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15.0 SUBJECT OF NOTE: WILDLIFE

15.1 Introduction

This section of the Developer's Assessment Report (DAR) for the NICO Cobalt-Gold-Copper-Bismuth Project (NICO Project) consists solely of the Subject of Note (SON) for Wildlife. In the Terms of Reference (TOR) for the NICO Project's DAR issued on 30 November 2009, the Mackenzie Valley Review Board (MVRB) identified wildlife as 1 of 7 top priority valued components requiring a high level of consideration by the developer (MVRB 2009).

As identified within the TOR, this SON for wildlife details any effects the NICO Project may have on wildlife communities including population effects and health.

All effects on wildlife are assessed in detail in this SON; however, issues addressed in the following other Key Lines of Inquiry (KLOI) and SONs may overlap with this SON:

- KLOI: Water Quality (Section 7);
- KLOI: Closure and Reclamation (Section 9);
- SON: Air Quality (Section 10);
- SON: Water Quantity (Section 11);
- SON: Vegetation (Section 14);
- SON: Human Environment (Section 16);
- Section 5: Traditional Knowledge; and
- Section 18: Biophysical Environment Monitoring and Management Plans.

15.1.1 Purpose and Scope

The purpose of the SON: Wildlife is to assess the effects of the NICO Project on wildlife and meet the TOR issued by the MVRB. The terms for the SON: Wildlife are shown in Table 15.1-1. The complete table of concordance for the DAR is in Appendix 1.I.

The Subject of Note: Wildlife includes an assessment of direct effects on all life stages of wildlife within the study area. This assessment includes potential changes resulting from NICO Project-related components and associated activities, including air quality, noise, water quality and quantity, terrain and soils, vegetation, and traditional and non-traditional land use within the study area.

The effects assessment will evaluate all NICO Project phases, including construction, operation, and closure and reclamation. Indirect and cumulative effects have been incorporated throughout this section, where applicable. Given the large home ranges of some species, the effects from the NICO Project must be considered in combination with other developments, activities, and natural factors that influence wildlife within the study area. More detailed information on the requirements of the DAR TOR for this SON can be found in Table 15.1-1.

Table 15.1-1: Subject of Note: Wildlife Concordance with the Terms of Reference

Section in Terms of Reference	Requirement	Section in Developer's Assessment Report
3.2.3	An overall environmental assessment study area and the rationale for its boundaries;	15.1.2.2, 15.1.2.3
	Fortune's chosen spatial boundaries for the assessment of potential impacts for each of the valued components considered; and	15.1.2.2, 15.1.2.3
	The temporal boundaries chosen for the assessment of impacts on each valued component.	15.4.1.1.1
3.2.4	**Description of the Existing Environment**	15.2
	The developer is encouraged to provide a description of the methods used to acquire the information used to describe baseline conditions.	15.2.3
3.3.1	**Impact Assessment Steps and Significance Determination Factors** In assessing impacts on the biophysical environment, the *Developer's Assessment Report* will for each subsection:	
	• Identify any valued components used and how they were determined;	15.1.1
	• For each valued component, identify and provide a rationale for the criteria and indicators used;	15.1.1
	• Identify the sources, timelines and methods used for data collection;	15.2.3
	• Identify natural range of background conditions (where historic data are available), and current baseline conditions, and analyze for discernible trends over time in each valued component, where appropriate, in light of the natural variability for each;	15.2.4
	• Identify any potential direct and indirect impacts on the valued components that may occur as a result of the proposed development, identifying all analytical assumptions;	15.3
	o Predict the likelihood of each impact occurring prior to mitigation measures being implemented, providing a rationale for the confidence held in the prediction;	15.3
	o Describe any plans, strategies or commitments to avoid, reduce or otherwise manage the identified potential adverse impacts, with consideration of best management practices in relation to the valued component or development component in question;	15.3
	o Describe techniques, such as models utilized in impact prediction including techniques used where any uncertainty in impact prediction was identified;	15.4
	• Assess and provide an opinion on the significance of any residual adverse impacts predicted to remain after mitigation measures; and	15.8.2

Table 15.1-1: Subject of Note: Wildlife Concordance with the Terms of Reference (continued)

Section in Terms of Reference	Requirement	Section in Developer's Assessment Report
3.3.1	• Identify any monitoring, evaluation and adaptive management plans required to ensure that predictions are accurate and if not, to proactively manage against adverse impacts when they are encountered.	Appendix 18.II
	The developer will characterize each predicted impact. These criteria will be used by the developer as a basis for its opinions on the significance of impacts on the biophysical environment.	15.7.2
3.3.7	**Wildlife** The Review Board notes that Section 79 of the federal *Species at Risk Act* (SARA) requires that all SARA-listed species be identified and any adverse impacts of a development on them be thoroughly assessed and mitigated, regardless of whether the impacts are deemed "significant". The developer will:	15.4.4, 15.4.5
	• Describe potential effects from the NICO Project on wildlife and its habitat. This will include impacts on hoofed mammals, large carnivores, furbearers (terrestrial and aquatic), and migratory birds. This description will consider:	15.4
	o direct and indirect habitat loss;	15.4
	o behavioural disturbance from NICO Project activities;	15.3, 15.4
	o barriers to movements;	15.3, 15.4
	o energetic costs from disturbance and barriers to movement;	15.3.2.2
	o impacts related to increased access; and	15.4
	o any other sources of direct or indirect mortality.	15.3, 15.4
	• Special consideration is required when looking at potential impacts on species that are harvested, and for species of wildlife at risk (SARA and Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed species).	15.4
	• Describe any mitigation proposed to avoid or reduce impacts to wildlife, and predict any residual impacts.	15.3.2
3.6	**Cumulative Effects** Pursuant to paragraph 117(2)(a) of the *Mackenzie Valley Resource Management Act*, the Review Board considers cumulative effects in its determinations. Cumulative effects are the combined effects of the development in combination with other past, present or reasonably foreseeable future developments and human activities. In addressing cumulative effects, the developer is encouraged to refer to Appendix H of the Review Board's Environmental Impact Assessment Guidelines. The developer will:	

Table 15.1-1: Subject of Note: Wildlife Concordance with the Terms of Reference (continued)

Section in Terms of Reference	Requirement	Section in Developer's Assessment Report
3.6 (continued)	• Describe and provide rationale for which past, present or reasonably foreseeable future developments and human activities are being considered in the cumulative effects assessment.	15.4.1.1.1
	• Identify which of the valued components may be affected by other past, present or reasonably foreseeable future developments and human activities.	15.4, 15.9
	• Assess the likelihood, duration and magnitude of the combined effect of these human activities on the identified valued components.	15.5
	• Describe any mitigation measures proposed to reduce or avoid the predicted effects, specifying if and how adaptive management will be used, and provide an assessment of any residual cumulative impacts.	15.3, 15.4, Appendix 18.II
Appendix A	**Existing Environment**	
	Biophysical environment Describe the biophysical environment within the relevant environmental assessment study areas. The following description should be at a level of detail sufficient to allow for a thorough assessment of NICO Project effects. Describe the following:	
	Wildlife (including resident and migratory bird species), wildlife habitat and migration corridors. Special emphasis will be placed on key harvested species including moose, caribou and furbearers. Where available, the following information is required for each species:	
	• population trends, including abundance, distribution and demographic structures;	15.2.4
	• habitat requirements, including identification of local areas of important habitat, attributes of the seasonal habitats that relate to how the species use them (e.g. travel routes, forage) and sensitive time periods;	15.2.4
	• migration routes, patterns and timings including typical patterns and the range of known variation;	15.2.4
	• factors known or suspected to be currently affecting the species in the environmental assessment study area (e.g. harvesting, disease);	15.2.4, 15.2.5
	• known or suspected sensitivities to human activities; and	15.2.4, 15.2.5
	• gaps in current knowledge of the species such as the impacts of disturbance on behaviour or abundance.	15.2.4
	Wildlife at risk occurring in the environmental assessment study area. The developer will:	
	• identify any species present or potentially present in the environmental assessment study area that are listed under schedule 1 of the federal SARA;	15.2.1

Table 15.1-1: Subject of Note: Wildlife Concordance with the Terms of Reference (continued)

Section in Terms of Reference	Requirement	Section in Developer's Assessment Report
Appendix A (continued)	• identify any species present or potentially present in the NICO Project area assessed by the COSEWIC; and	15.2.1
	• describe each species in terms of the above requirements.	15.2.4
Appendix F	**Wildlife**	
	For potential impacts to wildlife, the developer will do the following:	
	1) Describe the impacts the NICO Project is likely to have on wildlife and wildlife habitat. For each species, and/or species group consider the following:	
	a. potential impacts to habitat, including degradation and fragmentation, with a focus on important wildlife habitat;	15.4.1.1.2, 15.4.2.1.2, 15.4.3.1.2, 15.4.4.1.2, 15.4.5.1.2
	b. potential for increased mortality from all sources (including from vehicle collisions and changes to hunting access);	15.3.2.2, 15.5
	c. potential for increased attraction to the NICO mine site, risk of bear-human encounters, risk to people and associated carnivore mortality;	15.3.2.2
	d. potential for increased sensory disturbance from all sources (e.g., noise, odours, activity, vibrations, overflights, dust). Predict effective habitat loss resulting from changed behaviour;	15.4.1.2.2, 15.4.2.2.2, 15.4.3.2.2, 15.4.4.2.2, 15.4.5.2.2
	e. potential for disruption of movement and migration patterns;	15.3.2.2 15.4.1.2.2, 15.4.2.2.2, 15.4.3.2.2, 15.4.4.2.2, 15.4.5.2.2
	f. potential for increased contamination of food and water, including bio-accumulation, from all sources; and	15.3.1.2, 15.3.2.2
	g. potential energetic costs to wildlife from points d through f above.	15.3.2.2
	2) Describe the potential adverse impacts of the NICO mine on any "wildlife at risk" species known or suspected to reside in the environmental assessment study area or potential adverse impacts on their habitat including residences. Describe any management plans and specific mitigation commitments and monitoring proposed for any potentially affected species.	15.4, Appendix 18.II
	3) Considering that the NICO Project is on a regionally distinctive plateau landform, describe:	

Table 15.1-1: Subject of Note: Wildlife Concordance with the Terms of Reference (continued)

Section in Terms of Reference	Requirement	Section in Developer's Assessment Report
Appendix F (continued)	a. Fortune's efforts to determine whether the plateau landform and surrounding cliffs supports regionally limited wildlife habitat;	15.2.3
	b. how the NICO Project is expected to affect any specialized species using this distinctive habitat; and	15.4
	c. how Fortune proposes to mitigate those impacts identified.	15.3.2
	4) Describe how NICO Project planning has considered potential impacts on wildlife and wildlife habitat, best management practices to minimize impacts on wildlife, and what mitigation commitments have been made, with specific consideration of:	15.3.2
	a. rules for road use by employees and contractors;	15.3.2.2
	b. minimizing wildlife access to NICO Project components (e.g. by reducing attractants); and	15.3.2.2
	c. spill avoidance techniques and spill response plans for the transportation routes.	15.3.2.1
	5) Describe Fortune's draft wildlife management plan, including discussion of:	Appendix 18.II
Appendix K4b	**Traditional Land Use and Wildlife Harvesting**	
	The developer will:	
	1) Describe any potential impacts of the NICO Project on traditional harvesting activities for Aboriginal residents of Wek'èezhìi Settlement Area communities, including changes from impacts to wildlife, changes in all-season access from Wek'èezhìi Settlement Area communities due to the NICO access road, and any changes in access by non-resident hunters.	15.5
	2) Provide a prediction of the total impact of the NICO Project on traditional activities, and on the potential for increased or reduced harvesting success.	15.6.3, 15.7.2
Appendix L	**Cumulative Effects**	
	The following items are required for consideration of cumulative effects:	
	1) In terms of cumulative effects, predict:	
	d. potential impacts on wildlife due to increased access from the NICO access road in combination with the potential realignment of the winter road through the Wek'èezhìi Settlement Area; and	15.5
	e. potential impacts of the NICO Project on wildlife in combination with impacts from past or present pollution from contaminated sites in the area, including Rayrock and Colomac.	15.4
	2) Determine any other past, present and reasonably foreseeable human activities or developments that may affect the same valued components as the NICO Project.	15.4, 15.9

Table 15.1-1: Subject of Note: Wildlife Concordance with the Terms of Reference (continued)

Section in Terms of Reference	Requirement	Section in Developer's Assessment Report
Appendix L (continued)	3) Predict the combined impact of the NICO Project in combination with the impacts of the other developments identified above.	15.4, 15.9
	4) Identify means for Fortune, either on its own or cooperatively with others, to reduce or avoid the predicted cumulative effects.	15.3, 15.4, Appendix 18.II
	5) Describe the residual cumulative effects following mitigation.	15.6
	6) Provide the rationale for including the developments that are chosen for examination on specific valued components, as well as a description of and rationale behind the chosen geographic cumulative effects study area and temporal boundary.	15.3

Valued components (VCs) represent physical, biological, cultural, social, and economic properties of the environment that are considered to be important by society. The inter-relationships between components of the biophysical and socio-economic (human) environments provide the structure of a social-ecological system (Walker et al. 2004; Folke 2006). A range of representative wildlife VCs was selected for the NICO Project (Table 15.1-2). The VC caribou is discussed in KLOI: Caribou (Section 8). Factors considered when selecting VCs included the following (Salmo 2006):

- represent important ecosystem processes;
- territorial (ENR 2010a) and federal listed (COSEWIC 2010; *SARA* 2011) species;
- communities or species that reflect the interests of regulatory agencies, First Nations groups, communities, and other people interested in the NICO Project;
- can be measured or described with one or more practical indicators (measurement endpoints);
- allow cumulative effects to be considered; and
- current experience with environmental assessments and effects monitoring programs in the Northwest Territories (NWT) and Nunavut.

Table 15.1-2: Wildlife Valued Components

Group	Valued Components	Rationale
ungulate	caribou	important subsistence, cultural and economic species, migratory species with extensive range requirements; may be affected by disturbance during seasonal movements; primary prey species for large carnivores in northern environments
	moose	large home range; important subsistence and cultural species; prey species for large carnivores
large carnivore	wolverine	generally not migratory, but long distance movements are made by transient individuals; large home range; can be attracted to human disturbance; listed as '*sensitive*' in the NWT and '*of special concern*' federally
	black bear	large home range size; top predator in ecosystem, can be attracted to human disturbance; long generation time means one individual may be affected by disturbance over multiple years resulting in potential regional population effects
furbearer (terrestrial and aquatic)	marten	most commonly harvested furbearer; middle predator in ecosystem
	muskrat	second most important furbearer after marten; important prey species for many carnivores in northern environments; tolerant of human activities, but may be affected by habitat loss
migratory birds	upland breeding birds	small territory size and high bird density means large numbers of upland birds may be affected by habitat loss; migratory birds are susceptible to population declines as a result of changing environmental conditions on breeding and overwintering habitats; includes some species at risk (common nighthawk, rusty blackbird, and olive-sided flycatcher)
	waterbirds	includes ducks, loons, and grebes; waterbirds may be affected by loss of shoreline habitat for breeding; important staging habitat may also be lost; sensitive to noise disturbance and human activity; some species are important for subsistence; includes the horned grebe (species at risk)
	raptors	breeding habitat is limited; sensitive to noise disturbance and human activity during nesting; include peregrine falcon and short-eared owl (species at risk)

Grey wolf, lynx, and beaver were also considered as VCs, but ultimately not selected for the following reasons. There have been some observations of wolves in winter associated with caribou, but no observations have been made in summer, and no dens have been found near the NICO Project. Harvest data indicates that there are few wolves harvested by Tłı̨chǫ communities (Section 15.2.2; Table 15.2-2). Lynx were considered, but not included because baseline studies (i.e., winter track counts and incidental observations) indicated a low likelihood of occurrence in the regional study area (RSA). Although lynx pelts are valuable, fur returns indicated only 75 have been harvested by the Tłı̨chǫ communities between 2004 and 2009 (Section 15.2.2; Table 15.2-2). Beaver were not included as effects from the NICO Project are likely similar to muskrat (i.e., mostly direct changes to habitat quantity), and beaver are harvested less than muskrat.

Wildlife species are an important cultural and economic resource for the people in the NWT. Assessment endpoints represent the key properties of the VC that should be protected for their use by future human generations, while measurement endpoints are quantifiable (i.e., measurable) expressions of changes to assessment endpoints (Section 6.2). Assessment and measurement endpoints for the wildlife VCs are presented in Table 15.1-3.

Table 15.1-3: Summary of the Valued Components, Assessment and Measurement Endpoints for the Subject of Note Wildlife

Valued Component	Assessment Endpoints	Measurement Endpoints
• wolverine • black bear • marten • moose • muskrat • upland breeding birds • waterbirds • raptors	• Persistence of wildlife populations • Continued opportunity for traditional and non-traditional use of wildlife	• Habitat quantity and fragmentation • Habitat quality • Relative abundance and distribution of wildlife species • Survival and reproduction
People		• Access to wildlife • Availability of wildlife

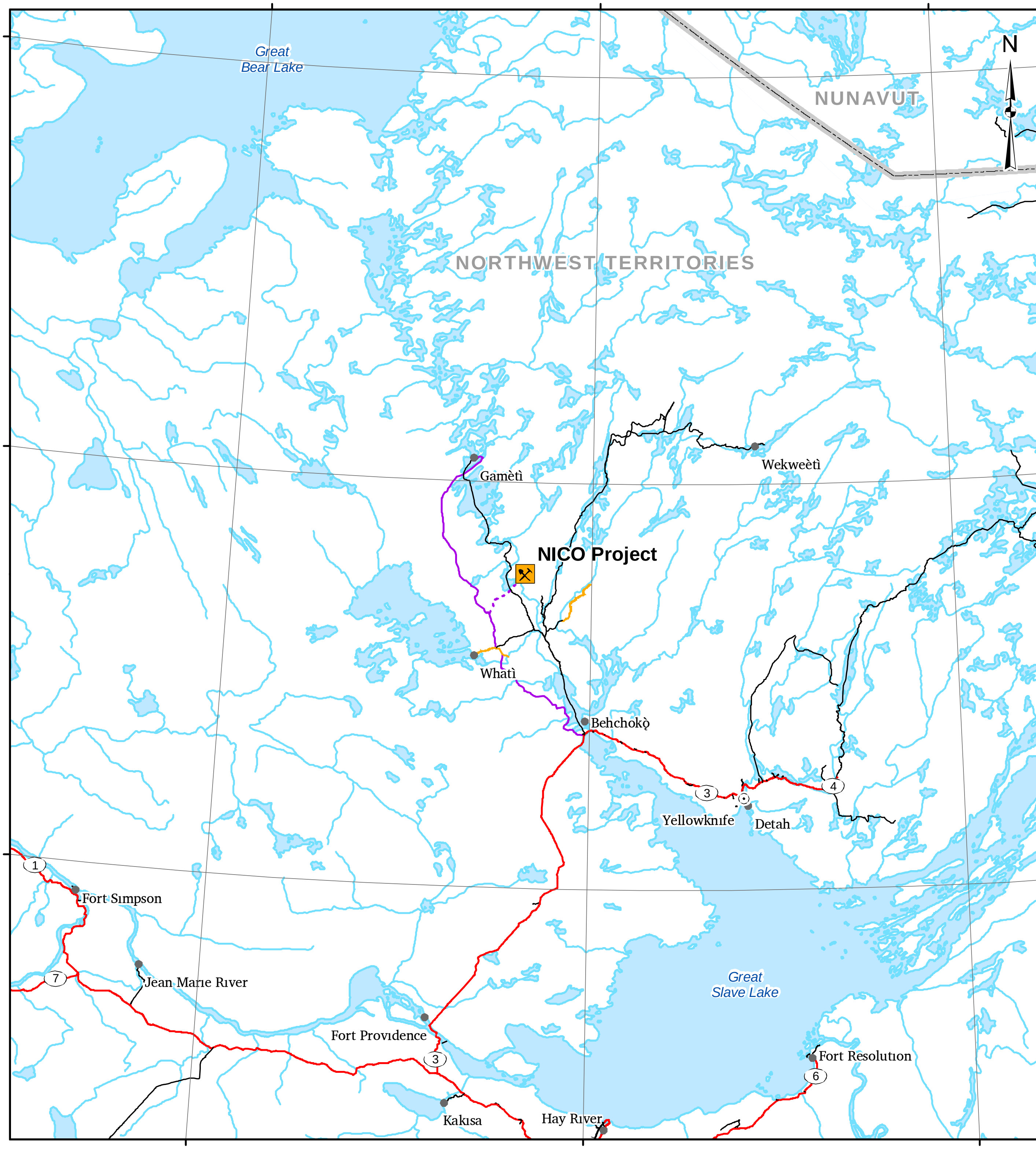
15.1.2 Study Areas

15.1.2.1 General Setting

The NICO Project is approximately 160 kilometres (km) northwest of Yellowknife in the NWT (Figure 15.1-1). The NICO Project is located within the Marian River drainage basin, approximately 10 km east of Hislop Lake at a latitude of 63°33’ North and a longitude of 116°45’ West, and within the Taiga Shield and Taiga Plains Ecoregions (Ecosystem Classification Working Group 2007, 2008). The NICO Project spans 2 Level II Ecoregions: Taiga Shield and Taiga Plains.

The Taiga Shield High Boreal Level III Ecoregion is bedrock-dominated with jack pine (*Pinus banksiana*) and mixed spruce forests on rock outcrops. White spruce (*Picea glauca*) and trembling aspen (*Populus tremuloides*) stands are found in low-elevation areas with adequate nutrient and water supplies. Peat plateaus and shore and floating fens are scattered throughout the Ecoregion (Ecosystem Classification Working Group 2008).

The Taiga Plains Ecoregion is comprised of the Great Slave Uplands High Boreal and Central Great Bear Plains Low Subarctic Level III Ecoregions. The Great Slave Uplands region is dominated by low-growing open black spruce (*Picea mariana*) forests, treed bogs, horizontal fens, and peat plateaus are dominant. Upland deciduous, mixedwood, and coniferous stands are found in elevated areas with better drainage (Ecosystem Classification Working Group 2007). The Central Great Bear Plains Ecoregion is dominated by closed to open mixed spruce forest with shrub, moss, and lichen understories or regenerating dwarf birch. Pond and fen complexes are scattered throughout, while closed mixedwood, white spruce, and jack pine stands occupy rolling to ridged glacial flutings (Ecosystem Classification Working Group 2007).



100 0 100

SCALE 1:3,000,000 KILOMETRES

LEGEND

- NICO PROJECT
- TERRITORIAL CAPITAL
- POPULATED PLACE
- HIGHWAY
- EXISTING ALL-WEATHER ROAD
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁĮCHǪ ROAD ROUTE
- RAILROAD
- TERRITORIAL/PROVINCIAL BOUNDARY
- WATERCOURSE
- WATERBODY

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and ESRI.
Projection: Canada Lambert Conformal Conic

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

LOCATION OF THE NICO PROJECT

Golder Associates
Edmonton, Alberta

EA-Wild-050-GIS				
PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	JG	17 Jan. 2011	FIGURE: 15.1-1	
GIS	MK	23 Feb. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

G:\2008\1373\08-1373-0017 Fortune Minerals Nico EIS\GIS\Mapping\MXD\Wildlife\EA-Wild-050-GIS.mxd

The NICO Project is located approximately 50 km northeast of Whatì and 70 km south of Gamètì, the nearest communities. Other communities include Behchokǫ̀, approximately 85 km southeast of the NICO Project, and Wekweètì, located approximately 140 km northeast of the NICO Project. All of these communities are within Tłı̨chǫ Land Claim. The NICO Project is surrounded by Tłı̨chǫ Land Claim. The mean annual temperature for this region is -4.6 degrees Celcius (°C) (Environment Canada; Yellowknife A Weather Station 2010). July is the warmest month with a mean temperature of 16.8°C, whereas January is typically the coldest month with a mean temperature of -26.8°C. The mean annual precipitation is approximately 280.7 millimetres (mm), with 164.5 mm falling as rain and the remainder as snow.

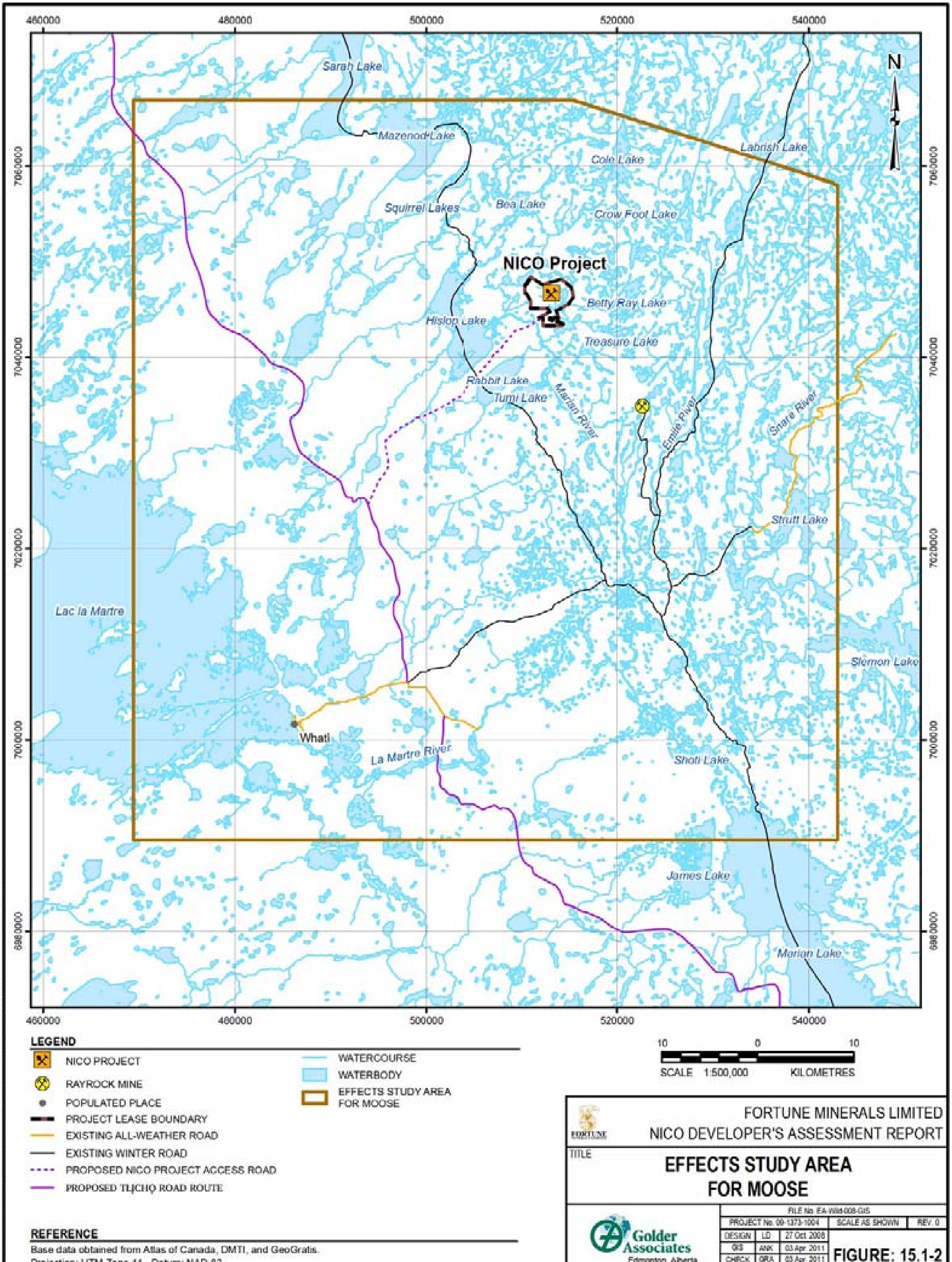
To facilitate the assessment and interpretation of potential effects associated with the NICO Project, it is necessary to define appropriate spatial boundaries. Study area boundaries were delineated based on the predicted spatial extent of the NICO Project-related effects and the life history attributes of wildlife populations potentially influenced by the NICO Project. The following 3 spatial boundaries were used:

- effects study area for moose (ESAM) was used to assess the incremental and cumulative effects from the NICO Project and other developments on the moose population;
- regional study area (RSA) for NICO Project-specific and potential cumulative effects on other wildlife populations including barren-ground caribou; and
- local study area (LSA) for small-scale direct and indirect effects from the NICO Project, which consists of the NICO mine site and 27 km Proposed NICO Project Access Road (NPAR).

15.1.2.2 Effects Study Area for Moose

The assessment of NICO Project effects on most wildlife VCs is completed at the scale of the RSA, which is likely large enough to contain all or most individuals that comprise the seasonal and annual populations that inhabit the area (Section 15.1.2.3). Here, the population (or population area) is defined by a group of individuals of the same species occupying an area of sufficient size so that emigration and immigration are infrequent, and most of the changes in abundance and distribution are determined by reproduction and survival (Berryman 2002). For moose, most of the individuals in the population likely have seasonal ranges that include areas outside of the RSA. Thus, in addition to NICO Project effects, there is a higher likelihood for the population to experience effects from other human developments beyond the RSA, and so the effects study area was extended outside of the RSA.

The effects study area for moose (ESAM) is 77 x 73 km (5621 square kilometres [km^2]), which includes the RSA for the NICO Project, the community of Whatì, several existing winter roads, the Proposed Tłı̨chǫ Road Route from Behchokǫ̀ to Gamètì, the Įdaà Trail, and the Taiga Shield and Taiga Plains ecozones (Figure 15.1-2). This area should be large enough to assess the incremental and cumulative effects from the NICO Project and other developments on most individuals comprising the population of moose that forms part of a larger metapopulation. Because changes to populations can influence metapopulation persistence (Levins 1969; Hanski and Gilpin 1991; Hanski 1996), especially for moose that can make long-distance movements, predicted effects from the NICO Project and other developments in the study area can be used to assess effects to the larger metapopulation.



Sarah Lake
Mazenod Lake
Labrish Lake
Cole Lake
Squirrel Lakes
Bea Lake
Crow Foot Lake
NICO Project
Betty Ray Lake
Hislop Lake
Treasure Lake
Rabbit Lake
Tumi Lake
Marian River
Emile River
Snare River
Strutt Lake
Lac la Martre
Slemon Lake
Whati
La Martre River
Shoti Lake
James Lake
Marian Lake
N
460000
480000
500000
520000
540000
7060000
7040000
7020000
7000000
6980000
LEGEND
NICO PROJECT
RAYROCK MINE
POPULATED PLACE
PROJECT LEASE BOUNDARY
EXISTING ALL-WEATHER ROAD
EXISTING WINTER ROAD
PROPOSED NICO PROJECT ACCESS ROAD
PROPOSED TŁICHO ROAD ROUTE
WATERCOURSE
WATERBODY
EFFECTS STUDY AREA FOR MOOSE
10 0 10
SCALE 1:500,000 KILOMETRES
REFERENCE
Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83
FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT
TITLE
EFFECTS STUDY AREA FOR MOOSE
FILE No. EA-Wild-008-GIS
PROJECT No. 09-1373-1004
SCALE AS SHOWN
REV. 0
DESIGN LD 27 Oct. 2008
GIS ANK 03 Apr. 2011
CHECK GRA 03 Apr. 2011
REVIEW GRA 03 Apr. 2011
Golder Associates
Edmonton, Alberta
FIGURE: 15.1-2

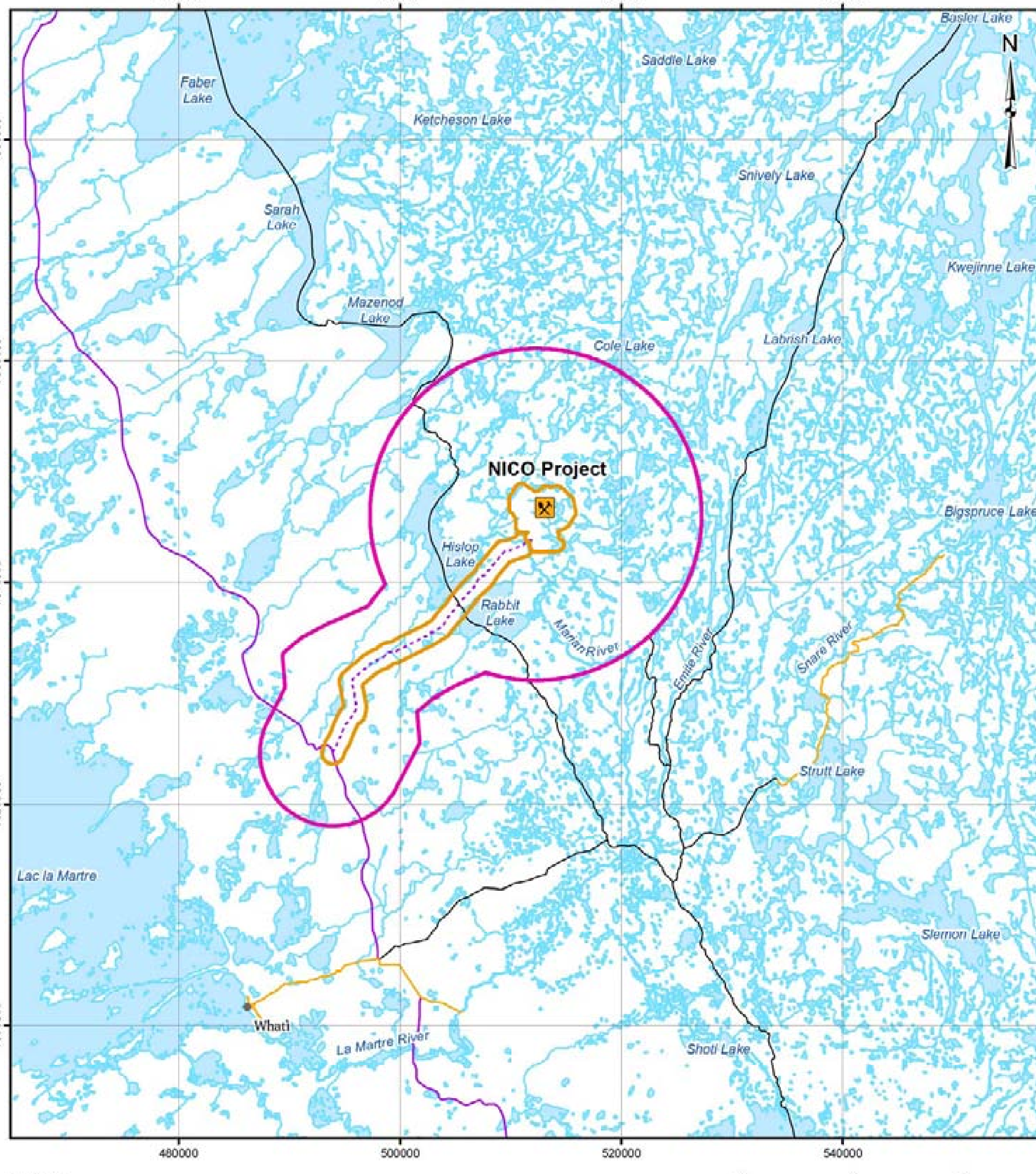
15.1.2.3 Regional Study Area

The regional study area (RSA) was selected to measure the existing baseline conditions at a scale large enough to capture the maximum predicted spatial extent of the combined direct and indirect effects (i.e., zone of influence) from the NICO Project on soils, vegetation, and wildlife (Figure 15.1-3). This area is intended to capture effects that extend beyond the immediate NICO Project footprint, such as noise, lights, smells, and other factors that can indirectly affect the environment at a distance. Cumulative effects from the NICO Project and other developments in the RSA (if present) can also be assessed at this scale for VCs that have most of the population distributed within the RSA. For species with small to moderate breeding home ranges (e.g., marten, muskrat, waterbirds, songbirds, and raptors), the population should be primarily affected by natural and human-related factors that change survival and reproduction of individuals within the RSA, and should be little influenced by emigration and immigration (Berryman 2002), and developments outside of the RSA should have no or little influence on these populations.

From 2003 to 2006 the RSA for the proposed mine site (mine RSA) was 314 km^2 (i.e., the radius was 10 km centered on the proposed mine site). This area was increased in 2007 to 706 km^2 (i.e., the radius was 15 km centered on the proposed mine site) because of increased knowledge about the effects from disturbance on barren-ground and woodland caribou. For example, studies on the movements of woodland caribou in the boreal forest of Newfoundland near resource extraction industries indicated that caribou avoided mining activities, with avoidance distances of up to 4 km during the summer and 6 km during the late winter, pre-calving, and calving seasons (Weir et al. 2007). More recent analysis has suggested that caribou are 4 times more likely to occur in areas greater than 11 to 14 km from the Ekati-Diavik mine complex (Boulanger et al. 2009). For the smaller Snap Lake Mine, caribou tend to prefer areas greater than 6.5 km from the mine, although the measurable avoidance of the mine was weak (Boulanger et al. 2009).

The RSA includes a 6.5 km buffer around the proposed road alignment (Figure 15.1-3). The NPAR at the time of baseline studies was a 50 km predicted alignment that joined the NICO site to the existing winter road between Behchokǫ̀ and Gamètì. Although the NPAR has since been reduced to 27 km, the original 50 km NPAR alignment was evaluated during baseline studies. The TOR (MVRB 2009) stipulate that the assessment for the NICO Project must include all aspects of the 27 km NICO access road (e.g., physical footprint and traffic), which will connect the mine to the transportation corridor between Behchokǫ̀ and Gamètì. For the remainder of the transportation corridor (from it's origin on Highway 3 to the intersection with the NPAR [approximately 110 km of road]), the DAR need only consider the effects of traffic from the NICO Project on the environment.

The mine RSA includes 2 Level II Ecoregions: Taiga Shield and Taiga Plains. The Taiga Shield Ecoregion is located northeast of Rabbit and Hislop lakes (Ecosystem Classification Working Group 2008), while the Taiga Plains Ecoregion covers the southwest portion of the mine RSA (Ecosystem Classification Working Group 2007). The NPAR is located primarily within the Taiga Plains ecoregion and is more heavily treed than the mine RSA (Figure 15.1-3). In the summer of 2008 wildfire burned approximately 10 percent (%) of the mine RSA.



FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

LOCAL AND REGIONAL STUDY AREAS FOR WILDLIFE

FILE No. EA-Wild-009-GIS

PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	LD	27 Oct. 2008	
GIS	ANK	03 Apr. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

Golder Associates
Edmonton, Alberta

FIGURE: 15.1-3

15.1.2.4 Local Study Area

The LSA boundary for the mine site and NPAR was defined by the expected spatial extent of the immediate direct (e.g., NICO Project footprint) and indirect effects (e.g., dust deposition) from the NICO Project on surrounding soil, vegetation, and wildlife (Figure 15.1-3). The LSA for the anticipated mine site (mine LSA) was defined as a 500 metre (m) buffer around the NICO Project Lease Boundary. The LSA for the NPAR was a 1000 m buffer on either side of the anticipated road right-of-way.

The mine LSA contains habitat that is characteristic of regional habitat conditions and vegetation that is typical of the Taiga Plains and Taiga Shield Ecoregions. Most habitat types are equally represented within the mine LSA and RSA; however, coniferous spruce, treed fen, marsh/graminoid fen, and deep water habitats are more common within the mine RSA than the mine LSA. Bedrock-open conifer habitat is more common within the mine LSA than the mine RSA. Habitat conditions along the NPAR LSA are characteristic of regional habitat conditions; however, the NPAR LSA is more heavily treed than the mine LSA.

15.1.3 Content

The general organization of this SON is outlined in Table 15.1-4. To verify that the contents of the TOR are addressed in this report, a table of concordance that cross-references the TOR to the information and location in this DAR is contained in Table 15.1-1.

Table 15.1-4: Wildlife SON Organization

Section	Content
Section 15.1	**Introduction** – Provides an introduction to the wildlife SON by defining the context, purpose, scope, and study areas, and providing an overview of the SON organization
Section 15.2	**Existing Environment** – Provides a summary of baseline methods and results for wildlife
Section 15.3	**Pathway Analyses** – Provides a screening level assessment of all potential pathways by which the NICO Project may influence wildlife after applying environmental design features and mitigation that reduce or eliminate NICO Project-related effects
Section 15.4	**Effects to the Abundance and Distribution of Wildlife** – Provides a detailed assessment of the effects on wildlife populations and communities
Section 15.5	**Related Effects to People** – Provides a summary of the potential effects from the NICO Project on the continued opportunities for the use of wildlife by people
Section 15.6	**Residual Effects Summary** – Summarizes the effects on wildlife that are predicted to remain after applying environmental design features, mitigation, and reclamation
Section 15.7	**Residual Impact Classification** – Describes the methods used to classify residual effects, and summarizes the classification results
Section 15.8	**Environmental Significance** – Provides a discussion of the environmental significance of the predicted impacts on wildlife
Section 15.9	**Uncertainty** – Provides a discussion of the sources of uncertainty related to predicting effects on wildlife
Section 15.10	**Monitoring and Follow-up** - Summarizes the objectives of the proposed monitoring and follow-up programs used to test the predicted effects, mitigation, and reclamation on wildlife

In addition to the content included in this SON, the following provides additional detailed baseline information for wildlife and proposed monitoring and follow-up programs:

- Annex D: Wildlife Baseline Report
- Biophysical Environment Monitoring and Management Plans (Section 18)

15.2 Existing Environment

15.2.1 Species at Risk

The MVRB has prepared draft guidelines outlining their expectations for considering effects to species at risk for the environmental effects assessment process in the Mackenzie Valley (MVRB 2008), until such time as the *Species At Risk Act* for the NWT is fully implemented. The guidelines were produced with substantial input from Environment Canada and the Government of the Northwest Terretories (GNWT) Department of Environment and Natural Resources. These guidelines (MVRB 2008) recommended that species at risk for environmental assessment include:

- species listed as At Risk in the General Status Ranks in NWT;
- species listed as *Endangered*, *Extirpated*, *Threatened*, or of *Special Concern* by the Committee on the Status of Endangered Wildlife in Canada; or
- species listed as *Endangered*, *Threatened*, or of *Special Concern* under Schedule 1 of *Species At Risk Act*.

The resulting list of wildlife species at risk for the NICO Project included one mammal and 6 birds (Table 15.2-1). In all but one case it is the federal COSEWIC listing that lead to the inclusion of the species; only olive-sided flycatcher (*Contopus cooperi*) triggered the first criteria of being listed At Risk in the NWT. This indicates that the risk of extirpation for NWT populations of the species is less than populations elsewhere in Canada. This is likely due to differences in the scales of assessment; COSEWIC must consider the national status of a species, whereas, the NWT General Status Ranks considers populations only in the context of the largely undisturbed NWT. As the *Species At Risk Act* (NWT) is implemented, the NWT status will be updated and will receive legal protection (ENR 2010a).

Table 15.2-1: Wildlife Species at Risk for the NICO Project

Common Name	Scientific Name	COSEWIC Status[a]	*SARA* Status[b]	NWT General StatusRank[c]
Wolverine (western population)	*Gulo gulo*	special concern	no status	sensitive
Horned grebe (western population)	*Podiceps auritus*	special concern	no status	secure
Peregrine falcon (anatum subspecies)	*Falco peregrinus anatum*	threatened	Schedule 1	not assessed
Short-eared owl	*Asio flammeus*	special concern	Schedule 3	sensitive
Common nighthawk	*Chordeiles minor*	threatened	Schedule 1	at risk
Olive-sided flycatcher	*Contopus cooperi*	threatened	Schedule 1	at risk
Rusty blackbird	*Euphagus carolinus*	special concern	Schedule 1	may be at risk

[a] COSEWIC 2010

[b] *SARA* 2011

[c] ENR 2010a

15.2.2 Furbearer Harvest

Furbearer statistics from the Tłįchǫ communities are summarized in Table 15.2-2 (ITT 2010). Average harvests from 2004 to 2009 are presented by community and by species. Total harvest over the entire period is also provided. Marten (*Martes Americana*) is the most commonly harvested furbearer, at over 11 000 between 2004 and 2009. Muskrat (*Ondatra zibethicus*) and beaver (*Castor canadensis*) are also commonly harvested. These data include furs submitted to the Department of Investment, Trade and Tourism through the Genuine Mackenzie Valley Furs Program, whereby the GNWT collects furs from trappers, provides advance payment, and sells the furs in bulk at auction. Thus, furs collected for domestic use are not reflected in these data.

Table 15.2-2: Annual Furbearer Harvest Statistics from 2004 to 2009

Common Name	Scientific Name	Behchokǫ̀ Average Harvest	Gamètì Average Harvest	Wekweetì Average Harvest	Whatì Average Harvest	Total Harvest, All Communities
Bear, Black	*Ursus americanus*	0.2	0	0	0	1
Beaver	*Castor canadensis*	151.4	3.8	1.6	8.6	827
Fisher	*Martes pennanti*	0.8	0	0.0	0	4
Fox, Cross	*Vulpes vulpes*	4.6	2.4	0.8	2.6	52
Fox, Red	*Vulpes vulpes*	4.8	1.4	1.4	2.2	49
Fox, Silver	*Vulpes vulpes*	0	1.0	0	0.0	5
Fox, White	*Alopex lagopus*	1.2	0.6	1.3	0.4	15
Lynx	*Lynx canadensis*	12.6	0.6	0.6	1.2	75
Marten	*Martes americana*	1 019.6	303.8	185.2	845.2	11 769
Mink	*Mustela vison*	19.0	14.4	3.0	26.2	313
Muskrat	*Ondatra zibethicus*	898.0	0	4.6	54.4	4 785
Otter	*Lontra canadensis*	0.8	0.4	0	1.0	11
Squirrel	*Tamiasciurus hudsonicus*	7.6	1.4	0	0.6	48
Weasel	*Mustela* spp.	4.0	0.2	0	4.6	44
Wolf, Boreal	*Canis lupus*	0.4	0	0	2.4	14
Wolverine	*Gulo gulo*	5.0	2.0	1.0	1.4	47

Source: ITT (2010)

15.2.3 Methods

Baseline studies on wildlife species and wildlife habitat were completed within the mine LSA and RSA and the NPAR LSA and RSA from 1998 to 2010 (Section 15.1.2.3 and Section 15.1.2.4). Qualitative data were collected from 1998 to 2002. Quantitative data were collected from 2003 to 2010. The objectives of the studies were to estimate the natural range of variation in annual and seasonal occurrence, abundance, and habitat association of hoofed mammals (e.g., ungulates like moose), carnivores (e.g., black bear [*Ursus americanus*] and wolverine [*Gulo gulo*]), furbearers (e.g., marten and muskrat), and migratory birds (i.e., upland breeding birds, waterbirds, and raptors) in the study areas.

15.2.3.1 Moose

Aerial surveys from 2004 to 2010 were divided into 2 components based on the study areas (Figure 15.2-1). A record of aerial survey dates is provided in Table 15.2-3. Within the mine RSA, from 2004 to 2006, there were 9 transects oriented in a north-south direction spaced 2 km apart. The survey width was 200 m on either side of the aircraft, which resulted in approximately 16% coverage of the mine RSA. From 2007 to 2010, there were 15 transects oriented in a north-south direction spaced 2 km apart. The survey width was still 200 m on either side of the aircraft, and resulted in approximately 20% coverage of the mine RSA.

Within the NPAR RSA from 2004 to 2010, 5 transects were flown parallel to the road alignment with a survey width of 100 m on either side of the aircraft, which covered approximately 13% of the area. A central transect was flown directly over the proposed road alignment, 2 transects were flown approximately 1 km from either side of the alignment, and 2 transects were flown 5 km from either side of the alignment (Figure 15.2-1). Further details regarding the aerial surveys are described in the wildlife baseline annex (Annex D; Section 2.2.1.1).

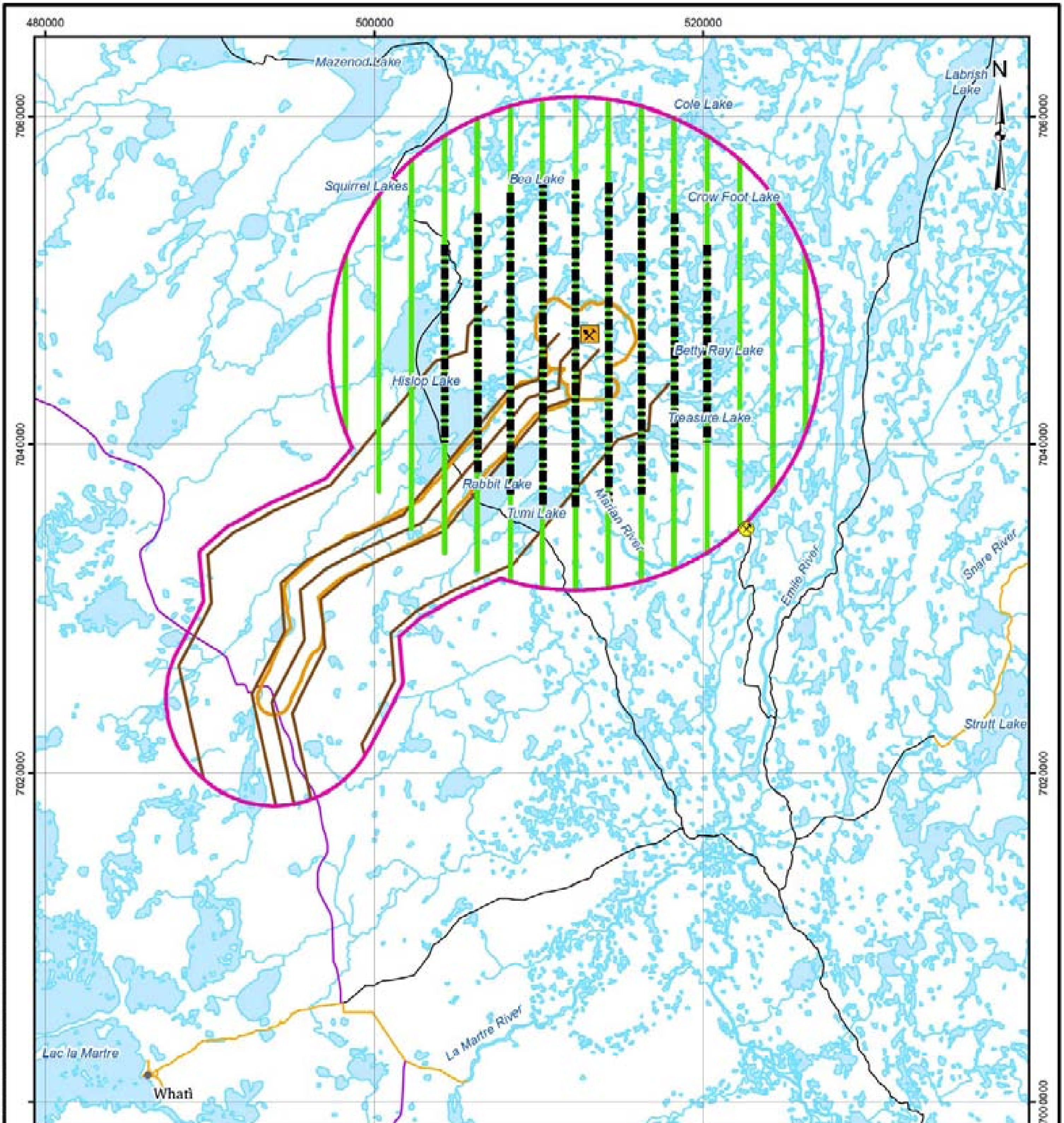
Table 15.2-3: Dates of Ungulate Aerial Surveys from 2004 to 2010

Year	Date	Size of Mine RSA	Proportion of Mine RSA Surveyed (%)
2004	26 November; 10 December	10 km radius	16
2005	11 April; 4 May	10 km radius	16
2006	11 April; 6 December	10 km radius	16
2007	11 April; 11 December	15 km radius	20
2008	15 April; 12 December	15 km radius	20
2009	17 December	15 km radius	20
2010	22 March	15 km radius	20

RSA = regional study area; km = kilometre; % percent

Pellet surveys were completed during the summers of 2005 to 2007 to determine moose distribution and habitat use within and adjacent to the mine LSA. Sampling periods included the following:

- 24 and 25 June 2005;
- 9 to 11 June 2006; and
- 13 and 16 June 2007.



LEGEND

- NICO PROJECT
- RAYROCK MINE
- POPULATED PLACE
- EXISTING ALL-WEATHER ROAD
- EXISTING WINTER ROAD
- PROPOSED TŁĮCHQ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- 10 km MINE REGIONAL STUDY AREA TRANSECT (2003-2006)
- 15 km MINE REGIONAL STUDY AREA TRANSECT (2007-PRESENT)
- PROPOSED NICO PROJECT ACCESS ROAD TRANSECT
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

10 0 10

SCALE 1:325,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

LOCATION OF AERIAL SURVEY TRANSECTS

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-010-GIS

PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	LD	27 Oct. 2008		
GIS	ANK	03 Apr. 2011		
CHECK	GRA	03 Apr. 2011	**FIGURE: 15.2-1**	
REVIEW	GRA	03 Apr. 2011		

Moose pellet groups were counted along twelve, 500 m long transects in 2005 and 2006, and five, 500 m long transects in 2007 (Figure 15.2-2). Further details regarding the pellet surveys are described in wildlife baseline annex (Annex D; Section 2.2.1.2).

In 2005, 2008, and 2009 winter track surveys were completed to determine the relative activity, distribution, and habitat use of moose within the mine and NPAR study areas. Ten transects (each 1 km long) were established within the mine study areas (i.e., mine LSA and RSA) in 2005 (Figure 15.2-3). Forty-one transects (range 0.1 to 1.3 km in length) were established within the mine study areas in 2009 (Figure 15.2-3). No winter track surveys were carried out within the mine study areas in 2008. Eleven transects (each 1 km long) were established within the NPAR study areas in 2005 and 24 transects (each 1 km long) were established within the NPAR study areas in 2008 (Figure 15.2-3). No surveys were completed within the NPAR study areas in 2009. Surveys were completed from 4 to 8 April 2005, 26 February to 1 March 2008, and 8 to 12 March 2009.

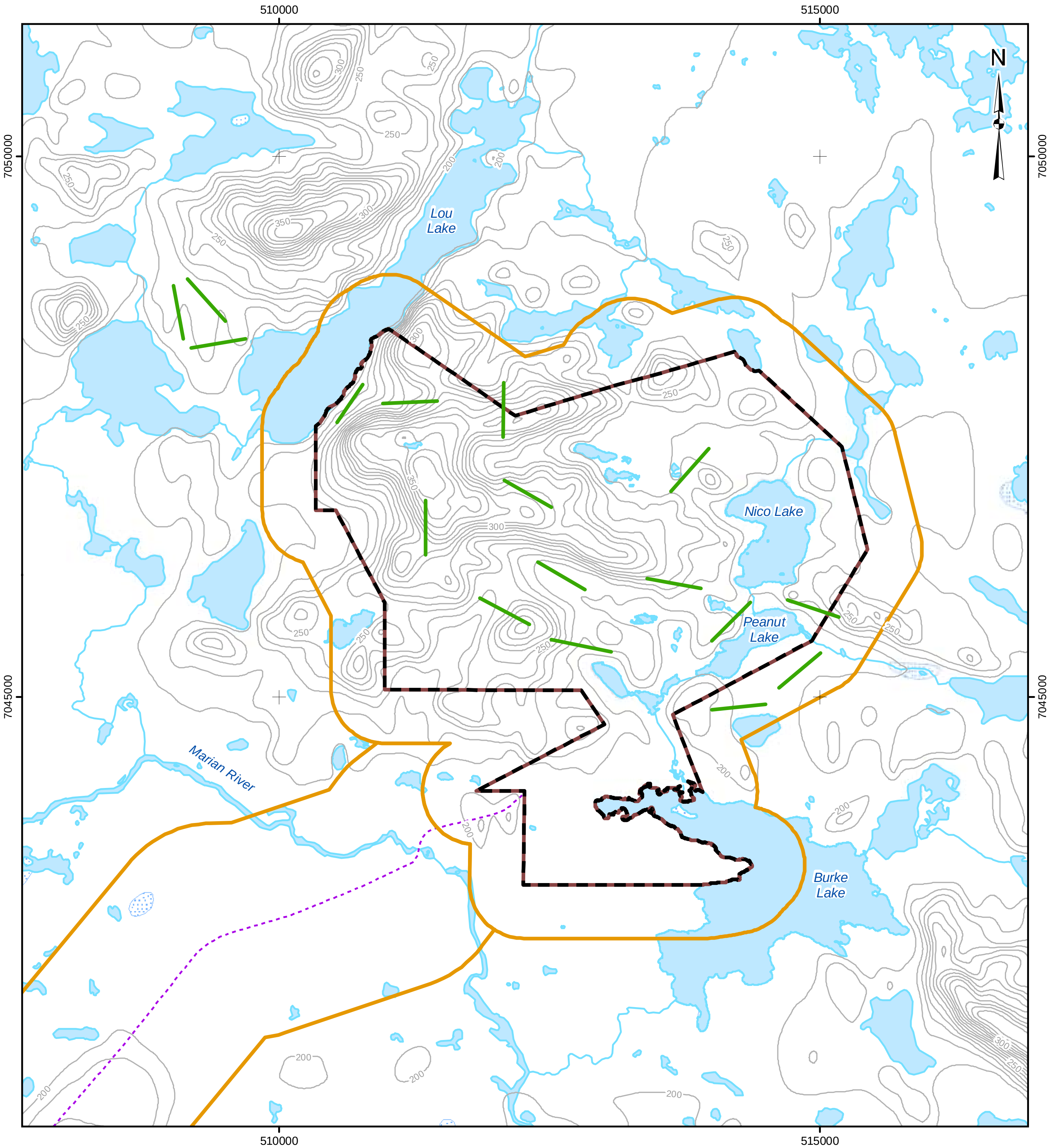
Winter track data for the NPAR RSA from 2005 and 2008 were pooled because the wildfire of 2008 did not burn any of the NPAR RSA. Winter track data of 2005 and 2009 for the mine RSA were analyzed separately because the forest fire of 2008 changed the amount of habitats that were available in the mine RSA. Further details regarding the winter track surveys are described in the wildlife baseline annex (Annex D; Section 2.2.1.3]).

15.2.3.2 Black Bear and Wolverine

Rapid assessment surveys for black bear sign were completed from 14 to 16 September 2003. Areas likely to have high concentrations of game trails and wildlife activity (perimeters of waterbodies, valleys, and other potential travel corridors) near the NICO Project were identified on topographic maps and aerial photographs. Searches of these areas were completed on foot and were focused on sign (e.g., tracks, scat, and dens). Incidental observations of black bear and black bear sign were also recorded during all other baseline surveys from 2004 to 2010.

15.2.3.3 Marten

The relative activity, distribution, and habitat use of marten in the mine and NPAR study areas were determined from winter track surveys. The sampling design and survey methods are similar to moose and are described in Section 15.2.3.1.



LEGEND

- PROJECT LEASE BOUNDARY
- CONTOUR (10 METRE INTERVAL)
- PROPOSED NICO PROJECT ACCESS ROAD
- WATERCOURSE
- WATERBODY
- WETLAND
- PELLET SURVEY TRANSECT (2005-2007)
- LOCAL STUDY AREA

1 0 1

SCALE 1:50,000 KILOMETRES

REFERENCE

Base data obtained from GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

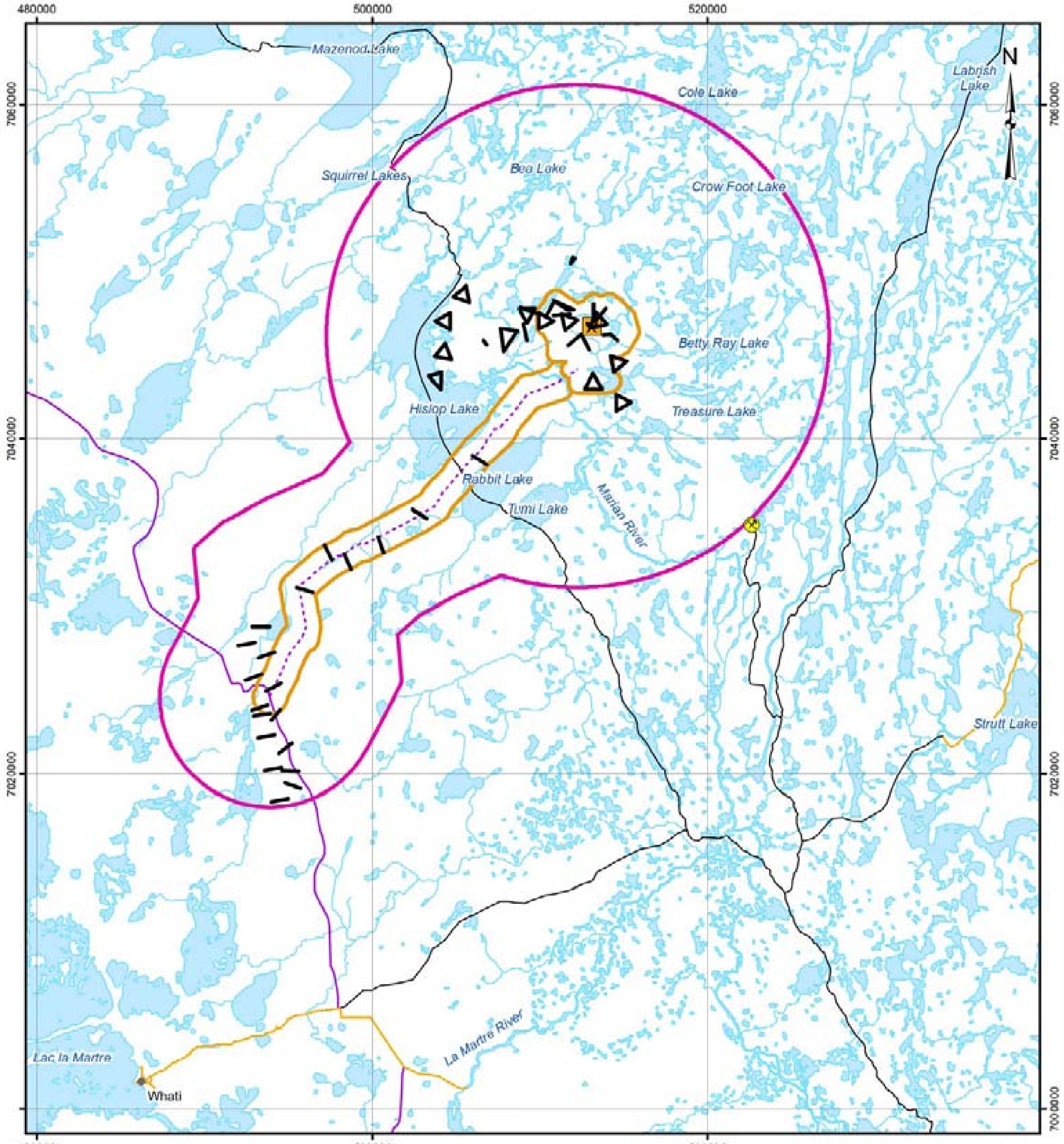
LOCATION OF PELLET SURVEYS

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-011-GIS			
PROJECT No. 09-1373-0017		SCALE AS SHOWN	REV. 0
DESIGN	LD	05 Nov. 2008	
GIS	MK	23 Feb. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

FIGURE: 15.2-2

G:\2008\1373\08-1373-0017 Fortune Minerals Nico EIS\GIS\Mapping\MXD\Wildlife\EA-Wild-011-GIS.mxd



LEGEND

- NICO PROJECT
- RAYROCK MINE
- POPULATED PLACE
- EXISTING ALL-WEATHER ROAD
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁICHQ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- WINTER TRACK TRANSECT (2005, 2008, 2009)
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

10 0 10

SCALE 1:325,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

LOCATION OF WINTER TRACK SURVEYS

FILE No. EA-Wild-012-GIS			
PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	LD	27 Oct. 2008	FIGURE: 15.2-3
GIS	ANK	03 Apr. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

Golder Associates
Edmonton, Alberta

G:\2008\1373\08-1373-0017 Fortune Minerals Nico EIS\GIS\Mapping\MXD\Wildlife\EA-Wild-012-GIS.mxd

15.2.3.4 Muskrat

In 2003 and 2004, lakes within the mine and NPAR RSAs were searched on foot for muskrat sign and these surveys were supplemented by aerial surveys in July 2004 (Fortune 2005). In 2005, surveys for muskrat sign were performed concurrently with aerial surveys for waterbirds (Section 15.2.3.6) and with ground surveys of the 2 stream crossings along the proposed NPAR (i.e., Unnamed creek [locally called the 3 m Stream] and the Marian River). Ground surveys were completed within 500 m on either side of each proposed stream crossing. Although there are 9 stream crossing points along the proposed NPAR, only the Marian River and 3 m Stream contain suitable habitat for muskrats (i.e., surface flowing with a clear channel and had sufficient volume to flow throughout the year).

15.2.3.5 Upland Breeding Birds

Upland breeding bird surveys were completed to describe species occurrence, relative abundance, and habitat use of songbirds and upland game birds that nest in upland and riparian habitat. Specifically, the objectives of the 2005 to 2009 upland breeding bird surveys were:

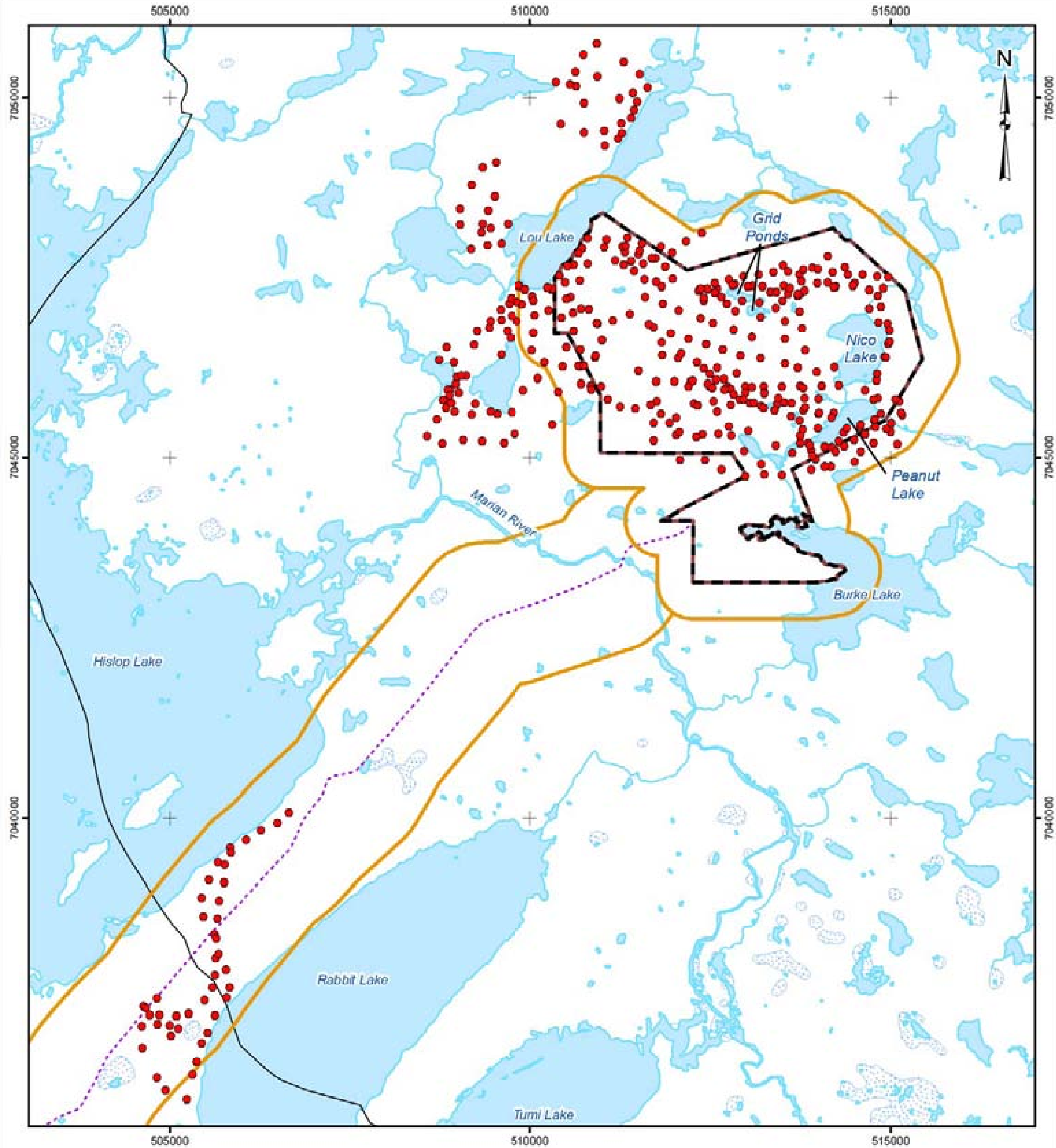
- to document the natural variation in upland bird species density and richness within the mine LSA; and
- to assess the importance of upland bird nesting habitats within the mine LSA.

Standard point count surveys were completed from 14 to 16 June 2005, 9 to 15 June 2006, 14 to 18 June 2007, 10 to 13 June 2008, and 13 to 17 June 2009. Surveys were carried out between 2:45 am and 9:00 am (i.e., within 6 hours of sunrise; Ralph et al. 1993). Point count stations were established along transects a minimum of 250 m apart, and at locations between lakes and within expected disturbance areas (Figure 15.2-4). Two levels of analysis were performed. A species-level analysis examined how the density of individual species varied across the habitats. A community-level analysis examined the variation in density and richness among habitats of all species in the bird community.

Relative abundance (density) was calculated as the number of individuals per effective area surveyed. The effective detection radius (EDR) (Buckland et al. 2001) was used to calculate the effective area surveyed using the formula:

$$EDR = \sqrt{\frac{2}{\left((\frac{2}{k^2}) * \ln(\frac{n}{n_2}) \right)}}$$

where k = the distance at which birds are declared as being in our out of the sampling area (i.e., 50 m), n = total number of birds detected, and n_2 = total numbers of birds detected outside the value of k (E. Bayne, pers. comm. 2009). Further details regarding the upland breeding bird surveys are described in the wildlife baseline annex (Annex D; Section 2.2.5).



LEGEND

- PROJECT LEASE BOUNDARY
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- WATERCOURSE
- WATERBODY
- WETLAND
- POINT COUNT STATION
- LOCAL STUDY AREA

2 0 2

SCALE 1:75,000 KILOMETRES

REFERENCE

Base data obtained from GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

LOCATION OF UPLAND BREEDING BIRD POINT COUNT STATIONS

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-013-GIS				
PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	AND	04 Nov. 2008	**FIGURE: 15.2-4**	
GIS	ANK	23 Feb. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

G:\2008\1373\08-1373-0017 Fortune Minerals Nico EIS\GIS\Mapping\MXD\Wild\EA-Wild-013-GIS.mxd

15.2.3.6 Waterbirds

Waterbirds include loons, grebes, mergansers, scoters, American coot, ducks, geese, swans, gulls, and terns. Waterbird surveys were completed to document the abundance, species composition, and production of waterbirds. Waterbirds were surveyed using aerial and ground surveys. Fall migration surveys were completed in 2003, whereas surveys from 2004 to 2006 were intended to coincide with the breeding season (June) and the brood-rearing/molting period (mid- to late July).

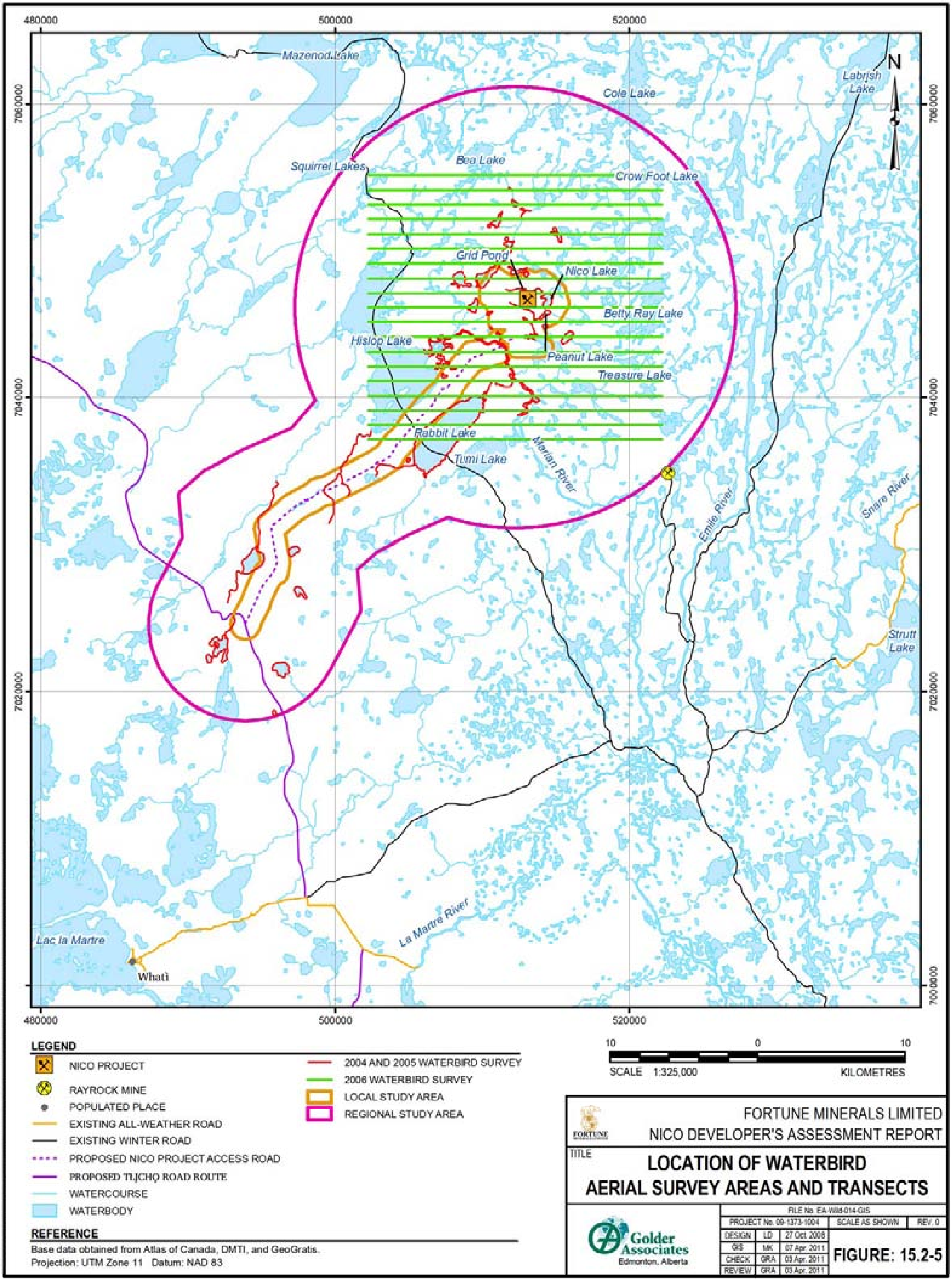
Migrating waterbirds were surveyed from the ground at lakes near the exploration bulk sampling site from 14 to 16 September 2003. In 2004 and 2005, aerial surveys were completed for waterbirds on 119 lakes within the mine and NPAR LSAs, and on an 8 km segment of the Marian River. Waterbodies were surveyed on 13 and 14 July 2004, 13 to 15 June 2005, and 23 to 25 July 2005. In 2006, 19 transects, each 20 km in length, were flown within the mine RSA (Figure 15.2-5). Each transect had a survey width of 200 m on either side of the aircraft. Surveys were completed on 4 June and 27 July 2006. Further details regarding the waterbird surveys are described in the wildlife baseline annex (Annex D; Section 2.2.6).

15.2.3.7 Raptors

Raptors are birds of prey and include falcons, hawks, eagles, and owls. The initial identification of raptor nest sites typically occurred during aerial and ground surveys for other species (e.g., moose, marten, upland birds, and waterbirds). Aerial surveys of identified raptor nests were completed to determine spring occupancy, summer nest success, and chick production.

Raptor studies began on 12 September 2003 with a ground survey of cliffs and trees along the shoreline of lakes and rivers, and again on 13 and 14 July 2004. From 2005 to 2009, the previously identified nests were monitored through fly-by observations from a helicopter. All visits were completed as briefly as possible and in suitable weather conditions to limit disturbance to the birds. Identified raptor nests were monitored from 13 to 15 June 2005, 5 June 2006, 14 June 2007, 11 to 13 June 2008, and 13 June 2009 to determine nest occupancy. Nests were considered occupied if at least one adult bird was observed. Eggs were counted if visible and the number of chicks was also recorded. Surveys to determine raptor productivity were carried out on 23 to 25 July 2005, 28 July 2006, 3 August 2007, and 16 July 2009. No productivity survey (i.e., July) was completed in 2008 due to a forest fire burning in the area. Nests were determined as successful if at least one chick was observed in the nest.

The Environment and Natural Resources Department (ENR) of the GNWT maintains a database of all known raptor nests in the NWT. In 2005, this database was queried for the entire 85N map sheet (extending from 63^{o} 00’ N 116^{o} 00’ W to 64^{o} 00’ N 118^{o} 00’ W) to determine if any other nests may be present in the region.


480000
500000
520000
7060000
7040000
7020000
7000000
N
Mazenod Lake
Cole Lake
Labrish Lake
Squirrel Lakes
Bea Lake
Crow Foot Lake
Grid Pond
Nico Lake
Betty Ray Lake
Hislop Lake
Peanut Lake
Treasure Lake
Rabbit Lake
Tumi Lake
Marian River
Emile River
Snare River
Strutt Lake
La Martre River
Lac la Martre
Whati
LEGEND
NICO PROJECT
RAYROCK MINE
POPULATED PLACE
EXISTING ALL-WEATHER ROAD
EXISTING WINTER ROAD
PROPOSED NICO PROJECT ACCESS ROAD
PROPOSED TLICHO ROAD ROUTE
WATERCOURSE
WATERBODY
2004 AND 2005 WATERBIRD SURVEY
2006 WATERBIRD SURVEY
LOCAL STUDY AREA
REGIONAL STUDY AREA
10 0 10
SCALE 1:325,000
KILOMETRES
REFERENCE
Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83
FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT
TITLE
LOCATION OF WATERBIRD AERIAL SURVEY AREAS AND TRANSECTS
FILE No. EA-Wild-014-GIS
PROJECT No. 09-1373-1004
SCALE AS SHOWN
REV. 0
DESIGN LD 27 Oct. 2008
GIS MK 07 Apr. 2011
CHECK GRA 03 Apr. 2011
REVIEW GRA 03 Apr. 2011
Golder Associates
Edmonton, Alberta
FIGURE: 15.2-5

15.2.4 Results

15.2.4.1 Moose

15.2.4.1.1 Population Status and Distribution

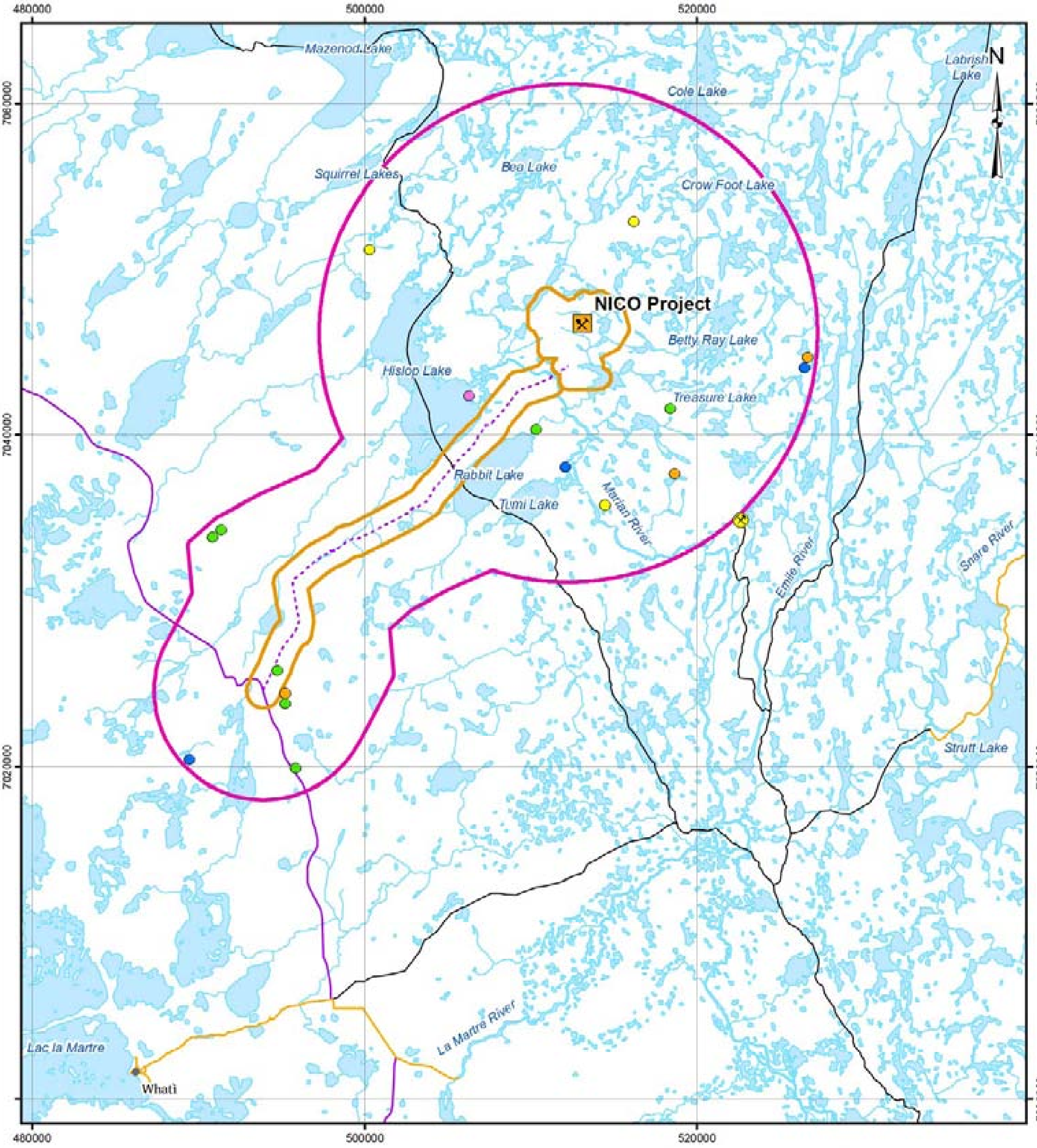
Moose populations in the NWT are listed as 'secure' (ENR 2010a), and are not listed federally (COSEWIC 2010; *SARA* 2011). Traditional moose range encompasses suitable habitat south of the treeline throughout the NWT; however, since the early 1900s, moose have been seen at numerous locations on the tundra where adequate forage is available (ENR 2010b). Moose densities in northern environments are low (5 to 15 moose per 100 km^2 [ENR 2010b]) compared to southern boreal forest regions (Sly et al. 2001). The estimated number of moose in the NWT is approximately 20 000 individuals (ENR 2010b).

The best areas for moose are characterized by semi-open forest cover, an abundance of willow and aspen stands, and are located close to lakes, river valleys, stream banks, or sand bars. During the summer, moose may move into the tundra where they feed on semi-aquatic vegetation in wetlands and shallow lakes (Bromley and Buckland 1995). Moose cows usually select areas in immediate proximity to small ponds and marshes for calving. Stenhouse et al. (1994) found that mean annual home range for cows in the Mackenzie Valley, NWT was 174 km^2 (SE = 31 km^2, N = 29). This home range estimate was larger than those reported for adult moose in other parts of North America (Stenhouse et al. 1994), which may indicate that forage abundance was lower (Mace et al. 1984; Risenhoover 1986).

Moose are primarily threatened by direct and indirect habitat loss, altered predator/prey relationships, and hunting. Their primary predators are wolves and bears, which most often kill calves, although adults can also become prey (Ballard and Van Ballenberghe 1997). Predation and snow conditions are interrelated factors that can affect moose survival and recruitment. When snow is deep, moose gather in areas of shallow snow, which increases predation risk from wolves (ENR 2010b). In addition, snow depth of over 90 centimetres (cm) greatly hinders their movements and reduces the availability of suitable browse species above the snowpack (ENR 2010b).

Currently in the NWT, moose are managed mostly by controlling the hunting season for residents and non-residents (ENR 2010b). The estimated total NWT moose harvest is 1000 to 2000 animals per year, 80 to 90% of which is taken by General Hunting License holders who are able to hunt during any season.

Moose were observed during 8 of the 12 aerial surveys (all surveys except 4 May 2005, 11 April 2006, 15 April 2008, and 22 March 2010). Incidental observations of moose were also made during other wildlife surveys (Figure 15.2-6; Table 15.2-4; Table 15.2-5). One observation of a moose calf was made in 2004 and one calf was observed in 2008. All other observations were of adults. An observation was also made of a moose swimming in Burke Lake on 13 June 2005. From 2004 through 2010, 11 adult moose and one calf were recorded in the mine RSA (Table 15.2-4), and 29 adult moose and one calf were observed in the NPAR study area (Table 15.2-5).



LEGEND

- NICO PROJECT
- RAYROCK MINE
- POPULATED PLACE
- EXISTING ALL-WEATHER ROAD
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁĮCHǪ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- MOOSE OBSERVATION, 2004
- MOOSE OBSERVATION, 2005
- MOOSE OBSERVATION, 2007
- MOOSE OBSERVATION, 2008
- MOOSE OBSERVATION, 2009
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

10 0 10

SCALE 1:325,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

LOCATION OF MOOSE OBSERVATIONS

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-015-GIS

PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	LD	27 Oct. 2008	**FIGURE: 15.2-6**	
GIS	MK	07 Apr. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

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Table 15.2-4: Observations of Moose within the Mine Regional Study Area, 2004 to 2010

Date	Bulls/Unknown	Cows	Calves	Habitat[a]
26-Nov-04	1 unknown	0	0	Bedrock-open conifer
10-Dec-04	1 unknown	0	0	Bedrock-open conifer
11-Apr-05	2 unknown	0	0	Coniferous spruce
11-Dec-07	1 unknown	0	0	Coniferous spruce
12-Dec-08	0	1	1	Frozen water (ice)
12-Dec-08	1 bull	0	0	Coniferous spruce
17-Dec-09	1 unknown	0	0	Coniferous spruce
17-Dec-09	2 unknown	0	0	Burn
17-Dec-09	1 unknown	0	0	Bedrock-open conifer

[a] Determined from the Ecological Landscape Classification

Table 15.2-5: Observations of Moose within the NICO Project Access Road Regional Study Area, 2004 to 2010

Date	Bulls/Unknown	Cows	Calves	Habitat[a]
13-Jul-04	0	1	1	Coniferous spruce
26-Nov-04	1 unknown	0	0	Coniferous spruce
26-Nov-04	2 unknown	0	0	Coniferous spruce
26-Nov-04	1 unknown	0	0	Treed fen
26-Nov-04	2 unknown	0	0	Frozen water (ice)
10-Dec-04	1 unknown	0	0	Open bog
10-Dec-04	1 unknown	0	0	Coniferous spruce
10-Dec-04	3 unknown	0	0	Coniferous spruce
23-Jul-05	0	1	0	Coniferous spruce
23-Jul-05	1 unknown	0	0	Open bog
6-Dec-06	0	2	0	Coniferous spruce
6-Dec-06	0	3	0	Coniferous spruce
6-Dec-06	0	2	0	Coniferous pine
6-Dec-06	0	1	0	Treed bog
11-Apr-07	0	1	0	Coniferous pine
11-Dec-07	1 bull	0	0	NR
12-Dec-08	4 bulls	0	0	Coniferous spruce
17-Dec-09	1 unknown	0	0	Treed bog

[a] Determined from the Ecological Landscape Classification

NR = Not recorded

Moose tracks were observed more frequently in deciduous trembling aspen-paper birch habitat than coniferous spruce habitat in the mine RSA during winter track surveys in 2005 (Table 15.2-6). No moose tracks were observed in any other surveyed habitat type within the mine RSA in 2005. Moose tracks were only recorded in coniferous spruce and treed fen habitat during winter track surveys in 2009 (Table 15.2-7). The highest density of moose tracks was observed within deciduous trembling aspen-paper birch habitat within the NPAR study area

(Table 15.2-8). Moose tracks were also found in coniferous spruce and coniferous pine habitats within the NPAR. The limited availability of some habitats in the RSAs constrained the ability to sample burn, bedrock-open conifer, coniferous pine, marsh/graminoid fen, shrubland, open bog, and treed fen habitats (Annex D; Table 2.2-5; Table 2.2-6; Table 2.2-7). Single tracks accounted for 100% of the moose track observations in the study areas.

The highest densities of moose pellets were recorded in bedrock-open conifer and coniferous spruce habitats (Table 15.2-9). Pellets were also recorded in deciduous trembling aspen-paper birch and treed bog habitats. No moose pellets were observed in other habitat types.

Table 15.2-6: Moose Snow Track Density among Habitats within the Mine Regional Study Area, 2005

Habitat Type	Number of Tracks[a] (mean ± SE)	Observed Use (TKD)	Distance Sampled (km)
Bedrock-Open Conifer	0	0	1.88
Burn	NS	NS	0
Coniferous Pine	0	0	0.05
Coniferous Spruce	0.40 ± 0.40	8.33	6.52
Deciduous Aspen	2.58 ± 1.30	7.74	0.17
Marsh/Graminoid Fen	0	0	0.01
Open Bog	0	0	0.14
Shrubland	NS	NS	0
Treed Bog	0	0	0.25
Treed Fen	NS	NS	0
Frozen Water (Ice)	0	0	0.78
Total		**16.07**	**9.80**

[a] Number of tracks per km surveyed per days since last snow fall. Includes single tracks, trails, and networks weighted by 1, 3, and 5, respectively.

SE = Standard Error; TKD = Presence of tracks (i.e., 0 [if no tracks, trails, or networks were observed] or 1 [if at least one trail, track, or network was observed) per km surveyed per days since last snow fall; NS = not surveyed; km = kilometre

Table 15.2-7: Moose Snow Track Density among Habitats within the Mine Regional Study Area, 2009

Habitat Type	Number of Tracks[a] (mean ± SE)	Observed Use (TKD)	Distance Sampled (km)
Bedrock-Open Conifer	0	0	5.13
Burn	0	0	6.32
Coniferous Pine	NS	NS	0
Coniferous Spruce	0.69 ± 0.40	39.44	14.50
Deciduous Aspen	0	0	0.07
Marsh/Graminoid Fen	0	0	0.31
Open Bog	0	0	0.35
Shrubland	0	0	0.68
Treed Bog	0	0	0.43
Treed Fen	0.27 ± 0.15	5.08	2.67
Frozen Water (Ice)	0	0	6.49
Total		**44.53**	**36.95**

[a] Number of tracks per km surveyed per days since last snow fall. Includes single tracks, trails, and networks weighted by 1, 3, and 5, respectively.

SE = Standard Error; TKD = Presence of tracks (i.e., 0 [if no tracks, trails, or networks were observed] or 1 [if at least one trail, track, or network was observed]) per km surveyed per days since last snow fall; NS = not surveyed; km = kilometre

Table 15.2-8: Moose Snow Track Density among Habitats within the NICO Project Access Road Regional Study Area, 2005 and 2008

Habitat Type	Number of Tracks[a] (mean ± SE)	Observed Use (TKD)	Distance Sampled (km)
Bedrock-Open Conifer	0	0	0.23
Burn	0	0	0.08
Coniferous Pine	0.22 ± 0.22	3.92	2.60
Coniferous Spruce	0.21 ± 0.09	10.86	24.87
Deciduous Aspen	0.64 ± 0.64	2.54	0.61
Marsh/Graminoid Fen	0	0	1.49
Open Bog	0	0	0.20
Shrubland	0	0	0.04
Treed Bog	0	0	1.50
Treed Fen	0	0	2.64
Frozen Water (Ice)	0	0	0.20
Total		**17.32**	**34.46**

[a] Number of tracks per km surveyed per days since last snow fall. Includes single tracks, trails, and networks weighted by 1, 3, and 5, respectively.

SE = Standard Error; TKD = Presence of tracks (i.e., 0 [if no tracks, trails, or networks were observed] or 1 [if at least one trail, track, or network was observed]) per km surveyed per days since last snow fall;km = kilometre

Table 15.2-9: Moose Pellet Group Density Observed among Habitat Types during Summer, 2005 to 2007

Habitat Type	Number of Pellet Groups (mean ± 1SE)[a]	Distance Sampled (km)
Bedrock-Open Conifer	1.64 ± 0.53	1.76
Coniferous Pine	0	0.04
Coniferous Spruce	0	1.09
Deciduous Aspen	1.0[b]	0.26
Mixedwood Spruce-Paper Birch-Aspen	1.19 ± 0.36	2.84
Open Bog	0	0.19
Treed Bog	0.50 ± 0.50	6.89
Total		**13.07**

[a] Number of pellet groups per habitat type per transect.

[b] Only one group of moose pellets was observed in deciduous aspen habitat.

SE = Standard Error; km = kilometre

15.2.4.1.2 Habitat Selection and Foraging

Optimal moose habitat consists of deciduous shrub and ground layers within deciduous, mixed, and conifer forests that offer edge or disturbed areas of early successional vegetation. In spring, moose tend to seek out low elevation areas, usually wetlands, muskeg, and river floodplains, as this is typically where the first green-up occurs (Stelfox 1993). They tend to continue to use these areas in the summer periods where they will also feed in adjacent forest stands. Habitat preference of moose during all study periods and study areas could not be determined because the number of moose tracks detected among habitats was not adequate (i.e., expected frequencies of moose tracks among habitats were less than 5).

Moose are positively influenced by forest fire because fire increases the availability of deciduous browse species that moose depend on throughout the winter (MacCracken and Viereck 1990; Collins and Helm 1997). Moose densities were found to be greatest in 10 to 26 year old burned areas (Maier et al. 2005). Moose occupation of burned areas will vary with fire intensity, as severely burned areas will have little vegetation growth for up to 5 years (Gasaway et al. 1989).

During summer, moose use upland forests and eat fresh shoots and leaves from deciduous shrubs and young deciduous trees (mainly trembling aspen and balsam poplar [*Populus balsamifera*]); however, moose are also known to browse on young coniferous trees, such as balsam fir, in the summer. In northern Alberta moose diet in summer was typically made up of 74% shrubs and trees, 25% forbs, and 1% graminoids (Rednecker 1987). Moose obtain the majority of their annual salt requirements from pond lilies and aquatic vegetation (Stelfox 1993). During the fall and winter, moose typically prefer habitats where adequate browse is available. Preferred fall and winter browse includes red-osier dogwood (*Cornus sericea*), willow species (*Salix* spp.), trembling aspen, balsam poplar, dwarf birch (*Betula occidentalis*), alder (*Alnus* spp.), and beaked hazelnut (*Corylus cornuta*), among others (Stelfox 1993). To access this forage, habitats with high cover of shrub species, such as shrubby fens and bogs and riparian habitats with open canopies, are usually preferred, particularly in late winter. Shrub height is important during winter conditions, as forage shrub species must be higher than the snowpack to be accessed by moose.

15.2.4.2 Black Bear

15.2.4.2.1 Population Status and Distribution

Black bears are found below the treeline in the NWT (ENR 2010c). Black bears are listed as ‘secure’ in the NWT (ENR 2010a) and are not listed federally (COSEWIC 2010; *SARA* 2011).

Black bears hibernate during winter, so the activity of bears within the RSAs will vary seasonally. Black bear abundance within the RSAs is also expected to vary between years in response to denning behaviour and food availability. Bears have a low level of den reuse and den locations are often several kilometres apart between consecutive years (Linnell et al. 2000). Black bears are also sensitive to disturbance during winter hibernation and may abandon their dens if disturbance occurs within 1 km of their den site (Linnell et al. 2000). Because black bear home range size fluctuates in response to food availability, less bears may be present within the study area during years of low food abundance. During these times, individual home ranges will likely be larger because bears will be forced to travel greater distances to obtain adequate amounts of forage (Pelchat and Ruff 1986).

Black bear home ranges cover between 75 and 200 km^2 in the NWT (ENR 2010c). Black bear home ranges may overlap but individual bears maintain small core areas within their home ranges as exclusive territories (ENR 2010c). Black bear cubs separate from their mother between 2 and 4 years of age (Schwartz and Franzmann 1992). Dispersal occurs between May and July, and males tend to disperse farther from natal home ranges than females (Schwartz and Franzmann 1992). Movement of male black bears is high in the spring when males travel large distances to mate with females (Young and Ruff 1982). Foraging movement is also greater at this time of year. Male black bear movement declines towards the fall (Young and Ruff 1982).

Black bear sign, including scat and bear skull and jaw remains, was found at 13 locations in the LSAs in September 2003 (Fortune 2004). A black bear den was identified by an archaeological crew in 2004, but it could not be re-located in the summer of 2005. The den was located in primarily organic soil, in a well drained mound at the edge of small graminoid wetland and had been constructed within the previous year. Between 10 June and 17 August 2005, there were 7 observations of black bears within the mine RSA, one of which included a sow and a cub. Two black bears were observed during caribou aerial surveys. One bear was observed on 11 April 2005, and another individual was observed on 11 April 2006.

15.2.4.2.2 Habitat Selection and Foraging

Black bears require habitat that provides them with cover for security and an abundance of forage; therefore, preferred black bear habitat is a mixture of forested and open areas (Lariviére 2001; ENR 2010c). Black bears also require secluded areas for denning. Dens may be made in tree cavities, crevices, caves, or under large rocks (Lariviére 2001; ENR 2010c).

Black bears may benefit from wildfire (Fisher and Wilkinson 2005) as berry production (Hamer 1996) and moose densities (Schwartz and Franzmann 1989, 1990) increase in recently burned areas. Fire may decrease appropriate denning habitat because black bears den in mature trembling aspen and spruce forests, while avoiding regenerating habitats (Tietje and Ruff 1980).

Black bears are omnivorous but most of their diet consists of herbaceous vegetation. Horsetails, graminoid species, and animal matter make up the majority of black bear early spring diet (Beeman and Pelton 1980; Graber and White 1983; Raine and Kansas 1989; Schwartz and Franzmann 1990: Lariviére 2001; ENR 2010c).

Bears prey on moose calves from birth until approximately 30 days of age, at which time moose calves are able to outrun the bears (Schwartz and Franzmann 1990). Snowshoe hares (*Lepus americanus*), adult moose carcasses, and birds and their eggs also make up an important part of early spring black bear diet (Schwartz and Franzmann 1990).

Later in the spring and throughout the summer, insects become more important staples in black bear diets (Beeman and Pelton 1980; Graber and White 1983; Raine and Kansas 1989). Most of the build up of fat reserves for the winter hibernation comes from berries, which make up the majority of the late summer and fall diet (Beeman and Pelton 1980; Graber and White 1983; Raine and Kansas 1989; Lariviére 2001; ENR 2010c).

15.2.4.3 Wolverine

15.2.4.3.1 Population Status and Distribution

Wolverine, the largest member of the weasel family, has a circumpolar distribution in the tundra, taiga plains, and boreal forests (Weir 2004). The western Canada population, which occurs in the NWT and Nunavut, is listed as a species of ‘special concern’ (COSEWIC 2010) and currently has no status under *SARA* (2011). Wolverine status in the NWT is ‘sensitive’ (ENR 2010a). Wolverines are an important cultural and economic resource for people of the NWT. Traditional knowledge indicates that wolverines were harvested primarily for their fur, although historically they were sometimes killed as an emergency food source (LKDFN et al. 2001).

Wolverines are highly adaptable, tending to change their location and distribution over time. Wolverines are known for their large home ranges and extensive movements in search of food, and during dispersal (Hash 1987). Males occupy territories from about 230 to 1580 km^2, and females from about 50 to 400 km^2 (Hornocker and Hash 1981; Gardner 1985; Whitman et al. 1986; Banci 1987; Copeland 1996; Landa et al. 1998). Smaller home ranges for females likely results from limitations on movement imposed during nursing (Hornocker and Hash 1981; Gardner 1985; Banci 1987). The size of a home range will vary seasonally, yearly, with habitat type, and with the age of the animal (Banci 1987).

Food availability is the primary factor determining movements and home range requirements (Hornocker and Hash 1981; Banci 1994). Wolverine populations generally exhibit low densities, which are likely related to their large home range requirements. Wolverines will defend territories from members of the same sex, although there may be some overlap in home ranges (Krebs and Lewis 2000). Home ranges will overlap substantially with those of the opposite sex (Banci and Harestad 1990; Copeland 1996). Individuals of the same sex may also tolerate each other when resources are abundant, predictable, and not easily defendable (Banci 1987).

In Norway, male juvenile wolverines disperse between 7 and 18 months of age, and females disperse between 7 and 26 months of age (Vangen et al. 2001). A large proportion of males (83%) and females (69%) were reported to disperse (Vangen et al. 2001).

One wolverine trail (i.e., assumed to have 3 times the activity level of a single track) and 3 tracks were recorded within the mine RSA during winter track surveys in 2009. The trail and 2 tracks were observed in coniferous spruce habitat and one track was recorded in treed fen habitat. A single wolverine track was observed within the NPAR study area during the 2008 winter track count survey. This track was found in coniferous spruce habitat. No wolverine sign was observed in the mine or NPAR RSAs in 2005. A wolverine was seen during vegetation surveys on 13 August 2008. The wolverine was observed in coniferous spruce habitat, in a spruce tree, near the existing winter road. Despite the low frequency of sign observed, it is likely that wolverines are present year round in the study area and the surrounding region. Wolverine abundance would be expected to increase during winters when caribou are present in the study area. The RSAs include a number of boulder areas that are potential wolverine denning habitats (Fortune 2004). No wolverine dens were found during baseline studies.

15.2.4.3.2 Habitat Selection and Foraging

Wolverines are associated with a variety of habitat types (Hatler 1989). Habitat use typically depends on adequate food resources and den site availability. Wolverines occur more frequently where large ungulates are common and where carrion is abundant from hunter kills, predation, and natural mortality (COSEWIC 2003). Preferred landscape features appear to depend less on vegetation characteristics, and more on the structure of the terrain and availability of secure hiding cover for dens and food caching (Lofroth 2001). No data are available for wolverine response to wildfire; however, it is likely that wolverine will be negatively influenced by wildfire because they avoid early succession habitats (Copeland 1996).

Den site requirements for wolverines in the boreal forest are not well understood. The persistence of snow cover at a den site through the spring is an important factor for wolverines throughout their range (Magoun and Copeland 1998; Aubry et al. 2007; Copeland et al. 2007).

Wolverines are scavengers and predators that will cache food for future use. Wolverine feed opportunistically and their diet generally reflects annual and seasonal changes in food availability (Magoun 1987). Although wolverines are capable of taking large ungulates as live prey, the presence of ungulates in the diet is mostly the result of scavenging (Hornocker and Hash 1981; Gardner 1985; Banci 1987; Copeland 1996). The remnants of a caribou carcass may be cached in den sites or in deep crevasses of rocky terrain for later consumption. The interdependence of wolverine on other large carnivores such as wolves and black bear to provide carrion is unclear.

Ungulates are important in the wolverine diet year round (Banci 1994), but the summer diet is more varied. Traditional knowledge has reported that wolverine consume minnows in the summer when the water is shallow (LKDFN et al. 1999). Small mammals, such as lemmings and voles, waterbirds and their eggs, ptarmigan, and other wolverines, are also hunted opportunistically (Gardner 1985; Hash 1987; Magoun 1987; Banci 1994; NSMA 1999). Plants and berries may also be consumed (Banci 1994).

15.2.4.4 Marten

15.2.4.4.1 Population Status and Distribution

Historically, marten have been trapped for fur in North America, and populations have declined since European contact (Buskirk and Ruggiero 1994). Marten are the most important fur bearing species in the NWT because of the size and the density of their fur (ENR 2010d). Marten is listed as ‘secure’ in the NWT (ENR 2010a). The Newfoundland/Labrador population is listed as ‘threatened’ under COSEWIC (2010) and ‘endangered’ under *SARA* (2011). All other North American populations are not listed federally.

Martens breed between July and August, and the young are born in March or April of the following year (Strickland et al. 1982). Marten occupy larger home ranges than would be expected for a mammal of their size (Buskirk and Ruggiero 1994). Adult males occupy ranges of 0.8 to 45 km^2, and adult females occupy ranges of 0.42 to 27 km^2 (Burnett 1981; Mech and Rogers 1977; Latour et al. 1994; Smith and Schaefer 2002). Marten home ranges vary as a function of geographic area, habitat type, and prey density (Soutiere 1979; Thompson and Colgan 1987). Marten movements have not been rigorously studied, and reports on the dispersal period ranges from August to October (Buskirk and Ruggiero 1994). There is no information on the dispersal distance in juveniles or adults.

Marten were the most abundant carnivore species in the RSAs according to winter track count surveys. The highest density of marten tracks were found in marsh/graminoid fen habitat followed by bedrock-open conifer habitat during winter track surveys within the mine RSA in 2005 (Table 15.2-10). Marten tracks were also recorded in coniferous spruce and treed bog habitats in 2005. Marten tracks were most abundant in shrubland habitat within the mine RSA in 2009 (Table 15.2-11). Marten tracks were also recorded in treed fen, open bog, coniferous spruce, burn, frozen water, and bedrock-open conifer habitats during surveys in 2009. Survey efforts (distance sampled) for several habitats within the RSAs (e.g., burn, coniferous pine, shrubland, and open bog) were constrained by the limited availability of habitats (Annex D [Table 2.2-5; Table 2.2-6]).

High densities of marten tracks were found within coniferous pine and treed fen habitats within the NPAR study area (Table 15.2-12). Marten tracks also were recorded in coniferous spruce, treed bog, deciduous trembling aspen-paper birch, and marsh/graminoid fen habitats within the NPAR study area (Table 15.2-12); however, survey efforts (distance sampled) for several habitats within the RSAs (e.g., burn, coniferous pine, shrubland, and open bog) were constrained by the limited availability of habitats (Annex D; Table 2.2-7).

Table 15.2-10: Snow Track Density and Habitat Selection of Marten among Habitats within the Mine Regional Study Area, 2005

Habitat Type	Number of Tracks (mean ± 1SE)[a]	Observed Use (TKD)	Distance Sampled (km)	Proportion of Total Tracks [Use]	Proportion of Total Habitat Available[b]	95% Confidence Intervals for Use
Bedrock-Open Conifer	1.57 ± 0.82	14.20	1.88	0.29	0.11	0.14 - 0.44
Burn	NS	NS	0	NS	0.00	NS
Coniferous Pine	0	0	0.05	0	0.01	NA
Coniferous Spruce	0.93 ± 0.25	31.96	6.52	0.35	0.56	0.19 - 0.51
Deciduous Aspen	0	0	0.17	0	0.01	NA
Marsh/ Graminoid Fen	25.00[c]	25.00	0.01	0.35	0.01	NA
Open Bog	0	0	0.14	0	0.01	NA
Shrubland	NS	0	0	NS	0.01	NS
Treed Bog	0.62 ± 0.62	1.23	0.25	0.02	0.04	NA
Treed Fen	NS	NS	0	NS	0.01	NS
Frozen Water (Ice)	0	0.00	0.78	0	0.23	0
Total		**72.39**	**9.80**	**1.00**	**1.00**	

[a] Number of tracks per km surveyed per days since last snow fall. Includes single tracks, trails, and networks weighted by 1, 3, and 5, respectively.

[b] Proportion of Total Habitat Available = Expected Proportion of Use. A habitat type is preferred if the expected proportion of use is below the 95% confidence intervals for use of that habitat type, the habitat is neutrally selected if the expected proportion of use is within the 95% confidence intervals, and the habitat is avoided if the expected proportion of use is above the 95% confidence interval values.

[c] Only one segment was surveyed in marsh/graminoid fen habitat; therefore, mean number of tracks equals the observed use.

SE = Standard Error; TKD = Presence of tracks (i.e., 0 [if no tracks, trails, or networks were observed] or 1 [if at least one trail, track, or network was observed) per km surveyed per days since last snow fall; NS = Not Surveyed; NA = Not Applicable (i.e., expected frequency of use was less than 5); km = kilometre

Table 15.2-11: Snow Track Density and Habitat Selection of Marten among Habitats within the Mine Regional Study Area, 2009

Habitat Type	Number of Tracks (mean ± 1SE)[a]	Observed Use (TKD)	Distance Sampled (km)	Proportion of Total Tracks [Use]	Proportion of Total Habitat Available[b]	95% Confidence Intervals for Use
Bedrock-Open Conifer	0.02 ± 0.02	6.52	5.13	0.04	0.12	0.00 - 0.09
Burn	0.43 ± 0.15	0.40	6.32	0.003	0.10	0.00 - 0.02
Coniferous Pine	NS	NS	0	0	0.02	NA
Coniferous Spruce	1.59 ± 0.42	79.27	14.50	0.54	0.49	0.43 - 0.66
Deciduous Aspen	0	0	0.07	0	0.01	NA
Marsh/ Graminoid Fen	0	0	0.31	0	0.01	NA
Open Bog	1.67 ± 1.67	10.00	0.35	0.07	0.01	NA
Shrubland	6.48 ± 5.80	6.87	0.68	0.05	0.01	NA
Treed Bog	0	0	0.43	0	0.03	0
Treed Fen	2.11 ± 0.86	40.18	2.67	0.28	0.01	NA
Frozen Water (Ice)	0.12 ± 0.12	2.22	6.49	0.02	0.19	0.00 - 0.04
Total		**145.46**	**36.95**	**1.00**	**1.00**	

a Number of tracks per km surveyed per days since last snow fall. Includes single tracks, trails, and networks weighted by 1, 3, and 5, respectively.

b Proportion of Total Habitat Available = Expected Proportion of Use. A habitat type is preferred if the expected proportion of use is below the 95% confidence intervals for use of that habitat type, the habitat is neutrally selected if the expected proportion of use is within the 95% confidence intervals, and the habitat is avoided if the expected proportion of use is above the 95% confidence interval values.

SE = Standard Error; TKD = Presence of tracks (i.e., 0 [if no tracks, trails, or networks were observed] or 1 [if at least one trail, track, or network was observed) per km surveyed per days since last snow fall; NS = Not Surveyed; NA = Not Applicable (i.e., expected frequency of use was less than 5); km = kilometre

Table 15.2-12: Snow Track Density and Habitat Selection of Marten among Habitats within the NICO Project Access Road Regional Study Area, 2005 and 2008

Habitat Type	Number of Tracks (mean ± 1SE)[a]	Observed Use (TKD)	Distance Sampled (km)	Proportion of Total Tracks [Use]	Proportion of Total Habitat Available[b]	95% Confidence Intervals for Use
Bedrock-Open Conifer	0	0	0.23	0	0.003	NA
Burn	12.50[c]	12.50	0.08	0.06	0.001	NA
Coniferous Pine	3.84 ± 1.39	58.02	2.60	0.27	0.09	0.19 - 0.36
Coniferous Spruce	1.71 ± 0.50	78.17	24.87	0.37	0.65	0.27 - 0.46
Deciduous Aspen	0.88 ± 0.88	3.51	0.61	0.02	0.01	NA
Marsh/ Graminoid Fen	0.72 ± 0.54	4.60	1.49	0.02	0.05	0.00 - 0.05
Open Bog	0	0	0.20	0	0.02	NA
Shrubland	0	0	0.04	0	0.004	NA
Treed Bog	1.67 ± 0.98	10	1.50	0.05	0.07	0.01 - 0.09
Treed Fen	2.60 ± 1.08	46.89	2.64	0.22	0.05	0.14 - 0.30
Frozen Water (Ice)	0	0	0.20	0	0.05	0
Total		**213.69**	**34.46**	**1.00**	**1.00**	

[a] Number of tracks per km surveyed per days since last snow fall. Includes single tracks, trails, and networks weighted by 1, 3, and 5, respectively.

[b] Proportion of Total Habitat Available = Expected Proportion of Use. A habitat type is preferred if the expected proportion of use is below the 95% confidence intervals for use of that habitat type, the habitat is neutrally selected if the expected proportion of use is within the 95% confidence intervals, and the habitat is avoided if the expected proportion of use is above the 95% confidence interval values.

[c] Only one segment were surveyed in burn habitat; therefore, mean number of tracks equals the observed use

SE = Standard Error; TKD = Presence of tracks (i.e., 0 [if no tracks, trails, or networks were observed] or 1 [if at least one trail, track, or network was observed) per km surveyed per days since last snow fall; NS = Not Surveyed; NA = Not Applicable (i.e., expected frequency of use was less than 5); km = kilometre

15.2.4.4.2 Habitat Selection and Foraging

Marten have been classified as requiring late succession forests and are intolerant of habitat types with sparse canopy cover (Buskirk and Ruggiero 1994; Chapin et al. 1997; Smith and Schaefer 2002). Some studies suggest that marten are closely associated with late-succession mesic conifer forests that have complex physical structure near the ground (Buskirk and Ruggiero 1994); however, other studies suggest that requirements of canopy cover and structure near the ground can be met in a variety of habitat types (Chapin et al. 1997).

Within the mine RSA in 2005, habitat selection analysis indicated that marten track encounters were statistically different among 3 habitats (Chi-square = 38.7,1 df = 2, P < 0.001). Bonferroni confidence intervals suggested that bedrock-open conifer habitat was preferred relative to its availability, whereas coniferous spruce and frozen water habitats were avoided relative to availability (Table 15.2-10). Analysis for the mine RSA in 2009 indicated that marten track encounters were statistically different among 5 habitats (Chi-square = 46.13, df = 4, P < 0.001). Bonferroni confidence intervals suggested that bedrock-open conifer, burn, treed bog, and frozen water habitats were avoided relative to availability (Table 15.2-11). Coniferous spruce was selected in proportion to availability. For the NPAR study area, the frequency of marten track observations was statistically different among 6 habitats (Chi-square = 224.27, df = 5, P < 0.001). Treed bog habitat was selected in proportion to its availability, whereas marsh/graminoid fen, coniferous spruce, and frozen water habitats were avoided relative to availability (Table 15.2-12). Coniferous pine and treed fen habitats were preferred by marten relative to availability.

Wildfire may provide a mosaic of habitats for marten to use throughout various life stages (Nelson et al. 2008). Marten do use burned areas, but burned habitat is avoided relative to its availability on the landscape (Latour et al. 1994). Non-breeding individuals were found in higher densities in 6 to 9 year old burn versus mature sites; however, breeding individuals were only found in low densities in these recently burned areas (Paragi et al. 1996; Fisher and Wilkinson 2005). Non-breeding individuals may be responding to the high density of microtine prey species that can be found in burned areas (Nelson et al. 2008). Burns may not provide adequate denning habitat for marten.

Although there is little information available on denning sites that are preferred by marten, especially in western and northern North America, studies have reported marten to be highly selective of sites used for denning. Marten have separate denning sites for parturition and raising their young with both den types reported to be found only in old-growth forest (Ruggiero et al. 1998).

Marten diet varies seasonally. In summer, marten eat bird eggs and nestlings, insects, fish, and young mammals. Their winter diet is more restricted and is comprised of small to medium sized mammals. In the NWT snowshoe hare is an important prey species for marten and can consist of 3 to 64% of marten diet by biomass (Poole and Graf 1996). Marten diet, body fat, ovulation rates, and juvenile recruitment vary with snowshoe hare density.

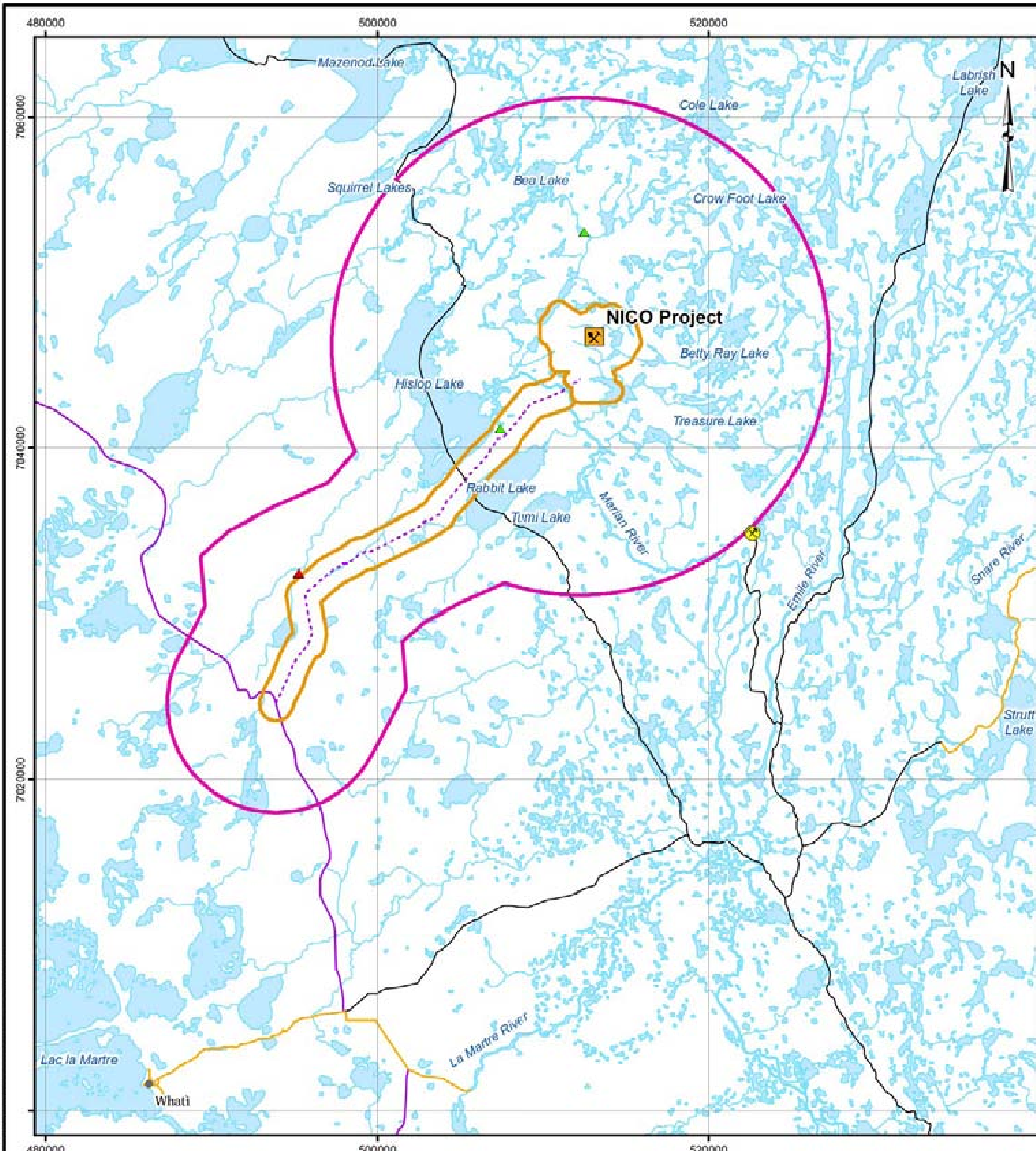
15.2.4.5 Muskrat

15.2.4.5.1 Population Status and Distribution

Muskrats occur throughout most of North America, with the exception of Florida and coastal Georgia and South Carolina (Allen and Hoffman 1984). Muskrat are listed as ‘secure’ in the NWT (ENR 2010a) and are not listed federally (COSEWIC 2010; *SARA* 2011).

Muskrat territories range from 40 to 100 m in diameter (Danell 1978), with larger territories usually present in areas of low emergent vegetation cover (Allen and Hoffman 1984). Muskrats are promiscuous and males compete over females (Aleksiuk 1986). Breeding occurs immediately after spring break up in March, April, or May (Aleksiuk 1986).

Muskrat lodges, feeding platforms, scat, and individuals were observed during ground surveys completed in September 2003. Four observations of muskrat sign were recorded during aerial surveys completed in 2004 and 2005. One muskrat platform was observed along the Marian River in 2005 (Figure 15.2-7). No muskrat sign was detected at 3 m Stream and it is unlikely that muskrat are present in this stream due to the fast water flow and rocky substrate.



LEGEND

- NICO PROJECT
- RAYROCK MINE
- POPULATED PLACE
- EXISTING ALL-WEATHER ROAD
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁĮCHQ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- MUSKRAT OBSERVATION, 2004
- MUSKRAT OBSERVATION, 2005
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

10 0 10

SCALE 1:325,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

LOCATION OF MUSKRAT OBSERVATIONS

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-016-GIS				
PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	LD	27 Oct. 2008	**FIGURE: 15.2-7**	
GIS	MK	07 Apr. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

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15.2.4.5.2 Habitat Selection and Foraging

Muskrats occur in marshes, ponds, lakes, and slow-moving rivers. Water at a site must be deep enough to not freeze in the winter, but shallow enough to allow the growth of aquatic vegetation (ideal water depth is between 1 and 2 m) (Aleksiuk 1986). Muskrats build a variety of structures depending on habitat conditions. Along rivers, where bank substrate is appropriate for digging, they construct extensive burrows with underwater entrances as a defence against predators. In marshes, muskrat build lodges out of vegetation and mud. They also build feeding platforms and "push ups," shelters made of vegetation that cover a hole in the ice, which are used for feeding and as breathing holes.

Wildfire is thought to improve muskrat habitat by maintaining wetlands and aquatic edge habitat around wetlands, as well as increasing the amount of herbaceous vegetation that is available in an area (Nelson et al. 2008). Marshes in southeastern United States are often burned to promote muskrat habitat (Nelson et al. 2008), and one study from Manitoba found that summer burning increased fall muskrat populations (Ward 1968).

Muskrats are primarily herbivores, although they will eat some animal matter (Allen and Hoffman 1984). Broad-leaved cattail (*Typha latifolia*) is a preferred food source (Bellrose 1950) and can support 2 to 7 times as many individuals as other vegetation types (Allen and Hoffman 1984). Stream dwelling muskrats tend to have more diverse diets than those that live in marshes. Individuals that inhabit lakes are more opportunistic feeders and may ingest more animal matter than other populations (Allen and Hoffman 1984).

15.2.4.6 Upland Breeding Birds

15.2.4.6.1 Population Status and Distribution

Upland breeding birds (e.g., passerines, shorebirds, and upland game birds) are commonly studied in baseline and monitoring programs because they are well-studied indicators of habitat quality and habitat change. Some birds are also an important resource for aboriginals in the NWT and Nunavut, as they are used for food and provide other materials, such as feathers, which are used to make blankets and pillows (LKDFN et al. 2001).

The spring migration of birds to the NWT begins in early May and peaks around mid- to late May. The breeding season for small perching birds (passerines) typically starts during the first week of June and continues for approximately 3 weeks. Fall migration begins in mid-August for some species such as sandpipers, and continues through to mid-September for late migrants such as horned larks. Common nighthawk (*Chordeiles minor)*, olive-sided flycatcher, and rusty blackbird (*Euphagus carolinus)* are federal listed species that were recorded within the RSAs.

A total of 42 bird species were identified in 10 habitat types during upland breeding bird surveys from 2005 to 2009, including incidental observations (i.e., heard outside of 50 m, fly-overs, waterbirds, and raptors [Annex D; Appendix I, Table I-5]). Thirty-eight bird species were identified within upland breeding bird survey plots (i.e., within 50 m) (Table 15.2-13).

Table 15.2-13: Mean (± 1SE) Density (Birds per Hectare) of Upland Breeding Bird Species by Habitat within the Local Study Areas, 2005 to 2009

Common Name	Scientific Name	Bedrock-Open Conifer	Burn	Coniferous Spruce	Deciduous Aspen	Marsh/ Graminoid Fen	Mixedwood Spruce-Aspen-Paper Birch	Open Bog	Shrubland	Treed Bog	Treed Fen
Spruce grouse	*Dedgragapus canadensis*	0	0	0.03 ± 0.01	0	0	0.01 ± 0.01	0	0	0	0
Lesser yellowlegs	*Tringa flavipes*	0	0.04 ± 0.04	0.01 ± 0.01	0	0.28 ± 0.13	0	0	0.25 ± 0.17	0.08 ± 0.05	0.02 ± 0.02
Wilson's snipe	*Gallinago delicata*	0	0.04 ± 0.04	0.02 ± 0.01	0	0.14 ± 0.10	0	0	0.13 ± 0.13	0	0
Common nighthawk	*Chordeiles minor*	0.01 ± 0.01	0	0	0	0	0	0	0	0	0
Hairy woodpecker	*Picoides villosus*	0	0	0	0	0	0.01 ± 0.01	0	0	0.04 ± 0.04	0
Northern flicker	*Colaptes auratus*	0	0	0.01 ± 0.01	0	0	0.01 ± 0.01	0	0	0	0
Olive-sided flycatcher	*Contopus cooperi*	0	0.04 ± 0.04	0.01 ± 0.01	0	0	0.01 ± 0.01	0	0	0	0.03 ± 0.03
Western wood-pewee	*Contopus sordidulus*	0	0	0	0	0.07 ± 0.07	0	0	0	0	0.02 ± 0.02
Least flycatcher	*Empidonax minimus*	0	0	0.01 ± 0.01	0	0	0	0	0	0	0
Alder flycatcher	*Empidonax alnorum*	0	0.04 ± 0.04	0.01 ± 0.01	0	0	0.03 ± 0.02	0	0	0	0.02 ± 0.02
Eastern phoebe	*Tyrannus tyrannus*	0.01 ± 0.01	0	0	0	0	0.02 ± 0.01	0	0	0	0.02 ± 0.02
Warbling vireo	*Vireo gilvus*	0	0	0	0	0	0.01 ± 0.01	0	0	0	0
Gray jay	*Perisoreus canadensis*	0.12 ± 0.04	0.13 ± 0.13	0.30 ± 0.06	0.19 ± 0.10	0	0.20 ± 0.05	0	0.13 ± 0.13	0.39 ± 0.14	0.17 ± 0.07
Boreal chickadee	*Poecile hudsonicus*	0	0	0.02 ± 0.01	0	0	0.03 ± 0.02	0	0	0	0
Ruby-crowned kinglet	*Regulus calendula*	0	0	0.09 ± 0.03	0	0	0.08 ± 0.03	0	0	0	0.03 ± 0.02
Townsend's solitaire	*Myadestes townsendi*	0.08 ± 0.03	0	0.01 ± 0.01	0	0	0.04 ± 0.03	0	0	0	0
American robin	*Turdus migratorius*	0.02 ± 0.01	0.04 ± 0.04	0.06 ± 0.02	0	0	0.03 ± 0.02	0	0	0.04 ± 0.04	0.03 ± 0.02
Hermit thrush	*Catharus guttatus*	0.15 ± 0.05	0	0.21 ± 0.04	0.19 ± 0.10	0.07 ± 0.07	0.23 ± 0.05	0.57[a]	0	0.12 ± 0.09	0.16 ± 0.06
Swainson's thrush	*Catharus ustulatus*	0.08 ± 0.04	0	0.20 ± 0.04	0.13 ± 0.13	0.07 ± 0.07	0.17 ± 0.05	0	0	0.27 ± 0.11	0.14 ± 0.05
Blackpoll warbler	*Dendroica striata*	0	0.09 ± 0.06	0.02 ± 0.01	0	0	0.03 ± 0.02	0	0.38 ± 0.19	0	0.02 ± 0.02

Table 15.2-10: Mean (± 1SE) Density (Birds per Hectare) of Upland Breeding Bird Species by Habitat within the Local Study Areas, 2005 to 2009 (continued)

Common Name	Scientific Name	Bedrock-Open Conifer	Burn	Coniferous Spruce	Deciduous Aspen	Marsh/ Graminoid Fen	Mixedwood Spruce-Aspen-Paper Birch	Open Bog	Shrubland	Treed Bog	Treed Fen
Yellow-rumped warbler	*Dendroica coronata*	0.29 ± 0.05	0.39 ± 0.13	0.43 ± 0.05	0.38 ± 0.13	0.07 ± 0.07	0.43 ± 0.07	0	0.51 ± 0.20	0.20 ± 0.08	0.30 ± 0.08
Palm warbler	*Dendroica palmarum*	0	0.04 ± 0.04	0.02 ± 0.01	0	0.07 ± 0.07	0	0	0	0.08 ± 0.05	0.08 ± 0.03
Yellow warbler	*Dendroica petechia*	0.01 ± 0.01	0	0.02 ± 0.01	0	0	0.01 ± 0.01	0	0.51 ± 0.33	0	0
Northern waterthrush	*Seiurus noveboracensis*	0.01 ± 0.01	0.04 ± 0.04	0.06 ± 0.02	0	0.21 ± 0.15	0.05 ± 0.03	0	1.14 ± 0.42	0	0.09 ± 0.05
Orange-crowned warbler	*Vermivora celata*	0.10 ± 0.03	0	0.19 ± 0.04	0.25 ± 0.15	0.07 ± 0.07	0.31 ± 0.05	0	0.13 ± 0.13	0.04 ± 0.04	0.19 ± 0.05
Tennessee warbler	*Vermivora peregrina*	0.01 ± 0.01	0.04 ± 0.04	0.07 ± 0.03	0	0.14 ± 0.10	0.09 ± 0.03	0	0.51 ± 0.20	0	0.17 ± 0.06
Dark-eyed junco	*Junco hyemalis*	0.21 ± 0.04	0.48 ± 0.13	0.50 ± 0.07	0.06 ± 0.06	0.07 ± 0.07	0.29 ± 0.06	0	0.13 ± 0.13	0.86 ± 0.18	0.47 ± 0.10
Chipping sparrow	*Spizella passerina*	0.23 ± 0.05	0.57 ± 0.16	0.27 ± 0.04	0.06 ± 0.06	0.36 ± 0.23	0.25 ± 0.06	1.14[a]	0.13 ± 0.13	0.43 ± 0.14	0.38 ± 0.08
Lincoln's sparrow	*Melospiza lincolnii*	0	0.13 ± 0.07	0.09 ± 0.02	0	0.14 ± 0.10	0.06 ± 0.03	0	0.25 ± 0.17	0.04 ± 0.04	0.19 ± 0.06
Song sparrow	*Melospiza melodia*	0	0	0.01 ± 0.01	0	0	0	0	0	0	0
Swamp sparrow	*Melospiza georgiana*	0	0.04 ± 0.04	0.05 ± 0.02	0	0.28 ± 0.13	0.02 ± 0.01	0.57[a]	0.76 ± 0.33	0	0.05 ± 0.03
White-crowned sparrow	*Zonotrichia leucophrys*	0.01 ± 0.01	0.04 ± 0.04	0	0	0	0	0	0	0	0.02 ± 0.02
White-throated sparrow	*Zonotrichia leucophrys*	0	0.09 ± 0.06	0.01 ± 0.01	0	0	0.02 ± 0.01	0	0.13 ± 0.13	0	0
Rusty blackbird	*Euphagus carolinus*	0	0	0	0	0	0	0	0.38 ± 0.27	0	0
Red-winged blackbird	*Agelaius phoeniceus*	0	0	0	0	0	0	0	0	0	0.02 ± 0.02
White-winged crossbill	*Loxia leucoptera*	0.01 ± 0.01	0	0	0	0	0	0	0	0	0
Pine grosbeak	*Pinicola enucleator*	0	0	0.01 ± 0.01	0	0	0	0	0	0	0
Common redpoll	*Carduelis flammea*	0.03 ± 0.02	0	0.01 ± 0.01	0	0	0.03 ± 0.02	0	0	0	0.02 ± 0.02

[a] Only the mean is reported because only 2 open bog plots were surveyed.

Density, measured as the number of individuals per hectare (ha), was calculated for each of the 38 species detected within survey plots for each habitat type (Table 15.2-13). The effective detection radius was 53.4 m. The effective sampling area was therefore 0.90 ha, which was used to estimate density for species and communities. Yellow-rumped warbler had the highest densities in bedrock-open conifer, deciduous aspen, and mixedwood spruce-trembling aspen-paper birch habitats. Chipping sparrow was the most abundant species in burn, marsh/graminoid fen, and open bog habitats. Dark-eyed junco had the highest densities in coniferous spruce, treed bog, and treed fen habitats. Northern waterthrush was the most abundant species in shrubland habitat.

Least flycatcher, song sparrow, and pine grosbeak were unique to coniferous spruce habitat (Table 15.2-13). Northern flicker, spruce grouse, and boreal chickadee were only observed in coniferous spruce and mixedwood spruce-trembling aspen-paper birch habitats. Common nighthawk and white-winged crossbill were unique to bedrock-open conifer habitat, while red-winged blackbird was only detected in treed fen habitat. Hairy woodpecker was only observed in mixedwood spruce-trembling aspen-paper birch and treed bog habitats, while rusty blackbird was only detected in shrubland habitat. Western wood-pewee was only observed in marsh/graminoid fen and treed fen habitats, while warbling vireo was only recorded in mixedwood spruce-trembling aspen-paper birch habitat.

Chipping sparrow was the only species recorded in all sampled habitat types (Table 15.2-13). Gray jay was observed in all habitats except for marsh/graminoid fen and open bog habitats. Hermit thrush and orange-crowned warbler were detected in all habitats except for burn and shrubland. Yellow-rumped warbler was not recorded in open bog habitat.

Observed species richness ranged from 1 to 8 species among habitats, and was highest in shrubland habitat (Table 15.2-14). Species richness was lowest in bedrock-open conifer, deciduous aspen, and open bog habitats; however, the number of plots sampled for several habitats within the LSAs (e.g., marsh/graminoid fen, open bog, shrubland, and treed fen) was constrained by limited availability of habitats (Annex D; Table 2.2-5; Table 2.2-6; Table 2.2-7).

Shrubland habitat had the highest average density of observed birds and deciduous aspen habitat had the lowest average density of observed birds (Table 15.2-14; Figure 15.2-8). Density ranged from 0 to 13.65 birds/ha among all habitat types.

Table 15.2-14: Relative Abundance (birds per hectare) and Observed Species Richness of Upland Birds among Habitats in the Local Study Areas, 2005 to 2009

Habitat Type	Number of Plots	Relative Abundance		Observed Species Richness	
		Mean ± 1SE	Min – Max	Mean ± 1SE	Min – Max
Bedrock-open conifer	113	1.43 ± 0.16	0 - 9.10	1.1 ± 0.1	0 - 5
Burn	26	2.54 ± 0.35	0 - 5.69	1.8 ± 0.3	0 - 4
Coniferous spruce	164	2.84 ± 0.17	0 - 10.24	2.0 ± 0.1	0 - 7
Deciduous aspen	18	1.33 ± 0.32	0 - 3.41	1.0 ± 0.2	0 - 3
Marsh/graminoid fen	16	2.42 ± 0.58	0 - 9.10	1.7 ± 0.3	0 - 5
Mixedwood spruce-aspen–paper birch	109	2.57 ± 0.18	0 - 7.96	1.9 ± 0.1	0 - 6
Open bog	2	2.27[a]	1.14 - 3.41	1.5 ± 0.5	1 - 2
Shrubland	9	5.94 ± 1.18	1.14 - 13.65	3.8 ± 0.6	1 - 8
Treed bog	29	2.75 ± 0.35	0 - 5.69	1.8 ± 0.2	0 - 4
Treed fen	72	2.76 ± 0.31	0 - 13.65	1.9 ± 0.2	0 - 8

[a] Only the mean is reported because only 2 sites were surveyed in open bog habitat.

Mean = mean of all plots; Min = minimum; Max = maximum; SE = standard error

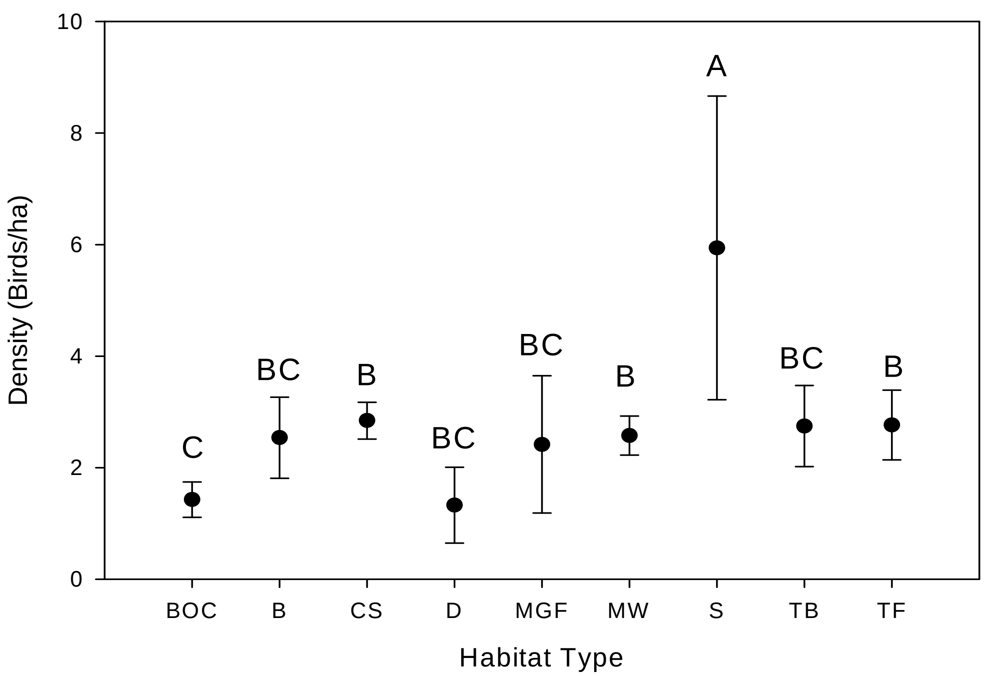


Figure 15.2-8: Mean (± 1SE) Density (birds per hectare) of Upland Breeding Birds by Habitat Type

Notes:

Habitats not connected by the same letter are significantly different from each other.

Open bog is not shown because only 2 sites were surveyed in this habitat type.

BOC = Bedrock-open conifer; B = Burn; CS = Coniferous spruce; D = Deciduous aspen; MGF = Marsh/graminoid fen; MW = mixedwood spruce-paper birch-aspen; S = Shrubland; TB = Treed bog; TF = Treed fen

The species accumulation curve for the LSA, using all birds recorded within the sampling radius (i.e., 50 m), did not reach an asymptote (Figure 15.2-9). The curve predicted that 38 species (34 – 43 [95% CI]) would be present in the LSA, based on 1121 observed birds. Using all observations recorded during the surveys (i.e., fly-overs and birds detected within 100 m) the generated species accumulation curve also did not reach an asymptote (Figure 15.2-9). The curve predicted that 44 species (38 – 50 [95% CI]) would be present in the LSA based on 1895 observed birds. These results suggest that survey effort was not adequate to record all birds that may be present within the study area.

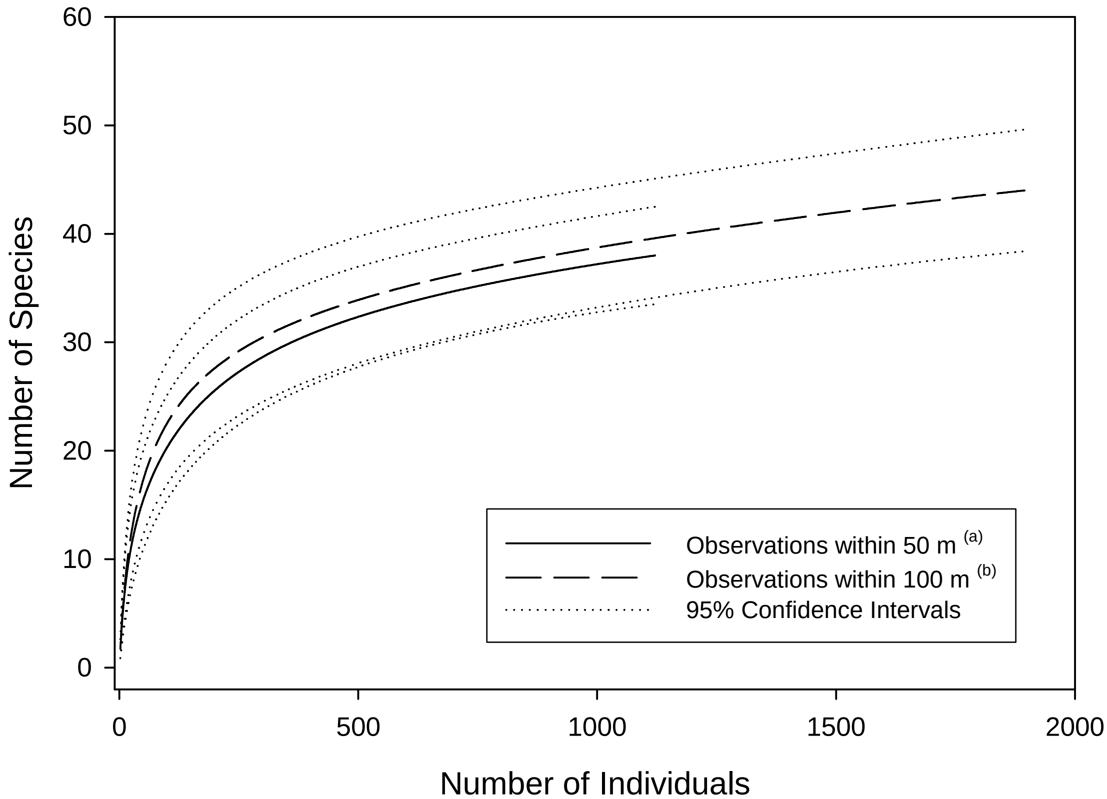


Figure 15.2- 9: Species Richness Curve (95% Confidence Intervals) for Upland Breeding Birds Recorded within the Local Study Area

[a] Only includes birds recorded within 50 m of the observer.

[b] Includes all birds recorded during point count surveys.

15.2.4.6.2 Habitat Selection and Foraging

Nest requirements (e.g., tree cavities) designate where certain bird species will nest and breed. Upland breeding birds nest in a variety of habitats, including woodland, grassland, shrubland, and disturbed habitats. Woodland habitat breeding species (e.g., least flycatcher, Tennessee warbler) were the most numerous species observed during surveys within the LSA and accounted for 63% of the 38 upland breeding bird species recorded. Shrubland breeding birds (e.g., yellow warbler, white-throated sparrow) accounted for 21% of the 38 species recorded. Wetland breeding species (e.g., northern waterthrush, red-winged blackbird) accounted for 10% of the species recorded, while open habitat (e.g., common nighthawk) and disturbed habitat nesting species (e.g., eastern phoebe) each accounted for 3% of the 38 species recorded.

Most upland breeding birds observed within the study area are insectivorous, although they will also occasionally eat seeds and fruit (Birds of North America Online 2010). Some exceptions to this are gray jay, which is omnivorous, and common redpoll, which is primarily a seed eater.

Wildfire affects upland breeding bird species by changing the vegetation structure and food sources that are available in forested areas. Fire decreases the amount of live trees and canopy cover that is present in an area, while it increases the amount of shrub and ground cover; therefore, tree-nesters, such as Tennessee warbler and red-eyed vireo, have decreased abundance in recently burned (less than 5 years) forests, while shrub- and ground-nesters, such as white-throated sparrow and chipping sparrow, have increased abundance in recently burned areas (Haney et al. 2008). Snag- and cavity-nesting birds, such as downy woodpecker (*Picoides pubescens*) and hairy woodpecker, may have increased abundance in recently burned landscapes (Jackson et al. 2002; Jackson and Ouellet 2002). Fire can decrease leaf-feeding insect and seed abundance, thereby limiting the presence of birds that rely on these food sources in recently burned areas (Russell et al. 2009); however, outbreaks of bark-beetle after fire may increase abundances of other bird species (Jackson and Ouellet 2002).

15.2.4.7 Waterbirds

15.2.4.7.1 Population Status and Distribution

The spring migration of waterbirds (e.g., loons, grebes, coots, ducks, and geese) to the NWT begins in early May, and in some years, at the end of April (Łutsel K’e Dene Elders and Land-Users et al. 2003). Throughout generations, people have depended upon ducks and geese to use the same migration routes to reach their staging and nesting areas in the NWT. People travel to these waterbird staging areas in the spring to harvest the migrating birds (Łutsel K’e Dene Elders and Land-Users et al. 2002), and in the summer, they travel to the barren-lands where birds migrate to lay eggs (NSMA 1999).

During interviews, residents of Whati and Gameti indicated that waterfowl are hunted throughout the region. Harvested waterfowl identified during interviews include black ducks, mallard ducks, and pintail ducks. While loons have been traditionally hunted to make loon skin bags, they are typically not eaten as they are too difficult to pluck. Duck harvesting areas identified during interviews are shown in Section 5, Figure 5.3-3

Horned grebe was the only federal listed species recorded within the RSAs during field surveys (Table 15.2-15; Table 15.2-16). Surf scoter, white-winged scoter, northern pintail, and long-tailed duck are territorial listed species that were observed within the RSA. Greater and lesser scaup are difficult to differentiate in the field, therefore observations of scaup were grouped into ‘scaup species’. Scaup were detected during field surveys and so it is possible that the territorial listed lesser scaup may be present within the RSA during the waterbird breeding season.

During the fall migration survey in 2003, 5 species of waterbirds were observed within the mine LSA. Buffleheads were commonly recorded on a number of lakes (27 individuals). An aggregation of scaup (40 individuals), buffleheads (40 individuals), and 3 mallards were observed on Nico Lake. Two flocks of tundra swans (15 birds and 6 birds) were observed flying over Burke Lake. A flock of approximately 40 Canada geese were recorded flying over the proposed NICO Project site.

Surveys completed in 2004 and 2005 identified 23 waterbird species or species groups (Table 15.2-15). Species in Table 15.2-15 were included in a species accumulation curve, and a list of all species observed by site staff and during wildlife surveys is provided in the baseline report annex (Annex D; Appendix I, Table I-7). The most common species or species groups observed included scaup species, common goldeneye, American wigeon, mallard, Pacific loon, and green-winged teal. The largest groups of scaup were observed on Burke, Hislop, and Rabbit lakes during summer production surveys. Broods for 14 of the 23 species were observed during these surveys. Densities of birds within the surveyed area ranged from approximately 0.04 adult/km^2 of water for red-throated loons, American coots, and ruddy ducks to 104 adult scaup/km^2 of water (Table 15.2-15). Total density was 167 adult waterbirds/km^2 of water and 7.5 young/km^2 of water.

Surveys completed in 2006 identified 15 waterbird species or species groups (Table 15.2-16). The most numerous birds observed were scaup species followed by buffleheads, mallard, American wigeon, surf scoter, and white-winged scoter (Table 15.2-16).

Waterbird surveys from 2004 to 2006 observed a minimum of 25 species distributed throughout the RSA (Figure 15.2-10), and 14 species were identified as producing young. Scaup species were the most common waterbirds recorded during all 4 years.

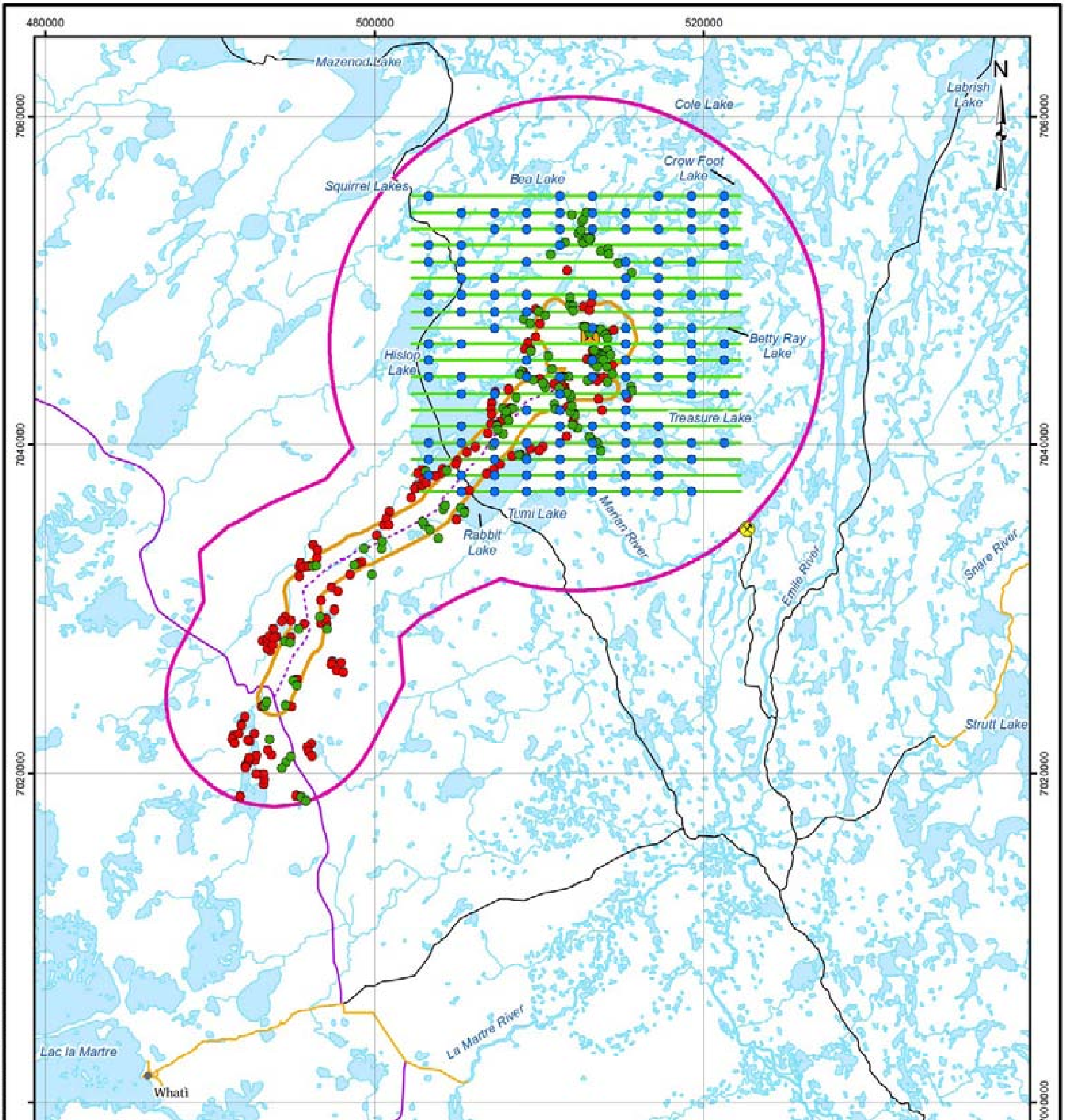
Table 15.2-15: Results of Waterbird Aerial Surveys within the Regional Study Areas, 2004 and 2005

Group	Common Name	Scientific Name	Brood Presence	Groups	Adults	Broods	Young	Groups/km^2 of Water	Adults/km^2 of Water	Young/km^2 of Water
Loons	Red-throated loon	*Gavia stellata*	Yes	1	1	1	1	0.04	0.04	0.04
	Pacific loon	*Gavia pacifica*	Yes	46	87	8	10	1.99	3.76	0.43
	Common loon	*Gavia immer*	Yes	17	29	3	3	0.74	1.25	0.13
Grebes	Horned grebe	*Podiceps auritus*	No	6	10	0	0	0.26	0.43	0.00
	Red-necked grebe	*Podiceps grisegena*	Yes	27	54	4	5	1.17	2.34	0.22
Mergansers and scoters	White-winged scoter	*Melanitta fusca*	No	11	36	0	0	0.48	1.56	0.00
	Surf scoter	*Melanitta perspicillata*	Yes	11	58	1	6	0.48	2.51	0.26
	Common merganser	*Mergus merganser*	Yes	6	10	1	6	0.26	0.43	0.26
Coot	American coot	*Fulica americana*	No	1	1	0	0	0.04	0.04	0.00
Ducks, geese and swans	Tundra swan	*Cygnus columbianus*	Yes	3	7	1	2	0.13	0.30	0.09
	Canada goose	*Branta canadensis*	Yes	8	26	4	12	0.35	1.12	0.52
	American wigeon	*Anas americana*	Yes	24	128	3	11	1.04	5.54	0.48
	Green-winged teal	*Anas carolinensis*	Yes	33	73	5	23	1.43	3.16	1.00
	Northern pintail	*Anas acuta*	No	4	11	0	0	0.17	0.48	0.00
	Northern shoveler	*Anas clypeata*	No	2	4	0	0	0.09	0.17	0.00
	Mallard	*Anas platyrhynchos*	Yes	57	115	10	48	2.47	4.98	2.08
	Common goldeneye	*Bucephala clangula*	Yes	34	493	2	10	1.47	21.33	0.43
	Bufflehead	*Bucephala albeola*	No	60	203	0	0	2.60	8.78	0.00
	Long-tailed duck	*Clangula hyemalis*	No	1	2	0	0	0.04	0.09	0.00
	Canvasback	*Aythya valisineria*	No	3	7	0	0	0.13	0.30	0.00
	Ring-necked duck	*Aythya collaris*	Yes	21	96	1	4	0.91	4.15	0.17
	Scaup spp.	*Aythya affinis or Aythya marila*	Yes	129	2 406	6	32	5.58	104.10	1.38
	Ruddy duck	*Oxyura jamaicensis*	No	1	1	0	0	0.04	0.04	0.00

km^2 = square kilometre

Table 15.2-16: Results of Waterbird Aerial Surveys within the Mine Regional Study Area, 2006

Group	Common Name	Scientific Name	Brood Presence	Pairs	Lone Drakes	Flocked Drakes	Groups
Loons	Common loon	*Gavia immer*	No	4	0	0	0
	Pacific loon	*Gavia pacifica*	No	2	0	0	0
	Unknown loon	*Gavia* spp.	No	1	0	0	0
Grebes	Red-necked grebe	*Podiceps grisegena*	Yes	0	0	0	0
Mergansers and scoters	Red-breasted merganser	*Mergus serrator*	No	2	1	0	0
	Surf scoter	*Melanitta perspicillata*	No	7	1	0	0
	White-winged scoter	*Melanitta fusca*	No	5	2	0	0
Ducks, geese, and swans	Tundra swan	*Cygnus columbianus*	No	2	0	0	0
	Mallard	*Anas platyrhynchos*	Yes	1	6	2	0
	American wigeon	*Anas americana*	No	3	5	0	0
	Common goldeneye	*Bucephala clangula*	No	1	1	0	0
	Bufflehead	*Bucephala albeola*	No	12	7	2	0
	Ring-necked duck	*Aythya collaris*	No	3	0	0	0
	Canvasback	*Aythya valisineria*	No	0	1	0	0
	Scaup species	*Aythya affinis* or *Aythya marila*	No	32	11	16	30
	Unknown diving duck		Yes	0	0	0	0
	Unknown duck		Yes	6	0	0	0
Terns	Tern species	*Sterna* spp.	No	2	0	0	0



10 0 10

SCALE 1:325,000 KILOMETRES

LEGEND

- NICO PROJECT
- RAYROCK MINE
- POPULATED PLACE
- EXISTING ALL-WEATHER ROAD
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁĮCHǪ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- WATERBIRD OBSERVATION, 2004
- WATERBIRD OBSERVATION, 2005
- WATERBIRD OBSERVATION, 2006
- 2006 WATERBIRD SURVEY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE
LOCATION OF WATERBIRD OBSERVATIONS, 2004 TO 2006

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-017-GIS

PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	LD	27 Oct. 2008		
GIS	MK	07 Apr. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

FIGURE: 15.2-10

Due to differences in survey methods between 2004/2005 and 2006, only data collected during 2004 and 2005 were used to generate a waterbird species accumulation curve (Figure 15.2-11). Baseline data from 2004 and 2005 generated a species rarefaction curve that did not reach an asymptote. Therefore, the sampling effort was not adequate to estimate total species richness in the RSA.

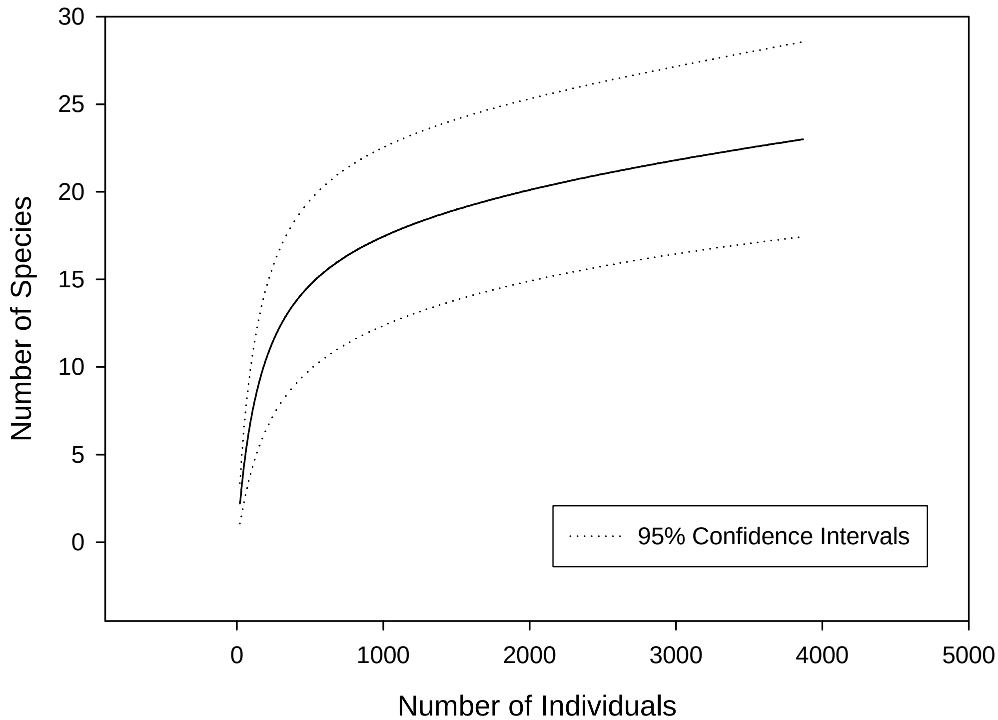


Figure 15.2-11: Species Richness Curve for Waterbirds in the Regional Study Areas, 2004 and 2005

15.2.4.7.2 Habitat Selection and Foraging

Following spring migration, mating pairs of waterfowl select a waterbody or portion of a waterbody (known as a pair pond) as their territory. In the boreal forest, dabbling ducks (e.g., mallard, blue-winged teal) generally nest in heavily vegetated marshes, bogs, shrubland, forests, or on islands. Diving ducks (e.g., canvasback, ring-necked duck) generally nest over water in either emergent vegetation or other structures (e.g., muskrat pushup) but are also known to nest in the uplands near water. Brood rearing occurs on larger wetlands as they provide food sources as well as cover from predators. Waterfowl densities vary with invertebrate presence and biomass as invertebrates are the primary food for most waterfowl species (Elmberg et al. 2000). Waterfowl young are dependent on invertebrates during their first 4 weeks of life because invertebrates satisfy protein requirements for feather development (Hornung 2005). Waterfowl also feed on a variety of submersed vegetation and seeds of emergent vegetation.

Runoff from burned watersheds or direct ash deposition from wildfire can change the water color and nutrient concentrations in wetlands (Haszard and Clark 2007). These changes may affect invertebrate presence and abundance, thereby impacting waterbird populations. Cavity-nesting species (e.g., bufflehead and common goldeneye) may also be affected by wildfire as fire increases the abundance of woodpeckers (i.e., the number of woodpecker holes) and number of snags in an area.

15.2.4.8 Raptors

15.2.4.8.1 Population Status and Distribution

Raptors are birds of prey and include falcons, eagles, hawks, and owls. Raptor species observed or expected to occur within the RSA include peregrine falcon, red-tailed hawk (*Buteo jamaicensis*), bald eagle (*Haliaeetus leucocephalus*), great gray owl (*Strix nebulosa*), and short-eared owl. Raptors are known to be sensitive to disturbances, particularly during breeding, and declines in raptor populations have been attributed to human activities and developments (Craighead and Mindell 1981).

The peregrine falcon is listed on Schedule 1 of *SARA* (2011). This species are also listed in NWT as 'sensitive' (ENR 2010a). Peregrine populations in the Canadian Arctic have increased due to the decline in the use of organochlorine pesticides in their wintering areas (Shank et al. 1993). The Canadian population of peregrine falcon (*anatum* subspecies) was estimated at 969 individuals in 2005 (COSEWIC 2007). Recent surveys estimate there are 113 breeding pairs of peregrine falcon (*anatum* subspecies) in the Mackenzie Valley, NWT; this is a dramatic increase from 9 nests in 1970 (COSEWIC 2007). The average number of young per pair in the Mackenzie Valley was 1.0 in 2000 (Rowell et al. 2003). Two peregrine falcon nests were recorded within the RSA (Table 15.2-17). One nest produced 3 young in 2005 and in 2007.

Table 15.2-17: History of Raptor Nest Site Occupancy in the Regional Study Area, 2003 to 2009

Nest Site	Common Name	Scientific Name	Occupied in 2003	Occupied in 2004	Occupied in 2005	Occupied in 2006	Occupied in 2007	Occupied in 2008	Occupied in 2009
RA01	Peregrine falcon	*Falco peregrinus*	no	no	no	no	yes – common raven	yes	no
RA02	Unknown		no	no	no	NS	no	no	no
RA03	Peregrine falcon	*Falco peregrinus*	no	no	yes	yes	yes	no	no
RA04	Red-tailed hawk	*Buteo jamaicensis*	ND	yes	NS	NS	NS	NS	yes- common raven
RA05	Unknown		ND	no	no	NS	NS	NS	no
RA06	Bald eagle	*Haliaeetus leucocephalus*	ND	no	yes	yes	yes	yes	no
RA07	Bald eagle	*Haliaeetus leucocephalus*	ND	no	no	no	no	no	no
RA08	Common raven	*Corvus corax*	ND	no	NS	NS	yes	no	no
RA09	Unknown		ND	no	no	NS	NS	NS	NS
RA10	Unknown		ND	no	no	NS	no	no	no
RA11	Bald eagle	*Haliaeetus leucocephalus*	ND	no	no	no	no	yes	no
RA12	Great gray owl	*Strix nebulosa*	ND	ND	no	no	yes	no	no
RA13	Bald eagle	*Haliaeetus leucocephalus*	ND	ND	yes	yes	no	no	no
RA14	Bald eagle	*Haliaeetus leucocephalus*	ND	ND	yes	no	yes	yes	yes

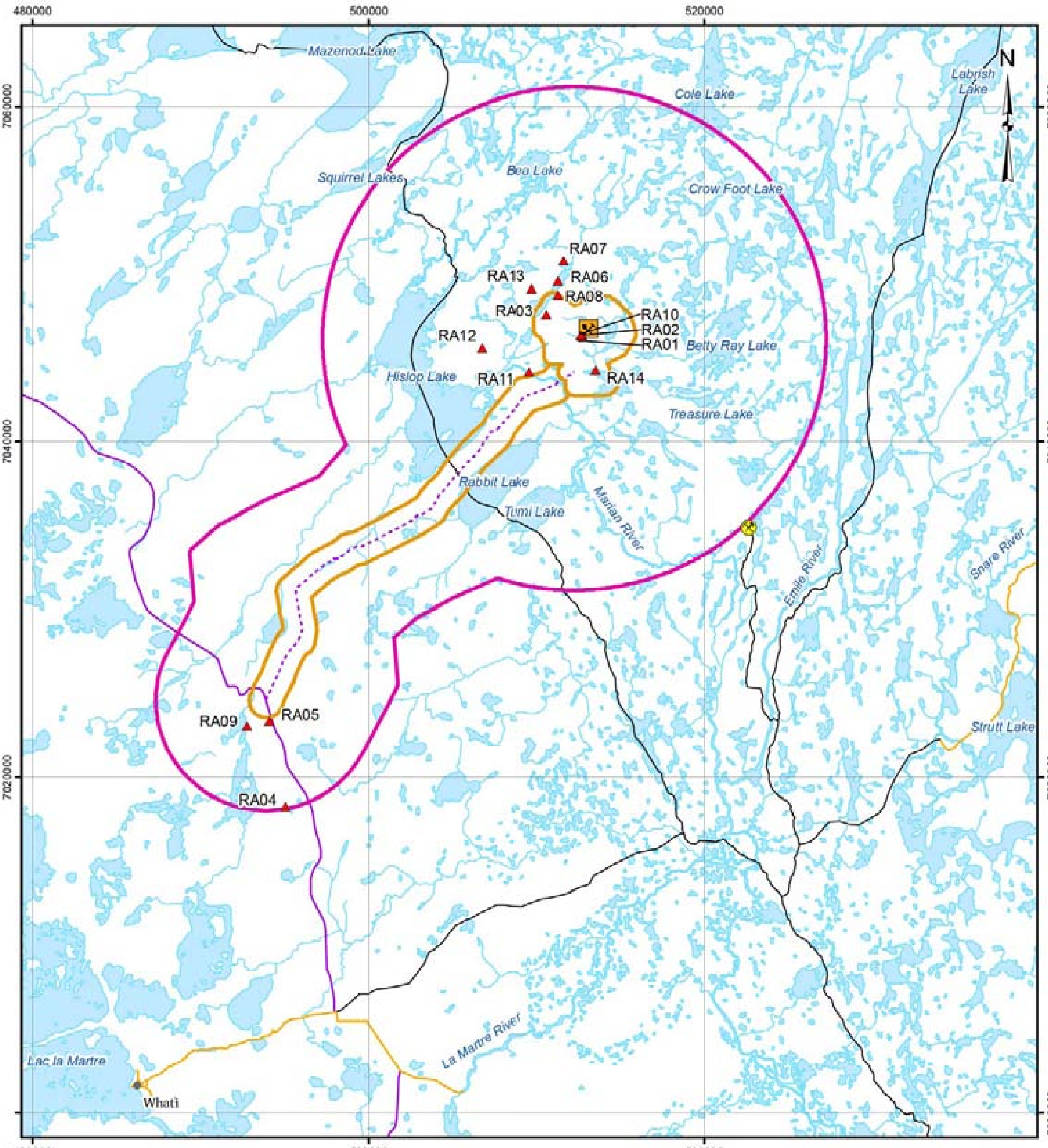
ND = No data because nest was not yet identified; NS = Nest not surveyed

Red-tailed hawks are not listed at territorial or federal levels. Global estimates of red-tailed hawk populations range from 100 000 to 1 000 000 individuals, with approximately 90% of these individuals occurring in North America (Preston and Beane 2009). Red-tailed hawk population trends from roadside surveys indicate an increase in numbers from 1966 to 2006 in Canada (Sauer et al. 2007). Positive population increases have also been reported for red-tailed hawks in the Taiga Plains Ecoregion and Taiga Shield Ecoregion (Kirk and Hyslop 1998). One red-tailed nest was observed within the RSAs (Table 15.2-17) and this nest produced 2 young in 2004.

Bald eagles are not listed within the NWT (ENR 2010a) or on *SARA* (2011) and COSEWIC (2010). Bald eagle populations have increased dramatically since DDT was banned in 1972 (Buehler 2000). Between 1982 and 1997 bald eagle populations have increased an average of 8.6% per year in the United States. The population estimate for North America in 1999 was 100 000 individuals. Bald eagles were the most common raptor species recorded within the RSAs and occupied 5 of the 14 raptor nests discovered in the RSA (Figure 15.2-12; Table 15.2-17). Two of the 3 bald eagle nests produced a total of 2 young in 2005. Both eagle nests produced one young each in 2006. One of the 2 occupied bald eagle nests produced 2 chicks in 2007 and one chick in 2008. The occupied bald eagle nest in 2009 produced 2 young.

Great gray owls are not territorially (ENR 2010a) or federally (COSEWIC 2010, *SARA* 2011) listed. There is little information on great gray owl population status and trends Canada, especially the NWT. Great gray owl populations and distributions are dependent on prey densities and therefore can fluctuate dramatically between years. Duncan (1997) estimates there are between 20 000 to 70 000 breeding pairs of great gray owls in Canada per year, depending on prey density. Great gray owls are unevenly distributed (Bull and Duncan 1993) and occur at low densities throughout their range (Duncan 1997). One great gray owl nest was observed in the RSA in 2007 (Table 15.2-17) and this nest produced 3 young.

The short-eared owl is listed as a species of ‘special concern’ under COSEWIC (2010) and Schedule 3 of *SARA* (2011). Short-eared owls are listed as ‘sensitive’ in the NWT (ENR 2010a). The short-eared owl population in Canada was estimated at 350 000 birds in 2008 (*SARA* 2011). Data suggests that short-eared owl populations have decreased approximately 23% in the last 10 years. Roadside surveys in the Taiga Plains Ecoregion have detected a decrease in short-eared owl populations of an average of 4.12% per year from 1966 to 1994 (Kirk and Hyslop 1998). Information on the population status and trends of short-eared owls in the Taiga Shield Ecoregion is not known. Determining population trends of short-eared owls is difficult because they are nomadic and densities fluctuate in relation to vole populations (COSEWIC 2008). In Canada, short-eared owls are most common in the Prairie Provinces and along the Arctic coast, although they breed throughout Canada (COSEWIC 2008). No short-eared owls have been observed within the RSA during baseline studies.



LEGEND

- NICO PROJECT
- RAYROCK MINE
- POPULATED PLACE
- EXISTING ALL-WEATHER ROAD
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁĮCHǪ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- NEST SITE
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

Note: RA = raptor nest site

10 0 10

SCALE 1:325,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

LOCATION OF RAPTOR NESTS, 2003 TO 2009

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-018-GIS

PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	LD	27 Oct. 2008	FIGURE: 15.2-12	
GIS	MK	07 Apr. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

15.2.4.8.2 Habitat Selection and Foraging

Peregrine falcons prefer to nest on cliffs with open gulfs of air (i.e., not confined areas), but human structures (e.g., skyscrapers) in urban areas can also be used (White et al. 2002). Peregrines also require open areas for foraging. Birds are the primary prey of peregrines although occasionally small mammals, bats, amphibians, fish, and insects will also be consumed.

Red-tailed hawks are very adaptable, and can be found nesting in a variety of habitats, as long as there are open areas interspersed with patches of trees or other elevated perches (Preston and Beane 2009). Red-tailed hawks primarily eat rodents and rabbits, but are also known to consume other birds, reptiles, fish, and carrion.

Bald eagles generally nest in forested areas adjacent to large, fish-bearing waterbodies; however, they will nest on cliffs, large rocks, and the ground if suitable trees are not available (Buehler 2000). Bald eagles prefer to eat fish but will consume carrion, muskrats, hares, and waterfowl if available.

Great gray owls generally nest in dense coniferous forest near bogs, forest edges, or other openings (Bull and Duncan 1993). Great gray owls are rodent specialists, although other small mammals (e.g., snowshoe hare) will also be eaten.

Short-eared owls nest in a variety of open areas, including arctic tundra, grasslands, peat bogs, marshes, and agricultural areas (Wiggins et al. 2006). Preferred nesting sites are dense grasslands, as well as tundra with areas of small willows (COSEWIC 2008). Short-eared owls primarily consume small mammals, although birds will also be eaten (Wiggins et al. 2006).

Wildfire primarily affects raptor species by changing nesting habitat and changing prey abundance (Bull and Wales 2001). Peregrine falcon may be negatively affected by fire since fire may change the presence and abundance of prey species (Bull and Wales 2001). Bald eagle was shown to be negatively affected by fire in the northeastern United States because of loss of suitable nest trees (Bull and Wales 2001). Fire may also reduce the abundance of nesting sites for great gray owls but may increase the amount of open foraging area and prey abundance (Duncan 1997). No information on red-tailed hawk or short-eared owl response to fire is available; however, as short-eared owls prefer open country for nesting and foraging (Wiggins et al. 2006), they may benefit from burned areas. Wildfire may also benefit red-tailed hawks because they prefer semi-open to open areas that contain suitable perch sites (Preston and Beane 2009).

15.2.4.9 Mine-Related Carnivore Incidents and Mortality

Table 15.2-18 summarizes the carnivore incidents and mortality that have occurred at the Diavik, Ekati, Jericho, and Snap Lake mines since 1996. Incidents include all occasions when there was an interaction between the mine and the carnivore, and some action was required (e.g., deterrent, re-location, or report of damage). Here, an incident does not include mortality. The cause of wildlife mortality is clear for cases where problem wildlife are deliberately destroyed, or when an accidental event was witnessed (such as the wolf pup that was struck by a vehicle at Ekati in 2002). However in other cases, such as when an animal is found dead within the mine property with no physical injury, the cause of death (natural or mine-related) may not be known.

Table 15.2-18: Carnivore Incidents and Mortality at the Ekati, Diavik, Jericho, and Snap Lake Mines, 1996 to 2009

Site	Year	Phase	Species	Incidents[a]	Mortalities		
					Intentional[b]	Non-intentional[c]	Found Dead[d]
Diavik	1996 to 1999	exploration	wolverine	1	1	-	-
	2000	construction	no incidents	-	-	-	-
	2001	construction	wolverine	2			1
	2001	construction	grizzly bear	3	-	-	-
	2002	construction	no incidents	-	-	-	-
	2003	production	grizzly bear	1	-	-	-
	2004	production	grizzly bear	20	1	-	-
	2005	production	grizzly bear	43	-	-	-
	2005	production	wolverine	5	-	-	-
	2006	production	grizzly bear	21	-	-	-
	2006	production	wolverine	2	-	-	-
	2007	production	grizzly bear	20	-	-	-
	2007	production	wolverine	1	-	-	-
	2008	production	no incidents	-	-	-	-
	2009	production	no incidents	-	-	-	-
Ekati	1998 to 2001	construction-production	wolverine	3	2	-	
	2000	production	grizzly bear	-	1	-	-
	2001	production	fox	-	9	-	-
	2001	production	wolverine	7	2	-	-
	2002	production	wolf	-	-	1	-
	2002	production	fox	-	1	1	-
	2003	production	grizzly bear	5	-	-	-
	2004	production	wolf	4	-	-	-
	2004	production	wolverine	3	-	-	-

Table 15.2-18: Carnivore Incidents and Mortality at the Ekati, Diavik, Jericho, and Snap Lake Diamond Mines, 1996 to 2009 (continued)

Site	Year	Phase	Species	Incidents[a]	Mortalities		
					Intentional[b]	Non-intentional[c]	Found Dead[d]
Ekati (continued)	2004	production	grizzly bear	3	-	-	-
	2005	production	fox	6	-	1	-
	2005	production	grizzly bear	18	2	-	-
	2005	production	wolverine	23	1	-	1
	2005	production	wolf	5	-	-	-
	2006	production	grizzly bear	15	-	-	-
	2006	production	wolf	4	-	-	1
	2006	production	fox	13	-	-	-
	2007	production	fox	-	6	-	2
	2008	production	wolf	5	1	-	-
	2008	production	fox	2	-	-	4
	2008	production	grizzly bear	15	-	-	-
	2008	production	wolverine	4	-	-	-
	2009	production	wolf	1	-	-	-
	2009	production	fox	11	-	1	1
	2009	production	grizzly bear	19	-	-	-
Jericho	2000 to 2004	exploration	no incidents	-	-	-	-
	2005	construction	wolverine	-	1	-	-
	2006	production	no incidents	-	-	-	-
	2007	production	wolverine	1	-	1	-

Table 15.2-18: Carnivore Incidents and Mortality at the Ekati, Diavik, Jericho, and Snap Lake Diamond Mines, 1996 to 2009 (continued)

Site	Year	Phase	Species	Incidents[a]	Mortalities		
					Intentional[b]	Non-intentional[c]	Found Dead[d]
Snap Lake	1999 to 2003	exploration	no incidents	-	-	-	-
	2004	exploration	fox	1	-	-	-
	2005	construction	fox	1	-	-	-
	2005	construction	grizzly bear	1	-	-	-
	2006	construction	wolverine	2	-	-	-
	2006	construction	fox	41	-	-	-
	2007	construction	fox	36	-	-	-
	2007	construction	black bear	2	-	-	-
	2008	production	no incidents	-	-	-	-
	2009	production	wolverine	-	-	1	-
	2009	production	fox	-	-	-	1

Sources: BHBP 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010; De Beers 2002, 2003, 2004, 2005, 2006, 2007, 2008, and 2010; DDMI 1998, 2003, 2004, 2005, 2006, 2007, 2008, and 2010; Tahera 2000, 2006, 2007a, 2007b, and 2008).

[a] Each occasion where animals are deterred, relocated, or a damage report was filed. General observations and mortalities are not included. The number of different individuals involved may not be unknown.

[b] Animal intentionally destroyed by mine or government personnel.

[c] Accidental mine-related mortality (e.g., vehicle collision).

[d] Animal found dead, mortality cannot be linked to mine activities.

Some of the carnivore incidents and mortalities have been directly associated with waste management. One source of attraction that has been problematic was the feeding of wildlife by mine staff, which has occurred deliberately and accidentally. For example, at the Ekati mine in 1997, lunch bags were found at a local fox den on several occasions, and staff reported seeing fox travelling with food scraps. In 1999, a fox became habituated to staff at the Ekati truck shop, presumably due to availability of food scraps. The fox was live-captured and relocated. The most effective means of managing this pathway is through continuing education of mine staff, and providing garbage cans labelled for food waste in areas where people eat.

15.2.4.9.1 Carnivore Incidents

Three hundred and seventy incidents have been recorded at the Ekati, Diavik, Jericho, and Snap Lake mines from 1998 through 2009. Although the definition of a wildlife incident varies, this statistic generally includes all occasions where there was some kind of direct interaction between an animal and the mine. Examples include the use of deterrents, wildlife gaining access to areas where they present a risk to themselves or to humans and are re-located, or causing damage to property. There were 45 recorded mortalities on all 4 mine sites from 1998 to 2009.

Approximately 5% of the incidents reported at mine sites involved wolves. Most of the recorded incidents have involved grizzly bears, probably because the presence of a bear is considered more of a threat than other carnivore species. The predominance of grizzly bear incidents at Diavik is likely due to the location of the mine on an island, which makes deterring animals away from the mine particularly difficult. There have also been relatively high numbers of grizzly bear and wolverine incidents at Ekati, and fox incidents at Snap Lake. In some cases, the frequency of incidents appears cyclic (i.e., periods associated with a high number of incidents interspersed with years with fewer incidents). This may be indicative of cycles in populations of the carnivores or their prey. Associated with the 370 incidents recorded, there have been 34 confirmed mine-related mortalities of various causes, suggesting a ratio of one mine-related mortality for every 11 recorded incidents.

15.2.4.9.2 Carnivores Intentionally Destroyed

Wildlife species that have been intentionally destroyed at existing diamond mines have included wolverine, grizzly bear, and fox (Table 15.2-18). Of the 28 individuals destroyed, 4 were grizzly bear, 7 were wolverine, 16 were fox, and one was a wolf. Grizzly bear kills included one cub of unknown sex in 2000, a 3-year old male and 13-year old male in 2005 at Ekati, and an adult male at Diavik in 2004. No wildlife has been intentionally destroyed at the Snap Lake Mine from 1999 through 2009. Ninety percent of foxes were destroyed at Ekati in 2001. All of these removals occurred with the permission of ENR, usually following an extended period of habituation to the site and multiple deterrent attempts with the same individual animal. One black bear was intentionally destroyed at the NICO Project in June 2009.

15.2.4.9.3 Carnivores Accidentally Destroyed

All 6 occasions where wildlife were accidentally destroyed at a project, and where the cause of death was clearly attributable to the mine, were a result of vehicle collisions. Three fox and one juvenile wolf were killed by vehicles at the Ekati Diamond Mine. On 9 October 2002 a wolf pup carcass was found on the Misery Road, 5 m from the shoulder. Fog and blowing snow resulted in poor visibility at the time. A necropsy revealed that cause of death was due to a blow to the back of the head, which broke the skull. A red fox mortality was reported in 2002 due to a vehicle collision on the Misery Road. A fox pup and adult mortality occurred at Ekati in 2005 and in 2009, respectively, was due to a vehicle collision. A wolverine was accidentally hit by a vehicle at Jericho in 2005. A wolverine was accidentally hit by a vehicle at Snap Lake in 2009.

15.2.4.9.4 Carnivores Found Dead

There have been 11 carnivores (2 wolverine, 1 wolf, and 8 fox) found dead among the 4 mines (Table 15.2-18). This category includes wildlife found dead, and for which the cause of death could not be directly linked to mine activities. For example, a wolf apparently died from starvation at Ekati in 2006. The carcass was found underneath a building at Misery Camp. A wolverine was found dead at Ekati in 2005, and the cause of death was not determined. One fox was found dead at each of the Snap Lake and Ekati sites during 2009.

15.2.5 Traditional and Non-traditional Use

Currently in the NWT, wildlife species are managed mostly by controlling the hunting season for resident and non-resident hunters (ENR 2010e). Non-resident hunters in the NWT require the services of an outfitter to hunt big game. The hunting rights of Aboriginal people in the NWT are based on traditional use and are different from those of other hunters. Hunting by many Aboriginal people is controlled by land claim agreements (in this case the Tłįchǫ Agreement). Hunting by other groups may also be affected by Tłįchǫ Agreement, through the Tłįchǫ Government and the Wek'èezhii Renewable Resource Board.

The moose hunting season within the effects study area for moose is from 1 September to 31 January for residents (ENR 2010e). Aboriginal hunters or General Hunting License holders may hunt moose year-round. The resident and General Hunting License hunting seasons currently overlap the average opening and closing dates of winter roads in the NWT (DOT 2008a). Resident hunters are limited to one moose per year. The estimated total NWT moose harvest is 1000 to 2000 animals per year, 80% to 90% of which is taken by General Hunting License holders (ENR 2010b).

Hunting and trapping continues to occur within the area overlapped by the traditional knowledge RSA and the LSA, including areas overlapped by NICO Project (which includes the NPAR). Hunting and trapping areas have been identified by interview participants from Whatì (Section 5, Figure 5.3-1 and Figure 5.3-2) and by interview participants from Gamètì (Section 5, Figure 5.3-3 and Figure 5.3-4). During interviews, residents of Whati and Gameti indicated that waterfowl are hunted throughout the region.

Animals are generally harvested for fur and meat. Harvested animals identified by both communities include caribou, moose, black bear, muskrat, mink (*Mustela vison)*, marten, wolverine, beaver, fox (*Vulpes vulpes)*, lynx, wolf, squirrel (*Tamiasciurus hudsonicus)*, duck, ptarmigan, and grouse. Gamètì interview participants also noted that otter (*Lontra Canadensis)* and rabbit are trapped. The literature review also indicated that porcupine and weasel are trapped in the Tłįchǫ Lands (DCI 1995).Marten are the most valuable furbearing species to trappers below the treeline (ENR 2010c). The marten trapping season is from 1 November to 28 February in the 'R' Wildlife Management Unit (*Wildlife Act* 2009), which covers the RSA. The average annual marten pelt submission to the GNWT for fur auctions from Gamètì, Behchokǫ̀, Whatì, Wekweetì, and Yellowknife between 2004 and 2009 was 576 pelts (ITT 2010).

The muskrat trapping season is from 15 October to 10 June in the 'R' Wildlife Management Unit (*Wildlife Act* 2009). The reported number of muskrats harvested by the communities of Gamètì, Wekweetì, Whatì, Yellowknife, and Behchokǫ̀ from 2004 to 2009 ranged between 0 and 1530 per year with an average of 267 per year (ITT 2010).

Geese, ducks, and loons are important to many communities in the NWT. According to traditional knowledge, geese and ducks are a favourite food source for communities, and the feathers are used for making blankets and pillows (LKDFN 2001). The spring migration of waterbirds to the NWT begins in early May, and in some years, at the end of April (LKDFN 2002). Throughout generations, people have depended upon ducks and geese to use the same migration routes to reach their staging and nesting areas in the NWT. People travel to these water bird staging areas in the spring to harvest the migrating birds (LKDFN 2002), and in the summer, they travel to the barren-lands where birds migrate to lay eggs (NSMA 1999). Egg collection during the breeding season is the primary use of water bird resources by traditional users.

Whatì and Gamètì traditional knowledge interview participants (Section 5) reported areas used for hunting or trapping within the traditional knowledge RSA as follows:

- hunting for birds including ptarmigan, ducks, and grouse occurs throughout the RSA;
- hunting for caribou and moose occurs throughout the RSA;
- hunting and trapping occurs within the Hislop Lake and Rabbit Lake areas, and along the Marian River;
- hunting or trapping occurs between Lac La Martre and the Hislop Lake, Rabbit Lake, and Tumi Lake area
- hunting and trapping along the NPAR;
- hunting north from Hislop Lake with camping areas all along the Marian River;
- hunting and trapping near Gamètì, Wekweètì, Grandin Lake (west of the RSA), and the Colomac Mine (outside the RSA);
- hunting and trapping near Bea Lake;
- hunting and trapping moose hunting occurs along the winter road to Gamètì; and
- trapping along the Marian River.

Gamètì interview participants noted that hunting around the NICO Project is generally limited to moose and rabbits and areas used for hunting and/or trapping that are near the NICO Project include the area near Burke Lake and Lou Lake.

15.3 Pathways Analysis

15.3.1 Methods

Pathway analysis identifies and assesses the linkages between NICO Project components or activities, and the correspondent potential residual effects to wildlife. Potential pathways through which the NICO Project could affect wildlife were identified from a number of sources including:

- a review of the development description and scoping of potential effects by the environmental and engineering teams for the NICO Project;
- scientific knowledge, and experience with other mines in the NWT;
- engagement with the public, Aboriginal people, communities, and government; and
- consideration of potential effects identified from the TOR for the NICO Project.

The first part of the analysis is to produce a list of all potential effects pathways for the NICO Project (Section 6.4). Each pathway is initially considered to have a linkage to potential effects on wildlife. This step is followed by the development of environmental design features and mitigation that can be incorporated into the development description to remove a pathway or limit (mitigate) the effects to wildlife. Environmental design features include NICO Project design elements, environmental best practices, management policies and procedures, and social programs. Environmental design features are developed through an iterative process between the NICO Project's engineering and environmental teams to avoid or mitigate effects.

Knowledge of the environmental design features and mitigation is then applied to each of the pathways to determine the expected amount of NICO Project-related changes to the environment and the associated residual effects (i.e., effects after mitigation) on wildlife. Changes to the environment can alter measurement endpoints such as quantity and quality of habitat. For an effect to occur there has to be a source (NICO Project component or activity) that results in a measurable environmental change (pathway) and a correspondent effect on wildlife.

NICO Project activity → change in environment → effect on wildlife

Pathway analysis is a screening step that is used to determine the existence and magnitude of linkages from the initial list of potential effects pathways for the NICO Project. This screening step is largely a qualitative assessment, and is intended to focus the effects analysis on pathways that require a more comprehensive assessment of effects on wildlife. Pathways are determined to be primary, secondary (minor), or as having no linkage using scientific and traditional knowledge, logic, and experience with similar developments and environmental design features. Each potential pathway is assessed and described as follows:

- no linkage – pathway is removed by environmental design features and mitigation so that the NICO Project results in no detectable environmental change and residual effects to wildlife relative to baseline or guideline values;
- secondary – pathway could result in a minor environmental change, but would have a negligible residual effect on wildlife relative to baseline or guideline values; or
- primary – pathway is likely to result in a measurable environmental change that could contribute to residual effects on wildlife relative to baseline or guideline values.

Primary pathways require further effects analysis to determine the environmental significance from the NICO Project on wildlife. Pathways with no linkage to wildlife or that are considered minor (secondary) are not analyzed further in the DAR because environmental design features and mitigation will remove the pathway (no linkage) or residual effects to wildlife can be determined to be negligible through a simple qualitative evaluation of the pathway. Pathways determined to have no linkage to wildlife or those that are considered secondary are not predicted to result in environmentally significant effects on wildlife. All primary pathways are assessed in the DAR.

15.3.2 Results

Potential pathways through which the NICO Project could affect wildlife are presented in Table 15.3-1. Environmental design features and mitigation incorporated into the design of the NICO Project to remove a pathway or limit the effects to wildlife are listed, and pathways are determined to be primary, secondary, or as having no linkage. The following section discusses the potential pathways relevant to wildlife.

Table 15.3-1: Potential Pathways for Effects to the Abundance and Distribution of Wildlife

NICO Project Component/Activity	Effect Pathways	Valued Components	Environmental Design Features and Mitigation	Pathway Assessment
Mine infrastructure footprint (e.g., Open Pit, site roads, Co-Disposal Facility, and Airstrip) NICO Project Access Road	Direct loss and fragmentation of wildlife habitat	wolverine black bear	The current layout of the mine footprint will limit the area that is disturbed (updated from 30 January 2009). The NICO Project Access Road will be as narrow as possible, while maintaining safe construction and operation practices.	Secondary
		marten moose muskrat waterbirds (including horned grebe) upland birds (including common nighthawk, rusty blackbird and olive-sided flycatcher) raptors (including short-eared owl)		Primary
	Loss or alteration of local flows, drainage patterns (distribution), and drainage areas from the NICO Project footprint can cause changes to soils, vegetation, and wildlife habitat	wolverine black bear marten moose muskrat waterbirds (including horned grebe) upland birds (including common nighthawk, rusty blackbird and olive-sided flycatcher) raptors (including short-eared owl)	Use of culverts and other design features that reduce changes to local flows, drainage patterns, and drainage areas.	Secondary

Table 15.3-1: Potential Pathways for Effects to the Abundance and Distribution of Wildlife (continued)

NICO Project Component/Activity	Effect Pathways	Valued Components	Environmental Design Features and Mitigation	Pathway Assessment
Operation of Co-Disposal Facility	Uptake of metals by wildlife through ingestion of tailings and dust on surface water, soils and vegetation can affect wildlife health	wolverine black bear marten moose muskrat waterbirds (including horned grebe) upland birds (including common nighthawk, rusty blackbird and olive-sided flycatcher) raptors (including short-eared owl)	The Co-Disposal Facility will minimize seepage; runoff from the facility will be captured in Seepage Collection Ponds and diverted to the Mineral Process Plant for recycling, or the Effluent Treatment Facility. At closure and post-closure, runoff will flow to constructed wetlands for treatment or the Open Pit. Any potential acid-generating Mine Rock will be sequestered within the interior of the Co-Disposal Facility. Overburden directed to the Co-Disposal Facility will be used to cover all areas in the pile where potentially metal leaching Mine Rock is to be sequestered to reduce any infiltration.	No Linkage
	Vertical and lateral seepage from the Co-Disposal Facility may cause changes to groundwater and surface water quality and soils, which may affect local vegetation and wildlife habitat			No Linkage
	Leaching of dissolved metals from Mine Rock may cause changes to groundwater and surface water quality and soils, which may affect vegetation and wildlife habitat			No Linkage
Process water and potable water supply	Process and potable water requirements for the NICO Project may decrease drainage flows and surface water levels, and affect vegetation, wetlands, and wildlife habitat	wolverine black bear marten moose muskrat waterbirds (including horned grebe) upland birds (including common nighthawk, rusty blackbird and olive-sided flycatcher) raptors (including short-eared owl)	Capture and reuse site water to reduce fresh water requirements. Water from tailings thickener and from the tailings basin will be recycled for Mineral Process Plant operations. Excess water from the Seepage Collection Ponds will be recycled and/or treated prior to entering the receiving environment.	Secondary

Table 15.3-1: Potential Pathways for Effects to the Abundance and Distribution of Wildlife (continued)

NICO Project Component/Activity	Effect Pathways	Valued Components	Environmental Design Features and Mitigation	Pathway Assessment
General construction and operation of mine and supporting infrastructure	Air emissions and dust deposition can cause changes to chemical properties of surface water, soils, vegetation, wetlands, and wildlife habitat	wolverine black bear marten moose muskrat waterbirds (including horned grebe) upland birds (including common nighthawk, rusty blackbird and olive-sided flycatcher) raptors (including short-eared owl)	Watering of roads will suppress dust production. Enforcing speed limits will assist in reducing dust. Equipment and fleet equipped with industry-standard emission control systems. Enclosing conveyance systems and processing facilities. Processing equipment with high efficiency bag houses to reduce emissions of particulate matter Operating procedures will be developed that reduce dust generation and air emissions (e.g., regular maintenance of equipment to meet emission standards).	Secondary
	Change in energetic costs from disturbance or displacement	wolverine black bear marten moose muskrat waterbirds (including horned grebe) upland birds (including common nighthawk, rusty blackbird and olive-sided flycatcher) raptors (including short-eared owl)	NICO Project design will use conventional insulation, baffles and noise suppressors on equipment. Stationary equipment will be housed inside buildings. Regular maintenance of equipment to limit emissions. Surface blasting will be temporarily suspended if large mammals are observed within the danger zone identified by the blast supervisor. All employees will be provided with environmental awareness training.	Secondary

Table 15.3-1: Potential Pathways for Effects to the Abundance and Distribution of Wildlife (continued)

NICO Project Component/Activity	Effect Pathways	Valued Components	Environmental Design Features and Mitigation	Pathway Assessment
General construction and operation of mine and supporting infrastructure (continued)	Destruction of migratory bird nests	waterbirds (upland nesters) upland birds (including common nighthawk, rusty blackbird and olive-sided flycatcher) raptors (including short-eared owl)	When possible, clearing of vegetation would take place outside the migratory bird breeding season (15 May through 31 July).	No linkage
	Sensory disturbance can change the amount of different quality habitats, and alter wildlife movement and behaviour (distribution)	wolverine black bear	NICO Project design will use conventional insulation, baffles and noise suppressors on equipment. Stationary equipment will be housed inside buildings. Regular maintenance of equipment to limit emissions. All employees will be provided with environmental awareness training. The crushing plant will be shut down at night.	Secondary
		marten moose muskrat waterbirds (including horned grebe) upland birds (including common nighthawk, rusty blackbird and olive-sided flycatcher) raptors (including short-eared owl)		Primary
	Improved access for harvesting can affect wildlife population sizes	wolverine black bear marten moose muskrat waterbirds (including horned grebe)	Develop and enforce “no hunting, trapping, harvesting or fishing policy”. Prohibit the use of recreational all terrain vehicles at site.	Primary

Table 15.3-1: Potential Pathways for Effects to the Abundance and Distribution of Wildlife (continued)

NICO Project Component/Activity	Effect Pathways	Valued Components	Environmental Design Features and Mitigation	Pathway Assessment
General construction and operation of mine and supporting infrastructure (continued)	Spills on the mine site or along the NICO Project Access Road can affect surface water quality, soils, vegetation, and wildlife habitat	wolverine black bear marten moose muskrat waterbirds (including horned grebe) upland birds (including common nighthawk, rusty blackbird and olive-sided flycatcher) raptors (including short-eared owl)	Smaller storage tanks (e.g., engine oil, hydraulic oil, and waste oil and coolant) will be double walled, or located in lined and bermed containment areas. Reagents and fuel Enviro-Tanks will be located in a larger, double-walled container. Separate areas will be established for the handling and temporary storage of hazardous wastes. Domestic and recyclable waste dangerous goods will be stored on-site in appropriate containers to prevent exposure until they are shipped off site to an approved facility (i.e., Materials and Waste Management Plan). Individuals working on-site and handling hazardous materials will be trained in the Transportation of Dangerous Goods. Soils from petroleum spill areas will be deposited and spread in a lined landfarm cell for bioremediation. An Emergency Response and Spill Contingency Plan has been be developed and will be implemented. Emergency spill kits will be available wherever toxic materials or fuel are stored and transferred. Construction and mining equipment, machinery, and vehicles will be regularly maintained.	No Linkage
	Spills on the mine site or along the NICO Project Access Road can increase risk of mortality to individual animals, which can affect wildlife population sizes			No Linkage

Table 15.3-1: Potential Pathways for Effects to the Abundance and Distribution of Wildlife (continued)

NICO Project Component/Activity	Effect Pathways	Valued Components	Environmental Design Features and Mitigation	Pathway Assessment
General construction and operation of mine and supporting infrastructure (continued)	Physical hazards on the mine site and collision with vehicles or aircraft causing injury or mortality to individual animals, which can affect population sizes	wolverine black bear marten moose muskrat waterbirds (including horned grebe) upland birds (including common nighthawk, rusty blackbird and olive-sided flycatcher) raptors (including short-eared owl)	Speed limits will be established. The presence of wildlife will be monitored and communicated to site personnel. All employees will be provided with environmental awareness training. Surface blasting will be temporarily suspended if large mammals are observed within the danger zone identified by the blast supervisor. Removal of physical hazards will be part of the Closure and Reclamation Plan.	Secondary
	Surface water runoff from the core mine facilities area can affect surface water quality, soil, vegetation, and wildlife habitat	wolverine black bear marten moose muskrat waterbirds (including horned grebe) upland birds (including common nighthawk, rusty blackbird and olive-sided flycatcher) raptors (including short-eared owl)	The site Water Management Plan will contain surface water on-site. Runoff from the mine site will be captured and diverted to the Effluent Treatment Facility or the Mineral Process Plant. The site will have sufficient storage capacity in Surge Ponds to store both operating flows and storm events. Sewage will be treated in the Sewage Treatment Plant and the effluent will either be re-used during processing or discharged to Peanut Lake through the Effluent Treatment Facility.	No Linkage

Table 15.3-1: Potential Pathways for Effects to the Abundance and Distribution of Wildlife (continued)

<table>
<tr><th>NICO Project Component/Activity</th><th>Effect Pathways</th><th>Valued Components</th><th>Environmental Design Features and Mitigation</th><th>Pathway Assessment</th></tr>
<tr><td rowspan="2">General construction and operation of mine and supporting infrastructure (continued)</td><td>Attraction to the NICO Project may increase human-wildlife interactions and removal of individual animals (e.g., relocation or mortality), which can affect wildlife population sizes</td><td>wolverine
black bear</td><td rowspan="2">Most construction of the NICO Project Access Road will be based out of the site reducing the need for temporary camps along the route.

Skirt all buildings and stairs to the ground to limit opportunities for use as shelter.

Development and implementation of a Domestic and Industrial Waste Management Plan.

Food wastes will be collected in suitable receptacles that limit attraction or impact to wildlife.

Food wastes will be incinerated regularly. The incinerator will be housed at the Waste Transfer Area.

Recyclables and waste hazardous materials will be stored on-site in appropriate containers to prevent exposure until shipped off-site to an approved facility.

A Wildlife Effects Monitoring Program will be developed and implemented.

Littering and feeding of wildlife will be prohibited.

Education and reinforcement of proper waste management practices to all workers and visitors to the site.

Education on the risk associated with feeding wildlife and careless disposal of food garbage.

Ongoing review of the efficiency of the waste management program and improvement through adaptive management.</td><td>Secondary</td></tr>
<tr><td>Attraction to the NICO Project may increase predator numbers and predation risk, which can affect prey populations</td><td>moose
muskrat
waterbirds (including horned grebe)
upland birds (including common nighthawk, rusty blackbird and olive-sided flycatcher)
raptors (including short-eared owl)</td><td>Secondary</td></tr>
</table>

Table 15.3-1: Potential Pathways for Effects to the Abundance and Distribution of Wildlife (continued)

NICO Project Component/Activity	Effect Pathways	Valued Components	Environmental Design Features and Mitigation	Pathway Assessment
Post-closure	Water quality in Flooded Open Pit and outflow may affect wildlife health	moose muskrat waterbirds (including horned grebe) upland birds (including common nighthawk, rusty blackbird and olive-sided flycatcher) raptors (including short-eared owl)	Co-Disposal Facility will be capped during closure to isolate tailings and mine rock and minimize leaching. Water will be treated prior to release from the Flooded Open Pit using a wetland treatment system prior to discharge into Peanut Lake	No Linkage
	Long-term seepage from the Co-Disposal Facility can change groundwater and surface water quality, which can affect soils, vegetation, and wildlife habitat			No Linkage

15.3.2.1 Pathways with No Linkage

A pathway may have no linkage if the pathway is removed by environmental design features and mitigation so that the NICO Project results in no detectable environmental change and residual effects to wildlife relative to baseline or guideline values. The pathways described in the following bullets have no linkage to wildlife and will not be carried through the effects assessment.

Changes to Habitat Quality, Movement, and Behaviour

- **Vertical and lateral seepage from the Co-Disposal Facility may cause changes to groundwater and surface water quality and soils, which may affect local vegetation and wildlife habitat.**
- **Leaching of dissolved metals from the Co-Disposal Facility may cause changes to groundwater and surface water quality and soils, which may affect vegetation and wildlife habitat.**
- **Long-term seepage from the Co-Disposal Facility can change groundwater and surface water quality, which can affect soils, vegetation, and wildlife habitat.**

During the life of the NICO Project, there is the potential for leachate (e.g., metals) from the tailings and mine rock Co-Disposal Facility (CDF) to seep through the co-disposed materials and report as seepage into the Seepage Collection Ponds. Additionally, there is potential for arsenic as well as other metals i.e., aluminum, arsenic, cadmium, cobalt, lead, selenium, and uranium) to be present in the leachate. Such water-borne elements could adversely affect vegetation growth through surface water runoff and seepage. Environmental design features and mitigation have been incorporated into the NICO Project to reduce the potential for water to contact metal leaching Mine Rock, tailings, and potentially acid generating rock and, thus reducing potential effects to the environment from surface water runoff and seepage from the CDF (Table 15.3-1).

The CDF is designed to limit runoff and seepage from contacting potentially acid generating and metal leaching Mine Rock by placing this material in the interior of the CDF interlayered with tailings. The cover placed on the top of the CDF at closure, will limit infiltration into the interior of the CDF where potentially acid generating and metal leaching rock is located.

Runoff and seepage from the CDF will not be released directly to the environment during construction or operations. Runoff and seepage from the CDF will report to 1 of 5 Seepage Collection Ponds. During operations, water in the Seepage Collection Ponds will be pumped to the Surge Pond. Water from the Surge Pond will be pumped for use in the Mineral Process Plant (Plant) or pumped to the Effluent Treatment Facility for treatment prior to release into Peanut Lake.

At closure, the surface of the CDF will be covered; thereafter, runoff from the CDF will not be in contact with the mine rock or tailings materials. Seepage out of the toe of the CDF will continue to be collected in the Seepage Collection Ponds. Water from Seepage Collection Ponds Nos. 1, 2, 3, and 5 and the Surge Pond will pass through constructed Wetland Treatment Systems prior to release into Nico Lake. The use of wetland treatment will be subject to demonstration of its technical feasibility by testing during the operating life of the mine. The Open Pit will slowly flood after closure. The water level is expected to reach Elev. 260 m roughly 120 years after closure, at which point it will overflow. At that time the pit lake overflow water will be directed through a ditch to Wetland Treatment System No. 4, which will discharge into Peanut Lake.

The Grid Ponds currently produces measureable natural arsenic loadings into Nico Lake. After construction, all releases from the NICO Project site into Nico or Peanut Lake will be subject to monitoring and treatment by active or passive means. Overall, release of runoff and long-term seepage from the CDF is not expected to result in a detectable change to wildlife habitat outside of the NICO Project footprint area relative to baseline conditions. Therefore, these pathways were determined to have no linkage to the persistence of wildlife populations.

- **Destruction of migratory bird nests can affect abundance and distribution of passerine, waterfowl, and raptor populations.**

The *Migratory Birds Convention Act* (*MBCA* 1994) prohibits the destruction of migratory bird nests (passerine, waterfowl, and raptor) during the breeding season. In the NWT, the migratory bird breeding season extends from approximately 15 May to 31 July. The majority of the vegetation removal is expected to include the Plant area, CDF, Open Pit, Airstrip, and NPAR. As much as possible, vegetation clearing would take place outside of the migratory bird season, resulting in little chance of destruction of migratory bird nests. If construction activities must be completed during the migratory bird breeding season, then vegetation and top soil will be removed prior to the nesting season. These mitigation practices are anticipated to result in no detectable change to the nest success of migratory birds from the NICO Project relative to baseline conditions. Therefore, this pathway was determined have no linkage to upland breeding bird, waterbirds, and raptor population persistence.

- **Surface water runoff from the core mine facilities area can affect surface water quality, soil, vegetation, and wildlife habitat.**

Surface water runoff from the Open Pit and Plant facilities area could potentially affect vegetation and wildlife habitat. These facilities incorporate several environmental design features to prevent release of untreated site water into the receiving environment (Table 15.3-1).

During operations, water which collects in the Open Pit sump, which will include seepage into the Open Pit as well as runoff from rainfall and snow, will be pumped to the Surge Pond. Runoff from the Plant will be collected in a site runoff collection pond and then transferred to the Surge Pond. Sewage will be treated and the effluent will either be re-used during processing or discharged to Peanut Lake through the Effluent Treatment Facility. Water collected in the Surge Pond will be reclaimed to the Plant to the extent that it is needed; all excess water will be pumped to the Effluent Treatment Facility. Following treatment, the water will be discharged through a diffuser into Peanut Lake.

After closure, dewatering of the Open Pit will cease and the Open Pit will slowly fill with water. The water level is expected to reach Elev. 260 m roughly 120 years after closure, at which point it will overflow. At that time, the overflow water from the Open Pit will be treated by one of several potential methods described in Section 3.9.2.3. After treatment, the Open Pit water will discharge into Peanut Lake. At closure, the Plant will be demolished and the area will be covered with till and re-vegetated. Runoff from part of the area will drain into the Surge Pond and then into Wetland Treatment System No. 4. Runoff from the remainder of the area will drain directly into Wetland treatment System No. 4, which will discharge into Nico Lake. Closure of the CDF will focus on reducing the risk of wind and water erosion of tailings. The exposed tailings will be covered with a 0.5 m thick layer of glacial till underlain by a 0.25 m layer of sand. Erosion control practices (e.g., erosion mats) will be used to limit erosion of topsoil stockpiles.

Implementation of these environmental design features is expected to result in no detectable changes to vegetation and wildlife habitat from the NICO Project. Subsequently, this pathway was determined to have no linkage to effects on the persistence of wildlife populations.

- **Spills on the mine site or along the NICO Project Access Road can affect surface water quality, soils, vegetation, and wildlife habitat**

Chemical spills are usually localized, and are quickly reported and managed. Mitigation practices identified in the Emergency Response and Spill Contingency Plan (Appendix 3.VI) and environmental design features (Table 15.3-1) will be in place to limit the frequency and extent of chemical spills that result from NICO Project activities. Hazardous material and fuel will be stored according to regulatory requirement to protect the environment and workers (i.e., Hazardous Substances Management Plan; [Appendix 3.V]). Smaller storage tanks (e.g., engine oil, hydraulic oil, waste oil, and coolant) will be double walled, and located in lined and bermed containment areas. Individuals working on-site and handling hazardous materials will be trained in the Transportation of Dangerous Goods. Emergency spill kits will be available wherever toxic materials or fuel are stored and transferred.

The implementation of the Emergency Response and Spill Contingency Plan, and environmental design features are expected to result in no detectable change to water quality, soils, vegetation, and wildlife habitat. Consequently, this pathway was determined to have no linkage to effects on the persistence of wildlife populations, and continued opportunity for traditional and non-traditional use of wildlife.

Changes to Survival and Reproduction

- **Spills on the mine site or along the NICO Project Access Road can increase risk of mortality to individual animals, which can affect wildlife population size.**

Chemical spills have not been reported as the cause of wildlife mortality at the Ekati Diamond Mine, Diavik Diamond Mine, Jericho Diamond Project, or Snap Lake Mine (Tahera 2008; BHPB 2010; DDMI 2010; De Beers 2010). Chemical spills are usually local, and are quickly reported and managed. Mitigation practices identified in the Emergency Response and Spill Contingency Plan (Appendix 3.VI), and environmental design features (Table 15.3-1) will be in place to limit the frequency and extent of chemical spills at the NICO Project, and along the NPAR.

The implementation of the Emergency Response and Spill Contingency Plan (Appendix 3.VI), environmental design features, and monitoring programs is expected to result in no detectable change to health or mortality of wildlife. Consequently, this pathway was determined to have no linkage to effects on the persistence of wildlife populations, and continued opportunity for traditional and non-traditional use of wildlife.

- **Uptake of metals by wildlife through ingestion of tailings and dust from tailings on surface water, soils, and vegetation can affect wildlife health.**
- **Water quality in the Flooded Open Pit and outflow may affect wildlife health.**

Wildlife within the RSA may be directly and indirectly exposed to airborne chemicals through fugitive dust and air emissions from the NICO Project. Direct exposure to chemicals includes inhalation of fugitive dust and air emissions, drinking of water, inadvertent ingestion of soil while foraging or grooming, and ingestion of vegetation. Airborne chemicals may deposit directly onto the surface of plants or may deposit onto soils and be subsequently taken up through plant roots (vascular plants) or tissues (lichen). Therefore, wildlife may be indirectly exposed to chemicals from fugitive dust and air emissions by intentionally or inadvertently consuming vegetation that has accumulated chemicals through the soil or air.

Waterfowl may also be at increased risk of mortality if they land in the CDF and ingest contaminated water, sediment, or invertebrates. This may be a greater issue during the spring and fall as heat from the tailings material may prevent the water in the CDF from freezing. Therefore, if the CDF contains the only open waterbody in the region surrounding the NICO Project it may be attractive to waterfowl.

Water quality in the Flooded Open Pit and the subsequent outflow may represent a risk to individuals that drink the water. In addition, there is a general concern that wildlife may drink from the Seepage Collection Ponds or associated containment ditches, which may result in negative changes to wildlife health. As such, environmental design features have been incorporated into the NICO Project to eliminate or reduce potential effects from surface water runoff and seepage (Table 15.3-1). Runoff and seepage from the CDF will not be directly released to the environment during construction and operations. Runoff from the CDF will be contained and report to one of the Seepage Collection Ponds. At closure, the CDF will be covered with a 0.5 m layer of glacial till underlain by a 0.25 m layer of sand. The facility will be graded to capture surface runoff and reduce infiltration. Progressive reclamation and closure of the CDF will involve contouring and re-grading and covering with vegetation.

A wildlife health risk assessment was completed to evaluate the potential adverse effect to individual animal health associated with exposure to chemicals from the NICO Project. Sources of chemicals considered in the assessment include fugitive dust, air emissions, treated effluent, and surface water runoff and seepage. The potential for effects to the health of wildlife evaluated for the NICO Project included changes in air, water, soil, and vegetation quality.

Based on the calculated exposure ratios it is anticipated that atmospheric depositions and surface water discharges from the NICO Project will result in negligible health risks to wildlife. The exposure ratios were calculated using the maximum predicted concentrations of contaminants of possible concern, which were predicted during operations, closure, and post-closure phases of the NICO Project. Risk was considered to be negligible if calculated exposure ratios were less than target risk levels of 1, which is consistent with standard practice in risk assessment. The exposure ratios for wildlife directly and indirectly exposed to chemicals were orders of magnitude less than 1. Because no unacceptable health risks to wildlife are anticipated during these phases of the NICO Project, it is predicted that wildlife health risks will also be negligible during the construction and operations phases of the NICO Project (i.e., containments of possible concern, are anticipated to be present at lower concentrations during construction and operation). Consequently, these pathways were determined to have no linkage to effects on the persistence of wildlife populations, and continued opportunity for traditional and non-traditional use of wildlife.

15.3.2.2 Secondary Pathways

In some cases, both a source and a pathway exist, but the NICO Project is anticipated to result in a minor environmental change, and would have a negligible residual effect on wildlife relative to baseline or guideline values. The pathways described in the following bullets are expected to be secondary and will not be carried through the effects assessment.

Changes to Habitat Quantity and Fragmentation

- **Direct loss and fragmentation of wildlife habitat can affect abundance and distribution of wolverine and black bear populations.**

Habitat loss and fragmentation from the NICO Project are not expected to influence the persistence of black bears and wolverines. The NICO Project footprint is small relative to the home range size of black bears and wolverine. Estimates of black bear and wolverine density and home range size were not available for the boreal forest in the NWT, so the nearest comparable estimates are provided. Average home range area estimates were 119 km^2 for male black bears and 20 km^2 for female black bears in Alberta (Young and Ruff 1982). Home range estimates for black bears in southern Manitoba were 465 km^2 for males and 295 km^2 for females (Pacas and Paquet 1994). Home range size estimates for wolverines in the Yukon varied between 76 and 269 km^2 for females and 209 and 269 km^2 for males (Bianci and Harestad 1990). To be conservative and not underestimate effects, the smallest home range estimates were used to assess effects. The NICO Project footprint (i.e., proposed mine and NPAR) is expected to be 4.9 km^2, which is approximately 4.1% of a male black bear's home range, 24.5% of a female black bear range, 6.4% of a female wolverine home range, and 2.3% of a male wolverine home range.

In addition to direct loss of habitat, the NICO Project may also result in fragmentation of the existing landscape, potentially changing the quality of habitats. Habitat fragmentation is the progressive subdivision of habitat blocks into fragments. Although fragmentation always accompanies habitat loss, it is a different phenomenon (McGarigal and Cushman 2002; Fahrig 2003). Habitat fragmentation effects are lesser in magnitude than direct habitat loss (Andrén 1999, Fahrig 1997, 2003), and species with very specific habitat requirements and low dispersal abilities are more likely to be affected by habitat fragmentation. Black bears and wolverines are habitat generalists and are highly mobile species; therefore, the total amount of habitat remaining is expected to be more important for survival of these species than the configuration of the remaining habitat (i.e., habitat loss is of greater concern than habitat fragmentation) (Fahrig 1997, 2003; Swift and Hannon 2010).

Baseline studies suggest that black bears and wolverines are not common in the RSA. Eleven black bear individuals were observed and 13 observations of black bear sign were recorded in the RSA from 2003 to 2010 (Section 15.2.4.2.1). One black bear den was found in the RSA in 2004. Five observations of wolverine sign and 1 individual were seen during baseline surveys. No wolverine dens were found during baseline surveys, although there is suitable denning habitat present within the RSA (Fortune 2004).

The results suggest that the RSA constitutes part of the home range of a few individual wolverines and black bears within the populations. Thus, the NICO Project is predicted to cause a minor change in the amount and configuration of habitat for these individuals relative to baseline conditions. The estimated decrease in habitat for some individuals should have a negligible residual effect on the persistence of wolverine and black bear populations.

Changes to Habitat Quality, Movement, and Behaviour

- **Air emissions and dust deposition can cause changes to the chemical properties of surface water, soils, vegetation, wetlands, and wildlife habitat.**

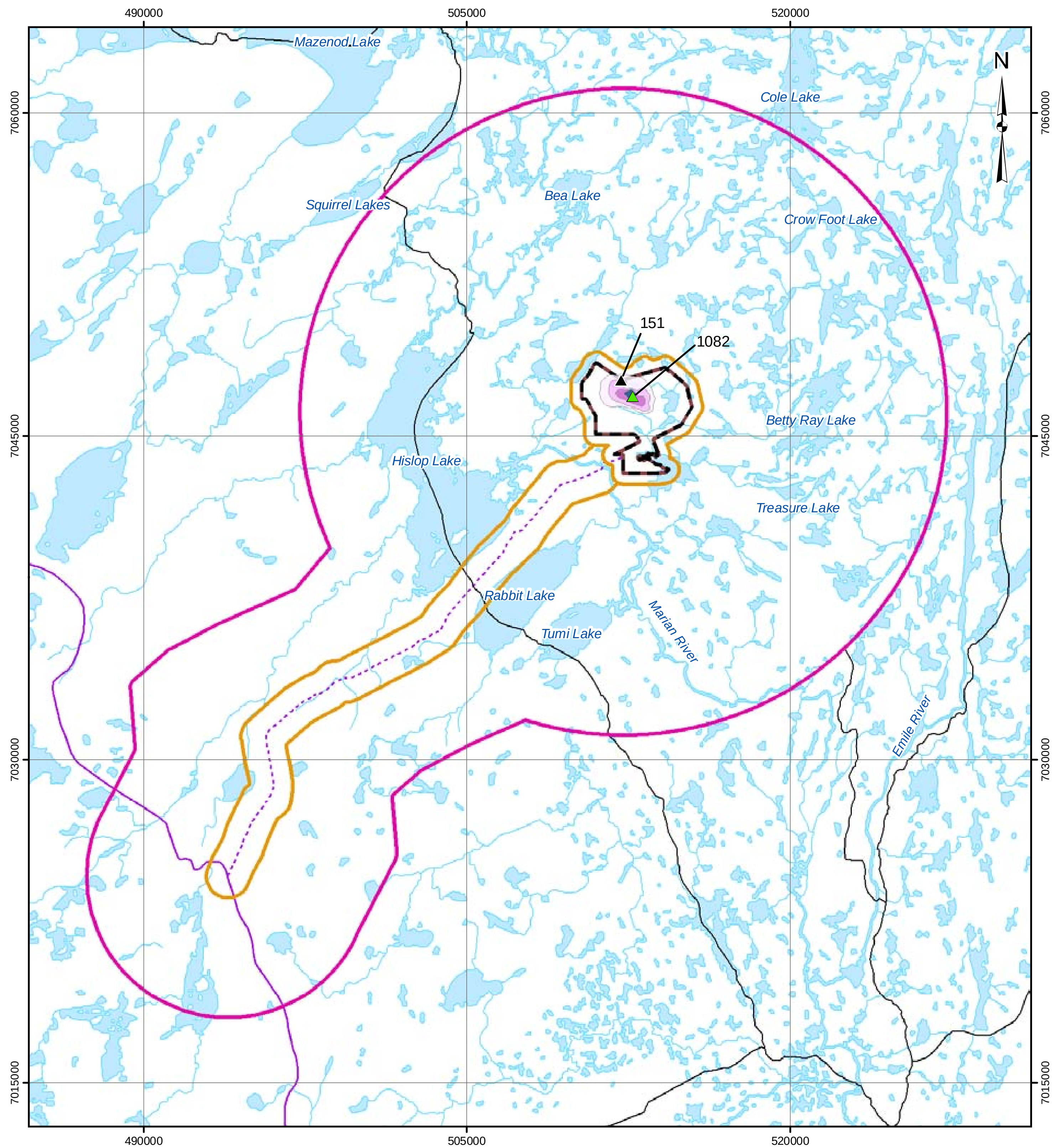
Accumulation of dust (i.e., total suspended particulate deposition) and concentrations of air emissions produced from the NICO Project may result in a local indirect change on the quality of habitat available within the LSA. Air quality modelling was completed to predict the spatial extent of dust deposition and air emissions from the NICO

Project (Section 10.4). Sources of dust deposition and air emissions modelled in the application case (maximum effect case) include blasting activities, haul roads, the Plant, activities at the Open Pit and other ancillary facilities, and vehicle traffic along the NPAR and the Proposed Tłįchǫ Road Route. Environmental design features and mitigation have been incorporated into the NICO Project to reduce potential effects from dust deposition (Table 15.3-1). For example, the watering of roads, Airstrip, and laydown areas during the non-winter period will facilitate dust suppression. In addition, programs will be implemented to review power and heat use to reduce energy use. Although these environmental design features and mitigation should reduce dust deposition and air emissions, assumptions incorporated into the model are expected to contribute to conservative estimates of emission concentrations and deposition rates.

Trucks travelling on the winter roads, NPAR, and the Proposed Tłįchǫ Road Route have the potential to transfer dust from vehicles and loads (e.g., dust deposited on wheels and undercarriage while at the NICO Project and in Yellowknife); however, the relative contribution of these loads to the overall dust accumulation in the area along the roads is considered to be negligible (Section 10.4). Similarly, dust generation from NICO Project vehicles along the NPAR and Proposed Tłįchǫ Road Route would occur annually, but would likely be higher during the non-winter period and not continuous (i.e., would occur less frequently during wet and cool conditions). Dust deposition is expected to result in minor and localized changes to vegetation and wildlife habitat along the right-of-ways for the NPAR and proposed Tłįchǫ Road Route. For example, Walker and Everett (1987) and Everett (1980) reported that effects were confined to a 50 m buffer on either side of a road. Moreover, Meininger and Spatt (1988) found that most of effects occurred within 5 to 50 m of a road, with less obvious effects observed between 50 m and 500 m from a road. Therefore, dust deposition from vehicles along the NPAR and Tłįchǫ Road Route are predicted to result in negligible residual effects to the persistence of wildlife populations.

Air emissions from vehicles along the NPAR and existing winter roads were included in the application case and assumed that winter roads were in operation for 63 days for construction, after which the NPAR and the Proposed Tłįchǫ Road Route would be open all year round. In general, emissions from the roads are small, and if extended over the whole year, a negligible effect from annual depositions was predicted (Section 10.4). Annual emissions from vehicles on the roads are anticipated to result in no detectable changes to soils and vegetation (Section 13.3.2.2 and Section 14.3.2.2), and are expected to have no detectable effects on wildlife habitat relative to baseline conditions.

The results of the air quality modelling predicted that the maximum annual dust deposition resulting from the NICO Project is 1083 grams per square metre per year ($g/m^2/y$) within the NICO Project Lease Boundary, and 151 $g/m^2/y$ outside of the NICO Project Lease Boundary (Table 15.3-2). Further, modelling showed minimal dust deposition (i.e., <79 $g/m^2/y$) beyond approximately 280 m from the Lease Boundary (i.e., there should be limited dust deposition outside of the LSA) (Figure 15.3-1). The only area that is predicted to receive dust beyond the NICO Project Lease Boundary is a small area of land located north-northwest of the NICO Project Lease Boundary (Figure 15.3-1). The major sources of dust will be associated with the Open Pit and haul roads. The strongest effects from dust are generally confined to the immediate area adjacent to the dust source, such as roads (Walker and Everett 1987). Walker and Everett (1987) and Everett (1980) reported that effects were confined to a 50 m buffer on either side of a road.



LEGEND

- PROJECT LEASE BOUNDARY
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁĮCHǪ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

- ▲ MAXIMUM PREDICTION WITHIN LOCAL STUDY AREA EXCLUDING PROJECT LEASE BOUNDARY
- ▲ MAXIMUM PREDICTION WITHIN LOCAL STUDY AREA

DEPOSITION (g/m^2/yr)

- >= 631
- 316 to < 631
- 158 to < 316
- 79 to < 158
- 0 to < 79

5 0 5

SCALE 1:250,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

DISTRIBUTION OF ANNUAL TOTAL SUSPENDED PARTICULATE DEPOSITION RATE DURING NICO PROJECT OPERATIONS

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-053-GIS				
PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	JV	15 Feb. 2011	FIGURE: 15.3-1	
GIS	MK	23 Feb. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

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Table 15.3-2: Summary of Predicted Annual Deposition Rates from the NICO Project

Substance	Criteria	Maximum Predicted Deposition Rate			
		Local Study Area Baseline	Application		
			Outside NICO Project Lease Boundary	Distance to Maximum from Project Centre (km)	Approximate Direction to Maximum
TSP	none	0.00 $g/m^2/y$	151 $g/m^2/y$	1.7	NW
PM_{10}	none	0.00 $g/m^2/y$	60 $g/m^2/y$	1.7	NW
$PM_{2.5}$	none	0.00 $g/m^2/y$	0.6 $g/m^2/y$	1.7	NW
PAI	0.25 keq/ha/y [a]	0.06 keq/ha/y	0.3 keq/ha/y	1.7	NW

[a]Criteria is based on the Clean Air Strategic Alliance (CASA 1999).
NW = northwest; m = metre; $g/m^2/y$ = grams per square metres per year; keq/ha/y = kiloequivalent per hectare per year; TSP = total suspended particulate; $PM_{2.5}$ = fine particles of 2.5 micrometres or less in size; PM_{10} = fine particles of 10 micrometres or less in size; PAI = potential acid input.

Potential acid input from air emissions can change the chemical properties of soil and water, which can affect vegetation and wildlife habitat (CASA 1999). For potential acid input and the application case, changes to soil and vegetation are expected to be minor (Section 13.3.2.2 and Section 14.3.2.2), which should result in minor changes to wildlife habitat.

The air emission modelling results show that predicted peak concentrations for sulphur dioxide during operations are below the Ambient Air Quality Standards for NWT (Table 15.3-3); however, annual peak concentrations for nitrogen dioxide are predicted to slightly exceed guidelines outside of the NICO Project Lease Boundary, reaching levels of 68 micrograms per cubic metre ($\mu g/m^3$). The predicted distance to maximum nitrogen dioxide predictions is 1.7 km from the NICO Project centre. The spatial extent that is predicted to exceed the NWT standard is 4 ha in size and located north/northwest of the NICO Project Lease Boundary and within the LSA. Nitrogen dioxide concentrations exceed guidelines for a distance of about 250 m from the NICO Project Lease Boundary. For total suspended particulate, the maximum predicted dust concentration rate will occur within 1.7 km of the NICO Project centre (Table 15.3-3). Total suspended particulate air concentrations are predicted to exceed guidelines within 500 m from the NICO Project Lease Boundary (Figure 15.3-1). In other words, total suspended particulate concentrations outside of the LSA will be below recommended guidelines.

Table 15.3-3: Summary of Predicted Peak Annual Air Quality Concentrations from the NICO Project

Substance	Criteria ($\mu g/m^3$)[a]	Maximum Predicted Concentration			
		Baseline	Application		
		Concentrations in the Regional Study Area ($\mu g/m^3$)	Concentrations Outside NICO Project Lease Boundary ($\mu g/m^3$)	Distance to Peak Predictions from NICO Project Centre (km)	Approximate Direction to Maximum
Nitrogen dioxide	60	2	68.4	1.7	NW
Sulphur dioxide	30	0.5	1.0	1.7	NW
Total suspended particulate	60	2	166.0	1.7	NW

[a] standard based on Ambient Air Quality Standards for NWT
$\mu g/m^3$ = micrograms per cubic metre; km = kilometre; NW = northwest

Although concentrations are predicted to be above baseline conditions, the anticipated changes to habitat quality are considered minor and localized. Maximum reported values are, in part, a consequence of local topography as there is a small area northwest of the NICO Project where there are moderate changes in elevation (e.g., hill or cliff). The maximum predicted annual deposition rate of potential acid input and maximum concentration of nitrogen dioxide are both expected to occur within 1.7 km of the NICO Project centre and have values exceeding guidelines for only a short distance outside the north/northwest boundary of the NICO Project Lease Boundary (i.e., all values are below recommended guidelines outside of the LSA). When comparing changes to the elemental concentrations in soil from total suspended particulate deposition, predictions are below Canadian Counil of Ministers of the Environment (2007) soil quality guidelines. Therefore, changes to the chemical content of soil should not affect the soils ability to support vegetation (habitat quality). In addition, the deposition predictions are considered to be conservative, and therefore the presented deposition rates are likely overestimated. Overall, changes in habitat quality (and associated changes to wildlife movement and behaviour) due to dust deposition and air emissions are anticipated to be minor relative to baseline conditions (secondary pathway; Table 15.3-1). Consequently, residual effects to the persistence of wildlife populations and the continued opportunity for traditional and non-traditional use of wildlife from dust deposition and air emissions are predicted to be negligible.

- **Change in energetic costs from disturbance or displacement.**

Wildlife survival and reproduction can be negatively affected by sensory disturbance (e.g., increased noise levels during construction and visual disturbances from moving vehicles and humans throughout operation) because animals may avoid (i.e., change movement patterns or flee the area) or move more quickly through areas with human disturbance (Tyler 1991; Fortin and Andruskiw 2003; Bayne et al. 2008). This increase in energy expenditure may reduce individual fitness because energy that could be allocated to survival or reproduction is instead used to cope with disturbance (Bisson et al. 2009).

Species may be more sensitive or vulnerable to disturbance during certain times of the year. Birds may be more sensitive to disturbance early in the nesting season because the amount of energy invested in brood-rearing is not outweighed by nest abandonment (Bisson et al. 2009). Birds may also be more vulnerable to disturbance during the molting season as they will have less energy to use towards stress responses (e.g., fleeing) (Cyr et al. 2008). Mammals are also likely to be more sensitive and vulnerable to disturbance during the breeding season. Adults are more protective of their young and may have lower tolerance to perceived threats (Maier et al. 1998). Females are also investing a lot of energy into milk production, which lowers the amount of energy that is available for fleeing from apparent threats.

Some studies have shown no responses (e.g., no changes in activity levels from baseline conditions; Telesco and VanManen 2006) or transitory responses (e.g., returning to normal hormone, heart rate, or activity levels within a few minutes; Krausman and Hervert 1983; Weisenberger et al. 1996) to human disturbance. Other studies note longer increases in activity, hormone, or heart rate levels with disturbance (e.g., returning to normal levels within a few hours or days; Weimerskirch et al. 2002). These responses may be related to how accustomed species are to disturbance, the time of year (e.g. breeding or non-breeding season), the type of sensory disturbance (olfactory or visual), as well as the duration and intensity of the disturbance (Fortin and Andruskiw 2003; Bayne et al. 2008; Fahrig and Rytwinksi 2009).

During construction, approximately 2200 truck loads will be delivered to the NICO Project site during the winter road season. This amounts to approximately 63 return trips per day over an average 70 day winter road season.

During operations, an estimated 5 to 9 trucks per day are anticipated to travel along the NPAR and Proposed Tłįchǫ Road Route. During operations, noise will be generated from mobile and stationary mining equipment, blasting, and aircraft at the NICO Project. Aircraft are anticipated to be used for medical emergencies and the transport of some goods to site (i.e., the annual volume of aircraft traffic is expected to be low with a maximum of 4 round-trip flights per week are expected during NICO Project construction, during normal operations there are no flights expected except for emergency purposes [Appendix 8.III]). In addition, environmental design features (Table 15.3-1) are expected to reduce disturbance and displacement of wildlife species during NICO Project operation. Some environmental design features and mitigation to reduce disturbance and displacement of wildlife species include:

- stationary equipment will be housed inside buildings;
- regular maintenance of equipment to limit emissions; and
- surface blasting will be temporarily suspended if large mammals are observed within the danger zone identified by the blast supervisor.

The recommended maximum value for the nighttime noise level for undeveloped areas is 40 dBA (ERCB 2007) (Appendix 8.III). This is the average nighttime (23:00 to 07:00) equivalent continuous sound and noise level (L_{eq}) in dBA, that includes both NICO Project related noises and the ambient sound level (existing sound levels without NICO Project related noises). The typical nighttime ambient sound level in rural Alberta is 35 dBA L_{eq} with higher winds, precipitation, and thunder being the principal sources of increase above this value (ERCB 2007). During daytime hours these levels can be higher, due to higher levels of human activity and associated tolerance for noise levels. The projected noise levels from the various NICO Project activities are compared with benchmarks in Table 15.3-4. The results show that noise predictions slightly exceed benchmarks for mine operations, but are below benchmarks for the NPAR and Airstrip. Similar values for the NPAR are predicted for NICO Project vehicles travelling along the proposed Tłįchǫ Road Route.

Table 15.3-4: Summary of Noise Levels from the NICO Project

Receptor	Mine Operations[c] L_{eq} (dBA)		NICO Project Access Road L_{eq} (dBA)		Airstrip L_{max} (dBA)	
	Prediction	Benchmarks	Prediction	Benchmarks	Prediction	Noise Event Benchmarks
Construction Camp	58.7	55[a]	35	55[a]	53.5	70[a]
1.5 km Boundary Location[d]	43.0	40[b]	36.2	40[b]	93.0	NA

[a] World Health Organization 1999

[b] ERCB 2007

[c] Highest cumulative noise levels calculated at each receptor

[d] Location with highest projected noise level along the length of the boundary

dBA = A-weighted decibel; km = kilometre; ≥ = greater than or equal to; L_{eq} = equivalent continuous sound and noise level; L_{max} = maximum sound and noise level; NA = not applicable.

A summary of the maximum distances for NICO Project-related noise to attenuate to background levels are shown in Table 15.3-5. The distances indicate that NICO Project-related noises may be found to be distinguishable from the natural environment by people within 0.9 to 26 km from the NICO Project; however, the frequency of aircraft traffic at the NICO Project is expected to be limited to a maximum of 4 round-trip flights per week during construction and for emergency purposes during operation. The duration of the effect is expected to short-term (less than 5 minutes). When NICO Project noise predictions diminish to levels below background, they are not expected to be distinguishable from natural noises. Similarly, noise from NICO Project vehicles travelling along the Proposed Tłı̨chǫ Road Route is expected to diminish to background levels within 0.9 km of the road right-of-way.

Table 15.3-5: Distance for Noise Attenuation to Background Sound Levels for the NICO Project

Background Noise Level	Mine Operations (km)	NICO Project Access Road (km)	Airstrip (km)
Continuous (35 dBA)	3.3[a]	NA	NA
Noise Event	NA	0.9[b]	25.8

[a] Based on the distance to the nearest noise sources

[b] Based on maximum pass-by level.

dBA = decibels; km = kilometres; NA = not applicable

Populations of species in the RSA with moderate to large home ranges (e.g., moose, wolverine, black bear, marten) and species with low densities (e.g., waterbirds) are not expected to be affected by noise from the NICO Project because noise is expected to attenuate at 3.5 km for normal operations. Noise from NICO Project vehicles travelling along the NPAR, existing winter road from Behchokǫ̀ to Gamètì, and Proposed Tłı̨chǫ Road Route are predicted to decrease to ambient levels within 0.9 km of the roads. As a result a small proportion of the populations (i.e., relatively few individuals) are expected to experience minor changes to energetic costs from disturbance or displacement. A small proportion of the different upland breeding bird populations in the RSA are also expected to experience changes in energetic costs from disturbance. Studies at the Ekati mine in the NWT have found no change in reproductive success (Male and Nol 2005) or density (Smith et al. 2005) of upland breeding birds adjacent to roads and the mine site. In addition, most of noise and associated sensory disturbance from the NICO Project (particularly from traffic along the winter access road and existing winter road from Behchokǫ̀ to Gamètì during construction) will occur when migratory species are not in the study area. Subsequently, minor changes in energetic costs to individuals are predicted to have a negligible residual effect on the persistence of wildlife populations.

- **Loss or alteration of local flows, drainage patterns (distribution), and drainage areas from the NICO Project footprint can cause changes to soils, vegetation, and wildlife habitat.**

Water diversions are not required for the development of the NICO Project infrastructure footprint, as the footprint is located near the top of a watershed; however, the CDF will eliminate the Grid Ponds, which are situated in a runoff catchment. The loss of the Grid Ponds is expected to result in represent minor fluctuations in water level relative to baseline values of Nico Lake (Section 11.3.2.2).

Because treated effluent will immediately mix with water from Peanut Lake, flows from Peanut Lake into Burke Lake will be increased during periods of effluent discharge. In general, the influence of discharge from the NICO Project to Peanut Lake is anticipated to result in lilttle to no effect on water levels in downstream waterbodies, including Ponds 11, 12, and 13 and Burke Lake relative to baseline conditions (Section 11.3.2.2). The water management system for the NICO Project has been optimized in terms of internal recycling within the Plant, thickening of the tailings, and high level of reclaim water from the CDF back to the Plant. The implementation of the mitigation practices and environmental design features is expected to result in a minor change (secondary pathway) to the hydrology in the LSA from the NICO Project relative to baseline conditions, which should have a negligible effect on Peanut Lake and downstream waterbodies such as Pond 11, 12, and 13, and Burke LakeThe NPAR will cross 9 streams. To mitigate effects to local flows, drainage patterns, and drainage areas along the NPAR, a bridge will be built to cross the Marian River while all other streams, because they are ephemeral, will be culverted. The mine infrastructure and NPAR footprints are not predicted to change local flows, drainage patterns, and drainage areas outside the range of baseline values. Therefore, changes to vegetation and wildlife habitat are expected to be minor and have a negligible residual effect on the persistence of wildlife populations.

- **Process and potable water requirements for the NICO Project may decrease drainage flows and surface water levels, and affect vegetation, wetlands, and wildlife habitat.**

The NICO Project will withdraw freshwater for dust suppression, potable water, and plant operations from Lou Lake. Department of Fishery and Oceans allowable lake under ice withdrawal volumes are 10% of the available water volume calculated using the appropriate maximum expected ice thickness (DFO 2010). The available water volume of Lou Lake is 9.42 million cubic metres (Mm^3) (Section 11.3.2.2). Thus the allowable volume that could be pumped from Lou Lake in winter is approximately 942 000 m^3. Throughout the life of the NICO Project it is anticipated that fresh water withdrawals during construction and operations will range from 112 000 m^3/year under average climatic conditions up to 146 000 m^3/year during a 1:25 year dry period (Section 11.3.2.2). This is below the allowable volume of water that could be taken from Lou Lake.

Environmental design features that will be implemented to reduce the amount of water required for plant operations and domestic uses include the capture and reuse of site water and excess water from the Seepage Collection Ponds in Mineral Processing Plant operations and the recycling of water from tailings thickener in grinding operations (Table 15.3-1). Water requirements for the NICO Project are not expected to decrease drainage flows and surface water levels below baseline conditions (Section 11.2), and should result in a minor change to wetlands and wildlife habitat. Therefore, this pathway is expected to have negligible residual effects to the persistence of wildlife populations.

- **Sensory disturbance can change the amount of different quality habitats, and alter the movement and behaviour (distribution) of black bears and wolverines.**

Carnivores have a keen sense of smell and can be attracted from long distances to a project if food items are frequently present (Eberhardt et al. 1982; Benn and Herrero 2002; Beckman and Berger 2003; Peirce and Van Daele 2006). Mining projects in the Arctic have reported carnivore attraction to landfills (BHBP 2007; DDMI 2008). Carnivores are also attracted to aromatic waste materials such as petroleum based chemicals, grey water, and sewage (CWS 2007). Olfactory disturbance of this type is a concern with large carnivores (e.g., black bears and wolverines) around human developments. Wolverine snow track monitoring at the Snap Lake Mine between 1999 and 2007 indicated slightly greater wolverine activity within 7 km of the mine (De Beers 2008), suggesting there may be a positive attraction to the mine site.

Auditory disturbance is expected to have less of an influence than olfactory disturbance on black bear and wolverine movement and behaviour. In a cumulative effects analysis using resource selection functions, Johnson et al. (2005) found that wolverine in a tundra environment lost approximately 1.6 to 2.4% of high quality habitat due auditory disturbance at existing developments (including mines, exploration camps, and outfitting camps). Although this study considered a tundra environment rather than the boreal environment of the NICO Project, the results do provide some indication of the influence that sensory disturbance has on wolverine. Black bears in North America seem to tolerate disturbance greater than 1 km of den sites (reviewed in Linnell et al. 2000). Activity less than 1 km and especially within 200 m of dens caused variable responses (i.e., some dens were abandoned while other bears tolerated close disturbance). Black bear habitat selection was not influenced by sensory disturbance in North Carolina (Telesco and Van Manen 2006).

A number of environmental design features (Table 15.3-1) and management plans (Appendix 3.IV, Appendix 3.V, Appendix 18.II) will be implemented to limit olfactory and auditory disturbance to large carnivores, which should result in minor changes to habitat quality relative to baseline conditions. Also, the large home range sizes of wolverines and black bears means that only a few individuals' home ranges should overlap the zone of influence of sensory disturbance from the NICO Project. Therefore, only a small proportion of the wolverine and black bear populations in the RSA should be affected by sensory disturbance from the NICO Project. Subsequently, this pathway is predicted to have a negligible residual effect on the persistence of black bear and wolverine populations.

Changes to Survival and Reproduction

- **Attraction to the NICO Project may increase human-wildlife interactions and removal of individual animals (e.g., relocation or mortality), which can affect wildlife population size.**
- **Attraction to the NICO Project may increase predator numbers and predation risk, which can affect prey populations.**

Carnivores can be attracted to mine sites from food smells and other aromatic compounds such as petroleum-based chemicals, grey water, and sewage. In addition, infrastructure may also attract carnivores as it can serve as a temporary refuge to escape extreme heat or cold. Corvids and raptors may also be attracted to infrastructure and anthropogenic food sources (Restani et al. 2001; Marzluff and Netherland 2006; CWS 2007; Kristan and Boarman 2007; Baxter and Allan 2008). Attraction of wildlife to the NICO Project also increases the risk for accidental mortality of wildlife (e.g., collisions with vehicles). The attraction of carnivores, raptors, corvids, and gulls can increase predation pressure on prey species (e.g., moose, passerines, and waterfowl) (CWS 2007; Liebezeit et al. 2009). This increase in predation may have the potential to cause local and regional population declines of these prey species (Monda et al. 1994; CWS 2007; Liebezeit et al. 2009).

The attraction of predators and prey species to the NICO Project has the potential to increase human-wildlife interactions, which may result in the removal of individuals by mortality or relocation. Wildlife species have been intentionally destroyed at existing mines in the NWT and Nunavut, either by government biologists or with government permission. For example, a total of 7 wolverines, 4 grizzly bears, 16 foxes, and 1 wolf have been intentionally destroyed at the Ekati, Diavik, and Jericho mine sites from 1996 to 2009 (Section 15.2.4.9). One black bear was intentionally destroyed at the NICO Project in June 2009. Intentional destruction of individuals generally followed habituation of an individual animal to the mine site over an extended period of time, and after multiple deterrent attempts failed with the same individual.

Improved waste management practices and staff education have resulted in decreasing the frequency of attractants at mine sites. Since 2004, no carnivores have been accidentally or intentionally destroyed at the Diavik Diamond Mine (Section 15.2.4.9). No carnivores have been intentionally destroyed and only one individual has been accidentally killed at the Snap Lake Mine during the 11 years of exploration through current operation (Section 15.2.4.9).

A number of environmental design features and management plans will be implemented at the NICO Project to limit the attraction of wildlife, and the associated increased risk of mortality from human-wildlife interactions and predation (Table 15.3-1). These mitigation strategies are provided in the Wildlife Effects Monitoring Program (Appendix 18.II) and the Waste Management Plan (Appendix 3.IV), and are similar to management practices and policies implemented at other mines in the NWT and Nunavut. Some environmental design features and mitigation that will be implemented at the NICO Project include the following:

- food wastes will be collected in suitable receptacles that limit attraction or impact to wildlife;
- littering and feeding of wildlife will be prohibited;
- recyclables and waste hazardous materials will be stored on-site in appropriate containers to prevent exposure until shipped off-site to an approved facility; and
- education and reinforcement of proper waste management practices to all workers and visitors to the site.

Environmental design features and management plans should limit attractants to the NICO Project and result in a minor increase in wildlife mortality risk from human-wildlife interactions and predation relative to baseline conditions (Table 15.3-1). Therefore, these pathways are predicted to have a negligible residual effect on the persistence of wildlife populations.

- **Physical hazards on the mine site, and collision with NICO Project vehicles, aircraft, and vehicles on the Proposed Tłı̨chǫ Road Route may cause injury or mortality to individual animals, which can affect wildlife population sizes.**

Infrastructure (e.g., buildings, ditches, road berms, Airstrip berms, and Open Pit) and blasting activities associated with the NICO Project may be hazardous to wildlife species. Birds are vulnerable to collisions with man-made structures such as buildings (reviewed in Erickson et al. 2005 and Drewitt and Langston 2008). The likelihood of bird collisions with buildings depends on the location of the building, seasonal activity levels of birds, the presence of windows, and the use of lighting within and around buildings (Klem 1990). Buildings that are located close to wetlands or bird congregation areas (e.g., nesting or roosting areas, migration flyways) increase the likelihood of bird-building collisions. Collisions may be expected to increase during spring and fall migration periods due to the lack of familiarity of migrant birds with the location of buildings, flocking behaviour of migrating birds (i.e., a higher concentration of birds), and the increased number of young and inexperienced birds (during the fall migration) (Drewitt and Langston 2008). Birds with poor manoeuvrability and high flight speeds (e.g., waterfowl) are more vulnerable to infrastructure collisions than other bird species (Bevanger 1998). The NICO Project is located approximately 100 m from Nico Lake and 175 m from Peanut Lake, which are 2 of the largest waterbodies near the NICO Project. Baseline studies observed low numbers of waterfowl on these lakes during breeding and fall migration periods (Annex D; Section 3.10.11); therefore, low numbers of collisions with NICO Project infrastructure, aircrafts, and vehicles are expected.

Mammals (e.g., wolverine, black bear, moose, and marten) may injure themselves when crossing road berms, Airstrip berms, and ditches. Mammal species are also vulnerable to injury or mortality if they enter the Open Pit or CDF. It is expected that traffic and the presence of humans will deter wildlife from entering the Open Pit and

CDF. If the Open Pit is accessed inadvertently, wildlife will be able to exit the Open Pit using the haul road during operations. At closure a boulder barrier will be constructed around the Open Pit to discourage wildlife species from entering the Open Pit (Section 9). No wildlife mortalities from animals entering the open pits at other mines in the NWT have been reported (BHPB 2010; DDMI 2010; De Beers 2010).

Construction and operation of the NICO Project and the Proposed Tłįchǫ Road Route will cause an increase in the volume of vehicle traffic in the RSA. As such, the potential for collisions of vehicles with wildlife may increase (Romin and Bissonette 1996; Hussain et al. 2007). Carnivores and raptors may be attracted to road kill (Fahrig and Rytwinski 2009) and carnivores may be insensitive to traffic and fail to avoid roads (Dickson and Beier 2002). Moose may be attracted to the presence of deciduous vegetation in roadside ditches (Laurian et al. 2008). Also, carnivores and ungulates may use roads more often during the winter because of the ease of travel along cleared roadways (Rost and Bailey 1979). Upland breeding birds, waterbirds, and raptors may have a higher incidence of collision during the breeding season if they are not accustomed to vehicular traffic (Mumme et al. 2000; Clevenger et al. 2003). Juvenile birds are also susceptible to vehicular collisions during their natal dispersal because they are inexperienced with vehicular traffic. No literature is available on vehicle collisions with muskrats.

Traffic speed and volume are the primary factors that contribute to road-related wildlife mortality. A total of 243 collisions involving animals have been reported in the NWT from 1998 to 2009 (DOT 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008b, 2010). Most of these collisions occurred on highways (91%), with a few collisions reported in communities (7%) and rural areas (2%). Data in the Department of Transportation reports from 2006 to 2009 suggests that most of these collisions involve bison. Bison collisions accounted for an average of 72% of all animal collisions reported in the NWT (71% in 2006, 74% in 2007, 70% in 2008, and 72% in 2009). The NICO Project and Proposed Tłįchǫ Road Route are not within the range of bison in the NWT. Other mine sites in the NWT have reported low carnivore-vehicle collisions; 2 wolverines, 2 wolves, and 2 foxes have been killed by vehicle collisions on the Ekati, Diavik, Jericho, and Snap Lake mine sites between 1996 and 2010 (Section 15.2.4.9). The incremental increase in the number of wildlife-vehicle collisions associated with the NICO Project and Proposed Tłįchǫ Road Route is expected to be minor relative to baseline conditions.

Aircraft are only anticipated to be used for medical emergencies and the transport of some goods to site (Appendix 8.II). Therefore the volume of air traffic associated with the NICO Project is predicted to be low but collisions with mammals and birds still have the potential to occur. Waterbirds have an especially high chance of collisions with aircraft because the east end of the Airstrip is located approximately 25 m from Burke Lake. Baseline studies indicate that few waterbirds breed on Burke Lake; higher collision risks may be during the spring and fall migration periods because Burke Lake is used as a staging point for some waterbird species (Section 15.2.4.7). In the United States, wildlife collisions with aircraft are most common between 0 and 150 m above ground level (Dolbeer 2008). Passerines (i.e., songbirds) account for 14% of these collisions, while waterfowl and raptors each account for 4% of these collisions. Bird strikes are more common at night during migration and are more common during the day during the breeding season. At the Yellowknife airport, most bird collisions with aircraft are gulls and ravens, which are attracted to the nearby municipal dump (NNSL 2008). The proposed mitigation to reduce this hazard is to improve waste management at the dump, including separation of organic waste (NNSL 2008). The primary mitigation to reduce the hazard of bird collisions with aircraft at the NICO Project will be a comprehensive and effective waste management system (see Appendix 3.IV). No aircraft collisions with wildlife at other mine sites in the NWT have been reported (BHPB 2010; DDMI 2010; De Beers 2010).

To mitigate the increase in mortality risk along roads in the NICO Project site and along the NPAR and Proposed Tłįchǫ Road Route several environmental design features will be implemented. A bus system will be available to transport workers from surrounding communities to site during construction and operation, which will reduce traffic volume (Table 15.3.1). Speed limits will be posted and enforced on the NPAR. The maximum speed on the NPAR will be 60 km/h and the speed limit will be 60 km/h within the NICO Project site. Lower speeds allow the motorist and animal to avoid a collision (van Langevelde et al. 2009). In addition, the presence of wildlife will be monitored and communicated to site personnel.

The implementation of environmental design features and mitigation (Table 15.3-1) are expected to decrease the risk to animals from physical hazards on-site and collisions with vehicles. Some environmental design features and mitigation that will be implemented at the NICO Project to reduce the risk of wildlife injury or mortality from physical hazards and vehicle collisions include:

- surface blasting will be temporarily suspended if large mammals are observed within the danger zone identified by the blast supervisor;
- the CDF will be regularly monitored for wildlife activity and wildlife hazards;
- road berms will be covered with small-sized granular material to reduce injury hazards to wildlife crossing the roads;
- at decommissioning, the entire site area will be re-contoured to reduce hazards to wildlife;
- ditches will be contoured or backfilled at decommissioning as appropriate to remove any hazards to wildlife;
- speed limits will be established;
- the presence of wildlife will be monitored and communicated to site personnel;
- all employees will be provided with environmental awareness training; and
- wildlife deterrent actions will be implemented by knowledgeable and trained personnel.

Some management practices that have been successful for deterring upland breeding birds, waterbirds, and raptors from using areas in and around airports in Canada include the removal of shrubs and trees which may serve as perching, nesting, and roosting habitat (Hesse et al. 2009). The Wildlife Effects Monitoring Program (Appendix 18.II) identifies a course of action for removing wildlife from roads and the Airstrip when necessary.

In summary, the implementation of environmental design features and wildlife management practices are expected to result in minor changes in mortality rate from physical hazards, and wildlife-vehicle and wildlife-aircraft collisions relative to baseline conditions, and should have a negligible effect on the persistence of wildlife populations.

15.3.2.3 Primary Pathways

The following primary pathways are analyzed in the effects assessment for wildlife VCs.

- **Direct loss and fragmentation of habitat from the physical footprint of the NICO Project may alter wildlife movement (i.e., distributions) and behaviour, and affect the carrying capacity of the landscape to support populations.**

- **Sensory disturbance (e.g., presence of buildings, people, lights, smells, and noise) from the NICO Project changes the amount of different quality habitats, and alters movement and behaviour, which can influence survival and reproduction.**
- **Improved access for harvesting can affect wildlife population sizes.**

15.4 Effects to the Abundance and Distribution of Wildlife

15.4.1 General Approach

The effects analysis considers all primary pathways that result in expected changes to the abundance and distribution of wildlife VCs, after implementing environmental design features and mitigation. Thus, the analysis is based on the residual effects from the NICO Project. Residual effects to wildlife populations are analyzed using measurement endpoints (Table 15.1-3) and are expressed as effects statements, including:

- effects from changes in habitat quantity and fragmentation;
- effects from changes in habitat quality, movement, and behaviour; and
- effects from changes in harvest levels due to increased access.

The magnitude, spatial extent, and duration of changes in measurement endpoints (e.g., habitat quantity and quality) from the NICO Project and other developments are expected to be similar to or greater than the actual effects to the abundance and distribution of populations. Effects statements may have more than one primary pathway that link a NICO Project activity with a change in wildlife populations. For example, the pathways for effects on habitat quality, movement, and behaviour include changes due to noise and the presence of vehicles, people, and mine infrastructure, which ultimately affect wildlife population abundance and distribution of wildlife VCs.

The analyses of residual effects from the NICO Project on wildlife were quantitative, where possible, and included data from field studies, scientific literature, monitoring programs at existing mines, government publications, and personal communications. Traditional knowledge and community information were incorporated where available. Due to the amount and type of data available, some analyses were qualitative and included professional judgement or experienced opinion.

15.4.2 Moose

15.4.2.1 Habitat Quantity and Fragmentation

15.4.2.1.1 Methods

The incremental and cumulative direct habitat effects to moose from the NICO Project footprint (including the NPAR) and other previous, existing, and future developments in the ESAM for moose were analyzed through changes in the area and spatial configuration of habitat types on the landscape (i.e., landscape metrics). Landscape metrics for each habitat included total area, number of patches, and mean distance to the nearest similar patch. Decreases in habitat area and number of similar quality habitat patches can directly influence population size by reducing the carrying capacity of the environment. Changes in the number of patches and distance between similar habitat patches can influence the distribution (and abundance) of moose by affecting the ability of animals to travel across the land.

Landscape metrics were determined using the program FRAGSTATS (Version 3.0; McGarigal et al. 2002) within a Geographic Information System (GIS) platform. The analysis determined the extent of landscape fragmentation by calculating statistical outputs based on the values of each raster cell. Raster cells (28.5 x 28.5 m) for habitats with extensive coverage in the ESAM (including disturbed areas) were based on the Ecological Landscape Classification (ELC) of broad ecosystem units (Section 14.2.2.1).

Previous and existing developments in the ESAM include 2 mineral exploration programs (NICO exploration program and Phelps Dodge Corp. Canada exploration program), 3 historic remediated and non-remediated sites (Rayrock mine, Maryleer Lake/Burke Lake #1, and Sun-Rose Claim Group), 6 winter roads, 3 all-weather roads, the Snare Hydro power station, Snare transmission line, and 1 community (Whatì). Data on the location and type of developments were obtained from the following sources:

- Mackenzie Valley Land and Water Board: permitted and licensed activities within the NWT;
- Indian and Northern Affairs Canada: permitted and licensed activities within the NWT;
- Indian and Northern Affairs Canada: contaminated sites database;
- Natural Resources Canada: obtained a GIS files of community locations from the GeoGratis website;
- individual operators for project-specific information such as component footprints and routes;
- company websites; and
- knowledge of the area and project status.

Initially, data indicating permitted and licensed activities were obtained in spreadsheet format. The file was examined for duplication of information (e.g., a water license and a land use permit for the same development). In cases where 2 or more pieces of location information for the same activity were present, the extra information was deleted from the file so that it contained only one point per development. Data associated with the location attributes (e.g., permit status, feature name) also were edited in some instances to update the information for running modelling scenarios efficiently.

The information was used to generate a development layer within a GIS platform. Because the database contains no information on the size of the physical footprint for exploration programs, a 500 m radius was used to estimate the area of the footprint for exploration sites and the Snare Hydro station (78.5 ha), which likely overestimates the amount of habitat directly disturbed by exploration activities. Exploration programs typically contain temporary shelters for accommodations and storage of equipment, and are elevated to limit the amount of disturbance to the soil and vegetation. Drilling is usually carried out with portable drill rigs (5 x 5 m area) at one location at a time. A 200 m radius (12.6 ha) was used to estimate the size of historic remediated and non-remediated site footprints.

Footprints for linear disturbances (e.g., winter roads and the proposed NPAR) consisted of a 28.5 m right-of-way (the actual right-of-way is anticipated to be 6 to 10 m). The NICO Project Lease Boundary was used to estimate the core mine area, which is conservative and over estimates the changes in habitat amount and fragmentation. For example, the anticipated area of the NICO Project footprint (including the NPAR) is approximately 485 ha (Section 13.4). The area used in the habitat fragmentation (and habitat quality) analysis was approximately 1516 ha. For all developments (including the NICO Project), the physical footprint was carried through each assessment case (Section 6.5.2.2) as it was assumed that direct effects to the landscape had not yet been reversed. Footprints with overlapping areas on the landscape were not counted twice. The development layer was then applied to the landscape classification of the study area for the baseline, application, and future cases (Table 15.4-1).

Table 15.4-1: Contents of Each Assessment Case

Baseline Case	Application Case	Future Case
Range of conditions from little or no development to all previous and existing projects[a] prior to the NICO Project	Baseline Case plus the NICO Project	Application case plus reasonably foreseeable projects

[a] Includes approved projects.

The baseline case includes the temporal changes in the number of previous and existing projects known to occur within the study area, which can include little or no previous development (Section 6.5.2.2). Environmental conditions on the landscape before human development (i.e., reference conditions) were also included in the analysis. Analyzing a range of temporal conditions on the landscape is fundamental to understanding the cumulative effects of increasing development on wildlife populations. The application case occurs in the anticipated year of construction of the NICO Project, through the duration of predicted effects (i.e., until the effects are reversed or are deemed irreversible).

The future case includes the baseline case, application case, and reasonably foreseeable developments (Section 6.5.2.2). Currently, there are two reasonably foreseeable developments that may generate incremental and cumulative changes on vegetation ecosystems (habitat) in the RSA and ESAM:

- the Proposed Tłı̨chǫ Road Route; and
- the Nailii Hydro Project.

The temporal boundary for cumulative effects from future developments is a function of the duration of effects from the NICO Project on wildlife populations. At a minimum, the time period for effects from the NICO Project, and reasonably foreseeable developments would occur over 21 years (construction through closure). The anticipated footprint for the Proposed Tłı̨chǫ Road Route is known, and this development was included in the landscape metrics for the future scenario. However, there are uncertainties in the route, size, components and construction methods of the Nailii Hydro Project transmission line. There are also uncertainties in the direction, magnitude, and spatial extent of future fluctuations in vegetation (i.e., habitat), independent of NICO Project effects. Consequently, potential cumulative effects from reasonably foreseeable developments (future case) for the Nailii Hydro Project transmission line are discussed qualitatively in the section on uncertainty (Section 15.9).

Landscape metrics were determined for the reference, 2010 baseline, application, and future case during the winter period only as this scenario has the maximum amount of disturbance because of the existing winter roads. Winter can also be a key period limiting moose population size (Modafferi and Becker 1997). As mentioned above, reference conditions represent the initial period of baseline conditions (as far back as data are available). Here, the 2010 baseline case includes all previous, existing, and approved developments up to 2010, and includes winter roads. Cumulative effects from the NICO Project and other developments influence the entire population range (i.e., beyond local scale effects). In contrast, the geographic extent of incremental changes to habitat quantity from the NICO Project has a local influence on the population range of moose.

The incremental and cumulative changes from the NICO Project and other developments on the loss and fragmentation of habitat were estimated by calculating the relative difference between the 2010 baseline and reference case, between the application and 2010 baseline case, and between the future and application case. The following equations were used:

- (2010 baseline value – reference value) / reference value
- (application case value – 2010 baseline value) / 2010 baseline value
- (future case value – application case value) / application case value

The resulting value was then multiplied by 100 to give the percent change in a landscape metric for each comparison, and provides both direction and magnitude of the effect. For example, a high negative value for habitat area would indicate a substantial loss of that habitat type. Alternately, a negative value for mean distance to nearest neighbour indicates an increase in patch connectivity. Appendix 15.I (Table 15.I-1 and Table 15.I-2) provides absolute values per habitat type and assessment case (i.e., reference, 2010 baseline, application, and future).

15.4.2.1.2 Results

The total area of the NICO Project footprint is estimated to be 485.4 ha, which includes the NPAR. However, because the NICO Project Lease Boundary was used in the analyses, and the width of the NPAR was increased to match the raster cell size (28.5 m) in the land cover classification, the estimated NICO Project footprint is 1516 ha. The NICO Project will alter 0.3% of the 2010 baseline ESAM. Previous and existing developments have removed 0.2% of habitat within the ESAM relative to reference conditions. The total combined loss of all habitats in the ESAM from the Proposed Tłįchǫ Road Route (future case) is less than 0.1%. The cumulative direct disturbance from the NICO Project and previous, existing, and future developments is predicted to be about 0.5% relative to reference conditions. Although progressive reclamation will be integrated into mine planning as part of Fortune's design for closure policy, subarctic ecosystems are slow to recover from disturbance. The Flooded Open Pit, CDF, constructed wetlands, Seepage Collection/Surge Ponds, and ditches will be permanent features on the landscape, covering approximately 84 ha.

Under reference conditions, the ESAM is mainly composed of coniferous spruce (50%) and deep water (19%). Burn, bedrock-open conifer, coniferous pine, and treed bog each make up less than 7% of the ESAM. Deciduous aspen, marsh/graminoid fen, open bog, shrubland, and treed fen each composed less than 3% of the ESAM. Habitat types that will be disturbed most by all developments include bedrock-open conifer, burn, and deciduous aspen (Table 15.4-2).

Table 15.4-2: Change (percent) in Area and Configuration of Habitat Types from Development within the Effects Study Area for Moose during Baseline, Application, and Future Conditions in the Winter

Habitat Type	Area (ha) Reference	% Change Reference to 2010 Baseline	% Change 2010 Baseline to Application	% Change Application to Future	% Cumulative Change from Reference
Burn	37 257	-0.3	-0.4	0.0	-0.7
Bedrock-Open Conifer	26 344	-0.4	-1.8	0.0	-2.2
Coniferous Pine	28 896	<-0.01	<-0.1	-0.1	-0.1
Coniferous Spruce	269 304	-0.2	-0.2	-0.1	-0.5
Deciduous Aspen	5 108	-0.4	-0.3	-0.1	-0.8
Deep Water	103 934	-0.2	-0.1	0.1	-0.2
Marsh/Graminoid Fen	15 772	-0.1	<-0.1	<-0.1	-0.1
Open Bog	11 179	-0.2	-0.2	<-0.1	-0.4
Shrubland	4 947	-0.4	-0.2	0.0	-0.6
Treed Bog	30 306	-0.2	-0.2	<-0.1	-0.5
Treed Fen	9 575	-0.1	-0.1	-0.1	-0.2
Habitat Type	**Number of Patches Reference**	**% Change Reference to 2010 Baseline**	**% Change 2010 Baseline to Application**	**% Change Application to Future**	**% Cumulative Change from Reference**
Burn	1 023	0.4	-1.7	0.0	-1.3
Bedrock-Open Conifer	8 941	0.3	-0.5	<0.1	-0.1
Coniferous Pine	3 667	0.4	-0.2	0.4	0.5
Coniferous Spruce	6 218	2.0	0.1	0.1	2.3
Deciduous Aspen	1 360	1.3	-0.4	0.1	1.0
Deep Water	6 302	0.6	-0.2	-0.2	0.3
Marsh/Graminoid Fen	5 334	0.4	<0.1	0.1	0.5
Open Bog	5 139	0.3	-0.4	<0.1	0.0
Shrubland	1 468	1.0	0.2	0.0	1.2
Treed Bog	5 815	1.2	-0.4	<0.1	0.8
Treed Fen	1 600	0.4	-0.1	1.0	1.3
Habitat Type	**Mean Distance to Nearest Neighbour (m) Reference**	**% Change Reference to 2010 Baseline**	**% Change 2010 Baseline to Application**	**% Change Application to Future**	**% Cumulative Change from Reference**
Burn	407	-0.4	1.2	0.0	0.8
Bedrock-Open Conifer	160	-0.3	0.2	<-0.1	-0.1
Coniferous Pine	329	-0.6	-0.2	-0.4	-1.1
Coniferous Spruce	103	-0.9	<0.1	<0.1	-0.8
Deciduous Aspen	600	-2.0	-0.1	-0.2	-2.4
Deep Water	195	-0.6	0.1	0.1	-0.5

Table 15.4-2: Change (percent) in Area and Configuration of Habitat Types from Development within the Effects Study Area for Moose during Baseline, Application, and Future Conditions in the Winter (continued)

Habitat Type	Mean Distance to Nearest Neighbour (m)	% Change Reference to 2010 Baseline	% Change 2010 Baseline to Application	% Change Application to Future	% Cumulative Change from Reference
	Reference				
Marsh/Graminoid Fen	271	-0.7	-0.2	-0.1	-1.0
Open Bog	300	-0.6	0.1	-0.1	-0.5
Shrubland	474	-1.2	-0.2	0.0	-1.4
Treed Bog	242	-1.3	0.3	-0.1	-1.2
Treed Fen	489	-0.5	-0.4	-1.3	-2.2

% = percent; ha = hectares; m = metres

Values with a less than (<) symbol indicate the change is approaching zero.

Forage requirements for moose vary seasonally; therefore, a range of habitat types may serve as high quality moose habitats. In the ESAM, deciduous aspen and shrubland were determined to be high quality habitats for moose (Section 15.4.2.2.1). Previous and existing developments are predicted to have decreased the area of both deciduous aspen and shrubland habitat in the ESAM by 0.4% (Table 15.4-2). Development of the NICO Project is expected to decrease deciduous aspen and shrubland habitat within the ESAM by 0.3% and 0.2%, respectively, relative to 2010 baseline conditions. Similarly, incremental changes to deciduous aspen and shrubland habitat from the Proposed Tłįchǫ Road Route are each expected to be less than or equal to 0.1%. Cumulative decrease in deciduous aspen and shrubland habitat from reference conditions to the future scenario is 0.8% and 0.6%, respectively.

Increasing development on the landscape has also resulted in marginal changes to the number of and distance between similar habitat patches in the ESAM. Previous and existing developments were predicted to have increased the number of each deciduous aspen and shrubland habitat patches by 1.3% and 1.0%, respectively, relative to reference conditions (Table 15.4-2). The NICO Project is expected to decrease the number of deciduous aspen habitat patches by 0.4% relative to 2010 baseline conditions. The NICO Project is expected to increase the number of shrubland habitat patches by 0.2%. Future developments and the cumulative change from previous, existing, and future developments are expected to increase in the number of deciduous and shrubland habitat patches by 1.0% and 1.2%, respectively, relative to reference conditions.

Previous and existing developments are predicted to have decreased the mean distance to nearest neighbour (MDNN) for deciduous aspen and shrubland habitat types relative to reference conditions. The NICO Project is expected to decrease MDNN for deciduous aspen and shrubland habitats. Deciduous aspen and shrubland habitats are also expected to have a decrease in MDNN from application to the future case and, cumulatively from reference conditions to the future case.

The development of edge habitat may benefit moose as moose prefer to eat deciduous shrubs and trees (Stelfox 1993), of which many species (e.g., trembling aspen) may have greater abundance in areas with a thinned canopy cover (e.g., forest edges and clearings) (Rice et al. 2001). The presence of the NPAR may represent a barrier to some individuals within the population, particularly during the winter construction phase when vehicle traffic is predicted to substantially increase. For example, roads may contribute to fragmentation of populations through both increased mortality and modifications of behaviour that makes animals less likely to cross roads (Trombulak and Frissell 2000; Dussault et al. 2006; Laurian et al. 2008). In some cases, roads appear to be "leaky barriers" (some animals do manage to cross successfully) but they may nevertheless restrict the regional-scale dynamics of species (Treweek 1999).

15.4.2.2 Habitat Quality, Behaviour, and Movement

15.4.2.2.1 Methods

In addition to direct habitat effects, changes to habitat quality from the NICO Project have the potential to indirectly affect the population size and distribution of moose, through altered movement and behaviour of individuals. To estimate the change in habitat quality for moose associated with the NICO Project and other developments, habitat suitability index (HSI) modelling was completed within the ESAM. Habitat suitability models are analytical tools for determining the relative potential of an area to provide quality habitat to support wildlife species. To estimate the effects of the NICO Project on moose, a HSI model was used to quantify habitat changes between the 2010 baseline and reference case, between the application and 2010 baseline case, and between the future and application case during the winter period. Good quality habitats were defined according to a threshold representing the minimum value below which the habitat is not suitable for reproduction and survival (Ackakaya et al. 2004). The standard threshold value is typically 0.5, which was used in this assessment, although there are cases where a lower value is used.

Historically, moose have been distributed across forested regions of Canada; however, moose have recently expanded their range to include prairie and tundra ecosystems. Although considered a generalist species, the moose has been shown to prefer deciduous aspen, shrubland, and wetlands interspersed with trees and shrubs. For example, in west-central Alberta, deciduous and shrubland patches were used more than expected based on availability (Stewart et al. 2010). Deciduous trees and shrubs are important dietary items during winter, a critical period when forage is scarce and a limiting factor for populations. Further, early successional forests have been described as being more favourable for moose (reviewed in Nelson et al. 2008). Time since fire for optimal moose habitat is most frequently reported in the range of 10 to 26 years. In general, it is thought that moose respond more to food availability than cover (e.g., Stewart et al. 2010); however, moose will adjust their behaviour and move to avoid areas of deep snow (e.g., greater than 90 cm; Peek et al. 1982). It has been proposed that, in some landscapes, primary habitat (i.e., high quality forage habitat such as shrubland) can provide all of the necessary winter resources for moose (Stewart et al. 2010). The majority of food resources and cover can be contained in shrubland and, potentially, in deciduous forest (e.g., Cairns and Telfer 1980; Dussault et al. 2006; Stewart et al. 2010). Further, the ideal availability of food may be when landscapes are comprised of approximately 25 to 40% primary habitat (Allen et al. 1987; Romito et al. 1999; Higgelke et al. 2000; Kurttila et al. 2002).

The proposed HSI for the effects analysis for moose is based on previously developed models (Allen et al. 1987; Romito et al. 1999; Higgelke et al. 2000; Dussault et al. 2006). The overall goal was to create a simple HSI to allow GIS-based assessments of habitat suitability into the future. The proposed model is for rapid evaluation of large areas of habitat using a coarse land cover classification (Section 14.2.2.1). The model assumed that the availability of forage habitat during winter was the most important limiting factor for individual fitness and the driving mechanism of habitat selection at multiple spatial scales (Romito et al. 1999; Kurttila et al. 2002). Given the land cover classification and the proposed habitat suitability components (see below), on-the-ground field observations were used to link measurements of tree and shrub cover to each land cover type (Table 15.4-3). For example, it was necessary to determine the percentage of tall shrub cover in a raster cell identified as being deciduous aspen. The percentage of cover determines the habitat suitability value (Romito et al. 1999). The field data were also used to verify that deciduous and shrubland habitat types were composed of important foraging species. The spatial extent of measurements of landscape cover were based on the approximate winter range of moose where the availability of food is anticipated to be low and of poor quality (30 km^2; reviewed in Romito et al. 1999; Herfindal et al. 2009).

Table 15.4-3: Summary of the Structure and Composition per Land Cover Type with Predicted Scores for Moose Foraging Habitat Suitability at a Local Scale (i.e., per 28.5 x 28.5 m raster cell)

Land Cover Type	Median Deciduous Aspen (%)	Average Deciduous Height (m)	Deciduous Tree HS Value[a]	Median Shrub Cover (%)	Median Tall (>0.5 m) Shrub Cover (%)	Tall Shrub HS Value[a]	Total HS Value[b]
Bedrock-Open Conifer	0.0	ND	0.0	15.0	7.0	0.2	**0.2**
Coniferous Pine	1.0	0.0	0.03	4.5	4.5	0.1	**0.1**
Coniferous Spruce	5.0	0.2	0.1	30.0	15.0	0.4	**0.5**
Deciduous Aspen	30.0	1.0	0.8	20.0	10.0	0.3	**1.0**
Marsh/Graminoid Fen	0.0	ND	0.0	2.0	2.0	0.1	**0.1**
Open Bog	0.0	ND	0.0	9.0	4.0	0.1	**0.1**
Shrubland	0.0	ND	0.0	50.0	42.5	1.0	**1.0**
Treed Bog	0.0	ND	0.0	40.0	9.0	0.2	**0.2**
Treed Fen	0.0	ND	0.0	60.0	22.0	0.6	**0.6**
Frozen Water (Ice)	0.0	ND	0.0	0.0	0.0	0.0	**0.0**
Recent Burn (less than10 years old)	ND	ND	ND	ND	ND	ND	**0.2**
Burn (10 to 26 years old)[c]	ND	ND	ND	ND	ND	ND	**1.0**

[a] Tree and tall shrub HS values were based on previously constructed habitat suitability index models (Allen et al. 1987; Romito et al. 1999; Higgelke et al. 2000; Dussault et al. 2006); values were calculated as Y=0.025X; percent cover greater than 40% = 1.0 (Figure 15.4-1).

[b] Values were calculated as the sum of tree and shrub HS values; maximum scores = 1.0.

[c] Information on burn (10 to 26 years old) was determined from the IBLSMD Fire History and Moderate Resolution Imaging Spectroradiometry (MODIS 2008). Areas within burn (10 to 26 years old) were assigned pre-burn values of the land cover type (e.g., coniferous spruce habitat that was burned 10 to 26 years ago was assigned a value of 0.5).

% = percent; m = metres; HS = habitat suitability; > = greater than; ND = data not available

There is also some evidence that roads and human settlements can influence habitat selection in moose (Laurian et al. 2008; Jiang et al. 2009). The effects of sensory disturbances on movements and behaviour were estimated to extend up to about 2 km from the perimeter of high human-use areas. The effects of sensory disturbance were captured in the proposed model with a curvilinear one-asymptote relationship and a 2 km zone of influence (ZOI) (Figure 15.4-2).

Winter Forage Habitat Suitability

a) Optimal habitats were shrubland, deciduous aspen, and any forested areas burned 10 to 26 years ago (Nelson et al. 2008; Stewart et al. 2010).

b) Optimal landscapes were areas with greater than 40% cover of shrubland, deciduous aspen, and any forested areas burned 10 to 26 years ago. A landscape unit was an area with a 3 km radius. The anticipated winter range size for moose in the study area was about 30 km^2. This estimate was based on the winter range size calculated for moose in northern Alberta and the assumption that the study area provides poor foraging conditions (reviewed in Romito et al. 1999; also see Herfindal et al. 2009).

c) Moderately suitable habitats were treed fen and coniferous spruce.

d) Moderately suitable landscapes were landscapes with 20 to 40% cover of shrubland, deciduous aspen, and any forested areas burned 10 to 26 years ago.

e) Poor habitats included bedrock-open conifer, coniferous pine, graminoid fen, treed bog, and frozen water (ice).

f) Poor suitability landscapes were landscapes with 0 to 20% of high quality habitats (i.e., shrubland, deciduous aspen, and forested areas burned 10 to 26 years ago).

g) Habitat suitability was reduced with proximity to major disturbances (e.g., NICO Project Lease Boundary; Laurian et al. 2008; Jiang et al. 2009).

Moose HSI Formula

$$Index = \frac{(\mathrm{HT} + \%\mathrm{LC})}{2} \times HSM$$

HT = habitat types were ranked according to values in Table 15.4-3.

%LC = landscape cover measurement, where each cell was ranked according to the percentage of high quality habitats within a 3 km radius. High quality habitats were deciduous aspen, shrubland, and any forest burned 10 to 26 years ago. Rankings were based on the formula Y=0.2+0.02X, where values greater than 40% = 1 (Figure 15.4-1)

HSM = habitat suitability modifier. Change between 0 to 2 km to disturbance was defined as a curvilinear one-asymptote relationship with equation $y = 1.0442 \times \left(1 - 0.9985^{distance(m)}\right)$ (Figure 15.4-2). Values = 1 at distances greater than 2 km.

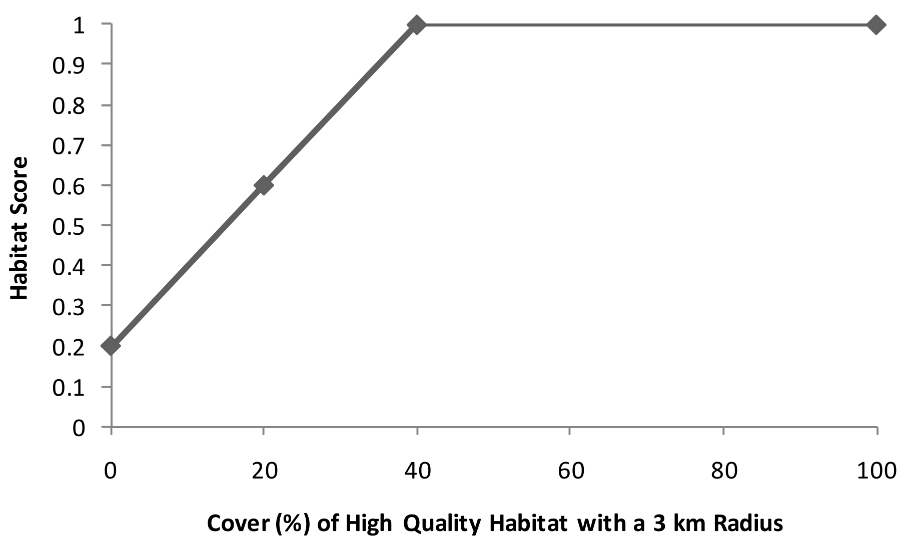


Figure 15.4-1: Relationship between Suitability Scores and Landscape Cover (%) of High Quality Habitats within a 3 km radius for Moose

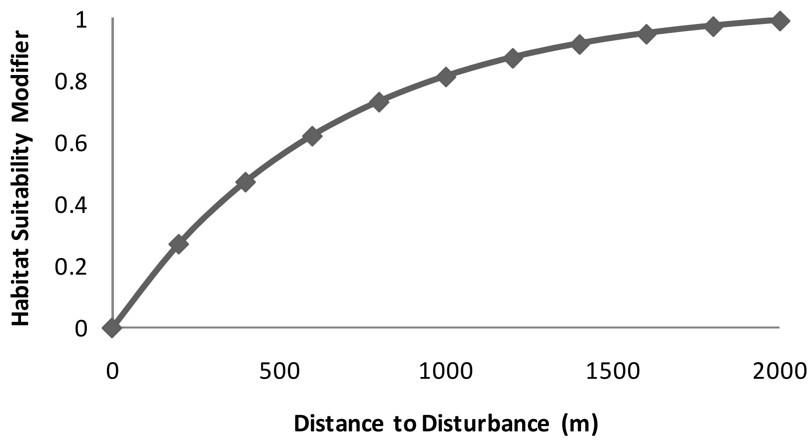


Figure 15.4-2: Relationship between Distance from Human Disturbance and Habitat Suitability Modifier for Moose

The following equations were used to calculate the relative change in the amount of different quality habitats for the different conditions on the landscape.

- (2010 baseline area – reference area) / reference area x 100
- (application case area – 2010 baseline area) / 2010 baseline area x 100
- (future case area - application case area) / application case area x 100

Although the indirect effects from noise are implicitly included in the HSI modelling, the potential effects on moose from noise are also assessed separately. Mining activities and associated infrastructure generate noise that may influence the movement and behaviour of moose. Sensory disturbance can result in increased levels of stress and energy expenditure, and disruption of feeding behaviour; therefore, a noise assessment (Appendix 8.III) was completed to identify the sound emissions associated with the NICO Project activities and the potential effects on moose.

During construction, approximately 2200 truck loads will be delivered to the NICO site during the winter road season. This amounts to approximately 63 return trips per day over an average 70 day winter road season. During operations, an estimated 5 to 9 trucks per day are anticipated to travel along the NPAR and Proposed Tłįchǫ Road Route. During operations, noise will be generated from mobile and stationary mining equipment, blasting, and aircraft at the NICO Project. Aircraft are anticipated to be used for medical emergencies and the transport of some goods to site (i.e., the annual volume of aircraft traffic is expected to be low [Appendix 8.III]).

The focus of the noise assessment is on determining changes to the existing ambient noise levels due to the NICO Project, and comparing the results with noise regulations and guidelines from North American jurisdictions (Appendix 8.III). Because there are no noise level guidelines for wildlife, human noise level guidelines were applied to predicting effects on moose. Although noise at the NICO Project site will be produced during the one-year construction period, the duration and magnitude of noise is expected to be greater during operations. The evaluation of noise effects focused on evaluating the noise levels associated with the fully developed operations.

Model scenarios were established to calculate normal NICO Project operations that could potentially affect noise levels (e.g., blasting, crusher, power plant, and auxiliary equipment) (Appendix 8.III). For the NPAR, the noise assessment focused on the construction phase when the number of vehicles along the road is expected to be much greater than during operations.

15.4.2.2.2 Results

The total area of good quality moose habitat available in the ESAM under reference conditions was 2.5% (Table 15.4-4). Previous and existing developments (including winter roads) in the ESAM have resulted in an 8.7% decrease in good quality habitat. The predicted incremental change of good quality habitat from the NICO Project, relative to 2010 baseline conditions, is 0.4% (Table 15.4-4). The Proposed Tłįchǫ Road Route is predicted to reduce good quality moose habitat by 2.1% relative to the application case. Relative to reference conditions, cumulative changes from the NICO Project and previous, existing, and potential future developments are expected to decrease good quality habitat by 11.1%. Figures 15.4-3 to 15.4-6 illustrate the changes to moose habitat suitability in the ESAM for reference conditions, 2010 baseline conditions, application of the NICO Project, and future conditions.

Table 15.4-4: Relative Changes in the Availability of Different Quality Habitats in the Effects Study Area for Moose from Reference to Reasonably Foreseeable Projects

Habitat Suitability (Range of Habitat Suitability Scores)	Reference		% Change Reference to 2010 Baseline	% Change 2010 Baseline to Application	% Change Application to Future	% Cumulative Change from Reference
	Area (ha)	% ESAM				
Poor (0-0.49)	544 323	97.5	0.2	<0.1	0.1	0.3
Good (0.50-1)	13 787	2.5	-8.7	-0.4	-2.1	-11.1

ha = hectares; % = percent; ESAM = effects study area for moose; < = less than

Noise sources from the NICO Project include mobile and stationary mining equipment, blasting, aircraft, and vehicles along the NPAR, existing winter roads, and Proposed Tłįchǫ Road Route. The recommended maximum value for the nighttime noise level for undeveloped areas is 40 dBA (ERCB 2007) (Appendix 8.III). This is the average nighttime (23:00 to 07:00) sound level L_{eq} that includes both human-related noises and the ambient sound level (existing sound levels without human-related noises). The typical nighttime ambient sound level in rural Alberta is 35 dBA L_{eq} with higher winds, precipitation, and thunder being the principal sources of increase above this value (ERCB 2007). During daytime hours these levels can be higher, due to higher levels of human activity and associated tolerance for noise levels. The predicted noise levels from the various NICO Project activities are compared with benchmarks in Table 15.3-4. The results show that noise predictions slightly exceed benchmarks for mine operations, and are below benchmarks for the NPAR and Airstrip.

A summary of the maximum distances for NICO Project noise to attenuate to background levels are shown in Table 15.3-5. The distances indicate the area within which NICO Project-related noises may be found to be distinguishable from the natural environment by people. When NICO Project noise predictions diminish to levels below background, they are not expected to be distinguishable from natural noises. The distance for noise attenuation to background levels for core mining operations (including blasting) is 3.3 km, but disturbance from blasting is anticipated to be infrequent (occur once per day). The distance for noise attenuation to reach background levels from the Airstrip is about 26 km (Table 15.3-5). However, disturbance from large aircraft is expected to be infrequent (Appendix 8.III) and short-term (less than 5 minutes in duration).

LEGEND

- POPULATED PLACE
- WATERCOURSE
- WATERBODY
- EFFECTS STUDY AREA FOR MOOSE

HABITAT SUITABILITY INDEX (HSI)

0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

10 0 10

SCALE 1:500,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

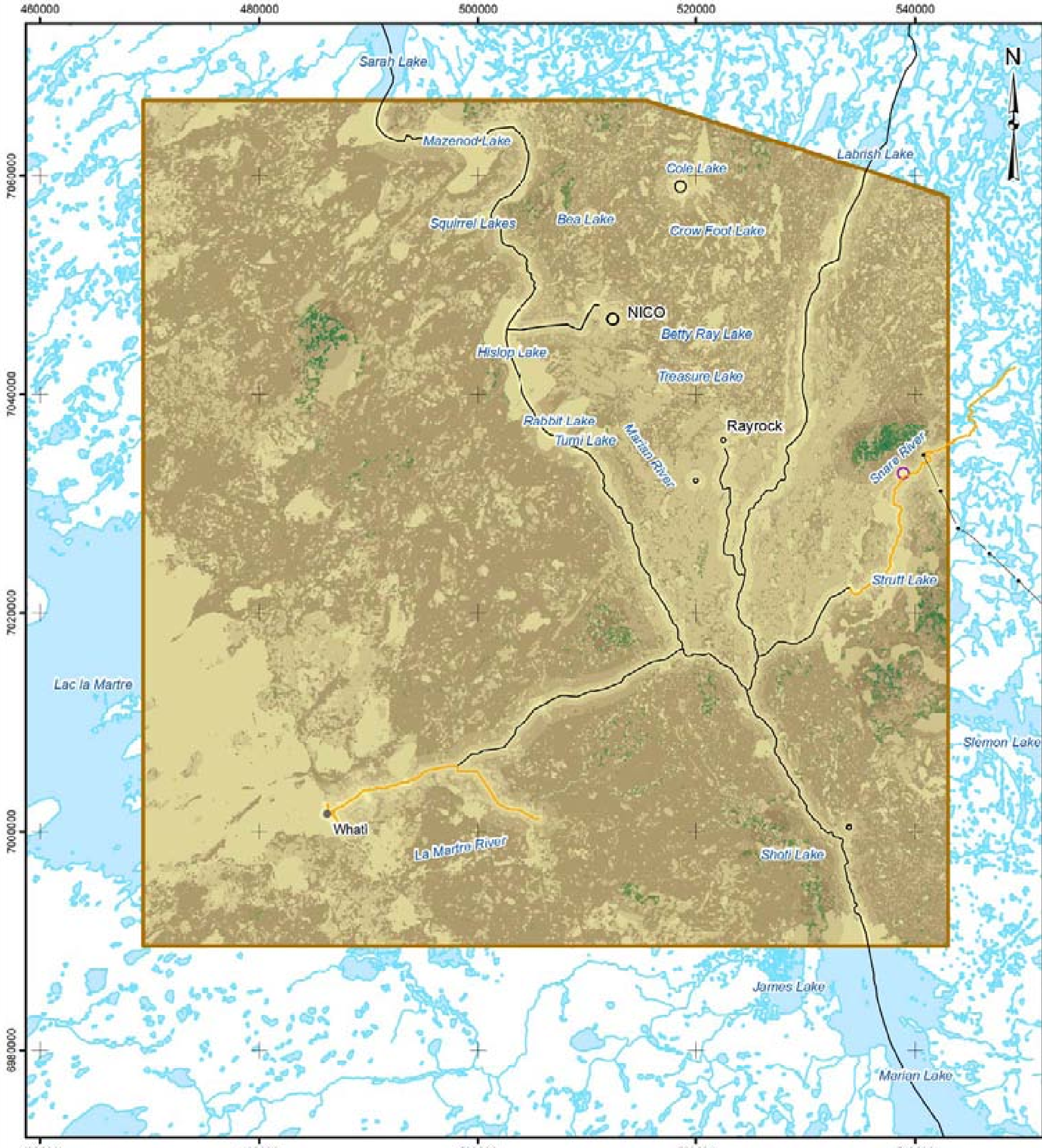
HABITAT SUITABILITY FOR MOOSE: REFERENCE CONDITIONS

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-028-GIS			
PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	LD	09 Feb. 2011	
GIS	ANK	23 Feb. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

FIGURE: 15.4-3

G:\2008\1373\08-1373-0017 Fortune Minerals Nico EIS\GIS\Mapping\MXD\Wildlife\EA-Wild-028-GIS.mxd



LEGEND

- POPULATED PLACE
- EXISTING ALL-WEATHER ROAD
- EXISTING WINTER ROAD
- WATERCOURSE
- WATERBODY
- HISTORIC REMEDIATED AND NON-REMEDIATED SITE
- POWER
- MINERAL EXPLORATION
- TRANSMISSION LINE
- EFFECTS STUDY AREA FOR MOOSE

HABITAT SUITABILITY INDEX (HSI)

0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

10 0 10

SCALE 1:500,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

HABITAT SUITABILITY FOR MOOSE: 2010 BASELINE CONDITIONS

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-029-GIS				
PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	LD	09 Feb. 2011		
GIS	ANK	03 Apr. 2011		
CHECK	GRA	03 Apr. 2011	FIGURE: 15.4-4	
REVIEW	GRA	03 Apr. 2011		

LEGEND

- POPULATED PLACE
- PROJECT LEASE BOUNDARY
- EXISTING ALL-WEATHER ROAD
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- WATERCOURSE
- WATERBODY
- HISTORIC REMEDIATED AND NON-REMEDIATED SITE
- POWER
- MINERAL EXPLORATION
- TRANSMISSION LINE
- EFFECTS STUDY AREA FOR MOOSE

HABITAT SUITABILITY INDEX (HSI)

0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

10 0 10

SCALE 1:500,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

HABITAT SUITABILITY FOR MOOSE: APPLICATION CASE

Golder Associates
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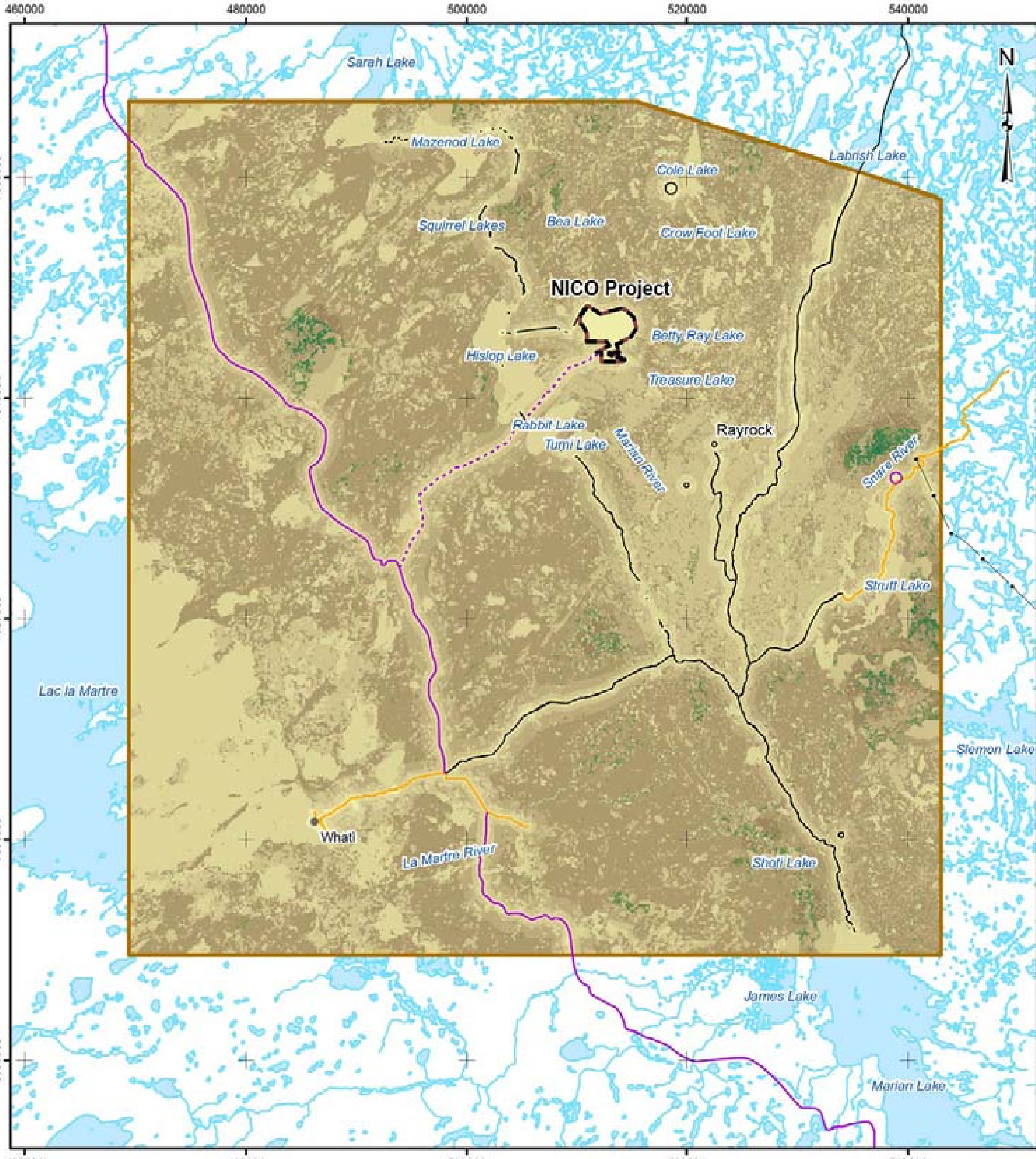
FILE No. EA-Wild-030-GIS			
PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	LD	09 Feb. 2011	
GIS	ANK	06 Apr. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

FIGURE: 15.4-5

G:\2009\1373\09-1373-1017 Fortune Minerals Nico EIS\GIS\Mapping\MXD\Wildlife\EA-Wild-030-GIS.mxd



LEGEND

- POPULATED PLACE
- PROJECT LEASE BOUNDARY
- EXISTING ALL-WEATHER ROAD
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁICHO ROAD ROUTE
- WATERCOURSE
- WATERBODY
- HISTORIC REMEDIATED AND NON-REMEDIATED SITE
- POWER
- MINERAL EXPLORATION
- TRANSMISSION LINE
- EFFECTS STUDY AREA FOR MOOSE

HABITAT SUITABILITY INDEX (HSI)

0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

10 0 10

SCALE 1:500,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

HABITAT SUITABILITY FOR MOOSE: FUTURE CASE

FILE No. EA-Wild-031-GIS

PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
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Edmonton, Alberta

FIGURE: 15.4-6

The distance for noise attenuation to background for traffic along the existing winter roads and the NPAR during the construction phase is 0.9 km (Appendix 8.III). Similarly, noise from vehicles along the Proposed Tłįchǫ Road Route is anticipated to approach background levels within 1 km of the right-of-way. The magnitude of the decrease in habitat quality for moose within 1 km along the NPAR and Proposed Tłįchǫ Road Route is predicted to approach or slightly exceed the limits of baseline conditions.

Horesji (1979) reported that moose were less likely to be found within 1 km of seismic lines while seismic operations were underway. Andersen et al. (1996) found that humans elicited flight responses in moose at greater distances than disturbances that were recognized as mechanical. For example, the noise of a jet flying at an altitude of 150 m did not trigger any flight response in moose, while people approaching moose on foot or skis from a distance of 200 to 400 m caused the animals to run (Andersen et al. 1996). Studies of the effects of noise on moose have focused on fixed-wing aircraft. Results indicate that moose reacted visibly to aircraft 55% of the time when overhead flights were below 60 m in altitude, and 37.5% of the time when overhead flights were at altitudes between 60 and 180 m (McCourt et al. 1974). Moose were not observed to react to overhead flights above 180 m of altitude (McCourt et al. 1974). Aircrafts associated with the NICO Project will fly a minimum of 300 m above ground level, except during takeoff and landing, and field work. Andersen et al. (1996) found that the home range size for moose increased during active military manoeuvres (e.g., helicopters and jet fighters), but no collared individuals abandoned the area.

15.4.3 Marten

15.4.3.1 Habitat Quantity and Fragmentation

15.4.3.1.1 Methods

The incremental and cumulative direct habitat effects on marten from the NICO Project and previous, existing, and future developments were analyzed through changes in the area, composition, and spatial configuration of habitat types on the landscape (i.e., landscape metrics). The change in landscape metrics from the developments on the landscape was determined for the winter period (i.e., period of maximum predicted effects winter roads and vehicle traffic). Methods for the habitat fragmentation analysis completed for moose (Section 15.4.2.1.1) are also applicable for marten, with the exception of the study area. The moose analyses were completed within the ESAM (Section 15.1.2; Figure 15.1-2), while the analyses for marten (and remaining wildlife VCs) were completed within the RSA (Section 15.1.2; Figure 15.1-3). Previous and existing developments in the RSA include 2 mineral exploration programs (NICO exploration program and Phelps Dodge Corp. Canada exploration program), the Rayrock mine (historic remediated site), and 2 winter roads. The analysis also included predicted changes from the Proposed Tłįchǫ Road Route (Section 15.4.2.1.1).

15.4.3.1.2 Results

The total area of the NICO Project footprint (including the NPAR) is estimated to be 485.4 ha. However, because the NICO Project Lease Boundary was used in the analyses, and the width of the NPAR was increased to match the raster cell size (28.5 m) in the land cover classification, the estimated NICO Project footprint is 1516 ha. The NICO Project footprint will alter 1.6% of the 2010 baseline RSA. Previous and existing developments have removed 0.3% of habitat within the RSA relative to reference conditions. The total combined loss of all habitats in the RSA from the Proposed Tłįchǫ Road Route (future case) is less than 0.1%. The cumulative direct disturbance from the NICO Project and previous, existing, and future developments is predicted to be about 1.9% relative to reference conditions. Although progressive reclamation will be integrated into mine planning as part of Fortune's design for closure policy, subarctic ecosystems are slow to recover from disturbance. The

Flooded Open Pit, CDF, constructed wetlands, Seepage Collection/Surge Ponds, and ditches will be permanent features on the landscape, covering approximately 84 ha.

Under reference conditions, the RSA is mainly composed of coniferous spruce (53%) and deep water (16%). Burn and bedrock-open conifer each compose less than 10% of the RSA. Deciduous aspen, coniferous pine, marsh/graminoid fen, open bog, shrubland, treed bog, and treed fen each make up less than 5% of the RSA. Habitat types that will be disturbed most include bedrock-open conifer, burn, and deciduous aspen (Table 15.4-5).

Table 15.4-5: Change (%) in Area and Configuration of Habitat Types from Development within the Regional Study Area during 2010 Baseline, Application, and Future Conditions in the Winter

Habitat Type	Area (ha)	% Change Reference to 2010 Baseline	% Change 2010 Baseline to Application	% Change Application to Future	% Cumulative Change from Reference
	Reference				
Burn	6 743	<-0.1	-2.1	0.0	-2.2
Bedrock-Open Conifer	8 630	-0.9	-5.5	0.0	-6.4
Coniferous Pine	3 299	-0.1	-0.4	-0.1	-0.5
Coniferous Spruce	49 338	-0.2	-1.3	-0.1	-1.6
Deciduous Aspen	730	-0.2	-2.4	-0.1	-2.7
Deep water	14 405	-0.5	-0.6	0.3	-0.8
Marsh/Graminoid Fen	1 844	-0.1	-0.1	<-0.1	-0.3
Open Bog	1 205	-0.3	-1.7	-0.1	-2.1
Shrubland	543	-0.3	-1.5	-0.1	-1.9
Treed Bog	3 979	-0.3	-1.8	0.0	-2.1
Treed Fen	1 587	-0.1	-0.3	-0.1	-0.5
Habitat Type	**Number of Patches**	**% Change Reference to 2010 Baseline**	**% Change 2010 Baseline to Application**	**% Change Application to Future**	**% Cumulative Change from Reference**
	Reference				
Burn	314	0.6	-5.4	0.0	-4.7
Bedrock-Open Conifer	2 067	0.1	-2.0	0.0	-1.9
Coniferous Pine	683	0.7	-1.0	0.0	-0.3
Coniferous Spruce	1 027	1.4	0.9	-0.2	2.0
Deciduous Aspen	191	1.1	-2.6	0.0	-1.5
Deep water	1 017	0.2	-1.4	-0.2	-1.4
Marsh/Graminoid Fen	697	0.4	0.3	0.0	0.7
Open Bog	811	-0.1	-2.4	0.1	-2.3
Shrubland	183	1.1	1.6	0.0	2.7
Treed Bog	1 081	0.2	-2.4	0.0	-2.2
Treed Fen	276	0.0	-0.4	0.0	-0.4
Habitat Type	**Mean Distance to Nearest Neighbour (m)**	**% Change Reference to 2010 Baseline**	**% Change 2010 Baseline to Application**	**% Change Application to Future**	**% Cumulative Change from Reference**
	Reference				
Burn	315	-0.5	3.5	0.0	3.0
Bedrock-Open Conifer	138	<-0.1	0.7	0.0	0.7
Coniferous Pine	351	-1.2	-0.9	0.0	-2.1

Table 15.4-5: Change (%) in Area and Configuration of Habitat Types from Development within the Regional Study Area during 2010 Baseline, Application, and Future Conditions in the Winter (continued)

Habitat Type	Mean Distance to Nearest Neighbour (m)	% Change Reference to 2010 Baseline	% Change 2010 Baseline to Application	% Change Application to Future	% Cumulative Change from Reference
	Reference				
Coniferous Spruce	92	-0.8	0.3	0.5	<-0.1
Deciduous Aspen	672	-2.4	-0.6	0.0	-3.0
Deep water	224	-0.2	0.6	0.1	0.6
Marsh/Graminoid Fen	331	-1.0	-1.5	<0.1	-2.4
Open Bog	340	<0.1	1.1	-0.1	1.0
Shrubland	623	-2.3	-1.6	<0.1	-3.9
Treed Bog	250	-0.7	1.5	0.0	0.9
Treed Fen	540	<0.1	-2.1	<0.1	-2.1

ha = hectares; % = percent; m = metres

Values with a less than (<) symbol indicate the change is approaching zero.

Marten use a variety of habitat types but have a general reliance on forests with specific vertical and horizontal structural components that can provide, for example, foraging habitat or a den (Poole et al. 2004). High quality habitats for marten within the RSA include deciduous aspen, shrubland, and treed fen habitats (Section 15.4.3.2.1). Previous and existing developments have removed less than or equal to 0.3% of each deciduous aspen, shrubland, and treed fen habitat from the reference RSA. Development of the NICO Project (including the NPAR) is expected to decrease deciduous aspen, shrubland, and treed fen habitat within the RSA by 2.4%, 1.5%, and 0.3%, respectively, relative to 2010 baseline conditions (Table 15.4-5). Incremental changes to deciduous aspen, shrubland, and treed fen habitat area from the Proposed Tłı̨chǫ Road Route are each expected to be 0.1%. The cumulative decrease in deciduous aspen, shrubland, and treed fen habitat area from reference conditions to the future case is 2.7%, 1.9%, and 0.5%, respectively.

Increasing development on the landscape has also resulted in marginal changes to the number of and distance between similar habitat patches in the RSA. Development of previous and existing projects increased the number of habitat patches of deciduous aspen and shrubland habitats in the RSA by 1.1%, relative to reference conditions; the number of treed fen habitat patches in the RSA have not been increased with the development of previous and existing developments (Table 15.4-5). The NICO Project is expected to decrease the number of deciduous aspen and treed fen habitat patches by 2.6% and 0.4%, respectively. The development of the Proposed Tłı̨chǫ Road Route is expected to result in no detectable change to the number of deciduous aspen, shrubland, and treed fen habitat patches, relative to the application case. Cumulatively, previous, existing, and future developments are expected to reduce the number of deciduous aspen and treed fen habitat patches by 1.5% and 0.4%, while the number of shrubland habitat patches is expected to increase by 2.7%.

Mean distance to nearest neighbour for deciduous aspen and shrubland habitats decreased from reference to 2010 baseline conditions, while MDNN for treed fen habitat has increased by less than 0.1% (Table 15.4-5). The NICO Project is expected to decrease MDNN of deciduous aspen, shrubland, and treed fen habitat types. A less than 0.1% change in MDNN is expected for deciduous aspen, shrubland, and treed fen habitat with the development of reasonably foreseeable future developments. Deciduous aspen, shrubland, and treed fen habitats are all expected to have a cumulative decrease in MDNN from reference conditions to the future case.

No literature on the influence of human disturbance and habitat fragmentation were found for American marten; however, a similar species, European pine marten (*Martes martes*), did not avoid human disturbances and edges in France (Pereboom et al. 2008). The presence of the NPAR may represent a barrier to some individuals within the population, particularly during the winter construction phase when vehicle traffic is predicted to substantially increase. For example, roads may contribute to fragmentation of populations through increased mortality (Clevenger et al. 2003).

15.4.3.2 Habitat Quality, Behaviour, and Movement

15.4.3.2.1 Methods

In addition to direct habitat effects, changes to habitat quality from the NICO Project have the potential to indirectly affect the population size and distribution of marten, through altered movement and behaviour of individuals. To estimate the change in habitat quality for marten associated with the NICO Project and other developments, HSI modelling was completed within the RSA. To estimate the effects of the NICO Project on marten, a HSI model was used to quantify habitat changes between the 2010 baseline and reference case, between the application and 2010 baseline case, and between the future and application case during the winter period. Good quality habitats were defined according to a threshold representing the minimum value below which the habitat is not suitable for reproduction and survival (Ackakaya et al. 2004). The standard threshold value is typically 0.5, which was used in this assessment, although there are cases where a lower value is used.

The prevailing theory for marten habitat in western North America and boreal regions is that marten use a wide range of habitats, but have a general reliance on forests with specific structural components (vertical and horizontal) that could provide, for example, foraging habitat or a den (Poole et al. 2004). Habitat that supports prey species such as snowshoe hare, red squirrel, and grouse may play an important role during winter (Poole and Graf 1996; Cumberland et al. 2001). However, marten are a generalist predator, and can switch prey species when preferred food sources are scarce (Ben-David et al. 1997). Specific habitat types with structures like coarse woody debris and rock piles may provide important refugia for resting and denning (Steventon and Major 1982; Raphael and Jones 1997).

The original HSI for marten was published in 1982 by the U. S. Fish and Wildlife Service (Allen 1982). Since then there have been multiple adaptations. Two of these models are applicable to the effects analysis for the NICO Project (Takats et al. 1999; Higgelke et all. 2000). Takats et al. (1999) developed an HSI for marten habitat in west-central Alberta. In brief, their model assumed that life requisites of winter food and cover were limiting. Prey was assumed to be associated with the same habitat features that provided suitable cover. Cover was represented by a combination of thermal and hiding cover. The HSI in this effects analysis for the NICO Project was similarly constructed and was based on the tree canopy closure component in Takats et al. (1999). The proposed HSI also integrated a shrub cover component proposed by Higgelke et al. (2000). Hiding cover of dense shrubby vegetation and small trees with some coverage of downed woody debris may offer protection from predation.

In addition to previously completed HSIs, local information on trends in habitat use and selection was considered in this effects analysis. Winter track survey data collected during 2005, 2008, and 2009 in the RSA provide information contributing to a better understanding of habitat requirements (Table 15.4-6; also see Section 15.2.3.1). Within the mine RSA in 2005 (pre-fire landscape), habitat selection analysis indicated that bedrock-open conifer habitat was preferred relative to its availability, whereas coniferous spruce and frozen water (ice) habitats were avoided relative to availability. In 2009 (post-fire), bedrock-open conifer, burn, treed bog, and frozen water (ice) habitats were avoided relative to availability. Coniferous spruce was used in proportion to availability. For the NPAR study area in 2005 and 2008, treed bog habitat was selected in proportion to its availability, whereas graminoid fen, coniferous spruce, and frozen water (ice) habitats were avoided relative to availability. Coniferous pine and treed fen habitats were preferred by marten relative to availability in the NPAR study area.

The suitability of variables for the marten HSI model is described below. The model assumes that winter is the critical period when available cover and food limit population size and distributions. The model was developed for application in a GIS platform using a coarse land cover classification (see Section 14.2.2.1). The challenge was to link the land cover classification to detailed descriptions of cover that could be used for the HSI. Thus, on-the-ground field observations were used to describe vegetation structure and composition, which were inputs in calculating an HS score per land cover type (Table 15.4-6). Also, the HSI model is based on habitat requisites at multiple spatial scales (Mowat 2006). The spatial extent of the landscape cover components was based on the approximate home range size of the marten (3 km^2; Poole et al. 2004).

The effect of sensory disturbances on marten behaviour was captured using a curvilinear one-asymptote relationship and a 1000 m zone of influence (Figure 15.4-7). Marten activity is typically lower near disturbances such as roads (Robitaille and Aubry 2000) but strong effects of disturbances are limited to areas that are no more than 1000 m away.

Table 15.4-6: Summary of Structure, Composition, and Habitat Suitability Values per Land Cover Type within the Regional Study Area

Habitat Type	Median % Tree Cover	Tree HS Value[a]	Median % Shrub Cover	Shrub HS Value[b]	Maximum Cover HS Value	Mine Pre-burn Selection 2005[c]	Mine Post-burn Selection 2009[c]	Road Area Selection 2005 and 2008[c]	Final HS Value[d]
Bedrock-Open Conifer	10.0	0.2	15.0	0.3	0.3	1.0	0.0	ND	**0.4**
Coniferous Pine	9.5	0.2	4.5	0.1	0.2	ND	ND	1.0	**0.6**
Coniferous Spruce	20.0	0.6	30.0	0.6	0.6	0.0	0.5	0.0	**0.3**
Deciduous Aspen	30.0	1.0	20.0	0.4	1.0	ND	ND	ND	**1.0**
Marsh/ Graminoid Fen	0.0	0.0	2.0	<0.1	<0.1	ND	ND	0.0	**0.02**
Open Bog	0.0	0.0	9.0	0.2	0.2	ND	ND	ND	**0.2**
Shrubland	0.0	0.0	50.0	1.0	1.0	ND	ND	ND	**1.0**
Treed Bog	2.0	0.0	40.0	0.8	0.8	ND	0.0	0.5	**0.4**
Treed Fen	5.0	0.0	60.0	1.0	1.0	ND	ND	1.0	**1.0**
Frozen Water (Ice)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**

[a] Tree HS value based on Takats et al. (1999) and calculated as Y=0.0417X-0.25 for tree cover between 6-30%; %tree cover less than 6% = 0, and %tree cover greater than 30% = 1;

[b] Shrubland HS value based on Higgelke et al. (2000) and calculated as calculated Y=0.02X for values between 0-49%; shrub cover >50% = 1.

[c] Cover types that were selected according to the habitat selection analysis = 1, types that were avoided = 0, and types that were used in proportion to availability = 0.5 (Section 15.2.4.4.1).

[d] Values were calculated as the average of the total cover HS value (which was the maximum of tree HS value and shrub HS value) and habitat selection ranks (if available).

% = percent; HS = habitat suitability; ND = data not available

Winter Habitat Suitability

a) Optimum suitability at the local scale was described as deciduous aspen, shrubland, and treed fen (Table 15.4-6; reviewed in Takats et al. 1999 and Higgelke et al. 2000).

b) Optimum habitat at the regional scale was described as areas with greater than 55% high quality habitat (i.e., deciduous aspen, shrubland, and treed fen) within a 1 km radius (Schultz and Joyce 1992). The spatial scale of a 1 km radius was based on a home range of approximately 3 km^2 (Poole et al. 2004).

c) Moderately suitable habitats at the local scale were bedrock-open conifer, coniferous pine, coniferous spruce, and treed bog habitats (Table 15.4-6).

d) Moderate suitability at the regional scale was described as areas with 25% to 55% high quality habitats within a 1 km radius, (see Table 15.4-6).

e) Poor suitability at the local scale included graminoid fen, open bog, and frozen water (ice).

f) Poor suitability at the regional scale included landscapes with a scarcity of deciduous aspen, shrubland and treed fen habitats (less than 25% within a 1 km radius).

g) Habitat suitability was reduced with proximity to major disturbances (e.g., NICO Project Lease Boundary; Robitaille and Aubry 2000).

Marten HSI Formula

$$Index = \frac{(\mathrm{HT} + \%\mathrm{LC})}{2} \times HSM$$

HT = habitat types were ranked according to values in Table 15.4-8.

%LC = landscape cover measurement where each cell was ranked according to the percentage of high quality habitats within a 1 km radius. High quality habitats included deciduous aspen, shrubland, and treed fen. Rankings were based on the formula of Y=0.2+0.015X, where values greater than 55% = 1 (Figure 15.4-7).

HSM = habitat suitability modifier. Change between 0 m to 1 000 m to disturbance was defined as a curvilinear one-asymptote relationship with equation $y = 1.0442 \times (1 - 0.9969^{distance})$ (Figure 15.4-8). Values = 1 at distances greater than 1000 m.

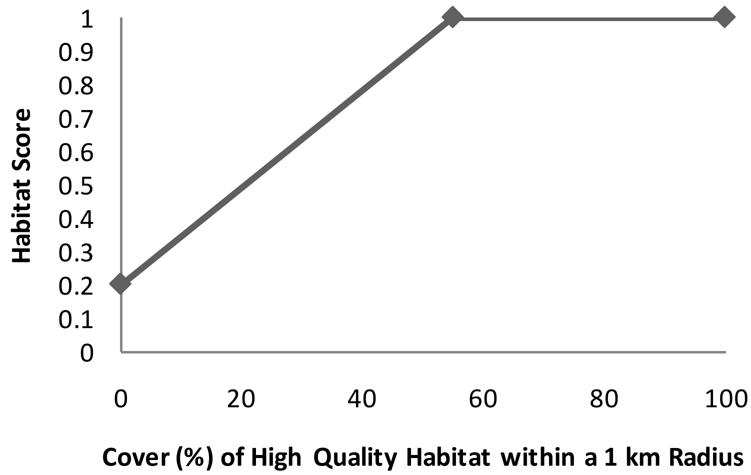


Figure 15.4-7: Relationship between Suitability Scores and Landscape Cover (%) of High Quality Habitats within a 1 km radius for Marten

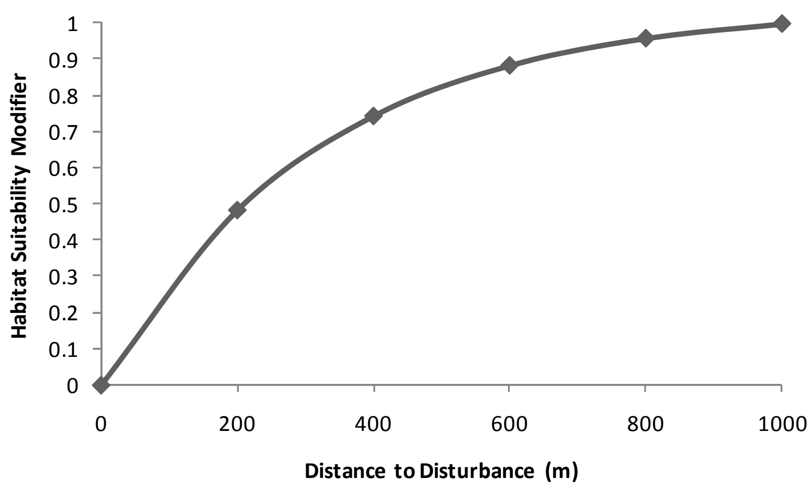


Figure 15.4-8: Relationship between Distance from Human Disturbance and Habitat Suitability Modifier for Marten

The following equations were used to calculate the relative change in the amount of different quality habitats for the different conditions on the landscape.

- (2010 baseline area – reference area) / reference area x 100
- (application case area – 2010 baseline area) / 2010 baseline area x 100
- (future case area - application case area) / application case area x 100

Although the indirect effects from noise are included in the HSI modelling, the potential effects on marten from noise are also discussed separately. Methods used to assess the effects from noise on the habitat quality, movement, and behaviour of marten are similar to moose, and are described in Section 15.4.1.2.1.

15.4.3.2.2 Results

The total amount of good quality habitat for marten in the RSA under reference conditions is approximately 8.4% (Table 15.4-7). Previous and existing developments decreased the amount of good quality habitat by 2.9%, and the application of the NICO Project is expected to decrease the amount of good quality habitat by an additional 6.2%. The construction and operation of the Proposed Tłı̨chǫ Road Route is expected to decrease the amount of good quality marten habitat by an additional 3.2%, relative to the application case, for a cumulative decrease in good quality marten habitat of 12.3% from reference conditions. Habitat suitability modelling for reference conditions, 2010 baseline conditions, the application case, and future case are shown in Figure 15.4-9 to Figure 15.4-12.

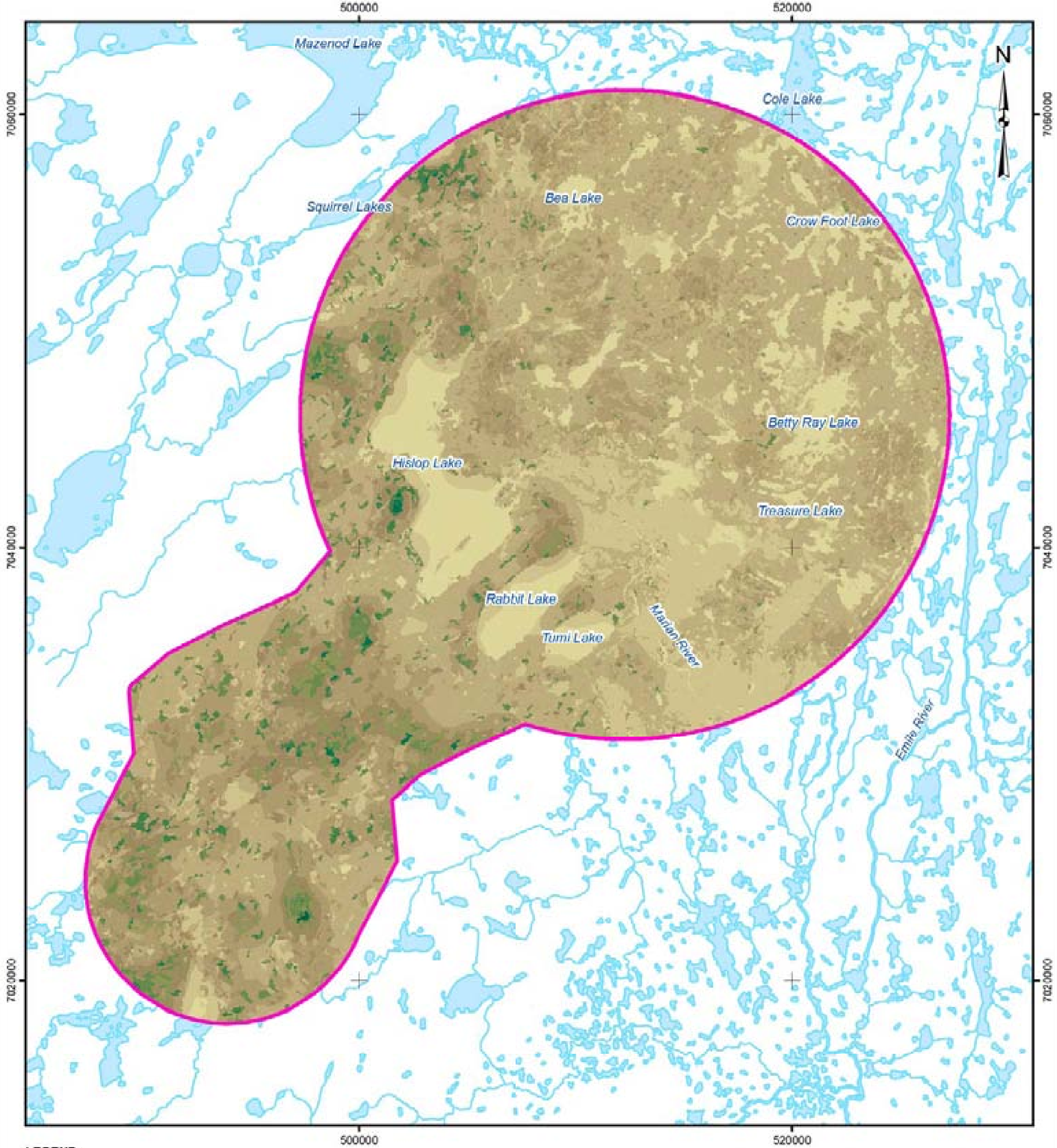
Table 15.4-7: Relative Changes in the Availability of Different Quality Habitats for Marten in the Regional Study Area from Reference to Reasonably Foreseeable Projects

Habitat Suitability (Range of Habitat Suitability Scores)	Reference		% Change Reference to 2010 Baseline	% Change 2010 Baseline to Application	% Change Application to Future	% Cumulative Change from Reference
	Area (ha)	% RSA				
Poor (0 to 0.49)	86 917	91.6	0.3	0.6	0.3	1.1
Good (0.50 to 1)	7 942	8.4	-2.9	-6.2	-3.2	-12.3

ha = hectares; % = percent; RSA = Regional Study Area

Noise sources from the NICO Project include mobile and stationary mining equipment, blasting, aircraft, and vehicles along the NPAR, existing winter roads, and Proposed Tłı̨chǫ Road Route. The results from modelling show that noise predictions slightly exceed benchmarks for mine operations, and are below benchmarks for the NPAR and Airstrip (Table 15.3-4). The distance for noise attenuation to background levels for core mining operations (including blasting) is 3.3 km (Table 15.3-5), but disturbance from blasting is anticipated to occur infrequently (about once per day). The distance for noise attenuation to reach background levels from the Airstrip is about 26 km. However, disturbance from large aircraft is expected to be infrequent (Appendix 8.III) and short-term (less than 5 minutes in duration).

The distance for noise attenuation to background for traffic along the winter roads and NPAR during the construction phase is 0.9 km (Appendix 8.III). Similarly, noise from vehicles along the Proposed Tłı̨chǫ Road Route is anticipated to approach background levels within 1 km of the right-of-way. The magnitude of the decrease in habitat quality for marten within 1 km along the NPAR and Proposed Tłı̨chǫ Road Route is predicted to approach or slightly exceed the limits of baseline conditions.



LEGEND

WATERCOURSE
WATERBODY
REGIONAL STUDY AREA

HABITAT SUITABILITY INDEX (HSI)

0
0.1
0.2
0.3
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0.5
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REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

5 0 5

SCALE 1:250,000 KILOMETRES

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

HABITAT SUITABILITY FOR MARTEN: REFERENCE CONDITIONS

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-032-GIS		
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DESIGN LD	09 Feb. 2011	
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FIGURE: 15.4-9

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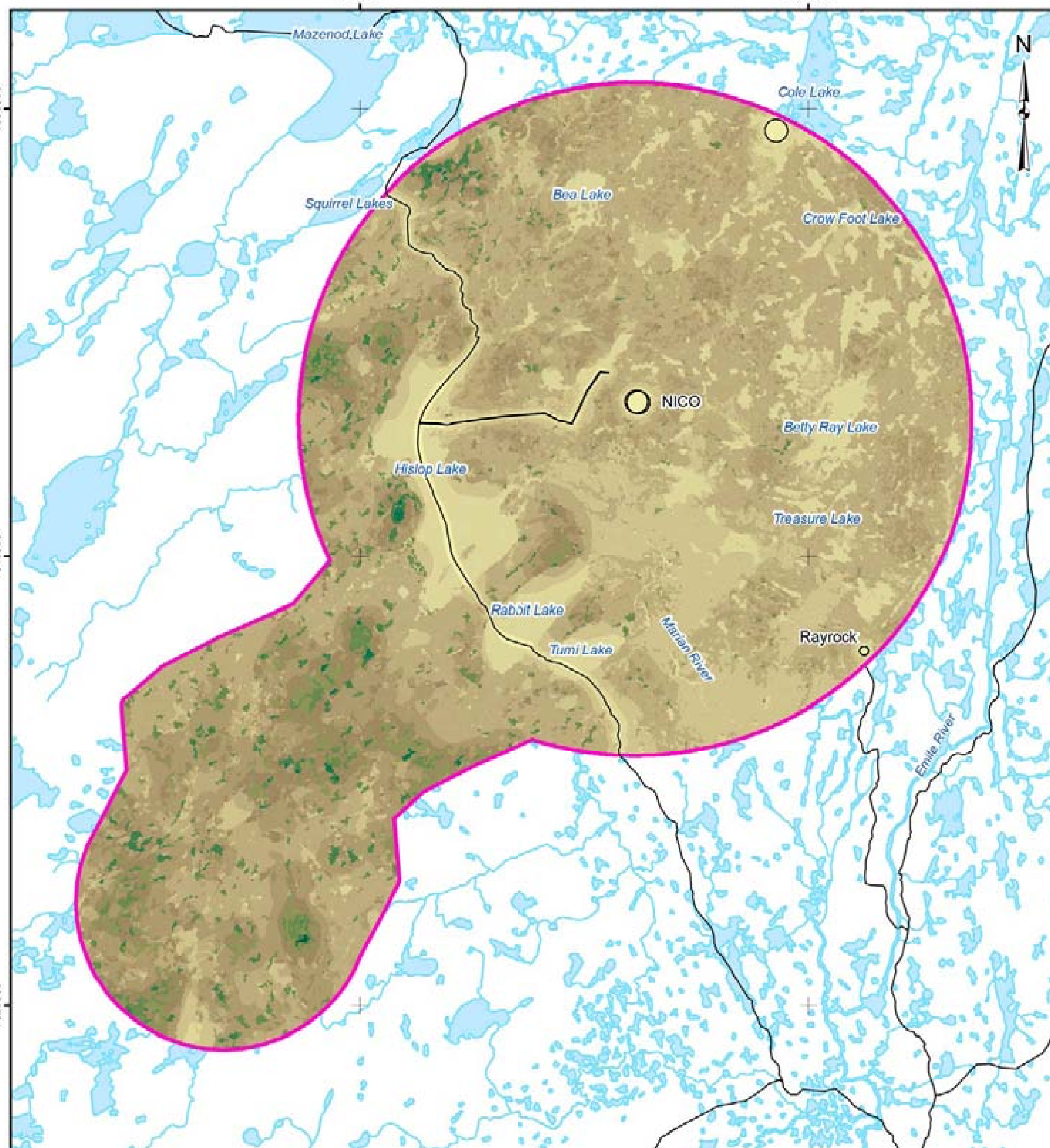

LEGEND

- EXISTING WINTER ROAD
- WATERCOURSE
- WATERBODY
- HISTORIC REMEDIATED AND NON-REMEDIATED SITE
- MINERAL EXPLORATION
- REGIONAL STUDY AREA

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0.1
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1.0

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FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

HABITAT SUITABILITY FOR MARTEN: 2010 BASELINE CONDITIONS

FILE No. EA-Wild-033-GIS

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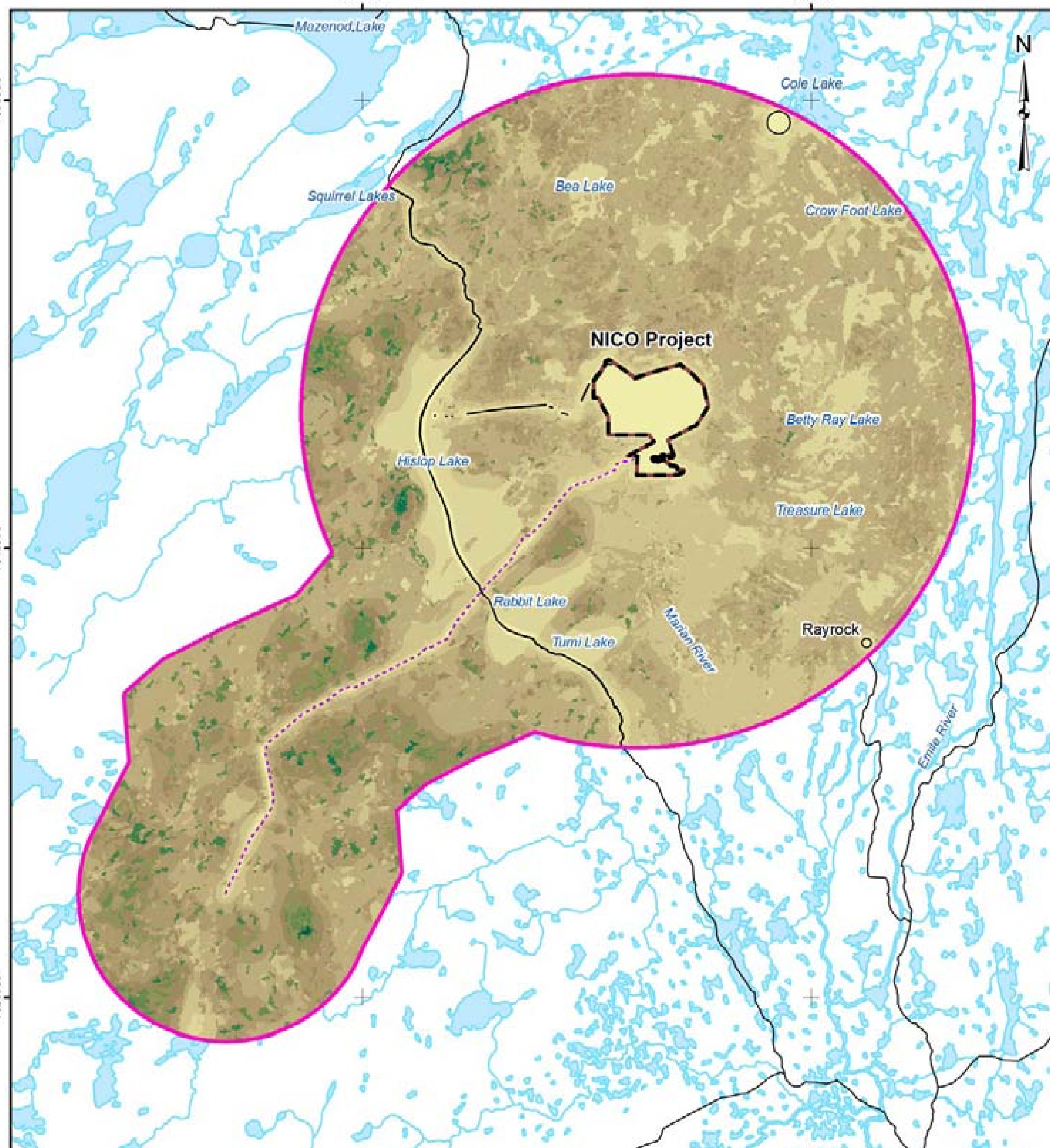
Edmonton, Alberta

FIGURE: 15.4-10



LEGEND

- PROJECT LEASE BOUNDARY
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- WATERCOURSE
- WATERBODY
- HISTORIC REMEDIATED AND NON-REMEDIATED SITE
- MINERAL EXPLORATION
- REGIONAL STUDY AREA

HABITAT SUITABILITY INDEX (HSI)

0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

5 0 5

SCALE 1:250,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

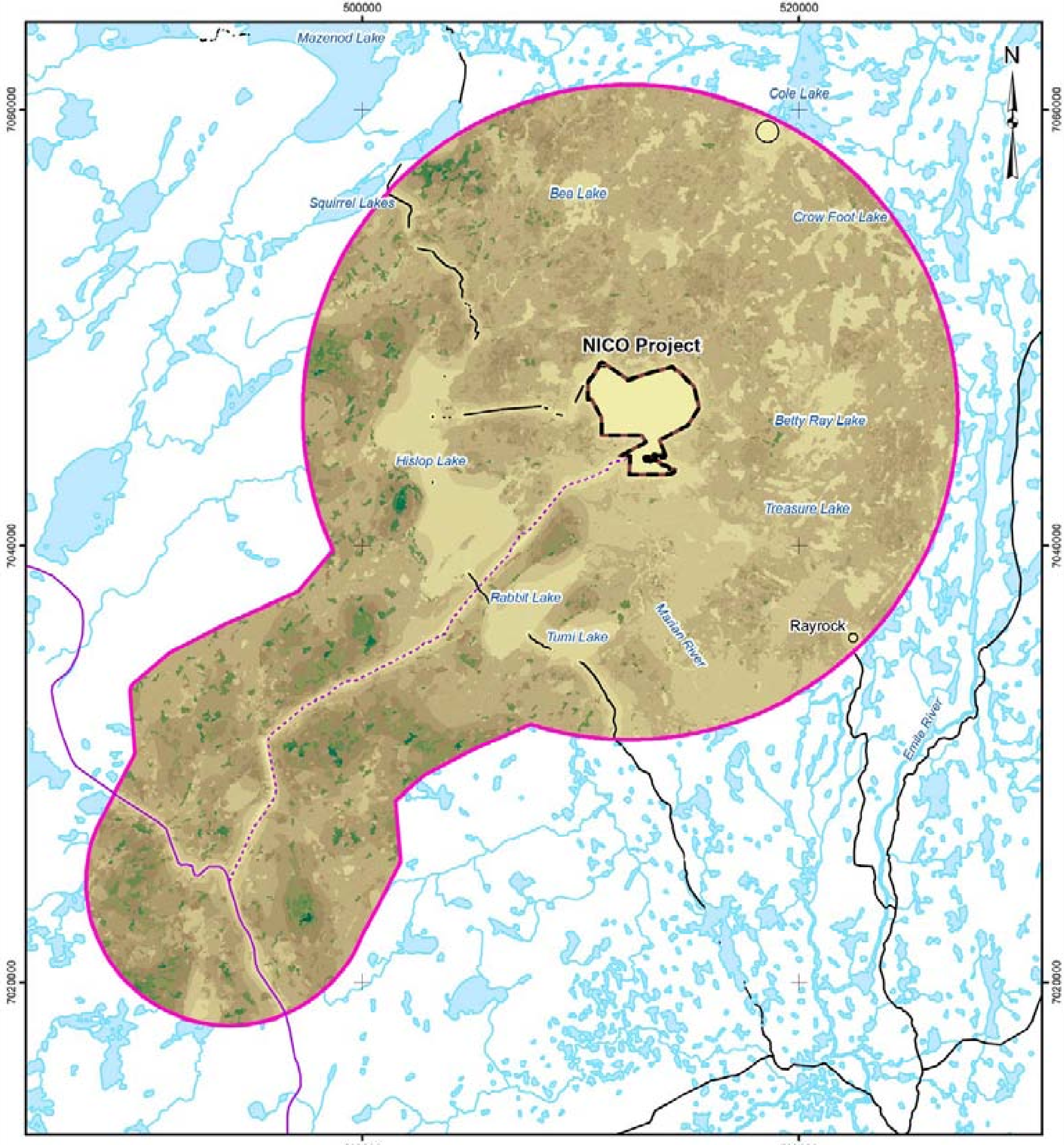
FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

HABITAT SUITABILITY FOR MARTEN: APPLICATION CASE

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-034-GIS				
PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	LD	09 Feb. 2011	FIGURE: 15.4-11	
GIS	ANK	03 Apr. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		



LEGEND

- PROJECT LEASE BOUNDARY
- EXISTING WINTER ROAD
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁĮCHǪ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- HISTORIC REMEDIATED AND NON-REMEDIATED SITE
- MINERAL EXPLORATION
- REGIONAL STUDY AREA

HABITAT SUITABILITY INDEX (HSI)

0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

5 0 5
SCALE 1:250,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

HABITAT SUITABILITY FOR MARTEN: FUTURE CASE

FILE No. EA-Wild-035-GIS

PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	LD	09 Feb. 2011	
GIS	ANK	03 Apr. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

Golder Associates
Edmonton, Alberta

FIGURE: 15.4-12

G:\2008\1373\08-1373-0017 Fortune Minerals Nico EIS\GIS\Mapping\MXD\Wildlife\EA-Wild-035-GIS.mxd

Discriminating wildlife perception of noise in isolation of other senses (such as odours and sight) is problematic. Although wildlife species are generally found to avoid areas with anthropogenic (i.e., human-generated) noise, especially when the noise first starts occurring, several species have been observed to eventually become habituated to high noise levels (Busnel and Briot 1980; Ronconi et al. 2004). Reproductive rates and pup survival in farmed blue fox were not found to be affected by aviation noise (Pyykoenen 2008). Noise varied from 85 to 120 dBA from aircraft overflights at a fox farm, which was compared to a control farm without aircraft overflights (Pyykoenen 2008). Few studies have focused on the effects of noise and disturbance on marten behaviour and movement. Zielinski et al. (2008) did not note a difference in marten occupancy of areas with or without vehicle access; however, this study did not examine behavioural, physiological, or demographic responses of marten to vehicle presence.

15.4.4 Muskrat

15.4.4.1 Habitat Quantity and Fragmentation

15.4.4.1.1 Methods

The incremental and cumulative direct habitat effects on muskrat from the NICO Project footprint (including the NPAR) and other previous, existing, and future developments in the RSA were analyzed through changes in the area and spatial configuration of habitat types on the landscape (i.e., landscape metrics). Analyses were completed using the existing winter road footprints so that changes to terrestrial habitats from road portages were included, which represents the maximum disturbance to the study area. Methods for the habitat fragmentation analysis completed for marten (Section 15.4.3.1.1) are also applicable for muskrat.

15.4.4.1.2 Results

The total area of the NICO Project footprint is estimated to be 485.4 ha. However, because the NICO Project Lease Boundary was used in the analyses, and the width of the NPAR was increased to match the raster cell size (28.5 m) in the land cover classification, the estimated NICO Project footprint is 1516 ha. The NICO Project will alter 1.6% of the 2010 baseline RSA. The cumulative direct disturbance from the NICO Project and previous, existing, and future developments is predicted to be about 1.9% relative to reference conditions. The Flooded Open Pit, CDF, constructed wetlands, Seepage Collection/Surge Ponds, and ditches will be permanent features on the landscape, covering approximately 84 ha.

High quality habitats for muskrat include waterbodies and riparian areas consisting of recently burned, fen, or bog habitat (Section 15.4.4.2.1). Previous and existing developments in the RSA have removed 0.5% of deep water habitat relative to reference conditions. Development of the NICO Project is expected to decrease deep water habitat within the RSA by 0.6%, relative to 2010 baseline conditions (Table 15.4-5). This is primarily due to the infilling of the Grid Ponds for the construction of the CDF. The cumulative decrease in deep water habitat from reference conditions is 1.1%.

Increasing development on the landscape has also resulted in marginal changes to the number of and distance between similar habitat patches in the RSA. The number of deep water habitat patches in the RSA has increased by 0.2% with the development of previous and existing developments compared with reference conditions. The number of deep water habitat patches in the RSA is expected to decrease by 1.4% with the development of the NICO Project relative to 2010 baseline conditions (Table 15.4-5), primarily because of the loss of the Grid Ponds in the CDF. Mean distance to nearest neighbour for deep water habitat decreased by

0.2% from reference to 2010 baseline conditions (Table 15.4-5). The NICO Project is expected to increase MDNN for deep water habitat by 0.6% relative to 2010 baseline conditions.

No literature is available on the response of muskrat to habitat loss and fragmentation. However, habitat fragmentation is likely to affect muskrats primarily during juvenile dispersal. The current level of development in the RSA and the low amount of habitat loss and fragmentation expected from the NICO Project is unlikely to affect muskrat populations in the RSA relative to 2010 baseline conditions.

15.4.4.2 Habitat Quality, Movement, and Behaviour

15.4.4.2.1 Methods

In addition to direct habitat effects, changes to habitat quality from the NICO Project have the potential to indirectly affect the population size and distribution of muskrat, through altered movement and behaviour of individuals. To estimate the change in habitat quality for muskrat associated with the NICO Project and other developments, HSI modelling was completed within the RSA. To estimate the effects of the NICO Project on muskrat, a HSI model was used to quantify habitat changes between the 2010 baseline and reference case, between the application and 2010 baseline case, and between the future and application case during the summer period. Good quality habitats were defined according to a threshold representing the minimum value below which the habitat is not suitable for reproduction and survival (Ackakaya et al. 2004). The standard threshold value is typically 0.5, which was used in this assessment, although there are cases where a lower value is used.

Muskrats are primarily herbivores (Allen and Hoffman 1984) and occur in wetlands, ponds, lakes, and slow moving rivers where abundant aquatic and emergent vegetation persists. Waterbodies must be deep enough so that some of the water column remains unfrozen during winter, but shallow enough to allow the growth of aquatic vegetation in the summer. Ideal water depths are between 1 and 2 m (Messier et al. 1990). Further, deep water, when in close proximity to where burrows are situated, provides refugia from predators, as well as potential access to energy-rich submerged macrophytes (Jelinski 1989; Virgl and Messier 1996). Interestingly, researchers have shown that muskrats can shift their burrow from deep water locations in winter to shallow water habitat in the summer as a life-history strategy for maximizing nutritional intake in northern environments (Jelinski 1989).

Wildfire is thought to improve muskrat habitat by maintaining wetlands and aquatic edge habitat around wetlands, as well as increasing the amount of herbaceous vegetation that is available in an area (reviewed in Nelson et al. 2008). Marshes in various regions of North America (e.g., Manitoba and southeastern United States) are often burned to promote muskrat habitat and increase populations (Nelson et al. 2008).

Muskrat habitat in northern ecosystems has been described for James Bay, Quebec (Nadeau et al. 1995). The occurrence of borrows along shoreline sections was 6% for lakes, 14% for beaver ponds, 20% for slow-flowing streams, and 44% for slow-flowing rivers. Muskrats were not found in peatland areas and in fast-flowing streams. The authors showed that bank slope, percent floating and submerged plant cover, presence of clay-loam soil, as well as the width of herbaceous vegetation along shorelines are important variables predicting the occurrence of muskrat burrows (Nadeau et al. 1995).

The model presented below was generated from GIS-based descriptors of suitable aquatic habitat for predator refugia and overwintering components, as well as for habitat to meet foraging requirements. There is no evidence to suggest that muskrat are sensitive to the proximity of human disturbance so no habitat suitability modifier for distance to disturbance was included in the muskrat model. The proposed model builds on similar work done by Allen and Hoffman (1984); however, the model in this assessment used GIS-based parameters only. These parameters were assumed to be directly linked with the carrying capacity of muskrat populations in the region.

Aquatic Habitat Suitability

a) Moderate-to-optimal habitats were areas classified as water, which were assumed to be permanent wetlands, lakes, and large streams and rivers (greater than 2nd order). These habitats should provide refugia from predators, suitable hydroperiods and food sources that persist through the summer and fall seasons, as well as suitable environmental conditions for overwintering (Allen and Hoffman 1984; Nadeau et al. 1995; Virgl and Messier 1996).

b) Recently burned (1 to 5 years) riparian areas (i.e., areas directly adjacent to the waterbody shoreline) were considered to provide high quality habitat. Fire is thought to benefit muskrat by increasing the amount of herbaceous vegetation that is available in an area (reviewed in Nelson et al. 2008).

c) Unsuitable habitats included fens and bogs, as well as deep water areas of lakes.

Muskrat HSI Formula

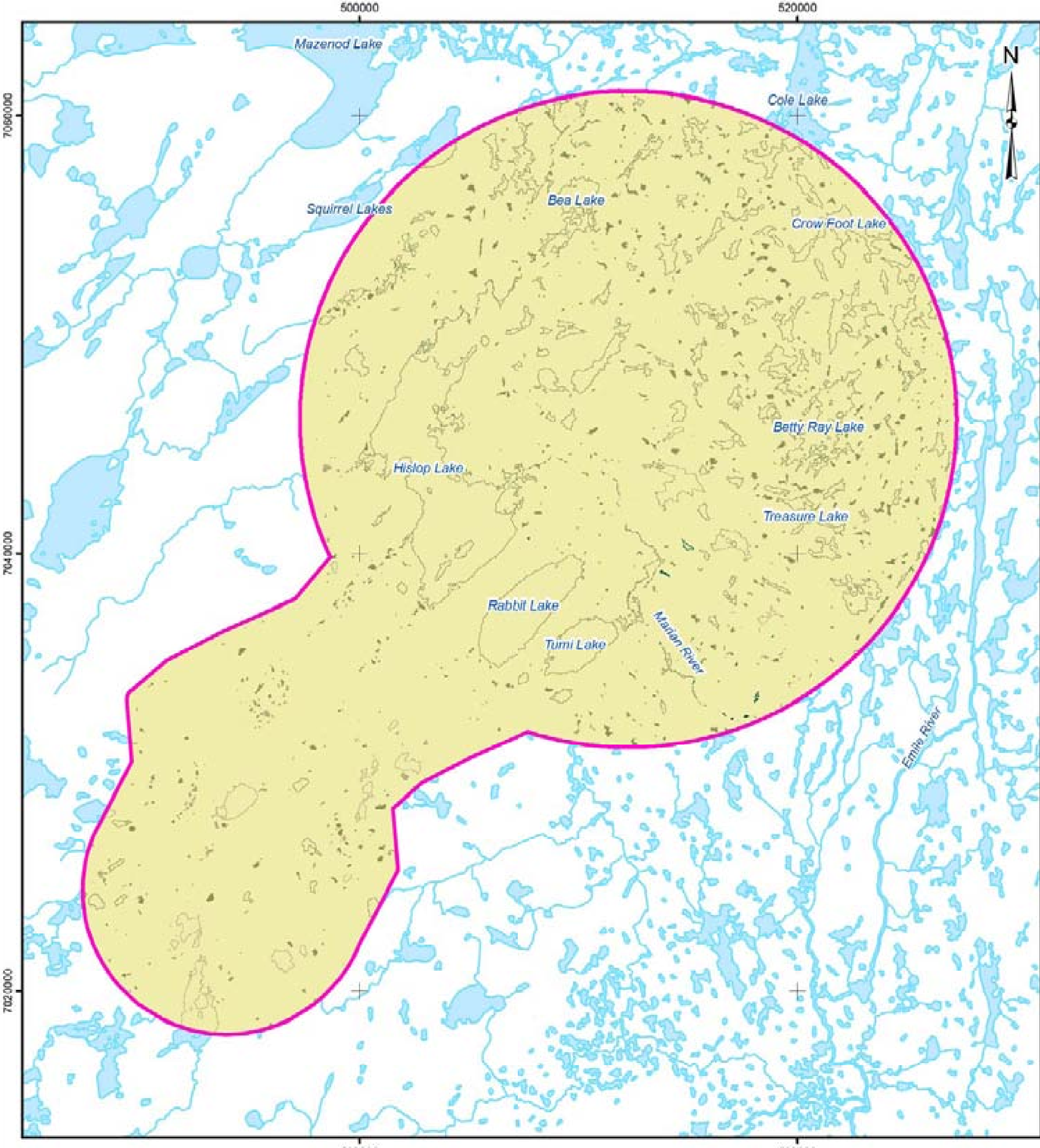
$$Index = \mathrm{W} \times \mathrm{R}$$

W = all waterbodies (e.g., wetlands, lakes, ponds) was assigned a score of 1. Waterbodies less than 10 ha in size were classified as wetlands, whereas lakes were identified as waterbodies greater than 10 ha in size. Only raster cells directly adjacent to lake shorelines were assigned a rank. Cells beyond 28.5 m from the lake shoreline (i.e., deep water) = 0. All cells within waterbodies classified as wetlands were given a score.

R = riparian habitat. Recent burn (1 to 5 yrs) = 1, riparian fen or bog habitat =0.5, disturbance = 0, and all other habitat types = 0.75. Riparian habitat score was determined by the habitat type that made up the majority of the raster cells surrounding the waterbody (e.g., if recent burn made up 70% of the raster cells while treed bog and bedrock-open conifer each made up 15% of the raster cells in the riparian area, then the score for the riparian habitat = 1). All cells that were not directly adjacent to waterbody shorelines got a score of 0.

15.4.4.2.2 Results

The total amount of good quality in the RSA for muskrat is 5.1% under reference conditions and changes little throughout all assessment cases (Table 15.4-8). Previous and existing developments decreased the habitat quality in the RSA by less than 0.2%. The anticipated incremental decrease of good quality habitat from the NICO Project relative to 2010 baseline conditions is less than 0.9%. The cumulative decrease of good quality muskrat habitat from the NICO Project and previous, existing and potential future developments in the RSA is approximately 1%. Habitat suitability modelling for reference conditions, 2010 baseline conditions, application case, and future case are shown in Figure 15.4-13 to Figure 15.4-16.



LEGEND

WATERCOURSE
WATERBODY
REGIONAL STUDY AREA

HABITAT SUITABILITY INDEX (HSI)

0
0.5
0.75
1.0

5 0 5
SCALE 1:250,000 KILOMETRES

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

HABITAT SUITABILITY FOR MUSKRAT: REFERENCE CONDITIONS

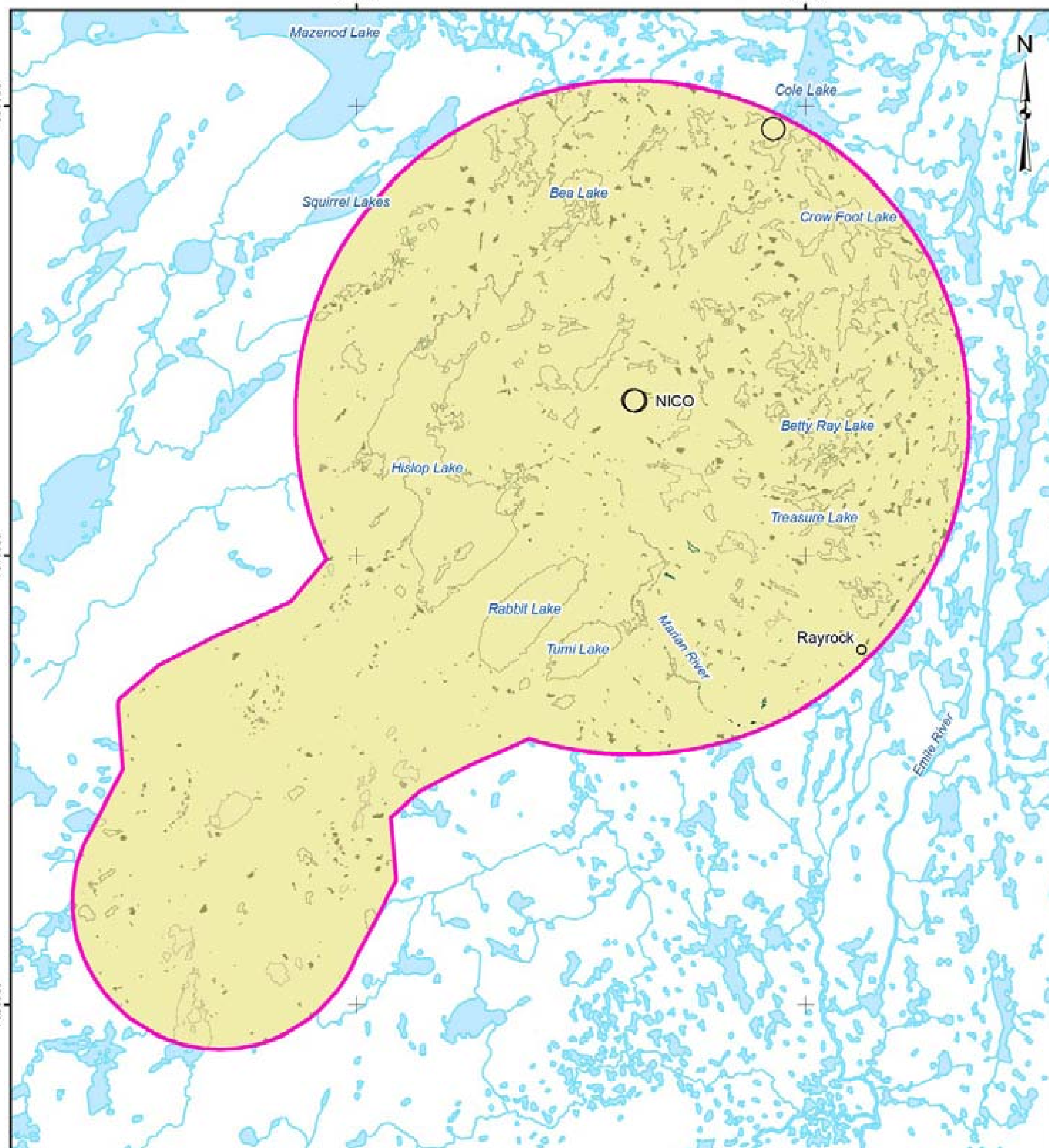
REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-036-GIS			
PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	LD	09 Feb. 2011	
GIS	ANK	24 Feb. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

FIGURE: 15.4-13



LEGEND

- WATERCOURSE
- WATERBODY
- HISTORIC REMEDIATED AND NON-REMEDIATED SITE
- MINERAL EXPLORATION
- REGIONAL STUDY AREA

HABITAT SUITABILITY INDEX (HSI)

- 0
- 0.5
- 0.75
- 1.0

5 0 5

SCALE 1:250,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

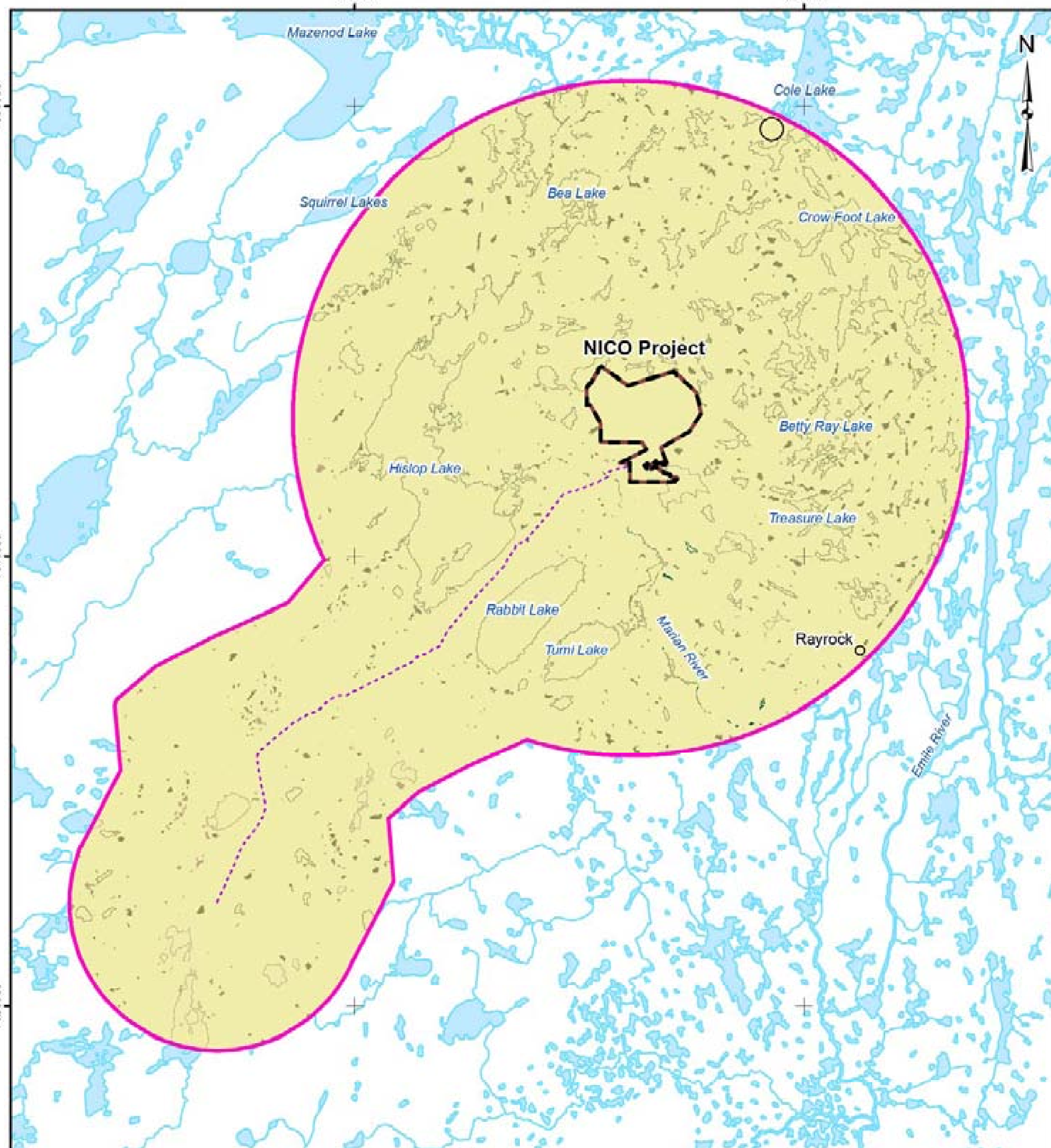
TITLE

HABITAT SUITABILITY FOR MUSKRAT: 2010 BASELINE CONDITIONS

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-037-GIS

PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	LD	09 Feb. 2011	**FIGURE: 15.4-14**	
GIS	ANK	03 Apr. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		



LEGEND

- PROJECT LEASE BOUNDARY
- PROPOSED NICO PROJECT ACCESS ROAD
- WATERCOURSE
- WATERBODY
- HISTORIC REMEDIATED AND NON-REMEDIATED SITE
- MINERAL EXPLORATION
- REGIONAL STUDY AREA

HABITAT SUITABILITY INDEX (HSI)

- 0
- 0.5
- 0.75
- 1.0

5 0 5

SCALE 1:250,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

HABITAT SUITABILITY FOR MUSKRAT: APPLICATION CASE

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-038-GIS

PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	LD	09 Feb. 2011	
GIS	ANK	03 Apr. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

FIGURE: 15.4-15

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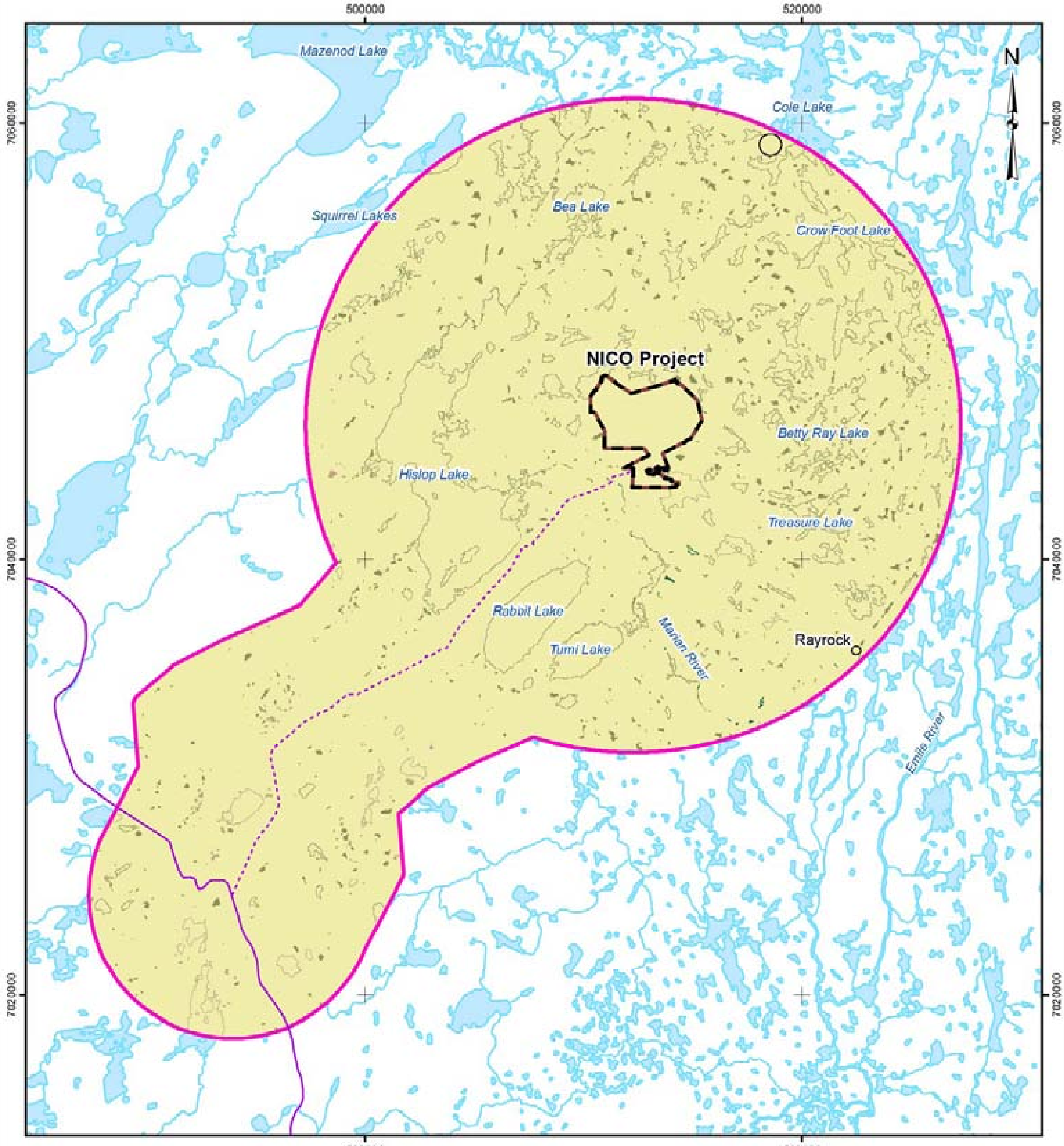

LEGEND

- PROJECT LEASE BOUNDARY
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁĮCHǪ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- HISTORIC REMEDIATED AND NON-REMEDIATED SITE
- MINERAL EXPLORATION
- REGIONAL STUDY AREA

HABITAT SUITABILITY INDEX (HSI)

- 0
- 0.5
- 0.75
- 1.0

5 0 5
SCALE 1:250,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE
HABITAT SUITABILITY FOR MUSKRAT: FUTURE CASE

FILE No. EA-Wild-039-GIS

PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	LD	09 Feb. 2011	
GIS	ANK	03 Apr. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

FIGURE: 15.4-16

Golder Associates
Edmonton, Alberta

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Table 15.4-8: Relative Changes in the Availability of Different Quality Habitats for Muskrat in the Regional Study Area from Reference to Reasonably Foreseeable Projects

Habitat Suitability (Range of Habitat Suitability Scores)	Reference		% Change Reference to 2010 Baseline	% Change 2010 Baseline to Application	% Change Application to Future	% Cumulative Change from Reference
	Area (ha)	% RSA				
Poor (0 to 0.49)	90 033	94.9	<0.1	0.1	0.0	0.1
Good (0.50 to 1)	4 826	5.1	-0.2	-0.9	0.0	-1.1

ha = hectares; % = percent; RSA = Regional Study Area; < = less than

15.4.5 Upland Breeding Birds

15.4.5.1 Habitat Quantity and Fragmentation

15.4.5.1.1 Methods

The incremental and cumulative direct habitat effects on upland breeding birds from the NICO Project footprint and other previous, existing, and future developments in the RSA were analyzed through changes in the area and spatial configuration of habitat types on the landscape (i.e., landscape metrics). Although upland breeding birds are not present within the study area during the winter season, analyses were completed using the existing winter road footprints so that changes to terrestrial habitats from road portages were included, which represents the maximum disturbance to the study area. Methods for the habitat fragmentation analysis completed for marten (Section 15.4.3.1.1) are also applicable for upland breeding birds.

15.4.5.1.2 Results

The total area of the NICO Project footprint (including the NPAR) is estimated to be 485.4 ha. However, because the NICO Project Lease Boundary was used in the analyses, and the width of the NPAR was increased to match the raster cell size (28.5 m) in the land cover classification, the estimated NICO Project footprint is 1516 ha. The NICO Project will alter 1.6% of the 2010 baseline RSA. The cumulative direct disturbance from the NICO Project and previous, existing, and future developments is predicted to be about 1.9% relative to reference conditions. The Flooded Open Pit, CDF, constructed wetlands, Seepage Collection/Surge Ponds, and ditches will be permanent features on the landscape, covering approximately 84 ha.

Key upland breeding bird habitats in the RSA include coniferous spruce, shrubland, and treed fen, although similar densities and richness of upland breeding birds were found in all habitat types (Section 15.2.4.6.1, Table 15.2-14). Previous and existing developments have decreased the amount of coniferous spruce, shrubland, and treed fen in the RSA by less than or equal to 0.3% relative to reference conditions. Development of the NICO Project is expected to decrease coniferous spruce, shrubland, and treed fen habitat within the RSA by approximately 1.3%, 1.5%, and 0.3%, respectively, relative to 2010 baseline conditions (Table 15.4-5). Incremental changes to coniferous spruce, shrubland, and treed fen habitat types from the Proposed Tłı̨chǫ Road Route are each expected to be less than or equal to 0.1%. The cumulative decreases in coniferous spruce, shrubland, and treed fen habitats from reference conditions to the future case are less than 1.6%, 1.9%, and 0.5%, respectively.

In addition to direct loss of habitat, the application of the NICO Project will also result in fragmentation (or perforation of habitats from a point source of disturbance such as mine sites) of the existing landscape. Fragmentation (or breaking apart of the landscape) can influence several ecological processes including movement between nesting and foraging areas, nest predation and parasitism along habitat edges, encounter rate between potential breeders, and dispersal between local populations. Although fragmentation can influence individual, population, and community processes, fragmentation effects have less influence than habitat loss when there is is a large proportion of natural habitat on the landscape (Fahrig 1997, 2003; Andrén 1999; Flather and Bevers 2002; Swift and Hannon 2010). Studies using simulation models found that the effect of habitat fragmentation on a species depends on its habitat requirements, amount of habitat remaining, and dispersal ability or vagility (With and Crist 1995; Flather and Bevers 2002; Swift and Hannon 2010).

For example, a species with very specific habitat requirements and low dispersal ability (or ability to move) is more likely to be negatively affected by habitat fragmentation. Species that can move effectively (such as most birds) may consider habitat patches to be connected even when covering only 35 to 40% of the landscape (With and Crist 1995). In other studies, effects from habitat fragmentation on populations are small until habitat amounts decrease below a threshold level (70 to 90% habitat loss) related to population persistence (Flather and Bevers 2002; Swift and Hannon 2010).

Distances of 50 to 200 m have been reported to effectively isolate birds in forested landscapes (Desrochers and Hannon 1997; Schmiegelow et al. 1997; St. Clair et al. 1998). The ability and willingness of a bird to cross a matrix (i.e., less preferred habitat portions of the landscape) may also be influenced by the quality of the matrix. That is, a matrix may decrease the survival probability of an individual because of increased risk of predation or collision with a vehicle (Swift and Hannon 2010). The NPAR is not expected to restrict upland breeding bird movement as the right-of-way is expected to be 6 to 10 m wide.

Habitat fragmentation can also increase edge habitat, which can increase nest predation and parasitism (Robinson and Wilcove 1994). Brood parasitism from species such as brown-headed cowbirds is not likely to occur in the RSA (i.e., cowbirds were not observed during baseline studies and are not expected to occur in the RSA). Although some studies have detected increased predation rate on nests near edges in forested and non-forested landscapes, other studies have shown no effect of distance from disturbed edge on nest success (Johnson and Temple 1990; Hanski 1996; Donovan et al. 1997; Winter et al. 2000; Chalfoun et al. 2002). At the Ekati Diamond Mine, Male and Nol (2005) found that nest success of Lapland longspurs was independent of distance to roads.

Increasing development on the landscape has also resulted in marginal changes to the number of and distance between similar habitat patches in the RSA. Development of previous and existing projects increased the number of coniferous spruce and shrubland habitat patches on the landscape by 1.4% and 1.1%, respectively, relative to reference conditions (Table 15.4-5). There was no change in the number of treed fen habitat patches from reference to 2010 baseline conditions. Coniferous spruce and shrubland habitats are predicted to have an increase in the number of patches in the RSA with the development of the NICO Project, relative to 2010 baseline conditions (by 0.9% and 1.6%, respectively). The number of treed fen habitat patches in the RSA is expected to decrease by 0.4% with the development of the NICO Project, relative to 2010 baseline conditions. The development of the Proposed Tłįchǫ Road Route is expected to increase the number of coniferous spruce, shrubland and treed fen habitat patches by less than or equal to 0.2% relative to the application case. Coniferous spruce and shrubland habitats are expected to have a cumulative decrease in the number of patches from reference conditions of 2.0% and 2.7%, respectively. The number of treed fen habitat patches in the RSA is expected to have a cumulative increase, from reference to future case, of 0.4%.

Mean distance to nearest neighbour for coniferous spruce and shrubland habitats decreased from reference to 2010 baseline conditions, while MDNN for treed fen habitat increased during this assessment period (Table 15.4-5). The NICO Project is expected to increase MDNN for coniferous spruce habitat by 0.3% relative to 2010 baseline conditions; shrubland and treed fen habitats are expected to have a decrease in MDNN. Coniferous spruce, shrubland, and treed fen habitats are expected to have a decrease in MDNN of less than 0.5% relative to the application case. Coniferous spruce, shrubland, and treed fen habitat types are expected to have a cumulative decrease in MDNN from reference conditions to the future case. Overall, NICO Project-related effects from habitat loss and fragmentation on upland breeding birds are are expected to be within the range of baseline conditions.

15.4.5.2 Habitat Quality, Movement, and Behaviour

15.4.5.2.1 Methods

In addition to direct habitat effects, changes to habitat quality from the NICO Project (including the NPAR) have the potential to indirectly affect the population size and distribution of upland breeding birds, through altered movement and behaviour of individuals. Upland breeding birds are a diverse array of species with a range of habitat requirements. A HSI model based on key life requisites would be very complex and so a different method of approximating the effect from the NICO Project on upland birds was used. Effects from the NICO Project and other developments in the RSA on upland breeding birds were estimated using relative abundance (density) data from baseline studies (Table 15.4-9). For the reference case, regional abundance estimates for upland breeding birds were calculated by multiplying mean density estimates (number of birds per 0.9 ha) for each habitat type by the area of the habitat type within the RSA (Table 15.4-9). All calculations were completed using raster file types within a GIS platform. Each 28.5 x 28.5 m raster cell in the RSA that represented a habitat type (other than deep water) was assigned a density value equal to the mean density estimate for the habitat type. Deep water habitat was not included in the analysis because upland breeding birds do not nest in this habitat type.

Table 15.4-9: Mean Relative Abundance of Upland Breeding Birds in Habitat Types within the Regional Study Area

Habitat Type	Number of Plots	Relative Abundance (Birds / 0.90 ha)	Area in RSA (ha)
Bedrock-Open Conifer	113	1.4	8 859
Burn	26	2.5	6 921
Coniferous Pine	0	1.3	3 394
Coniferous Spruce	164	2.7	50 720
Deciduous Aspen	18	1.3	753
Marsh/Graminoid Fen	16	2.4	1 894
Open Bog	2	2.3	1 238
Shrubland	9	5.9	556
Treed Bog	29	2.8	4 093
Treed Fen	72	2.8	1 629

Note: Deep water habitat was not included.
ha = hectares; RSA = regional study area

Coniferous pine was given a density of 1.33 birds per 0.9 ha. Although no upland breeding bird surveys were completed in this habitat type during baseline surveys, this estimate represents the lowest density of birds recorded in the RSA (in deciduous aspen habitat). Coniferous pine habitat in the boreal forest has been found to support a low density of upland breeding birds (Hobson and Bayne 2000). Also, only 0.4% of coniferous pine in the RSA will be lost with the development of the NICO Project and the cumulative loss of this habitat from all anticipated development is predicted to be 0.5% (Table 15.4-5). Therefore, the decrease in the number of birds with the loss of coniferous pine is expected to be negligible.

The relative abundance for coniferous spruce habitat used in the upland breeding bird model is an average of the baseline bird densities determined for coniferous spruce and mixedwood spruce-trembling aspen-paper birch habitats (Table 15.2-14). Mixedwood spruce-trembling aspen-paper birch was combined with coniferous spruce habitat in the ELC for the RSA, as these lowland cover types could not be separated (Section 14.2.2.1.1).

For all development scenarios, the quality of habitats (i.e., raster cell bird density values) associated with habitat types within the NICO Project footprint and footprints for previous, existing and future developments (e.g., existing and future road portages and corridors) were reduced to zero (direct effects). The effects of sensory disturbances on movements and behaviour were estimated to extend up to about 1 km from the perimeter of high human-use areas (Miramar 2005; Male and Nol 2005; Smith et al. 2005; Bayne et al. 2008). The effects of sensory disturbance were captured in the proposed model with a curvilinear one-asymptote relationship and a 1 km zone of influence (Figure 15.4-17). For example, at 100 m from an active development (e.g., NICO Project Lease Boundary), the baseline value for bird density was multiplied by a disturbance modifier equal to about 0.2, which reduced the density of birds by 80%. At a distance of approximately 800 m from a development, there is a correspondent 5% decrease in density.

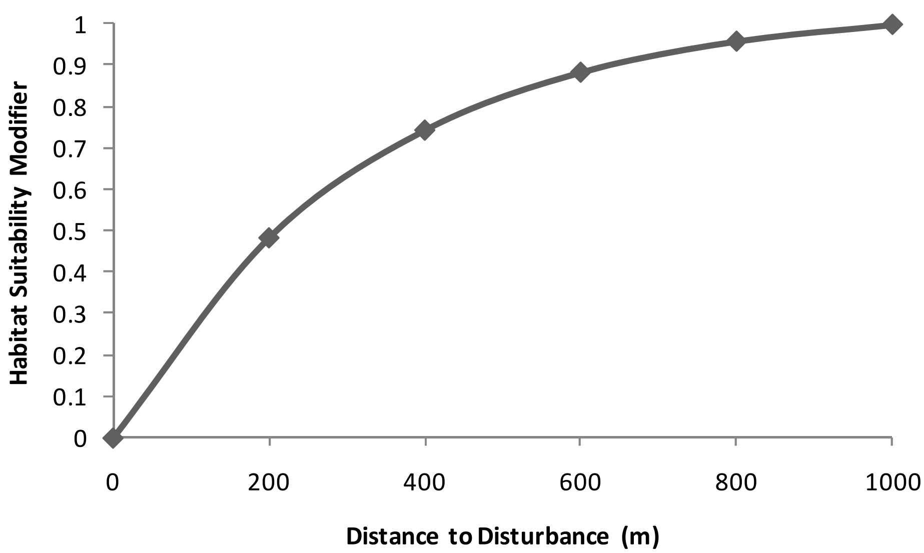


Figure 15.4-17: Relationship between Distance from Human Disturbance and Habitat Suitability Modifier for Upland Breeding Birds

Next, the adjusted densities were multiplied by the habitat area within the zone of influence. Abundances were then summed by habitat type within the footprint and across the zone of influence to estimate the reduction in bird abundance caused by direct and indirect effects from the NICO Project and other developments. Effects were expressed as relative differences in upland bird abundance between the 2010 baseline and reference case, between the application and 2010 baseline case, and between the future and application case. A coefficient of variation of 30% was applied to the resulting effect size values to approximate the uncertainty in modelled (sensory disturbance-adjusted) density estimates.

The following equations were used to calculate the relative change in upland breeding bird abundance for the different conditions on the landscape.

- (2010 baseline abundance – reference abundance) / reference abundance x 100
- (application case abundance – 2010 baseline abundance) / 2010 baseline abundance x 100
- (future case abundance - application case abundance) / application case abundance x 100

Although the indirect effects from noise are included in the HSI modelling, the potential effects on upland breeding birds from noise are also discussed separately.

15.4.5.2.2 Results

Direct loss of habitat from reference to 2010 baseline conditions is predicted to have decreased the amount of total bird abundance in the RSA by 0.2% (Table 15.4-10). The NICO Project is expected to decrease overall upland breeding bird abundance in the RSA by 1.6% relative to 2010 baseline conditions. Direct habitat loss from future developments is expected to decrease total bird abundance in the RSA by 0.1% relative to the application case. Cumulative loss of habitat from reference conditions to the future case is expected to decrease total bird abundance in the RSA by 1.8%.

Direct habitat loss from previous and existing developments decreased habitat-specific bird abundance by less than 1.0% for all habitat types (Table 15.4-10), relative to reference conditions. With the development of the NICO Project, habitat-specific decrease in bird abundance was less than 2.5% for all habitat types, except for bedrock-open conifer habitat, which is expected to have an abundance decrease of 6.5%, relative to 2010 baseline conditions. Future developments are expected to decrease habitat-specific upland bird abundance by less than or equal to 0.1%.

Indirect effects (e.g., noise, presence of humans, and vehicles) from previous and existing developments are predicted to have reduced upland breeding bird abundance in the RSA by a total of 0.3% relative to reference conditions (Table 15.4-10). Indirect effects from the NICO Project are expected to decrease total upland breeding bird abundance in the RSA by 2.4% relative to 2010 baseline conditions. Sensory disturbance from the development of the Proposed Tłįchǫ Road Route are expected to decrease total upland breeding bird abundance in the RSA by 1.0% relative to the application case. Cumulative sensory disturbance from previous, existing, and future developments in the RSA are expected to reduce upland breeding bird abundance by 3.6% from reference conditions to the future case.

Indirect effects from previous and existing developments are predicted to have reduced habitat-specific bird abundance by less than or equal to 0.6%, relative to reference conditions, for all habitat types, except bedrock-open conifer (Table 15.4-12). Indirect effects from previous and existing developments are predicted to have decreased bird abundance in bedrock-open conifer habitat by 1.5%, relative to reference conditions. Sensory disturbance from the NICO Project is expected to decrease habitat-specific bird abundance between 0.5% and 2.4%, except for bedrock-open conifer (decrease of 4.7%) and treed fen (decrease of 4.0%) habitats. Indirect effects from future developments are expected to decrease habitat-specific bird abundance by less than or equal to 3.2% relative to the application case. The cumulative effects of sensory disturbance from previous, existing, and future developments are expected to decrease habitat-specific bird abundance between 2.0% and 7.2%.

Table 15.4-10: Relative Changes in the Abundance of Upland Breeding Birds in the Regional Study Area from Reference to Reasonably Foreseeable Projects

Effects/ Habitat Type	Bird Abundance under Reference Conditions	% Change Reference to 2010 Baseline (30% CV)	% Change 2010 Baseline to Application (30% CV)	% Change Application to Future (30% CV)	% Cumulative Change from Reference (30% CV)
Direct Effects					
Bedrock-Open Conifer	14 076	-0.9 (0.3)	-5.6 (1.7)	<-0.1 (<0.1)	-6.5 (2.0)
Burn	19 533	<-0.1 (<0.1)	-2.1 (0.6)	<-0.1 (<0.1)	-2.1 (0.6)
Coniferous Pine	5 016	<-0.1 (<0.1)	-0.4 (0.1)	-0.1 (<0.1)	-0.5 (0.1)
Coniferous Spruce	152 723	-0.2 (<0.1)	-1.3 (0.4)	-0.1 (<0.1)	-1.5 (0.4)
Deciduous Aspen	1 113	<-0.1 (<0.1)	-2.3 (0.7)	-0.1 (<0.1)	-2.5 (0.7)
Marsh/Graminoid Fen	5 094	<-0.1 (<0.1)	-0.1 (<0.1)	<-0.1(<0.1)	-0.1 (<0.1)
Open Bog	3 122	-0.2 (<0.1)	-1.8 (0.5)	-0.1 (<0.1)	-2.0 (0.6)
Shrubland	3 671	<-0.1 (<0.1)	-1.4 (0.4)	-0.1 (<0.1)	-1.5 (0.4)
Treed Bog	12 507	-0.1 (<0.1)	-1.8 (0.6)	<-0.1 (<0.1)	-1.9 (0.6)
Treed Fen	4 996	<-0.1 (<0.1)	-0.3 (0.1)	-0.1 (<0.1)	-0.4 (0.1)
Total	**221 851**	**-0.2 (0.1)**	**-1.6 (0.5)**	**-0.1 (<0.1)**	**-1.8 (0.5)**
Indirect Effects					
Bedrock-Open Conifer	14 076	-1.5 (0.4)	-0.5 (0.2)	<-0.1 (<0.1)	-2.0 (0.6)
Burn	19 533	-0.1 (<0.1)	-4.7 (1.4)	<-0.1 (<0.1)	-4.7 (1.4)
Coniferous Pine	5 016	-0.1 (<0.1)	-2.3 (0.7)	-2.0 (0.6)	-4.3 (1.3)
Coniferous Spruce	152 723	-0.2 (0.1)	-2.4 (0.7)	-1.1 (0.3)	-3.7 (1.1)
Deciduous Aspen	1 113	-0.3 (0.1)	-1.1 (0.3)	-2.3 (0.7)	-3.6 (1.1)
Marsh/Graminoid Fen	5 094	<-0.1 (<0.1)	-1.3 (0.4)	-1.1 (0.3)	-2.4 (0.7)
Open Bog	3 122	-0.6 (0.2)	-1.2 (0.3)	-1.1 (0.3)	-2.9 (0.9)
Shrubland	3 671	<-0.1 (<0.1)	-0.7 (0.2)	-1.4 (0.4)	-2.1 (0.6)
Treed Bog	12 507	-0.3 (0.1)	-1.9 (0.6)	-0.4 (0.1)	-2.6 (0.8)
Treed Fen	4 996	<-0.1 (<0.1)	-4.0 (1.2)	-3.2 (1.0)	-7.2 (2.2)
Total	**221 851**	**-0.3 (0.1)**	**-2.4 (0.7)**	**-1.0 (0.3)**	**-3.6 (1.1)**

% = percent; CV = coefficient of variation, < = less than

Values with a less than (<) symbol indicate the change is approaching zero.

Few studies have focused on the effects of noise and disturbance to upland bird behaviour and movement. Behaviours most likely to be affected are nest site selection, territory selection, mate attraction, and foraging. Noise may also inhibit predator detection and interfere with mate/chick communication (Habib et al. 2007). Many boreal upland breeding bird species have lower abundance in noisy areas than pristine areas (Habib et al. 2007; Bayne et al. 2008). Noise sources from the NICO Project include mobile and stationary mining equipment, blasting, aircraft, and vehicles along the NPAR, existing winter roads, and Proposed Tłįchǫ Road Route. The results from modelling show that noise predictions slightly exceed benchmarks for mine operations, and are below benchmarks for the NPAR and Airstrip (Table 15.3-4). The distance for noise attenuation to background levels for core mining operations (including blasting) is 3.3 km (Table 15.3-5), but disturbance from blasting should occur infrequently (one blast per day). The distance for noise attenuation to reach background levels from the Airstrip is about 26 km. However, disturbance from large aircraft is expected to be infrequent (Appendix 8.III) and short-term (less than 5 minutes in duration).

According to Jalkotzy et al. (1997), many studies have found a relationship between traffic volume and bird densities adjacent to roads. For example, a 12% to 15% reduction in bird densities was observed within 500 m of roads with more than 50 cars per day (Reijnen et al. 1996). The distance for noise attenuation to background for traffic along existing winter roads and the NPAR during the construction phase is 0.9 km, which represents the maximum volume of traffic (63 vehicles per day over a 70 day winter road season) associated with the NICO Project (Appendix 8.III). During operations, the volume of traffic associated with the NICO Project along the Proposed Tłįchǫ Road Route and NPAR is anticipated to be 5 to 9 vehicles per day. For the assessment, noise from vehicles along the Proposed Tłįchǫ Road Route is also anticipated to approach background levels within 1 km of the right-of-way (i.e., maximum case during construction). The magnitude of the decrease in habitat quality for upland birds within 1 km along the NPAR and Proposed Tłįchǫ Road Route is predicted to approach or slightly exceed the limits of baseline conditions.

According to Trombulak and Frissell (2000), disturbances such as roads have the potential to change the reproductive success of wildlife species. Habib et al. (2008) found that pairing success of ovenbirds was significantly lower in noisy areas by compressor stations. Conversely, a study by Canaday and Rivadeneyra (2001) found noise to be a disturbance to birds only over distances less than 300 m. A study of Lapland longspurs by Male and Nol (2005) showed no difference in nest success between sites with high and low levels of human noise at the Ekati Diamond Mine. Overall, it appears as though some bird species may benefit from human disturbance (i.e., roads) while others do not (Spellerberg and Morrison 1998).

15.4.6 Waterbirds

15.4.6.1 Habitat Quantity and Fragmentation

15.4.6.1.1 Methods

The incremental and cumulative direct habitat effects on waterbirds from the NICO Project footprint (including the NPAR) and other previous, existing, and future developments in the RSA were analyzed through changes in the area and spatial configuration of habitat types on the landscape (i.e., landscape metrics). Although waterbirds are not present within the study area during the winter season, analyses were completed using the existing winter road footprints so that changes to terrestrial habitats from road portages were included, which represents the maximum disturbance to the study area. Methods for the habitat fragmentation analysis completed for marten (Section 15.4.3.1.1) are also applicable for waterbirds.

15.4.6.1.2 Results

The total area of the NICO Project footprint is estimated to be 485.4 ha. However, because the NICO Project Lease Boundary was used in the analyses, and the width of the NPAR was increased to match the raster cell size (28.5 m) in the land cover classification, the estimated NICO Project footprint is 1516 ha. The NICO Project will alter 1.6% of the 2010 baseline RSA. The cumulative direct disturbance from the NICO Project and previous, existing, and future developments is predicted to be about 1.9% relative to reference conditions. The Flooded Open Pit, CDF, constructed wetlands, Seepage Collection/Surge Ponds, and ditches will be permanent features on the landscape, covering approximately 84 ha.

High quality habitats for waterbirds include waterbodies and riparian fen areas (Section 15.4.6.2.1). The area of deep water habitats was predicted to have decreased by 0.5% from reference to 2010 baseline conditions (Table 15.4-5). Development of the NICO Project is expected to decrease the amount of deep water habitat within the RSA by 0.6%, relative to 2010 baseline conditions. This loss is primarily due to the infilling of the Grid Ponds. The cumulative decrease in deep water habitat area from reference conditions is 1.1%.

Increasing development on the landscape has also resulted in marginal changes to the number of and distance between similar habitat patches in the RSA. Previous and existing developments have increased the number of deep water habitat patches by 0.2% relative to reference conditions (Table 15.4-5). The NICO Project is expected to decrease the number of deep water habitat patches by 1.4% relative to 2010 baseline conditions and future developments are expected to decrease the number of deep water habitat patches by 0.2% relative to the application case. Mean distance to nearest neighbour for deep water habitat decreased by 0.2% from reference to 2010 baseline conditions. The NICO Project is expected to increase MDNN for deep water habitat by 0.6% (Table 15.4-5).

There is little literature available on the effects of habitat loss and fragmentation on waterbirds; however, they are highly mobile species, and it is predicted that the effects from habitat loss and fragmentation on waterbirds should be within the range of baseline conditions. The infilling of the Grid Ponds in the CDF will remove some waterbird habitat but this loss will likely only affect a few individuals of the population.

15.4.6.2 Habitat Quality, Movement, and Behaviour

15.4.6.2.1 Methods

In addition to direct habitat effects, changes to habitat quality from the NICO Project have the potential to indirectly affect the population size and distribution of waterbirds, through altered movement and behaviour of individuals. To estimate the change in habitat quality for waterbirds associated with the NICO Project and other developments, HSI modelling was completed within the RSA. To estimate the effects of the NICO Project on waterbirds, a HSI model was used to quantify habitat changes between the 2010 baseline and reference case, between the application and 2010 baseline case, and between the future and application case for the summer period. Good quality habitats were defined according to a threshold representing the minimum value below which the habitat is not suitable for reproduction and survival (Ackakaya et al. 2004). The standard threshold value is typically 0.5, which was used in this assessment, although there are cases where a lower value is used.

Waterbirds include waterfowl, such as dabbling and diving ducks, geese, loons, coots, and grebes. Following spring migration, mating pairs typically select a waterbody (known as a pair pond) or portion of a waterbody as their territory. For waterfowl, density and diversity can be strongly linked to the amount and spatial distribution of vegetation in a wetland (Murkin et al. 1997), as well as to the presence and abundance of aquatic invertebrates (Nummi et al. 1994; Haszard and Clark 2007). General use of habitat by waterbirds can be correlated with waterbody size, nutrient status, depth, amount of vegetation, structure of vegetation, and landscape surrounding the waterbody (e.g., Heglund et al. 1994; Rempel et al. 1997; Paszkowski and Tonn 2006). The availability of suitable nesting and brood-rearing habitat may be a key limiting factor for waterbird populations.

In boreal forest ecosystems, key habitats for waterfowl include beaver ponds, river deltas, and open water fens (Rempel et al. 1997). In the Mackenzie Delta region, broods of white-winged scoter are associated with wetlands with high abundances of invertebrates (i.e., amphipods) and wetlands with high concentrations of total phosphorous (Haszard and Clark 2007). Scoters and scaup are generally more abundant on waterbodies with emergent vegetation such as sedges and grasses (Decarie et al. 1995). In Yukon Flats National Wildlife Refuge, the occurrence and abundance of Pacific loons and horned grebes are influenced by waterbody area and limnological variables, such as water color, total phosphorous, pH, and chlorophyll, and most lakes larger than 40 ha supported at least one pair of Pacific loons in the refuge (Heglund et al. 1994).

The suitability of habitat variables for the waterbird HSI are described below. The habitat model was based on breeding habitat components and considered adjacent terrestrial habitat that can influence breeding conditions.

Breeding Habitat Suitability

a) Optimal waterbird habitats consisted of lakes with delta-like habitat created from the mouth of a large tributary (e.g., greater than or equal to 4^{th} order watercourses) and marsh-graminoid fens (greater than 1 ha in size) adjacent to open water.

b) Optimal conditions included waterbodies with water cover adjacent to fens (versus bedrock). Open water provides foraging habitat, while wetland vegetation cover provides protection from predators and from inclement weather.

c) Moderate quality habitat was characterized by water cover representing lake habitat surrounded by bedrock, as well as lakes without deltas and large watercourses (greater than 3^{rd} order). Although such habitat types may provide foraging conditions that persist through the summer, emergent and aquatic vegetation is likely sparse and limited to the shoreline.

d) Poor quality habitat was characterized by bog habitat and small watercourses (less than 3^{rd} order).

e) Habitat conditions were enhanced by the presence of fire. Runoff from recently burned watersheds and direct ash deposition from wildfire can enhance nutrient concentrations and primary production in waterbodies (McEachern et al. 2000).

f) Habitat suitability was reduced with proximity to major disturbances (e.g., NICO Project Lease Boundary).

Waterbird HSI Formula

$$HSI = \text{Max}\left[MT, AT \times \left(\frac{RF + RB}{2}\right), LD\right] \times F \times HSM$$

MT = marsh habitat types were ranked. Cells of marsh-graminoid fens not directly adjacent to water (i.e., greater than 57 m from the waterbody shoreline) = 0.5, whereas cells of marsh-graminoid fens directly adjacent to water (i.e., within 57 m of the waterbody shoreline = 1. Only fens greater than 1 ha in size were considered.

AT = non-marsh aquatic habitat types were ranked. Cells of lakes or ponds = 1.0, and rivers greater than 3^{rd} order in size = 0.5 (e.g., Marian River); all other cells = 0.

RF = riparian fen cover (within 57 m of shorelines) modified the water cells for non-marsh aquatic habitat. The modifier is described as Y = 0.5 + 0.01X, where cells of waterbodies with more than 50% of shorelines as fen habitat were unchanged (i.e., the modifier was 1.0) (Figure 15.4-18a).

RB = riparian boulder cover (within 57 m of shorelines) also modified the water cells for non-marsh, aquatic habitat. The modifier is described as 1.0 for cells of waterbodies with riparian areas with 0 to 50% bedrock, and described as Y = 1.5 - 0.01X for cells of waterbodies with riparian areas with greater than 50% bedrock (Figure 15.4-18b).

LD = lakes with a delta (i.e., a mouth of a tributary greater than 3rd order in size; e.g., Hislop Lake) were ranked such that cells of lakes that have a delta = 1; all other cells = 0.

F = fire in the riparian zone (i.e., within 57 m of shoreline) influenced the values of the cells of the associated waterbody. The modifier = 1.0 for all water cells of the waterbody if at least one riparian zone cell was adjacent to a recent burn; whereas the modifier = 0.95 if recent burns were absent in the riparian area.

HSM = habitat suitability modifier. Change between 0 m to 1 000 m to disturbance was defined as a curvilinear one-asymptote relationship with equation $Y = 1.0442 \times (1 - 0.9969^{distance})$ (Figure 15.4-19).

The following equations were used to calculate the relative change in the amount of different quality habitats for the different conditions on the landscape.

- (2010 baseline area – reference area) / reference area x 100
- (application case area – 2010 baseline area) / 2010 baseline area x 100
- (future case area - application case area) / application case area x 100

Although the indirect effects from noise are included in the HSI modelling, the potential effects on waterbirds from noise are also discussed separately.

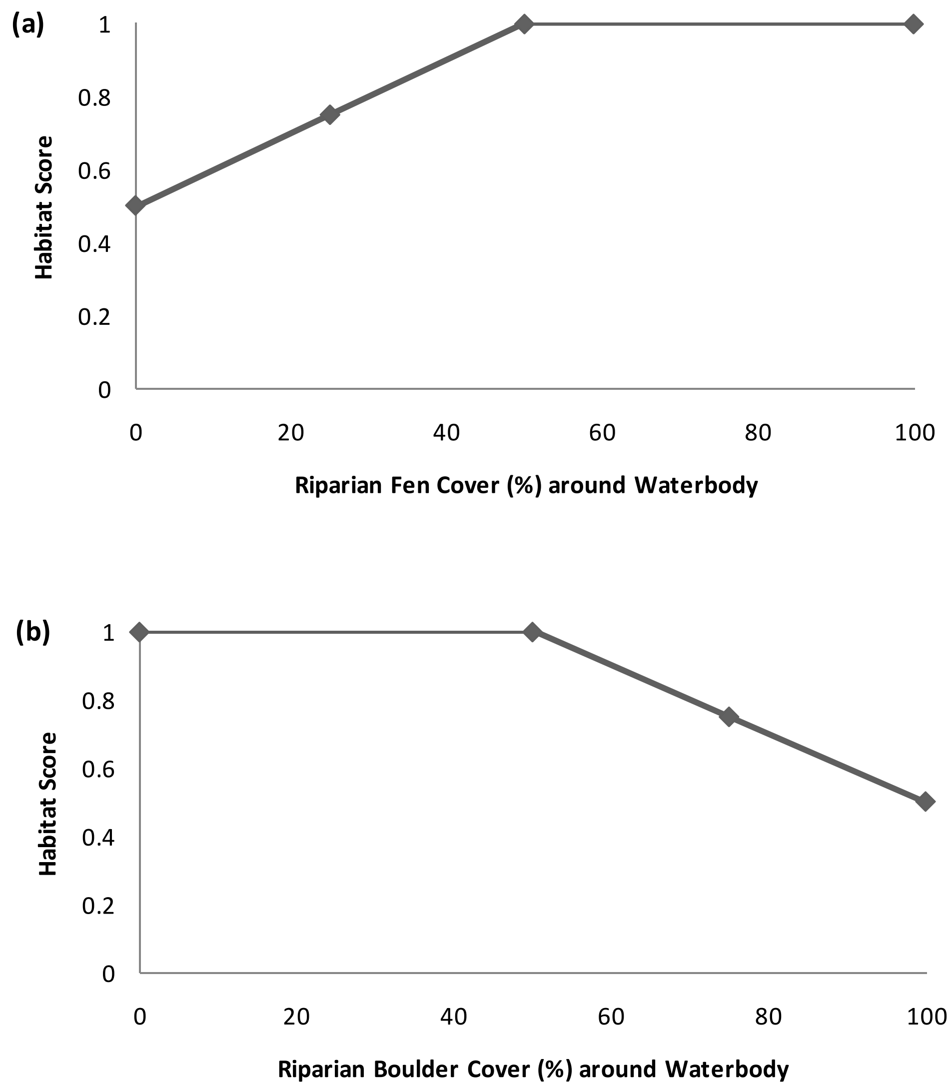


Figure 15.4-18: Relationship between Suitability Scores and Two Habitat Variables for Waterbirds

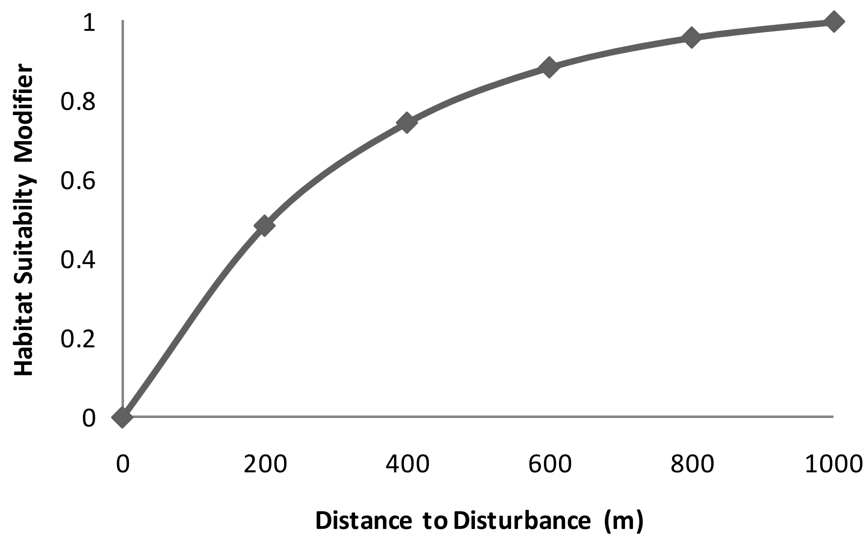


Figure 15.4-19: Relationship between Distance from Human Disturbance and Habitat Suitability Modifier for Waterbirds

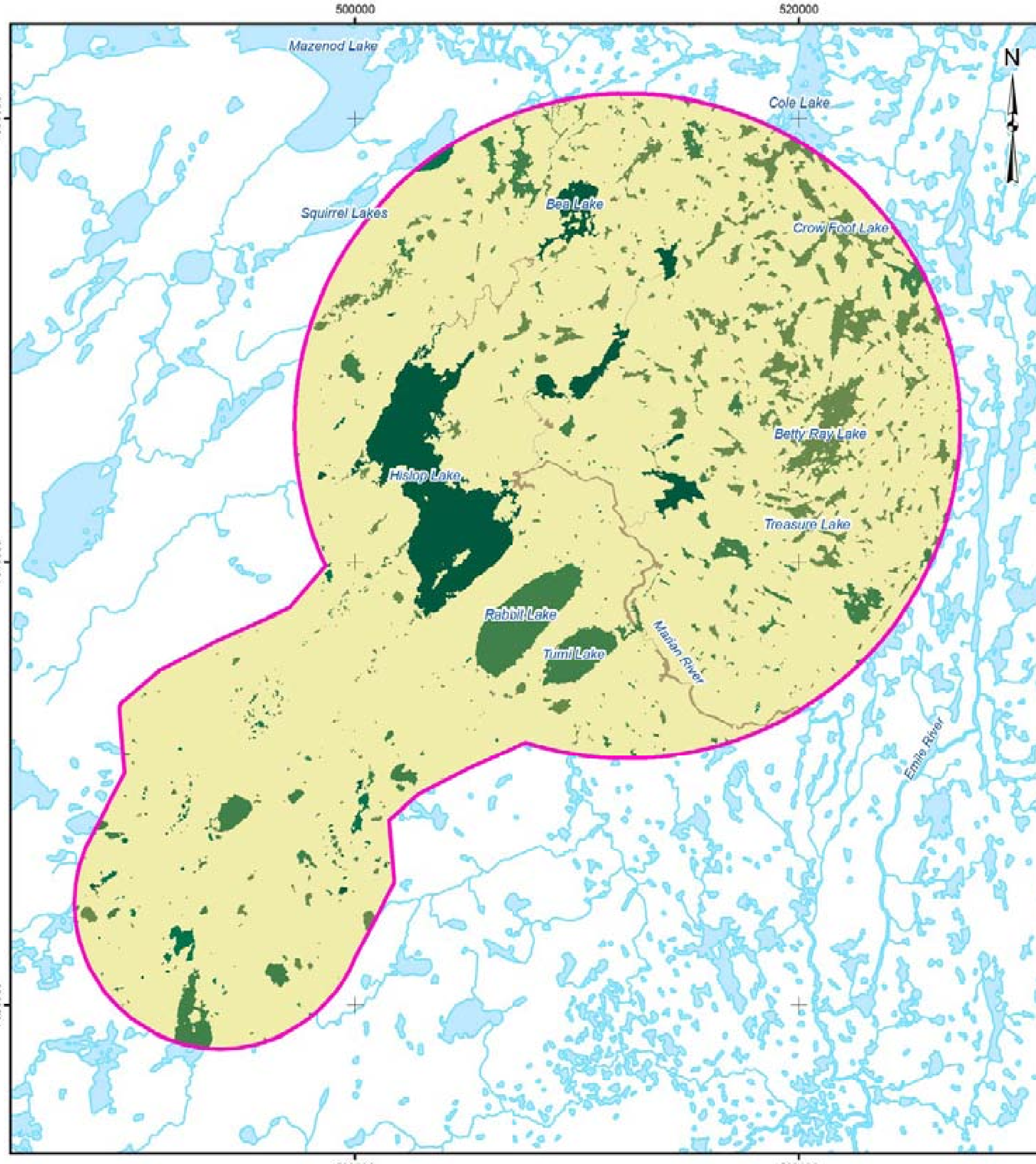
15.4.6.2.2 Results

Good quality waterbird habitat comprised 15.4% of the RSA under reference conditions, and changes little throughout all assessment cases (Table 15.4-11). All assessment periods indicate that good quality waterbird habitat will be decrease by less than 1.5% from previous assessment periods. The cumulative decrease of good quality waterbird habitat from the NICO Project and previous, existing and potential future developments in the RSA is approximately 2% (Table 15.4-11). Habitat suitability modelling for reference conditions, 2010 baseline conditions, application case, and future case are shown in Figure 15.4-20 to Figure 15.4-23.

Table 15.4-11: Relative Changes in the Availability of Different Quality Habitats for Waterbirds in the Regional Study Area from Reference to Reasonably Foreseeable Projects

Habitat Suitability (Range of Habitat Suitability Scores)	Reference		% Change Reference to 2010 Baseline	% Change 2010 Baseline to Application	% Change Application to Future	% Cumulative Change from Reference
	Area (ha)	% RSA				
Poor (0-0.49)	80 294	84.7	0.1	0.3	<0.1	0.4
Good (0.50-1)	14 564	15.4	-0.4	-1.4	<-0.1	-1.8

ha = hectares; % = percent; RSA = Regional Study Area



LEGEND

WATERCOURSE
WATERBODY
REGIONAL STUDY AREA

HABITAT SUITABILITY INDEX (HSI)

0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

5 0 5
SCALE 1:250,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE
HABITAT SUITABILITY FOR WATERBIRDS: REFERENCE CONDITIONS

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-040-GIS			
PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	LD	09 Feb. 2011	FIGURE: 15.4-20
GIS	MK	24 Feb. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

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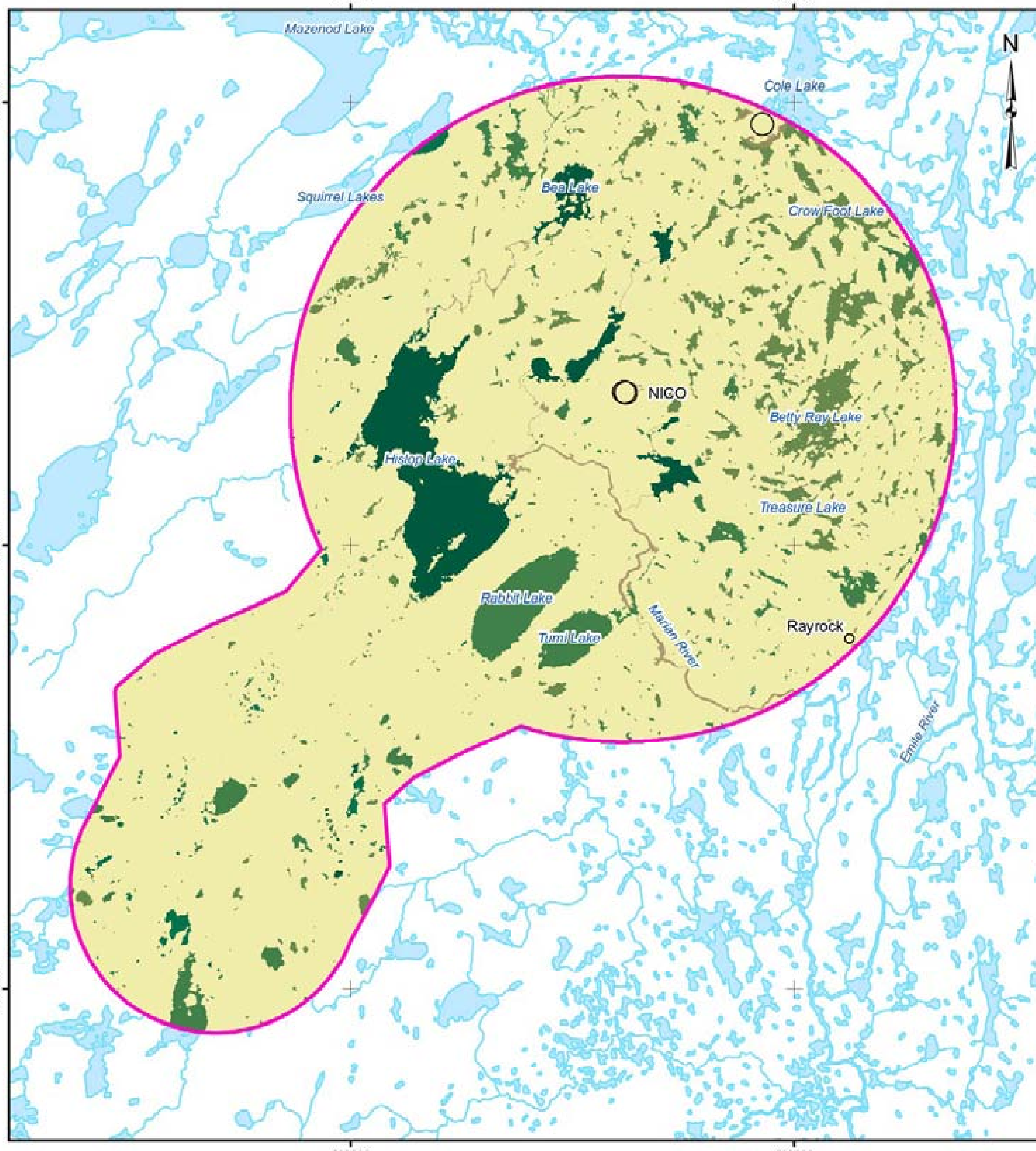


LEGEND

WATERCOURSE	
WATERBODY	
HISTORIC REMEDIATED AND NON-REMEDIATED SITE	
MINERAL EXPLORATION	
REGIONAL STUDY AREA	

HABITAT SUITABILITY INDEX (HSI)

0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

5 0 5

SCALE 1:250,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

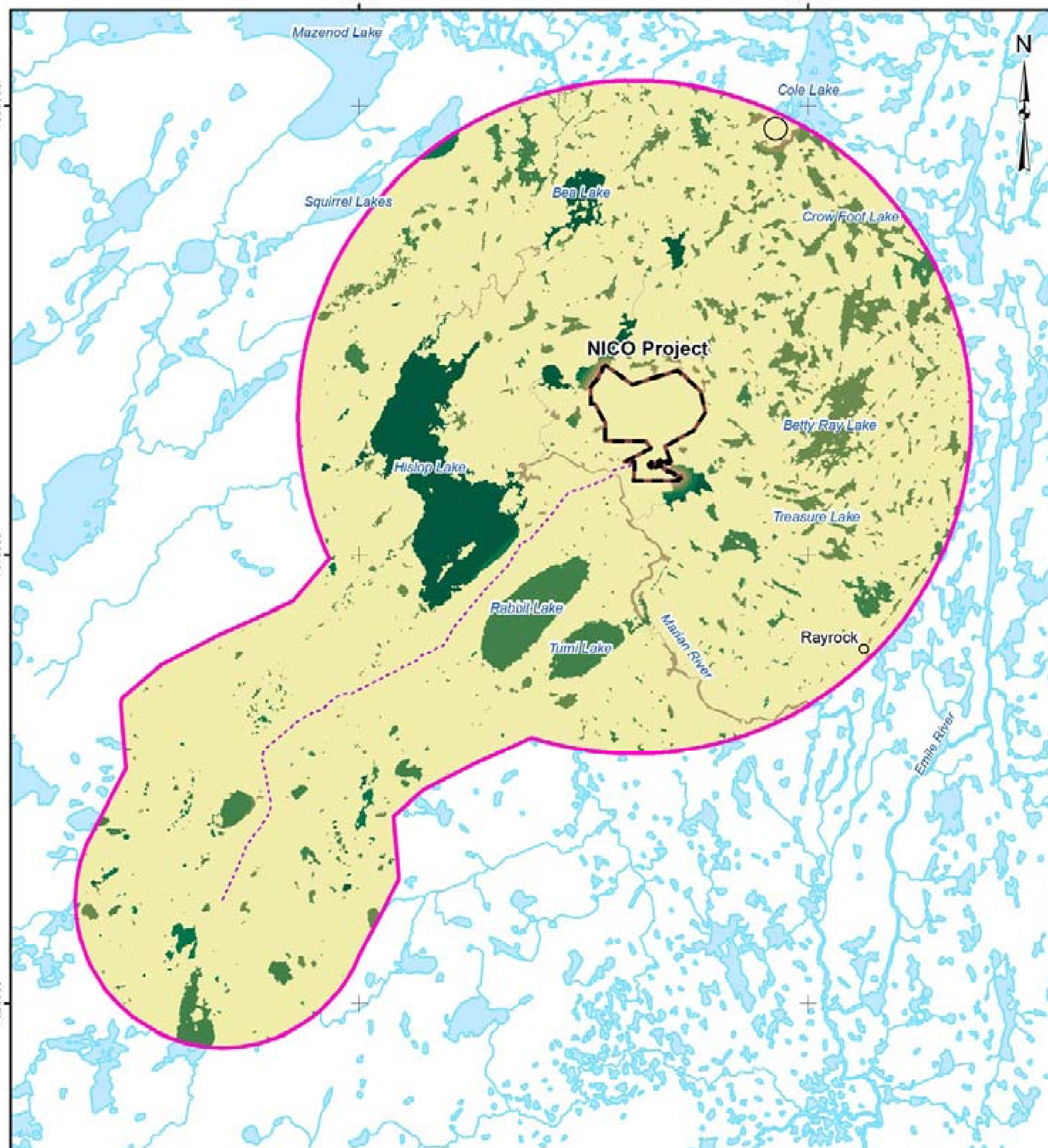
TITLE
HABITAT SUITABILITY FOR WATERBIRDS: 2010 BASELINE CONDITIONS

FILE No. EA-Wild-041-GIS

PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	LD	09 Feb. 2011	
GIS	MK	03 Apr. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

Golder Associates
Edmonton, Alberta

FIGURE: 15.4-21



LEGEND

PROJECT LEASE BOUNDARY
PROPOSED NICO PROJECT ACCESS ROAD
WATERCOURSE
WATERBODY
HISTORIC REMEDIATED AND NON-REMEDIATED SITE
MINERAL EXPLORATION
REGIONAL STUDY AREA

HABITAT SUITABILITY INDEX (HSI)

0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

SCALE 1:250,000 — 5 0 5 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

HABITAT SUITABILITY FOR WATERBIRDS: APPLICATION CASE

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-042-GIS

PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
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GIS	MK	03 Apr. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

FIGURE: 15.4-22

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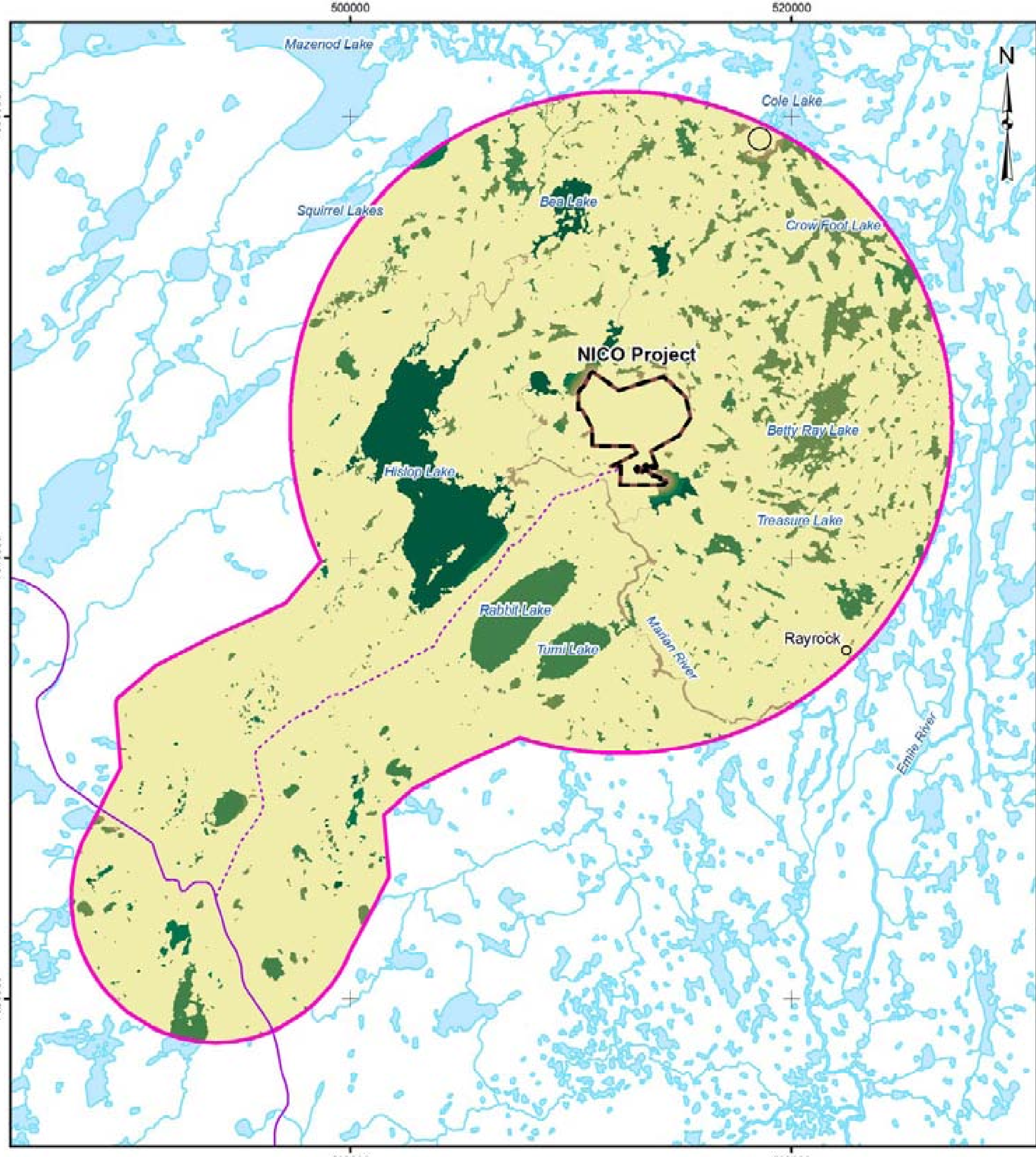

LEGEND

- PROJECT LEASE BOUNDARY
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁĮCHǪ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- HISTORIC REMEDIATED AND NON-REMEDIATED SITE
- MINERAL EXPLORATION
- REGIONAL STUDY AREA

HABITAT SUITABILITY INDEX (HSI)

0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

5 0 5
SCALE 1:250,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE
HABITAT SUITABILITY FOR WATERBIRDS: FUTURE CASE

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-043-GIS				
PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	LD	09 Feb. 2011	FIGURE: 15.4-23	
GIS	MK	03 Apr. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

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Few studies have focused on the effects of noise and disturbance to waterbird behaviour and movement. However some studies (Korschgren et al. 1985; Ward and Stein 1989; Dahlgren and Korschgren 1992) have found that noise and motion disturbances originating from man-made sources can negatively affect waterbird behaviour. Disturbance effects on waterbirds may include displacement, nest abandonment, reduced nest success, or reduced foraging efficiency (Hockin et al. 1992; Dahlgren and Korschgren 1992). Concerns regarding noise and birds include noises that startle or disturb nesting birds and noises that mask mating calls, affecting the ability of males to attract a mate. Studies have found that several waterbird species may eventually become habituated to high noise levels (Busnel and Briot 1980; Ronconi et al. 2004).

Although noise and sensory disturbance can alter the movement and behaviour of wildlife, particularly hunted species like waterbirds (Bommer and Bruce 1996), the specific effects of NICO Project-related sensory disturbance on many species of waterbirds are unknown. A relatively low density of waterbirds is expected near the site and only a small proportion of the population is expected to be affected by sensory disturbance from the NICO Project. Although loons are relatively sensitive to human disturbance (Ehrlich et al. 1988), analysis of information collected at the Ekati Diamond Mine suggested that the level of mining activities had not negatively influenced the presence of loons adjacent to the mine site (BHPB 2003). Minimum distance recommendations to reduce the effects to waterbird behaviour from man-made noise are 200 to 300 m for traffic disturbance (Fruzinski 1977; Mooij 1982; Madsen 1985) and 3 to 4 km for aircraft disturbances (Davis and Wisely 1974; Berger 1977).

Noise sources from the NICO Project include mobile and stationary mining equipment, blasting, aircraft, and vehicles along the NPAR, existing winter roads, and Proposed Tłı̨chǫ Road Route. The results from modelling show that noise predictions slightly exceed benchmarks for mine operations, and are below benchmarks for the NPAR and Airstrip (Table 15.3-4). The distance for noise attenuation to background levels for core mining operations (including blasting) is 3.3 km (Table 15.3-5), but disturbance from blasing should be infrequent (approximately once per day). The distance for noise attenuation to reach background levels from the Airstrip is about 26 km. However, disturbance from large aircraft is expected to be infrequent (Appendix 8.III) and short-term (less than 5 minutes in duration).

The distance for noise attenuation to background for traffic along the winter roads and NPAR during the construction phase is 0.9 km (Appendix 8.III). Similarly, noise from vehicles along the Proposed Tłı̨chǫ Road Route is anticipated to approach background levels within 1 km of the right-of-way. The magnitude of the decrease in habitat quality for waterbirds within 1 km along the NPAR and Proposed Tłı̨chǫ Road Route is predicted to approach or slightly exceed the limits of baseline conditions.

15.4.7 Raptors

15.4.7.1 Habitat Quantity and Fragmentation

15.4.7.1.1 Methods

The incremental and cumulative direct habitat effects on raptors (including ravens, which are functional raptors) from the NICO Project footprint (including the NPAR) and other previous, existing, and future developments in the RSA were analyzed through changes in the area and spatial configuration of habitat types on the landscape (i.e., landscape metrics). Although raptors (except ravens) are not present within the study area during the winter season, analyses were completed using the existing winter road footprints so that changes to terrestrial habitats from road portages were included, which represents the maximum disturbance to the study area. Methods for the habitat fragmentation analysis completed for marten (Section 15.4.3.1.1) are also applicable for raptors.

15.4.7.1.2 Results

The total area of the NICO Project footprint is estimated to be 485.4 ha. However, because the NICO Project Lease Boundary was used in the analyses, and the width of the NPAR was increased to match the raster cell size (28.5 m) in the land cover classification, the estimated NICO Project footprint is 1516 ha. The NICO Project will alter 1.6% of the 2010 baseline RSA. The cumulative direct disturbance from the NICO Project and previous, existing, and future developments is predicted to be about 1.9% relative to reference conditions. The Flooded Open Pit, CDF, constructed wetlands, Seepage Collection/Surge Ponds, and ditches will be permanent features on the landscape, covering approximately 84 ha.

Short-eared owls are open country, ground nesting species that inhabit marshes, bogs, taiga and tundra (reviewed in Wiggins et al. 2006). High quality habitats for short-eared owl within the RSA are marsh/graminoid fen and open bog habitats (Section 15.4.7.2.1). At the scale of the RSA, the relative change in the amount of marsh/graminoid fen and open bog habitats from reference to 2010 baseline conditions is less than 0.3% for each habitat type (Table 15.4-5). Incremental loss of marsh/graminoid fen and open bog habitat with the development of the NICO Project is 0.1% and 1.7%, respectively, relative to 2010 baseline conditions. Future developments are expected to decrease the amount of marsh/graminoid fen and open bog habitat in the RSA by less than or equal to 0.1%. The cumulative loss of marsh/graminoid fen and open bog habitat in the RSA from reference conditions to the future case is predicted to be 0.3% and 2.1%, respectively.

Increasing development on the landscape has also resulted in marginal changes to the number of and distance between similar habitat patches in the RSA. The number of marsh/graminoid fen patches in the RSA increase incrementally throughout all modelling scenarios and there is a cumulative increase of 0.7% from reference conditions to the future case. The number of open bog habitat patches in the RSA decreases from reference to 2010 baseline conditions and from 2010 baseline conditions to the application case; however, the number of open bog patches is expected to increase with the development of the Proposed Tłįchǫ Road Route (by 0.1%) relative to the application case. The cumulative decrease of number of open bog habitat patches in the RSA from reference conditions to the future case is anticipated to be 2.3%.

Mean distance to nearest neighbour for marsh/graminoid fen has incremental decreases through all modelling scenarios and has a cumulative decrease in MDNN of 2.4% from reference conditions to the future case. The NICO Project is expected to increase MDNN for open bog habitat by 1.1% relative to 2010 baseline conditions. Changes in open bog MDNN from reference to 2010 baseline conditions and the application to the future case are less than or equal to 0.1%. The cumulative decrease in open bog MDNN from reference conditions to the future case is expected to be 1.0%.

Peregrine falcons prefer to nest on cliffs that have open gulfs of air (i.e., unconfined areas) (White et al. 2002). Most of the RSA is comprised of level to rolling terrain but the bedrock terrain unit, which covers 10.1% of the RSA has the potential to contain steep areas (i.e., cliffs) (Section 13.2.2.1.1). Previous and existing developments have decreased the amount of bedrock-open conifer habitat in the RSA by 0.9% from reference conditions (Table 15.4-5). The NICO Project is expected to decrease the amount of bedrock-open conifer habitat in the RSA by 5.5% from 2010 baseline conditions and there is no change in the amount of bedrock-open conifer in the RSA expected with future developments. The cumulative amount of bedrock-open conifer that is expected to be lost because of previous, existing, and future developments is 6.4% relative to reference conditions. Cumulative changes in the number and distance between bedrock-open conifer patches are less than 2%.

Bald eagles typically nest on cliffs or in forested areas adjacent to large, fish-bearing waterbodies (Buehler 2000). Previous and existing developments have decreased the amount of deep water habitat in the RSA by 0.5% relative to reference conditions. The NICO Project is expected to decrease the amount of deep water habitat by 0.6% relative to 2010 baseline conditions. The cumulative loss of deep water habitat from reference conditions is expected to be 1.1%. Cumulative changes in the number and distance between deep water patches are less than 2%. Overall, it is predicted that the effects from habitat loss and fragmentation on raptors should be within the range of baseline conditions.

15.4.7.2 Habitat Quality, Movement, and Behaviour

15.4.7.2.1 Methods

In addition to direct habitat effects, changes to habitat quality from the NICO Project have the potential to indirectly affect the population size and distribution of raptors, through altered movement and behaviour of individuals. Habitat suitability index modeling was completed for the short-eared owl in the RSA to quantify habitat changes between the 2010 baseline and reference case, between the application (NICO Project) and 2010 baseline case, and between the future and application case during the summer period. Good quality habitats were defined according to a threshold representing the minimum value below which the habitat is not suitable for reproduction and survival (Ackakaya et al. 2004). The standard threshold value is typically 0.5, which was used in this assessment, although there are cases where a lower value is used.

Although no short-eared owls were observed during baseline studies, a habitat suitability model was developed to predict potential effects from the NICO Project and other developments on this territorial and federal listed species (ENR 2010a, COSEWIC 2010, *SARA* 2011). Peregrine falcon is a federal listed species (COSEWIC 2010, *SARA* 2011) and 1 productive nest site was observed during baseline studies (Section 15.2.4.8.1). A HSI model was not developed for this species as the broad-scale habitat map determined from the ELC would not provide a reasonable predictor for potential peregrine nesting sites (i.e., most of the bedrock-open conifer land cover type is not suitable for peregrine nest sites).

The short-eared owl is an open country, ground-nesting species that inhabits marshes, bogs, taiga, and tundra (reviewed in Wiggins et al. 2006). Nests are typically located on dry sites with dense vegetation cover to conceal incubating females. Tundra with areas of small willow represented preferred sites near Churchill, Manitoba (COSEWIC 2008). The owls are ground nesters and may be susceptible to predators that often thrive in fragmented areas. Reforestation in some areas may also contribute to habitat loss; however, in general, this species is not sensitive to human activity and nests are generally difficult to locate (Leasure and Holt 1991). Further, habitat loss and fragmentation appears to be an issue only in areas with widespread development and with long histories of development (e.g., Canadian prairies, southern Ontario; COSEWIC 2008). In addition to the availability of nesting habitat, population dynamics may be closely linked to the density of primary prey, such as shrews, mice, and lemmings (reviewed in Wiggins et al. 2006). Small mammals generally make up to 75% of their diet. It is thought that food abundance is the primary factor influencing habitat choice during both summer and winter seasons.

The suitability of variables for the short-eared owl HSI model is described below. The model was based on breeding requisites of upland and wetland habitat at regional and local scales. The landscape cover modifiers were based on an approximate home range size of 82 ha (Clark 1975). To the knowledge of the authors of this assessment, the proposed HSI model is one of the first developed for the short-eared owl.

Breeding Habitat Suitability

a) Optimal habitats at the regional scale included areas with at least 23 ha of contiguous cover of marsh/graminoid fen and open bog, and areas with 100% graminoid fen and open bog within a 0.5 km radius. Wiggins et al. (2006) contends that short-eared owls require relatively large tracts of open habitat for successful reproduction.

b) Optimal habitats at the local scale included raster cells classified as marsh/graminoid fen. The short-eared owl is a ground-nesting species that inhabits wetlands and grassland (Wiggins et al. 2006).

c) Moderately suitable habitats at the regional scale included areas with at least 23 ha of contiguous cover of marsh/graminoid fen and open bog, and areas with at least 50% of the surrounding landscape as marsh/graminoid fen and open bog.

d) Moderately suitable habitats at the local scale included raster cells classified as open bog, treed fen, and treed bog.

e) Marginal habitats at the regional scale included areas with little to no cover of open peatland habitat.

f) Habitat suitability was reduced with proximity to major disturbances (e.g., NICO Project Lease Boundary).

Short-eared Owl HSI Formula

$$Index = \frac{(LC + \%LC + HT)}{3} \times HSM$$

LC = landscape cover calculation of marsh/graminoid fen and open bog. Contiguous cover less than 23 ha = 0.5, contiguous cover greater than 82 ha =1, and a linear relationship was assumed for scores between 23 and 82 ha (Y = 0.305 + 0.00847X) (Figure 15.4-24a).

%LC = percentage of landscape cover (within a 0.5 km radius) of marsh/graminoid fen and open bog, where 0% = 0.1, 100% = 1.0, and for scores between 0 and 100%, Y = 0.1 + 0.009X (Figure 15.4-24b).

HT = habitat type of the raster cell was ranked such that marsh/graminoid fen = 1.0, open bog = 0.75, and treed peatland types (i.e., treed bog and treed fen) = 0.5; all raster cells in other habitat types = 0.

HSM = habitat suitability modifier. Change between 0 m to 1 000 m to disturbance was defined as a curvilinear one-asymptote relationship with equation $Y = 1.0442 \times (1 - 0.9969^{distance})$ (Figure 15.4-25).

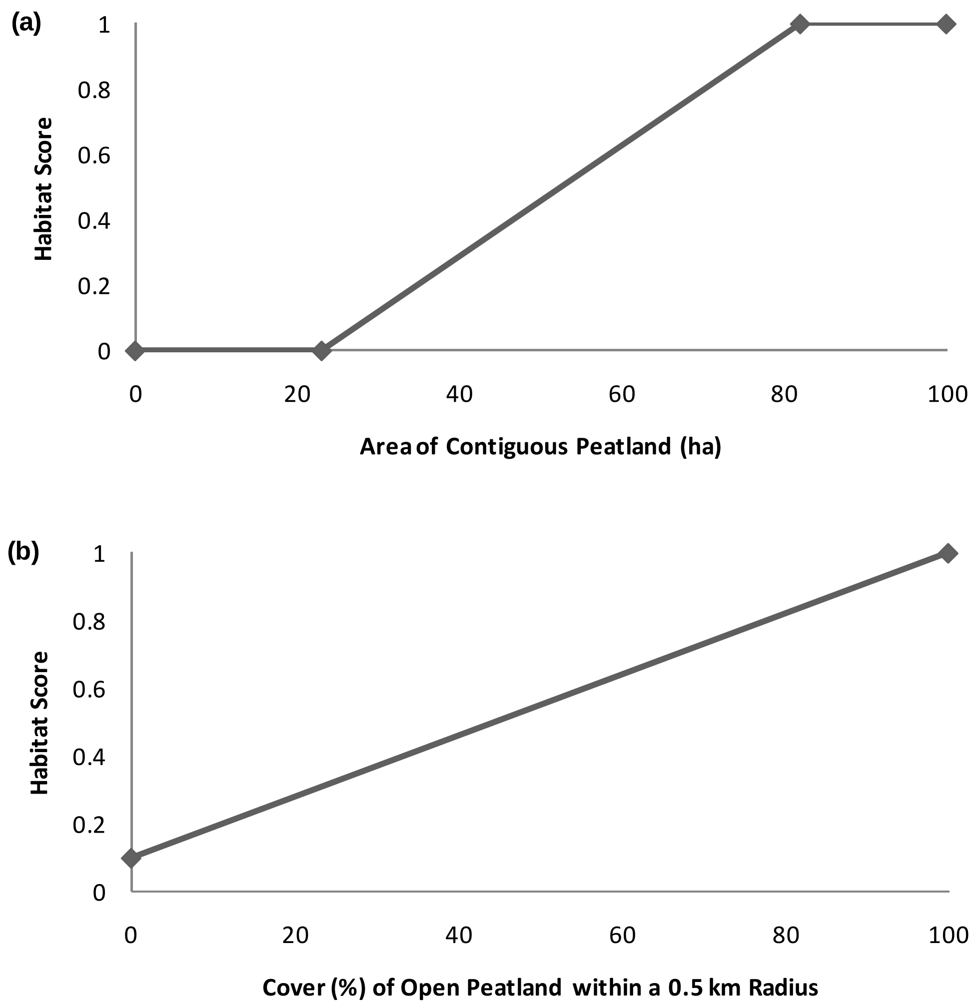


Figure 15.4-24: Relationship between Suitability Scores and Two Habitat Variables for Short-Eared Owl

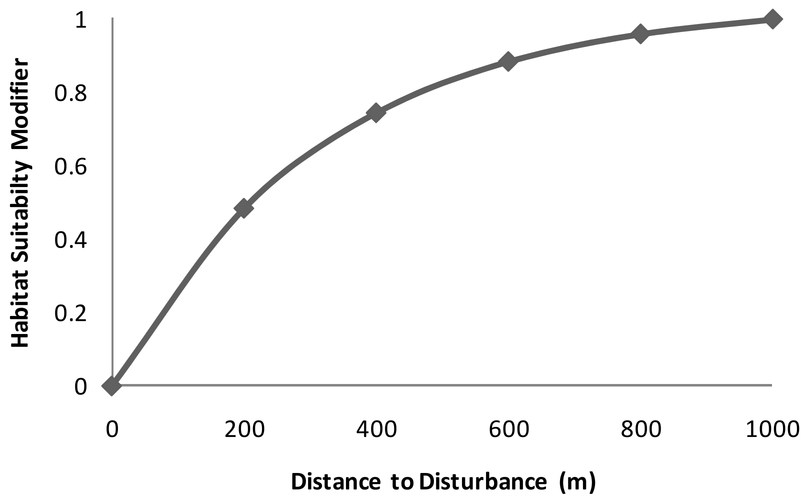


Figure 15.4-25: Relationship between Distance from Human Disturbance and Habitat Suitability Modifier for Short-eared Owl

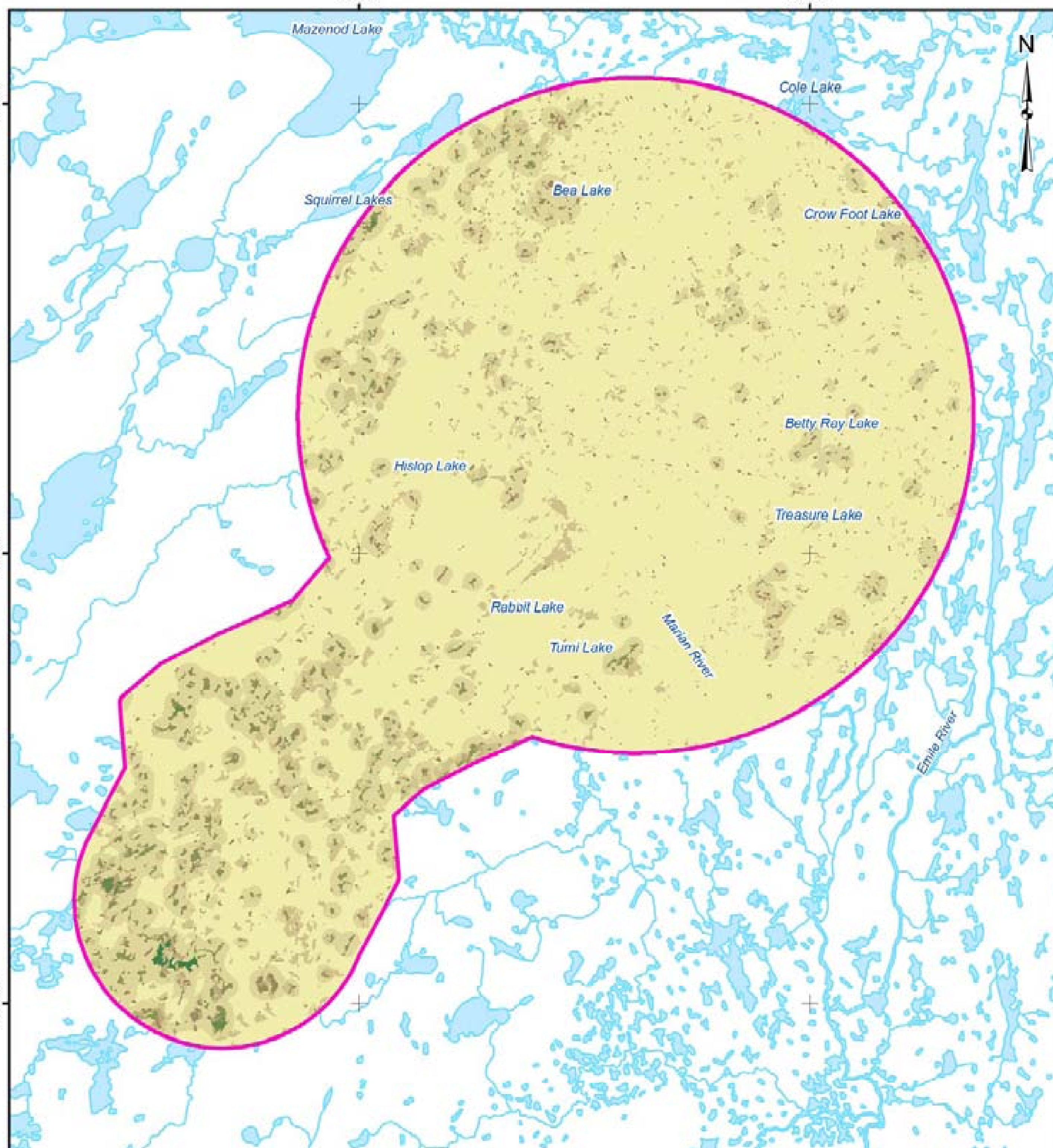
15.4.7.2.2 Results

There was approximately 2.2% of good quality short-eared owl habitat present within the RSA under reference conditions (Table 15.4-12). Previous and existing developments decreased the amount of good quality short-eared owl habitat by 0.1% relative to reference conditions. The development of the NICO Project is expected to decrease good quality habitat by 3.7% relative to 2010 baseline conditions. The construction of the Proposed Tłįchǫ Road Route is expected to decrease the amount of good quality short-eared owl habitat by 3.2% relative to the application case. Cumulative loss of good quality habitat from previous, existing, and future developments is estimated to be 7.1% relative to reference conditions to the future case (Table 15.4-12). Habitat suitability modelling for reference conditions, 2010 baseline conditions, baseline case, application case, and future case are shown in Figure 15.4-26 to Figure 15.4-29.

Table 15.4-12: Relative Changes in the Availability of Different Quality Habitats for Short-Eared Owl in the Regional Study Area from Reference to Reasonably Foreseeable Projects

Habitat Suitability (Range of Habitat Suitability Scores)	Reference		% Change Reference to 2010 Baseline	% Change 2010 Baseline to Application	% Change Application to Future	% Cumulative Change from Reference
	Area (ha)	% RSA				
Poor (0 to 0.49)	92 814	97.8	0.0	0.1	0.1	0.2
Good (0.50 to 1)	2 045	2.2	-0.1	-3.7	-3.2	-7.1

ha = hectares; % = percent; RSA = Regional Study Area



LEGEND

WATERCOURSE

WATERBODY

REGIONAL STUDY AREA

HABITAT SUITABILITY INDEX (HSI)

0

0.1

0.2

0.3

0.4

0.5

0.6

0.7

0.8

0.9

1.0

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.

Projection: UTM Zone 11 Datum: NAD 83

5 0 5

SCALE 1:250,000 KILOMETRES

FORTUNE MINERALS LIMITED

NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

HABITAT SUITABILITY FOR SHORT-EARED OWL: REFERENCE CONDITIONS

Golder Associates

Edmonton, Alberta

FILE No. EA-Wild-044-GIS

PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	LD	09 Feb. 2011	**FIGURE: 15.4-26**	
GIS	MK	23 Feb. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

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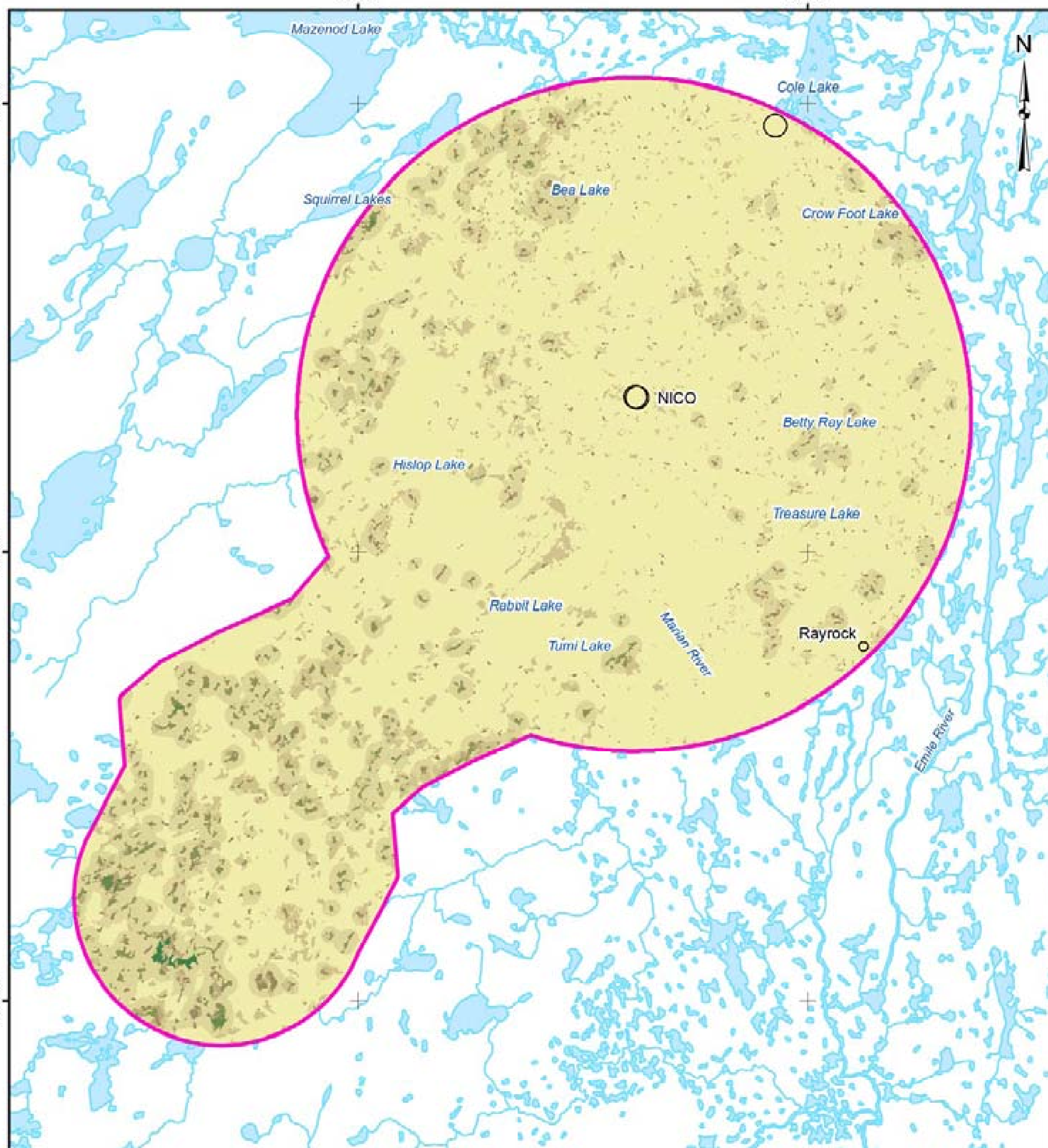

LEGEND

WATERCOURSE
WATERBODY
HISTORIC REMEDIATED AND NON-REMEDIATED SITE
MINERAL EXPLORATION
REGIONAL STUDY AREA

HABITAT SUITABILITY INDEX (HSI)

0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

5 0 5
SCALE 1:250,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

HABITAT SUITABILITY FOR SHORT-EARED OWL: 2010 BASELINE CONDITIONS

FILE No. EA-Wild-045-GIS

PROJECT No. 09-1373-1004		SCALE AS SHOWN	REV. 0
DESIGN	LD	09 Feb. 2011	
GIS	MK	03 Apr. 2011	
CHECK	GRA	03 Apr. 2011	
REVIEW	GRA	03 Apr. 2011	

Golder Associates
Edmonton, Alberta

FIGURE: 15.4-27

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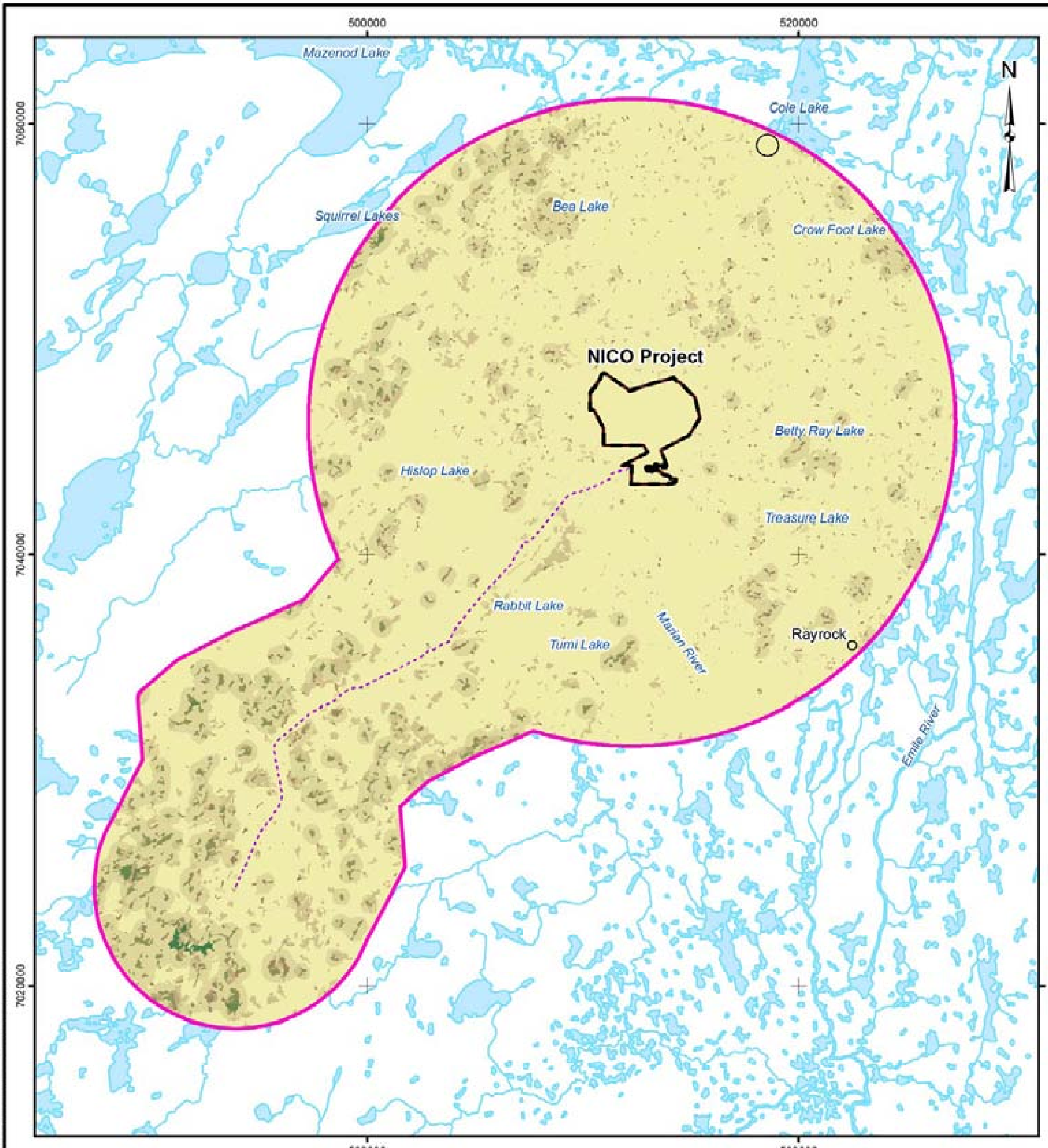


LEGEND

- PROJECT LEASE BOUNDARY
- PROPOSED NICO PROJECT ACCESS ROAD
- WATERCOURSE
- WATERBODY
- HISTORIC REMEDIATED AND NON-REMEDIATED SITE
- MINERAL EXPLORATION
- REGIONAL STUDY AREA

HABITAT SUITABILITY INDEX (HSI)

0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

5 0 5
SCALE 1:250,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

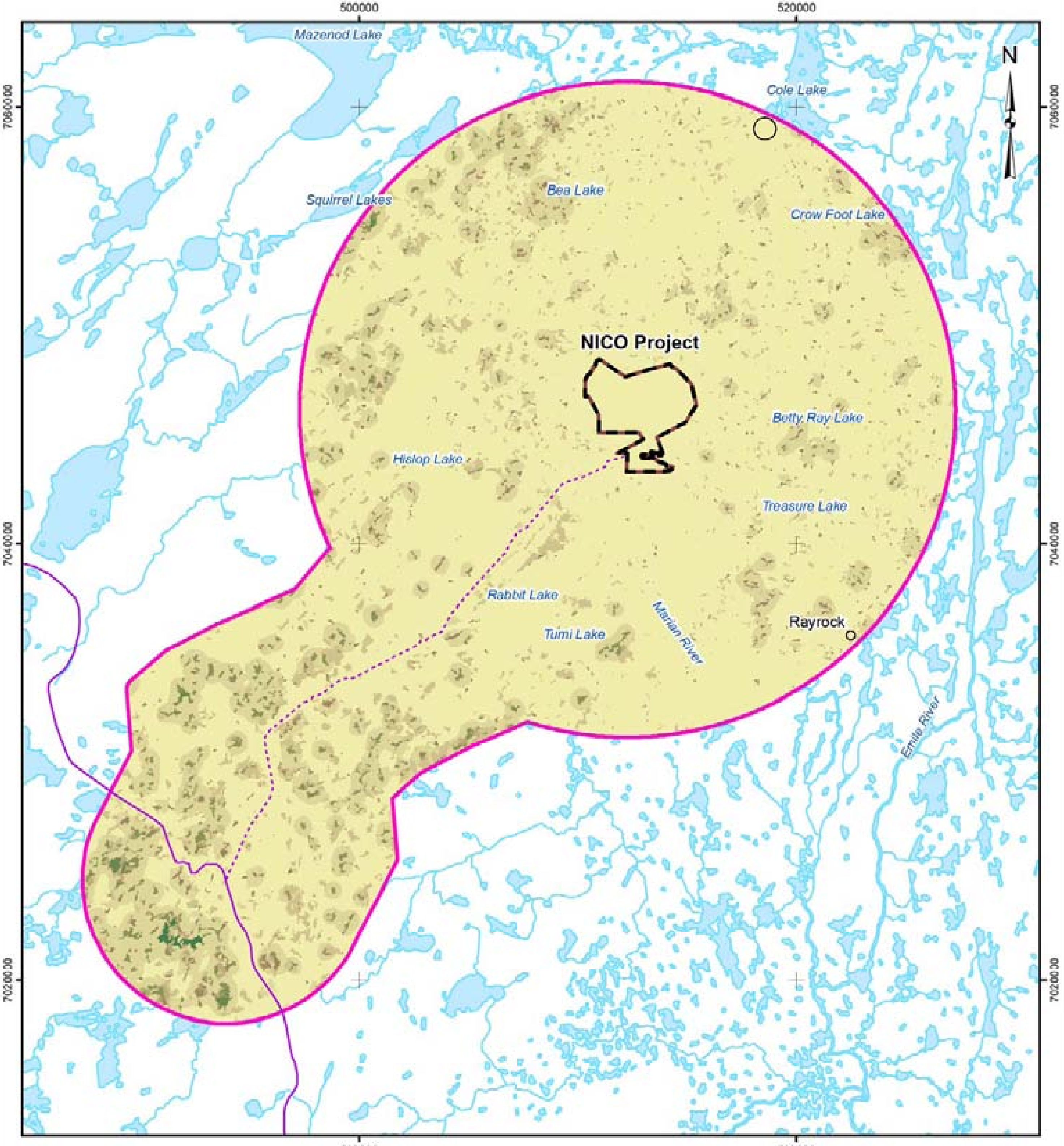
FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

HABITAT SUITABILITY FOR SHORT-EARED OWL: APPLICATION CASE

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-046-GIS				
PROJECT No. 09-1373-1004			SCALE AS SHOWN	REV. 0
DESIGN	LD	09 Feb. 2011	FIGURE: 15.4-28	
GIS	MK	03 Apr. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		



LEGEND

- PROJECT LEASE BOUNDARY
- PROPOSED NICO PROJECT ACCESS ROAD
- PROPOSED TŁĮCHǪ ROAD ROUTE
- WATERCOURSE
- WATERBODY
- HISTORIC REMEDIATED AND NON-REMEDIATED SITE
- MINERAL EXPLORATION
- REGIONAL STUDY AREA

HABITAT SUITABILITY INDEX (HSI)

0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

5 0 5
SCALE 1:250,000 KILOMETRES

REFERENCE

Base data obtained from Atlas of Canada, DMTI, and GeoGratis.
Projection: UTM Zone 11 Datum: NAD 83

FORTUNE MINERALS LIMITED
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

HABITAT SUITABILITY FOR SHORT-EARED OWL: FUTURE CASE

Golder Associates
Edmonton, Alberta

FILE No. EA-Wild-047-GIS

PROJECT No. 09-1373-1004		SCALE AS SHOWN		REV. 0
DESIGN	LD	09 Feb. 2011	**FIGURE: 15.4-29**	
GIS	MK	03 Apr. 2011		
CHECK	GRA	03 Apr. 2011		
REVIEW	GRA	03 Apr. 2011		

Noise sources from the NICO Project include mobile and stationary mining equipment, blasting, aircraft, and vehicles along the NPAR, winter roads, and Proposed Tłı̨chǫ Road Route. The results from modelling show that noise predictions slightly exceed benchmarks for mine operations, and are below benchmarks for the NPAR and Airstrip (Table 15.3-4). The distance for noise attenuation to background levels for core mining operations (including blasting) is 3.3 km (Table 15.3-5), but disturbance from blasing should be infrequent (approximately once per day). The distance for noise attenuation to reach background levels from the Airstrip is about 26 km. However, disturbance from large aircraft is expected to be infrequent (Appendix 8.II) and short-term (less than 5 minutes in duration). The nest sites of four bald eagles, 2 peregrine falcons, and one great gray owl were occasionally occupied from 2003 through 2009, and within 4 km of the core mine facilities area (Table 15.2-17; Fiigure 15.2-12). These nest sites may experience infrequent and short-term disturbance events during the landing and takeoff of aircraft.

The distance for noise attenuation to background for traffic along the existing winter roads and NPAR during the construction phase is 0.9 km (Appendix 8.II). Similarly, noise from vehicles along the Proposed Tłı̨chǫ Road Route is anticipated to approach background levels within 1 km of the right-of-way. The magnitude of the decrease in habitat quality for raptors nesting within 1 km along the NPAR and Proposed Tłı̨chǫ Road Route is predicted to approach or slightly exceed the limits of baseline conditions.

The specific effects of NICO Project-related sensory disturbance on many species of raptors are unclear. For example, at the Snap Lake Mine, variation in nest site occupancy and success was not strongly related to distance from the mine (De Beers 2008). Although weather and prey abundance were not highly correlated with nest success, these environmental variables had stronger associations with nest success than did distance from the mine; however, raptor nest success and occupancy increased with distance from the Diavik Diamond Mine, and nest success appeared to decline over time from construction through current operations (Golder 2005, 2008). However, the relationships were weak, and spring rainfall also contributed to the variation in nest success (Golder 2008).

Few studies have focused on the effects of noise and disturbance to raptor behaviour and movement; however some studies (Korschgren et al. 1985; Ward and Stein 1989; Dahlgren and Korschgren 1992) have found that noise and motion disturbances originating from man-made sources can negatively affect bird behaviour. Disturbance effects on raptors may include displacement, nest abandonment, reduced nest success or young survival, and reduced foraging efficiency (Hockin et al. 1992; Dahlgren and Korschgren 1992). The concern regarding noise and birds includes noises that startle or disturb nesting birds and noises that mask mating or young calls, affecting the ability of males to attract a mate or to hear young begging calls.

Studies of prairie falcon responses to blasting activities found that falcons showed behavioural reactions to blasting in 54% of blasts (Holthuijzen et al. 1990). Incubating or brooding falcons flushed from their aeries in 22% of the blasts, but returned to their nests within an average of 3.4 minutes. The authors suggested that blasting associated with limited human activity does not need to be restricted at distances greater than 125 m from occupied prairie falcon nests, provided that peak noise levels do not exceed 140 dB at the aerie and no more than 3 blasts occur on a given day or 90 blasts during the nesting season. Blasting at the NICO Project is anticipated to occur once per day. Maximum explosive loads for the NICO Project are not expected to exceed 120 dBL at the construction camp (Appendix 8.III), which is closer than the nearest raptor nest site.

There are indications that raptors are able to habituate to disturbance. There have been several attempts by peregrine falcons, gyrfalcons (*Falco rusticolus*), rough-legged hawks (*Buteo lagopus*), and common ravens

(*Corvus corax*) to nest within both active and abandoned open pits at the Ekati and Diavik diamond mines. Peregrine falcons made nesting attempts in open pits at Diavik Diamond Mine in 2005 and 2006 (DDMI 2007). Since 2004, there have been 8 such occurrences among 5 open pits at the Ekati Diamond Mine, and all 5 Ekati pits had nesting birds in 2006 (BHPB 2007). In some cases, young have been detected in these nests (BHPB 2003, BHPB 2007).

15.5 Related Effects to People

Hunting and trapping continues to occur within the area overlapped by the tradiitional knowledge RSA and the LSA, including areas overlapped by NICO Project (which includes the NPAR). Hunting and trapping areas have been identified by interview participants from Whatì and by interview participants from Gamètì (Section 5). Animals are generally harvested for fur and meat. Harvested animals identified by both communities include caribou, moose, black bear, muskrat, mink, marten, wolverine, beaver, fox, lynx, wolf, squirrel, duck, ptarmigan, and grouse. Gamètì interview participants also noted that otter and rabbit are trapped. The literature review also indicated that porcupine and weasel are trapped in the Tłįchǫ Lands (DCI 1995).

During interviews, residents of Whati and Gameti indicated that waterfowl are hunted throughout the region. Harvested waterfowl identified during interviewsl include black ducks, mallard ducks, and pintail ducks (Section 5).

Whatì and Gamètì traditional knowledge interview participants (Section 5) reported areas used for hunting or trapping within the traditional knowledge RSA as follows:

- hunting for birds including ptarmigan, ducks, and grouse occurs throughout the RSA;
- hunting for caribou and moose occurs throughout the RSA;
- hunting and trapping occurs within the Hislop Lake and Rabbit Lake areas, and along the Marian River;
- hunting or trapping occurs between Lac La Martre and the Hislop Lake, Rabbit Lake, and Tumi Lake area
- hunting and trapping along the NPAR;
- hunting north from Hislop Lake with camping areas all along the Marian River;
- hunting and trapping near Gamètì, Wekweèti, Grandin Lake (west of the RSA), and the Colomac Mine (outside the RSA);
- hunting and trapping near Bea Lake;
- hunting and trapping moose hunting occurs along the winter road to Gamètì; and
- trapping along the Marian River.

Gamètì interview participants noted that hunting around the NICO Project is generally limited to moose and rabbits and areas used for hunting and/or trapping that are near the NICO Project include the area near Burke Lake and Lou Lake.

Geese, ducks, and loons are important to other communities in the NWT. According to traditional knowledge, geese and ducks are a favourite food source for communities, and the feathers are used for making blankets and pillows (LKDFN 2001). The spring migration of waterbirds to the NWT begins in early May, and in some years, at the end of April (LKDFN 2002). Throughout generations, people have depended upon ducks and geese to use the same migration routes to reach their staging and nesting areas in the NWT. People travel to these water bird staging areas in the spring to harvest the migrating birds (LKDFN 2002), and in the summer, they travel to the barren-lands where birds migrate to lay eggs (NSMA 1999). Egg collection during the breeding season is the primary use of water bird resources by traditional users. Because access into the ESAM and RSA is limited during the summer period, the Proposed Tłı̨chǫ Road Route and NPAR may increase harvesting pressure on waterbirds.

A measurable change in the abundance and distribution of wildlife populations is predicted within 1 to 2 km of the NICO Project and other developments, which will likely influence the availability of animals for trapping and hunting. The magnitude of the incremental decrease from the NICO Project on the amount of good quality habitat is 0.4% for moose, 6.2% for marten, 0.9% for muskrat, 1.4% for waterbirds. Current harvest numbers for moose, marten, and muskrat indicate that harvesting pressure is unlikely to be a limiting factor for these populations in the NWT (Section 15.2.5). Therefore, the decrease in the availability of wildlife for harvesting from NICO-Project related effects is predicted to be within the range of baseline values (i.e., people that hunt and trap in the region should not observe a change in the availability of animals due to effects from the NICO Project, relative to current natural changes in population sizes).

Currently, spring to autumn access into the ESAM and RSA is limited to aircraft or watercraft that can be portaged. Access is less limited in the winter because existing winter roads pass through the ESAM and RSA (Figure 15.1-1). Snowmobiles can access the ESAM and RSA through existing trails and along winter roads before it is open and after it closes to vehicle traffic. The NPAR and the Proposed Tłı̨chǫ Road Route will allow hunters and trappers more vehicle access to their traplines near the NICO Project and the Proposed Tłı̨chǫ Road Route, which has the potential to increase harvesting pressure on wildlife.

Fortune will not permit hunting, trapping, harvesting, or fishing by staff and contractors and will prohibit the recreational use of all-terrain vehicles at site, so that people working on site will not benefit from increased access to the region. Regardless, the Proposed Tłı̨chǫ Road Route as well as the NPAR may still be used to hunt wildlife. A study on the Tibbitt-to-Contwoyto Winter Road reported that hunting was the most common land use along the road, followed by fishing, sightseeing, and camping (Ziemann 2007).

Currently in the NWT, wildlife species are managed mostly by controlling the hunting season for resident and non-resident hunters (ENR 2010e). Non-resident hunters in the NWT require the services of an outfitter to hunt big game. As such, non-resident hunters are not anticipated to use the NPAR or Proposed Tłı̨chǫ Road Route to hunt big game (e.g. moose). The hunting rights of Aboriginal people in the NWT are based on traditional use and are different from those of other hunters. Hunting by many Aboriginal people is controlled by land claim agreements (in this case the Tłı̨chǫ Agreement). Hunting by other groups may also be affected by Tłı̨chǫ Agreement, through the Tłı̨chǫ Government and the Wek'èezhii Renewable Resource Board.

The moose hunting season within the ESAM is from 1 September to 31 January for residents (ENR 2010e). Aboriginal hunters or General Hunting License holders may hunt moose year-round. The resident and General Hunting License hunting seasons currently overlap the average opening and closing dates of winter roads in the NWT (DOT 2008a). Resident hunters are limited to one moose per year. The estimated total NWT moose harvest is 1000 to 2000 animals per year, 80 to 90% of which is taken by General Hunting License holders (ENR 2010b).

Marten are the most valuable furbearing species to trappers below the treeline (ENR 2010c). The marten trapping season is from 1 November to 28 February in the 'R' Wildlife Management Unit (*Wildlife Act* 2009), which covers the RSA. The annual numbers of marten pelt submissions to the GNWT for fur auctions from Gamètì, Behchokǫ̀, Whatì, Wekweetì, and Yellowknife between 2004 and 2009 ranged between 52 and 1871 pelts per year with an average of 592 pelts per year (ITT 2010). Winter roads near the NICO Project are generally opened to vehicle traffic around the beginning of January (DOT 2008a). Snow machines may be able to use existing winter roads for a longer period. Marten pelts are of the highest quality between November and January (ENR 2010c) so between 2 and 4 weeks of prime marten harvesting could be aided by vehicle support on the Proposed Tłı̨chǫ Road Route and NPAR.

Muskrat are the second most important furbearing species in the NWT. The muskrat trapping season is from 15 October to 10 June in the 'R' Wildlife Management Unit (*Wildlife Act* 2009). The reported number of muskrats harvested by the communities of Gamètì, Wekweetì, Whatì, Yellowknife, and Behchokǫ̀ from 2004 to 2009 ranged between 0 and 1530 per year with an average of 287 per year (ITT 2010).

Harvesting of wildlife may increase with the operation of the Proposed Tłı̨chǫ Road Route and NPAR; however, the harvest numbers for moose, marten, and muskrat indicate that harvesting pressure is unlikely to be a limiting factor for these populations in the NWT. Although some residents of the NWT rely on harvesting wildlife for food and income, the NWT is also sparsely populated and communities are widely spaced. Should harvesting on the Proposed Tłı̨chǫ Road Route or NPAR reach a level of concern, the Tłı̨chǫ Government or the Wek'èezhii Renewable Resources Board could enact regulations to control the harvest. For example, further restrictions could be placed on hunting seasons, bag limits for resident harvesters, and a no-hunting corridor could be implemented, similar to that currently in place for the Ingraham Trail. Overall, it is predicted that the number of wildlife harvested in the region from improved access due to the NPAR and Proposed Tłı̨chǫ Road Route will be within the range or approach the upper limits of baseline values.

15.6 Residual Effects Summary

15.6.1 Habitat Quantity and Fragmentation

The total area of the NICO Project footprint (including the NPAR) is estimated to be 485.4 ha. However, because the NICO Project Lease Boundary was used in the analyses, and the width of the NPAR was increased to match the raster cell size (28.5 m) in the land cover classification, the estimated NICO Project footprint is 1516 ha. Therefore, changes in habitat amount and fragmentation are conservative. Although most bird species and species groups do not inhabitat the study area during winter, the fragmentation analysis was completed using the existing winter road footprints so that changes to terrestrial habitats from road portages were included, which represents the maximum disturbance to the study areas.

The NICO Project will alter approximately 0.3% of the 2010 baseline moose study area (ESAM) and 1.6% of the 2010 baseline RSA for other wildlife VCs. Terrestrial habitat types that will be disturbed most in both study areas are bedrock-open conifer, burn, and deciduous aspen. Previous and existing developments have removed 0.2% of the ESAM and 0.3% of the RSA relative to reference conditions. The Proposed Tłı̨chǫ Road Route is expected to remove less than 0.1% of habitat from the ESAM and RSA. Cumulative loss of all habitat types in the ESAM and RSA from reference through reasonably foreseeable developments is expected to be 0.5% and 1.9%, respectively. Although progressive reclamation will be integrated into mine planning as part of Fortune's design for closure policy, subarctic ecosystems are slow to recover from disturbance. The Open Pit, CDF, constructed wetlands, Seepage Collection/Surge Ponds, and ditches will be permanent features on the landscape, covering approximately 84 ha.

The relative change in the amount of habitat from reference to 2010 baseline conditions in the ESAM is less than 0.5% for each habitat type and in the RSA is less than 1% for each habitat type. The anticipated incremental loss of any habitat type from the NICO Project, relative to 2010 baseline conditions, is less than 0.4% of the ESAM and 3% of the RSA, except for bedrock-open conifer habitat which is expected to decrease by 1.8% in the ESAM and 5.5% in the RSA. Incremental habitat-specific changes from the Proposed Tłįchǫ Road Route (future case) are expected to be less than 0.4% for both the ESAM and the RSA.

Increasing development on the landscape has also resulted in marginal changes to the number and distance between similar habitat patches in the ESAM and the RSA. For a particular habitat, previous and existing developments increased the number of habitat patches on the landscape between 0% and 2% relative to reference conditions in both study areas. Similarly, habitat-specific changes in distance between similar patches were estimated to be less than or equal to 2.4% relative to reference conditions. Development of the NICO Project and the Proposed Tłįchǫ Road Route are each expected to change the number and distance between similar patches on the landscape by less than 3% in both study areas, with the exception of burn habitat in the RSA. Cumulative habitat-specific changes in the number and distance between similar patches are less than 4.7% for all habitats in the ESAM and RSA.

15.6.2 Habitat Quality, Movement, and Behaviour

In addition to direct habitat effects, indirect changes to habitat quality from the NICO Project (including the NPAR) have the potential to affect the population size and distribution of wildlife through altered movement and behaviour. To estimate indirect habitat effects on wildlife, HSI models were used to quantify habitat changes from reference conditions through application of the NICO Project and reasonably foreseeable developments. Habitat suitability modelling for moose was completed within the ESAM and HSI modelling for marten, muskrat, upland breeding birds, waterbirds, and short-eared owl was completed within the RSA. Because most wildlife species are likely to exhibit some degree of sensitivity to human disturbance, zones of influence and associated habitat suitability modifier coefficients were applied to all species' models (except muskrat) to estimate indirect effects (e.g., sensory disturbance from noise and human activities) from the NICO Project and other active projects in the ESAM and RSA. The indirect effects from noise were also analyzed separately.

The HSI models for moose and marten considered the winter season, which is likely limiting for these species. Habitat models for upland breeding birds, waterbirds, and short-eared owl considered the summer season as these species are not present within the RSA during the winter. The HSI modelling results predict that the incremental decrease from the NICO Project on the amount of good quality habitat is 0.4% for moose, 6.2% for marten, 0.9% for muskrat, 1.4% for waterbirds, and 3.7% for short-eared owl. Cumulative changes from the NICO Project and previous, existing developments, and the Proposed Tłįchǫ Road Route are expected to decrease good quality moose habitat by 11.1%, marten habitat by 12.3%, muskrat habitat by 1.1%, waterbird habitat by 1.8%, and short-eared owl habitat by 7.1%.

The effects of sensory disturbance (e.g., noise, presence of humans and vehicles [indirect effects]) were found to have a greater effect on total upland breeding bird abundance in the RSA than direct effects from habitat loss. Indirect effects had a greater effect on bird abundance than direct effects in all habitat types, except for bedrock-open conifer habitat. Direct effects from the NICO Project are expected to decrease upland breeding bird abundance by 1.6% relative to 2010 baseline conditions. The cumulative amount of habitat loss from the NICO Project and previous, existing, and future developments is expected to decrease upland breeding bird abundance by 1.8% relative to reference conditions. Indirect effects from the NICO Project are expected to reduce upland breeding bird abundance in the RSA by 2.4% relative to 2010 baseline conditions. Cumulative sensory disturbance effects from the NICO Project and previous, existing, and future developments in the RSA are expected to decrease overall upland breeding bird abundance by 3.6% relative to reference conditions.

The distance for noise attenuation to background for mining operations (including blasting) and the Airstrip is 3.3 km and 26 km, respectively. Various studies have documented wildlife avoidance of areas with anthropogenic noise (Horesji 1979; Korschgren et al. 1985; Ward and Stein 1989; Dahlgren and Korschgren 1992; Andersen et al. 1996), although several species have also been found to habituate to noisy environments (Busnel and Briot 1980; Ronconi et al. 2004). Aircraft are anticipated to be used for medical emergencies and the transport of some goods to site (i.e., the annual volume of aircraft traffic is expected to be low [Appendix 8.II]). Noise associated with the Airstrip will be infrequent and limited to take-off and landings (about 5 minutes). Similarly, disturbance from blasting is anticipated to be infrequent during operations (occurs once per day) whereas the frequency of noise levels from general mining operations are continuous.

During construction, approximately 2200 truck loads will be delivered to the NICO site during the winter road season. This amounts to approximately 63 return trips per day over an average 70 day (10 week) winter road season. During operations, an estimated 5 to 9 trucks per day are anticipated to travel along the NPAR and Proposed Tłįchǫ Road Route. Noise from the NPAR, existing winter roads, and the Proposed Tłįchǫ Road Route is predicted to diminish to background noise levels within 0.9 km. The potential noise effects associated with existing winter roads and the NPAR during construction are temporary (limited to 8 to 12 weeks). During operations, noise from vehicles associated with NICO Project along the NPAR and Proposed Tłįchǫ Road Route will occur year-round. The magnitude of the decrease in habitat quality for wildlife within 1 km along the NPAR and Proposed Tłįchǫ Road Route is predicted to approach or slightly exceed the limits of baseline conditions.

Habitat modeling predicted that the maximum spatial extent of indirect changes to habitat quality (i.e., zone of influence) from the NICO Project and other active developments in the effects study areas was 2 km for moose and 1 km for other wildlife VCs (except muskrat). Although the incremental changes to habitat quality from each active development occur at the local scale, the cumulative effect to the movement and behaviour of wildlife extends to the populations within the effects study areas (i.e., regional geographic extent). The duration of sensory disturbance effects on wildlife from noise and the presence of people, vehicles, and aircraft traffic is anticipated to occur over a 26 to 31 year period (i.e., effects should be reversed within 5 to 10 years following closure).

15.6.3 Related Effects to People

The decrease in the availability of wildlife for harvesting from direct and indirect effects from the NICO-Project is predicted to be within the range of baseline values. In addition, current harvest numbers for moose, marten, and muskrat indicate that harvesting pressure is unlikely to be a limiting factor for these populations in the NWT. In other words, people that hunt and trap in the region should not observe a change in the availability of animals due to effects from the NICO Project, relative to current natural cycles in populations. Effects are expected to last from construction until 5 to 10 years after closure, and should be regional in geographic extent.

Currently in the NWT, wildlife species are managed mostly by controlling the hunting season for resident and non-resident hunters (ENR 2010e). The hunting rights of Aboriginal people in the NWT are based on traditional use and are different from those of other hunters. Hunting by many Aboriginal people is controlled by land claim agreements.

With the development of the NPAR and Proposed Tłįchǫ Road, hunters and trappers would be able to make more use of vehicles (including snow machines) to access areas in the region and for a longer duration relative to winter roads. The spatial extent of incremental and cumulative effects from NPAR and Proposed Tłįchǫ Road Route on wildlife populations from changes in harvesting pressure is expected to be regional. Although, the development of the Proposed Tłįchǫ Road Route and the NPAR during operations will increase access into the ESAM and RSA during the entire year, harvesting of wildlife would occur periodically during traditional and non-tradtional hunting seasons.

Current harvest levels in the ESAM and RSA appear to be low, and harvest numbers indicate that harvesting pressure is unlikely to be a limiting factor for wildlife populations in the area surrounding the NICO Project. Although some residents of the NWT rely on harvesting wildlife for food and income, the NWT is also sparsely populated and communities are widely spaced. Should harvesting on the Proposed Tłįchǫ Road Route or NPAR reach a level of concern, the Tłįchǫ Government or the Wek'èezhii Renewable Resources Board could enact regulations to control the harvest. As such, it is expected that the incremental and cumulative increase in the harvest of wildlife from the NPAR and Proposed Tłįchǫ Road Route will be within the range or approach the upper limits of baseline harvesting values. The duration of effects to wildlife from increased access is predicted to be permanent as these roads will likely be maintained well beyond the temporal boundary of the assessment (i.e., more than 21 years [construction through closure]).

15.7 Residual Impact Classification

The purpose of the residual impact classification is to describe the residual effects from the NICO Project on wildlife using a scale of common words (rather than numbers or units). The use of common words or criteria is a requirement in the TOR for the NICO Project (MVRB 2009). The following criteria must be used to assess the residual impacts from the NICO Project:

- direction;
- magnitude;
- geographic extent;
- duration;
- reversibility;
- frequency; and
- likelihood.

Generic definitions for each of the residual impact criteria are provided below.

15.7.1 Methods

In the DAR, the term “effect”, used in the effects analyses and residual effects summary, is regarded as an “impact” in the residual impact classification; therefore, in the residual impact classification, all residual effects are discussed and classified in terms of impacts to wildlife.

The effects analyses and residual effects summary presented both the incremental and cumulative changes from the NICO Project (aniticipated mine site and the NPAR) and other developments on the environment, wildlife, and use of wildlife by people. Incremental effects represent the NICO Project-specific changes relative to baseline values in 2010. NICO Project-specific effects typically occur at the local scale (e.g., habitat loss due to the NICO Project footprint) or regional scale (e.g., combined habitat loss, noise, and sensory disturbance from NICO Project activities [i.e., zone of influence]).

Cumulative effects are the sum of all changes from reference values through application of the NICO Project and reasonably foreseeable developments. In contrast to NICO Project-specific (incremental) effects, the geographic extent of cumulative effects is determined by the distribution of the defined population. This is because the local and regional effects from the NICO Project and other developments overlap with the distribution of wildlife populations.

For wildlife, the assessment and classification of residual impacts was based on the predicted cumulative changes from reference conditions through application of the NICO Project and into the future case. The spatial boundary of the assessment is at the regional scale or the distribution of the populations, which is a requirement in the TOR (MVRB 2009). The incremental effects from the NICO Project relative to 2010 baseline conditions are also classified. Essentially, the only difference in the outcome of impact criteria between cumulative and incremental effects from the NICO Project is in the magnitude and geographic extent of impacts. The magnitude for cumulative impacts involves changes from reference conditions through application of the NICO Project and into the future case, while incremental impacts are based on changes from the NICO Project relative to 2010 baseline values. Cumulative impacts from the NICO Project and other developments influence the entire annual range of the populations. In contrast, the geographic extent of incremental impacts from the NICO Project may have a local or regional influence on the range of the populations.

Effects statements are used to focus the analysis of changes to wildlife that are associated with one or more primary pathways. The residual effects summary (Section 15.6) presents a numerical assessment for criteria such as magnitude, geographic extent, duration, and frequency. From the summary of residual effects, pathways associated with each effects statement are then classified using scales (categorical values such negligible, low, or high) for each impact criterion (e.g., magnitude).

To provide transparency in the DAR, the definitions for these scales were ecologically or logically based on wildlife. Although professional judgement is inevitable in some cases, a strong effort was made to classify impacts using scientific principles and supporting evidence. The scale for the residual impact criteria for classifying effects from the NICO Project are specifically defined for wildlife, and definitions for each criterion are provided in Table 15.7-1. More detailed explanations for magnitude, geographic extent, and duration are provided below.

Table 15.7-1: Definitions of Criteria Used in the Residual Impact Classification of Pathways for Effects on Abundance and Distribution of Wildlife Populations

Direction	Magnitude[a]	Geographic Extent	Duration	Frequency	Reversibility[b]	Likelihood
Negative: a less favourable relative to baseline values **Positive:** an improvement over baseline values or conditions	**Negligible:** no predicted detectable change from baseline values **Low:** impact is predicted to be within the range of baseline values **Moderate:** impact is predicted to be at or slightly exceeds the limits of baseline values **High:** impact is predicted to be beyond the upper or lower limit of baseline values so that there is likely a change of state from baseline conditions	**Local:** small-scale direct and indirect impacts from the NICO Project (e.g., footprint, and dust deposition) **Regional:** the predicted maximum spatial extent of combined direct and indirect impacts from the NICO Project that exceed local-scale effects (can include cumulative direct and indirect impacts from the NICO Project and other developments at the regional scale) **Beyond Regional:** cumulative local and regional impacts from the NICO Project and other developments extend beyond the regional scale	**Short-term:** impact is reversible at end of construction **Medium-term:** impact is reversible at end of closure **Long-term:** impact is reversible within a defined length of time (e.g., animal life spans) beyond closure	**Isolated:** impact confined to a specific discrete period **Periodic:** impact occurs intermittently but repeatedly over the assessment period **Continuous:** impact will occur continually over the assessment period	**Reversible:** Impact will not result in a permanent change of state of the population compared to "similar" environments not influenced by the NICO Project **Irreversible:** impact is not reversible (i.e., duration of impact is unknown or permanent)	**Unlikely:** the impact is likely to occur less than one in 100 years **Possible:** the impact will have at least one chance of occurring in the next 100 years **Likely:** the impact will have at least one chance of occurring in the next 10 years **Highly Likely:** the impact is very probable (100% chance) within a year

[a] baseline includes range of predicted values from reference conditions (no development) through 2010 baseline conditions.

[b] "similar" implies an environment of the same type, region, and time period.

15.7.1.1 Magnitude

Magnitude (i.e., intensity of the impact) for NICO Project-specific (incremental) effects is scaled to the expected change (quantified or qualified) from 2010 baseline conditions to application of the NICO Project. Magnitude for cumulative effects is scaled to the expected quantified and/or qualified change from reference conditions (no development) through application of the NICO Project and reasonably foreseeable developments. Baseline conditions represent the historical and current environmental selection pressures that have shaped the observed patterns in wildlife. Environmental selection pressures include both natural (e.g., weather, changes in gene frequencies, predation, and competition) and human-related factors (e.g., mineral development, traditional harvest, and sport hunting).

Depending on which selection pressures are currently driving changes to wildlife and the system, baseline conditions typically fluctuate within a range of variation through time and space. The fluctuations are generated by changes in natural factors (natural variation) and variation associated with human influences. Relative to ecological time and space, baseline conditions are in a constant state of change due to the pushing and pulling of environmental selection pressures. Thus, baseline conditions can be thought of as a distribution of probability values, and the location of the value (e.g., middle or ends of the distribution) is dependent on which environmental factors are currently playing a key role in the trajectory of the wildlife populations.

The approach used to classify the magnitude of changes in measurement endpoints (and related impacts) was based on scientific literature and professional opinion, and incorporated conservatism. Other environmental assessments often use the universal effect size approach for categorizing magnitude such as negligible changes (0 to 10%), small changes (10 to 25%), and medium changes (25 to 40%) (Munkittrick et al. 2009). Ideally, effect threshold values would be known, and measurement endpoints could be quantified accurately with a high degree of confidence. However, little is known about ecological thresholds, and biological parameters are typically associated with large amounts of natural variation; therefore, the classification of magnitude included a level of conservatism so that the impacts would not be underestimated.

The definition of magnitude provided in Table 15.7-1 is applicable for more qualitative results (e.g., impacts on wildlife movement and behaviour, and related impacts to people). For quantitative analyses and results (e.g., loss and fragmentation of habitat, and changes to habitat suitability), the following definition for magnitude is applied:

- negligible: less than a 1% change from the NICO Project relative to baseline values;
- low: 1 to 10% change from the NICO Project relative to baseline values;
- moderate: greater than 10 to 20% change from the NICO Project relative to baseline values; and
- high: more than 20% change from the NICO Project relative to baseline values.

The proposed scale is consistent with the 20% rule for the severity of effects from chemical exposure on varying spatial scales of ecological effects (i.e., a 20% change in a measurement endpoint constitutes an ecological effect) (Suter et al. 1995). The scale is also consistent with and below thresholds identified by empirical and theoretical work on the relationship between loss of suitable habitat and the likelihood of population decline (Andrén 1994, 1999; Fahrig 1997; Mönkkönen and Reunanen 1999; Flather and Bevers 2002). These studies suggested that critical thresholds for changes in rates of population parameters in non-tropical bird and mammal species occur between 10% and 60% of original habitat. In other words, a measurable decrease in species abundance and diversity may be observed when the amount of suitable habitat that is lost exceeds a threshold value of 40%. In a recent review, Swift and Hannon (2010) found that most empirical studies demonstrated negative effects on insects, plants, birds, and mammals when the amount of habitat lost from the landscape was greater than 70%.

15.7.1.2 Geographic Extent

Geographic extent is the area or distance influenced by the direct and indirect effects from the NICO Project, and is different from the spatial boundary (i.e., study area) for the effects analysis and impact assessment. The study area for the effects analysis represents the maximum area used for the assessment and is related to the spatial distribution and movement (i.e., population boundary) of wildlife (Section 15.1.2).

However, the geographic extent of impacts can occur on a number of scales within the spatial boundary of the assessment. As defined in Table 15.7-1, geographic extent for classifying impacts is based on three scales: local, regional, and beyond regional. Local-scale impacts mostly represent incremental (NICO Project-specific) changes to wildlife population size and distribution that are directly related to the NICO Project footprint and activities (e.g., physical disturbance to vegetation [habitat], loss of individuals due to habitat alteration, and mortality of individual animals). Local impacts may also include small-scale indirect effects such as dust deposition on vegetation and sensory disturbance.

Changes at the regional scale are largely associated with the predicted maximum extent of incremental impacts from the NICO Project on wildlife (i.e., zone of influence), such as changes to habitat quality that occur beyond the local scale (e.g., more than 1 km from the NICO Project). Changes at the regional scale also can result from the incremental and cumulative impacts from the NICO Project and other developments on the population (which is the effects study area or spatial boundary for the assessment). Cumulative impacts from the NICO Project and other developments also occur at the regional scale for traditional and non-traditional use of wildlife. Beyond regional scale effects are associated with cumulative changes to populations that range over very large areas (e.g., barren-ground caribou).

15.7.1.3 Duration

Duration has 2 components. It is the amount of time between the start and end of a NICO Project activity or stressor (which is related to NICO Project development phases), plus the time required for the impact to be reversible. Essentially, duration is a function of the length of time that wildlife are exposed to NICO Project activities, and reversibility.

By definition, impacts that are short-term, medium-term, or long-term in duration are reversible. NICO Project activities may end at closure, but the impact on wildlife may continue beyond NICO Project closure. Some impacts may be reversible soon after removal of the stressor, such as effects on air quality from power generation and equipment operation (e.g., medium-term impact).

For wildlife, the amount of time required for the impact to be reversed (i.e., duration of the effect) is presented in context of the number of life spans that wildlife may be influenced. The anticipated duration of effects on wildlife are then used to determine the number of human generations that may be affected by the related changes to traditional and non-traditional land use practices (e.g., wildlife harvesting). In this manner, the impact assessment links the duration of NICO Project impacts on wildlife to the amount of time that human use of ecological resources may be influenced.

For impacts that are permanent, the duration of the effect is determined to be irreversible. An example of an irreversible impact includes the localized loss of vegetation and habitat due to the Open Pit, constructed wetlands, Seepage Collection/Surge Ponds, and ditches.

15.7.2 Results

Direct incremental impacts from the NICO Project footprint (i.e., habitat loss) are local in spatial extent. The magnitude of incremental impacts from the NICO Project footprint on moose populations is predicted to be negligible (i.e., the NICO Project will alter 0.3% of the ESAM). The magnitude of incremental impacts from the NICO Project footprint on marten, muskrat, upland breeding birds, waterbirds, and raptors is predicted to be low (i.e., the NICO Project will alter 1.6% of the RSA); however, individuals from wildlife populations may interact with other developments and activities in the effects study area (defined as the distribution of these populations [i.e., ESAM or RSA]). Therefore, the cumulative impacts from direct habitat loss and fragmentation from the NICO Project footprint and other developments on population size and distribution are expected to be regional in geographic extent (Table 15.7-2). Cumulative impacts of direct habitat loss from the NICO Project and previous, existing, and reasonably foreseeable future developments is expected to be 0.5% of the ESAM (negligible magnitude) and 1.9% of the RSA (low magnitude) (Table 15.7-2). Direct impacts from the NICO Project will be continuous over the duration of the assessment period.

Although progressive reclamation will be integrated into mitigation and management plans for the NICO Project, subarctic terrestrial ecosystems are slow to recover from disturbance. In addition, not all the areas for the NICO Project will be reclaimed. The Open Pit, constructed wetlands, Seepage Collection/Surge Ponds, and ditches will be permanent features on the landscape (i.e., not reversible within the temporal boundary of the assessment) and will cover approximately 84 ha (Table 15.7-2). Cumulative and incremental habitat loss values from development in the ESAM and RSA are well below the 40% threshold value for habitat loss associated with expected declines in bird and mammal species (Andrén 1994, 1999; Fahrig 1997; Swift and Hannon 2010). Although some individuals of populations in the ESAM and RSA may be affected by habitat loss the magnitude of incremental and cumulative impacts to the populations are predicted to negligible to low.

Table 15.7-2: Summary of Residual Impact Classification of Primary Pathways for Incremental and Cumulative Effects on Abundance and Distribution of Wildlife Populations and Related Effects to People

Pathway	Direction	Magnitude		Geographic Extent		Duration	Frequency	Reversibility	Likelihood
		Incremental	Cumulative	Incremental	Cumulative				
Physical footprint decreases habitat quantity and causes fragmentation	negative	negligible to low	negligible to low	local	regional	long-term to permanent	continuous	reversible to irreversible	highly likely
Sensory effects (e.g., noise, presence, lights, smells) changes the amount of different quality habitats, and alters movement and behaviour of wildlife	negative	negligible to low	low to moderate	local to regional	regional	long-term	isolated or periodic (construction) to continuous	reversible	highly likely
Improved access for harvesting can affect wildlife population sizes	negative	low to moderate	low to moderate	regional	regional	permanent	periodic	irreversible	likely
Effects on population size and distribution changes the availability of animals for traditional and non-traditional use	negative	low	low to moderate	regional	regional	long-term	continuous	reversible	likely

Development of the NICO Project is expected to cause indirect changes to the amount of different quality habitats for wildlife populations in the region. Based on estimated zones of influence from the literature, habitat quality is predicted to decrease within 1 to 2 km of the NICO Project and other developments in the study areas. These changes are expected to result from the combination of noise and other sensory disturbances from the NICO Project, and are local to regional in geographic extent (Table 15.7-2). Noise level from general mining operations and aircraft should reach background levels within 3.3 km and 26 km of the NICO Project, respectively. Sensory disturbance from vehicles travelling on the NPAR and Proposed Tłı̨chǫ Road Route are expected to diminish within 0.9 km of the road; however this impact will be regional in extent because of the length of the roads. All of these NICO Project pathways can combine with similar impacts from other developments in the region and decrease the amount of quality habitat for wildlife populations.

Direct and indirect impacts from the NICO Project are anticipated to decrease good quality habitat for moose by 0.4% (negligible magnitude), marten by 6.2% (low magnitude), muskrat by 0.9% (negligible magnitude), waterbirds by 1.4% (low magnitude), and short-eared owl by 3.7% (low magnitude). Direct habitat loss from the NICO Project is predicted to reduce total upland breeding bird abundance in the RSA by 1.6% (low magnitude) relative to 2010 baseline conditions. Sensory effects from the NICO Project are expected to reduce upland breeding bird abundance by 2.4% relative to 2010 baseline conditions. Relative to reference conditions (no development), cumulative indirect impacts from the NICO Project and previous, existing, and reasonably foreseeable future developments are expected to reduce good quality moose habitat by 11.1%, marten habitat by 12.3%, muskrat habitat by 1.1%, waterbird habitat by 1.9%, and short-eared owl habitat by 7.1%. Direct and indirect impacts from the NICO Project and previous, existing, and reasonably foreseeable future developments are expected to decrease upland breeding bird abundance by 1.8% and 3.6%, respectively. Therefore, the magnitude of cumulative impacts on the abundance and distribution of wildlife populations is expected to be low to moderate (Table 15.7-2). Indirect impacts from the NICO Project and roads will be continuous during operations while indirect impacts from the NPAR and existing winter roads during construction will be isolated or periodic (i.e., limited to one or more winter seasons).

Impacts on the abundance and distribution of wildlife populations from changes in habitat quality, movement, and behaviour from NICO Project activities are expected to be reversible within 5 to 10 years following closure (long-term). The average life span of moose is estimated at 15 years (National Geographic 2010), marten is 12 years (Buskirk and Ruggerio 1994), muskrat is 2 years (Virgl and Messier 2000), upland breeding birds is 2 years (Sallabanks and James 1999), and waterbirds (Fergus 2003) and raptors (Wiggins et al. 2006) is 8 years. Therefore, the duration of the long-term impact is 26 to 31 years or about 2 life spans for moose and marten, 15 life spans for muskrat and upland breeding birds, and 4 life spans for waterbirds and raptors.

Hunting and trapping continues to occur within the area overlapped by the traditional knowledge RSA and the LSA, including areas overlapped by NICO Project (which includes the NPAR). Hunting and trapping areas have been identified by interview participants from Whatì and by interview participants from Gamètì and included Hislop, Rabbit, Tumi, Burke, and Lou lakes, Lac La Martre and along the Marian River. Animals are generally harvested for fur and meat. Harvested animals identified by both communities include caribou, moose, black bear, muskrat, mink, marten, wolverine, beaver, fox, lynx, wolf, squirrel, duck, ptarmigan, and grouse. Gamètì interview participants also noted that otter and rabbit are trapped. The literature review also indicated that porcupine and weasel are trapped in the Tłı̨chǫ Lands (DCI 1995). During interviews, residents of Whati and Gameti indicated that waterfowl are hunted throughout the region. Harvested waterfowl identified during interviewsl include black ducks, mallard ducks, and pintail ducks.

Geese, ducks, and loons are important to other communities in the NWT. According to traditional knowledge, geese and ducks are a favourite food source for communities, and the feathers are used for making blankets and pillows (LKDFN 2001). The spring migration of waterbirds to the NWT begins in early May, and in some years, at the end of April (LKDFN 2002). Throughout generations, people have depended upon ducks and geese to use the same migration routes to reach their staging and nesting areas in the NWT. People travel to these water bird staging areas in the spring to harvest the migrating birds (LKDFN 2002), and in the summer, they travel to the barren-lands where birds migrate to lay eggs (NSMA 1999). Egg collection during the breeding season is the primary use of water bird resources by traditional users. Because access into the ESAM and RSA is limited during the summer period, the Proposed Tłįchǫ Road Route and NPAR may increase harvesting pressure on waterbirds.

With the development of the NPAR and Proposed Tłįchǫ Road, hunters and trappers would be able to make more use of vehicles (including snow machines) to access areas in the region, and be able to access the region for a longer period during harvest seasons. The spatial extent of incremental and cumulative effects from NPAR and Proposed Tłįchǫ Road Route on wildlife populations from changes in harvesting pressure is expected to be regional. Although, the development of the Proposed Tłįchǫ Road Route and the NPAR during operations will increase access into the ESAM and RSA during the entire year, harvesting of wildlife would likely occur periodically during traditional and non-tradtional hunting seasons (Table 15.7-2).

Current harvest levels in the ESAM and RSA appear to be low, and harvest numbers indicate that harvesting pressure is unlikely to be a limiting factor for moose, marten, and muskrat populations in the area surrounding the NICO Project. Although some residents of the NWT rely on harvesting wildlife for food and income, the NWT is also sparsely populated and communities are widely spaced. Should harvesting on the Proposed Tłįchǫ Road Route or NPAR reach a level of concern, the Tłįchǫ Government or the Wek'èezhii Renewable Resources Board could enact regulations to control the harvest. As such, it is expected that the incremental and cumulative increase in the harvest of wildlife from the NPAR and Proposed Tłįchǫ Road Route will be within the range or approach the upper limits of baseline values (low to moderate magnitude). The duration of effects to wildlife from increased access is predicted to be permanent as these roads will likely be maintained well beyond the temporal boundary of the assessment (i.e., more than 21 years [construction through closure]) (Table 15.7-2).

Changes to the abundance and distribution of wildlife populations from development may negatively influence the harvesting of wildlife in the region. The magnitude of the incremental decrease from the NICO Project on the amount of good quality habitat in the effects study areas is 0.4% for moose, 6.2% for marten, 0.9% for muskrat, and 1.4% for waterbirds. Relative to reference conditions (no development), cumulative impacts from the NICO Project and previous, existing, and reasonably foreseeable future developments are expected to reduce good quality moose, marten muskrat, and waterbird habitat by 11.1%, 12.3%, 1.1%, and 1.9%, respectively. In addition, current harvest numbers for moose, marten, and muskrat indicate that harvesting pressure is unlikely to be a limiting factor for these populations in the NWT. Therefore, changes to the harvesting potential of wildlife because of the incremental impacts from the NICO Project and cumulative effects from all developments are expected to be low to moderate (Table 15.7-2). The duration of the impacts to wildlife is expected to last for 26 to 31 years, which is equivalent to about 1.5 human generations (assuming human generation time is 20 years). The impact is expected to be reversible in the long term (Table 15.7-2).

15.8 Environmental Significance

15.8.1 Approach and Methods

The TOR requires that the developer "assess and provide an opinion on the significance of any residual adverse impacts predicted to remain after mitigation measures" (MVRB 2009). Environmental significance was used to evaluate the significance of incremental and cumulative impacts from the NICO Project and other developments on wildlife, and by extension, on the use of wildlife by people. The evaluation of significance was based on ecological principles, to the extent possible, but also involved professional judgment and experienced opinion.

The classification of residual impacts on primary pathways provides the foundation for determining environmental significance from the NICO Project on the persistence of wildlife populations. Magnitude, geographic extent, and duration are the principal criteria used to predict significance (Section 6.6.3). Other criteria, such as frequency and likelihood are used as modifiers (where applicable) in the determination of significance.

Frequency may or may not modify duration, depending on the magnitude of the impact. Likelihood will also act as a modifier that can influence environmental significance. Environmental impact assessment considers impacts that are likely or highly likely to occur; however, within the definition of likelihood there can be a range of probabilities that impacts will occur. In special circumstances, the environmental significance may be lowered if an impact is considered to have a very low likelihood of occurring, and increased for impacts with a very high likelihood of occurring.

Duration of impacts, which includes reversibility, is a function of ecological resilience, and these ecological principles are applied to the evaluation of significance (Section 6.6.3). Although difficult to measure, resilience is the capacity of the system to absorb disturbance, and reorganize and retain the same structure, function, and feedback responses. Resilience includes resistance, capability to adapt to change, and how close the system is to a threshold before shifting states (i.e., precariousness).

The evaluation of significance for wildlife considers the entire set of primary pathways that influence the assessment endpoint (e.g., persistence of wildlife populations). The relative contribution of each pathway is used to determine the significance of the NICO Project on wildlife, which represents a weight of evidence approach (Section 6.6.3). For example, a pathway with a high magnitude, large geographic extent, and long-term duration is given more weight in determining significance relative to pathways with smaller scale effects. The relative impact from each pathway is discussed; however, pathways that are predicted to have the greatest influence on changes to the persistence of wildlife are also assumed to contribute the most to the determination of environmental significance.

Environmental significance is used to identify predicted impacts that have sufficient magnitude, duration, and geographic extent to cause fundamental changes to wildlife. The following definitions are used for assessing the significance of impacts on the persistence of wildlife, and the associated continued opportunity for traditional use of wildlife.

Not significant – impacts are measurable at the individual level, and strong enough to be detectable at the population level, but are not likely to decrease resilience and increase the risk to population persistence.

Significant – impacts are measurable at the population level and likely to decrease resilience and increase the risk to population persistence. A number of high magnitude and irreversible impacts at the population level (regional scale) would likely be significant.

15.8.2 Results

The results predict that the incremental and cumulative impacts from the NICO Project and other developments should not significantly influence the persistence of wildlife populations. For all primary pathways influencing the abundance and distribution of populations, cumulative impacts were determined to be regional in geographic extent, which implies that at least some portion of the population is affected. For incremental impacts, the geographic extent of pathways ranged from local to regional. Local impacts to habitat were associated with the NICO Project footprint and changes in habitat quality from noise and other sensory disturbance for all species, and will continuously influence individuals that travel through or occupy habitats within 1 to 3.3 km from the NICO Project site. Regional impacts are associated with periodic noise from aircraft (up to 26 km during takeoff and landing at the NICO Project site) and changes to habitat, movement, and behaviour from the cumulative effects from noise, lights, and human activities from the NICO Project and other developments. The likelihood of the impacts occurring is expected to be likely to highly likely for all pathways (Table 15.7-2), which does not change the expected magnitude and duration (or environmental significance). Similarly, the frequency of most impacts is anticipated to occur periodically or continuously throughout the life of the NICO Project.

Sensory disturbance impacts associated with influences of exploration, mining activities, and roads on wildlife populations are anticipated to be reversible over the long term (26 to 31 years [2 moose and marten, 15 muskrat and upland breeding bird, and 4 waterbird and raptor life spans]). However, the incremental and cumulative direct disturbance impacts to populations from non-reclaimed portions of the footprint (e.g., constructed wetlands), were assumed to be irreversible within the temporal boundaries of the assessment. Similary, potential harvesting of wildlife near the NPAR and Proposed Tłįchǫ Road Route will likely continue well beyond the temporal boundary of the assessment (i.e., permanent impact).

The magnitude for the 3 primary pathways impacting wildlife ranged from negligible to moderate (Table 15.7-2). The magnitude of the cumulative impact from direct habitat loss associated with the NICO Project and previous, existing, and reasonably foreseeable future developments is expected to be about 0.5% of the ESAM and about 1.9% of the RSA relative to reference conditions. The relative amount of change in quality habitats from reference conditions to the future case in the study areas is estimated to be 11% for moose, 12% for marten, 1% for muskrat, 2% for waterbirds, and 7% for short-eared owl. Approximately 5% of upland birds will be lost, relative to reference conditions, because of direct and indirect effects of the NICO Project and previous, existing, and future developments in the RSA. The incremental impact from the NICO Project on direct and indirect habitat effects to wildlife is less than or equal to 6% relative to 2010 baseline conditions for all species assessed.

There is a moderate to high degree of confidence in the predictions of environmental significance from the incremental and cumulative impacts on wildlife. The frequency of baseline observations of wildlife species in the study area correlated well with the independent assessment of habitat quality for the species. For example, no short-eared owls were observed during baseline surveys and it was estimated that there was roughly 3% good quality short-eared owl habitat in the RSA under 2010 baseline conditions. In contrast, 3858 waterbird individuals were recorded during surveys in 2004 and 2005 and approximately 15% of good quality waterbird habitat was predicted in the RSA under 2010 baseline conditions. In addition, habitat models contained conservative estimates for influences from development to increase confidence that the assessment would not underestimate impacts.

The current level of activity in the region (i.e., 2 active exploration sites [including the NICO exploration program]) and the implementation of environmental design features at the NICO Project should not negatively influence the resilience of wildlife populations in the ESAM and RSA. Moose and marten display life history traits (e.g., high reproductive rates, ability to eat many types of plants/prey species) that provide flexibility to adapt to different ecozones and rates of development across North America. There is no evidence to suggest that muskrat are sensitive to proximity to human disturbance and several waterbird species have been found to habituate to areas with high noise levels. Impacts from different projects in the region should be limited to individuals within local populations around each footprint. Most bird species are migratory, and will be influenced by the NICO Project and other developments for 4 to 5 months each year during spring to autumn. Although nest productivity can be influenced by human disturbance, this is also a time of year in the region when weather conditions are typically less harsh and food is abundant, which can increase resistance in individuals to natural and human-related stressors. Upland and waterbird populations have high reproductive rates that provide flexibility to adapt to different environmental selection pressures. Similarly, raptors display life history traits (variation in time between egg laying and hatching of young) that provides adaptability and resilience for populations experiencing different extremes of prey abundance and weather patterns.

This resilience in the current state of wildlife populations suggests that the impacts from the NICO Project and existing and future developments should be reversible. Overall, the weight of evidence from the analysis of the primary pathways predicts that the incremental and cumulative impacts from the NICO Project and other developments should not have a significant adverse impact on the persistence of wildlife populations. Subsequently, cumulative impacts from development also are not predicted to have a significant adverse effect on continued opportunities for use of wildlife by people that value these animals as part of their culture and livelihood.

15.9 Uncertainty

The purpose of the uncertainty section is to identify the key sources of uncertainty and to discuss how uncertainty has been addressed to increase the level of confidence that impacts are not worse than predicted. Confidence in the assessment of environmental significance is related to the following elements:

- adequacy of baseline data for understanding current conditions and future changes unrelated to the NICO Project (e.g., extent of future developments, climate change, catastrophic events);
- model inputs (e.g., zone of influence and disturbance coefficients from developments);
- understanding of NICO Project-related impacts on complex ecosystems that contain interactions across different scales of time and space (e.g., exactly how the NICO Project will influence wildlife species); and
- knowledge of the effectiveness of the environmental design features (mitigation) for reducing or removing impacts (e.g., revegetation of wildlife habitat).

Like all scientific results and inferences, residual impact predictions must be tempered with uncertainty associated with the data and current knowledge of the system. It is anticipated that the baseline data is sufficient for understanding current conditions and future changes not related to the NICO Project, and that there is a moderate to high level of understanding of NICO Project-related impacts on the ecosystem. However, there remains a degree of uncertainty surrounding the degree to which some effects may occur (e.g., magnitude and duration).

It is understood that development activities will directly and indirectly affect habitat, and wildlife behaviour and movement; however, long-term monitoring studies documenting the resilience of wildlife species to development and the time required to reverse impacts are lacking. Direct disturbance from previous, existing, and future development footprints was calculated to be about 0.5% of the regional habitat for the moose population and 1.9% of the regional habitat for marten, muskrat, upland breeding birds, waterbirds, and raptors. Yet there remains a high degree of uncertainty in the effectiveness of revegetation techniques for reversing the impact from direct changes to habitat.

Adding to the challenges of understanding complex systems is the difficulty of forecasting a future that may be outside the range of observable baseline environmental conditions such as factors related to climate change (Walther et al. 2002). Potential future developments such as the Proposed Tłįchǫ Road Route also generate uncertainty in impact predictions.

Although quantitative and less biased than models based on expert opinion, HSI-based habitat maps have numerous sources of uncertainty; these include the structure of the models, the accuracy and precision of underlying data layers, and biases associated with the chosen GIS algorithms (Burgman et al. 2005). Further, habitat maps are a static view between a species and its environment, ignoring changes over time with ecological succession and natural disturbances such as climatic events. However, when considering the predictions on the effects from the NICO Project on wildlife habitat, sources of uncertainty were reduced by using multiple habitat mapping methods (Burgman et al. 2005). For example, the assessment included both fragmentation analyses and the use of HSI models, which together limit bias and imprecision in predictions.

To reduce uncertainty associated with changes in habitat quality, and altered movement and behaviour of wildlife, conservative estimates of the zones of influence and habitat suitability modifier coefficients were applied to the HSI models. For example, the zones of influence and habitat suitability modifier coefficients for wildlife used for the NICO Project were also applied to smaller and less active exploration sites. In addition, a 500 m radius was used to estimate the area of the footprint for exploration sites (78.5 ha). This likely overestimates direct habitat loss as drilling activities are generally completed in the winter to avoid rutting from the rig and on-site vehicles (unless a heli-portable drill rig is used). A 200 m radius was used to estimate the area of historic remediated and non-remediated site footprints (e.g., Rayrock mine).

Zones of influence were also applied to all active exploration sites in the ESAM and RSA for the entire permit period even though activities typically do not occur throughout the year, and some sites may have been abandoned before permit expiration. Habitat suitability modifier coefficients (used for reducing habitat quality in the zones of influence) with the greatest effect were applied in cases where zones of influenced overlapped, rather than using the average of two or more coefficients. All of these attributes provide confidence that the assessment has not underestimated the environmental significance of the incremental and cumulative impacts from the NICO Project and other developments on wildlife, and the people that value wildlife for their livelihood.

15.9.1 Previous and Reasonably Forseeable Future Projects

Predicting effects from past developments such as historic remediated and non-remediated sites also contains uncertainty. The removal of physical hazards to people and wildlife at the Rayrock and Colomac mines was one objective of permanent closure for both mines. During closure and reclamation, the town sites were demolished, mine buildings were removed, the tailings areas were covered, the shafts were capped, and landfill sites were isolated and stabilized, garbage collected and removed, and all slopes prone to erosion were stabilized or are monitored annually (INAC 2010 a, b, internet sites). The Rayrock mine was remediated between 1996 and 1997, and long-term monitoring data have indicated that caribou in the area have the normal range of radionuclides for the NWT, very little risk remains to humans from radionuclides, and downstream water quality is not affected by the former mine (INAC 2010a, internet site). Remediation at the Colomac site was initiated in 2008 and is still ongoing. The water quality is improving; however it will be continued to be monitored until all remediation is complete in 2011 (INAC 2010b).

Reasonably foreseeable developments in the ESAM and RSA include the Proposed Tłı̨chǫ Road Route and the Nailii Hydro Project. The Proposed Tłı̨chǫ Road Route will be an all-weather road linking Highway 3 with Gamètì and would pass through the ESAM and RSA. Potential effects from the Proposed Tłı̨chǫ Road Route were quantitatively and qualitatively analyzed in the future case of the effects assessment for wildlife. The magnitude of incremental changes to wildlife habitat quantity and quality from the Proposed Tłı̨chǫ Road Route was predicted to be negligible to low. Most impacts from the Proposed Tłı̨chǫ Road Route should be associated with localized changes in habitat quantity and quality.

The Nailii Hydro Project would include a run-of-river hydro plant constructed on the La Martre River, downstream of the community of Whatì. The largest scale plan includes a 12 megawatt hydro facility connected to Whatì to reduce their dependency on diesel generated power, and a transmission line to the existing Snare Hydro Complex to distribute power to Behchokǫ̀ and Yellowknife. Surplus power could be made available to the NICO Project through a purpose-built transmission line. While only the transmission line would enter the RSA, the entire Nailii Hydro Project would be within the ESAM.

Transmission lines generally have a negligible to low effect on wildlife. Most sensory disturbance occurs during the construction phase, which would likely be completed within one year. Once installed, transmission lines can affect wildlife distribution at the local scale due to the cleared vegetation within the right-of-way. Considering the amount of open forest and bare rock in the RSA and the ESAM, this would likely result in a negligible change to wildlife habitat. Transmission lines are also known to cause bird mortalities through direct collisions. Waterfowl are known to be particularly sensitive as they are fast with poor manoeuvrability, but baseline wildlife studies have indicated that waterfowl densities are low in the RSA. With respect to moose, the entire Nailii Hydro Project would be within the EASM, including the hydro plant. As the hydro plant would be run-of-river, there would be no changes to riparian vegetation, except the clearing required to construct the project. Once operational, the hydro station would likely cause little sensory disturbance to moose. Overall, the project would likely have localized and negligible to low impacts on wildlife habitat, distribution, and abundance.

15.10 Monitoring and Follow-Up

Upon approval of the NICO Project, a Wildlife Effects Monitoring Program will be implemented to limit effects to wildlife and wildlife habitat, determine the effectiveness of mitigation, and test impact predictions. The principal goal of the Wildlife Effects Monitoring Program is to provide information required for the NICO Project Environmental Management System to adaptively manage the NICO Project to protect wildlife and wildlife habitat. In addition, the Wildlife Effects Monitoring Program is designed to provide a process for regulators, communities, and other people interested in the NICO Project to participate in the development and review of wildlife effects mitigation and monitoring.

Specific objectives of the Wildlife Effects Monitoring Program include:

- provide information to test predicted impacts from the NICO Project DAR, and reduce uncertainty;
- implement environmental design features and mitigation to reduce the risks and disturbance to wildlife and wildlife habitat;
- determine the effectiveness of environmental design features and mitigation;
- incorporate local traditional and ecological knowledge, where applicable and available;
- propose action levels or adaptive management triggers that can be used as early warning signs for reviewing and implementing wildlife mitigation practices and policies;
- design studies and data collection protocols that are consistent with other programs in the region; and
- consider existing regional and collaborative programs, such as Cumulative Impact Monitoring Program and the NWT Environmental Stewardship Framework.

More information regarding the Wildlife Effects Monitoring Program can be found in Appendix 18.II.

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