DEPARTMENT OF ENVIRONMENT

WATER RESOURCES SERVICE

James A. Nielsen, Minister
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KOOTENAY
AIR AND WATER QUALITY STUDY
PHASE I

ASSESSMENT OF INFORMATION AVAILABLE TO SEPTEMBER 1975

WATER QUALITY IN REGION 1, THE FLATHEAD RIVER BASIN

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SUMMARY

This report is an evaluation of the information available to September 1975 on the water quality of the Flathead River basin. It is one of a series of 12 similar reports which assess air and water quality in the Kootenay region. These reports constitute Phase I of the Kootenay air and water quality study.

The Flathead River basin is relatively undisturbed by man. The major influence is mining exploration, with extensive work being carried out to locate coal deposits. A proposal is currently under consideration to operate a large open pit coal mine at Cabin Creek on the west side of the Flathead River. Some logging activity is also taking place in the region.

There has been very little water sampling in the region and sampling of aquatic biology has just begun. From the data obtained, the water appears to be of good quality. However, in view of the proposed mining development, more detailed information is to be obtained by government agencies and by the mining company. These data will be discussed in our Phase II report.

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1.1 Introduction

The Flathead River basin, (Figure 1-1) has an area of approximately 623 square miles and is located entirely within the Rocky Mountains in the extreme southeast corner of the province. The basin is bounded on the east by the Clark Range, on the west by the Macdonald Range, on the north by the Flathead and Taylor Ranges, and on the south by the British Columbia-Montana boundary. The Flathead River valley runs in a southerly direction at an elevation of 4000 to 5000 feet, varying in width from one to five miles[1].

1.2 Settlement

The basin is virtually uninhabited. Settlements include Flathead, which had a population of four in 1971[2], semipermanent big game guide camps, a B.C. Forest Service summer cabin, and a mining exploration camp. At present the main economic use of the area centres around timber extraction, big game hunting and recreation[3,4].

Summer access into the Flathead valley is provided by forest development roads through Flathead Pass in the north and Harvey Pass in the west[4].

1.3 Climate

Long-term climatic data are not available for the area. It has been estimated however, that in the Flathead valley (elevation 4588 feet), the frost-free period is less than one month. The mean maximum and minimum temperatures for July are 22°C and 3°C. On this basis, the Flathead valley and tributary valleys below 5000 feet are suitable for the production of only the most hardy varieties of forage crops[4]. Another source indicates that the mean temperature in January is -15°C and that the area receives about 500 cm of snow per year[5]. The mean annual precipitation

may exceed 1000 mm per year in the lower Flathead valley and increases with elevation to about 1500 mm per year in the mountainous uplands[4].

1.4 Geology

The western portion of the region is occupied by the Macdonald Range which is a series of north-westerly trending, parallel ridges composed predominantly of limestone with elevations of 6000 to 7500 feet. The Clark Range, in the eastern part of the region, consists of thick layers of argillite, siltstone, sandstone and limestone. The mountains in the Clark Range descend abruptly from elevations of about 8500 feet to the broad, flat valley of the Flathead River at about 4500 feet[6].

The Lower Flathead River valley was formed by erosion of the poorly consolidated conglomerates (gravel and clay origin) which underlie the basin between these two mountain ranges. The entire region was glaciated to an elevation of about 6500 feet during the last glacial era[6], and is underlain by the coal-bearing Kootenay formation which also underlies the Elk Basin to the north[3].

1.5 Soils and Vegetation

Glaciation has resulted in both bedrock sculpturing and deposition of glacial till over much of the region. Post-glacial erosion has generally removed the till on the steep slopes. The till on the milder slopes has been modified by the additions of material eroded from the mountain sides and is referred to as steepland till. Deposits in the valleys consist mainly of glaciofluvial and recent alluvial deposits, including terraced deposits along the Flathead River.

Soils developed on steepland till and on material eroded from the mountain sides of the Macdonald, Clark, and Flathead Ranges support a climax vegetation of Engelmann spruce and subalpine fir. Soils supporting Douglas fir have developed on the slightly drier, southwest slopes of the Macdonald Range. The soils on the floodplains and terraces of

the river valleys support mostly lodgepole pine, although the soils of the Flathead River floodplain have a high capability for production of Englemann spruce[4,7].

1.6 Hydrology

The Flathead, the major river in the region, rises in the Taylor Range at the north end of the region, and flows south and southeast for about 35 miles to the B.C.-Montana border. The Flathead drains 427 square miles of the region between its headwaters and the border. The flow in the Flathead at the border has been measured continously since 1952 (station number 8NP-1)[8]. The southeast corner of the region is drained by Sage and Kishinena Creeks which join the Flathead River south of the border.

Spring flood peaks due to snowmelt and rainfall occur in the Flathead during May and June, followed by a steady decline in discharge during the summer, and a minor peak due to fall rains during October and November. The minimum flows occur during December, January and February. The mean annual flow at the U.S. border is 964 CFS, while the maximum and minimum daily flows recorded since 1952 are 13,500CFS and 74 CFS[9].

There are no lakes, dams, diversions, or wells of major significance within the region.

1.7 Water Uses

Only one water licence has been issued in the region. It permits the use of 500 gallons per day (GPD) from Cabin Creek (Kootenay Land District lots 8727 and 9385) for domestic and industrial purposes[10]. The water licence is associated with coal exploration operations of Rio Tinto Canadian Exploration Ltd. for Sage Creek Coal Ltd.

1.8 Land Use

1.8.1 Agriculture

Very little agricultural development has taken place in the region. It is limited primarily to grazing by domestic animals.

1.8.2 Forestry

There is no manufacturing of forest products in the Flathead River basin. Logging activities have been confined primarily to spruce/fir stands in the Macdonald Range along Harvey, Howell and Cabin Creeks, and in the Clark Range along Sage and Commerce Creeks. Logging operations are proposed for the Kishinena, Elder and Starvation Creek drainages. The soils of the Flathead valley have a relatively high capability for the production of timber. However, much of the timber is young and stands are not well established because of past fires and management practices[7,21]. Current and proposed logging areas are shown on Figure 1.1.

1.8.3 Mining and Petroleum

There are at present no active mining or petroleum operations in the Flathead region. Exploration for coal, minerals, and petroleum has been carried out, and there is a proposal for a large open-pit coal operation by Sage Creek Coal Ltd.[11,12].

Rio Tinto Canadian Exploration Ltd., under an exploration permit from the B.C. Mines and Reclamation Branch, is conducting extensive coal exploration for Sage Creek Coal Ltd. Less extensive exploration for copper has been carried out along Sage, Commerce and Kishinena Creeks, and in the area east of the Flathead River but south of North Kootenay Pass (Lat. 49° 21"; Long. 114° 34"). Minor exploration for copper, lead, zinc and fluoride was conducted near and between the headwaters of Howell and Twentynine Mile Creeks[3]. Oil and gas were found in the Akamina, Sage and Kishinena Creek domes[13], however, exploratory work indicated that commercial development was not warranted. Shell Canada Ltd., Total Petroleum Co., Pan Canadian Petroleum Ltd., and CIGOL-Trans Prairie-Winnek Ltd. have rights to the petroleum reserves[14].

1.8.4 Recreation

The Canada Land Inventory[15] has classified the land in the Flathead region as having mainly moderate to low capability for outdoor recreation (classes 4, 5 and 6), with a few small areas with moderately high capability (class 3). A 1970 proposal[16] to create an 82 square mile ecological reserve in the Akamina - Kishinena watershed was rejected. A proposal for a reserve encompassing only 16 square miles of the original area has recently been made[17].

There is an exceptional potential for sport fish angling along the Flathead River and Sage and Kishinena Creeks. Big game and upland game hunting is reported to be excellent throughout the area. Other types of recreation suited to the area include camping and hiking[15].

1.8.5 Wildlife

Many of the valleys between 4,000 and 6,000 feet elevation support rangelands used by ungulates. One area, having a southerly aspect and found in the middle reaches of Sage Creek is an important winter range area for ungulates[18].

The Flathead Basin is of little importance for the production of waterfowl, due to topography and climate[19].

2. MAJOR INFLUENCES OF MAN

Coal exploration by Rio Tinto Canadian Exploration Ltd. for Sage Creek Coal Ltd. (controlled by Rio Algom Mines Ltd.) is the major industrial activity in the Flathead region. There is also a minimal amount of agriculture and some logging. Flathead is the only settlement in the region.

2.1 Industrial

Sufficient coal deposits were isolated by Rio Tinto Canadian Exploration Ltd. to warrant a proposed coal operation (Sage Creek Coal Ltd.). To evaluate the environmental impact of the project, the B.C. Lands Branch recommended that studies in three stages be carried out[11]. The three stages are:

Stage I	Project Justification
Stage II	Evaluation of Alternatives (General Environmental Ramifications)
Stage III	Determination of Project Development Criteria (Specific Environmental Ramifications)

A fourth stage, the implementation of continuing monitoring programs, will also be carried out, if the project proceeds. Stage I and a proposal for Stage II have been completed by consultants[11] retained by Rio Algom Mines Ltd. In Stage II information will be obtained on the water quality, benthic invertebrates and fish populations in the creeks and rivers in the vicinity of the proposed Sage Creek Ltd. mine. Much of the data collection will overlap into Stage III.

A preliminary engineering feasibility report on the Sage Creek Project has also been completed[12]. The following outline of the mining proposal is derived from the consultants' and engineering reports.

The Sage Creek Coal Ltd. coal deposits are not near Sage Creek but lie in the Kootenay formation immediately north and south of Cabin Creek on the west side of the Flathead River. There are three economically

significant coal seams which could yield a total of 110 million long tons of clean and washed coal in twenty to thirty years of mining. The coal is described as medium volatile bituminous coal with favorable coking characteristics.

The proposed locations of the two open pits and the coal preparation plant are shown in Figure 1-1. The pits border on Cabin Creek and would be separated from the creek by a minimum of 400 feet. The exact location of the preparation plant depends on the siting of refuse piles. About 1,300 million cu. yds. of waste rock and 40 million cu. yds. of preparation plant rejects would have to be disposed of over the life of the mine. Possible locations for the refuse disposal sites include areas immediately west of the pits, northwest of the north hill between Howell Creek and the Flathead River, and southeast of the south hill. Refuse may also be returned to the north pit, which is to be mined first.

Coal from the open pits (28 to 30 percent ash) would be trucked to the preparation plant. Coal cleaning techniques, similar to those used by Kaiser Resources Ltd. and Fording Coal Ltd. in the Elk River Basin, would be employed to separate the coal from the waste rock and reduce the ash content to 9.5 percent. Water from the preparation plant tailing will be recycled. However, as an alternative to the tailing ponds in current use in the East Kootenays, the feasibility of using filter presses and solid bowl centrifuges to obtain a relatively dry tailing is being investigated.

Power at the plant would be thermally generated (40 megawatts) by burning middling coal (20 to 25 percent ash). The ash would be quenched, crushed and pumped to the tailing thickener. A cooling tower designed to minimize water usage and to virtually eliminate the discharge of cooling water would be used.

Water for the preparation plant would be obtained from groundwater and possibly from Cabin Creek. Storm ditches would be dug to collect and divert runoff from the vicinity of the plant to existing watercourses.

The feasibility of establishing a town near the plant site is being investigated. The alternative is for personnel to commute from an existing town such as Elko, Sparwood or Fernie. A new town could be located three miles southeast of the proposed plant site and its water supply could possibly be drawn from wells near Sage Creek.

Approximately three million long tons of coal would be shipped to Roberts Bank each year. A study on the ability of Roberts Bank to handle the extra coal is being conducted. Three alternative railway routes have been proposed from the mine site to meet the existing CPR line. These are routes via McGillivray, Morrissey, or Elko. The road from the mine site to Fernie is being upgraded.

2.2 Municipal

The unorganized community of Flathead (population of four in 1971) is the only population centre in the region, apart from mining exploration camps and other non-permanent settlements. We assumed that the effects of domestic discharges from these present sources is negligible. If a new town is developed, the water quality studies should include examination of the possible effects of sewage disposal on the river quality.

2.3 Forest Industry

Logging activities in the Flathead Basin have been confined to harvesting operations along Nettle Creek and at the headwaters of Harvey, Howell Cabin and Commerce Creeks. The logs are utilized by a sawmill at Elko[7].

At this time, the extent of any environmental degradation due to logging practices is not known. Any deterioration which does occur will likely be associated with road-building activities and with logging on steep slopes, at high elevations and adjacent to water courses. Erosion of surface soils, slumps and slides are undesirable land-based effects of logging. Sedimentation of stream beds, the accumulation of debris in streams and valley bottoms, and increased summer stream temperatures are

also side-effects of logging activities.

2.4 Agricultural

The agricultural activity is considered to be very minimal in the Flathead River valley. At present, a limited number of grazing permits have been issued for livestock. The area is restricted to low density livestock grazing and production of frost-hardy varieties[4], due to the short frost free period, and soil limitations. Also the distance from markets discourages agricultural development. Land capability information revealed that relatively little acreage is suitable for production of native or perennial forage crops[18].

3. WATER SAMPLING DATA

3.1 Presentation of Data

From 1971 to 1974, the Pollution Control Branch collected eight water samples at Flathead on the Flathead River (Figure 1-1). The results of the analyses for 29 parameters are summarized in Table 1-1. The values of several parameters plotted against time are given in Figure 1-2.

During the summer of 1975, the Pollution Control Branch established three additional sampling sites on Cabin and Howell Creeks (Figure 1-1). The data collected at these sites are given in Table 1-2. On August 20, 1975, the Inland Waters Directorate of Environment Canada collected samples from six stations in the Flathead basin including one on Cabin Creek and one on Howell Creek. The preliminary results are similar to the Pollution Control Branch results.

The consultants for Sage Creek Coal Ltd. have proposed a water sampling program to obtain data, before and after mining, on Cabin, Howell, Leslie and Couldrey Creeks and on the Flathead River (Figure 1-1). The data are not yet available.

3.2 Discussion

The available water quality data for the Flathead River and Cabin and Howell Creeks are summarized in Tables 1-1 and 1-2. All of the values, except the spring turbidity levels, were within the B.C. Recommended Drinking Water Standards[20]. The low metal content and the relatively high dissolved solids, alkalinity, and hardness values are associated with the limestone nature of the MacDonald Range from which much of the water flows.

At Flathead, on the Flathead River, seasonal variations were apparent for several parameters (Figure 1-2). The specific conductance, dissolved solids, hardness and alkalinity were low during spring runoff and increased during summer. The reverse was observed with the suspended solid values.

During spring runoff suspended solids were high due to increased erosion and sediment transport caused by the higher flows. Specific conductance, dissolved solids, hardness and alkalinity were low since the flow was comprised mainly of melt water which had had little contact with the soil. In summer, during low flow, specific conductance, dissolved solids, hardness and alkalinity increased at Flathead and were high on Cabin and Howell Creeks. This may be due to groundwater comprising a greater proportion of streamflow and being mineralized after prolonged contact with limestone and siliceous rock.

South of the International Boundary, the Flathead River forms the boundary of Glacier National Park. The river will be designated by the U.S.A. for possible protection under the Wild and Scenic Rivers Act if studies show its inclusion to be feasible.

3.3 Recommendations

The study proposed by the consultants for Sage Creek Coal Ltd.[11] is being modified. We expect that in its final form the study will provide enough information to assess the impact on water quality of the proposed mine. The Inland Waters Directorate of Environment Canada is also planning to study water quality and aquatic biology in the area. Therefore no further recommendations are made at this time, other than to suggest that priority be given to the measurement of suspended solids, turbidity and stream flow of the major creeks and rivers.

4. AQUATIC BIOLOGY

Rock-basket invertebrate samplers were set in August, 1975 at the three Pollution Control Branch sites on Cabin and Howell Creeks (Figure 1-1) but the data are not yet available. No other studies of aquatic biology in the Flathead River basin have been carried out. However, the consultants for Sage Creek Coal Ltd. have proposed aquatic biological studies as part of Stages II and III of the environmental impact study. The proposal includes sediment analysis, benthic invertebrate surveys, fish species distribution, fish habitat and population studies, and recreation potential and impact surveys.

The study proposal is now under review to ensure that the information collected will be adequate.

REFERENCES

1. B.C. Dept. of Lands, Forests & Water Resources, Topographical Map Sheet 82G/SE, Flathead, Kootenay land district, (Scale 1:126, 720), First Status Edition, March 1, 1963.

2. Hawkins, W., B.C. Dept. of Economic Development, Victoria, Personal Communication, October 28, 1974.

3. B.C. Dept. of Mines Petroleum Resources, Geology, Exploration and Mining in British Columbia, 1970, 1971, and 1972.

4. Canada Land Inventory, Soil Capability for Agriculture, Flathead 82 G/SE, Department of Regional Economic Expansion.

5. Canada Land Inventory, ARDA, British Columbia, Map Number 2, Mean January Temperature, and Map No. 18, Mean Annual Snowfall.

6. Holland, S.S., Landforms of British Columbia, B.C. Dept. of Mines and Petroleum Resources. Bulletin No. 48, 1964.

7. Canada Land Inventory, Soil Capability for Forestry, Flathead 82 G/SE, Department of Regional Economic Expansion.

8. Water Survey of Canada, Surface Water Data Reference Index, Canada, 1972, Inland Waters Directorate, Dept. of the Environment, Ottawa, 1972.

9. Water Survey of Canada, Historical Streamflow Summary to 1970 British Columbia, Inland Waters Directorate, Dept. of the Environment, Ottawa, 1972.

10. Water Rights Branch, Licensing Division, Water Register, Fernie District, Flathead Precinct, B.C. Water Resources Service.

11. Piteau Gadsby Macleod Ltd. and B.R. Hinton and Associates, Rio Algom Ltd., The Sage Creek Project, Stage I Environmental and Geotechnical Assessment, July 25, 1975.

12. Rio Algom Mines Ltd., Engineering Department, Sage Creek Project, Rio Algom/Rio Tinto, Toronto, Canada, April, 1975.

13. Hume, G.S., Waterton Lakes, Flathead valley area, Alberta and British Columbia, Canada Dept. of Mines, Summary Report, 1932, Part B.

14. B.C. Dept. of Mines and Petroleum Resources, Map of Flathead Area showing petroleum permittees to 1975.

15. Canada Land Inventory, Land Capability for Agriculture, Fernie 82G, Department of the Environment.

16. Ogilvie, R.T., Report No. 60, Flathead Area, University of Calgary, 1970.

17. Ecological Reserves, Lands Service, Proposal #243, Frederick, B.G., Polster, D.A., Bell, M.A.M., 1975.

18. Canada Land Inventory, Land Capability Analysis, East Kootenay Area, Dept. of Regional Economic Expansion.

19. Canada Land Inventory, Land Capability for Wildlife-Waterfowl, Fernie 82 G, Dept. of Regional Economic Expansion.

20. Recommended Water Quality Standards, Health Branch, Province of British Columbia, 1969.

21. B.C. Forest Service, Nelson Forest District, Map of Existing and Proposed Areas of Forest Harvesting Operations, 1974.

FIGURE I-I
REGION I, THE FLATHEAD RIVER BASIN

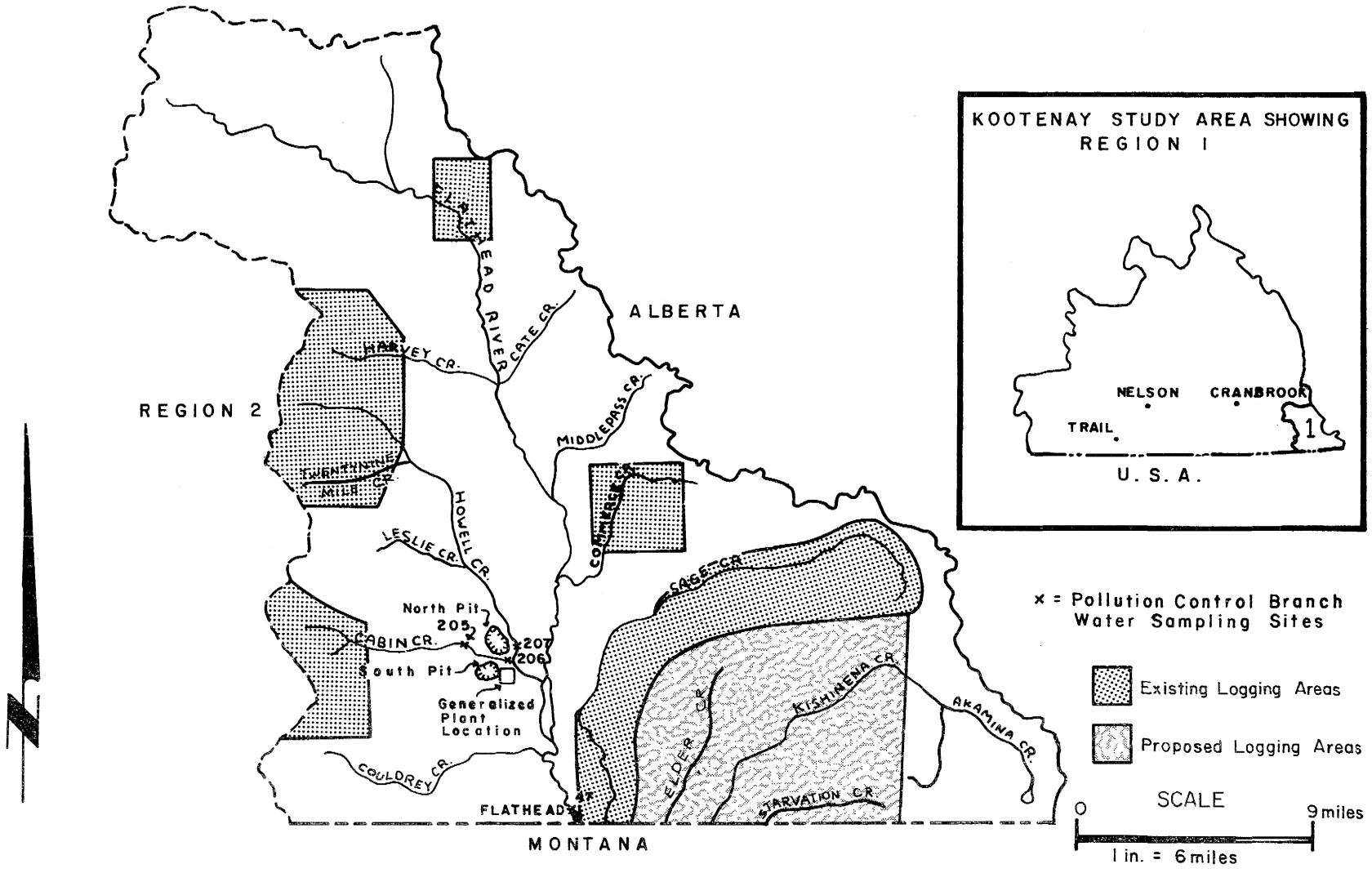

FIGURE 1-2

POLLUTION CONTROL BRANCH RESULTS AT SITE 47 ON THE FLATHEAD RIVER FROM 1971 TO 1974

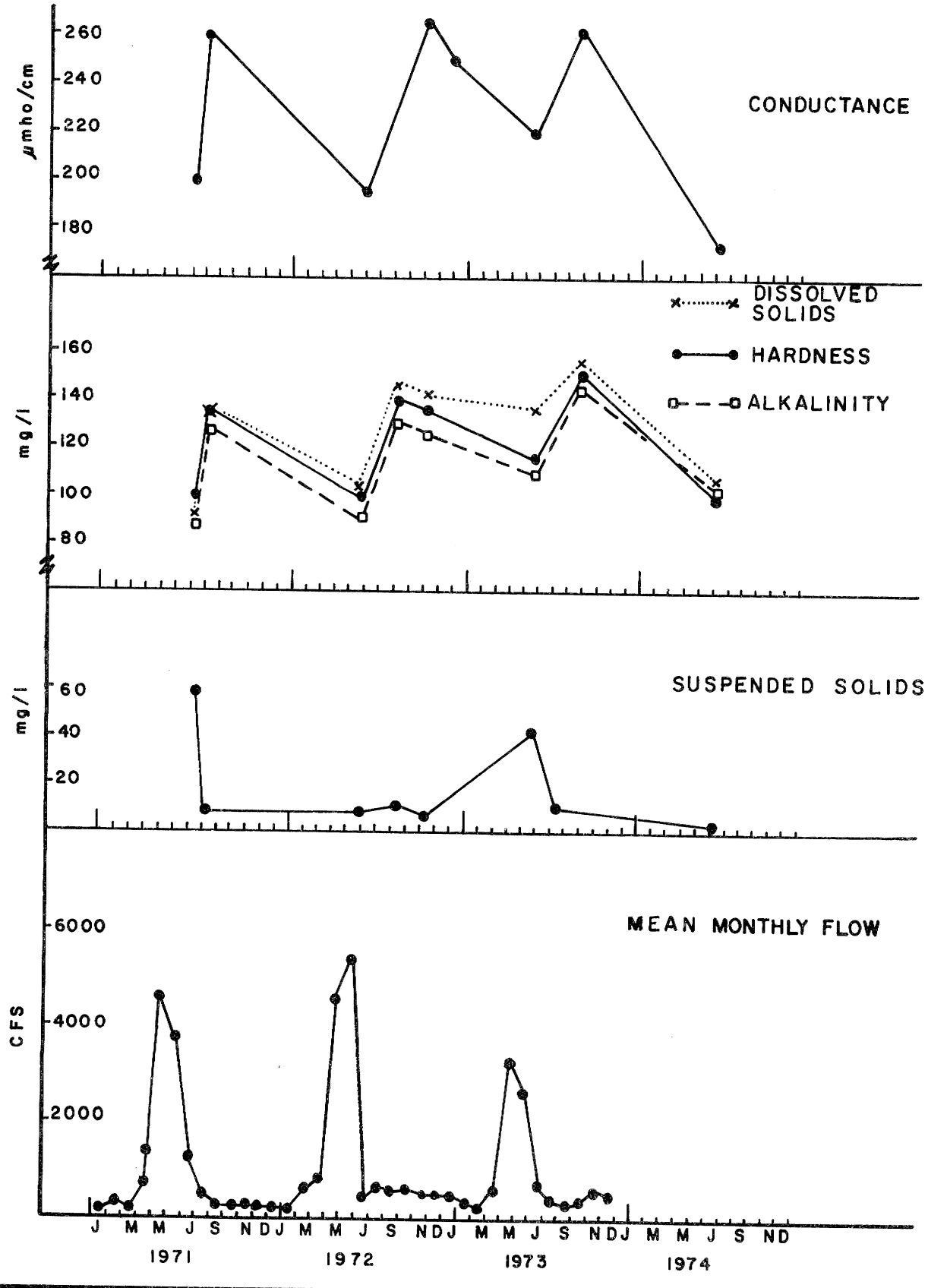

TABLE 1-1

SUMMARY OF WATER QUALITY DATA FROM POLLUTION CONTROL BRANCH

SITE 47 ON THE FLATHEAD RIVER AT FLATHEAD

Parameter \ Data Source	Pollution Control Branch 1971-74(a)				Thomas 1949(b)	B.C. Max. Permissible Drinking Water Standards (20)
	Number Of Values	Max.	Min.	Average		
alkalinity (total) mg/l	8	127	90	112	121	
calcium (total) mg/l	7	43.5	27.0	33.4	31.5	200
chloride mg/l	7	0.8	0	0.5	0	250
colour APHA	7	10	5	5.7	2	15
conductivity µmho/cm	8	265	176	228	218	
copper (diss.) mg/l	4	0.001	0.001	0.001		1.0
fluoride mg/l	8	0.13	0.10	0.11	0.10	1.5
hardness mg/l $CaCO_3$	8	146	92	117	120	180
iron (diss.) mg/l	6	0.04	0.001	0.03	0.04	0.3
lead (diss.) mg/l	6	0.013	0.001	0.005		0.05
magnesium (diss.) mg/l	4	9.2	6.2	7.6	8.0	150
manganese (diss.) mg/l	6	0.02	0.01	0.01		
nitrogen						
ammonia mg/l	8	0.32	0	0.06		0.5
nitrate mg/l	7	1.47	0.02	0.39	0	10
nitrite mg/l	7	0.22	0.04	0.08		10
organic N mg/l	8	0.22	0.02	0.08		
oxygen (diss.) mg/l	8	12.3	9.4	10.7		
pH	8	8.6	7.9	8.3	8.3	6.3-8.3
phosphorus (diss.) mg/l	7	0.004	0.003	0.003		0.2 as $(PO_4)\equiv$
phosphorus (total) mg/l	8	0.03	0.004	0.014		
potassium mg/l	8	0.9	0.3	0.4	0.1	
silica mg/l	7	4.9	3.9	4.3	4.2	
sodium mg/l	8	1.3	0.5	0.8	0.5	
solids (total) mg/l	8	182	108	141		1000
(suspended) mg/l	8	57	2	19.5		
(dissolved) mg/l	8	152	91	122	121	
sulphate mg/l	8	6.8	4.5	5.4	10.9	500
turbidity JTU	8	13	0.5	6.6	0.3	5
zinc mg/l	6	0.120	0.005	0.024		5

a - Data obtained from 1971, 1972, 1973, and 1974 Pollution Control Branch Files, Nelson, B.C. and Water Resources Service, Data Base

b - Thomas, J.F.J. Industrial Water Resources of Canada, Water Survey Report #4, Columbia River drainage basin in Canada, 1949-1950.

TABLE 1-2

SUMMARY OF POLLUTION CONTROL BRANCH WATER QUALITY DATA

FOR CABIN AND HOWELL CREEKS, COLLECTED JULY, AUGUST, SEPTEMBER 1975

Parameter \ Sample Location	Cabin Creek, Site 205				Cabin Creek, Site 206				Howell Creek, Site 207			
	n	Maximum	Minimum	Average	n	Maximum	Minimum	Average	n	Maximum	Minimum	Average
alkalinity mg/l	3	129	116	122	3	129	123	126	3	139	133	135
cadmium mg/l	1	<0.0005	<0.0005	<0.0005	1	<0.0005	<0.0005	<0.0005				
calcium mg/l	2	34.2	35.8	35	2	36.8	34.2	35.5	2	42.2	40.4	41.3
chloride mg/l	2	0.5	<0.5	<0.5	2	0.5	<0.5	<0.5	2	0.5	<0.5	<0.5
colour (true) rel. unit	2	10	5	7.5	2	5	5	5	2	5	5	5
coliforms-fecal MPN	1	<20	<20	<20	2	<20	11	<15.5				
-total MPN	1	50	50	50	1	<20	<20	<20				
conductivity µmho/cm	3	270	257	264	3	270	123	219	3	280	258	268
copper mg/l	2	<0.001	<0.001	<0.001	2	<0.001	<0.001	<0.001	2	<0.001	<0.001	<0.001
cyanide mg/l	1	<0.01	<0.01	<0.01	1	<0.01	<0.01	<0.01	1	<0.01	<0.01	<0.01
fluoride mg/l	2	0.22	0.17	0.195	2	0.22	0.17	0.195	2	0.11	0.11	0.11
hardness mg/l	2	133	125	129	2	136	124	130	2	137	132	135
iron (diss.) mg/l	3	<0.1	<0.1	<0.1	2	0.1	0.1	0.1	2	0.1	<0.1	<0.1
lead (diss.) mg/l	2	<0.001	<0.001	<0.001	2	<0.001	<0.001	<0.001	2	<0.001	<0.001	<0.001
magnesium mg/l	2	10.7	9.6	10.15	2	10.7	9.5	10.1	2	7.8	7.5	7.65
manganese mg/l	3	<0.02	<0.02	<0.02	3	<0.02	<0.02	<0.02	3	<0.02	<0.02	<0.02
nitrogen												
ammonia mg/l	2	0.01	<0.005	<0.0075	2	0.005	<0.005	<0.005	2	<0.005	<0.005	<0.005
nitrite mg/l	2	<0.005	<0.005	<0.005	2	<0.005	<0.005	<0.005	2	<0.005	<0.005	<0.005
nitrate mg/l	2	<0.02	<0.02	<0.02	1	<0.02	<0.02	<0.02	1	0.02	0.02	0.02
nitrogen, kjeldahl mg/l	3	0.08	0.03	0.057	3	0.15	0.02	0.9	3	0.36	0.1	0.18
nitrogen, organic mg/l	2	0.08	0.05	0.065	2	0.1	0.02	0.06	2	0.1	0.07	0.085

TABLE 1-2 Continued

SUMMARY OF POLLUTION CONTROL BRANCH WATER QUALITY DATA

FOR CABIN AND HOWELL CREEKS, COLLECTED JULY, AUGUST, SEPTEMBER 1975

Parameter \ Sample Location	Cabin Creek, Site 205				Cabin Creek, Site 206				Howell Creek, Site 207			
	n	Maximum	Minimum	Average	n	Maximum	Minimum	Average	n	Maximum	Minimum	Average
oxygen (diss.) mg/l	3	10.5	8.7	9.6	3	10	8.9	9.6	3	10.5	9.2	9.8
pH	3	8.7	8.4	8.53	3	8.7	8.1	8.4	3	8.6	8.2	8.4
phosphorus (diss.) mg/l	3	0.014	0.009	0.012	3	0.013	0.008	0.011	3	0.003	<0.003	<0.003
(total) mg/l	3	0.02	0.015	0.018	3	0.018	0.017	0.018	3	0.008	0.006	0.007
potassium mg/l	2	0.4	0.4	0.4	2	0.4	0.4	0.4	2	0.3	0.3	0.3
silica mg/l	2	5	4.4	4.7	2	5.0	4.4	4.7	2	4.6	4.3	4.45
sodium mg/l	2	1.0	0.8	0.9	2	1.0	0.8	0.9	2	0.6	0.4	0.5
solids (diss.) mg/l	3	156	105	135.7	3	158	136	146	3	156	140	147
(total) mg/l	3	160	136	148	3	162	138	150	3	158	142	149
sulphate mg/l	2	9.8	7.4	8.6	3	9.8	6.9	8.3	2	5	<5	<5
turbidity JTU	3	0.6	0.4	0.5	3	3.1	0.5	1.4	3	0.7	0.4	0.52
zinc (diss.) mg/l	2	<0.005	<0.005	<0.005	2	<0.005	<0.005	<0.005	2	<0.005	<0.005	<0.005

Note: n = number of samples