMATION FOR MONTANA

12/0376

LAKE CODE 3001 CANYON FERRY LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3001B1	10	74	0.113	5	0.113				
	11	74	0.085	3	0.113				
	12	74	0.113	8	0.142				
	1	75	0.099	18	0.113				
	2	75	0.065	9	0.085	23	0.0		
	3	75	0.071	9	0.085				
	4	75	0.057	6	0.057				
	5	75	0.142	4	0.085				
	6	75	0.793	8	0.768				
	7	75	0.425	31	0.425				
	8	75	0.227	29	0.198				
	9	75	0.142	5	0.198				
3001E1	10	74	0.051	5	0.057				
	11	74	0.085	3	0.042				
	12	74	0.014	8	0.003				
	1	75	0.003	19	0.003				
	2	75	0.003	9	0.003				
	3	75	0.011	9	0.014				
	4	75	0.269	6	0.011				
	5	75	1.699	4	0.934				
	6	75	2.633	8	1.982	25	2.265		
	7	75	0.793	16	0.765	31	0.566		
	8	75	0.425	20	0.368				
	9	75	0.311	18	0.283				
3001G1	10	74	0.255	5	0.255				
	11	74	0.311	3	0.425				
	12	74	0.255	8	0.255				
	1	75	0.212	18	0.227				
	2	75	0.198	9	0.0				
	3	75	0.198	9	0.198				
	4	75	0.368	6	0.227				
	5	75	1.897	4	1.388				
	6	75	4.134	8	3.681				
	7	75	1.614	31	1.161				
	8	75	0.793	29	0.453				
	9	75	0.453	5	0.481				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/05/05

300101
46 22 18.0 111 31 06.0 3
CANYON FERRY RESERVOIR
30007 MONTANA

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 CAC03 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
75/05/28	11 10	0000	10.5	8.4	6	251	7.70	133	0.060	0.900	0.340	0.044
75/07/31	09 00	0000	13.1	8.4	42	289	8.50	134	0.020	0.400	0.110	0.020
75/09/04	11 10	0000	14.9	8.2	40	322	8.40	162	0.020K	0.300	0.040	0.004
75/10/22	11 55	0000	9.9	10.2	42	241	8.25	154	0.020	0.300	0.120	0.012
	11 55	0005	10.0	10.7		241	8.25	157	0.020K	0.200	0.120	0.012

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/28	11 10	0000	0.247	9.5	
75/07/31	09 00	0000	0.037	3.3	
75/09/04	11 10	0000	0.026		
75/10/22	11 55	0000	0.046	4.6	
	11 55	0005	0.050		

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

300102
46 25 40.0 111 31 17.0 3
CANYON FERRY RESERVOIR
30007 MONTANA

11EPALES 2111202
0027 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 CONDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CAC03 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
75/05/28	11 25	0000	9.7	9.2	12	227	7.20	122	0.080	0.500	0.230	0.073
	11 25	0005	9.7	9.0		226	7.50	124	0.080	0.500	0.220	0.045
	11 25	0015	9.6	9.0		225	8.30	125	0.080	0.600	0.220	0.047
	11 25	0023	9.5	8.8		225	8.20	125	0.070	0.500	0.220	0.044
75/07/31	09 25	0000	17.2	7.4	48	229	8.60	101	0.040	0.500	0.030	0.015
	09 25	0005	17.1	7.2		231	8.60	102	0.040	0.400	0.030	0.016
	09 25	0015	17.2	7.2		223	8.60	102	0.030	0.600	0.030	0.014
	09 25	0030	17.1	7.4		229	8.60	102	0.030	0.200	0.030	0.015
	09 25	0045	15.1	4.0		219	8.00	106	0.070	0.300	0.130	0.042
75/09/04	11 25	0000	18.5	7.4	35	260	8.35	129	0.020	0.300	0.120	0.029
	11 25	0005	18.3	7.6		258	8.30	137	0.020	0.200	0.120	0.026
	11 25	0015	18.1	7.2		257	8.25	129	0.020	0.200	0.120	0.025
	11 25	0030	18.0	7.4		259	8.25	130	0.020	0.200	0.120	0.025
75/10/22	12 15	0000	12.9	9.4	36	221	8.20	140	0.040	0.200	0.110	0.029
	12 15	0005	12.1	9.1		222	8.25	139	0.040	0.200	0.110	0.029
	12 15	0015	12.1	9.2		223	8.20	140	0.050	0.300	0.110	0.028
	12 15	0031	11.7	8.9		229	8.25	138	0.050	0.400	0.110	0.029

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/28	11 25	0000	0.077	3.4	
	11 25	0005	0.091		
	11 25	0015	0.087		
	11 25	0023	0.079		
75/07/31	09 25	0000	0.040	11.4	
	09 25	0005	0.042		
	09 25	0015	0.042		
	09 25	0030	0.038		
	09 25	0045	0.099		
75/09/04	11 25	0000	0.049	9.2	
	11 25	0005	0.044		
	11 25	0015	0.042		
	11 25	0030	0.040		
75/10/22	12 15	0000	0.060	7.7	
	12 15	0005	0.062		
	12 15	0015	0.052		
	12 15	0031	0.055		

STORET RETRIEVAL DATE 75/08/35

300103
46 30 42.0 111 34 15.0 3
CANYON FERRY RESERVOIR
30007 MONTANA

11EPALES 2111202
0060 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 CAC03 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&N03 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/28	11 45	0000	9.9	9.0	19	251	8.30	136	0.090	0.700	0.220	0.045
	11 45	0005	9.6	9.2		245	8.30	136	0.090	0.600	0.220	0.052
	11 45	0028	9.2	8.8		244	8.20	135	0.090	0.600	0.220	0.043
	11 45	0056	7.0	9.2		264	8.10	137	0.100	0.600	0.220	0.048
75/07/31	09 55	0000	17.2	7.2	90	227	8.55	99	0.030	0.300	0.040	0.013
	09 55	0005	17.3	7.2		229	8.60	98	0.030	0.500	0.040	0.020
	09 55	0015	17.2	8.4		232	8.55	97	0.020	0.300	0.040	0.009
	09 55	0035	17.2	8.6		235	8.50	96	0.020	0.200	0.040	0.009
	09 55	0055	14.1	2.6		230	7.90	130	0.040	0.400	0.270	0.053
	09 55	0077	10.7	2.2		213	7.85	106	0.040	0.400	0.280	0.057
75/09/04	11 45	0000	18.9	9.4	40	250	8.30	123	0.020K	0.300	0.090	0.019
	11 45	0005	18.7	7.2		248	8.30	124	0.020K	0.200	0.080	0.019
	11 45	0015	18.6	7.0		251	8.25	125	0.020K	0.200K	0.090	0.019
	11 45	0040	18.5	6.8		251	8.20	124	0.020K	0.300	0.100	0.021
	11 45	0065	17.5	6.4		274	8.10	125	0.060	0.300	0.160	0.035
75/10/22	12 40	0000	14.0	8.3	54	219	8.15	128	0.020K	0.200	0.140	0.032
	12 40	0005	13.9	8.5		221	8.20	130	0.020K	0.200	0.140	0.031
	12 40	0017	14.0	8.4		221	8.20	128	0.020K	0.400	0.150	0.036
	12 40	0045	13.7	8.6		219	8.20	131	0.020K	0.200	0.140	0.032
	12 40	0079	12.0	9.0		229	8.20	141	0.040	0.300	0.110	0.030

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/08/05

300103
46 30 42.0 111 34 15.0 3
CANYON FERRY RESERVOIR
30007 MONTANA

11EPALES 2111202
0060 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 P-OS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/28	11 45	0000	0.076	3.8	
	11 45	0005	0.077		
	11 45	0028	0.072		
	11 45	0056	0.072		
75/07/31	09 55	0000	0.035	9.2	
	09 55	0005	0.044		
	09 55	0015	0.034		
	09 55	0035	0.033		
	09 55	0055	0.108		
	09 55	0077	0.118		
75/09/04	11 45	0000	0.034	6.4	
	11 45	0005	0.038		
	11 45	0015	0.034		
	11 45	0040	0.041		
	11 45	0065	0.070		
75/10/22	12 40	0000	0.047	1.2	
	12 40	0005	0.050		
	12 40	0017	0.047		
	12 40	0045	0.046		
	12 40	0079	0.062		

STORET RETRIEVAL DATE 76/08/05

300104
46 34 55.0 111 39 20.0 3
CANYON FERRY RESERVOIR
30049 MONTANA

11EPALES 2111202
0100 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 CONDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CAC03 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
75/05/28	12 15	0000	8.9	11.0	48	270	8.40	152	0.030	0.600	0.160	0.025
	12 15	0005	8.3	11.2		266	7.50	154	0.030	0.700	0.150	0.025
	12 15	0025	7.1	11.2		260	7.50	158	0.060	0.600	0.200	0.036
	12 15	0050	6.6	10.4		259	7.60	159	0.050	0.500	0.190	0.019
	12 15	0075	6.3	10.6		255	7.60	159	0.040	0.500	0.180	0.016
	12 15	0096	6.2	10.4		254	7.80	161	0.040	0.400	0.180	0.016
75/07/31	10 15	0000	17.2	7.2	78	229	8.55	96	0.020	0.400	0.050	0.017
	10 15	0005	17.3	7.4		211	8.60	95	0.020K	0.600	0.040	0.018
	10 15	0015	17.2	6.8		228	8.50	94	0.020K	0.400	0.040	0.018
	10 15	0035	15.8	6.2		224	8.10	99	0.020	0.200	0.120	0.038
	10 15	0060	12.1	5.6		215	8.00	98	0.020K	0.200	0.160	0.039
	10 15	0090	9.1	4.6		228	7.90	110	0.020	0.200K	0.250	0.051
	10 15	0113	6.7			245	7.85	127	0.050	0.300	0.340	0.060
75/09/04	12 05	0000	19.1	7.0	75	243	8.25	109	0.040	0.200	0.060	0.028
	12 05	0005	18.8	7.2		243	8.20	108	0.020	0.200	0.060	0.022
	12 05	0015	18.1	7.2		242	8.20	110	0.020K	0.200K	0.060	0.019
	12 05	0050	18.7	7.2		244	8.20	109	0.020K	0.200K	0.060	0.020
	12 05	0085	17.7	4.6		246	7.90	111	0.020K	0.200	0.190	0.044
	12 05	0110	14.7	1.8		226	7.65	111	0.020	0.400	0.270	0.053
75/10/22	13 00	0000	14.0	8.4	60	221	8.10	125	0.020K	0.200	0.160	0.032
	13 00	0005	14.0	9.4		221	8.10	126	0.020K	0.200	0.150	0.032
	13 00	0017	14.0	8.4		221	8.15	127	0.020K	0.200	0.150	0.031
	13 00	0045	14.0	8.6		221	8.20	127	0.020K	0.200	0.150	0.031
	13 00	0070	13.0	9.0		227	8.20	133	0.030	0.300	0.130	0.030
	13 00	0095	12.7	8.3		231	8.15	134	0.070	0.400	0.120	0.022

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

300104
46 34 55.0 111 39 20.0 3
CANYON FERRY RESERVOIR
30049 MONTANA

11EPALES 2111202
0100 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/28	12 15	0000	0.057	7.7	
	12 15	0005	0.062		
	12 15	0025	0.049		
	12 15	0050	0.042		
	12 15	0075	0.040		
	12 15	0096	0.032		
75/07/31	10 15	0000	0.041	13.2	
	10 15	0005	0.059		
	10 15	0015	0.033		
	10 15	0035	0.042		
	10 15	0060	0.057		
	10 15	0090	0.071		
	10 15	0113	0.099		
75/09/04	12 05	0000	0.030	4.3	
	12 05	0005	0.035		
	12 05	0015	0.032		
	12 05	0050	0.032		
	12 05	0085	0.064		
	12 05	0110	0.112		
75/10/22	13 00	0000	0.040	1.5	
	13 00	0005	0.043		
	13 00	0017	0.039		
	13 00	0045	0.039		
	13 00	0070	0.046		
	13 00	0095	0.244		

STORET RETRIEVAL DATE 76/08/95

300105
46 37 59.0 111 42 35.0 3
CANYON FERRY RESERVOIR
30049 MONTANA

11EPALES 2111202
0145 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 CONDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CAC03 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
75/05/28	12 50	0000	5.6	11.6	160	255	7.80	161	0.030	0.500	0.200	0.014
	12 50	0005	5.2	11.6		250	8.00	161	0.030	0.500	0.200	0.015
	12 50	0025	5.1	11.2		250	7.80	141	0.030	0.400	0.210	0.022
	12 50	0050	5.0	11.0		249	8.20	143	0.040	0.400	0.210	0.024
	12 50	0100	4.8	11.0		250	8.20	145	0.040	0.400	0.210	0.026
	12 50	0141	4.8	11.0		249	7.90	144	0.030	0.500	0.190	0.015
75/07/31	10 50	0000	16.4	5.8	117	220	8.20	97	0.020	0.300	0.090	0.024
	10 50	0005	16.4	6.8		208	8.20	95	0.020K	0.400	0.080	0.022
	10 50	0015	16.3	5.8		214	8.20	96	0.020K	0.200	0.080	0.020
	10 50	0035	15.0	6.0		219	8.10	96	0.020K	0.300	0.110	0.028
	10 50	0060	11.6	6.4		226	8.05	100	0.020	0.300	0.160	0.034
	10 50	0095	8.5	6.2		229	8.00	105	0.020	0.300	0.200	0.046
	10 50	0140	5.8	5.6		274	7.95	135	0.030	0.300	0.330	0.063
	10 50	0161	5.4	6.0		276	7.90	136	0.140	0.600	0.360	0.059
75/09/04	11 35	0000	18.6	7.4	100	235	8.10	110	0.020K	0.200	0.080	0.023
	11 35	0005	18.5	6.4		233	8.15	108	0.020K	0.200	0.070	0.022
	11 35	0015	18.5	6.4		237	8.10	109	0.020K	0.200	0.070	0.021
	11 35	0050	18.4	6.4		236	8.05	110	0.020	0.200	0.070	0.024
	11 35	0090	17.2	3.8		294	7.75	112	0.020K	0.300	0.200	0.049
	11 35	0125	12.2	1.4		328	7.60	126	0.020K	0.300	0.320	0.058
	11 35	0160	10.4	0.6		380	7.50	132	0.100	0.700	0.330	0.063
75/10/22	13 30	0000	14.4	7.6	42	222	7.95	126	0.020K	0.200	0.160	0.035
	13 30	0005	14.4	7.6		223	8.00	126	0.020K	0.300	0.160	0.036
	13 30	0015	14.4	7.6			8.00	127	0.020K	0.200	0.160	0.036
	13 30	0045	14.4	7.4			8.00	130	0.020K	0.200	0.160	0.037
	13 30	0090	13.8	6.2			7.90	136	0.020	0.300	0.160	0.041
	13 30	0130	13.3	7.2			8.00	135	0.040	0.300	0.140	0.040
	13 30	0165	13.0	0.6		243	7.70	141	0.040	0.600	0.040	0.074

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

300105
46 37 59.0 111 42 35.0 3
CANYON FERRY RESERVOIR
30049 MONTANA

11EPALES 2111202
0145 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/28	12 50	0000	0.032	7.3	
	12 50	0005	0.029		
	12 50	0025	0.029		
	12 50	0050	0.028		
	12 50	0100	0.033		
	12 50	0141	0.028		
75/07/31	10 50	0000	0.040	2.6	
	10 50	0005	0.121		
	10 50	0015	0.039		
	10 50	0035	0.042		
	10 50	0060	0.049		
	10 50	0095	0.055		
	10 50	0140	0.076		
	10 50	0161	0.160		
75/09/04	11 35	0000	0.034	2.9	
	11 35	0005	0.032		
	11 35	0015	0.033		
	11 35	0050	0.034		
	11 35	0090	0.067		
	11 35	0125	0.093		
	11 35	0160	0.282		
75/10/22	13 30	0000	0.047	1.3	
	13 30	0005	0.048		
	13 30	0015	0.052		
	13 30	0045	0.050		
	13 30	0090	0.061		
	13 30	0130	0.067		
	13 30	0165	0.200		

APPENDIX E
TRIBUTARY AND WASTEWATER
TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/08/05

3001A1
 46 38 57.0 111 43 39.0 4
 MISSOURI RIVER
 30 15 CANYON FERRY
 O/CANYON FERRY LAKE
 BRDG ON HWY 284 BELOW CANYON FERRY 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 URTHO MG/L P	00665 PHOS-TOT MG/L P
74/10/05	10 20		0.016	1.500	0.010	0.005K	0.045
74/11/03	10 00		0.200	1.500	0.070	0.050	0.050
74/12/08	09 00		0.248	0.900	0.020	0.035	0.040
75/01/18	23 00		0.248	0.200	0.005K	0.030	0.035
75/02/09	15 30		0.264	0.500	0.024	0.024	0.050
75/03/09	11 30		0.270	0.150	0.024	0.016	0.040
75/04/06	13 45		0.300	0.490	0.085	0.025	0.025
75/05/04	10 00		0.270	0.300	0.030	0.025	0.025
75/06/08	10 00		0.160	0.750	0.050	0.020	0.040
75/08/29	12 30		0.190	0.700	0.025	0.060	0.120
75/09/05	08 45		0.150	0.400	0.005K	0.040	0.050
75/09/18	18 50		0.035	0.400	0.005	0.005	0.030

K VALUE KNOWN TO BE
 LESS THAN INDICATED

STORET RETRIEVAL DATE 7/20/05

3001A2
46 20 10.0 111 31 50.0 4
MISSOURI RIVER
30 15 TOWNSEND
T/CANYON FERRY LAKE
RR BRDG 1.2 MI NW OF TOWNSEND
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPT- 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	11 10		0.050	0.250	0.005K	0.005K	0.010
74/11/03	11 00		0.176	0.200	0.020	0.025	0.025
74/12/08	11 00		0.200	0.300	0.035	0.010	0.030
75/01/19	11 45		0.336	0.400	0.025	0.025	0.025
75/02/09	12 00		0.320	0.600	0.032	0.024	0.050
75/03/09	11 30		0.240	0.600	0.040	0.016	0.080
75/04/06	11 00		0.170	0.650	0.022	0.022	0.040
75/05/04	11 20		0.210	0.950	0.160	0.040	0.140
75/06/08	11 45		0.075	1.450	0.045	0.040	0.220
75/06/25	19 00		0.050	1.200	0.040	0.040	0.160
75/07/16	18 45		0.080	0.912	0.125	0.032	0.100
75/07/31	07 30		0.065	0.500	0.030	0.025	0.070
75/08/29	18 45		0.050	1.250	0.330	0.050	0.060

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

300181
 46 39 15.0 111 40 00.0 4
 MAGPIE CREEK
 30 15 CANYON FERRY
 T/CANYON FERRY LAKE
 BRDG ON HWY 284 3.5 MI E OF CANYON FERRY
 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	10 40		0.008	0.900	0.020	0.015	0.015
74/11/03	15 30		0.056	0.900	0.045	0.015	0.015
74/12/08	09 30		0.080	0.100K	0.015	0.010	0.010
75/01/18	23 30		0.088	0.150	0.009	0.017	0.020
75/02/09	15 00		0.088	0.200	0.016	0.008	0.040
75/03/09	11 00		0.056	0.200	0.032	0.008K	0.020
75/04/06	11 20		0.040	0.700	0.020	0.010	0.010
75/05/04	13 30		0.040	0.300	0.020	0.005	0.040
75/06/08	10 15		0.075	0.300	0.020	0.015	0.030
75/07/31	12 30		0.040	0.250	0.005K	0.017	0.025
75/08/29	11 00		0.055	0.250	0.010	0.030	0.070
75/09/05	09 00		0.050	0.200	0.015	0.015	0.020

K VALUE KNOWN TO BE
 LESS THAN INDICATED

STORET RETRIEVAL DATE 7-13-75

3001C1
46 36 20.0 111 36 45.0 4
AVALANCHE CREEK
30 15 CANYON FERRY
T/CANYON FERRY LAKE
BRDG ON HWY 284 7.5 M SE OF CANYON FERRY
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE	TIME	DEPTH	00630 NO2-N 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
FROM	OF						
TO	DAY	FEET					
75/05/04	14	30	0.950	0.950	0.120	0.020	0.160
75/06/08	10	30	0.075	1.450	0.110	0.020	0.200
75/07/31	13	00	0.015	0.300	0.010	0.015	0.030
75/08/28	11	30	0.005	0.200	0.010	0.020	0.030
75/09/05	09	30	0.005	0.200	0.005K	0.007	0.010K

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

300101
46 33 40.0 111 33 50.0 4
WHITE CREEK
30 15 CANYON FERRY
T/CANYON FERRY LAKE
BRDG ON HWY 284 13 MI SE CANYON FERRY
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE	TIME	DEPTH	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
FROM	OF						
TO	DAY	FEET					
75/05/04	10	40	0.080	0.250	0.010	0.020	0.050

STORET RETRIEVAL DATE 76/08/05.

3001E1
 46 30 35.0 111 36 15.0 4
 BEAVER CREEK
 30 15 CANYON FERRY
 T/CANYON FERRY LAKE
 BRDG ON UNPVD RD .1 MI E OF HWY 554
 11EPALES 2111204
 0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&N03 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS URTHO MG/L P	00665 PHOS-TOT MG/L P
74/10/05	10	30	0.016	0.500	0.050	0.060	0.050
74/11/03	10	10	0.040	0.200	0.015	0.040	0.050
74/12/08	10	05	0.104	0.200	0.010	0.050	0.060
75/01/19	11	15	0.136	0.300	0.010	0.055	0.055
75/02/09	11	10	0.136	0.400	0.016	0.040	0.070
75/03/09	10	45	0.152	0.200	0.024	0.032	0.050
75/04/06	10	20	0.140	0.300	0.005K	0.040	0.040
75/05/04	10	30	0.120	0.500	0.047	0.050	0.050
75/06/08	10	45	0.070	1.300	0.030	0.080	0.170
75/06/25	14	15	0.005	0.750	0.020	0.040	0.060
75/07/16	19	15	0.045	0.375	0.020	0.070	0.110
75/07/31	18	30	0.045	0.100K	0.020	0.065	0.090
75/08/20	18	00	0.055	1.150	0.180	0.105	0.150
75/09/18	18	10	0.025	0.200	0.010	0.060	0.070

K VALUE KNOWN TO BE
 LESS THAN INDICATED

STORET RETRIEVAL DATE 76/03/05

3001G1
 46 29 25.0 111 30 40.0 4
 CONFEDERATE CREEK
 30 15 TOWNSEND
 1/2 CANYON FERRY LAKE
 BRDG ON SEC RD 15 MI N OF TOWNSEND
 11EPALES 2111204
 0000 FEET DEPTH CLASS 00

DATE	TIME	DEPTH	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
FROM TO	OF DAY	FEET					
74/10/05	14 50		0.116	0.600	0.015	0.005	0.010
74/11/03	15 00		0.192	0.500	0.025	0.015	0.015
74/12/08	15 30		0.256	0.500	0.045	0.010	0.010
75/01/18	23 10		0.336	0.400	0.005	0.020	0.025
75/03/09	10 30		0.384	0.200	0.040	0.008K	0.020
75/04/06	12 30		0.280	1.200	0.035	0.010	0.020
75/05/04	15 00		0.105	0.500	0.055	0.005	0.010
75/06/08	11 00		0.025	0.550	0.045	0.010	0.040
75/07/31	14 00		0.010	0.700	0.010	0.030	0.120
75/08/29	11 45		0.080	0.500	0.020	0.025	0.050
75/09/05	10 10		0.080	0.300	0.025	0.010	0.010

K VALUE KNOWN TO BE
 LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/95

3001J1
46 22 10.0 111 29 15.0 4
MANLEY DITCH
30 15 DUCK CRK PASS
T/CANYON FERRY LAKE
200 YDS UPSTRM FRM BRDG 5 MI NE TOWNSEND
11EP4LES 2111204
0000 FEET DEPTH CLASS 00

DATE	TIME	DEPTH	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
FROM	OF						
TO	DAY	FEET					
74/10/05	15	30	0.036	0.400	0.015	0.130	0.140
75/06/08	13	15	0.145	0.850	0.060	0.130	0.340

STORET RETRIEVAL DATE 76/08/05

3001AA PD3001AA P001300
46 19 00.0 111 31 00.0 4
TOWNSEND
30 15 TOWNSEND
T/CANYON FERRY RES
MISSOURI RIVER
11EPALES 2141204
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	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
75/02/05	14 15		0.080	5.000	0.050K	0.950	1.000	0.979	1.000
75/03/03	14 00		0.080	3.500	0.080K	0.960	1.100	0.612	0.500
75/04/01	14 00		0.080	3.200	0.080	0.280	1.100	0.707	0.661
75/05/07	09 40		0.050	1.900	0.130	0.310	0.850	0.777	0.700
75/06/02	15 00		0.050	1.500	0.050K	0.420	0.950	0.661	0.650
75/08/08	10 30		0.150	2.800	0.050K	0.440	0.660	2.580	2.430
75/10/06	10 00		0.150	1.900	0.050K	0.600	0.740	1.920	2.000

K VALUE KNOWN TO BE
LESS THAN INDICATED