Appendix 7

- **Wildlife and Wildlife Habitat Assessment, Canamera Geological Ltd. Environmental Resources Division, November 1996.**

ECHO BAY MINES LTD.
ULU PROJECT

WILDLIFE AND WILDLIFE HABITAT ASSESSMENT

November 1996

Prepared for:
Echo Bay Mines Ltd.
N.W.T.

Prepared by:
Canamera Geological Ltd.
Environmental Resources Division
Vancouver, B.C.

EXECUTIVE SUMMARY

In 1996, Echo Bay Mines Ltd. retained the Environmental Resources Division of Canamera Geological Ltd. to conduct an inventory and environmental evaluation of terrestrial wildlife and wildlife habitat in the area of Echo Bay's Ulu project. Hubert and Associates Ltd. was subsequently contracted to assist in conducting the wildlife and habitat studies. Canamera's experience in conducting ongoing wildlife and habitat studies for Lytton Minerals' nearby Jericho Diamond Project provided a useful contribution to the database for Ulu project study area.

The Ulu project is a gold property with a reserve of approximately 608,000 ounces. Purchased in 1995, it is being developed as a satellite ore body to supply Echo Bay's existing milling facility at Lupin Mine, NWT. Site facilities consist of camp, airstrip, mine and maintenance facilities. The primary access for supplies and ore transport is via winter road to the Lupin mine site, located approximately 120 km south of the Ulu site. Production is expected to extend over a period of six or seven years, beginning in 1998.

The main objective of this report is to assist Echo Bay Mines in the selection of its winter road access, and in subsequent regulatory applications. The report further identifies interactions, mitigative measures and residual impacts that the mine and winter road might have on wildlife and wildlife habitat. An annotated inventory of the wildlife was prepared which provides information on individual wildlife species in the region, ecological notes, and interactions the project may have on them. The report is also intended to provide Echo Bay with reference information on wildlife and habitat in the Ulu project area.

The Ulu Project will encompass 164.0 hectares of natural habitat[1]. It was determined by the environmental evaluation that this will be the only incremental change to the terrestrial environment as a direct result of the project.

Wildlife identified as being potentially impacted are: grizzly bears, caribou and raptors (golden eagle, rough-legged hawk, peregrine falcon and gyrfalcon). The impacts to the wildlife populations will be negligible because the overall capacity of the ecosystem to sustain natural wildlife populations will not be significantly impaired. Also, the direct linkages between the project and wildlife in the region are such that measures necessary to mitigate impacts are complementary to good industrial practice.

[1] Data provided by Echo Mines Ltd.

Surveillance of selected species will enable evaluation of mitigation measures and assist in their refinement. Raptor nest sites should be monitored in April on the winter roads and in July near the mine site. This will assist in determining pre-nesting and nesting tolerance thresholds and responses.

The Ulu Project has the potential to interact with caribou. Caribou management is recognized as a concern, and it is recommended that the seasonal distribution of caribou in the Project area be monitored, and that any substantial impact on caribou migration and movement be mitigated by avoiding interactions between caribou and project personnel or vehicles.

Programs for garbage management should be implemented at all Ulu project camps. A rigorous incineration program will eliminate the risk of garbage luring bears to the camp. All quarry sites in the study area should be assessed for dens and denning activity.

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1.0 INTRODUCTION

The prospect of resource development in remote and wilderness areas often prompts concern regarding potential project effects on wildlife. The report that follows was requested by Echo Bay Mines Ltd. to provide supporting documentation in selecting a winter road alignment between the Ulu Mine and the Lupin Mine, some 120 km to the south. It also serves as an inventory of terrestrial birds and mammals that may be encountered in the region of the Ulu Project and the winter road.

Annotated species lists of birds and mammals in the region were assembled from faunal compendia for Canada and supplemented by observations recorded by biologists and others with a working knowledge and field experience in or near the region. They are presented in their entirety in Appendices A and B.

The Valued Ecosystem Components (VEC's) used for evaluating potential impacts on wildlife and wildlife habitat in this environmental evaluations are those prepared by the Regional Environmental Review Committee (RERC) for the Izok Project in 1993. The project guidelines and the rationale for adopting them are discussed in greater detail in Section 6.1. The VEC's identified in the Izok Project Guidelines are:

- terrestrial vegetation (including wildlife habitat)
- grizzly bears
- caribou
- wolverines
- wolves
- muskoxen
- raptors
- waterbirds (loons, shorebirds and waterfowl)

Sections 2.0, 3.0 and 4.0 focus on wildlife and wildlife habitat baseline information, studies and observations. A concise summary of project-wildlife interactions and potential impacts is presented in Section 5.0. Project-environment interactions, mitigative measures and residual impacts are evaluated extensively in Section 6.0, which also includes an assessment of the impacts that may result from fuel spills and acid rock drainage. Cumulative impacts are discussed in Section 7.0, and a wildlife surveillance and monitoring program is outlined in Section 8.0.

1.1 Ulu Project Description

The Ulu project is an Echo Bay Mines Ltd. gold property that is located at 66 55 N x 110 58 W (7421904 N, 501458 E)[1] (See Figure 1). The Ulu deposit is being developed as a satellite ore body to supply Echo Bay's existing milling facility at Lupin Mine. Site facilities consist of camp, airstrip, mine and maintenance facilities. The habitat disturbance at the Ulu mine site will be 42.66 hectares[1]. The primary access for supplies and ore transport is via winter road to the Lupin mine site, located approximately 120 km south of the Ulu site. Production is expected to extend over a period of six or seven years, beginning in 1998.

1.2 Winter Road Access Routes

A number of access routes were evaluated. Proceeding south from the Ulu Site is a single route option to the Hood River. At the Hood River, two routes are proposed: the western section, to be utilized as a winter road to haul construction materials and supplies for the 1997-1998 winter seasons; and an eastern route which will have upgraded portages and will be used as a resupply and ore haul route once the mine goes into production. The section of the road south of Lake 501 was assessed for three options: a western section passing through the southern portion of the Jericho project, a central section, and a eastern section running along an extensive esker system and down Kathawachaga Lake. The central section was not selected in part due to the presence of a limited system of eskers which were heavily utilized by wildlife. The eastern route was chosen as the preferred route.

1.3 Study Area

The region of interest for the purposes of this environmental evaluation is the ore body and the winter road, an area of approximately 19,000 km^2 bounded to the south by 65° N latitude, to the north by 67° N latitude, to the east by 110° W longitude and to the west by 112° W longitude. The project does not contain any areas currently being considered for conservation status by governments; however, the World Wildlife Fund Canada has proposed an area around Contwoyto Lake as a "Conservation Study Area" (World Wildlife Fund Canada, 1996), as shown in Appendix F. A Protected Areas Strategy in the NWT, coordinated by the GNWT in conjunction with Indian and Northern Affairs Canada, is also being considered. A discussion paper on this initiative has been prepared and released for consultation with northern conservation groups, aboriginal groups, government, industry and the public. Notwithstanding the above activities, the area

[1] Data provided by Echo Bay Mines Ltd.

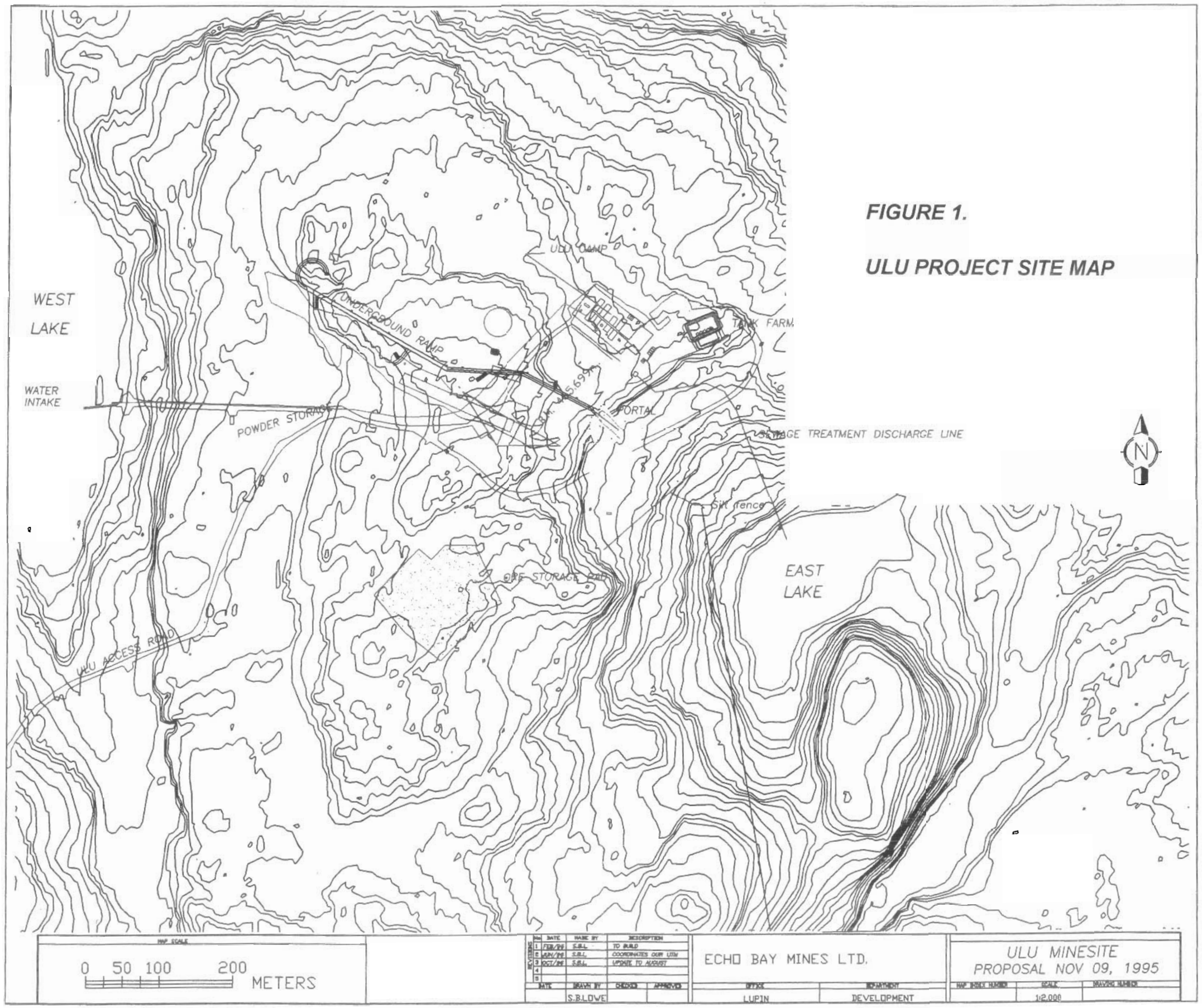


FIGURE 1.

ULU PROJECT SITE MAP

around the Ulu project does not include any land recommended for withdrawal for conservation purposes.

The field studies for the data documented in this report were conducted under Wildlife Research Permits issued by the GNWT Department of Resources, Wildlife and Economic Development (Research Permit Number WL 000954).

1.4 Methodology

Aerial surveys were conducted for significant site-specific wildlife sign and presence around the mine site and in the area of the proposed winter routes between Ulu project site and the Lupin mine. Surveys were conducted from helicopter and followed up by any required ground reconnaissance as required.

Surveys were conducted by flying along the route and searching for dens located in eskers and examining raptor nest terrain, which is characterized by steep cliff faces. The Kitikmeot Inuit Association (KIA) had indicated to Echo Bay Mines (Rod Cooper, Ulu Project Manager, Echo Bay Mines, pers. comm.) that the terrain extending two (2) kilometres on either side of the center line should be included in the survey areas. The two-kilometre zone is consistent with discussions with the Department of Resources, Wildlife and Economic Development (RWED) as a guiding principle for assessing impacts on raptor sites (Chris Shank, GNWT RWED, pers. comm.). This limit was exceeded for all the winter road routes as well as around the mine and camp sites. Locations of all specific wildlife observations were recorded using GPS navigation systems.

Figure 2 shows the Ulu site, proposed winter road routes, areas of high burrow density, raptor nest sites, and the locations of esker habitat. Figure 3 shows alternate route alignments through the Jericho project site, plus the locations of raptor nest sites. Further site-specific information is provided in Appendix C.

1.5 Summary of Observations

1.5.1 Carnivore and Den Locations

Bears, wolves, and foxes use dens for shelter during winter months. Dens are also used for the early stages of rearing young to the stage where they can travel overland. In the case of Grizzly bears, the cubs leave the den area shortly after the female emerges in the spring, usually late May. Both wolves and foxes use the den as a nursery well into the summer.

Bear dens are simple and usually shallow excavations in a sandy bank or slope. They are dug in the fall, used for one winter and then usually collapse in the following summer.

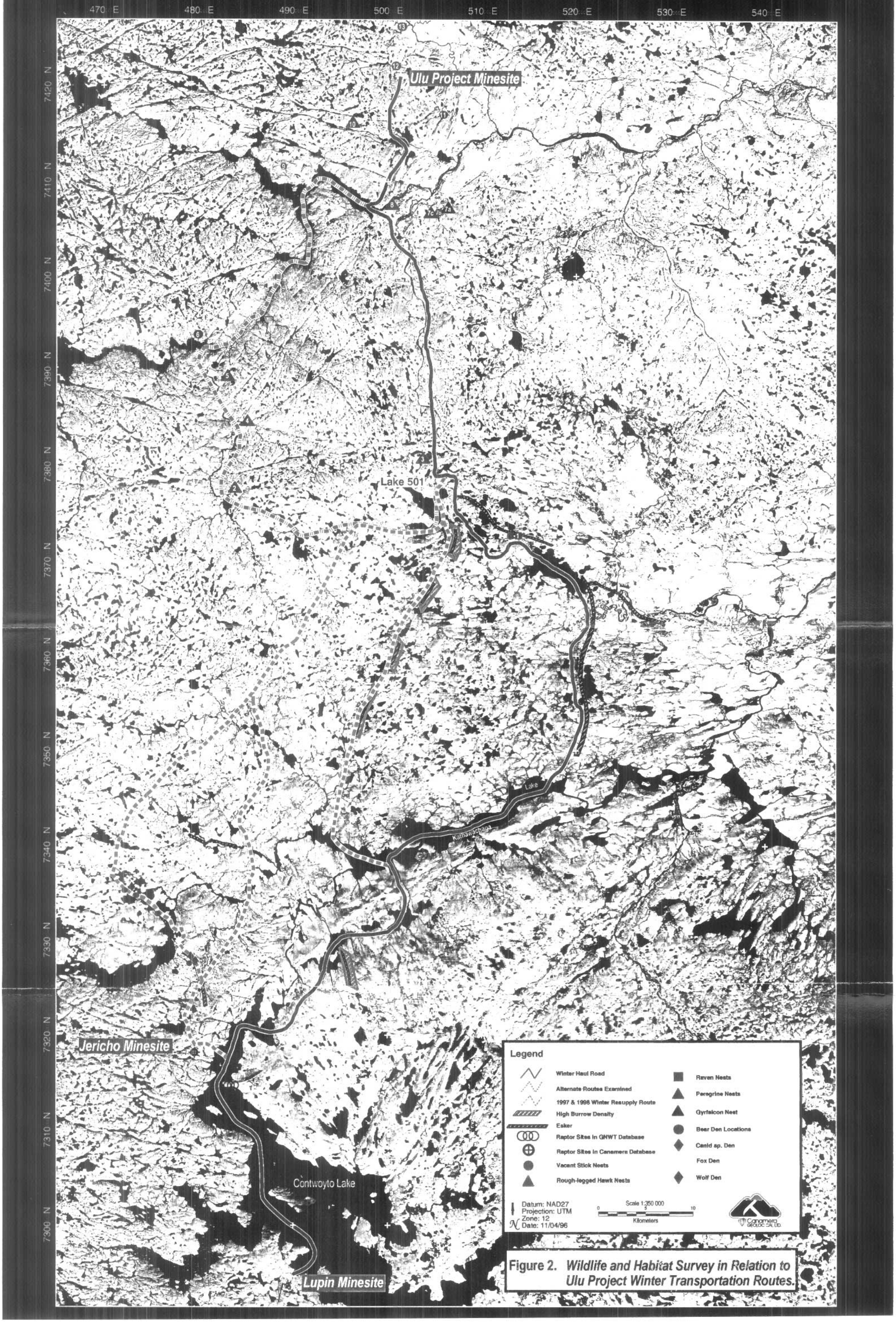
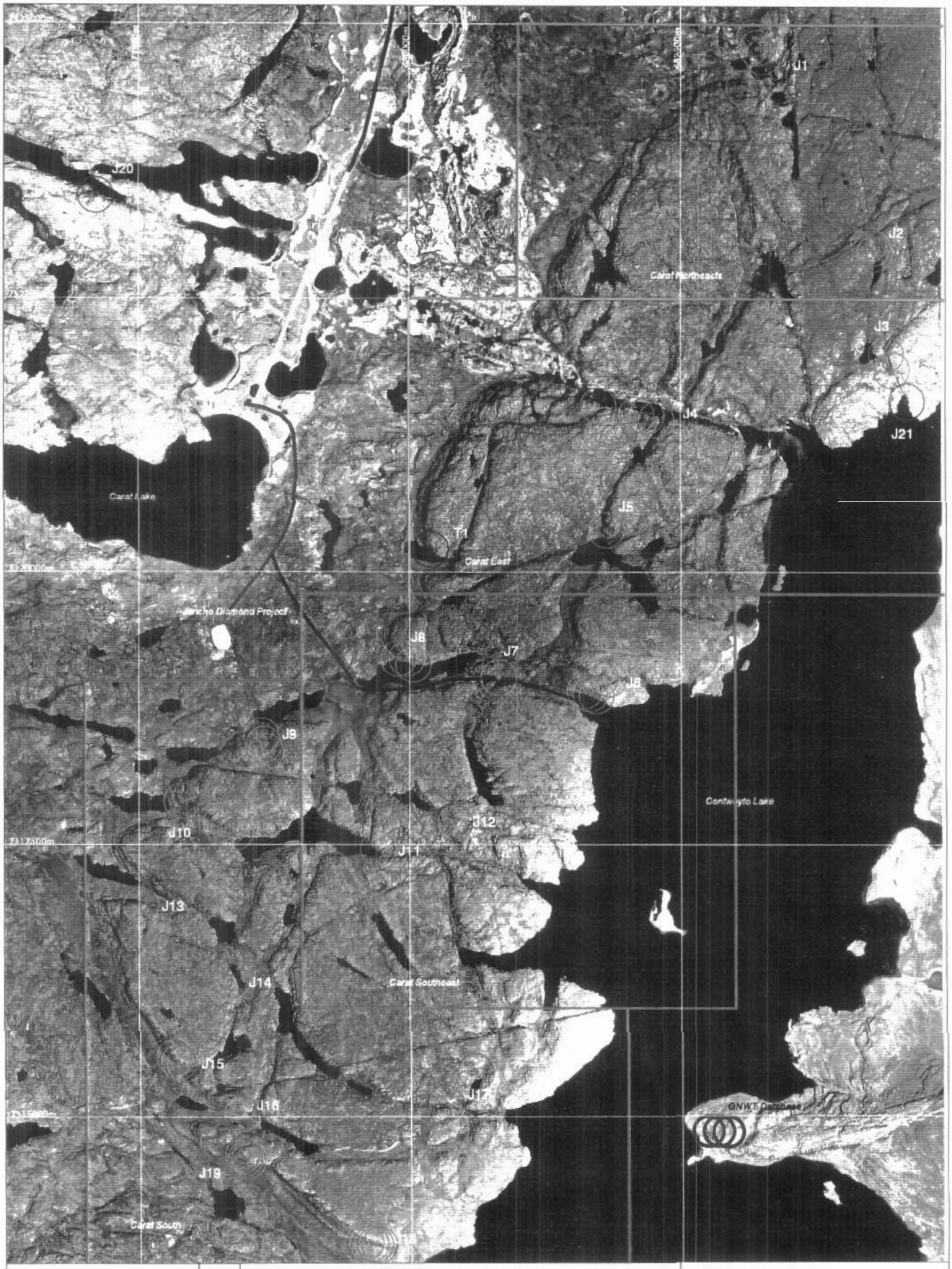


Figure 2. *Wildlife and Habitat Survey in Relation to Ulu Project Winter Transportation Routes.*



Datum: NAD 27		Legend
Projection: NUTM 12	**Jericho Project Area**	Nesting Sites; Canamera Database 1995 - Sites Revisited in 1996
Figure #: 3	**Nesting Sites**	Nesting Sites; Canamera Database - New in 1996
	Scale 1:50,000	Active Territory; No Nests Found
		Existing Road — Winter Road Alternative
		Airstrip

Wolf and fox dens may be used in successive years. Because of such repeated use, wolf and fox dens are characterized by lush vegetation dominated by grasses from added nutrients provided by feces and bones.

Canid (fox/wolf) dens, which are scattered throughout the esker systems, were examined during the surveys, both northwest of the Jericho project site and along the Kathawachaga Lake esker system. Some were examined during these surveys, northwest of the Jericho project site, along the Kathawachaga Lake esker system and the central road alignment from Kathawachaga Lake to Lake 501. Although fresh grizzly bear tracks and/or scat were found, bear dens were found only on the eskers northwest of the Jericho project site. Their locations are indicated in Figure 2.

Further information on den sites and radio-collared grizzly bears was received from the Department of Resources, Wildlife and Economic Development (Dean Cluff, GNWT RWED, pers. comm.). This information appears in Appendix C, where it is documented and illustrated (Figure 5).

1.5.2 Birds of Prey

Birds of prey are known collectively as raptors. Because they are summit predators, in that their ecological niche is at the top end of a food chain, their presence is an indication of a healthy ecosystem. The study area supports several species: golden eagle, rough-legged hawk, peregrine falcon, and gyrfalcon. Bald eagles were also observed during the surveys, but the tundra is marginal to their breeding range and no nests were observed. As nest sites occupied by ravens are also used by raptors, these were also recorded.

As a group, raptors are seasonally migratory, and there is significant variation in return dates to nesting territories among individuals. Birds of prey establish and occupy nesting areas well before spring melt, and are therefore potentially sensitive to operations associated with winter roads. For this reason it is important to identify raptor nesting sites and ensure their tolerance thresholds are not exceeded. A detailed description of each species is presented in Appendix A. The locations of nest sites and their location in relation to infrastructure are provided in Figures 2 and 3, and in Appendix C.

1.5.2.1 Bald Eagle

On July 12 a single bald eagle was observed in the in vicinity of 66 06 N X 111 30 W (7330957 N, 477395 E). On July 29 two bald eagles were seen in the same general area. A search was made for a nest but none was located. Nests are usually built near the top of a tall tree or occasionally on a cliff (Godfrey, 1986); neither were evident in the area where these bald eagles were observed.

1.5.2.2 Golden Eagle

Single golden eagles were observed during surveys on July 29 in the vicinity of 66 04 30 N X 111 27 11 W (7328154 N, 479497 E) and on July 31 at 66 44 09 N X 111 17 02 W (7401773 N, 487487 E). Searches throughout both areas failed to locate active golden eagle nests. Non-active stick nests in the area may provide suitable nesting sites for golden eagles, which nest regularly near the central Arctic coast (Poole and Bromley, 1988).

1.5.2.3 Rough-legged Hawks

One active rough-legged hawk nest was observed beyond the critical distance (*i.e.*, >2 km) from the Ulu winter haul road, west of the airstrip. Two nests were observed within the critical distance (*i.e.*, <2 km) of the proposed Jericho project winter road alignment.

1.5.2.4 Peregrine Falcon

Seven active peregrine nests were located along the Ulu project winter haul route and 1997 & 1998 resupply route; two within 2 km of the proposed winter haul route, and three along the winter resupply route. In addition, the Jericho project area had two active peregrine nests; one of which was within 2 km of the proposed Ulu winter road route as it crosses Contwoyto Lake (Figure 3).

1.5.2.5 Gyrfalcon

One active gyrfalcon nest was located during surveys in the Ulu winter haul route, but was not within 2 km of this haul route. No active gyrfalcon nests were found in the Jericho study area.

1.5.2.6 Raven

Ravens are not technically considered raptors, but their nesting habitat is similar to that of raptors in the region. Sites occupied by ravens are generally considered part of the overall nest site inventory for raptors in a given region. Like hawks and eagles, raven nests are stick structures and over successive years can grow to a considerable size.

One active raven nest was observed during the surveys.

1.6 Acknowledgements

Canamera would like to express its appreciation to Hubert and Associates Ltd. for their contribution to the preparation of this report.

Current information cannot be documented and relayed without the cooperation of many professionals familiar with the subject matter and issues under review. We would therefore like to acknowledge the assistance and cooperation of persons who provided information, some of which is not yet available in reports and publications. Page Burt of Bathurst Inlet Lodge provided valuable information which supplemented that of reference texts on wildlife species in the region. Anne Gunn of the GNWT Department of Resources, Wildlife and Economic Development provided as yet unpublished results of caribou data in the region, and Ray Case and Dean Cluff contributed archival data on grizzly bears. Adrian D'Hont provided caribou harvest values from the Department's records and files. Unpublished data from the nest site data base on birds of prey were kindly supplied by Chris Shank. The prompt response to data requests of Echo Bay Mines were provided by Barry Lowe. The assistance and skill of pilot John Buckland were invaluable. Support at the Ulu mine site was generously provided by Kevin Mealy and Phil Flaumitsch. Ongoing discussions with the project manager, Rod Cooper, helped in putting the overall perspective on ongoing operations at Lupin Mine.

The assistance of these persons is gratefully acknowledged. Any errors in the interpretation and use of the information they provided is the responsibility of the author and editors.

2.0 WILDLIFE HABITAT – MINE SITE

2.1 Wildlife Habitat Studies

The habitat in the area of the camp, mine site and airstrip is upland rocky tundra (Plate 1). The vascular plant community here was examined in July 1996. Species and structural composition was measured by way of walking line-intercept transects. Points were read at one-metre intervals along 1,000 m of transect and recorded on 100-point data forms. (See Lodge *et al.* 1969 for a complete description of this range evaluation technique.) Figure 4 shows the transect area and Table 1 summarizes these data.

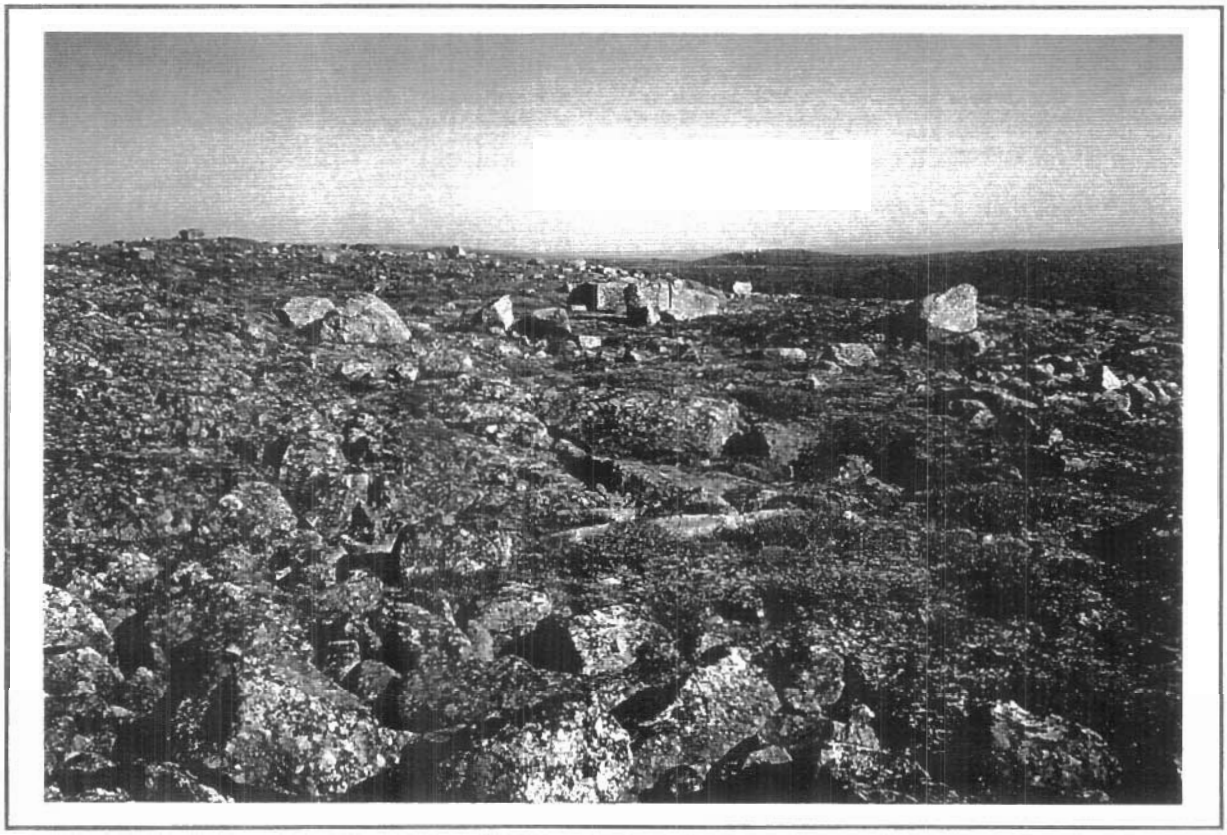


Plate 1. Rocky upland tundra near Ulu Project mine site and camp.

The dominant feature of this habitat type is the preponderance of rock. The dominant plant species are dwarf birch (*Betula glandulosa*), Labrador tea (*Ledum sp.*), and heather (*Cassiope tetrogana*), all indicators of acidic soils (Lawrence, 1965).

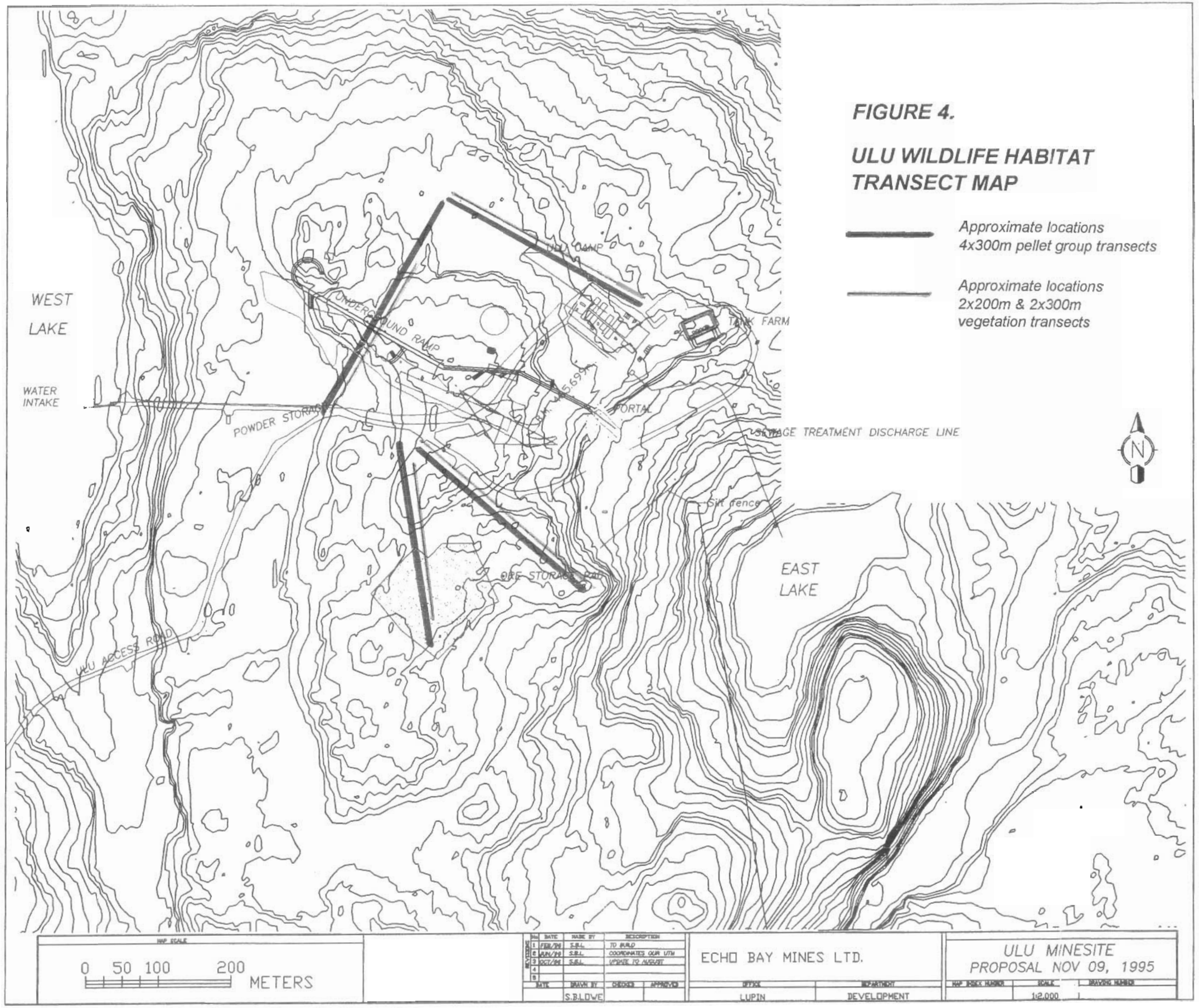


FIGURE 4.

ULU WILDLIFE HABITAT TRANSECT MAP

Approximate locations 4x300m pellet group transects

Approximate locations 2x200m & 2x300m vegetation transects

The value of an area as wildlife habitat can be evaluated directly and indirectly. The direct method used was fecal pellet counts. Walking line intercept transects over 1,200 m were also used for these parameters. Caribou pellet groups were encountered with a frequency of one pellet group per 100 m while arctic hare pellet groups were encountered with a frequency of five per 100 m. This further underscores the relatively low usage by caribou on an annual basis.

Another wild herbivore habitat evaluation technique is to examine the physical condition of willow (*Salix sp.*) on an area. Willow is a preferred browse species in most herbivore habitats throughout the boreal world. A willow shrub community incorporates more nutrients ($mg/m^2/yr.$) than other tundra plant communities (Dowding et al, 1981). It is therefore not uncommon to observe very heavily browsed willow shrub on tundra range commonly frequented by large herbivores. The willow around the Ulu Project camp and mine site show little effect of browse (Plate 2).

Plate 2. Willow near Ulu Project camp showing annual growth and absence of browse by herbivores.

Table 1. Percent frequency of plant species and other ground cover in the vicinity of the Ulu Project camp and mine site, July 1996.

Ground Cover	% Frequency	Range*
Lichen	<1	0 - 1
Horsetail (*Equisetum sp)*	<1	0 - 1
Draba sp.	<1	0 - 2
Mtn. Avens (*Dryas integrifolia*)	1.7	0 - 4
Cotton grass (*Eriophorum sp.*)	1.2	0 - 4
Bearberry (*Arctostaphylos sp.*)	<1	0 - 3
Cranberry (*Vaccinium vitis-idaea*)	2.0	0 - 6
Sedge (*Carex nardina*)	2.5	0 - 14
Blueberry (*Vaccinium uliginosum*)	2.6	0 - 6
Crowberry (*Empetrum nigrum*)	3.3	0 - 5
Willow (*Salix sp.*)	4.7	1 - 11
Labrador tea (*Ledum sp.*)	5.8	2 - 9
White heather (*Cassiope tetragona*)	6.2	0 - 14
Bare ground	6.5	0 - 17
Dwarf birch (*Betula glandulosa*)	10.6	4 - 24
Rock	51.5	13 - 68

* range in % in a 100-point sample

Habitat disturbance required for mine site development is as follows:

airstrip	7.5 ha*
camp / mine site	18.66 ha
road	15.5 ha
tank farm	1.0 ha
Total	42.66 ha

* data provided by Echo Bay Mines Ltd.

2.2 Winter Road

The southern portion of the winter haul road will pass through medium- to well-drained meadow habitat bordering the flanks of an esker system. Between Contwoyto and Kathawachaga Lakes this habitat type includes a semi-continuous cover of dwarf birch. Plate 3 shows this habitat type and the effect of a 1989 winter road in which the shrubbery was bulldozed along with the snow cover. Although there has been no thermal response in the soils, there is no sign of shrub recovery in the intervening period.

Plate 3. Habitat between Contwoyto Lake and Kathawachaga Lake showing effects of 1989 winter road.

The middle portion of the winter road, Camp 501 to the Hood River, is over cobble and granular outwash habitat which hosts no continuous plant cover.

The route between the Hood River to the mine site is similar to the habitat described by transects conducted at the mine site. Habitat disturbance required for upgrading (Plate 4) the winter road is as follows:

Lupin to Camp 501	65.065 ha
Camp 501 to Hood River	43.81 ha
Hood River to airstrip	12.35 ha
Total	121.225 ha

Plate 4. Summer view of "upgraded" winter road near Lupin

3.0 BIRDS

3.1 Introduction

The short arctic summer with abundant daylight is an ideal breeding environment for migratory birds. The long daylight hours and abundant food resources give the birds summering in the region more time to feed their young during a season when food is most in demand (Welty, 1962).

An initial review of literature and the species list for Bathurst Inlet Lodge and nearby inland camps (Beyersbergen, nd.) show that 51 species are regularly present at a given time of year in the inland environment. Of these, 39 species are known to breed in the area.

Several of the species recorded for the region, like three species of scoter, do not breed there but are migrants passing through to their breeding or wintering ranges. Others, like the bald eagle and osprey observed at Bathurst Inlet Lodge, are accidental non-breeding visitors that are clearly beyond their normal range for breeding and migration. The notes in Appendix A concentrate on those species that are regular residents for either breeding or migration.

Only four species can be considered residents for the full year: the raven, gyrfalcon and two species of ptarmigan. All the remaining species migrate to southern latitudes or coastal environments which offer open water.

In several cases, the general ecology of groups of birds (*e.g.*, shorebirds) is discussed by group rather than by species, since the ecological relevance of one species to the project may differ little, if at all, from other species within the group. In other cases, like birds of prey and waterfowl, ecological relationships relevant to the overall project are presented on a species-by-species basis.

3.2 Bird habitat considerations

Tundra environments generally are critical to the breeding success of many North American migratory bird species. Agencies concerned with migratory birds, especially waterfowl, have conducted surveys to document the summer distribution of nesting and molting waterfowl here (Belrose, 1976). The Canadian Wildlife Service has monitored the results of surveys that describe the summer distribution of nesting waterfowl in the NWT

and has published a compendium of "key" terrestrial habitat sites for waterfowl in the NWT (Alexander *et al.*, 1991). It sets a minimum requirement as a guideline for designating "key habitat sites":

> *"Sites that are believed to support at least 1% of a national population are considered to be Key Habitat Sites."*

This is the same criterion used for designating sites in Europe and under the Convention on the Conservation of Wetlands of International Importance (Alexander *et al.*, 1991). The region under consideration in the annotated inventory of terrestrial bird species does not include any designated sites for migratory waterfowl.

The annotated inventory in Appendix A is based on a review of literature, field work during the summer of 1996, and the personal knowledge of other professional biologists who have experience in the region.

As noted in Section 1.0, the discussion that follows is limited to raptors and "waterbirds" (*i.e.*, loons, shorebirds, and waterfowl), birds that were identified in the Izok Project Guidelines as Valued Ecosystem Components by the Regional Environmental Review Committee (1993). Included in the discussion is an assessment of project interactions with each enumerated species. Appendix A contains the complete annotated list of birds in the region, and Appendix C provides the locations of raptor nest sites (Lat./Long. and UTM) in relation to Ulu project infrastructure.

4.0 MAMMALS

4.1 Introduction

Sixteen species of terrestrial mammals occupy the region under discussion. Unlike the birds of the region, mammals are not migratory with the exception of caribou, and even some caribou remain on the tundra overwinter.

The annotated list of mammalian fauna, presented in Appendix B, is a full complement of the natural ecosystem in that no species has been extirpated from the region. All populations are healthy, and although the muskox population here was heavily hunted to near extirpation 100 years ago, it has made a strong recovery and continues to expand the overall territory occupied.

The species inventory was developed by reviewing the range maps for northern mammals in reference compendia and in consultation with biologists familiar with the region. Supplementary wildlife observations made by project personnel at Ulu camp are presented in Appendix E.

Several of the species in Appendix B are presented for the purposes of establishing a complete record of the known terrestrial mammalian fauna of the region. The information available for the masked shrew, for example, is inadequate to make an assessment on impact. On the other hand, it is difficult to see what the impacts on this tiny insectivore at the margins of its continental range could be.

The description of the species' ecology is not intended to be either exhaustive or definitive, but is intended rather to discuss those aspects that are relevant to the developments under construction at the Ulu Project mine site and winter road to Lupin Mine. Similarly the notes on interaction with the project are intended to serve as a screen that may identify species at risk and then what aspect of their annual cycle may be affected and how. Where inadequate information on the presence or seasonal distribution of the species becomes apparent, suggestions for additional work are offered.

5.0 SUMMARY OF PROJECT – WILDLIFE INTERACTIONS AND POTENTIAL IMPACTS

The following table summarizes project-wildlife interactions identified in the annotated inventory (Appendices A and B) and places them in the context of potential impacts due to the Ulu Project for species or groups of species. The potential impacts are assessed in terms of the effects of the project on the sustainability of wildlife population(s) for tabulated species in the region.

Table 2. Ulu Project-Wildlife Interactions and Potential Impacts

Species	Season(s) of interaction	Area of interaction	Potential impact
BIRDS			
loons	summer	mine site	negligible
waterfowl	summer	mine site	negligible
golden eagles	spring / summer	road & mine site	negligible
gyrfalcon	spring / summer	road & mine site	negligible
peregrine	spring / summer	mine site	negligible
rough-legged hawks	spring / summer	mine site	negligible
ptarmigan	summer	mine site	negligible
cranes	spring	mine site	negligible
shorebirds	summer	mine site	negligible
jaegers	summer	mine site	negligible
gulls	summer	mine site	negligible
terns	summer	mine site	negligible
owls	summer	mine site	negligible
nighthawks	summer	mine site	negligible
swallows	summer	mine site	negligible
ravens	year-round	road & mine site	negligible
song birds	summer	mine site	negligible

(Continued)

Table 2. (cont'd) Ulu Project-Wildlife Interactions and Potential Impacts

Species	Season(s) of interaction	Area of interaction	Potential impact
MAMMALS			
shrews	year-round	road & mine site	negligible
voles and lemmings	year-round	road & mine site	negligible
hares	year-round	road & mine site	negligible
ground squirrels	summer	mine site	negligible
foxes	year-round	road & mine site	negligible
wolves	year-round	road & mine site	negligible
grizzly bear	summer	mine site	negligible
weasels	year-round	road & mine site	negligible
wolverine	year-round	road & mine site	negligible
muskox	year-round	road & mine site	negligible
caribou	year-round	road & mine site	negligible

Project interactions, mitigative measures and residual impacts are reviewed for selected species in greater detail in Section 6.0.

6.0 PROJECT – ENVIRONMENT INTERACTIONS, MITIGATIVE MEASURES AND RESIDUAL IMPACTS

6.1 Rationale

6.1.1 Methods of Impact Evaluation

This section describes the methods of impact evaluation that will be employed to assess project-environment interactions and the types and levels of potential impacts on wildlife and wildlife habitat that could be associated with the Ulu Project. Impact definitions that will be used in this evaluation are provided.

The impact evaluation methods described below are based on the approach used for the Izok Project (Metall Mining Corp. 1993) which proposed similar components to those in the Ulu Project.

6.1.2 Objectives of the Impact Evaluation

The primary objective of the impact evaluation section is to describe the nature and significance of potential interactions between the project and the environment to provide a sound basis for the review of wildlife related issues by the Nunavut Impact Review Board. The evaluation of project effects on the environment will focus on valued wildlife species of economic significance in the region and on key ecosystem linkages between project actions and effects on these species.

6.1.3 Valued Ecosystem Components

Valued Ecosystem Components (VEC's) to be considered in an assessment of this nature have traditionally been enumerated in guidelines prepared by the regulator and referred to the proponent.

This evaluation has not had the benefit of such guidelines and so assumed the same VEC's as were issued for the Izok Project in 1993.

The terrestrial VEC's enumerated in the Izok Project Guidelines included: terrestrial vegetation (as the key component of wildlife habitat), grizzly bear, caribou, wolverines, wolves, muskoxen, raptors and waterbirds (RERC 1993). The guidelines go on to

emphasize specific project/VEC's interactions that should be addressed. These are highlighted in the linkages developed to describe project/VEC's interactions.

6.1.4 Levels of Potential Impacts

Project Guidelines usually request that levels of impact be specified in terms of significance and spatial (local/regional) and temporal (long-term/short-term) extent, and that these levels of impact be explicitly defined. The following definitions provide criteria for classifying potential impacts of the Ulu Project, on VEC's in particular. While the definitions are relatively precise, the impact predictions are necessarily approximate. Seldom are environmental data sufficient to allow precise quantitative impact predictions and/or measurements. Accordingly, the project impacts have been classified based on the informed judgement of experienced scientists. In many cases these classifications are considered accurate and sound, based on the available information, the nature of the linkage and the scientists' considerable understanding of this environment. Where impact predictions are considered tenuous, this is noted in the text. Where data gaps prevent impact assessment, a monitoring effort is recommended to improve the predictive capacity for environmental effects.

The following terms are used to define project impacts on VEC's:

Major Impact - An impact is rated major if it is judged to result in a 10%, or greater, change in the carrying capacity of the environment, size of an animal population, or the size of a resource harvest.

Moderate Impact - An impact is rated moderate if it is judged to result in a 1% to 10% change in the carrying capacity of the environment, size of an animal population, or a resource harvest.

Minor Impact - An impact is rated minor if it is judged to result in a change in the carrying capacity of the environment, animal population size, or resource harvest that is less than 1%.

Negligible Impact - Negligible impacts are those that are judged to have essentially no effects.

Residual Impacts - Those impacts that despite mitigating measures remain active with ongoing, and perhaps progressive, negative effect on the VEC in question.

Regional Significance - An impact of regional significance would affect a broad area or resource base of common interest to a large number of people. For the purposes of this report, there is one region encompassing the range of the Bathurst caribou herd. This can

be described as the central barrenlands, an unpopulated, relatively inaccessible area within the tundra biome, which is used at low intensity by the Inuit communities to the north and which supports caribou used by communities to the southwest.

Local Significance - An impact of local significance would affect one community and the area immediately adjacent, a specified activity area (e.g., a hunting or fishing area), or a discrete geographical area.

Short-Term - Impacts are considered to be short term if their effects on the environment last for a period of less than one year.

Medium-Term - Impacts are considered to be of medium term if their effects last for periods of one to five years.

Long-Term - Long term impacts are those whose effects are judged to last for more than five years.

Terms are combined, as appropriate, to define an impact. For example, an impact can be classified as a positive, long-term impact of regional significance.

In using these terms to define impacts, the mitigative effects of specified project design and operating procedures are taken into account, so that the impact classification describes residual effects.

The impact assessment which follows is patterned on a similar assignment prepared for the Izok Project which had several components that were very similar to the Ulu Project.

6.2 Impacts on Terrestrial Vegetation and Wildlife Habitat

6.2.1 Background

Vegetation is a VEC in that it provides food and shelter for wildlife species. Habitat diversity ensures overall biodiversity and so contributes to ecological stability.

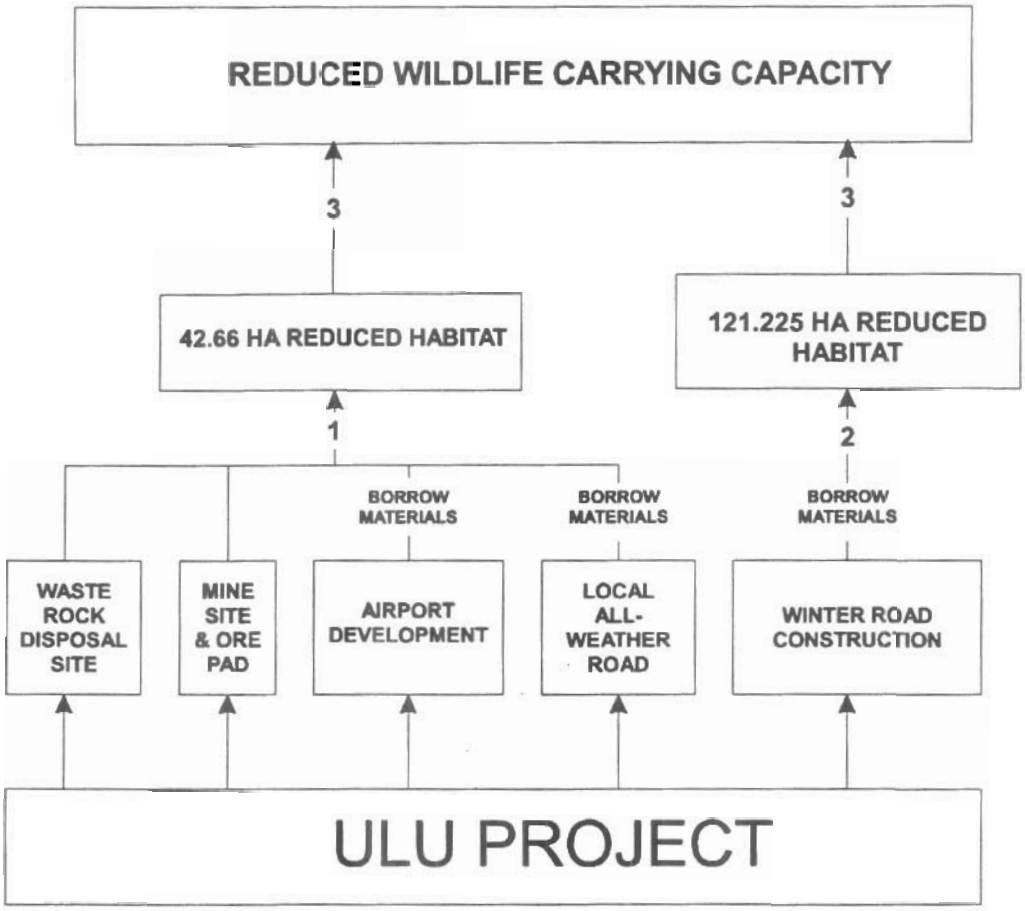
Vegetation communities in the area of the mine site are described in Section 2.1. It is unlikely that the project will result in reduction of floral biodiversity, as the affected communities are representative of the vast tundra biome. There will be impacts on vegetation associated with granular extraction for upgrading the winter haul road and development of the mine site.

Mine site development has altered approximately 42.6 ha including building sites, roads, airstrip, ore pad, and borrow areas. The winter road and associated borrow pits will alter

122.225 ha. Disturbed areas will take many years to revegetate, therefore impacts on vegetation will be long-term and local. A residual impact would be local aesthetic effects.

Will loss or alteration of terrestrial habitat required by the Ulu Project and winter road reduce overall wildlife carrying capacity?

Diagram 1. Project-Habitat Linkages



6.2.2 Linkages

1. The combined area of habitat destruction in the area of the mine and airstrip will be 42.66 ha.

2. The winter road will traverse 116 km of terrestrial habitat and cover an estimated 121.225 ha.

3. The total terrestrial habitat loss from all Ulu Project infrastructure will be 163.9 ha.

The overall amount and quality of wildlife habitat sustains productivity of wildlife populations.

6.2.3 Discussion

Terrestrial habitat alterations required for the Ulu Project involves constructing level building and storage sites, establishing waste rock disposal sites, building roads and airstrips, and operating and abandoning quarry sites for granular materials. The nature of the disturbance will be such that regeneration of plant communities will be very slow and take a long period. Surface materials on disturbed sites will be mineral and granular and therefore revegetation will not show any significant effect until the disturbed surfaces contain the organics and clay necessary for moisture retention and true soil development. No unique plant communities were encountered.

The impact of the Ulu Project on terrestrial vegetation will be direct, local, and very long term.

Residual impacts expected: none

The distribution of wildlife in the area of the Ulu Project is a function of the natural habitats there. The minimum site criteria for a species' "key habitat" is "to support at least 1% of a national population." This definition has been used for assessing significance of migratory bird habitat in the NWT (Alexander et al., 1991). It is being extended to all other wildlife habitat in this discussion. None of the wildlife species found in the study area are found in concentrations that would represent 1% of their population. The study area therefore does not meet the criteria for "key habitat" for any species.

The most abundant (seasonally and spatially) VEC species in the study area is the barren-ground caribou. It is conceivable that during periods of migration, concentrations of 1% or more of the Bathurst Herd may be in the vicinity of the project for brief periods of time. Since the total range of the herd covers 250,000 km^2 (GNWT Renewable Resources, unpublished) the loss of 163.9 ha of habitat used briefly in summer and also in winter along the winter road will have no significant effect on the productivity of the herd.

The other VEC herbivore species considered here is the muskox. Muskox were not seen at the mine site during visits in July, August, September and October. Habitat similar to that of the Ulu Project is common throughout the region.

Migratory birds species are represented in the local fauna by individual breeding pairs for species that are generally distributed throughout the continental tundra and, for some species, beyond. Displacement of these breeding pairs will not reduce the productivity of the VEC species' populations.

The location of construction sites, quarries and the winter road alignment will not destroy any known raptor nest sites.

The impacts on wildlife carrying capacity in the study area due to alteration and/or destruction of terrestrial wildlife habitat will be negligible, local and long-term.

Residual impacts expected: none

6.3 Impact Evaluation for Terrestrial Wildlife

The Ulu Project involves several site specific activities that in and of themselves do not require widespread habitat alteration or other disturbances to the natural environment. The assessment on impact to the wildlife VEC's species are guided in part by the observation made by Alexander et al, 1991):

> *"Populations that are geographically widespread or widely dispersed throughout a variety of habitats are less vulnerable to site-specific threats, as only a small portion would be affected. For these species, very large areas would be required to support a significant portion of the population."*

Although this statement was made in the context of migratory bird habitat in the NWT, it is also relevant to other wildlife species and is therefore used as a guiding principle in this assessment of impacts on terrestrial wildlife by the Ulu Project.

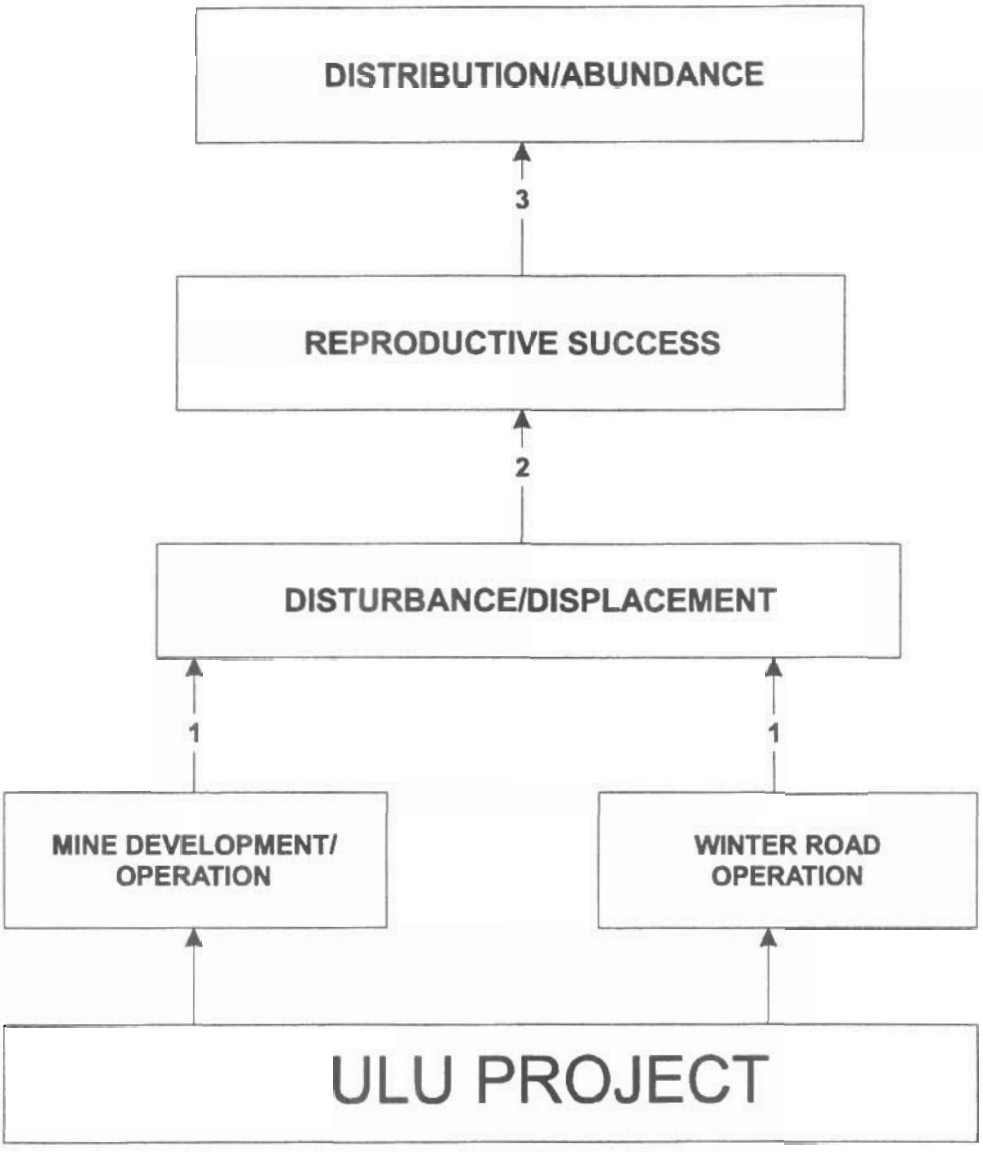
6.3.1 Loons, Waterfowl and Shorebirds

Will the construction and operation of the Ulu Project create sufficient disturbance to affect the local distribution and abundance of VEC's migratory bird species?

6.3.1.1 Background

The numbers of loons, waterfowl and shorebirds observed in the vicinity of the Ulu Project mine site were very low. Site specific habitat alterations will affect very few individual birds.

Diagram 2. Project-Waterbird Linkages



6.3.1.2 Linkages

1. Construction activity and noise cause disturbance to birds in the vicinity of the site.

2. Disturbance and displacement results in reduced nesting success.

3. Reduced nesting success results in reduced distribution and abundance of migratory bird species.

6.3.1.3 Discussion

1. Construction at the mine site and winter road will occur in all seasons of the year. These sites are upland sites away from habitats usually occupied by the VEC migratory bird species. Occurrence of shorebirds and waterfowl in both sites is very low to nil in the area of the proposed airstrip, and all weather road from the airstrip to the mine site.

Construction of the winter road will occur in terrestrial habitats not normally frequented by concentrations of migratory birds.

2. Any displacement of breeding pairs is likely to be local and so reproductive success is not expected to change.

3. Distribution and abundance of migratory birds should not change as a result of the Ulu Project.

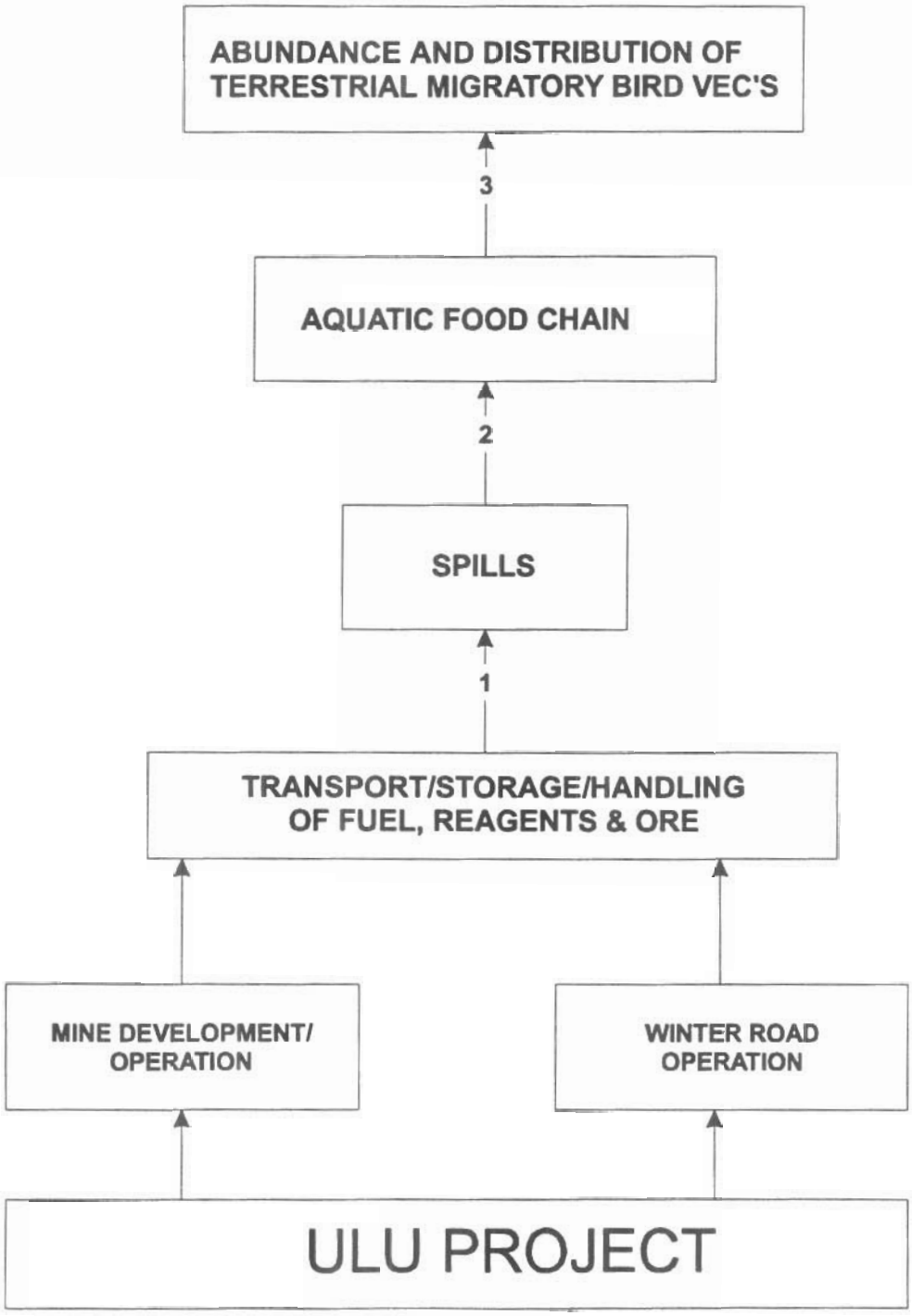
Disturbance and displacement impacts on VEC migratory bird species will be negligible, local and short term.

Residual impacts expected: Displaced breeding birds will establish territories in new locations within the region.

6.3.2 Fuel Spills

Will spills of fuels, reagents and/or ore-concentrates affect the distribution and abundance of terrestrial migratory bird VEC's?

Diagram 3. Fuel Spill Linkages



6.3.2.1 Linkages

1. Transport and transfer of substances that are foreign to the natural environment may be accidentally spilled during transport and handling procedures.

2. Soluble substances may enter the aquatic food chain in the immediate area of the spill.

3. A buildup of polluting substances in the aquatic food chain may affect the distribution and abundance of loons, waterfowl and shorebirds.

6.3.2.2 Discussion

1. Transport of bulk materials will occur during the season when migratory birds are absent from the area. Accidental spills of harmful substances should be removed in keeping with spill clean-up plans. Residual amounts of spilled substances will be diluted during spring runoff.

2. In view of the sparse density of these migratory birds in the study area, impacts resulting from local changes in the aquatic food chain may be reflected in a shift in the territory of the birds rather than the loss of a breeding pairs to the region.

3. Spills of substances during mining operations will in most, if not all, cases occur in controlled environments making it possible to retrieve and dispose all spilled volumes in an approved manner.

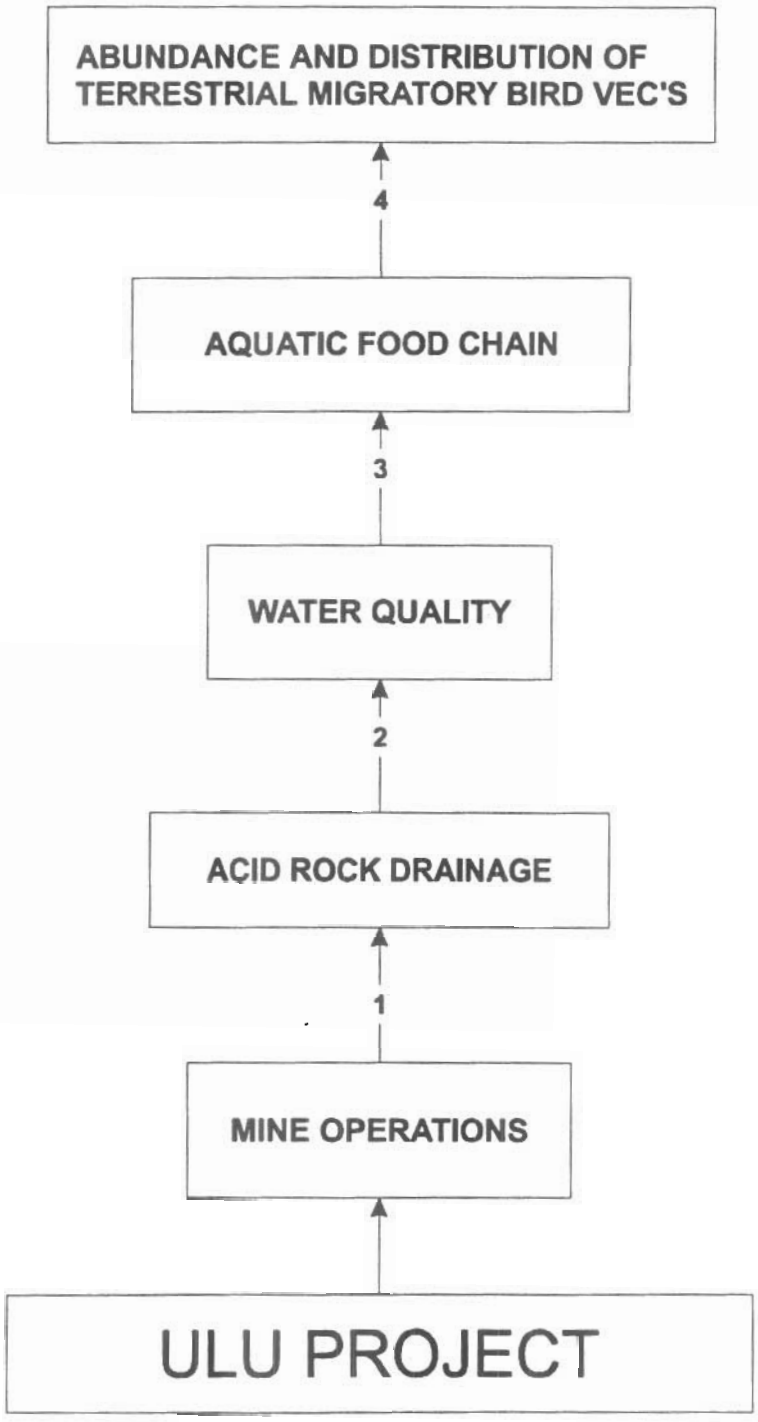
Impacts on loons, waterfowl and shorebirds due to changes in the aquatic food chain from spills of fuels, reagents and ore concentrate will be minor, local and short term.

Residual impacts expected: Displaced breeding birds will establish territories in new locations within the region.

6.3.3 Acid Rock Drainage

Will acid rock drainage at the mine site affect abundance and distribution of loons, waterfowl and shorebirds?

Diagram 4. Acid Rock Drainage Linkages



6.3.3.1 Linkages

1. Developing an ore body requires that rock which has not been exposed to oxidation be brought to surface and disposed.

2. Oxidation of this raw material may produce acidic drainage from areas where development waste rock is stored.

3. Discharge from rock storage areas accumulates in local lakes and may affect pH and other water quality parameters.

4. Water quality characteristics determine the dynamics of aquatic food chains on which local waterfowl, loons and shorebirds are sustained in whole or in part.

6.3.3.2 Discussion

Managing acid-generating waste rock is a key focus of environmental planning and assessment for all mining ventures. Current technology for managing acid rock drainage concentrates on preventing oxidation of sulphur bearing minerals. This requires depositing and storing acid generating rock and tailings in oxygen deprived space. This is achieved by deep burial in the permafrost zone or underwater. The Ulu Project method for acid rock and tailings management will be under water disposal and so the necessary oxidation process required for acid generation should be prevented.

The impact on loons, waterfowl and shorebirds from acid generating rock and tailings underwater disposal will be insignificant.

Residual impacts: Displaced breeding birds will establish territories in new locations within the region.

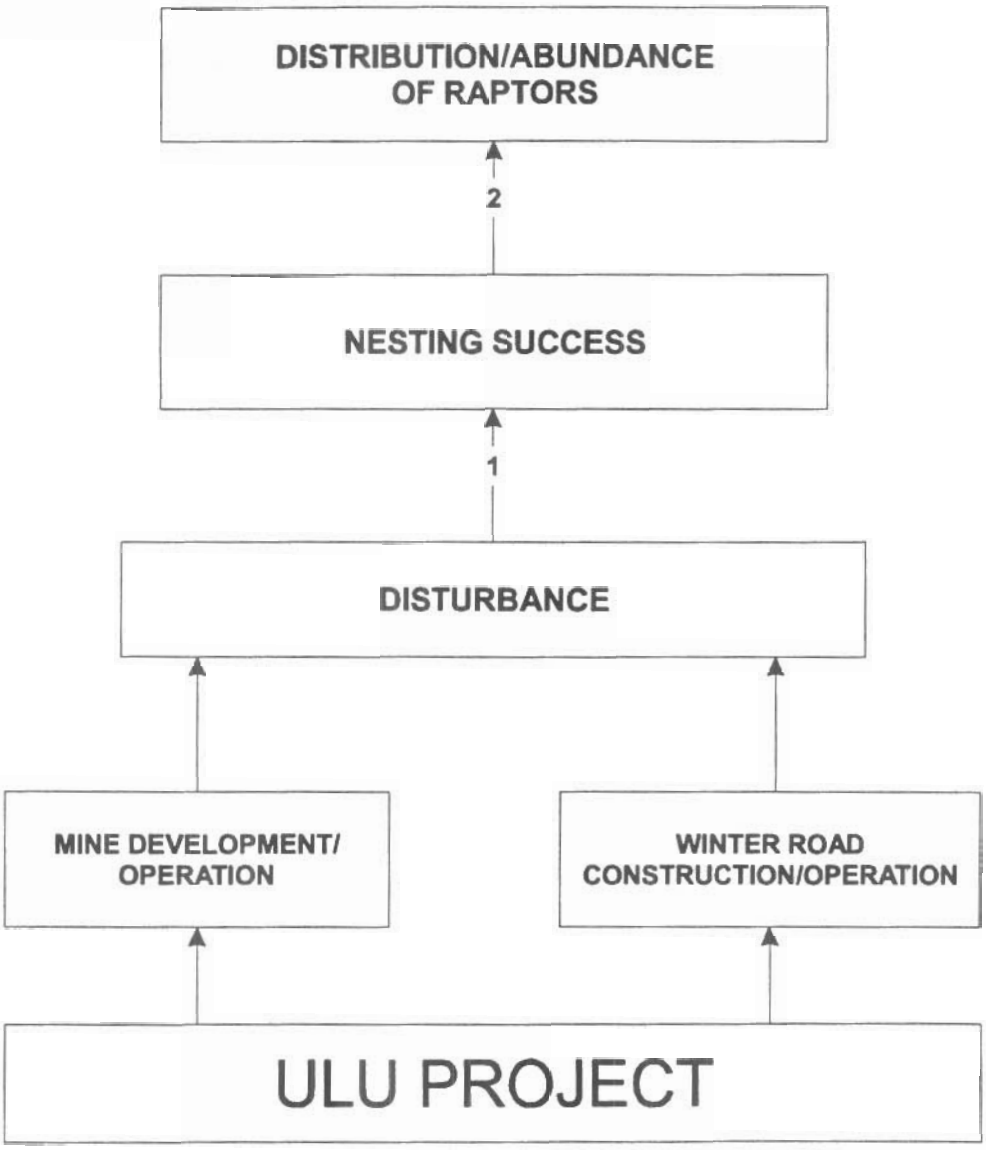
6.3.4 Raptors

Will the Ulu Project affect the distribution and abundance of raptors in the study area?

6.3.4.1 Background

The study area supports four species of raptors: golden eagles, rough-legged hawks, peregrine falcons and gyrfalcons. Surveys in July and August identified eight active nests and seven additional inactive sites. Please see Figure 2 for nest site locations. An additional three sites on Contwoyto Lake are documented in the GNWT raptor nest site data base.

Diagram 5. Project-Raptor Linkages



6.3.4.2 Linkages

1. Noise and other disruptions from construction and operations disturb raptors during the incubation and fledging period.

2. Nest abandonment affects abundance and distribution of raptors in the study area.

Discussion of these linkages will follow for each species separately.

6.3.4.3 Golden Eagles

Golden eagles arrive on their breeding territories near Coppermine in April and stay until late September to mid-October (C. Shank, unpublished data). A single golden eagle was observed on the Hood River in July 1996. All suitable nesting habitat in the immediate area of the mine site was examined and no sites resembling eagle nests were found.

As the eagles occupy nest sites and start laying eggs in late April, and the winter road may operate until the end of April, there is concern that winter road use will disturb golden eagles on their nests. Two mitigation measures may come into play. Studies by Matthews (Boreal Ecology Services, 1988) on the Norman Wells pipeline indicated that a minimum 3.2 km buffer zone between raptor nest sites (Appendix C) and ground and air access may be effective in mitigating disturbance of raptor nest sites. Also, there is usually more than one nest site in a raptor breeding territory, so that abandonment of one site as a result of winter road use during the early stages of nesting and incubation, would not automatically result in the breeding territory being abandoned (Chris Shank, personal communication).

The impact of construction and operation at the mine site and from winter road construction and operations, on golden eagle will be negligible, short-term and local.

Residual impacts expected: none.

6.3.4.4 Rough-legged Hawks

Rough-legged hawks arrive in their nesting territories in May and stay until early fall (Poole and Bromley, 1988b).

Only one nest was found in the area of the mine site. Seven inactive stick nests were found in the area surveyed.

Construction and operation of the winter haul road will occur from December through April and therefore disturbance from these activities will not affect early phases of hawk nesting along its route.

The impact of the Ulu Project on rough-legged hawks will be negligible.

Residual impacts expected: none.

6.3.4.5 Peregrine Falcons

Peregrine falcons arrive in their nesting territories in May and stay until early fall (Poole and Bromley, 1988b). Six active peregrine territories were located: three along the 1997 and 1998 resupply route, two near the winter road and a third some distance away.

The impacts from the mine, winter road construction and operations on peregrine falcon will be negligible.

Residual impacts expected: none.

6.3.4.6 Gyrfalcons

Gyrfalcons occupy their breeding territories as early as February. One gyrfalcon nest was found approximately 4 km from the winter road (Bromley and Poole, 1988a).

The operating period for the winter road will extend from December through April and has potential for disturbing gyrfalcon on their breeding territories during the months of February to April.

The impact of mine development and operations, and winter road construction and operations on gyrfalcons will be negligible.

Residual impacts expected: none.

6.3.5 Carnivores

6.3.5.1 Wolves

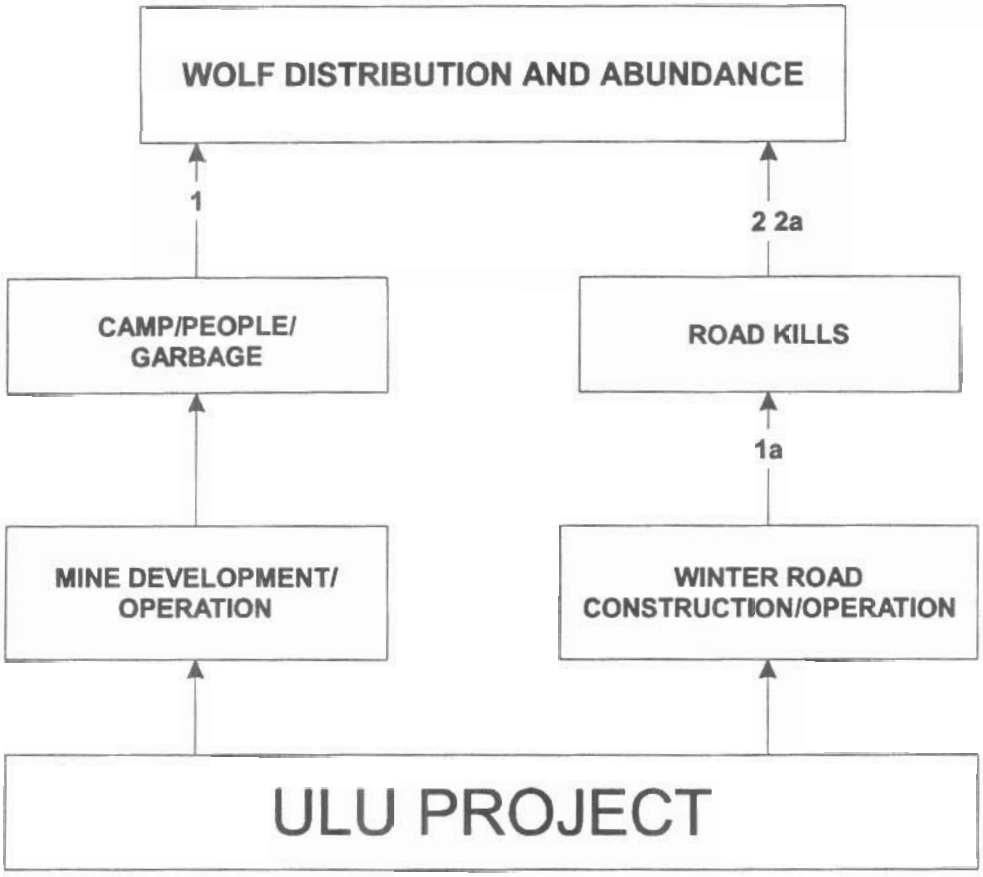
Will the Ulu project affect the distribution and abundance of wolves in the region?

Background

Wolves range over a large area on a seasonal basis in response to caribou distribution. Wolves have been observed near the mine site in spring and summer, when caribou are in the vicinity and are found throughout the study area. In discussing wolf conservation and encroachment of industrial activity like mining into wilderness occupied by wolves, Paradiso and Nowak (1982) stated that aside from providing access to more hunters "such

activities seldom directly affect wolves." There is nothing in the experience at Lupin Mine that suggests a possible impact on wolves. Hunting in the vicinity of the mine site would be prohibited. Incineration of all organic waste at all camps will prevent habituating wolves to Ulu Project garbage dumps.

Diagram 6. Project-Wolf Linkages



Linkages

1. Camps and people produce garbage which may attract wolves to the camp garbage dump.

1a. Road kills of ground squirrels and/or caribou at the mine site, or caribou on winter roads, create carrion which may attract wolves.

2. Wolves attracted to camps may become a nuisance and so may need to be destroyed.

2a. Wolves, especially pups of the year, will be attracted to road kills, and may themselves become road kills.

Discussion

1. Wolves will remain in areas where there is a reliable food source. Rigorous garbage management will prevent wolves from becoming habituated to the camps operated by the Ulu Project.

2. Road kills are accidents that are sometimes impossible to prevent and should be expected on all roads operated by the Ulu Project. Ground squirrels will probably be cleaned up by ravens and gulls, but left out may attract foxes, wolves and other carnivores. Like perishable camp garbage, road kills must be cleaned up and disposed of by incineration immediately to avoid attracting scavengers and carnivores who may themselves become road kills.

An ancillary issue to attracting carnivores to camps is the high frequency of rabid foxes (especially arctic foxes) at certain points of the predator/prey cycle. Rabid foxes and other carnivores often display unusual behaviour which may include attacking equipment and personnel. Contingency plans should include training personnel to recognize these situations.

A rigorous garbage management and road kill disposal plan will ensure that the impact of the Ulu Project on wolves is insignificant.

Residual impacts expected: none.

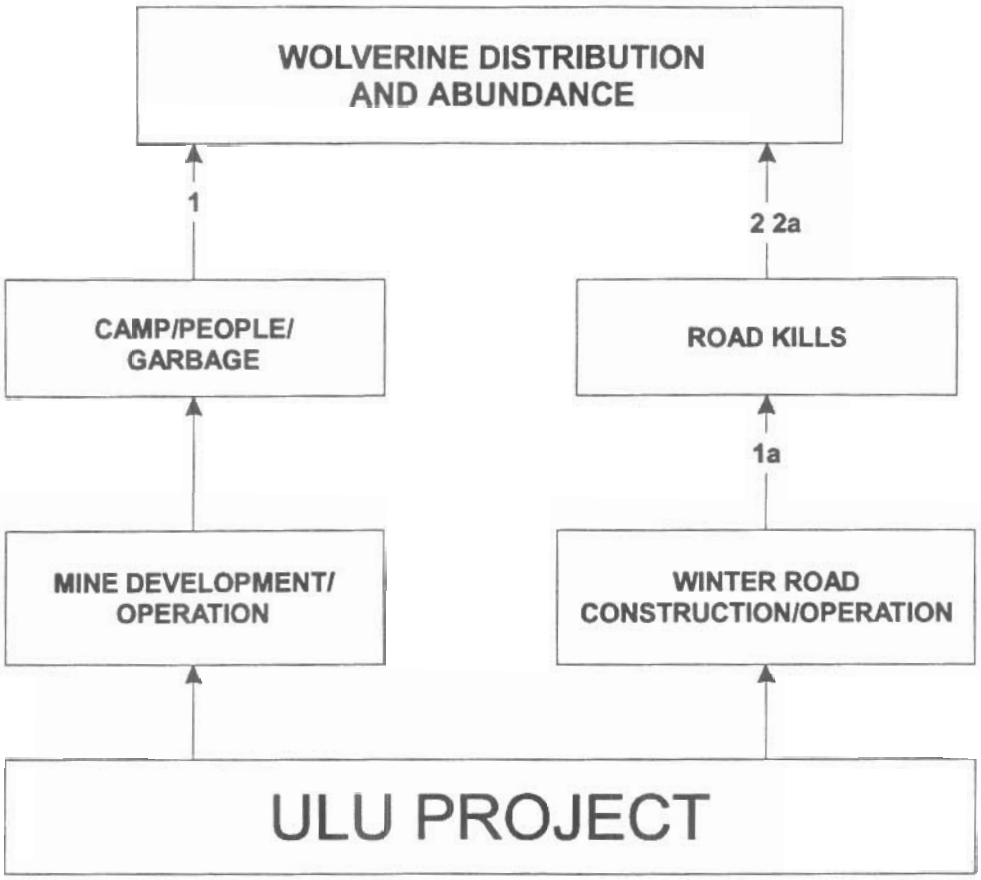
6.3.5.2 Wolverine

Will the Ulu project affect the distribution and abundance of wolverine in the region?

Background

Wolverine are solitary, nomadic animals with an extensive range. Individuals have been observed in the vicinity of the mine site. It is unlikely that the site-specific activities of mine and winter road operations would affect the well being of this species. Waste management measures to prevent attracting carnivores generally, will also be effective for wolverine.

Diagram 7. Project-Wolverine Linkages



Linkages

1. Camps and people produce garbage which may attract wolverine to the camp garbage dump.

1a. Road kills of ground squirrels and/or caribou at the mine site or caribou on winter roads, create carrion which may attract wolverine.

2. Wolverine attracted to camps may become a nuisance and so may need to be destroyed.

2a. Wolverine attracted to road kills, may themselves become road kills.

Discussion

1. Wolverine may become opportunistic scavengers at camps that do not practice diligent garbage control.

2. Wolverine's naturally destructive nature may create a nuisance situation requiring the destruction of wolverine. Road kills are accidents that are sometimes impossible to prevent and should be expected on all roads operated by the Ulu Project. Ground squirrels will probably be cleaned up by ravens and gulls, but left out, may attract wolverine.

2a. Camp garbage and road kills must be cleaned up and disposed immediately by incineration to avoid attracting scavengers and carnivores who may themselves become road kills.

A rigorous garbage management and road kill disposal plan will ensure that the impact of the Ulu Project on wolverine is insignificant.

Residual impacts expected: none.

6.3.5.3 Grizzly Bear

Will the Ulu Project affect the distribution and abundance of grizzly bear in the study area?

Background

The grizzly has been able to survive in North America only where spacious habitat has insulated it from excessive human-caused mortality. Its habitat has traditionally been protected by rugged physiography or inaccessibility. (Craighead and Mitchell, 1982).

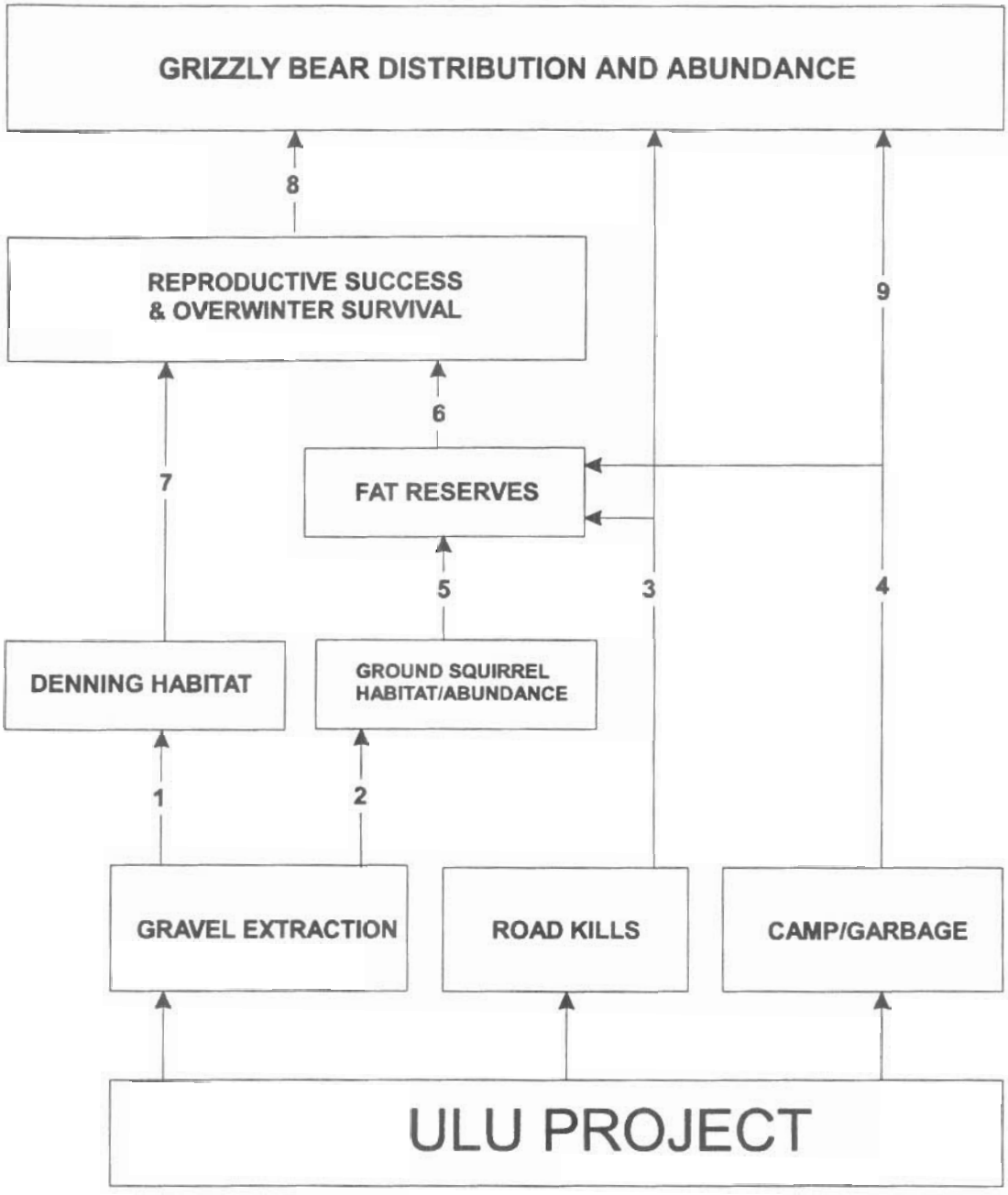
Grizzly bear occupy the range of the mine site and winter road. The experience at Lupin Mine shows that there has been very little impact on grizzly bears over the past ten years. This suggests that the site specific activities associated with a mine and winter road do not destroy the wilderness characteristics needed to sustain grizzly populations. The observations of the study near Coppermine also show that grizzly females can raise their cubs in relatively close proximity to a community of 1,000 without becoming a problem.

Concern has been expressed that gravel extraction from eskers will impact on grizzly denning habitat. An aerial survey of potential borrow and quarry areas on October 3, 1996 revealed no fall denning activities near the winter road alignment.

A primary concern of the Ulu Project will be to develop and implement a strategy which ensures that bears are not attracted to facilities associated with the mine and winter road, where they could become a problem and need to be destroyed. A situation at Lupin demonstrates the importance of prevention. A female grizzly with cubs was attracted to garbage at the mine site at a time when the waste incinerator was malfunctioning. She returned to the site twice after being removed by helicopter. The cost and inconvenience

of managing nuisance wildlife in this way indicates the need for contingency planning in the event that the primary waste management equipment fails.

Diagram 8. Project-Grizzly Bear Linkages



Linkages

1. Gravel extraction for the winter haul road may disturb or remove esker denning habitat.

2. Gravel extraction may affect ground squirrel esker habitat.

3. Road traffic will involve accidental collisions with caribou (and perhaps other wildlife) producing carrion available to grizzly bear which could improve their fat reserves.

4. Camps produce garbage available to grizzly bears which could improve their fat reserves.

5. Reduced ground squirrel habitat and productivity reduces prey availability and so deplete fat reserves.

6. Fat reserves are significant in determining cub survival in maternity dens and the first summer of life, as well as overwinter survival of males, juveniles and non-breeding adult females.

7. Suitable denning habitat is essential for reproductive success and overwintering survival for all grizzly bear.

8. Reproductive success and overwinter survival determine grizzly bear population trends.

9. Grizzly bears that are attracted to camps and become habituated to feeding on camp garbage can become a nuisance and perhaps a safety risk and may have to be destroyed, resulting in a decrease to the grizzly population.

Discussion

1. Grizzly bear dens are usually dug in exposed and well drained slopes or banks with sufficient depth to permafrost (Nagy, 1983). Dens are dug in September and October, occupied until spring at which time they are abandoned. In almost all cases spring runoff results in the den roof collapsing (Nagy, personal communications) which means that dens are not occupied in successive years. The den for successive years may however be in the same general area. Females always den within their summer territory (Nagy, personal communication). Nagy described the Tuk peninsula as flat and featureless and yet felt that the grizzly population there was not limited by lack of denning habitat (personal communications). Thirteen female grizzly that were monitored by telemetry in 1995 had a mean territory of 1960 km^2 (Cluff and Case, 1995). This study focused on bear around Lac de Gras but also included animals near Kugluktuk. Male territories for a given grizzly population are larger than female's (Craighead and Mitchell, 1982). The abundance of esker habitat in the region should permit site specific quarrying of eskers to

construct 97.25 km over land portion of the winter haul road[2] without limiting the denning habitat for grizzly in the region. This linkage does not represent a potential barrier to denning in the region.

Reconnaissance flights or surface inspections should be made in the fall (October) to determine if bears are intending to den in eskers proposed for winter quarrying. Tracks and diggings will show clearly in the fresh fall snow cover. If a den shows up in a targeted esker and if alternate gravel sources are not at hand, the quarrying schedule for the site could be set so that work near the den site would not be conducted until as late in the season as possible to allow for minimum overwinter disturbance at the den.

2. Arctic ground squirrels are abundant throughout the region. Their burrows are found in all well drained habitats. Site specific quarrying in eskers will not limit the overall abundance and distribution of ground squirrels as prey species for a predator as wide ranging as the grizzly bear.

3. Road kills, if left on the land along the winter road, will attract bear as they emerge from their dens. This would be a very attractive source of instant high quality food when bear are making up reserves depleted over the winter and so would have a positive effect on the grizzly. The bear may however associate roads with food which may lead to problems "down the road."

4. The linkage between garbage and grizzly bear is well known. There have been no bear problems at the Ulu camps to date. Continued prompt incineration of all perishable garbage should keep this record intact.

5. In the study of grizzly bear on the Tuk Peninsula, Nagy (1983) found that ground squirrels are an important food source in the fall as grizzly fatten up in preparation for denning.

6. The condition of the bear in fall is significant in the timing of when dens are occupied. Nagy (1983) found that bears that were out late into winter were in poor condition. Also, if sows are in poor shape cubs may not survive (in the den) until spring, or through the first summer.

7. Denning habitat does not seem to be in short supply in the region and so this linkage does not represent a negative impact on reproductive success of grizzly bear in the region.

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[2] Data provided by Echo Bay Mines Ltd.

8. The relationship between reproductive success and overwinter survival is self-evident.

9. A rigorous garbage incineration plan will prevent nuisance bear situations for the life of the project.

Recommended mitigation measures:

1. A road kill removal and garbage management program that disposes all perishable refuse and garbage within a time period that is efficient to maintain total effectiveness to prevent attracting grizzly bears must be implemented at all Ulu Project camps.

2. A bear response plan should be developed and all staff made aware of it. Notices of it should be posted at key points in camps and work sites.

3. A garbage disposal equipment back up capability should be in place to ensure that there is never an interruption in the camps' ability to incinerate garbage promptly.

The impact on grizzly bear abundance and distribution by the Ulu Project will be negligible.

Residual impacts expected: none.

6.3.5.4 Muskox

Will disturbances to muskox by Ulu Project facilities and activities change muskox abundance and distribution?

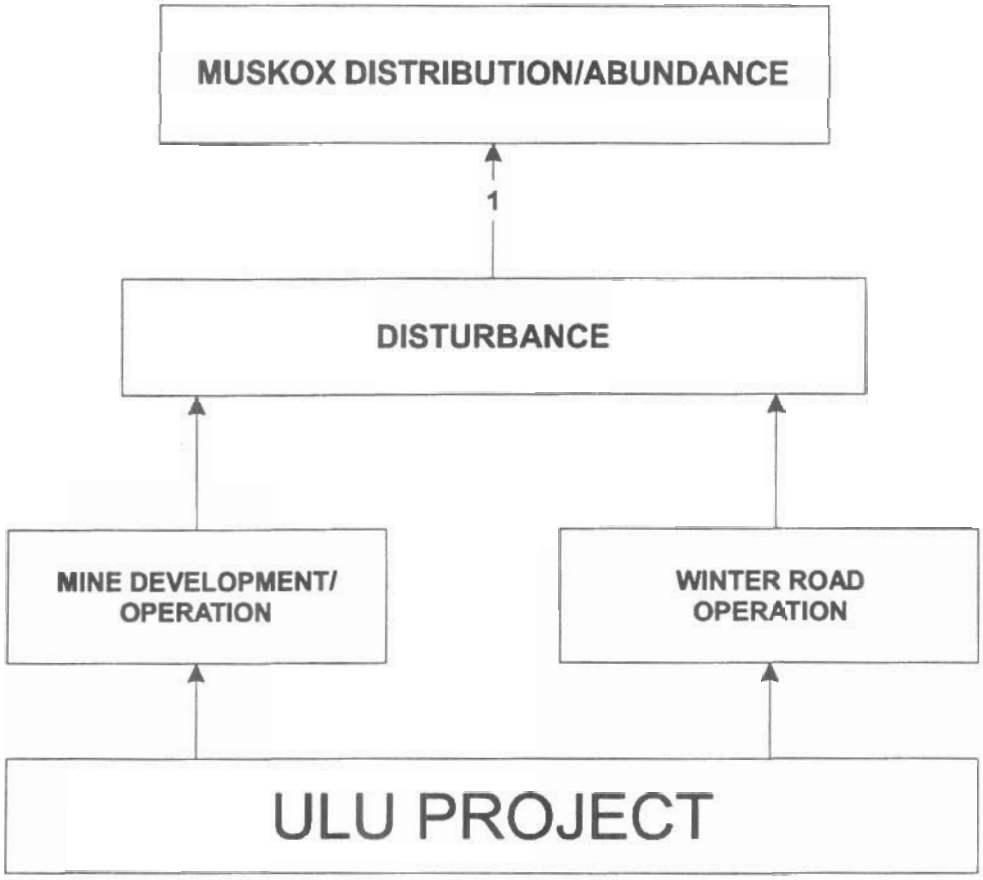
Background

Muskox are present throughout the area of the winter haul road and mine site at low densities.

Mining activities and the construction and operation of the winter road should not impede muskox from increasing their population throughout the area. Muskox are regularly observed at Lupin. In August 1996, a mixed herd of 21 included at least five calves. The presence of a winter road has not created a barrier to their movements around Lupin.

The potential for excessive harassment (Appendix D) by people and/or machines in the vicinity of the Ulu Project mine site and winter road should be addressed by giving wildlife the "right of way" along all transportation routes. Hunting and harassment of wildlife should not be permitted by employees or contractors at Ulu Project sites.

Diagram 9. Project-Muskox Linkages



Linkages

1. Noise and constant commotion at the mine site and by ore trucks on the winter road may create sufficient disturbance that muskox in the area will change their annual movements and so affect their abundance in the region.

Discussion

Since their near extirpation in the last century, muskox have made a strong recovery to the point where they are now a common sight on much of the NWT tundra. In habitats near human habitation or industrial activity where their ecological needs are satisfied in the absence of harassment and hunting they appear relatively sedentary and seem to become accustomed and tolerant to human activities. This has been observed at Eureka, Truelove Inlet, and Polar Bear Pass. Muskox are also a common sight at Lupin Mine. Since nothing in the Ulu Project requires large scale habitat alteration, and since hunting and harassment of wildlife at Ulu Project facilities will not be tolerated, the impact on muskox will be insignificant.

The impact of the Ulu Project on muskox in the region will be negligible.

Residual impacts expected: none.

6.3.5.5 Caribou

Will the Ulu Project affect the productivity and distribution of the Bathurst Caribou Herd?

Background

The Ulu Project study area is encompassed by the range of the Bathurst caribou herd. Potential interactions between concentrations of caribou and Ulu Project facilities and activities include:

- on the winter road during spring migration to the calving ground (from mid-April to mid-May);
- at the mine site, during the summer dispersal in late June and throughout July and perhaps August; and
- on the winter road from December through April with caribou that overwinter on the tundra.

In general, mineral exploration and development on the caribou range has not been seen to affect the productivity of the Bathurst herd. In the first four years of operations at Lupin Mine, population estimates for the Bathurst herd increased from 174,000 in 1982 (when Lupin was commissioned) to 486,000 in 1986 (GNWT, unpublished). It spite of the new mine site on the summer range and the development of a winter road providing greater hunter access from the Yellowknife area, there was no negative impact apparent on the overall productivity of the herd.

These general observations notwithstanding, there are several site specific issues that bear consideration.

Winter Road

In relation to the proposed winter road alignment from Lupin to Ulu the calving grounds of the Bathurst herd are to the east and major portions of the winter range are to the south and west. The winter road would be in operation from December through April. Kelsall (1968) described the general routes of the Bathurst herd's spring migration as follows. On reaching treeline:

Most then follow height of land between the headwaters of the northwest-flowing Coppermine River and the east and northeast flowing Lockhart, Burnside, and Back rivers to Contwoyto Lake or its vicinity. From there the valleys of several large rivers funnel the animals directly to Bathurst Inlet.

Animals on the northern extremity of this movement have a number of alternatives.... Most cross the lower Coppermine River valley, which lies nearly at right angles to their course.... Once the valley is crossed the animals move along a band of high rolling tundra which extends almost to Bathurst Inlet, and which is separated from Coronation Gulf to the north by rough and broken country. During survey flying in 1955, caribou bands were backtracked for nearly 175 miles from Wilberforce Falls on the Hood River to the big bend in the Coppermine River. The animals chose the highest and most level country for travel and avoided rocky terrain to the north and the major valleys to the south.

Migrations of significant numbers passed through this area in nine of ten years, between 1949 and 1960. The closer the caribou are to the calving ground, the narrower the migratory corridor becomes (Kelsall, 1968; Thomas, 1969). The southern terminus of the winter road will be approximately 160 km west of Bathurst Inlet and therefore, the front of migrating caribou may encompass the mine site and the southern portion of the winter road. The pregnant cows would pass first in late April and early May followed by barren cows and yearlings with bulls bringing up the rear the middle of May and perhaps later.

> *". . . the duration of movement through a given point generally extends over a period of three weeks or more." (Kelsall, 1968).*

The region is generally a low-precipitation zone and the road will be upgraded to blow clear of snow as much as possible to minimize clearing requirements. Therefore plowing of the winter road should not create continuous banks of accumulated snow. As such the road itself will not become a barrier or deflector for migrating caribou. Kelsall described the spring migratory behaviour as "purposeful." Jakimchuk and Carruthers (1983) observed caribou of the Bathurst herd on migration to the calving ground near Contwoyto Lake in May 1980. Their conclusions included the following:

Caribou responses to varying natural terrain include deflections and paralleling behaviour. These responses are aimed at seeking the path of least energetic resistance.

In searching the literature on the subject, we found no references to the Lupin winter road impeding caribou migration in spring.

Winter roads in the NWT are operated under federal land use permit. Procedures and requirements for minimizing impacts on wildlife, including caribou, should be developed by Echo Bay Mines Ltd. in consultation with GNWT wildlife biologists as terms and

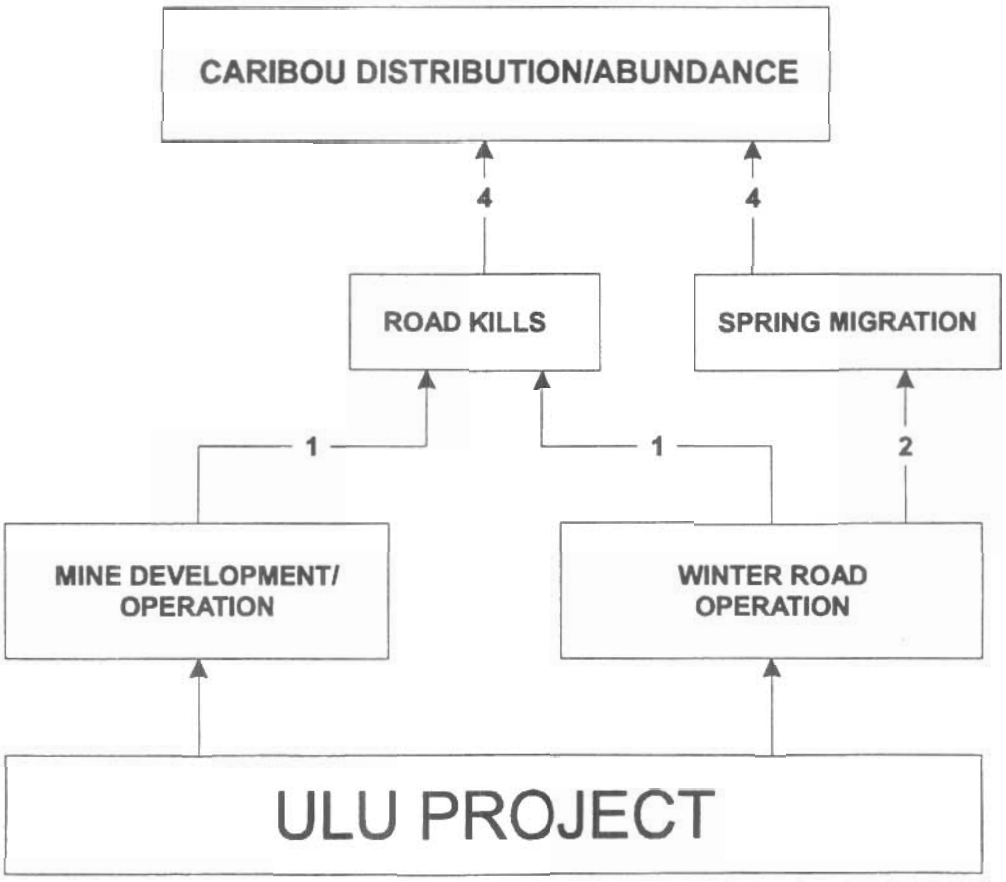
conditions to the permit. These requirements should be incorporated into maintenance and operating plans for the winter road.

The experience with caribou at Lupin is a valuable reference for indicating the types of interactions that may be expected at Ulu. The facilities and general scale of activities at Ulu will be much smaller than that of Lupin. There will be buildings, roads, an airstrip and rock disposal areas.

Interactions between standard mining activities and caribou have occurred at Lupin for more than ten years with no apparent ongoing negative impact on the Bathurst herd. The same is expected at Ulu Lake, 120 km to the north.

The primary interaction at the mine site will be with surface operations (mobile equipment, aircraft etc.) while caribou are moving around and past the site on seasonal migrations. In addition, some mine related activities such as grass reseeding and creation of high ground with waste rock dumps, may attract caribou.

Diagram 10. Project-Caribou Linkages



Linkages

1. Road traffic at the mine site and on the winter road will result in accidental collisions with caribou either maiming or killing them.

2. Concentrations of migrating caribou will cross the winter road during April in varying numbers from year to year.

3. Serious delays or deflections to migrating females in spring may affect their arrival on the calving ground and so affect birthing and calf survival.

4. Combined, these impacts may affect caribou productivity and thereby distribution.

Discussion

1. Road kills will occur but not in the quantity that will measurably affect the productivity and distribution of a herd which numbered 352,000 head in 1990 occupying a range of 250,000 km^2. A policy of "caribou always have the right of way" will greatly reduce the incidence of collisions.

2. In some years, the spring migration of females through the Ulu Project area will be very low. Other years may see concentrations described by Thomas for 1967 (93,000 in 1 - 2 days) or Williams for 1985. Williams reported caribou in significant numbers from Camsell River to Rockinghorse Lake, a straight line distance of 260 km. If that herd was travelling at 25 km/day it would take 10 - 11 days to pass the mine site and winter road. Both these observations were made in mid to late April. There has been no documentation of the Lupin winter road affecting caribou spring migration. Caribou are very purposeful on spring migration and so the impact on migration to the calving ground will be minor.

3. As the winter road will not have a significant impact on spring migration this linkage is of little consequence.

4. The cumulative effects of road kills and the winter road will not affect productivity and distribution of the Bathurst Caribou Herd.

Mitigative measures

If the Project adopts a traffic/wildlife policy that gives caribou (wildlife) the "right of way," it would help manage traffic on the winter road to know the configuration and density of the herd encountered. It is recommended that when significant caribou concentrations (concentrations that affect traffic flow on the winter road) are encountered, that a reconnaissance survey be conducted in order to develop an optimum traffic management strategy based on caribou concentrations and rate of movement in relation to the winter road.

The impact of the Ulu Project on the productivity and distribution of the Bathurst caribou herd will be negligible.

Residual impacts expected: none.

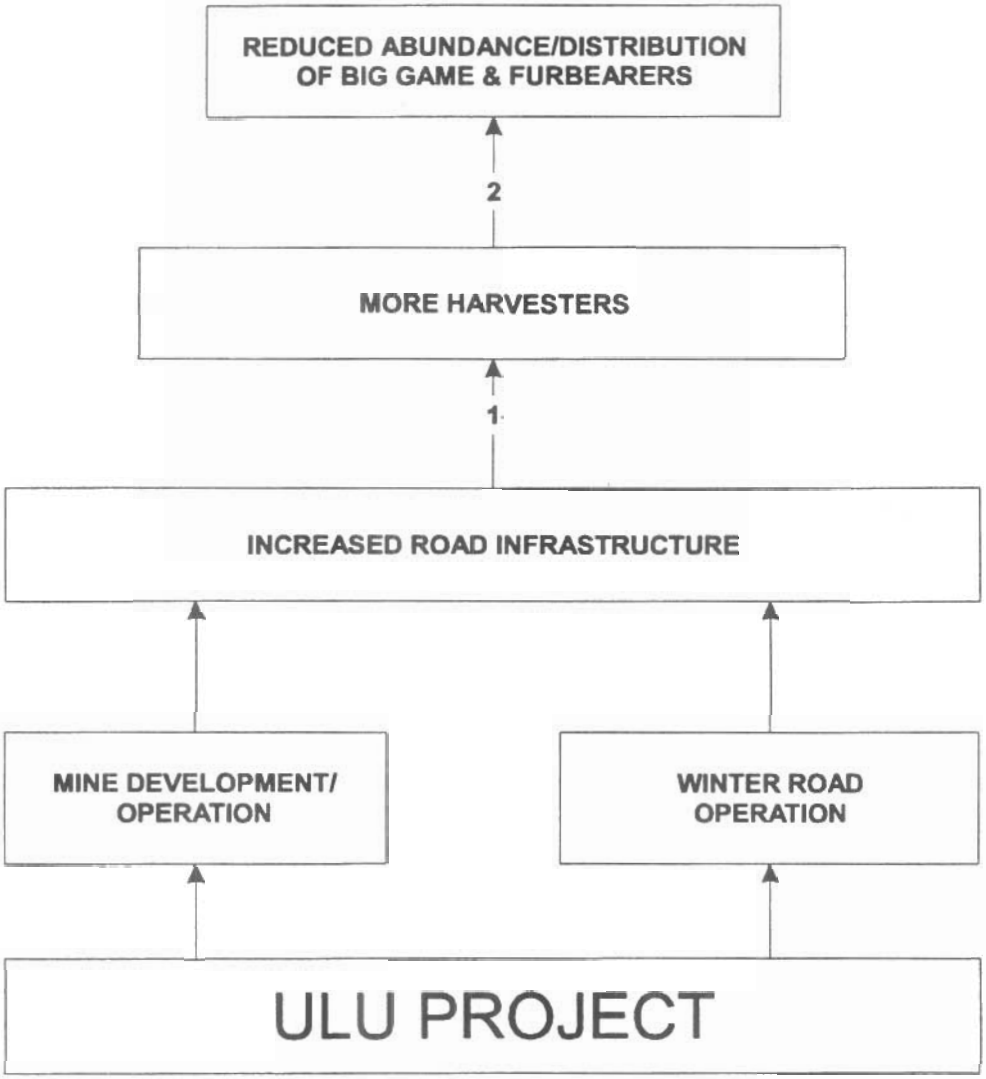
6.3.5.6 Wildlife Harvesting

Will increased road infrastructure in the region for hunters and trappers, affect the abundance and distribution of big game and furbearer VEC species?

Background

Whenever virgin country like the study area is subjected to expanded surface transport infrastructure, concern is expressed that added access will increase harvesting pressure. Similar concerns were raised when the Lupin winter road was established 16 years ago.

Diagram 11. Project-Wildlife Harvesting Linkages



Linkages

1. The Ulu Project will create more road infrastructure in the region.

2. Increased access will allow increased hunting/trapping pressure in the area of the Ulu Project winter road and adjacent areas.

Discussion

1. The winter road to Ulu is a continuation of the road from Yellowknife to Lupin Mine. Hunters using this road rarely travel beyond McKay Lake and so will not get into the region of the Ulu project (GNWT Resources, Wildlife and Economic Development, unpublished data).

2. This linkage is of no consequence to wildlife in the region of the Ulu project.

The overall impact of increased and improved access to wildlife populations in the region of the Ulu Project by harvesters using the winter road will be negligible.

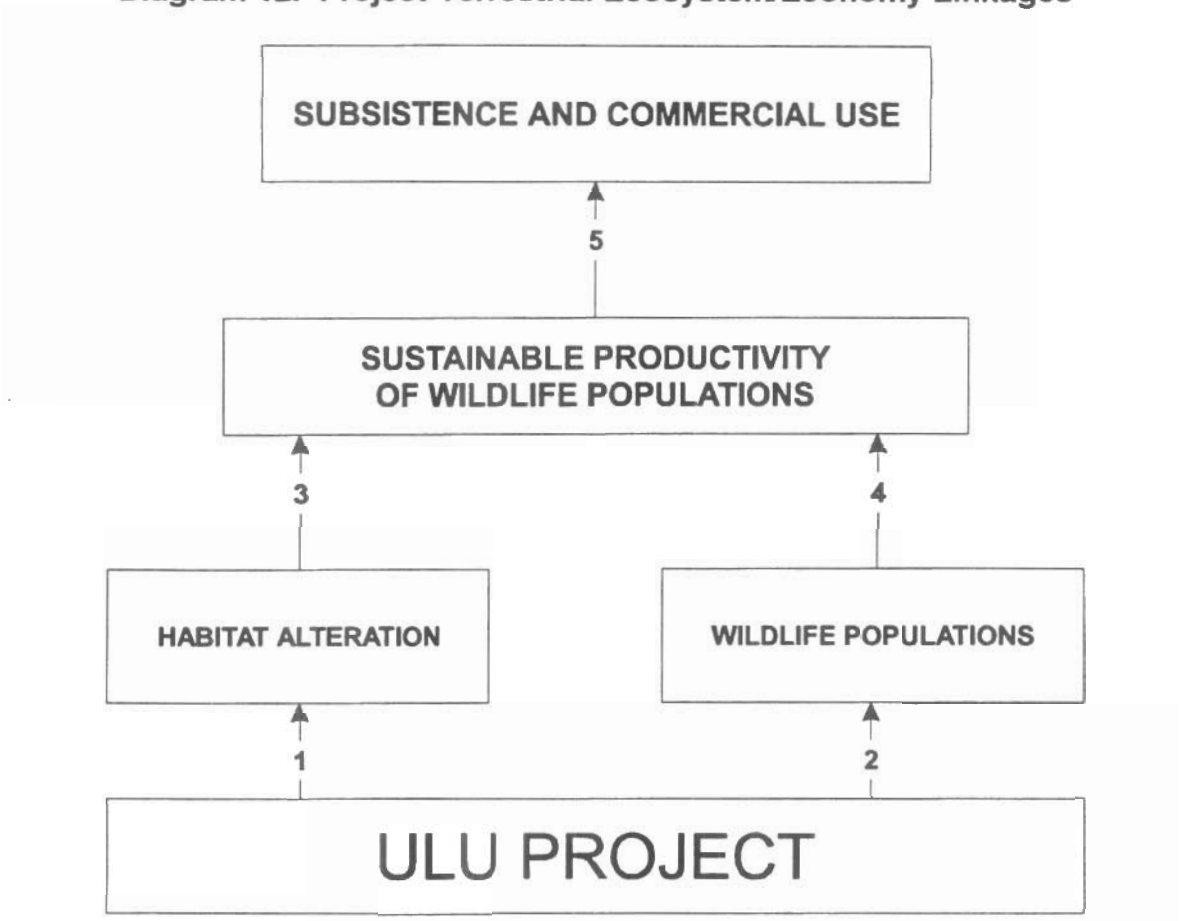
6.3.5.7 Terrestrial Ecosystem/Economy

Will the Ulu Project have a negative impact on the ability of the terrestrial ecosystem to sustain the production of natural resources used by local/regional communities for subsistence and economic development?

Background

It is expected that mineral development ventures like the Ulu Project proceed in the context of sustainable development. In this case there may be a concern for the effects of the project on the continued use of renewable resources by northern communities' land based economies and impact on sustainable harvests of renewable resources.

Diagram 12. Project-Terrestrial Ecosystem/Economy Linkages



Linkages

1. The Ulu Project requires that an area of 164.0 ha of natural habitat be altered at site specific locations over a lateral distance of 122 km.

2. Accidental collisions with caribou and unavoidable interactions with carnivores may result in the deaths of occasional animals.

3. Wildlife habitat destruction on a significant scale reduces carrying capacity of wildlife ranges leading to declining populations.

4. Loss of animals to a breeding population in significant numbers reduces the productivity of the population.

5. Reduced productivity in wildlife populations may force reduced harvests by subsistence harvesters, recreational hunters and commercial outfitters serving recreational and trophy hunters.

Discussion

1. The tundra ecosystem covers much of the mainland NWT and loss of 164.0 ha of natural habitat will not threaten the sustainability of this ecosystem or biodiversity within it.

2. Accidental losses of caribou will happen, perhaps every year. The most recent population estimate for the Bathurst Herd stands at 352,000. Losses of individual animals to the population due to accidental collisions will not threaten the productivity of the herd. This linkage is not relevant to caribou productivity.

Mitigation measures will ensure that grizzly bear, wolf and wolverine are not attracted to camp garbage dumps. If nuisance animals need to be destroyed it will occur rarely (one event in 14 years at Lupin). This will not undermine the productivity of these carnivore populations. This linkage is not of serious consequence for these species productivity.

3. No key habitat for any VEC's or other wildlife species will be destroyed. The habitats affected by the Ulu Project are not unique. Use of the habitats in the vicinity of Ulu Project facilities by VEC's species are seasonal and intermittent. Loss of 164.0 ha habitat will not affect the sustainable production of wildlife in the region.

4. The loss of isolated individuals due to accidental collisions will not undermine the productivity of the herd and its ability to sustain present subsistence and commercial harvests.

5. Ulu Project facilities and infrastructure are beyond the present operating range of outfitters. Hunters based in Yellowknife and other communities to the south do not travel beyond McKay Lake for winter caribou hunts. The time of year for most hunting by outfitters coincides with the period when caribou are in peak velvet through to just before the caribou rut near freeze-up. Most of the caribou will be at or near treeline then and few will remain in the vicinity of the Ulu Project.

The productivity of terrestrial ecosystems and wildlife populations there will not be diminished as a result of the Ulu Project. Any negative impacts on the harvests of wildlife and other terrestrial renewable resources by communities in the region and adjacent areas will be negligible.

7.0 CUMULATIVE IMPACTS

7.1 Project-Specific Cumulative Impacts

7.1.1 Terrestrial Ecosystems

The environmental evaluation reported in the previous section determined that the only incremental change to the terrestrial environment as a direct result of the Ulu Project is the loss of 164.0 ha of natural habitat. As the project is in an extremely arid region with low primary productivity, the changes in habitat will be visible for a long time, perhaps permanently. The impacts to the wildlife populations will be negligible because the overall capacity of the ecosystem to sustain natural wildlife populations will not be significantly impaired. Also, the direct linkages between the Project and wildlife in the region is such that measures necessary to mitigate impacts are complementary to good industrial practice. This conclusion is, in a sense, confirmed by the response of wildlife populations to Lupin Mine and the associated winter road. The Bathurst Herd increased in size despite the winter road providing access into the heart of the herd's winter range. Muskox continue to graze in the shadow of the mine's headframe. There has been only one incident requiring the destruction of a grizzly bear (with two cubs) in 14 years. Like Lupin, there are no components in the Ulu Project that, of necessity, create cumulative impacts on the terrestrial ecosystem.

7.1.2 Cumulative Impacts Among Projects in the Project Area

The Ulu Project is an extension of Lupin Mine and so uses existing infrastructure to the greatest extent possible. The transportation infrastructure developed by the Project is not expected to facilitate any other industrial or tourism activity during the four to six years it expects to be operating.

8.0 WILDLIFE SURVEILLANCE AND MONITORING PROGRAM

This regional environmental evaluation on wildlife and habitat by the Ulu Project has found that mitigation measures can ensure impacts will be negligible in all cases. Surveillance of selected species, however, will enable evaluation of mitigation measures and assist in their refinement.

Raptor nest sites (Appendix C) near the winter haul road should be monitored during operations from mid April. Resulting data will aid in determining thresholds of tolerance during the pre nesting periods for gyrfalcons and golden eagles. Nest sites near the mine site should be monitored for nesting activity in early June and again in July to assess if activities there influence nest site selection by peregrine falcons and/or rough-legged hawks.

The Ulu Project has the potential to interact with caribou. Seasonal distribution of caribou in the Project area should be monitored, and any substantial impact on caribou migration and movement should be mitigated by avoiding adverse project-caribou interactions.

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NOTES ON APPENDICES A AND B

A combination of reference texts and records from Bathurst Inlet Lodge were used to develop the species inventory that is described. The notes on the species' ecology are intended to describe the critical elements of the species' natural history that may be at risk. The notes under "Management status" provide a reference to the legislation under which the species is managed or protected as well as any designation under domestic or international conventions for wildlife protection. None of the birds that regularly breed in the region or any of the mammals resident here are currently designated as "endangered" or "threatened" by The Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Status under endangered species designation was taken from *1995 Canadian Endangered Species* published by the World Wildlife Fund (WWF).

The annotations for the species listed in Appendices A and B are not intended to serve as definitive statements on the subjects covered. They are offered rather as descriptions of elements in the species' ecology and natural history that are important for its survival as a member in the faunal assemblage of the region. The statements in the report on interactions and impact are made in the context of experience gained at Lupin since operation began there in 1982 and acceptable mining practices as we know them from other northern mining operations in the NWT and winter road operations here for many years. This report is intended to assist in developing operating terms and conditions and wildlife monitoring plans that emerge from the environmental review by the Nunavut Impact Review Board as required by the Nunavut Land Claims Agreement.

The notes under "Project-species interactions" are the author's views on how acceptable mining practices and standard winter road operations may affect the species under review. Similarly, the notes on interaction with the project are intended to serve as a screen that may identify species at risk, and determine how and in what way their annual cycle may be affected. Where inadequate information on the presence or seasonal distribution of the species becomes apparent, suggestions for additional work are offered. The author's views were guided by a criterion used by the Canadian Wildlife Service (CWS) when assessing the significance of a particular site for migratory birds:

"Populations that are geographically widespread or widely dispersed throughout a variety of habitats are less vulnerable to site-specific threats, as only a small portion would be affected. For these species, very large areas would be required to support a significant portion of the population." (Alexander *et al.*, 1991.)

Appendix A

Annotated Bird Species List

ANNOTATED BIRD SPECIES LIST

LOONS

Red-throated loon *(Gavia stellata)*

A common summer resident.

Breeding range: circumpolar

Winter range: east and west coasts of North America.

Arctic loon *(Gavia arctica)*

A common summer resident.

Breeding range: circumpolar

Winter range: southeastern Alaska and coast of British Columbia.

Yellow-billed loon *(Gavia adamsii (Gray))*

A common summer resident.

Breeding range: circumpolar

Winter range: southeastern Alaska

Common loon *(Gavia immer)*

An occasional visitor that does not breed in, or migrate through, the region (Bathurst Inlet Lodge, unpublished).

Notes on loon ecology: Adept and swift in the water, loons are very cumbersome on land and so their nests are located at the water's edge (Sutton, 1965). Nests are widely spaced, with usually only one nest per small lake or pond. Nests are constructed with heaps of rotting vegetation. Usually two eggs are laid which are incubated from 27 to 29 days. A relatively long fledging time requires that young loons are often in the breeding range very late and may not leave until freeze-up. The diet of the adults and chicks is almost exclusively fish, caught by diving and underwater pursuit. The annual molt of the flight feathers, which leaves the adult loon flightless, occurs before or after breeding and rearing

the young, depending on the species (Godfrey, 1986). A study of red-throated loons in the arctic showed that pairs nesting near (11 km) the ocean had greater success in rearing their young than those with more distant nests (Eberle, 1991).

Relationship to man: Loon skins with the feathers intact were used for Inuit clothing in times past. Today there is little or no consumption of loons. Loons with their characteristic call are however a universal symbol of wilderness and so are a significant factor in the overall experience of the southern visitor to the northern wilderness.

Management status: All loons are protected under the *Migratory Bird Convention Act (Canada)*. None are listed as endangered species. The Canadian Wildlife Service is the agency responsible for protecting loons in Canada.

Project interactions with loons: Only one lake in the area of the minesite will be affected directly by camp sewage. An examination of this lake on July 30 revealed no loons in the vicinity.

Given the site-specific nature of the mine and winter road and the low density for loons nesting on the tundra, there should be minimal disruption to loons occupying the lakes near these facilities.

Loons will not be in the region during operations on the winter road.

WATERFOWL

The term "waterfowl" is a misnomer in that it does not include all bird species occupying aquatic environments. It includes only ducks, geese and swans. The region generally shows a very sparse distribution and presence of waterfowl as observed during surveys of winter road routes during the course of 1996 fields studies.

A review of waterfowl species of northern Canada presented in Belrose (1976) shows that ten species frequent the inland areas with five nesting there. Field examinations on foot and by helicopter showed no waterfowl on the two lakes in the immediate vicinity of the minesite either on the lake to be used for a water supply or sewage outfall by the camp.

Tundra swan *(Cygnus columbianus)*

A common resident nesting on ponds and lakes throughout the region. It was not uncommon to see swans on ponds and lakes during winter road route reconnaissance flights.

Breeding range: throughout the tundra of continental North America and southern portions of Banks Island, Victoria Island, Baffin Island and islands in Hudson Bay.

Winter range: mainly in Chesapeake Bay, Maryland, several inland marshes in the western states and coastal marshes near San Francisco.

Notes on swan ecology: Pairs arrive on the nesting ground of the central Arctic in late May, and prepare a nest by piling a mound of moss, dead grass and sedge on an elevated site near water. Nesting mounds may be 12 to 18 inches above the surrounding area. Three to five eggs are laid and incubated 31 days (Belrose, 1976). Cygnets are flying 60 to 70 days later. Breeding and non-breeding adults lose and replace their flight feathers during the fledging period. The period in which they cannot fly lasts about 35 to 40 days. Swan diet consists of leaves, stems and tubers of aquatic and marsh vegetation. Most tundra swans leave their nesting ranges with the onset of fall and progress southward, congregating on the Peace-Athabasca Delta in October before dispersing to their respective wintering grounds.

The tundra swan is one of the few waterfowl species of the region whose breeding range falls entirely within the North American tundra, with most of it in Canada (Belrose, 1976). The Canadian population of 151,000 birds, nests entirely within the NWT (Alexander, 1991). The numbers in the Canadian population have been increasing in recent years (Bromley and Stenhouse, 1989).

Relationship to man: Although swans may be taken for the pot near spring hunting camps, it is not a major item in the diets of northern peoples.

Management status: Tundra swans are protected under the *Migratory Bird Convention Act (Canada)*. They are not listed as an endangered species. The Canadian Wildlife Service is the agency responsible for protecting swans in Canada.

Project interactions with swans: Given the site specific nature of the mine and winter road, and the relatively sparse density of swan nests on the tundra, there should be minimal disruption to swans occupying the lakes in the region.

Swans will not be in the region during operations on the winter road.

White-fronted goose *(Anser albifrons)*

White-fronted geese occasionally nest in the region. Major nesting colonies are located in Queen Maud Bird Sanctuary and southern Victoria Island, and in the Anderson River and Mackenzie River deltas.

Breeding range: circumpolar

Winter range: western states, coastal and interior Mexico and Texas coast.

Notes on white-fronted goose ecology: The white-fronted goose is normally a colonial nesting species but nests may be found far from colonies. This goose arrives in its nesting area from mid to late May and may be expected as a migrant through the region in May. Nesting in the region on a regular basis is not expected.

Relationship to man: Geese are hunted in the north in spring and in the south in fall.

Management status: Geese are listed under the *Migratory Bird Convention Act (Canada)*. None are listed as endangered species. The Canadian Wildlife Service is the agency responsible for managing geese in Canada.

Canada goose *(Branta canadensis)*

This species is distributed sparsely throughout the region. Small flocks of Canada geese were a common sight on lakes and ponds during reconnaissance flights over routes for the winter road. These birds seemed to be non breeding birds presumably molting in the area. No young of the year were observed.

Breeding range: throughout North America, but segregated into distinct races and populations. The population occupying the region breeds from the Mackenzie Delta east to eastern Victoria Island.

Winter range: south central states.

Notes on Canada goose ecology: Birds arrive for nesting from mid-May to early June. The nest will be a site used in previous years or a new "scrape" near to water, usually on an island. Most clutch sizes range from 4 to 7 eggs (Belrose, 1976). Incubation takes 24 - 33 days (Godfrey, 1986). The goslings attain flight in 40 to 46 days (Belrose, 1976). Pairs mate for life. Family groups migrate south as a unit and stay together until they return to the breeding grounds the following spring (Godfrey, 1986). The diet consists of tundra plants including berries.

Relationship to man: Geese are hunted in the north in spring and in the south in fall.

Management status: All geese are listed under the *Migratory Bird Convention Act (Canada)*. None are listed as endangered species. The Canadian Wildlife Service is the agency responsible for managing geese in Canada.

Green-winged teal *(Anas crecca)*

An occasional visitor with no breeding records in the region. (Bathurst Inlet Lodge, unpublished).

Breeding range: Throughout the northern hemisphere but divided into New World and Old World subspecies.

Winter range: southern states and Mexico, both coastal and inland.

Pintail *(Anas acuta)*

A resident that nests throughout the region, both near the coast and inland.

Breeding range: Throughout most of continental North America and occasionally some of the arctic islands (Godfrey, 1986). The region under consideration is on the margins of pintail breeding range and few are expected in the vicinity of the minesite.

Winter range: southern states and Mexico, both inland and coastal.

Notes on ecology: Pintail ducks arrive on their nesting grounds in late May or early June depending on the rate of melt for the year. Nests are usually on open ground with sparse vegetation. An average of 7.76 eggs are produced and incubated for 22 to 23 days. It appears that males migrate to molt their flight feathers; females molt while tending broods on water bodies on the nesting grounds (Belrose, 1976). The young attain flight more quickly on northern ranges (36 days in Alaska) than southerly nesting grounds (46 to 57 days in South Dakota).

Relationship to man: Ducks are hunted in the north in spring and in the south in fall.

Management status: All ducks are listed under the *Migratory Bird Convention Act (Canada)*. No local species are listed as endangered species. The Canadian Wildlife Service is the agency responsible for managing ducks in Canada.

Canvasback *(Athya valisineria)*

An occasional visitor with no breeding records in the region (Bathurst Inlet Lodge, unpublished).

Breeding range: western North America within treeline and south to California and New Mexico (Godfrey, 1986).

Winter range: southern states and Mexico.

Oldsquaw *(Clangula hyemalis)*

A common resident nesting throughout the region.

Breeding range: all circumpolar tundra. In Canada the Oldsquaw nests throughout the north and is the most common duck in the arctic (Belrose, 1976).

Winter range: ice-free coastal waters south to California and the Carolinas in the U.S. plus the Great Lakes.

Notes on Oldsquaw ecology: This duck arrives on the nesting grounds in early June and selects nest sites close to water (the greatest distance recorded is 200 metres) (Belrose, 1976). Clutch sizes vary from 2 - 11 eggs. Incubation takes 24 to 29 days. The diet of this diving duck is almost entirely invertebrates, with crustaceans, molluscs and insects the major food items taken.

Relationship to man: Ducks are hunted in the north in spring and in the south in fall.

Management status: All ducks are listed under the *Migratory Bird Convention Act (Canada)*. No northern species is listed as endangered. The Canadian Wildlife Service is the agency responsible for managing ducks in Canada.

Scoters

White winged scoter *(Melanitta fusca)*

An occasional visitor to inland lakes that has been recorded to nest at Bathurst Inlet (Bathurst Inlet Lodge, unpublished).

Breeding range: This duck breeds from north-central N. Dakota northwest across Canada into central Alaska (Belrose, 1976). Nesting on the tundra is well beyond the breeding range described for it in Godfrey (1986).

Winter range: Winters on both Pacific and Atlantic coasts.

Black scoter *(Melanitta nigra)*

An occasional migrant with no breeding records for the region.

Breeding range: A circumpolar species with few nesting records for the Canadian tundra.

Winter range: Both Pacific and Atlantic coasts.

Surf scoter ***(Melanitta perspicillata)***

An occasional migrant with no breeding records for the region.

Breeding range: within the boreal forest of North America.

Winter range: coastal waters of North America

Notes on scoter ecology: Scoters as a group have received very little attention from ornithologists. All species appear to prefer very dense cover like nettles, gooseberry shrubs and other forest shrubbery for their nest sites. This may explain why they are not common in tundra environments.

Relationship to man: Ducks are hunted in the north in spring and in the south in fall. Scoters bear the distinction of being the only species named in the *Migratory Bird Convention Act (Canada)* as group of birds that can be taken by "Indians .... at any time for food."

Management status: All ducks are listed under the *Migratory Bird Convention Act (Canada)*. No northern species is listed as endangered. The Canadian Wildlife Service is the agency responsible for managing ducks in Canada.

Mergansers

Red-breasted merganser ***(Mergus serrator)***

A resident that is more common at the coast than inland but nests in both environments (Bathurst Inlet Lodge, unpublished).

Breeding range: Circumpolar and in Canada nests on the tundra and in the boreal forest.

Winter range: Atlantic and Pacific coastal waters of North America.

Common merganser ***(Mergus merganser)***

An occasional visitor in the region which is known to nest on the inland tundra (Bathurst Inlet Lodge, unpublished).

Breeding range: Circumpolar and throughout the northern hemisphere. According to Godfrey (1986) the nesting range of the common merganser in Canada is restricted to the parkland of the prairie provinces and the boreal forest.

Winter range: throughout the lower 48 states and into northern Mexico.

Notes on merganser ecology: The red-breasted merganser nests in highly variable ground conditions while the common merganser usually nests in cavities in trees which explains its forest breeding distribution. Mergansers will also lay their eggs in the nests of other waterfowl; but will also accept the same treatment from scaup. Nesting is initiated in late June (Belrose, 1976). Incubation lasts 30 days for the red-breasted merganser. The male will depart the nesting grounds for large water bodies soon after incubation begins, to molt the flight feathers. Mergansers are predominantly fish eaters.

Relationship to man: Mergansers are not a highly sought after species by subsistence or recreation hunters.

Management status: All ducks are listed under the *Migratory Bird Convention Act (Canada)*. No northern species is listed as endangered. The Canadian Wildlife Service is the agency responsible for managing ducks in Canada.

Project interactions with waterfowl: No waterfowl nesting habitat has been disturbed in the construction of the portal, camp and local roads and airstrips. Given the site specific nature of the mine and related activities, no impacts on ducks and geese are expected.

Waterfowl will not be in the region during operations on the winter road.

BIRDS OF PREY

The region of the Northwest Territories where the minesite is located and through which the winter haul road will be routed is within the breeding ranges of four raptor species: the golden eagle, the rough-legged hawk and the peregrine and the gyrfalcon. All are open country raptors taking their prey live; as opposed to utilizing carrion like the raven or bald eagle which scavenge for a significant portion of their food requirements. Each of these species of raptor is a summit predator in that its ecological niche is at the end of a food chain. Their presence therefore is evidence of an ecosystem, or series of ecosystems in the case of migratory species, that produces an assemblage of species supporting a complete food chain. These species are therefore important indicators of a healthy and productive environment.

In most birds of prey the female of the species is larger than the male (Godfrey, 1986). Most raptors are monogamous and pair for the full life of the adult bird (Brown, 1977). It is therefore important to keep adult mortality on the breeding range to a minimum if local populations are to maintain their numerical status and grow from there. All birds of prey need a relatively long period for incubation and fledging their young. They therefore occupy the nests early, usually well before the spring melt, and are often found on their summer breeding ranges well into the fall. Gyrfalcons may be permanent residents of the tundra (Poole and Bromley, 1988a).

Notes on the sites observed during survey in July 1996 appear as Appendix 1.

Golden eagle *(Aquila chrysaetos)*

A summer resident whose breeding range includes this region but is more abundant near the coast (GNWT Department of Resources Wildlife and Economic Development, unpublished data).

Breeding range: The golden eagle is a cosmopolitan species found on all circumpolar continents and ranges south to northern Africa. In Canada it breeds in the western mountains, Yukon, and along the arctic coast. One author (Mansell, 1980) reports that the breeding range of golden eagles coincides with the presence of ground squirrels, hare or marmots.

Surveys in July, 1996 of potential raptor nesting habitat near the minesite and along the winter road did not locate any active golden eagle nests or territories. A golden eagle nest on Contwoyto Lake is documented in the GNWT raptor nest site data base.

Winter range: the southern U.S. states.

Notes on golden eagle ecology: Nests, constructed of sticks and other coarse material, are usually situated on a cliff and are often used in successive breeding seasons. Two eggs are incubated for 43 days (Godfrey, 1986). This long incubation period requires the birds to occupy their nests in early April, long before the snowmelt. Egg laying begins in mid-April. The main prey species include ground squirrels, hare and ptarmigan (Pearson, 1936). Chicks leave the nest between 65 and 80 days after hatching (Brown, 1977). Observations of golden eagle nests on the Coppermine study area show fledging in 65 - 77 days after hatching (C. Shank, personal communication). Young golden eagles stay in the vicinity of the nest for a period of up to 12 weeks (C. Shank, unpublished data) before migrating to temperate latitudes where they winter in open country.

Relationship to man: The golden eagle is not considered to be an active ingredient in the local economy.

Management status: Golden eagles are not protected by the *Migratory Bird Convention Act (Canada)*, but are a species protected by the *Wildlife Act (NWT)*. They are not named in international conventions and are not listed as an endangered species.

Project interactions with golden eagles: Golden eagles arrive on their breeding territories near Coppermine in April and stay until late September to mid-October (C. Shank, unpublished data). Surveys of the area around the minesite did show eagle nest sites and so there appears to be little chance of disrupting nesting birds. This could be confirmed with further field examinations.

The timing of golden eagle's return to the region in spring in relation to winter road operations needs to be monitored to further assess potential impacts and optimum winter road operating schedules.

Gyrfalcon *(Falco rusticolus)*

A permanent resident that nests throughout the region where suitable nest sites can be found.

An active gyrfalcon nest site was located near the winter road route at 66° 42' 13" N x 110° 51' 49" W (Figure 2).

Site 949 (GNWT data base) on Contwoyto Point was occupied in 1984. Depending on winter road location this site could be within 2 km of the winter road route.

Breeding Range: The gyrfalcon is a holarctic species which breeds on all circumpolar continents plus Iceland and Greenland. It often winters on the tundra but may also be found in more southerly latitudes (Godfrey, 1986).

Notes on gyrfalcon ecology: Gyrfalcons do not build nests *per se* but will occupy structures built by ravens and rough-legged hawks. One site (#1070 near Coronation Gulf east of Kugluktuk) was occupied by a raven in 1984, by a peregrine falcon in 1985 and by a gyrfalcon in 1986 (GNWT raptor nest site database). In a study south of the Kent Peninsula Poole and Bromley (1988a) observed that gyrfalcons occupied the abandoned nests of ravens and golden eagles. When not occupying a site prepared by another species, the nest is nothing more than a scrape, which when used in successive years will accumulate bones and other debris of prey brought to the nest. The winter ecology of gyrfalcons is poorly documented. Males are known to be on nesting territories in February (Poole and Bromley, 1988a) and may indeed overwinter on the tundra (C. Shank, unpublished). Nests are almost always located on inaccessible ledges of cliffs. Incubation starts in Mid to late April. Usually three or four eggs are laid which hatch after 28 or 29 days incubation (Brown, 1977). The young birds observed in the Kilgavik study area fledged seven weeks after hatching (Poole and Bromley, 1988a). Most young birds had fledged by late July or early August. Gyrfalcons are the largest falcon and therefore can take larger prey than other falcons. The diet of gyrfalcon in the central Arctic was predominantly rock ptarmigan (73%) and ground squirrel (14%) (Poole and Boag, 1988).

Relationship to man: Gyrfalcons have been prized by falconers for centuries. In the early 1980's several young falcons were taken from the Coppermine area for sale to falconers. This practice has since been stopped in the NWT and gyrfalcons are prohibited from being an item of commercial trade under the *Convention on International Trade in Endangered Species.*

Management status: All falcons are protected by the *Wildlife Act (NWT)*. The gyrfalcon is not listed as an endangered species in Canada but is included on Appendix 1 of the *Convention on International Trade in Endangered Species* (CITES) which requires that the gyrfalcon cannot be exported except for exceptional reasons like research or breeding purposes. Export for commercial purposes as for falconry in a foreign country would not be permitted for any species listed in Appendix I of CITES.

Project interactions with gyrfalcons: Gyrfalcons occupy their breeding territories as early as February (Bromley and Poole, 1988a). No gyrfalcons were observed near the minesite in the summer of 1996. Unlike the peregrine, very little is documented on the tolerance thresholds of gyrfalcons for human activities in the area of nest sites.

The distribution of gyrfalcon in the region in relation to winter road operations and the minesite should be monitored to further assess potential impacts and optimum winter road operating schedules. As with the construction of the Norman Wells pipeline, measures during road operations can be developed to mitigate disruptive aspects in the immediate vicinity of active raptor nest sites (Matthews, in Boreal Ecology Services Ltd., 1988).

Peregrine falcon *(Falco peregrinus)*

A summer resident nesting throughout the region where suitable nest sites are available.

Active nest sites as well as birds on territories were observed at six sites during surveys in July 1996. Two sites are located near the winter haul road and three are located near the route to be used for the development period hauling in 1997 and 1998.

Peregrines have also been observed nesting on Contwoyto Point (#854, GNWT data base) in 1973, 1975 and 1984. This site could be within 2 km of the winter road depending on its location. The width of the lake at its narrowest point at this location is approximately 1 km.

Breeding range: The peregrine falcon is truly a cosmopolitan species breeding throughout both northern and southern hemispheres. Several subspecies with rather discrete ranges are recognized for peregrine populations in Canada (Godfrey, 1986). Peregrines in the Northwest Territories are of the *tundrius* subspecies (Bromley, 1988) and seem to be nesting throughout the mainland tundra wherever suitable nesting habitat is available.

Winter range: The winter range includes the northern states, southern British Columbia and southern Ontario.

Notes on peregrine ecology: Open country is preferred at all seasons. Nests are usually in cliffs or their equivalent in cases where ledges of skyscrapers are occupied in cities. Unoccupied nest sites of other raptors and ravens will also be occupied (GNWT raptor

nest site data base). Little is done by way of nest preparation for the three to five eggs. Egg laying begins in late May and incubation lasts 33 to 35 days. The young birds will fledge about 35 to 40 days later and stay in the area of the nest for four to six weeks (C. Shank, personal communication). Prey, almost exclusively other birds, are taken in flight by diving to deliver a sharp blow with their large taloned feet; a speed of 180 mph during a dive has been recorded (Godfrey, 1986).

Relationship to man: There is no direct economic utilization of peregrine falcons in the region but it is a species whose survival has attracted world wide attention.

Management status: In Canada all peregrine falcon were classified by COSEWIC which placed the *tundrius* subspecies in the "threatened" status due to apparent severe declines in populations of all subspecies in Canada due to pesticide use, which resulted in poor or no breeding success. Following a ban on the indiscriminate use of organochloride pesticides in many countries, the numbers of peregrine falcons have increased significantly. Populations in the NWT were reported "apparently numerically healthy.... and are reproducing at normal rates" (Bromley, 1988). In 1992, the *tundrius* subspecies in Canada was downlisted from "threatened" to "vulnerable."

Project interactions with peregrines: Peregrines arrive in their nesting territories in May and stay until early fall (Poole and Bromley, 1988b). The area north of the minesite had peregrine active in July 1996. There is approximately 1.5 km separating the camp from the gorge where peregrine activity was noted on July 30, 1996. Monitoring should be done to assess the continued presence of peregrines and nesting activity in this area during initial years of camp and minesite summer operations.

Winter road operations will have been suspended in most years during the early phase of nesting and so may not pose long term disturbance to peregrines in the region.

Monitoring the timing of peregrines return to the region in relation to late winter road operations should be done to better understand the tolerance thresholds of peregrines for winter road operations during courting and early nesting activities.

Rough-legged hawk *(Buteo lagopus)*

A regular summer resident that nests in the region (Godfrey, 1986). One active nest was located during surveys of raptor nesting habitat in the region (Figure 2).

Breeding range: nests on all circumpolar continents. In Canada this hawk nests throughout the mainland tundra plus the islands of Hudson Bay, Baffin Island and north including the western Queen Elizabeth Islands of the Arctic Islands Archipelago (Godfrey, 1986).

Winter range: the open country in the south of Canadian provinces and into the states south to Oklahoma and New Mexico.

Notes on rough-legged hawk ecology: Like other raptors that nest in the region, the rough-leg nests on ledges of cliffs. It builds a nest of sticks and grasses and will use the same nest in successive years. Nesting is initiated in May. Two to six (usually three or four) eggs are laid and incubated for 28 to 31 days (Godfrey, 1986). Prey consists almost entirely of small mammals (voles, lemmings and occasionally ground squirrels) (Brown, 1977). The young are flying about 41 days after hatching (Fleck, 1981).

Relationship to man: The rough-legged hawk is not considered to be an active ingredient in the local economy of nearby communities.

Management status: Rough-legged hawks are not protected by the *Migratory Bird Convention Act (Canada)*, but are a species protected by the *Wildlife Act (NWT)*. They are not named in international conventions and are not considered an endangered species.

Project interactions with rough-legged hawks: Rough-legged hawks arrive on their nesting territories in May and stay until early fall (Poole and Bromley, 1988b) and so will not be affected by winter road operations. The area in the immediate vicinity of the minesite had several inactive stick nests which may have been former rough-legged hawk nests. These sites are all away from the area of the camp and airstrip and so are not exposed directly to activities there.

The winter road may well not be in use during the early phase of nesting and so may not pose any disturbance to these raptors throughout its route.

Monitoring the timing of rough-legged hawks return to the region in relation to late winter road operations should be done to better understand the tolerance thresholds of rough-legged hawks for winter road operations during courting and early nesting activities.

PTARMIGAN

Ptarmigan are the grouse of the arctic. They differ from their temperate equivalent in that they have separate summer and winter plumage. They are also migratory in the sense that they seem to move out of the extreme northern portions of their ranges for the duration of the winter dark period. Two species are resident in the region.

Willow ptarmigan *(Lagopus lagopus)*

A common resident nesting throughout the region (Bathurst Inlet Lodge, unpublished).

Breeding range: Circumpolar.

Winter range: similar to their breeding range but many migrate south into forested habitats for the dark period.

Rock ptarmigan *(Lagopus mutus)*

A resident nesting in the region; is seen only occasionally.

Breeding range: Circumpolar, including Canada's high arctic Islands.

Winter range: similar to the breeding range but many withdraw for the depth of winter (Godfrey, 1986).

Notes on ptarmigan ecology: During the non-breeding season ptarmigan are often found in flocks of up to 20 or more birds. As the breeding season approaches, males establish nesting territories which they will defend from male intruders. Up to ten eggs are laid (Godfrey, 1986), and incubation lasts 21 or 22 days. The hen stays with the chicks, which can fly short distances within a week of hatching. Equipped with excellent camouflage coloration, it is not uncommon for ptarmigan to nest in close proximity to camps without the inhabitants being aware of the nest's location.

Relationship to man: Ptarmigan are hunted in summer and winter.

Management status: Ptarmigan are not listed in the *Migratory Bird Convention Act - (Canada)*, but are included as upland game birds in the *Wildlife Act (NWT)* administered by the GNWT Department of Resources, Wildlife and Economic Development. Ptarmigan are not listed as endangered, nor covered in any international convention.

Project interaction with ptarmigan: The territorial nesting habit of ptarmigan ensures that impact, if any, during the nesting period will be slight at the minesite and related surface infrastructure. Road kills should be expected from time to time, especially on the winter road in the area of willow thickets when ptarmigan return to the region in late winter. Ptarmigan may also come to the road for grit required to macerate their woody diet in winter and spring. The cumulative impacts of these effects should not be different from the impact the NWT highway system has had on ptarmigan stocks over the past 30 years.

CRANES

Sandhill crane *(Grus canadensis)*

Sandhill cranes are regular visitors to the region during migration and may occasionally nest here. None were observed during aerial surveys and reconnaissance in the region.

Breeding range: Northeastern Siberia, Alaska, and throughout Canada west of Quebec including Banks, Victoria and the north half of Baffin Island.

Winter range: southern states to central Mexico and Cuba (Godfrey, 1986).

Notes on sandhill crane ecology: The sandhill crane is a resident of open country and parkland where it frequents the edges of ponds and marshes. Their diet consists of invertebrates, small mammals and plant matter. Two eggs are laid and incubated 29 to 30 days. Although sandhill cranes concentrate in large numbers for migration, they are not gregarious during the summer nesting period.

Relationship to man: sandhill cranes are hunted both in the north and in the south but not in large numbers. Once a common bird in the bag of successful hunters, sandhill cranes are managed under rigid bag limits in southern Canada and the USA.

Management status: Sandhill cranes are protected under the *Migratory Bird Convention Act (Canada)* and managed by the Canadian Wildlife Service. The sandhill crane is not listed as an endangered species.

Project interaction with cranes: Sandhill cranes are not expected in the region in significant numbers either on migration or during the summer. Impact, if any, will be negligible.

SHOREBIRDS

Thirteen species of shorebird are known to frequent the region in summer. All shorebirds are characterized by their plump bodies, relatively long legs and long, probe like beaks. As their name suggests, their preferred habitat is the edges of lakes, ponds or wetlands where they wade through the emergent vegetation in search of molluscs, insects and crustaceans. These birds are very much fair weather creatures arriving on the tundra to establish nesting territories as spring weather produces open water for feeding and bare ground for nesting.

Most shore birds establish nesting territories which the male will defend against other shorebirds. The nesting habitat is often a dry gravel ridge that camouflages their eggs

which are laid without the benefit of any nest preparation in many shorebird species, other than the obligatory scrape.

Nests usually hold four eggs which are incubated between 18 and 23 days depending on the species. Upon hatching the chicks seem to feed on their own, can swim within a few days and fly short distances within two weeks (Pettingill, 1965). The growth of the young is rapid and both adults and young leave the breeding grounds before the first snows of autumn.

Most shorebirds were heavily hunted in the late nineteenth and twentieth century and so were protected by the *Migratory Bird Convention Act (Canada)* administered by the Canadian Wildlife Service. All are now protected and only the snipe is hunted in southern latitudes. No species resident in the region is listed as endangered.

During migration shorebirds will congregate and migrate in huge flocks. Their nesting habit however is not gregarious (Pearson, 1936). This spacing ensures that developments of a site specific nature will not affect a large number of nest sites.

Lesser golden plover *(Pluvialus dominica)*

An occasional summer resident that nests both in inland and coastal habitats (Bathurst Inlet Lodge, unpublished).

Breeding range: Northern Siberia, Alaska and northern Canada.

Winter range: South America, eastern Asia, Hawaii, Australia and New Zealand (Godfrey, 1986).

Semipalmated plover *(Charadrius semipalmatus)*

A common resident which nests both at the coast and inland.

Breeding range: Alaska and northern Canada including the southern arctic islands.

Winter range: Southern states, Mexico and throughout South America (Godfrey, 1986).

Lesser yellowlegs *(Tringa flavipes)*

A rare visitor at Bathurst Inlet with no breeding records for the region (Bathurst Inlet Lodge, unpublished).

Breeding range: Alaska and the Canadian boreal forest west of James Bay.

Winter range: southern states, Mexico, the Caribbean and throughout South America (Godfrey, 1986).

Ruddy turnstone *(Arenaria interpres)*

A rare visitor with no nesting records in the region.

Breeding range: coastal circumpolar.

Winter range: southern states and throughout the southern hemisphere (Godfrey, 1986).

Sanderling *(Calidris alba)*

A rare visitor with no breeding records in the region.

Breeding range: Holarctic tundra.

Winter range: coastal environments throughout the temperate and mid-latitudes of both hemispheres.

Semipalmated sandpiper *(Calidris pusilla)*

An occasional resident with nesting records at Bathurst Inlet but not inland nearby (Bathurst Inlet Lodge, unpublished). Both male and female parents leave the nesting grounds before the young of the year are able to fly (Gratto-Trevor, 1991).

Breeding range: northern Alaska and sub-arctic Canada.

Winter range: southern states, Caribbean, Mexico and South America (Godfrey, 1986).

Least sandpiper *(Calidris minutilla)*

A common resident nesting in both coastal and inland environments (Bathurst Inlet Lodge, unpublished).

Breeding range: Alaska and throughout subarctic Canada.

Winter range: southern states south to Peru including the Caribbean.

White-rumped sandpiper *(Calidris fuscicollis)*

A rare visitor at Bathurst Inlet with no breeding records for the region (Bathurst Inlet Lodge, unpublished).

Breeding range: arctic islands and rarely in Alaska (Godfrey, 1986).

Winter range: southern South America.

Baird's sandpiper *(Calidris bairdii)*

A common summer resident nesting in both coastal and inland environments.

Breeding range: northeastern Siberia, coastal Alaska and throughout Arctic Canada.

Winter range: western and southern South America (Godfrey, 1986).

Pectoral sandpiper *(Calidris melanotos)*

A rare visitor to the coastal environment at Bathurst Inlet Lodge (Bathurst Inlet Lodge, unpublished).

Breeding range: the coasts of eastern Siberia, western and northern Alaska and the mid-arctic tundra of Canada.

Winter range: southern South America and Australia and New Zealand (Godfrey, 1986).

Stilt sandpiper *(Calidris himantopus)*

A rare visitor in the coastal environment of Bathurst Inlet, (Bathurst Inlet Lodge, unpublished).

Breeding range: northeastern Alaska, and low arctic tundra of western Canada to the coast of Hudson Bay.

Winter range: South America (Godfrey, 1986).

Common snipe *(Gallinago gallinago)*

A rare visitor nesting at Bathurst Inlet but with no nesting records inland (Bathurst Inlet Lodge, unpublished).

Breeding range: throughout southern Canada north to treeline and the subarctic tundra of the western Keewatin (Godfrey, 1986).

Winter range: southern British Columbia to North Carolina south to central South America (Godfrey, 1986).

Red-necked phalarope *(Phalaropus lobatus)*

A common summer resident in both inland and coastal environments (Bathurst Inlet Lodge, unpublished).

Breeding range: low and subarctic regions of North America and Eurasia.

Winter range: at sea mainly south of the equator (Godfrey, 1986).

Project interactions with shorebirds: No shorebirds were observed during field studies at the minesite. Shore birds will not be in the region during winter road operations.

JAEGERS

Jaegers are predatory sea birds that nest on the arctic tundra. They will often attack other birds in flight forcing them to give up or disgorge their prey. They also prey on small birds, small mammals and will raid the nests of other birds and feed on carrion. Occasionally ranging inland, their summer range is mainly coastal and in winter they range over the open seas (Godfrey, 1986).

Pomarine jaeger *(Stercorarius pomarinus)*

An occasional visitor to the region. There are no nesting records for the Pomarine jaeger at or near Bathurst Inlet (Bathurst Inlet Lodge, unpublished).

Breeding range: circumpolar islands, Alaska and arctic Canada including the mainland coast of the central arctic (Godfrey, 1986).

Winter range: open oceans of the mid-latitudes south to Australia (Godfrey, 1986).

Parasitic jaeger *(Stercorarius parasiticus)*

An occasional visitor to the region. There are no nesting records for the parasitic jaeger at or near Bathurst Inlet (Bathurst Inlet Lodge, unpublished).

Breeding range: circumpolar tundra not including extreme northern islands of Canada's high arctic (Godfrey, 1986).

Winter range: at sea over both Atlantic and Pacific Oceans.

Long-tailed jaeger *(Stercorarius longicaudus)*

An occasional visitor to the region. There are no nesting records for the long-tailed jaeger at or near Bathurst Inlet (Bathurst Inlet Lodge, unpublished).

Breeding range: circumpolar including Canada's mainland tundra and all the arctic islands.

Winter range: at sea over both Atlantic and Pacific Oceans.

Notes on jaeger ecology: Jaegers nest in coastal habitats that offer prey like insects, small birds, and small mammals. They will also raid the nests of other birds and feed on carrion. They usually nest singly on the open tundra, laying two eggs followed by and incubation period of 23 to 23 days (Godfrey, 1986).

Relationship to man: Jaegers can be habituated to take food from the hand and are often seen in considerable numbers around tundra camps that leave food scraps for them where they will put on a spectacular display of aerial acrobatics and piracy.

Management status: All jaegers are included in the *Migratory Bird Convention Act (Canada)* which is administered by the Canadian Wildlife Service. None are listed as endangered species.

GULLS AND TERNS

Of the numerous gull species in Canada, only three are known for the region. All are predatory in habit and usually nest in colonies (Godfrey, 1986).

Herring gull *(Larus argentatus)*

A common summer resident that nests both inland and in coastal environments. Two herring gulls was observed near the lake immediately east of the camp.

Breeding range: North America, Greenland, Iceland, Europe and northern Siberia; in Canada, throughout forested regions and mainland tundra plus parts of Southampton and Baffin Islands.

Winter range: southern parts of the breeding range, the Caribbean, Africa and southeast Asia (Godfrey, 1986).

Glaucous gull *(Larus hyperboreus)*

A common summer resident throughout the mid- and high Arctic tundra.

Breeding range: circumpolar.

Winter range: temperate latitudes of northern hemisphere.

Saline's gull *(Xema sabini)*

An occasional visitor at Bathurst Inlet with no breeding records for the region (Bathurst Inlet Lodge, unpublished).

Breeding range: Alaska, Greenland, Spitsbergen, and Siberia; in Canada, the coasts of the western arctic mainland and arctic islands.

Winter range: poorly documented but includes the coast of Peru (Godfrey, 1986).

Notes on gull nesting ecology: Both species known to nest in the region will often nest in association with other gulls or terns in the colony. Herring gull colonies are situated on flat ground, often on islands or sandbars while glaucous gull colonies are found in cliffs. Nest construction is simple with dry grass, mosses and seaweed lining a shallow depression. Usually 2 eggs are laid and incubated 23 to 28 days (Godfrey, 1986). Chicks are able to swim immediately. All gulls are rapacious predators of the young and nests of other birds in their nesting area including their own kind.

Relationship to man: Gull colonies are often a source of fresh eggs for nearby communities. There are little or no other uses made of gulls. In some locales herring gulls are becoming a nuisance at dumps.

Management status: All gulls are included in the *Migratory Bird Convention Act (Canada)* administered by the Canadian Wildlife Service. None are listed as endangered in Canada.

Project interactions with gulls: There are no records of nesting colonies in the region. No impact on gulls should be expected from normal operations at the minesite. The most common interaction with gulls would be at a garbage dump but as garbage will be incinerated daily, these situations are not expected to occur.

Arctic tern *(Sterna paradisaea)*

A regular summer visitor to the region (Bathurst Inlet Lodge, unpublished). None were observed at the minesite nor along the winter road.

Breeding range: Circumpolar arctic and subarctic, in Canada the arctic tern breeds throughout the Yukon, NWT, and northern Quebec.

Winter range: over the oceans of the southern hemisphere.

Notes on arctic tern ecology: On arrival after there is ample open water, the arctic tern nests singly or in small colonies in association with other terns and gulls. Nests are simple depressions in dry ground often unlined. Usually two eggs are laid and incubated for 21 or 22 days. Food consists of small fish which are caught by diving.

Relationship to man: None known for the region.

Management status: Terns are listed in the Migratory Bird Convention Act (Canada) administered by the Canadian Wildlife Service. Arctic terns are not endangered species.

Project interactions with terns: There are no records of colonies in the region. In the absence of colonies, the interactions with birds nesting singly would be very infrequent at the minesite. Terns will not be in the region during operations of the winter road.

OWLS

Snowy owl *(Nyctea scandiaca)*

A rare visitor seen on migration through the region (Bathurst Inlet Lodge, unpublished).

Breeding range: circumpolar tundra.

Winter range: southern portion of breeding range and open countryside of temperate latitudes.

Notes on snowy owl ecology: The breeding range of this owl is restricted to tundra environments. A predator, the snowy owl will take several species of bird or mammal as prey but seems to depend on lemming for breeding success. It is therefore only following years of a "lemming high" that large numbers of owls will be seen in southern locations during winter (Godfrey, 1986). In between years of lemming abundance adult owls are nomads on the tundra with poor reproductive success. Nests are mounds on the tundra and are usually occupied in late winter. Incubation of the 5 to 7 eggs lasts 32 - 33 days.

Relationship to man: Baby owls are considered a traditional Inuit delicacy, but are not a significant item in the northern diet (Rt. Rev. J. Sperry, personal communications)

Management status: Owls are not included in the *Migratory Bird Convention Act (Canada)*, but are protected in the *Wildlife Act (NWT)* administered by the GNWT Department of Resources, Wildlife and Economic Development. The snowy owl is not an endangered species.

Short-eared owl *(Asio flammeus)*

A rare visitor with records of nesting in the region (Bathurst Inlet Lodge, unpublished).

Breeding range: North America, Europe, Asia, South America and in Canada throughout most of the mainland except the extreme northeast Keewatin and northern Quebec.

Winter range: southern portions of the breeding range (Godfrey, 1986).

Notes on short-eared owl ecology: The short-eared owl is a resident of open grassland, bogs, bushy meadows and low-arctic tundra (Godfrey, 1986). Its principle prey are small rodents. It nests on the ground in open grasslands, laying 4 to 9 eggs which are incubated 24 to 28 days.

Relationship to man: None documented for the region.

Management status: Owls are not included in the *Migratory Bird Convention Act (Canada)*, but are protected in the *Wildlife Act (NWT)* administered by the GNWT Department of Resources, Wildlife and Economic Development. The short-eared owl is not listed as an endangered species.

Project interactions with owls: No impact on these infrequent visitors to the region should be expected.

OTHER BIRDS

Common nighthawk *(Chordeiles minor)*

An infrequent visitor, there are no breeding records for the region (Bathurst Inlet Lodge, unpublished). A bird known to local Inuit as one that turns to fire, presumably because of its bright red eyes and the perfect camouflage while resting on the ground which could lead one to believe that the bird disappears (Page Burt, personal communication).

Breeding range: Throughout North America south of Great Bear Lake and within the treeline (Godfrey, 1986).

Winter range: South America

Horned lark *(Eremophila alpestris)*

A common summer resident nesting throughout the region. Numerous larks were observed in the area around the minesite in July and August, 1996.

Breeding range: North America, Eurasia, South America, northern Africa, and in Canada from the southern arctic islands to the Canada/US border but not including the boreal forest (Godfrey, 1986).

Notes on horned lark ecology: The horned lark enjoys a near global distribution and occupies open country that includes natural prairies, plowed fields and airports. Nesting on the ground, it lays three to five eggs which are incubated for 11 days. It is often one of the earliest migrants to return to the nesting grounds. As its diet consists mainly of seeds, it can survive in snow covered habitat where seed stalks are exposed.

Relationship to man: None documented in the region.

Management status: Larks are included in the *Migratory Bird Convention Act (Canada)* and are not listed as endangered.

Project interactions with larks: None, and no impact should be expected for this widely distributed species.

SWALLOWS

Two species are rare visitors in the region and have no nesting history at Bathurst Inlet Lodge (unpublished).

Cliff swallow *(Hirundo pyrrhonota)*

Breeding range: Throughout North America and in Canada north to include most of the mainland tundra (Godfrey, 1986).

Winter range: South America.

Notes on cliff swallow ecology: This small insectivorous bird nests in colonies whose mud daubed nests may be built under the eaves of buildings or in protected exposures of cliffs. Most feeding takes place in the proximity of open water of lakes, ponds and marshes.

Bank swallow *(Riparia riparia)*

Breeding range: throughout North America and Eurasia and in Canada north to treeline (Godfrey, 1986).

Winter range: South America.

Notes on bank swallow ecology: Nests are located at the end of long tunnels excavated in banks of sand, sandstone, clay or gravel. Feeding takes place over water and open land.

Relationship to man: None documented for the region.

Management status: Swallows are included in the *Migratory Bird Convention Act (Canada)* and are not listed as endangered.

Project interactions with swallows: None should be expected with these occasional visitors to the region. Cliff swallows may be attracted to exterior building walls at the minesite for nesting sites.

RAVENS *(CORVUS CORAX)*

A common year-round resident nesting throughout the region. Ravens were observed near the lake east of the campsite as well as on the esker east of the Reno Lake camp. Several family groups were also observed along the winter road route during July reconnaissance flights.

Breeding range: global and throughout Canada except on the prairies (Godfrey, 1986).

Winter range: Ravens do not migrate except perhaps locally and so occupy the breeding range throughout the year.

Notes on raven ecology: The raven is in many ways the symbol for the hardy northern wilderness species that live here throughout the year. Raven nests are built of sticks and located on inaccessible cliffs and ledges, and often man made structures like communication and transmission line towers. These hardy birds feed largely on carrion and where available on garbage scraps. They are able to survive on the tundra throughout the year and initiate nesting in late winter. Two to five eggs are laid and incubated 20 to 21 days.

Relationship to man: None is documented for the region but they can be a desperate nuisance when garbage is not disposed of properly.

Management status: Ravens are not included in the *Migratory Bird Convention Act (Canada)* but are covered as a "non-game" bird in the *Wildlife Act (NWT)* administered by the GNWT Department of Resources, Wildlife and Economic Development. Ravens are not an endangered species in the Northwest Territories.

Project interactions with ravens: The increased activity and human presence in the region may contribute to new nest sites in towers and under eaves of tall buildings. No negative impact should be expected for this species.

SONGBIRDS

The remaining discussion of birds in the region will cover the small birds that are summer residents in the region. They are included more so that a complete list of the avifauna of the region is in the project record. All species discussed in this section are included in the *Migratory Bird Convention Act (Canada)*. All nest singly on defended territories and so impact would be minimal and on individuals of a population with a much larger breeding range rather than colonies for species with clumped breeding distributions. None of these species are considered rare or endangered by Canadian or international agencies that designate the status of wildlife.

Northern wheatear *(Oenanthe oenanthe)*

A rare summer visitor observed nesting and rearing young near the Hood River (Bathurst Inlet Lodge, unpublished).

Breeding range: throughout the old world and in North America throughout the Yukon and Alaska and along the eastern shores of Labrador, Baffin Island and on Ellesmere Island (Godfrey, 1986).

Winter range: old world

Thrushes

Two species are present in the region.

Gray-cheeked thrush *(Catharus minimus)*

A common summer resident nesting in shrubbery or on the ground throughout the region (Godfrey, 1968).

Breeding range: Siberia, Alaska and across Canada near treeline and in the boreal forest.

Winter range: Mexico south to Peru.

American robin *(Turdus migratorius)*

A common summer resident nesting usually well above ground in bushes and occasionally on buildings (Godfrey, 1986).

Breeding range: throughout North America to the low arctic.

Winter range: southern Canada to central America.

Water pipit *(Anthus spinoletta)*

A common summer resident nesting in sites offering natural cover of vegetation or rock throughout the region.

Breeding range: Eurasian, North American and Greenland tundra and mountain ridges and alpine meadows (Godfrey, 1986).

Winter range: U.S. south to Central America.

Northern shrike *(Lanius excubitor)*

A rare summer visitor observed nesting near Wilberforce Falls (Bathurst Inlet Lodge, unpublished).

Breeding range: Eurasia, northern Africa and northern portion of boreal forest of North America.

Winter range: across central and southern U.S. states (Godfrey, 1986).

Warblers

Three species of warbler are known to nest in the region.

Yellow warbler *(Dendroica petechia)*

A regular resident in selected habitat nesting in alder or willow thickets throughout the region (Godfrey, 1986).

Breeding range: North central Alaska, throughout Canada from near treeline south to Peru.

Winter range: southern states, through the Caribbean and Venezuela.

Yellow-rumped warbler *(Dendroica coronata)*

An occasional summer visitor nesting in tall willow thickets (Bathurst Inlet Lodge, unpublished).

Breeding range: Throughout Canada within the treeline south to Mexico (Godfrey, 1986).

Winter range: Southern British Columbia to Central America.

Blackpoll warbler ***(Dendroica striata)***

A regular summer resident throughout the region nesting on the ground under mixed wood thickets (Godfrey, 1986).

Breeding range: Northern forests and low arctic tundra of Canada and Alaska.

Winter range: South America.

Sparrows

Four different sparrow species are summer residents in the region.

American tree sparrow ***(Spizella arborea)***

A ground-nesting summer visitor throughout the region in suitable habitat (Godfrey, 1986).

Breeding range: Alaska and across central Canada.

Winter range: southern Canada and throughout the U.S. states.

Savannah sparrow ***(Passerculus sandwichensis)***

A common summer resident nesting on the ground, usually in open country (Godfrey, 1986).

Breeding range: throughout Alaska, mainland Canada and Newfoundland, and throughout the U.S.

Winter range: southern Canada to the Caribbean and Central America.

White-crowned sparrow ***(Zonotrichia leucophrys)***

A common summer resident throughout the region nesting near the ground in shrubs (Godfrey, 1986).

Breeding range: throughout mainland North America.

Winter range: U.S. and Cuba.

Harris's sparrow *(Zonotrichia querula)*

A common summer resident nesting on the ground with cover throughout the region (Godfrey, 1986).

Breeding range: Canadian mainland tundra and adjacent forest from James Bay to the Mackenzie Delta (Godfrey, 1986).

Winter range: Western U.S. states.

Lapland longspur *(Calcarius lapponicus)*

A common summer resident nesting on the ground throughout the region (Godfrey, 1986).

Breeding range: circumpolar and in Canada throughout the tundra including many of the arctic islands (Godfrey, 1986).

Winter range: southern Canada and throughout the U.S.

Smith's longspur *(Calcarius pictus)*

A rare visitor in the region (Bathurst Inlet Lodge, unpublished).

Breeding range: Alaska, and in Canada along treeline to James Bay (Godfrey, 1986).

Winter range: south central states.

Snow bunting *(Plectrophenax nivalis)*

Perhaps the most common songbird on the tundra of northern Canada, this bird arrives early before the snow melts and nests as soon as sites are free of snow in crevices and rock piles (Godfrey, 1986).

Breeding range: circumpolar tundra and in Canada throughout the mainland tundra and all the arctic islands.

Winter range: open country throughout south central Canada and U.S.

Redpolls

Both species *(Carduelis flammea and hornamanni)*, the common and hoary respectively are combined in this description. Both nest throughout the region in dwarf shrubbery or on the ground including crevices in rock (Godfrey, 1986).

Breeding range: Circumpolar arctic and subarctic and in Canada throughout the Yukon and NWT including arctic islands.

Winter range: southern portion of breeding range and throughout the U.S.

Appendix B

Annotated Mammal Species List

ANNOTATED MAMMAL SPECIES LIST

MASKED SHREW *(Sorex cinereus)*

This tiny insectivore is the smallest mammal in the north and is active under the snow throughout the winter.

Range: The masked shrew ranges widely across North America with six geographical subspecies recognized in Canada. *S. cinereus ugyunak* is found from the arctic coast south and east to the NWT/Manitoba border.

Notes on shrew ecology: Shrews are tiny (4 g) solitary hunters, tolerant of their own kind only during the mating season. They are active almost twenty-four hours a day all year long in constant search of food to maintain their high metabolic rate. They require a habitat that offers ample cover and high humidity, not only for protection but also for foraging among leaves and debris of the ground cover. Tunnels and burrows of larger rodent species are often utilized. Their principle foods are insects and other invertebrates but they will also scavenge on the remains of prey of larger predators. Shrews eat their own weight in food daily and pregnant females can eat up to three times their weight. Life span is short, usually two summers and the intervening winter, approximately 23 months (Banfield, 1974).

Relationship to man and local economy: Shrews are beneficial due to the large quantities of insects they consume.

Management status: Shrews are not subject to management legislation and are not designated as endangered in any national or international convention.

Project interaction with shrews: none that pose a significant risk to shrew populations in the region.

ARCTIC HARE *(Lepus arcticus)*

This is the largest of the hare species in North America. It is present in the immediate area of the camp and minesite where its feces are more abundant than those of caribou as measured on transects over the upland tundra plant community there.

Range: Arctic hare are found in the tundra regions across northern Canada including the arctic islands, and also in Greenland.

Notes on arctic hare ecology: Arctic hare are moderately gregarious, usually found alone or in small family groups in the southern part of their range, but from northern Baffin Island northward are often found in large bands of up to 120. They are found only in the tundra zone beyond the treeline, frequenting windswept hillsides in winter, and in summer utilizing the meadows of lower areas of glacial till. They are nocturnal and crepuscular and remain active all winter, often frequenting snowy areas in the lee of some shelter or an excavated snow den consisting of a short tunnel with an enlarged terminal chamber. Home range is small and daily range is short. Frequent use of the same trails establishes well worn pathways. Breeding season is between April and September. Usually one and occasionally possibly two litters of two to eight are produced. Maturity does not occur during the first year. Fluctuations in populations of arctic hare occur but little data is available. There is no evidence of mass migration. Diet consists of a wide variety of tundra vegetation including grasses, sedges, saxifrages, cinquefoils, campions, mountain sorrel, and twigs and roots of arctic willow and crowberry. They also feed on seaweed and eat meat when available. Arctic hare are an important food source for arctic fox, wolf, snowy owl, and rough-legged hawk (Banfield, 1974).

Relationship to man and local economy: Arctic hare are a popular resource for Inuit who use both meat and pelts.

Management status: The Wildlife Act (NWT) designates arctic hare as small game. It is not an endangered species.

Project interactions with arctic hare: none that place the hare population in the region at significant risk.

ARCTIC GROUND SQUIRREL *(Spermophilus parryii)*

This is the only true hibernating mammal in the region. It is common throughout the region, establishing borrows and colonies on eskers and other well drained habitat.

Range: The arctic ground squirrel is widely distributed from Siberia, across the northern N. American mainland east to Hudson Bay.

Notes on ground squirrel ecology: Arctic ground squirrels are a colonial species, active from late April or early May until mid September or early October, when they begin a seven month hibernation. The area utilized by a colony is extensively tunneled and contains many burrows. Distribution is therefore restricted to ice-free soils, such as gravel or sandy areas with good drainage. One litter of between five and ten is born mid-June, and the young are mature by the following spring. Diet consists of leaves, seeds, fruit, stems, flowers and roots of a wide variety of tundra vegetation. Arctic ground squirrels

will also scavenge meat from carcasses when available. In the late summer, seeds and leaves are stored in the hibernation den or in passages leading to it for use in the spring before the new vegetation is available. Arctic ground squirrels are an important food source for arctic carnivores including weasel, wolf, arctic fox and grizzly bear and raptors (Banfield, 1974).

Relationship to man and local economy: Traditionally the pelts of arctic ground squirrels were used by Inuit to line winter parkas.

Management status: Ground squirrels are designated small game in the Wildlife Act (NWT) which is administered by the Department of Resources, Wildlife and Economic Development. Arctic ground squirrels are not an endangered species.

Project interactions with arctic ground squirrels: Several different routes for the winter road were considered and examined. A route that would have gone from the western end of Kathawachaga Lake to Lake 501 in more or less a direct line followed a small esker system for most of its length. This esker system had low volumes of granular materials for most of its length that would have been exhausted in most locations. The number of ground squirrel colonies and fox dens counted along this route totaled 79. Most of these would have been destroyed in the use of granular materials for upgrading the winter road through this area. It was due in large measure to the impact on these burrows that this route was rejected, although it was the shortest distance between the entry onto Kathawachaga Lake and Lake 501.

The winter route selected follows a major esker system between Kathawachaga Lake and Lake 501. Twenty colonies were found along this route. Only a fraction of these will be disturbed by granular extraction from the esker whereas most would have been disturbed in the central alignment (see Figure 2). Only 20 colonies were found along the route from Lake 501 to the Hood River, a distance of 33.7 km. Volumes of granular materials are so massive that the proportion of ground squirrel habitat destroyed will be negligible.

TUNDRA REDBACK VOLE *(Clethrionomys rutilus)*

This is an important species in that it is a basic element in the food chain of both mammalian carnivores and birds of prey.

Range: Redback voles are a holarctic species, found in Canada throughout the NWT mainland in both forest and tundra.

Notes on redback vole ecology: *Clethrionomys* are nocturnal or crepuscular over most of their range but active in arctic daylight and remain active all winter. Northern shrub

vegetation or open taiga forest is preferred habitat. On tundra, shrubby areas are preferred but if not available rock fields and talus will be used. They utilize surface runways through vegetation, nesting in short underground burrows or under protective cover such as rocks and roots. Winter nests are above ground with tunnels under the snow for travelling. Diet consists of leaves, buds, twigs and fruit of shrubs and forbs (Banfield, 1974).

Relationship to man and local economy: provide an important food source for northern furbearers.

Management status: Small rodents are not covered by the Wildlife Act (NWT). The redback vole is not an endangered species.

Project interactions with voles: none that pose a significant risk to the vole populations in the region.

BROWN LEMMING *(Lemmus sibiricus)*

This small rodent is best known for its cyclic population dynamics.

Range: The brown lemming has a wide distribution including Siberia, and northern North America from Hudson Bay to Alaska, the lower arctic islands from Baffin to Banks, and southward in the Rocky Mountains to central B.C.

Notes on brown lemming ecology: Usually found in colonies, these lemmings prefer wet tundra swales covered with grasses and sedges but may also be found on stream banks, lake shores and grassy slopes. In winter they will be found in wet meadows and in the shelter of snowbanks. One to three litters are born to a female each summer. Diet consists of grasses and sedges and to a lesser extent forbs and bark of willow and dwarf birch added in winter. During summer, shallow runways or tunnels are made through the moss, joining larger chambers used for nesting, resting, or as toilets. Winter nests are balls of dried grass constructed on the ground surface. Food is not stored for winter. Extensive tunneling under the snow through meadows provides access to the bases of sedge and grass plants. Lemming densities undergo great fluctuations reaching peaks every two to five years. Overpopulation causes emigration, particularly during spring flooding, when they become very vulnerable to a variety of predators, especially raptors (Banfield, 1974).

Relationship to man and local economy: These small mammals have great importance as a food source for northern fur bearers.

Management status: Small rodents are not covered by the Wildlife Act (NWT). The brown lemming is not an endangered species.

GREENLAND COLLARED LEMMING *(Dicrostonyx torquatus)*

This small tundra rodent changes coat colour for the winter.

Range: This lemming has an almost circumpolar distribution, being found across the arctic tundra zone of N. America, Greenland and Siberia.

Notes on collared lemming ecology: This species is less colonial than the brown lemming living rather in family groups until the young are sexually mature. They have many of the same habits and are found in common runways during the winter. Population fluctuations, thought to be influenced by weather and intrinsic factors, occur with peaks every two to five years. Probably two to three litters are born each summer (Banfield, 1974).

Relationship to man and local economy: plays an important role as a major food source for northern fur bearers such as weasel and arctic fox.

Management status: Small rodents are not covered by the Wildlife Act (NWT). The collared lemming is not an endangered species.

Project interactions with lemmings: none that place the lemming population in the region at risk.

TUNDRA VOLE *(Microtus oeconomus)*

This small rodent is another important species for the tundra food chain supporting larger predators, both bird and mammal.

Range: Tundra voles are found Scandinavia, Soviet Union, Alaska and northern Canada, specifically in Yukon, NW B.C., and the Mackenzie district of the NWT eastward along the coastal tundra to Bathurst Inlet.

Notes on tundra vole ecology: Tundra voles are active at all times of day and throughout the year, travelling in a network of runways often found in frost cracks. They are excellent swimmers. Preferred habitat is damp tundra around lakes, stream banks or sedge and cotton grass marshes. They utilize shallow burrows in loose soil and vegetation and build bulky nests under roots in hummocks or under protective ground features. Summer diet consists of sedges and grasses. Grass seeds and forb rhizomes are stored in burrows

during autumn. Voles form an important part of the diet of many birds, including the snowy owl, rough-legged hawk, peregrine falcon, gyrfalcon, jaeger, gull, shrike; and mammals including weasel, arctic fox, wolverine; and lake trout (Banfield, 1974).

Relationship to man and local economy: Voles are an important food source for northern furbearers.

Management status: Small rodents are not covered by the Wildlife Act (NWT). The tundra vole is not an endangered species.

Project interactions with voles: none that place this species at risk in the region.

WOLF *(Canis lupus)*

The welfare of this large carnivore, in the NWT, is intimately tied to the distribution and abundance of caribou.

Range: The wolf has a holarctic distribution. Once spread throughout Canada with the exception of the Queen Charlotte Islands, they have been exterminated in large areas of southern B.C., the Prairie provinces, Ontario, Quebec and the Maritime provinces.

Notes on wolf ecology: The basic social unit of wolf society is the family pack which consists of a dominant male, his mate, their offspring, and other close family members, usually totaling between four and seven in number. They are the dominant predator of large ungulate species and also utilize small game such as hare, ground squirrels, and mice; and will occasionally take ground nesting birds, fish, berries, insects and grass. They will return to a previous kill but are not carrion feeders in general. Wolves are reported to mate for life. All members of the pack however, take responsibility for the rearing the pups which are born to the dominant female in early May. Average size of litters is seven (range 5-14). Female pups are sexually mature at two years, males at three. Seasonal migrations may occur as wolf packs follow migrating caribou herds (Banfield, 1974).

In a study of wolves at 209 dens (63 on the range of the Bathurst caribou herd) Heard and Williams (1992) projected statistically that most dens will be located at or near treeline. They concluded that wolves den at treeline because that is where the caribou are most likely to be in September when the nutritional demands of the growing pups are the greatest.

None of the dens monitored in the course of the study cited above were located in the region of the Ulu Project camp and minesite or winter road. Also, no wolf dens were noted during reconnaissance flights of the winter road route..

Relationship to man and local economy: Wolf have traditionally been an important fur bearing species in the NWT.

Management status: Wolves are classed as furbearers and big game animals under the Wildlife Act (NWT) administered by the Department of Resources, Wildlife and Economic Development. The wolf is not listed as an endangered species in the NWT.

Project interactions with wolves: There is no experience at Lupin mines over its 14 year operating history that suggests a possible impact on wolves. In discussing wolf conservation and encroachment of industrial activity (like mining) into wilderness occupied by wolves, Paradiso and Nowak (1982) stated that aside from providing access to more hunters "such activities seldom directly affect wolves."

ARCTIC FOX *(Alopex lagopus)*

This arctic carnivore varies in abundance in synchrony with its prey species. It is not uncommon to see it well within the treeline during winters after highs in its cycle.

Range: Arctic fox are holarctic in distribution and are found widely in northern Canada with treeline usually forming the southern boundary of its range.

Notes on arctic fox ecology: Arctic foxes are primarily nocturnal hunters with an acute sense of smell. They are solitary except during the breeding season. Summer dens are dug in light sandy soils in river banks, eskers or small hillocks with south facing entrances and tunnels sloping downward to the permafrost. Winter shelters are tunnels in snowbanks. Diet consists primarily of lemmings and small voles supplemented by ground squirrels, young hares, eggs and fledglings of ground nesting birds, and ducks and geese during their flightless period. Food is cached for use when prey is not as abundant. Arctic foxes are also carrion feeders and follow larger carnivores (wolves and especially polar bear) to clean up leftover caribou and seal carcasses. Dramatic population fluctuations occur with peaks every three to five years followed by a crash. These usually can be tied to the population cycles of lemmings. Long migrations may also occur, often in response to a crash in the food supply. These are most evident just after freeze up and occur in a series of waves, led by one made up of males in prime condition. Breeding season occurs between mid February and the end of April with litters averaging six in number born between mid May and mid June (Banfield, 1974).

Relationship to man and local economy: The arctic fox pelt has been a valuable natural resource for trappers in the Canadian arctic. Outbreaks of rabies in northern Canada are normally associated with arctic fox.

Management status: A furbearer under the Wildlife Act (NWT), the arctic fox is not listed as an endangered species.

Project interactions with arctic fox: Like bears, arctic fox can become habituated to camps by feeding them. A rigid food and waste disposal program should be implemented to avoid the nuisance of "tame" foxes around the facilities. Also, project personnel should be trained to recognize rabid animals and be vigilant on the matter.

RED FOX *(Vulpes vulpes)*

This carnivore has expanded its range onto the tundra in the last fifty years. Fox were observed around the temporary camp at Reno lake on several occasions. Fox burrow systems are not uncommon in the region.

Range: Red foxes are widely distributed in the Northern Hemisphere, (Europe, Northern Africa, Asia and N. America). They occur across Canada, including the southern continental tundra of the N.W.T. and have recently spread onto Baffin Island. They have also been sighted in the Queen Elizabeth Islands. It appears that their range now overlaps that of the arctic fox in many areas.

Notes on red fox ecology: Red foxes exist in family groups during the reproductive season dispersing into solitary habit for the autumn and winter. They are primarily nocturnal. They are omnivorous, utilizing whatever is most readily available. Small mammals form the bulk of their diet but birds invertebrates and plant material are also utilized. Food is often cached. Red foxes are monogamous. Average litter size is about five, born between March and May depending upon latitude. Populations show regular fluctuations with peaks between eight and ten years apart. During population peaks considerable emigration may occur (Banfield, 1974).

Relationship to man and local economy: Red foxes are important fur bearers throughout their range.

Management status: A furbearer under the Wildlife Act (NWT), the red fox is not listed as an endangered species.

Project interactions with red fox: none that place the red fox population in the region at risk.

GRIZZLY BEAR *(Ursus horribilis)*

Grizzly bears are the largest carnivore on the tundra and are resident throughout the region.

Range: Grizzly bear are found throughout Alaska, Yukon in the Rocky Mountains of Alberta and BC, and in the mountain states of the U.S. northwest. In the NWT grizzly bears roam throughout the Mackenzie Mountains, much of the Mackenzie Delta, and most of the mainland tundra including the adjacent forest/tundra transition zone (Banfield, 1974). It is extinct in most of its historic range which included all of western North America south to central Mexico.

Notes on grizzly ecology: "The grizzly has been able to survive in North America only where spacious habitat has insulated it from excessive human-caused mortality. Its habitat has traditionally been protected by rugged physiography or inaccessibility" (Craighead and Mitchell, 1982).

Adult grizzlies are mostly solitary except during the mating season. They shun human contact but may react fiercely when surprised, cornered, wounded or separated from their cubs. Eyesight is poor but senses of smell and hearing are excellent. Grizzlies prefer open areas and are most active during evening, night and early morning hours, usually napping during the day. Diet is omnivorous including roots, berries, fish, small mammals, and sometimes large mammals. They will also scavenge, cleaning up carcasses of winter-killed big game. Mid-November to April is spent in a den or natural shelter. Sows breed every second year and cubs remain with their mother for their first two winters. Sexual maturity is reached at an age of six to seven years (Banfield, 1974).

Studies on the grizzly bear have not been conducted in the region however the GNWT Department of Resources, Wildlife and Economic Development has been studying the grizzly population in the area west and south of Coppermine. It determined a density of one bear for every 212 square km. The age of first breeding for females was 7.33 years. Breeding females have a mean home range size of 1,350 sq. km. (Renewable Resources, unpublished, and Ray Case, personal communication).

Monitoring the movements of marked bear in the area of Bloody Falls showed that females with cubs were in the area of summer cabins and within 120 km. of a major community without creating situations which required the removal of bears from the area due to nuisance situations. Home ranges of 13 female bear were monitored by telemetry in 1995. Average range size was 1,968 km^2 (median 1,000 km^2), (Cluff and Case, 1995). Home ranges of males are usually larger (Craighead and Mitchell, 1982).

Statistics on problem grizzly bears killed in the central mainland between 1967 and 1992 have compiled characteristics on the animals killed. Of the 48 bears killed, only 3 were

identified as adult females, two were accompanied by two cubs each. (Data on sex and age for five bears were not provided in the kill report.) Of the remaining 42 bears in the statistics, 25 were immature of which 12 were male and 7 were female. Six reports did not identify the sex of the young bear (GNWT Resources, Wildlife and Economic Development, unpublished). On the face of these data it would appear that killing problem bears would have little effect on the productive female cohort of the population. The probability is that a problem bear will be an immature male.

The 48 bears in the statistics above included a report from Lupin Mine in which a female with two cubs had to be destroyed. They had been removed from the area by helicopter two times and had returned from their release 200 km away. They were originally attracted to camp at the time that the incinerator was inoperable (Hugh Wilson, personal communication). An 11 year data set was prepared by the GNWT Department of Renewable Resources and presented to the NWT Diamonds Environmental Assessment Panel (1996). It reported a total of 146 known bears killed "in the Coppermine and Slave Geological Province Area," between 1985 and 1995. Of these "industry" was responsible for 15 (10.3%), outfitters for 21 (14.4%), aboriginal hunters 27 (18.5%) and subsistence harvests (including quota bears), 83 (56.8%).

Relationship to man: Except as suggested by the data for immature bears above, grizzly bear do not normally seek out sites of human occupation unless they are attracted to it by food. Grizzlies can very quickly become habituated to "a free lunch" (Follmann and Hechtel, 1990). The Alaska study concluded: "Conscientious food and waste management, fencing of permanent and semi-permanent facilities, education and prompt action whenever potentially troublesome situations occur all can reduce the types of bear problems that were encountered....." And "We predict that application of these solutions will result in fewer bears being killed and that economic losses incurred by contractors will be significantly reduced" (Follmann and Hechtel, 1990).

There is no grizzly bear quota for the area around the Ulu Project (John Nishi, personal communication).

Management status: Grizzly bear are included in the Wildlife Act (NWT) administered by the Department of Resources, Wildlife and Economic Development It is not listed as an endangered species in Canada. It is included in Appendix II of CITES which means that an export and import permit are required for international shipments of grizzly bear or their parts. Grizzlies in Canada are classified as "vulnerable" by the Committee on the Status of Endangered Wildlife in Canada.

Project interactions with bears: Lupin Mine is a demonstration that the site specific activities of a mine and winter road do not destroy the characteristics of wilderness that are necessary for grizzly populations. The observations of the study near Coppermine also show that grizzly females can raise their cubs in relatively close proximity to a community

of 1,000 without becoming a problem. The necessary precautions with food and waste management at the Ulu Project site can show similar results. It will be important to develop a strategy that ensures bears are not attracted to facilities where they will become a problem and need to be destroyed. The case of the female with cubs at Lupin demonstrates the importance of prevention. If the bear had not had a rewarding visit to the mine site at a time that the incinerator was malfunctioning, she probably would not have returned - and indeed may not have been attracted to the site initially.

The use of granular materials from eskers raises concerns for grizzly denning habitat (GNWT Renewable Resources, 1996). A search for old den sites along the esker complex between Kathawachaga Lake and Lake 501 in July did not show old den sites. Also, a search for fall denning activity in the same area on Oct. 3, 1996 showed no denning activity and also no tracks in snow cover less than 7 days old.

SHORT-TAILED WEASEL *(Mustela erminea)*

Not seen very often, this carnivore changes coat colour with the seasons.

Range: Distribution is circumpolar. The short-tailed weasel is found throughout Canada with the possible exception of a few offshore islands.

Notes on short-tailed weasel ecology: Weasels are agile, quick moving and fierce carnivores. They are mostly nocturnal and prefer to stay under cover. Burrows of other small mammals such as voles or ground squirrels are commonly taken over and adapted to the weasels' needs. Nests are lined with fur of their prey or dry grasses and shredded leaves. Sections of the burrow are used as larders and toilet areas. One litter is born annually in mid April or early May. Females are sexually mature within three months and are able to bear young the following spring. Adult males are twice the size of females and become sexually mature during their first winter. Mice and voles form the largest part of the short-tailed weasel's diet and drastic population fluctuations occur in response to availability of this food source. They also prey upon shrews and ground squirrels (Banfield, 1974).

Relationship to man and local economy: White winter pelts are of economic value.

Management status: Classed as a furbearer in the Wildlife Act (NWT), the ermine is not an endangered species.

Preliminary impact assessment: none

LEAST WEASEL *(Mustela nivalis)*

This is the smallest carnivore on the tundra which also changes coat colour with the seasons.

Range: The least weasel has a circumpolar distribution, and is found in most of continental Canada. It is not an abundant species in the coastal tundra but occasional sightings occur.

Notes on least weasel ecology: The least weasel is the smallest carnivore, barely exceeding the size of the small rodents on which it preys. In habits it resembles the short-tailed weasel. Two or more litters may be born each year. Diet is almost exclusively mice and voles (Banfield, 1974).

Relationship to man and local economy: Not significant.

Management status: Classed as a furbearer in the Wildlife Act (NWT), the least weasel is not an endangered species.

Preliminary impact assessment: none

WOLVERINE *(Gulo luscus)*

This large and solitary carnivore enjoys the respect of man and beast alike.

Range: This holarctic species occurs in Europe Asia and N. America. In Canada wolverine are found primarily on the tundra of Yukon and the Northwest Territories where their distribution extends to northern Ellesmere Island.

Notes on wolverine ecology: The wolverine is a solitary species. Sexes associate briefly during mating season and family groups of females and their cubs during the first season are the only social groupings. Wolverine are omnivorous, primarily scavengers cleaning up carcasses left by wolves and bears, and also feeding on a wide variety of roots and berries, small game and fish. One litter of between two to five are born in late April or early May and remain with their mother until the following spring (Banfield, 1974).

Relationship to man: Wolverine can be a costly nuisance to trappers as they follow traplines destroying the catch. They also are known to break into caches of food, furs, and gear, destroying them. Their pelt is valued as parka trim for its frost resisting quality.

Management status: Wolverine are classed as furbearers and big game animals under the Wildlife Act (NWT) administered by the Department of Resources, Wildlife and Economic

Development. The wolverine is not listed as an endangered species in western Canada or the NWT.

Preliminary impact assessment: It is difficult to see how the site specific activities of normal mining practice and winter road could affect the well being of so solitary and nomadic animal as the wolverine.

CARIBOU *(Rangifer tarandus)*

Perhaps the most conspicuous and widely distributed of the large game animals on the tundra, caribou occupy the region in varying numbers in all seasons but were not observed during aerial reconnaissance of winter road routes in July, August, September and October, 1996. Caribou were sighted regularly at the camp in June 1996. (See Appendix E for sightings by Ulu Project personnel.)

Range: Lupin Mine, the winter road and the Ulu minesite are all located in the range of the Bathurst Caribou Herd. Caribou herds in the NWT are named after a major landmark near to the herd's calving grounds. In this case, the herd is named after Bathurst Inlet. Most of the animals in this herd spend the winter (October through mid-April) at or within the treeline in a broad band from Hottah Lake south of Great Bear Lake east to the forests north of the East Arm of Great Slave Lake. Kelsall (1968) provided numerous winter range maps that show this herd wintering as far west as the Mackenzie River in the early 1950's. The summer range on the tundra stretches from the Coppermine River east to the Perry River including the lands north of the Back River.

The overall annual distribution of this herd has not been documented in a comprehensive way since the studies by the Canadian Wildlife Service in the 50's. Current studies using satellite telemetry are underway to fill this information void. It is well known however that not all the caribou of this herd spend their winter in the forests south and west of their summer range (Land Use Information Map, 86O, Environment Canada, 1978). Kelsall (1968) shows that between 1948 and 1960, caribou spent the winters of 1951/52, 1955/56, 1958/59, and 1959/60 on the tundra between the Coppermine River and Bathurst Inlet in significant numbers. Also, there were caribou in the vicinity of Coppermine throughout the winter of 1974/75.

Herd size: The Bathurst herd increased from 100-120,000 adults in 1979 to 484,000 in 1986 (Department of Resources, Wildlife and Economic Development, unpublished). The most recent population estimate for the herd places its size at 352,000 in 1990. The growth of the herd between 1979 and 1986 was likely associated with immigration of animals from an adjacent caribou herd, and since there has been high survival of caribou calves in the years since 1986, the apparent decline between 1986 and 1990 is not

considered to be as severe as a comparison of the 1986 to 1990 population estimate indicate (Renewable Resources, unpublished).

Seasonal distribution: Caribou start the spring migration from their winter ranges to a common calving ground in mid-April. By late May the females of the herd are on the calving ground. In early June 75% of the calving occurs within a space of five days (Calef, 1981). The yearlings of the herd are near the edges of the calving ground at this time with the bulls still en route to the summer range. After calving the herd may or may not combine into one mass of animals. It is not uncommon for the bulls to remain segregated from the cow/calf herd for the summer. During the early stages of the post-calving period in June and July caribou stay in one or several aggregations which may number in the thousands and remain within the general region of the calving ground, however in late July they move away and reach their maximum summer distribution in August (Kelsall, 1968). In late July it is common to see caribou in large numbers moving south past the northerly and southerly extremities of Contwoyto Lake.

On calm summer days the main preoccupation of caribou may well be to escape the torment of mosquitoes by searching for high ground that offers summer breezes. During periods of warble infestations Kelsall described caribou as going "berserk." Beside the obvious discomfort caused by insects, the greatest effect that insect harassment may have on caribou is to reduce the feeding time due to evasive behaviour (Kelsall, 1968).

The herd approaches the treeline along a broad front in early September and will stay in the forest - tundra transition zone until breeding has been completed in late October. Following the rut, the herd breaks into smaller groups and disperses throughout the winter range.

Interaction with humans: Caribou have been the mainstay of northern cultures for their food, clothing and shelter for millennia. They remain important today. A rough economic value of the Bathurst herd prepared by the Department of Resources, Wildlife and Economic Development estimates the replacement value of the annual harvest from this herd to be 12.5 million dollars, not including the secondary economic activities generated from hunting like the purchase of supplies and transportation. This total is the result of applying the replacement cost of beef in the smaller communities to the combined harvest in the following categories:

GHL (general hunting licence)	$10,580,000
Resident hunters	649,000
Non-resident hunters	1,100,000
Commercial tags	831,000

These values show the importance caribou of the Bathurst herd to aboriginal hunters (GHL), non-aboriginal hunters (resident) and the growing number of non-resident hunters who must secure the services of a northern guide or outfitter. The herd also represents a tremendous potential for commercial development of caribou meat.

The overall annual range of the Bathurst herd places it within hunting reach of 19 communities. Some are directly on the range while others have access by way of the Lupin winter road. Table 1 summarizes the harvest statistics that are provided by the GNWT Department of Resources, Wildlife and Economic Development. It is noteworthy that a significant portion of the annual value of the Bathurst herd is the direct result of access provided by the Lupin winter road. The harvest along the winter road was monitored from a hunter check station in winter from 1979/80 through 1984/85. A minimum annual harvest total of 3,700 caribou is reported for this 6 year period. It is felt that the winter harvest along the road has increased since these data were assembled (Renewable Resources, unpublished).

Management status: Caribou are covered by the Wildlife Act (NWT) which is administered by the Department of Resources, Wildlife and Economic Development. Caribou were designated to be "in danger of becoming extinct" by Order-in-Council under the NWT Act (Canada). This was deemed necessary to regulate harvesting by "Indians" and "Eskimos." No restrictions have been placed on the harvest of caribou from the Bathurst herd by "Indians" or "Eskimos" for food (Renewable Resources, unpublished). Barren-ground caribou are not listed as endangered in any domestic or international wildlife conservation convention.

A draft management plan for the Bathurst herd prepared in 1988 was the subject of public discussions. These discussions and management "objectives" are reviewed by Case et al 1996.

Table 1. Harvest of Caribou (Bathurst Herd) by General Hunting Licence Holders.

Community	Population [a]	GHL Holders [b]	Max. harvest Since 1980	Type, Year [c]
Fort Rae/Edzo*	1,443	574	5,999	E,87/88
Yellowknife/Dettah*	13,142	954	1,445	E,80/81
Rae Lakes*	188	103	2,289	E,87/88
Lac la Martre*	413	113	877	E,88/89
Snare Lake*	123	44	1,255	E,87/88
Bay Chimo/Bathurst*	80	51	627	E,88/89
Cambridge Bay*	1,027	311	140	E,87/88
Coppermine*	956	322	227	E,88/89
Subtotal - Primary Users	**17,372**	**2,472**	**12,859**	
Fort Smith	2,505	699	828	E,83/84
Hay River	3,008	465	269	E,80/81
Fort Resolution	475	372	132	E,82/83
Snowdrift	263	125	125	R,83/84
Reliance	11	3	8	R,78
Fort Good Hope	586	279	1,129	R,80/81
Fort Franklin	550	292	991	E,83/84
Fort Norman	360	137	72	R,81/82
Fort Providence	577	325	164	R,83/84
Fort Simpson	1,006	424	178	E,83/84
Wrigley	161	99	50	E,77/78
Total	**26,874**	**7,692**	**16,805**	

a Data from GNWT Bureau of Statistics, 1989. Population Estimates Northwest Territories June 1988.

b All data up to August 1990. GNWT Department of Resources, Wildlife and Economic Development data summary.

c Estimated harvest (E) or reported figures only (R) and year for which data was obtained also included.

* Primary user community.

Source: GNWT Department of Resources, Wildlife and Economic Development unpublished data.

Table 2. Resident hunter harvest of Bathurst Caribou 1981/82 - 1994/95.

Year	Number of Hunters [a]	Estimated Harvest [b]
1981/82	467	250
1982/83	567	389
1983/84	696	924
1984/85	706	348
1985/86	602	432
1986/87	778	1,065
1987/88	990	1,905
1988/89	1,011	1,437
1989/90	-	1,547
1990/91	1,094	2,004
1991/92	987	1,469
1992/93	1,040	2,143
1993/94	1,010	1,238
1994/95	926	1,668

a Number of hunters who purchased caribou tags in the primary user communities (see Table 1).

b From hunter harvest questionnaire returns.

Source: GNWT Department of Renewable Resources, unpublished data from the draft Bathurst Caribou Management Plan (1988) and Case et al, 1996

Project interactions with caribou: Interactions between concentrations of caribou and the project should be expected on the winter road during spring migration to the calving ground, at the minesite in June and late July, and with lower concentrations of caribou overwintering on the tundra during operation of the winter road.

In light of the accumulated experience at Lupin Mine and the Lupin winter road through the winter range of the herd, it is difficult to envisage direct impact from the developments proposed that alone would affect the productivity of the herd. It is noteworthy that in the first four years of operations at Lupin Mine the population estimates for the herd increased

from 174,000 in 1982 (when Lupin was commissioned) up to 486,000 in 1986 (Renewable Resources, unpublished). It seems clear that the combined effects of the new mine on the summer range and the presence of a winter road providing greater hunter access had no apparent negative impact on the overall productivity of the herd.

These global observations notwithstanding, there are several site specific issues that bear consideration.

Winter road: The discussion on interactions with caribou on the winter road between Lupin and Ulu assume that it will be usable until the end of April every year and until the middle of May at least one year in two.

In relation to the proposed winter road from Lupin to the Ulu minesite, the calving grounds are to the east and a major portion of the winter range is to the south and west. Kelsall (1968) described the general routes of the Bathurst herd's spring migration. On reaching treeline:

"Most then follow height of land between the headwaters of the northwest-flowing Coppermine River and the east and northeast flowing Lockhart, Burnside, and Back rivers to Contwoyto Lake or its vicinity. From there the valleys of several large rivers funnel the animals directly to Bathurst Inlet.

"Animals on the northern extremity of this movement have a number of alternatives . . . Most cross the lower Coppermine River valley, which lies nearly at right angles to their course . . . Once the valley is crossed the animals move along a band of high rolling tundra which extends almost to Bathurst Inlet, and which is separated from Coronation Gulf to the north by rough and broken country. During survey flying in 1955, caribou bands were backtracked for nearly 175 miles from Wilberforce Falls on the Hood River to the big bend in the Coppermine River. The animals chose the highest and most level country for travel and avoided rocky terrain to the north and the major valleys to the south."

Migrations of significant numbers passed through this area in nine of ten years between 1949 and 1960. The closer the caribou are to the calving ground, the narrower the migratory corridor (Kelsall, 1968). The summer terminus of this winter road will be approximately 250 km from Bathurst Inlet and so the front of migrating caribou may encompass the minesite and the southern portion of the winter road every year. The pregnant cows would pass first in late April and early May followed by barren cows and yearlings with bulls bringing up the rear after the middle of May. ". . . the duration of movement through a given point generally extends over a period of three weeks or more." (Kelsall, 1968).

Monitoring the onset and sequence of the spring migration may reveal a pattern that can help plan a schedule for road use in early to mid-May. Kelsall found a correlation between the dates for the vanguard of caribou on spring migration and the spring melt.

When dates of observation of the van of caribou migration are plotted on such a map, (mean date of last snow cover) it is found that the animals move through an area 2½ to 3 weeks before the mean date for last snow cover.

The region is generally a low precipitation zone. The winter road should not have to contend with large amounts of snow and so it is not expected that the road itself will become a barrier or deflector for migrating caribou. Kelsall described the spring migratory behaviour as "purposeful." Jakimchuk and Carruthers (1983) observed caribou of the Bathurst Herd on migration to the calving ground near Contwoyto Lake in May 1980. Their conclusions included the following:

"Caribou responses to varying natural terrain include deflections and paralleling behaviour. These responses are aimed at seeking the path of least energetic resistance."

In searching the literature on the subject, we found no references to the Lupin winter road causing difficulty to migrating caribou. None should be expected with the winter road between Lupin and Ulu.

It is assumed that regulations and guidelines developed by Echo Bay for their drivers on the winter road will be prepared and implemented so that migrating caribou have the "right of way."

The winter road to Ulu should not contribute to increased hunting pressure on caribou in the region. The hunters using the winter road gain access to the road from the south and the Ulu extension is well beyond that portion of the herd's winter range that normally hosts overwintering caribou.

Mine facilities: The experience with caribou at Lupin is a valuable reference for indicating the types of interactions that may be expected at Ulu. The facilities will be similar although the relative scale may differ. There will be buildings, roads, an airstrip, fuel storage and rock disposal areas. Some of the activities will stimulate vegetation growth which may attract caribou and others will result in changing the local topography. It may be more appropriate to try to manage human movement in relation to these features than to attempt to manage caribou movement. The use of barriers like fences may serve the intended purposes under one set of conditions, but serve as a funnel under another. Kelsall (1968) describes a scene where large numbers of caribou on spring migration were marching past each other ("sometimes passing within a few yards of each other without apparent interest") in opposite directions. Similarly, erecting barriers to caribou in

summer when the general movement of caribou in the area of the mine will be southerly, may not have a similar effect as in May when the general movement will be easterly.

A close examination of summer caribou trails in the immediate vicinity of the lakes in the area indicated relatively lesser use than west and south of the area. Also, the trails indicated a movement around the high ground on which the minesite and airstrip are located and at which all the summer activities will occur.

Interactions between standard mining activities and caribou have occurred at Lupin for more than 14 years with no apparent ongoing negative impact on the Bathurst herd. The same should be expected at Ulu, 110 km to the north. (A total of three accidental deaths of caribou have been reported at Lupin since 1980 (GNWT Renewable Resources, 1996).

Calving Grounds: The GNWT Department of Resources, Wildlife and Economic Development (formerly known as Renewable Resources for wildlife purposes) defines "traditional calving grounds" as follows: "the total area known to used for calving over many years." A recent study (Sutherland and Gunn, 1996) reported the cumulative area used by the Bathurst herd as documented by 16 surveys over a span of 31 years. The view of the herd as calving around Bathurst Inlet is challenged by its calving distribution in 1996 when it extended from the inlet westward to 110°40' on the Hood River, some 25 km southwest of the minesite. This is the furthest west that calving for the herd has been documented. The report suggests that "16 surveys during four decades may not be an adequate sample" with which to define traditional calving grounds (Sutherland and Gunn, 1996) .

MUSKOX *(Ovibos moschatos)*

This large tundra ungulate is resident in the region but is still recovering from serious over hunting more than one hundred years ago.

Range: The historic range of muskox included the entire mainland tundra of Canada and most of the arctic islands as well. Over hunting in the 1800's reduced their numbers to the point where all hunting was banned in 1917. They have made a strong recovery throughout their range. The most serious reductions in the populations occurred on the mainland accessible by hunting parties and explorers who traded the hides used as carriage robes. Recolonization of former mainland ranges has progressed slowly but steadily to the point where muskox are again hunted under quota. Ranges to the west and south of Bathurst Inlet have been recolonized more slowly than the range east of Bathurst Inlet (Barr, 1991).

Only single bulls (2) were observed during reconnaissance flights over winter road routes however both single animals and small herds were recorded in the Ulu Project camp wildlife log (Appendix E).

Notes on muskox ecology in the region: Muskox are not migratory like the caribou but relatively sedentary, moving more in response to feeding conditions than to innate seasonal triggers (Hubert, 1974). Their diet includes all classes of tundra vegetation from the woody willow to the delicate lichen (personal observations, and Gunn, 1982). The average herd size varies from season to season being the largest in winter (Tenner 1965, Hubert 1974). Large herds can however be encountered at any time of year.

Muskox are not numerous around the Ulu minesite. Aerial surveys for muskox conducted over the area from the headwaters of the Hood, James and Mara Rivers west to Coppermine (115 degrees W) and south to Rocking Horse Lake (approximate southern boundary of survey) in the summer of 1991 revealed an estimated population of 1,403 muskox. The frequency of observations was highest north of Contwoyto Lake and lowest in the southwest quadrant of the survey area. Only one herd was noted in the entire area (approximately 16,000 km^2) between 113 and 115 W in the transect survey covering 10% of the area.

Relationship to man: Muskox have probably been hunted as long as they have occupied the same range as humans. In the central mainland they were hunted to near extinction in the late 1800's (Barr, 1991). Afforded full protection from 1917 they recovered sufficiently to allow hunting again in 1969 in the High Arctic and in 1977 on the mainland. All muskox hunting is managed by the Department of Resources, Wildlife and Economic Development under specific quotas for each muskox management area. The harvest quota for muskox in the vicinity of the minesite, Zone MX/19, allows a harvest of 60 animals annually (GNWT Resources, Wildlife and Economic Development Game Regulations 1996). These animals may be taken by local aboriginal hunters for subsistence needs, for non-aboriginal hunters for recreational/domestic needs and by non-resident trophy hunters. Like caribou, muskox represent considerable economic potential for local hunters and outfitters.

After reviewing the current status of muskox, Barr (1991) concludes that the muskox is in "a safer position than it has been at any time since it was first encountered by Europeans." In assessing risks to muskox it is probably safe to say that in the absence of wanton habitat destruction, the beast is largely immune to the hardships of the environment except under weather conditions that result in extremely heavy precipitation in the form of wet snow under freezing conditions (Barr, 1991). They also cannot withstand indiscriminate hunting like that of the 1800's. Muskox have demonstrated that they can accommodate and indeed become habituated to certain activities associated with resource development activities on their ranges without being displaced (Gunn, 1982). Eureka, Truelove Inlet, and Polar Bear Pass on Bathurst Island are a few locations where camps served by aircraft

have co-existed with muskox for many years with no apparent effect on their seasonal activities and distribution.

Management status: Muskox are protected under the Wildlife Act (NWT) managed by the Department of Resources, Wildlife and Economic Development. They are named in an Order-in-Council pursuant to the NWT Act (Canada) to be a species "in danger of becoming extinct." This designation was deemed necessary for the government to regulate harvests by native hunters taking muskox for food. Muskox are not listed as endangered in any other national or any international wildlife conservation convention.

Project interactions with muskox: In the absence of hunting, overt harassment by men and equipment and/ or dogs, normally accepted mining practices and related transportation infrastructure and activities should not impede muskox from increasing their population throughout the area. The presence of a winter road through their range should not be a barrier to their movements. The snow berm on either side of the road should be frozen hard enough to support animals crossing the road and the disturbed snow should not be a barrier. The author observed a mixed herd of 14 muskox picking a trail through the treacherous jumble of ice ridges created by tides along the shores of Truelove Inlet, Devon Island in May 1970. Muskox are regularly observed at Lupin and in August 1996 a mixed herd of 21 included at least four calves.

Appendix C

RAPTOR NEST SITES AND WILDLIFE LOCATION DATA IN RELATION TO ULU PROJECT INFRASTRUCTURE

RAPTOR NEST SITES AND WILDLIFE LOCATION DATA IN RELATION TO ULU PROJECT INFRASTRUCTURE

The data presented below consist of data collected for the Ulu project in July 1996, as well as sites located in the Lytton Minerals Jericho Project study area in 1995 and 1996. Site-specific notes on all nest sites are documented in two sets: those within the Ulu Project area (prefixed with the letter "U") and those within the Jericho Project area (prefixed with the letter "J")[1]. Ulu Project nest locations are shown in Figure 2; Jericho project nest sites are shown in Figure 3. Also presented in this appendix are supplementary data on wolf dens and radio-collared bears provided by the GNWT.

Ulu Sites

Locations of all site-specific raptor observations were recorded with the locations taken from the helicopter's GPS navigation system.

U1. 66 28 28 N X 110 40 36 (7372644 N, 514402 E) - within 2 km of the proposed winter haul road

- occupied by ravens in 1996; 3 young visible on July 29
- a ledge with a strong overhang and a northern exposure facing the esker in a small gorge over the rapids
- the river flows along the flank of an esker that may be used for granular materials
- the nest site may be within 2 km of the road alignment between lakes along this esker
- topographic features are such that a minimum distance of the nest site might be achieved and so mitigate potential impacts of disturbance
- a vacant stick nest is immediately west.

U2. 66 31 06 N X 111 22 16 W (7377548 N, 483498 E) - within 2 km of the proposed 1997/98 winter resupply road where it turns north

- occupied by peregrines in 1996; 1 fully feathered chick visible on July 31
- a south-facing site with a strong overhang
- routing the supply road on the south side of the watercourse to avoid rapids and spring overflow may reduce disturbance at this site.

[1] Because there is an overlap between the two areas surveyed, the Jericho data have been used to supplement the data for the Ulu project.

U3. 66 33 24 N X 110 50 02 W (7381782 N, 507375 E) - within 2 km of proposed winter haul road

- occupied by peregrines in 1996; 4 chicks in white down visible on July 31
- ledge with SE exposure in a short ravine running to the SW
- 2 vacant stick nests nearby
- a family of ravens at ravine mouth, no nest was located.

U4. 66 35 06 N X 111 20 48 W (7384973 N, 484627 E) - within 2 km of proposed 1997/98 winter resupply route

- occupied by peregrines in 1996; 2 chicks visible on July 31
- ledge with a SE exposure
- distance from the nest site might be achieved by taking route as far west as topography and practicality will permit.

U5. 66 37 28 N X 111 22 50 W (7389379 N, 483151 E) - within 2 km of proposed 1997/98 winter resupply route

- occupied by peregrines in 1996; 4 chicks in down visible on July 31
- ledge over small lake with a NE exposure
- following a route south of water course will achieve greatest distance from nest site.

U6. 66 40 09 N X 11 27 25 W (7394387 N, 479805 E) - within 2 km of proposed 1997/98 winter resupply route on Hood River

- unoccupied stick nest in 1996; a single rough-legged hawk observed in vicinity on July 31
- a SE exposure
- a distance of 2 km can be achieved if route follows SE bank of Hood River.

U7a. 66 42 13 N X 110 51 49 W (7398159 N, 506019 E) - 2+ km from proposed winter haul road

- occupied by gyrfalcon in 1996; 1 adult and 1 fully feathered young observed at nest July 31

- ledge with strong overhang and SW exposure
- does not seem to be within critical distance of present alignment of proposed winter haul road.

U7b. 66 42 14 N X 110 51 56 W (7398190 N, 505934 E) - 2+ km from proposed winter haul road

- unoccupied stick nest with a SW exposure
- does not seem to be within critical distance of present alignment of project haul road.

U7c. 66 42 16 N X 110 52 17 W (7398251 N, 506019 E) - 2+ km from proposed winter haul road

- occupied by peregrines in 1996; 4 chicks in down observed July 31
- exposed pinnacle overlooking ravine
- does not seem to be within critical distance of present alignment of project haul road.

U8. 66 47 42 N X 110 59 35 W (7408340 N, 500305 E) - within 2 km of proposed winter haul road at Hood River crossing

- occupied by peregrines in 1996; birds active in area but young appear to have fledged by 30 July, very prominent whitewash on cliff below nest
- ledge with some sticks above rapids on Hood River with strong overhang
- northerly exposure with intervening high ground between nest and proposed haul road route
- 2 stick nests in immediate vicinity, 1 upstream and 1 downstream.

U9. 66 48 48 N X 111 14 20 W (7410407 N, 489503 E) - 2+ km west of 1996/97 winter supply route

- unoccupied stick nest on ledge with a northerly exposure.

U10. 66 52 10 N X 111 04 32 W (7416641 N, 496688 E) - 2+ km west of airstrip

- occupied by rough-legged hawks in 1996; 3 chicks observed July 30
- ledge with a NE exposure

U11. 66 52 33 N X 110 52 29 W (7417357 N, 505491 E) - 2+ km from proposed winter haul road, in gorge SE of old BHP camp

- 2 unoccupied stick nests
- SE exposure in gorges SE of old BHP camp
- not within critical distance of Ulu Project infrastructure.

U12. 66 55 07 N X 110 59 41 W (7422120 N, 500231 E) - within 2 km of Ulu Project mine and camp facilities, west of inflow to East Lake

- unoccupied stick nest in 1996
- single peregrine in immediate vicinity of nest on 30 July
- on ledge with northerly exposure
- seems to be within 2 km of Ulu Project camp facilities.

U13. 66 57 00 N X 110 50 02 W (7425629 N, 507258 E) - 2+ km north of mine and camp sites

- unoccupied stick nest
- single peregrine in immediate vicinity of nest on 30 July
- on ledge with NE exposure
- not within the critical distance of Ulu Project infrastructure.

The road proposed for the 1997/98 winter construction period passes near four peregrine nests that were active in July 1996. All four nest sites (U2, U4, U5, and U8) appear to be within 2 km of the proposed route. However, the route will be used by slow-moving track vehicles and large low-pressure tire vehicles. Further, since this route will be used for only two seasons at most, the impact, if any, of late season winter road use on the peregrine population should not be significant.

Nevertheless, the risk of impact should be kept to a minimum. Mitigation measures include reducing the number of traffic passes. This might be accomplished by concentrating all traffic in convoy and so reduce the number of potentially disruptive incidents. Also, if breeding pairs are active in these territories, their response to the traffic should be monitored; this is especially relevant in the case of the nest site on the Hood River (U8) directly south of the current Ulu camp (Camp 3) as this site is situated near the haul road proposed for the operational period of the Ulu Project.

Only one nest site - U1 - is located within the critical distance of the southern portion of the winter road system whose final alignment remains under review. This site was

occupied by ravens in 1996. It faces north and a large rock outcrop lies between the nest site and the terrain suitable for a road route to the south which probably reduces the risk of impact from winter road traffic.

It is noteworthy that two nests at U7 were occupied in 1996 in that this site appears to be within 1 km of the route used as a winter supply route to set up Camp 3 and bring in heavy equipment and materials for construction at the mine site. The last load by Delta Commander (large low-pressure tires) over this route was hauled in on April 20. The gyrfalcon at U7 was almost certainly on the breeding territory on that date, since gyrfalcons are believed to remain in their territories most of the winter, and late April falls within the range of dates for egg-laying initiation reported by Poole and Bromley (1988) for the central Arctic. Assuming that the fully feathered young bird observed in the nest was within a week of fledging, counting backwards from an assumed fledging date of August 6 places its egg laying date at around May 20 (nestling period is 45 - 50 days [Poole, 1989] plus 29 days for incubation).

Two sites are located within 2 km of the project haul road. One site (U8 - discussed above) has high ground between it and the project haul road alignment and risk of impact is low. The other site- U3 - is in a ravine that may shield it from most of the disturbance. It also may be possible to move the alignment to the east to gain greater separation from this site.

JERICHO SITES

Figure 2 shows the approximate route location under consideration through the Lytton Minerals Jericho Project area and down onto Contwoyto Lake. This route was used as a winter road by the Jericho Project in 1996. The last load to pass over this route was in mid- to late April. Canamera carried out a raptor study in the summer of 1995. All nest sites identified in 1995 were revisited in the summer of 1996. In addition, two more sites (J19 and J22) were observed in 1996. All site-specific raptor observations were recorded with the locations taken from the helicopter's GPS navigation system.

J1 66 2.96 N x 111 22.69 W (7325271 N, 482868 E)

- 2 clusters of 1 and 3 stick nests on opposite sides of a lake-studded valley
- middle nest of 3 on northern side of valley occupied by rough-legged hawks in 1996
- 2 chicks present on July 26, 1996.

J2 66 1.76 N x 111 21.17 W (7323035 N, 484004 E)

- a cluster of 3 stick nests on NE exposure
- all unoccupied in July 1996

J3 66 1.25 N x 111 20.97 E (7322087 N, 481150 E)

- a cluster of 2 stick nests on cliff with SW exposure
- both unoccupied in July 1996

J4 66 1.01 N x 111 23.99 W (7321654 N, 481864 E) in gorge east of Jericho Lake

- a cluster of 4 stick nests in gorge with northerly exposure
- all unoccupied in July 1996

J5 66 0.48 N x 111 24.25 W (7320671 N, 481586 E)

- 1 stick nest unoccupied in July 1996

J6 65 59.78 N x 111 24.45 W (7319372 N, 481502 E) within 2 km of Jericho winter road

- 2 clusters of 2 and 3 stick nests on cliff with southerly exposure
- all nests were inactive in July 1996

J7 65 59.81 N x 111 25.65 W (7319433 N, 480594 E) within 2 km of Jericho winter road

- 1 stick nest on cliff with a northerly exposure
- unoccupied in July 1996

J8 65 59.90 N x 111 26.75 W (7319606 N, 479763 E) within 2 km of Jericho winter road

- a cluster of 3 stick nests with a southwest exposure over small lake
- 1 occupied by rough-legged hawks with 3 chicks in white down present on July 27, 1996

J9 65 59.52 N x 111 28.47 W (7318901 N, 478457 E)

- 2 peregrines active in this area, but no occupied nests found
- a cluster of 3 stick nests with a northwest exposure, all unoccupied in July 1996

J10 65 59.15 N x 111 28.99 W (7318226 N, 478058 E)

- 2 clusters of 1 and 3 stick nests with southwest exposure
- easterly most with 4 rough-legged hawk chicks on July 27, 1996

J11 65 59.05 N x 111 27.11 W (7318029 N, 479479 E)

- 1 stick nest with southwest exposure over eastern tip of lake
- unoccupied in July 1996

J12 65 59.16 N x 111 26.17 W (7318229 N, 480192 E)

- 1 stick nest on cliff with northwest exposure over small gorge
- unoccupied in July 1996

J13 65 58.76 N x 111 29.68 W (7317505 N, 477530 E)

- 1 stick nest on cliff with northerly exposure
- unoccupied in July 1996

J14 65 58.42 N x 111 28.83 W (7316869 N, 478169 E)

- 1 stick nest with northeast exposure over a small lake
- inactive on July 27, 1996

J15 65 58.05 N x 111 29.51 W (7316185 N x 477648 E)

- a cluster of 3 nest sites
- 1 occupied by rough-legged hawks with 4 chicks on July 27, 1996

J16 65 67.83 N x 111 28.77 W (7315772 N, 478206 E)

- occupied by rough-legged hawks in July 1996 with 1 chick present on July 27, 1996

J17 65 58.01 N x 111 25.91 W (7316091 N, 480374 E)

- 2 single stick nests in cliffs with southeast exposure
- the southerly nest occupied by rough-legged hawks in 1996 with 4 chicks present on July 27, 1996

J18 65 57.23 N x 111 27.21 W (7314649 N, 479379 E)

- a cluster of 4 nest sites on cliff with southerly exposure, 3 unoccupied
- 1 occupied by peregrines in 1996 with 2 chicks at easternmost site on July 27, 1996

J19 65 57.63 N x 111 28.70 W (7315400 N, 478256 E)

- 2 clusters of 3 nest sites each on cliff with southeast exposure
- all unoccupied in July 1996

J20 66 00.20 x 111 30.45 W (7320185 N, 476969 E) within 2 km of Jericho winter road

- 1 stick nest on ledge with a northerly exposure over Jericho Lake
- occupied by rough-legged hawks with 3 chicks present on July 28, 1996

J21 66 01.50 N x 111 20.96 W (7321715 N, 484155 E) within 2 km of Ulu winter road on Contwoyto Lake

- ledge with grass and willow over water occupied by peregrine in 1996, 2 chicks present on July 27, 1996

T1 66 0.49 N x 111 24.46 W (7320691 N, 481503 E)

- 2 peregrines active in this area but no nest found in July 1996

Information on raptor nests in the Jericho project area was collected and presented in Canamera's submission in support of a Class A Land Use Application for Lytton Minerals' Jericho Diamond Project.

GNWT RAPTOR DATABASE

Site 854	August 1, 1973	occupied by peregrine with young
	July 28, 1975	occupied by peregrine with young
	July 18, 1984	occupied with female peregrine on nest
Site 948	July 18, 1984	occupied by ravens
Site 949	July 18, 1984	occupied by gyrfalcon with young

(Source: Chris Shank, GNWT RWED)

LOCATIONS OF CANID DENS AND RADIO-COLLARED GRIZZLY BEARS

The following are locations of wolf dens and radio collared grizzly bears provided by Dean Cluff, Regional Biologist, Department of Resources, Wildlife and Economic Development. Den site locations are also shown in Figure 5.

Wolf and Fox Dens:

W001	66 27 N X 110 43 W (7369910 N, 512633 E)
W002	66 42 N X 111 17 W (7397778 N, 487493 E)
W003	66 22 N X 110 07 W (7360871 N, 539516 E)
RF001	66 19.97 N X 111 03.87 W (7356822 N, 497111 E) (Dean Cluff, 1996, pers. comm.)

Radio-Collared Grizzly Bear Locations:

G 660*	66 50.22 N X 111 25.44 W (7413086 N, 481388 E) - Female
G 646	66 25.71 N X 110 40.98 W (7367521 N, 514146 E) - Female with 1 cub.
G 600	66 15.54 N X 110 28.38 W (7349357 N, 523481 E) - Male

* This bear was located by satellite (*i.e.*, using telemetry data) but has not yet been confirmed by ground surveys.

470 E 480 E 490 E 500 E 510 E 520 E 530 E 540 E

7420 N 7410 N 7400 N 7390 N 7380 N 7370 N 7360 N 7350 N 7340 N 7330 N 7320 N 7310 N 7300 N

Ulu Project Minesite

G660

W002

W003

Lake 501

W001

G646

RF001

Lake

G600

Kathawachaga

Jericho Minesite

Contwoyto Lake

Lupin Minesite

Legend

- Winter Haul Road
- Alternate Routes Examined
- 1997 & 1998 Winter Resupply Route
- High Burrow Density
- Esker
- Red Fox Den
- Wolf Den
- Radio Collared Grizzly Telemetry

Datum: NAD27
Projection: UTM
Zone: 12
Date: 11/04/96

Scale 1:350 000
0 5 10
Kilometers

Canamera Geological Ltd.

Figure 5. ***Wolf Dens & Radio Collared Grizzly Bears***
(Data Provided by Dean Cluff, DRWED, (GNWT))

Appendix D

GUIDELINES FOR MITIGATING HARASSMENT OF NESTING RAPTORS

GUIDELINES FOR MITIGATING HARASSMENT OF NESTING RAPTORS

There are no specific regulations in the NWT that apply to acceptable or unacceptable human activities in the vicinity of raptor nest sites. This was discussed with officials in the GNWT Department of Renewable Resources (the agency with statutory responsibility for birds of prey in the NWT), who indicated that the 2-km distance is an acceptable guiding principle for assessing which sites are at risk from project-related activities. Within that distance, however, conditions that may affect an individual bird's responses to disturbance. For example, a cliff exposure facing away from the direction of the sources of disturbance reduces the disturbance, as does an intervening height of land. As well, there is significant variability in the tolerance thresholds among birds of the same species.

The following are "Guidelines for Mitigating Harassment of Nesting Raptors" prepared by Chris Shank, a raptor specialist with GNWT Renewable Resources.

Principle #1 Disturbance is most harmful early in the nesting period.

Commentary: Raptors act to maximize their chances of raising the greatest number of young possible. If they "decide" early in the breeding period that their nest is insecure, they might abandon it. Sometimes they will re-nest at another site but such "re-nests" usually fledge fewer young than first nests. If nests are disturbed late in nesting, insufficient time remains for a re-nesting attempt and the parents accordingly have little to lose by sticking to their original nest site. Risk of nest abandonment therefore declines through the nesting period.

Management implications: When there is pressure to have restricted access for as short a time period as possible, restrictions should cover the courtship and incubation periods. Tourist viewing and photography of nests should be restricted to the mid- and late nestling periods.

Principle #2 Individuals show variability in their response to disturbance.

Commentary: A predominant finding of most harassment studies is that there is considerable variability in the response to disturbance between individuals and areas. These differences apparently result from differing genetic propensities of individuals, unique life experiences, and specific conditions such as vulnerability, body condition and so on.

Management Implications: To protect individuals and populations at the sensitive end of the disturbance spectrum, management practices must err on the conservative side. It therefore follows that most raptors should be over protected. This must be accepted and justified to the public. Managers and biologists should not be embarrassed by those

instances of raptors nesting happily on bombing ranges. At the more discrete level, tourist operations should avoid particularly sensitive pairs and steer tourists toward pairs that are robust to disturbance.

Principle #3 Nest failures in several subsequent years can lead to territory abandonment.

Commentary: Experience shows that failure of a nest or breeding territory in several consecutive years often leads to abandonment of the breeding territory and loss of the breeding pair to the population. This is particularly evident at marginal nest sites; ones providing minimal protection. Nest failure and loss of a single year's breeding effort is regrettable but rarely of major significance to long-term population trend. However, loss of breeding pairs in low-density species like raptors can quickly lead to population decline.

Management Implications: Much stricter controls must be placed on persistent, resident disturbances than on those occurring during a single season. Tourist operations should not exist at a nest site in years immediately subsequent to a nest failure.

Principle #4 Approaches by animals, including humans, are among the most severe disturbances to nesting raptors.

Commentary: Raptors generally nest in cliffs or treetops as a means of providing their young protection from ground predators. This strategy is effective but costly with nest site availability acting to limit populations in many areas. Predation has exercised strong selective pressure on the reproductive strategy of raptors. This would appear to explain why raptors react so severely to approach from the ground by free moving animals.

Management Implications: Protective measures should emphasize mitigating the proximity of free moving people and perhaps place less emphasis on other disturbance sources such as vehicles and noises. Campsites should not be near nests whereas roads could be. Raptors must be provided protection from tourists and photographers as a matter of priority.

Principle #5 Startling nesting raptors leads to worse consequences than a deliberate, gradual disturbance.

Commentary: When startled, an incubating raptor leaps instantly from the nest. The sharp talons can puncture the eggs or slash the young. A gradually intensifying disturbance alerts the incubating bird gradually allowing a gentler and safer exit from the nest.

Management Implications: Tourists and photographers should be educated not to attempt to sneak up on raptor nests. Use of blinds or hides in close proximity to nests should be discouraged. Low level flights by supersonic aircraft can be expected to have far greater

impacts on nesting raptors than have been documented in studies of disturbance by propeller and rotor winged aircraft.

Principle #6 Entering the nest near the time of fledging often leads to premature nest departure.

Commentary: During the last week or so as nestlings, severe disturbance at the nest often causes young raptors to jump out of the nest. This can cause death from exposure, predation, starvation or from the fall itself.

Management Implications: Any activity entailing entry or close approach to the nest should be avoided late in the nestling stage. The most serious infringement of this principle is by bird-banders.

Appendix E

WILDLIFE OBSERVATIONS AT ULU PROJECT CAMP, 1996

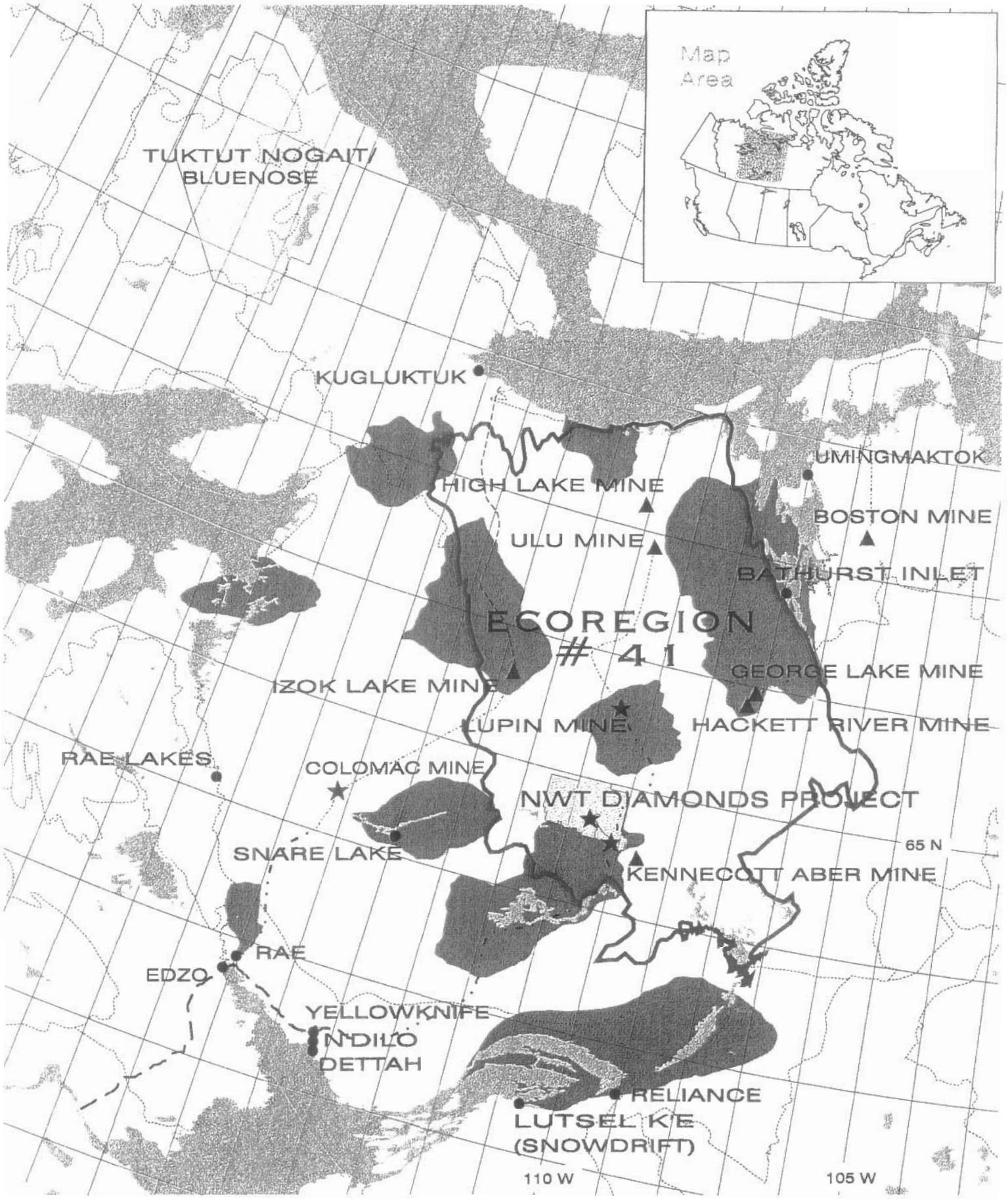
WILDLIFE OBSERVATIONS AT ULU PROJECT CAMP, 1996

Date	Observations
96/05/23	large grey wolf walked through camp
96/05/25	wolverine crossed airstrip in front of packer
96/05/27	white/dark head fox in front of office
96/05/28	cross fox at sewage lagoon
96/06/01	wolverine west side of ore body
96/06/01	two ptarmigan (m & f) north end of ore body
96/06/02	one male ptarmigan and one arctic hare north of ore body
96/06/05	two muskox south of camp / west of lake
96/06/08	one caribou male south west of camp
96/06/08	fox behind kitchen
96/06/09	two male caribou laying down by lake (south)
96/06/12	dozen or so caribou laying down by lake (south)
96/06/14	three swans, white - lake north esker
96/06/15	dozen or so caribou - Reno Lake
96/06/15	12 caribou to NW below powder mags
96/06/21	grizzly bear noted 5 km north of camp
96/06/23	seven caribou and one fox by water hole
96/07/03	muskox northwest end of airstrip
96/07/16	large red mangy looking fox at camp
96/07/18	wolverine crossed road
96/07/20	large grey wolf around garbage bin
96/07/21	grey wolf around road; two muskox on road to Ulu site
96/08/01	herd of muskox; one brown wolf at portal

Date	Observations
96/08/06	red fox outside front door
96/08/06	female white wolf
96/08/09	two muskox at lake below camp 3.
96/08/10	one wolverine 300 m. North of flood zone
96/08/10	two muskox 1 km north of new Ulu camp
96/08/11	one muskox south of airstrip
96/08/14	one scrawny wolf walked past helipad heading west
96/08/14	one red fox at incinerator
96/08/14	one mouse in hallway
96/09/08	two rabbits at camp; one white, one half-white
96/07	grizzly den approximately 8.8 km northeast of mine site

Appendix F

CONSERVATION STUDY AREAS PROPOSED BY WORLD WILDLIFE FUND CANADA FOR THE SLAVE GEOLOGICAL PROVINCE


Map Area
TUKTUT NOGAIT/ BLUENOSE
KUGLUKTUK
UMINGMAKTOK
HIGH LAKE MINE
BOSTON MINE
ULU MINE
BATHURST INLET
ECOREGION #41
IZOK LAKE MINE
GEORGE LAKE MINE
LUPIN MINE
HACKETT RIVER MINE
RAE LAKES
COLOMAC MINE
NWT DIAMONDS PROJECT
65 N
SNARE LAKE
KENNECOTT ABER MINE
RAE
EDZO
YELLOWKNIFE
N'DILO
DETTAH
RELIANCE
LUTSEL K'E (SNOWDRIFT)
110 W
105 W
Community
Existing Mine
Proposed Mine
Ecoregion #41
Water
WWF Conservation Study Areas
Terrestrial Ecoregions of Canada
Existing All Weather Road
Proposed All Weather Road
Existing Winter Road
Proposed Winter Road
Approximate Scale
0
100 km
Prepared By
World Wildlife Fund Canada
Date
July 22 1996