TIBBITT TO CONTWOYTO WINTER ROAD

ENVIRONMENTAL SETTING REPORT

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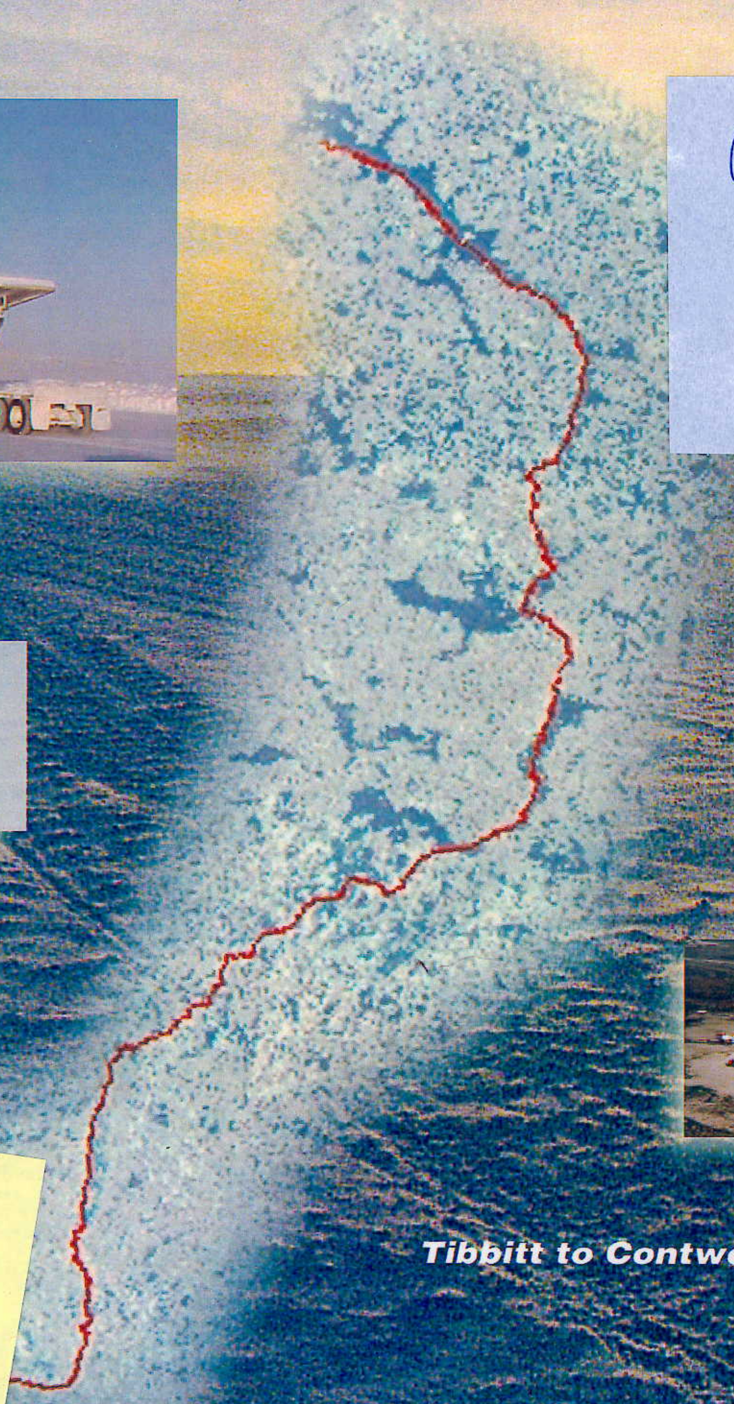

Index & Return

Submitted to:

Tibbitt to Contwoyto Winter Road Joint Venture
Yellowknife, NT

Prepared by:

EBA Engineering Consultants Ltd.
Yellowknife, NT

September, 2001

TIBBITT TO CONTWOYTO
WINTER ROAD JOINT VENTURE

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TIBBITT TO CONTWOYTO WINTER ROAD
ENVIRONMENTAL SETTING REPORT

Prepared by:

EBA ENGINEERING CONSULTANTS LTD.
Yellowknife, NT

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Yellowknife, NT

Project No. 0101-01-14875

September 2001

TIBBITT TO CONTWOYTO

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1.0 INTRODUCTION

The Lupin winter road, now referred to as the Tibbitt to Contwoyto Winter Road (winter road), evolved out of an earlier winter road that had been built in the 1960's to service the old Tundra Mine near Courageous Lake. Echo Bay Mines extended the winter road in the late 1970's to service their new Lupin Mine on Contwoyto Lake. Echo Bay assumed the operation of the winter road in the early 1980's. With minor route changes, the winter road has serviced the Lupin Mine since 1982. Since 1991, this winter road has also serviced the needs of the expanding diamond industry in the Slave Geologic Province.

The existing winter road corridor begins at Tibbitt Lake, located at the end of the Ingraham Trail in the NWT. From this point, the winter road extends north for 568 km, terminating at the Lupin Mine on the shores of Contwoyto Lake (also known as Tahikyoak Lake) in Nunavut (Figure 1.1-1). the route traverses lakes, streams, boreal forest, the transitional zone and barrenlands terrain. Approximately 87% (495 km) of the corridor passes over frozen lake surfaces. The overland portages that account for the rest of the route run through the boreal forests of the Taiga Shield Ecozone around Yellowknife and the barrenlands of the Southern Arctic Ecozone north of Mackay Lake. Both ecozones fall within the Slave Geologic Province (Environment Canada 2000).

Winter road construction generally begins around mid December. The road is typically open for industrial traffic from mid to late January, to early April. The operating window is limited by conditions over the southern part of the road (south of Lockhart Lake), which is generally available for one month less than the section of road north of Lockhart Lake Camp. Based on previous operating experience, the road has been used for the transportation of supplies to the mines and exploration areas for between 50 and 91 days each season (average of 67 days) (EBA 2001). North of the treeline, much of the road maintenance work consists of clearing snow accumulations caused by high winds and drifting across the barrenlands.

This Environmental Setting Report presents an overview of the biophysical, social and cultural conditions in, and in proximity to the winter road corridor. The information has been drawn primarily from the available technical and resource management literature, traditional knowledge studies and previous assessments of mining developments and proposed transportation corridors in the Slave Geologic Province that are relevant to the area of interest. Where appropriate, the descriptive material emphasizes conditions prevailing during the winter period when the winter road is in operation.

The Environmental Setting Report was prepared to assist with the planning of a comprehensive field study program of the winter road corridor which was conducted during the summer of 2001. In addition, the document will be used for ongoing and future planning, assessment and effective environmental management of the Tibbitt to Contwoyto Winter Road.

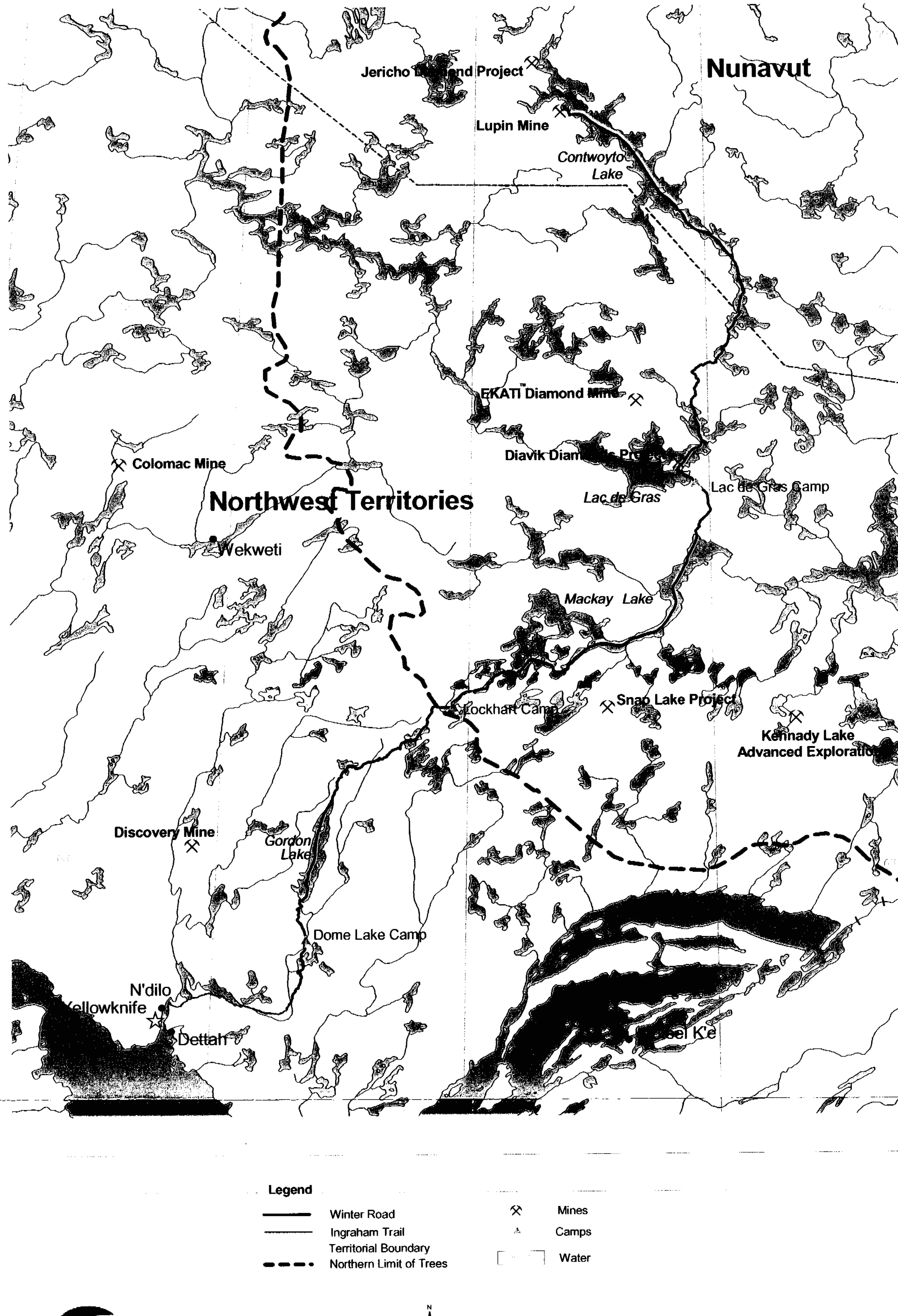


Figure 1.1-1 Tibbitt to Contwoyto Winter Road Location Map

2.0 CLIMATE

The general area surrounding the winter road corridor is considered to have a continental polar climate, with long cold winters and short cool summers. Daily temperatures are often below –30°C during winter and can reach 25°C in summer. Precipitation is sparse, ranging from 200 to 400 mm annually, approximately half of which falls as snow (BHP 1995; 2000). The cold climate is fundamental for successful winter road operations.

Environment Canada–Atmospheric Environment Service (AES) operates regional meteorological stations at Yellowknife Airport, Lupin Mine and Kugluktuk. Privately operated stations have also been established for a number of years at the EKATI™ Diamond Mine (BHP 1995) and the Diavik Diamond Project site on Lac de Gras (DDMI 1998).

Records from Yellowknife indicate that the daily mean temperature ranged from a minimum of –27.9°C in January to 16.5°C in July over the period 1961 to 1990 (BHP 2000). In comparison, the mean daily temperature at Contwoyto Lake from 1956 to 1995 ranged from –31.2°C in January to 10.2°C in July.

Recorded annual precipitation at Yellowknife Airport was 263.5 mm from 1961 to 1990, 393 mm at EKATI™ from 1993 to 1999, and 266.1 mm at Lupin Mine from 1959 to 1995 (BHP 2000).

Prevailing winds at Yellowknife are most frequently from the east and average 15 km throughout the year. At Lupin, the prevailing winds are most frequently from the north at an average speed of 17 km (1998). Blowing snow, particularly across the barrenlands, is a significant issue for winter road operations in this area.

Existing air quality in the vicinity of the winter road corridor is considered to be good and comparable to conditions found in other undeveloped and remote areas of the Slave Geologic Province. Regional air quality monitoring has not been conducted, but recent baseline air quality sampling for suspended particulate matter at the Diavik site in Lac de Gras (DDMI 1998) reported low ambient concentrations of suspended particulates, less than 10 Mg/Nm^3, compared to Environment Canada's air quality objective of 120 Mg/Nm^3 for a 24-hour average. DDMI (1998) also estimated background levels of approximately 4 Mg/Nm^3 for sulphur dioxide (SO_2), 100 Mg/Nm^3 for carbon monoxide (CO), 20 Mg/Nm^3 for nitrogen oxide (NO_2) and 80 Mg/Nm^3 for ozone (O^3).

The impact of climate change has direct implications for northern Canada and the winter road. According to the available scientific evidence, the earth's average temperature has increased by about 0.5°C over the past 100 years (Environment Canada 2000). The 1980s and 1990s have been the warmest decades recorded to date. The Mackenzie River Basin Study concluded that this area has experienced a warming trend of 1.5°C this century (Cohen 1997).

Most recently, EBA (2001) projected a future 0.3°C per decade increase in mean annual air temperature, using recorded Atmospheric Environment Service (AES) data for Yellowknife (1940 to present) and Lupin (1959 to present) for the winter months (November-March). The results of this analysis, projected to 2010, are illustrated in Figure 2.1-1. The implications of this current and continuing warming trend on the annual operating season for the winter road are discussed in EBA (2001).

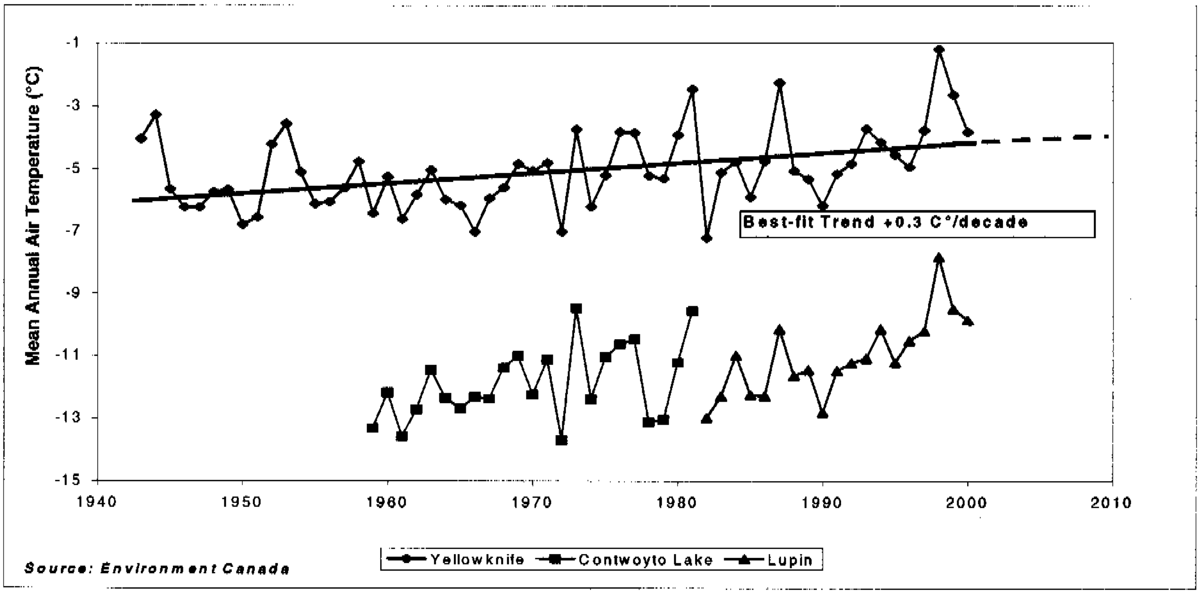


Figure 2.1-1 Mean Annual Winter Air Temperature Trends

3.0 TERRAIN AND VEGETATION

3.1 Terrain

The terrain in the region (Figure 3.1-1) formed as a result of multiple glaciations, the most recent occurring during the late Wisconsinan Period (Dike *et al.* 1989). During this time (10,000 to 15,000 years ago), the area was covered by glaciers flowing in several directions. Glacial striations indicate that the earliest ice-flow direction was to the southwest, then to the west and west-northwest. Varying thicknesses of till were deposited on bedrock over most of the area as the glaciers receded.

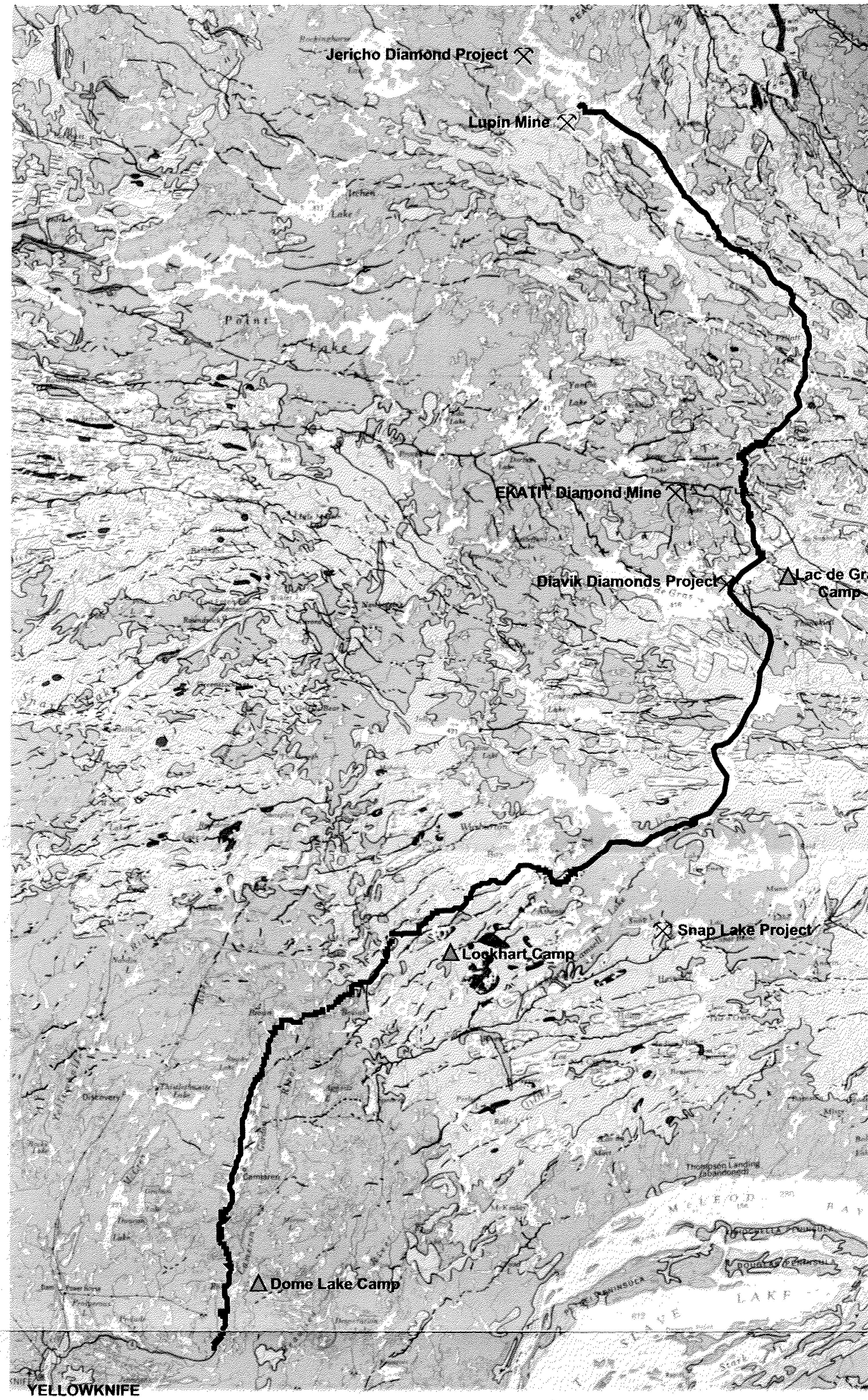
Deglaciation involved retreat in a generally east-northeasterly direction across the territories and concurrent lowering of the Wisconsinan Laurentide Ice Sheet Surface elevation. The successively reduced ice mass remained active until very near the end, which in the Lac de Gras region occurred approximately 9,500 years ago (Dike and Dredge 1989). There was an abundant supply of meltwater during the early stages of deglaciation.

As the receding ice mass continued to melt, meltwater movement caused extensive erosion and deposition. Newly exposed till plains were extensively eroded; in some cases the till was completely removed. Glaciofluvial materials were deposited as irregular hills and knolls, transverse ridges and bar-like features. Large concentrations of boulders, and small patches and blankets of sand and gravel, were commonly deposited on the remaining till and bedrock surfaces (Dike and Dredge 1989).

Following deglaciation, the levels of some lakes were higher than at present, as evidenced by strandlines. High lake levels were short-lived, however, as indicated by the lack of deltas and well-developed beaches.

Through the remainder of the Holocene Period, periglacial processes resulted in mechanical breakdown of bedrock and coarse glacial materials and contributed to gravity transport of both glacial soils and products of periglacial grinding. Thin alluvial soil deposits have formed along some streams, and pond deposits have accumulated in shallow depressions. Organic deposits of soil have also formed on some poorly drained floodplains and low, flat areas (Dike and Dredge 1989). Figure 3.1-1 illustrates the regional terrain features found in the general area that includes the winter road corridor.

In general, the portage sections of the winter road corridor follow the low-lying terrain, including frozen streams and wetland areas, commonly found between connecting lakes along the route. Where the terrain is hilly, the route follows existing grades and contours as much as possible to prevent or minimize potential terrain damage. To improve transportation safety and throughput, granular padding has been deposited as an upgrading measure along approximately 20% of the existing portages.



Legend

- Glaciofluvial Deposits
- Ribbed (rogen) Moraine
- Drumlins, Flutings, & Crag & Tail
- Undifferentiated Surficial Materials
- Drift-Poor Areas
- Winter Road
- Drumlin or Fluting
- Crag & Tail
- Ribbed Moraine Ridges
- Hummocky Moraine
- Camps
- Major Moraine Ridge
- Geological Boundary
- Esker
- Mines

0 25 50 75 Kilometers

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Figure 3.1-1 Regional Glacial Features

3.2 Vegetation

The winter road corridor begins in the boreal forest of the Taiga Shield Ecozone and crosses into the barrenlands of the Southern Arctic Ecozone (Figure 3.2-1). Within the Taiga Shield Ecozone, the corridor traverses the Tazin Lake Upland and Coppermine River Upland ecoregions. The route includes approximately 73 km of vegetated terrain. Forty five (65%) of the portages are within boreal forest areas.

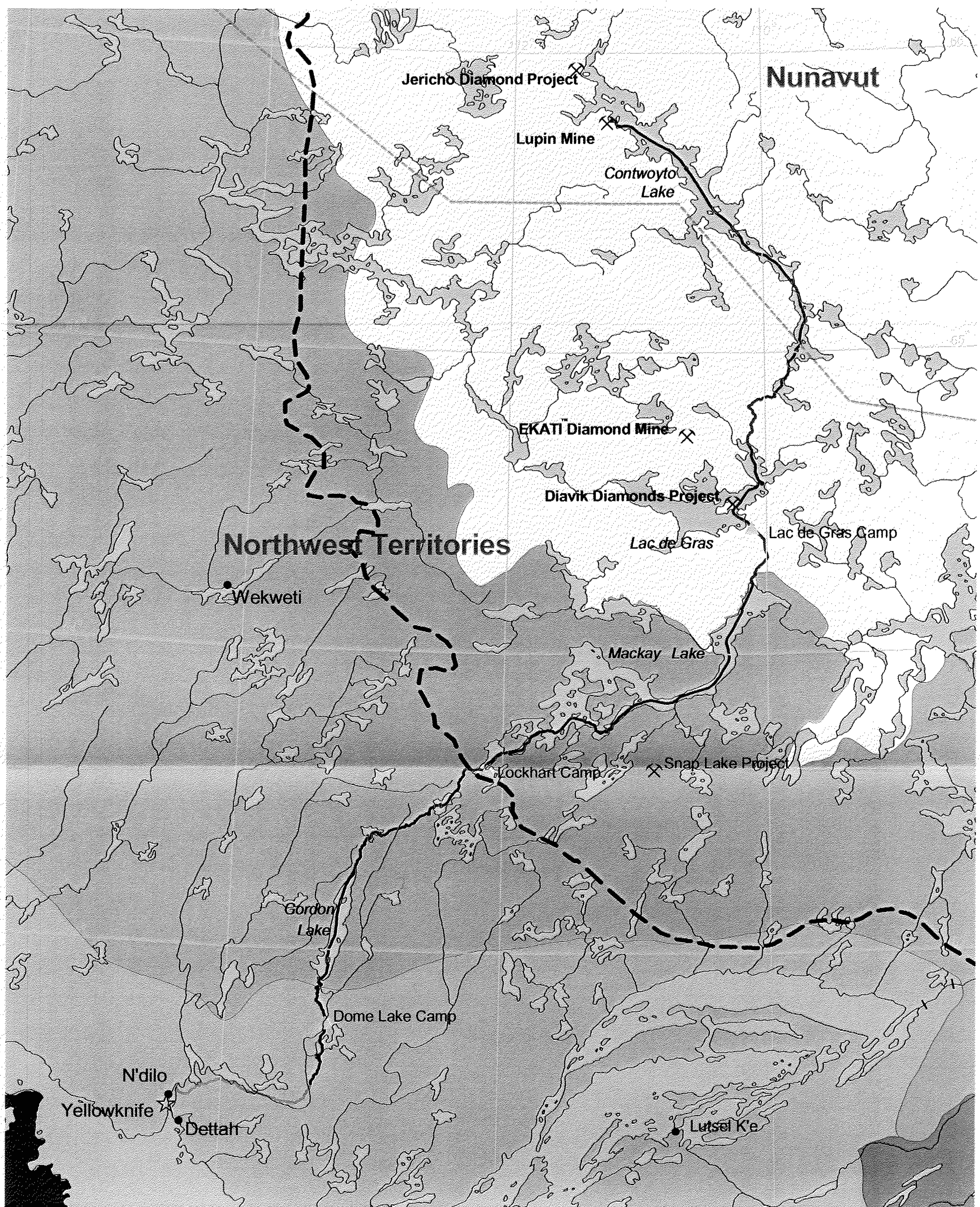
The boreal forest of the Tazin Lake Upland is characterized by medium to tall, closed stands of trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), Alaskan paper birch (*Betula papyrifera*) and jack pine (*Pinus banksiana),* with white spruce (*Picea glauca*) and black spruce (*Picea mariana*) dominating in later successional stands. Poorly drained fens and bogs in this region are covered with low, open stands of larch (*Larix laricina*) and black spruce (Environment Canada 2000).

A number of the portages in forested areas of the corridor have been cleared of trees and taller shrub vegetation (Plates 3.2-1 and 3.2-2). In addition, the boreal forest around the winter road corridor has experienced numerous forest fires over the years. Figure 3.2-2 shows the burn areas located in the vicinity of the winter road dating back to 1965. Some of the more recent burn areas impinging on the winter road occur south of Ross Lake, at Dome Lake, Gordon Lake, Brown Lake and south of Drybones Lake (Plate 3.2-3). A brief discussion on the effects of burned areas on caribou is provided in Section 5.1. The route crosses through the northern limits of the boreal forest and enters transitional forest en route to the barrenlands in the general area between Drybones Lake and Lockhart Lake (Plate 3.2-4).

The Coppermine River Upland represents the tundra and boreal forest transition, or transitional forest zone. The dominant vegetation types in this zone include open, stunted stands of black spruce and larch with lesser amounts of white spruce. The shrub or ground cover community in these open forests consists of dwarf birch (*Betula glandulosa*), willow (*Salix spp.*), ericaceous shrubs (such as northern Labrador tea (*Ledum decumbens*) and red bearberry (*Arctostaphylos rubra*), cottongrass (*Eriophorum spp.*) and lichens. Poorly drained areas support tussocks of sedge (*Carex spp.*), cottongrass and sphagnum moss (*Sphagnum spp.*). Extensive areas of low shrub tundra marked by dwarf birch and willow are also common in this ecoregion (Environment Canada 2000).

From the Lac de Gras area northward, the winter road corridor mainly passes over frozen lake surfaces within the barrenlands of the Takijuq Lake Upland Ecoregion of the Southern Arctic Ecozone. The vegetative cover in this area is characterized by shrub tundra consisting of dwarf birch, willow, northern Labrador Tea, mountain avens (*Dryas spp.*), bilberry (*Vaccinium uliginosum*) and mountain cranberry (*V. vitis-idaea*). Wet areas and depressions are dominated by sedge tussock (*Carex spp.*), willows and sphagnum moss. Scattered stands of spruce along the southern boundary of this ecoregion (south of Lac de Gras) represent aspects of transitional forest (Environment Canada 2000).

To minimize effects on the terrain and vegetation in the area of the corridor (and to facilitate operations), all construction and transportation activities related to commercial use of the winter road are limited to the colder months of winter, generally extending from early December to the end of March or early April. To date, at the time of winter road closure, signage has been posted and the winter road officially closed to all traffic. However, typically the winter road has continued to be used well into the spring by the general public. Unfortunately, this practice has led to minor, localized vegetation and terrain damage in some more southerly sections of the corridor.



Source: Environment Canada 2000.

Legend

- Winter Road
- Ingraham Trail
- Territorial Boundary
- Northern Limit of Trees
- Water
- Mines
- Camps

- Taiga Shield Ecozone
- Southern Arctic Ecozone
- Taiga Plains Ecozone

- Coppermine River Upland Ecoregion
- Tazin Lake Upland Ecoregion
- Takijuq Lake Ecoregion
- Selwyn Lake Ecoregion
- Great Slave Lake Ecoregion

N

20 0 20 40 60 80 100 Kilometers

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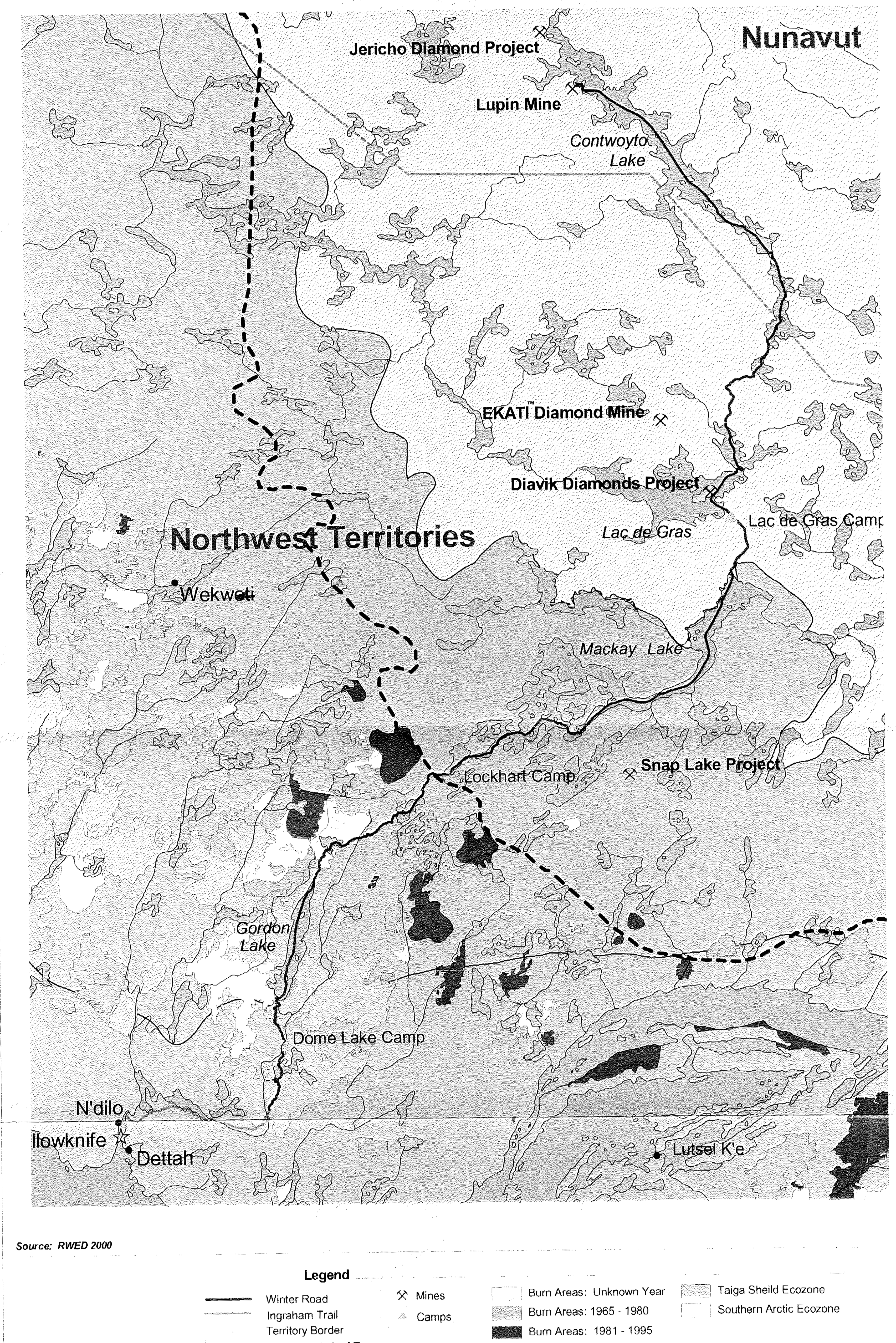
Figure 3.2-1: Ecozones and Ecoregions of the Winter Road Corridor



Source: RWED 2000

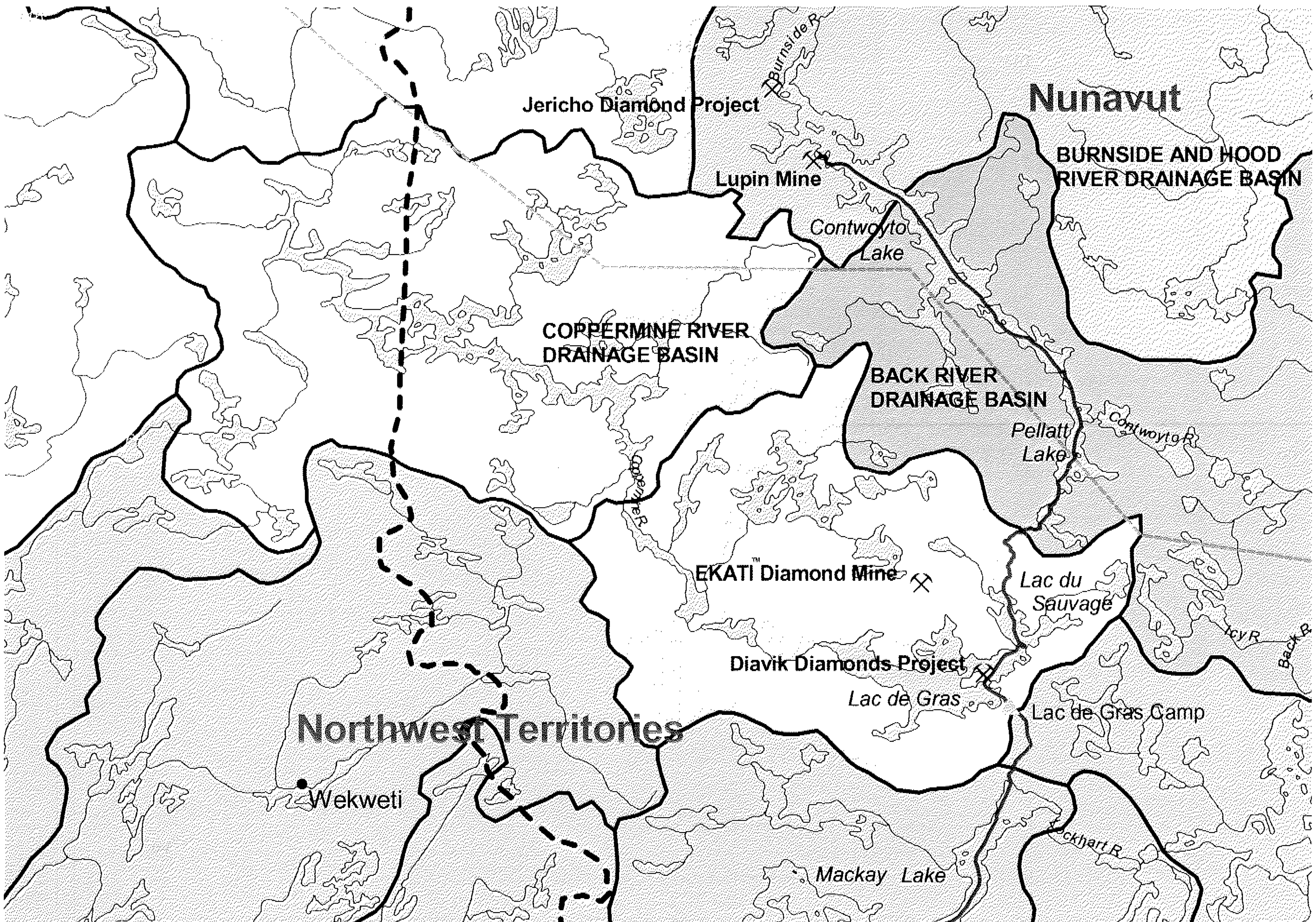
Figure 3.2-2 Forest Fire Burn Areas in the Vicinity of the Winter Road

Plate 3.2-1 Mature White Spruce Forest Along Portage 10 South of Dome Lake

Plate 3.2-2 Boreal Forest Along Portage 29 North of Long Lake

Plate 3.2-3 Older Burn Area Along Portage 22 South of Brown Lake

Plate 3.2-4 Remnants of Transitional Forest Near the Treeline at Drybones Lake



Source: GeoAccess Division, Canada Centre for Remote Sensing, Natural Resources Canada

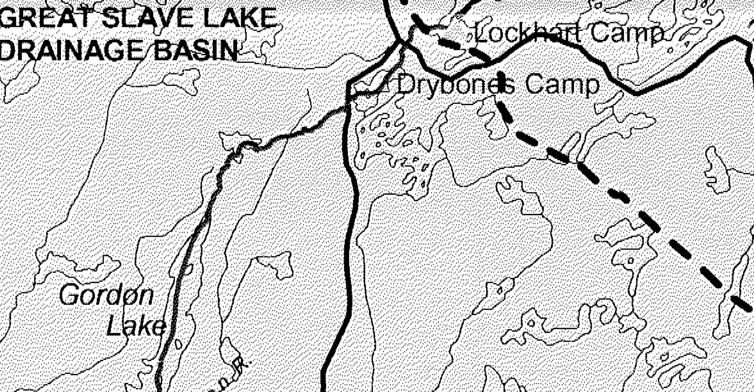


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Figure 4.1-1 Drainage basins in the Winter Road Corridor

4.0 WATERSHEDS AND AQUATIC LIFE

Most of the winter road corridor crosses frozen lake surfaces (495 km). The water from these lakes and associated waterbodies drains into four primary drainage basins: the Great Slave Lake and Mackenzie River Drainage Basin, the Coppermine River Drainage Basin, the Back River Drainage Basin and the Hood and Burnside rivers Drainage Basin (Figure 4.1-1).

On the southern end, within the Great Slave Lake and Mackenzie River Drainage Basin, the winter road traverses the Cameron, Beaulieu and Lockhart river watersheds. In the vicinity of Lac de Gras Camp, the winter road crosses Lac de Gras and Lac du Sauvage, located in the headwaters of the Coppermine River Drainage basin, which flows into Coronation Gulf.

On the northern end of the winter road, Contwoyto Lake drains both north and south through two rivers: the Burnside and the Back. The Burnside River flows from the northern end of the lake into Bathurst Inlet. At its southern end, Contwoyto Lake drains into Pellatt Lake, which in turn flows via the Contwoyto River into Back River and then on to Chantry Inlet.

Many of the watersheds and aquatic resources along the winter road corridor have been historically important use areas for Aboriginal people. Within the more southerly forested areas, the corridor follows some of the traditional trails used by the Yellowknives Dene and crosses a number of the more important fishing, trapping and hunting areas (Weledeh Yellowknives Dene 1997). Similarly, the barrenlands from Lac de Gras to Contwoyto Lake has been used for hunting, fishing and trapping by the Copper Inuit people. The Contwoyto Lake area has been important for Inuit land-use activities in all seasons for centuries and maybe longer (NTKP in prep.). Historicallly, Copper Inuit travelled extensively in pursuit of fish and game. During winter, the Inuit looked for areas of flowing water and thin ice where fish could be harvested, such as the outflow of Lac de Gras (BHP 1995).

Protection of the fish and aquatic habitat resources in the area of the winter road corridor is an important consideration for the operators and users of the winter road. Although most streams and wetlands crossed by the winter road are frozen to the bottom before construction and operations commence, and resident fish have returned to larger lakes to over-winter, fish and other aquatic life could be harmed by spills of petroleum or other potentially hazardous products into the water column below the ice. Fortunately, there have been very few spills during the operation of the current winter road, a period of approximately 20 years. In addition, winter conditions effectively contain most spills on the ice or snow surface. This facilitates effective recovery and clean up in accordance with the procedures of the Winter Road Spill Contingency Plan (Echo Bay 2001).

Other potential concerns for the aquatic resources along the winter road corridor relate to the possibility of direct physical damage to or alteration of lakeshore aquatic habitats and the introduction of small amounts of sediments into water bodies. Highly localized incidents of this nature have occasionally arisen, primarily as a result of late-season, unauthorized use of the winter road by third parties.

4.1 Fish Resources

Beginning at the southern end of the route, the larger lakes traversed by the winter road corridor include Gordon Lake, Drybones Lake, Lockhart Lake, Mackay Lake, Lac de Gras, Lac du Sauvage, Pellatt Lake and Contwoyto Lake (Figure 4.1-1). Many of these lakes are important for ongoing subsistence, domestic and recreational fishing. Drawing on the traditional knowledge of the Weledeh Yellowknives Dene (1997), historically:

> *"The people know that the large lakes have good fishing with lots of old and very large fish. Shallows in these lakes, including Ek'ati (Lac de Gras), have important fall spawning areas, which the people respect. In the fall, fish were thin and not good for harvesting. In winter, the people harvested fish at holes in the ice, often at channels where a swift current kept the water open, visiting their nets up to four times per day. Two of the most important channels are at Mackay Lake and the Narrows between Lac du Sauvage and Lac de Gras."*

The most common and culturally/economically important fish species harvested in the larger lakes along the winter road corridor that flow into Great Slave Lake include lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), northern pike (*Esox lucius*), walleye (*Stizostedion vitreum*) and burbot (*Lota lota*). Further north, in Lac de Gras, Lac du Sauvage and Contwoyto lakes, the main fish species harvested for domestic consumption or sport fishing are lake trout and arctic grayling (*Thymalus arcticus)* and may include cisco (*Coregonus artedii*), round whitefish (*Prosopium cylindraceum*) and burbot (BHP 1995; DDMI 1998). Arctic char (*Salvelinus alpinus)* are targeted for sport fishing in Contwoyto Lake, which drains northward via the Burnside and Back rivers into Bathurst Inlet, Nunavut. Stewart (1997) provides a recent review of the status and harvests of fish stocks in the North Slave area, including some of the lakes along the winter road corridor.

4.2 Fish Species Descriptions

Comprehensive baseline aquatic studies have been conducted, or are in progress for the lakes and streams of the Koala Watershed (BHP 1995; 2000), Lac de Gras (DDMI 1998), Snap Lake (De Beers 2001), and the Gahcho Kué area (Kennady Lake) (EBA *et al.* 2000). In addition, the Department of Fisheries and Oceans (DFO) has completed a number of studies and/or reviews of the status of fish stocks in the area of interest, including many of the larger lakes along the winter road corridor. Information from these and other studies has been used to identify and describe the more important fish species in lakes along the winter road corridor.

4.2.1 Lake Whitefish

Lake whitefish is the most economically valuable species in the NWT (Fisheries and Oceans Canada 1983). Important for both commercial and sport fishing, lake whitefish are distributed in many of the interior lakes and rivers of the Slave Geologic Province, including Tibbitt, Gordon, Mackay and Lockhart lakes along the southern part of the winter road corridor (Stewart 1997). Lake whitefish spawn in the fall, but specific timing varies from year to year. This species prefers to spawn in shallow water over a hard, stone or sand substrate at depths less than 7.6 m. The eggs incubate over the winter (Scott and Crossman 1973), when the winter road is operational, and hatch in April or May, after the winter road has been closed to commercial traffic.

4.2.2 Northern Pike

Northern pike is the third most economically valuable fish species (after whitefish and arctic char) in the NWT and Nunavut (Fisheries and Oceans Canada 1983). Northern pike are distributed throughout lakes and rivers in the NWT and are important for both commercial and sport fisheries (Fisheries and Oceans Canada). Along the winter road corridor, pike are found in many of the lakes adjacent to the Ingraham Trail, Tibbitt Lake and Gordon Lake (Roberge and Read 1986; Stewart 1997).

Northern pike spawn in the spring after the ice on the lakes melts. They prefer to spawn in heavily vegetated river floodplains, marshes and the shallow bays of large lakes. The eggs incubate and hatch within a period of 12 to 14 days. The young remain inactive and often attach themselves to vegetation for another 6 to 10 days until their yolk sac has been absorbed (Scott and Crossman 1973).

4.2.3 Lake Trout

Lake trout form an important part of the commercial, sport and subsistence fisheries in the NWT and Nunavut. Lake trout are widely distributed throughout the fish-bearing lakes of the winter road corridor from Tibbitt to Contwoyto (Stewart 1997). It is a cold-water species, preferring temperatures between 4°C and 12°C.

Lake trout spawn in autumn, but timing depends on latitude, water temperature, photoperiod, weather and lake size and morphology (Johnson 1976). In arctic lakes, most mature females spawn every two to three years (McPhail and Lindsay 1970). Spawning takes place primarily over rubble or gravel areas along lakeshores. In lakes along the winter road corridor, successful spawning occurs below the maximum depth of ice development, which typically extends to 1.5 m (BHP 1995). The embryos develop over the winter, when the winter road is operational, and hatch the following spring during ice break-up.

4.2.4 Arctic Grayling

Arctic grayling are widely distributed throughout the NWT and Nunavut, including most fish-bearing lakes and streams along the winter road corridor. Grayling generally inhabit large rivers, rocky creeks and lakes with cold, clear water. During ice break-up (usually between May and June), when the winter road is disappearing, adults move from ice-covered lakes and large rivers to spawn in smaller tributaries with gravel or rock substrates. Based on recent monitoring studies at the EKATI™ Mine, grayling eggs hatch after a short incubation period of 13 to 25 days when water temperatures reach 8 or 9°C (Dillon 2001).

4.2.5 Walleye

Walleye are fished both commercially and recreationally in the NWT. Along the winter road corridor, walleye are found in many of the fish-bearing lakes adjacent to the Ingraham Trail, Tibbitt Lake and Gordon Lake (Roberge and Read 1986; Stewart 1997). Walleye spawn in the spring or early summer, except in years with unfavourable temperatures, when they may not spawn at all. This species prefers to spawn in rocky areas in white water below falls and dams in rivers, or in bouldery or coarse gravel shoal areas of lakes. Eggs hatch after a short incubation period of 12 to 18 days (Scott *et al.* 1973).

4.2.6 Arctic Char

Arctic char is the most important freshwater fish found in waters flowing into the Arctic Ocean and is statistically the second most valuable fish species in the NWT and Nunavut (Fisheries and Oceans Canada 1983).

Along the winter road corridor, arctic char are found only in Contwoyto Lake (Roberge *et al.*; Stewart 1997). Arctic char spawn in the autumn in either lakes or slow-moving pools in rivers. They prefer to spawn in lakes with gravel substrates or rocky shoals. In the Arctic, successful spawning occurs at depths below the maximum thickness of winter ice to 4.6 m. The eggs incubate over the winter, when the winter road is operational, and hatch after the winter road has closed around April. Fry emergence generally occurs during ice break-up (Scott *et al.* 1973).

4.2.7 Burbot

Burbot are widely distributed across the northern mainland of the NWT and Nunavut and are found in most of the fish-bearing lakes along the winter road corridor (Stewart 1997). Burbot spawn in late winter under ice in streams or lake shallows, by dispersing their eggs over coarse rubble substrates in water depths from 3 to 5 metres (McPhail and Lindsay 1970).

4.2.8 Round Whitefish

Round whitefish is primarily a northern species commonly found in fish-bearing lakes and associated streams in the barrenlands such as Lac de Gras, Lac du Sauvage, Pellatt Lake and Contwoyto Lake (Stewart 1997). They generally inhabit shallow areas of these lakes and streams. Spawning occurs in autumn when their eggs are broadly dispersed over gravel or coarse substrates. The fry emerge in spring after the winter road has closed for the season.

5.0 WILDLIFE

Wildlife species found in the vicinity of the winter road corridor are typical of those that live in boreal forest and arctic tundra habitats. The Bathurst caribou herd (*Rangifer tarandus spp.*) generally overwinters in the forested areas and migrates across the barrenlands during the spring and fall. Moose (*Alces alces*) and muskoxen (*Ovibus moschatus*) are found in low numbers in the vicinity of the winter road corridor. Black bears (*Ursus americanus*), grizzly bears (*Ursus articus*), wolves (*Canis lupus*), wolverines (*Gulo gulo*), arctic foxes (*Alopex lagopus*) and red foxes (*Vulpes vulpes*) forage and den in the region. A variety of furbearers are found within the forested areas of the winter road corridor, including marten (*Martes americana*) and lynx (*Lynx canadensis*). The small herbivores mice, voles, lemmings, arctic hare (*Lepus articus*), snowshoe hare (*Lepus americanus*), red squirrels (*Tamiasciurus hudsonicus*) and arctic ground squirrels (*Spermophilus parryii*) are important sources of food for carnivores. Many species of birds inhabit the corridor region during the snow-free months, but only a few live in the area year-round.

The wildlife resources along much of the winter road corridor have been described in detail in the following reports:

- NWT Diamonds Project Environmental Impact Statement (BHP 1995)
- Diavik Diamonds Project Environmental Assessment Submission (DDMI 1998)
- Snap Lake Diamond Project Scoping and Technical Support Document (De Beers 2001)
- Gahcho Kué (Kennady Lake) Environmental Studies (EBA & Jacques-Whitford 2000)
- Jericho Diamond Project Draft Environmental Impact Assessment (Tahera 2001)
- Environmental Scoping, Existing Data Collection and Regulatory Identification for a Transportation Corridor in the Slave Geologic Province (Ferguson, Simek & Clark *et al.* 1999)
- State of Knowledge Report, West Kitikmeot/Slave Study area (Sly *et al.* 1999).

A summary of abundance, distribution and importance of wildlife along the winter road corridor based on these and other supporting reference sources is presented. Only some of these wildlife species are active or present during winter road construction and operation, and only in some areas.

5.1 Barren-Ground Caribou

Barren-ground caribou are a significant resource for the people of the NWT and Nunavut. Caribou hunting is a vital component of Dene, Metis and Inuit cultures and is the most important factor in a lifestyle largely dependent on natural resources (Case *et al.* 1996; Yellowknives Dene 1997; Nunavut Planning Commission 1998; North Slave Metis Alliance 1999). The caribou found along the winter road corridor are part of the

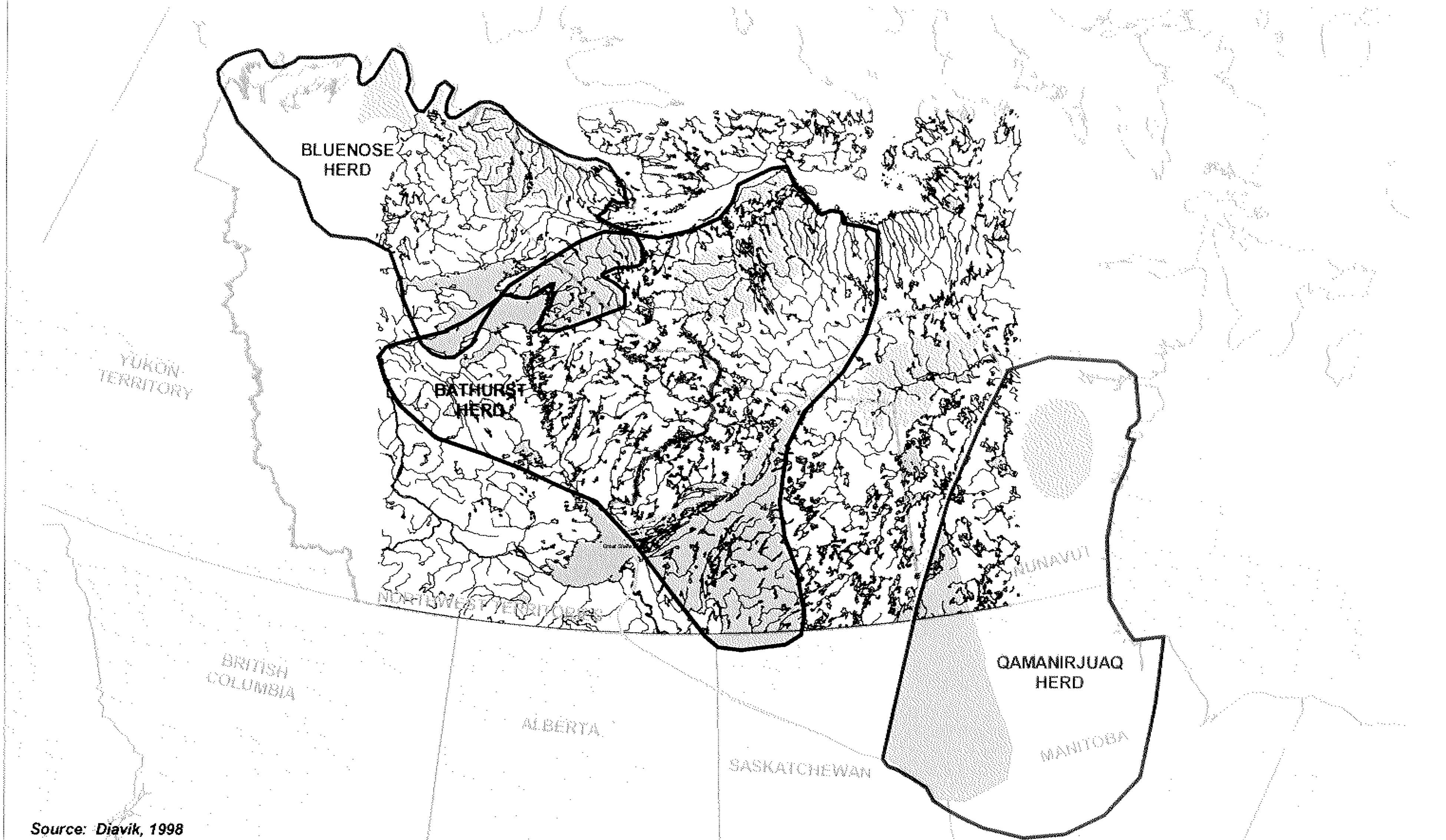
Bathurst herd, the largest of the barren-ground caribou herds in the NWT and Nunavut. Bathurst caribou are accessible to more people than any other herd (Case *et al.* 1996). In 1996, the population was estimated at 349,000 ± 95,000 (Gunn *et al.* 1997). In the past, the herd has ranged in size from an estimated 174,000 in 1982 to 486,000 in 1986 (Case *et al.* 1996).

The geographic range of the Bathurst caribou herd is approximately 250,000 km^2, from major spring calving areas near Bathurst Inlet, to wintering habitat within the boreal forest (Figure 5.1-1). The annual range of the Bathurst herd may overlap with those of three adjacent caribou herds: the Bluenose East herd in the vicinity of Great Bear Lake; the Queen Maud Gulf herd (Gunn *et al.* 2000) to the northeast; and the Beverly herd in the area south of Great Slave Lake and extending to the Saskatchewan border (BQCMB 1992).

The Bathurst herd is harvested every year by hunters. Holders of a General Hunting Licence account for the bulk of the harvest, followed by Resident, Non-Resident and Non-Resident Alien hunters. The total annual harvest of Bathurst caribou (including commercial harvest) is estimated to be between 14,500 and 18,500, representing about 5% of the most recent Bathurst caribou population estimate (Case *et al.* 1996). When caribou wintering grounds include the winter road corridor, a substantial proportion of the annual harvest can occur along the winter road. In addition, wolves, the primary predators of caribou, kill ten of thousands of Bathurst caribou annually (Case *et al.* 1996). More accurate estimates of annual wolf kill and natural mortality are unavailable.

Studies on caribou habitat and migration patterns using radio telemetry and traditional ecological knowledge studies were initiated in 1996 and continue to provide information on caribou movements and behaviour (Ferguson, Simek & Clark *et al.* 1999; NTKP in prep.). Caribou spring migration begins along broad corridors within forested winter ranges and becomes more directed as movements coalesce towards calving areas. Major lake crossing areas include Lac de Gras, Point Lake and Contwoyto Lake. Frequently used migration corridors follow the drainages of major rivers such as the Hood and Burnside, funnelling animals toward Bathurst Inlet (Kelsall 1968; Calef 1981). After calving, summer aggregations and dispersals lead to a more leisurely drift into treeline that eventually becomes a more directed fall migration in October and November. Although migration corridors are not specifically predictable for a given year, corridors such as those mentioned above are used regularly. The intensity of use of known corridors during spring migration depends largely on the late winter distribution of the herd in any given year.

The two most sensitive periods for caribou, when they are most stressed and most responsive to disturbance, are the calving season and during episodes of insect harassment in the summer (Wolfe *et al.* 2000). Neither of these periods occurs during winter road construction and operation. However, winter is also a time of energetic stress for caribou, especially when the availability of forage is reduced because of deep and/or crusted snow or extensive recent burns, or if winter follows a stressful summer with extreme insect harassment.



Source: Diavik, 1998

Legend

Winter Road
Ingraham Trail
Territorial Boundary
Lakes
Overlap Areas
Calving Grounds

EBA Engineering Consultants

70 0 70 140 210 280 350 Kilometers

N

Figure 5.1-1 Annual Ranges, Calving Grounds, and Areas of Overlap between Four Barren-Ground Caribou Herds Residing in the Northwest Territories

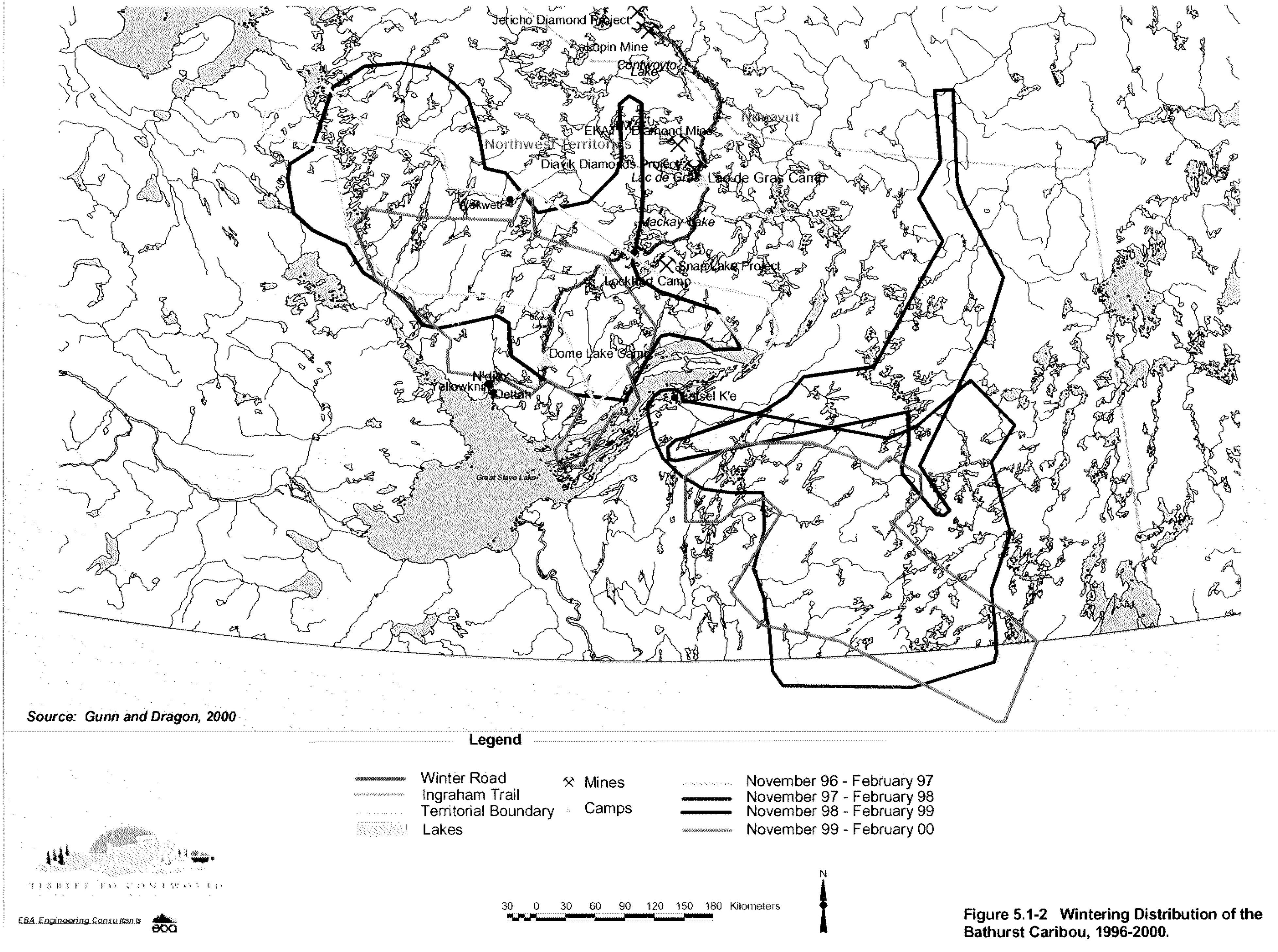


Figure 5.1-2 Wintering Distribution of the Bathurst Caribou, 1996-2000.

Satellite tracking of collared Bathurst caribou since 1997 has confirmed that wintering areas are variable and include areas south of the treeline from the Coppermine River to Great Slave Lake, extending in some years as far south as the Saskatchewan border (Gunn and Dragon 2000). In most years, some of the herd overwinters within the boreal forest, including the vicinity of the winter road corridor. In addition, Inuit still resident in the area report that caribou have been observed at the north end of Contwoyto Lake during winter, but these individuals are few in number and may have migrated south from Victoria Island (NTKP in prep.).

In winters 1996-97, 1998-99 and 1999-00, the wintering grounds of Bathurst caribou included the southern half of the winter road corridor (Figure 5.1-2) (Gunn and Dragon 2000). During 1999-00, the winter distribution of the collared cows was split northwest and southeast of Great Slave Lake, similar to the winter of 1998-99 (Figure 5.1-2). In contrast, all collared cows were located southeast of Great Slave Lake in 1997-98, and northwest of Great Slave Lake in 1996-97. In some years, groups of caribou will use habitats adjacent to the winter road and cross it regularly (Plate 5.1-1).

Fire is the most important cause of non-anthropogenic disturbance in the boreal forest (Johnson 1992) and since records have been kept, fires appear to be occurring more often annually and burning increasingly larger areas (Weber & Flannigan 1997). It was once believed to be detrimental because it destroys the slow-growing lichens considered as a primary caribou winter food. These lichens can take a minimum of 30 years to recover (Cumming 1992; Scotter 1964; Wein 1975). However, there is some dispute over what constitutes recovery, and lichen re-establishment does not always lead to caribou recovery (Lutz 1956). Many researchers now believe that although the short-term effects are negative, in the long-term fire is beneficial (Davis and Franzmann 1979; Johnson and Rowe 1975; Kelsall *et al.* 1977; Klein 1979; Klein 1982), and plays a crucial role in maintaining habitat diversity for caribou (Rowe and Scotter 1973; Schaeffer and Pruitt 1991).

Issues related to the potential effect of the winter road on barren-ground caribou include:

- loss of foraging habitat at portage sites
- loss of lake ice habitat for resting and escape terrain
- mortality (road kills)
- greater access for hunters, contributing to poor hunting practices such as wounding, waste, and potential overharvest
- disturbance caused by winter road traffic, leading to changes in distribution, movements and migratory corridors.

Plate 5.1-1 Group of Caribou Adjacent to the Winter Road.

5.2 Moose

Moose in the NWT and Nunavut are at the northern extent of their range and few are present in the vicinity of the winter road corridor. Densities are low throughout, ranging from 5 to 15 moose per 100 km^2 (Graf 1992). A survey in the Gordon Lake area reported an average density of 2 moose per 100 km^2 (Case and Graf 1992). Moose populations in northern areas have increased slightly between 1960 and 1990 (Karns 1998). Harvests of moose are currently low and likely opportunistic; approximately 60 were taken by hunters in the West Kitikmeot-Slave Geologic Province in 1996-97 (A.D'Hont, pers. comm. in Ferguson, Simek & Clark *et al.* 1999). The few moose present in the area of the winter road use a variety of habitats including lakeshores, river valleys and alder swamps on a year-round basis, sometimes moving onto the barrenlands in summer to areas of lush willow growth (Britton 1983). Few moose are expected to interact with winter road traffic.

5.3 Muskoxen

Most of the muskoxen in the world are found in the NWT and Nunavut (Graves and Hall 1998) but few are found as far south as the winter road corridor. These animals are found on most arctic islands, along the coast and in some areas of the barrenlands as far south as the treeline. Historic numbers and distribution were greatly reduced during the last century, probably through a combination of over-hunting and unfavourable weather conditions (Graf and Shank 1989). Over the last few decades the population in the central mainland of the NWT has been growing steadily (Graves and Hall 1988). Occasional sightings ranging from single individuals to small herds of up to 28 animals have been recorded through ongoing wildlife monitoring and baseline studies at the EKATI™ Diamond Mine (BHP 2000), Lupin Mine (Hohnstein 1996), Diavik Diamond property (DDMI 1998) and the Kennady Lake diamond exploration property (EBA & Jacques-Whitford 2000). Based on their distribution and the winter road alignment, which is largely across frozen tundra lakes, few muskoxen are expected to interact with winter road traffic.

5.4 Black Bears and Grizzly Bears

Black bears are found at low densities in the area of the winter road corridor below the treeline because they are at the northern end of their range (Ferguson, Simek & Clark 1999). In recent years a few black bears have been observed in the vicinity of the Snap Lake and Kennady Lake diamond projects during the summer months (De Beers 2001; EBA & Jacques-Whitford 2000). During 1996-97 approximately 12 black bears were harvested by residents in the West Kitikmeot-Slave Geologic Province (A. D'Hont, pers. comm. in Ferguson, Simek & Clark *et al.* 1999). Black bears are in hibernation when the winter road is operational and have been hunted on a limited basis in the general vicinity of the winter road corridor after road closure.

Grizzly bears are present in low densities in the vicinity of the winter road and are also in hibernation when the winter road is operational. The grizzly bear was classed as "vulnerable" (current equivalent is "species of special concern") by COSEWIC (1997) because of its low resiliency to human-caused impacts. This is largely a function of low population densities, low reproductive capacity and sensitivity to human activity. Home ranges of adult grizzly bears in the central Arctic are large; those of adult males (ca. 6,685 km^2) exceed those of adult females (ca. 2,074 km^2) (McLoughlin *et al.* 1998). Barren-ground grizzlies use a wide variety of habitats and show seasonal habitat preferences related to food availability, thermal shelter, hunting and escape cover (Gau 1998; McLoughlin 2000).

Gau and Veitch (1999) estimated a total population of 5,170 bears in the NWT, exclusive of Nunavut. Two locally-derived population estimates are available for the Slave Geologic Province (BHP 2000). Based on telemetry data and visual sightings of radio-collared and uncollared bears, 30 adult and subadult grizzly bears (1 bear per 455 km^2) were estimated to be present within the 13,865 km^2 Diavik regional study area, centred on Lac de Gras (Penner and Associates 1998). Extrapolation of this population estimate suggests that 407 adult and subadult grizzly bears reside in the Slave Geologic Province (665 grizzly bears, including cubs).

Grizzly bear dens and denning areas are widely distributed throughout the Slave Geologic Province (Banci and Moore 1997; McLoughlin *et al.* 1997; Penner and Associates 1998). In the WKSS study of radio-collared barren-ground grizzlies, most (61% of 56) dens were found in heath tundra habitat or heath tundra with greater than 30% boulders (McLoughlin 2000). Only 7 of 56 dens were located in esker habitat, previously thought to be a major denning habitat. Five dens (9%) were located in spruce forest (McLoughlin 2000). Grizzly bears typically enter their dens in late October to early-November (before construction of the winter road has begun) and emerge in late April to early May (McLoughlin *et al.* 1997), after the winter road has closed.

The few grizzly and black bears along the winter road corridor are in hibernation when the winter road is operational. In the spring, after road closure, they may be attracted to the winter road corridor to search for food sources such as animal remains left behind by winter hunters.

Issues related to the potential effect of the winter road on grizzly and black bears include:

- the loss of some potential denning habitat because of the use of eskers and esker materials for gravel pads
- disturbance to bears in their dens caused by road traffic, noise and vibration
- after winter road closure, attraction of bears to caribou carcasses and gut piles preserved by ice and snow.
- after road closure, attraction of bears to residential human wastes at camps.

5.5 Wolves

Wolves are found throughout the Slave Geologic Province and are usually present along the winter road corridor in association with caribou (Plate 5.5-1). An estimated 1,400 to 3,000 wolves are present within the range of the Bathurst caribou herd (Bromley and Buckland 1995) and they are the predominant predators of these caribou (Williams 1990). Annual ranges for radio-collared males in the Slave Geologic Province are large, and average over 63,000 km² (Walton 1999). Like most carnivores, wolves can be sensitive to disturbance, especially during their reproductive period (Chapman 1977). However, their high productivity and dispersal capabilities ensure resiliency to sustained levels of moderate human disturbance (Weaver *et al.* 1996).

No wolf dens are thought to exist within 10 km of the winter road corridor (D. Cluff 2001 pers. comm.) and the denning period for wolves begins in early May, after road closure. Wolf dens are traditional and may be used over many years (BHP 1995, 2000; D. Cluff, RWED, pers. comm.). Of 63 wolf dens found in the Bathurst caribou range, 26 were on tundra, 28 in the treeline transition area and 9 in the boreal forest (Heard and Williams 1992). In the barrenlands, most den sites have been found on eskers or other glacial deposits (Mueller 1995; Rescan 1996; Golder 1998). Dogrib elder knowledge suggests a concentration of wolf dens north of Lac de Gras (Dogrib 1998, 1999).

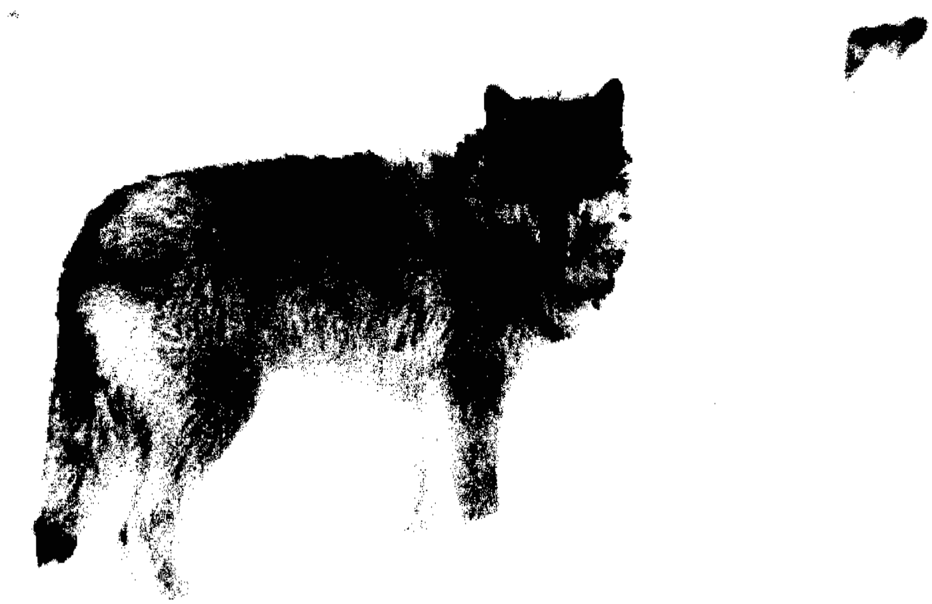


Plate 5.5-1 Wolves are Commonly Associated with Caribou.

Wolves are hunted and trapped and are important to local and regional economies. Inuit traditionally hunted wolves north of Lac de Gras, especially when wintering camps were located at Contwoyto Lake (BHP 2000). During winter, wolves are commonly observed along the winter road corridor, particularly within forested areas in the vicinity of the Bathurst caribou herd. They have also been observed feeding on caribou remains left behind by hunters along the winter road (S. Moore 2001, pers. obs.). When caribou are accessible to hunters along the winter road corridor, so are wolves.

Issues related to the potential effect of the winter road on wolves include:

- the loss of some potential denning habitat because of the use of eskers and esker materials for gravel pads
- disturbance caused by road traffic
- mortality (road kills)
- greater access for hunters, leading to potential overharvest (mortality sink)
- attraction of wolves to food sources at camps and along the winter road.

5.6 Wolverines

Wolverines are solitary carnivores that range over large areas in most of northern and western Canada, including the winter road corridor. Wolverines are scavengers and predators of birds and small mammals, relying on a diversity of foods to offset the uncertainty of availability in the harsh northern environment. The presence of large prey, such as ungulates, at least at some time during the year, appears to be important for the persistence of wolverine populations (Banci 1994).

Although wolverines occupy a variety of habitats within the boreal forest and on the barrenlands year-round, little is known about their distribution and abundance. Studies have proved to be difficult and logistically expensive, more so than where access is readily available. Based on limited data, home ranges of wolverines in the central Arctic vary from 59 to 1,905 km^2, although some of the larger ranges reflect the activities of juveniles that move over very large areas. The longest recorded straight-line movement involved two wolverines travelling from Daring Lake to the Lutsel K'e area, a distance of more than 300 km (Mulders 1999). In 1998, movements of some individuals corresponded with the general distribution of Bathurst caribou and wolves during winter (R. Mulders 1999 pers. comm.). Magoun (1985) found no evidence that Alaskan wolverines on the tundra followed migratory barren-ground caribou. However, young and transient individuals may adopt this behaviour, and resident wolverines will be drawn from long distances towards accumulations of food such as over-wintering caribou.

Wolverines are an important furbearer for local communities throughout the NWT and Nunavut. Most (70%) wolverines in the territories are hunted from snowmachines during winter (Mulders 1999). Harvests are typically centred around communities, although complete information on wolverine harvests is not collected, and no accurate estimates of the number of wolverines killed are available. In the recent past, RWED had a voluntary carcass submission program in the West Kitikmeot region. Hunters from Kugluktuk and Umingmaktok brought in 137 wolverine carcasses during the 1996-97 hunting season, and 139 carcasses in 1997-98, comparable to previous recorded harvests in the Kitikmeot (Mulders 1999). A winter road can become an area of concentration and a mortality sink for wolverines if they are attracted to gut piles left by human hunters. Few hunters pass up the opportunity to harvest wolverines, which have high-value pelts.

Issues related to the potential effect of the winter road on wolverines include:

- disturbance caused by winter road traffic and noise
- attraction of wolverines to food sources at camps and along the winter road, resulting in habituation of animals
- mortality (road kills)
- greater access for hunters, leading to potential overharvest (mortality sink).

5.7 Foxes

Arctic and red foxes are year-round residents of the Slave Geologic Province and the area of the winter road corridor. The southern distribution limit of the arctic fox is generally along the northern edge of the treeline. Arctic fox numbers fluctuate widely following changes in lemming populations, their primary food source (MacPherson 1969; Garrott and Eberhardt 1987). Red foxes, which are larger, have been known to displace arctic foxes in the barrenlands by taking over their dens and other limited habitat resources and food supplies (Rudzinski *et al.* 1982; Bailey 1992).

For much of the year, foxes live alone but they form temporary social groups during the breeding season. Pairs seek den sites beginning in February and March when the winter road is operational and are typically established at dens by early May after the winter road has closed for the season. Foxes require suitable substrate to establish their dens. In the barrenlands, fox dens are commonly found on eskers and other accumulations of glacio-fluvial materials. According to Dogrib elders, a high concentration of fox denning sites is found on glacial features between the north end of Mackay Lake and the southeast end of Lac de Gras (Dogrib 1998, 1999). Family groups focus much of their activity around dens until midsummer, when the pups begin to wander extensively. Juvenile foxes disperse in the fall.

Both arctic and red foxes are important species in the fur-trade. Arctic foxes are the main furbearers harvested on the barrenlands. Foxes are also frequently in conflict with people. Arctic and red foxes are active in the vicinity of the winter road during the seasonal construction and operating period, and are present year-round at all mine sites, camps and wherever people generate and dispose of garbage and food. Despite stringent regulations, history has shown that problems with people feeding foxes at mines, exploration camps and along the winter road are inevitable. Habituated foxes pose a health risk to humans. Arctic foxes are a primary vector of rabies, especially during the population highs that occur roughly every three years.

Arctic and red foxes are plastic in their behavior and tolerate high levels of human disturbance. Issues related to the potential effect of the winter road on foxes include:

- attraction of foxes to food sources at camps and along the winter road
- mortality (road kills)
- greater access for trappers.

5.8 Furbearers in the Boreal Forest

Furbearers occurring in the forested areas of the winter road corridor include marten, mink (*Mustela vison*), ermine, or short-tailed weasel (*Mustela erminea*), muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), river otter (*Lontra canadensis*), lynx and red squirrel (*Tamiasciurus hudsonicus*). Lynx and marten are the two species of highest value to trappers. Marten are the "bread-and-butter" species for trappers, and lynx have been especially important because of demand for long-haired furs.

Marten inhabit mature and old-growth forests and/or younger forests with adequate food and structural diversity. In the NWT marten will use sparse open forests if there is sufficient undergrowth and fallen trees to provide resting sites, under-snow spaces for winter hunting, and suitable habitat for prey (Latour *et al.* 1994). Generally marten avoid large clearings, although they may use natural clearings or small cut blocks with sufficient cover in summer.

Lynx follow the 10-year cycle of snowshoe hares and the distribution of hares directly influences the distribution of lynx. Lynx require forest cover for denning and can move over long distances, especially during low periods in the snowshoe hare cycle (Mowat *et al.* 2000). Northern furbearers produce some of the highest quality pelts in the world, and commercial trapping provides an important source of income for First Nations people in the region (GNWT 1998).

Riparian and water-associated species such as mink, muskrat, beavers and river otters have often been used as indicators of healthy ecosystems. Poole *et al.* (1998) recommended mink as a good indicator for assessing trends in environmental contaminants and ecosystem health in the western NWT.

Issues related to the potential effect of the winter road on furbearers include:

- winter habitat loss for lynx and marten
- disturbance and displacement of lynx and marten from important habitats caused by traffic and noise
- greater access for trappers into previously untrapped areas that are functioning as refugia (habitat and population reserves)
- accumulation of toxins in tissues of aquatic furbearers due to the ingestion of spilled industrial fluids.

5.9 Small Mammals and Hares

Small mammals and hares are an important component of the local biodiversity along the winter road. Arctic ground squirrel, brown lemming (*Lemmus sibiricus*) and collared lemming (*Dicrostonyx torquatus*), are typically found only on the barrenlands (Banfield 1974). Brown and collared lemmings exhibit cyclic population fluctuations and remain active year-round. The deer mouse (*Peromyscus maniculatus*), heather vole (*Phenacomys intermedius*) and chestnut-cheeked vole (*Microtus xanthognathus*) are found primarily within forested areas. Arctic hare, snowshoe hare, northern bog lemming (*Synaptomys borealis*), northern red-backed vole (*Clethrionomys rutilus*) and meadow vole (*Microtus pennsylvanicus*) are distributed throughout the winter road corridor area at varying densities. These species also exhibit cyclic population fluctuations.

In the north, small mammal populations tend to be cyclic, with large fluctuations in population sizes throughout the cycle. These fluctuations are often regular (every three to four years), with population peaks up to 200 times greater than the lows, depending on the species (Danell *et al.* 1998). The abundance of small mammals affects the behaviour, use of habitats and population dynamics of the species that prey on them. Small mammals are important prey for carnivores such as arctic and red foxes and for avian predators. These species are not migratory and many are available all winter, if foxes and wolverines can access them. Ground squirrels are consumed by all carnivorous species, including grizzly bears. They establish their burrows in glaciofluvial deposits, using eskers to a large extent. Ground squirrels hibernate, but wolverines have been known to dig them out of their burrows (Gardner 1985). Lemmings and voles remain active in the winter under the snow, and hares are active above ground throughout winter. People harvest hares, red squirrels and ground squirrels for food, and their skins.

Potential issues pertaining to the winter road on small mammals and hares relate to limited habitat loss and contamination of vegetation by spills of industrial fluids, which may subsequently become accumulated in the tissues of these species and concentrated in their predators.

5.10 Passerine Birds

Several species of sparrow, swallow, thrush, longspur, redpoll, and warbler nest in the area of the winter road corridor during the early summer. Many of these species are at the northern extent of their range. Most are migratory and spend only the short summer breeding season in the area. Spring bird migration northward begins in early May and peaks around mid to late May. The breeding season for passerines generally begins during the first week of June and continues until approximately late June. Fall migration southward begins in mid-August and continues through to mid-September (BHP 1995, 2000).

A total of 66 species of passerines occur along the winter road corridor during some part of the year (Bromley and Trauger *no date*). However, only seven species are considered to be year-round residents. These include Boreal Chickadee (*Parus hudsonicus*), Black-capped Chickadee (*Parus atricapillus*), Canada Jay (*Perisoreus canadensis*), Pine Grosbeak (*Pincola enucleator*), White-winged Crossbill (*Loxia leucoptera*), Red Crossbill (*Loxia curvirostra*) and Common Raven (*Corvus corax*) (Godfrey 1986; Bromley and Trauger *no date*).

Ravens are the only passerine that are commonly present along the winter road during the winter road construction and operating period. They are commonly found near the camps and other locations along the winter road where food wastes are present. Habitat reductions for passerines at the overland portages are considered to be small, localized and dispersed.

5.11 Raptors

The Slave Geologic Province supports a number of raptor species, including Golden Eagle (*Aquila chrysaetos*), Rough-Legged Hawk (*Buteo lagopus*), Peregrine Falcon (*Falco peregrinus*) and Gyrfalcon (*Falco rusticolus*). These species breed in areas with suitable cliff or hill habitat which are avoided by the winter road route. The *tundrius* subspecies of Peregrine Falcon is listed by COSEWIC as "vulnerable" (COSEWIC 1997). Confirmed breeders in the barrenlands include Peregrine Falcon, Gyrfalcon, Short-eared Owl (*Asio flammeus*) and Rough-legged hawk; Bald Eagle (*Haliaeetus leucocephalus*) may also breed in the area (BHP 1995; 2000). The density of raptor nests is highest in areas with greater topographic relief, more cliffs and, consequently

greater densities of nesting raptors, such as those southeast of Lac de Gras and the western shore of Contwoyto Lake (BHP 2000).
The southern section of the winter road corridor, below the treeline, likely represents the northern breeding distribution of tree-nesting species such as Bald Eagle, Osprey (*Pandion haliaetus*), Great Horned Owl (*Bubo virginianus*) and Northern Harrier (*Circus cyaneus*) (Godfrey 1986). Numerous bald eagle nests have been identified within the Yellowknife area and along the shores and islands of the east arm of Great Slave Lake (Searing and Alliston 1979). The Short-Eared Owl is a ground-nesting bird that may be found throughout the tundra and is listed as "vulnerable" by COSEWIC. The Snowy Owl (*Nyctea scandiaca*) can be expected to winter in the region, particularly in years when small mammal numbers are low (Godfrey 1986).

Other species of raptors occurring and nesting within the winter road corridor area include the Northern Goshawk, Sharp-shinned Hawk (*Accipiter striatus*), Red-tailed Hawk (*Buteo jamaicensis*), Merlin (*Falco columbarius*), American Kestrel (*Falco sparverius*), Hawk Owl (*Surnia ulula*), Great Gray Owl (*Strix nebulosa*), Boreal Owl (*Aegolius funereus*) and Long-eared Owl (*Asio otus*). Most species of raptors are thought to be fairly common along the winter road corridor, with the exception of Sharp-shinned Hawk, Northern Goshawk and Red-tailed Hawk, which are occasional visitors. In general, raptors are not present during winter road operation and are not affected by the winter road, as habitat losses at portages are small and dispersed.

5.12 Waterfowl

Waterfowl are common spring and fall migrants throughout the winter road corridor area. A number of species remain in the area to breed and nest in the many ponds and lakes. Ducks begin returning as soon as the ice begins to melt, using the shoreleads and ice-free wetlands. Mallards are normally the first ducks to arrive, with a mean arrival date in Yellowknife of May 27th (Bromley and Trauger *no date*).

During the spring, summer and fall, 29 species of waterfowl, including geese, swans, dabbling and diving ducks, are found throughout the lakes and wetland areas along the winter road corridor. Some of these species are Greater White-fronted Goose (*Anser albifrons*), Lesser White-fronted Goose (*Anser erythropus*), Ross' Goose (*Chen rossii*), Canada Goose (*Branta canadensis*), Tundra Swan (*Cygnus columbianus*), Gadwall (*Anas strepera*), American Wigeon (*Anas americana*), Mallard (*Anas platyrhynchos*), Blue-winged Teal (*Anas discors*), Northern Shoveler (*Anas clypeata*), Northern Pintail (*Anas acuta*), Green-winged Teal (*Anas crecca*), Canvasback (*Aythya valisineria*), Redhead (*Aythya americana*), Ring-necked Duck (*Aythya collaris*), Greater Scaup (*Aythya marila*), Lesser Scaup (*Aythya affinis*), Harlequin Duck (*Histrionicus histrionicus*), Surf Scoter (*Melanitta perspicillata*), White-winged Scoter (*Melanitta fusca*), "Oldsquaw" (Clangula hyemalis), Bufflehead (*Bucephala albeola*), Common Goldeneye (*Bucephala clangula*), Common Merganser (*Mergus merganser*) and Red-breasted Merganser (*Mergus serrator*).

Waterfowl densities along the winter road corridor are low compared to those in more southerly localities such as the southern prairie provinces (Bellrose 1980; CWS 2000).

The Canadian Wildlife Service conducts waterfowl surveys along the Yellowknife Highway (Highway #3) on an annual basis. Average waterfowl density along the highway is reported to be 21 pairs/km^2 (J. Hines 2001 pers. comm.). Empirical knowledge suggests that the densities along Highway #3 are likely higher than those along the southern end of the winter road corridor based on habitat availability (J. Hines 2001 pers. comm.; S. Moore 2001 pers. obs.)

Waterfowl species are not present in the winter road corridor area during winter. However, potential contamination of lakes and marshes by oil spills and other industrial pollutants and subsequent effects on birds are of concern. Many of the waterfowl species are hunted for food, especially during fall and spring migration and during the breeding season.

6.0 LAND USE AND HARVESTING

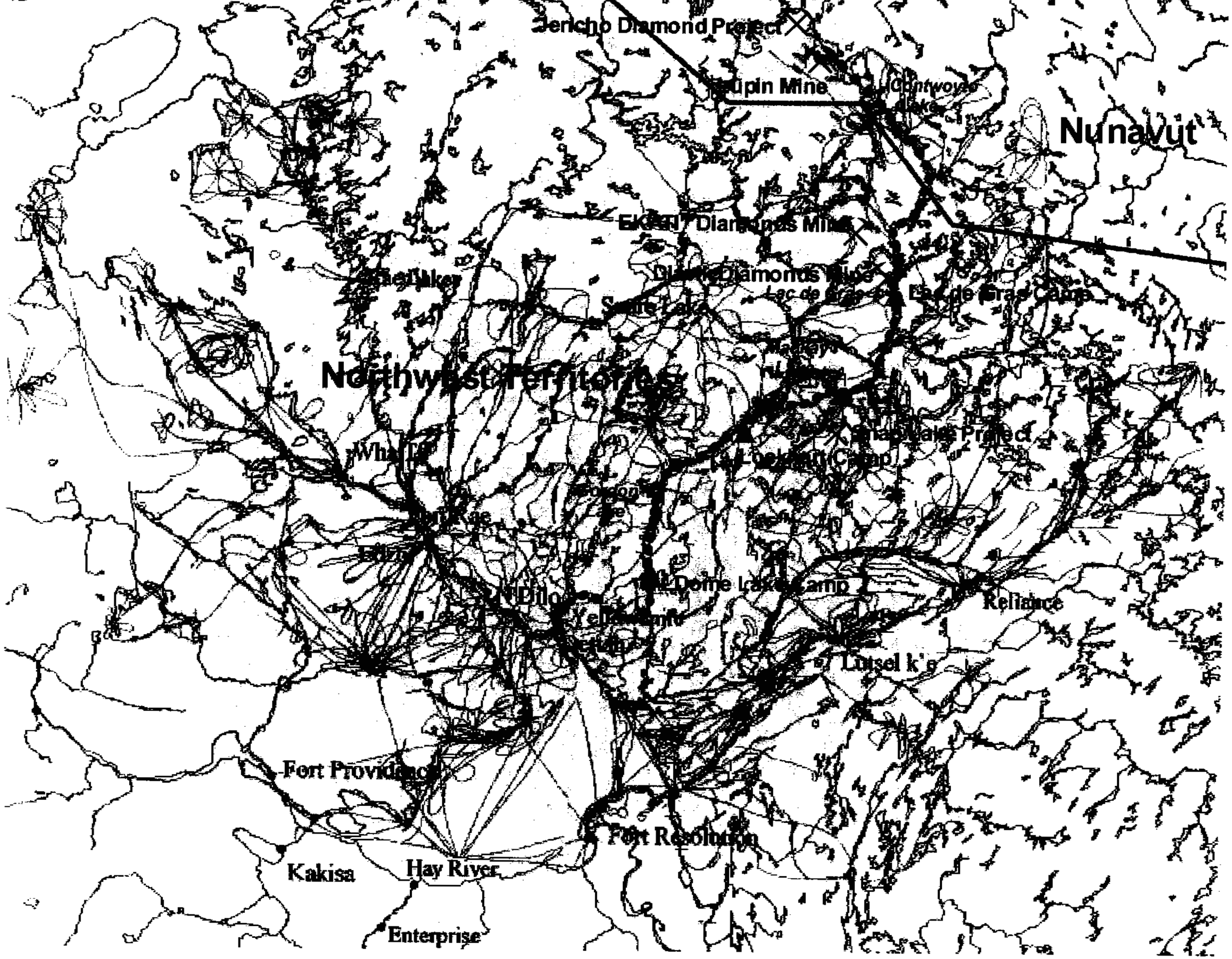
In recent times the Yellowknives Dene, Inuit and North Slave Metis have been the prominent users of the winter road corridor area. Dogribs from Rae and Snare Lake, and Chipewyan from Lutsel K'e trapped and hunted in some areas along the winter road corridor in the past and maintain an ongoing interest in these areas.

First Nations and Inuit have acknowledged the importance of traditional knowledge in describing baseline conditions in the distant and recent past and in developing management plans to avoid negative impacts on wildlife and their habitat resulting from development. A number of traditional knowledge studies are in various stages of completion. This discussion concentrates on First Nations and Inuit use of the area that includes the winter road corridor since the winter road has been in existence. The importance of the area before the existence of the winter road is interpreted from historical information.

6.1 Yellowknives Dene

The winter road follows a traditional Yellowknives Dene dogsled and canoe route along the Courageous River to the barrenlands north from Great Slave Lake (Figure 6.1-1). During late summer to early fall, hunters traditionally took canoes up the Weledeh (Yellowknife River) and other rivers. Their trails converged on camps at Gordon, Lockhart, Mackay, Courageous, Lac de Gras (Ek'ati) and Lac du Sauvage (Yellowknives 1997). During the fur-trade, the Yellowknives went into the barrenlands to hunt caribou and muskoxen and to trap white fox (arctic fox) at Courageous Lake, Mackay Lake, Lac de Gras, Lac du Sauvage and Coppermine River (Yellowknives 1997). The Yellowknives Dene called Contwoyto Lake, the "lake with many camps," referring to winter hunting settlements (Yellowknives 1997).

Fishing on the barrenlands was historically important during winter, to provide food for the sled dogs. The Yellowknives fished in areas where the waterways remained open during winter. Two important areas were channels south of Mackay Lake and the narrows between Lac de Gras and Ek'ati (Yellowknives 1997). Land use patterns began to change in the 1930s and 1940s when mine, town and dam developments were established. Caribou migration routes also changed, and fur prices declined. Dog team travel was longer and loads were heavier. More fish were required to feed the dogs, increasing the demand on the hunter. However, some Yellowknives Dene remained in the boreal forest near Yellowknife Bay throughout the winter, sustained by caribou migrating through this region in late fall and over-wintering. Trappers made a living along the corridor now occupied by the Ingraham Trail (Yellowknives 1997). Yellowknives Dene from N'dilo, Dettah and Yellowknife continue to actively hunt and trap within the winter road corridor.



Source: Dene First Nation
NWT Treaty #8 Tribal Corporation

Legend

Winter Road
Territorial Boundary
Dettah Trails
Mines
Camps

N

Approximate Scale
1 : 40 000

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Figure 6.1-1: Dettah Trails

6.2 Inuit

During the years of the fur-trade the Copper Inuit of the western Kitikmeot hunted caribou, wolf and wolverine in a swath from Bathurst Inlet to Contwoyto Lake (NTKP in prep. unpublished data; Inuit Land Use and Occupancy Project 1976). Contwoyto and the surrounding area became especially important as a winter camping area for many Inuit. Some Inuit returned to the coast during the spring to hunt seals, while others spread out across the barrenlands throughout the summer and returned to Contwoyto in the fall to hunt caribou (NTKP in prep.). This pattern of hunting continued up to the early 1970s (Inuit Land Use and Occupancy Project). Currently, several Inuit families still live year on the shores of Contwoyto Lake where they continue to use Contwoyto and Pellatt lakes for hunting wolf and wolverine during the winter, and for harvesting caribou during their spring migration.

6.3 Dogrib Dene

Past trapping and hunting activities of Dogrib encompassed a broad region within the boreal forest, with Marian Lake, the lower Marian River, Russell Lake, Snare River-Snare Lakes and the Lac La Martre winter road being major winter travel routes (Lutra Associates 1989; Dogrib 1998; 1999). The fur trade and high pelt prices for fox encouraged the Dogrib people to travel to the barrens to trap. Dogrib from the communities of Yellowknife and Snare Lakes continue to hunt and trap within the winter road corridor.

6.4 Metis

During the years of the fur-trade the Metis spread out across the barrens, trapping white fox in the winter, hunting muskox and fishing to feed their dogs. Trapping continued to be important into the 1960s, and the present. Metis from the communities of Yellowknife and Snare Lakes currently hunt and trap within the winter road corridor.

6.5 Current Harvesting

The Ministry of Resources, Wildlife and Economic Development (RWED) regulates hunting within the NWT. According to the NWT Wildlife Act and Regulations, hunting, which includes trapping, falls into one of three categories:

- subsistence hunting by holders of a General Hunting Licence (GHL)
- hunting by holders of a Resident Hunting Licence (RHL)
- guiding and outfitting of hunters who are not from the NWT, and who hold either a Non-Resident or a Non-Resident Alien hunting licence.

To be eligible for a GHL, a person must be a member of a family or a group that hunted lawfully in the NWT before June 30, 1953. Most holders of a GHL are Dene, Metis or Inuit. Subsistence hunting activities in the area of the winter road corridor are not recorded, and no registered traplines or registered trapping areas are present. RWED maintains fur sales records for each community but these are not related to areas of catchment. Local use of pelts, which can be extensive for some species, is not monitored except for wolverine carcass collections in western Kitikmeot communities.

6.5.1 Hunting and Outfitting

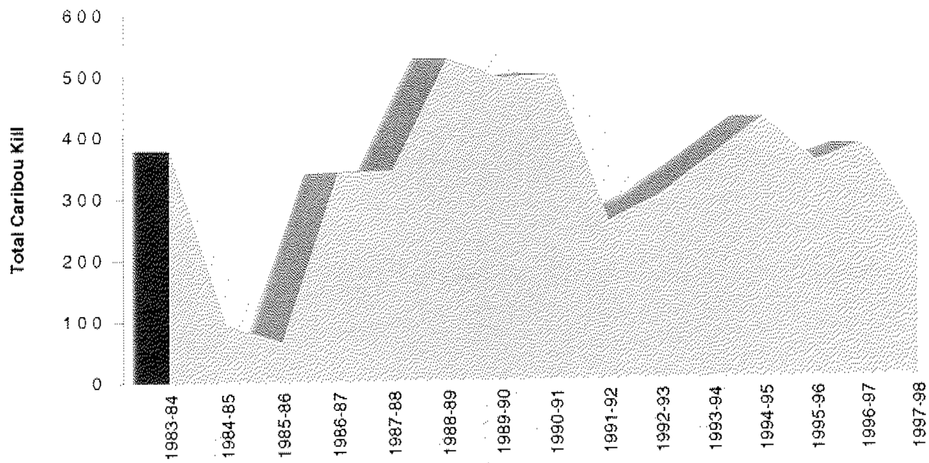
Hunters along the winter road corridor are primarily GHL holders from N'dilo and Dettah, Rae, Edzo and secondarily Lutsel K'e (Axys and Uma 1998). Yellowknives Dene camps at the north end of Gordon Lake and accessible from the winter road and are seasonally occupied for hunting, trapping and fishing. In the fall, access is by aircraft. In the winter, snowmachines and winter roads enable overland travel (Lutra 1987). The importance of caribou to Inuit and Dene, economically, socially and culturally, is substantial; however, information on the relative numbers of Bathurst caribou harvested by the communities are unknown.

The Inuit regularly travel across the tundra by snowmachine during the winter. A traditional Inuit hunting camp on Pellatt Lake is seasonally occupied for wolf hunting/trapping and outfitting opportunities. The camp may also be used for mineral exploration (Warners Arctic Services). Travel by Inuit south of Pellatt Lake is less frequent now but they continue to travel regularly to Contwoyto to hunt wolverines and wolves (NTKP in prep.). Their use of the north end of the winter road corridor is independent of the winter distribution of caribou to the south in the boreal forest.

Most caribou hunting is done in fall and winter when access by snowmachines is possible and the winter road is open. The importance of the winter road for hunting is a direct function of the winter distribution of caribou. If overland access to caribou is not available, as was the case in 1997, GHL holders may use aircraft to access caribou winter ranges (Axys and Uma 1998). In 2001 Bathurst caribou migrated to the south of Great Slave Lake and east of the Beaulieu River. Their presence near the winter road corridor was brief.

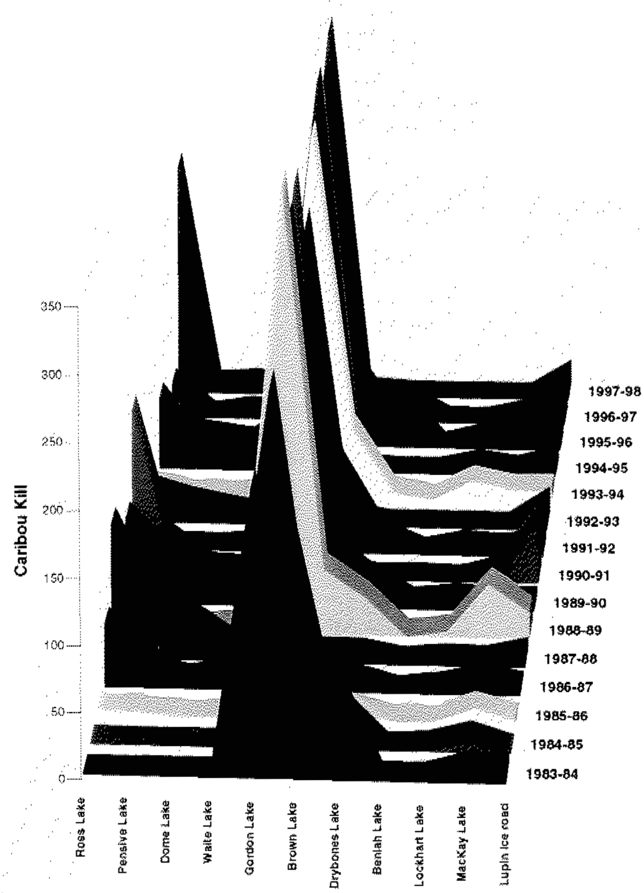
The open season for caribou for resident hunters extends from August 15 to April 30. Most (>95%) of all caribou harvested by resident hunters are obtained during winter, when caribou are in the winter road corridor (RWED records). Since 1983-84, the estimate of the annual harvest or caribou near the winter road has ranged from 66 to 537 (Figure 6.5-1).

The winter road provides important vehicle access for hunters. Between the winters of 1983/84 to 1997/98, most of the caribou hunting occurred along the southern quarter of the winter road, specifically between Waite and Gordon lakes, and Gordon and Brown lakes (Figure 6.5-2; RWED records). Harvests have also taken place at Ross Lake, and on a few occasions, at Mackay Lake.



Source: RWED Records

Figure 6.5-1 Estimated Annual Caribou Kill by Resident Hunters along the Winter Road from 1983 to 1998



Source: RWED Records

Figure 6.5-2 Estimated Caribou Kill by Resident Hunting Licence Holders in the Winter Road Corridor from 1983-84 through 1997-98

RWED wildlife officers monitor the winter road on a regular basis on weekends, and when caribou are near the winter road (RWED records). The Tibbitt Lake to Gordon Lake portion of the winter road where most of the hunting takes place. Few people hunt beyond Gordon Lake. On any given weekend, when caribou are present, between forty and fifty hunters are typically active along the winter road (Axys and Uma 1998, RWED records).

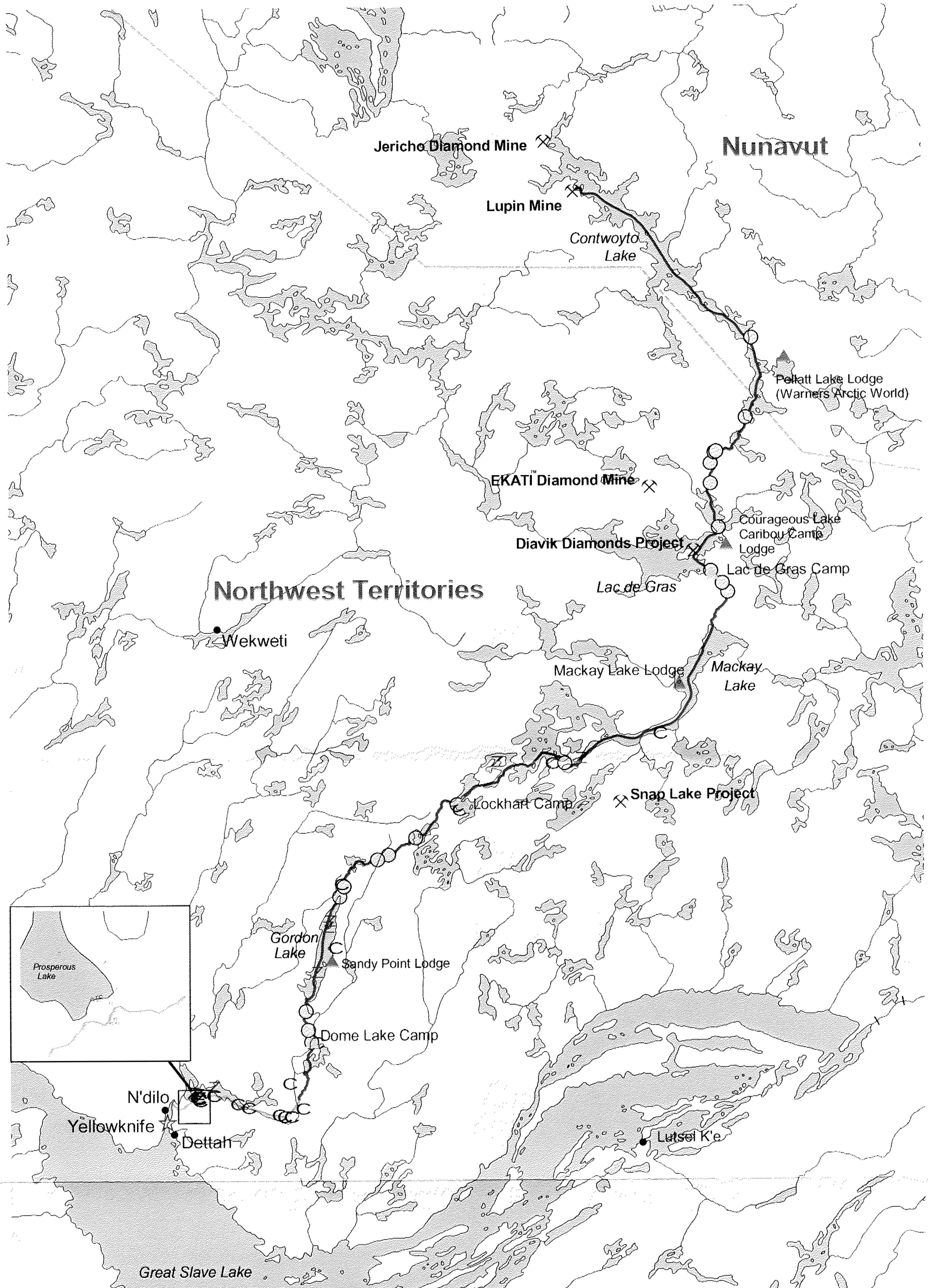
Some hunting pressure is also directed toward wolves and wolverines by resident hunters who hold tags for these species (Axys and Uma 1998). In the winter of 1997, when caribou were present, "quite a few" wolves and wolverine were taken from the winter road (Axys and Uma 1998).

Land leases and Outfitters licences are issued to Mackay Lake Lodge, Courageous Lake Caribou Camps, Sandy Point Lodge and Warner's Arctic World to carry out big game sport outfitting, sport fishing, nature tours and tourism operations on Mackay Lake, Lac de Gras, Gordon Lake and Pellatt Lake (Figure 6.5-3). These local outfitters are active for short periods during the year, particularly in late summer and early fall. Outfitters are known to use the winter road as a supply route for the transport of construction materials. DIAND records (2001) identified a total of 23 registered land use permittees and 9 unregistered users along the winter road corridor. Most are concentrated near the Ingraham trail, Tibbitt Lake, Gordon Lake and north to Mackay Lake (Figure 6.5-3). In addition, eleven occupied recreational leases are located on Tibbitt Lake adjacent to the winter road, and DIAND has identified 11 other camps north of Tibbitt, adjacent to the winter road (some of which may be Yellowknives hunting camps at the north end of Gordon Lake and others may be illegal/squatter camps).

6.5.2 Trapping

Residents of three communities – N'dilo and Dettah (Yellowknife) and Wekweti – have traplines that encompass the winter road corridor. From 1987-88 through 1998-99, most trappers were from Yellowknife (27 to 83 per year). Between 2 and 22 trappers came from Dettah and Wekweti each year (Figure 6.5-4). In 1999-2000 the value of furs harvested by Yellowknife trappers comprised 8.8% of the total NWT and Nunavut value, representing the highest contribution of any community.

Marten are the most valuable furbearer for trappers below the treeline. They are typically known as the "bread and butter" species for trappers, as the value of their pelts has remained consistently high and has allowed trappers to successfully maintain a subsistence lifestyle. In 1996-97, marten pelts made up more than one third of the total value of the $1.7 million fur harvest in the NWT. The total harvest and value of all species has decreased dramatically in recent years, dropping approximately 56% in value for all of the Northwest Territories and Nunavut, from $1.7 million in 1996-97 to $842,000 in 1999-2000 (RWED records). The average value of a marten pelt during recent 2001 fur sales has been about $53.



Source: DIAND records 2001

Legend

- Winter Road
- Ingraham Trail
- Territory Border
- Lakes
- Mines
- Maintenance Camps
- Lodges
- Borrow Pits
- Registered Users
- Unregistered Users

10 0 10 20 30 40 Kilometers

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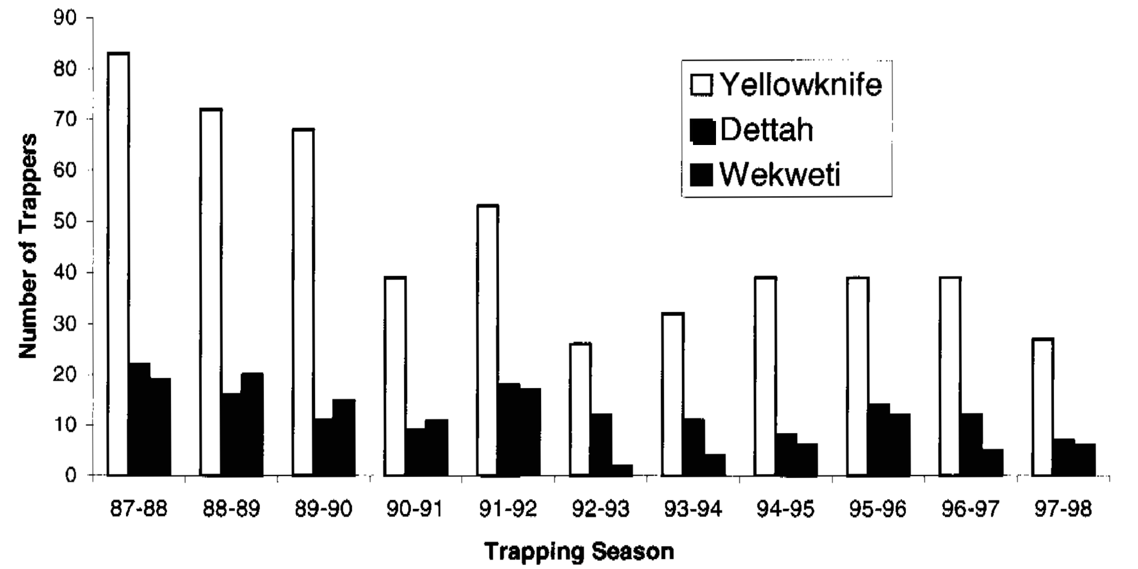
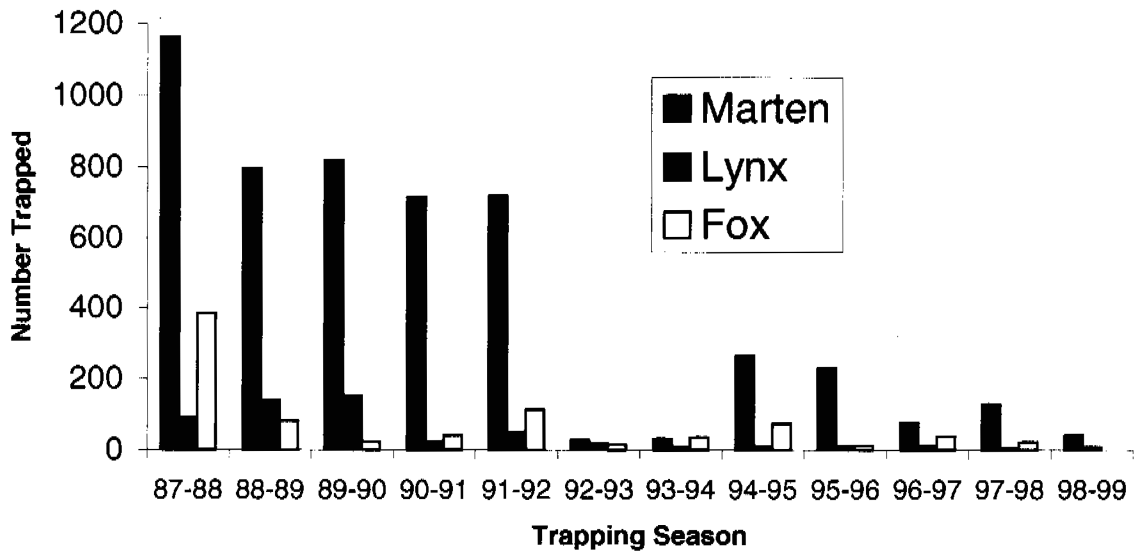
Figure 6.5-3 Mines, Lodges, Road Infrastructure and Cabins Along the Winter Road



Source: RWED Data

Figure 6.5-4 Number of Trappers from the Three Communities that Trapped in the Winter Road Corridor from 1983/84 through 1997/98



Source: RWED Data

Figure 6.5-5 Total Numbers of Marten, Fox and Lynx Pelts Sold for the Communities of Yellowknife, Dettah and Wekweti from 1987/88 through 1998/99

Marten consistently maintained the highest-value for trappers from Yellowknife, Wekweti and Dettah. In 1999-2000, they represented 60% to 80% of the total value of all furbearers for these communities, followed by lynx at 4% (Figure 6.5-5). The value of wolves and wolverine is not accurately reflected in fur harvest statistics, since many of the pelts are used locally. Typically most marten, lynx and fox pelts are sold at auction in the south.

The economic importance of lynx varies from year to year. In some years, the value of lynx has exceeded that of any other furbearer including wolves and wolverine. The average value of a lynx pelt during fur sales in 2001 has been about $93. Although market demand is unpredictable, lynx remains important to fur harvesters below the treeline.

Arctic foxes were of considerable economic value to earlier trappers and was one of the main resources that attracted people to the barrenlands (North Slave Metis Alliance 1999). Since the decline in fur prices, very few people still trap fox on a regular basis. In 2001, arctic fox pelts are selling for about $25.

Unlike foxes, wolverines and wolves still retain high economic importance. During recent fur sales (2001), wolverine pelts sold for an average of $363, and wolf, $235. In recent years, the NWT and Nunavat have been the top producers of wolverine pelts in Canada (Banci 2000). They are also the only jurisdictions in which a considerable number of pelts are used locally (Meredith and Todd 1979; Gunn 1986).

In the past decade, fur trapping has ceased to be a major economic activity for most people, largely driven by decreases in demand and drops in fur prices. For the Inuit, the DEW-Line and other government-sponsored construction programs provided wage employment opportunities more profitable than trapping. Year-round employment offered by the mines in the Slave Geologic Province and companies with both summer and winter exploration and drilling programs have also played a role in providing other opportunities for trappers.

6.5.3 Future

More hunting and trapping was carried out in the winter road corridor in the past than is occurring at present. There is always potential for activity levels to increase in the future. Trapping tends to be a cyclic activity, with people returning to the land as other opportunities ebb and flow (V. Banci pers. obs.). The Dene, Metis and Inuit are all active participants in guiding and outfitting ventures along the winter road. The demand for these types of operations is expected to increase in the future.

Despite the benefits provided by industry and technology, and the lure of high-paying jobs in the mining industry, First Nations retain a strong connection to the land. The land is an integral part of Aboriginal culture, and hunting and trapping constitute much more than the harvest of animals. Living off the land remains a strong sign of self-respect and demonstrates a commitment to maintaining traditional ties.

7.0 ARCHAEOLOGICAL RESOURCES

When the Lupin (now Tibbitt to Contwoyto) winter road was first used in the early 1980s, archaeological assessments were not conducted. More recently, a number of such assessments have been undertaken in the vicinity of the winter road, primarily in association with diamond exploration and development activities. This section briefly summarizes the state of knowledge regarding archaeological sites near the winter road prior to the completion of the summer 2001 archaeological survey of the winter road corridor.

The winter road traverses variable terrain that includes rocky lakeshore, open tundra and elevated landforms such as eskers. However, most of the roadway passes over frozen lakes, which are not of concern to this archaeological review. In addition to the portages, ancillary facilities such as some of the gravel pits and camps are situated on terrain with good archaeological potential.

High potential locations for the discovery of archaeological sites include eskers and the banks or terraces associated with lakes and rivers. Sites are most likely to be associated with well-drained landforms and locations that provide a strategic viewpoint for observation, including knolls. They may also occur in association with bedrock outcrops containing quartz veins or other materials suitable for stone tool manufacture, and at locations where caribou congregate to cross lakes or rivers. Sites will commonly be present along natural travel routes. The nature of the portages along the winter road corridor is such that most have potential for archaeological resources, since they are situated between lakes and represent natural travel routes. However, not all parts of all portages are expected to have sufficient archaeological potential to justify ground reconnaissance. The portages also represent potential for sites associated with historic and traditional activities, as do eskers.

Before mineral exploration and mining in the mid to late 20th century, most activity in the vicinity of the winter road corridor was largely limited to subsistence hunting, trapping and fishing. The Dene, Metis and Inuit have traditionally used the land traversed by the winter road corridor (DCI 1996; Dogrib Treaty 11 Council 2000; NSMA 1999; YDFN 1997; Riewe 1992). Seasonal camps and traditional use areas are associated with some of the portages and lakeshores. Some of the portages used for the winter road were likely also utilized in earlier times, including prehistory (prior to the written record). Preliminary discussions with the Yellowknives First Nation indicate that there are travel routes, burials and camp sites associated with this corridor. The work of Andrews and Zoe (1997) has confirmed that archaeological sites, as well as traditional sites, are associated with traditional trails. Archaeological investigations have demonstrated that some eskers served as travel routes for humans (and animals) through time. Many eskers contain evidence of human use in the form of archaeological sites.

The earliest references to human activities in the central NWT are found in the journals of 18th and 19th century explorers and adventurers who visited the region. Individuals such as Sir John Franklin (1969), Samuel Hearne (1958), George Back (1970), Warburton Pike (1892) and Frank Russell (1898) traveled the region searching for minerals and to explore and map the region and its resources. Pike (1892) is responsible for naming a number of topographic features near the winter road corridor, including Mackay Lake, Warburton Bay and Pointe de Misere.

Early archaeological assessments include investigations conducted by MacNeish (1951), Metcalf (1977, 1978), Morrison (1981, 1982) and Noble (1966 to 1969). Summaries of archaeological investigations and specific chronologies or attributes are provided in the work of Gordon (1996), Morrison (1982), Noble (1971, 1975) and Wright (1981). Gordon (1996) provides the most recent and comprehensive compilation of data on the archaeology of the barrenlands. His review of archaeological sites indicates that people have harvested caribou during their annual migrations for thousands of years. Gordon (1996: 12) states that this is evidenced at stratified sites on the tundra containing multiple occupations with artifacts to depths of 2 m and ages to 8,000 years B.P. (before present). A general overview of the status of archaeological resources in the Slave Geologic Province is provided by Ferguson (1999), but requires updating due to investigations conducted in 1999 and 2000.

As part of the archaeological review, it was requested that the Archaeological Survey of Canada (Canadian Museum of Civilization) conduct a search of the National Sites Inventory using a corridor extending 10 km to either side of the existing winter road surface area. Data were provided on approximately 19 sites within the 20 km wide corridor, but none were within the boundaries of the winter road or ancillary facilities. Excluded from this request for data were sites associated with the EKATI™ and Diavik diamond mines, since this information was already available in various reports. Also omitted (because the data were not yet available) were site records relating to the 2000 archaeological field work conducted south of Mackay Lake for De Beers Canada Mining Inc. However, Thomson (pers. comm. 2001) provided a summary of relevant site information and confirmed that one survey had located sites on and in proximity to the Tibbitt to Contwoyto winter road.

Thomson (1998, 1999a, 1999b, 1999c) conducted archaeological investigations associated with Kennady Lake in 1998 and 1999 for Monopros Limited, but his reports indicate that the sites are sufficiently distant from the winter road corridor. Earlier investigations at Kennady Lake by Fedirchuk (1996b) also yielded sites, but these are also well removed, as are sites found by Bussey (2000b) in association with the Snap Lake project. Fedirchuk (1996a) also conducted archaeological investigations northwest of Contwoyto Lake at the Jericho property (now known as the Tahera project area); again the sites are well removed from the winter road corridor. Reports by Fedirchuk (1995, 1997a, 1997b, 1999) and Bussey (1994, 1995, 1997a, 1997b, 1998, 1999a, 1999b, 2000, 2001) on work conducted around Lac de Gras were then reviewed to confirm the locations of sites. A few of the sites found by Fedirchuk or Bussey are near the winter road or ancillary facilities. As an existing facility, the winter road has not been the subject of systematic archaeological reconnaissance, but Figure 7.1-1 identifies areas where archaeological sites have been found at development-related spur roads connecting to the winter road or around development locations.

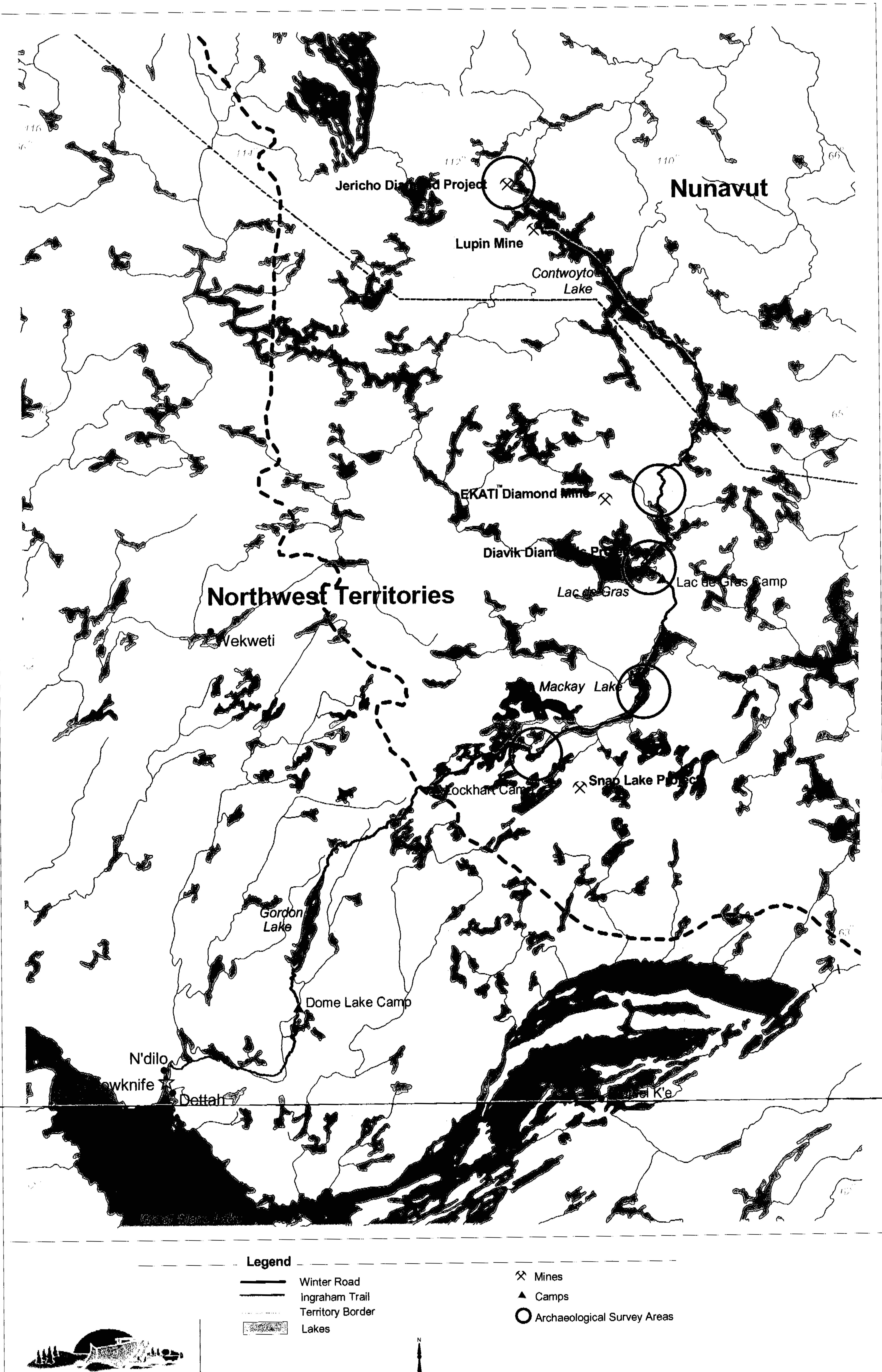


Figure 7.1-1 Survey areas where archaeological sites have been recorded near the winter road

The Nunavut Planning Commission Transition Team (1996) also determined that a number of sites were located near the winter road corridor, most on the shores of Contwoyto Lake. One of these sites, on the portage between Pellatt and Contwoyto lakes, has reportedly been disturbed by activities associated with the winter road. These sites are not recorded and are predicted to represent both archaeological and traditional locations.

Including the 2000 field work, more than 600 sites have been recorded as a result of the archaeological reconnaissance conducted for the Kennady Lake, Snap Lake and Lac de Gras projects. The majority of these sites consist of lithic or artifact scatters, that is, surface artifacts. Most of the artifacts are unworked flakes, also known as detritus or debitage, that represent pieces of stone knocked off in the process of manufacturing stone tools. The vast majority of the artifacts are quartz, but specimens of shale, chert, basalt and other materials have also been identified. Also recorded are camps, tent rings, hearths, isolated finds, quarries, workshops, lookouts and cairns or markers. A number of traditional and historic sites or features have also been identified, including cairns, hunting blinds, camps, axe or knife cut trees, tent rings, burials and cut poles.

Archaeological investigations suggest that occupation of the barrenlands could extend to 8,000 years B.P. (Wright 1976, Harp 1961, Noble 1971). The earliest cultural period is typified by lanceolate (long, narrow or lance-shaped) spear points of stone and is commonly referred to as the Northern Plano tradition. It is believed to have spread into the area from the south as the climate improved after deglaciation. Few Plano sites have been identified in the territories and no recorded sites from this time period are evident near the study area.

The period between approximately 6500 and 3500 years B.P. is also relatively poorly represented in the archaeological record. It has been referred to by a variety of names, including the Shield Archaic. Wright (1971, 1981) has suggested that the Shield Archaic developed from local Paleo-Indian complexes present in the region. This tradition is believed to be associated with a warming trend that may have prompted changes in animal and subsistence behaviour as a result of the expansion of forests. Characteristic stone tools include corner-notched projectile points, wedges and a variety of knives and scrapers. Known site distribution is broader than evidenced in the Northern Plano tradition (Gordon 1996), but no recorded sites associated with this period are located near the winter road.

Around 3500 years B.P., a cooler climatic period is postulated; noted at this time is the appearance of the Pre-Dorset or Arctic Small Tool tradition (ASTt). This tradition, unlike the two earlier ones, is identified as a Paleo-eskimo tradition that moved in from the north in response to changing climatic conditions. The stone tools associated with this tradition are noticeably smaller, thinner and better fashioned. Fine-grained chert appears to be the preferred lithic (stone) material for a number of tool types. Point characteristics include concave bases, triangular outlines and side-notches. Other tool types include wedges, scrapers, burins and knives (Gordon 1996; Noble 1971; Wright 1981). Variations of this tradition have been found throughout much of the subarctic (Gordon 1996) and a few sites near Lac de Gras are suggestive of this time period.

Around 2500 to 2600 years B.P., the ASTt was replaced by the Taltheilei tradition. This tradition is associated with Athapaskan occupation of the territories. Tools are commonly made of a grey siliceous shale or quartzite/quartz; specimens of chert, basalt, red slate and other materials have also been recovered. The use of native copper is associated with this tradition. The Taltheilei tradition is typified by a variety of point styles, including lanceolate and side- and corner-notched specimens. It is associated with barrenlands and forest environments and, as with the ASTt, involves heavy dependence on caribou hunting (Gordon 1996; Noble 1971; Wright 1971). It is suggested that the majority of the recorded archaeological sites near the winter road are likely associated with this tradition.

The Tibbitt to Contwoyto winter road study area extends far enough north that the Thule tradition may also be found in this later time period. Interior Thule culture relied heavily on caribou and fish. Associated is the use of semi-permanent sod and stone winter houses and extensive use of bone. The historic Copper Inuit evolved from Thule. Copper Inuit activity is known to extend to the winter road study area (Riewe 1992).

The archaeological field study of the winter road conducted during the summer of 2001 is expected to contribute significantly to the current archaeological database. It will also improve our understanding of the nature of impacts that can occur at different types of archaeological sites and will assist in the development of mitigation measures to more effectively protect these sites in the future.

8.0 SOCIO-ECONOMIC ENVIRONMENT

The winter road corridor traverses a relatively unpopulated region in the NWT and Nunavut. Communities most directly affected by the winter road are Yellowknife, Dettah and N'dilo. In addition, the West Kitikmeot communities of Kugluktuk, Umingmaktok and Cambridge Bay have an interest in the winter road. This section provides a regional overview of the people, demographics, human health, education, employment and income, economy and infrastructure of these communities. Information presented is drawn from a number of current sources, including the annual reports on community health and well-being prepared by GNWT.[1]

8.1 Regional Socio-Political Setting

Significant changes have taken place in NWT and Nunavut political institutions over the past four decades. After an era of political control by a distant Federal Government administered through the Roman Catholic and Anglican churches, the RCMP and the Hudson's Bay Company, a new political regime began to take shape near the end of the 1960s. The Government of the NWT (GNWT) was established as a result of a recommendation of the 1966 Carrothers Commission. Yellowknife became the new capital of the NWT in 1967. Political organizations such as the Indian Brotherhood, the Metis Association of the NWT, Inuit Tapirisat of Canada and Committee of Original Peoples Entitlement were founded in the early 1970s to serve the social and political interests of the Dene, Metis, Inuit and Inuvialuit, respectively. Aboriginal political organizations have continued to evolve, largely through the negotiation of land claims and Aboriginal self-government.

In 1999, the NWT was split into two territories. The new Nunavut Territory emerged from the settlement of the Nunavut Land Claim Agreement in 1994. The establishment of public government in Nunavut created a regional and community-based structure for government and political organizations in the West Kitikmeot communities of Kugluktuk, Cambridge Bay, Bathurst Inlet and Umingmaktok.

Following division, a smaller Government of NWT (GNWT) and numerous political organizations evolved to manage public and Aboriginal affairs in the new NWT. Unlike existing provincial governments, the public governments of the NWT and Nunavut are based on a consensus, rather than a bipartisan approach to decision-making. They are fiscally tied to the Federal Government, which provides the majority of their annual budgets. The territorial governments provide a wide range of services, including education, health, housing, wildlife management, economic development, justice and transportation. The GNWT and Government of Nunavut maintain regional, district and agency offices in Yellowknife, and Rae-Edzo, and Kugluktuk and Cambridge Bay, respectively.

[1]The GNWT/ BHP Socio-Economic Agreement requires annual monitoring of the impact of the EKATI™ Diamond Mine on 14 community health and wellness indicators in directly affected communities. Subject to the Agreement, the GNWT publishes an annual community health and well-being report.

In 2000, the Dogrib Treaty 11 Council signed a land claim and self-government agreement-in-principle. The ratification of a final agreement is imminent. Traditionally, the Dogrib occupied the Mackenzie Lowlands between Great Bear Lake and Great Slave Lake. Under the land claim, the Dogrib have selected lands around the communities of Wekweti, Rae Edzo, Gameti and Wha Ti. These four Dogrib communities have a combined population of about 2,500 people. Rae-Edzo is the largest, most economically diverse of the Dogrib communities, with about 1,662 residents. Dogribs from the communities of Yellowknife and Wekweti currently hunt and trap within the winter road corridor.

The Akaitcho Territory Dene First Nations (Akaitcho DFN) represents Yellowknives Dene in Dettah and N'dilo as well as Chipweyan Dene in Lutsel K'e, whose traditional lands lay along the winter road. N'dilo (est. pop. 209) and Dettah (est. pop. 190) are located on the northeast shore of Great Slave Lake adjacent to Yellowknife. N'dilo and Dettah have separate band council structures and administrations. They rely on Yellowknife for most retail, professional and personal services. Lutsel K'e (est. pop. 304) is on the east shore of Great Slave Lake, about 200 km by air east of Yellowknife.

In July 2000, the NWT Treaty #8 Tribal Corporation initialled a framework agreement on behalf of Akaitcho DFN. The agreement will guide the negotiations toward an agreement-in-principle respecting governance arrangements and land and resource provisions. Akaitcho DFN have identified an area of interest for a land and resource base that includes the winter road corridor. The area of interest refers to the current and traditional land use of the Yellowknives Dene and the Chipweyan from Lutsel K'e to a lesser degree.

The North Slave Metis Alliance formally represents the direct descendents of Metis who used and occupied land in the North Slave Region of the NWT before 1921. While this group does not include all of the Metis currently residing in the region, the North Slave Metis Alliance has asserted Aboriginal claim to a land base in the North Slave and is seeking recognition through regional claims processes. Currently, approximately 1,200 Metis live in the North Slave Region, most in Yellowknife. A smaller number live in Rae-Edzo, Lutsel K'e and Wekweti. The North Slave Metis continue to have a land interest in relation to the winter road.

8.2 Demographics

The winter road corridor passes through the North Slave Region of the NWT and the West Kitikmeot Region of Nunavut. Persons of Aboriginal ancestry comprise the majority (82%) of residents in West Kitikmeot, and an almost equal number of Aboriginal (48%) and non-Aboriginal (52%) people share the NWT. Between 1991 and 1996, populations in West Kitikmeot and the NWT have grown much faster than the national rate, increasing annually at 3.3% and 1.8%, respectively.

Yellowknife, N'dilo and Dettah are located about 70 km southwest of Tibbitt Lake where the winter road begins. The populations of Yellowknife, N'dilo and Dettah grew faster than the NWT average between 1991 and 1996. The trend is expected to continue through 2008, despite GNWT estimates for 1997-1999 that show no change in Dettah's population (195) and a decline in Yellowknife's population (17,702).

NWT and West Kitikmeot populations are young. In 1996, about 44% of the NWT and 53% of the West Kitikmeot populations were 24 years of age or younger. Yellowknife has the largest and fastest-growing Aboriginal population in the NWT. In 1996, Aboriginal people made up 20% of Yellowknife's population and 100% of N'dilo and Dettah populations.

8.3 Human Health and Well-being

The health and well-being of individuals and communities in the NWT and West Kitikmeot regions is influenced by a range of socio-economic and personal factors. Some of these are recognized as wellness indicators in socio-economic monitoring agreements signed by the GNWT and BHP Diamonds Inc. and Diavik Diamond Mines Inc. Although current mining developments and exploration activities in the Slave Geologic Province are generating considerable opportunities and benefits for the communities in the region, the general health and well-being of residents in the West Kitikmeot and NWT communities continue to lag behind the rest of Canada. The following is a brief review of selected regional and community indicators of these circumstances:

- Housing conditions are improving but overcrowding and inadequate accommodation continue in West Kitikmeot communities, N'dilo and Dettah.
- The number of children in care increased by as much as 50% in the NWT between 1993 and 1999.
- There is no overall pattern of reported family violence in NWT and West Kitikmeot communities. Reported incidents of spousal assault increased in Yellowknife by more than 46% between 1990 and 1999.
- The NWT suicide rate is 39% higher than in Canada. Suicide rates in West Kitikmeot are approximately three times higher than in NWT.
- The NWT crime rate is close to three times the national average. Assault-related violence is likely to be involved in almost 20% of reported offences in West Kitikmeot and NWT communities, compared to 10% in Canada (RCMP).
- NWT seniors experience poorer health compared to elderly persons elsewhere in Canada (Health and Social Services 1999).
- The rate of infectious diseases such as tuberculosis and STDs in the NWT are seven to nine times higher than in the rest of Canada (Health and Social Services 1999). Rates of STD in West Kitikmeot communities are more than twice the rates in the NWT.

8.4 Education

About 13% of the 1999 NWT working age population is considered to be illiterate (<Grade 9), compared to 19% in 1991 (Bureau of Statistics 1999 b; Statistics Canada). While education levels are improving, educational achievement is a significant issue for northern people. At least one-third of NWT residents have not achieved a high school graduation diploma. There is a significant disparity in grade achievement levels between Aboriginal and non-Aboriginal people and between residents of urban/regional centres and small communities. It is estimated that 26% and 55% of NWT Aboriginal adults are illiterate or have low literacy (<Grade 12), compared to 2% and 13% of non-Aboriginal adults. In small NWT communities, over half (54%) of the adult population is considered illiterate (<Grade 9) or as having low literacy (<Grade 12), compared to 18% in the Yellowknife population in 1999 (Lutra Associates 2000).

Although graduation rates have been improving in West Kitikmeot and NWT high schools, they are still far behind the Canadian average. Graduation levels of 40% or less from NWT and West Kitikmeot schools, leaving school early, illiteracy and low literacy levels in Aboriginal adult populations, are significant capacity issues faced in the NWT and West Kitikmeot. In response to this situation, one of the Joint Venture partners (BHP Billiton) has found it necessary to provide literacy training to assist in bringing people into the workforce.

8.5 Labour Force Participation

Labour force surveys (NWT Bureau of Statistics 1999 b; Nunavut Bureau of Statistics 1999) provide the most recent information on labour force activity in the NWT and West Kitikmeot.

In 1999, 78% of the NWT and 69% of the West Kitikmeot[2] working age population participated in the labour force. Labour force participation increased in both regions between 1994 and 1999. At the same time, the West Kitikmeot employment rate (81%) remained high compared to the NWT employment rate (67.5%).

Labour force participation and employment rates are very different between Yellowknife and smaller communities such as Dettah. For example, 1999 labour force participation of 86% and employment of 79.5% in Yellowknife, are well above NWT rates but have varied only slightly since 1994. By comparison, labour force participation of 64% and an employment rate of 48% in Dettah represent a significant increase since 1994. The growing labour force, higher education levels and improving employment circumstances in various economic sectors may account for the faster growing employment and labour force participation rates experienced in smaller NWT communities.

[2] Kugluktuk and Cambridge Bay

The employment rate for students completing high school, trades, diploma or university programs is significantly higher than for those with less than Grade 9 or without a secondary certificate.

8.6 Economic Activity

In 1996, the average NWT and West Kitikmeot personal incomes of $33,767 and $27,842, respectively, were above the Canadian average of $26,554. The income circumstances in NWT and West Kitikmeot communities are greatly influenced by the much higher northern living costs. For example, the cost of living in Yellowknife, N'dilo and Dettah is 20% to 25% higher than in Edmonton, and 70% to 80% higher in Kugluktuk and Cambridge Bay.

In addition, considerable disparity exists in the income distribution between large and small NWT communities (NWT Bureau of Statistics 2000). In Yellowknife, the average personal income was 24% above the NWT average. Average income in small communities near Yellowknife is almost one-half the NWT average.

Between 1995 and 2000, the annual average number of monthly NWT income assistance cases (1,502) and payments ($10.7 million) decreased by 29% and 26%, respectively. Income assistance payments in Dettah declined tenfold between 1995 and 2000. Changes to the Income Assistance Program instituted in 1996-97 and increased employment opportunities due to government and private sector developments may be contributing to a decreasing dependency on income assistance.

8.7 Community Services and Infrastructure

The extent of physical and organizational infrastructure in NWT and West Kitikmeot communities is directly related to the size and economy of the community. In smaller communities, physical, human and organizational infrastructure is available to meet basic day-to-day governance, health, education, protection, safety, housing and recreation needs. In larger centres such as Yellowknife, more complex physical, human and organizational infrastructure offers a variety of service and program options to meet a wide range of needs. Yellowknife is a "magnet community" in that it provides a wide range of specialized services to regions and communities both in the NWT and West Kitikmeot. For example, the Stanton Regional Hospital provides a range of medical services such as birthing and surgical services to residents in these communities.

Yellowknife, N'dilo and Dettah are strategically located at the north end of NWT Highway #3, which connects to NWT Highway #1 near the northern terminus of the Rail Link (railway line) in Hay River. Highway #1 continues south into Alberta to close the supply link with Edmonton. The highways are mainly paved/chip except for the 100 km section between Rae-Edzo and Yellowknife. From this point, the Ingraham Trail (Highway #4) extends a further 70 kilometres, linking to the winter road at the southern end of Tibbitt Lake.

A highway strategy outlines the GNWT's priority projects in the NWT (NWT Transportation 2000). The GNWT has committed to accelerating the construction and paving of the remaining section of NWT Highway #3 within four years. The GNWT will also pursue additional funding from the Federal Government to upgrade the Ingraham Trail. In his second budget address to the 14th Legislative Assembly, the Minister of Finance announced a commercial traffic toll to help finance needed upgrading of the NWT highway system.

Significant transportation and storage infrastructure, and its proximity to the winter road has positioned Yellowknife as the main staging centre for shipment of general freight, fuel and construction supplies to mines and mineral development camps along the winter road.

West Kitikmeot communities are isolated and accessible by scheduled or charter air service for passengers and freight from Yellowknife and by marine barge service for freight from Hay River. Like many other northern communities, West Kitikmeot communities have local truck delivery for water and sewage. Since 1999, the Government of Nunavut's decentralized/regional style of government has led to capital investment in new office and accommodation facilities in Kugluktuk and Cambridge Bay. At the present time, the winter road represents the only road link from the NWT to the mines and associated activities in the West Kitikmeot.

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GLOSSARY AND ABBREVIATIONS

Adaptive management A formal process of formulating and continually improving resource management policies and practices by learning from the outcomes of operational programs.

Air contaminant Any solid, liquid, gas or odour, or combination thereof, which, if emitted into the air, would create or contribute to the creation of air pollution.

Alluvial Clay, silt, sand and gravel material deposited by running water.

Ambient air quality The surrounding air quality present at a particular site.

Anthropogenic Caused by human activity.

Archaeological excavation An area of ground systematically dug out to collect archaeological information and artifacts.

Archaeological significance A site's potential to provide new knowledge and, specifically, to contribute to the existing archaeological database.

Archaeological site A location exhibiting physical signs of past human use, typically greater than 50 years in age.

ASTt Arctic Small Tool tradition; an early Inuit culture (also called Pre-Dorset) characterized by use of distinctive small tools, usually of chert.

Basal till Unsorted glacial debris at the base of the soil column where it comes into contact with the bedrock below.

Baseline studies Initial scientific investigations that determine the present ecological state of an area and establish a basic reference necessary for further studies.

Bedrock The more-or-less solid, undisturbed rock in place either at the ground surface or beneath superficial deposits of gravel, sand or soil

Benthos Assemblage of animals living in or on the bottom sediments of a lake and dependent upon the decomposition cycle for most if not all of its basic food supply.

Biface A stone tool worked on both sides or "faces"; also referred to as a formed biface, projectile point, knife, etc., depending on degree of modification, shape, function and other factors.

Biodiversity An expression that describes the relative variety of organisms or species that exists within an ecosystem, on a local, regional or global scale.

B.P. Before present – used to refer to age of archaeological materials or cultures; is generally relative to 1950.

Burin A stone tool characterized by a chisel-like working edge produced by the removal of a specialized flake called a burin spall.

Camp An archaeological site containing cultural material suggestive of a variety of activities and/or containing structural or hearth remains.

Canadian Ambient Air Quality Objectives (CAAQO) The objectives and standards for permissible air pollutant concentrations in parts per billion.

Canadian dollar $ or CDN$

Carnivore A flesh-eating animal. In the context of this report, grizzly bears, wolverines and wolves.

Centimetre cm

Closed mat tundra A common eco-system type consisting of unbroken vegetated tundra with average soil and moisture conditions. The most common plants include low shrubs such as dwarf birch, Labrador tea, crowberry, bearberry and willow.

Committee of the Status of Endangered Wildlife in Canada (COSEWIC) A committee that produces the official list of Canadian endangered species.

Cubic metre m^3

Cumulative effects Changes to the environment that are caused by an action in combination with other past, present and future actions.

Day d

Degree °

Degrees Celsius °C

Demographics The analysis of factors such as births, marriages, diseases and other vital statistics, which allow the assessment of a population in a given area.

Department of Environment (DOE) The Federal Government department responsible for ensuring that the environment is properly protected and conserved.

Department of Fisheries and Oceans (DFO) The Federal Government department responsible for protecting and maintaining healthy aquatic environments.

Department of Indian Affairs and Northern Development (DIAND) The Federal Governmental department responsible for programs that support the needs and interests of First Nations in Canada.

Detritus or Debitage The unworked flakes discarded during the manufacture of stone tools.

Drumlin An elongate or oval hill of glacial drift material, commonly till, deposited by glacier ice and having its long axis parallel to the direction of ice movement.

Ecosystem A community of interacting organisms considered together with the chemical and physical factors that make up their environment.

Environment The components of the earth including land, water and air, and all layers of the atmosphere. Also all organic and inorganic matter and living organisms and the interacting natural systems of such, including the cultural, social and spiritual components.

Environmental Assessment Report (EAR) A report completed by the developer describing the development, impacted environment, potential environmental effects and proposed mitigation.

Environmental Assessment and Review Process (EARP) The process previously used by the Federal Government to consider the environ-mental implications of all proposals for which the Federal Government had decision-making authority. This process reviewed and approved development of the EKATI™ Diamond Mine.

Ephemeral Stream A stream that lasts for only a short time.

Esker Sinuous ridge of weakly stratified gravel and sand deposited by a stream flowing in (or beneath) the ice of a retreating glacier, and left behind when the ice melted.

Features Non-portable artifacts of human construction; examples include hearths, tent rings and caches.

Flakes Fragments of rock discarded during core reduction or the manufacture of stone tools.

Food chain The transfer of nutrients and energy from one group of organisms to another, linked together in a series resembling a "chain".

Geographic Information System (GIS) A mapping tool that is used to depict large amounts of information in a spatial context.

Glacial till Stiff clay containing boulders, sand, and other rocks deposited by melting glaciers and ice sheets.

Glaciofluvial deposits Unconsolidated rock material deposited by melt water streams flowing from glaciers.

Global Positioning System (GPS) A sophisticated system used to define a precise geographic location with the aid of a satellite system.

Gram g

Grams per cubic centimetre g/cm^3

Grams per litre g/L

Greater than >

Greenhouse effect The phenomenon describing warming of the Earth's surface by trapping the sun's warmth in the lower atmosphere by "greenhouse gases" (e.g., carbon monoxide, carbon dioxide).

Graver A stone tool characterized by a narrow working edge produced by intentional retouch and intended for incising softer materials.

Groundwater Water found in soil or in pores, crevices, etc., under the ground.

Habitat Any area that provides food, water and/or shelter for an organism.

Herbivore An animal that feeds on plants.

Hectare ha

Historic Refers to the period of time for which there are written records; also referred to as post-contact.

Hour h

Hydrology The study of the properties of water and its movement in relation to land.

Impact Benefit Agreements (IBA) Benefits agreements negotiated between BHP and the four Aboriginal groups that have traditionally used the claim block: Dogrib Treaty 11; Akaitcho Treaty 8; North Slave Metis Alliance; and Inuit of Kugluktuk.

Independent Environmental Monitoring Agency An agency established in 1997 to serve as a public watchdog for environmental management at the EKATI™ Diamond Mine.

Infrastructure The basic structural installations used for operations (e.g., roads, buildings, water supply and sewage treatment facilities, etc.)

Isolated find An archaeological site consisting of a single artifact, whether an unworked flake, stone tool or other specimen.

Kame A mound, knob or short irregular ridge composed of stratified sand and gravel. The deposit can be formed by a subglacial stream as a fan or delta at the margin of a melting glacier, by a superglacial stream through a hole on the surface of the glacier, or as a ponded deposit on the surface or at the margin of sedentary ice.

Kettle A depression in a glacial deposit formed by the melting of a detached block of ice buried in the deposit.

Kilogram kg

Kilometre km

Kilometres per hour km/h

Lacustrine Pertaining to, or produced by, a lake.

Lanceolate A long, narrow "lance-shaped" biface or spear point.

Less than <

Lichen Any plant organism composed of a fungus and an alga in symbiotic association, usually of green, grey or yellow tint and growing on and colouring rocks, trees, roofs, walls, etc.

Lithic Stone

Lithic scatter An archaeological site consisting of unworked flakes and/or stone tools (also referred to as an artifact scatter).

Litre L

Littoral Region of a lake from the highest water level to the depth at which photosynthesis ceases, usually within the upper 10 m.

Lookout An archaeological site presumed to have served as a strategic location for viewing the surrounding terrain.

Metre m

Metric tonne t

Milligrams per litre mg/L

Millimetre mm

Mitigation An activity aimed at avoiding, controlling or reducing the severity of adverse physical, biological and/or socio-economic impacts of a project activity.

Moraine deposit An accumulation of earth materials carried by and finally deposited by a glacier.

Nutrient Any substance that provides essential nourishment for the maintenance of life.

Nutrient enrichment The enhancement of nutrients in a water body over and above the concentration that would be considered typical.

Oligotrophic Nutrient-deficient waters with low primary productivity. The vast majority of Arctic lakes are oligotrophic

Operational Environmental Management Plan (OEMP) A general plan that outlines environmental practices and policies followed at the EKATI™ Diamond Mine. Covers all major environment-related issues such as environmental monitoring and the management of air quality, materials, wildlife and aquatic life.

Open mat tundra An ecosystem type characterized as having patchy, un-vegetated terrain (boulders and rocky outcrops) with an open map of dwarf birch and prostrate shrub vegetation.

Percent %

Permafrost A soil or rock layer that has been frozen for at least two years.

Plano tradition Refers to a Paleo-Indian culture characterized by distinctive lanceolate-shaped spear points.

Plus or minus ±

Prehistoric Refers to the period of time prior to written records; also referred to as pre-contact.

Quarry A location where outcroppings of a lithic material suitable for stone tool manufacture has been quarried or mined.

Reclamation Any activity aimed at rehabilitating a disturbed site.

Resource Wildlife and Economic Development (RWED) Territorial government department responsible for the management of wildlife resources.

Retouch A type of modification used in the manufacture of stone tools.

Revegetation Introduction of new vegetation on disturbed or barren ground.

Riparian area The wet soil areas that border a stream, lake or wetland.

Scraper For the purposes of this study, a stone tool worked intensively on one face or side assumed to have been used to scrape hides and other materials; often called a formed uniface when it has been intentionally shaped.

Sedge Any grasslike plant with triangular stems, usually growing in wet areas.

Shield Archaic A culture that follows and may be ancestral to the Plano tradition.

Square kilometre km^2

Sustainable Development Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Taltheilei tradition A culture that is associated with the Athapaskan occupation that followed the Arctic Small Tool tradition.

Tent ring A ring of rocks presumably used to hold down a tent or tipi-like structure.

Tonne T

Total suspended particulates (TSP) Airborne particles with a diameter of less than 30 microns, collected by a high-volume air sampler and recorded as micrograms per cubic metre of air ($\Phi g/m^3$).

Total suspended solids (TSS) The weight of solids suspended in a known volume of water (e.g., mg/L).

Toxicity The inherent potential or capacity of a material to cause adverse effects in a living organism.

Traditional Environmental Knowledge (TEK) As defined by the Den Cultural Institute: *"a body of knowledge and beliefs transmitted through oral tradition and first hand observation. It includes a system of classification, a set of empirical observation about the local environment and a system of self-management that governs resource use. Ecological aspects are closely tied to social and spiritual aspects of the knowledge system."*

Tundra Habitat typically found in the Arctic, north of the treeline, that is adapted to cold temperatures, a short growing season and low precipitation. Typical tundra vegetation includes moss, licen, Labrador tea and small shrubs.

U.S. dollar US$

Watershed An entire geographic area that contributes surface and ground-water to a particular lake, river or stream.

Wedge A stone tool characterized by bipolar battering and flaking to produce a double wedge shape, may be worked on all edges forming a disc; inferred use is for splitting antler and bone.

Wedge A stone tool characterized by bipolar battering and flaking to produce a double wedge shape, may be worked on all edges forming a disc; inferred use is for splitting antler and bone.

Wetland A swamp, march or other land that is usually water-saturated.

West Kitikmeot Slave Study Society (WKSS) A society located in Yellowknife that deals largely with research focused on a mineral-rich area that stretches north of Yellowknife to the Arctic Ocean.

Workshop Archaeological site containing a significant quantity of lithic material suggesting intensive use of locally available stone to manufacture tools or tool blanks/preforms.