4.0 THE PROPOSED ULU PROJECT

The following documents were used in the compilation of this section of the assessment.

Ulu Project Environmental Overview, Rescan Environmental Services, December 1991, submitted to BHP. See Appendix 3.

Lupin Operation General Information, Echo Bay Mines Ltd., October 1996. See Appendix 10.

Ulu Gold Project Prefeasiblity Study, H.A. Simons Ltd., September 1995. See Appendix 17 for excerpts from the report.

Ulu Mine Project Archaeological Impact Assessment: Phase I, Quarternary Consultants Limited, July 1996. See Appendix 8.

Ulu Mine Project Archaeological Impact Assessment: Phase II, Quarternary Consultants Limited, September 1996. See Appendix 9.

Final Report on an Airphoto and Map Study of Lupin to Ulu Alternative Haul Route Locations Examined with Terrain Mapping, J.D. Mollard and Associates Ltd., September 30, 1996. See Appendix 20 for excerpts from the report.

Fisheries Assessment of Streams and Lakes in the Ulu Project Area, Nunavut, RL & L Environmental Services Ltd.,October 1996. See Appendix 5.

The Ulu project consists of the Ulu site ore body development and the winter haul road connecting the Ulu site with the Lupin mine site. The intent of the Ulu Project is for EBM to mine the gold bearing ore zone using underground mining techniques and haul the ore to the Lupin mine site for processing. At the present time, underground mine exploration, which started in July 1996 (only surface drilling and sampling had occurred prior to 1996), is progressing to the stage of mining a 5 tonne bulk sample and performing approximately 25,000 metres of underground diamond drilling, some of which was completed in 1996. Bulk sampling and diamond drilling is expected to take about two years to complete (by mid 1998). Over this period, a winter road will be required to accommodate the transport of equipment and fuel from Lupin to Ulu. This supply road will be similar to that established during the winter of 1995/96. Once the required permits are in place, the construction of an "upgraded portage" winter road will commence, likely in the spring of 1998. This road will be capable of handling the trucks hauling ore from Ulu to Lupin for processing.

The Ulu Project is situated in the Northwest Territories with the Ulu site at longitude 110° 58' W and latitude 66° 55' N, and the winter haul road running from the Ulu site to the Lupin mine site (longitude 111°14' W and latitude 65°46' N). The Ulu site is in treeless arctic tundra currently accessible year round by aircraft only. It is about 12 kilometres north of the Hood River, the major drainage system for the area or about 150 kilometres north of Lupin (see Figure 1).

Long range plans for the Ulu Project include the complete development and permitting of an underground mine and winter road capable of handling the vehicles transporting stockpiled ore from Ulu to Lupin. Present estimates indicate a feasible six to seven year mine life (1998-2004) at a production rate of about 273,000 tonnes of ore per year (750 tonnes per day).

4.1 PROJECT FACILITIES

4.1.1 Ulu Site Description

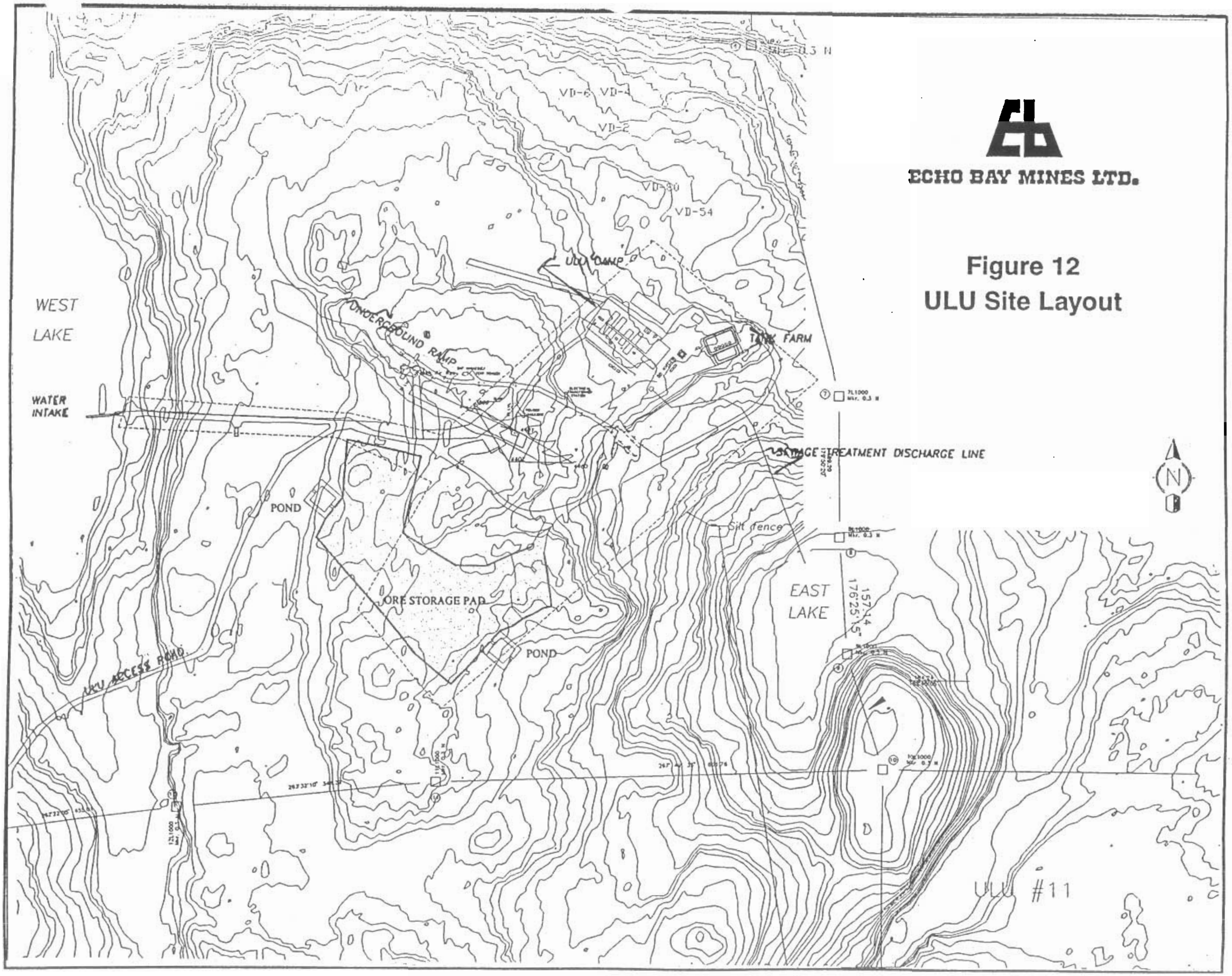
4.1.1.1 Site Layout

Facilities planned for the Ulu site include a 60 person camp with sleeping and dining sections, vehicle repair shop, power house, warehousing and cold storage, office and change rooms, diesel power generating plant, fuel storage tanks, fresh water and sewage systems, a garbage incinerator, and an ore storage area. The main storage area for explosives and detonator storage is about 12 kilometres from the Ulu site near Camp 3. A 40 person camp is in place to accommodate the present exploration activity.

Figure 12 shows the general layout of the site facilities as well as West Lake and East Lake. These lakes have relatively small surface areas and discharge on an intermittent basis. West Lake discharge appears to enter the bouldery material at the north end of the lake and is thought to drain into the Frayed Knots River. During periods of overland flow out of the lake (possibly during spring snow melt), discharge may enter a drainage route to Ulu Lake. Any discharge from East Lake appears to flow into Ulu Lake which eventually drains into Frayed Knots River.

4.1.1.2 Water Supply

The source of water for the housing units, kitchen, mine and fire control will be West Lake. A seven horse power submersible electric pump and pipe line delivers water as required to two storage tanks; a 27,000 litre storage tank for general water use and a 63,000 litre tank for fire water storage. From the 27,000 litre tank, the water enters a distribution system to the housing and kitchen units for domestic purposes and to the



ECHO BAY MINES LTD.

Figure 12
ULU Site Layout

mine for drill water. A plant located in the surface maintenance shop produces a brine for use by the mine drilling equipment to prevent freezing while drilling in the permafrost. The brine is a mixture of sodium chloride and water. Mine water will be recycled as much possible to minimize fresh water consumption. Domestic water will be treated using a UV disinfection unit prior to use.

Water consumption at the Ulu site will be about 50 cubic metres per day. West Lake has a surface area of approximately 94,000 square metres and receives runoff during summer rains and spring snowmelt. Without recharge, West Lake is expected to drop 0.2 to 0.3 metres based on an annual withdraw of 18,250 cubic metres. However, surface runoff is expected to be adequate to replace the consumed water.

4.1.1.3 Sewage Disposal

Sanitary sewage is treated prior to release to the environment. Treatment consists of an enclosed rotating biological contactor which has been sized to handle the sewage discharge from the camp. Once treated, the effluent is released to East Lake. Sludge from the sewage treatment system will be spread within the site disturbance area and capped with waste rock.

4.1.1.4 Site Drainage

Surface runoff follows the natural drainage paths toward either East Lake or West Lake. Where necessary, culverts are installed in access roads to prevent the interruption of overland flow. This will reduce the amount of ponding on the upstream sides of the roads and reduce the risk of erosion or washout of the roads during precipitation events or spring breakup.

Runoff from the ore storage pad will be collected in several lined ponds. Prior to discharge from these ponds, the water will be tested and treated as required. These lined ponds will also receive and store excess water pumped from the underground operation. This water will also be tested and treated, if required, prior to discharge. Treatment, if required, will consist of the addition of lime for pH adjustment and/or ferric sulphate for lowering the concentration of dissolved metals. Since the ponds are relatively small, treatment will be done by either pumping out a chemical mixture or spreading dry chemicals on the water surface from a small boat.

4.1.1.5 Waste Disposal

Solid waste from the accommodation camp, kitchen and repair shops is burned in a packaged waste incinerator. The incinerator is diesel fired and located on the down wind side of the facilities. Burning is carried out on a regular basis to prevent the buildup of burnable wastes around the site, especially food wastes which may attract bears and other scavengers. Waste oil burners are used for the disposal of used oils and solvents while waste greases and other lubes are incinerated with the burnable solid wastes. Other wastes, such as waste metals, used tires and batteries, will be transported to Lupin annually for disposal.

4.1.1.6 Fuel Storage

Diesel fuel will be delivered by tanker during the winter over the winter haul road. This fuel will be stored in a remote tank farm established at the Camp 3 location, then transported to the Ulu site as required. The Camp 3 tank farm consists of two 350,000 imperial gallon storage tanks and six 14,000 imperial gallon tanks. At the Ulu site, fuel is stored in five 14,000 imperial gallon tanks. Both tank farms are constructed within dyked areas designed to contain 110 percent of the largest tank within the area. Both also have attached truck loading/unloading aprons. The dyked areas and loading/unloading aprons are lined with high density polyethylene to prevent the exfiltration of any spilled material. The dyked area at the Ulu site will also be used to store items such as tote containers of oils, lubes and antifreeze.

A tank farm will be established at the Lake 501 maintenance camp. It will be constructed in a similar manner to those at Camp 3 and the Ulu site and will contain 10 to 12 tanks each with a capacity of 14,000 imperial gallon tanks. This tank farm will store fuel used for the ore haulage fleet as well as for equipment used to construct the upgraded portage sections of the winter haul road.

Emergency equipment and employees trained in its use are available at both Ulu and Camp 3. Included in the emergency equipment are zodiacs and booms which will be used to contain any spill hydrocarbons that may reach a surface water body. Section 4.1.4 briefly discusses the contingency plans developed for the Ulu Project; spill containment and control procedures are included in these plans.

4.1.2 Landing Strips

An airstrip has been constructed at the Ulu site that is capable of handling small aircraft (ie., Twin Otter) used for the transport of people and some freight. The airstrip is approximately 1,200 metres long and 23 metres wide. It was constructed of aggregate borrowed from the esker to the northeast of Camp 3. Landing lights and a non-directional beacon have been installed.

During the 1995/96 winter season, an ice landing strip was established on Reno Lake to accommodate manpower and fuel movement for the construction of Camp 3 and the Ulu site infrastructure.

Future plans include the construction of a gravel landing strip near Lake 501 to service the winter haul road maintenance camp which will be established. An ice strip will be established near the west end of Kathawachaga Lake to service a temporary construction camp to be used during construction of the upgraded portages between Kathawachaga Lake and Contwoyto Lake.

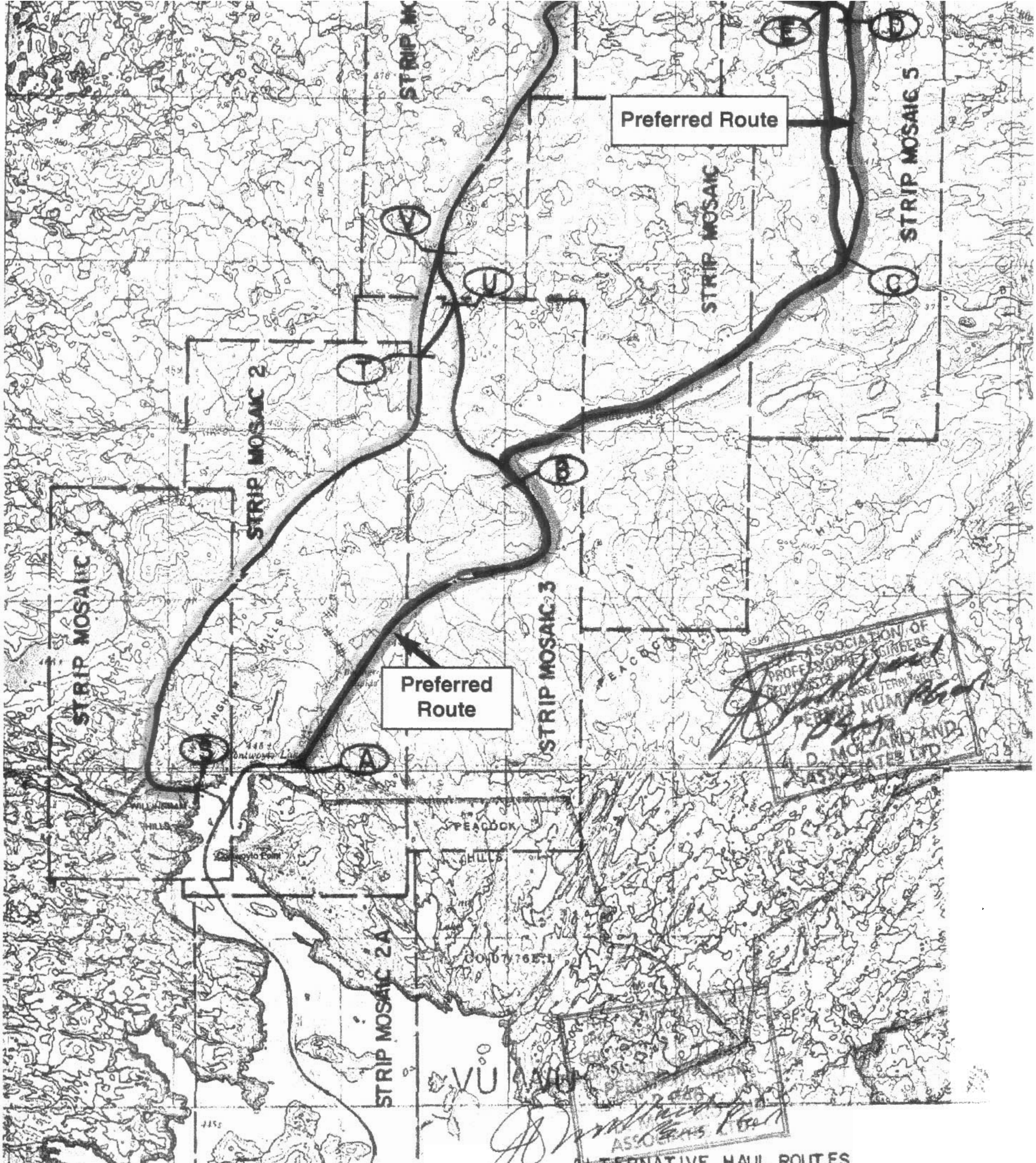
4.1.3 Ulu to Lupin Winter Haul Road

To meet the ore transport function, a winter road capable of handling the travel of a fleet of 45 tonne payload (B-train configuration) trucks will be established. About twenty five trucks will be in the fleet with twenty four hour per day operation during the 150 day haul season, December to May. Of the 150 days, 135 are expected to be available for travel, with 15 days lost due to poor driving conditions. The total length of the winter haul road will be 171.85 kilometres with 97.25 kilometres being overland (portages).

Due to the traffic type and trip frequency, the portage sections of the road will require upgrading in the form of an aggregate layer to smooth the ground surface, especially any rough, bouldery sections. For these sections, a thicker aggregate layer will be necessary. Considering this, care has been taken to choose a road alignment that avoids such areas whenever possible. Where avoidance is not possible due to the presence of archaeological sites or environmentally sensitive areas (denning, nesting, etc), the depth of the aggregate layer will be kept to a minimum, thus minimizing the cost associated with excavating and hauling the aggregate as well as minimizing the extent of disturbance at the aggregate source.

The source of aggregate will be eskers adjacent to the haul road right-of-way. Excavation of these eskers will be done such that any environmentally sensitive areas or archaeological sites are given a wide birth (250 metres as a minimum). When aggregate material is no longer needed from a particular esker, or will not be needed for some period of time, the disturbed area will be rounded and contoured to minimize erosion.

In the process of selecting the alignment for the winter road, several potential routes were considered and are shown on Figure 13. The preferred route, made up from sections of the potential routes, is also indicated on the figure.



ALTERNATIVE HAUL ROUTES

FIGUR 13

(all lengths in kilometres)

Route alternative	Total length	Water/ice length	Land length	Granular terrain	Till terrain	Rock terrain	Wetland terrain	Other terrain	Crossing Inuit land	Crossing federal land
Orange§ (ABCDFGIJR)	138.5	42.0	96.5	28.4	42.9	14.6	6.3	4.3	52.5	86.0
Red (ABCEHIJR)	137.0	35.7	101.3	27.0	48.2	14.3	9.3	2.5	52.5	84.5
Blue (ABUVJR)	123.5	20.5	103.0	32.9	46.8	16.0	5.0	2.3	52.5	71.0
Green (STVJR)	124.5	5.6	118.9	37.9	54.0	21.2	5.1	0.7	64.6	59.9

Evaluation of the potential haul road route options considered various geologic, engineering, environmental and archaeological controls such as:

- Avoiding bedrock terrain because of difficult larger-scale relief scarp-like features, and choppy and jagged smaller relief features on frost-shattered bedrock.
- Avoiding bumpy, kettled eskers and uneven bedrock topography because both involve tight curves and rapid slope gradient changes along the route alignment.
- Fewer curves and straighter horizontal alignment provide a route that is easier to follow during bad weather.
- Gentle grades (vs steep) speed the rate of ore haul travel and the haul trip turnaround time. Try to keep grades below 5 percent.
- Avoid sidehill locations because of the potential for ore-load tilting and tipping.
- Proximity to granular deposits. Since the portage sections of the road will have a layer of aggregate 0.5 metres or deeper depending on the ground surface characteristics, distance to the granular deposits must be minimized.
- Keep a minimum distance of 250 metres between the road alignment and known nesting or denning sites as well as minimizing the number of stream crossings to reduce the risk of damaging the local fishery.
- Gravel extraction is not to be undertaken within 250 metres of known archaeological sites and should occur only at lower elevations on eskers to minimize the risk of disturbing unidentified archaeological sites which are usually located on the tops of eskers.
- Choose an alignment that minimizes the number of stream crossings required and choose stream crossings that will have minimum potential impact on the local fishery.

A camp will be located to the north of Lake 501 to act as a road maintenance base and stopover point for the haul trucks. The camp will include kitchen and accommodations for twenty people, shop and tank farm. Accommodations from Camp 3 will be moved and used at this camp.

Intermittent drainage paths (flowing only during precipitation events or during spring breakup) that are crossed by the portage sections of the winter haul road will typically use culverts to convey water under the road. This will prevent ponding upstream of the road and reduce the risk of erosion or washout by overtopping. Stream crossings will utilize ice bridges to prevent damage to the channel through the placement and, ultimately, the removal of aggregate. This will also reduce the potential of washing of aggregate from the road down the stream channel during runoff events.

Prior to spring breakup, a dozer equipped with a ripper will be used to breakup the ice to allow spring runoff to flow freely without backing up at the ice bridges. Remaining ice will simply melt or erode away without the risk of any suspended solids loading on the stream.

4.1.4 Ulu Site and Winter Haul Road Contingency Plans

Contingency plans for the Ulu site and the winter haul road will be generally the same as those existing for the Lupin site and the Yellowknife to Lupin winter road with modifications where appropriate. These modified plans are part of the Ulu Emergency Procedures Manual which is shown in Appendix 18. Spill control equipment and employees trained in its use are located at Camp 3 and both the Lupin and Ulu sites. Once established, the Lake 501 maintenance camp will also have spill control equipment and trained employees on site.

As a proactive measure EBM has established a Planned General Inspection Program for all the camp locations established for the exploration program and temporary winter road; the Ulu site, Kathawachaga Camp 2[1] and Camp 3. These inspections are carried out at least every two months and address safety/loss control and environmental issues. Examples of the checklists used during an inspection are shown in Appendix 19.

4.2 ULU MINE OPERATION

Long range plans for the Ulu Project include the complete development and permitting of an underground mine and winter road capable of supporting the transport of stockpiled ore from Ulu to Lupin. Present estimates indicate a feasible seven year mine life at a production rate of about 273,000 tonnes of ore per year (750 tonnes per day).

As the ore is mined, it will be stockpiled on an ore storage pad to await transport to Lupin. This ore storage pad has been designed to stockpile ore mined during the period when hauling to Lupin is not possible. Included in the pad design is a system for the collection and testing of runoff prior to release.

The gold deposit lies within three mineral claims which covers a 2 to 3 kilometre wide lobe of mafic metavolcanic and metasedimentary rocks. The lobe is tightly folded into a north plunging asymmetrical anticline dissected by east-west trending faults.

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[1] Kathawachaga Camp 2 has been established as part of the present temporary winter road between Lupin and Ulu. It will be moved to Lake 501 when required to act as a base of operations for construction on the upgraded portage sections of the winter haul road between Lake 501 and the Hood River.

Mineralization is within a zone of basalt with subordinate sediments and gabbro. This zone can be traced on surface for 400 metres in a north west direction near the core of the anticline. The 2 to 5 metre thick mineralized zone dips steeply at 70° to 80° to the south west and has been intersected by diamond drilling to depths of about 600 metres. Areas of local thickening up to 10 metres correspond to flexure points along the roughly tabular body. Mineralization is comprised of an intensely silicified zone with arsenopyrite contained in fractures and dilatancies within basalts.

4.2.1 Mine Plan

Prior to Echo Bay Mines Ltd. purchasing the Ulu property from BHP, a contractor was retained to perform a feasibility study of the deposit. Though dated, Simons (1995) describes the basic development process that will be used for Ulu. Excerpts from Simons (1995) are shown in Appendix 17. Some development work has already been accomplished as part of the ongoing exploration process for the project. As exploration further defines the ore body and underground conditions, the development process and plan will change; many deviations from the Simons (1995) report have already taken place.

Primary Development

Access to the mine is by a ramp driven at -15 % grade from the surface, at an elevation of approximately 430 masl. The portal excavation is in the footwall of the Flood Zone and in a northwesterly direction. There is no surficial material and all ramp excavation has been in rock requiring drilling and blasting. The mine will be within permafrost and air temperatures will be low. All drilling will use a brine solution to prevent freezing.

The ramp system will be driven such that it will be about 50 metres from the footwall of the vein. At 20 metre vertical intervals cross cuts will be driven from the ramp to intersect the vein. The ramp and cross cuts will be driven large enough to accommodate haulage trucks and services requirements. These will be driven on geology control with mapping and sampling.

The surface crown pillar (about 25 metres thick) for the mine will be maintained during mining to prevent snow and water accumulation underground.

The ramp will be driven using a 2 boom electro hydraulic jumbo drilling a 4.2 metre round and breaking 4.0 metres. Mucking will be with a 6.1 cubic metre load-haul-dump (LHD) to the nearest remuck station or crosscut. This muck will then be loaded onto 44 tonne trucks for haulage to the surface. A 1.22 metre by 1.2 metre pattern of

2 metre mechanical rock bolts will be installed in the back of the ramp and the crosscuts. Services installed in the ramp will include two 1200 millimetre diameter ventilation ducts, 550 volt power cable, 100 millimetre compressed air line and water line and 50 millimetre drainage lines.

A drainage sump will be established at every level and at the bottom of the developed workings.

Stope Development

As the ramp reaches the predetermined sub level elevations, the sub levels will be developed. Sub levels will be driven at widths dictated by the vein width. Each drift will be driven on geology control with mapping and sampling.

A single boom electro hydraulic jumbo will be used for driving the sub drifts. Mucking will be by 2.7 cubic metre LHD to a truck located in the crosscut. Muck will be hauled to the surface waste dump or ore stockpile as appropriate.

Stoping

Blasthole open stoping is the most likely mining method to be used; continued exploration will determine the preferred mining method. Mineable vein widths appear to vary from 3 to 10 metres. Accurate drilling, minimum hole deviation, and control of blasting to minimize overbreak and ore dilution are essential. Continuity and uniformity of the vein is also necessary. These appear to apply generally to the veins in the Flood Zone. These are areas of multiple sub parallel veins. Limits of stoping blocks and the need to include waste intervals within those stoping blocks can only be determined as detailed geological knowledge is acquired during level development.

The vertical and lateral extents of the multiple veins vary. It appears that areas of waste rock will be left unmined both between and within the veins. It has been assumed that these waste pillars will maintain local ground stability and permit stopes to be left open, except where it is expedient to dispose of development waste into completed stopes.

Generally there will be 16 metres of vein material between levels. A vertical slot raise will be established at the stope block limit. A pattern of blastholes will be drilled to create a 1.5 metre by 1.5 metre raise. These will be blasted from the upper drift as a drop raise.

Production blastholes will generally be drilled from both the upper and lower drifts, with up to 2 metres overlap between drill patterns. This will permit production to proceed as sublevels and stope blocks are established and while the main ramp is still advancing. Careful machine setup and controlled drilling will permit accurate drilling.

Holes will be drilled on a staggered pattern with the pattern and burden varying according to vein width. Side holes will be located about 0.3 metres from the vein limit. Actual practice will depend on local conditions and will benefit from experience acquired at Lupin.

Blastholes will be drilled using a single boom electro hydraulic production drill. Depending on the final stope length, complete stope blocks could be drilled before starting production blasting. If the stope will be long, or if intervals of waste occur which are planned to be left as pillars, then drilling and blasting can proceed in cycles. It is anticipated that most holes will be loaded with ANFO, primed with NG explosive, and detonated using non-electric delays. Generally four rows will be blasted with a design break of between 1,200 and 4,000 tonnes, depending on vein width. Blasting will retreat back to the end of the stope, normally at the crosscut location.

Ore Handling

Broken ore will be mucked at the brow of the sub drift using two diesel powered LHD's, one unit with a 2 cubic metre capacity and one with 2.7 cubic metre capacity. Ore not removed can be recovered with ore from the sub level below. If there is no stope planned for immediately below that area then remote mucking beyond the brow will be required. Several of the LHD's will be equipped with this capability.

The LHD's will tram muck back to the crosscut for loading into 26 and 44 ton haul trucks. It is planned to have at least two stope blocks active and available for blasting and production mucking. Ore will be hauled to surface and dumped on the stockpile.

Exploration and Ore Definition

The primary exploration and ore definition for layout of stope blocks will be from development of the levels. Remuck stations and crosscuts will provide potential diamond drill sites along the ramp system.

Ventilation

A primary intake fan is currently located at the collar of the ramp. During winter mine air may be heated using an indirect diesel powered system; engineering studies will be done to determine if heating is recommended during the mining operation. Fresh air is ducted down the ramp with exhaust air flowing up the ramp to the surface.

During the present underground exploration program, short ventilation cross cuts will be driven from alternate legs of the ramp and connected by ventilation raises. Raises will be driven as each crosscut becomes available to minimize forced ventilation distances on the ramp. Raise lengths will be between 20 and 60 metres. They will be driven using stopers equipped with a ladderway to serve as the second means of egress from the mine. The raise will break through the surface approximately above the mid point of the top level drift.

To accommodate ventilation during the mining operation, a 3 metre by 3 metre raise, driven with a raise climber, will become the primary ventilation intake (in addition to the raise mentioned above). Regulators constructed in each raise access cross cut will control the air flow to the ramp.

Mine Personnel and Equipment

The maximum number of personnel underground at any time will vary from about 18 to 22. Refuge stations off the ramp are planned at about the 360, 280 and 200 metre elevations. These will also serve as lunchrooms. All mining equipment will be maintained and repaired in the surface shop; steam cleaning and pressure washing of equipment will be done in a controlled area of a building adjacent to the maintenance shop. Drainage from the washing area will be collected in a sump and recycled through an oil/water separator. Waste oil burners are used for waste oil disposal. Explosives will be delivered daily from the surface magazines. Day boxes will be used for short term underground storage.

The expected mine equipment list is shown in Table 10 and manpower levels in Table 11 (both lists are subject to change). The numbers shown in the two tables are typical of the development and production periods, nominally from the start of mining to day 600 (development period) and from day 300 to end of mining (production period). During concurrent activity (about day 300 to 600) the two numbers would not be added; the larger would apply. Safety and Environmental personnel for the Ulu Project will be based at Lupin with frequent trips to the Ulu site.

Mine Production

Table 12 shows the expected production through the life of the mine. Typically, daily production will be 300 tonnes of development ore and 450 tonnes production ore for a total mine production of 750 tonnes per day. The table also estimates the tonnes of ore stockpiled at Ulu and Lupin as well as tonnes of ore transported.

4.2.2 Ore Storage and Transport

The ore from the underground operation at Ulu will be hauled to an ore storage pad for stockpiling by the underground haulage trucks. The stockpile will be constructed to avoid driving over the pile in order to minimize frost compaction and difficult reclamation. Figure 12 shows the general location and geometry of the ore storage pad and Table 12 shows the annual tonnes of ore expected to be in stockpile, both at Ulu and at Lupin.

The ore storage pad will be constructed using waste rock then capped and graded with esker aggregate. Lined storage ponds will collect runoff from the pad and allow the water to be tested and treated if necessary prior to release to the environment.

Table 10
Mining Equipment

	Development	Production
2 boom jumbo	2	---
1 boom jumbo	1	---
Long hole jumbo	---	2
Rock bolter	1	---
LHD 2.7 m^3	2	3
LHD 6.1 m^3	2	2
L-90 loader	1	1
Truck 26 ton	1	1
Truck 44 ton	1	1
Grader	1	1
Utility vehicle	1	1
Explosives truck	1	1
Mechanics truck	1	1
Service jeep	2	2

4.2.3 Waste Rock Disposal

Presently, waste rock from the mine development has been used in the construction of pads for the Ulu site facilities. Esker material is placed over the waste rock to complete the pads. This process will also be used in the construction of the ore storage pad, thus utilizing a large volume of produced waste rock.

As mine development progresses, waste material may be used as backfill for mine out stopes. Excess material will be stockpiled on the surface. Further information on waste rock disposal is discussed in Section 4.4: Final Reclamation.

Table 11
Mining Manpower On-Site

On Site	Development	Production
Staff		
Superintendent (based at Lupin)	1	1
Mine Captain	1	1
Shift Boss	2	2
Geologist	1	1
Surveyor	2	2
Sampler	2	2
First Aid	1	1
Hourly		
Development miner	6	---
Stope miner	---	8
Equipment operator	4	8
Nipper	2	2
Diamond driller	1	1
Labourer	1	1
Lead mechanic	1	1
Journeyman mechanic	2	2
Tradesman	3	3
Journeyman electrician	1	1
Total	31	37

Table 12
Ulu Mine Production/Stockpile Forecast

	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Development in ore										
Days	90	364	364	371*	364	364	364	0	0	2281
Tonnes/day	300	300	300	300	300	300	300	300	300	300
Tonnes	27,000	109200	109200	111300	109200	109200	109200	0	0	684300
Production										
Days	0	180	364	371*	364	364	364	329	0	2336
Tonnes/day	0	450	450	450	450	450	450	450	450	450
Tonnes	0	81000	163800	166900	163800	163800	163800	147969	0	1051119
Total Mine										
Days	90	364	364	371*	364	364	364	329	0	2610
Tonnes/day	300	523	750	750	750	750	750	750	0	665
Tonnes	27000	190200	273000	278250	273000	273000	273000	147969	0	1735419
Ulu Stockpile Opening Tonnes	0	27000	217200	490200	498450	501450	504450	507450	385419	0
Ore Transportation										
Days	0	0	0	135	135	135	135	135	135	810
Tonnes/day	2000	2000	2000	2000	2000	2000	2000	2000	2855	2142
Tonnes	0	0	0	270000	270000	270000	270000	270000	385418	1735418
Ulu Stockpile Closing Tonnes	27000	217200	490200	498450	501450	504450	507450	385419	1	1
Lupin Stockpile Opening Tonnes	0	0	0	0	90000	141600	193200	244800	5200	0
Ore Processing										
Days	0	0	0	300	364	364	364	364	179	1935
Tonnes/day	0	0	0	600	600	600	600	1400	2178	897
Tonnes	0	0	0	180000	218400	218400	218400	509600	390619	419
Lupin Stockpile Closing Tonnes	0	0	0	90000	141600	193200	244800	5200	0	0

* the number of days per year greater than 365 is done as an accounting correction.

4.2.4 Ore Processing: Lupin

This section describes the present methods used to process ore mined at Lupin. Alterations will be made to the Lupin processing plant as required to allow the introduction of the Ulu ore. Ulu ore will enter the Lupin process circuit at the coarse ore bin which is part of the ore crushing circuit.

The Lupin mineral processing plant is a conventional gold ore processing facility using crushing, grinding, pre-aeration, cyanide leaching, and Merrill-Crowe zinc precipitation for gold recovery. The plant processing capacity is 2400 tons per day and is presently operating at approximately 2000 tons per day.

Crushing

The ore from the Lupin mine is crushed underground to 140 millimetres by a primary jaw crusher. It is then delivered to a to a 545 tonne coarse ore bin on surface. A vibrating feeder and conveyor transport the ore to a secondary cone-crusher. After being reduced to -38 millimetres, the ore passes over a double deck vibrating screen. The material larger than 16 millimetres is fed into the tertiary cone-crusher and recirculated over the vibrating screen until it passes through the 16 millimetre openings. The ore passing this screen is conveyed to two 900 tonne capacity fine ore bins which feed the grinding circuit. The crushing circuit operates at a rate of 220 tonnes per hour.

Grinding

Liberation of the gold from the host rock is done by further reduction of the ore size. The is accomplished with a 2.9 metre by 3.65 metre rod mill feeding two 2.4 metre diameter by 7.3 metre long ball mills in parallel. The ore is fed into the rod mill from the fine ore bins via belt feeders and conveyors. The ball mill discharge slurry is pumped to the cyclone feed pump box then to a cluster of cyclones which classifies the material. Cyclone underflow (+200 mesh material) is fed back to the ball mills. The cyclone overflow slurry (-200 mesh) is pumped to the pre-aeration circuit at about 33% solids. The grinding circuit operates at a rate of 2090 tonnes per day, with the target-grind being 57% passing -400 mesh.

Pre-Aeration

The cyclone overflow is fed to the centre well of the pre-aeration thickener, a 15.2 metre diameter shallow settling tank. The thickener overflow solution flows by gravity to the recycle-water tank and is recycled back to the grinding circuit. The thickener underflow slurry (60% solids) is pumped to the first of three 310 cubic metre pre-aeration tanks. These tanks provide air to oxidize sulfide minerals, which would otherwise consume large amounts of cyanide and oxygen, thus hindering the leaching reaction. The circuit is tuned for efficient mechanical and chemical performance by operating under alkaline conditions (pH 10), adding lead nitrate reagent, and by using primary filtrate to dilute the thickener underflow density to 45% solids.

Leaching

The liberated gold particles are leached into solution by a reaction involving cyanide, oxygen and water. Slurry from the preaeration circuit is leached in six consecutive 490 cubic metre agitated and aerated tanks. Lime is added to the circuit to maintain a constant pH of 10. These six tanks in series give the circuit 30 hours of retention time. The overflow from the last tank feeds the cyanidation thickener. Thickener overflow solution is loaded with gold and flows to the pregnant solution tank. The underflow, also containing some gold in solution, is pumped to the filtration circuit.

Filtration

A two stage filtration system separates dissolved gold from the waste solids of the cyanide thickener underflow. Each stage consists of four 2.4 metre diameter by 4.3 metre long vacuum drum filters. In the first stage, the cyanidation thickener underflow slurry contacts the outside of the filter unit and the solution is drawn through the filter while the filter cake is washed with barren solution. The solution is returned to the cyanidation thickener or pumped to pre-aeration as dilution water. The filter cake passes through a repulper to second stage filtration. The second stage filter cake is washed with either barren, fresh or recycle water and the solution is again returned to the cyanidation thickener. The filter cake is repulped with plant recycle water and flows by gravity to the tailings disposal box.

Recovery

The pregnant solution from the cyanidation thickener overflow is clarified and de-aerated, precipitated and refined to obtain dore bullion in a conventional Merrill-Crowe System. Three pressure clarifiers remove suspended solids from the solution, then the oxygen is removed prior to precipitation in a de-aeration solution and the precipitated gold is collected in precipitation presses. The now barren solution is bled to tailings and recirculated throughout the plant. Once the filter press becomes loaded with precipitate, the feed is transferred to the other presses and the loaded press is emptied. After being mixed with suitable fluxes, the precipitate is smelted in the bullion furnace to produce dore bullion and slag. The bullion contains approximately 85% gold and 12% silver, the balance being base metals.

Tailings Disposal

Tailings are pumped to a tailings containment area approximately 6 kilometres south of the Lupin processing plant. Tailings are first dumped into a solids retention cell, where the solids settle and the tailings solutions drains or permeates through a dam into Pond 1. In Pond 1, cyanide undergoes natural degradation due to sunlight, air and agitation provided by wind. Contaminants such as heavy metals (copper, iron, nickel, lead and zinc) precipitate naturally under these conditions. Each summer, water from Pond 1 is syphoned to Pond 2 and simultaneously injected with ferric sulphate in order to precipitate arsenic. Lime is also added in Pond 2 for pH control. Pond 2 basically provides additional retention time for the natural degradation process to continue. The following summer, prior to additional water transfer from Pond 1 to Pond 2, water from Pond 2 is discharged into the environment, eventually to Contwoyto Lake. A study is planned to forecast the chemistry changes in Pond 1 resulting from the addition of Ulu ore to the Lupin process circuit and to determine what, if any, treatment changes will be necessary to precipitate the arsenic and heavy metals inherent to the tailings. No adverse impacts are expected based on Ulu geology.

The 750 hectare tailings disposal area is adequate for the needs of Lupin for the foreseeable future, even with the processing of Ulu ore. As the Lupin mine takes more tailings for backfill, the demand for tailings space will be significantly reduced.

Paste Backfill

EBM has incorporated a process known as Paste Backfill as a method for the final disposal of tailings solids at Lupin. This process allows underground areas that have been mined out to be utilized as disposal sites, thus greatly reducing the volume of solids that must be disposed of in the tailings containment area.

The filter cake that is discharged from the filtration circuit is conveyed to the paste backfill plant. It is mixed with cement in a pan mixer such that each batch contains approximately 4.5 tonnes of cement and filter cake. The mixture is diluted with water to obtain the desired slump. This is determined by measuring the power draw of the mixer, which is directly proportional to the slump. Once the power draw set point has been reached, the mixer discharge gate will open, allowing the paste to dump into the pump hopper. The paste is then pumped underground continuously by a Schwing positive displacement pump, through a 150 millimetre line.

The process is fully automated by a process control computer system. The only part of the plant that requires manual labour is the dumping of 1800 kilogram cement bags into a tanker, where it is then pneumatically transported to the cement silo. The storage for this cement is contained in an unheated building with an area of approximately 2975 square metres. All of the cement, about 4000 bags, is trucked to Lupin within a six week period on the Yellowknife to Lupin winter road.

4.3 ULU PROJECT ENVIRONMENTAL MONITORING

Terrestrial Wildlife Surveillance and Monitoring

This regional environmental evaluation on wildlife and habitat in the vicinity of 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 near the winter haul road will 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 spring migration of caribou to the calving ground may pass though the region. A surveillance program during years when significant numbers of caribou overwinter near Great Bear Lake can be useful in assessing the probability of the caribou migration to the calving ground interrupting traffic on the winter haul road to Lupin.

Fishery and Water Resources Monitoring

Stream crossings on the selected routing of the potential winter haul road will be surveyed in the spring of 1997 to document seasonal use of these streams, particularly those near Kathawachaga Lake where these is a high probability of encountering Arctic grayling.

As xylene was detected in Ulu Creek and downstream areas, further water sampling will be conducted to determine the source of the contamination.

Since the East Lake/Ulu Lake system will be receiving runoff from the mine and treated effluent from the ore stockpile and the camp, several pieces of information need to be determined to fully understand the dynamics of these lakes and assess what potential impacts any discharge may have:

- Volume and rate of discharge from East Lake. Given that most of the discharge appears to be underground a tracer method may be required. Discharge should be measured throughout the year.
- Volume and rate of discharge from Ulu Lake.
- Water residence time in East and Ulu Lakes.

Routine sampling will be carried out on an annual basis on the raw water supply for the Ulu site (West Lake) and monthly on the effluent from the sewage treatment plant. During the open water season, monthly samples from the settling/neutralization pond associated with the ore storage pad, East Lake and Ulu Lake will be collected and analysed. Samples will be collected prior to discharge from the settling/neutralization pond and weekly during periods of discharge. Analysis for the collected samples will consist of the following:

West Lake: Total arsenic, total copper, total nickel, total mercury, total cadmium, total lead, total zinc, total suspended solids, pH and faecal coliform.

Sewage treatment plant effluent: pH, total suspended solids and BOD_5.

Settling/neutralization pond: Total arsenic, total copper, total nickel, total mercury, total cadmium, total lead, total zinc, total suspended solids and pH.

East Lake/Ulu Lake: Total arsenic, total copper, total nickel, total mercury, total cadmium, total lead, total zinc, total suspended solids, pH and faecal coliforms.

Additional monitoring will be done as required by any issued water licence.

Acid Rock Drainage Monitoring

A kinetic testing project has been initiated as a continuation of earlier acid-base accounting work (see Section 2.3.1). This project has two purposes:

1. To clarify whether or not arsenic contamination will be a concern regardless of the acid generation potential of the Ulu ore or arsenopyrite-containing waste.

2. To confirm whether using an NPR of 1 rather than a higher number is appropriate to discriminate PAG from non-PAG rocks.

The kinetic testing project started in January 1997 and will continue for about 40 weeks with completion expected in late 1997.

Weather Monitoring

A weather monitoring station has been installed at the Ulu site to provide wind speed and direction information for aircraft using the landing strip. An updated version of this station ('Wind Tracker') is expected to be installed in 1997.

4.4 ULU PROJECT FINAL RECLAMATION

The main objective of the final reclamation of the Ulu Project will be to protect hydrologic resources, control erosion and provide a feasible growth medium for natural revegetation of the area. Reclamation will begin on the cessation of mining at Ulu with the reclamation of the winter haul road portage sections being the final activity as the last of the reclamation equipment retreats toward Lupin. According to the present project schedule (Table 12), mining will end in the latter part of 2003 with ore delivery continuing into 2004. Reclamation of the Ulu site will begin in late 2003 or early 2004. Some reclamation work will be done before the end of mining, ie. removal of unnecessary equipment and buildings, but due to the small size of area and nearly total utilization, progressive reclamation is unlikely. Reclamation is expected be complete in 2005.

At the Ulu site all machinery[1], equipment[1], tanks[1] and buildings[1] will be removed or dismantled with all burnables, if not feasible for removal, being burned. Any of these items not removed or burnt will be placed in the underground workings. Building foundations will be buried or levelled with heavy equipment and used as backfill in the underground workings. Hydrocarbon contaminated soils which cannot be burned off will be placed underground and allowed to freeze. Liner materials used in the tank farm berm and the ore storage pad settlement pond will be removed and deposited in

[1] According to Section 14.5 of the IIBA signed on September 17, 1996 between EBM and the Kitikmeot Inuit Association, EBM will provide the KIA or any organization designated by the KIA with the first opportunity to negotiate the purchase of any equipment, buildings or materials considered by EBM to be surplus to its requirements at anytime during the operation of the project. If no agreement is reached, and EBM negotiates a price for the equipment, buildings or materials with another party, then EBM shall offer the KIA the opportunity to purchase these items at that negotiated price.

the mine workings. The above comments also apply to the infrastructure remaining at the Camp 3 location near Reno Lake at the time of final reclamation.

As much as possible, potentially acid generating materials remaining on the surface at the Ulu site will be transported to the underground workings as backfill. The remaining materials will be covered with esker material such that the active thaw zone will be entirely above the PAG material, leaving the PAG material in a constantly frozen state. Acid/base accounting work indicates that waste rock from Ulu is not acid generating, but ore material has the potential to generate acid drainage after approximately four years of exposure.

The portal will be permanently sealed and the area immediately in front will be recontoured and covered with esker material.

At the winter road maintenance camp at Lake 501, or any other established maintenance camp, all machinery, equipment, tanks and buildings will be removed or dismantled for salvage, with all burnables, if not feasible for removal, being burned. Building foundations will be covered with esker material with proper grading to control runoff erosion.

Culverts or obstructions to drainage on the roads around the Ulu site, air strips and the upgraded portage sections of the winter haul road will be removed with the bedding (esker material) being excavated as much as is feasible to allow unrestricted flow to resume. Care will be taken to prevent the removal of natural vegetation or cutting into the banks of the drainage path.

Slopes requiring protection from erosion will be recontoured and, if necessary, covered with esker material. Roads used both in winter and summer, typically those surrounding the Ulu site, will be scarified to reduce compaction and allow natural revegetation to occur.

4.5 ULU PROJECT LICENCE REQUIREMENTS

Permit and licence are necessary for the development and operation of the Ulu Project. Regarding the winter haul road, Land Use Permits and Quarry Permits from the Department of Indian Affairs and Northern Development (DIAND) are needed to accommodate the development of the portions of the winter haul road that traverse Crown Land. Similar permits are required from the Kitikmeot Inuit Association (KIA) for those sections that are within Inuit Owned Land. The majority of the road is situated on Crown land; of the 171.85 kilometres of winter haul road, 52.5 kilometres crosses Inuit Owned Land with the remaining on Crown land (119.35 kilometres).

Although the Ulu site is located on Inuit Owned Land (surface and subsurface) (NPCTT, 1996), the federal government has retained control of the subsurface for this area since the area was initially leased before the Nunavut Land Claims Agreement was enacted. For this reason, a Production Lease will be required from DIAND, the representative of the federal government in the NWT. A KIA Land Use Permit will be necessary to accommodate the surface development associated with the Ulu site.

A application will be made to obtain a Type B water licence from the Nunavut Water Board (NWB) to accommodate the possibility of discharging water from the site that has been treated with chemical additives. As much as possible, water collected on the site will be recycled for use underground, however, the water licence will allow discharge as a contingency for the disposal of excess water.

The following table summarizes the regulatory agency addresses associated with the licences and permits required for the Ulu Project.

Table 13
Regulatory Agencies

Regulatory Agency	Contact/Address
Department of Indian Affairs and Northern Development	DIAND PO Box 370 Yellowknife, NT X1A 3T2
Kitikmeot Inuit Association	Jim Cunningham Kitikmeot Inuit Association Kugluktuk, NT X0E 0C0
Nunavut Water Board	Director of Operations Nunavut Water Board PO Box 119 Gjoa Haven, NT X0E 1J0

4.6 ULU PROJECT SCHEDULE

The development of satellite ore bodies such as Ulu is crucial to extending the life of the Lupin mining/milling operation. As ore tonnage at the Lupin mine decreases toward the end of its economic life, satellite ore shipped to Lupin will make up the extra tons required to allow continued feasible operation of the Lupin mine. As indicated in Table 12 shown in Section 4.2.2: Ore Storage and Transport, ore is scheduled to start arriving at Lupin from the Ulu site during the winter of 1998/1999. To accomplish this, Land Use Permits must be in place to allow construction of the upgraded portage sections of the winter haul road to start early in 1998. Permits to allow the mining of ore from Ulu and its surface stockpiling at Ulu and Lupin must also be in place.

On the present schedule for mining of the Ulu ore body, production ore stockpiling will begin in 1997 with initial ore deliveries to Lupin scheduled for early 1999. Mining will continue through the year 2003 with ore delivery being completed in 2004.

Reclamation of the Ulu site will begin on cessation of mining (2003), though, if feasible, removal of unnecessary equipment and buildings will occur earlier. The last reclamation activity will be the reclaim of the portage sections of the winter haul road as the reclamation equipment retreats toward Lupin. Reclamation is expected to be complete in 2005.

4.7 OTHER POTENTIAL DEVELOPMENT IN THE REGION

Figure 14 shows the known significant mineral deposits in the West Kitikmeot region of Nunavut, one of which is the Ulu site. At the present time, there is no identified development in the vicinity of the Ulu Project that will affect the operation of the Ulu site or the winter haul road. Bulk sampling of the Lytton Mineral's Jericho property (not identified on Figure 14) near Carrot Lake, approximately 3 kilometres west of the north end of Contwoyto Lake and about 30 kilometres north west of Lupin, is the most advanced exploration activity known in the area. This activity will not affect the Ulu Project though the portion of the Ulu winter road that runs on Contwoyto Lake will be used as winter access by the Jericho project (one of the routes considered for the Ulu project winter haul road was near the Jericho project but was rejected due to extensive wildlife habitat along the alignment north of the Jericho site). Preliminary exploration activity is ongoing throughout the region.

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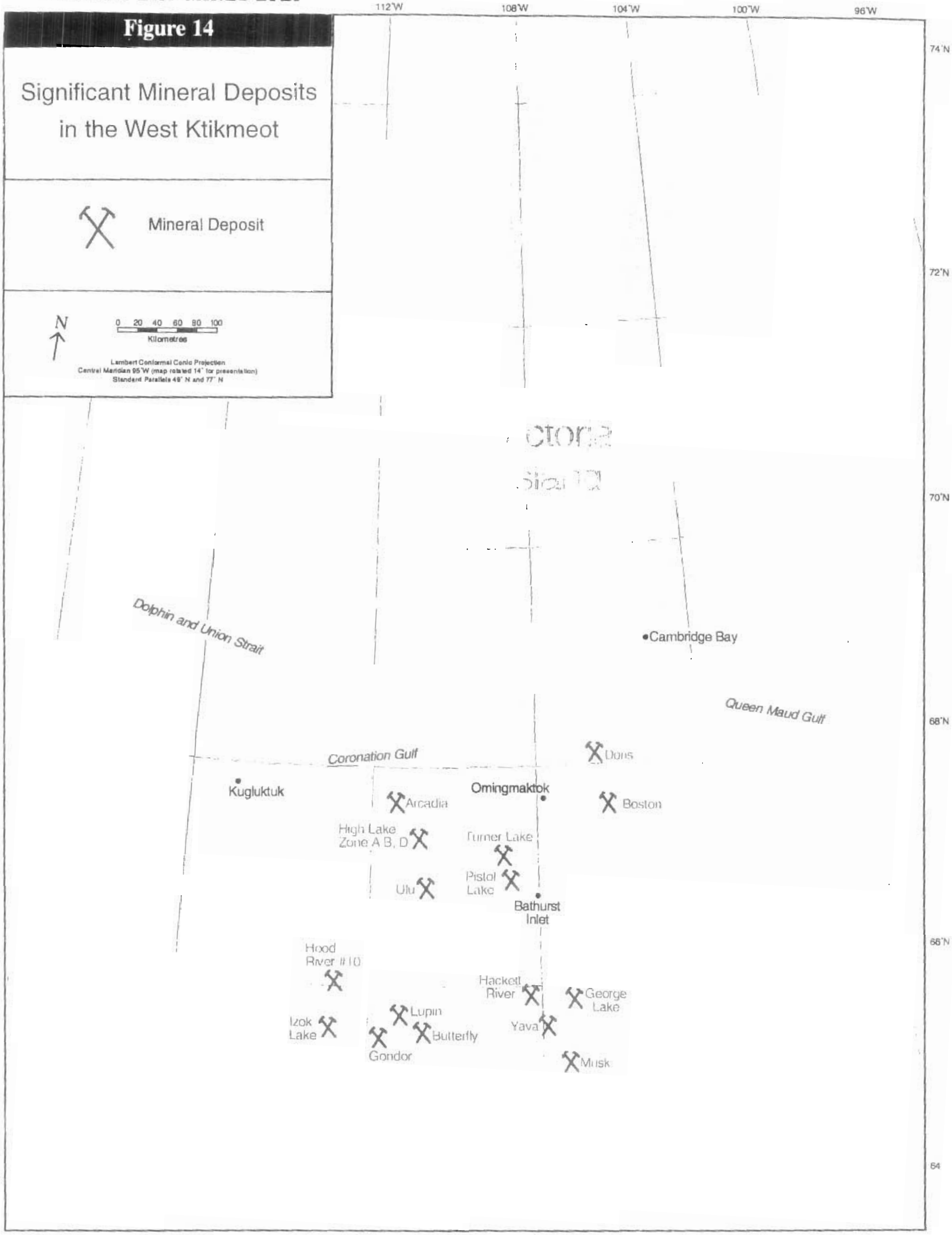

4.8 ULU PROJECT/ENVIRONMENT INTERACTIONS, MITIGATIVE MEASURES AND RESIDUAL IMPACTS

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 terrestrial wildlife and terrestrial 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.

This section is based on the following consultant reports:

Wildlife and Wildlife Habitat Assessment, Canamera Geological Ltd., Environmental Resources Division, November 1996. See Appendix 7.

Fisheries Assessment of Streams and Lakes in the Ulu Project Area, Nunavut, RL & L Environmental Services Ltd., November 1996. See Appendix 5.

Ulu Mine Project Archaeological Impact Assessment: Phase I, Quaternary Consultants Limited, September 1996. See Appendix 8.

Ulu Mine Project Archaeological Impact Assessment: Phase II, Quaternary Consultants Limited, September 1996. See Appendix 9.

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 environmental review. 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 affects on these species.

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 proponents.

This evaluation has not had the benefit of such guidelines and so assumes 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[1] 1993). The guidelines go on the emphasize specific project/VEC's interactions that should be addressed. These are highlighted in the linkages developed to describe project/VEC's interactions.

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

1 See Wildlife and Wildlife Assessment, Canamera Geological Ltd., Environmental Resources Division, November 1996 for reference.

	animal population size, or resource harvest that is less than 1%.
Negligible Impact	Negligible impacts are those that are judged to have essentially no affects.
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 barren lands, 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 (eg. 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.

Table 14 summarizes the identified valued ecosystem components that have the potential of being affected by the Ulu Projects. The table indicates the activity that could cause the impact, the potential impact and its classification and what, if any, the residual impacts may be.

Table 14
Impact Evaluation Summary on VEC's due to the Ulu Project

VEC	Activity	Impact	Impact Classification	Residual Impact
Terrestrial Vegetation	Ulu Project construction	loss of vegetation	negligible	none expected
Terrestrial Habitat	Ulu Project construction	loss of habitat	negligible	none expected
Loons, Waterfowl, Shorebirds	1. Ulu Project construction and operation 2. fuel/chemical spills 3. acid rock drainage	affect on the distribution and abundance of VEC migratory bird species	1. negligible 2. minor, local, short term 3.negligible	displaced breeding birds will establish new locations within the region
Raptors	Ulu Project construction and operation	affect on the distribution and abundance of raptors	negligible	none expected
Wolves	Ulu Project construction and operation	affect on the distribution and abundance of wolves	negligible	none expected
Wolverines	Ulu Project construction and operation	affect on the distribution and abundance of wolverines	negligible	none expected
Grizzly Bears	Ulu Project construction and operation	affect on the distribution and abundance of grizzly bears	negligible with mitigation measures	none expected
Muskox	Ulu Project construction and operation	affect on the distribution and abundance of muskox	negligible	none expected
Caribou	Ulu Project construction and operation	affect on the distribution and abundance of caribou	negligible with mitigation measures	none expected
Wildlife Harvesting	access to hunting areas over winter haul road	affect on the distribution and abundance of big game and furbearer VEC species	negligible	none expected
Terrestrial Ecosystem/Economy	Ulu Project construction and operation	affect on the sustainability of production of natural resources used by local/regional communities for subsistence and economic development	negligible	none expected

4.8.1 Impact Evaluation for Terrestrial Vegetation and Habitat

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 project area were described in Section 2.5 of this report. 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. Ulu 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 122.25 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.

Key Ecosystem Linkages: loss or alteration of terrestrial habitat

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 97.25 km of terrestrial habitat and cover an estimated 122.25 ha.

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

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. 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 long term.

Residual impacts expected: none

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[1] 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 square kilometres (GNWT Renewable Resources unpublished) the loss of 163.9 ha of habitat 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 there 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 longterm.

Residual impacts expected: none

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[1] see Wildlife and Wildlife Habitat Assessment, Canamera Geological Ltd., Environmental Resources Division, November 1996, for reference information.

4.8.2 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[1] 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 relevant also to other wildlife species and so is used as a guiding principle in this assessment of impacts on terrestrial wildlife by the Ulu Project.

Loons, Waterfowl and Shorebirds

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.

Key Ecosystem Linkages: disturbance due to construction and operation of the Ulu Project

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.

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's 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.

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[1] See Wildlife and Wildlife Habitat Assessment, Canamera Geological Ltd., Environmental Resources Division, November 1996 for reference information.

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.

Key Ecosystem Linkages: disturbance due to fuel/chemical spills

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.

Discussion

1. Transport of bulk materials will occur during the season when migratory birds are absent from the area. Accidental spills of harmful substances will be removed in keeping with spill clean-up plans. Residual amounts of spilled substances will be minimal with that remaining being 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 (incineration or transport to Lupin).

Impacts on loons, waterfowl and shorebirds due to changes in the aquatic food chain from spills of fuel, 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.

Key Ecosystem Linkages: disturbance due to acid rock drainage

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.

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. Acid-base accounting analysis for the Ulu site indicates that the ore does have acid generation potential but sampling of ore that had been exposed for up to four years had not yet reached the acid generating state. No ore is expected to be left on surface for an expended period of time. As well, the method of ore storage at the Ulu site will allow runoff to be collected and treated if necessary and so the release low pH water should be prevented. Waste rock has little potential for acid generation.

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

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

Raptors

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. An additional three sites on Contwoyto Lake are documented in the GNWT raptor nest site data base.

Key Ecosystem Linkages: disturbance due to construction and operation of the Ulu Project

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

Discussion of these linkages will follow for each species separately.

Golden Eagles

Golden eagles arrive in 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[1], 1988) on the Norman Wells pipeline indicated that a minimum 3.2 km buffer zone between raptor nest sited 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.

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[1] see Wildlife and Wildlife Habitat Assessment, Canamera Geological Ltd., Environmental Resources Division, November 1996, for reference information.

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

Rough-legged Hawks

Rough-legged hawks arrive in their nesting territories in May and stay until early fall.

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.

Peregrine Falcons

Peregrine falcons arrive in their nesting territories in May and stay until early fall (Poole[1] 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.

Gyrfalcons

Gyrfalcon occupy their breeding territories as early as February. One gyrfalcon nest was found approximately 4 km from the winter road (Poole[1] and Bromley, 1988a).

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1 see Wildlife and Wildlife Habitat Assessment, Canamera Geological Ltd., Environmental Resources Division, November 1996, for reference information.

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.

Wolves

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[1] (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.

Key Ecosystem Linkages: disturbance due to construction and operation of the Ulu Project

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

1a. Road kills of round squirrels and/or caribou at the mine site, or 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 themselves become road kills.

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[1] see Wildlife and Wildlife Habitat Assessment, Canamera Geological Ltd., Environmental Resources Division, November 1996, for reference information.

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.

Wolverine

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 these species. Waste management measures to prevent attracting carnivores generally, will also be affective for wolverine.

Key Ecosystem Linkages: disturbance due to construction and operation of the Ulu Project

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

1a. Road kills of ground squirrels/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 practise 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 raven and gull, 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.

Grizzly Bear

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[1], 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

1 see Wildlife and Wildlife Habitat Assessment, Canamera Geological Ltd., Environmental Resources Division, November 1996, for reference information.

females can raise their cubs in relatively close proximity to a community of 1000 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 haul 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 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 indicated the need for contingency planning in the event that the primary waste management equipment fails.

Key Ecosystem Linkages: disturbance due to construction and operation of the Ulu Project

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 will become a nuisance and perhaps a safety risk and will be destroyed, resulting in a decrease to the grizzly bear population.

Discussion

1. Grizzly bear dens are usually dug in exposed and well drained slopes or banks with sufficient depth to permafrost (Nagy[1], 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 communications). Nagy described the Tuk peninsula as flat and featureless and yet felt that a 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 square kilometres (Cluff and Case[1], 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[1], 1982). The abundance of esker habitat in the region should permit site specific quarrying of eskers to construct 97.25 km of winter haul road without limiting the denning habitat for grizzly in the region. This linkage does not represent a potential barrier to denning in the region.

   October reconnaissance flights or surface inspections will be made to determine if bear are intending to den in eskers proposed for the winter quarrying. Tracks and diggings will show clearly in the fresh 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 it limit

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[1] see Wildlife and Wildlife Habitat Assessment, Canamera Geological Ltd., Environmental Resources Division, November 1996, for reference information.

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 in the Tuk Peninsula, Nagy[1] (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[1] (1983) found that bears that were out late into 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.

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 attraction grizzly bears must be implemented at all Ulu Project camps.

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[1] see Wildlife and Wildlife Habitat Assessment, Canamera Geological Ltd., Environmental Resources Division, November 1996, for reference information.

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.

Muskox

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 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 by people and/or machines in the vicinity of the Ulu Project mine site and winter road will be addressed by giving wildlife the "right of way" along all transportation routes. Hunting and harassment of wildlife will not be permitted by employees or contractors at Ulu Project sites.

Key Ecosystem Linkages: disturbances due to construction and operation of the Ulu Project

Noise and constant commotion at the mine site and by ore trucks in 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 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

Caribou

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). In 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.

<u>Winter Road</u>

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 tough 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 the ten years, between 1949 and 1960. The closer the caribou are to the calving ground, the narrow migratory corridor becomes (Kelsall[1], 1968; Thomas[1], 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[1], 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 ploughing 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". Jakimchuck and Carruthers[1] (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 parallelling behaviour. These responses are aimed at seeking the path of least energetic resistance.

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1 see Wildlife and Wildlife Habitat Assessment, Canamera Geological Ltd., Environmental Resources Division, November 1996, for reference information.

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

Winter roads in the NWT are operated under federal and Inuit land use permits. Procedures and requirements for minimizing impacts on wildlife, including caribou, will be developed by Echo Bay Mines Ltd. in consultation with GNWT wildlife biologists as terms and conditions to the permit. These requirements will 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 at Lupin. There will be buildings, roads, an airstrip and disposal areas.

Interactions between standard mining activities and caribou have occurred at Lupin for more than ten years with no apparent ongoing negative impact in the Bathurst herd. The same is expected at Ulu.

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.

Key Ecosystem Linkages: disturbances due to the construction and operation of the Ulu Project

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 effect 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 square kilometres. A policy of "caribou always have the right of way" will greatly reduce the incidence of collision.

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[1] for 1967 (93,000 in 1-2 days) or Williams[1] 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 to 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 in 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.

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1 see Wildlife and Wildlife Habitat Assessment, Canamera Geological Ltd., Environmental Resources Division, November 1996, for reference information.

4.8.3 Impact Evaluation for Wildlife Harvesting

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

Key Ecosystem Linkages: increased access for hunters due to the operation of the winter haul road

1. The Ulu Project will create more 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.

4.8.4 Impact Evaluation for Terrestrial Ecosystem/Economy

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

Key Ecosystem Linkages: disruption on terrestrial ecosystem to sustain the production of natural resources due to the construction and operation of the Ulu Project.

1. The Ulu Project requires that an area of 163.9 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 163.9 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 VECs species are seasonal and intermittent. Loss of 170.3 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 harvest of wildlife and other terrestrial renewable resources by communities in the region and adjacent areas will be negligible.

4.8.5 Impact Evaluation for Water Resources and Fisheries

The potential road alignments investigated traverse an area which can be characterized as having poor quality fish habitat. Of the 76 crossing locations assessed in June and August, 1996 fish were encountered in only 14 of the streams.

From a biological point of view, none of the proposed winter road routes stands out as having significantly less potential impacts on the aquatic environment than the others. Regardless of the route chosen, the stream crossing locations should be located at least 150 metres upstream of lakes which are greater than 3 metres in depth.

All four of the lakes sampled in 1996 have resident fish (primarily lake trout) populations. These populations are isolated from other populations in the area and are sensitive to over exploitation.

Water and sediment quality in three lakes (Reno Lake North, Reno Lake South and Ulu Lake) are typical of unperturbed lakes. West Lake has experienced an introduction of a saline substance as evidenced by elevated concentrations of sodium, calcium and chloride.

Recommended Mitigation Measures

1. Stream crossing locations for the winter haul road should be located at least 150 metres upstream of lakes which are greater than 3 metres in depth.

2. Fishing activity in the lakes in the vicinity of the Ulu site should closely adhere to established limits set in the fishing regulations and possibly be limited to the "catch and release" style of fishing.

3. Spill cleanup procedures and operating methodology should be established and adhered to to prevent the introduction of contaminants (ie. hydrocarbons, brine, ARD) to the environment.

Residual impacts expected: none.

4.8.6 Impact Evaluation for Archaeological Sites

With regard to the Ulu project, it appears that extractive mineral development and heritage resource protection and preservation are not incompatible. The Ulu site and ancillary components are situated on a bedrock outcrop. Such outcrops are relatively vegetation-poor, providing little inducement for caribou or muskoxen. Interim sites, such as Camp 3, are often situated on well-drained land which is on, or adjacent to, eskers but on a low portion or side ridge of the main esker. The data derived from the survey of the major north/south esker northeast of Kathawachaga Lake indicates that archaeological sites are usually located on the higher portions of the esker in order to obtain an unobstructed view of the surrounding countryside.

The projected winter haul road route options generally traverse low-lying (in comparison to the eskers) terrain and, as much, will not encounter areas of proven archaeological potential. Traversing eskers, with their undulating nature and rapid changes in elevation, is not practical for speedy, economical transport. In addition, while large sections of the major esker are quite wide and could easily accommodate a winter road, other portions are very narrow and would require considerable modification prior to use as a road location. The logistics of transporting heavy equipment to the specific locations, as well as the expense of the operation, would argue against the transformation of eskers into haul roads.

The land /ice transitions of the winter haul roads are areas where there could be impact on archaeological sites which had been chosen for their proximity to water-based resources. This is not a problem in the central portions of any of the routes a the smaller lakes, shallow and/or fish-poor, would have been ignored by subsistence-oriented populations in favour of lakes like Kathawachaga, Contwoyto, or Concession Lake.

The utilization of Kathawachaga Lake, documented in the Inuit Land Use and Occupancy Project[1], suggests that there is a potential for numerous archaeological sites around the perimeter. In practical terms, campsite location would not be selected at

1 see Ulu Mine Project Archaeological Impact Assessment: Phase II, Quaternary Consultants Ltd., September 1996, for reference information.

random, but with specific criteria in mind. These criteria would include proximity to a river for transportation and harvesting fish during spawning season, well-drained areas elevated above the lake shore, higher locations which would provide observation across a considerable expanse of countryside and ease of travel into the hinterland. The implementation of these criteria means that certain locations are occupied sequentially throughout the centuries, while other, less favourable locations are never used. A combination of helicopter survey and subsequent foot survey of the more favourable locations can delineate the sites which have been used-usually at a considerable distance from each other. Inasmuch as soil accretion is minimal, buried archaeological sites are minimally likely. Soil deflation through wind and water erosion will usually provide some surface evidence of past utilization of a location.

The results of the investigations of the west arm of Kathawachaga Lake are the identification of five archaeological sites; two campsites in opposite sides of the mouth of the Burnside River known from the 1985 survey by Gordon[1] (MaNv-4 and MaNv-5); a campsite adjacent to the river which flows into the southwest corner of Kathawachaga (MbNv-2); a chipping station on an isolated bedrock outcrop on the north side (MbNv-3); and a recent biological research campsite in a steep slope of a bedrock outcrop on the north side (MbNv-4). The four sites west of the Burnside River can be easily avoided by the haul route corridor.

An adjunct component of the projected winter haul road would be the establishment of a way station in the vicinity of Crossroad Lake or the larger lake south of it. During helicopter survey of the routes and the major esker, the archaeological team watched for areas which could be considered as possible locations. Any location which appeared to be suitable was investigated, even though it was not directly on any of the projected haul routes. The location that appeared to be the most suitable, to an unpractised eye, is located north of the small lake immediately north of Crossroad Lake. The expanse of glacial outwash is archaeologically sterile. Other locations in the region were also examined and found to contain no obvious archaeological resources

To summarize, no archaeological sites or evidence were found during an intensive foot survey of the Ulu site area by a qualified archaeologist. Investigations of the various options for the establishment of a winter haul road between Ulu and Lupin were undertaken. Most of the twenty-one archaeological sites identified were considerably beyond the impact zone of the projected haul road corridors.

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1 see Ulu Mine Project Archaeological Impact Assessment: Phase II, Quaternary Consultants Ltd., September 1996, for reference information.

Utilization of eskers as gravel sources is quite feasible, providing that the extraction areas are on the lower sides and lateral ridges of the esker complexes. The archaeological sites associated with the eskers are usually located at the higher portions of the esker and, as such, would not be affected by excavations at lower locations.

Recommended Mitigation Measures

1. The Ulu site, winter haul road and gravel excavation sites should not occur within 250 metres of identified archaeological sites.

2. Gravel extraction should occur at low elevations and on the lateral esker ridges to avoid any unidentified archaeological sites.

3. When the location is chosen for a way station campsite, the surveyors selecting the location should be familiar with the types of tent rings which would characterize an archaeological campsite. This would ensure the avoidance of impact upon any archaeological site which may not have been previously identified.

Residual Impacts Expected: none.

4.8.7 Project Specific Cumulative Impacts

Terrestrial Ecosystems

The environment evaluation reported in previous sections determined that the only incremental change to the terrestrial environment as a direct result of the Ulu Project is the loss of 163.9 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. 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 complimentary to good industrial practise. 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.

4.8.8 Cumulative Impacts Among Projects in the Ulu Project Area

The Ulu Project is a satellite of the Lupin Operation and so uses existing infrastructure to the greatest extent possible. The transportation infrastructure developed by the Ulu Project is expected to facilitate little or no other industrial or tourism activity during the years (1997 to 2004) it is expected to be operating. A portion of the winter road built on the ice of Contwoyto Lake will be used for winter access between Lupin and Lytton's Jericho project during the winter of 1996/97. Besides a somewhat higher traffic volume for this portion of the winter road, no additional impacts are expected.