Appendix

(to be included as part of the Wolverine Advanced Exploration Program Level III MLU Upgrade Application)

Expatriate Resources Ltd.

WOLVERINE ADVANCED EXPLORATION PROGRAM

WILDLIFE CONSIDERATIONS

November 2004

TABLE OF CONTENTS

Summary v
1.0 Introduction 1
2.0 Wildlife Resources and Previous Wildlife Studies Within the Project Area 1
2.1 Woodland Caribou 2
2.1.1 Ecotypes 2
2.1.2 General Habitat Requirements and Usage Patterns 3
2.1.3 Previous Studies 3
2.2 Moose 4
2.2.1 General Habitat Requirements and Usage Patterns 4
2.2.2 Previous Studies 4
2.3 Wolves 5
2.3.1 General Habitat Requirements and Usage Patterns 5
2.3.2 Previous Studies 5
2.4 Bears 5
2.4.1 General Habitat Requirements and Usage Patterns 5
2.4.2 Previous Studies 6
2.5 Thinhorn Sheep 6
2.6 Furbearers and Small Carnivores 6
2.7 Small Mammals 7
2.8 Birds 7
2.8.1 Waterfowl/Waterbirds 7
2.8.2 Raptors 7
2.8.3 Ptarmigan 7
2.9 Critical/Sensitive Habitats 7
3.0 Potential Project Effects on Wildlife 8
3.1 Potential Effects of Proposed Program and Corresponding Mitigation Measures 8
3.1.1 Caribou 9
3.1.1.1 Access Effects 9
3.1.1.2 Habitat Effects 9
3.1.1.3 Disturbance Effects 10
3.1.1.4 Trail Traffic Effects 11
3.1.2 Moose 12
3.1.2.1 Access Effects 12
3.1.2.2 Habitat Effects 12
3.1.2.3 Disturbance Effects 12
3.1.2.4 Trail Traffic Effects 12
3.1.3 Wolves 12
3.1.4 Bears 13
3.1.5 Furbearers and Small Carnivores 13
3.1.6 Birds 13
3.2 Potential Cumulative Effects in Program Area 14
3.2.1 Development and Mining Activities 14
3.2.2 Exploration Activities 14
3.2.3 Other Activities 15

4.0 Conclusion 15
5.0 References.....15
6.0 Appendix.....18
Figure 1: Map of project area with existing and proposed access routes.
Table 1: Summary of potential effects of proposed Wolverine Advanced Exploration Program and mitigative measures.

SUMMARY

Expatriate Resources Ltd. is currently planning mining operations within the Finlayson District west of the Robert Campbell Highway. This area is located midway between Ross River and Watson Lake in southeastern Yukon. To complete feasibility studies for the proposed Yukon Silver-Zinc Project, Expatriate needs to conduct an advanced exploration program at their Wolverine property. This advanced exploration program requires the development of an underground test mine.

The Finlayson region has high wildlife value due to its geographic location and its variety of ecosystems and habitats contained therein. The local populations of woodland caribou and moose are particularly important for the local First Nations. This report describes general ecology of these and other wildlife resources in the region and summarizes existing information from previous studies on these wildlife resources. Using this information, the effects of the proposed advanced exploration program on wildlife are assessed and potential mitigative measures are suggested to reduce such effects.

1.0 INTRODUCTION

Expatriate Resources Ltd. (Expatriate) is currently planning mining operations within the Finlayson District of Southeast Yukon (Expatriate Resources Ltd. 2004). The project area is roughly midway between the communities of Ross River and Watson Lake, immediately west of the Robert Campbell Highway.

A component of the Yukon Zinc-Silver Project, Applied Ecosystem Management Ltd ("AEM") carried out a study of the wildlife for the proposed underground Wolverine mine area. It has been recognized there is a diverse wildlife in the Wolverine deposit area; which has led to this review. In AEM's Wolverine Advanced Exploration Program Wildlife Considerations Report, Anderson et al. (2001) concluded that in isolation, the proposed Yukon Zinc-Silver Project (formerly referred to as the Finlayson Project), does not appear to cause adverse effects on the local wildlife populations; however, that all care must be undertaken to ensure development and mining activities do not introduce a measurable negative influence on the local environment. Recommendations to mitigate impact on the local environment and wildlife was summarized and can be found presented in Table 1.

In order to complete feasibility studies for the proposed Yukon Silver-Zinc Project, Expatriate needs to conduct an advanced exploration program at their Wolverine property. This advanced exploration program requires the development of an underground test mine for the purpose of assessing ground conditions and underground mining costs. Facilities necessary for test mining at the Wolverine site consist primarily of underground development, laydown areas for equipment and materials, a waste rock stockpile, a borrow area for aggregate, and settling ponds for runoff and water management. An existing airstrip will be utilized for air traffic. Multi-season ground access is not required at this time to support the advanced exploration work. A temporary winter access route will be rehabilitated off of the Robert Campbell Highway, which leads to the Yukon Silver-Zinc Project (Figure 1). The rehabilitated temporary winter access is approximately 32 km long. The advanced exploration program, including test mining, is expected to last approximately 6 to 8 months with additional follow up activities based on the results of the exploration program. Expatriate had contracted Applied Ecosystem Management Ltd. (AEM) in 2001 to assess the potential effects of the proposed Wolverine Advanced Exploration Program on wildlife and to suggest mitigative measures to reduce such effects.

2.0 WILDLIFE RESOURCES AND PREVIOUS WILDLIFE STUDIES WITHIN PROJECT AREA

The Yukon Silver-Zinc Project area occurs at the southern extent of the Tintina Trench at the intersection of three ecoregions, the Pelly Mountains, Liard Basin, and Yukon Plateau North ecoregions (ESWG 1995), and includes boreal, subalpine, and alpine environments. Within a single Yukon ecoregion, environmental gradients created by elevation perhaps exert the strongest control over the distribution of vegetation communities. In the Yukon Silver-Zinc Project area the definition of boreal zone refers to the forested, low elevation valley bottoms and low-lying terrain surrounding Finlayson and Wolverine Lakes. Most waterbodies and wetlands are associated with this zone. Subalpine zone refers to the zone between the relatively closed-canopy forests in the boreal zone and the dwarf shrub, herb, and non-vegetated rock areas in the

alpine zone. It should be recognized that the subalpine zone represents a btrail gradient between these low and high elevation conditions; the subalpine environment is dominated by tall shrub vegetation with scattered spruce and fir forests at its lower limits, grading into lower stature shrub and herb communities at upper elevations. The alpine zone is defined by treeless conditions with rock, low shrub, and herb communities being characteristic features. Similar to most areas of Yukon, wildfire exerts an important control over the distribution and seral stage of vegetation communities in the area.

General physiographic conditions within the project area range from the low lying, rolling topography near Finlayson Lake to the high elevation, rugged terrain of the Pelly Ranges. Elevation ranges between approximately 1000 – 2000 m above sea level within the general project vicinity, with treeline occurring between 1300 – 1500 m. Discontinuous permafrost underlies much of the area.

The Finlayson region contains high wildlife values, likely owing to its location with respect to the intersection of the three ecoregions, the range of topographical features on the landscape, and the juxtaposition of various habitats. Although a comprehensive species inventory and local ecosystem mapping have not been completed for the project area, considerable information on wildlife resources and habitat values has been gathered. Primary information sources include studies on caribou, wolf, and moose population dynamics conducted over the past 20 years by YTG Renewable Resources (e.g. Farnell & McDonald 1988; Jingfors 1988; Larsen & Ward 1995; Hayes et al. 2000; Hayes & Harestad 2000). Information available from these studies includes published and unpublished reports, caribou survey data and population distribution, and radio-tracking results. General information on wildlife in the Finlayson region and specifically the Kudz Ze Kayah and Yukon Silver-Zinc Project areas was also gained through discussions between Expatriate representatives and the Department of Renewable Resources, Fish and Wildlife Branch. Baseline wildlife survey programs have also been implemented by Expatriate and its predecessors to identify critical species and their habitats and to provide or supplement existing information sources (e.g. Cominco 1996). Other potential sources of data that exist but have not been explored fully include local First Nations trapline returns and licensed hunt databases.

The following sections will synthesize any previously collected information on various wildlife species or species groups. Due to the quantity of information and value to local First Nations groups, resident sport hunters, and the Yukon guiding industry, emphasis will be placed on caribou, moose, wolves, and bears. For these species, general habitat requirements and usage patterns will also be outlined.

2.1 Woodland Caribou

2.1.1 Ecotypes

Several subspecies of caribou exist within Canada. Barrenground caribou (e.g. Porcupine and Bathurst caribou herds) include three subspecies: Arctic Island caribou (*Rangifer tarandus pearyi*), continental tundra caribou (*Rangifer tarandus granti*), and Canadian barrenground caribou (*Rangifer tarandus groenlandicus*) (Mallory & Hills 1998). These caribou are gregarious, forming herds sometimes numbering in excess of 10,000 animals, and typically exhibit long-distance migrations between open coniferous habitats during the winter and tundra calving grounds in the

summer. Although they may forage on herbs, mosses, willows, and grasses, terrestrial reindeer lichens are the preferred food source, particularly on winter ranges.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recognizes three ecotypes of the woodland caribou subspecies (*Rangifer tarandus caribou*) (COSEWIC 2000), which have characteristic adaptations and tremendous variation in behaviour, habitat use patterns, and morphology (Dzus 2000). The *boreal ecotype* includes non-migratory animals found in coniferous forests and muskeg throughout parts of Yukon, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and Newfoundland. In contrast to barrenground caribou, the boreal ecotype woodland caribou typically occur in small herds of 3 to 5 animals, occasionally numbering up to 20 or more. The primary winter forage of this ecotype is terrestrial lichens. The *northern mountain ecotype* includes those animals found in more mountainous terrain of northern British Columbia, Yukon, and Northwest Territories. Northern mountain caribou are moderately gregarious and undertake short-distance migrations from alpine and subalpine calving and summer ranges to winter ranges in low elevation lodgepole pine/black spruce forests. Within these winter ranges, the caribou forage on terrestrial lichens. The *southern mountain ecotype* inhabits mountainous terrain in southeastern British Columbia and west central Alberta. Similar to the northern mountain ecotype, these animals undergo short migrations between summer and winter ranges. However, the southern mountain ecotype forages primarily upon arboreal lichens during winter and may return to higher elevations to do so as the snowpack deepens. Although the latest COSEWIC classification identifies west-central Alberta populations as the southern mountain ecotype, they are more similar to the northern mountain ecotype in their migratory and food habits as well as habitat utilization patterns (Edmonds & Bloomfield 1984; Brown & Hobson 1998).

2.1.2 General Habitat Requirements and Usage Patterns

The Finlayson Caribou Herd belongs to the northern mountain ecotype of the woodland caribou. Caribou give birth to a single calf (rarely twins) on ridges and upper slopes of subalpine basins in late May. Small aggregations form by mid-June in the uplands and upper forests where the caribou remain throughout the summer. From late spring through the summer, caribou utilize many of shrub and herb vegetation types as well as open-canopy subalpine fir forests on valley slopes.

Rutting aggregations form in early October and occupy the uplands (ridges and plateaus), including the upper elevations of the project area. At this time, caribou may utilize any of the alpine shrub and herb vegetation types. After the rut, caribou disperse throughout the area and occupy the alpine, subalpine, and upper forests until late fall (mid-November), utilizing a wide range of vegetation types. By mid-November, caribou start to move down into the boreal forest, including open-canopy black spruce forest vegetation.

By December-January, caribou have moved down to their traditional winter range in the Pelly River lowlands. This winter range includes the boreal forest along the Robert Campbell Highway north of the project area. In early to mid-May, caribou once again move to higher elevations, following the receding snow to their upland calving areas.

2.1.3 Previous Studies

The Finlayson Caribou Herd is highly valued as a subsistence base for the Ross River Dena, by resident sport hunters, by the Yukon guiding industry, and for their own intrinsic value.

Accordingly, this woodland caribou herd has been the subject of a significant management effort by the YTG Renewable Resources department since the early 1980s when caribou population numbers were declining. Although wolves prey primarily upon moose in the study area (Hayes et al. 2000), wolf predation is also an important factor in caribou calf survival. Data from 1982 to 1997 show a significant negative correlation between wolf numbers and calf survival. A wolf control program was implemented between 1983 and 1989 out of concern for the declining caribou population. In conjunction with wolf control, sport hunting was limited to bull caribou and First Nations hunters were encouraged to select male over female caribou. Annual monitoring of the caribou herd (population surveys, rut surveys, radio-collaring) by YTG is ongoing.

During wolf control, the wolf population was substantially reduced in the area occupied by the Finlayson Caribou Herd, allowing the herd population numbers to increase. The Finlayson herd rebounded from a low of approximately 1,800 adults in the early 1980s to an estimated 4,500 by 1990 and stabilized at approximately 4,000 adults by the mid 1990s (Farnell et al. 1998). Approximately 1,000 to 2,000 caribou inhabit the general region around the project area. Woodland caribou use of the Kudz Ze Kayah and Wolverine Lake areas shows high variability as between 66 and 552 caribou were counted in the general project areas during annual rut surveys throughout the 1990s.

In co-operation with YTG Renewable Resources, both the Kudz Ze Kayah and Yukon Silver-Zinc Projects conducted baseline ungulate surveys in the immediate project area. Aerial surveys were flown in 1995 and 1996 to document caribou distribution and numbers at key periods of the year, corresponding to late winter, calving, post-calving aggregation, and rutting activity. Additional information on caribou was also obtained during a 1995 moose survey. The survey data provided key population characteristics (such as peak calving date, post-calving calf:cow ratio, and numbers on rutting range). Most upper subalpine and alpine areas surrounding Wolverine Lake and the Kudz Ze Kayah mine site are considered Key Habitats by YTG Renewable Resources for the Finlayson Caribou Herd during the fall rut; however, survey data indicates that limited calving and post-calving aggregation activity occurs in or immediately adjacent to the Yukon Silver-Zinc Project area.

2.2 Moose

2.2.1 General Habitat Requirements and Usage Patterns

Moose (*Alces alces*) utilize forested vegetation types during much of the year, particularly in the winter when they inhabit the lowlands along Finlayson Creek down to the Robert Campbell Highway. Riparian forests and closed conifer stands provide important browse and thermal cover during this time. Tall shrub vegetation types are also utilized into the winter period. During spring to fall, moose are widely distributed throughout the area and can occur in any of the vegetation types. Alpine areas are infrequently utilized due to their poor cover and food availability. During the rut and post-rut, moose occupy upper subalpine basins and utilize the tall shrub vegetation types and the open-canopy subalpine fir forests. One or occasionally two calves are born during late spring each year.

2.2.2 Previous Studies

Finlayson region moose are also an important resource for the user groups identified above, including the Ross River Dena, as YTG surveys in 1992 showed densities in the Frances Lake area

to be among the highest (381 moose/1000 km^2) recorded in Yukon (Larsen and Ward 1995). During wolf control, the regional moose population increased from 3,000 to 10,000 animals (Farnell et al. 1998). Data on moose distribution and numbers were also obtained through baseline aerial surveys flown in March and November 1995 to document late-winter and post-rut distribution. Additional data on moose were obtained during the course of caribou surveys. Moose may occur on the Kudz Ze Kayah and Wolverine properties throughout the year. Moose are well dispersed in the project area during summer and early fall but tend to congregate in post-rut groups in the upper elevations around the project area. The information indicates that moose spend early winter in the project area and may remain into late winter during some years.

Moose represent 94% of the biomass killed by wolves in the Finlayson area (Hayes et al. 2000) and the population dynamics of these two species have been examined intensively as a result of the wolf control program implemented during the 1980s. As moose calves are preyed upon most frequently by wolves, it is not surprising that calf recruitment into the breeding population decreases as wolf densities increase (Hayes et al. 2000).

2.3 Wolves

2.3.1 General Habitat Requirements and Usage Patterns

Wolves (*Canis lupus*) are found in most forested and tundra habitats. Pack sizes in east-central Yukon range from 2 to 20, with a mean of about 6.5 (Hayes et al. 2000). Large ungulates dominate their prey base, though they forage occasionally on smaller mammals such as beaver, snowshoe hare, and ground squirrel. An average of 6 pups (Hayes & Harestad 2000) are born in late April/early May in den sites excavated into ridges, in old beaver lodges, in shallow rock caves, or in hollow trees.

2.3.2 Previous Studies

Similar to most areas of Yukon, wolves play an important role in the Finlayson region. They are considered to be the primary predator of caribou and moose and thus have been studied intensively by YTG Renewable Resources. The wolf control program between 1983 and 1989 was successful in reducing the wolf population by approximately 85% (Farnell and Hayes 1992). During the control program, the caribou calf to cow ratio increased as did calf survival and total population size. Following the control program, the wolf population was monitored to examine recovery rates and within six years wolf numbers recovered to pre-control levels (Hayes & Harestad 2000). This quick rebound was attributed to increased pup survival and decreased dispersal during the early years of population recovery. These studies also revealed that kill rates of wolves on moose are best modeled by the number of packs and pack sizes and are unrelated to prey density or snow depth (Hayes et al. 2000).

During previous wildlife studies, wolves or their sign were observed infrequently around the Kudz Ze Kayah and Wolverine properties. Any wolf sitings were scattered throughout the uplands of the area. It was acknowledged, however, that mineral exploration activities concurrent with the 1995 baseline fieldwork programs may have discouraged wolves from fully utilizing some portions of the Yukon Silver-Zinc Project area.

2.4 Bears

2.4.1 General Habitat Requirements and Usage Patterns

Grizzly bears (*Ursus arctos*) are found in mountainous and tundra terrains in northern and western Canada. They emerge from hibernation in March and utilize lower elevation forests, meadows, and wetlands in the spring where they forage on early green-up vegetation. As the snowpack recedes, they move to higher elevations where they forage above the treeline for much of the summer. Subalpine and alpine habitats are particularly important during late summer and fall for the variety of berries that can be found throughout these environments. Grizzlies enter dens, often excavated into alpine slopes, in late fall where they remain until the following spring. Sows breed every two or three years and give birth to one or two young in their dens in January.

Black bears (*Ursus americanus*) are most common in forested habitats below treeline. Sows breed every two years and typically produce two or three young in January or Febuary. They emerge from hibernation in late winter/early spring and spend the summer foraging on vegetation, berries, insects, and carrion. Dens are excavated under tree roots, in banks, or in hollow logs and hibernation usually begins in late October. Black bears are typically more tolerant of human development than are grizzly bears.

2.4.2 Previous Studies

Both grizzly and black bears can be found throughout the entire Finlayson area and were occasionally observed near the Kudz Ze Kayah and Wolverine properties during baseline wildlife data collection programs. In north Yukon, grizzly bear home ranges are generally very large and it is likely that one or two grizzlies include the project area as part of their home ranges. No bear den sites were observed during previous wildlife surveys. Grizzlies range throughout the open valleys, subalpine, and alpine environments of the region, and may occur in any portion of the project area. Black bears are more abundant in the lower forests toward Finlayson Lake and the Robert Campbell Highway. Black bears are not expected to be common in the project area because of the predominance of high elevation subalpine and alpine habitats.

2.5 Thinhorn Sheep

Key habitats for thinhorn sheep (*Ovis dalli*) include winter ranges, lambing areas, rutting grounds, mineral licks, and migration corridors. These habitats are critical because they are limited in extent and are used repeatedly by the sheep. Thinhorn sheep inventories were not carried out in either the Kudz Ze Kayah or Wolverine Lake baseline programs, but incidental sightings were recorded. YTG sheep surveys flown in 1986, 1988, and 1995 suggest that sheep utilize portions of the Campbell Range to the east of Wolverine Lake as late winter range and lambing areas. Between 41 and 72 individual sheep were surveyed during these flights but all occurred outside of the Yukon Silver-Zinc Project area. The mountains southwest of Wolverine Lake and north of Money Creek are also believed to be used by sheep as a lambing area and a summer range for nursery bands. A small portion of the mountain range has been designated as a Key Habitat for sheep; however, baseline vegetation mapping for the Yukon Silver-Zinc Project does not indicate that this area contains high sheep values.

2.6 Furbearers and Small Carnivores

Beavers (*Castor canadensis*) are moderately abundant in small lakes and ponds of the project area and can be expected throughout the lower and mid-elevation streams and ponds. Other furbearers and small carnivores that were not recorded during previous wildlife programs but which

are known to occur in the region and expected to occur in parts of the project area include coyote (*Canis latrans*), lynx (*Lynx canadensis*), red fox *(Vulpes vulpes*), wolverine (*Gulo gulo*), marten (*Martes amaricana*), short-tailed weasel (*Mustela erminea*), least weasel (*Mustela nivalis*), mink (*Mustela vison*), and river otter (*Lutra canadensis*).

2.7 Small Mammals

No direct information was collected for small mammals in the project area. Similar to most areas of Yukon, snowshoe hares (*Lepus americanus*) occur throughout the region and inhabit most forested and shrub habitats throughout the boreal and subalpine zones of the project area. Ground squirrels (*Spermophilus parryii*) occur on subalpine slopes in the area. One observation of a grizzly bear foraging for ground squirrels was recorded in the Kudz Ze Kayah project area. Both snowshoe hares and ground squirrels represent an important prey base for numerous avian and mammalian predators. No information is available on mice and voles.

2.8 Birds

2.8.1 Waterfowl/Waterbirds

Waterfowl use of the immediate project area is limited to the few scattered ponds and larger waterbodies and suitable wetlands are restricted to the small lakes and ponds at the top end of Geona Creek and South Creek. However, the Finlayson Lake/River area and the east slope of the Pelly Mountains form part of the important Tintina Trench migration corridor, used extensively by waterfowl and other waterbirds on their north-south migrations. For example, trumpeter swans (*Cygnus buccintor*) are known to migrate through the Finlayson River valley and breed in the lakes and potholes throughout the Pelly lowlands. Greater white-fronted geese (*Anser albifrons*) also migrate through the Pelly River and Finlayson River valleys in significant numbers from late August until mid-September. Migrating northern phalaropes (*Phalaropus lobatus*) were observed in small numbers on ponds near Wolverine Lake. Approximately 200,000 Alaskan and Siberian breeding sandhill cranes (*Grus canadensis*) migrate northward through the study area in May and June and return southward between late August and late September. Common loons (*Gavia immer*) are also known to occur on Wolverine Lake.

2.8.2 Raptors

Golden eagles (*Aquila chrysaetos*) were observed on numerous occasions during the baseline wildlife programs. Bald eagles (*Haliaeetus leucocephalus*) and gyrfalcons (*Falco rusticolus*) have also been observed in the Kudz Ze Kayah – Wolverine Lake area. No raptor nest sites or family groups were observed in the immediate project footprints during previous studies.

2.8.3 Ptarmigan

Ptarmigan (*Lagopus spp*.) are common in the project area and all three species of ptarmigan (willow, rock, and white-tailed) may occur within the region. The various willow, willow/birch, and subalpine fir/shrub habitats provide abundant cover and food for willow ptarmigan during the breeding season and into the fall. Shrub communities are utilized in the winter for food and cover by all three species.

2.9 Critical/Sensitive Habitats

With the current limited extent of vegetation mapping and the lack of a regional framework in which to evaluate the project, it is very difficult to assess habitat rarity and sensitivity. Within the immediate project area, the most sensitive and potentially important habitats for a range of species include wetlands, open waterbodies, and riparian shrub and forest communities. These habitat types are also of limited spatial extent in the Finlayson area; however, it is not currently possible to quantify their regional distribution. Most upland forest, shrub, and alpine habitat types that occur within the immediate project area are expected to be common throughout the region.

3.0 POTENTIAL EFFECTS OF THE ADVANCED EXPLORATION PROGRAM ON WILDLIFE

The Wolverine and Kudz Ze Kayah wildlife programs were developed to: provide necessary information to assess wildlife resources and habitat values in the study area; provide the basis for an assessment of the potential effects of mine development, operation, and decommissioning; and provide a baseline for future monitoring activities. The intent of the programs was not to provide a complete inventory of all wildlife in the project area, but rather to identify important species and their habitats and to supplement existing information sources collected by government agencies. The amount of baseline wildlife information collected for the Kudz Ze Kayah and Wolverine (Yukon Silver-Zinc) Projects, in addition to YTG Department of Renewable Resources information, represents some of the most extensive ungulate baseline data collection performed in Yukon. Both types of wildlife programs were focused on species of regional concern, woodland caribou and moose. These data sources, as summarized in the previous sections, will form the basis for an assessment of the potential effects of the Wolverine Advanced Exploration Program.

General habitat requirements that should be considered in such an assessment include forage availability, cover, travel corridors, territory size and boundaries, etc. in addition to the critical components (rutting and calving grounds, nesting sites, etc.) that were evaluated in previous studies. An understanding of the regional availability of these general habitat requirements is necessary to most accurately assess potential effects to wildlife resulting from the Wolverine Program. It should be noted, however, that information for the project area is lacking with respect to regional ecosystem information. Ecosystem mapping for the region may allow direct and potential project effects to be quantified. The following assessment makes use of existing information to identify potential program effects and is qualitative in nature only.

3.1 Potential Effects of Proposed Program and Corresponding Mitigation Measures

The primary wildlife concerns associated with increased resource development related to the Wolverine Advance Exploration Program are:

- Increased hunting and predation pressure facilitated by new access trails (access effects);
- Alteration or loss of habitats such as winter ranges and nesting areas (habitat effects);
- Disruption or displacement of critical wildlife functions such as breeding and migration (disturbance effects);
- Increased animal-vehicle collisions (trail traffic effects).

The following sections deal with the potential effects of the program on wildlife (see Table 1 for a summary). Mitigation and management measures proposed in this report have been drawn largely from previous work done for the Kudz Ze Kayah Project. These strategies were developed by Cominco Ltd. through extensive consultation Renewable Resources biologists and Ross River Dena Council.

3.1.1 Caribou

3.1.1.1 *Access Effects*

Although increased access to caribou range may be somewhat beneficial for First Nations sustenance hunters, the potential for unsustainable harvest (legal or illegal) and uncontrolled recreational activity over the duration of the trail life (potentially < 2 yrs solely in winter months) may be detrimental to the Finlayson Caribou Herd. Accordingly, YTG Renewable Resources and the Ross River Dena have identified increased access to the traditional range of the herd, especially along their migration route to winter range, and the potential for increased harvest as the primary concern of resource development in the Finlayson area.

As the access trail would be rehabilitated from the Robert Campbell Highway to the existing exploration trails on the Wolverine property, it will be afforded the same protection measures to restrict access during the winter months of operation. A security station post with 24-hour guard will be maintained near the junction with the Robert Campbell Highway. Only authorized vehicles are allowed on the trail and there is a 'No Hunting' or 'Fishing' policy for company employees. This arrangement will be in place when the access trail is first used in January 2005 and should be very effective at mitigating the potential effects of increased hunting and recreational activity on local wildlife populations. The importance of maintaining a manned station cannot be under-stressed as gates alone are not necessarily an effective access prevention method (R. Anderson, pers. obs.).

Research on interactions between wolves and boreal woodland caribou has revealed that linear corridors may act to increase wolf hunting efficiency (James 1999). However, as the proposed trail avoids traveling directly through key caribou habitat, noticeable increased predator efficiency from the trail is not expected.

3.1.1.2 *Habitat Effects*

No rare habitat types were identified during the Wolverine (Yukon Silver-Zinc) Project vegetation survey and all habitat types encountered appear to be typical of the region. The proposed program will, nonetheless, result in short-term and long-term direct habitat loss for caribou in the Finlayson region. Caribou depend on subalpine basins and ridges for calving and on high ridges and plateaus for rutting. Most calving activity occurs outside of the project area and habitat on rutting ranges adjacent to the development area will not be directly affected by the project. The proposed access trail from Robert Campbell Highway to the Wolverine site is expected to directly impact less than 12.0 hectares of boreal and subalpine habitat because of the existing footprint. Since the habitat that will be effected by the program is common and widely distributed in the region, and the program area is not designated as Key Habitat for caribou, the direct loss of a small amount of habitat should not be detrimental to caribou populations.

A larger effect may arise, however, from a functional loss of habitat. Studies have shown short-term changes in the movement and distribution of woodland caribou in response to

hydroelectric development (Northcott 1985), timber harvesting (Chubbs et al. 1993), simulated oil and gas exploration (Bradshaw et al. 1997), and haul-trail activity (Cumming & Hyer 1998). Long-term avoidance of landscape features resulting from resource development activities (e.g. seismic lines, trails, harvested or otherwise fragmented habitats) have also been noted for woodland caribou in northeastern (Dyer 1999; James and Stuart-Smith 2000) and west-central Alberta (Smith 2000; Oberg 2001). The distance to which these disturbances will have been avoided ranges from a few hundred metres to several kilometres, depending on the magnitude of the disturbance. Dyer (1999) found reduced use of habitat near trails for boreal caribou in northern Alberta. This avoidance affect varied by habitat type and season. In open habitat, caribou used areas within 500 m of a trail less than expected throughout the year. In closed habitat, avoidance ranged from 250 m in the winter (high trail activity) to 100 m in the summer (low trail activity). Oberg (2000) found similar trail avoidance with mountain ecotype caribou in west-central Alberta, where caribou showed less than expected use within 100 m of inactive trails. Avoidance of active trails was not tested. Based on a conservative estimated avoidance area of 500 m on either side of the access trail, 1800 ha may receive less use that expected by chance. This does not, however, mean that this 1800 ha will receive no use by caribou.

Recent work by Oberg (2000) revealed that mountain caribou avoided streams by up to 250 m. The observation database provided by Renewable Resources indicates very few caribou sightings in the vicinity of the proposed access trail corridor. As much of this corridor parallels streams from the Robert Campbell Highway to Wolverine Lake, it may be that the lack of sightings in the area is related to Oberg's findings. If caribou naturally avoid this area, functional habitat loss from the proposed trail, which parallels streams for much of its length, may be limited.

Since the area of direct habitat loss within the proposed exploration mine site is expected to be small (less than 1 ha), short-term mitigation of habitat effects for the mine site will focus on minimizing the disturbance of caribou and potential functional habitat loss. Such mitigation measures are described in detail below (Section 3.1.1.3 Disturbance Effects).

Over the long term, direct habitat loss will be mitigated through closure and reclamation procedures. Access trails and staging areas used for this program will be closed according to standard operation practice in Yukon. Surfaces will be scarified if required and all ice bridges removed. Stockpiled organic materials such as brush and trees will be placed on the scarified surface in a random manner to create an uneven surface. Large boulders will be moved onto the surface when available. Stream crossing areas will be crossed in such a way to minimize streambank erosion and potential sedimentation of streams. However, scarified surfaces will only be seeded in areas where ground stability or potential stream sedimentation is a concern. Most portions of the trail will be allowed to revegetate naturally from trailside seed sources, thereby returning the area to a more natural state. Because a portion of the access trail that forms part of the proposed access route is swamp to bog, upon completion of the project no permanent access to the Wolverine site will remain.

As terrestrial lichen is notoriously slow to regenerate and woodland caribou prefer old-growth forested stands with relatively high lichen abundance, caribou use of reclaimed mine and trail areas may be limited by forage availability for several decades. However, as the total area

of disturbance is relatively small and the area is not located within the main wintering area, the loss will not likely have a noticeable effect on winter forage availability for the herd.

Deactivation of the trail will limit access to the area and will limit passage through the program area with motorized vehicles. Reclamation procedures should assist in initiating the natural regeneration process. As the footprint of the proposed project is relatively small in size, it will directly disturb only a small percentage of caribou habitat in the Finlayson area and will likely have little direct effect on habitats that are critical to caribou reproductive activities. The functional habitat loss is considerably harder to quantify and is expected to affect a larger area.

3.1.1.3 *Disturbance Effects on Energetics and Movements*

In addition to disturbance-related habitat effects, access construction and exploration activities may affect caribou through increased energetic requirements (due to increased movement rates, decreased feeding, etc.) or through barrier effects to movement.

Several studies have addressed the energetic effects of disturbance on caribou (see Dyer 1999 for a review). Disturbance from human activity related to trails, oil wells, and aircraft have been found to influence caribou behaviour, which in turn has the potential to increase energetic demands. Information from 1995 surveys and from previous YTG radio-collar location surveys indicates that the main calving and post-calving aggregation areas are to the south of the project area (Figure 2). Likewise, key rutting areas are several kilometres west of the test mine site. Given the distance between the mine site and the upland calving, post-calving, and rutting areas, the majority of development and mining-related activity (truck traffic, machinery, heavy equipment operation, and camp/office operation) should not interfere with caribou calving or rutting activity. Winter has been suggested as the period in which caribou are most susceptible to increases in energetic cost (Bradshaw et al. 1997). As the winter range of the Finlayson herd lies to the northwest of the project area, disturbance effects are not expected to be large during this critical time.

Effects on movement may be important during other sensitive periods such as calving, post-calving, and during the rut. Dyer (1999) found that trails may act as semi-permeable barriers to movement within homeranges for boreal woodland caribou. Based on simulated random movement within an animal's homerange, Dyer found that caribou crossed trails less than 40% of expected. Unfortunately there is no similar study of the barrier affects of trails on mountain-ecotype caribou. However, low traffic volume on the access trail, combined with an access corridor that does not appear to bisect core areas of a particular seasonal range, should mean that barrier effects of the trail will be limited. Caribou in the Finlayson area are known to disperse after the rut and inhabit the uplands and lower slopes into mid-November. During this time, caribou occur in varying numbers in the general project area. The project is not expected to interfere with movements of caribou between their upland calving, summer, and rutting ranges and winter range in the Pelly River lowlands as movement to the winter range should be in a north-westerly direction, away from the proposed mine site. Additionally, movements towards the winter range will likely correspond with freeze-up on Wolverine Lake. Traffic on the access trail during this time will be very light as the lake will be unusable for barge traffic or ice trail development. However, the access trail will be monitored during mid-November to early-January and April to May to provide site-specific data for managing this potential effect.

To prevent the disturbance of caribou outside the mine site or trail, employees will not be allowed to construct any unnecessary trails or operate motorized recreational vehicles. Occasional aircraft traffic to the Wolverine airstrip would not be close to the caribou calving areas; nonetheless, limited aerial activity periods will be enforced during caribou calving (May to early June) and rutting (October) seasons.

3.1.1.4 *Trail Traffic Effects on Mortality*

Vehicle and truck traffic along the access trail have the potential to increase caribou mortality through collisions. Measures to reduce the potential for collisions will include:

- driver education,
- setting and enforcing speed restrictions during the migration periods,
- posting warning signs at locations with the greatest potential for animal collisions;
- reporting animal locations by radio to the security gate and other drivers, and
- adjusting speed and frequency of traffic during particularly high risk periods.
- "right of way" and "minimum distance" provisions for caribou crossing the access trail.

No vehicular animal mortalities have been reported for the Kudz Ze Kayah Trail since its construction.

3.1.2 Moose

3.1.2.1 *Access Effects*

Increased access has been identified by YTG as a concern for local and regional moose populations. This potential effect can be managed by controlling access, as outlined above for caribou. Use of the trail as a travel corridor by wolves may impact predation rates in the local area; however, regional effects are expected to be small.

3.1.2.2 *Habitat Effects*

Direct habitat loss is expected to have a minimal effect on moose. The area comprising the mine site provides spring, summer, and fall habitat for moose. As with caribou habitat, the removal of this small amount of moose range in the mine area is not expected to be substantial. Moose are generally more tolerant of human activity than caribou and often use disturbed sites as they begin to regenerate. Hence, the area representing functional habitat loss is not expected to be significantly larger than the area of direct habitat loss.

The effect of habitat removal for the trail and test mine site is expected to represent only a relatively short-term habitat loss extending until shortly after decommissioning. Natural regeneration is expected to return these disturbed sites to productive moose habitat within 10 years after decommissioning. Reclamation activities, including re-grading and seeding/planting, will help decrease this short-term effect. In instances where the initial habitat was mature forests, the younger successional stages occurring after mine closure may actually benefit moose.

3.1.2.3 *Disturbance Effects on Energetics and Movements*

A potential exists for displacement of moose from habitat as a result of construction and mining activities as moose may react by staying out of the mine site and immediately adjacent

area. The mine site, however, is not expected to create a complete barrier to moose movement either during or after mining. The mine site is relatively small and compact and large mammals will be readily able to move around the mine site features. It has been shown that some large mammals adapt very quickly to the presence of industrial activity and readily move through and around a mine site (e.g. Echo Bay's Lupin Mine, Cominco's Red Dog Mine). Animals will still be able to travel through the adjacent areas to access the upper subalpine basins, which are used during the rut and post-rut. The lower portions of these subalpine basins and the lower valley slopes are used by moose for calving and will also still be accessible. Limited aerial activity periods will also benefit moose in the project area.

3.1.2.4 *Trail Traffic Effects*

Mortality from collisions with vehicles along the access trail has the potential to effect the local moose population. Measures to mitigate and manage this potential effect on moose are the same as those outlined above for caribou. Wildlife logs will be kept throughout the operating period and can be reviewed by YTG Renewable Resources as requested. Although this is not considered a scientific monitoring program, the results can be used to indicate presence at different times of the year.

3.1.3 Wolves

Wolves are a significant component of the wildlife resources of the region. Habitat reduction during life of the project is likely not substantial for wolves, which travel large areas in pursuit of prey. Disturbance associated with the project is likely to deflect wolves away from the immediate mine area and result in a loss of hunting terrain during the life of the project. Mitigation for this short-term loss of habitat for wolves is not considered necessary. Reclamation and natural succession after decommissioning will return much of project related facilities to suitable hunting terrain for wolves. The long-term reduction of habitat at the mine site is not expected to have a substantial effect on the regional wolf population. Wolves should still be able to travel through the project area, between the boreal forest to the north and the uplands and valleys to the south. The presence of the access trail may have a minor positive energetic effect for wolves that take advantage of the trail for movement during low-use periods. Although fatalities from collisions with vehicles could result, speed restrictions should minimise this risk. Overall, substantial effects on the regional wolf population are not expected.

3.1.4 Bears

Access control will minimize the potential for increased hunting pressure on both black bears and grizzly bears. The reduction of habitat at the mine site and access trail should not substantially affect the regional grizzly bear population. Based on home range size in other parts of the Yukon (26 km^2 in south-western Yukon, Pearson 1975), the actual amount of habitat directly-affected by the proposed trail and Wolverine Advance Exploration mine site should be less than 2% of the home range of one or possibly two grizzlies. Additionally, the habitat types affected by the project are common in the region. Since the habitat in the project area is not considered ideal for black bear, very few black bears are expected to inhabit the project area. Hence removal of habitat is not expected to have a noticeable effect on black bears. The

potential for direct mortality of bears through encounters with construction and mine site workers will be reduced through implementation of the following practices:

- recording of all bear sightings;
- warning signs posted and information circulated for workers in the event that bears are regularly observed near the camp and mine site; and
- containment of food wastes in suitable, bear proof containers, daily incineration of food wastes, and hauling of residue to a landfill.

Persistent bear problems will be reported to the local conservation officer who will deal with any bear control issues.

3.1.5 Furbearers and Small Carnivores

Effects to smaller carnivores and furbearers will be related to reduction in available habitat. The access trail will likely remove a small amount of boreal forest habitat that is used by upland furbearers (e.g., foxes, marten, weasel). The areas involved are expected to return to productive habitat once they are decommissioned and natural succession occurs.

3.1.6 Birds

The Tintina Trench is a major migration corridor of continental significance for very large numbers of migrating ducks, geese, swans, and sandhill cranes. Air traffic around the Wolverine airstrip will increase the risk of bird strikes. Bird strikes could have serious consequences for aircraft and occupants. This potential effect will be mitigated by restricting flights during periods of poor visibility and during migration periods. No bird strikes have been reported at the Wolverine airstrip since its construction.

Effects to raptors (mostly golden eagles and gyrfalcon) are not expected to be substantial. The short-term reduction of hunting terrain is not likely to effect local or regional populations of these two species. Breeding by either species has not been documented in the vicinity. No nest sites were observed during aerial surveys and no family groups were observed in the area during groundwork or overflights.

The most significant bird species that rely on the mine site area for habitat are ptarmigan species. In terms of direct habitat removal, the mine development will affect willow ptarmigan that breed in the willow, birch and mixed shrub units. Densities of breeding willow ptarmigan can vary widely, ranging from 4-5 pairs/km^2 in low years to 25-30 pairs/km^2 in high years. Although it is difficult to predict population-level effects without detailed habitat information, based on direct habitat loss of approximately 0.18 km^2, decreases in population numbers should be minimal. It will, however, be important to ensure that the No Hunting rules for employees are enforced , as this likely posses the greatest threat of population-level effects from the project.

3.2 Potential Cumulative Effects on Caribou and Moose in the Program Area

A determination of the significance of cumulative effects on caribou and moose populations would require a quantitative analysis of previous and current project effects, including mapping and classifying the existing human footprint on the landscape (e.g. old trails, clearings, etc.).

Since such quantification is not currently possible, the following section discusses qualitatively the potential cumulative effects of the proposed project in conjunction with other existing or potential activities in the region.

3.2.1 Development and Mining Activities

Timber harvesting and oil and gas potential in the region is very low, with no current programs operating nor proposed; as a result, the potential for additive negative effects from these activities is considered to be very low. Similarly, the area has no agricultural capability and urban development will continue to be very limited. Expatriate Resources Ltd. currently holds the majority of mineral claims in the immediate region; it is therefore unlikely that further mine development will proceed from a separate company. No additional Expatriate mines (beyond the proposed Wolverine mine as part of the Yukon Silver-Zinc Project) are currently in the planning stages for the Finlayson area.

While the Wolverine Advanced Exploration Program and the Yukon Silver-Zinc Project (Wolverine) are essentially one project, therefore consideration should be given to the potential for negative cumulative effects associated with one project. When considering potential cumulative effects of the project, it is important to recognize that due to the nature of mineral exploration and development the Wolverine Advanced Exploration Program necessarily precedes the Yukon Silver-Zinc Project (end result). Also, much of the surface disturbance that will be created during the Wolverine Advanced Exploration Program will likely be incorporated into the Yukon Silver-Zinc Project. As such, these two separate activities are expected to have limited additive spatial effects. However, the Wolverine Advanced Exploration Program will add an additional component to existing human activity in the region in the years leading up to development of the Yukon Silver-Zinc Project.

The effects on wildlife from the Yukon Silver-Zinc Project cannot be determined at this time and, as such, it is difficult to predict the cumulative effects of the Wolverine Advanced Exploration Program and through extension, the Yukon Silver-Zinc Project. A short-term reproductive impact (decreased calf/female ratio) was observed in the southern portion of the Finlayson Herd's range during the "staking rush" that occurred in the Finlayson region between 1995 and 1996 (Farnell 2000). Once the intense helicopter-assisted staking activities ceased, calf/female ratios returned to pre-disturbance levels. However, the intensity and spatial extent of exploration activities that occurred during the 1995-1996 seasons are orders of magnitude beyond the levels that will be associated with either the Wolverine Advanced Exploration Program or Yukon Silver-Zinc Project. Based on this observation, it seems unlikely that the advanced exploration program will contribute substantially to the total cumulative effects of existing factors and future mine development.

3.2.2 Exploration Activities

Expatriate is the only company currently conducting mineral exploration activity in the Finlayson region. The company holds the majority of the mineral claims and has valid land use approvals and permits for exploration activity. Grassroots exploration, including prospecting and mapping, line cutting, geophysical surveys, trenching, and diamond drilling, will be conducted on an ongoing basis. The magnitude of the activity in any given season will be dependent on the results of previous exploration. A reasonable estimate would be 15 to 30

exploration staff working in the region between June and September each year. Workers would be housed at one of the main camps (Wolverine) and supported by helicopter to the various remote exploration targets. Since exploration workers will utilise planned infrastructure, the only impact on habitat will be habitat alteration from line cutting operations, drill pad clearing, etc. The most disruptive impact of exploration activities will be the use of helicopters to access remote areas. Human presence in work areas may result in short term habitat avoidance during the summer exploration season. As stated in Section 3.2.1, the intensity of the Wolverine Advanced Exploration Program is expected to be orders of magnitude less than that incurred during the 1995-1996 "staking rush", when a short-term measurable reduction in the caribou cow/calf ratio was recorded.

3.2.3 Other Activities

Hunting and the direct/indirect effects of the Robert Campbell Highway are probably the largest sources of anthropogenic-caused wildlife mortalities in the area. The exact numbers of vehicle-wildlife collisions on the Highway are not currently known. The Finlayson region is part of the Teslin Outfitters guiding concession. Hunting activity (moose and caribou) occurs during the late fall. Data on estimated licensed harvest for the Finlayson Caribou Herd suggests that an average of 47 animals were taken per year during the seven years prior to the permit hunt. First Nations harvest is not included in these figures, however. The exact number of visitors and animals taken is not known. Direct caribou and moose mortalities resulting from development and mining activities, in particular vehicle-animal collisions, may be cumulative with legal harvest and highway mortalities. However, the likelihood of direct animal mortality occurring as a result of advanced exploration activity is very low. No known vehicle collisions or hunting deaths have occurred in the area as a result of exploration activities in the past. Given the mitigation and management measures proposed, this trend is expected to continue; therefore, cumulative, additional animal mortalities from the advanced exploration program are unlikely.

3.2.4 Total Cumulative Effects

Potential cumulative effects to caribou and moose in the region resulting from past and future activities include mortality from hunting and vehicle collisions, direct habitat loss through clearing, earthworks, and trail construction, and functional habitat loss through avoidance of active work areas (Table 2). The proposed advanced exploration program is not expected to provide a substantial addition to existing cumulative effects given the mitigation and management measures proposed herein. As no current threshold levels for total cumulative effects have been set, it is not possible to assess the current situation in relation to a total allowable cumulative impact from all influencing factors. YTG, DIAND and Ross River Dena will need to begin to address this issue if potential projects are to be assessed in this light.

4.0 CONCLUSION

The Finlayson area of Southeast Yukon is home to many wildlife species. Moose and caribou are of particular importance to several stakeholders including YTG Renewable Resources and the Ross River Dena. As a result, every effort must be extended to ensure

development activities do not result in measurable negative effects to local populations. To assess the feasibility of the Wolverine mine, the Wolverine Advanced Exploration Program has been proposed. The potential effect of this program on local wildlife and methods to mitigate these effects are summarised in Table 1.

In isolation, the proposed advanced exploration program is not anticipated to result in substantial adverse effects to local wildlife populations. The Wolverine Advanced Exploration Program is also not expected to contribute substantially to existing negative cumulative environmental effects for regional wildlife populations. However, it should be recognized that in the absence of regional ecosystem mapping, land use planning objectives, and allowable thresholds for cumulative effects, total cumulative adverse temporal and spatial effects are currently difficult to quantify and assess in terms of significance.

5.0 REFERENCES

AEM. 2000. Terrestrial lichen enhancement of harvest blocks in west-central Alberta. Prep. By Applied Ecosystem Management Ltd. For Weldwood of Canada Limited, Hinton Division.

Bradshaw, C.J.A., Boutin, S., and Hebert, D.M. 1997. Effects of petroleum exploration on woodland caribou in northeastern Alberta. J. Wildl. Manage. 61: 1127-1133.

Brown, W.K. and Hobson, D.P. 1988. Caribou in west-central Alberta – Information review and synthesis. Prep. For: The Research Subcommittee of the West-central Alberta Caribou Standing Committee, Grande Prairie, AB. 74 pp.

Chubbs, T.E., Kieith, L.B., Mahoney, S.P., and McGrath, M.J. 1993. Responses of woodland caribou (*Rangifer tarandus caribou*) to clear-cutting in east-central Newfoundland. Can. J. Zool. 71: 487-493.

Cominco Ltd., 1996. Kudz Ze Kayah Project Initial Environmental Evaluation

COSEWIC. 2000. Canadian Species At Risk. November 2000. Committee on the Status of Endangered Wildlife in Canada. 24pp.

Dyer, S. 1999. Movement and distribution of woodland caribou (Rangifer tarandus caribou) in response to industrial development in northeastern Alberta. M.Sc. Thesis, Department of Biological Sciences, University of Alberta, Edmonton, AB. 106pp.

Dzus, E. 2000. Status of Woodland Caribou (*Rangifer tarandus caribou*) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division and Alberta Conservation Association, Wildlife Status Report No. 30. Edmonton, AB. 47pp.

Edmonds, E.J. and Bloomfield, M. 1984. A study of woodland caribou (*Rangifer tarandus caribou*) in west-central Alberta, 1979-1983. Alberta Energy and Natural Resources Fish and Wildlife Division, Edmonton, AB. 150pp.

Expatriate Resources Ltd. 2000. Yukon Silver-Zinc Project – Project Description Report. Vancouver, BC.

Farnell, R., Florkiewicz, R., Kuzyk, G., and Egli, K. 1998. The status of *Rangifer tarandus caribou* in Yukon, Canada. Rangifer Special Issue 10: 131-137.

Farnell, R. and McDonald, J. 1988. The demography of Yukon's Finlayson caribou herd, 1982-1987. Yukon Fish and Wildlife Branch Rep., Whitehorse.

Hayes, R.D., Baer, A.M., Wotschikowsky, U., and Harestad, A.S. 2000. Kill rate by wolves on moose in the Yukon. Can. J. Zool. 78: 49-59.

Hayes, R.D. and Harestad, A.S. 2000. Demography of a recovering wolf population in the Yukon. Can. J. Zool. 78: 36-48.

James, A.R.C. and Stuart-Smith, A.K. 2000. Distribution of caribou and wolves in relation to linear corridors. J. Wildl. Manage. 64: 154-159.

Jingfors, K. 1988. Moose population characteristics in the North Canol and Frances Lake areas, November 1987. Yukon Fish and Wildlife Branch Rep. TR 91-1, Whitehorse.

Larsen, D.G. and Ward, R.M.P. 1995. Moose population characteristics in the Frances Lake and North Canol areas. Yukon Fish and Wildlife Branch Rep. PR 95-1, Whitehorse.

Mallory, F.F. and Hillis, T.L. 1998. Demographic characteristics of circumpolar caribou populations: ecotypes, ecological constraints, releases, and population dynamics. Rangifer Special Issue 10: 49-60.

Northcott, P.L. 1985. Movement and distribution of caribou in relation to the Upper Salmon hydroelectric development, Newfoundland. In Second North American Caribou Workshop. Edited by: T.C. Meredith and A.M. Martell. Val Morin, Quebec, Centre for Northern Studies and Research, McGill University, pp 69-84.

Oberg. P.R. 2001. Responses of mountain caribou to linear features in a west-central Alberta landscape. M.Sc. Thesis. Department of Renewable Resources, University of Alberta, Edmonton, AB.

Pearson, A.M. 1975. The northern interior grizzly bear *Ursus arctos* L. Canadian Wildlife Service, Report Series No. 34. Ottawa, ON.

Smith, K.G., Ficht, E.J., Hobson, D., Sorensen, T.C., and Hervieux, D. 2000. Winter distribution of woodland caribou in relation to clear-cut logging in west-central Alberta. Can. J. Zool. 78: 1433-1440.

Zoladeski, C..A. and Cowell, D.W. 1996. Ecosystem Classification for the Southeast Yukon: First Approximation. Yukon Renewable Resources, Whitehorse, Yukon.

6.0 APPENDIX: Figures and Tables

Figure 1: Map of project area with existing and proposed access routes.

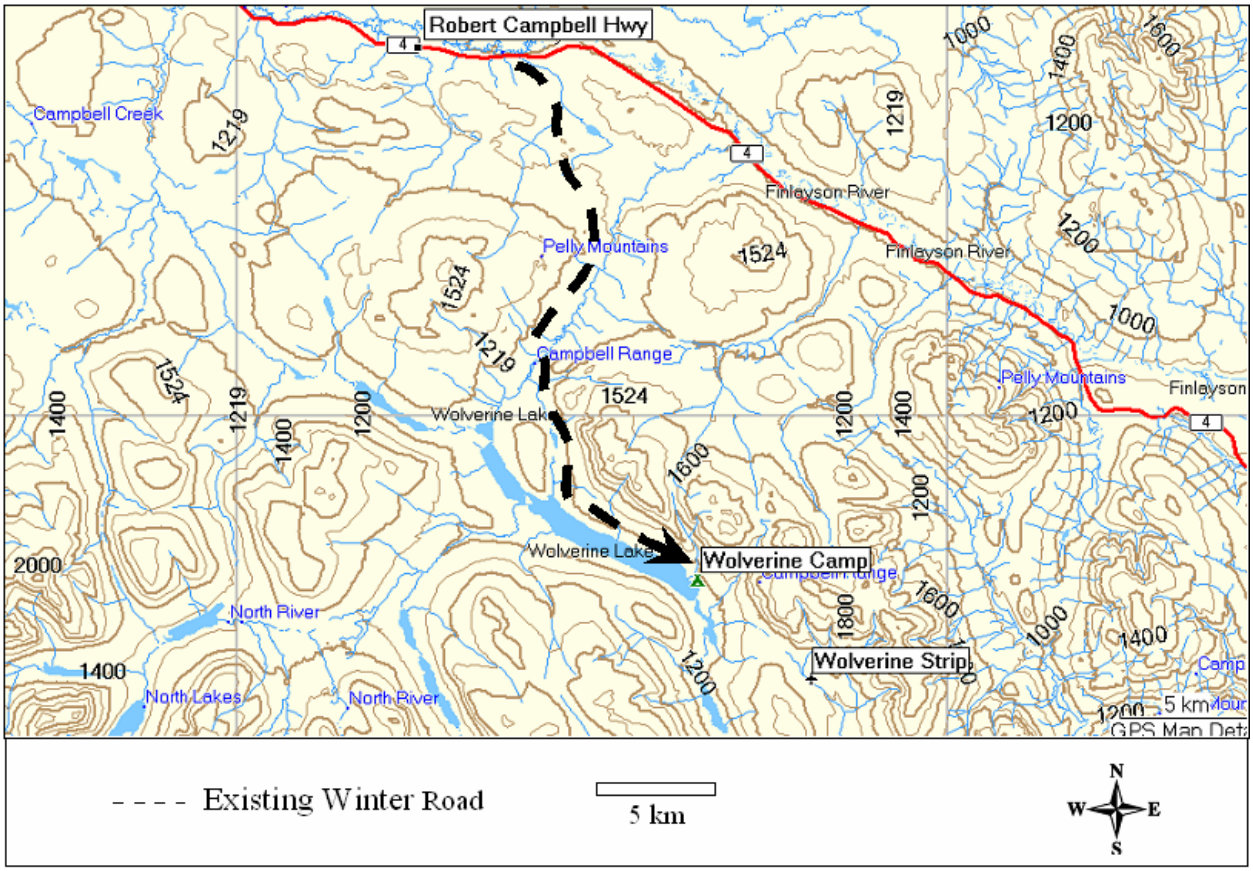

Figure 2: Map of greater project area with seasonal caribou distribution data.

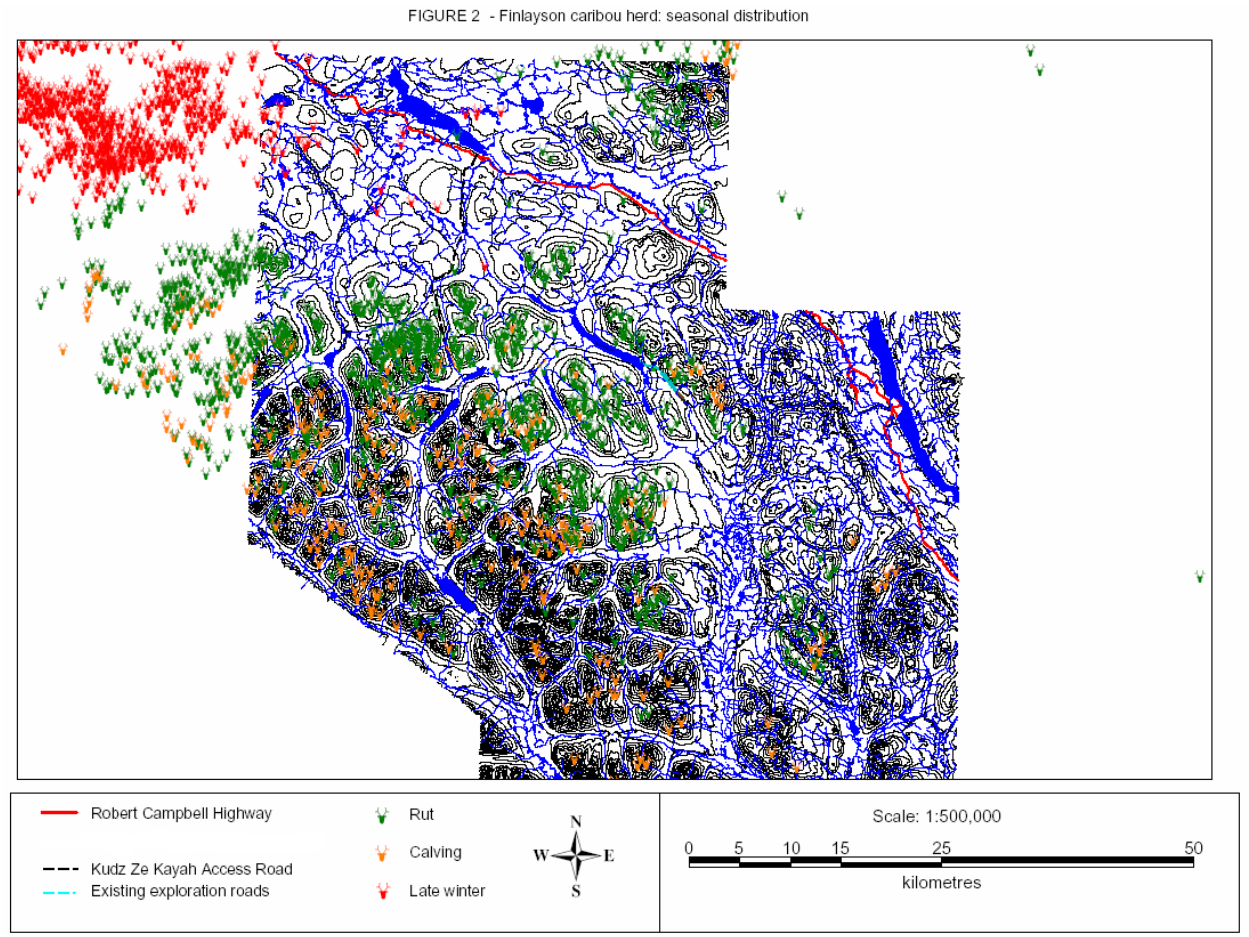

Table 1: Summary of potential effects of proposed Wolverine Advanced Exploration Program and mitigative measures.

Species	Predicted Effect	Potential Mitigation

Caribou	- access effect	- access control including
		  - gated, manned security station
		  - no hunting policy for employees
		  - closure of trail using reclamation procedures, ditching/berming, removal of stream crossings, replacement of organic mat, recontouring of trail surface

	- habitat effect	- reclamation of mine site and access trail using various scarification techniques and natural regeneration - mitigation of functional habitat loss through disturbance effect mitigation as described below - no construction of unnecessary trails
	- disturbance effect	- no operation of off-trail vehicles - limited aerial activity periods during calving and rutting - attempt to avoid caribou in Wolverine Lake - monitoring to assess disturbance

	- trail traffic effect	- driver awareness/traffic control as follows
		  - driver education programs
		  - setting and enforcing speed restrictions during migration periods
		  - posting warning signs at locations with high potential for animal collisions
		  - reporting animal locations by radio to security gate and other drivers
		  - adjusting speed and frequency of traffic during particularly high risk periods
		  - right of way and minimum distance provisions for caribou crossing the trail

Moose	- access effect - habitat effect - disturbance effect - trail traffic effect	- access control as per above - no mitigation planned though natural succession will occur after decommissioning - no mitigation planned though limited aerial activity periods will also benefit moose - driver awareness/traffic control as per above - avoidance of moose swimming in Wolverine Lake (barge traffic) - wildlife logs
Wolves	- habitat effect	- no mitigation planned though natural succession will occur after decommissioning
Bears	- access effect - habitat effect - trail traffic effect - direct conflict with workers	- access control as per above - no mitigation planned - driver awareness/traffic control as per above - record of all sightings - warning signs/information for mine workers when bear in area - containment of food wastes in bear proof containers, incineration of food wastes, haul residues to landfill
Furbearers & Small Carnivores	- habitat effect	- no mitigation planned though natural succession will occur after decommissioning
Birds	- air traffic effect	- flight restrictions during conditions of poor visibility and during migration periods

Table 2: Potential for substantial additions to cumulative effects for caribou and moose.

Focus Species	Issue	Potential for substantial addition associated with Wolverine Advanced Exploration Program
Caribou	Direct habitat loss (through alteration, development)	Low. The direct footprint of the Advanced Exploration Program (drill pads, survey lines, test pit and waste rock storage) is estimated to be less than 40 ha over the duration of the project.
	Functional habitat loss and disruption (avoidance of active work areas and increased disturbance)	Low regional, with moderate potential for local impacts, but of limited duration and spatial extent. Most functional loss from trail, which may be in an area naturally avoided by caribou.
	Increased vehicle mortality (vehicle-animal collisions)	Low. Low vehicle speeds and a minimal numbers of vehicles will be active in the area.
	Increased human hunting mortalities.	Low. No new public access will be created directly from the Robert Campbell Highway. The original Kudz Ze Kayah access trail will remain gated and manned. The proposed barge/ice trail link across Wolverine Lake will avoid the creation of a permanent trail between the Kudz Ze Kayah and Wolverine deposit.
Moose	Direct habitat loss (through alteration, development)	Low regional, moderate local. The direct footprint of the Advanced Exploration Program (drill pads, survey lines, access trail, test pit and waste rock storage) is estimated to be less than 40 ha over the duration of the project.
	Functional habitat loss and disruption (avoidance of active work areas and increased disturbance)	Low regional and local.
	Increased vehicle mortality (vehicle-animal collisions)	Low. Low vehicle speeds and a minimal numbers of vehicles will be active in the area.
	Increased human hunting mortalities.	Low. No new public access will be created directly from the Robert Campbell Highway. The original Kudz Ze Kayah access trail will remain gated and manned. The proposed barge/ice trail link across Wolverine Lake will avoid the creation of a permanent trail between the Kudz Ze Kayah and Wolverine deposit.