WATER QUALITY STATUS REPORT

BLACKFOOT MARSH RESERVOIR

BINGHAM COUNTY, IDAHO

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WATER QUALITY STATUS REPORT

Blackfoot Marsh Reservoir

(Bingham County)

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ABSTRACT

A water quality survey of the Blackfoot Marsh Reservoir and its major tributaries was conducted from May to November, 1977. The study was designed to collect background data on the reservoir for future trend monitoring. Those data were supplemented with samples from the Blackfoot River, isolating major mining activity areas.

The study data consisted of water quality samples collected at 12 reservoir stations at three discrete depths each. Nine river stations were sampled. Approximately 15 water samples were collected, preserved, and analyzed for algal growth potential. However, due to the high water hardness of the Blackfoot River system, the assay procedure was unsuccessful.

Sediment cores were collected at 14 reservoir stations. They were analyzed in 5 cm. depth units over the top 15 cm. The sediments were analyzed for full nutrient and metal chemistry.

The results show that the Blackfoot Marsh Reservoir is a shallow wind mixed reservoir. Flow through time is short, about 175 days on the average. The winds agitate the water along the broad shallow edges suspending sediment and aiding in the dissolution of nutrients in the sediments.

The reservoir is considered eutrophic. Nitrate-nitrogen is below algal bloom potential levels, and is the limiting factor for algal growth in the lake. Ortho-phosphate and total phosphorus exceed algal bloom potential criteria. The predominant alga in the reservoir is Aphanizomenon flos-aquae, a blue green alga capable of utilizing atmospheric nitrogen. Thus, when phosphorus is increased even a little, there is usually a significant response in algal populations and biomass (as reflected by chlorophyll a concentration).

Reservoir water quality stresses to be expected from future mining activity are erosion and nutrient addition. In monitoring for the effects of those stresses, it appears necessary to monitor only four reservoir stations rather than the twelve monitored in 1977. Similarly, a depth composite sample would provide an accurate reflection of water quality and reduce costs over three samples from discrete depths. However, more emphasis should be placed on the planktonic algal community, and samples should be taken more frequently over the study period.

INTRODUCTION

The Blackfoot River Basin is the primary watershed draining the Idaho Phosphate Belt. The phosphate mining activity currently underway, and the anticipated increase in activity can be expected to have an impact on the Blackfoot River watershed. Those impacts may be localized turbidity and sediment increases in the river, or they may be nutrient and metal exports from the river system to Blackfoot reservoir. In either case, it is necessary to have background water quality data on the system so that the impact of future activities can be measured. Relatively little data of that nature have been collected on the Blackfoot River, and prior to this study, no water quality information had been collected on the Blackfoot reservoir.

This study was designed to collect water quality data at several locations on the Blackfoot reservoir during the summer of 1977. These data could then be analyzed in such a way that future studies could monitor the most sensitive and/or most indicative parameters within the reservoir. Additionally selected river stations were sampled. These river data would supplement previous river water quality studies, and would allow greater definition of the effects of river water quality on the Blackfoot reservoir.

The Blackfoot River drains a 2,080 km^2 (1,300 mi^2) watershed in southeastern Idaho. The river begins in mountainous terrain in Caribou National Forest, near the Wyoming state line. The river flows northwesterly to the Blackfoot reservoir, which is located in the last major upper basin valley. Below the Blackfoot reservoir dam the river flows through a steep canyon for several kilometers before emerging on to the Snake River plain. The Blackfoot empties into the Snake River just above the headwaters of American Falls reservoir (Miss, 1974). The watershed comprises 910 km^2 (350 mi^2) above the reservoir and 1,500 km^2 (581 mi^2) including the reservoir and its tributaries (U.S. Geological Survey, 1977).

The mean annual air temperature at Conda on the southeast end of the reservoir is 4.7°C (40.5°F). Mean annual precipitation is 41 cm (16 in.). Approximately 50% of that precipitation falls between October and April. Mean annual snowfall is 325 cm (128 in.) (U.S. Army Corps of Engineers, 1969).

The Blackfoot Reservoir is located in a modified graben which has been flooded with basalt. The geologic formations in this area are primarily carboniferous rock and triassic rock bodies of basaltic lava flows and associated clastic volcanic beds. A portion of the drainage to the south and east of the reservoir consists of cretaceous and tertiary sedimentary beds (Mansfield, 1927 and Miss, 1974). The upper Blackfoot River basin is comprised of large areas of triassic sedimentary rocks with smaller areas of the Permian Phosphoria formation. (Platts and Primbs, 1976). This latter formation contains as much as 25% phosphorus pentoxide (P_2O_5) and is commercially extracted.

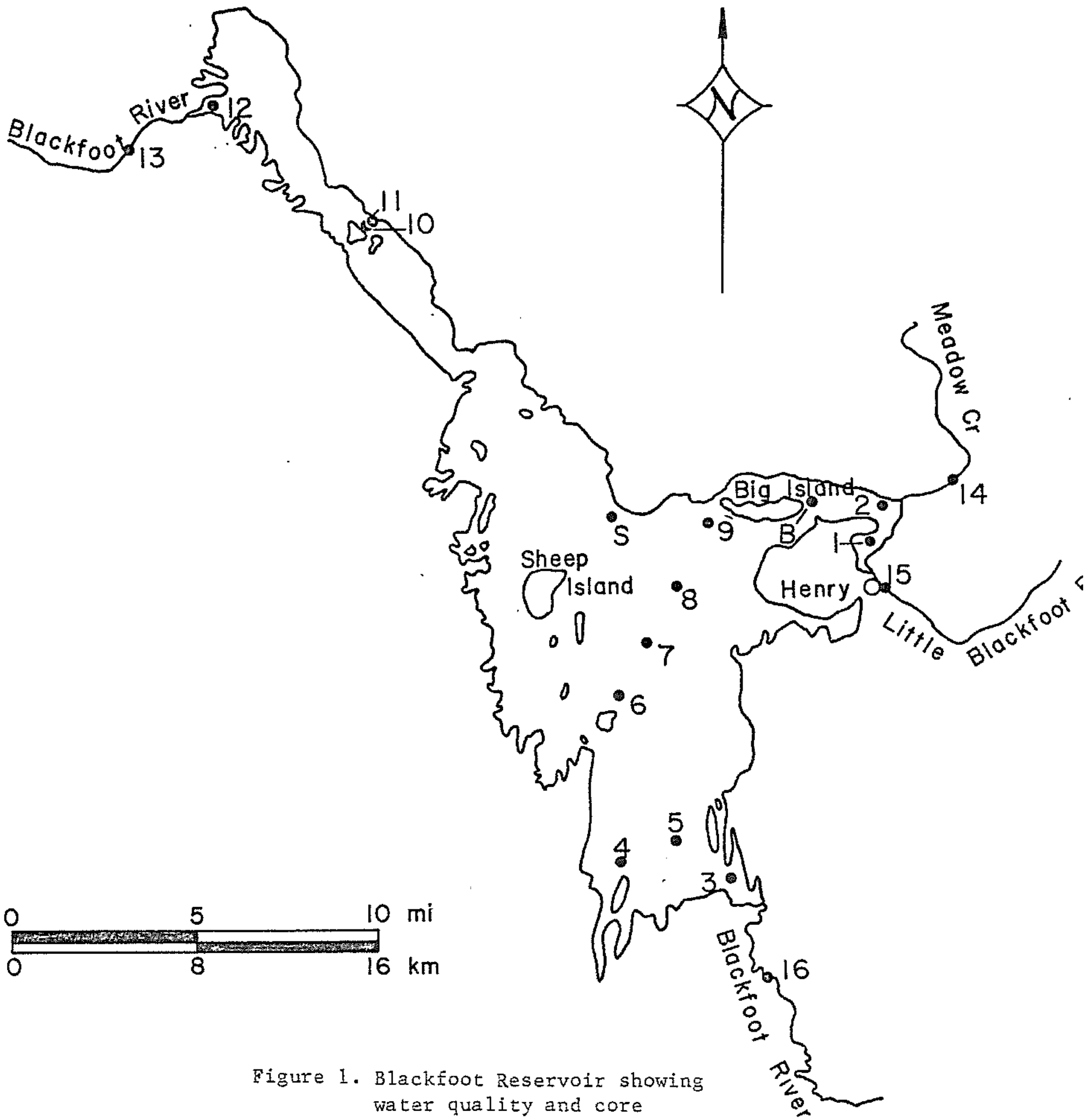

Figure 1. Blackfoot Reservoir showing water quality and core sample stations.

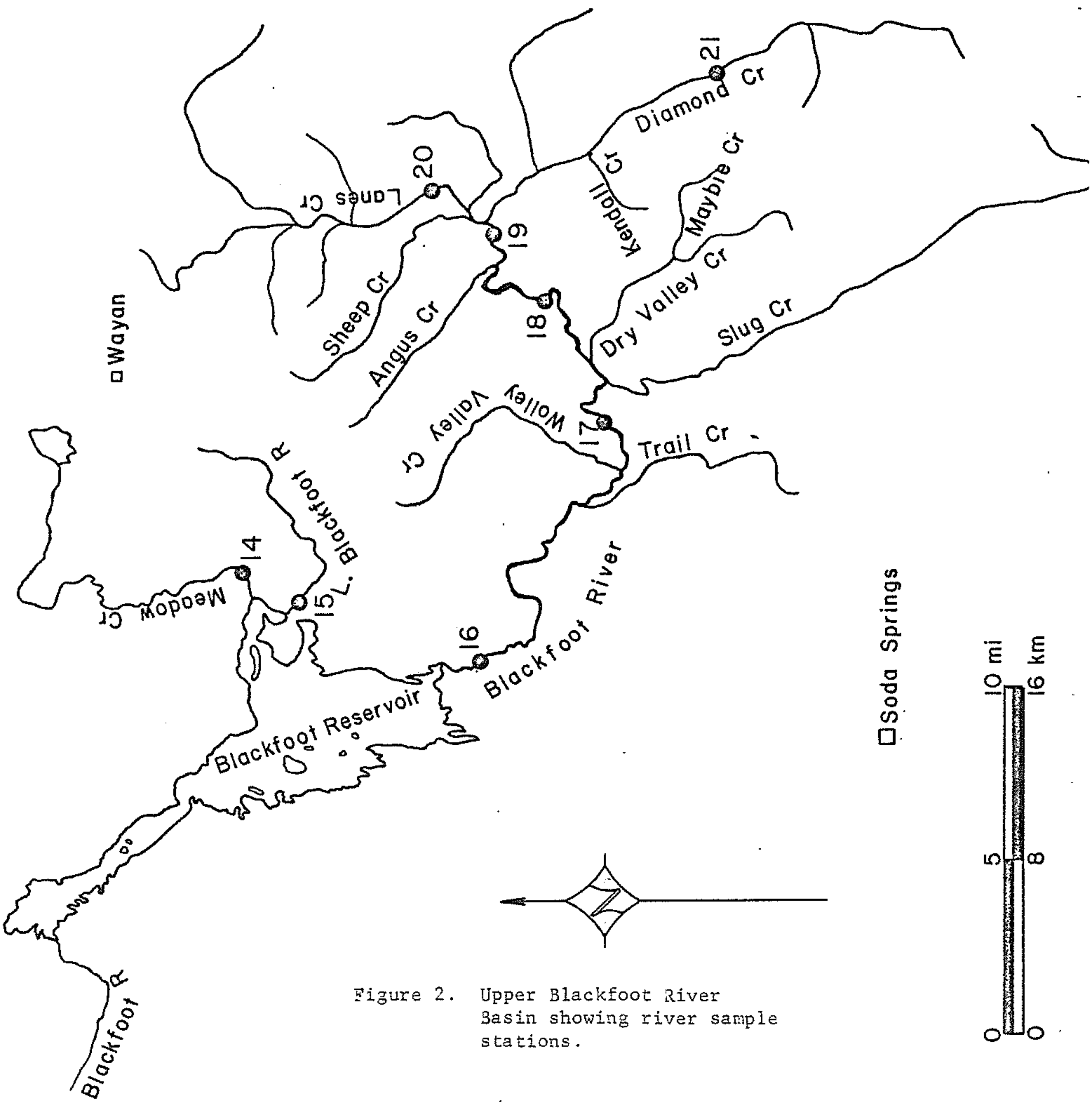

Figure 2. Upper Blackfoot River Basin showing river sample stations.

METHODS AND MATERIALS

PHYSICAL AND CHEMICAL

Reservoir water quality samples were collected at twelve stations (Figure 1) approximately bi-weekly from June through October, 1978. These stations were chosen to reflect the influence of the three reservoir tributaries and to monitor the water quality of the entire reservoir. At all stations, temperature and dissolved oxygen were measured at half meter intervals. These two parameters were measured with a YSI Model 57 dissolved oxygen meter.

Where water depth exceeded three meters, three grab samples were taken at 0.5 m, mid-depth, and 0.5 to 1.0 m above the bottom. When water depth was 1.5 to 3.0 meters, two samples were collected, excluding the middle sample. At depths less than 1.5 m only one water quality sample was collected, and complete mixing was assumed.

Water samples were collected with a 2.0 liter vertical Van Dorn sampler. Water was released from the sampler directly into sample containers. Cubitainers of 1.15 liter (one quart) size were used for most samples. Nutrient samples were preserved with concentrated sulfuric acid to pH 2. Metal samples were preserved with concentrated nitric acid to pH 2. Samples for solids analysis and other routine parameters were cooled to 4°C. Bacterial samples were collected into 250 ml, autoclaved, nalgene bottles, and were stored at 4°C. Specific conductance was measured with a Barnstead Conductivity Bridge, and was measured on site, on each sample. All water quality samples were analyzed by the Idaho Department of Health and Welfare, Bureau of Laboratories. Routine EPA approved methods were used in all cases.

ALGAL BIOMASS

Secchi disc transparency was determined at each station, on the shaded side of the boat. The disc was lowered until it disappeared, raised until it re-appeared, and the two readings were averaged. The photic zone (1% light transmittance) was defined as 2.5 times the secchi disc reading. A composite sample was taken from this photic zone by collecting two liters of water at each half meter of depth. These samples were composited in a carboy, mixed by swirling, and the sample was tapped from the bottom one-third of the composite.

Chlorophyll samples were siphoned directly from the composite sample into a millipore field filtration apparatus. The volume was noted (normally 200 ml) and the water was filtered through a 47 mm 0.45 μ membrane filter. The filter was immediately placed in a 50 mm plastic petri dish, wrapped in aluminum foil, labeled, and placed directly onto dry ice. Samples were kept frozen until delivery to the laboratory.

SEDIMENTS

Core samples from the reservoir were taken with a standard coring device (EPA Seattle). The sampler collects cores 5 cm (2 in.) in diameter, up to 60 cm (24 in.) long. Cores are preserved inside transparent plastic tubing. Samples were collected in pairs at each of the 12 reservoir stations and at the two additional stations marked "S" and "B" on Figure 1. Core tubes were sealed with rubber stoppers and placed on dry ice. They were kept frozen until sectioning. Cores were removed from the tubes sectioned longitudinally with a band saw. Samples from the top of the core were sectioned in 5 cm (2 inch) units horizontally. Thus, there were three 5 cm pairs of samples from the top 15 cm of each core. These samples were individually weighed and placed in 1.15 liter (1 quart) cubitainers. Half of the samples were suspended in 500 ml of distilled water and preserved with concentrated sulfuric acid to pH 2. The complimentary half was suspended and preserved with concentrated nitric acid to pH 2. After the core samples were analyzed, the dilution water used was also analyzed for the same elements. The appropriate correction was formulated for dilution water contamination, and the results were converted from mg/l in the suspended sample to mg/kg in wet sediment.

PLANKTONIC AND BENTHIC SAMPLES

Selected plankton and benthos samples were also collected from the reservoir. Plankton samples were collected with a 13 cm (5 in.) net, which had a mesh size of 153 μ. Plankton tows were through a horizontal column of water 100 m long and 0.5 m deep. Samples were preserved with Lugol's solution. Benthos was collected with an Ekman dredge.

RIVER SAMPLES

Nine river stations were sampled as a supplement to the reservoir study. Location of these stations is shown in Figure 2. River water quality samples were grab samples taken from mid-stream, at sub-surface depth. Temperature, oxygen, and conductivity were measured in the field. Chemistry samples were collected and preserved as described above for reservoir samples. Coliform bacteria samples were taken in sterile 250 ml nalgene bottles and were kept refrigerated until delivery to the laboratory.

STATISTICAL ANALYSIS

Results of reservoir water quality were tabulated and statistically analyzed. The effects of three influences were investigated for each parameter. These influences were station effects, time effects, and depth effects. Thus, each parameter was tested in three two-way analyses of variance. The data were first tested to see if they met the assumptions of the parametric analysis of variance test, i.e., normally distributed and homogeneity of variance (Sokal and Rholf 1969). The data failed to meet these assumptions in nearly all cases.

Therefore, all data were tested for significance using a Friedman X_r^2 non-parametric two-way analysis of variance. Reservoir water quality data were tested for the significance of depth, time, and station. Core data were tested for the significance of vertical stratification and station, and the river water quality data were tested for time and station. When significance (P .05) was detected, the Friedman multiple range test was used to identify significantly different groups (Miller, 1966).

The Friedman X_r^2 is a ranking test, i.e., the data points are ranked within each block and the test measures differences among mean ranks for various treatments. Therefore, "significance" implies differences in consistency or direction instead of differences in magnitude. Two stations that were not found to have significantly different ranks could conceivably have different mean values.

RESULTS

TEMPERATURE

The reservoir is warm in the summer; maximum temperatures were often recorded at 22°C (72°F). This exceeds the recommended maximum of 19°C for growth of salmonid species of fish. River stations have lower temperatures and vary less with season. However, all river stations exceeded the 19°C maximum at least once during the summer.

OXYGEN

River oxygen is high and relatively uniform, remaining above the 6 mg/l standard. An isolated boundary layer of oxygen depleted water occurs at the sediment/water interface, but this layer is very shallow; i.e., less than 30 cm. The rest of the reservoir remains well oxygenated.

pH

The reservoir and river are typical of Southeast Idaho waters; i.e., they are high in carbonates, high in pH, and well buffered.

BACTERIA

No significant concentrations of fecal coliform bacteria were found among the river and reservoir samples. Neither water body was found to violate the applicable standards.

TROPHIC

The reservoir is eutrophic as evidenced by chlorophyll and secchi disc readings. Nitrogen: Phosphorus ratios indicate nitrogen limitation. Phosphorus is present in levels conducive to algal blooms and in levels in excess of the recommended criteria.

AESTHETIC

The Blackfoot River exceeds the 25 JTU limit during isolated runoff periods. Intense blue-green algal blooms on the reservoir detract from the latter's aesthetic qualities.

SOLIDS

As discussed above, wind action raises sediment from shallow shorelines and puts them into suspension. Thus, sediments are concentrated in the water column over the shallow areas. In general, however, solids do not exceed recommended criteria.

DISSOLVED GAS

No samples were collected for dissolved gas.

RADIOACTIVITY

The few samples collected for radioactivity show both gross Beta and gross Alpha to be well within accepted limits.

ORGANIC TOXICITY

Although the land around the reservoir is intensely farmed, no signs of pesticide problems were found.

INORGANIC TOXICITY

Previous unpublished reports have referred to mercury leaving the Blackfoot River system and being deposited in the reservoir. Water samples and core samples from the reservoir and water samples from the river showed no signs of inorganic toxicity.

Neither depth nor time were shown to have significant effects on reservoir water quality. Depth was not significant primarily because of the effects of wind, and because the reservoir is so shallow (mean depth 4.8 meters). Time was not shown to be significant with regard to river or reservoir water quality, because of the small sample size and relatively short time involved (June to October). There were significant differences among the reservoir stations. These differences were relatively consistent across several parameters. These statistics seem to group the reservoir stations into four groups, centered around Stations 5, 7, 9, and 11 (Figure 1).

Depth was not a significant factor with regard to sediment chemistry. This is probably a result of the depth strata chosen for analysis. The top 15 cm of core were analyzed in 5 cm units. However, most significant chemistry changes take place in the top 1-2 cm (Ruttner, 1963).

Results of the Friedman multiple range tests are presented in Appendix A: Figure A-1 (Reservoir Water Qualtiy), Figure A-2 (River Water Quality), and Figure A-3 (Core Samples). Concentrations of selected ions at the reservoir and river water quality stations, and the mean concentration of selected parameters in reservoir sediments are also presented in the Appendix: Tables A-1 (Reservoir Water Quality), A-2 (River Water Quality), and A-3 (Sediment Chemistry). Analyses of Chlorophyll A are highly correlated with phytoplankton populations, and are an acceptable measure of those populations. Twenty-two (22) chlorophyll A samples were collected from the Blackfoot Reservoir. Results from the analyses of those samples are presented in Table A-4.

Two species of planktonic algae were identified as being primarily responsible for the dense algal blooms. These two, Aphanizomenon flos-aquae and Anabena flos-aquae were potentially toxic to mammals near the reservoir. An intraperitoneal bioassay on white mice showed the reservoir population to be non-toxic in August 1, 1977 (Perry and House, 1977).

Sediment chemistry data did not show significant localizations of heavy metals near the mouths of the tributary streams. In fact, metal concentrations were usually below detectable limits for the more toxic metals; i.e., arsenic, mercury, selenium. A correlation matrix between all sediment chemistry parameters was calculated in order to test future predictability (Figure A-4). The only parameters that were significantly related were nitrogen and organic matter. Table 1 summarizes the significant correlations.

Table 1. Significant Correlations among Blackfoot Reservoir Sediment Chemistry Data.

Parameter : Parameter	Correlation Coefficient (r^2)
Total Organic Carbon : Total Nitrogen	0.78
Total Organic Carbon : Total Kjeldahl Nitrogen	0.79
Total Nitrogen : Total Kjeldahl Nitrogen	0.70
Ammonia : Total Nitrogen*	0.78

*Overall Ammonia: Total Nitrogen correlation was 0.58, but correlation was 0.78 in the upper 5 cm of sediment.

DISCUSSION AND CONCLUSIONS

These results indicate that the Blackfoot Reservoir is a shallow, wind mixed body of water. Total solids in the reservoir are well above the levels in the major incoming stream—the Blackfoot River. These elevated solids levels are the result of wind action which agitates the shallows and suspends the sediments. This wind action, characterized by the short flow through time of 175 days, precludes the detection of significant differences amongst the reservoir stations. It is a relatively homogenous body of water.

The results of this study do allow one to compare the overall reservoir water quality with accepted criteria in order to categorize the Blackfoot Reservoir in comparison to other water bodies.

Temperature exceeds the 19° C limit for an extended period during the summer. However, the wind agitation keeps the oxygen levels well above standards. Therefore, elevated temperatures are not as detrimental to the fauna as they could be. pH is so well buffered by the carbonate waters that it does not exceed the criterion. Similarly, fecal coliform bacteria were not concentrated enough to violate standards. Turbidity measurements were not taken in the lake, but the 25 JTU limit is surely exceeded over the wind-mixed shallows. That does not represent sufficient area for this to be a significant violation of standards. The same comments may be applied to total and dissolved solids levels; i.e., there are isolated concentrations, but the reservoir in general is well within the accepted criteria.

The ortho-phosphate levels in the reservoir exceed the algal growth potential level of 0.01 mg/l P. Nitrate nitrogen is much less than the 0.3 mg/l needed for algal blooms (Hem, 1970). Total dissolved nitrogen to total dissolved phosphorus ratios are low, ranging from less than 2:1 to nearly 9:1. In comparison, the optimum ratio for algal blooms is 11.3:1 (Middlebrooks, et al., 1975). These data indicate that nitrate concentrations are limiting algal growth in the reservoir.

An algal species that was able to utilize atmospheric nitrogen would be at a selective advantage in such a nitrogen limited system. Indeed, the predominant algal species in the reservoir is *Aphanizomenon flos-aquae*, a blue-green algae which is capable of utilizing atmospheric nitrogen. As would be expected in such a system, the nitrogen:phosphorus ratio is lowest near the mouth of the Big Blackfoot River and highest near the dam. This is due to the algal activity which is entraining nitrogen from the air into the water.

Nutrient levels, and the corresponding chlorophyll *a* concentrations indicate that the Blackfoot Reservoir is a beta-mesosaprobic body of water (Environmental Studies Board, 1972; Clark and Wroten, 1976). In contrast, comparison of Blackfoot Reservoir chlorophyll *a* and secchi disc transparency with cosmopolitan lake samples shows the Blackfoot Reservoir to be highly eutrophic. Bul'on, 1977, presents a plot of 76 simultaneous chlorophyll *a* and secchi disc readings. Blackfoot Reservoir mean data fall well below the margin of the 95% confidence limits of that graph. Such a position would indicate advanced eutrophy (Bul'on, 1977).

Dissolved and total solids data from the river and reservoir show no exceedances of accepted criteria. That result is approximately what would be expected from such a water body. Specific ions may exceed criteria and suspended matter may exceed criteria. But most cations (the principal offenders in dissolved solids problems) are not sufficiently concentrated to cause problems.

No samples for dissolved gasses or organic toxicity were collected during this study. Those parameters are not expected to exceed criteria, but those expectations are based solely upon a subjective evaluation of the watershed.

RECOMMENDATIONS FOR FUTURE STUDIES

Since depth was never shown to be a significant influence on water quality, future studies would not require samples at discrete depths. A depth composite sample, representing three or more samples would accurately reflect water quality at stations over three metres deep. In more shallow water, a mid-depth grab would be adequate.

Paired samples from reservoir stations near the mouth of tributaries and the tributary itself show high correlation. This indicates that tributary samples alone are sufficient to monitor water quality of these areas.

An overview of the reservoir data shows that relatively few significant differences exist among station water quality values. So, a few selected stations could be sampled more intensely and a more sensitive picture of reservoir quality would be achieved. In fact, this study shows that intensive sampling of stations 5, 7, 9, and 11, in addition to the nine river stations, would provide an accurate reflection of water quality changes.

Also, the core sample data show that an adequate examination of sediment chemistry can be gained from a relatively few samples. Future core sampling could concentrate on the four reservoir stations mentioned above, and on the river stations. However, chemical analyses should be completed on 0.5 to 1.0 centimeter units of core depth. Nutrient and/or toxin releases would come from the first centimeter or two, not from five centimeter units.

Finally, more emphasis should be placed on the biological aspects of reservoir quality. Bluegreen algae are numerous on the reservoir, and intense blooms of Aphanizomenon flos-aquae are common. This species is known to be toxic to mammals in some populations. The Blackfoot Reservoir populations were not toxic to white mice in August 1977 (Perry and House, 1977). However, the potential does exist for toxins to be released from other populations at other times. Other species of algae live in the reservoir and respond to changes in water quality. A well designed study of water quality and algal populations would provide a sensitive device for monitoring reservoir quality. The chemistry data reported here will serve as a broad base which would allow future studies to concentrate more on reservoir biology at a fewer number of stations.

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APPENDIX A

Figures and Tables of Water Quality Concentrations and Significant Differences Among Stations.

Figure A1. Statistically significant differences ($P < .05$) among Blackfoot Reservoir water quality stations. Stations connected by a line were not significantly different with regard to that parameter at that time. Nearly all samples represent three samples from that station on that date. In all cases, stations are ranked from highest (left) to lowest (right). Nsd indicates that there were no significant differences.

Parameter	Date	Stations
Temperature	6/7-16/77	12 7 8 9 6 11 4 3 5 10 12
	7/8/77	2 9 7 8 6 1 4 5 3 10 12
	7/27/77	9 4 6 8 11 12
	8/9-10/77	2 7 1 3 5 10
	9/28/77	nsd
Dissolved Oxygen	6/7-16/77, 7/8/77, 7/27/77, 8/9-10/77, 9/28/77	nsd
pH	7/8/77	12 8 11 3 5 2 4 9 1 6 7
Chemical Oxygen Demand	6/7-16/77, 7/8/77, 7/27/77, 8/9/77	All nsd
	9/28/77	2 4 9 5 6 3 7 8 1
Nitrate Nitrogen	6/7-16/77, 7/8/77, 7/27/77, 8/9/77	All nsd
	9/28/77	7 6 5 4 3 8 9 1 2
Nitrite Nitrogen	6/7-16/77	nsd
	7/8/77	1 9 3 2 4 5 6 7 8 11 12
	7/27/77, 8/9/77, 9/28/77	All nsd
Ammonia Nitrogen	6/7-16/77, 7/8/77, 7/27/77	All nsd
	8/9/77	1 2 10 7 5 3
	9/28/77	nsd
Total Kjeldahl Nitrogen	6/7-16/77, 7/8/77, 7/27/77, 8/9-10/77, 9/28/77	All nsd

Figure A1. (Cont'd)

Parameter	Date	Stations
Total Phosphorus	6/7-16/77	nsd
	7/8/77	3 1 9 5 4 6 2 7 8 11 12
	7/27/77, 8/9/77, 9/28/77	All nsd
Ortho-phosphate Phosphorus	6/7-16/77, 7/8/77, 7/27/77, 8/9/77, 9/28/77	All nsd
Total Solids	6/7-16/77	nsd
	7/8/77	1 2 3 9 4 5 12 8 7 6 11
	7/27/77	nsd
	8/9/77	1 2 3 5 7 10
	9/28/77	nsd
Suspended Solids	6/7-16/77, 7/8/77, 7/27/77, 8/9/77, 9/28/77	All nsd
Volatile Suspended Solids	6/7-16/77, 7/8/77, 7/27/77, 8/9/77, 9/28/77	All nsd
Turbidity	6/7-16/77, 7/8/77, 7/27/77, 8/9/77	2 3 5 10 7 1
	9/28/77	nsd
Specific Conductivity	6/7-16/77	1 9 6 12 5 2 4 7 3 11 10 8
	7/8/77	1 2 8 9 7 11 6 4 5 12 3
	7/27/77	9 6 8 4 11 12
	8/9/77	1 2 10 5 7 3
	9/28/77	nsd
Total Hardness	6/7-16/77	1 2 7 10 8 9 6 5 4 3 11 12
	7/8/77	1 2 9 7 8 4 11 12 6 5 3
	7/27/77, 8/9/77, 9/28/77	All nsd

Figure A1 (Cont'd)

Parameter	Date	Stations
Magnesium	6/7-16/77	nsd
	7/8/77	1 2 12 11 8 4 9 5 3 7 6
	7/27/77, 8/9/77, 9/28/77	All nsd
Total Alkalinity	6/7-16/77	1 2 5 8 7 3 6 4 9 12 11 10
	7/8/77	1 2 9 7 4 8 6 5 11 3 12
	7/27/77	nsd
	8/9/77	1 2 7 5 10 3
	9/28/77	1 2 8 9 6 4 7 5 3
Iron	6/7-16/77	nsd
	7/8/77	3 2 4 5 6 9 7 11 1 12 8
	7/28/77	nsd
	8/9/77	3 2 5 10 7 1
	9/28/77	nsd
Sodium	6/7-16-77	1 2 11 10 12 8 7 5 9 6 4 3
	7/8/77	1 2 9 12 7 11 6 5 4 8 3
	7/27/77	nsd
	8/9/77	1 2 10 7 5 3
	9/28/77	nsd
Potassium	6/7-16/77, 7/8/77, 7/27/77, 8/9/77, 9/28/77	All nsd
Chloride	6/7-16/77	nsd
	7/8/77	1 2 9 5 6 7 3 4
	7/28/77, 8/9/77, 9/28/77	All nsd
Sulphate	6/7-16/77	1 2 10 6 5 11 8 7 4 12 9 3
	7/8/77	1 2 9 6 7 8 5 4 12 11 3
	7/27/77	nsd
	8/9/77	1 2 5 7 10 3
	9/28/77	nsd

Figure A1 (Cont'd)

Parameter	Date	Stations
Silica	6/16/77	nsd
	7/8/77	1 2 5 4 6 8 7 9 3 11 12
	7/27/77	nsd
	8/9/77	1 7 2 5 10 3
	9/28/77	nsd
Fluoride	7/8/77	1 2 8 11 12 9 6 4 7 5 3
	9/28/77	nsd

Figure A2. Statistically significant differences among Blackfoot Reservoir Sediment-Chemistry Stations. In all cases, chemical concentrations at the stations are ranked from highest (left) to lowest (right). Stations connected by a line showed no significant difference with regard to that parameter. NSD indicate that there were no significant differences. B is the Big Island Station and S is the Sheep Island Station.

PARAMETER	STATION													
Water (as %)	7	6	8	9	5	B	12	4	11	3	1	2	10	S
Ammonia (as N)	4	8	9	6	5	7	B	12	3	11	2	10	S	1
Kjeldahl Nitrogen	4	8	3	5	7	9	1	6	12	11	B	2	10	S
Total Nitrogen	8	5	4	7	9	6	11	B	3	12	1	2	10	S
Total Phosphorus	S	3	1	2	10	12	11	B	5	4	7	8	6	9
C O D	4	8	7	9	5	3	6	B	1	2	11	12	10	S
Organic Carbon	4	8	7	6	5	3	9	1	B	2	11	12	10	S
Arsenic	N S D													
Barium	4	3	7	12	9	10	11	5	8	B	2	6	S	1
Cadmium	9	3	8	11	12	S	5	7	4	B	1	6	10	2
Chromium	2	1	10	6	3	8	9	7	11	4	B	5	12	S
Copper	N S D													
Iron	10	2	1	11	7	3	4	12	6	5	9	B	8	S
Lead	8	9	7	3	11	12	5	1	B	6	4	S	10	2
Manganese	12	9	4	7	11	S	5	8	6	3	B	10	2	1
Mercury	N S D													
Selenium	N S D													
Silver	8	9	S	B	3	12	4	1	11	5	7	10	6	2
Zinc	4	7	3	1	5	6	2	9	12	11	10	B	8	S

Figure A3. Statistically significant differences among Blackfoot River water quality stations, summer 1977. In all cases, chemical concentrations are ranked from highest (left) to lowest (right). Stations connected by a line showed no significant differences with regard to that parameter. NSD indicates that there were no significant differences.

PARAMETER	STATION								
Temperature	NSD								
Oxygen	NSD								
Ph	18	20	13	14	19	21	17	16	15
COD	NSD								
NO_3	NSD								
NO_2	NSD								
NH_3	NSD								
TKN	NSD								
TP	NSD								
PO_4	NSD								
Total Solids	15	13	16	14	19	21	17	20	18
Suspended Solids	13	16	20	14	15	19	21	17	18
Turbidity	13	14	16	17	20	21	19	15	18
Conductivity	15	16	19	14	21	18	13	17	20
Hardness (as $CaCO_3$)	15	13	16	19	21	17	14	18	20
Magnesium	15	13	16	14	17	18	19	21	20
Alkalinity (as $CaCO_3$)	15	13	16	21	19	18	20	17	14
Iron	16	14	20	13	17	19	21	18	15
Sodium	15	14	13	20	16	17	19	18	21
Potassium	15	13	14	16	17	20	21	19	18
Chloride	15	14	13	20	17	18	19	16	21
Sulphate	15	14	13	16	19	17	18	20	21
Silica	15	13	14	21	19	16	20	18	17
Flouride	15	13	14	16	17	18	21	20	19
Fecal Strep	NSD								
Fecal Coliform	NSD								
Total Coliform	NSD								

Figure A4. Correlation Matrix of Descorri Sediment Chemistry Data. Entries are Correlation Coefficients (r^2).

	Total Organic Carbon	Total Phosphorus	Total Nitrogen	Ammonia	Water Content	Kjeldahl Nitrogen	Barium	Cadmium	Chromium	Copper	Silver	Manganese	Lead	Zinc	Iron
Total Organic Carbon		.24	.78	.11	.25	.79	.07	.03	.01	.06	.02	$1x10^{-3}$	.04	.19	.03
Total Phosphorus			.14	.09	.35	.11	$1.6x10^{-3}$	.01	.01	.05	$4x10^{-6}$	$3x10^{-3}$	.01	.02	.002
Total Nitrogen				.58	.07	.70	.06	.06	.06	.02	.03	.03	.12	.13	.04
Ammonia					.35	.47	.19	$7x10^{-4}$	.05	$2x10^{-4}$	.11	.09	.24	.06	.05
Water Content						.33	.04	.09	.08	.01	.01	.01	$8.1x10^{-5}$	.13	.06
Kjeldahl Nitrogen							.12	.09	.002	.01	.04	.03	.10	.27	.002
Barium								.34	.01	.04	.12	.40	.14	.07	.04
Cadmium									.08	$2x10^{-4}$	.50	.47	.13	.001	.06
Chromium										$4x10^{-4}$	.10	.18	.07	.11	.43
Copper											.09	.01	.01	.03	.08
Silver												.15	.35	.14	.03
Manganese													.19	.01	.02
Lead														.02	.02
Zinc															.19
Iron															

Table A1. Mean Water Quality Concentrations in the Blackfoot Reservoir, Summer of 1977.

PARAMETER (mg/l unless otherwise noted.)	STATION 1			2			3			4		
	$\bar{X}$ *	N *	S *	$\bar{X}$	N	S	$\bar{X}$	N	S	$\bar{X}$	N	S
Temperature (°C)	18.2	11	2.7	19.0	11	3.0	17.7	9	2.6	18.2	11	3.3
Dissolved Oxygen	8.1	11	1.9	7.7	11	2.5	6.6	9	1.0	5.9	9	1.4
C O D	15.7	11	11.6	17.5	11	5.4	18.3	9	10.6	17.0	10	9.2
Nitrate (as N)	.03	11	.02	.05	11	.07	.02	9	.02	.04	11	.03
Nitrite (as N)	.04	11	.07	.03	9	.07	.01	9	.01	.003	11	.002
Ammonia (as N)	.15	11	.12	.17	11	.11	.11	9	.10	.07	11	.05
TKN (as N)	1.2	11	.73	.97	11	.47	.99	9	.47	.91	11	.29
Total Phos. (as P)	.08	11	.05	.08	11	.04	.17	9	.23	.08	11	.06
Ortho Phos. (as P)	.05	11	.04	.05	11	.03	.09	9	.10	.04	11	.05
Total Solids	431	7	54.2	380	8	28.8	347	9	88.6	325	11	34.6
Suspended Solids	19.4	7	29.6	20.2	8	9.7	47	9	76.2	14.8	11	26.7
Volatile Suspended Solids	5.5	4	2.4	7.6	5	2.6	5.3	6	5.0	2.8	8	1.9
Turbidity (JTU)	5.8	5	9.1	7.7	5	4.2	7.4	6	5.6	3.4	8	2.6
Conductivity	387	11	187	341	11	145	321	9	93	361	11	66
Hardness (as $CaCO_3$)	342	11	52	289	11	18	250	9	11	255	11	7
Magnesium	26.5	11	4.3	23.3	11	5.4	20.7	9	2.4	20.0	11	2.0
Alkalinity ($CaCO_3$)	306	11	38	263	11	13	229	9	12	238	11	4.7
Iron	.19	11	.21	.49	11	.52	1.08	9	1.49	.37	11	.40
Sodium	13.5	11	1.9	12.5	11	1.7	8.0	9	1.1	9.4	11	0.9
Potassium	2.2	10	0.3	2.2	11	0.2	4.1	9	6.7	2.1	11	0.2
Chloride	17.2	11	3.3	16.5	11	4.1	12.3	9	2.1	12.4	11	1.2
Sulphate (as SO_4)	35.3	11	7.2	30.7	11	5.3	19.3	9	1.9	21.7	11	1.1
Silica (as SiO_2)	15.7	8	1.6	15.6	8	1.2	14.1	9	2.5	15.7	11	2.0
Fluoride	.46	4	.01	.39	4	.03	.31	4	.04	.33	3	.01
pH (Standard units) (N(Range))	6(6.6-8.2)			6 (7.4-7.6)			4 (7.5-7.9)			8 (7.4-8.5)		

* $\bar{X}$ = Arithmetic Mean

N = Sample Size S = Standard Deviation

Table A1. (Continued)

PARAMETER	STATION 5			6			7			8		
	$\bar{X}$	N	S	$\bar{X}$	N	S	$\bar{X}$	N	S	$\bar{X}$	N	S
Temperature	17.4	11	3.0	18.4	12	2.8	18.4	14	3.1	18.3	11	2.9
Dissolved Oxygen	7.5	11	1.8	5.9	9	1.3	7.9	14	2.0	6.5	9	1.0
C O D	15.6	11	6.1	22.2	12	10.9	21.4	14	11.1	17.1	8	9.5
Nitrate (as N)	.04	11	.03	.05	12	.03	.07	14	.07	.04	11	.02
Nitrite (as N)	.02	11	.05	.003	12	.002	.004	13	.002	.01	11	.03
Ammonia (as N)	.09	11	.06	.07	12	.03	.16	14	.11	.07	11	.04
TKN (as N)	1.10	11	.35	.91	12	.25	.98	14	.42	.95	11	.51
Total Phos. (as P)	.08	11	.04	.08	12	.04	.08	14	.06	.06	11	.04
Ortho Phos. (as P)	.04	11	.02	.03	12	.02	.04	13	.02	.02	10	.02
Total Solids	322	11	24	318	12	19	327	13	26	317	11	18
Suspended Solids	11.6	11	12.2	7.9	12	7.6	13.8	13	12.4	3.4	11	2.7
Volatile Suspended Solids	5	8	3.5	3.6	9	2.5	5.5	10	3.8	1.9	11	0.8
Turbidity	5.6	8	3.8	3.7	9	4.1	6.3	10	5.9	2.4	11	1.2
Conductivity	349	11	102	394	12	91	303	14	133	367	11	82
Hardness (as $CaCO_3$)	255	11	7	259	12	11	263	13	11	263	11	14
Magnesium	19.9	11	1.4	20.5	12	2.3	21.6	13	3.3	21.9	11	3.0
Alkalinity ($CaCO_3$)	237	11	4	240	12	7	240	13	5	239	11	8.2
Iron	.45	11	0.38	.27	12	.19	.34	14	.25	.14	11	.08
Sodium	9.4	11	0.6	9.6	12	0.9	9.9	13	.9	9.6	11	0.8
Potassium	2.1	11	0.2	2.2	12	0.3	2.2	13	.2	2.2	11	0.1
Chloride	12.4	11	1.3	12.4	12	1.0	12.8	13	1.4	12.8	8	1.8
Sulphate (as SO_4)	22.3	11	1.2	22	12	4.1	23	13	1.4	24	11	4.7
Silica (as SiO_2)	16.0	11	1.9	16.3	12	2.5	15.8	13	2.3	16.6	11	2.7
Flouride	.34	5	.02	.33	3	0	.35	5	.03	.35	3	.02
PH (N(Range))	5 (7.5-7.8)			9 (7.3-8.0)			7 (7.3-7.7)			8 (7.8-8.55)		

Table A1. (Continued)

PARAMETER	STATION 9			10			11			12		
	$\bar{X}$	N	S	$\bar{X}$	N	S	$\bar{X}$	N	S	$\bar{X}$	N	S
Temperature	18.8	11	3.0	17.5	6	0.8	19.1	9	1.3	18.8	9	0.9
Dissolved Oxygen	6.2	9	2.5	6.9	6	1.9	5.8	9	1.7	5.9	9	2.0
C O D	18.8	11	7.0	13.8	6	3.6	17.3	6	6.0	18.4	6	7.8
Nitrate (as N)	.03	11	.02	.02	6	.01	.03	9	.01	.04	9	.02
Nitrite (as N)	.05	11	.10	.04	6	.07	.002	9	.001	.003	9	.004
Ammonia (as N)	.10	11	.06	.20	6	.12	.13	9	.10	.13	9	.13
TKN (as N)	1.4	11	1.0	1.0	6	0.5	0.9	9	.15	1.1	9	.04
Total Phos. (as P)	.08	11	.06	.09	6	.06	.06	9	.04	.04	9	1.1
Ortho Phos. (as P)	.03	11	.03	.05	6	.04	.02	9	.01	.02	9	.01
Total Solids	331	11	39	309	6	23	308	9	11	303	9	10
Suspended Solids	8.8	11	7.7	11.0	6	5.3	4.7	9	6.6	3.7	9	3.0
Volatile Suspended Solids	3.4	8	2.2	4.8	6	2.6	2.2	9	1.2	1.8	9	0.4
Turbidity	3.7	8	3.6	6.2	6	3.8	4.2	9	4.0	2.2	9	1.2
Conductivity	402	11	86	290	6	50	326	9	22	333	9	53
Hardness (as $CaCO_3$)	258	11	11	245	6	6	257	9	15	251	9	7.8
Magnesium	20.5	11	2.1	19.0	6	2.6	21.2	9	1.4	21.3	9	2.2
Alkalinity ($CaCO_3$)	241	11	8.2	228	6	1.4	233	9	3.2	230	9	1.9
Iron	.26	11	.31	.43	6	.21	.29	9	.23	.15	9	.07
Sodium	9.8	11	1.0	9.6	6	0.3	9.6	9	0.2	9.9	9	0.8
Potassium	2.2	11	0.3	2.1	6	0.3	2.2	9	0.3	2.2	9	0.4
Chloride	13.4	11	1.0	12.4	6	0.4	12.9	6	0.9	13.5	6	1.1
Sulphate (as SO_4)	22	11	2.4	22.5	6	2.2	20.9	9	2.9	21.2	9	2.2
Silica (as SiO_2)	15.9	11	2.2	15.4	6	0.7	13.9	9	2.1	12.2	9	1.6
Flouride	.34	3	.01	-	-	-	.35	3	.01	.35	3	.01
PH (N(Range))	8 (7.5-8.11)			No Samples			6 (7.9-8.5)			6 (7.8-8.7)		

Table A2. Mean Concentration of Selected Parameter in the Upper 15 cm of Blackfoot Reservoir Sediments. All values represent the mean of 3 samples: 0-5 cm; 5-10 cm., and 10-15 cm., as µg/kg.

PARAMETER	STATION 1		2		3		4	
	$\bar{X}$*	S*	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S
Water (as %)	37.8	7.1	34.3	0.7	52.9	10.3	62.4	2.7
Ammonia as (N)	717	211	1324	357	1620	1271	3094	567
Kjeldahl Nitrogen	2272	328	1916	390	2829	519	3793	912
Total Nitrogen	1955	305	1645	198	2393	986	4765	2361
Total Phosphorus	749	150	818	98	881	96	676	145
C O D	25055	6536	21519	794	32905	4182	56217	25043
Organic Carbon	13720	3595	11775	436	18037	2300	33995	13861
Arsenic	always undetectable (<10)							
Barium	35.2	9.9	58.8	17.2	78.5	26.8	81.0	20.5
Cadmium	0.6	0.09	0.5	0.05	1.1	0.03	0.08	0.1
Chromium	4.8	1.3	4.8	1.0	2.7	1.0	1.9	0.5
Copper	7.1	0.7	6.9	0.6	8.1	2.2	6.5	1.7
Iron	2952	724	2925	632	2144	633	2101	219
Lead	6.3	4.6	7.7	1.4	11.6	2.9	8.6	1.9
Manganese	52	12	157	41	236	52	307	15
Mercury	always undetectable (<0.5)							
Selenium	always undetectable (<10)							
Silver	0.5	0.1	0.3	0.1	0.8	0.3	0.7	0.2
Zinc	31.9	19.8	23.9	9.5	27.9	7.1	32.7	11.1

*X = Mean
S = Standard Deviation

Table A2. (Continued)

PARAMETER	STATION 5		6		7		8	
	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S
Water (as %)	67.4	0.4	69.5	1.4	74.0	3.9	69.5	6.4
Ammonia (as N)	1924	398	2126	325	2047	755	3022	1212
Kjeldahl Nitrogen	2754	366	2236	257	2744	986	3507	371
Total Nitrogen	3999	1036	3445	410	3910	1476	4669	926
Total Phosphorus	672	105	460	52	504	128	436	197
C O D	33069	4360	25130	4028	44775	9407	52465	11943
Organic Carbon	18128	2400	17504	1846	20800	6171	28795	6569
Arsenic	always undetectable (<10)							
Barium	60.2	10.3	51.5	10.9	68.0	8.1	61.1	12.6
Cadmium	0.8	0.1	0.5	0.1	0.8	0.07	1.0	0.2
Chromium	1.8	0.6	2.3	0.7	2.1	0.7	2.3	0.4
Copper	6.8	0.8	8.8	3.5	6.0	0.7	4.4	64.7
Iron	1770	148	2130	330	2384	365	1206	496
Lead	9.5	1.2	8.2	1.8	11.6	1.9	13.0	2.0
Manganese	257	46	181	88	300	35	247	105
Mercury	always undetectable (<0.5)							
Selenium	always undetectable (<10)							
Silver	0.6	0.2	0.5	0.07	0.5	0.008	1.2	0.2
Zinc	24.9	3.1	23.5	3.5	25.6	3.3	15.9	5.1

Table A2.(Continued)

PARAMETER	STATION 9		10		11		12	
	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S
Water (as %)	68.2	2.7	31.1	2.4	54.3	3.7	64.0	1.9
Ammonia (as N)	2574	530	1097	66	1468	408	1606	220
Kjeldahl Nitrogen	2717	439	1071	120	1874	301	2105	343
Total Nitrogen	3591	347	1445	360	2588	529	2324	36
Total Phosphorus	416	44	793	48	696	119	710	180
C O D	35000	2817	14595	1268	22120	5920	19425	2813
Organic Carbon	17667	1535	7729	844	12016	3256	9888	1794
Arsenic	always undetectable (<10)							
Barium	66.5	5.9	59.6	2.3	63.6	17.6	76.4	18.3
Cadmium	1.3	0.1	0.5	0.09	1.0	0.3	1.0	0.2
Chromium	2.2	0.9	3.5	0.2	2.1	0.8	1.7	0.5
Copper	7.6	1.7	7.8	0.4	6.8	0.6	6.8	1.2
Iron	1536	306	3213	308	2705	453	2077	372
Lead	12.0	1.9	8.7	0.9	11.2	2.6	11.0	1.5
Manganese	346	47	183	61	306	57	502	85
Mercury	always undetectable (<0.5)							
Selenium	always undetectable (<10)							
Silver	1.2	0.04	0.5	0.07	0.6	0.2	0.7	0.2
Zinc	21.0	3.8	18.2	0.9	17.7	4.3	18.1	1.6

Table A2. (Continued)

PARAMETER	STATION					
	Big Island		Sheep Island			
	$\bar{X}$	S	$\bar{X}$	S		
Water (as %)	66.2	6.8	24.8	0.4		
Ammonia (as N)	2005	346	954	232		
Kjeldahl Nitrogen	1938	327	843	175		
Total Nitrogen	2653	915	991	289		
Total Phosphorus	5.38	167	1645	1031		
C O D	22428	1500	10607	1608		
Organic Carbon	12275	827	5773	884		
Arsenic	always undetectable (<10)					
Barium	53.6	8.7	52.6	3.0		
Cadmium	0.6	0.09	0.9	0.08		
Chromium	1.8	0.07	1.2	0.4		
Copper	5.1	0.7	3.7	1.1		
Iron	1431	203	1095	345		
Lead	9.1	0.7	8.8	0.6		
Manganese	202	34	288	65		
Mercury	always undetectable (<0.5)					
Selenium	always undetectable (<10)					
Silver	0.8	0.2	1.0	0.09		
Zinc	16.4	2.5	8.9	2.0		

Table A3. Mean Water Quality Concentrations at the Blackfoot River Stations, Summer 1977.

PARAMETER (mg/l unless otherwise noted)	STATION 13			14			15			16		
	$\bar{X}$ *	N *	S *	$\bar{X}$	N	S	$\bar{X}$	N	S	$\bar{X}$	N	S
Temperature (°C)	15.8	5	6.2	17.9	5	8.2	17.1	5	3.0	17.0	5	6.9
Dissolved Oxygen	8.4	5	1.6	10.3	5	1.4	9.6	5	1.7	9.4	5	2.7
C O D	14.9	6	7.6	16.2	6	12.9	8.2	6	8.9	10.8	6	6.1
Nitrate (as N)	.08	6	.09	.07	6	.11	.05	6	.04	.04	6	.06
Nitrite (as N)	.01	4	.02	.01	6	.01	.02	6	.04	.01	6	.01
Ammonia (as N)	.15	5	.08	.05	6	.03	.05	6	.02	.08	6	.07
TKN (as N)	1.16	5	.63	.77	6	.14	.58	6	.34	.77	6	.39
Total Phos. (as P)	.11	5	.09	.07	6	.05	.03	5	.02	.06	6	.02
Ortho Phos (as P)	.04	4	.02	.04	6	.03	.05	6	.06	.03	6	.02
Total Solids	323	4	22	246	6	32	496	6	87	271	6	28
Suspended solids	16.2	4	17.2	7.4	5	6.2	7.4	6	4.5	10.7	6	7.7
Volatile Suspended Solids	9.0	2	7.1	2.4	3	0.8	4.3	4	2.6	5.4	4	2.7
Turbidity (JTU)	6.8	3	7.1	2.9	5	1.2	1.0	5	0.6	2.3	5	1.4
Conductivity	348	3	106	370	5	53	724	5	151	420	5	49
Hardness (as $CaCO_3$)	247.	4	13	178	6	31	394	6	97	237	6	18
Magnesium	22.7	4	5.1	17.9	6	4.5	29.3	6	9.8	19.5	6	1.2
Alkalinity ($CaCO_3$)	228	4	7.7	138	6	22	359	6	70	223	6	19
Iron	.27	6	.27	.23	6	.11	.07	6	.05	.23	6	.07
Sodium	11.9	5	2.9	15.5	6	3.0	22.8	6	1.1	4.6	6	0.3
Potassium	2.7	5	1.0	1.9	6	0.6	2.5	6	0.1	1.2	6	0.3
Chloride	11.7	4	3.5	19.2	6	4.7	27.6	6	4.2	5.9	6	1.5
Sulphate (as SO_4)	21.5	6	0.6	40.3	6	7.9	61.7	6	19.3	13.3	6	1.2
Silica (as SiO_2)	14.2	4	3.6	11.1	6	3.7	15.1	6	2.2	9.1	6	2.8
Fluoride	.36	4	.06	.27	6	.03	.46	6	.10	.25	6	.02
pH (Standard units) (N(Range))	5 (7.8-9.8)			5 (7.6-10.4)			5 (7.4-8.7)			5 (7.8-9.7)		
Discharge(cfs)	884	1		13.2	2	0.2	11.9	2	1.9			

* $\bar{X}$ = Arithmetic Mean

N = Sample Size

S = Standard Deviation

Table A3. (Continued)

PARAMETER	STATION 17			18			19			20		
	$\bar{X}$	N	S	$\bar{X}$	N	S	$\bar{X}$	N	S	$\bar{X}$	N	S
Temperature (°C)	15.7	5	5.6	15.3	5	6.0	14.7	5	7.4	17.9	5	7.4
Dissolved Oxygen	8.8	5	1.6	10.2	5	2.1	9.8	5	2.2	9.0	5	1.3
C O D	13.6	6	7.1	10.7	6	9.0	10.9	6	11.1	9.7	6	7.9
Nitrate (as N)	.04	5	.04	.03	5	.02	.06	5	.05	.02	5	.01
Nitrite (as N)	.003	5	.002	.01	5	.01	.002	5	.001	.003	4	.002
Ammonia (as N)	.08	5	.05	.05	5	.02	.06	5	.04	.05	4	.01
TKN (as N)	.93	6	.32	.70	6	.25	.61	6	.28	.74	5	.36
Total Phos. (as P)	.08	6	.06	.07	6	.06	.10	6	.08	.07	5	.05
Ortho Phos (as P)	.04	5	.02	.03	5	.02	.04	5	.02	.05	4	.01
Total Solids	205	6	28	202	6	22	222	6	7	206	5	16
Suspended Solids	6.0	6	6.6	5.2	6	5.3	5.5	6	3.5	8.2	5	8.4
Volatile Suspended Solids	5.0	3	4.0	2.7	3	2.1	3.3	3	2.3	7.3	2	1.0
Turbidity (JTU)	1.2	6	0.5	0.9	6	0.4	0.9	6	0.5	1.2	5	1.0
Conductivity	329	4	37	334	4	32	364	4	5	329	3	26
Hardness (as $CaCO_3$)	193	6	43	178	6	22	196	6	6	172	5	16
Magnesium	18.4	6	8.2	13.5	6	2.4	13.2	6	1.3	11.1	5	2.0
Alkalinity ($CaCO_3$)	161	5	24	167	5	17	183	5	5	167	4	16
Iron	.15	6	.07	.07	6	.06	.12	6	.04	.20	5	.11
Sodium	4.6	6	0.5	4.1	6	0.4	4.2	6	0.1	5.5	5	1.0
Potassium	1.3	6	0.8	0.7	6	0.2	0.7	6	0.2	0.9	5	0.3
Chloride	7.2	6	2.3	6.2	5	1.0	6.2	6	1.3	6.6	5	2.1
Sulphate (as SO_4)	11.5	6	1.4	11.3	6	1.4	11.7	6	1.0	10.8	6	0.8
Silica (as SiO_2)	7.5	6	2.7	7.4	6	2.3	9.1	6	0.9	8.6	5	0.9
Fluoride	.14	5	.03	.13	5	.04	.10	4	.04	.11	4	.04
pH (Standard units) (N(Range))	4 (7.8-9.7)			4 (8.0-9.9)			4 (7.8-9.6)			4 (8.0-9.8)		
Discharge (cfs)	49.0	1		84.0	1		19.7	1		4.0	1	

Table A3. (Continued)

PARAMETER	STATION 21					
	$\bar{X}$	N	S			
Temperature (°C)	13.6	5	4.5			
Dissolved Oxygen	9.6	5	2.0			
C O D	12.9	6	10.8			
Nitrate (as N)	.04	5	.03			
Nitrite (as N)	.002	5	.001			
Ammonia (as N)	.07	5	.03			
TKN (as N)	.62	6	.24			
Total Phos (as P)	.05	6	.01			
Ortho Phos (as P)	.03	5	.02			
Total Solids	218	6	13			
Suspended Solids	5.9	6	8.6			
Volatile Suspended Solids	4.6	3	2.9			
Turbidity (JTU)	1.1	6	0.4			
Conductivity	356	4	13			
Hardness (as $CaCO_3$)	194	6	11			
Magnesium	13.5	6	2.1			
Alkalinity ($CaCO_3$)	182	5	9			
Iron	.13	6	.08			
Sodium	4.0	6	0.9			
Potassium	0.7	6	0.2			
Chloride	5.8	6	1.2			
Sulphate (as SO_4)	10	6	0			
Silica (as SiO_2)	9.6	6	0.3			
Fluoride	.11	4	.04			
pH (Standard units) (N(Range))	4 (7.8-9.5)					
Discharge	7.1	1				

Table A4. Chlorophyll *a* Concentrations in mg/m^3, from the Blackfoot Reservoir.

DATE	STATION											
	1	2	3	4	5	6	7	8	9	10	11	12
7/14/78	50.0	8.4	11.0	6.4	7.4	9.7	7.1		8.1			
8/9/78	32.4	9.1	19.0		24.8		18.9			6.6		
8/23/78	6.6	11.7					41.4					
10/4/78	9.5	65.0	5.6		11.9		10.3					

Entire Reservoir over entire sample period:

Mean 17.31 mg/m^3, Variance 16.04