DEPARTMENT OF ENVIRONMENT

WATER RESOURCES SERVICE

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KOOTENAY
AIR AND WATER QUALITY STUDY
PHASE I

WATER QUALITY IN REGION 3, THE UPPER KOOTENAY RIVER BASIN

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SUMMARY

This report is an evaluation of the information available to the end of 1974 on the water quality of the Upper Kootenay 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.

Parks occupy much of the northern half of the region. In contrast much of the southern half of the region is being used for timber harvesting. Apart from recreation and logging there are no other significant activities in the region.

The water of the Kootenay River, just before it leaves the region at Canal Flats, was found to be of generally good quality. Turbidity was higher than one might expect, due possibly to the effect of logging. Further samples will be collected at a few more sites to confirm the data. We will present future results in a Phase II report.

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1. DESCRIPTION OF THE REGION

1.1 Introduction

The Upper Kootenay River Basin has an area of 2080 square miles and is located in the north-east corner of the Kootenay Study Region, as shown in Figure 3-1. The region is extremely mountainous, as it lies along the western slope of the Rocky Mountains. The Kootenay and Park Ranges form the eastern and western boundaries of the region, with the longitudinal U-shaped valley of the Kootenay River lying between these ranges. The valley is two to three miles wide and lies at an elevation of 3000 to 4000 feet.

Kootenay National Park occupies much of the northern part of the region, following the valleys of the Kootenay and Vermillion Rivers (Figure 3-1). The main activities in the region are recreation and logging.

1.2 Settlement

There is very little permanent habitation in the region. Topographical maps[1] show a small settlement at the northeast end of Whiteswan Lake. In Kootenay National Park, there are several very small settlements for the park staff. Seasonal habitation in the park occurs at picnic areas, campgrounds, fire lookouts, and a park maintenance camp[2].

Access to the region is provided by the Banff-Windermere Highway.

1.3 Climate

The climate within the region varies considerably because of the mountainous terrain. In general, snowfall and total precipitation increase and temperatures and frost-free periods decrease from west to east across the region as the western slope of the Rockies is ascended. The

valley of the Kootenay River receives about 1000 mm of precipitation per year which includes 250 cm of snowfall[3]. Snowfall in the Park Ranges adjacent to the Alberta border can exceed 500 cm per year. The mean temperature in the Kootenay valley is 13.5°C in July and -12°C in January. The frost-free period averages about 60 days[3].

1.4 Geology

The region lies entirely within the Kootenay and Park Ranges of the Rocky Mountains. The Kootenay Ranges form the western boundary of the region, consisting of the Brisco, Stanford and Hughes Ranges. These are north-westerly trending, parallel ridges 5000 to 9000 feet high and are characterized by geologic structures of great complexity. The Stanford Range is composed of limestone, limestone conglomerate, shale and phyllite[18,19].

The Park Ranges form the eastern boundary of the region and consist of north and north-westerly trending ridges over 10,000 feet high. These ranges are largely underlain by sedimentary and metamorphic rocks. Thick, cliff-forming limestone and quartz formations comprise many of the mountains. The ranges are extremely rugged and world renowned for their alpine scenery[18].

The Upper Kootenay River valley is a U-shaped, glaciated valley lying between the Park and Kootenay Ranges. The portion of the valley between the headwaters and Gibraltar Rock is two to three miles wide and has a northwest, southeast orientation. Between Gibraltar Rock and Canal Flats, the valley swings to the southwest around the south end of the Stanford Range. This portion of the valley is deeply cut and only half a mile wide[19].

1.5 Soils and Vegetation

The landforms, surficial deposits, and soils of the Upper Kootenay River Basin strongly reflect the influences of glaciation. Rock outcrops,

talus, and shallow soils derived from till are common on the steep slopes at high elevations. Engelmann spruce and alpine fir communities occur in these regions, but site productivity is low. The gentler slopes of the valley walls, with deeper soils derived from tills, support more productive stands of western larch, lodgepole pine, and western red cedar. Coarse-textured deposits from glacial meltwater channels and outwash terraces flank many of the valleys. Glacial tills and recent alluvial fans and floodplains occur in the valley bottoms. Below 4000 feet, the soils support a variety of communities, primarily of grassland and lodgepole pine, but with some western red cedar and western larch. These lowlands, particularly the valleys of the Palliser, Albert, Cross, White and Kootenay Rivers are the most productive forestlands of the region.

1.6 Hydrology

The Kootenay River and its major tributaries (the White, Palliser, Cross, and Vermillion Rivers) drain the entire 2080 square miles of the region. The Kootenay starts in the northern end of the basin between the Kootenay and Park Ranges and flows in a southerly direction for about 70 miles to Canal Flats where it enters the Rocky Mountain Trench.

The seasonal flow patterns of the Kootenay and its tributaries are characterized by spring flood peaks in May, June and July due to snowmelt. About three quarters of the annual flow occurs in this time. There is a steady decline in discharge during the summer, with the minimum flows occurring during the winter months of December through March. The streamflows of the Kootenay, Vermillion, and White Rivers are summarized in Table 3.1. The Kootenay River at Canal Flats has an average annual discharge of 3060 CFS with a daily maximum of 29,700 CFS and a daily minimum of 310 CFS[4].

There are no major lakes or dams in the region and there are no records of any groundwater wells[5]. The diversion of the Kootenay River into the Columbia River at Canal Flats is allowed by the Columbia River Treaty, but not until 1984. The feasibility of this diversion and its environmental impact are being investigated by B.C. Hydro.

1.7 Water Uses

Licenced water usage within the region is very limited and is summarized in Table 3-2[6].

1.8 Land Uses

1.8.1 Agriculture

Agricultural activity in the Upper Kootenay River Basin is minimal. The only land suitable for agriculture lies along the Kootenay River between Canal Flats and Whitetail Creek.

1.8.2 Forestry

Much of the northern half of Region 3 is devoted to Kootenay National Park and Mount Assiniboine Provincial Park. In contrast, most of the southern half of the region, including practically all land east of the Kootenay River, is being utilized for timber harvesting. Much of this timber is immature lodgepole pine and is trucked to the Skookumchuck pulp mill and the Canal Flats sawmill.

1.8.3 Mining and Petroleum

There are no mining or petroleum developments within the region, although in 1972, exploration for magnesite was conducted near the confluence of Assiniboine Creek and the Mitchell River on the west flank of Mount Brussilof[7].

1.8.4 Recreation

The upper Kootenay River rates as moderately high for uplands-oriented recreation, but has limited capability for water-based recreation[8,9]. Excluding Kootenay National Park, the highest Canada Land Inventory recreational capability designations in the study region are given to Whiteswan Lake, the Mount Assiniboine area and the lower Palliser River.

The upper Kootenay River and its major tributaries, the Mitchell, Cross, Palliser and White Rivers, have good potential for streamside camping, angling and viewing of wetlands wildlife. Scenery such as waterfalls and canyons are common. Whiteswan and Alces Lakes have potential for fishing, cottaging, camping, swimming and boating. Thermal springs and an alpine lake are within hiking distance.

Mount Assiniboine Provincial Park, 20 square miles in extent, is situated 30 miles northeast of Radium Hot Springs. The Park and a large area extending along Simpson Ridge to the northeast, contain outstanding alpine areas of high recreational quality. Lake Magog and the Cerulean Lakes within the park are designated Canada Land Inventory recreational classes 1 and 2, respectively. A fisheries evaluation of these lakes by the Provincial Parks Branch during summer 1974 concluded that, although numerous Dolly Varden, yellowstone cutthroat and rainbow trout were present, a stocking program should be initiated in anticipation of future increases in park visitors[10].

The park is currently being considered for a proposed 115 square mile enlargement that would include the remaining wedge of land, comprising the upper Simpson and Mitchell River drainages, between Kootenay National Park on the west and Banff National Park on the east.

The 543 square mile Kootenay National Park encompases the full length of the Vermillion River, as well as a large part of the upper Kootenay River. Recreational activities are year-round and include nature studies, fishing, hiking, camping, climbing, boating (restricted use), skiing, and snowshoeing.

1.8.5 Wildlife

Big game winter range extends intermittently along the full length of the upper Kootenay River, with a particularly important section along the east side of Kootenay River between Palliser and White Rivers and extending up the lower portion of both tributaries. The lower slope of White Knight Peak, on the north side of Alces and Whiteswan Lakes, is also

an important ungulate winter range, as is the small portion of the Rocky Mountain Trench within the study area in the vicinity of Canal Flats.

Moderate waterfowl production occurs on a small tract along the northeast shore of Whiteswan Lake. Elsewhere in the study area, waterfowl habitat is severely limited by adverse topography and climate[11].

2. MAJOR INFLUENCES OF MAN

2.1 Industrial

There are no significant industrial activities in the region and no industrial effluents. There are however, two solid-waste disposal sites. Crestbrook Forest Industries Ltd. has submitted Pollution Control Application No. AR-2554 to discharge 10 cubic yards of wood wastes per day to two refuse disposal sites (A and B) at Canal Flats. Application details are given in Table 3-3.

Site A is about 1200 feet from the Kootenay River and five to 10 feet above the floodplain. The effect of discharges from this site on groundwater and surface water is considered to be negligible. Site B is located on the flood plain of the Kootenay River within 50 feet of the river channel. The site has an area of 40 acres and is located in the mill's abandoned log pond. The log pond is separated from the river by a good dyke. Another dyke constructed primarily of wood wastes, protects the log yard to the east of the log pond. Sections of this dyke have been washed away and erosion is likely to continue since the dyke is on the outside of a river meander.

There is a potential at site B for adverse effects on groundwater and on surface water because of the danger of flooding and a high groundwater table which probably fluctuates with river stage. There is not enough information available regarding the characteristics of site B to make a complete evaluation of possible adverse effects. The Pollution Control Branch is currently obtaining the data necessary for a more complete evaluation. In the interim, the site has been rated as posing a moderate threat to groundwater and surface water quality.

We recommend that Site B be re-evaluated when the additional data become available.

2.2 Municipal

2.2.1 Effluent

The only sources of domestic wastes are from employees and visitors

to Kootenay National Park. Within Region 3, the Park has one commercial bungalow development for 34 persons, campsites with 180 sites and picnic areas for about 700 persons. The picnic areas have seepage pits, one campground has an exfiltration basin and all other sources have septic tanks with tile-fields[12]. These effluents do not appear to affect groundwater or surface water quality.

2.2.2 Solid Waste

The only significant source of municipal solid waste in the Region is the Canal Flats Improvement District. The District has submitted an application (AR-2982) to the Pollution Control Branch for a refuse disposal site on the south bank of Kootenay River, east of Canal Flats. The application is for a discharge of five cubic yards/day. Pertinent information regarding the site is listed in Table 3-3.

The proposed refuse site is a small "over the bank and burn" type located within 30 feet of the Kootenay River. The applicant has been advised by the Pollution Control Branch that the site is unsuitable and that a new site should be located.

The danger of leachate from the old site reaching the Kootenay River is high because of the risk of flooding and a consequent high groundwater table. However, the impact on the river is probably negligible, considering the small size of the refuse site and the relatively large flow in the Kootenay River at Canal Flats.

No monitoring program appears necessary at this time.

2.3 Agriculture

The agricultural activity in the Kootenay River Valley upstream from Canal Flats is considered to be very minimal. Soil and Land Capability Maps indicated that the only area suitable for agriculture is between Canal Flats and Whitetail Creek.[14] One major farm in this area has been issued a water licence for 120 acre-feet per year to irrigate 60 acres

(Table 3-2). Since there are less than 10 farms in the region, no census data were available[15]. However, the farm size and livestock population estimates were based on typical farms in the East Kootenay region. The annual nutrient loadings from livestock and fertilized irrigated land to the Kootenay River are tabulated in Table 3.4. The loadings were estimated by using the loading factors established in the Okanagan Basin Agreement Study[16]. The methodology has been described in the Phase I report on water quality for Region 2[13]. Table 3.4 shows that the annual nutrient loading to the Kootenay River from the agricultural activities is negligible.

2.4 Forestry

The northern half of Region 3 is dominated by Kootenay National Park; the southern half is dominated by logging operations. Most of the lands in the area east of the Kootenay River and south of Kootenay National Park (the Albert, Palliser and White River drainages) are being logged, or will be subject to logging, within the next five to ten years. These areas are shown in Figure 3-1. Much of the timber in this region is immature lodgepole pine and is harvested as pulpwood for the mill at Skookumchuck.

The rugged topography, steep slopes and shallow soils common in the region are factors that will likely contribute to soil erosion, slumping, and stream sedimentation during road-building and logging operations. The presence of highly erodible phyllites and shales in some areas compounds this hazard. In the White River valley, the very silty glacial till deposits could present similar problems of slope instability and erosion.

3. WATER SAMPLING DATA

3.1 Presentation of Data

There is one Pollution Control Branch sampling station in this region on the Kootenay River at Canal Flats (Figure 3-1). Samples were collected between 1969 and 1974 and the data are summarized in Table 3-5. The B.C. Recommended Drinking Water Standards are included for comparison.

3.2 Discussion

The water quality data (Table 3-5) show high values for alkalinity, conductivity, hardness, dissolved and suspended solids, and turbidity. These values are due to the limestone bedrock and calcareous glacial till of the terrain through which the water flows. Some individual measurements of hardness, pH, total phosphorus, and turbidity exceeded the B.C. Recommended Drinking Water Standards[17].

Seasonal variations were evident for the majority of the parameters. Low concentrations occurred during spring runoff and high concentrations during stabilized flow. Phosphorus, and turbidity were exceptions to this trend.

The phosphorus levels increased during freshet, due to the high silt and detritus loading during this time. No phosphorus rock deposits have been found in the area to date.

High turbidity values were evident throughout the summer months, suggesting that glaciers melting at high altitude contributed silt during the summer. Logging activity along the upper Kootenay River may also contribute to the high turbidity, especially with road building occurring along the steep slopes where shallow soils prevail. As there was no sampling site upstream from the logging activities, the effects of these activities cannot be assessed.

3.3 Recommendations

We recommend two sampling sites on the Kootenay River. The site at Canal Flats should be retained and an additional sampling site established to monitor the background water quality. This site should be located where the Banff-Radium Hot Springs Highway crosses the Kootenay River. Since logging is the major land use activity in this basin, additional sampling locations may be included to monitor this activity. A grab sample should be taken twice during the low summer flow and the following parameters measured.

- ammonia
- alkalinity
- calcium
- conductivity
- hardness
- magnesium
- nitrate
- ortho phosphate
- oxygen - dissolved
- phosphorus - total
- solids - total and dissolved
- temperature
- turbidity

4. AQUATIC BIOLOGY

Qualitative estimates of successful fisheries in all of the major streams in the region and in the lakes in Mount Assiniboine Provincial Park are the only available data for the region. Timber-harvesting operations along drainages east of the Kootenay River in the southern half of the study region are the only operations likely to affect aquatic biota.

Logging may have an effect on aquatic communities, however, the effect is not thought to be severe enough to warrant biological sampling.

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FIGURE 3-1
REGION 3 - UPPER KOOTENAY RIVER BASIN

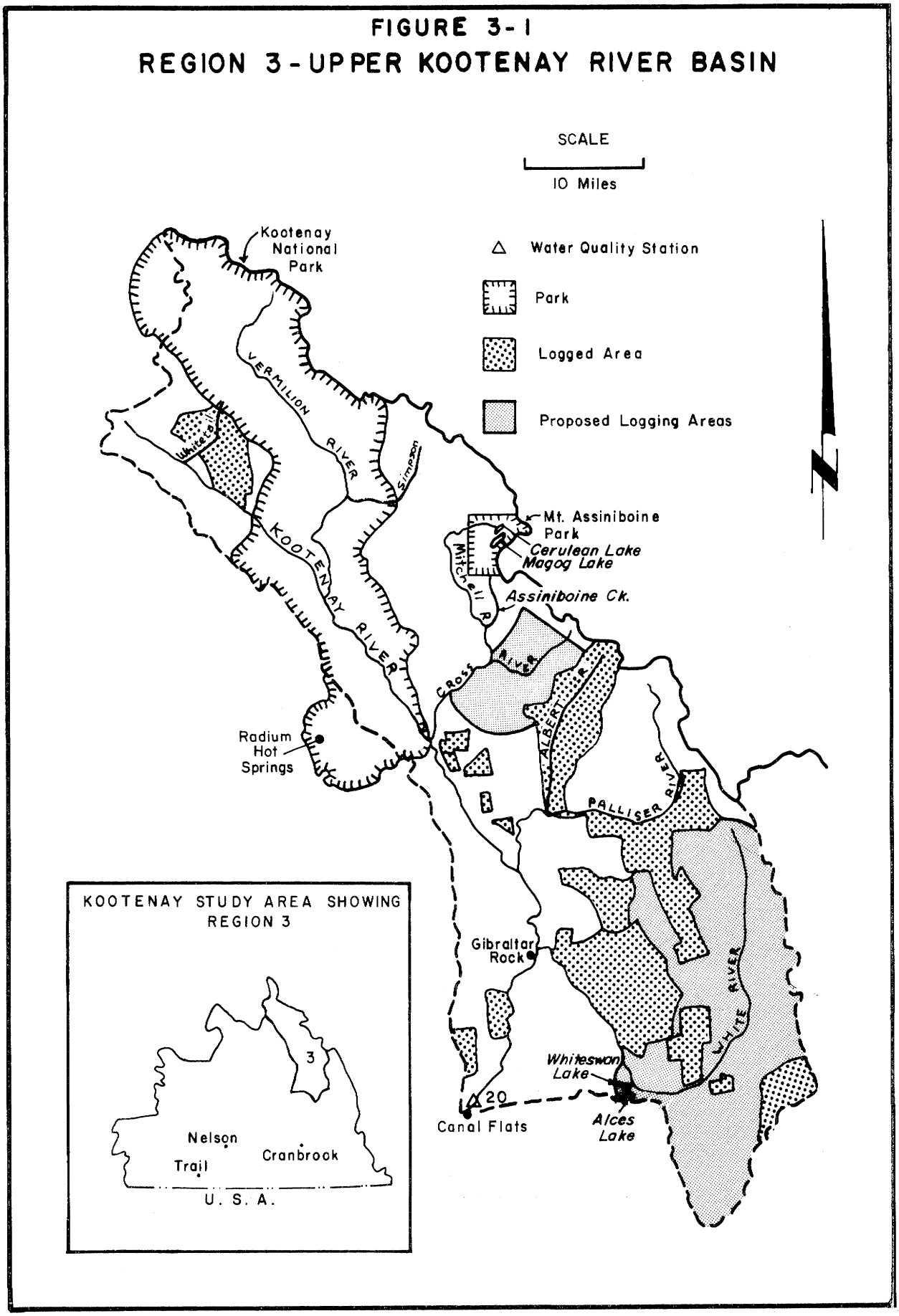

TABLE 3-1

SUMMARY OF STREAM FLOWS OF THE KOOTENAY, VERMILLION AND WHITE RIVERS[4]

Stream	Drainage Area (mi^2)	Mean Annual Discharge (CFS)	Maximum Daily Discharge Recorded (CFS)	Minimum Daily Discharge Recorded (CFS)
Kootenay River at Canal Flats	2080	3060	29,700	310
Kootenay River at Kootenay Crossing	160	174	1870	0
Vermillion River near the mouth	360	766	5870	75
White River at Whiteswan Lake	360	435	1900	150

TABLE 3-2

SUMMARY OF WATER LICENCES IN REGION 3[6]

Source	No. of Licences	Quantity	Purpose	Owner	Location	Comments
Kootenay R.	1	200 AF/Y	industrial	Crestbrook Forest Industries Ltd.	Canal Flats	log pond fluming
	1	10 CFS	industrial	" "	" "	
Whitetail Creek	1	120 AF/Y	irrigation	J.L. Johnson	D.L. 111, S.L. 80, D.L. 4596	S. of Kootenay R., E. of Canal Flats 60 acres irrigated
Inlet Creek	1	80 AF/Y 1000 GPD	irrigation domestic	P.M. Kennelly	D.L. 10326	NE. end of Whiteswan Lake

Minor sources of water supply for domestic and irrigation purposes: Magog Creek, Mud Creek, Home Basin Creek.

TABLE 3-3

DESCRIPTION OF REFUSE DISPOSAL SITES IN REGION 3

Pollution Control Branch application or permit number	Operator location & status of refuse disposal site & level of operation	Type of refuse and quantity of refuse	Site Suitability Factors					Potential for adverse effects on groundwater or surface water	Comments
			Depth to groundwater table (feet)	Underlying soils	Surface runoff or flooding	Distance to surface water(feet)	Distance to wells (feet)		
AR-2554	Crestbrook Forest Industries Ltd. Canal Flats (Sawmill-planer operation) In operation level C*	wood-wastes (mainly log yard wastes) 10 cu.yd/day	Site A:5	gravel, clay	no	1200	750 (mill well)	Groundwater:negligible (monitoring wells required by Regional office) Surface water: negligible (Kootenay River)	Site B has been in use since 1930 MAP=16 in/year** PE=22 in/year***
			Site B:2	gravel, clay	possible flooding by Kootenay R.	50(old dyke between site B& Kootenay River)	300 (mill well)	Groundwater:Moderate Surface water:moderate (Kootenay R.)	
AR-2982	Canal Flats Improvement District In operation	Municipal 5 cu.yd/day		clay	flooding by Kootenay R.	30 (Kootenay R.)	none nearby	Groundwater:nil Surface water: negligible	Refuse dumped down bank of Kootenay R. Applicant advised to locate another site.

*As defined in the Operational Guidelines for the Discharge of Refuse on Land, Pollution Control Branch, Oct. 1971.
**MAP: Mean annual precipitation.
***PE: Average annual potential evapo-transpiration.

TABLE 3-4

ANNUAL NUTRIENT LOADINGS FROM

AGRICULTURAL SOURCES TO THE UPPER KOOTENAY RIVER

Farms reporting cropland[(a)]	1
Crop land acreage[(a)]	200
Irrigated acreage	60
Nitrogen, lbs/year	400
Phosphorus, lbs/year	10
Livestock, cattle	150
Nitrogen, lbs/year	1800
Phosphorus, lbs/year	40
Total Nitrogen, lbs/year	2200
Total Phosphorus, lbs/year	50

Note: (a) = estimated values

TABLE 3-5

SUMMARY OF WATER QUALITY DATA FOR SITE 20

COLLECTED BY THE POLLUTION CONTROL BRANCH FROM 1969 TO 1974

Parameter	Number of Values	Maximum	Minimum	Average	B.C. Maximum Permissible Drinking Water Standards (17)
alkalinity, mg/l $CaCO_3$	69	164	100	130	
calcium, mg/l	52	60	32	45	200
chloride, mg/l	51	12	2	6.4	250
conductivity, µmho/cm	63	470	50	334	
flow, X 10^3 CFS	62	11.3	0.52	2.8	
fluoride, mg/l	51	0.26	0.08	0.12	1.5
hardness, mg/l $CaCO_3$	51	215	115	167	180
iron, mg/l	34	0.2	0.02	0.07	0.3
magnesium, mg/l	36	20	9	14	150
nitrogen					
ammonia, mg/l	51	0.2	0	0.02	0.5
nitrate, mg/l	54	0.5	0.03	0.13	10
organic N, mg/l	51	0.32	0	0.04	
pH	101	8.5	7.3	8	6.5-8.3
phosphorus-ortho, mg/l	54	0.67	0	0.03	
total, mg/l	55	0.33	0	0.014	0.2 as $(PO_4)^{\equiv}$
sodium, mg/l	42	7	2	5	
solids-total, mg/l	52	415	110	236	1000
suspended, mg/l	50	276	103	200	
dissolved, mg/l	13	310	89	158	
turbidity, JTU	55	100	0	16	5