ENVIRONMENTAL UP-DATE REPORT FOR THE MOUNT NANSEN GOLD PROJECT

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SUMMARY

Environmental studies of the Mount Nansen Project have been carried out by Norecol Environmental Consultants Ltd. since October, 1985. Additional baseline data collection has been carried out by Environmental Protection and by Water Resources. Field studies by Norecol have included water quality sampling, hydrology, stream sediment sampling, collection of rock samples for acid-base accounting tests, and reconnaissance for wildlife. These field studies have been complemented by a compilation and review of available information for the project area and discussions with Chevron Minerals Ltd., B.Y.G. Natural Resources Inc., Archer Cathro and Associates (1981) Limited and other consultants to the project. A program of liaison with the Government of the Yukon and the public with respect to project planning and approvals was initiated in 1988.

This report provides: an up-date on the project development plans; the available environmental information for the project area; and identifies sensitivities specific to development of the Brown-McDade Zone. This represents a change from the previous concepts for development of the project which had been discussed at meetings with Yukon and Federal government agencies during 1988.

The operation would involve mining of the two small open pits at the Brown-McDade Zone over a period of approximately two summers, stockpiling of ore at the existing mill site, refitting of the mill to accommodate an agitated cyanide leach process, establishing a work camp at the mill site, and tailings impoundment construction at a site just above the mill site (at the old work camp location). The mill would operate at 270 t/d for 15 months.

The process will involve agitated cyanide leach and a carbon-in-pulp circuit. Tailings will be disposed of into the tailings impoundment. Recycle of water to the mill will reduce the volume of water in the impoundment. Make up water will come from Victoria Creek and will vary with season; however, the average demand after start-up would be 4.7 L/s.

Potential environmental effects from the presently proposed development would be primarily from the tailings impoundment and how this could affect downstream receiving water in Victoria Creek. This could occur through seepage through the impoundment or through emergency decant. Tailings water decant would be treated, if required, to ensure that receiving water criteria established for the project are met at the compliance point.

The proposed sand-bentonite liner of the tailings impoundment would minimize seepage, estimated at 2 L/s. Monitoring of down gradient groundwater wells will determine the quality of seepage from the impoundment. Pumping back to the tailings impoundment from these wells will be done, if necessary, to meet downstream receiving water criteria of the compliance point.

Alternatives to pumping back seepage water include a geomembrane liner with much lower permeability, or treatment of tailings slurry or liquor in the mill prior to discharge to the tailings pond.

Based on the acid-base accounting tests conducted to-date, it is unlikely that the Brown-McDade Zone would be acid producing. The ore to be mined is oxidized, has apparently not produced acid as a result, and is therefore unlikely to produce acidic runoff from the ore stockpile, pit walls or waste rock dump, nor should the tailings be acid generating.

Fish populations in Nansen and Victoria creeks would not be affected by the development of the Brown-McDade Zone. Careful management of the tailings system to meet water quality criteria will ensure minimal effects on downstream fisheries values. The small streams draining the deposit and development area (Dome and Pony creeks) do not have any suitable fish habitat. The small amount of make-up water (maximum 4.7 L/s) required from Victoria Creek should not affect fish populations. The section of Victoria Creek on the property freezes down to the substrate during the winter so that fish overwintering areas are non-existent.

The development area is relatively small (9.54 ha for tailings impoundment, open pits and waste rock disposal), and given that the old mill will be used, effects on terrestrial resources will not be significant. Soils will be removed from the open pits prior to development and can be stockpiled, if suitable for future reclamation.

There has been hard rock and placer mineral exploration and development in the area since early in the century and mining has been the predominant land use. Mineral claims in the area to be developed are all held by B.Y.G. Natural Resources Inc. Hunting opportunities in the area are marginal and this should not be noticeably affected by the small operation proposed. A "closed area" will have to be posted around the mine area, mill, tailings and other facilities for safety purposes.

No unique or significant vegetation occurs in the area. Effects on wildlife will be negligible. The small amount of upland habitat involved will not affect local populations of moose or caribou and there are not expected to be any significant effects on birds.

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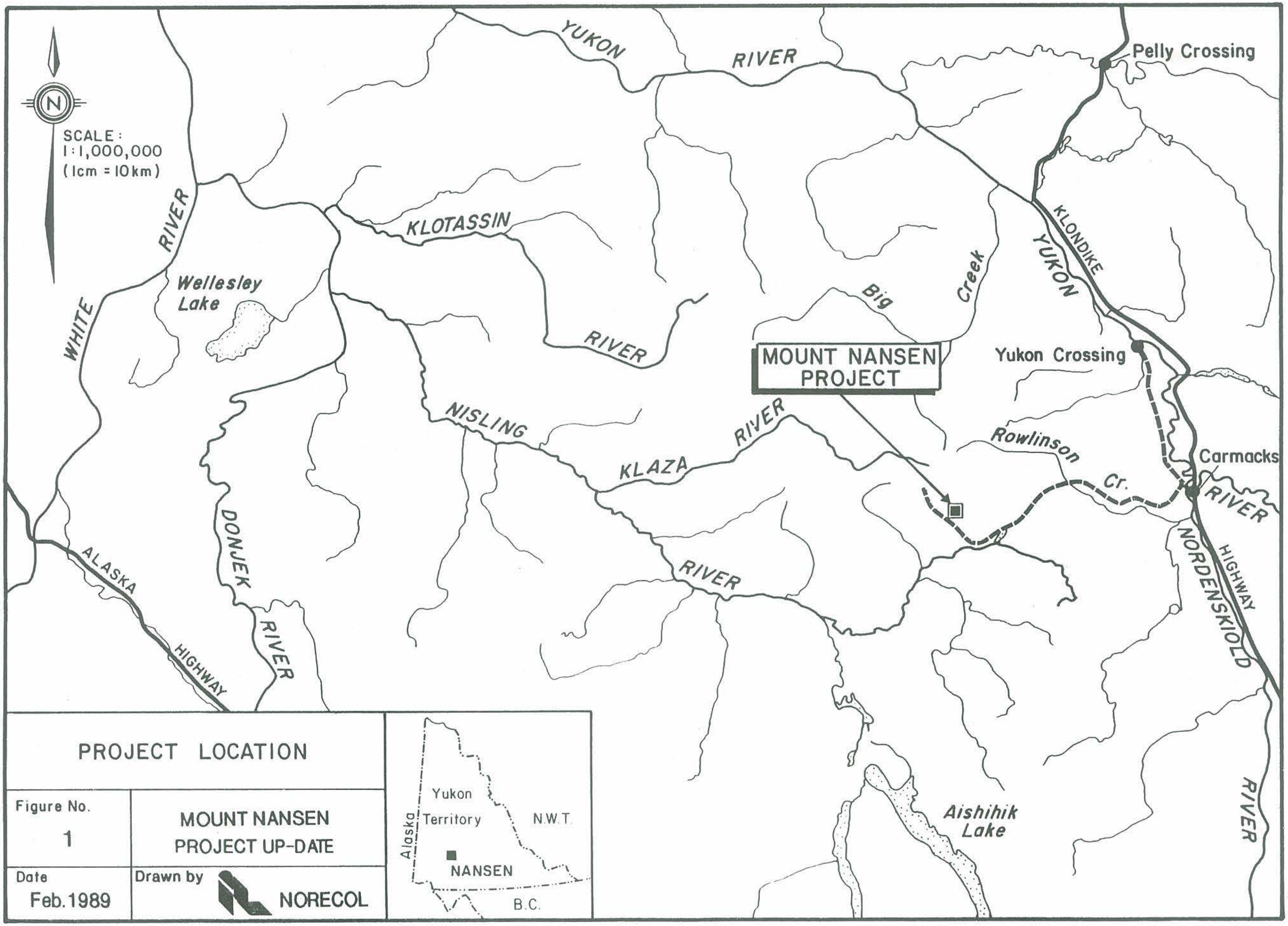
1.0 INTRODUCTION

1.1 Background

Chevron Minerals Ltd. and B.Y.G. Natural Resources Inc. (Chevron and B.Y.G., respectively) are investigating the potential of the Mount Nansen Gold Project in the Yukon Territory (Figure 1). The project area is located approximately 190 km northwest of Whitehorse at 62°03'N and 137°07'W (NTS 115I/3W). The property is accessed by a gravel road from Carmacks, located 50 km to the east.

The claims area covers 5299 ha (13 095 acres) and consists of 30 mineral leases and 257 mineral claims. Four surface leases are also held by B.Y.G. to protect the existing mill, tailings ponds and water supply systems. B.Y.G. owns the property. Chevron has an option to acquire a 62% interest but B.Y.G. has entered into a sub-option agreement whereby it can earn 50% of Chevron's interest. If all options are exercised, B.Y.G. will hold a 69% interest and Chevron 31%.

The four main vein systems occurring on the property are the Huestis, Webber, Brown-McDade and Flex zones (Figure 2). B.Y.G. plans to develop the Mount Nansen property, starting with the Brown-McDade Zone. This would involve open pit mining, refitting existing mill facilities and constructing a tailings impoundment and work camp. Road access upgrading from Carmacks is



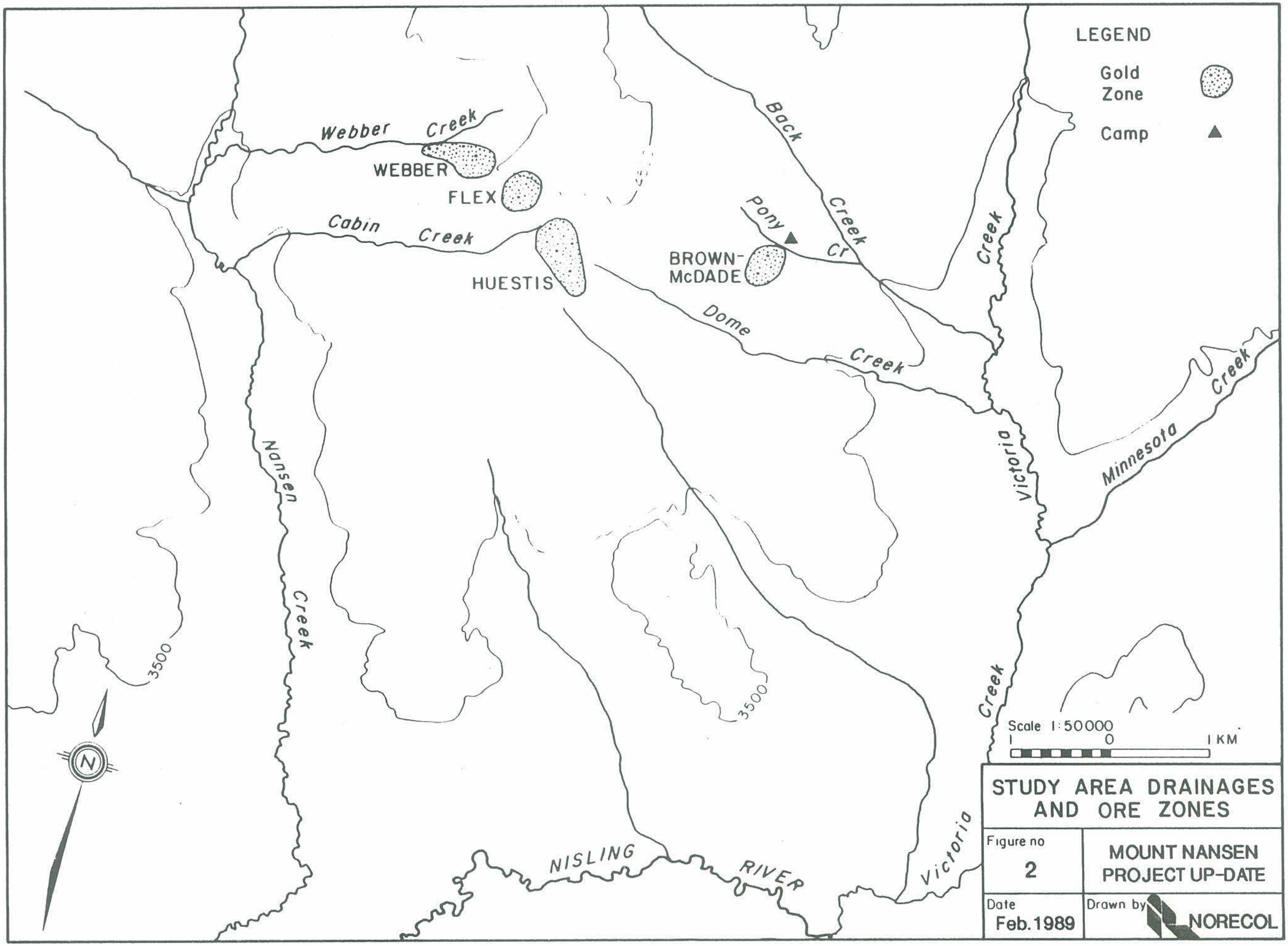
PROJECT LOCATION

Figure No. 1

MOUNT NANSEN PROJECT UP-DATE

Date Feb. 1989

Drawn by NORECOL


LEGEND
Gold Zone
Camp
Webber Creek
WEBBER
FLEX
Cabin Creek
HUESTIS
Back Creek
Pony Cr
BROWN-McDADE
Dome Creek
Creek
Victoria Creek
Minnesota Creek
Nansen Creek
3500
3500
NISLING RIVER
Victoria
N
Scale 1:50000
1 0 1 KM
STUDY AREA DRAINAGES AND ORE ZONES
Figure no
2
MOUNT NANSEN PROJECT UP-DATE
Date
Feb. 1989
Drawn by
NORECOL

considered the responsibility of the Government of the Yukon.

Exploration was first carried out in 1946 and 1947 by Leitch Gold Mines Ltd., Huestis Syndicate and Conwest Exploration Ltd. Mt. Nansen Mines Ltd. carried out further work from 1962 through 1964. Recent exploration has been carried out by the Chevron/B.Y.G. joint venture from 1985 through 1988.

Underground development was carried out by Leitch Gold Mines Ltd. in 1946 and 1947 and Mt. Nansen Mines Ltd. in 1965 through 1968. From 1967 through 1968, the mine produced 16 330 t of ore, with milling on-site. The mill had a capacity of 270 t/d and there were three separate tailings structures on Dome Creek. The mine subsequently closed, but was re-opened in 1975 by Mt. Nansen Mines Ltd. It only ran until 1976. During this second operation, 7435 t of ore were mined and milled. The mine was closed due to poor recovery of gold caused by the refractory nature of sulphide ores and the lack of a cyanidation circuit to treat the oxide ores.

1.2 Current Exploration and Plans For Development

Recent exploration has outlined strongly oxidized, open pit mineable reserves at the Brown-McDade and Flex zones and generally unoxidized, underground reserves at the Brown-McDade, Flex, Webber and Huestis zones. Several other zones have yielded significant intersections but have not yet been explored sufficiently to determine potential.

Initial production would be oxidized, open pit mineable material from the Brown-McDade Zone, with later mill feed probably coming from a Flex Zone open pit, then from underground workings on various zones. The geology and mineral inventory of the project area and an economic assessment of open pit mining of the Brown-McDade Zone are described in an Archer, Cathro and Associates (1981) Limited report (1989).

Melis Engineering Ltd. has supervised metallurgical tests on samples from the Brown-McDade Zone and has prepared a feasibility report on milling of ore from this zone (Melis Engineering Ltd. 1989). Klohn Leonoff Ltd. has investigated three potential tailings impoundment sites and preliminary design is provided in their report (Klohn Leonoff 1988).

Proposed development would begin with open pit mining from two pits in the Brown-McDade Zone. The existing mill facilities and buildings would be used and modified to permit cyanide leaching. A network of exploration roads provides good access to most of the property. The exploration camp is located adjacent to the Brown-McDade adit on upper Pony Creek. A permanent camp would be constructed adjacent to the mill facilities for mill employees and a seasonal camp near the Brown-McDade Zone for mining crews.

Access to the property is along a 60 km gravel road from Carmacks. For project development, some upgrading of the road may be required, along with improvements to stream crossings. An airstrip is located along Victoria Creek, but has not been maintained regularly.

1.3 Objectives

The objective of this up-date report is to summarize and review the current mine plans, review the environmental information collected to date, focussing on data collected by Norecol for the project since 1985 and to assess the potential areas of environmental concern along with alternatives to mitigate potential impacts. Other environmental information obtained from government agencies has been reviewed and referenced. The information presented covers the Mount Nansen Project area, but specific reference is to development of the Brown-McDade Zone.

2.0 DEVELOPMENT PLAN

2.1 Geology and Reserves

The Mount Nansen property is underlain by highly deformed Upper Paleozoic or older gneisses and schists that are intruded by Upper Triassic and Jurassic granodiorite and syenite batholiths, which are in turn intruded or overlain by Mid- to Late Cretaceous, mafic to felsic stocks, dykes, volcanic flows and pyroclastic rocks related to the Coast Plutonic Complex. A series of subparallel anastomosing veins occur in a 6 km long by 2.5 km wide belt extending the length of the property. The veins strike northwesterly, exhibit steep northeasterly to moderate southeasterly dips and cut all rock types.

The Brown-McDade Zone lies at the southeasterly end of the belt. It is 500 m long by 200 m wide and consists of quartz veins and associated feldspar prophyry dykes developed in the hanging wall of a strong fault (Footwall Fault), which strikes 160° and dips 50 to 70° to the southwest. The fault cuts obliquely across a contact between granodiorite and metamorphic rocks and is best mineralized where granodiorite forms both walls. Footwall rocks are relatively massive and unaltered, while hanging wall rocks are fractured and clay altered.

The strongest veins occur in a 3 to 40 m wide band directly adjacent to the Footwall Fault, while weaker subsidiary structures are common further out on the hanging wall. The highest assays are normally found within the quartz veins, and adjacent fractured or gougy wallrocks are often weakly to moderately mineralized. Supergene weathering has converted near-surface sulphide minerals to limonite and other oxides. The oxidation gradually diminishes with increasing depth and depth of total oxidation ranges from 5 m at the north end of the zone to at least 75 m at the south end. Primary sulphide minerals, in approximate order of abundance, are pyrite, arsenopyrite, sphalerite, galena and sulfosalts.

Close-spaced excavator trenching and diamond drilling along the length of the Brown-McDade Zone have outlined proven oxide reserves of 124 600 t grading 10.42 g/t Au and 98 g/t Ag in two shallow open pits that can be mined with a stripping ratio of 3:1

Work elsewhere on the property has defined an additional 62 606 t of oxidized open pit mineralization grading 7.44 g Au/t and 178 g Ag/t at the Flex Zone and 390 202 t of oxidized or sulphide-rich underground mineralization averaging 12.91 g Au/t and 232 g Ag/t in the Brown-McDade, Huestis, Webber and Flex zones.

2.2 Metallurgy

Open pit mineable oxide reserves at the Brown-McDade Zone have been extensively tested for gold and silver recovery using cyanide extraction (Melis 1989).

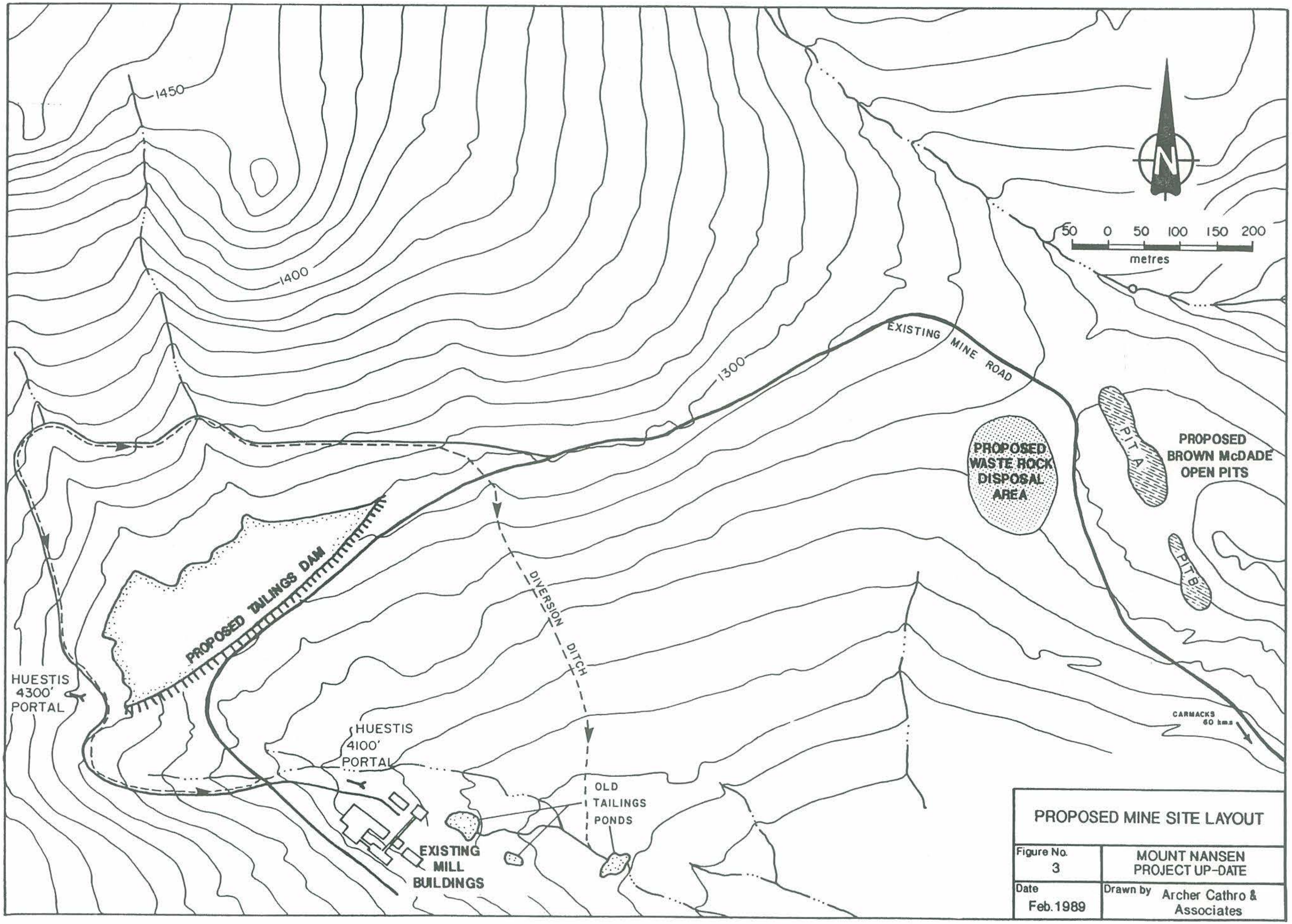
Bottle roll tests on finely ground material indicate that gold recovery is inversely proportional to sulphide content and depth below surface. Silver recovery is more erratic and is not as directly related to the abundance of sulphide minerals. The tests indicate that approximately 86% of the gold and 35% of the silver should be recoverable in twenty-four hours from material ground to 70% minus 74 microns. Cyanide and lime consumption are expected to average about 1.2 kg/t and 6.5 kg/t, respectively. Further details are found in the Melis (1989) report.

2.3 Mining Plan

The Brown-McDade oxide mineralization will be mined from two open pits located 100 m apart (see Figure 3). Mining will be done during the summer months at a rate of approximately 1 000 t/d. Mineralization will be stockpiled near the mill and waste will be piled adjacent to the pit or used to construct tailings dams. It is expected that most of the excavation will be done with a minimum of drilling and blasting, using a backhoe excavator. A bulldozer will be used to push away waste while dump trucks will transport the mineralization to the mill.

2.4 Milling

The mineralization will be treated in the existing mill after it has been retrofitted to permit aggitated cyanide leaching (Melis 1989). The proposed design utilizes the present crushing and grinding circuit (which based on work indexes for Brown-McDade oxide


1450
1400
1300
EXISTING MINE ROAD
50 0 50 100 150 200
metres
N
PROPOSED WASTE ROCK DISPOSAL AREA
PIT A
PIT B
PROPOSED BROWN McDADE OPEN PITS
PROPOSED TAILINGS DAM
DIVERSION DITCH
HUESTIS 4300' PORTAL
HUESTIS 4100' PORTAL
OLD TAILINGS PONDS
EXISTING MILL BUILDINGS
CARMACKS 60 kms
PROPOSED MINE SITE LAYOUT
Figure No. 3
MOUNT NANSEN PROJECT UP-DATE
Date Feb. 1989
Drawn by Archer Cathro & Associates

mineralization should be capable of generating 270 t of minus 74 micron material per day) and replaces the present flotation equipment with cyanide leach tanks, a carbon-in-pulp circuit and a bullion furnace. Electrical and heating systems will be totally replaced and a new trailer camp to house mill personnel will be constructed adjacent to the mill. Further details are found in the Melis report.

2.5 Tailings and Water Management

Water will be pumped from wells near Victoria Creek and transported to the mill in a 4.5 km long pipeline, most of which is already in place. Whenever possible mill water will be reclaimed from the tailings pond. Total daily water requirements for the mill and camp are estimated at 820 000 L. Make up water requirement from Victoria Creek will vary considerably depending upon evaporation rates from the tailings pond but will not exceed 6.1 L/s.

A tailings dam will be constructed 300 m northwest and 60 m uphill from the mill (Figure 3) at the old mine camp site. The dam and reservoir cover a relatively level 150 by 250 m area and will have the capacity to hold 300 000 t of tailings. The reservoir will be partially excavated into bedrock and lined with a bentonite-sand mixture. Seepage is estimated to be in the order of 2 L/s (Klohn Leonoff 1988) and will be monitored with test wells located downhill from the tailings dam. The proposed pond has a very small catchment area and this will be further reduced by a system of cutoff ditches that will redirect water around it (Klohn Leonoff 1988).

Tailings will be treated using the SO_2/air process to reduce cyanide levels prior to discharging to the tailings pond. Treatment will be accomplished by mixing the tailings slurry in the presence of copper sulfate, sodium metabisulfite and air using lime for pH control (Melis 1989).

3.0 ENVIRONMENTAL STUDIES

3.1 Introduction

A brief review of the environmental data collected by Norecol is given in this section. Data collected by government agencies and others is referenced.

Preliminary environmental studies, including collection of baseline data, have been undertaken by Norecol Environmental Consultants Ltd. (Norecol) since the fall of 1985. These have been summarized in two reports (Norecol 1985; 1987). Additional on-site data have been collected by Archer Cathro and Associates, who have been responsible for overall coordination of activities on the project. Indian and Northern Affairs Canada, Water Resources Division have also been collecting water quality data for the site since the previous mining operation.

Initial discussions have been held with government agencies to inform them of the proposed development and to identify environmental data and permitting and approval requirements. These meetings have been coordinated with the Regional Environmental Review Committee (RERC) and have included Fisheries and Oceans Canada, the Northern Affairs Program of Indian and Northern Affairs Canada, Economic Development, the Yukon Water Board and the Yukon Conservation Society. Initial review with government agencies included the possible construction of a heap leach pad. However, present plans exclude heap leaching of ore.

3.2 Environmental Setting

The Mount Nansen claims are located in the Dawson Range at elevations ranging between 945 and 1525 m. The area is drained by the Nisling River, which empties into the Yukon River via the Donjek and White rivers (Figure 1). Drainage from the property flows into two moderate sized tributaries of the Nisling River, Nansen Creek to the west and Victoria Creek to the east (Figure 2). Back and Dome creeks are tributaries of Victoria Creek which drain the east side of the property, while Webber and Cabin creeks are tributaries of Nansen Creek which drain the west side of the property (Figure 2).

Average monthly temperatures in the Mount Nansen area range from about 15^{o}C in July to -15^{o}C in January. Frost is rare from late May to early September. Annual precipitation averages about 25 cm, most of which falls as rain in the summer months. Late winter snow pack is normally 30 to 40 cm deep.

The property lies in the Dawson Range Ecosystem with vegetation characteristics described by Oswald and Senyk (1977). Open stands of black spruce (<u>Picea mariana</u>) and white spruce (<u>Picea glauca</u>) occur in the valley along Victoria Creek and Nansen Creek; black spruce is predominant on wetter sites. Stunted black spruce and trembling aspen (<u>Populus tremuloides</u>) occur on the lower slopes while the upper slopes and ridges are largely devoid of trees. Birch (<u>Betula</u> spp.) and willow shrubs form extensive cover from valley bottom to above treeline. Labrador tea (<u>Ledum groenlandicum</u>), mosses and lichens are dominant in the understory.

Preliminary geotechnical and permafrost information was gathered in the project area by Klohn Leonoff Consulting Engineers (1985). In general, the ridge tops and steeper hillsides have either no tree cover and bedrock outcropping or there is a cover of 1 to 3 m of weathered rock over intact bedrock. Extensive deposits of grey-brown sand occur in the valley bottoms and in the benchland near Dome Creek. Permafrost is evident at shallow depths (about 0.4 m) where the rock has an organic or moss cover, but where cover has been removed the permafrost layer occurs at greater depths (about 5.0 m). The permafrost layer in this region is 30 to 60 m thick. Mean annual temperature at the site is approximately -3^{O}C.

3.3 Status of Environmental Studies

Some environmental information was collected in relation to the earlier mining activity in the area. The Environmental Protection Service (1979) examined water chemistry and biological conditions in the Victoria Creek watershed in 1976 and 1977. EPS found that the tributary receiving mine decant water had reduced bottom fauna, but there was little impact on the bottom fauna and fish populations in Victoria Creek.

During 1982, EPS conducted leaching experiments on tailings from the Mount Nansen mine to determine oxidation potential (Davidge 1984). It was found that the tailings remained alkaline, did not oxidize appreciably, and leaching bacteria were prevented from becoming established due to acid consuming properties of the tailings.

Water quality monitoring was carried out by the Water Resources Division, Northern Affairs Program (Indian and Northern Affairs Canada) and some of these data have been reviewed. Their sampling was done to monitor operational mines or active exploration areas and their data for 1986, 1987 and 1988 are available from the Whitehorse Office.

Environmental Protection instituted a sampling program in the Mount Nansen project area in 1988. Samples of water quality were taken at 12 sites along with stream flow of most of these sites in July and August 1988. Benthic invertebrate sampling was also carried out in August, 1988.

Norecol's environmental studies were initiated in 1985 and consisted of seasonal sampling of water quality of a network of sites. Initial acid-base accounting and reconnaissance level wildlife studies were also carried out. A program of hydrologic studies was initiated in June 1988 and limited data were collected to September 1988.

A synopsis of the status of environmental studies for the project to the end of 1988 is given in Table 1.

3.4 Water Quality

3.4.1 Introduction

Water quality sampling was carried out by Norecol in the Mount Nansen Project area on October 11, 1985;

TABLE 1

SYNOPSIS OF ENVIRONMENTAL STUDIES FOR THE
MOUNT NANSEN PROJECT

COMPONENT	DATE OF STUDIES	WORK COMPLETED	STATUS/WORK REMAINING
Water Quality	September 21, 1976 August 31, 1977	Sampling network of 5 stations by Environmental Protection Service (3 sampled in 1976, 5 in 1977).	
	August 27, 1986	Limited sampling by Water Resources Service, Northern Affairs Program.	
	July 11-14, 1988 August 22-24, 1988	Additional sampling was carried out by Environmental Protection at 12 sites.	
	October 11, 1985 March 4, 1986 June 9, 1986 September 4, 1986 July 4, 1987 August 28, 1987 May 27, 1988	Total of 11 surface water sample sites plus 1 adit water site were established and sampled by Norecol on a seasonal basis.	Adequate level of sampling has been completed to form the basis for impact assessment and project permitting.
Stream Sediment	September 4, 1986	Samples collected at 10 surface water sample sites by Norecol.	Sufficient samples have been collected for assessment of project impacts.
	August 22-24, 1988	Sediment samples were collected by Environmental Protection at most of their 12 sample sites (data will not be available until late in 1988).	

TABLE 1 (continued)

SYNOPSIS OF ENVIRONMENTAL STUDIES FOR THE MOUNT NANSEN PROJECT

COMPONENT	DATE OF STUDIES	WORK COMPLETED	STATUS/WORK REMAINING
Hydrology/Climate	May 25-27, 1988	Established continuous flow recorder and did flow measurements on Victoria Creek. (Instrument was a Stevens A-71 recorder provided by Water Resources, DIAND). A V-notch weir was installed on Dome Creek below the main road. Staff gauge on Victoria Creek was monitored by camp staff. Precipitation and temperature were also measured at camp on an on-going basis.	A-71 recorder should be reinstalled in spring 1989 (after break-up) and at least 3 discharge measurements should be taken to provide a complete record during the open water season. Staff gauge records on Victoria Creek should be monitored twice weekly during open water; daily during storm events. Daily records of precipitation and temperature should be continued when camp is open. Complete records from A-71 recorder should be processed and estimated flows calculated in conjunction with the Water Resources Division. Additional hydrology and climate analysis may be required for engineering design.
	July 11-14, 1988 August 22-24, 1988	Environmental Protection also did flow measurements at most surface water sites.	
	September 21, 1988	Flows on Victoria Creek and Dome Creek were measured and recorder was serviced. Recorder had been operating intermittently, with some significant gaps in the record.	

TABLE 1 (continued)

SYNOPSIS OF ENVIRONMENTAL STUDIES FOR THE MOUNT NANSEN PROJECT

COMPONENT	DATE OF STUDIES	WORK COMPLETED	STATUS/WORK REMAINING
Hydrology/Climate	September 29, 1988	Flow recorder removed by the Water Resources Division, Northern Affairs Program	
Hydrogeological	-	-	A hydrogeological program should be carried out in conjunction with engineering design. Piezometers should be installed down gradient of the tailings impoundment for monitoring purposes.
Benthic Invertebrates	September 21, 1976 August 31, 1977	Limited sampling carried out by Environmental Protection Service using a Surber sampler (1 site in 1976, 3 sites in 1977).	
	August 22-24, 1988	Artificial substrates were placed at 9 of the 12 Environmental Protection stream sample sites in July and removed in late August, 1988. Analysis will not be completed until early 1989.	Sampling and analysis by Environmental Protection is adequate.
Fisheries	August 31, 1977	Sampling at two sites was carried out by the Environmental Protection Service; limited analysis of fish tissues for metals was conducted.	

TABLE 1 (continued)

SYNOPSIS OF ENVIRONMENTAL STUDIES FOR THE MOUNT NANSEN PROJECT

COMPONENT	DATE OF STUDIES	WORK COMPLETED	STATUS/WORK REMAINING
		Data compilation and review have been undertaken by Norecol, including discussions with Fisheries and Oceans staff. Field reconnaissance were done during various water quality samplings.	Site investigation of main project streams is required in summer to document presence, distribution and relative abundance of fish.
Acid-base Accounting	1984	Environmental Protection Service did test on Mount Nansen tailings; tests indicated acid consumption.	Preliminary tests indicate that the Brown-McDade Zone should not be an acid producer; this requires confirmation. Further test work is advised on future zones to be mined and on simulated tailings material.
	October 11, 1985	Eight samples collected by Norecol from Brown-McDade, Heustis and Webber zones. Analysis completed on ore and rock.	
Wildlife	March 4, 1988	Aerial survey flown by Norecol - small numbers (3) of wintering moose seen in project area. Observations have also been recorded during the course of other environmental work and by camp staff.	Detailed ground work is not considered necessary for the present scope of the project.
Soils/Surficial/ Vegetation	-	-	Site reconnaissance and mapping of surficial materials, and description of soil types for reclamation planning and materials handling may be required.

TABLE 1 (concluded)

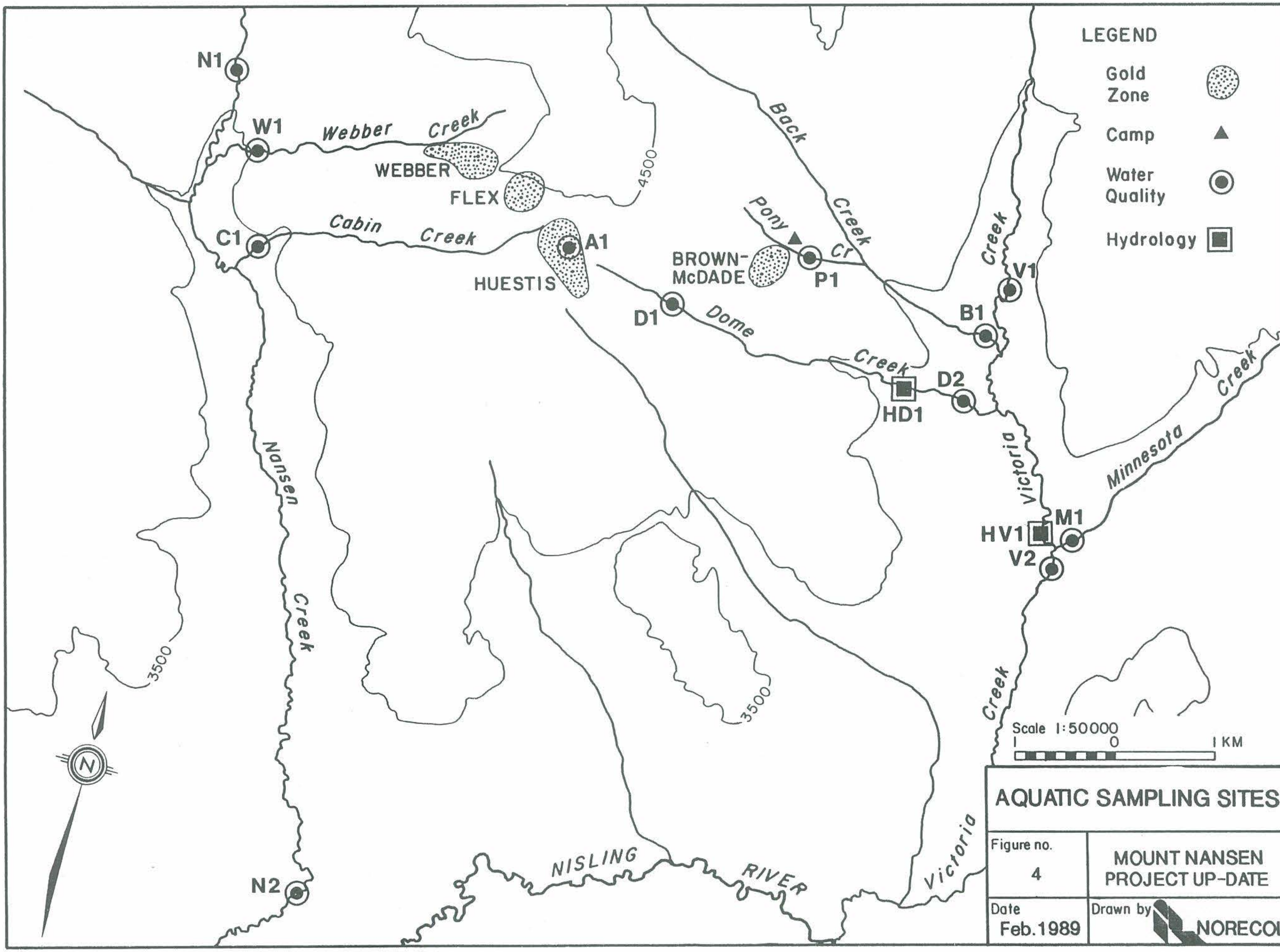
SYNOPSIS OF ENVIRONMENTAL STUDIES FOR THE
MOUNT NANSEN PROJECT

COMPONENT	DATE OF STUDIES	WORK COMPLETED	STATUS/WORK REMAINING
Land Status/ Resource Use/ Heritage	-	-	Detailed assessment not essential for the present scope of the project.
Government, Liaison, Public Involvement	March, 1988	Program was initiated in March 1988 - met with RERC, Northern Affairs, Water Resources, Fisheries and Oceans, Economic Development, Yukon Water Board, and Yukon Conservation Society. Project information package was submitted in March 1988.	Follow up required with respect to project approvals and permitting through the RERC and the Yukon Water Board.

March 4, June 9 and September 4, 1986; July 4 and August 28, 1987; and on May 27, 1988. Water quality sites are shown in Figure 4 and are described as follows:

A1	-	Lower Huestis Adit.
N1	-	Nansen Creek, 1.0 km upstream of Webber Creek.
N2	-	Nansen Creek, 1.2 km from mouth.
W1	-	Webber Creek, 0.6 km from mouth (drains Webber Zone).
C1	-	Cabin Creek, 0.3 km from mouth (drains Huestis Zone).
V1	-	Victoria Creek, 0.8 km upstream of Back Creek.
V2	-	Victoria Creek, approximately 5 km from mouth.
M1	-	Minnesota Creek, 0.1 km from mouth.
B1	-	Back Creek, 0.2 km from mouth.
P1	-	Pony Creek, tributary to Back Creek, 0.6 km from mouth (drains Brown-McDade Zone).
D1	-	Dome Creek, 3.5 km from mouth (drains Huestis Zone and old mill and tailings area).
D2	-	Dome Creek, 0.4 km from mouth.

Analytical parameters and laboratory detection limits are given in Table 2. Analytical results are given in Appendix I. On March 4, 1986 water was collected only from Webber Creek (W1) due to ice conditions and lack of water at the other sites; most sites were covered with 1 to 2 m of ice which was continuous to the creek bottom. Webber Creek (W1) was sampled where groundwater recharge had softened the ice.


LEGEND
Gold Zone
Camp
Water Quality
Hydrology
N1
W1
Webber Creek
WEBBER
FLEX
4500
Back Creek
Pony Cr
C1
Cabin Creek
A1
HUESTIS
BROWN-McDADE
P1
Creek
V1
B1
D1
Dome Creek
HD1
D2
Victoria
Minnesota Creek
HV1
M1
V2
Nansen Creek
3500
3500
Creek
Scale 1:50000
1 0 1 KM
N
N2
NISLING RIVER
Victoria
AQUATIC SAMPLING SITES
Figure no. 4
MOUNT NANSEN PROJECT UP-DATE
Date Feb.1989
Drawn by NORECOL

3.4.2 General parameters

Analytical results of the water samples collected by Norecol indicate that the surface water in the Mount Nansen Project area is generally soft to moderately soft and moderately alkaline. However, water from the lower Huestis adit (A1) is hard, very alkaline, highly conductive, and high in total solids. Dome Creek receives water from the lower Huestis adit, and as a result, exhibits similar hard, alkaline conditions. In fact, the upstream site on Dome Creek (D1), which also receives decant from a tailings impoundment, sometimes had higher conductivity, hardness and total solids than Site A1.

Elevated levels of suspended solids occur in certain streams in the area, particularly during periods of peak runoff. Concentrations of suspended solids in excess of 100 mg/L were found during high flows in Nansen Creek (N1) in June 1986 and in Dome (D1), Nansen (N1), and Victoria (V2) creeks in July 1987. Levels greater than 300 mg/L were found in Victoria (V2) and Webber (W1) creeks in September 1986. The highest levels of suspended solids were found in Back Creek (B1), where Norecol recorded 1418 mg/L in June 1986 and 965 mg/L in September 1986. Even higher concentrations, sometimes exceeding 10 000 mg/L, were measured by Environmental Protection in 1988. The source of these sediment loads is an operating placer mine upstream on Back Creek. The high sediment levels in Nansen and Victoria creeks may also reflect the historical placer activity on these streams.

TABLE 2

NORECOL WATER QUALITY PARAMETERS FOR THE MOUNT NANSEN PROJECT

Characteristics	Detection Limits
Temperature	field
pH	0.1
Total Solids	1 mg/L
Suspended Solids	1 mg/L
Turbidity	0.1 NTU
Specific conductivity	1 umhos/cm
EDTA Hardness	1 mg/L
Total Alkalinity	1 mg/L
Sulphate	1 mg/L
Nitrate	5 ug/L as N
Nitrite	2 ug/L as N
Ammonia	5 ug/L as N
Total Phosphorus	3 ug/L as P
Total Cyanide	1 ug/L
Total Mercury	0.05 ug/L
<u>Total and dissolved metals</u>	
Aluminum*	10 ug/L
Arsenic	1 ug/L
Barium	5 ug/L
Cadmium	0.2 ug/L
Copper	0.5 ug/L
Iron	5 ug/L
Lead	1 ug/L
Silver	0.2 ug/L
Zinc	0.5 ug/L

* May 1988 samples only

Levels of nutrients are highly variable in study area streams. In most samples, nitrate concentrations were less than 0.06 mg N/L, and ammonia levels were below 0.02 mg N/L. However, levels of both substances in excess of 0.1 mg N/L were sometimes found in upper Dome Creek (D1), Back Creek (B1), Pony Creek (P1) and the lower Huestis adit (A1). Nitrate concentrations exceeded 0.3 mg N/L in the adit on two occasions. A maximum ammonia concentration of 0.342 mg N/L was measured in upper Dome Creek. Nitrate concentrations generally were below the detection limit (0.002 mg N/L).

Total phosphorus concentrations varied from undetectable to a few milligrams of phosphorus per litre. The highest total phosphorus concentrations (0.113 to 2.18 mg P/L) were measured in Back Creek (B1), the maximum level being recorded on June 1986. The elevated phosphorus levels in Back Creek are probably associated with sediments from placer mining. The effect of the phosphorus loading to Victoria Creek from the Back Creek drainage was evident during the summer of 1986 at the lower Victoria Creek sampling location. Phosphorus concentrations above 0.3 mg P/L were recorded occasionally in Dome Creek (D1), Minnesota Creek (M1), Nansen Creek (N1, N2) and Webber Creek (W1), and usually were associated with increased levels of suspended solids.

3.4.3 Metals

Pony Creek was used for drinking water during the exploration program, and Minnesota Creek has been considered as a possible future water supply. Therefore, the water quality results for Pony Creek (P1) and Minnesota Creek (M1) have been compared to recommended drinking water guidelines in Table 3. Since the recommended metal levels in Table 3 are based on total concentrations, the total metal values presented in Appendix I are used as the source for comparison. These results indicate that Pony Creek had elevated cadmium levels in October 1985 and August 1987. Arsenic also exceeded the drinking water guideline in August 1987. Both Pony Creek and Minnesota Creek had consistently elevated iron levels on all three occasions. These values ranged from 0.81 to 3.52 mg/L for Pony Creek, and from 0.54 to 1.33 mg/L for Minnesota Creek. The recommended level of 0.3 mg/L for iron is established for aesthetic reasons (staining) and is not a health consideration.

In order to assess the potential water quality effects on aquatic biota in the Mount Nansen area, the water quality results at all sites are compared to guidelines recommended for protection of aquatic life (Table 3). As with the drinking water guidelines, these guidelines are based on total metal concentrations, therefore, the total metal values appearing in Appendix I were used for comparison.

Table 4 shows the range of values that exceeded the Canadian Council of Resource and Environment Ministers (1987) guidelines at each site. Pony Creek (P1), which drains the Brown - McDade Zone, had the highest value of cadmium (0.020 mg/L) and copper (0.34 mg/L) of all sites, and was very high in zinc (up to 1.44 mg/L).

TABLE 3

WATER QUALITY GUIDELINES

PARAMETER	DRINKING WATER	AQUATIC LIFE[a]	COMMENTS
Aluminum	-	0.1 mg/L	ph $\geq$ 6.5; $[Ca^{2+}]$ $\geq$ 4.0 mg/L; DOC $\geq$ 2.0 mg/L
Arsenic	0.05 mg/L	0.05 mg/L	
Barium	1.0 mg/L		
Cadmium	0.005 mg/L	0.2 ug/L	Hardness 0-60 mg/L ($CaCO_3$)
		0.8 ug/L	Hardness 50-120 mg/L ($CaCO_3$)
		1.3 ug/L	Hardness 120-180 mg/L ($CaCO_3$)
		1.8 ug/L	Hardness >180 mg/L ($CaCO_3$)
Chromium	0.05 mg/L	0.2 mg/L	To protect fish
		2.0 ug/L	To protect aquatic life, including zooplankton and phytoplankton
Copper	<1.0 mg/L[b]	2 ug/L	Hardness 0-60 mg/L ($CaCO_3$)
		2 ug/L	Hardness 60-120 mg/L ($CaCO_3$)
		3 ug/L	Hardness 120-180 mg/L ($CaCO_3$)
		4 ug/L	Hardness >180 mg/L ($CaCO_3$)
Cyanide	0.2 mg/L	5.0 ug/L	Free cyanide as CN
Iron	<0.3 mg/L[b]	0.3 mg/L	

continued . . .

TABLE 3 (continued)

WATER QUALITY GUIDELINES

PARAMETER	DRINKING WATER	AQUATIC LIFE	COMMENTS
Lead	0.05 mg/L	1 ug/L	Hardness 0-60 mg/L ($CaCO_3$)
		2 ug/L	Hardness 60-120 mg/L ($CaCO_3$)
		4 ug/L	Hardness 120-180 mg/L ($CaCO_3$)
		7 ug/L	Hardness >180 mg/L ($CaCO_3$)
Manganese	<0.05 mg/L[b]		
Mercury	0.001 mg/L	0.1 ug/L	
Nickel		25 ug/L	Hardness 0-60 mg/L ($CaCO_3$)
		65 ug/L	Hardness 60-120 mg/L ($CaCO_3$)
		110 ug/L	Hardness 120-180 mg/L ($CaCO_3$)
		150 ug/L	Harndess >180 mg/L ($CaCO_3$)
Nitrogen Ammonia (total)		2.2 mg N/L	pH 6.5; temperature 10°C
		1.37 mg N/L	pH 8.0; temperature 1°C
Nitrite	1.0 mg/L	0.06 mg/L	
Nitrate	10 mg/L		Concentrtions that stimulate profilic weed growth should be avoided.

continued . . .

TABLE 3 (concluded)

WATER QUALITY GUIDELINES

PARAMETER	DRINKING WATER	AQUATIC LIFE[a]	COMMENTS
pH	6.5 - 8.5[b]	6.5 - 9.0	
Selenium	0.01 mg/L	1 ug/L	
Silver		0.1 ug/L	
Zinc	<5.0 mg/L[b]	0.03 mg/L	
Total Suspended solids		Increase of 10 mg/L	Background suspended solids $\leq$100 mg/L
		Increase of 10% back-ground	Background suspended solids >100 mg/L

Sources: Drinking Water: Health and Welfare Canada 1987
Aquatic Life: Canadian Council of Resource and Environment Ministers 1987;

[a] Maximum acceptable level unless otherwise stated; guidelines refer to total metals.
[b] Aesthetic objective

DOC = Dissolved Organic Carbon

Back Creek (B1) had the highest values of total arsenic (0.168 mg/L) and iron (45.5 mg/L) of all sites. The elevated levels of metals in Back Creek are related to the disturbance of the stream by placer mining operations, both upstream and in the immediate vicinity of the water sampling site. Back Creek also receives water from Pony Creek which has high levels of heavy metals.

The Dome Creek drainage, which drains the Huestis Zone, has also shown high levels of some constituents. The sample from the lower Huestis adit (A1) had high levels of cadmium (0.0070 mg/L) and zinc (1.36 mg/L). The nearest downstream site on Dome Creek (D1) had the highest zinc value (2.47 mg/L) of all sites and was very high in iron (maximum 11.8 mg/L). All streams had high concentrations of total iron, with values ranging to 45.5 mg/L.

The previous discussion identified areas of environmental concern from a water quality perspective, but it should be noted that the effect of a given concentration of any metal on aquatic biota is difficult to predict. The effects can vary, depending on numerous water quality characteristics such as pH, temperature, alkalinity, conductivity, suspended solids, chelating qualities and the form of the metal (ionic being more available biologically).

3.5 Stream Sediment

Stream sediments were collected at water quality sites in the Mount Nansen area on September 4, 1986. The analytical results of these samples are shown in Table 4.

TABLE 4

RANGE OF VALUES ABOVE RECOMMENDED LEVELS FOR WATER QUALITY CHARACTERISTICS EXCEEDING[a] GUIDELINES FOR THE PROTECTION OF AQUATIC ORGANISMS IN THE MOUNT NANSEN PROJECT AREA[b]

SITE	TOTAL Ag (mg/L)	TOTAL As (mg/L)	TOTAL Cd (mg/L)	TOTAL Cu (mg/L)	TOTAL IRON (mg/L)	TOTAL Pb (mg/L)	TOTAL ZINC (mg/L)
A1	0.0002(2)	0.050 - 0.094(3)	0.0049 - 0.0070(4)	0.0053 - 0.0064(2)	0.62 - 2.89(5)		0.01 - 1.36(5)
B1	0.0004 - 0.0028(2)	0.056 - 0.42(3)	0.0004 - 0.0046(5)	0.0063 - 0.080(6)	1.80 - 45.5(6)	0.0035 - 0.08(5)	0.07 - 0.27(3)
C1				0.0022 - 0.0023(2)	0.37 - 0.80(4)		
D1	0.0003(1)	0.061 - 0.072(2)	0.0021 - 0.0050(2)	0.0042 - 0.030(2)	0.96 - 11.8(6)		0.19 - 2.47(5)
D2					0.34 - 1.37(4)		
M1				0.0025 - 0.0034(5)	0.54 - 1.33(5)		
N1			0.0003 - 0.0010(4)	0.0083 - 0.020(5)	0.64 - 3.02(5)	0.005(1)	
N2	0.0003(1)		0.0003 - 0.0008(3)	0.0058 - 0.040(5)	0.54 - 10.5(5)	0.004 - 0.009(2)	0.06(1)
P1	0.0002 - 0.0003(2)	0.095(1)	0.0004 - 0.020(6)	0.0027 - 0.34(6)	0.81 - 3.52(8)		0.14 - 1.44(5)
V1			0.0003(1)	0.0025 - 0.016(3)	0.33 - 2.99(5)	0.003(1)	
V2			0.0003 - 0.0010(3)	0.0228 - 0.018(5)	0.77 - 4.74(6)	0.003(1)	
W1	0.0005(1)		0.0006(1)	0.0021 - 0.010(2)	1.18 - 6.16(4)		

[a] Recommended levels for protection of aquatic life (Canadian Council of Resource and Environment Ministers 1987)

Silver	0.0001 mg/L
Total Arsenic	0.05 mg/L
Total Cadmium	0.0002 mg/L at hardness <60 mg $CaCO_3$/L to 0.0018 mg/L at hardness >180 mg $CaCO_3$/L
Total Copper	0.002 mg/L at hardness <60 mg $CaCO_3$/L to 0.004 mg/L at hardness >180 mg $CaCO_3$/L
Total Iron	0.3 mg/L
Total Lead	0.001 mg/L at hardness < 60 mg $CaCO_3$/L to 0.007 mg/L at hardness >180 mg $CaCO_3$/L
Total Zinc	0.03 mg/L

[b] Values in parentheses represent number of samples exceeding guidelines

The Pony Creek (P1) sediment samples contained the highest levels of metals relative to the other sites. With the exception of iron, mercury and silver, the Pony Creek sediment metals concentrations were all at least 10 times greater than those at the other sites; lead and arsenic reached levels of over 100 times those of the other sites. The high metal levels at Site P1 are attributed to material eroding from the old ore dumps at the Brown-McDade adit.

Sediment metals concentrations are higher in the Victoria Creek drainage than in the Nansen Creek drainage. The area of highest metal enrichment is likely from the Brown - McDade Zone and the Back Creek placer mining area.

Stream sediment samples were also collected during August, 1988 by Environmental Protection. Laboratory analyses of these samples have not been completed as of January 1989.

3.6 Climate and Hydrology

Climate data collected at the Mount Nansen exploration camp during 1985, 1986 and 1988 (generally end of May to September) consisted of daily temperature (maximum, minimum) and precipitation. Long term climate data for temperature and precipitation are available for Carmacks, 45 km to the east (Station No. 2100300). More details on climate, particularly precipitation, are provided in Klohn Leonoff's (1988) report.

A hydrology program for the project was initiated in late May 1988. A continuous water level recorder

TABLE 5

TOTAL METAL CONCENTRATIONS IN SEDIMENT SAMPLES FROM THE MOUNT NANSEN PROJECT

SAMPLE[a]	TOTAL METALS: (ug/g DRY WEIGHT)							
	Cu	Zn	Pb	Cd	As	Fe	Ag	Hg
B1	11.5	59.4	14.9	<1.25	22.1	19223	<1.25	<0.05
C1	5.46	39.0	<2.5	<1.24	10.7	33009	<1.24	<0.05
D1	5.46	43.4	3.47	<1.24	12.2	9927	<1.24	<0.05
D2	5.93	47.4	8.90	<1.23	25.2	12112	<1.23	<0.05
N1	26.0	51.5	18.1	<1.22	21.1	14216	<1.22	<0.05
N2	14.9	41.6	9.13	<1.20	13.0	10333	<1.20	<0.05
P1	456	702	1268	11.8	2093	49994	8.13	0.122
V1	13.6	42.2	6.33	<1.17	9.60	13138	<1.17	<0.05
V2	21.1	91.9	21.8	<1.22	50.4	18384	<1.22	<0.05
W1	5.59	28.7	3.89	<1.21	14.2	17015	<1.21	<0.05

[a] Sites shown on Figure 3

(Stevens A-71) was installed by Norecol on Victoria Creek above Minnesota Creek (Figure 3) on May 24, 1988. The recorder was provided on loan by the Water Resources Division, Northern Affairs Program, for use during the 1988 season. The site was gauged on three occasions in 1988: May 26, June 23 and September 22. (Table 6). Staff gauge readings were taken by Mount Nansen exploration camp personnel on a regular basis. Problems arose with the water level recorder around June 23 and it stopped recording shortly after that date. The station was inspected on September 21 and again operated until September 29 when the recorder was removed by Water Resources Division staff. Data for the flow recorder station have not been analyzed to date.

A 90° V-notch weir was installed on Dome Creek on May 26, 1988 (Figure 3) and measurements were taken by Norecol and exploration camp staff. These measurements were used to calculate estimated discharge for Dome Creek (Table 6).

Spot measurements were also done by Environmental Protection at 12 water sample sites on July 13 and August 24, 1988.

Although the data record is incomplete, some data were obtained for Dome Creek during peak rainfall events during July and August 1988. The project area received above average rainfall during July of 1988 (Steele pers. comm.) and this is reflected in the high discharges given for July and August in Table 6. During the period July 1 - 25, 1988, the Carmacks area

TABLE 6

MOUNT NANSEN PROJECT AREA
1988 HYDROLOGY DATA

SITE	DATE (1988)	STAFF GAUGE LEVEL (m)	DISCHARGE (m^3/s)	DISCHARGE $(L/S/Km^2)$
Victoria Creek above Minnesota Creek[a]	May 26	0.495	0.976	11.9
	June 23	0.33	0.211	2.57
	September 22	0.35	0.277	3.38
Dome Creek[b]	May 26	0.172[c]	0.0169	3.48
	May 27	0.165	0.0153	3.15
	May 29	0.230	0.0350	7.20
	June 2	0.210	0.0279	5.74
	June 12	0.166	0.0155	3.19
	July 4	0.271	0.0528	10.9
	August 4	0.311	0.0744	15.3
	September 22	0.155	0.0131	2.70

a 82 km^2 drainage area
b 4.86 km^2 drainage area
c 90^o V-notch weir

received 85.4 mm of rain whereas the mean for July is approximately 45 cm.

The Mount Nansen area would also have received about twice the mean total rainfall during this period. Much of the southwest and central Yukon received significant precipitation during July and August of 1988.

3.7 Acid Generation

Eight rock samples were collected on October 11, 1985 to conduct acid-base accounting tests. This test is a preliminary evaluation of potential of these materials to generate acid. The source of this rock, type of material, and assay analysis results are shown in Table 7.

These initial test results indicate that the Brown-McDade Zone is not likely to be an acid producer. One sample of marginal ore (No. 7) had a slight acid generation potential but the majority of the ore would have a net neutralization potential. The blending of ore is not likely to produce acid generating tailings. Waste rock may be used for construction purposes and the net neutralization potential should not cause a problem with its use; however, confirmatory test work for this zone is recommended.

Previous studies showed that the tailings from the abandoned Mount Nansen mine had the ability to consume acid, had little or no oxidation potential, and remained alkaline (Davidge 1984). This tailings

TABLE 7

ACID NEUTRALIZATION POTENTIALS OF ORE, WASTE ROCK AND TAILINGS FROM THE MOUNT NANSEN PROJECT

SAMPLE NUMBER	SOURCE	MATERIAL	PERCENT SULFUR	ACID AND BASE TONS $CaCO_3$ EQUIVALENT/1000 TONS		
				ACID GENERATION POTENTIAL	ACID CONSUMING POTENTIAL ($CaCO_3$ equivalent)	NET ACID GENERATION POTENTIAL (Acid-Base)
1	Huestis Zone (upper adit)	Ore	7.56	236.9	38.10	198.80
2	Huestis Zone	Ore	16.90	529.4	3.50	525.90
3	Webber Zone	Wall Rock	0.11	3.3	8.68	-5.38
4	Webber Zone	Wall Rock (with pyrite)	0.84	25.8	57.60	-31.80
5	Brown-McDade Zone	Marginal Ore	0,38	11.8	20.70	-8.90
6	Brown-McDade Zone	Wall Rock	0.09	2.6	19.80	-17.20
7	Brown-McDade Zone (hanging wall)	Marginal Ore	0.46	14.3	6.20	8.10
8	Huestis Zone (lower adit)	Tailings	4.53	141.8	30.20	111.60

material does not appear to constitute a concern to the environment from acid generation.

3.8 Fisheries

The Nisling River appears to have moderate fisheries capability, but little is known of the fisheries resources in the vicinity of the Mount Nansen area. Radio tagging studies have been conducted by Fisheries and Oceans which have tracked chum and chinook salmon approximately 30 km and 80 km, respectively, up the Nisling River from its confluence with the Donjek River (Etherton, pers. comm.). It is unlikely that chum salmon would migrate upstream as far as the project area, but chinook salmon could reach the general area providing that there are no fish barriers.

Fisheries information for the mine development area is extremely limited. Arctic grayling (Thymallus arcticus) and sculpins (Cottus sp.) have been captured in Victoria Creek (Environmental Protection Service 1979). These may be the only species occurring in Nansen and Victoria creeks, but both streams have moderate fish habitat capability and may be capable of supporting other fish species.

Nansen and Victoria creeks have no sport fishing potential, but the Nisling River may offer angling opportunities.

3.9 Wildlife

The property generally has low to moderate capability for wildlife. Moose occur throughout the area in low numbers in summer and fall, favouring the valley bottoms and riparian edges of streams. Caribou occur in the general area and occasionally move through the property. A bull caribou was observed on an open ridge between Victoria and Back creeks on June 9, 1986 and occasional sightings are made by exploration crews on and near the property.

During the winter period, it appears that a few moose utilize the lower elevations, in particular the floodplain and lower slopes along Victoria Creek, for at least part of the winter. Several sightings were made in March, 1986 (Appendix II), including one moose near the confluence of Back and Victoria creeks and a cow moose and yearling further downstream in the wide Victoria Creek valley south of the airstrip. Scattered moose tracks were also observed along the floodplain of Victoria Creek. The low snow depth and availability of browse, primarily willows, offer limited winter range for low densities of moose. The only other ungulate that could occur on the property in winter would be caribou which may occasionally move through the area.

Other large mammals which may occur in low numbers include black bear and wolf. The area appears to have generally low productivity for furbearers. Very little sign of furbearers was observed during field visits, including helicopter flights and reconnaissance during March, 1986.

A general note of interest is that the Yukon Game Branch has transplanted bison to the Nisling River area, approximately 10 to 15 km downstream (southwest) of the Mount Nansen property. Large pens were constructed for the bison and hay was moved in to provide winter feed. The bison were brought in by road from Carmacks in the late winter of 1986. This herd is sufficiently removed from the Mount Nansen project area that it would not be affected by project development.

4.0 ENVIRONMENTAL SENSITIVITIES

4.1 Introduction

Potential environmental sensitivities to project development were outlined in the Norecol (1987) report. These related to the overall Mount Nansen property and covered all mineral zones in a general sense. For the Brown-McDade Zone development the evaluation of environmental sensitivities is based on the environmental baseline data collected by Norecol and government agencies, and the engineering and geological information provided in the reports by Archer Cathro and Associates (1989), Melis (1989) and Klohn Leonoff (1988).

4.2 Acid Mine Drainage

The initial acid-base accounting test work (Table 7) indicates that the Brown-McDade Zone should not be an acid producer. The oxidized nature of the ore indicates that there should not be acid generation in the ore stockpile at the mill, in the waste rock pile, in the pit walls, or from waste rock used for construction purposes.

Acid mine drainage is a concern whenever high sulphide ores are involved. The oxidized nature of the Brown-McDade Zone ore should minimize this concern.

The metallurgical test work for the Brown-McDade ore indicates that the tailings will have a low sulphide content (<0.01 to 0.58% sulphide) and that acid generation should not occur from the oxidized ore (Melis 1989). However, confirmatory test work is recommended prior to construction.

4.3 Water Quality

The most important source of potential water quality impacts associated with the mining of the Brown-McDade Zone would be the tailings facility.

4.3.1 Tailings system operation

Conceptual operation of the tailings facility is detailed in the Melis (1989) and Klohn Leonoff (1988) reports. Untreated tailings will be piped to the tailings pond and reclaim water pumped back to the mill. This will result in a no-positive-discharge system under normal operation. Some water is forecast to seep from the tailings dam.

If tailings water must be discharged for any reason it will be treated with an SO_2-air or H_2O_2 process and additionally with ferric sulphate, if required. Surface discharge will need to meet Canadian Council of Resource and Environment Ministers (CCREM) water quality criteria for protection of freshwater aquatic life at the compliance point, which we recommend being on Victoria Creek below the confluence with Dome Creek.

4.3.2 Characteristics of mill feed and tailings supernatant water

The present mining plan calls for open pit mining of oxide ore from the Brown-McDade Zone. Representative oxide ore assays are presented by Melis (1989, Table 3-1). In summary, the oxide ore has fairly high concentrations of arsenic, lead and zinc and moderately high concentrations of cadmium, copper and antimony. No assays of milled tailings solids are available but these will be similar in assays to the oxide ore analyses. The mill process will be an agitated cyanide leach, followed by adsorption on carbon and precipitation of gold and silver with zinc dust.

An estimate of the quality of tailings liquor is available from the barren bleed assay for oxide ore presented as Table 2-6 in Melis (1989). Seepage water from the tailings dam would be lower in metal content since co-precipitation of heavy metals is known to occur in tailings ponds. The barren solution is high in copper, zinc, and total cyanide. Arsenic, and lead were not assayed and so cannot be compared with the head assays discussed above. High concentrations of cadmium did not appear in the barren solution.

4.3.3 Water quality impact scenarios

Seepage of tailings water from the dam and the floor of the tailings pond, and discharge of tailings decant water are the two aspects of the proposed operation of the tailings pond that have potential to impact the water quality of Victoria Creek (Dome Creek is assumed here to be a dilution zone). The former would be due to permeability of the dam and would consist of untreated tailings water. The latter would be required by an emergency release and would be treated water.

Mass balance calculations were used to estimate the quality of Victoria Creek at V2 (Figure 4) during mean flows and minimum October flows if seepage water from untreated tailings is allowed to enter Dome Creek and flow from there into Victoria Creek. Klohn Leonoff (1988) give an estimate of 2 L/s seepage from a tailings dam, assuming that a sand-bentonite liner is used. This analysis provides a worst case estimate since co-precipitation in the tailings pond will lower metal levels in solution.

Table 8 lists estimated water quality at V2 resulting from tailings seepage assuming barren bleed water quality, or worst case. Mean annual flows are taken from Norecol hydrology data listed; minimum flows are based on a comparison with Big Creek data provided by the Inland Waters Directorate (1988). Big Creek was assumed to have a similar runoff regime to Victoria Creek. A ten-year October low flow value was used to represent minimum flows.

The rationale for this choice was as follows: winter flows in Victoria Creek are likely to be negligible due to freezing conditions; seepage from the tailings pond will also be curtailed during winter. Winter was assumed to be November through May. October flows are the lowest of the year in Big Creek (and likely in Victoria Creek) outside of this winter period.

TABLE 8

PREDICTED WATER QUALITY OF VICTORIA CREEK AT STATION V2
WITH SEEPAGE FROM PROPOSED TAILINGS POND

PARAMETER	TAILINGS EFFLUENT[a]	VICTORIA CREEK AVERAGE WATER QUALITY (V2)[b]	MAY	JUN	JUL	AUG	SEP	MEAN ANNUAL	MINIMUM
Stream Discharge rate (m^3/s) Victoria Creek @HV1[c]	-	-	0.976	0.211	-	-	0.277	0.488	0.077[d]
Seepage Discharge Rate (m^3/s)[e]	-	-	-	-	-	-	-	0.002	-
Dilutions	-	-	488	106	-	-	139	244	39
Total Cyanide (mg/L)	157	0.001	0.322	1.488	-	-	1.134	0.981	4.078
TOTAL METALS (mg/L)									
Ca[f]	0.04	0.005	0.000	0.001	-	-	0.000	0.001	0.001
Cd	0.14	0.0002	0.000	0.001	-	-	0.001	0.001	0.004
Cu	69	0.0155	0.142	0.655	-	-	0.499	0.432	1.792
Fe	2	2.23	0.051	0.227	-	-	0.104	0.127	-[g]
Mo[f]	0.11	0.01	0.000	0.002	-	-	0.001	0.001	0.003
Ni[f]	0.06	0.02	0.001	0.002	-	-	0.001	0.001	0.001
Sb[f]	0.45	0.05	0.002	0.009	-	-	0.005	0.005	0.010
Zn	59	0.006	0.121	0.560	-	-	0.426	0.369	1.532

Notes:

a From untreated barren solution characterized by Melis Engineering (1989), composite 'A'.
b From Norecol water quality data, this report, except as noted.
c From Norecol hydrology data, this report.
d Calculated by runoff/unit area comparison with October minimum flows for Big Creek, Yukon (source Inland Water Directorate, 1988).
e From Klohn Leonoff (1988).
f From Environmental Protection data, (1988).
g Background higher than calculated level.

Two assumptions were made about water quality. Mean water quality in Victoria Creek was calculated from Norecol data from 1985 to 1988 listed in this report. Where parameters were missing from Norecol data, Environment Canada data were used. This included the elements cobalt, molybdenum, nickel and antimony. Environment Canada data were from the probable point of compliance near the Dome Creek mouth, while Norecol data were from slightly further downstream on Victoria Creek below its junction with Minnesota Creek. The distance is about 2 km further down Victoria Creek.

Table 8 predicts that several parameters would exceed CCREM guidelines at V2 on Victoria Creek, if seepage were to be allowed to flow to the receiving environment at 2 L/s. Levels of cyanide, copper and zinc would exceed CCREM criteria for the protection of freshwater aquatic life during both average and low flows. However, copper is naturally well in excess of the CCREM criterion (0.0155 mg/L; criterion 0.002 mg/L for soft water). Furthermore, predicted copper levels are misleading because the value used was from barren bleed assay, whereas the level in the tailings seepage would be lower due to co-precipitation in the tailings pond. The criterion for iron is also exceeded naturally. The level set for iron is on aesthetic, rather than toxic, considerations.

The conclusion from the mass balance calculations is that tailing seepage water would have to be pumped back to the pond if untreated seepage water were contained in a sand-bentonite lined tailings pond with the water quality predicted by barren solution assays. As noted

TABLE 9

REQUIRED TAILINGS SEEPAGE QUALITY TO MEET
RECEIVING ENVIRONMENT QUALITY AT STATION V2 ON VICTORIA CREEK

PARAMETER	VICTORIA CREEK AVERAGE WATER QUALITY AT V2[a]	TAILINGS SEEPAGE		CCREM WATER QUALITY GUIDELINE
		AVERAGE FLOWS[a]	MINIMUM FLOW	
Stream Discharge rate (m^3/s) Victoria Crk @ HV1	-	0.488	0.077	-
Seepage Discharge Rate (m^3/s)	-	0.002	0.002	-
Dilutions	-	244	39	-
Ammonia (mg N/L)	0.011	537	85	2.2
Nitrate (mg N/L)	0.044	2440	385	10
Nitrite (mg N/L)	0.002	15	2	0.6
Total Cyanide (mg/L)	0	1.220	0.193	0.005
TOTAL METALS (mg/L)				
Ag[b]	0.0002	0.0242	0.004	0.0001
Al	0.11	24.3	3.7	0.1
As	0.009	12	1.92	0.05
Cd	0.0004	0.0484	0.007	0.0002
Cu	0.0073	0.481	0.070	0.002
Fe	2.23	71	9.3	0.3
Hg (ug/L)	0.05	244	38	1
Pb[b]	0.001	0.243	0.038	0.001
Se	0.001	0.243	0.038	0.001
Zn	0.006	7.314	1.149	0.03

Notes:

[a] From Norecol water quality data, this report, except as noted.
[b] From Environmental Protection data, 1988.

previously, barren bleed concentrations of metals are higher than levels likely to occur in tailings seepage water because there is no reflection of co-precipitation that would occur in the tailings pond. Pumping back would be required during summer months, that is June through October. Alternatives to pumping back seepage water include a geomembrane liner with much lower permeability, or treatment of tailings slurry or liquor in the mill before discharge to the tailings pond. Table 9 lists the required quality of seepage water for average and minimum flows in Victoria Creek in order that CCREM freshwater aquatic life criteria would be met at V2.

Seepage is assumed to be 2 L/s and other assumptions are similar to the mass balance model used to predict impact from untreated seepage water.

4.4 Water Management

Surface water management of the mill site and tailings impoundment will be achieved by a system of drainage collection ditches which will divert clean surface runoff around the sites and into Dome Creek (Figure 3). Runoff from the mill area and ore stockpile will be collected in ditches and flow to a settling pond adjacent to the mill. Decant from this will be directed toward Dome Creek. Detailed design will occur prior to construction and will follow general guidelines required for such structures (see Klohn Leonoff (1988) report for general design of ditch around the tailings impoundment).

Precipitation into the tailings impoundment has been incorporated in Klohn Leonoff's feasibility design for the impoundment (Klohn Leonoff 1988). Water recycle from the tailings to the mill process will reduce the likelihood of decant from the impoundment.

The Brown-McDade open pits will be dug into highly fractured rock and are not likely to fill with water. The north pit will likely break into the old adit and water would drain through the adit. The rock in the footwall of the pits has low sulphide and is impermeable, thereby minimizing the potential for acidification of seepage draining through the old workings. Seepage from the old adit may require monitoring to determine if any changes are occurring in water quality during mining and to confirm the absence of acid generation. In the absence of acid generation, this water could be discharged directly to Pony Creek.

4.5 Fisheries

The information available on fisheries resources of the area indicates that Victoria and Nansen creeks have capability for Arctic grayling. Spawning salmon are not expected in the area of the property. The small streams draining the development area (Dome, Pony and Back creeks) are too small to have fisheries habitat and have in some cases (especially Back Creek) been significantly impacted by placer mining activity.

The mining at the Brown-McDade Zone and milling will not affect fisheries resources in Victoria Creek. Seepage and decant from the tailings impoundment has the potential to affect water quality in Victoria

Creek, and consequently aquatic fauna, if not treated. As discussed previously (Section 4.3), seepage return or treatment of decant may be required to meet receiving water criteria.

4.6 Soils/Vegetation

Surface disturbance for the present scope of the development will be relatively small. The open pits (1.03 ha), waste rock dump (4.12 ha) and tailings impoundment (4.39 ha) will not result in any significant effects on soils or vegetation of the area. Stripping of overburden is required and where feasible, this can be stockpiled for latter use in reclamation. The tailings site is already a disturbed site, being the site of the old mine camp facilities. The existing mill site will be used and should result in minimal additional surface disturbance.

Drainage control will minimize the risk of erosion and site reclamation, where required, will stabilize the waste rock dump. The tailings impoundment will drain and a spillway will be constructed upon completion at that site. Once the material is dry, then the surface of the impoundment can be scarified and seeded with a mixture of grasses and forbs. The embankments and surfaces of drainage ditches and settling ponds can also be seeded and stabilized, as required.

Reclamation scheduling will be dependent upon the timing of development of the other mineralized zones and the requirement for additional tailings impoundment, waste rock dumps, and other facilities.

The mill facilities will be removed and the site revegetated, if required.

4.7 Wildlife

The scope of the present project and the small size should not affect local wildlife populations and would not result in a significant reduction in available habitat. Populations of moose and caribou range through the area and are not dependent upon any of the sites to be developed. There is an abundance of similar habitats on the property and in adjoining areas. Effects of riparian habitat, notably the valley bottom along Victoria Creek, will be minimal.

4.8 Land Use

The proposed development at the Brown-McDade Zone should not have any effects on land use or status. The property is presently owned by B.Y.G. through mineral claims and surface leases. Mineral exploration and mining has been a long standing land use of the area. There are no significant recreation features or users in the area. Angling potential at Victoria Creek is limited and would not be affected by development. The property is a considerable distance by road from Carmacks (60 km) and does not have a high enough number of resident moose or caribou to attract significant levels of sport hunting.

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APPENDIX I

WATER QUALITY DATA FOR THE MOUNT NANSEN PROJECT AREA

(Tables 1 to 7)

(Samples collected by Norecol Environmental Consultants Ltd. and Laboratory analysis by B.C. Research Corporation)

TABLE 1

ANALYTICAL RESULTS FOR WATER SAMPLES FROM MOUNT NANSEN PROJECT

Sampling Date: October 11, 1985

ANALYTICAL PARAMETER	SITE A1	SITE B1	SITE C1	SITE D1	SITE D2	SITE M1	SITE N1	SITE N2	SITE P1	SITE V1	SITE V2	SITE W1
Temperature (°C)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pH	7.3	7.3	7.2	7.3	7.0	6.9	7.5	7.8	7.5	7.7	7.5	7.1
Alkalinity (mg$CaCO_3$/L)	192	67	28	236	58	22	50	55	89	69	61	43
Turbidity (NTU)	6	48	4.5	30	3.7	2.5	5.5	5.5	5.2	0.8	9	5.8
Conductance (µmhos/cm)	660	150	67	1200	350	51	126	136	264	140	125	150
Total Solids (mg/L)	782	248	112	1435	370	96	144	144	269	120	154	170
Suspended Solids (mg/L)	1	57	<1	14	<1	<1	7	4	1	2	16	<1
EDTA-Hardness (mg$CaCO_3$/L)	535	94	39	963	212	24	72	77	162	83	69	83
Sulfate (mg/L)	334	31	15	694	156	<1	29	25	82	11	17	44
Ammonia (mgN/L)	0.063	0.053	0.011	0.342	0.010	0.006	0.006	<0.005	0.081	<0.005	<0.005	0.005
Nitrate (mgN/L)	0.092	0.021	0.013	0.117	0.015	0.030	0.035	0.023	0.037	0.044	0.037	0.011
Nitrite (mgN/L)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Total Phosphorus (mgP/L)	0.026	0.113	0.008	0.077	0.017	0.006	0.014	0.014	0.017	0.008	0.024	0.008
Total Cyanide (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
<u>TOTAL METALS</u>: (mg/L)												
Ag	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
As	0.062	0.024	0.004	0.072	0.019	<0.001	0.002	0.002	0.016	<0.001	0.004	0.005
Ba	0.023	0.12	0.041	0.072	0.046	0.048	0.056	0.042	0.050	0.067	0.071	0.033
Cd	0.0070	0.0004	<0.0002	0.0021	<0.0002	<0.0002	<0.0002	<0.0002	0.0089	<0.0002	<0.0002	<0.0002
Cu	0.0022	0.0063	0.0019	0.0031	0.0014	0.0028	0.0083	0.0077	0.19	0.0015	0.0028	0.0011
Fe	0.85	4.14	0.78	8.8	1.04	0.83	0.64	0.54	1.42	0.12	0.77	1.18
Hg (µg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Pb	<0.001	0.0035	<0.001	0.0017	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	1.19	0.0093	0.0009	0.65	0.013	0.0015	0.0030	0.0022	0.95	0.0010	0.0026	0.0010
<u>DISSOLVED METALS</u>: (mg/L)												
Ag	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
As	0.005	0.006	0.003	0.007	0.012	<0.001	<0.001	0.001	0.012	<0.001	0.001	0.004
Ba	0.020	0.12	0.040	0.058	0.044	0.046	0.041	0.040	0.050	0.059	0.069	0.030
Cd	0.0054	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0071	<0.0002	<0.0002	<0.0002
Cu	0.0012	0.0046	0.0019	0.0025	0.0013	0.0026	0.0075	0.0075	0.11	0.0015	0.0025	0.0010
Fe	0.036	0.51	0.48	0.033	0.56	0.46	0.22	0.14	0.81	0.10	0.09	0.52
Pb	<0.001	<0.001	<0.001	<0.0011	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	1.10	0.0042	0.0010	0.39	*_	*_	*_	*_	0.77	0.0010	0.0022	*_

*Samples stored and analysed at a later date. All dissolved values were equal to or less than totals indicated.

(0318d)

TABLE 2

ANALYTICAL RESULTS FOR WATER SAMPLES FROM MOUNT NANSEN PROJECT

Sampling Date: March 4, 1986

ANALYTICAL PARAMETER	SITE W1
Temperature (°C)	0.0
pH	6.8
Alkalinity (mg$CaCO_3$/L)	80
Turbidity (NTU)	0.65
Conductance (μmhos/cm)	183
Total Solids (mg/L)	181
Suspended Solids (mg/L)	<1
EDTA-Hardness (mg$CaCO_3$/L)	123
Sulfate (mg/L)	50
Ammonia (mgN/L)	0.039
Nitrate (mgN/L)	0.007
Nitrite (mgN/L)	<0.002
Total Phosphorus (mgP/L)	<0.003
Total Cyanide (mg/L)	<0.001
TOTAL METALS: (mg/L)	
Ag	<0.0005
As	<0.001
Ba	0.057
Cd	<0.0002
Cu	0.0006
Fe	0.09
Hg (μg/L)	<0.05
Pb	<0.001
Zn	0.0046
DISSOLVED METALS: (mg/L)	
Ag	<0.0005
As	<0.001
Ba	0.055
Cd	<0.0002
Cu	0.0006
Fe	0.037
Pb	<0.001
Zn	0.0010

(0318d)

TABLE 3

ANALYTICAL RESULTS FOR WATER SAMPLES FROM MOUNT NANSEN PROJECT

Sampling Date: June 9, 1986

ANALYTICAL PARAMETER	SITE A1	SITE B1	SITE C1	SITE D1	SITE D2	SITE M1	SITE N1	SITE N2	SITE P1	SITE V1	SITE V2	SITE W1
Temperature (°C)	1.0	5.0	5.0	3.0	4.0	3.0	5.0	7.0	4.0	3.5	3.0	3.0
pH	7.4	7.3	7.6	7.5	7.3	7.3	7.6	7.7	7.5	7.7	7.8	7.4
Alkalinity (mg$CaCO_3$/L)	172	26	21	128	40	19	24	28	30	44	41	37
Turbidity (NTU)	3.6	150	1.2	6.2	0.5	1.0	29	23	3.0	2.0	11	0.8
Conductance (μmhos/cm)	805	105	69	940	410	42	74	82	103	87	88	115
Total Solids (mg/L)	825	1563	175	1044	424	116	242	198	169	150	171	152
Suspended Solids (mg/L)	3	1418	5	6	<1	<1	108	50	5	14	42	1
EDTA-Hardness (mg$CaCO_3$/L)	547	35	29	641	234	20	36	41	55	49	48	59
Sulfate (mg/L)	368	19	11	496	187	<1	14	14	23	7	9	22
Ammonia (mgN/L)	0.026	0.043	<0.005	0.230	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nitrate (mgN/L)	0.336	0.096	0.027	0.223	0.010	0.058	0.064	0.030	0.054	0.070	0.078	0.022
Nitrite (mgN/L)	0.005	<0.002	<0.002	0.009	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Total Phosphorus (mgP/L)	<0.003	2.18	<0.003	<0.003	<0.003	<0.003	0.176	0.076	<0.003	<0.003	0.040	<0.003
Total Cyanide (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TOTAL METALS: (mg/L)												
Ag	0.0002	0.0028	<0.0002	0.0003	<0.0002	<0.0002	<0.0002	<0.0002	0.0003	<0.0002	<0.0002	<0.0002
As	0.049	0.168	<0.001	0.021	0.012	<0.001	0.006	0.004	0.015	<0.001	0.005	0.001
Ba	0.017	0.18	0.031	0.027	0.038	0.038	0.053	0.038	0.031	0.032	0.034	0.030
Cd	0.0061	0.0025	<0.0002	0.0050	<0.0002	<0.0002	0.0004	0.0003	0.0017	<0.0002	<0.0002	<0.0002
Cu	0.0064	0.08	0.0019	0.0042	0.0018	0.0025	0.019	0.015	0.034	0.0025	0.0038	0.0021
Fe	0.64	45.5	0.37	1.04	0.24	0.81	2.73	1.96	0.81	0.33	1.12	0.24
Hg (μg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Pb	0.0013	0.08	<0.001	0.0019	<0.001	<0.001	0.0011	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	1.36	0.27	0.0019	2.47	0.04	0.0040	0.018	0.012	0.14	0.0018	0.0018	0.0015
DISSOLVED METALS: (mg/L)												
Ag	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
As	0.005	0.037	<0.001	0.018	0.009	<0.001	0.003	0.002	0.011	<0.001	0.002	<0.001
Ba	0.016	0.095	0.023	0.026	0.038	0.036	0.025	0.019	0.029	0.028	0.030	0.026
Cd	0.0058	0.0006	<0.0002	0.0041	<0.0002	<0.0002	<0.0002	<0.0002	0.0015	<0.0002	<0.0002	<0.0002
Cu	0.0061	0.0057	0.0017	0.0027	0.0018	0.0024	0.0068	0.0073	0.031	0.0020	0.0023	0.0015
Fe	0.45	6.85	0.34	0.37	0.16	0.74	0.79	0.71	0.67	0.09	0.35	0.16
Pb	<0.001	0.0025	<0.001	0.0017	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	1.34	0.014	0.0011	2.37	0.04	0.0037	0.0041	0.0040	0.13	0.0015	0.0018	0.0015

(0318d)

TABLE 4

ANALYTICAL RESULTS FOR WATER SAMPLES FROM MOUNT NANSEN PROJECT

Sampling Date: September 4, 1986

ANALYTICAL PARAMETER	SITE A1	SITE B1	SITE C1	SITE D1	SITE D2	SITE M1	SITE N1	SITE N2	SITE P1	SITE V1	SITE V2	SITE W1
Temperature (°C)	2.0	8.0	7.0	6.5	7.5	6.0	10.0	8.0	8.0	9.0	8.5	8.5
Dissolved Oxygen (mg/L)	-	11.2	10.9	7.4	8.3	10.7	8.4	10.9	-	9.7	9.7	9.4
pH:												
Field	6.8	7.7	7.7	7.5	7.5	7.1	7.8	8.2	7.7	7.8	7.8	7.7
Laboratory	7.7	7.8	7.6	7.6	7.6	7.3	7.7	8.0	7.8	8.0	8.0	7.6
Alkalinity (mg$CaCO_3$/L)	208	47	24	85	46	18	39	43	31	60	52	49
Turbidity (NTU)	10	110	2.5	6.8	1.5	3.5	6.9	4.3	16	4.2	40	46
Conductance (µmhos/cm)	900	135	65	330	230	39	110	106	89	115	115	156
Total Solids (mg/L)	850	1167	179	362	219	115	134	117	128	101	567	485
Suspended Solids (mg/L)	9	965	2	32	3	9	15	6	23	8	322	363
EDTA-Hardness (mg$CaCO_3$/L)	601	69	32	194	118	22	54	56	46	62	61	80
Sulfate (mg/L)	420	40	10	126	130	<1	21	18	18	9	16	38
Ammonia (mgN/L)	0.078	0.119	0.008	0.104	0.014	0.005	0.009	0.009	0.065	0.008	0.020	0.024
Nitrate (mgN/L)	0.220	0.057	0.010	0.066	0.006	0.005	0.020	<0.005	0.048	0.019	0.022	0.006
Nitrite (mgN/L)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Total Phosphorus (mgP/L)	0.059	0.693	0.091	0.054	0.059	0.043	0.038	0.041	0.084	0.024	0.223	0.374
Total Cyanide (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
<u>TOTAL METALS</u>: (mg/L)												
Ag	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
As	0.050	0.056	0.004	0.010	0.026	0.001	0.002	0.002	0.011	<0.001	0.024	0.021
Ba	0.011	0.15	0.021	0.031	0.018	0.038	0.026	0.020	0.051	0.044	0.10	0.09
Cd	0.0051	0.0026	<0.0002	0.0005	0.0003	0.0002	0.0003	0.0002	0.0004	<0.0002	0.0010	0.0006
Cu	0.0023	0.027	0.0022	0.0021	0.0025	0.0034	0.0083	0.0058	0.0027	0.0027	0.013	0.010
Fe	0.62	17.7	0.80	1.95	1.37	0.94	1.01	0.57	1.70	0.43	4.74	6.16
Hg (µg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Pb	<0.001	0.018	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.004
Zn	1.33	-	-	-	-	-	-	-	-	-	-	-
<u>DISSOLVED METALS</u>: (mg/L)												
Ag	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
As	0.013	0.006	0.003	0.005	0.008	<0.001	<0.001	0.002	0.006	<0.001	0.001	0.001
Ba	0.011	0.036	0.014	0.025	0.013	0.025	0.021	0.016	0.040	0.038	0.023	0.033
Cd	0.0051	0.0002	<0.0002	0.0004	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	<0.0002	0.0002	0.0003
Cu	0.0008	0.0065	0.0022	0.0014	0.0025	-	0.0054	0.0046	-	0.0026	0.0066	0.0027
Fe	0.23	0.47	0.51	0.93	0.39	0.41	0.46	0.26	0.77	0.18	0.24	0.26
Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	1.31	-	-	-	-	-	-	-	-	-	-	-

(0318d)

TABLE 5

ANALYTICAL RESULTS FOR WATER SAMPLES FROM MOUNT NANSEN PROJECT

SAMPLING DATE: JULY 4, 1987

ANALYTICAL PARAMETER	SITE A1	SITE B1	SITE C1	SITE D1	SITE D2	SITE M1	SITE N1	SITE N2	SITE P1	SITE V1	SITE V2	SITE W1
Temperature (°C)	1.5	11.0	5.5	7.0	8.0	5.5	5.5	9.5	8.0	6.0	7.5	7.0
Dissolved Oxygen (mg/L)	–	–	–	–	–	–	–	–	–	–	–	–
pH	7.5	7.6	7.1	7.3	7.3	7.0	7.1	7.3	7.3	7.4	7.4	7.5
Alkalinity (mg $CaCO_3$/L)	182	58	29	104	72	20	25	36	72	41	41	52
Turbidity (NTU)	11	50	3.2	40	4.6	1.6	25	33	10	37	49	2.8
Conductance (μmhos/cm)	910	190	97	670	480	45	82	110	240	94	95	160
Total Solids (mg/L)	798	392	95	1684	384	80	222	155	198	183	201	156
Suspended Solids (mg/L)	6	135	<1	145	2	<1	124	59	<1	88	105	<1
EDTA Hardness (mg $CaCO_3$/L)	570	88	43	376	251	23	36	51	46	46	47	73
Sulfate (mg/L)	401	47	20	271	194	1	16	21	60	8	10	30
Ammonia (mg N/L)	0.127	0.083	<0.005	0.123	0.009	<0.005	0.011	0.018	0.039	0.013	0.017	0.013
Nitrate (mg N/L)	0.300	0.137	0.024	0.019	0.026	0.019	0.057	0.051	0.051	0.053	0.052	0.028
Nitrite (mg N/L)	<0.002	0.005	<0.002	0.005	<0.002	<0.002	<0.002	<0.002	0.004	<0.002	<0.002	0.004
Total Phosphorus (mg P/L)	0.070	0.370	0.040	0.815	0.050	0.048	0.195	0.183	0.057	0.215	0.235	0.030
Total Cyanide (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TOTAL METALS: (mg/L)												
Ag	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
As	0.094	0.034	0.005	0.061	0.042	<0.001	0.012	0.010	0.039	0.002	0.004	0.009
Ba	0.023	0.29	0.039	0.21	0.055	0.047	0.079	0.063	0.063	0.089	0.10	0.043
Cd	0.0049	0.0022	<0.0002	0.0012	<0.0002	<0.0002	0.0010	0.0005	0.0021	0.0003	0.0004	<0.0002
Cu	0.0053	0.017	0.0019	0.030	0.0018	0.0035	0.020	0.021	0.013	0.016	0.018	0.0013
Fe	2.89	7.4	0.71	11.8	1.41	0.54	3.02	3.01	1.89	2.99	3.79	1.09
Hg (μg/L)	<0.05	<0.05	–	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Pb	<0.001	0.011	<0.001	0.007	<0.001	<0.001	0.005	0.004	<0.001	0.003	0.003	<0.001
Zn	1.01	0.07	0.0006	0.24	0.014	0.0017	0.03	0.03	0.13	0.012	0.015	0.0011
DISSOLVED METALS: (mg/L)												
Ag	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
As	0.008	0.009	0.004	0.004	0.024	<0.001	0.002	0.002	0.032	<0.001	<0.001	0.006
Ba	0.023	0.077	0.032	0.072	0.041	0.040	0.026	0.024	0.057	0.038	0.039	0.035
Cd	0.0044	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0013	<0.0002	<0.0002	<0.0002
Cu	0.0013	0.0029	0.0018	0.0013	0.0017	0.0029	0.0068	0.0061	0.0096	0.0050	0.0045	0.0011
Fe	0.15	0.85	0.52	0.66	0.66	0.38	0.54	0.34	1.09	0.38	0.30	0.74
Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	0.83	0.0051	0.0006	0.0063	0.0095	0.0017	0.0026	0.0017	0.11	0.0014	0.0010	0.0010

TABLE 7
ANALYTICAL RESULTS FOR WATER SAMPLES FROM MOUNT NANSEN PROJECT
SAMPLING DATE: MAY 27, 1988

ANALYTICAL PARAMETER	SITE B1	SITE D1	SITE D2	SITE P1	SITE V1	SITE V2
Temperature (°C)						
pH	7.3	7.6	7.3	7.1	7.3	7.4
Alkalinity (mg $CaCO_3$/L)	25	112	42	37	36	37
Turbidity (NTU)	16	7.0	6.5	8.0	10	14
Conductance (µmhos/cm)	90	690	350	180	78	85
Total Solids (mg/L)	169	589	289	173	115	112
Suspended Solids (mg/L)	86	7	<1	18	40	39
EDTA-Hardness (mg $CaCO_3$/L)	43	391	174	86	40	41
Sulfate (mg/L)	24	252	154	54	7	11
Ammonia (mg N/L)	0.017	0.230	<0.005	0.040	<0.005	<0.005
Nitrate (mg N/L)	0.035	0.062	0.005	0.086	0.033	0.046
Nitrite (mg N/L)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Total Phosphorus (mg P/L)	0.220	0.050	0.013	0.063	0.063	0.077
Total Cyanide (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TOTAL METALS: (mg/L)						
Ag	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Al	1.22	0.050	0.019	0.36	0.77	0.81
As	0.008	0.039	0.011	0.013	0.001	0.002
Ba	0.07	0.028	0.032	0.060	0.050	0.050
Cd	0.0004	0.0007	<0.0002	0.0034	<0.0002	<0.0002
Cu	0.0066	0.0033	0.0016	0.034	<0.0005	<0.0005
Fe	1.80	1.04	0.22	1.25	0.74	0.96
Hg (µg/L)	<0.05	<0.05	<0.05	0.13	<0.05	<0.05
Pb	<0.001	0.002	<0.001	<0.001	<0.001	<0.001
Zn	0.0061	0.19	0.0044	0.22	<0.0005	0.0029
DISSOLVED METALS: (mg/L)						
Ag	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Al	0.11	<0.01	0.019	0.13	0.28	0.09
As	0.003	0.008	0.008	0.009	<0.001	0.001
Ba	0.037	0.024	0.031	0.047	0.035	0.034
Cd	<0.0002	0.0005	<0.0002	0.0030	<0.0002	<0.0002
Cu	0.0034	0.0015	0.0016	0.027	<0.0005	<0.0005
Fe	0.38	0.40	0.18	0.83	0.31	0.17
Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	0.0022	0.16	0.0044	<0.0005	<0.0005	<0.0005

APPENDIX II

WILDLIFE AERIAL SURVEY REPORT
MOUNT NANSEN PROJECT
March 4, 1986

Time of Survey:	During water sampling conducted between 0900 and 1500 hours.	
Helicopter:	Bell 206B Jet Ranger, Trans North Air, Carmacks	
Observers:	C. Schmidt	(Norecol) left front
	Mike Phillips	(Archer Cathro) left rear
	Bill	(Archer Cathro) right rear
Weather:	Cloud:	100%
	Wind:	light, strong on ridges
	Temperature:	$-15^{\circ}C$
	Visibility:	excellent
Area Surveyed:	Mount Nansen Property, along major creeks - Victoria, Back, Dome, Webber, Nansen; immediate exploration area.	
Observations:	Moose:	3
	Tracks - occasional moose along Victoria Creek flood plain.	