DOMINION DIAMOND

SECTION 13

WILDLIFE AND WILDLIFE HABITAT

Section 13 Table of Contents

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Section 13 Abbreviations

Abbreviation	Definition
ANOVA	analysis of variance
BHP Billiton	BHP Billiton Canada Inc.
BSA	baseline study area
CI	confidence interval
CO	carbon monoxide
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DAR	Developer's Assessment Report
DDMI	Diavik Diamond Mines Inc.
De Beers	De Beers Canada Inc.
Diavik Mine	Diavik Diamond Mine
DKFN	Deninu K'ue First Nation
DNA	deoxyribonucleic acid
Dominion Diamond	Dominion Diamond Ekati Corporation
e.g.	for example
Ekati Mine	Ekati Diamond Mine
ELC	Ecological Landscape Classification
ENR	Environment and Natural Resources, Government of the Northwest Territories
ESA	effects study area
et al.	and more than one additional author
GIS	Geographic Information System
GNWT	Government of the Northwest Territories
GPS	Global Positioning System
HSI	habitat suitability index
ICRP	Interim Closure and Reclamation Plan
i.e.	that is
Jay Project	Project
Jericho	Jericho Diamond Project
KIA	Kitikmeot Inuit Association
KLOI	Key Line of Inquiry
LKDFN	Łutsel K'e Dene First Nation
MANOVA	multiple analysis of variance
MBCA	Migratory Birds Convention Act
MDNN	mean distance to nearest similar habitat patch
MVRB	Mackenzie Valley Review Board
NAD	North American Datum
non-PAG	non-potentially acid generating
NOx	oxides of nitrogen
NSMA	North Slave Métis Alliance
NWT	Northwest Territories
NWTMN	Northwest Territories Métis Nation

Abbreviation	Definition
PAG	potentially acid generating
PC	principal component
$PM_{2.5}$	particulate matter that is 2.5 micrometres or less in size
RFD	reasonably foreseeable development
SARA	*Species at Risk Act*, Government of Canada
SE	standard error: standard deviation divided by the square root of sample size
Snap Lake Mine	Snap Lake Diamond Mine
SO_2	sulphur dioxide
SOx	oxides of sulphur
SON	Subject of Note
spp.	multiple species
TCWR	Tibbitt to Contwoyto Winter Road
TG	Tłįchǫ Government
TSP	total suspended particulates
UTM	Universal Transverse Mercator
VC	valued component
WEMP	Wildlife Effects Monitoring Program
WPKMP	Wastewater and Processed Kimberlite Management Plan
WMP	Wildlife Monitoring Program
WROMP	Waste Rock and Ore Storage Management Plan
WRSA	waste rock storage area
YKDFN	Yellowknives Dene First Nation
ZOI	zone of influence

Section 13 Units of Measure

Unit	Definition
%	percent
<	less than
>	greater than
=	equal
+	plus
±	plus or minus
dBA	A-weighted decibels
ha	hectare
kg/ha/y	kilograms per hectare per year
km	kilometre
km^2	square kilometre
km/day	kilometres per day
km/h	kilometres per hour
km/km^2	kilometres per square kilometre
kV	kilovolts
m	metre

13 WILDLIFE AND WILDLIFE HABITAT

13.1 Introduction

13.1.1 Background

The existing Dominion Diamond Ekati Corporation (Dominion Diamond) Ekati Diamond Mine (Ekati Mine) and its surrounding claim block are located approximately 300 kilometres (km) northeast of Yellowknife in the Northwest Territories (NWT) (Map 13.1-1). Dominion Diamond proposes to develop the Jay Project (Project), which includes the Jay Pit, along with associated mining and transportation infrastructure (Map 13.1-2) to add 10 or more years of operations life to the Ekati Mine. The majority of the facilities required to support the Project and process the kimberlite already exist at the Ekati Mine, including:

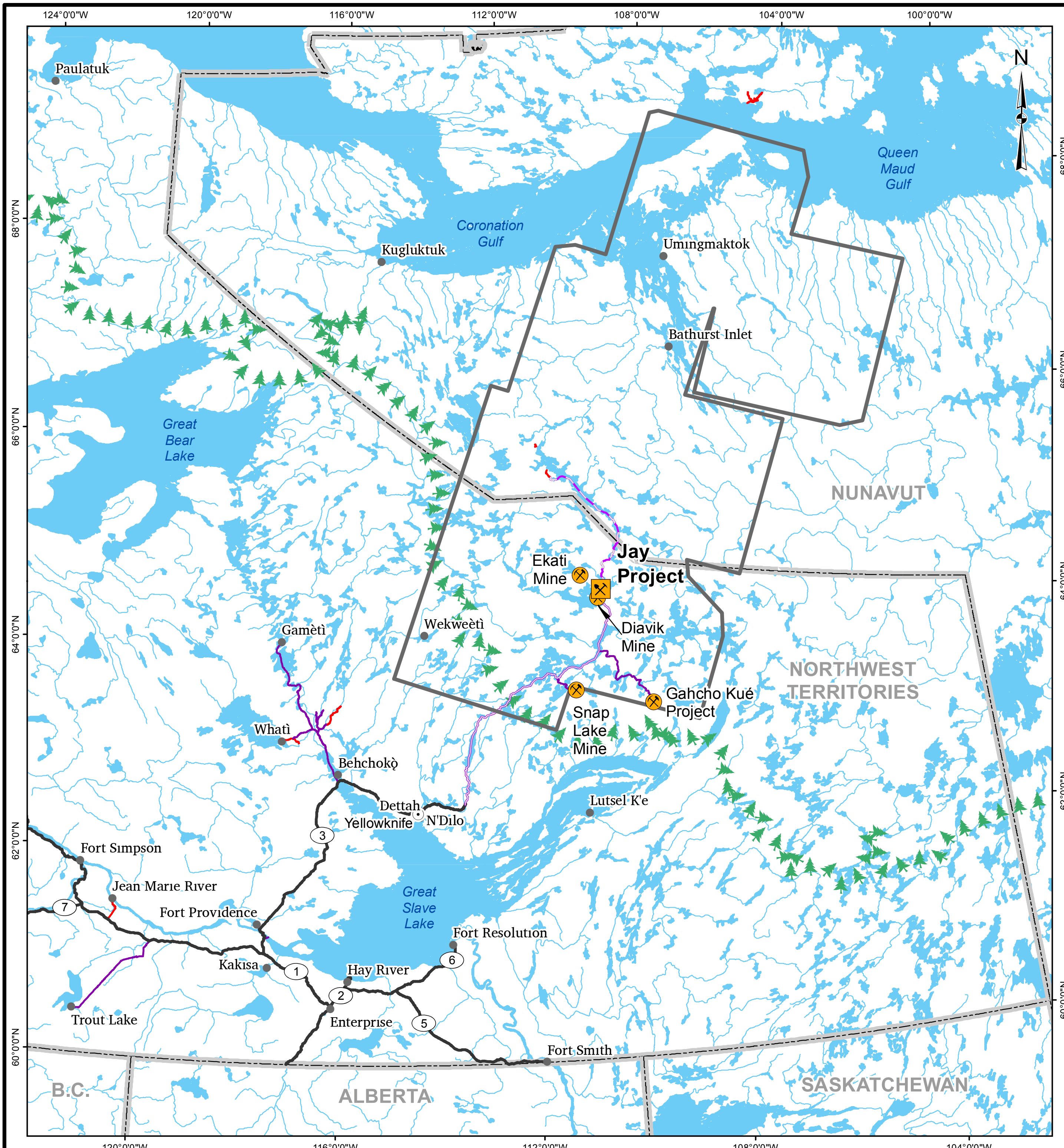
- Misery Pit mining infrastructure (e.g., fuel facility, explosives magazines);
- primary roads and transportation infrastructure (e.g., Ekati airstrip, Misery Road);
- Ekati main camp and supporting infrastructure;
- Ekati processing plant; and,
- fine processed kimberlite management facilities.

The Jay kimberlite pipe is located beneath Lac du Sauvage in the southeastern portion of the Ekati claim block, approximately 7 km to the northeast of the Misery Pit (Map 13.1-2). A horseshoe-shaped dike will be constructed to isolate the portion of Lac du Sauvage overlying the Jay kimberlite pipe. The isolated portion of Lac du Sauvage will be dewatered to allow for open-pit mining of the kimberlite pipe. The Project will also require an access road, pipelines, and power lines to the new open pit.

13.1.2 Purpose and Scope

This section of the Developer's Assessment Report (DAR) for the Jay Project addresses the Subject of Note (SON): Impacts to Wildlife and Wildlife Habitat from Project Components identified in the Terms of Reference issued on February 21, 2014 by the Mackenzie Valley Review Board (MVRB). The Terms of Reference document is included in Appendix 1A, and the Table of Concordance for the DAR is provided in Appendix 1D of Section 1.

The purpose of this section of the DAR is to meet the Terms of Reference issued by the MVRB, and specifically to assess the significance of incremental and cumulative effects from the Project and other developments on wildlife, other than caribou, and their habitat.



LEGEND

- JAY PROJECT
- EXISTING MINE OR PROJECT
- TERRITORIAL CAPITAL
- POPULATED PLACE
- HIGHWAY
- WINTER ROAD
- ALL-SEASON ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- TERRITORIAL/PROVINCIAL BOUNDARY
- TREELINE
- WATERCOURSE
- WATERBODY

150 0 150

SCALE 1:6,000,000 KILOMETRES

REFERENCE

WATER OBTAINED FROM ATLAS OF CANADA
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
PROJECTION: CANADA LAMBERT CONFORMAL CONIC

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

LOCATION OF THE JAY PROJECT

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_001_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	02/10/14	MAP 13.1-1	
CHECK	LD	02/10/14		
REVIEW	LD	02/10/14		

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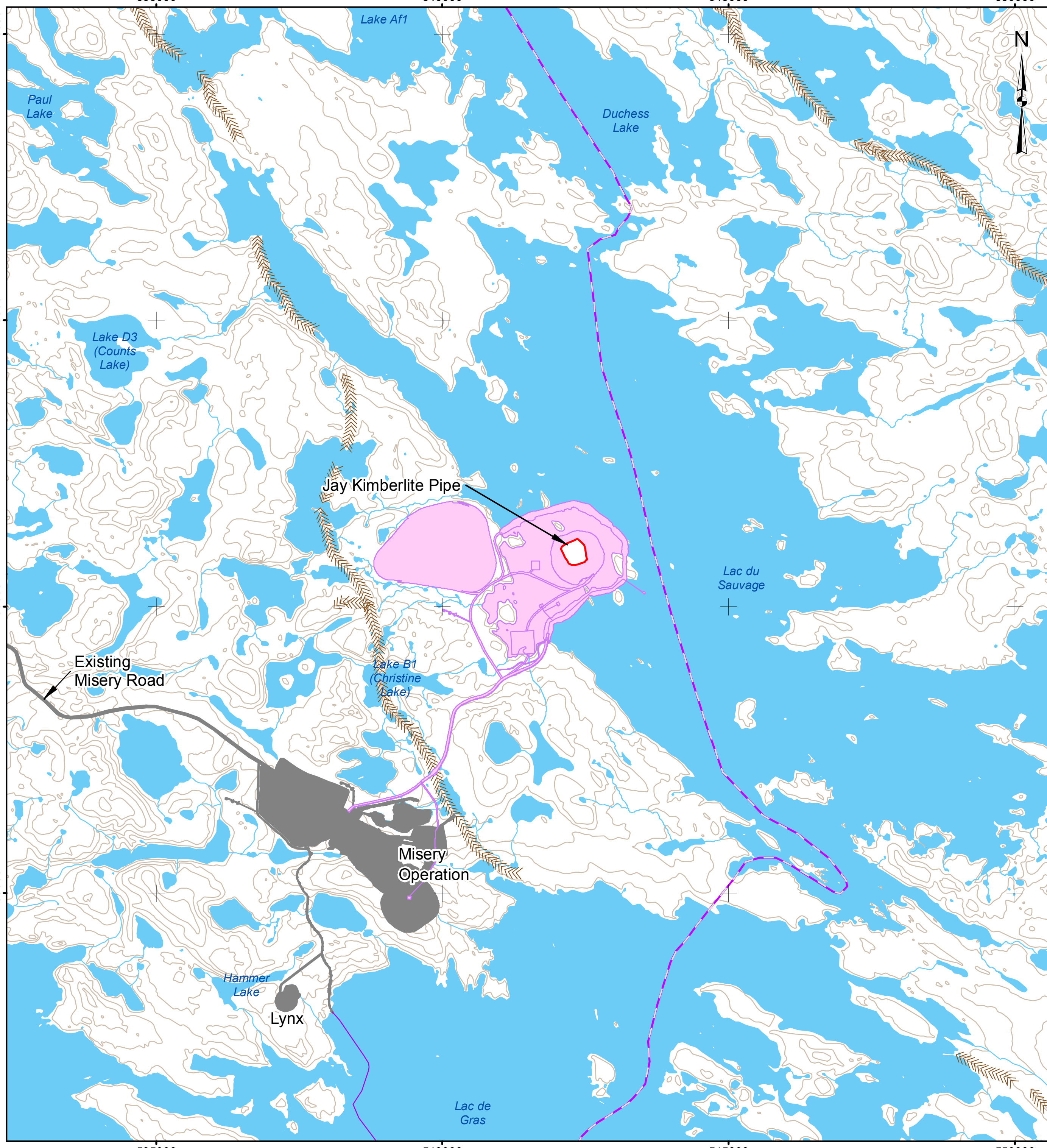

LEGEND

- EKATI MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (10 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY
- KIMBERLITE PIPE

2 0 2

SCALE 1:100,000 KILOMETRES

REFERENCE

CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

LOCATION OF THE JAY KIMBERLITE PIPE

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_002_GIS
DESIGN	LD	01/05/14	SCALE AS SHOWN REV. 0
GIS	ANK	01/10/14	**MAP 13.1-2**
CHECK	LD	01/10/14	
REVIEW	LD	01/10/14	

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13.1.3 Valued Components, Assessment Endpoints, and Measurement Indicators

Valued components (VCs) represent physical, biological, cultural, social, and economic properties of the environment that are considered important to society. Six wildlife VCs were selected for detailed study in the DAR (Table 13.1-1) based on the following criteria:

- presence, abundance, and distribution within, or relevance to, the area associated with the Project;
- potential for interaction with the Project and sensitivity to effects;
- species conservation status and concern;
- valued components chosen and assessed in the Environmental Impact Statement for the NWT Diamonds Project (BHP 1995);
- local and traditional knowledge, and related concerns identified at community scoping sessions for the Project in Behchokǫ̀, Yellowknife, and Lutsel K'e, and a technical scoping session in Yellowknife (Section 4);
- previous and on-going engagement with communities involved in the Ekati Mine;
- ecological and socio-economic value to communities, government agencies, the Independent Environmental Monitoring Agency, and the public; and,
- recent experience with similar projects in the NWT and Nunavut.

The Terms of Reference for the Project (MVRB 2014) identified carnivores (wolverine, grizzly bears, and wolves), birds, and species at risk as VCs to be used in the assessment of effects from the Project. In the Terms of Reference the birds VC included upland birds, waterbirds (geese, ducks, loons, and grebes), and raptors (falcons, hawks, eagles, and owls). Upland birds are those birds that nest in terrestrial habitats such as passerines (perching birds, excluding common raven [*Corvus corax*]), ptarmigan, and shorebirds. In this SON, separate assessments are completed for upland birds, waterbirds, and raptors (Table 13.1-1).

For the purposes of this report, species at risk are defined as species recommended by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to be protected under Canada's *Species at Risk Act* (SARA), as well as species currently protected under the SARA. Five wildlife species at risk have the potential to occur at and around the Project site (Table 13.1-2). A separate species at risk section is not included in this SON. Instead, effects to grizzly bear (*Ursus arctos*) and wolverine (*Gulo gulo*) are assessed in independent sections, as outlined in the Terms of Reference (MVRB 2014). Effects to short-eared owl (*Asio flammeus*) and peregrine falcon (*Falco peregrinus anatum/tundrius*) are assessed as part of the raptor VC. Effects to rusty blackbird (*Euphagus carolinus*) are assessed as part of the upland bird VC.

Horned grebe (*Podiceps auritus*) were initially considered for inclusion as a species at risk in this SON but were screened out based on the following information. Although horned grebes were observed on the Coppermine River during baseline studies for the Diavik Diamond Mine (Diavik Mine) in 1997, they were not considered to be regularly present or breeding on the Coppermine River (DDMI 1998). Horned grebes were not observed during baseline studies at the Ekati Mine in 1994 and 1996 (BHP 1998), during bird plot monitoring at the Ekati Mine from 1996 to 2008 (Rescan 2010a), or during North American breeding bird surveys from 2003 to 2013 (ERM Rescan 2014a). Further, Lac de Gras is not considered to be within the range of the horned grebe (NWT Infobase 2014). Thus, any observations of horned grebe on or near the Project site are considered to be extra-limital.

Table 13.1-1 Rationale for Selection of Wildlife Valued Components

Group	Valued Component	Rationale
large carnivores	wolverine (*Gulo gulo*)	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 (NWT Infobase 2014) and '*of special concern*' federally (COSEWIC 2014)
	grizzly bear (*Ursus arctos*)	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; listed as '*sensitive*' in the NWT (NWT Infobase 2014) and '*of special concern*' federally (COSEWIC 2014)
	gray wolf (*Canis lupus*)	large home range size; top predator in ecosystem; long generation time means one individual may be affected by disturbance over multiple years resulting in potential regional population effects
birds	upland 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 a species at risk (rusty blackbird [*Euphagus carolinus*])
	waterbirds	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
	raptors	breeding habitat is limited; some species are sensitive to noise disturbance and human activity during nesting; includes peregrine falcon (*Falco peregrinus anatum/tundrius*) and short-eared owl (*Asio flammeus*) (species at risk)

Table 13.1-2 Wildlife Species at Risk[a] for the Project

Common Name	Scientific Name	COSEWIC Status[b]	SARA Status[c]	NWT List of Species at Risk[d]
grizzly bear (western population)	*Ursus arctos*	Special Concern	under consideration	no status
wolverine (western population)	*Gulo gulo*	Special Concern	no status	no status
peregrine falcon (anatum-tundrius complex)	*Falco peregrinus anatum/tundrius*	Special Concern	Special Concern - Schedule 1	no status
short-eared owl	*Asio flammeus*	Special Concern	Special Concern - Schedule 1	no status
rusty blackbird	*Euphagus carolilnus*	Special Concern	Special Concern - Schedule 1	no status

a) Species recommended by the Committee on the Status of Endangered Wildlife in Canada to be protected under Canada's *Species at Risk Act*, as well as species currently protected under the *Species at Risk Act*

b) COSEWIC 2014.

c) SARA Public Registry 2014.

d) NWT Infobase 2014.

COSEWIC = Committee on the Status of Endangered Wildlife in Canada; SARA = Canada's *Species at Risk Act*; NWT = Northwest Territories.

Wildlife species are an important cultural and economic resource for people in the NWT. Assessment endpoints are qualitative expressions used to assess the significance of effects on VCs and represent the key properties of VCs that should be protected for future human generations (i.e., incorporate sustainability). Identification of assessment endpoints was determined partially from the outcome of the community (including local and traditional knowledge), public, and regulatory engagement process (Section 4).

Self-sustaining and ecologically effective populations are the assessment endpoint for each VC. Self-sustaining populations are healthy, robust populations capable of withstanding environmental change and accommodating random demographic processes (Reed et al. 2003). For VCs that have strong effects on ecosystem structure and function (i.e., highly interactive species), the concept of ecologically effective populations is also used (Soulè et al. 2003). An ecologically effective population of a highly interactive species is one that is large enough to maintain ecosystem function.

The wildlife assessment focuses on measurement indicators and assessment endpoints derived from ecology and conservation science. Community and regulatory engagement, and local and traditional knowledge were a key consideration for selecting VCs, but assessment endpoints for wildlife VCs do not explicitly consider societal values, such as continued opportunities for traditional and non-traditional use of wildlife. Societal values concerning changes in wildlife populations are important and must also be considered to understand the full suite of potential effects of the Project (i.e., both human and ecological dimensions). Consequently, measurement indicators from the wildlife section were carried forward so that effects on societal values could be appropriately captured in the sections dealing specifically with those values (Culture: Section 15).

Measurement indicators represent properties of the environment and VCs that, when changed, could result in or contribute to an effect on assessment endpoints. For example, the area of habitats, connectivity between habitats, and quality of habitat (which influence animal occupancy, movement, and behaviour) are measurement indicators for the assessment endpoint of wildlife VCs (Table 13.1-3). Measured and predicted changes in survival and reproduction are also used to indicate the influence of human-related and natural factors on the assessment endpoint, and include results from other disciplines such as the wildlife health risk assessment.

Table 13.1-3 Summary of the Valued Components, Assessment Endpoints, and Measurement Indicators

Valued Component	Assessment Endpoint	Measurement Indicators
grizzly bear wolverine gray wolf upland birds waterbirds raptors	• self-sustaining and ecologically effective populations	• habitat quantity • habitat arrangement and connectivity (fragmentation) • habitat quality (occupancy, movement, and behaviour) • survival and reproduction • abundance and distribution of valued components

13.1.4 Spatial Boundaries

13.1.4.1 *General Setting*

The Project is located in the Level III Tundra Shield Low Arctic (south) Ecoregion in the Level II Tundra Shield Ecoregion (Ecosystem Classification Working Group 2012). Soils in the Level III Tundra Shield Low Arctic (south) Ecoregion are dominantly Crysols, with Brunisols and Regosols in rockland areas. Vegetation in the Tundra Shield Low Arctic (south) Ecoregion is primarily characterized by continuous to discontinuous low-shrub and erect dwarf-shrub tundra.

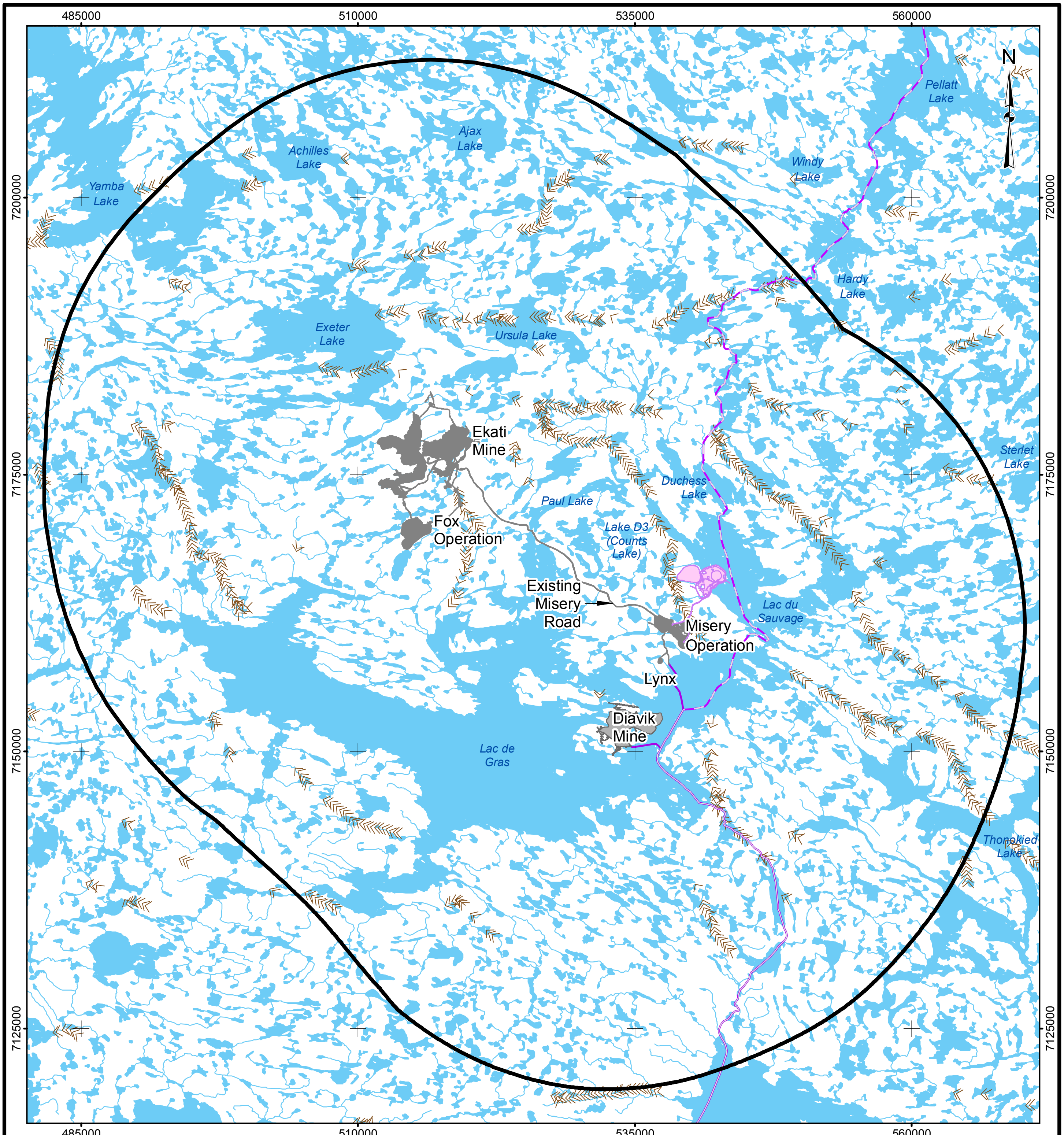
13.1.4.2 *Baseline Study Area*

The baseline study area (BSA) was designed to characterize existing environmental conditions at various spatial scales ranging from the Project site to broader, regional levels (Section 6.3.1). Data collected at the Project site and local scales were used to provide precise measures of baseline environmental conditions and predict the direct and indirect changes from the Project on VCs (e.g., changes to terrestrial habitat from the Project's physical footprint and dust and air emissions). Data collected at larger scales were used to measure broader-scale baseline environmental conditions, and provide regional context for the combined direct and indirect effects from the Project on VCs. The BSA is approximately 5,933 square kilometres (km^2) (Annex VII, Section 1.4).

13.1.4.3 *Birds Effects Study Area*

The birds effects study area (ESA) is the same as the BSA (5,933 km^2; Map 13.1-3). The scale and boundaries of the birds ESA were defined to capture the diversity of habitats that support the seasonal requirements of upland birds, waterbirds, and raptors. The boundary includes all of the downstream area predicted to be affected by the Project, such that downstream effects (e.g., relating to water flow and level changes) on waterbirds can be determined.

The assessment of Project effects on birds is completed at the scale of the birds ESA, which is intended to be large enough to contain all or most individuals that comprise the breeding populations that inhabit the area for part or all of the year. 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 species with small to moderate breeding home ranges (e.g., 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 birds ESA, and should be little influenced by dispersal. In other words, developments outside of the birds ESA should have no or little influence on these populations while they inhabit the area for part or all of the year.



LEGEND

- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ESKER
- WATERCOURSE
- WATERBODY
- EFFECTS STUDY AREA

10 0 10

SCALE 1:500,000 KILOMETRES

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

BIRDS AND GRAY WOLF EFFECTS STUDY AREA

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_003_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14	MAP 13.1-3	
CHECK	LD	01/10/14		
REVIEW	LD	01/10/14		

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13.1.4.4 *Gray Wolf Effects Study Area*

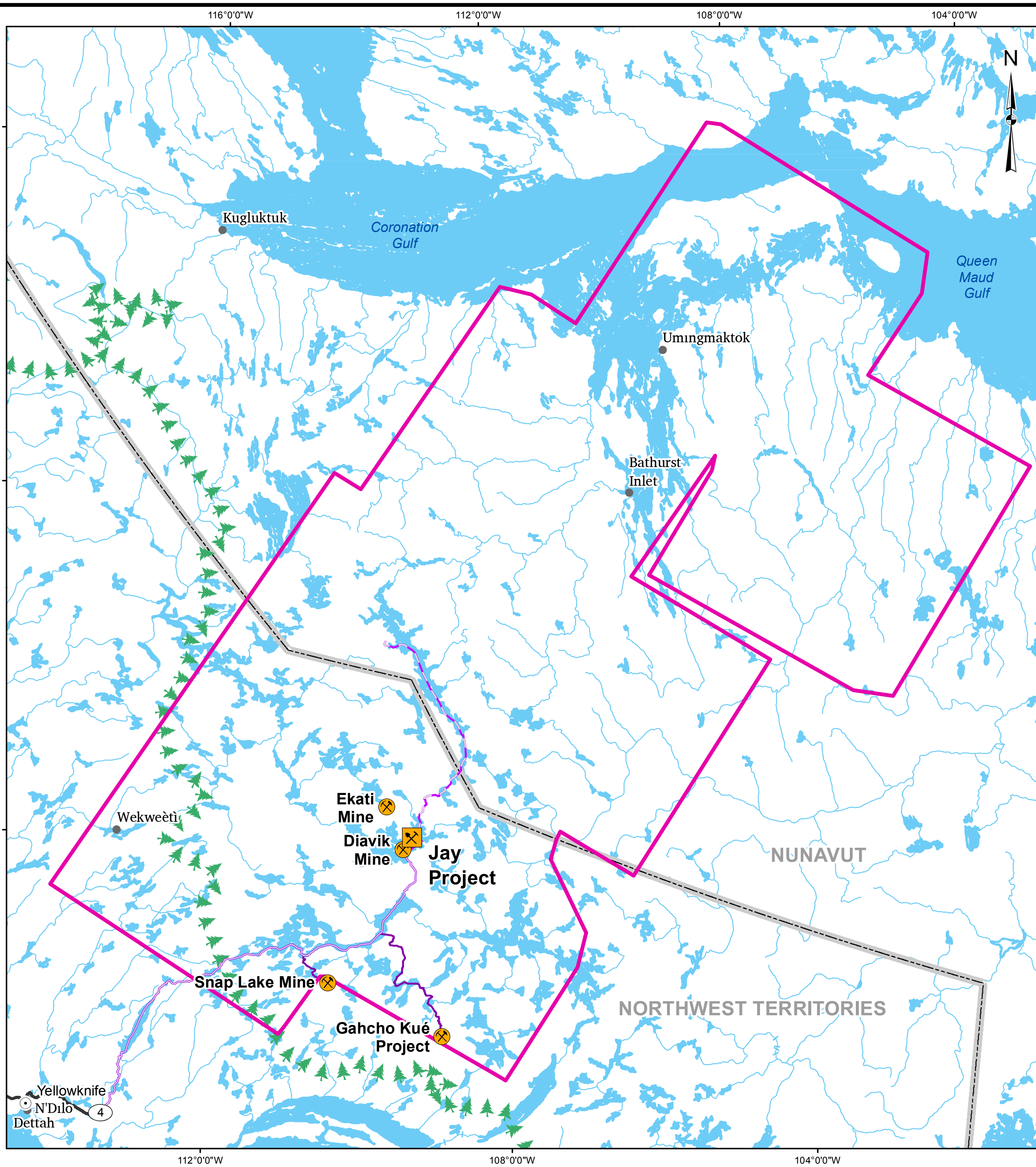
The gray wolf ESA (Map 13.1-3) is the same as the birds ESA (Section 13.1.4.3) and was chosen to assess the effects from the Project on the gray wolf population because wolves may be most sensitive to disturbance during the denning stage (Thiel et al. 1998; Theuerkauf et al. 2003). The wolf ESA provides a sufficient spatial scale for assessing effects on wolf den habitat and productivity from the Project and existing developments in the Lac de Gras area.

13.1.4.5 *Grizzly Bear and Wolverine Effects Study Area*

The grizzly bear and wolverine ESA includes those portions of the North Slave Region of the NWT for which landscape classifications exist (Map 13.1-4). The landscape classification in the North Slave Region was adapted from Matthews et al. (2001). The life history and annual movement patterns of grizzly bears in this area are closely tied to the Bathurst caribou herd (Gau and Case 1999; McLoughlin et al. 1999). However, most individuals from this population of grizzly bears spend little time within the boreal forest.

Although wolverines are wide-ranging, they have smaller home range sizes relative to grizzly bears and are generally not migratory. However, long distance movements are made by transient individuals (Mulders 2000). Wolverine are also dependent on caribou as sources of energy and protein, but mostly through scavenging.

Incorporating the North Slave Region boundaries into the grizzly bear and wolverine ESA is appropriate since most of the existing demographic and habitat selection data for grizzly bears (Gau and Case 1999; McLoughlin et al. 1999; McLoughlin and Messier 2001; Gau et al. 2002; McLoughlin et al. 2002a,b; McLoughlin et al. 2003a,b) and wolverine (Johnson et al. 2005; Boulanger and Mulders 2007; Mulders et al. 2007; Boulanger and Mulders 2013) have been collected in this area. The grizzly bear and wolverine ESA includes other developments, such as the previous Jericho Diamond Project, the existing Ekati and Diavik mines, the Snap Lake Diamond Mine (Snap Lake Mine), and the Gahcho Kué Project. The grizzly bear and wolverine ESA includes the BSA, and has an area of approximately 200,000 km^2.



LEGEND

- JAY PROJECT
- EXISTING MINE OR PROJECT
- TERRITORIAL CAPITAL
- POPULATED PLACE
- HIGHWAY
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- TERRITORIAL/PROVINCIAL BOUNDARY
- TREELINE
- WATERCOURSE
- WATERBODY
- EFFECTS STUDY AREA

75 0 75

SCALE 1:3,750,000 KILOMETRES

REFERENCE

WATER OBTAINED FROM ATLAS OF CANADA
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
PROJECTION: CANADA LAMBERT CONFORMAL CONIC

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

GRIZZLY BEAR AND WOLVERINE EFFECTS STUDY AREA

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_086_GIS	
DESIGN	LD	15/07/14	SCALE AS SHOWN	REV. 0
GIS	DW	03/10/14	MAP 13.1-4	
CHECK	LD	03/10/14		
REVIEW	LD	03/10/14		

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13.2 Existing Environment

The purpose of this section is to describe the existing composition, population status, and distribution of wildlife VCs within the BSA. The detailed methods and results for the baseline surveys are located in Wildlife Baseline Report (Annex VII). An overview of wildlife effects monitoring and research data collected in the effects study areas is also presented to provide a historical and regional perspective on wildlife and species at risk populations for the Project. Information obtained from studies in the BSA and regional programs is used for the assessment of potential effects on wildlife and species at risk from the Project.

13.2.1 Methods

13.2.1.1 *Review of Regional Effects Monitoring and Research*

13.2.1.1.1 *Upland Birds*

Ekati Mine

North American breeding bird surveys were completed in the BSA from 2003 to 2013 (ERM Rescan 2014a). The surveys were completed along the Misery Road and Long Lake Containment Facility Road, and included 50 point counts spaced approximately 0.8 km apart (Map 13.2-1). Surveys were conducted annually in June; they started a half hour before sunrise and concluded before 10:00 am. Each point count was three minutes in length and all bird species seen and heard within 400 m were recorded.

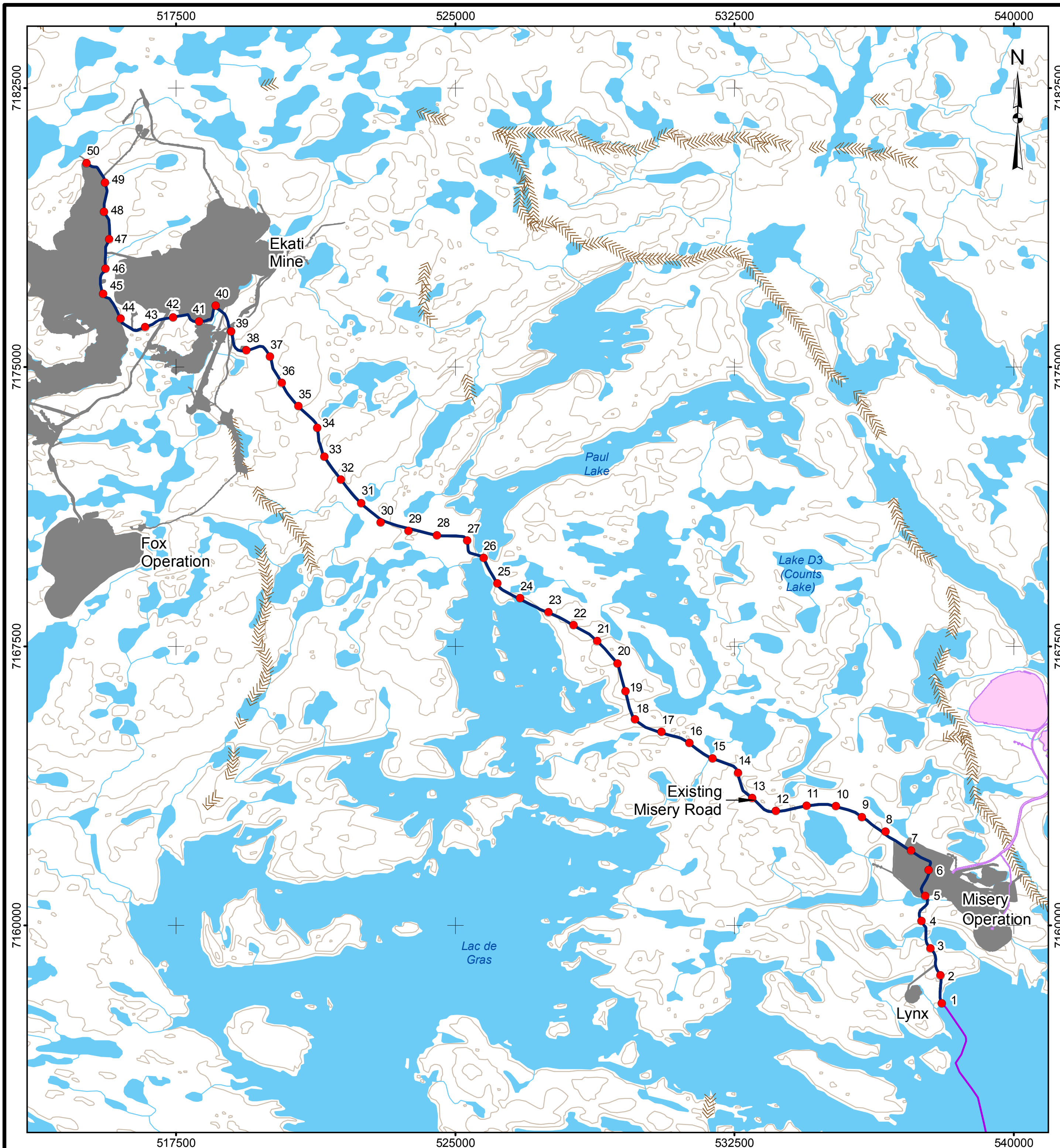
Tundra breeding bird surveys were completed in the BSA in 1996 and from 1998 to 2008 (surveys were completed in 1997, but were excluded due to limited data) (Rescan 2010a). The surveys were completed by foot on 100-m-wide strip-transects within 500 x 500 m plots classified as either mine or control plots, and were surveyed each year in June during the peak breeding season (Map 13.2-2). Mine plots were located within 1 km of the mine footprint, and control plots were located between 5 and 13 km from the mine footprint. To limit habitat variation, plots were located in areas dominated by heath tundra and sedge wetland. Surveys were completed between 5:00 am and 12:00 am by observers walking parallel to each other along the transects. All birds seen and heard within the plot were recorded and included in the surveys. Birds seen flying over the plot and those seen and heard outside the plot were not included in the surveys. Tundra breeding bird surveys were discontinued after 2008 based on engagement with regulators.

Gahcho Kué Project

Rapid assessment breeding bird surveys were conducted within the Gahcho Kué Project study area from 1998 to 2001 to complete a comprehensive species list (De Beers 2010a). Linear transect breeding bird surveys were completed in 2004 and 2005 to determine the relative abundance, distribution, and habitat use (De Beers 2010a). In 2013, breeding bird surveys were again completed in the Gahcho Kué Project study area to determine breeding territory occurrence in terrestrial areas predicted to be flooded during future project construction (Golder 2013a).

Snap Lake Mine

Upland breeding bird surveys were completed at 19 plots within the Snap Lake Mine study area from June 9 to 16, 1999 and June 7 to 13, 2000 (De Beers 2002). Data were used to estimate density, species richness, and species diversity in the study area.



LEGEND

- EKATI MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- ELEVATION CONTOUR (20 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY
- 3 MINUTE POINT COUNT LOCATION
- BREEDING BIRD SURVEY ROUTE

3 0 3

SCALE 1:150,000 KILOMETRES

REFERENCE

BREEDING BIRD DATA PROVIDED BY RESCAN
NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND™

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

NORTH AMERICAN BREEDING BIRD SURVEY ROUTE, EKATI MINE, 2003 TO 2013

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_004_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14		
CHECK	LD	01/10/14	MAP 13.2-1	
REVIEW	LD	01/10/14		

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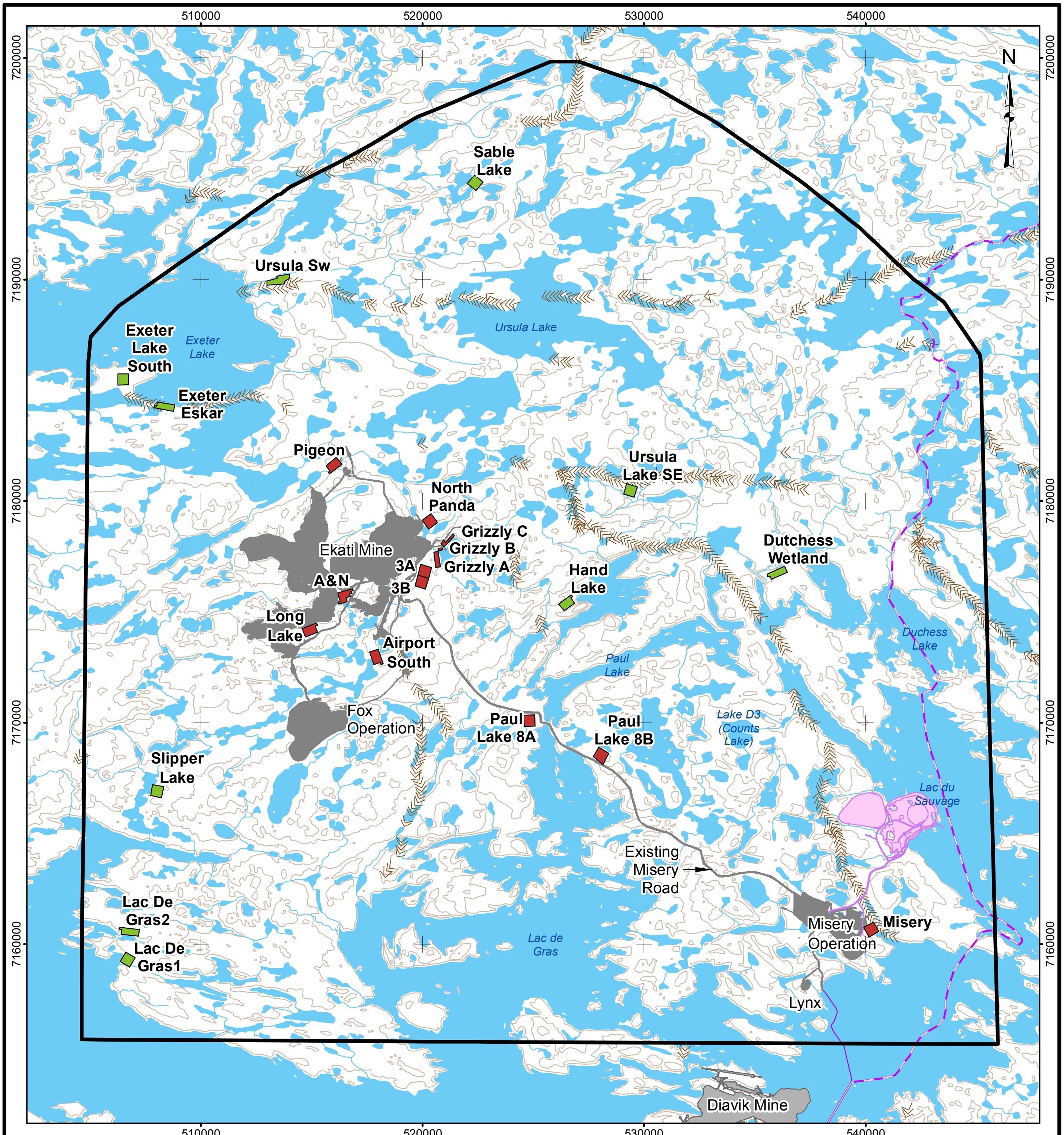

LEGEND

- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (20 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY
- CONTROL PLOT
- MINE PLOT
- EKATI WILDLIFE STUDY AREA, 1998 TO 2005

5 0 5

SCALE 1:250,000 KILOMETRES

REFERENCE

BREEDING BIRD PLOTS PROVIDED BY RESCAN
NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

TUNDRA BREEDING BIRD PLOTS, EKATI MINE 1996, AND 1998 TO 2008

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_005_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14	MAP 13.2-2	
CHECK	LD	01/10/14		
REVIEW	LD	01/10/14		

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13.2.1.1.2 *Waterbirds*

Diavik Mine

Presence Surveys

Ground-based presence surveys have been conducted at the Diavik Mine since 1996 (Golder 2014a). Waterbird presence at the East Island shallow bays and mine-altered waterbodies (Map 13.2-3) was surveyed daily for five weeks during peak migration (May and June). The surveys were conducted by surveyors walking the perimeter of the bays and waterbodies. The identity and number of all birds observed were recorded.

Habitat Selection

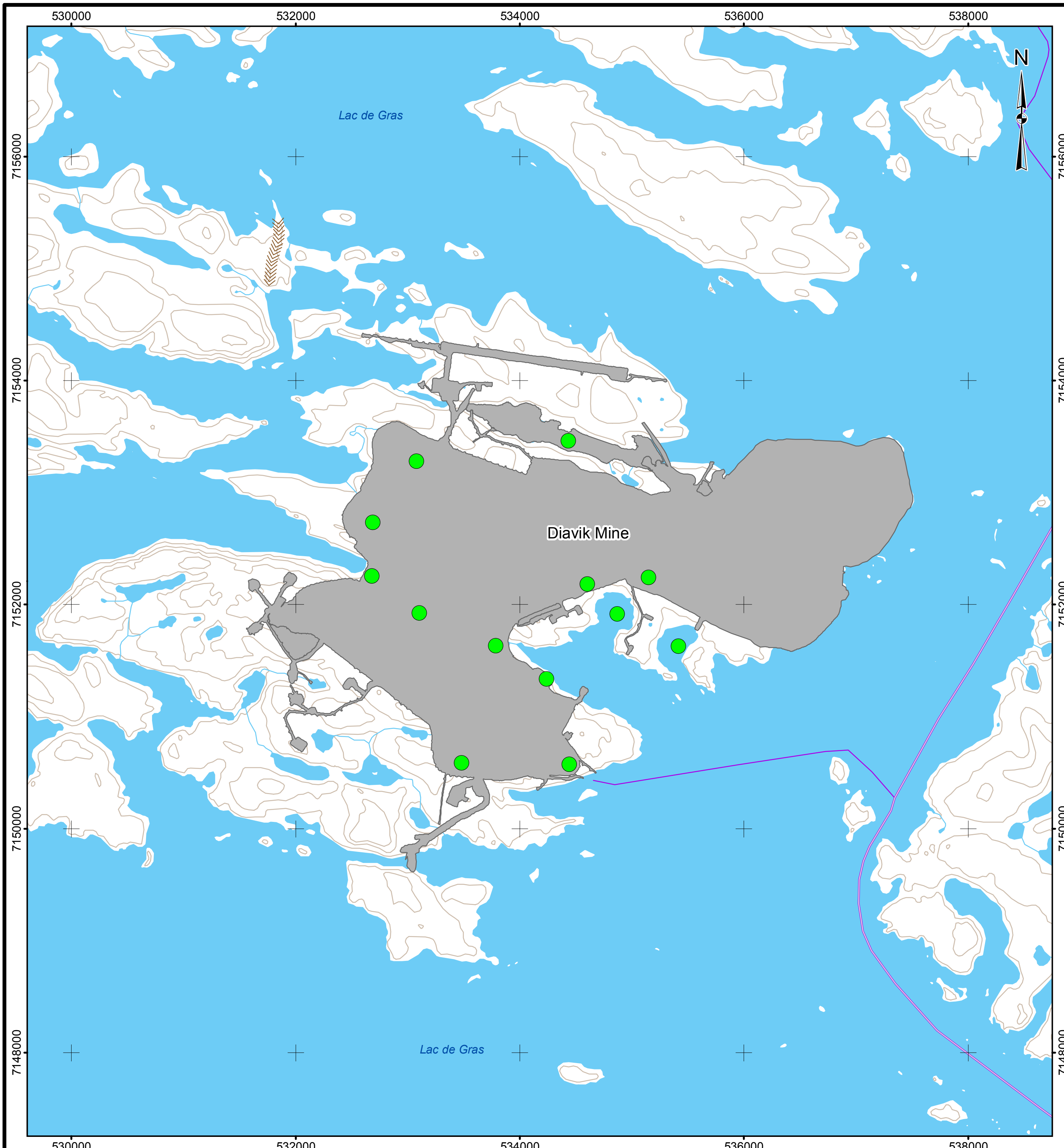
Ground-based habitat selection surveys of the East Island shallow bays and mine-altered waterbodies (Map 13.2-3) have been conducted at the Diavik Mine during peak spring migration (May and June) since 2001 (Golder 2014a). Surveyors identified and recorded all birds observed from the perimeter of the shallow bays and mine-altered waterbodies.

Gahcho Kué Project

Waterbird aerial surveys have been completed annually since 2010 at Kennady Lake and Lake X6 (as well as D2, D3, and E1 lakes in 2012) to determine species occurrence and composition (Golder 2013a). Aerial surveys were completed by one observer using a helicopter flying 45 to 50 m above ground level at a speed of 80 kilometres per hour (km/h). The survey route followed the shoreline of each lake and island (Map 13.2-4), and the observer sat on the shoreline side of the helicopter. Smaller waterbodies occurring within 200 m of Kennady Lake and Lake X6 shoreline were also included in the survey. Waterbird aerial surveys were also completed in the Gahcho Kué Project study area in 2004 to document species occurrence, relative abundance, and habitat use during the spring migration, breeding season, and fall migration (De Beers 2010a).

Snap Lake Mine

Waterbird aerial surveys were completed in June of 1999 and 2000 on 18 lakes (including the water management pond area) (De Beers 2002). Ten lakes were within 10 km of the Snap Lake mine site; eight lakes were more than 11 km from the mine site (Map 13.2-5). Surveys of the 10 lakes closest to the mine site were repeated on July 22 and 24, 1999. Lakes were large enough to support loons (*Gavia* spp.), but not so large that identification of individuals was compromised. Maximum diameter for any lake was 500 m, and perimeters ranged from 761 to 2,391 m. Shoreline characteristics were similar among lakes, and typically consisted of 40 percent (%) to 95% sedge (median = 75%) and 5% to 60% rock. The lakes were noted on a 1:50,000-scale Map and Global Positioning System (GPS) coordinates were recorded.



LEGEND

- DIAVIK MINE FOOTPRINT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (10 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY
- WATERBIRD SURVEY LOCATION

1 0 1

SCALE 1:50,000 KILOMETRES

REFERENCE

CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

WATERBIRD SURVEY LOCATIONS, DIAVIK MINE, 1996 TO 2013

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_006_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14	MAP 13.2-3	
CHECK	LD	01/10/14		
REVIEW	LD	01/10/14		

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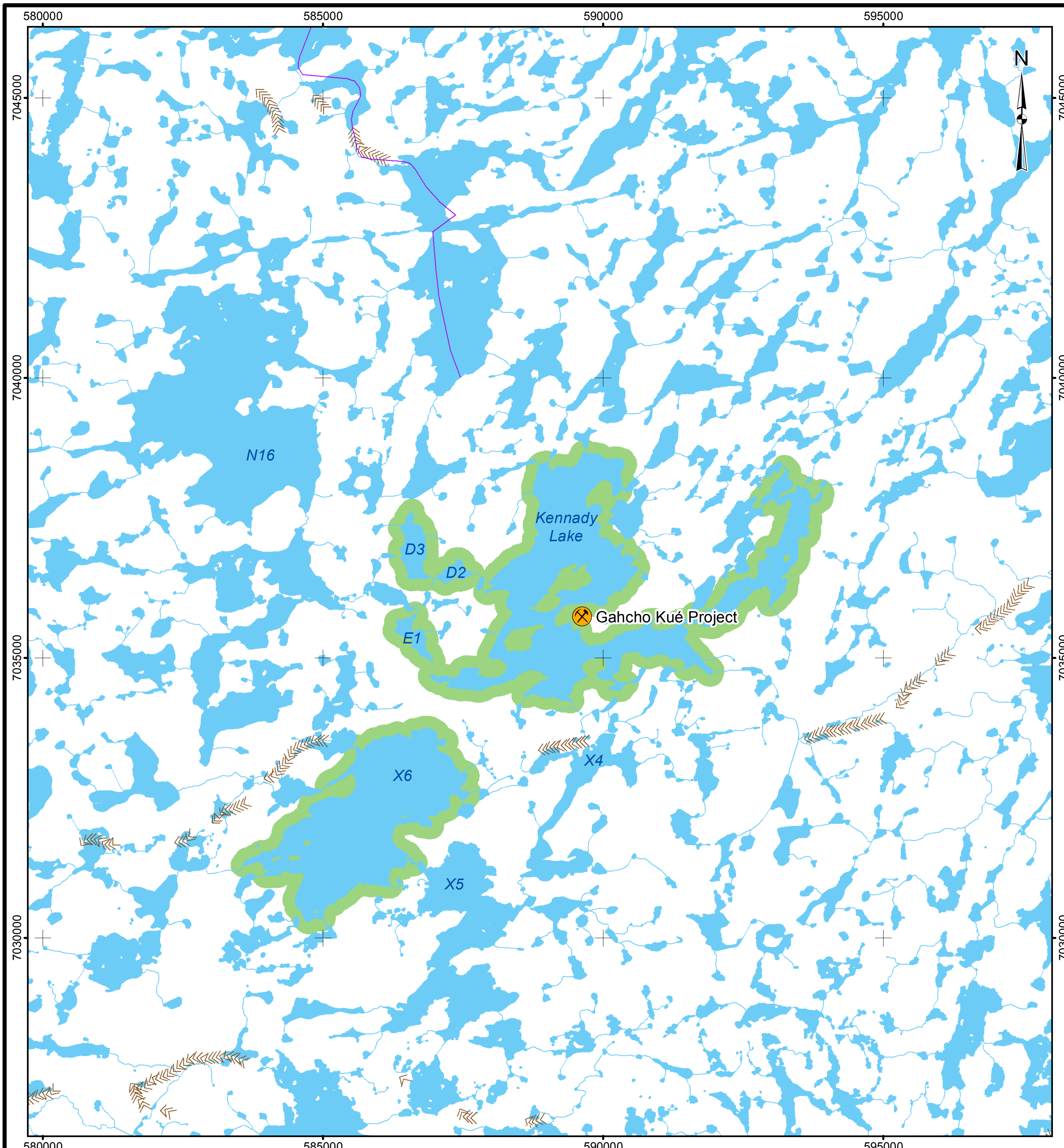

LEGEND

- WINTER ROAD
- ESKER
- WATERCOURSE
- WATERBODY
- EXISTING PROJECT
- LAKES SURVEYED

2 0 2

SCALE 1:100,000 KILOMETRES

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

WATERBIRD SURVEY AREAS, GAHCHO KUÉ PROJECT, 2010 TO 2013

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_007_GIS
DESIGN	LD	01/05/14	SCALE AS SHOWN REV. 0
GIS	ANK	07/10/14	
CHECK	LD	07/10/14	MAP 13.2-4
REVIEW	LD	07/10/14	

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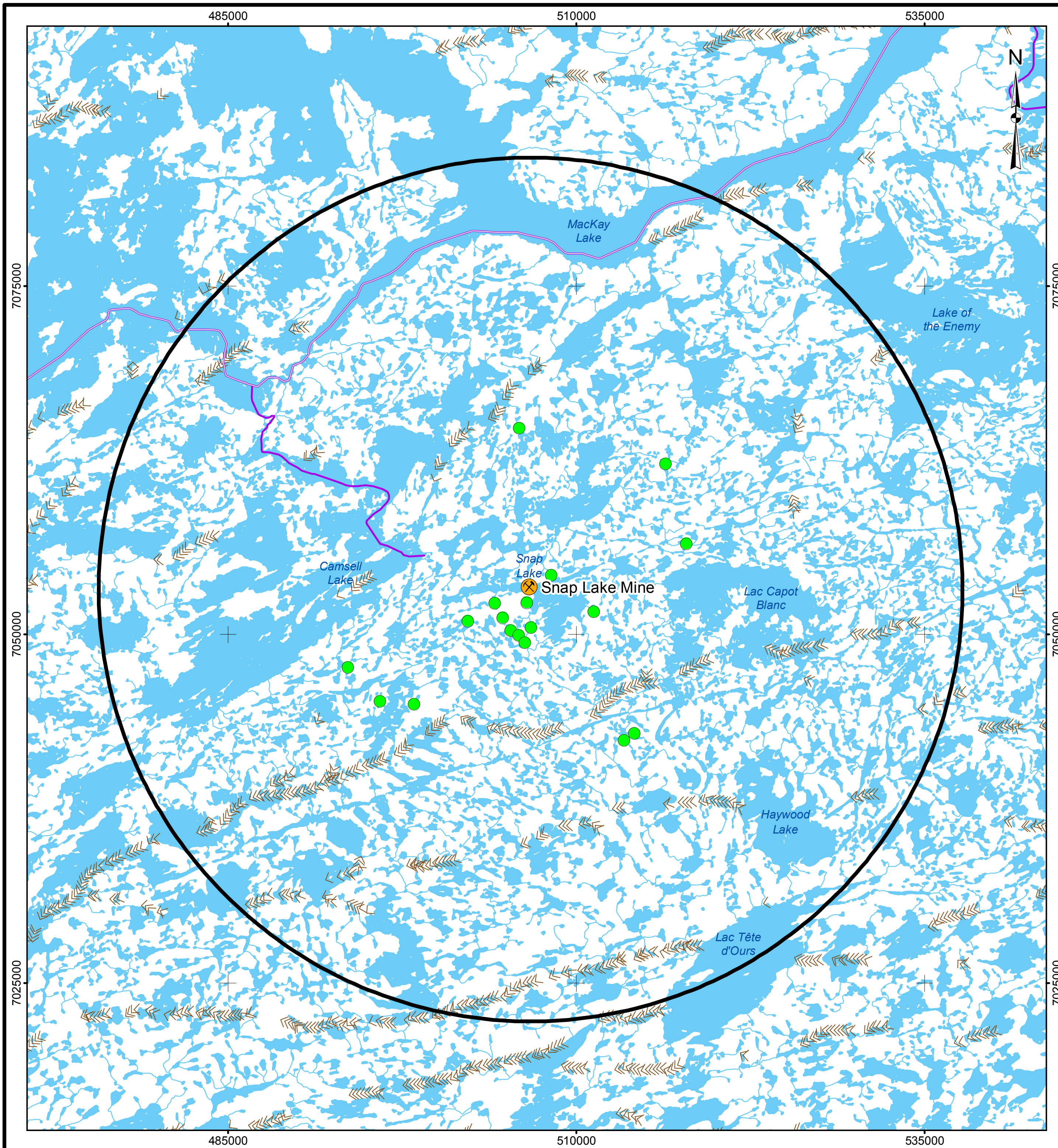

LEGEND

- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- ESKER
- WATERCOURSE
- WATERBODY
- EXISTING MINE
- WATERBIRD SURVEY LOCATION
- STUDY AREA

8 0 8

SCALE 1:400,000 KILOMETRES

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

WATERBIRD SURVEY LOCATIONS, SNAP LAKE MINE, 1999 AND 2000

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_008_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14	MAP 13.2-5	
CHECK	LD	01/10/14		
REVIEW	LD	01/10/14		

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DOMINION DIAMOND

13.2.1.1.3 *Raptors*

The peregrine falcon is listed as "special concern" under the COSEWIC and Schedule 1 of the SARA (COSEWIC 2014; SARA Public Registry 2014) (Table 13.1-3). In addition to the peregrine falcon, the gyrfalcon is also a high-profile species in the North and the official bird of the NWT (Legislative Assembly of the Northwest Territories 2014).

Ekati and Diavik Mines

Surveys for occupied raptor nest sites in natural areas were initiated in the BSA in 1995; occupancy was determined through visual observation of two adults exhibiting territorial behaviour, the presence of eggs, or a single adult sitting on the nest (Coulton et al. 2013). Nest sites identified during monitoring studies of falcons have been added to the database since 1995. Currently there are 20 known raptor nest sites that range from 1 to 26 km from either the Ekati or Diavik mines (Map 13.2-6). Although annual monitoring of falcons nesting along pit walls continues at the Ekati and Diavik mines, off-site annual falcon raptor nest monitoring in the BSA was discontinued after 2010 following recommendations of communities, regulators and mine monitoring agencies (Handley 2010). Off-site monitoring of nest occupancy and productivity is completed every five years (next in 2015) in conjunction with the Canadian Peregrine Falcon Survey.

Ekati Mine

Visual nest surveys have been completed since 2004 on the pit walls within the Ekati claim block (before 2004, surveys were completed informally and were based on an incident-based approach) (ERM Rescan 2014a). The surveys involved Beartooth, Misery, Fox, Koala North, Panda, and Koala pits. In 2006, power poles along the Misery Road and the Long Lake Road were added to the survey. From mid-April to early September, visual surveys of birds, nests, and nesting activity (including nest construction, perching, and incubation) were observed and recorded by environmental staff. Nests observed below the top third of any pit were immediately reported to Environment and Natural Resources, Government of the Northwest Territories (ENR) for advice on mitigation.

Diavik Mine

The pit walls and mine infrastructure have undergone visual inspections during nesting season (May through September) at the Diavik mine since 2004 (Golder 2014a). The surveys recorded bird nest presence in the pit wall/mine infrastructure at the A154 Pit area, A418 Pit area, south tank farm, processing plant, powerhouse, site services building, and backfill plant; if identified, species and presence of eggs or chicks were recorded.

Gahcho Kué Project

Aerial surveys were performed in the Gahcho Kué Project study area to identify raptor nesting habitat in June 2004 (De Beers 2010a). The survey focused on areas containing the most suitable nesting habitat, including prominent rock outcrops, cliff faces, and ledges. The presence of raptor pairs, a single adult exhibiting territorial behaviour, old nest sites, and evidence of use (i.e., scrapes and perches) were recorded. In 1996 and from 1998 to 2005 (excluding 2004), raptor species were recorded on an incidental observation basis (De Beers 2010b).

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LEGEND

- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ESKER
- WATERCOURSE
- WATERBODY
- FALCON NESTS MONITORED BY DIAVIK
- FALCON NESTS MONITORED BY EKATI
- BASELINE STUDY AREA

10 0 10

SCALE 1:500,000 KILOMETRES

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

RAPTOR NEST SITES, JAY PROJECT, DIAVIK MINE, AND EKATI MINE, 1995 TO 2013

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_009_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	07/10/14	MAP 13.2-6	
CHECK	LD	07/10/14		
REVIEW	LD	07/10/14		

In July 2004, 2010, and 2011, previously identified nest sites in the study area were investigated through aerial surveys to determine species and nesting status (Golder 2012). Nests were considered occupied if at least one adult was observed. Eggs were counted if visible. Nests were recorded as successful if at least one chick was observed in the nest. The number of chicks was also recorded.

Snap Lake Mine

Aerial surveys were completed within the Snap Lake Mine study area from 1999 to 2010. Monitoring was discontinued in 2010 based on a recommendation from workshops held in 2009 and 2010 (Golder 2010a). The surveys were conducted on known nest locations by helicopter and identified species, egg, and chick numbers. The surveys were done in May and early June for nest occupancy, and mid to late July for nest success and productivity. Nests were considered occupied if at least one adult was observed. Eggs were counted if visible. Nests were recorded as successful if at least one chick was observed in the nest. The number of chicks was also recorded.

Government of the Northwest Territories

The Tundra Ecosystem Research Station at Daring Lake is a government-run research station that is approximately 50 km from the Ekati Mine (Golder 2011). Among the environmental monitoring studies completed at the research station is raptor monitoring. Environment and Natural Resources has collected information on falcon nest success and production in the Daring Lake area from 1999 through 2010. This area currently has no industrial development and can be considered a reference area for monitoring falcons near Lac de Gras. Falcon nest site demographics were typically collected during the third week of July; no nest site occupancy data were collected in the spring (Golder 2011).

13.2.1.1.4 *Gray Wolf*

Ekati and Diavik Mines

Surveys of gray wolf den sites in the BSA has been completed in conjunction with the ENR from 1995 to 2013 to assess the potential for mine development to affect wolf den site distribution and pup production (ERM Rescan 2014a). Surveys were completed by ENR during late May to early June to determine den occupancy. Active dens were then re-surveyed by ENR in August to determine the presence of pups.

Incidental observations of wolves in the BSA have been recorded to help determine the presence, timing, and family composition of wolf packs moving through the study areas (DDMI 2013; ERM Rescan 2014a).

Gahcho Kué Project

Esker surveys were completed in 1998, 1999, 2001, and 2004, to identify historical and active wolf dens in the Gahcho Kué Project study area (De Beers 2008). Wolf dens were also recorded during aerial surveys for caribou, and during non-systematic aerial searches of select areas deemed to have high potential for wolf den habitat (1998 to 2005). Incidental observations of wolves in the study area were also recorded.

When active wolf dens were identified during the aerial and ground surveys, an attempt was made to revisit each site from late July to August 2004 to record pup production. Ground surveys of 17.5 km along the main esker in the Gahcho Kué Project local study area were completed on July 25 and 26, 2005. The purpose of the ground survey was to identify any den sites that were missed during the aerial survey.

Wolf sign surveys were completed on July 21 and 23, 2007, along eskers identified as possible sources for gravel material that were within 35 km of the Gahcho Kué Project (De Beers 2008). Wolf use on these eskers was estimated by calculating the sign per kilometre surveyed.

Snap Lake Mine

Specific surveys for wolves were completed at the Snap Lake Mine from 1999 to 2009 (De Beers 2010b). Based on input from the ENR wolf monitoring at Snap Lake was discontinued in 2010 and instead incidental observations of wolves were recorded during surveys for other wildlife species (Golder 2013b).

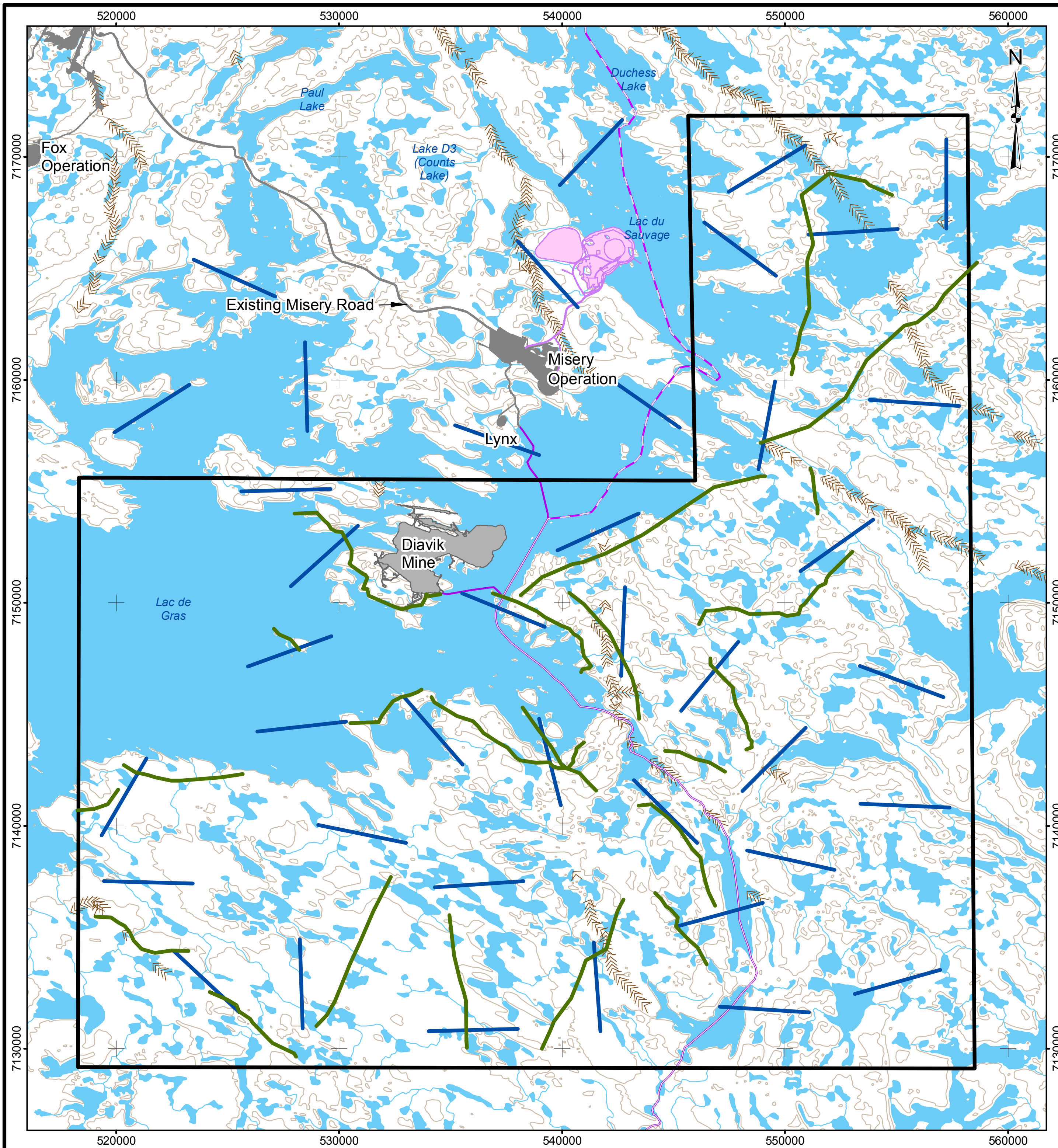
13.2.1.1.5 *Wolverine*

Ekati and Diavik Mines

Snow Track Surveys

From 2003 to 2006, 23 transects of variable length within a 1,270 km^2 study area (which is within the BSA) surrounding the Diavik Mine were surveyed for wolverine tracks (Map 13.2-7; DDMI 2011). Transects were established within habitats that contained boulders and valleys, and intersected lakes and drainages, based on a local resident's knowledge of wolverine life history and behaviour (DDMI 2005). The length of individual transects ranged from 1.5 to 13 km (mean = 6.4 km). A change in survey design was implemented in 2008 and 2009 to increase statistical power to detect changes in wolverine occurrence in the study area (Golder 2014a). Design changes included the placement of 40 transects of equal length (4 km long) located in areas of preferred wolverine habitat including heath tundra or heath boulder habitat (Map 13.2-7).

Surveys were completed by snowmobile 11 times over 9 years (Table 13.2-1). Two observers (usually one local community assistant and an environment representative) drove parallel to each other, separated by approximately 25 m, to reduce the chance of missing tracks. Surveys were completed in late March and April (late winter) of each year; additional surveys were completed in December 2004 and 2005 (mid-winter).



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LEGEND

- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (20 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY
- SNOW TRACK TRANSECT, 2003 TO 2006
- SNOW TRACK TRANSECT, 2008 TO 2009
- STUDY AREA

5 0 5

SCALE 1:250,000 KILOMETRES

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

WOLVERINE SNOW TRACK SURVEYS, DIAVIK MINE, 2003 TO 2006 AND 2008 TO 2009

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_013_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14	MAP 13.2-7	
CHECK	LD	01/10/14		
REVIEW	LD	01/10/14		

Table 13.2-1 Survey Periods for Wolverine Snow Track Surveys in the Diavik Mine Study Area, 2003 to 2013

Year	Survey Period
2003	April 10 to April 12
2004	April 16 to April 24
2004	December 2 to December 8
2005	March 30 to March 31
2005	December 7 to December 12
2006	March 30 to April 1
2008[a]	April 30 to May 2
2009	April 2 to April 6
2010[b]	n/a
2011	March 30 to April 3
2012	March 28 to April 3
2013	April 2 to April 6

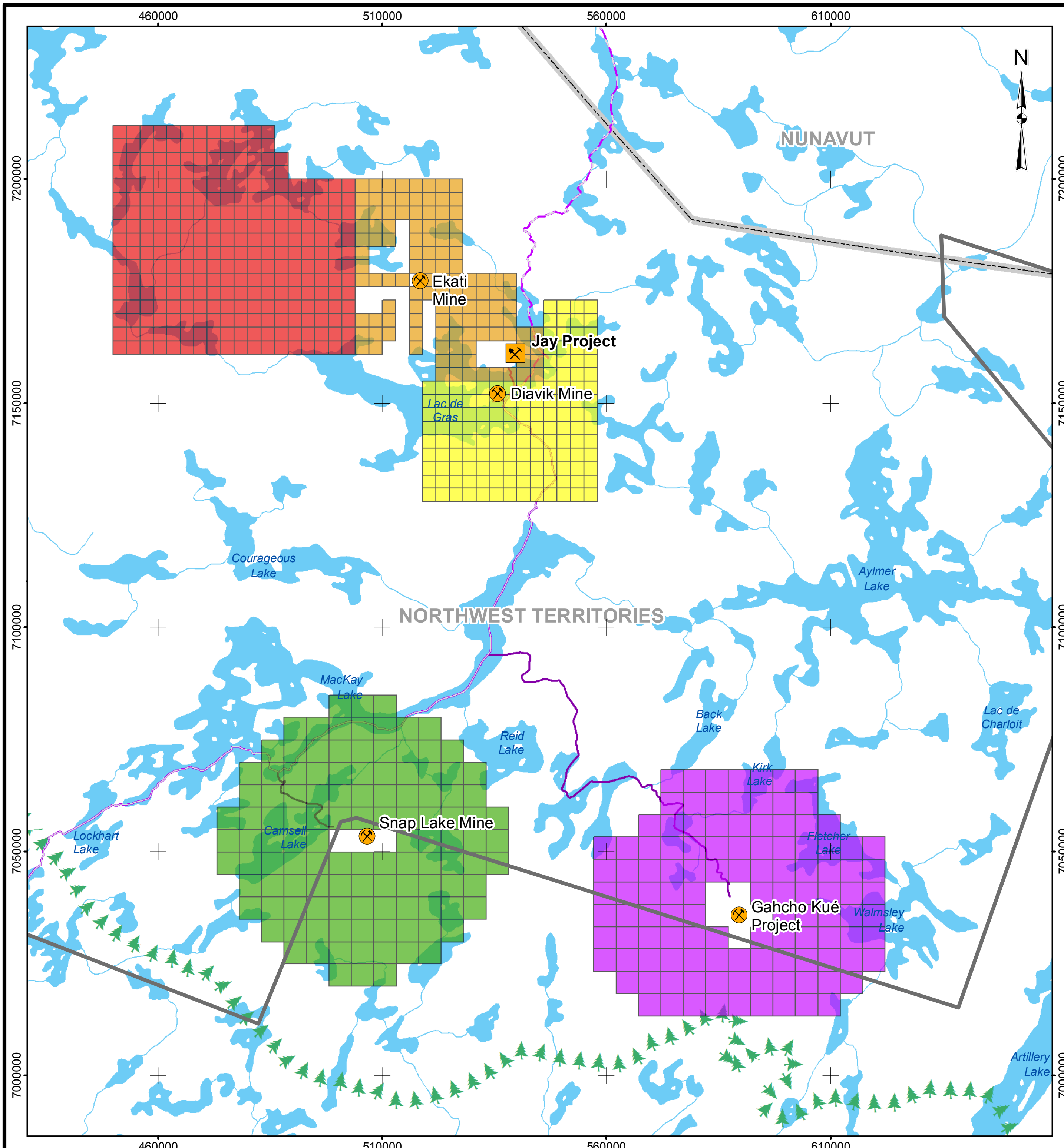
a) New survey technique introduced in 2008, see text.

b) Survey was not completed in 2010 due to local community assistant not being available to participate in survey.

n/a = not applicable.

Hair Snagging Surveys

In 2005, 2006, 2010, and 2011, a regional wolverine DNA (deoxyribonucleic acid) study was completed in four sampling grids in the North Slave Region (Daring Lake, Ekati Mine, Diavik Mine, and Kennady Lake) (Map 13.2-8; Rescan 2012a). Two crews with two crew members each installed 184 baited posts within the sampling grid that covered part of the North Slave Region study area. Scent posts were wrapped in barbed wire and positioned within a 3 by 3 km grid cell. Following the initial set-up, each post was sampled twice during two 10-day sessions. Hair samples collected from the barbed wire were submitted for DNA analysis.



LEGEND

- JAY PROJECT
- EXISTING MINE OR PROJECT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- TREELINE
- TERRITORIAL/PROVINCIAL BOUNDARY
- WATERCOURSE
- WATERBODY
- DARING LAKE GRID, 2005 TO 2006, AND 2010 TO 2011
- DIAVIK GRID, 2005 TO 2006, AND 2010 TO 2011
- EKATI GRID, 2005 TO 2006, AND 2010 TO 2011
- GAHCHO KUÉ GRID, 2013
- SNAP LAKE GRID, 2013
- NORTH SLAVE REGION

25 0 25

SCALE 1:1,250,000 KILOMETRES

REFERENCE

WATER OBTAINED FROM ATLAS OF CANADA
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

WOLVERINE SAMPLING GRIDS, NORTH SLAVE REGION, 2005, 2006, 2010, 2011, AND 2013

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_012_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14		
CHECK	LD	01/10/14	MAP 13.2-8	
REVIEW	LD	01/10/14		

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Gahcho Kué Project

Hair Snagging Surveys

A wolverine DNA hair snagging program was completed within a circular 1,600 km^2 study area centred on the Gahcho Kué Project camp from April 16 to May 8, 2005 (De Beers 2008). Two crews with two crew members each installed 175 baited posts within the sampling grid that covered part of the Gahcho Kué Project study area. Scent posts were wrapped in barbed wire and positioned within a 3 x 3 km grid cell. Following the initial set-up, each post was sampled twice during two 10-day sessions. Hair samples collected from the barbed wire were submitted for DNA analysis. In 2006, Boulanger and Mulders (2007) repeated the wolverine DNA hair snagging program in the Gahcho Kué Project study area, in conjunction with programs completed at Daring Lake, the Ekati Mine, and the Diavik Mine (see above).

In 2013, a regional hair snagging study was completed in conjunction with the Snap Lake Mine (Map 13.2-9). A total of 232 hair snagging posts were set up within the regional hair snagging study area (3,000 km^2); 118 posts were set up near the Snap Lake Mine, and 114 posts were set up near the Gahcho Kué Project. Posts were spaced approximately 5 km from each other. Hair snagging posts consisted of a 4 x 4 post wrapped in barbed wire and secured upright in snow. The lure and bait were attached to the top of the post by rebar wire connected to fencing staples hammered into the top of the post.

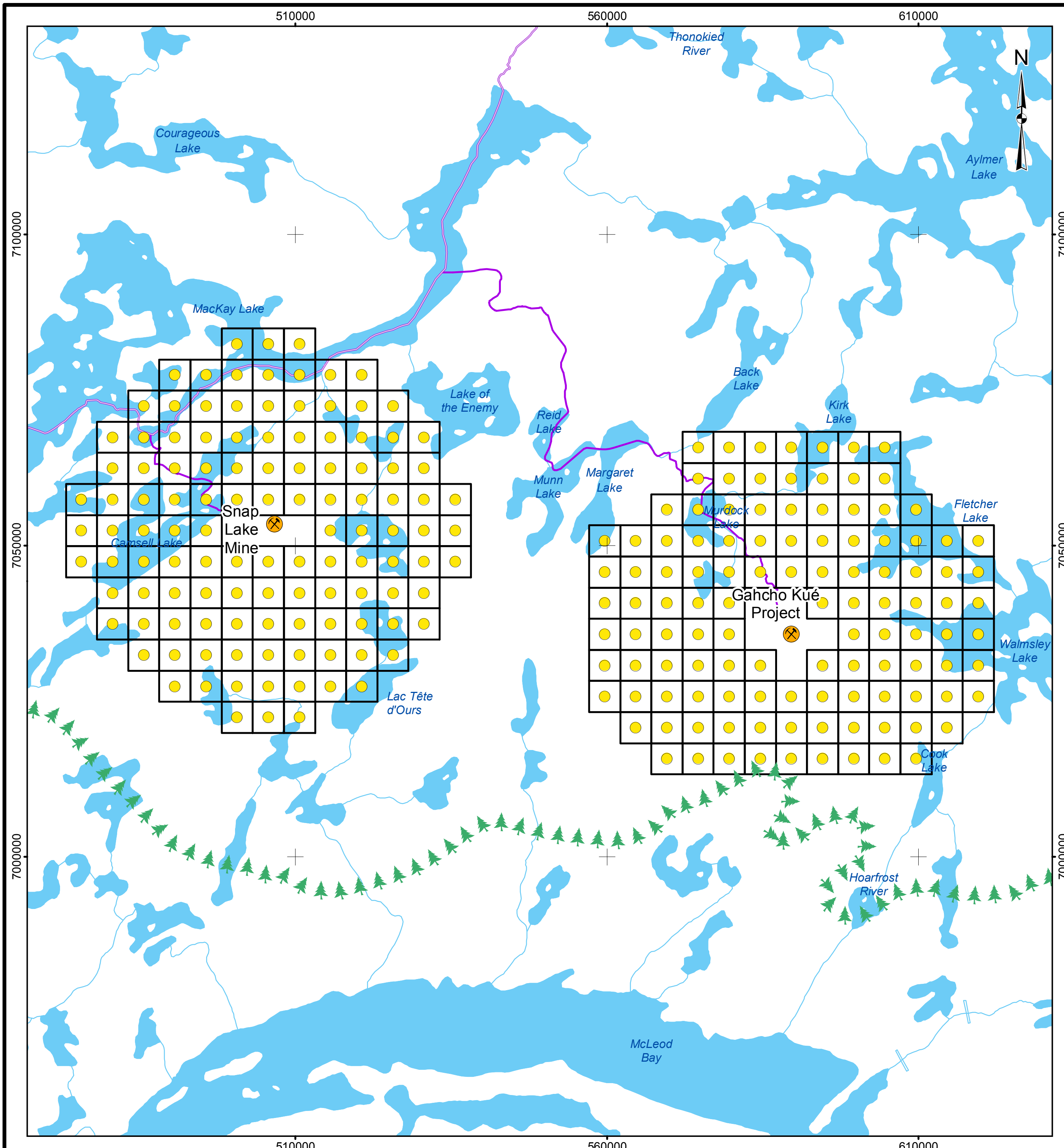
Hair snagging posts around the Gahcho Kué Project were deployed from April 2 to 12, 2013, and were surveyed twice: once from April 13 to 21, 2013, and again from April 28 to May 1, 2013. Posts were surveyed in the order they were deployed and were removed after the second visit by observers.

Snap Lake Mine

Snow Track Surveys

Surveys for wolverine have been completed using fifty 4-km-long transects that passed through boulder, heath tundra/boulder, and shoreline areas in the Snap Lake study area from 2003 through 2012 (Map 13.2-10; Golder 2013b). Transects were established by stratified random selection of 4 km^2 plots within the study area that contained at least 15% boulder and heath tundra/boulder habitat. Transects intersected the centre of these plots and were oriented to cross the nearest shoreline of the largest body of water within a 3 km radius of the centre of the plot. The study design from 1999 through 2002 included a single 100 km survey route around the proposed mine (Golder 2006a).

The survey was completed by snowmobile. Two observers drove parallel to each other, separated by a distance of approximately 25 m to reduce the chance of missing tracks. During the survey, observations were made of the number of wolverine tracks encountered, estimated age of the track, and the GPS location of each track.



LEGEND

- EXISTING MINE OR PROJECT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- TREELINE
- WATERCOURSE
- WATERBODY
- WOLVERINE HAIR SNAGGING STATION
- 5 Km X 5 Km GRID CELL

20 0 20

SCALE 1:900,000 KILOMETRES

REFERENCE

WATER OBTAINED FROM ATLAS OF CANADA
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

WOLVERINE HAIR SNAGGING STATIONS, GAHCHO KUÉ PROJECT AND SNAP LAKE MINE, 2013

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_014_GIS	
DESIGN	LD	17/01/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14	MAP 13.2-9	
CHECK	LD	01/10/14		
REVIEW	LD	01/10/14		

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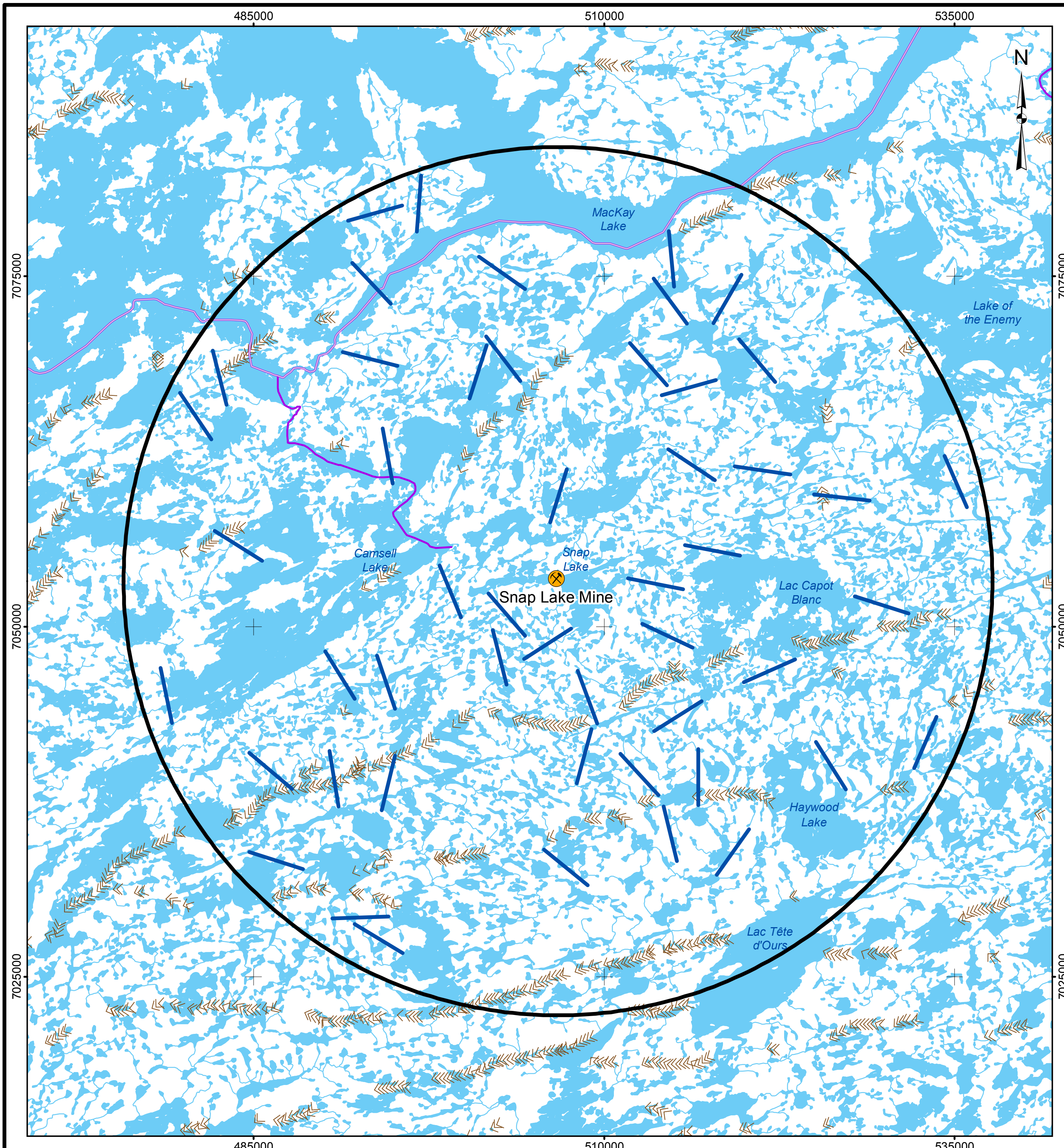

LEGEND

- EXISTING MINE
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- ESKER
- WATERCOURSE
- WATERBODY
- WOLVERINE SNOW TRACK TRANSECT
- STUDY AREA

8 0 8

SCALE 1:400,000 KILOMETRES

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

WOLVERINE SNOW TRACK SURVEYS, SNAP LAKE MINE, 2003 TO 2013

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_016_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14	**MAP 13.2-10**	
CHECK	LD	01/10/14		
REVIEW	LD	01/10/14		

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Hair Snagging Surveys

In 2013, a regional hair snagging survey was completed in conjunction with the Gahcho Kué Project. A total of 232 hair snagging posts were set up within the regional hair snagging study area (3,000 km^2); 118 posts were set up near the Snap Lake Mine, and 114 posts were set up near the Gahcho Kué Project (Map 13.2-9). Posts were spaced approximately 5 km from each other. Hair snagging posts around the Snap Lake Mine were deployed from April 3 to 16, 2013, and were surveyed twice: once from April 17 to 26, 2013, and again from April 27 to May 7, 2013. Posts were surveyed in the order they were deployed and were removed after the second visit by observers.

Government of the Northwest Territories

Wolverine DNA sampling around the Daring Lake, the Diavik and Ekati mines, and the Gahcho Kué Project was completed collaboratively by the Government of the Northwest Territories (GNWT), Ekati Mine, DDMI, and De Beers Canada Inc. (De Beers) (Boulanger and Mulders 2013; see sections above). The study was implemented to: estimate the population size and density of wolverines; complete a demographic analysis to estimate trends in wolverine abundance; and, examine potential factors related to change in wolverine abundance. In 2005, a grid of 284, 3 x 3 km cells was delineated around Daring Lake, and a bait post was located in the centre of each cell (Boulanger and Mulders 2007) (Map 13.2-8). Sampling at Daring Lake was completed in 2005, 2006, 2007, 2009, and 2011 (Boulanger and Mulders 2013).

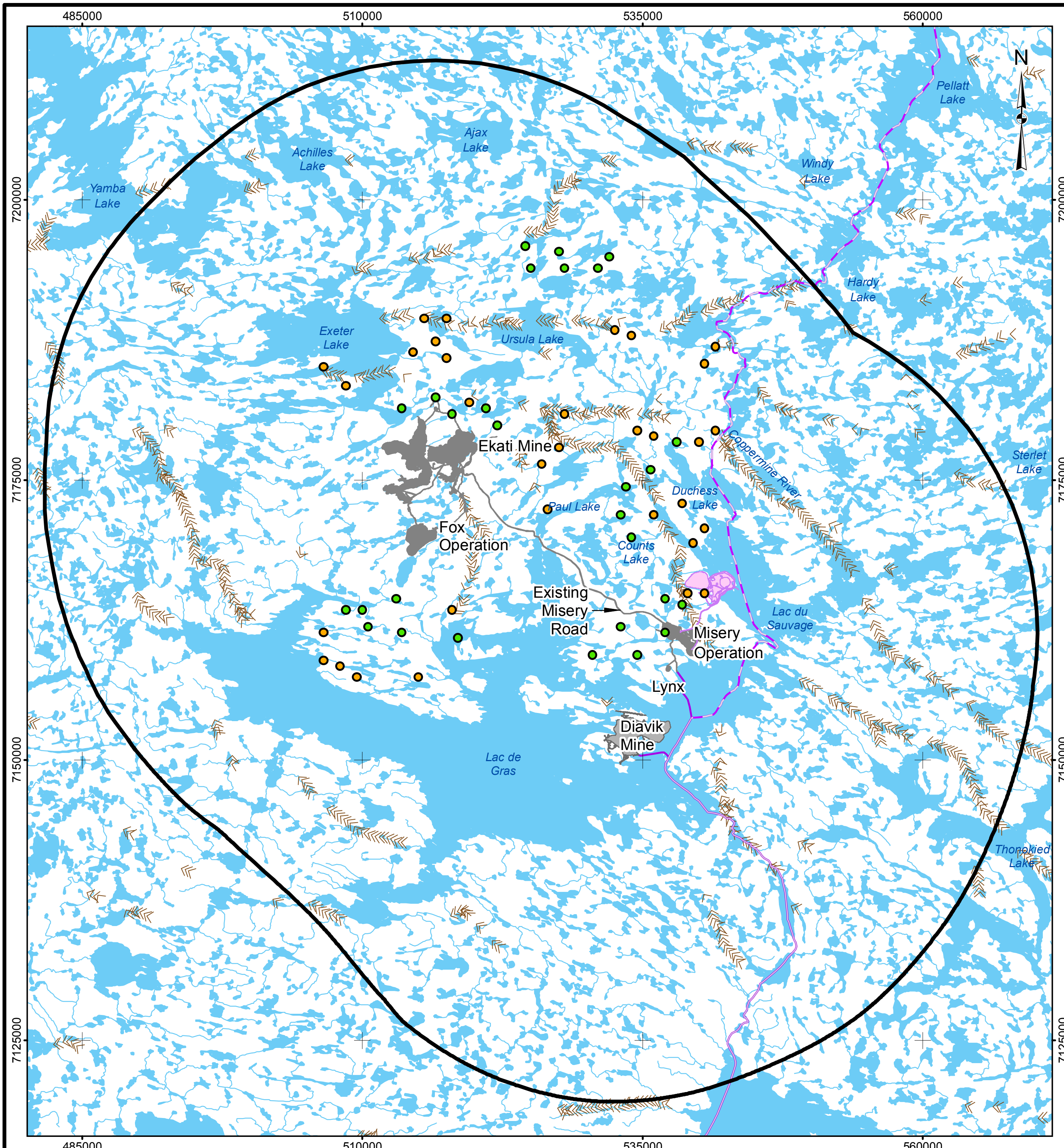
13.2.1.1.6 *Grizzly Bear*

Ekati and Diavik Mines

Habitat Surveys

Surveys to determine the presence of grizzly bear sign in various habitat types in the BSA were completed from 1999 to 2008 (Rescan 2009). In 1999, surveys were completed within different habitat types. From 2000 to 2008, surveys focused on habitats with high potential for finding grizzly bear sign. A total of 60 permanent survey plots were established in sedge wetland (30 plots) and riparian (30 plots) habitats (Map 13.2-11). Surveys in sedge wetland habitats were completed in June and July, while surveys in riparian habitats were completed in late July and early August. Survey plots were 500 by 500 m; surveys were standardized to one hour and completed by two observers. All recent bear sign (dens, diggings, tracks, scat, hair, and kill sites) was recorded. Habitat plot surveys were stopped in 2009 because of limited success of these surveys to detect changes in grizzly bear activity and distribution and improved study designs (e.g., DNA studies) were considered.

Grizzly bear habitat surveys were completed in the Diavik Mine study area (which is within the BSA) from 2002 to 2008 (DDMI 2009). A total of 36 randomly selected 500 by 500 m plots were set up within the Diavik Mine study area (Map 13.2-12). Each plot contained at least 25% sedge wetland or riparian shrub habitats. Each plot was searched for bear sign for approximately one hour by two observers; all bear sign (dens, diggings, tracks, scat, hair, and kill sites) was documented. Surveys in sedge wetland plots were completed in early July, and plots in riparian shrub habitat were surveyed in early August. Habitat plot surveys were suspended in 2009 because of limited success of previous surveys to detect changes in grizzly bear activity and distribution and improved study designs (e.g., DNA hair snagging) were considered.



LEGEND

- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ESKER
- WATERCOURSE
- WATERBODY

GRIZZLY BEAR PLOT

- RIPARIAN PLOT
- WETLAND PLOT
- STUDY AREA

10 0 10

SCALE 1:500,000 KILOMETRES

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

GRIZZLY BEAR HABITAT STUDY AREA, EKATI MINE, 2000 TO 2008

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_017_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14	MAP 13.2-11	
CHECK	LD	01/10/14		
REVIEW	LD	01/10/14		

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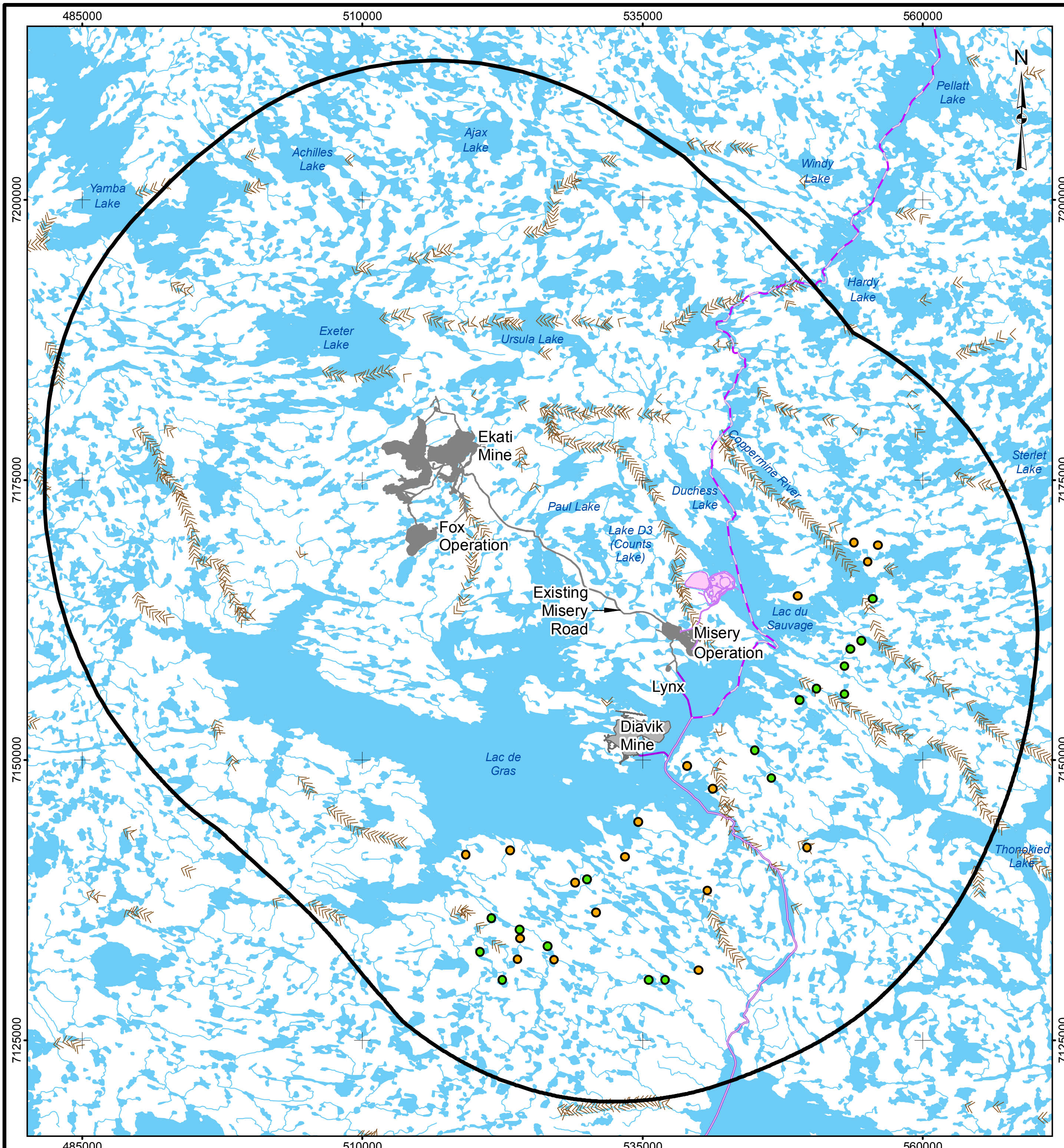


LEGEND

- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ESKER
- WATERCOURSE
- WATERBODY

GRIZZLY BEAR PLOT

- RIPARIAN PLOT
- WETLAND PLOT
- STUDY AREA

10 0 10

SCALE 1:500,000 KILOMETRES

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

GRIZZLY BEAR HABITAT STUDY AREA, DIAVIK MINE, 2002 TO 2008

Golder Associates

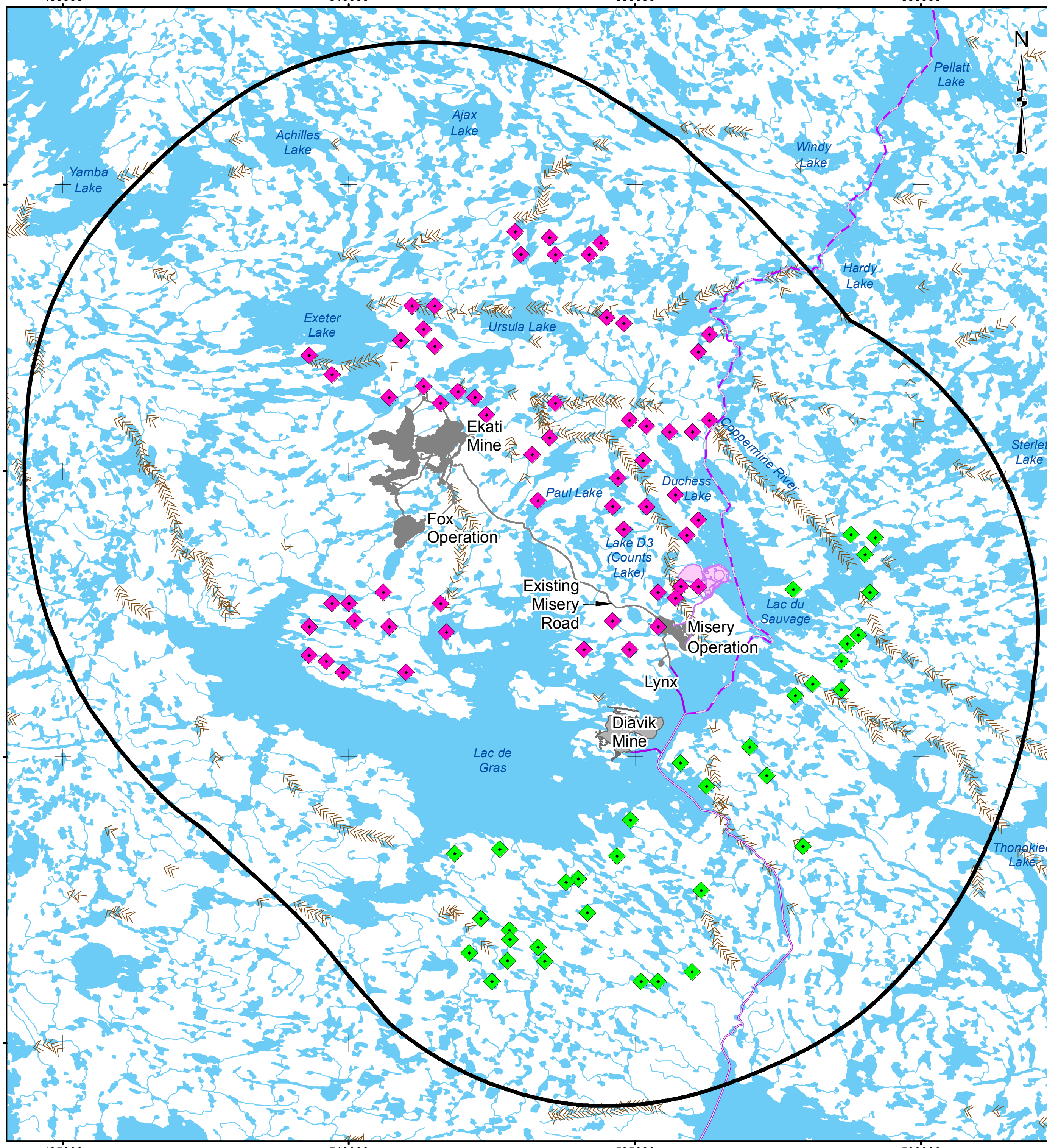
PROJECT		13-1328-0041	FILE No. DAR_Wild_018_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14	MAP 13.2-12	
CHECK	LD	01/10/14		
REVIEW	LD	01/10/14		

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\13-1328-0041 Jay & Lynx EA\Wildlife\DAR\DAR_Wild_018_GIS.mxd

Hair Snagging Surveys

A hair snagging pilot study was completed jointly by DDMI and Ekati Mine in 2010 and 2011 (DDMI 2012; Rescan 2012a). Hair snagging stations were located in 10 x 10 km cells surrounding the Ekati Mine; 8 stations were set up in 2010 and 13 stations were set up in 2011. Stations were re-surveyed three times. Elders, land users, and youth from Kugluktuk, Lutsel K'e Dene, Yellowknives Dene, and the North Slave Métis Alliance (NSMA) participated in site visits during the initial planning phases of the program (Boulanger and Mulders 2013).

A grizzly bear hair snagging study was jointly implemented by the Ekati and Diavik mines in 2012 and 2013 (ERM Rescan 2014b). A total of 113 stations were surveyed and arranged in a grid pattern of 12 x 12 km cells (Map 13.2-13). Stations consisted of a wooden tripod with barbed wire wrapped around the legs and were located in high-quality grizzly bear habitat (i.e., esker, riparian, upland meadow, wetland meadow). Non-reward lures were used to attract bears to the tripods. There were six sampling sessions from June 23 to September 4, 2012. Each session lasted from 9 to 13 days. At the end of each session, the snagged hair was removed and placed in a paper envelope. Each grouping of hair was stored separately and was sent to Wildlife Genetics International in Nelson, British Columbia for DNA fingerprinting.



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LEGEND

- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ESKER
- WATERCOURSE
- WATERBODY
- DIAVIK HAIR SNAGGING STATION
- EKATI HAIR SNAGGING STATION
- STUDY AREA

10 0 10

SCALE 1:500,000 KILOMETRES

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

GRIZZLY BEAR HAIR SNAGGING STATIONS, EKATI AND DIAVIK MINES, 2012 AND 2013

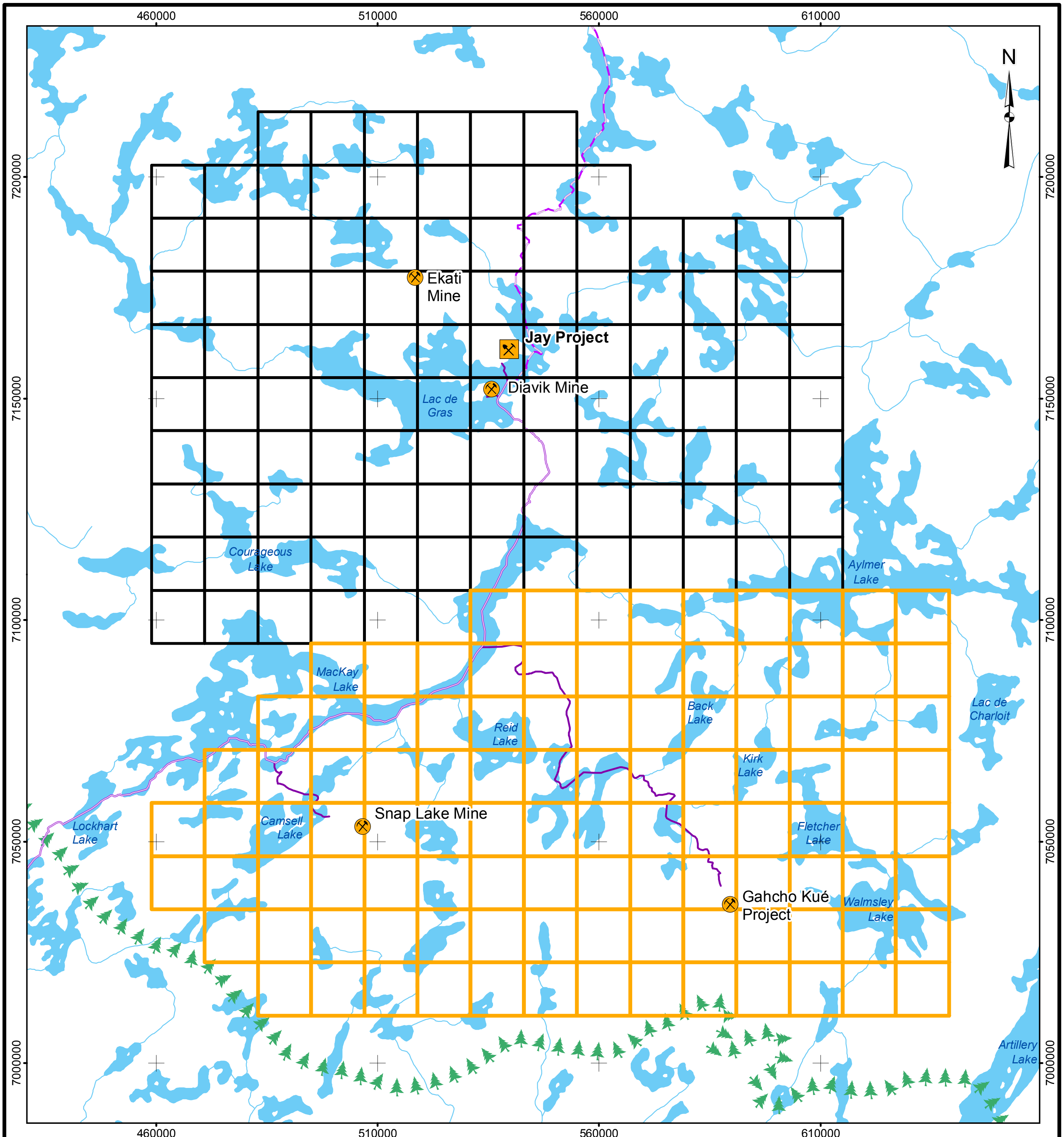
Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_019_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14	MAP 13.2-13	
CHECK	LD	01/10/14		
REVIEW	LD	01/10/14		

Hair Snagging Surveys

Limited success of previous surveys to detect changes in grizzly bear activity and distribution from searches for bear sign (e.g., tracks, digs, and scat) at the Gahcho Kué Project and other mine developments in the NWT (Marshall 2009; Handley 2010) resulted in testing of alternative study designs that will address problems with detection of species presence. In 2010 and 2011, a grizzly bear hair snagging pilot study was implemented at the Gahcho Kué Project as part of baseline monitoring as an alternative to earlier monitoring designs (Golder 2012). Forty hair snagging stations were distributed throughout the survey's study area in sedge wetlands habitat locations that were surveyed for fresh sign of bear activity during previous years. Hair snagging stations were placed in sedge wetland habitats to increase the likelihood of bears encountering the hair snagging stations, based on patterns of seasonal diet and habitat preferences of barren-ground grizzly bears (Gau et al. 2002; McLoughlin et al. 2002a). Each station was surveyed every 10 to 14 days (three times in 2010 and four times in 2011) for the presence of hair. The pilot study produced limited and variable results for measuring mine-related effects to bears (Golder 2012).

In 2013, a regional grizzly bear monitoring program was implemented to support ENR with cumulative effects monitoring (Rescan 2012b). This monitoring program included the use of hair snagging stations in a 30,000 km^2 area in the North Slave Region located around the Jay Project, the Ekati, Diavik, and Snap Lake mines, and the Gahcho Kué Project (Map 13.2-14). The abundance and distribution of grizzly bears was determined using DNA markers to track individuals through time. This program was completed by De Beers in collaboration with the University of Calgary.



LEGEND

- JAY PROJECT
- EXISTING MINE OR PROJECT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- TREELINE
- WATERCOURSE
- WATERBODY
- BHP BILLITON/RIO TINTO STUDY AREA
- DE BEERS CANADA INC. STUDY AREA

25 0 25

SCALE 1:1,250,000 KILOMETRES

REFERENCE

WATER OBTAINED FROM ATLAS OF CANADA
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

GRIZZLY BEAR HAIR SNAGGING SURVEY GRID, NORTH SLAVE REGION, 2013

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_020_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14	MAP 13.2-14	
CHECK	LD	01/10/14		
REVIEW	LD	01/10/14		

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Snap Lake Mine

Habitat Surveys

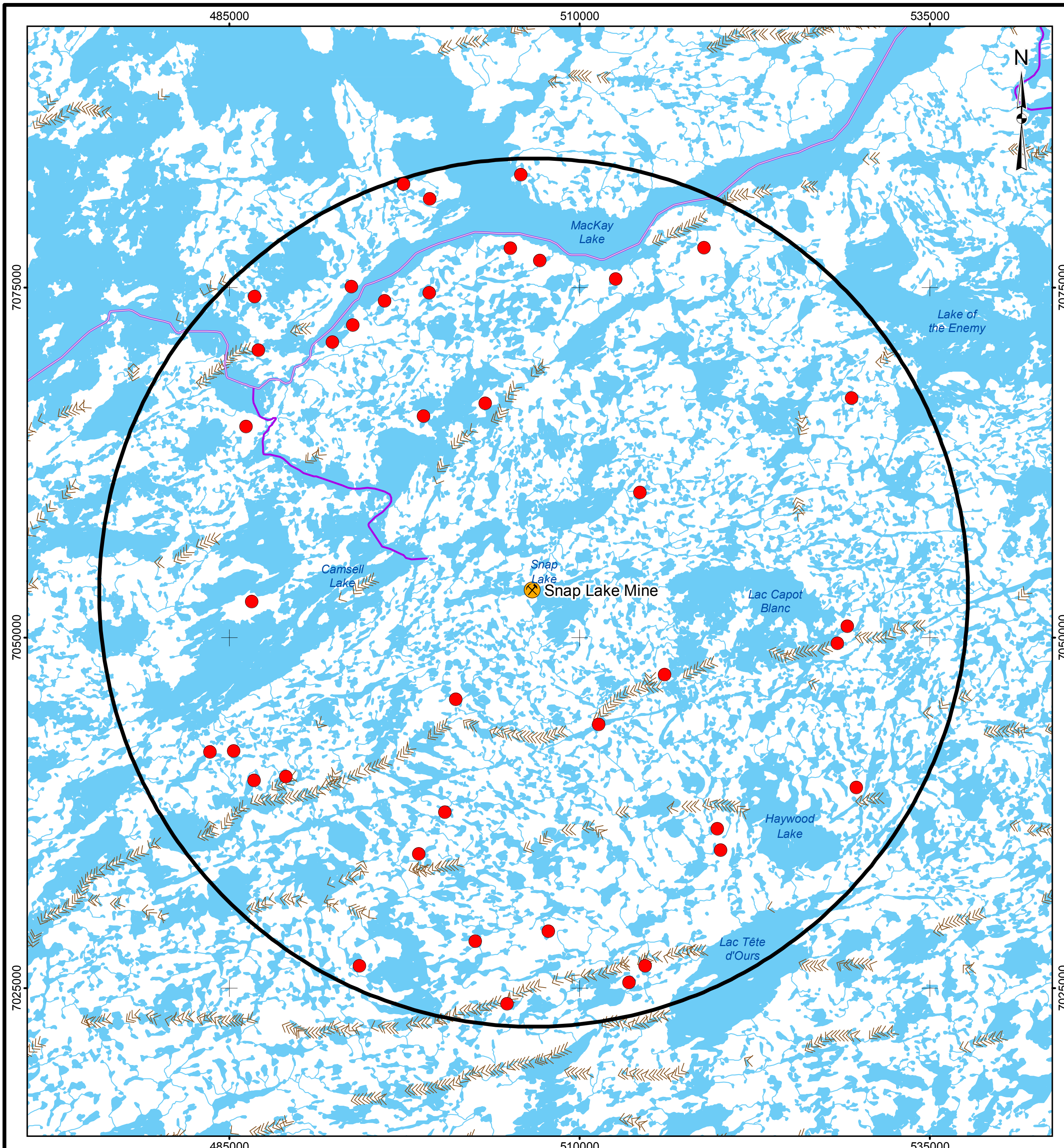
From 2001 to 2009, surveys in the Snap Lake Mine study area have focused on searches for bear sign in randomly selected sedge wetland and riparian habitat plots (Golder 2010b). Plot selection criteria required at least 30% sedge wetland or 10% riparian shrub habitat/birch seep vegetation classes within a 250 x 250 m area. Sedge wetland plots were surveyed in late June to early July, and riparian shrub/birch seep plots were surveyed in mid-August. A 1-km radius from the centre of the plot was searched by two observers for one hour. Observers recorded all bear sign, including beds, digs, tracks, scat, hair, and prey remains. All bear sign found was recorded, but only fresh sign from bear activity that had occurred in the year of the survey (i.e., since den emergence) was included in the survey. Up to 40 sedge wetland and 40 riparian shrub/birch seep plots have been surveyed annually.

Hair Snagging Surveys

Due to the limited success of habitat surveys to determine bear activity and distribution, a hair snagging program was piloted in 2010 and 2011 (Rescan 2012b). Forty hair snagging stations were distributed throughout the study area in sedge wetlands habitat locations surveyed for fresh sign of bear activity during previous years (Map 13.2-15). Minor changes to the survey occurred in 2011, specifically the survey of stations during autumn and the use of alternate non-reward lures. These changes were implemented in an effort to increase the number of stations that collect grizzly bear hair. Four surveys documenting the presence of bear hair occurred from August 3 to 4, August 17 to 18, August 31 to September 1, and September 11 to 12, 2011.

Following the initial set-up, each station was visited six times at 10-day intervals. Surveys were completed by a biologist and a community assistant. Hair samples collected from the barbed wire were identified to species by a community assistant or expert, and archived for possible DNA fingerprinting to validate species identification. Residual hair that could not be removed from the barbed wire was burned with a torch to avoid confusion about the presence of new hair during subsequent visits. Fresh lure was applied to each station after each visit to attract bears. No lure was applied at the last visit.

In 2013, a regional grizzly bear monitoring program was implemented to support ENR with cumulative effects monitoring (Rescan 2012b). This monitoring program includes the use of hair snagging stations in a 30,000 km^2 area in the North Slave Region located around the Jay Project, the Ekati, Diavik, and Snap Lake mines, and the Gahcho Kué Project (Map 13.2-8). The abundance and distribution of grizzly bears is being determined using DNA markers to track individuals through time.



LEGEND

- EXISTING MINE
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- ESKER
- WATERCOURSE
- WATERBODY
- BEAR HAIR SNAGGING STATION
- STUDY AREA

8 0 8

SCALE 1:400,000 KILOMETRES

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

GRIZZLY BEAR HAIR SNAGGING STATIONS, SNAP LAKE MINE, 2010 AND 2011

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_023_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14	MAP 13.2-15	
CHECK	LD	01/10/14		
REVIEW	LD	01/10/14		

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13.2.1.1.7 *Specific Mine-Related Incidents and Mortalities*

Project-related wildlife mortalities on mine sites in the NWT are monitored by voluntary reporting of wildlife incidents by site personnel.. Wildlife mortalities at the mine site are investigated by environmental personnel.

13.2.1.2 *Jay Project Baseline Surveys*

Baseline surveys for the Project began in 2013. Reconnaissance-level surveys were completed for carnivore dens, waterbirds, and raptors.

13.2.1.2.1 *Waterbirds*

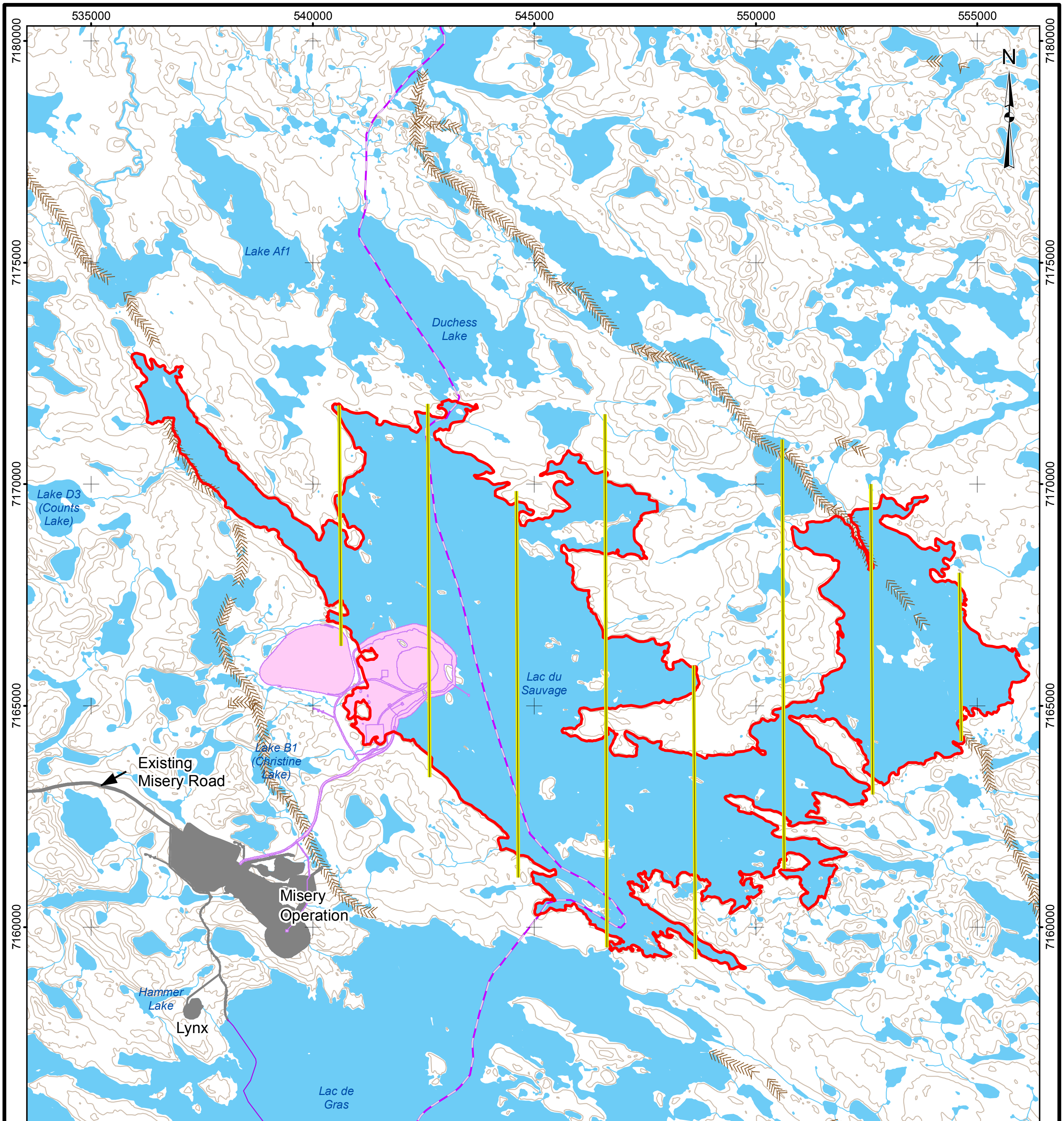
An aerial survey of waterbirds present on Lac du Sauvage was completed on August 8, 2013 and involved nine transects spaced 2 km apart and the shoreline contour (Map 13.2-16). The surveys were completed by helicopter 80 m above ground level at a speed of 80 to 100 km/h. Observers recorded water birds seen within 200 m on either side of the helicopter. The survey also assessed the presence of nesting colonies on near-shore islands. Due to rough water conditions on Lac du Sauvage on August 8, the shoreline survey was completed a second time on August 12, 2013.

13.2.1.2.2 *Raptors*

An aerial survey was completed on July 24 and 25, 2013, of 36 potential nest sites located in highly suitable habitat (high elevation and steep terrain) to determine the presence of raptors. The survey covered an area up to 30 km from the Project site. Nest locations were visually observed and the presence and absence of adult raptors, white wash, stick nests, fledglings in stick nests, or fledglings on scrapes were noted.

13.2.1.2.3 *Carnivores*

Select eskers near the Project were surveyed on foot from August 9 to 11, 2013 to determine the presence of carnivore dens (Map 13.2-17). One observer walked along the top of the esker while two other observers walked on either side of the esker to search for areas excavated by wolf, grizzly bear, or fox. The survey included the entire length of the Misery esker and associated branches, south of Lac du Sauvage.



LEGEND

- EKATI MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (10 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY
- WATERBIRD SURVEY TRANSECT
- SHORELINE SURVEY

2.5 0 2.5

SCALE 1:125,000 KILOMETRES

REFERENCE

CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

WATERBIRD SURVEY AREA, LAC DU SAUVAGE, 2013

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_024_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14	MAP 13.2-16	
CHECK	LD	01/10/14		
REVIEW	LD	01/10/14		

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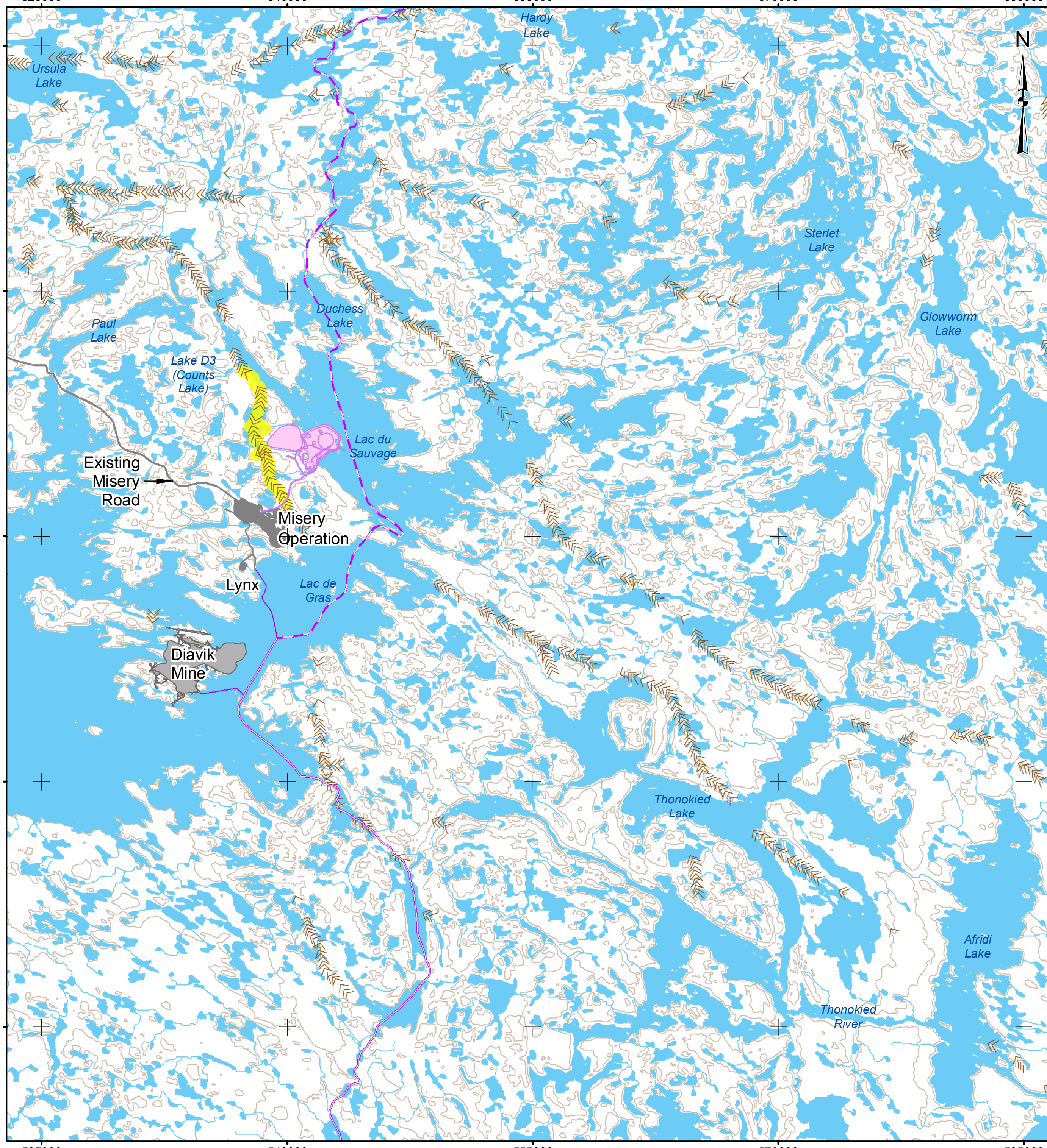

LEGEND

- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (20 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY
- SURVEYED ESKER

6 0 6

SCALE 1:350,000 KM

NOTE

LOCATION OF PATHWAYS, OBSTACLES AND ESKERS SURVEYED DURING THE CARNIVORE DEN SURVEYS

REFERENCE

CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

ESKERS SURVEYED DURING CARNIVORE DEN SURVEYS, EKATI MINE, 2013

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_025_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14	MAP 13.2-17	
CHECK	LD	01/10/14		
REVIEW	LD	01/10/14		

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13.2.2 Results

13.2.2.1 *Upland Birds*

Tundra bird plot surveys at the Ekati Mine from 1996 to 2008 show that Lapland longspurs (*Calcarius lapponicus*) are the most numerous upland bird in the BSA (Rescan 2010b). Other commonly observed species are savannah sparrow (*Passerculus sandwichensis*), American tree sparrow (*Spizella arborea*), and Harris's sparrow (*Zonotrichia querula*). Species richness and species density have remained stable at control and mine plots since 1996 (Rescan 2010b). The mine does not appear to have a strong influence on the number of upland birds that nest in the area.

The North American breeding bird surveys at the Ekati Mine have recorded from18 to 38 species during surveys from 2003 to 2009 (Rescan 2010a). The most common species observed during the North American breeding bird surveys are American tree sparrow, common redpoll (*Carduelis flammea*), Harris's sparrow, Lapland longspur, savannah sparrow, and white-throated sparrow (*Zonotrichia albicollis*). Species diversity and evenness have remained similar among years.

13.2.2.2 *Waterbirds*

Waterbird observations have been recorded in the Diavik Mine study area since 1996 (Golder 2014a). During this time, 40 different species have been recorded (range: 14 to 27 species annually). Total number of individuals of all species has ranged from 410 to 6,060 annually (Golder unpublished data). The abundance and diversity of waterbirds fluctuates annually, with no increasing or decreasing trend observed over time (Golder 2014a).

13.2.2.3 *Raptors*

13.2.2.3.1 *Raptor Distribution and Abundance*

Falcon nest sites have been monitored for occupancy in the BSA since 1995 (Golder 2011). From 6 to 19 sites were checked each year and occupancy rates ranged from 44% to 100% during baseline (1995 to 1999), 64% to 79% during construction (2000 to 2002), and 63% to 94% during current operation of the Diavik Mine (2003 to 2010). Model predictions for the Diavik Mine site showed that nest occupancy was higher closer to the mine footprint and decreased up to 13.9 km away, and then increased further away. This pattern is correlated with the spatial distribution of nest site suitability relative to the Ekati and Diavik mines and Lac de Gras area (Coulton et al. 2013).

In the Daring Lake area, annual occupancy rates for falcon nest sites from 1999 to 2010 ranged from 20% to 75% (Golder 2011). The average annual occupancy rate was 46% and has been relatively constant. However, these rates are likely biased high due to failure to account for nests that were occupied earlier in the breeding season but failed before the July survey.

From 1996 to 2005, ten raptor species were recorded within the Gahcho Kué Project study area (De Beers 2010a). The most frequently observed species were peregrine falcons, northern harriers (*Circus cyaneus*), bald eagles (*Haliaeetus leucocephalus*), rough-legged hawks (*Buteo lagopus*), and gyrfalcons. Currently, all known raptor nests in the study area occur more than 18 km from the Project site; the majority are located near Margaret Lake. The remaining nests are located in the southern half of the study area. Fifteen raptor nest sites have been identified within the Snap Lake Mine study area since 1999, although not all of these sites have been surveyed or occupied every year (Golder 2013b).

These nests are located at sites with lower elevation, greater slope, and less area of deep water within 1 km of the nest site than sites elsewhere in the study area. The distance of nest sites to the Snap Lake Mine footprint ranges from 8 km (Reference Lake) to 30 km (Munn C and Portage Bay). From 1999 to 2010, occupancy at raptor nest sites (not including eagle and kestrel [*Falco sparvius*]) varied from 27% to 92%.

Of the six mine pits surveyed at Ekati Mine in 2012, three were found to have active nests present, all of which produced fledglings (Rescan 2013). Rough-legged hawk, peregrine falcon, and gyrfalcon established nests within the Fox Pit. Each nest successfully produced three chicks. Peregrine falcons nested in the Beartooth and Koala North pits and successfully produced four chicks at each nest. In 2011, two open pits produced nests and, in 2012, nesting activity was found in all Ekati open pits (Rescan 2013).

In the most recent pit wall/mine infrastructure inspections at the Diavik Mine in 2013, rough-legged hawks were observed nesting at A418 Lookout #1 and Lookout #2, and one peregrine falcon was observed nesting on the site services building (Golder 2014a).

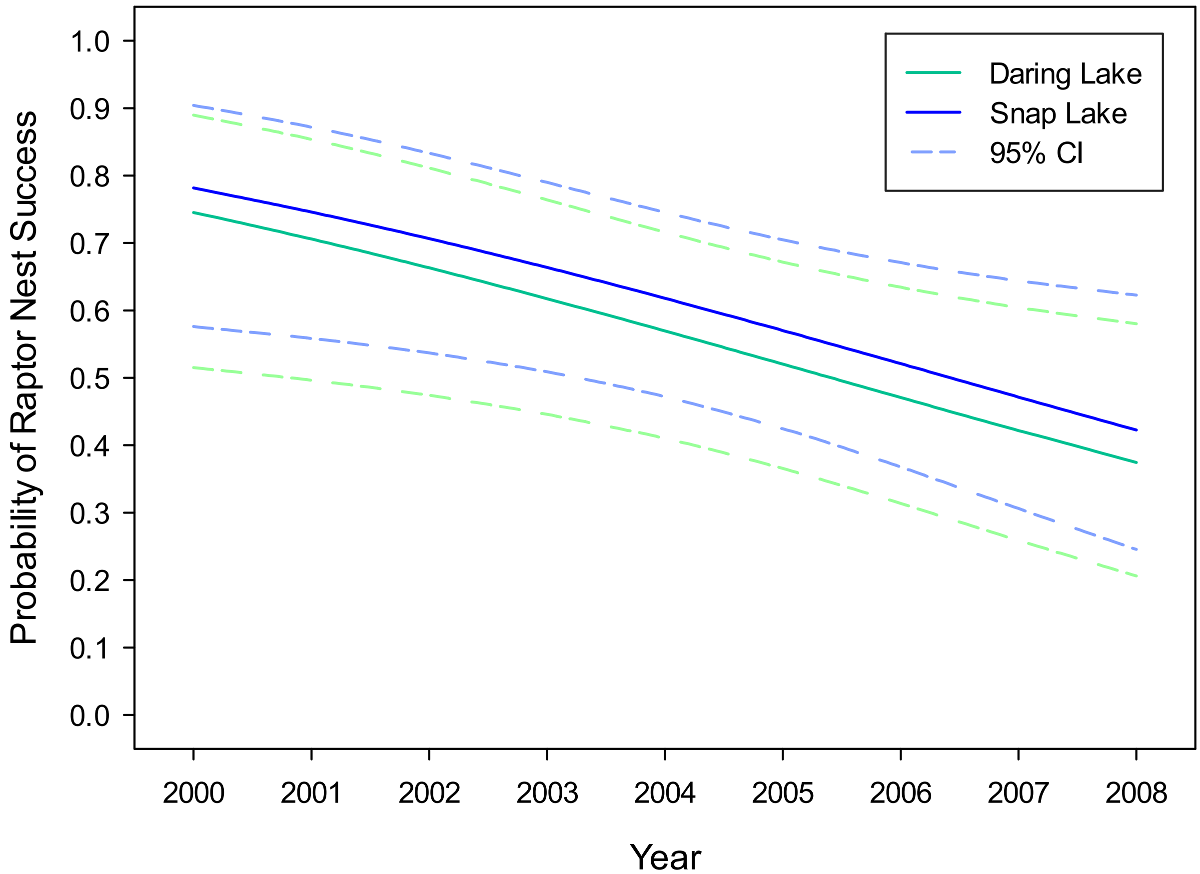
13.2.2.3.2 *Raptor Nest Success*

From 1998 to 2010, from 6 to15 occupied peregrine falcon nests were detected each year in the BSA surveys. The nests were monitored for success (i.e., chick production). The mean annual nest success rate for all years of monitoring was 31.0% (range: 0% to 100%). Variation in nest success was best explained as a function of the relative age of nests in the study area (Coulton et al. 2013). Total mean annual productivity from all monitored nests in the combined Diavik and Ekati mine study areas (1998 to 2010) was 9.2 plus or minus (±) 1.8 (standard error [SE]) young, a mean annual productivity of 0.9 ± 0.2 young per occupied site (Golder 2011).

From 1999 to 2010, the number of occupied peregrine falcon nests at Daring Lake ranged from 2 to 10. Mean annual nest success was 56% (range: 17% to 100%). Total mean annual productivity in the Daring Lake area was 5.7 ± 1.2 (SE) young per year, while mean annual productivity was 1.2 ± 0.3 young per occupied site (Golder 2011). Estimates for Daring Lake do not account for birds that abandoned their nests from spring to early summer. Estimated nest success may be higher because birds remaining on nests later in the season are more likely to reproduce successfully.

Peregrine falcon nest success in the Snap Lake Mine study area ranged from 14% to 83% in 2000 to 2003. Chicks have been produced every year and productivity has ranged from 0.25 to 2.8 chicks per occupied site. The analysis of nest success indicated that a decline in success of raptors has occurred in the Snap Lake Mine study area. However, a similar decline in raptor nest success was also observed at Daring Lake where industrial development does not occur (Figure 13.2-2; Golder 2013b). Thus, the decline observed in the Snap Lake Mine study area cannot be attributed solely to the presence of the mine. The variables of site quality, prey, and rainfall were not supported in the analysis, indicating that these factors were not contributing to changes in nest success.

Figure 13.2-2 Model Predictions of Mean Probability of Raptor Nest Success at Daring Lake and Snap Lake Study Areas, 2000 to 2008



Source: Golder (2013b).

% = percent; CI = confidence interval.

13.2.2.4 *Gray Wolf*

13.2.2.4.1 *Gray Wolf Distribution and Abundance*

The abundance of gray wolves within the BSA is expected to vary annually and seasonally in response to prey availability. The mean annual territory sizes of female and male wolves in the central Canadian Arctic (minimum convex polygon) were 44,936 and 63,058 km^2, respectively (Walton et al. 2001). Winter wolf territories are generally larger than summer territories, which may be due to low prey densities during the winter. Wolves can disperse from their natal territories during all months of the year, but dispersal is generally highest in April through September (Walton et al. 2001).

Three gray wolf dens were located during carnivore den surveys for the Project in 2013 (Map 13.2-18). One den was active and two dens were inactive. The three dens were located 400 to 600 m west of the proposed Jay waste rock storage area (WRSA).

Twenty-three wolf den sites have been identified near the Ekati Mine from 1995 to 2013 (Map 13.2-19; ERM Rescan 2014a). Overall, active wolf den sites have continued to be present in the BSA over the last 15 years. Although some sites appear to have been abandoned, additional den sites have been established in the BSA. From one to seven dens have been occupied each year. Overall, the average pup production for the BSA since 1995 is 6 pups per year, 2.3 pups per active den, and 3.2 pups per productive den.

Since 2003 (excluding 2006), wolf productivity has been lower (from 0 to 1.7 pups per year) than the average of 2.3 pups per occupied den pooled across years (ERM Rescan 2014a). However, these results may be skewed because some den sites were not surveyed in 2006 and 2007, potentially missing active wolf dens in the area. Alternatively, the wolves may have moved their pups away from the area before the August survey (Frame et al. 2007). The decline of the Bathurst caribou herd and other herds in the NWT may also be negatively influencing wolf productivity in the BSA (Nesbitt and Adamczweski 2013; Cluff and Klaczek 2014).

LEGEND

- EKATI MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- KIMBERLITE PIPE
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (10 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY
- GRAY WOLF DEN LOCATION

1 0 1

SCALE 1:50,000 KILOMETRES

REFERENCE

CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

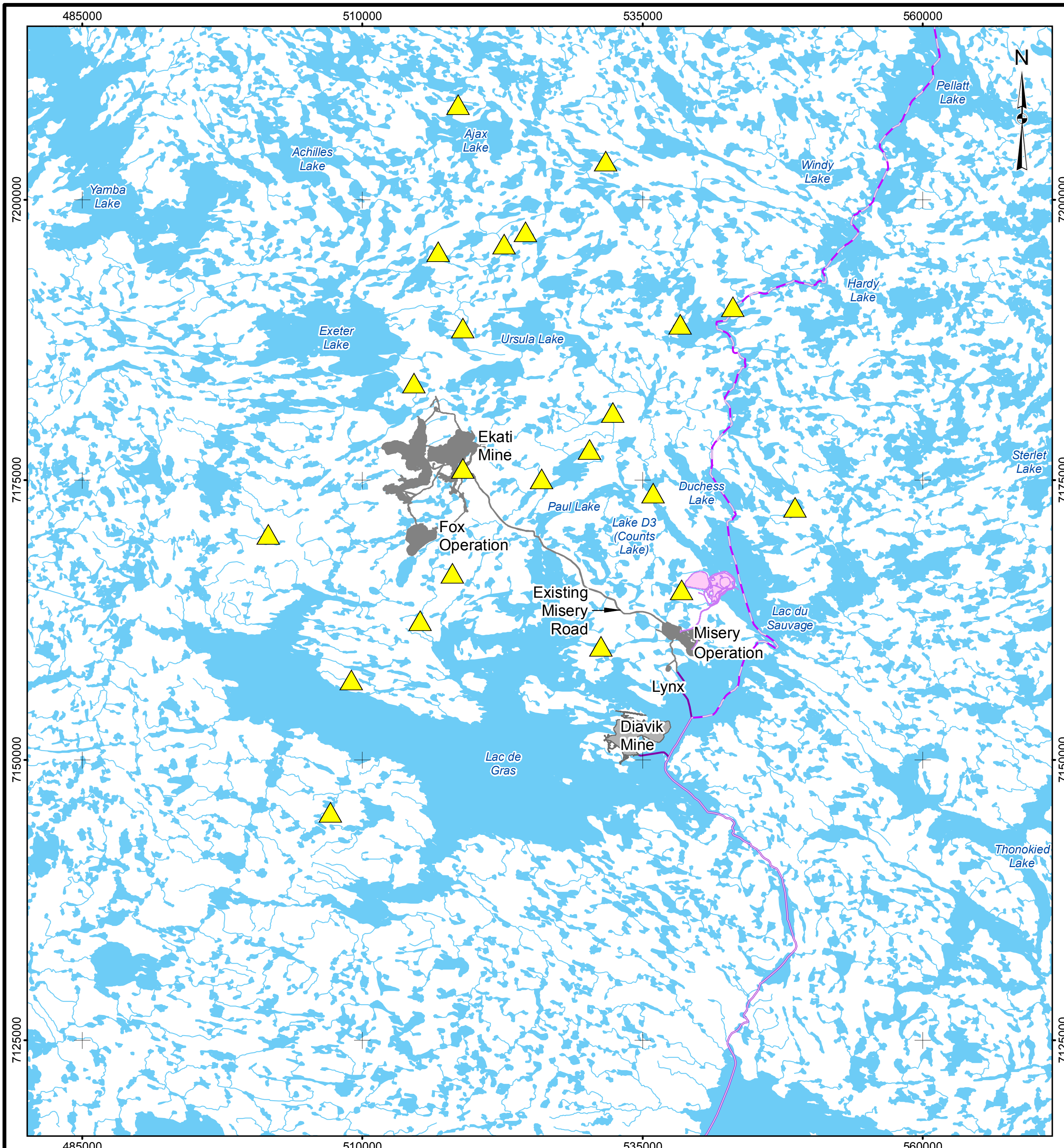
TITLE

GRAY WOLF DENS OBSERVED, JAY PROJECT, 2013

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_026_GIS	
DESIGN	LD	01/05/14	SCALE AS SHOWN	REV. 0
GIS	ANK	01/10/14	MAP 13.2-18	
CHECK	LD	01/10/14		
REVIEW	LD	01/10/14		

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\13-1328-0041 Jay & Lynx EA\Wildlife\DAR\DAR_Wild_026_GIS.mxd



LEGEND

- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- WATERCOURSE
- WATERBODY
- GRAY WOLF DEN LOCATION

10 0 10

SCALE 1:500,000 KILOMETRES

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND™

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

GRAY WOLF DENS KNOWN TO OCCUR IN THE BASELINE STUDY AREA, 1995 TO 2013

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_093_GIS
DESIGN	LD	15/07/14	SCALE AS SHOWN REV. 0
GIS	NS	03/10/14	MAP 13.2-19
CHECK	LD	03/10/14	
REVIEW	LD	03/10/14	

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\13-1328-0041 Jay & Lynx EA\Wildlife\DAR\DAR_Wild_093_GIS.mxd

DOMINION DIAMOND

13.2.2.4.2 *Gray Wolf Behaviour and Habitat Use*

Suitable habitat for gray wolf includes areas that have high densities of prey species (Theuerkauf et al. 2003; Theberge and Theberge 2004; OMNR 2005), although wolves are considered habitat generalists (Mladenoff et al. 1995; Kuzyk et al. 2004; McLoughlin et al. 2004; Houle et al. 2010; Gurarie et al. 2011; Milakovic et al. 2011). Esker habitat is preferred at the home range scale for wolves in the North Slave Region, possibly because it provides suitable denning habitat (McLoughlin et al. 2004).

Wolves have a positive correlation with road density in forested areas with low road density and use by humans (Thurber et al. 1994; Houle et al. 2010; Bowman et al. 2010). Roads with high traffic volumes may be a partial barrier to wolf movement, but other linear developments such as roads with low traffic volumes and power lines may be preferred travel corridors for wolves in the boreal forest, especially when snow is deep (Paquet and Callaghan 1996; Gurarie et al. 2011). However, road densities greater than 0.6 kilometres per square kilometre (km/km^2) have been found to negatively affect gray wolf populations in the northeastern United States (Thiel 1985; Jensen et al. 1986; Mech et al. 1988; Mladenoff et al. 1995; Potvin et al. 2005). Research in Canada, Italy, and the United States shows that gray wolves can adapt to the presence of humans and may select areas closer to human activity (Mech 1995; Thiel et al. 1998; Boitani 2000; Hebblewhite and Merrill 2008).

Wolves in northwest Alaska were found to primarily consume caribou and moose (51% and 42% of kills, respectively) (Ballard et al. 1997). Caribou were preferred but wolves switched to preying on moose when caribou densities were less than 200 individuals per 1,000 km^2. Caribou was also the most important dietary item for wolves in Nunavut, but seasonally abundant foods (e.g., migratory birds) were also important during certain times of the year (e.g., during the late summer during the molt season for ducks and geese) (Wiebe et al. 2009).

13.2.2.4.3 *Gray Wolf Population Characteristics*

The abundance of wolves within the BSA is expected to vary annually and seasonally in response to factors such as prey availability and suitability of den habitat. At the regional scale, home ranges are established based on food availability (McLoughlin et al. 2004). As predators of migratory caribou, wolves in the Arctic have larger home ranges and less territorial behaviour than other wolves of North America (Walton et al. 2001). At the local scale, wolves select areas with suitable den habitat, such as eskers, kames, and other glaciofluvial deposits (McLoughlin et al. 2004). The gray wolf population in the NWT is considered secure (NWT Infobase 2014), and considered not at risk by COSEWIC (2014).

The mean annual survival rate for wolves in northwest Alaska, when rabies was not a substantial source of mortality, was estimated to be from 58.5% to 65.4% (Ballard et al. 1997). Survival rates for wolves in the Kenai Peninsula, Alaska are reported to be 64%. Survival rates for heavily harvested wolf populations in south-central Alaska and the Yukon are reported to be 48% and 40%, respectively. Wolf populations are most vulnerable to changes in hunter-related mortality (OMNR 2005; Sidorovich et al. 2007; Creel and Rotella 2010).

13.2.2.5 *Wolverine*

13.2.2.5.1 *Wolverine Distribution and Abundance*

The wolverine DNA mark-recapture study at Daring Lake, Ekati Mine, and Diavik Mine suggests that the wolverine populations around Daring Lake and the Diavik Mine are decreasing at approximately 11% per year, while the population around the Ekati Mine may be stable (Boulanger and Mulders 2013). However, population trends for Ekati Mine may be positively biased, because the sampling area of the Ekati Mine grid was increased each sampling year from 2005 to 2011 (1,062 km^2 in 2005; 1,197 km^2 in 2006; 1,593 km^2 in 2010; and, 1,647 km^2 in 2011). The density of wolverines in the Daring Lake sampling grid was estimated to have decreased from 8 wolverine per 1,000 km^2 in 2005 to 4 wolverine per 1,000 km^2 in 2011. Similarly, in the Diavik Mine sampling grid, the density of wolverines has decreased from 11 wolverine per 1,000 km^2 in 2005 to 4 wolverine per 1,000 km^2 in 2011. The density of wolverine in the Ekati Mine sampling grid ranged from 10 wolverine per 1,000 km^2 in 2005 to 6 wolverine per 1,000 km^2 in 2011. There were estimated to be 18 wolverine individuals near the Gahcho Kué Project in 2005 and 2006 (Boulanger and Mulders 2007). The decline of wolverine populations may be related to the decline of the Bathurst caribou herd (Boulanger and Mulders 2013).

The wolverine track index recorded in the Diavik Mine study area (which is within the BSA) ranged from 0.03 to 0.17 tracks/km from 2003 to 2013 (Golder 2014a).

From 2003 to 2012, mean wolverine track densities at the Snap Lake Mine study area ranged from 0.01 to 0.21 track/km (Golder 2013b). Generally, the mean track density index has decreased over time, although the associated variances indicate that the track densities may not statistically differ among most years. However, the mean track density index during 2008 to 2011 was lower than during 2003 to 2006. The proportion of transects in the Snap Lake Mine study area with wolverine tracks ranged from 22% in 2009 to 67% in 2003. Since 2005, point estimates of the proportion of transects with wolverine tracks has been lower than in 2003 and 2004. Since 2005, the proportion of transects with tracks has been consistent based on overlap of confidence intervals.

In 2011, the mean probability estimate (1SE) of wolverine presence in the Gahcho Kué Project study area after accounting for detection of snow tracks was 0.96 (0.27) (Golder 2012). Detection probability of snow tracks was 0.37 (0.12), after controlling for effect of weather. This detection rate suggests that failure to observe tracks in previous years, where a single survey was completed, likely underestimated wolverine activity and distribution.

13.2.2.5.2 *Wolverine Behaviour and Habitat Use*

There is limited evidence that the operation of the Diavik Mine has caused a measurable shift in the presence of wolverine in the study area across years (Golder 20114a). These findings are different than those observed at Snap Lake Mine where trends related to distance from the mine and survey weather were important indicators of wolverine snow track occurrence (Golder 2013b).

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13.2.2.5.3 *Wolverine Population Characteristics*

The western population of wolverine in Canada is not listed under SARA (2013) but has been recommended by COSEWIC (2014) to be listed as a species of special concern. The wolverine is considered a sensitive species in the NWT (NWT Infobase 2014). The DNA mark-recapture study completed by Boulanger and Mulders (2013) suggests that the wolverine population around Daring Lake may be declining at approximately 11% per year.

13.2.2.6 *Grizzly Bear*

13.2.2.6.1 *Grizzly Bear Distribution and Abundance*

Approximately 4,000 to 5,000 grizzly bears are found in the NWT, with most individuals residing in the Mackenzie Mountains (NWT Infobase 2014). No barren-ground grizzly bear dens were found near the Project during the carnivore dens surveys in 2013.

The number of dens located during esker surveys in the BSA from 1994 to 1998 was low and statistical analyses could not be completed (BHP 1999). Esker surveys are deemed unsuitable for determining whether bears have denned in an area or continue to use an area that supports a mine or other development (BHP Billiton 2001).

Analysis of grizzly bear DNA in the BSA showed that grizzly bears are most frequent in the northeast half of the study area, which has a higher coverage of water and esker habitat (ERM Rescan 2014b). The total number of grizzly bears in the BSA in 2012, as determined from DNA analysis, was 72 females and 42 males (ERM Rescan 2014b). In 2013, DNA analysis identified 60 males and 76 female grizzly bears in the BSA.

13.2.2.6.2 *Grizzly Bear Behaviour and Habitat Use*

Barren-ground grizzly bears in the North Slave Region were found to prefer esker, tussock-hummock, lichen veneer, birch seep, and tall shrub riparian habitats (McLoughlin et al. 2002a). Esker and tall shrub riparian habitats were selected throughout the year, while lichen veneer, tussock-hummock, and birch seep were preferred during different seasons. Female grizzly bears with cubs avoided areas preferred by male grizzly bears (McLoughlin et al. 2002a; Suring et al. 2006). Barren-ground grizzly bears in the North Slave Region were found to construct dens under tall shrub cover on well-drained esker slopes (McLoughlin et al. 2002b). During habitat surveys at Diavik Mine in 2008, 72% of sedge wetland plots and 61% of riparian shrub plots contained grizzly bear sign (DDMI 2009).

Barren-ground grizzly bears in the North Slave Region primarily consume caribou in the spring, mid-summer, and autumn (Gau et al. 2002). Horsetail (*Equisetum* spp.) and sedges (*Carex* spp.) are the primary food items eaten during the early summer. Berries (e.g., black crowberry [*Empetrum nigrum*]) are an important dietary component during the late summer and contribute greatly to body fat reserves.

13.2.2.6.3 *Grizzly Bear Population Characteristics*

The barren-ground grizzly bear (western population) is not currently listed under the SARA (2013) but has been recommended by COSEWIC (2014) to be listed as a species of special concern. McLoughlin et al. (2003a) considered the barren-ground grizzly bear population in the North Slave Region of the NWT stable or slightly increasing. However, barren-ground grizzly bear is considered a sensitive species in the NWT (NWT Infobase 2014) because the population is sensitive to increased harvest rates and direct mine-related mortality. It is estimated that the harvesting of an additional six bears per year could result in a greater than 40% chance of a decrease by one-quarter of the population size over the next 50 years (McLoughlin et al. 2003b). In contrast, there is a 10% chance of a one-quarter of the population size decrease over the next 50 years with the current of level of harvesting (13.4 bears per year).

13.2.2.7 *Carnivore Mine-Related Incidents and Mortality*

Carnivore incidents and mortality that have occurred at the Diavik, Ekati, Snap Lake, and Jericho mines since 1996 are summarized in Table 13.2-2. Incidents include all occasions when there was an interaction between the mine and the carnivore, and action was required (e.g., deterrent, re-location, or report of damage). 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 Mine 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.

13.2.2.7.1 *Intentionally Destroyed*

When diamond mines in the NWT were first being developed, many of the carnivore incidents and mortalities on the mine sites were directly associated with waste management. The feeding of wildlife by mine staff, which occurred deliberately and accidentally, was also a problematic source of attraction. For example, at the Ekati Mine in 1997, lunch bags were found at a local fox den on several occasions, and fox were seen travelling with food scraps. From 1996 to 2001, there were an average of three animals per year intentionally destroyed at diamond mines in the NWT. From 2002 to 2014, there were an average of 1.3 animals per year intentionally destroyed at diamond mines in the NWT. The decrease in the number of intentionally destroyed animals in more recent years is a result of diamond mines using the lessons learned and implementing more robust, effective, and diligent waste management policies and practices including continuing education of mine staff, and providing garbage cans labelled for food waste in areas where people eat.

The 30 carnivores that were intentionally destroyed on the Ekati, Diavik, Snap Lake, and Jericho mine sites since 1996 included 4 grizzly bears, 7 wolverines, 17 foxes, and 2 wolves (Table 13.2-2). Grizzly bear kills on the Ekati Mine site were one cub of unknown sex in 2000, and a 3-year old male and 13-year old male in 2005. One adult male grizzly bear was killed at the Diavik Mine in 2004. 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 wolf was intentionally destroyed at the Snap Lake Mine in 2012. One wolf was intentionally destroyed at the Ekati Mine in 2008. From 1996 to 1999, one wolverine was intentionally destroyed at the Diavik Mine, five wolverine were destroyed at the Ekati Mine from 1997 to 2005, and one wolverine was killed at the Jericho Mine in 2007.

Table 13.2-2 Carnivore Incidents and Mortality at the Ekati, Diavik, Snap Lake, and Jericho Mines, 1996 to 2013

Site	Year	Phase	Species	Mortalities			Other Incidents[d]
				Intentional[a]	Non-Intentional[b]	Found Dead[c]	
Diavik[e]	1996 to 1999	exploration	wolverine	1	—	—	1
	2000	construction	grizzly bear	—	—	—	10
	2000	construction	wolverine	—	—	—	9
	2001	construction	wolverine	—	—	1	12
	2001	construction	grizzly bear	—	—	—	9
	2002	construction	grizzly bear	—	—	—	2
	2003	production	grizzly bear	—	—	—	7
	2003	production	wolverine	—	—	—	1
	2004	production	grizzly bear	1	—	—	20
	2004	production	wolverine	—	—	—	1
	2005	production	grizzly bear	—	—	—	23
	2005	production	wolverine	—	—	—	5
	2006	production	grizzly bear	—	—	—	8
	2006	production	wolverine	—	—	—	2
	2007	production	grizzly bear	—	—	—	20
	2007	production	wolverine	—	—	—	1
	2008	production	grizzly bear	—	—	—	3
	2008	production	wolverine	—	—	1	17
	2009	production	grizzly bear	—	—	—	18
	2009	production	wolverine	—	—	—	1
	2010	production	grizzly bear	—	—	—	40
	2011	production	grizzly bear	—	—	—	31
	2012	production	grizzly bear	—	—	—	66
	2012	production	wolverine	—	—	2[f]	1
	2013	production	grizzly bear	—	—	—	53

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Table 13.2-2 Carnivore Incidents and Mortality at the Ekati, Diavik, Snap Lake, and Jericho Mines, 1996 to 2013

Site	Year	Phase	Species	Mortalities			Other Incidents[d]
				Intentional[a]	Non-Intentional[b]	Found Dead[c]	
Ekati[g]	1997 to 2001	construction-production	wolverine	2	—	—	3
	2000	production	grizzly bear	1	—	—	—
	2001	production	fox	9	—	—	—
	2001	production	wolverine	2	—	—	7
	2002	production	gray wolf	—	1	—	—
	2002	production	fox	1	1	—	—
	2003	production	grizzly bear	—	—	—	5
	2004	production	gray wolf	—	—	—	4
	2004	production	wolverine	—	—	—	3
	2004	production	grizzly bear	—	—	—	3
	2005	production	fox	—	1	—	6
	2005	production	grizzly bear	2	—	—	18
	2005	production	wolverine	1	—	1	23
	2005	production	gray wolf	—	—	—	5
	2006	production	grizzly bear	—	—	—	15
	2006	production	gray wolf	—	—	1	4
	2006	production	fox	—	—	—	13
	2007	production	fox	6	—	2	—
	2008	production	gray wolf	1	—	—	5
	2008	production	fox	—	1	4	2
	2008	production	grizzly bear	—	—	—	15
	2008	production	wolverine	—	—	—	4
	2009	production	gray wolf	—	—	—	1
	2009	production	fox	1	1	—	44
	2009	production	grizzly bear	—	—	—	16
	2010	production	fox	—	1	3	

Table 13.2-2 Carnivore Incidents and Mortality at the Ekati, Diavik, Snap Lake, and Jericho Mines, 1996 to 2013

Site	Year	Phase	Species	Mortalities			Other Incidents[d]
				Intentional[a]	Non-Intentional[b]	Found Dead[c]	
Ekati[g] (continued)	2010	production	gray wolf	—	—	—	2
	2011	production	grizzly bear	—	—	—	4
	2011	production	fox	—	1	—	—
	2012	production	fox	—	1	—	2
	2012	production	grizzly bear	—	—	—	7
	2012	production	gray wolf	—	—	—	2
	2013	production	fox	—	3	—	2
Snap Lake[h]	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	grizzly bear	—	—	—	1
	2009	production	wolverine	—	1	—	—
	2009	production	fox	—	—	1	—
	2011	production	fox	—	—	1	—
	2011	production	wolverine	—	—	1	—
	2012	production	fox	—	—	2	—
	2012	production	gray wolf	1	—	—	—
	2013	production	fox	—	—	—	1
	2013	production	grizzly bear	—	—	—	1
	2013	production	wolverine	—	—	—	7

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Table 13.2-2 Carnivore Incidents and Mortality at the Ekati, Diavik, Snap Lake, and Jericho Mines, 1996 to 2013

Site	Year	Phase	Species	Mortalities			Other Incidents[d]
				Intentional[a]	Non-Intentional[b]	Found Dead[c]	
Jericho[i]	2000 - 2004	exploration	-	—	—	—	—
	2005	construction	wolverine	—	1	—	—
	2006	production	-	—	—	—	—
	2007	production	wolverine	1	—	1	—

a) Animal intentionally destroyed by mine or government personnel.

b) Accidental mine-related mortality (e.g., entanglement in fence).

c) Animal found dead, mortality could not be linked to mine activities.

d) 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 be unknown.

e) The mortalities and incident reports were not included in the 2012 Wildlife Monitoring Program, thus cause of death is unknown.

f) Sources: DDMI (1998, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013) and Golder (2014a).

g) Sources: BHP Billiton (2001, 2002, 2003, 2004), Rescan (2005, 2006, 2007, 2008, 2009, 2010b, 2011, 2012a, 2013), and ERM Rescan (2014a).

h) Sources: De Beers (2002) and Golder (2006a, 2007, 2008a, 2010a,b, 2013b).

i) Sources: Tahera Corporation (2003) and Golder (2006b, 2008b).

— = no incident or mortality.

13.2.2.7.2 *Accidentally Destroyed*

The six occasions where carnivores were accidentally destroyed, 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 Mine. On October 9, 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 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, and were due to vehicle collisions. A wolverine was accidentally hit by a vehicle at the Snap Lake Mine in 2009. A wolverine was accidentally hit by a vehicle at the Jericho Mine in 2005.

13.2.2.7.3 *Found Dead*

Seventeen carnivores (5 wolverine, 1 wolf, and 11 fox) have been found dead among the Ekati, Diavik, Snap Lake, and Jericho mines since 1996. 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 the Ekati Mine in 2006. The carcass was found underneath a building at Misery Camp. A wolverine was found dead at the Ekati Mine in 2005; the cause of death was not determined. One wolverine was found dead in a shipping container on the Snap Lake mine site in 2011; it was assumed that the wolverine gained access and became trapped when the door of the shipping container was closed. Cause of death could not be determined because the carcass was well decomposed.

13.2.2.7.4 *Other Carnivore Incidents*

From 1996 to 2013, 563 carnivore incidents (not including mortalities) were reported at the Ekati, Diavik, Snap Lake, and Jericho mines. Although the definition of a wildlife incident varies, this statistic generally includes occasions where direct interaction between an animal and the mine occurred. 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 wildlife causing damage to property.

Most incidents recorded on the four mines involved grizzly bears (63%). Approximately 4% of recorded incidents involved wolves, 13% involved wolverines, and 20% involved foxes. Two black bear incidents were recorded on the Snap Lake mine site in 2007.

13.2.3 Summary of Local and Traditional Knowledge

13.2.3.1 *Yellowknives Dene First Nation*

13.2.3.1.1 *Ungulates*

Historically, moose were common around Great Slave Lake (Weledeh Yellowknives Dene 1997). Moose habitat includes areas with willow and birch and wetlands with old grass (Sadownik and Harris 1995). In the summer, some moose move through the barrenlands around large lakes to avoid insects and to feed on dwarf birch and berries (Weledeh Yellowknives Dene 1997). Others stay in damp areas in the forest to keep cool. In the fall, moose move to higher ground in the forest to breed. Females calve from May to June in areas of thick brush near the water or muskeg.

The Yellowknives Dene First Nation (YKDFN) believe that moose cows are so protective of their young that wolves avoid approaching a cow and calf (Weledeh Yellowknives Dene 1997). In general, moose and caribou do not share the same space since they prefer different food and because the moose are irritated by the noisy caribou (Sadownik and Harris 1995). Like caribou, moose meat was dried and saved for travelling in the barrenlands, often powdered, rolled in fat, and frozen for the trip. Moose hide is thicker and more durable than caribou hide and was often saved for making footwear (Weledeh Yellowknives Dene 1997).

Before the Government of Canada's ban on muskox hunting in 1917, the YKDFN often hunted muskox with the help of their dogs in the winter for their delicious meat, strong skins, and their thick, warm furs, which were used as warm blankets and jackets. Babiche (cord or lacing) made from muskox hide is much stronger than caribou babiche, and could be woven to make temporary fish and meat drying racks in the winter. Muskox bones can also be burned in place of wood, which is scarce in the barrenlands (Weledeh Yellowknives Dene 1997).

13.2.3.1.2 *Large Carnivores*

Grizzly bear on the barrenlands are not often hunted by the YKDFN. They are a respected animal and can be used, if necessary, for medicinal purposes (Weledeh Yellowknives Dene 1997). The grizzly bear is considered by the YKDFN to share many human traits and the habits of the grizzly are well known (Sadownik and Harris 1995).

Wolf packs on the barrenlands were a good sign for the YKDFN hunters, often signalling the upcoming arrival of a migrating caribou herd. Wherever wolves might be, the YKDFN would expect to find other scavengers such as fox, weasel, and ravens, waiting to take advantage of wolf kills. As a result, the benefits of wolves were two-fold: wolves were a source of furs and they provided information on the whereabouts of caribou.

The YKDFN expressed concerns about the impacts of dust on migratory and non-migratory wildlife. They expressed the desire to protect mammals by using fences, while maintaining enough of the land area available for safe migration (Weledeh Yellowknives Dene 1997).

13.2.3.1.3 *Furbearing Animals*

Snares have been traditionally set on traplines to catch small furbearing animals such as rabbit, lynx, muskrat, and fox. Fur-bearing animals were caught largely for their furs but the meat was also often used for food or bait (Weledeh Yellowknives Dene 1997).

Fox provided signs for YKDFN hunters that caribou were nearby. Fox were also an important target of much barren-ground trapping during the fur-trading era. Eskers are important habitat for foxes (Weledeh Yellowknives Dene 1997).

Arctic hare and ground squirrel are respected animals for the YKDFN and have been harvested for their meat and furs. Muskrat teeth could be used to fashion fish hooks attached to winter nets set under the ice (Weledeh Yellowknives Dene 1997). Marten can be found throughout the woods and on the tundra, wherever they have access to mice and rabbits. Marten are rarely hunted by other animals because they are quick and able to climb (Sadownik and Harris 1995).

Beavers have also been a source of food and income for the YKDFN. Beavers usually live in small lakes with muddy soils where there is sunlight, protection from the wind and drifting ice, and access to vegetation such as black spruce, poplar, white birch, and shrubs. The YKDFN recognize beavers for their important ecological role in controlling water levels and creating new habitat. The size of beaver lodges and food stockpiles provide an indication of how many beaver are living together and the size of the population in general. This knowledge helps harvesters maintain a sustainable population. The main predators of the beaver are wolverine and black bear (Sadownik and Harris 1995). Before the fur trade, small game furs were used to make clothing and blankets. After the arrival of the fur trading companies, small game furs were collected for trade (Weledeh Yellowknives Dene 1997).

13.2.3.1.4 *Birds*

The YKDFN have expressed concerns about the impacts of dust on migratory and non-migratory birds. They have expressed the desire to protect birds by using deterrents, while maintaining enough of the land area available for safe migration (Weledeh Yellowknives Dene 1997).

Ptarmigan and grouse were an important addition to the YKDFN diet in the winter. Women would often catch the ptarmigan in low shrub areas using nets made of willow and babiche. Snares and nets were also set to catch waterfowl. Feathers were used for arrow shafts, blankets, and pillows. Ptarmigan feet were used as charms for children to grow "as surefooted as the ptarmigan" (Weledeh Yellowknives Dene 1997).

Ravens in the barrenlands were also important to the YKDFN. Although they were not harvested for food, ravens provided important information to hunters for locating the presence of animals. Raven behaviour would help hunters locate game:

> *"Ravens can't kill animals themselves, so they depend on hunters and wolves to kill food for them. Flying high in the sky, they spot animals too far away for hunters or wolves to see. They fly to the hunter and attract his attention by croaking loudly, then fly back to where the animals are"* (Sadownik and Harris 1995).

Earlier this century ravens and other large birds, such as the whisky jack, disappeared from the barrenlands (Weledeh Yellowknives Dene 1997).

13.2.3.2 *Łutsel K'e Dene First Nation*

13.2.3.2.1 *Ungulates*

Members of the Łutsel K'e Dene First Nation (LKDFN) have observed changes in the muskox range. Muskox are moving south into the bush, as far as Łutsel K'e (Rescan 2011).

13.2.3.2.2 *Large Carnivores*

In 2011, community participants in the Wildlife Effects Monitoring Program Community Engagement Program helped Ekati Mine staff identify 23 habitat locations around the mine for establishing plots for the grizzly bear DNA hair snagging program, which is designed to assess and monitor the distribution and occupancy of grizzly bears near the mine (Rescan 2011).

13.2.3.2.3 *Furbearing Animals*

Many fox used to live in the Ekati area but the LKDFN recognize that fox come and go in cycles. They change where they live and where they travel; this cycle may be the reason fewer foxes are seen now in the Ekati area (Rescan 2011).

13.2.3.3 *Deninu K'ue First Nation*

13.2.3.3.1 *Ungulates*

Bison (*Bison bison athabascae*), moose, and muskoxen were hunted by the Deninu K'ue First Nation (DKFN) to supplement the caribou hunt. Muskoxen are found exclusively on the barrenlands, while buffalo and moose are found almost exclusively south of the treeline (DKFN 2012). Moose were often chased down because they are easy to catch as they are "so tender-footed, and so short-winded" (DKFN 2012). Moose are easiest to capture in early March when the snow had a hard crust on its surface (Hearne 1795). After a long chase, the women would leave camp to collect and dismember the animal to share with the group (Franklin 1924).

Muskoxen were taken as required while travelling on the barrenlands but the meat is less favorable than that of caribou. Muskox fur, however, was a valuable trade commodity resulting in the over-harvest of muskoxen in the late 1800s and early 1900s. Muskoxen were hunted by the Deninu K'ue in groups of approximately ten men who would travel long distances in search of them. In an effort to preserve the species, the Government of Canada banned muskox hunting in 1917, and in 1927 established the Thelon Game Sanctuary to protect the last remaining muskoxen along the Thelon River (Bradley et al. 2001). Since that time, the population has rebounded and the hunt of muskoxen has been reinstated. Today, the DKFN travel to the Thelon River basin to hunt them (DKFN 2012).

13.2.3.3.2 *Large Carnivores*

According to members of the DKFN (2012), the wolves eat the caribou, and the wolverines and foxes eat the wolves' leftovers. Today, members of the DKFN hunt white wolves for their fur (DKFN 2012). Wolverine were trapped and traded regularly in the 1800s. According to the DKFN (2012), most wolverines are hunted rather than trapped and, despite their highly valued fur, most are taken opportunistically.

13.2.3.3.3 *Furbearing Animals*

Snares have been traditionally set on traplines to catch small furbearing animals such as beavers, muskrats, and hares. Furbearing animals are caught largely for their fur, which provides income, and were valued as trade items by the Hudson's Bay Company in the late 1700s. The meat is also often used for food and bait. Oftentimes, children begin hunting small game such as squirrels, muskrats, beavers and hares in preparation for the hunting of larger animals (DKFN 2012).

During the early 1900s Arctic fox trapping likely increased due to the decline in muskox populations. The trapping season for the Arctic fox typically extends from November to April and coincides with the caribou hunt on the barrenlands (DKFN 2012). Red foxes were harvested regularly through the trading days and continue to be hunted from early November to late February in areas below the treeline, and from early November to mid-April in the barrenlands (DKFN 2012).

Beaver furs were the standard by which all other furs were valued; beavers were trapped year-round. Trapping continues today; beavers are generally easy to locate based on the location of the beaver lodges and dams along rivers and streams. Muskrats and otters can also be found around or using beaver lodges and can therefore be relatively easily located and captured. Beaver and muskrat furs remain valuable for trade and the meat is also good to eat (DKFN 2012).

Arctic and snowshoe hares are more commonly caught for their fur but have also been known to supplement the Yellowknives Dene and Chipewyan diets, particularly in the fall when the hares are feeding on berries. The Arctic hare is found exclusively on the barrenlands (DKFN 2012).

13.2.3.3.4 *Birds*

The DKFN hunted geese, ducks, grouse, and ptarmigan. Geese were a staple in the spring and fall when they can be found in large migrating flocks. Before the spring migration, ptarmigan were an important food source. Traditionally, these birds were trapped using snares. Often, children began hunting small birds, such as grouse and ptarmigan in preparation for the hunt of larger animals (DKFN 2012).

13.2.3.4 *Northwest Territories Métis Nation/Fort Resolution Métis*

13.2.3.4.1 *Furbearing Animals*

Snares have been traditionally set on traplines to catch small furbearing animals such as beavers, muskrats, and hares. The meat is often used for food and bait, but fur-bearing animals are caught largely for their furs, which provide income and were historically valued as trade items by the Hudson's Bay Company in the late 1700s (NWTMN 2010).

13.2.3.5 *North Slave Métis Alliance*

13.2.3.5.1 *Ungulates*

The Métis participated in muskox hunting for the Hudson's Bay Company in the late 1800s. This hunt took them northeast and into the barrenlands. Between trapping and muskox hunting on the barrenlands, it is very likely that the old Métis knew and used the lands around Lac de Gras. Métis have provided knowledge about the movements of the muskox in relation to the caribou:

> *They'd [the caribou] come through for days right passed the tent. Of course the musk-ox disappear because they know that the caribou are there, that means the wolves are there. After the caribou have gone through the musk-ox shows up again* (NSMA 1999).

Moose also play an important part in the Métis diet and as part of the Métis culture. Moose and deer hide are used for clothing and moccasins (a travelling man could go through a pair of moccasins in a day). Sinews were extracted from large game and prepared for use in snares, snowshoes, clothing, and equipment (Jones undated).

13.2.3.5.2 *Large Carnivores*

The Ekati area has been identified by the Métis as good grizzly bear habitat: *"The grizzly bears, they den up and stay in the area, they don't migrate anywhere"* (NSMA 1999). The bears den in the sand and gravel hills (eskers) in the vicinity of Lac de Gras (BHP 1995). The Métis identified the possibility that the bears in the area might be attracted to the smell of garbage around the mine and suggested that changes in the fat content and grizzly bear behaviour could be used as indicators or signals that they are under stress (NSMA 1999).

Wolves have been and continue to be trapped for their furs by the Métis. The wolves follow the caribou, "*they kill the weaklings*" (BHP 1995) and so wolves are found in the Ekati area around the same time as the caribou, moving from lake to lake. The wolf-caribou relationship is one of interdependence. Métis have expressed thoughts about the intelligence of the wolves, and their importance to the health of the caribou:

> *Foxes do more damage to a caribou than a wolf does because a fox doesn't know its calving season. The little guy comes out, hits the ground, the fox is not big enough to kill it so he winds up biting holes in it and then it gets sick and then the wolf comes and cleans up. So that's why I don't like shooting wolves because I know that if the wolf is gone, then the caribou will be sick* (NSMA 1999).

Wolverines tend to stick to a defined territory and territories are established around Lac de Gras. Traditionally, the Métis have used wolverine furs to trim parkas. Trappers who sell the furs for trim or at auction continue to get a good price for wolverines.

13.2.3.5.3 *Furbearing Animals*

Because of their close affiliation with the fur trade, the Métis have always relied heavily on trapping furbearing animals for food, furs, and as an economic base:

> *...They're all important to me, and they all have their reasons for being on the land, whether they're scavengers or they're there for us to eat, they have their use on the land. They're all important* (NSMA 1999).

According to the Métis, the lands around Lac de Gras are prime habitat for a range of mammals, including foxes. The Métis had warned that the mines will attract these animals, which could become dangerous for people and the animals, and they recommended that the mines keep everything clean to keep the scavengers away (BHP 1995).

Trapping has played an important role in Métis culture and for this reason they have expressed concerns about the potential negative impacts of development on their ability to trap. For example, Métis have identified the presence of access roads as both a potential benefit and detriment to ongoing trapping activities. New access could both interrupt existing traplines and improve access to additional trapping locations for the Métis and other trappers (BHP 1995). The loss of trapping would result in an economic and socio-cultural loss for the Métis.

Arctic foxes used to be of considerable economic value to NSMA trappers, and were one of the main resources that, along with muskox, attracted them to the Lac de Gras area in the past. Members of the NSMA camped near MacKay Lake to trap white fox (NSMA 1999).

Muskrat and beaver pelts have traditionally been used for clothing and small game; rabbits were a staple at northern posts (Jones undated). The Métis have expressed concern that small furbearers will be impacted, not only through destruction of their habitat and subsequent displacement, but also by dust and through other environmental impacts (NSMA 1999).

13.2.3.5.4 *Birds*

The Métis had expressed concern about the potential impacts of the mines on birds, such as ptarmigan and grouse; waterfowl, such as geese and ducks; and their habitat.

> *That whole [Coppermine River] valley is [filled] with geese and swans and they have their young there* (BHP 1995).

Impacts as a result of the increased levels of dust and potential contaminant spills were of special concern for the birds.

> *If you compare the BHP site there is a number of lakes that have been taken out of the system that birds have normally used and that is going to happen at the Diavik site… if those areas aren't there [anymore] they'll have to go elsewhere and we don't know what the impact* (NSMA 1999).

Others did not think the development would have a substantial impact on the birds, comparing the ongoing use in a developed area to that of Yellowknife. Making a comparison with Pine Point, some suggested that after reclamation is complete, the mine area might become prime waterfowl habitat (BHP 1995).

13.2.3.6 *Tłı̨chǫ Government*

13.2.3.6.1 *Large Carnivores*

Tłı̨chǫ have identified the importance of the Ekati area for gray wolf denning (DCI 1995).

13.2.3.6.2 *Furbearing Animals*

The eskers in the Ekati area represent good trapping territory.

> *We traveled with a canoe and we go right beside the eskers. That's where I trap, the place was good for trapping. That's why we have always traveled there* (DCI 1995).

Tłı̨chǫ have identified the importance of the Ekati area for fox denning (DCI 1995).

13.2.3.6.3 *Birds*

In addition to hunting caribou, catching fish and trapping furbearers in the Ekati area, Tłı̨chǫ also hunted ducks (DCI 1995).

13.2.3.7 *Kitikmeot Inuit Association*

13.2.3.7.1 *Ungulates*

Inuit observe that muskox would never travel on the eskers, preferring to stay in the wetlands, around lakeshores, eating the grass. Muskox were hunted mostly when caribou were not available or for dog food. Muskox horns were used to make the bows for hunting (Banci et al. 2006).

13.2.3.7.2 *Large Carnivores*

Bears can be hunted from eskers, their furs used for sleeping mats and their fat used for mixing with dry caribou meat. Similar to caribou, if there is extra meat, it has traditionally been buried to preserve for future use (Banci et al. 2006). The Kitikmeot Inuit Association (KIA) have expressed concerns about the impacts of roads and other developments on bear denning habitat, specifically any construction impacting eskers. In 2011, KIA participation in the Wildlife Effects Monitoring Program helped Ekati Mine staff identify grizzly bear habitat in the vicinity of the Ekati Mine, where they established sampling plots to collect hair samples for DNA testing to assess and monitor the distribution and occupancy of grizzly bears near the mine (Rescan 2011).

The Inuit have traditionally hunted wolves and wolverine, which are trapped on eskers and can be found on the lakes while looking for caribou. Wolves are a main predator of the caribou and can sometimes be responsible for declining caribou populations (Banci et al. 2006). Traditionally, hunters left bait on lakes to lure and catch wolves, wolverine, and other animals. Some wolves den around creeks and rivers; only wolves use the steep eskers to den. Elders remember stealing gray wolf pups from their dens to breed with their own dogs when disease, such as rabies, threatened their own dog populations (Banci et al. 2006).

In the *Naonayaotit Traditional Knowledge Study*, the Ekati area was referred to as wolverine country. Elders recall catching wolverine and wolves while hunting in the area every time (Banci et al. 2006). Traveling through the Ekati area, the KIA made special note of the dens found throughout the eskers:

> *It's probably a den site (used by wolves) during the spring. For two springs straight (that we were in) that area, there always seemed to be wolves there. This happened during the day trips at Lac de Gras, when we saw wolves around there* (Banci et al. 2006).

The Inuit have recommended that the eskers and denning areas for wolves and wolverine be protected. One of the main concerns was potential impacts on the presence and health of game in the area for hunting and trapping in the future (BHP 1995). Many Elders have made reference to a wolf control program that was initiated by the government in the 1960s that used poison to kill wolves but that also had the effect of killing numerous non-target species such as wolverine, fox, and scavenging birds. Members of the KIA who participated in the Caribou and Roads workshops recognized that the wolf population around Ekati was beginning to decline; they noted that wolf and caribou have been living together for thousands of years and that wolves will decline as the caribou do (Banci et al. 2006).

13.2.3.7.3 *Furbearing Animals*

When caribou were not available, many other small fur-bearing animals were hunted or trapped for food and furs. Even mice were killed for their skins, which were easy to burn and facilitated starting fires. Once trading posts were established, trapping took on a larger role for the Inuit. The pelts they collected came from white and red fox, hares, voles, ground squirrels, and muskrat (Banci et al. 2006).

Foxes were hunted and trapped for their warm furs and often traded at the coast to the traders or to the coastal Inuit for clothing. Foxes were noted by the for denning around Contwoyto Lake and in the eskers at Lac de Gras:

> *"There is some kind of fox dens on every esker that you run across out there. You always find fox dens. Almost everywhere you go you are bound to find coloured fox or white fox dens"* (Banci et al. 2006).

The Inuit had warned that foxes and other scavengers, such as ravens and seagulls, would be attracted to the mine site if it was not kept clean. Concern about the ongoing ability to trap fox in the area had also been expressed (BHP 1995).

Hikhik (ground squirrels) were captured when available and used to make food and clothing if the caribou supply was low. Young children were taught how to hunt, starting with ground squirrel, ptarmigan, and rabbits (hares) (Banci et al. 2006).

13.2.3.7.4 *Birds*

Birds such as ducks and geese are hunted when available. In the summer, moulting ducks could be chased using a kayak towards the shore to waiting hunters. Geese were also hunted around Lac de Gras (Banci et al. 2006).

13.3 Pathway Analysis

13.3.1 Methods

Pathway analysis identifies and assesses the linkages between Project components or activities, and the correspondent changes to the environment and potential residual effects (after mitigation) to wildlife valued components (VCs). The first part of the analysis is to identify all potential effects pathways for the Project. Each pathway is initially considered to have a linkage to potential effects on the VCs. Potential pathways through which the Project could affect VCs were identified from several sources:

- a review of the Project Description and scoping of potential effects by the environmental and engineering teams for the Project;
- information from past and ongoing consultations with Aboriginal communities that are part of the Ekati Mine Community Engagement Programs
- local and traditional knowledge obtained from community scoping sessions in Behchokǫ̀, Yellowknife, and Łutselk'e, and a technical scoping session in Yellowknife (Section 4);
- previous and on-going engagement with communities involved in the Ekati Mine;
- local and traditional knowledge obtained from existing studies (Section 13.2.3);

- scientific knowledge and experience with other mines in the NWT; and,
- consideration of potential effects identified from the Terms of Reference (Appendix 1A).

Preparation and construction, operation, and closure of the Project will result in changes to the existing environment with potential effects on wildlife. The Project components and associated activities that could potentially affect wildlife are the following:

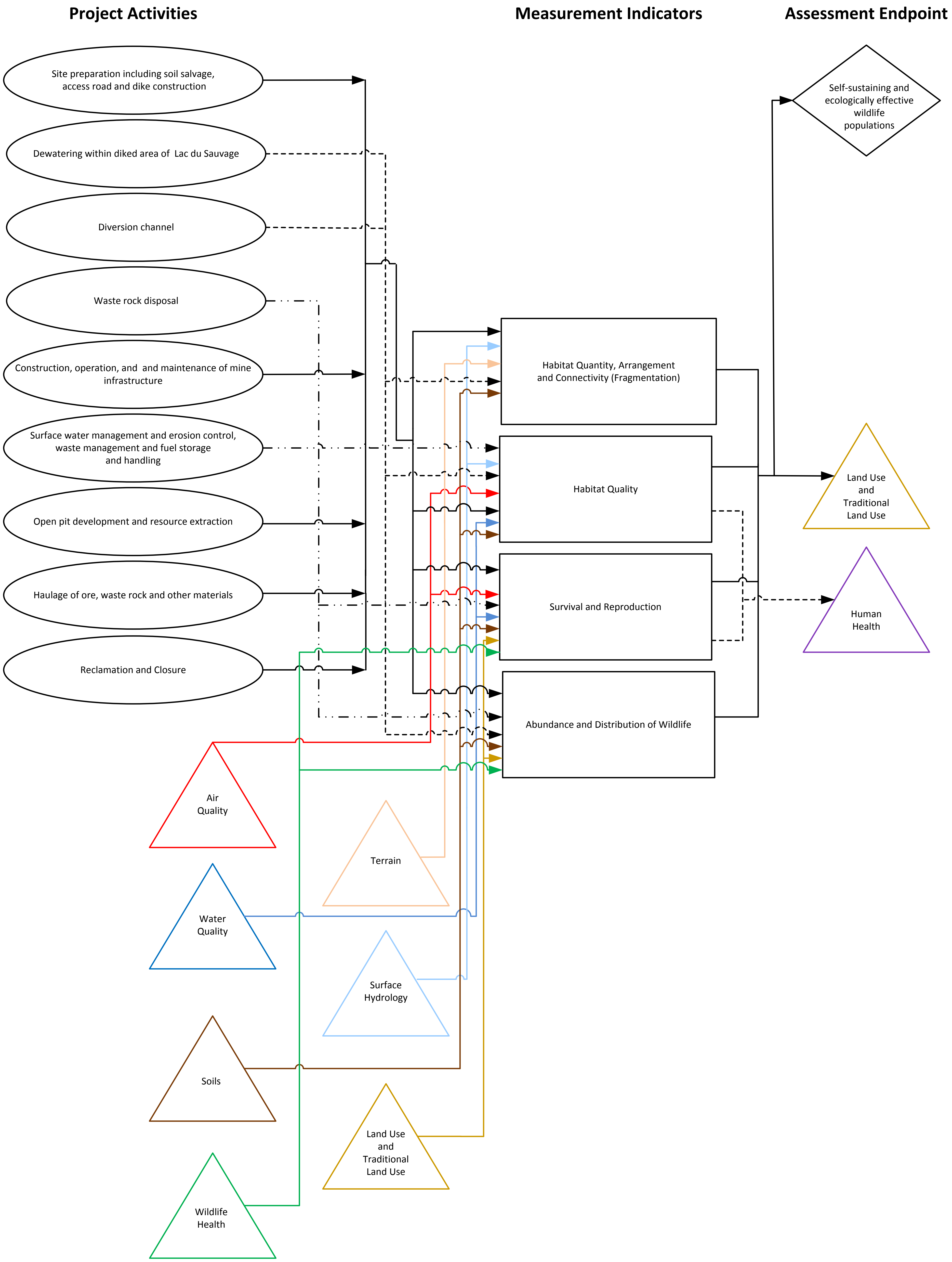
- roads, pipelines, and power lines to Lac du Sauvage;
- continued use of Misery Road;
- quarrying of granite rock for construction material;
- diversion of a small drainage area on the northwest shore of Lac du Sauvage (Sub-Basin B Diversion Channel) to direct the Christine Lake outflow south around the dike into the main basin of Lac du Sauvage;
- Lac du Sauvage pumping stations for initial dewatering and ongoing operational pumping;
- open-pit mining of the Jay Pit;
- Jay waste rock storage area;
- processed kimberlite deposition;
- continued use of Ekati main camp, processing plant, airstrip, and all other related facilities;
- fuel and material management; and
- reclamation of the Jay Project (re-established surface flows, dike breaching, and other activities).

These Project-environment interactions (or linkages) can generate effects on wildlife VCs. For an effect to occur there has to be a source (Project component or activity) that results in a measurable change to the environment (pathway or measurement indicator) and a corresponding effect on the VC.

Project Activity → **Change in Environment** → **Effect on VC**

Project components and activities that are linked to changes in measurement indicators are illustrated as ovals in Figure 13.3-1. Effects from the Project on other disciplines that can influence measurement indicators for wildlife are shown as triangles on the left side of the figure (e.g., air quality, hydrology, water quality, vegetation). Similarly, changes to wildlife and wildlife habitat can affect other disciplines such as land use and traditional land use (shown as triangles on the right side of Figure 13.3-1). Ultimately, changes in measurement indicators can have an effect on the assessment endpoint for wildlife VCs (represented by the diamond).

Figure 13.3-1: Linkage Diagram Identifying Potential Effects on Wildlife Populations



Note: Ovals represent Project activities, rectangles represent measurement indicators, triangles represent connections to and from other disciplines, and the diamond represents the assessment endpoint.

A key aspect of the pathway analysis is to identify environmental design features and mitigation that can reduce or eliminate potential effects of the Project to VCs, including appropriate application of the precautionary principle (Section 6.1.2). Environmental design features include engineering design elements, environmental best practices, management policies and procedures, and spill response and emergency contingency plans. Environmental design features and mitigation were developed as an integral part of the Project's design through an iterative process between the Project's engineering and environmental teams to avoid or mitigate adverse effects identified by the pathways analysis.

After applying environmental design features and mitigation, a screening-level analysis is used to determine the existence and magnitude of linkages from the initial list of potential effects pathways for the 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 VCs. Pathways are determined to be primary, secondary (minor), or as having no linkage using scientific, local, and traditional knowledge, logic, and experience with similar developments and environmental design features and mitigation. Each potential pathway is assessed and described as follows:

- **no linkage –** analysis of the potential pathway reveals that there is no linkage or the pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable environmental change and would therefore have no residual effect on VCs relative to the Base Case; or,
- **secondary –** pathway could result in a measurable minor environmental change, but would have a negligible residual effect on VCs relative to the Base Case and is not expected to contribute to effects of other existing, approved, or reasonably foreseeable projects to cause a significant effect; or,
- **primary –** pathway is likely to result in environmental change that could contribute to residual effects on VCs relative to the Base Case.

Pathways with no linkage to wildlife VCs are not assessed further because environmental design features or mitigation will remove the pathway. Pathways that are assessed to be secondary and demonstrated to have a negligible residual effect on VCs through simple qualitative or semi-quantitative evaluation of the pathway are also not advanced for further assessment. In summary, pathways determined to have no linkage to wildlife VCs or those that are considered secondary are not expected to result in environmentally significant effects to self-sustaining and ecologically effective wildlife populations. Primary pathways require further evaluation through more detailed quantitative and qualitative effects analysis (Section 13.4).

13.3.2 Results

13.3.2.1 *Review of Mitigation Effectiveness*

13.3.2.1.1 *Non-Vehicle Wildlife Incidents and Mortalities*

The effectiveness of mitigation efforts to reduce wildlife conflicts with the mine can vary. For example, the chain-link fence around the Misery camp designed to reduce the presence of wildlife in the camp area is only effective if the gates are kept closed and if the fence is maintained in good repair. Once an animal gains entrance, the chain-link fence makes removal more difficult.

13.3.2.1.2 *Vehicle or Aircraft Collisions*

Vehicle Collisions on Mine Roads

Mitigation efforts to limit vehicle-wildlife collisions include speed limits and radio communication of wildlife presence. Radio communications regarding the presence of wildlife are the most effective mitigation for limiting wildlife-vehicle collisions. Eleven animals (10 fox and 1 wolf) have been reported as killed by vehicle collisions on the Ekati Mine site since 1998. This is an average of less than one animal per year.

A wildlife right-of-way policy is in place at the Ekati Mine and all drivers are informed of this policy. Wildlife sightings are reported to technicians at the Ekati Environment Department who investigate and manage wildlife interactions for the safety of wildlife and people. Training is an important component of on-site mitigation and workers are instructed on wildlife communications. Continual improvement of wildlife-vehicle interactions is pursued at the Ekati Mine to reduce risks to people, wildlife, and the environment.

Vehicle Collisions on the Tibbitt to Contwoyto Winter Road

Mitigation implemented for commercial traffic on the Tibbitt to Contwoyto Winter Road (TCWR) involves speed limits, communication between drivers of wildlife presence, and regular security patrols. Drivers observing wildlife incidents are encouraged to contact ENR directly. Mitigation on the winter road appears to be effective. Traffic volumes on the winter road have ranged from 3,506 to 10,922 trucks per operating period and yet only 13 road-related wildlife mortalities have been reported along the TCWR from 1996 to early winter 2014 (Near 2014a).

13.3.2.1.3 *Waste Management*

Implementation of waste management and wildlife mitigation plans have been effective at limiting the risks of injury and death to wildlife at diamond mines in the NWT. Fifteen animals were intentionally destroyed at the Ekati Mine from 1997 to 2002 (Table 13.2-2). No animals were intentionally destroyed at the Ekati Mine in 2003 and 2004. Nine animals were intentionally destroyed at the Ekati Mine from 2005 to 2009, and no animals have been intentionally destroyed since 2009 (Table 13.2-2). Only one animal has been intentionally destroyed at the Snap Lake Mine from 1999 to 2013 (Table 13.2-2). One grizzly bear and one wolverine were intentionally destroyed at the Diavik Mine from 1996 to 2004, and no animals have been intentionally destroyed at the Diavik Mine since 2004 (Table 13.2-2). Continual improvement of waste management practices is pursued at the Ekati Mine to reduce risks to people, the environment, and wildlife (ERM Rescan 2014a).

Employee education and awareness training on the importance of proper waste management is conducted at the Ekati Mine. Managing attractants and human activity is more effective than repeatedly monitoring and deterring wildlife from the site if they become a threat. All departments are responsible for managing the waste in their work areas and separating misdirected waste before it is transported for disposal.

13.3.2.1.4 *Open Pits*

The presence of open pits may lead to wildlife injuries or deaths through the presence of steep cliffs, blasted rock, and traffic. Cliff-nesting species such as peregrine falcon (*Falco peregrinus*), rough-legged hawk (*Buteo lagopus*), gyrfalcon (*Falco rusticolus*), and raven (*Corvus corax*) are attracted to the steep-sided bench walls in the open pits. In cases where the safety of the birds is a concern (due to active mine operations), Dominion Diamond staff will actively deter wildlife from the area using bear bangers, trucks, air horns, and helicopters (ERM Rescan 2014a).

13.3.2.2 *Pathway Screening*

Project components and activities, effects pathways, and environmental design features and mitigation are summarized in Table 13.3-1. Classification of effects pathways (no linkage, secondary, primary) to wildlife VCs is also summarized in Table 13.3-1, and detailed descriptions are provided in the subsequent sections.

Table 13.3-1 Potential Pathways for Effects on Wildlife Valued Components

Project Component/ Activity	Valued Component	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
Project Infrastructure and Footprint • access roads • surface infrastructure and support facilities • power lines • open pit • mine rock storage areas • accommodations • dikes	• Grizzly Bear • Wolverine • Waterbirds • Raptors	Direct loss and fragmentation of habitat from the Project footprint may cause changes in wildlife abundance and distribution	• The Project maximizes the use of the existing infrastructure to reduce the environmental footprint to the extent practical. • The new access roads will be as narrow as feasible, while maintaining safe construction and operation practices. • Only one access road crosses the Lac du Sauvage esker. • The Jay WRSA is set back 200 m from the Lac du Sauvage esker. • The existing (Misery) and new (Jay) power lines parallel the haul roads to avoid additional fragmentation and reduce the environmental footprint • A pipe bench will be constructed to accommodate the pipelines, which will follow existing and proposed road alignments to the extent practical, to minimize the Project footprint. • Soil disturbance will be limited to only those areas required for construction and operation of the Project. • Siting and construction of the Project will be planned to avoid environmentally sensitive areas (e.g., critical wildlife habitat, listed plants and wildlife species, and wetlands) to the extent practical. • Design of the Jay Project minimizes the construction of new buildings, roads, pads, or excavations. • The existing Misery and Lynx Pits will be used for dewatering and mine water management, limiting the requirement for additional areas to be disturbed for mine water management. • Environmental monitoring programs already in place at the Ekati Mine will be extended to incorporate construction and operation of the Jay Project. • Management practices already in place at the Ekati Mine will be implemented to control erosion and sediment. • The existing Ekati Mine IRCP will be amended to include the Project. • Conditions will continue to be monitored over time to evaluate the success of the IRCP and, using adaptive management and newer proven methods as available, to adjust the IRCP, as necessary and appropriate.	Primary
	• Gray Wolf • Upland Birds			Secondary
	• Grizzly Bear • Wolverine • Gray Wolf • Upland Birds • Waterbirds • Raptors	Physical hazards (open pit, blasting, buildings, WRSAs) may result in increased risk of injury or mortality to individual animals	• The WEMP implemented at the Ekati Mine will include the Jay Project. • Site environmental technicians will investigate all wildlife incidents and mortalities, report to government, and recommend follow-up. • Wildlife will be deterred from areas of risk. • Mitigation is currently in place to minimize human-wildlife interactions, including awareness training. • Pit wall monitoring procedures for raptor nests implemented at the Ekati Mine will include the Jay Project. • Birds showing nesting activity in areas of critical risk will be actively deterred. • Animals will be deterred from entering the diked area where most fly rock will occur (until pit is too deep for escape of fly rock).	Secondary
Project Infrastructure and Footprint • access roads • surface infrastructure and support facilities • power lines • open pit • mine rock storage areas • accommodations • dikes	• Upland Birds • Waterbirds • Raptors	The Misery and Jay power lines may cause increased risk of injury or mortality to birds	• The power line will incorporate perching deterrents on poles including cone-shaped pole caps and cross arm perch preventers to prevent large birds from perching and nesting on poles or on dangerous areas around phase conductors. • Bird deterrents (e.g., spinning reflectors) will be installed on the power line in areas of concern (e.g., near waterbodies known to represent staging areas) and identified through monitoring of bird strikes along the power line.	Secondary
	• Upland Birds • Waterbirds • Raptors	Site preparation and construction may result in the destruction of nests, eggs, and individuals of migratory birds (incidental take)	• If vegetation clearing is required, activities will be managed to comply with the Species at Risk Act and the Migratory Birds Convention Act.	Secondary
General Construction and Operation Activities • mining of the kimberlite pipe • operation of surface infrastructure and support facilities • vehicle traffic along the access road	• Grizzly Bear • Wolverine • Gray Wolf • Upland Birds • Waterbirds • Raptors	Air and dust emissions and subsequent deposition can change the quantity or quality of plant forage, and subsequently prey abundance	• Regular maintenance of equipment will continue at the Ekati Mine. • Dust suppression will be applied as appropriate to roads, airstrip, and laydown areas. • Speed limits will continue to be applied to limit fugitive dust.	Secondary

Table 13.3-1 Potential Pathways for Effects on Wildlife Valued Components

Project Component/ Activity	Valued Component	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
General Construction and Operation Activities • mining of the kimberlite pipe • operation of surface infrastructure and support facilities • vehicle traffic along the access road	• Grizzly Bear • Wolverine • Gray Wolf • Upland Birds • Waterbirds • Raptors	Ingestion of water, soil, and vegetation, or inhalation of air that has been chemically altered by air emissions or dust deposition may affect wildlife health	• Water quality is monitored and managed through the Water Licence, including the WPKMP, Aquatics Effects Monitoring Program and Surveillance Network Program. Water quality discharge criteria are provided in the Water Licence, which will be extended to include the Jay Project • Spill mitigation and response plans are in effect. • The small, intermittent water pond at the landfarm is covered with flagging to prevent bird landings.	No Linkage
	• Grizzly Bear • Wolverine • Waterbirds • Raptors	Sensory disturbance (lights, smells, noise, dust, human activity, viewscape) may cause changes in wildlife habitat quality, movement and behaviour	• Use of existing surface facilities will limit the area disturbed at construction and limit the quantity of new sensory disturbances. • Only one access road crosses the Lac du Sauvage esker. • The Jay WRSA is set back 200 m from the Lac du Sauvage esker. • Kimberlite stockpile areas have been designed in strategic locations that facilitate continued mine operations through various types of road closures. • The current, effective practices and mitigations for safety of wildlife on roads, airstrip and other areas of the mine will be continued and expanded as necessary to include the Jay Project. These practices include reporting of wildlife sightings by all employees, and control of encounters by Environment staff. • A minimum flying altitude of 600 m above ground level (except during takeoff and landing and field work) will be maintained for cargo, passenger aircraft, and helicopters outside of the Project site. • Environmental sensitivity training will be provided for personnel. • The WEMP implemented at the Ekati Mine will include the Jay Project. • Wildlife always have the right-of-way. • Vehicles are restricted to designated roads and prepared work areas (recreational use of off-road vehicles is prohibited).	Primary
	• Gray Wolf • Upland Birds			Secondary
General Construction and Operation Activities • mining of the kimberlite pipe • operation of surface infrastructure and support facilities • vehicle traffic along the access road	• Grizzly Bear • Wolverine • Gray Wolf • Upland Birds • Waterbirds • Raptors	Collisions between wildlife and vehicles/aircraft causes injury or mortality of animals	• Current mitigation includes deterring and removing wildlife from the airstrip. • Speed limits are in place. • Wildlife always have the right-of-way. • Drivers have standard safety training and are provided with awareness training. • Appropriate signage is in place to identify areas of high wildlife use. • Vehicles encountering wildlife on roads are required to communicate the presence of wildlife on the roads to the Environment Department and others in the area. • Vehicles are restricted to designated roads and prepared work areas (recreational use of off-road vehicles is prohibited). • The current, effective practices and mitigations for safety of wildlife on roads, airstrip and other areas of the mine will be continued and expanded as necessary to include the Jay Project. These practices include reporting of wildlife sightings by all employees, and control of encounters by Environment staff. There have been no incidents of caribou mortality caused by vehicle collisions at the Ekati Mine.	Secondary
General Construction and Operation Activities • operation of surface infrastructure and support facilities	• Grizzly Bear • Wolverine • Gray Wolf • Upland Birds • Waterbirds • Raptors	Attractants to site (food, shelter) may result in problem wildlife or disruption to predator-prey relationships	• Apply the Waste Management Plan, Landfill Management Plan, and Incinerator Management Plan. • The WEMP is implemented at the Ekati Mine and will be amended to incorporate the Jay Project; wildlife activity will be monitored at waste management areas. • The efficiency of the waste management program will be reviewed as needed and improved through adaptive management where practical. • Separate bins will be located throughout the accommodations complex, shops, and other facilities on-site for immediate sorting of domestic wastes. • Food wastes will be collected in specific bins for transport directly to the incinerator storage area for incineration. • Littering and feeding of wildlife is prohibited. • Raised, heated buildings will be skirted to prevent wildlife access to shelter under the buildings. • Education and reinforcement of proper waste management practices and issues surrounding habituation is provided to all workers and visitors to the site. • Incinerator is enclosed and camp waste is burned regularly. • Landfill sites and waste storage areas will be inspected. • A chain-link fence is maintained around Misery Camp to prevent wildlife from entering. • Wildlife are deterred from areas of risk.	Secondary
General Construction and Operation Activities • operation of surface infrastructure and support facilities	• Grizzly Bear • Wolverine	Increased traffic on the Misery Road and Jay Road, and the above-ground power line along these roads, may create barriers to carnivore and caribou movement, which may affect carnivore	• Only one access road crosses the Lac du Sauvage esker. • Spatially and temporally staged monitoring of Bathurst caribou herd to track migratory movements via (i) satellite radiocollars, and (ii) road surveys (i.e., advanced information on approaching caribou).	Primary
	• Gray Wolf			Secondary

Table 13.3-1 Potential Pathways for Effects on Wildlife Valued Components

Project Component/ Activity	Valued Component	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
• vehicle traffic along the access road		population connectivity, abundance, and distribution	• Kimberlite stockpile areas have been designed in strategic locations that facilitate continued mine operations through various types of road closures. • The current, effective practices and mitigations for safety of wildlife on roads, airstrip and other areas of the mine will be continued and expanded as necessary to include the Jay Project. These practices include reporting of wildlife sightings by all employees, and control of encounters by Environment staff. • Modified traffic patterns and road closures will be used as necessary to protect caribou and people.	
Mine Rock Management	• Grizzly Bear • Wolverine • Gray Wolf • Upland Birds • Waterbirds • Raptors	Ingestion of seepage and surface runoff from WRSAs and kimberlite stockpiles or ingestion of water, soil, and vegetation that has been chemically altered by seepage and surface runoff may affect wildlife health	• Metasediment rock mined from the Jay open pit will be encapsulated within a thermally protective cover layer of granite such that metasediment is frozen into permafrost; this continues the approach successfully established at the Ekati Mine. • The existing Ekati WROMP, including seepage monitoring, will be expanded to include the Jay WRSA. • Thermistors will be installed within the mine rock piles to monitor permafrost. • Mine rock used to construct the dikes will be non-potentially acid generating (non-PAG). • The WRSA will include a basal layer of non-PAG granite that enhances permafrost aggradation and physically separates potentially reactive materials to prevent drainage with low pH.	No Linkage
Mine Rock Management		Surface run-off and seepage from the WRSAs and kimberlite stockpiles may change habitat quality		No Linkage
Site Water Management • dewatering of diked area of Lac du Sauvage • diversions	• Grizzly Bear • Wolverine • Gray Wolf • Upland Birds • Waterbirds • Raptors	Changes in surface flows (e.g., isolation and diversion, altered drainage patterns) and water levels from the dewatering of the diked area of Lac du Sauvage alters riparian habitat	• Where practical, natural drainage patterns will be unaltered to reduce the use of ditches or diversion berms. • The diversion channel that will be constructed at the Christine Lake outflow (Sub-Basin B Diversion Channel) will be reclaimed so that water flows through the natural drainage pattern to Lac du Sauvage. • Culverts will be installed along site access roads, as necessary, to maintain drainage. • The road route alignment will minimize stream crossings and limit disturbance to sensitive habitat as feasible.	No Linkage
Site Water Management • dewatering of diked area of Lac du Sauvage • diversions		Changes in surface flows (e.g., isolation and diversion, altered drainage patterns) and water levels may alter water quality (e.g., suspended sediments, metals, and nutrients) and affect the quality of riparian habitat	• The Sub-Basin B diversion channel will be designed to manage flows and minimize potential for erosion and bank instability. • Dewatering and operational discharges will be monitored for downstream erosion and actions will be taken to prevent erosion in downstream lakes and channels • Water quality monitoring for total suspended solids will be completed during the dewatering period. • Standard erosion and sediment control measures (e.g., silt curtains, runoff management) will also be used during construction around areas to be disturbed, where appropriate.	No Linkage
	• Waterbirds	Nets set for the fishout of the diked area of Lac du Sauvage before dewatering may increase risk of injury or mortality to loons and other diving bird species	• Established risk mitigation practices will be taken to reduce risk of mortalities of loons from nets based on experience at the Ekati Mine and other recent northern fish-out projects .	Secondary
Site Water Management • dewatering of diked area of Lac du Sauvage • diversions	• Grizzly Bear • Wolverine • Gray Wolf • Upland Birds • Waterbirds • Raptors	Dewatering of diked area of Lac du Sauvage may result in newly established vegetation on exposed lakebed sediments and change wildlife habitat quantity	• None possible, these changes will be temporary (during mine operations only).	Secondary
Site Water Management • dewatering of diked area of Lac du Sauvage • diversions	• Grizzly Bear • Wolverine • Gray Wolf	Injury or mortality to animals from being trapped in exposed lakebed sediments	• By design, the dewatered portion of Lac du Sauvage will be contained within the Jay dike	No Linkage
General Closure and Decommissioning Activities • back-flooding of Jay Pit • seepage	• Grizzly Bear • Wolverine • Gray Wolf • Upland Birds • Waterbirds • Raptors	Changes in surface flows (e.g., isolation and diversion, altered drainage patterns) and water levels from the back-flooding of diked area of Lac du Sauvage alters riparian habitat	• The existing ICRP will be expanded to include the Jay Project. • Dike breaching and re-flooding of the dewatered area will be done in a controlled manner so water levels will be equalized on both sides of the dike and back-flooding will be managed to avoid adverse effects to source waterbodies and downstream. • Water quality monitoring for total suspended solids will be completed during the back-flooding period. • During excavation of dike breaches, silt curtains and other sediment and turbidity mitigation will be used as appropriate. • Reclamation of shoreline and shallow areas within the diked area will include localized repair of erosion and revegetation with aquatic and riparian plants, as necessary.	No Linkage
	• Grizzly Bear • Wolverine • Gray Wolf • Upland Birds • Waterbirds	Ingestion of seepage and surface runoff from WRSAs after closure or ingestion of water, soil, and vegetation that has been chemically altered by long-term seepage and surface runoff may affect wildlife health	• Following established Ekati WRSA practices, PAG metasediment rock will be encapsulated within a thermally protective cover layer of granite to facilitate permafrost development. • The existing Ekati WROMP, including seepage monitoring, will be expanded to include the Jay WRSA. • Thermistors will be installed within the mine rock piles to monitor permafrost.	No Linkage
		Long-term seepage from the WRSAs may change		No Linkage

Table 13.3-1 Potential Pathways for Effects on Wildlife Valued Components

Project Component/ Activity	Valued Component	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
	• Raptors	habitat quality		
Accidents and Malfunctions	• Grizzly Bear • Wolverine • Gray Wolf • Upland Birds • Waterbirds • Raptors	Ingestion of soil, vegetation, or water than has been altered by chemical spills (i.e., fuels, petroleum products, reagents, pipelines) on site can affect wildlife health	• The existing Spill Contingency Plan in place for the Ekati Mine will be expanded to include the Jay Project. • Regular equipment maintenance (e.g., regular checks for leaks) will continue. • Drip trays and/or absorbent pads are used during servicing and refuelling. • Hazardous substances are stored and handled on site in accordance with applicable regulations. • Fuel is stored at a central bulk fuel farm at the Ekati main camp and at satellite fuel farms located at Misery, Fox, and Koala North. Fuel tanks are housed within bermed areas. • The Project will follow Ekati's standard policies in the event of a spill; spill response training is provided and updated. • Soil and snow affected by hydrocarbon spills will continue to be handled in accordance with the existing Hydrocarbon-impacted Materials Management Plan and soil will be remediated in the landfarm or shipped off-site. • Dewatering and mine water management in the WPKMP will include the pipelines used for ongoing water management of the Jay Pit. • Mine water and fine processed kimberlite slurry pipelines will be monitored and inspected throughout construction (i.e., dewatering of diked area), operations, and closure. Additional mitigation will be applied, if required. • Any leaks or spills identified along the pipelines will be addressed and clean-up, if required, will be implemented following the existing Spill Contingency Plan.	No Linkage

WRSA = Waste Rock Storage Area; ICRP = Interim Closure and Reclamation Plan; WRKMP = Wastewater and Processed Kimberlite Management Plan; WROMP = Waste Rock and Ore Storage Management Plan; PAG = potential acid generating; non-PAG= non-potentially acid generating; km/h = kilometres per hour; m = metre.

13.3.2.2.1 *Pathways With No Linkage*

A pathway may have no linkage to environmental effects if the activity does not occur, or if the pathway is removed by mitigation or environmental design features so that the Project results in no measurable change in measurement indicators. Subsequently, no residual effect to wildlife is expected. The pathways described in the following bullets have no linkage to wildlife and are not carried forward in the assessment.

- Ingestion of water, soil, and vegetation, or inhalation of air that has been chemically altered by air emissions or dust deposition may affect wildlife health.
- Ingestion of seepage and surface runoff from WRSAs and kimberlite stockpiles, or ingestion of water, soil, and vegetation that has been chemically altered by seepage and surface runoff may affect wildlife health.
- Ingestion of seepage and surface runoff from WRSAs after closure, or ingestion of water, soil, and vegetation that has been chemically altered by long-term seepage and surface runoff may affect wildlife health.

Members from the KIA, YKDFN, and NSMA have expressed concerns about effects of dust on wildlife, particularly the amount of sand that has been observed inside ducks' stomachs (Section 13.2.3). Concern has also been voiced regarding how contaminants on dust could travel through the food chain and affect other wildlife.

Surface runoff, seepage, and long-term seepage from waste rock can change groundwater and surface water. Changes to groundwater and surface water can affect soil quality. Acid rock drainage and metal leaching can result from chemical weathering of minerals present in rock exposed during construction and mining. Metasedimentary and diabase rock are considered potentially acid generating because they contain trace amounts of sulphide minerals. Approximately 25% of waste rock from the Jay Pit will be metasedimentary, with minor amounts of diabase (Section 3.2.2). The remaining 75% of waste rock from the Jay Pit will be granite, which is non-potentially acid generating (non-PAG) and non-metal leaching.

Waste rock from the Jay Pit will be stored in the new Jay WRSA. The existing Ekati Waste Rock and Ore Storage Management Plan (WROMP) will be expanded to incorporate the Jay WRSA. Seepage quality will be monitored and reported to the Wek'èezhìi Land and Water Board as part of the requirements set out in the Water Licence. The Jay WRSA will be constructed following existing WRSA practices to facilitate permafrost development. Any potentially acid-generating waste rock removed from the Jay Pit will be encapsulated for closure within a thermally-protective cover of non-PAG material (in this case 5 m of granite rock). The WRSA will be stabilized according to the methods described in the Ekati Mine ICRP and will focus on providing a thermally protective surface cover over PAG materials, providing a relatively flat upper surface that discourages snow accumulation, and providing for wildlife safety through caribou emergency egress ramps. The WRSA will then be monitored for long-term thermal performance as part of existing monitoring programs under the WROMP and Interim Closure and Reclamation Plan (ICRP).

The Panda and Koala open pits are the primary deposition locations for processed kimberlite resulting from the Project (Section 3.5.6). The use of mined-out open pits for processed kimberlite deposition has generally been acknowledged as a preferred approach as outlined in the original Environmental Assessment in 1995 (Section 3.5.6).

Overall, leaching of PAG mine rock and release of seepage and surface water runoff from the WRSA and kimberlite storage facilities, and long-term seepage from the WRSA is not expected to result in a measurable change to wildlife health. Dominion Diamond plans to complete an ecological risk assessment to further demonstrate that there will be no adverse effects on wildlife population health associated with exposure to chemicals from the Project. Sources that will be considered in the assessment include fugitive dust, air emissions, surface water runoff, seepage from facilities, and discharge. Potential exposure pathways will include changes in air, water, soil, and vegetation quality, as well as bioaccumulation of chemicals. A similar risk assessment for the Gahcho Kué Project determined that there would be no impact to carnivores and breeding birds (De Beers 2012). Based on these results, it is predicted that the Project will have no influence on the health of wildlife populations. Furthermore, this prediction will be verified with the completion of the ecological risk assessment for the Project during the Environmental Assessment Review process.

- Ingestion of soil, vegetation, or water that has been chemically altered by chemical spills (e.g., fuel, reagents, pipelines) on site can affect wildlife health.

Accidental spills from equipment, storage areas and pipelines could affect wildlife health. Water will be transferred between mine water management areas via pumping and pipeline systems. Mitigations and management identified in Ekati's existing WPKMP and environmental design features will be in place to limit the potential for pipeline failure. The integrity and performance of the pumping and pipeline systems will be monitored throughout the Project construction and operations phases to prevent the unintentional release of mine water to the environment. If any leaks or spills occur, clean-up will follow existing procedures in place at the Ekati Mine.

Chemical spills have not been reported as the cause of wildlife mortality at the Ekati, Diavik, Jericho, or Snap Lake mines (Tahera 2007; Golder 2013a,b, 2014; ERM Rescan 2014a;). Large ruptures or leaks in pipelines have also not been observed. Chemical spills are usually small and localized, and are quickly reported and managed. The implementation of proven mitigation practices identified in the existing Spill Contingency Plan, WPKMP, and environmental design features is expected to result in no measurable change to the health of wildlife from this pathway.

- Changes in surface flows (e.g., isolation and diversion, altered drainage patterns) and water levels from the dewatering of the diked area of Lac du Sauvage alters riparian habitat.
- Changes in surface flows (e.g., isolation and diversion, altered drainage patterns) and water levels from the back-flooding of the diked area of Lac du Sauvage alters riparian habitat.

Dewatering of the diked area of Lac du Sauvage and diversion of flows from tributaries that flow into this area are required for the Project. The location of the proposed Jay Pit currently receives runoff from Sub-Basin B and a small portion of the Lac du Sauvage main watershed. To divert water away from the proposed Jay Pit, the Sub-Basin B Diversion Channel will be constructed to divert water to Lac du Sauvage outside the dewatered area. Changes in water levels in Lac du Sauvage beyond the natural range of variation could lead to a loss of soils through erosion, and could change the quantity and quality of wetland riparian vegetation (Section 11.3.2.2), which would change associated wildlife habitat. Changes in inflows and outflows (e.g., altered drainage patterns, flow velocities) from alteration in water levels in Lac du Sauvage could also affect riparian vegetation downstream.

Wetland and riparian vegetation distribution is a result of water regime and plant species tolerance to flooding and saturation (Casanova and Brock 2000; Odland and del Moral 2002). Natural water fluctuations result in cyclic vegetation changes. Alternating wet and dry patterns determine plant establishment and composition by stimulating or inhibiting germination of seeds in the soil seed bank (Casanova and Brock 2000); water depth is the primary influence on seed bank composition (Lu et al. 2010). Prolonged flooding or drying eliminates some plant species while favouring others because of changes in soil oxygen levels, nutrients, and species tolerance to saturated or dry soil conditions (Casanova and Brock 2000).

A change in water levels would alter the distribution of vegetation in wetlands, riparian areas, and in adjacent upland areas in relation to the changes in soil moisture (Nilsson and Svedmark 2002; Odland and del Moral 2002; Shafroth et al. 2002; Leyer 2005). As soil moisture levels change, plant species that thrive in drier soil moisture regimes can out-compete riparian species that rely on fluctuations in soil moisture (Shafroth et al. 2002; Leyer 2005).

Dewatering of the diked area in Lac du Sauvage is expected to temporarily increase the lake water level and outflow. During construction, the largest changes to Lac du Sauvage would result from dewatering discharge. The dewatering phase modelling predicts an increase of up to 0.05 m in the water level in Lac du Sauvage compared to median baseline conditions, and an increase in the 2-year daily peak flood discharge of approximately 10% compared to baseline conditions (Section 8.5.3.2). Discharge flow rates will be managed to reduce the potential soil loss through erosion and associated changes to riparian habitat.

At closure, the back-flooding of the Jay Pit is predicted to result in a decrease in Lac du Sauvage water levels of up to 0.06 m (Section 8.5.3.2). Back-flooding will be managed to minimize adverse effects in source waterbodies and downstream. Following back-flooding of the Jay Pit, baseline water levels in Lac du Sauvage are anticipated to be re-established. The riparian (shoreline) and littoral (shallow) areas around the perimeter of Lac du Sauvage at the re-established water elevation will be reclaimed where necessary to enable natural regrowth of riparian and aquatic vegetation. The reclamation work is expected to include localized repair of erosion, and re-vegetation of select areas with aquatic and riparian plants as necessary. This work will be based on experience gained through reclamation research of riparian areas and operations and closure of other areas of the Ekati Mine.

The cumulative effects from overlapping activities for the Ekati and Diavik mines are within the Lac de Gras watershed downstream of the Lac du Sauvage sub-basin. Negligible effects to surface hydrology from Ekati Mine closure and Diavik Mine operational and closure activities are expected for Lac du Sauvage. Based on modelling results, the maximum annual change to the average Lac du Sauvage mean discharge is predicted to be less than 0.02% and the maximum annual change to the Lac du Sauvage mean water levels are predicted to be less than 0.001 m for the period of 2016 to 2037 (Section 8.5.3.3).

The largest cumulative increase in Lac de Gras outlet flows predicted is during Project dewatering and the back-flooding of the Fox Pit, and Diavik operational activities during 2019. Modelling results predicted a less than 1% cumulative increase in the mean annual discharge and a 0.001 m cumulative increase in the mean annual water levels as compared to baseline conditions (Section 8.5.3.3). The largest cumulative decrease in Lac de Gras outlet flows is predicted to occur during the back-flooding of the diked area in Lac du Sauvage in 2032. Modelling results predicted a 5% cumulative reduction in the mean annual discharge and a 0.04 m cumulative reduction in the mean annual water levels as compared to baseline conditions (Section 8.5.3.3). Cumulative effects to Lac de Gras outlet flows and water levels in an average climate year are within the range of natural variability.

Environmental design features and mitigation will be implemented to limit loss of soils through erosion and to reduce the changes in the quantity and composition of wetland and riparian plant communities from dewatering and back-flooding the diked area in Lac du Sauvage. Lac du Sauvage water levels and Lac du Sauvage outflow discharges will be monitored, and pit back-flooding rates may be adjusted during low water years. Cumulative changes in Lac du Sauvage and Lac de Gras are predicted to be temporary and within the range of natural variability. Minor changes in soil moisture distribution, and composition and abundance of riparian vegetation are expected (Section 11.3.2.2). These minor and localized alterations in riparian vegetation composition and distribution are predicted to result in no measurable changes to the abundance and distribution of wildlife VCs. Therefore, these pathways were determined to have no linkage to effects on wildlife populations.

- Changes in surface flows (e.g., isolation and diversion, altered drainage patterns) and water levels may alter water quality (e.g., suspended sediments, metals, and nutrients) and affect the quality of riparian habitat.

Construction and operation of the Project may change surface flows and lake levels, which can change the water directly through altered chemistry or indirectly through change in biogeochemical processes. Water quality changes from alterations in surface flows and lake levels may lead to the deposition and accumulation of sediments, metals, and nutrients onto soils adjacent to receiving waterbodies, thereby affecting soil quality. Changes in soil quality can influence soil nutrient cycling, microbial communities, and the bioavailability of metals for plant uptake (Ewing and Singer 2012; Pan 2012; Violante et al. 2012), which can therefore affect wildlife habitat quality.

Runoff and surface flows will be managed as part of dewatering and mine water management in the Mine Water Management Plan to limit introduction of sediment into receiving waterbodies. Where practical, natural drainage courses will be used to reduce the need for constructed ditches and diversion berms. Existing erosion and sediment control practices (e.g., silt curtains) already in place at the Ekati Mine will be implemented to limit the generation of sediments, metals, and nutrients that can cause changes in surface water quality. To reduce the potential for erosion in channels or backwatering due to higher than normal water flows and levels, natural drainage courses will be surveyed to evaluate capacity, and then modified, if required.

Water quality monitoring will occur during the Project and water will not be released to the surrounding environment unless it meets discharge criteria. Areas of exposed soils may require localized repair of erosion and re-vegetation to stabilize and prevent erosion (BHP Billiton 2011). This work will be based on experience gained through operations and closure of other areas of the Ekati Mine, and is summarized in the ICRP.

It is anticipated that implementing environmental design features and mitigation will result in minor changes to water quality and would cause minor and local changes to soil and vegetation quality. The minor alterations to water, soil, and vegetation quality are not anticipated to cause measurable changes to the abundance and distribution of wildlife VCs. Therefore, this pathway was considered to have no linkage to residual effects on wildlife VCs.

- Surface runoff and seepage from WRSAs and kimberlite stockpiles may change habitat quality.
- Long-term seepage from the WRSAs may change habitat quality.

Surface runoff and seepage from WRSAs and kimberlite stockpiles, and long-term seepage from waste rock can change groundwater, surface water and soil quality, which can affect vegetation and wildlife habitat quality. Acid rock drainage and metal leaching can result from chemical weathering of minerals present in rock exposed during construction and mining. When PAG rock is exposed to the atmosphere, oxidation of sulphide minerals can produce acidic compounds, sulphate, and metals. Metasedimentary and diabase rock are considered PAG because they contain trace amounts of sulphide minerals. Approximately 25% of waste rock from the Jay Pit will be metasedimentary, with minor amounts of diabase (Section 3.3.2). The remaining 75% of waste rock from the Jay Pit will be granite, which is non-PAG and non-metal leaching.

Waste rock from the Jay Pit will be stored in the new Jay WRSA. The existing WROMP will be expanded to incorporate the Jay WRSA. Seepage quality will be monitored and reported to the Wek'èezhìi Land and Water Board as part of the requirements set out in the Water Licence The Jay WRSA will be constructed following existing Ekati Mine practices to facilitate permafrost development. Any PAG waste rock removed from the Jay Pit will be encapsulated for closure within a thermally-protective cover of non-PAG material (in this case, 5 m of granite rock). The Jay WRSA will be stabilized according to the methods described in the ICRP and will focus on providing a thermally protective surface cover over PAG materials, providing a relatively flat upper surface that discourages snow accumulation, and providing for wildlife safety through caribou emergency egress ramps. The WRSA will be monitored for long-term thermal performance as part of existing monitoring programs under the WROMP and ICRP.

The Panda and Koala open pits are the primary deposition locations for processed kimberlite resulting from the Project (Section 3.5.6). The use of mined-out open pits for processed kimberlite deposition has generally been acknowledged as a preferred approach as outlined in the original Environmental Assessment in 1995 (Section 3.5.6).

Changes to groundwater, surface water, and soil quality from surface runoff, seepage, and long-term seepage from leaching of PAG mine rock in the WRSA and from the kimberlite storage facilities is expected to be limited through the use of mitigation and Project design features. No changes to vegetation are predicted (Section 11.3.2.2). Therefore, these pathways were determined to have no linkage to wildlife VCs.

- Injury or mortality to grizzly bear, wolverine, and wolf from being trapped in exposed sediments.

A portion of Lac du Sauvage will be dewatered so that the Jay Pit can be mined. The dewatered portion of Lac du Sauvage will be contained within the Jay Pit dike. Although exposed lakebed sediments could potentially trap and cause injury or mortality to grizzly bear, wolverine, and wolf, this interaction is not expected at the Project because animals are unlikely to enter the Jay Pit dike area. The dike is anticipated to physically deflect wildlife movement, and the high amount of human activity in the dike area is likely to result in avoidance of the area by wildlife. Also, exposed lakebed sediments in the dewatered portion of Lac du Sauvage will form a hardpan crust, which will reduce the risk of wildlife getting trapped in the sediments if animals do enter the dike area. No wolf, wolverine, or grizzly bear have been killed or injured at mines in the NWT from being stuck in exposed lakebed sediments (Section 13.2.2.7). This pathway was determined to have no linkage to wildlife VCs.

13.3.2.2.2 *Secondary Pathways*

In certain cases, both a source and a pathway exist, but because the change caused by the Project is anticipated to be minor relative to Base Case values, it is expected to have a negligible residual effect on wildlife. The pathways described in the following bullets are predicted to be secondary and are not carried forward in the assessment.

- Direct loss and fragmentation of habitat from the Project footprint may cause changes in gray wolf abundance and distribution.

Wolves are considered habitat generalists but eskers provide important denning habitat (Cluff et al. 2002; McLoughlin et al. 2004; Johnson et al. 2005). According to Inuit, wolves can be caught by trapping on eskers, and can be found around creeks and rivers and on lakes (Section 13.2.3.7.2). Eskers may be a limiting factor for wolf populations in the NWT because eskers cover less than 3% of the Arctic tundra ecosystem (Cluff et al. 2002; McLoughlin et al. 2004). Previous and existing developments have removed 4.7% (258 hectares [ha]) of esker habitat in the wolf ESA, relative to the Reference Condition (Section 13.4.1.2). Approximately 119 patches of esker habitat have been removed by previous and existing developments; the mean esker patch size has decreased by 14.6% (0.8 ha) between reference and baseline conditions.

The Project is predicted to remove 0.1% (4 ha) of esker habitat, relative to the 2014 Baseline Condition in the wolf ESA. One patch of esker habitat will be added to the landscape with the development of the Project because the proposed Jay Road intersects the Misery esker (Map 13.1-2). There are no reasonably foreseeable future developments in the wolf ESA. Cumulative loss of esker habitat from the Reference Condition through the Application Case is predicted to be 4.7% (262 ha).

Habitat loss and fragmentation are predicted to result in a minor and local change in wolf abundance and distribution. The Project is predicted to remove 4 ha of esker habitat, relative to the 2014 Baseline Condition, and will create a negligible increase in esker fragmentation. As such, the Project is predicted to have a negligible effect on the gray wolf population.

- Direct loss and fragmentation of upland bird habitat from the Project footprint may cause changes in abundance and distribution.
- Sensory disturbance (lights, smells, noise, dust, viewscape) may cause changes to upland bird habitat quality and movement and behaviour.

To determine direct changes to upland breeding bird populations from the Project and other previous and existing developments in the birds ESA, the area of all terrestrial habitat disturbed by development footprints was assumed to be unavailable for upland breeding birds. For indirect changes from sensory disturbance, a 300 m buffer area was applied around the Project and previous or existing development footprints, and was also assumed to be unavailable. The buffer distance was based on a sensory disturbance distance described for passerines by Bayne et al. (2008). The assumption of no use by upland breeding birds is expected to overestimate the reduction to occupancy due to sensory disturbance because habitat that is not completely removed may continue to be used (Male and Nol 2005). Direct and indirect effects from previous and existing human developments were estimated using hypothetical development footprints when actual disturbance footprints were unavailable (Table 13.3-2).

Table 13.3-2 Hypothetical Footprints for Previous, Existing Developments in the Bird Effects Study Areas

Type of Development	Feature Type	Footprint Extent (m)
Lodge (outfitters, tourism)	Point	200
Mine	Polygon	Actual[a]
Mineral exploration	Point	500
Staging area (equipment or material storage)	Point	200
Winter road portages	Line	200
All-season road segments	Line	200

a) Delineated and digitized from remote sensing imagery.

The Project footprint is 1,132 ha and is comprised primarily of upland habitats (62.0%). Deep and shallow water cover 38.0% of the Project footprint. Data from Smith et al. (2005) were used to determine effects from habitat loss and fragmentation (direct effects) on upland breeding bird populations. From 1996 to 2003, Smith et al. (2005) surveyed sedge wetland and heath tundra plots near the Ekati Mine to record the density and diversity of upland breeding birds (i.e., upland game birds, shorebirds, and songbirds) near and far from the Ekati Mine. The maximum density of birds recorded in the study was 109.5 birds/0.25 km^2 (438.0 birds/km^2).

Heath tundra is the most abundant habitat type in the birds ESA and covers 37.3% of the area under the Reference Condition. Water (deep and shallow) is the second most common habitat type and covers 32.7% of the ESA under the Reference Condition. Heath tundra (30% to 80% bedrock), heath tundra (30% to 80% boulder), and sedge wetland cover 2.5%, 12.7%, and 2.7%, respectively. Under the Reference Condition, upland habitat (i.e., all habitats except deep water, shallow water, and disturbance) is mainly comprised of heath tundra habitat types and sedge wetland (total 83.0% of upland habitat).

Most upland habitat in the birds ESA is comprised of habitats surveyed by Smith et al. (2005) (i.e., heath tundra habitat types and sedge wetland). Upland habitat covers 3,976 km^2 and 3,933 km^2 of the birds ESA under reference and 2014 Baseline Conditions, respectively. Using the maximum bird density from Smith et al. (2005) of 438 birds/km^2 there were approximately 1,741,909 bird territories in the ESA under the Reference Condition. Previous and existing developments have directly removed 1.1% (19,105) of bird territories in the ESA, relative to the Reference Condition. The Project is predicted to remove 3,110 bird territories (change of 0.2% from 2014 baseline to Application Case). Cumulatively, there are predicted to be 22,215 bird territories removed in the study area from the Reference Condition through the Application Case (change of 1.3%).

In addition to direct habitat effects, changes to habitat quality from the Project have the potential to indirectly affect the population size and distribution of upland birds through altered movement and behaviour of individuals. Most studies have found that birds avoid human disturbance by less than or equal to 1 km. Studies at the Ekati Mine found few effects on the upland bird community within 1 km of the Ekati Mine (Smith et al. 2005), and no measurable effect on the reproductive success of Lapland longspurs nesting adjacent to roads (Male and Nol 2005). Bayne et al. (2008) detected changes in abundance within 300 m of a gas compressor station (75 to 90 A-weighted decibels [dBA]) for approximately 33% of the boreal songbirds monitored. Benitez-Lopez et al. (2010) found that most birds have lower abundance within 1 km of human infrastructure.

The area within 300 m of previous and existing development footprints is 96.5 km^2 (Table 13.3-2). Using the maximum recorded upland bird density (438 individuals/km^2; Smith et al. 2005), sensory disturbance from previous and existing developments has influenced approximately 42,267 upland bird individuals, relative to the Reference Condition. This is a 2.5% change from reference to 2014 Baseline Conditions.

The area of upland habitat within the 300 m buffer around the Project footprint is 9.8 km^2. Sensory disturbance from the Project is predicted to adversely influence approximately 4,292 upland bird individuals (0.3% from the 2014 Baseline Condition relative to the Application Case). Cumulatively, the area within 300 m of the Project and previous and existing developments in the birds ESA is 106.3 km^2. Therefore, conservatively, approximately 46,559 birds are predicted to be adversely affected due to the cumulative sensory effects from the Project and previous and existing developments (a 2.8% change from the Reference Condition relative to the Application Case). This estimate used the maximum density estimate from Smith et al. (2005) and assumed all areas within 300 m of any disturbance are not used by birds, which likely overestimates the effects.

Direct and indirect effects from the Project are anticipated to remove territories for 7,402 upland breeding bird individuals. This is approximately 0.4% of the total upland breeding bird territories that are available in the birds ESA under the 2014 Baseline Condition. Cumulative direct and indirect effects from previous and existing developments and the Project are anticipated to remove territories for 68,774 upland birds. This is a cumulative 3.9% decrease in the number of upland breeding territories relative to the Reference Condition.

In conclusion, previous and existing developments along with the Project are predicted to result in relatively minor and local changes in the number of upland breeding nesting territories in the bird ESA. As such, incremental and cumulative changes from the Project and other developments are predicted to have negligible effects on self-sustaining and ecologically effective upland breeding bird populations.

- Physical hazards (open pit, blasting, buildings, WRSAs) may result in increased risk of injury or mortality to individual animals.

The presence of physical hazards on-site may result in an increased frequency of injury or mortality to wildlife. However, the implementation of environmental design features (Table 13.3-1) and the Wildlife Effects Monitoring Program (WEMP) are expected to decrease the risk to animals from physical hazards on-site. Environmental design features and mitigation will include the following:

  - Blasting in the pit will be carefully planned and controlled to reduce the throw of materials that could harm wildlife.
  - At closure, the entire site area will be made safe for wildlife.

Wildlife deterrent actions will be also implemented by knowledgeable and trained personnel. The goal of these deterrents is to respond to wildlife situations using humane management methods in ways that will keep both humans and animals safe.

The frequency of accidental mine-related wildlife mortalities has been extremely low at existing mine sites from 1998 through 2013 (the latest reporting period). For example, the six occasions where carnivore species were accidentally destroyed at a project, and where the cause of death was clearly attributable to the mine, were a result of vehicle collisions (Section 13.2.2.7). No reported injuries or mortalities have been related to open pits, fly rock, or waste rock piles.

Monitoring results from other diamond mines in the NWT and Nunavut have documented the following mine-related mortalities of birds.

Four unidentified birds, one white-crowned sparrow, one savannah sparrow, three common redpolls, two American robins, one northern pintail, one mallard, one snow goose, three common ravens, five ptarmigan, one peregrine falcon, and one red-throated loon have been documented as mine-related mortalities at the Ekati Mine, not including vehicle collisions (Rescan 2009, 2010b, 2011, 2012a, 2013a,b; ERM Rescan 2014a). One of the sparrows died after being tangled in a telephone line, one sparrow was found dead in the Panda Diversion Channel fish box, and the red-throated loon drowned after becoming tangled in a net in Kodiak Lake. One peregrine falcon, two of the ptarmigan, and two of the common ravens died after being electrocuted by a power line. Two ptarmigan and one snow goose were killed by predators. One ptarmigan died after colliding with a wall at the Misery Camp; the northern pintail died after flying into a door on the mine site. The causes of death for the other birds were not determined.

At the Diavik Mine from 2000 to 2013, three common ravens, one red-throated loon, one Lapland longspur, six rock ptarmigan, one snowy owl, one short-eared owl, and four peregrine falcons have been reported as mine-related mortalities. One of the common ravens died of starvation resulting from a blockage caused by the ingestion of plastic, another common raven was killed after falling out of its nest, and the red-throated loon died after becoming entangled in gill nets during the 2006 A418 fishout (DDMI 2006). One of the peregrine falcons died after hitting a power line (Golder 2014a). The causes of death for the other bird species were not determined.

At the Snap Lake Mine, one American kestrel was found dead in 2004 and an unidentified raptor was found dead in 2008; the cause of death was not determined (Golder 2010b). Two unidentified songbirds were found dead in 2012 (Golder 2013). No other bird mortalities have been reported on the Snap Lake mine site from 1999 to 2012 (Golder 2013).

Although there is a potential for mortality or injury to occur, the implementation of proven successful mitigation (Section 13.3.2.1) and environmental design features, applied in context of monitoring information collected through the WEMP, are anticipated to reduce the risk to wildlife mortality from physical hazards on-site. Changes in mortality are predicted to be minor relative to Base Case conditions (Table 13.3-1). As such, mortality from physical hazards on-site is expected to have a negligible residual effect on wildlife populations.

- The Misery and Jay power lines may cause increased risk of injury or mortality to birds.

Dominion Diamond is proposing to use the power line from the Ekati central powerhouse to the Misery Operation, and extend the power line from the Misery Operation to the necessary locations for the Jay Project. The total length of the power line would be 33.5 km. The Ekati power line will be a distribution line (as opposed to transmission line). Transmission lines carry 115 kilovolts (kV) or higher to load centres, while distribution lines carry lower loads of electricity (1 to 69 kV) from the centre to peripheral users (APLIC 2012). The Ekati power line is 69 kV.

Shield wires, which protects the power line from lightning strikes, are suspected to be the cause of most bird collisions (Bevanger and Brøseth 2001) because shield wires are thinner and less visible than the conductor lines (APLIC 2012). The Ekati power line will have a shield wire and will be slightly taller (14.5 to 22.7 m) than other distribution lines, which generally have heights from 6.4 to 14.8 m (APLIC 2012). Taller power lines may increase bird collision rates, especially during bird migrations.

Birds are generally more vulnerable to collisions with transmission lines than distribution lines (Rioux et al. 2013). It has been estimated that 2.5 million to 25.6 million birds may be killed by transmission lines in Canada each year (Rioux et al. 2013). Distribution lines are conservatively estimated to kill 377,764 to 3.9 million birds per year (Rioux et al. 2013). The poor manoeuverability of waterfowl and other waterbirds (e.g., grebes, cranes) appears to increase these species vulnerability to collisions with power lines, especially when power lines are located near wetlands (Erickson et al. 2005; Calvert et al. 2013; Rioux et al. 2013). Raptors and songbirds seem to be the most vulnerable to collisions with power lines in upland areas (Erickson et al. 2005). Raptors are vulnerable to electrocution because of their large wingspan and perching behaviour (Bevanger 1998; Lehman et al. 2010). All bird groups are more vulnerable to electrocution and collisions with power lines during migration periods (Rioux et al. 2013). This may be due to flocking behaviour or inexperience of young birds (during fall migration).

The differences in the documented results of collision rates may vary among studies because power line collisions are a function of the following factors (Avery 1979; Bevanger 1995; Bevanger and Brøseth 2004; APLIC 2012):

- awareness of the presence of power lines;
- wind and weather (especially fog);
- time of day (collisions are more frequent at dawn and dusk);
- disturbance or distractions (e.g., mating);
- cable size (smaller gauge wires have higher collision rates);
- use of a shield wire to protect against lightning strikes (the shield wire is smaller in diameter and so increases collision rates);
- age of birds (increased collision frequency among juvenile birds); and,
- line location (lines near wetlands or above tree tops are more hazardous to birds).

The distribution of power from generators at the Ekati Mine to the Misery Pit complex and the Project will be provided by approximately 33.5 km of elevated line adjacent to the Misery Road and Project access road. Rioux et al. (2013) estimate that distribution lines kill an average of 0.66 to 6.8 birds per kilometre per year. These mortality rates are the average of the five lowest casualty estimates for transmission lines because data on bird mortalities from distribution lines is limited (Rioux et al. 2013). Analysis to determine a more exact bird mortality rate from distribution lines will need to be completed when additional data are available (Rioux et al. 2013). As such, the number of birds anticipated to be killed or injured by the Misery and Jay power lines per year is unknown. Monitoring of bird strikes will be completed along the Misery and Jay power lines. If areas with large numbers of bird strikes are identified during monitoring, Dominion Diamond will implement mitigation in these areas (e.g., installation of reflective spinners).

Power lines may also cause mortality from electrocution to raptors using poles as perches (Mannville 2005; Dwyer and Mannon 2007; Lehman et al. 2010). Poles that are considered high risk include three-phase designs with line intersections (taps) or specialized equipment such as transformers (Lehman et al. 2010). Electrocution from power lines has been attributed to mortality of raptors at mines in the Northwest Territories. One peregrine falcon and two raven (a functional raptor) electrocution mortalities occurred at the Ekati Mine in 2006 and 2010, respectively (Rescan 2007, 2011). A peregrine falcon death in 2012 was attributed to the bird hitting a power line on the Diavik Mine site (Golder 2014a). In 2004, a dead juvenile peregrine falcon was found underneath a power line transformer at the Diavik Mine (DDMI 2005). Assuming this mortality was from electrocution and not natural, there have been a total of five recorded raptor mortalities related to power lines in 43 mine-years at the Diavik, Ekati, Snap Lake, and Jericho mines (rate of 0.09 raptor electrocution mortalities per mine per year).

The Misery and Jay power lines will incorporate perching deterrents on poles including cone-shaped pole caps and cross arm perch preventers to prevent large birds from perching and nesting on poles or on dangerous areas around phase conductors.

The Misery and Jay power lines are anticipated to result in minor changes to bird mortality relative to Base Case conditions. The locations of the power lines and mitigation are expected to result in a negligible effect to self-sustaining and ecologically effective bird populations.

- Site preparation and construction may result in the destruction of eggs, nests, and individuals of migratory birds (incidental take).

The *Migratory Birds Convention Act* (MBCA 1994) prohibits the destruction of migratory bird nests (e.g., passerine and waterfowl) during the breeding season. Short-eared owls and their nests are protected under the SARA (2013), which prohibits the damage or destruction of the residence (e.g., nest) of one or more individuals of a species listed in Schedule 1 as endangered, threatened, or extirpated. Bird nests, eggs, and/or birds could be destroyed during construction of roads and other land-based facilities as well as during dewatering the diked area of Lac du Sauvage (i.e., flooding of downstream areas). If vegetation clearing is required, activities will be managed to comply with the *Species at Risk Act* and the *Migratory Birds Convention Act.*

Overall, it is expected that mitigation policies and practices for construction and dewatering activities will limit incidental take of migratory birds and nests. As such, this pathway is predicted to have localized and negligible residual effects on migratory bird populations.

- Air and dust emissions and subsequent deposition can change the quantity or quality of plant forage, and subsequently prey abundance.

Construction and operation of the Project will generate air emissions such as carbon monoxide (CO), oxides of sulphur (SO_x includes sulphur dioxide [SO_2]), oxides of nitrogen (NO_x), particulate matter ($PM_{2.5}$), and total suspended particulates (TSP). Air emissions such as SO_x and NO_x can result from the use of fossil fuels in generators, vehicles, machinery, and explosives. The deposition of air and dust emissions can lead to changes in soil and vegetation quality by altering soil pH and nutrient content, and soil fauna composition (Rusek and Marshall 2000; Jung et al. 2011). Changes in soil fauna can lead to changes in vegetation, as there could be alterations in rates of organic matter decomposition and nutrient cycling. Deposition of SO_x and NO_x can also lead to acidification of wetlands, which can cause changes in plant communities (Bobbink et al. 1998). Deposition of SOx and NOx can also have direct effects on plant communities (Section 11.3.2.2.2). Dust deposition can also cause chemical loading in soils and plants if dust emissions include elevated concentrations of metal particles.

Roads that are used to access the Project and the dewatered diked area in Lac du Sauvage are the main source of dust ($PM_{2.5}$ and TSP) due to the re-suspension of soil and sediment particles (Farmer 1993; Harrison et al. 2003; Peachey et al. 2009; Liu et al. 2011). Accumulation of dust (i.e., TSP deposition) may result in a local direct change on the quantity, distribution, and quality of vegetation near the Project.

During the scoping and technical sessions for the Project, Elders and the communities expressed concerns about the effects of dust on the vegetation in and around the Ekati Mine. Members of the YKDFN, NSMA, and KIA have expressed concerns about the effects of dust on wildlife, especially birds (Section 13.2.3).

Air quality modelling was completed to predict the spatial extent of air and dust emissions and deposition from the Project (Section 7.4). Modelling was completed for the Base Case and Application Case. The Base Case includes emissions from the existing Ekati Mine and the Diavik Mine (Section 7.4.1). The Application Case includes the Base Case plus emissions during a worst case operations year and provides the maximum potential effects from the Project. Assumptions were incorporated into the model to contribute to conservative estimates of emission concentrations and deposition rates.

Results of the air quality modelling indicate that the maximum ground-level concentrations of CO and SO_x, are below the Northwest Territories Ambient Air Quality Standards (GNWT-ENR 2014; Section 7.4.2.2). The maximum 1-hour and annual NO_2 concentrations are above the NWT standard in both the Base Case and Application Case. The maximum 24-hour NO_2 concentrations in the Base Case are below the NWT standard but above the standard in the Application Case. All predictions exceeding the NWT standards are confined to small areas within a few hundred metres from the edge of the Diavik Mine or Jay Pit. These higher predictions are primarily a result of mine fleet exhaust along the haul roads at the perimeters of the mine sites. The predicted concentrations decrease with distance from the edge of the mine sites.

Modelling results indicate that the maximum annual potential acidic inputs is 1.46 kiloequivalents per hectare per year (keq/ha/yr), and is associated with the boundary of the Jay Pit. The Project's maximum annual potential acidic input outside of the Project footprint is predicted to be between 0.17 keq/ha/yr to 0.5 keq/ha/yr, with values dropping below 0.17 keq/ha/yr within 1 km of the Project. The sensitivity of soils to acidification is low to medium; therefore, it is expected there will be no change to soils from acidification, and subsequently no effects on vegetation (Section 11.3.2.2.2).

The maximum annual $PM_{2.5}$ emissions resulting from the Project is 39.4 micrograms per cubic metre (µg/m^3), which is above the NWT air quality standard of 10 µg/m^3. The maximum annual TSP emissions resulting from the Project is 607 µg/m^3, which is above the annual NWT air quality standard of 60 µg/m^3. The maximum annual totals are predicted to be confined to the boundaries of the existing Ekati Mine, the Jay Pit and the Diavik Mine. The area with $PM_{2.5}$ and TSP above the annual NWT air quality standards extends no further than approximately 1 km beyond the sources. In addition, because of the conservatism used for the air quality modelling, it is expected that the actual $PM_{2.5}$ and TSP concentrations at the Project will be lower than predicted, closer to the concentrations currently measured at the Ekati Mine.

Dust on vegetation can result in a reduction of plant growth and biomass, and can alter species composition (Grantz et al. 2003). Sources of dust deposition modelled in the Application Case include blasting activities, the processing plant, activities at the open pit and other ancillary facilities, the exposed lake bed sediments, the air strip, and vehicle traffic along the mine roads (Section 7.4). The results of the air quality modelling predicted that the estimated deposition rate outside of the Project footprint is approximately 4,722 kg/ha/y. The maximum deposition that occurs would be mostly associated with the Jay Pit and haul roads. This conservative estimate is equivalent to 1.29 grams per square metre per day (g/m^2/d). Dust production and deposition would likely be higher during the non-winter period, but would occur less frequently during wet and cool conditions. Lichens and mosses that derive some of their moisture and nutrient requirements from the atmosphere can be sensitive to the effects of dust (Farmer 1993). For example, *Sphagnum* along a gravel road in the Alaskan tundra have been observed to have decreased photosynthetic rates and a decline in cover when dust deposition was 1.0 to 2.5 g/m^2/d (Farmer 1993). Although there was a decline in *Sphagnum* cover, it was replaced by more tolerant mosses such as haircap moss (*Polytrichum* spp.) and Bryum moss (*Bryum* spp.) (Farmer 1993). Auerbach et al. (1997) found that, although plant species composition may change and aboveground biomass may be reduced by dust deposition, ground cover is still maintained. Long-term monitoring at the Diavik mine indicates that dust deposition adjacent to the mine has resulted in statistically lower lichen cover and higher vascular plant species richness relative to reference plots (Golder 2014b).

The area receiving dust deposition extends no further than approximately 1 km beyond the Project footprint. This is to be expected, as in general the majority of dust tends to settle out within 1 km of ground-level sources, which are the primary sources of TSP at the Project (Everett 1980; Walker and Everett 1987; Watson et al. 1996; Meininger and Spatt 1988; Grantz et al. 2003). Environmental design features and mitigation have been incorporated into the Project to reduce potential effects from dust deposition (Table 13.3-1). For example, dust suppression will be applied as appropriate to roads, airstrip, and laydown areas and speed limits are established on all roads to reduce the production of dust. These environmental design features and mitigation, which should reduce dust deposition, have not been incorporated into the modelling; thus, the modelling results provide conservative estimates of deposition rates (Section 7.4). Because of the conservatism used for the air quality modelling, it is expected that the actual dust deposition from the Project will be lower than predicted, closer to the concentrations measured currently at the Ekati Mine. In addition, because the result represents the emissions during worst case operations year (i.e., during initial blasting of the Jay Pit), once mining activities advance, it is expected that dust will no longer be emitted outside of the Jay Pit. The amount of dust deposition will decrease substantially.

Overall, air and dust emissions and subsequent deposition are expected to result in minor changes to soil and vegetation quality. Localized alterations in plant forage quantity or quality are predicted to result in minor changes to the abundance and distribution of wildlife populations relative to Base Case conditions. Therefore, this pathway was determined to have a negligible residual effect on self-sustaining and ecologically effective wildlife populations.

- Sensory disturbance (lights, smells, noise, dust, viewscape) may cause changes in gray wolf habitat quality and movement and behaviour (and subsequent effect on den occupancy and productivity).
- Increased traffic on the Misery Road and Jay Road, as well as and the above-ground power line along these roads, may create barriers to gray wolf and caribou movement, which may affect gray wolf population connectivity, abundance, and distribution.

Wolves vary in their response to human disturbance near den sites and pups. For example, one analysis found that the probability of occupancy of a gray wolf den increased with decreasing distance to the Ekati Mine (BHP Billiton 2004). Conversely, in open tundra habitat in northern Alaska some wolves did not tolerate humans approaching within 800 m of a den and moved their pups to a secondary location (Thiel et al. 1998). Wolves generally move from their natal dens to rendezvous sites in August (Walton et al. 2001). However, wolves that have been undisturbed have successfully relocated their pups as early as June (Frame 2005). Therefore, even if wolves are disturbed soon after denning, relocation to a new site may not necessarily result in mortality of pups. Also, although wolves show den site fidelity, new dens may be established within 25 km of previous dens (Walton et al. 2001).

In the central Canadian Arctic, prey abundance may be a more important factor influencing wolf productivity than human development (Frame 2005). The Bathurst caribou herd is the main source of prey for wolves in the gray wolf ESA (Walton et al. 2001) and this herd has declined in recent years (GNWT-ENR 2014b). The decline of the Bathurst caribou herd, along with declines in other caribou herds, may have negatively affected gray wolf populations throughout the NWT (Cluff et al. 2013; Nesbitt and Adamczweski 2013). From 2005 to 2009 the number of active wolf dens in the southern portion of the Bathurst caribou herd range decreased from 17 to 1 (Nesbitt and Adamczweski 2013). This decrease coincides with the decline of the Bathurst caribou herd from 186,000 individuals in 2003 to 32,000 individuals in 2009 (GNWT-ENR 2014b). Studies in other regions have found similar trends. In Quebec and Labrador, the population of wolves that relied on the George River caribou herd declined substantially when the herd had low numbers in the 1940s (Bergerud et al. 2008).

The caribou energetics model conservatively assumed caribou would not cross the Misery and Jay roads (i.e., that the roads were a complete barrier to movement) and be required to travel using longer alternate routes to continue migration through the Lac de Gras area (Section 12.4.2.3.1). However, observations through 16-years of operations at the Ekati Mine, including camera monitoring, confirm that caribou do cross the Misery Road and other site roads. Therefore, mine roads are not acting as complete barriers to caribou (and carnivore) movements (ERM Rescan 2014b). Dominion Diamond will implement staged monitoring of the Bathurst caribou herd to track migratory movements via (i) satellite radiocollars, (ii) aerial reconnaissance surveys for caribou approaching the roads, and (iii) road surveys. The data collected during these monitoring activities will be used to test effects predictions and the success of proposed mitigation for increased traffic on the Misery and Jay roads.

Effects to wolf (and other carnivores and caribou) movement from traffic on the Misery and Jay roads will be mitigated by the following:

- modified traffic patterns and road closures will be used as necessary to protect caribou and people; and,
- stockpiling ore to provide supply for processing during road closures.

Mitigation activities are anticipated to reduce effects to caribou and wolf movements and population connectivity.

Roads with high traffic volumes may be a partial barrier to wolf movement. Alexander et al. (2005) found that crossing rates of roads by carnivores (including wolf) in Banff National Park significantly ($P \leq 0.05$) decreased when traffic volumes were greater than 300 vehicles per day. In this assessment, road trains were predicted to make 56 trips per day on the Misery and Jay roads during Project operation (Section 3.5.1.6). Sensory disturbance from increased traffic may decrease the use of habitat near these roads by wolves. However, traffic volumes are not anticipated to be high enough to result in large changes in the crossing rates by wolves.

A total of 23 gray wolf dens have been found in the wolf ESA from 1995 to 2013 (Map 13.2-19; ERM Rescan 2014a). From 1 to 7 of these dens have been occupied each year, with each den being occupied for 1 to 6 of the 18 survey years. One active wolf den was found in the Misery esker during carnivore den surveys for the Project in 2013 (Map 13.2-19). The den is located approximately 400 m west of the proposed Jay WRSA and 3 km north of the proposed Jay Road. The den in the Misery esker was found in 2006 and has been occupied for 5 of the 8 years it has been surveyed (ERM Rescan 2014a).

The Project is predicted to result in minor changes to den occupancy and productivity in the wolf ESA. Of the 23 dens that have been found in the wolf ESA, only one is likely to be affected by the Project (Misery esker den; Map 13.2-19). The close proximity of the den to the proposed Jay WRSA may lead to abandonment of this den, although wolves in the ESA have been found to den close to the Ekati Mine (BHP Billiton 2004). Wolves can develop new den sites and there are numerous other den sites in the wolf ESA that can be used. Since 1995, a maximum of seven dens in the ESA have been occupied in any given year (ERM Rescan 2014a). Traffic volumes of 56 vehicles per day along the Misery and Jay roads are anticipated to result in a minor adverse change to crossing rates by wolves relative to Base Case conditions. As such, the Project is predicted to have a negligible effect on the gray wolf population.

- Collisions between wildlife and vehicles or aircraft cause injury or mortality of animals.

There is potential for an increase in the risk of injury or death to wildlife species through collisions with aircraft, on-site vehicles, and traffic along the TCWR (Tibbitt to Contwoyto winter road). For example, 121 vehicle-related wildlife mortalities were reported from 1997 to 2013 at the Ekati Mine (ERM Rescan 2014a). Most of these mortalities were birds (42 mortalities, 32 of which were ptarmigan) or Arctic hares (54 mortalities). Aircraft collisions have only been responsible for one wildlife mortality at the Ekati, Diavik, Jericho, or Snap Lake mines (one fox at the Ekati mine in 2010) (Rescan 2011; DDMI 2013; Golder 2013a,b; ERM Rescan 2014a).

Similar to other mining operations in the region, access to the Project in the winter will be via the TCWR. From 1998 to 2007, traffic volume on the TCWR increased from 2,543 loaded trucks in 2000 to 10,922 in 2007 (Table 13.3-3; TCWR Joint Venture 2013a). Traffic volume on the TCWR decreased during 2008 through 2013 (6,071 northbound loads in 2013; TCWR Joint Venture 2013a,b).

Table 13.3-3 Operating Period and Number of North and Southbound Truck Loads on the Tibbitt to Contwoyto Winter Road, 2000 to 2013

Year	Operating Period	Number of Northbound Trucks	Number of Southbound Backhauls
2000[(a)]	January 29 to April 3	3,703	135
2001[(a)]	February 1 to April 13	7,981	201
2002[(a)]	January 26 to April 16	7,735	433
2003[(a)]	February 1 to April 2	5,243	883
2004[(a)]	January 28 to March 31	5,091	165
2005[(a)]	January 26 to April 5	7,607	243
2006[(a)]	February 5 to March 26	6,841	469
2007[(a)]	January 27 to April 9	10,922	818
2008[(a)]	January 29 to March 31	7,484	890

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Table 13.3-3 Operating Period and Number of North and Southbound Truck Loads on the Tibbitt to Contwoyto Winter Road, 2000 to 2013

Year	Operating Period	Number of Northbound Trucks	Number of Southbound Backhauls
2009[(a)]	February 1 to March 22	4,847	530
2010[(a)]	February 4 to March 24	3,506	424
2011[(a)]	January 28 to March 31	6,832	530
2012[(a)]	February 1 to March 31	6,551	648
2013[(b)]	January 30 to March 31	6,071	454

a) Source: TCWR Joint Venture (2013a).

b) Source: TCWR Joint Venture (2013b).

The predominant factors that contribute to road-related wildlife deaths are traffic volume, vehicle speed, and animal crossing speed (EBA 2001; Jaarsma et al. 2006; Litvaitis and Tash 2008). These factors directly affect the success of an animal reaching the opposite side of the road. An increase in either factor reduces the probability of an animal crossing safely (Underhill and Angold 2000). However, implementation of the winter road policy, rules, and procedures for the TCWR is anticipated to limit the potential for injury/mortality of wildlife from vehicle collisions (TCWR Joint Venture 2000). For example, from 1996 to early winter 2014, there have been 13 reported road-related wildlife mortalities along the TCWR. In 1996, a wolverine was killed by a pick-up truck (Banci 2001). In 2011, one wolverine was killed by a haul truck near Gordon Lake (Near 2014a). One wolverine was killed by a haul track in March 2013 (Near 2014a). In March 1999, five caribou were killed by a grocery (meat) truck on a portage near Gordon Lake (EBA 2001). In January 2014, two caribou were killed by a haul truck (Near 2014a). In 2009, a red fox was killed on the TCWR (Madsen 2010). In 2012, one white fox was killed by vehicle near Portage Lake and in 2013, one cross fox was killed by a haul truck near Lockhart Lake (Near 2014a,).

Mitigation strategies have been established to reduce the potential for vehicle and aircraft collisions at the Project (Table 13.3-1). These strategies are outlined in the WEMP, and are similar to management practices and policies implemented at other diamond mines in the NWT and Nunavut. The following environmental design features and mitigation are expected to limit the risk from vehicle and aircraft collisions with wildlife:

- personnel arriving at or leaving the site will be transported by bus, which will reduce the amount of traffic between the airstrip and the accommodation complex;
- all wildlife have the right-of-way;
- the Project site will be designed to limit blind spots where possible to reduce the risk of accidental wildlife-human encounters;
- speed limits will be established; and,
- drivers will be warned when wildlife are moving through an area, using signage and radio.

Based on the success of mitigation and management practices used at the Ekati Mine and other operating mines in the NWT (Section 13.3.2.1), the environmental design features and mitigation implemented for the Project are anticipated to limit wildlife mortality from vehicle or aircraft collisions relative to Base Case conditions. As such, mortality from vehicle and aircraft collisions is expected to have a negligible residual effect on wildlife populations.

- Attractants to site (food, shelter) may result in problem wildlife or disruption to predator-prey relationships.

Food smells and other aromatic compounds such as petroleum-based chemicals, grey water, and sewage can attract carnivores to human developments (Benn and Herrero 2002; Peirce and Van Daele 2006; Canadian Wildlife Service 2007; Beckmann and Lackey 2008). Members from the NSMA and KIA have voiced concerns about grizzly bears being attracted to mines because of smells (Section 13.2.3). In addition, infrastructure may also attract carnivores as it can serve as a temporary refuge to escape extreme heat or cold (Canadian Wildlife Service 2007). Corvids (e.g., crows and ravens) and raptors may also be attracted to infrastructure and anthropogenic food sources (Restani et al. 2001; Marzluff and Neatherlin 2006; Canadian Wildlife Service 2007; Kristan and Boarman 2007; Baxter and Allan 2008). For example, wildlife effects monitoring programs completed at the Ekati Mine (2000 through 2013), the Diavik Mine (2002 through 2013), the Jericho Mine (2000, 2005 through 2007), and the Snap Lake Mine (2001 through 2013) have reported attractants (e.g., non-burned food items, oil products, and food packaging) in the landfill. However, most of the animals and sign observed during these landfill surveys were foxes (Section 13.2.2.7). Grizzly bears, wolverine, and wolf tracks were occasionally observed. Attraction of carnivores and predatory birds (e.g., ravens and gulls) to the Project can increase predation pressure on prey species (e.g., passerines and waterfowl), and may cause local population declines in these prey species (Monda et al. 1994; Canadian Wildlife Service 2007; Liebezeit et al. 2009).

The attraction of wildlife to the 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 the Ekati, Diavik, Snap Lake, and Jericho mines, either by government biologists or with government permission (Section 13.2.2.7). Intentional destruction of individual animals generally followed habituation of the animal to operating mines over an extended period of time, and after multiple deterrent attempts failed with the same individual. Lessons learned from these mines have shown that diligent waste management practices and staff education can substantially decrease the frequency of attractants and the number of carnivore incidents (Section 13.3.2.1). These waste management practices are in effect at the Ekati Mine.

Environmental design features and mitigation strategies have been established to reduce the numbers of carnivores attracted to the Project (Table 13.3-1). These strategies are outlined in the WEMP, and are similar to management practices and policies implemented at other diamond mines in the NWT and Nunavut:

- Education and reinforcement of proper waste management practices to all workers and visitors to the site will be provided.
- People will be educated on the risks associated with feeding wildlife and careless disposal of food garbage.

- Separate bins will be located throughout facilities on-site for immediate sorting of domestic waste.
- Food waste will transported directly to the incinerator storage area for incineration.
- Incinerator ash from combustion of kitchen and office waste will be transported to the landfill.
- Ongoing review of the efficiency of the waste management program will continue including improvement through adaptive management.

Based on the success of mitigation and management practices used at operating mines in the NWT (Section 13.3.2.1), the environmental design features and mitigation implemented for the Project are anticipated to limit the attraction of wildlife to the site and result in minor changes in problem wildlife and predator-prey relationships relative to Base Case conditions. Subsequently, this pathway is expected to have a negligible residual effect on wildlife populations.

- Nets set for the fishout of the diked area of Lac du Sauvage before dewatering may increase risk of injury or mortality to loons and other diving bird species.

Loons and other diving bird species have the potential for injury or mortality during the fishout of the diked area of Lac du Sauvage. For example, a red-throated loon died when it became entangled in gill nets during the A418 fishout at the Diavik Mine (DDMI 2006). At the Ekati Mine, a red-throated loon drowned after becoming entangled in a net in Kodiak Lake (Rescan 2009). Loons have not been commonly observed in the Lake de Gras area. One loon was observed during baseline surveys of Lac du Sauvage in 2013 (Section 13.2.1.2.1). Surveys of 36 lakes in the BSA during mid-August from 1998 through 2001 detected 28 adult loons and 5 fledglings (BHP Billiton 2002). No loons were observed during surveys of the East and West Bays of Lac de Gras from 1996 to 2004 (DDMI 2005). These data suggest that habitat quality for loons and perhaps other diving birds is low in the BSA. As such, loons and other diving birds are not anticipated to be commonly present during fishout activities. Mortality and injury from fishout activities are predicted to have negligible residual effects on loon and other diving bird populations.

- Dewatering of the diked area of Lac du Sauvage may result in newly established vegetation on exposed lakebed sediments and change wildlife habitat quantity.

It is expected that vegetation will colonize the dried dewatered areas within the diked area, which may reduce potential for soil erosion, and result in an increase in plant communities in this area (Section 11.3.2.2). Odland and Moral (2002) found that vegetation, primarily annuals, rapidly established in areas of drawdown and was a result of the persistent seed bank present in the soil. The primary influence of plant colonization on a lake bed is the condition of the surface (e.g., moisture status, resistance to wind erosion) and proximity to the former shoreline (Ovenden 1986). Species commonly observed to colonize disturbed and drawdown areas often include the genera *Carex*, *Puccinellia*, *Arctagrostis*, *Calamagrostis*, *Epilobium*, and *Polytrichum* (Ovenden 1986; Kershaw and Kershaw 1987; Odland and Moral 2002; Hugron et al. 2011).

Establishment of vegetation in these areas has the potential to provide habitat for wildlife that access the diked area, although it is expected that wildlife would likely avoid the area during open-pit operations due to high human activity, and the dike will likely deflect wildlife from the area. During closure, back-flooding of the open pit and breaching of the dike would remove vegetation and associated wildlife habitat established during operations. Overall, the localized and temporary establishment of vegetation in the diked area during the operation of the Project is predicted to result in a minor change in habitat quantity relative to Base Case conditions, and have a negligible effect on wildlife populations.

13.3.2.2.3 *Primary Pathways*

The following primary pathways are assessed in detail in the residual effects analysis.

- Direct loss and fragmentation of wildlife habitat from the Project footprint may cause changes in abundance and distribution of grizzly bear, wolverine, waterbirds, and raptors.
- Sensory disturbance (lights, smells, noise, dust, viewscape) may cause changes to habitat quality, and the movement and behaviour of grizzly bear, wolverine, waterbirds and raptors, and influence population abundance and distribution.
- Increased traffic on the Misery Road and Jay Road, as well as the above-ground power line along these roads may create barriers to wolverine, grizzly bear, and caribou movement, which may affect wolverine and grizzly bear population connectivity, abundance, and distribution.

13.4 Residual Effects Analysis

13.4.1 General Approach

13.4.1.1 *Project Phases*

The residual effects analysis was completed for the following wildlife VCs:

- waterbirds;
- raptors;
- wolverine; and,
- grizzly bear.

The Project phases include construction, operation, and closure. Final relinquishment of the Project generally occurs after the completion of reclamation. Many effects of the Project will end when operations cease or at closure, but effects to wildlife populations will continue after Project closure.

The effects analysis encompasses the Project phases as follows:

- construction (2016 to 2019);
- operations (2019 to 2029); and,
- closure (2030 to 2033).

The above timeframes are intended to be sufficiently flexible to capture the effects of the Project on wildlife. Effects to wildlife VCs begin during the construction phase with the removal and alteration of wildlife habitat, and continue through the operation phase and for a period of time after the closure phase (unless determined to be permanent). This approach generates the maximum potential spatial and temporal extent of effects on the abundance and distribution of wildlife populations, which provides confident and ecologically relevant effects predictions.

13.4.1.2 *Assessment Cases*

The residual effects analysis consists of three cases: Base Case, Application Case (the maximum point of development of the Project [includes construction, operation, and closure]), and the Reasonably Foreseeable Development (RFD) Case (Table 13.4-1). Cumulative effects could occur in all three cases because of past, existing, and future mining and reclamation activities. The objective of the DAR is to assess cumulative effects for VCs where Project effects could overlap with effects from other developments. Therefore, incremental and cumulative effects of the Project and other developments are analyzed and assessed together in this section of the DAR.

Table 13.4-1 Contents of Each Assessment Case

Base Case		Application Case	Reasonably Foreseeable Development (RFD) Case
Reference Condition	**2014 Baseline Condition**		
No to little development	Conditions from all previous, existing, and planned approved developments before the Project.	Base Case plus the Project	Application Case plus reasonably foreseeable developments.

Base Case represents a range of conditions over time within the effects assessment study area before application of the Project. Environmental conditions on the landscape before human development, which represent the Reference Condition, were considered independently within the Base Case. The Reference Condition includes Aboriginal communities, as part of historical natural ecosystems. The Base Case describes the existing environment before the application of the Project to provide an understanding of current conditions that may be influenced by the Project. Existing (baseline) conditions include the cumulative effects from all previous and existing developments and activities that are approved, and are either under construction or not yet initiated in the effects study area (e.g., Lynx Project). The expanded WRSA for the crusher is included in the 2014 Baseline Condition because it is anticipated to be in use before Jay Project construction begins. Current (baseline studies) and effects from ongoing projects that are approved (e.g., mining and reclamation at Ekati and Diavik mines) are also included in the 2014 Baseline Condition. Previous and existing human developments also include areas of exploration activities and portages associated with winter roads.

Application Case represents predictions of the cumulative effects of the developments in the Base Case combined with the effects from the Project. Physical disturbance to soils and vegetation (wildlife habitat) is expected to occur at the beginning of construction; the effects from the Project are expected to be strongest during construction and the initial period of mining operation. The main components of the Project footprint are the proposed infrastructure (Jay Pit, Jay Waste Rock Storage Area, Ore Stockpile and Transfer Pad, Sub-Basin B Diversion Channel, and dike alignment) and Jay access roads, pipeline, and power line. The physical changes to the terrestrial environment from the Project footprint and the effects on wildlife are considered permanent because the time required to reverse the effect is uncertain. The Application Case is also used to identify the incremental changes from the Project that are predicted to occur between the Base and Application cases.

Reasonably Foreseeable Development (RFD) Case represents the Application Case and reasonably foreseeable developments. The RFD Case includes the predicted duration of residual effects from the Project, plus other previous, existing, and future projects and activities. Thus, the minimum temporal boundary for the Application Case and RFD Case is the expected lifespan of the Project that, like the Base Case, includes a range of conditions over time. The difference between the Application and RFD case is that the Application Case considers the incremental effect from the Project in isolation of potential future land use activities. The RFDs are defined as projects that:

- are currently under regulatory review or have officially entered a regulatory application process;
- have a reasonable likelihood of being initiated during the life of the Project, or may be induced by the Project; and/or,
- have the potential to change the Project or the effects predictions.

None of the reasonably foreseeable developments identified in Section 6.5.2.4 are located within the birds ESA. The closest reasonably foreseeable development is the Courageous Lake project, which is located approximately 73 km to the southwest of the Project, outside of the waterbirds and raptors ESA. Therefore, the RFD Case is not included in the waterbird and raptor sections of the DAR. A RFD Case was included in the grizzly bear and wolverine analyses because there are numerous reasonably foreseeable developments that could be constructed in the grizzly bear and wolverine ESA.

13.4.1.3 *Previous and Existing Developments*

The Aboriginal Affairs and Northern Development Canada Cumulative Impact Monitoring Program provided the development database through the Inventory of Landscape Change initiative. The dataset included all disturbances for which information was publicly and digitally available, including developments requiring a land use permit, contaminated sites, transmission lines, winter and all-season roads, communities, and mines up to the end of 2013. The database also included recent land use permit applications from the Mackenzie Valley Land and Water Board and the Nunavut Impact Review Board up to the end of 2013.

Point disturbances in the Inventory of Landscape Change originated from spreadsheet databases of land use permits (except for campgrounds, contaminated sites, mines, and parks), thus locations are not precise. While land use permits are generally issued for five-year spans, information on the duration or seasonality of activity within that five years (or if development proceeded at all) is not recorded by any agency in the NWT or Nunavut. Thus, it was conservatively assumed that all developments were active throughout the entire year for all five years following issuance, with the exception of winter roads, which were assumed to be active only in winter. Winter road portages were assumed to be permanent disturbance to the terrestrial landscape. The assumption that all developments were active throughout the entire five years of the land use permit is conservative because many of these developments (e.g., mineral exploration camps and hunting camps) are only active seasonally.

Because the Inventory of Landscape Change database does not describe the footprint of developments, the physical area of the footprint was estimated (Table 13.4-2). Actual footprints were used for mines and communities. For the spring to fall analyses, only terrestrial habitat (i.e., all habitats except open water) that occurred within the 500 m buffer around exploration activity point features was removed because exploration activities do occur in open water habitat. For winter analyses, terrestrial and open water habitats within the 500 m buffer around exploration activities were removed because exploration activities can occur on ice. For all closed mines and inactive developments, the physical footprint was carried through the entire effects analysis as it was assumed that direct disturbance to the landscape had not yet been reversed. Footprints with overlapping areas on the landscape were not counted twice.

Contaminated site information was provided by the Federal Contaminated Sites Inventory (TBCS 2013). Only sites classified as High and Medium Priority for Action were included. Sites that were classified as Low Priority for Action were considered too small to lead to measurable habitat loss or to have indirect habitat effects.

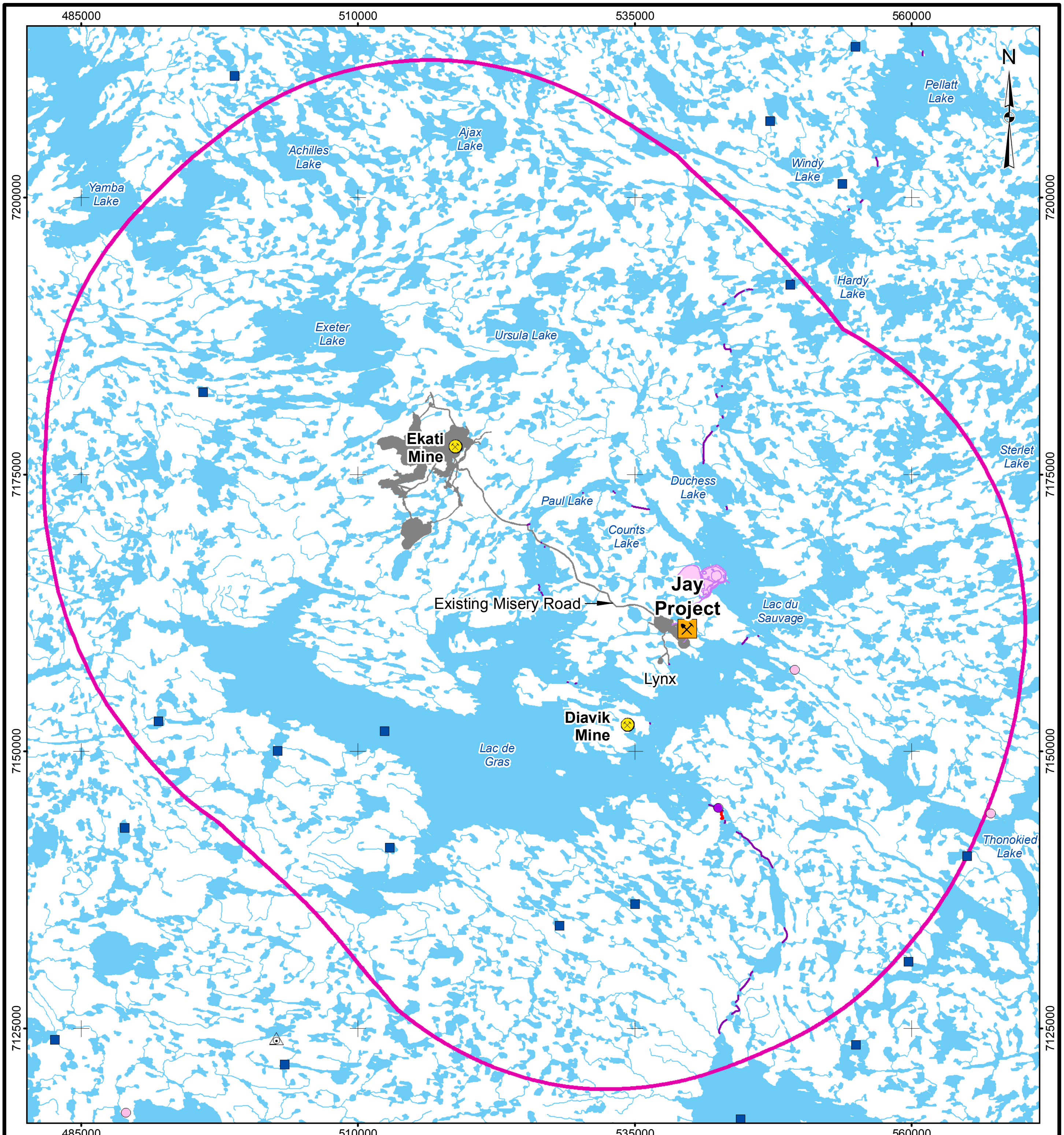
The data were examined for duplication of information. In cases where two or more pieces of location information were present for the same activity (such as a land use permit for an exploration camp and a second land use permit to expand the fuel cache), the extra information was deleted so that only one point per development was considered. For locations with more than one permit, the activity that was considered to create the largest amount of disturbance (e.g., habitat loss or sensory disturbance) was the activity that was kept in the development database.

The number and type of previous and existing developments in the birds ESA are listed in Table 13.4-3 and illustrated in Map 13.4-1. The number and type of previous, existing, and reasonably foreseeable developments in the grizzly bear and wolverine ESA are listed in Table 13.4-4, and illustrated in Map 13.4-2.

Table 13.4-2 Estimated and Hypothetical Footprints for Previous, Existing, and Reasonably Foreseeable Developments in the Effects Study Areas

Type of Development	Feature Type	Footprint Extent (m)
Campground	Point	200
Community	Polygon	Actual[a]
Communications (e.g., microwave towers)	Point	200
Fuel storage	Point	200
Contaminated Site [b] - High and Medium Priority for Action	Point	200
Lodge (outfitters, tourism)	Point	200
Mine	Polygon	Actual[a]
Mineral exploration	Point	500
Miscellaneous (e.g., bridge/culvert installation)	Point	200
Power	Point	500
Quarrying	Point	200
Staging area (equipment or material storage)	Point	200
Transmission line	Line	200
Winter road segments	Line	200
Winter road portages	Line	200
All-season road segments	Line	200
Highway segments	Line	200

a) Delineated and digitized from remote sensing imagery.
b) As defined by the Federal Contaminated Sites Inventory (TBCS 2013).
Note: Point features were buffered with a circular footprint. Linear features were buffered with a corridor (e.g., 250 m right-of-way).
m = metre.



LEGEND

	JAY PROJECT		COMMUNICATIONS
	EKATI MINE FOOTPRINT		MINE
	PROPOSED JAY FOOTPRINT		MINERAL EXPLORATION
	ALL-SEASON ROAD		STAGING AREA
	PORTAGE		TOURISM
	WATERCOURSE		
	WATERBODY		
	EFFECTS STUDY AREA		

10 0 10

SCALE 1:500,000 KILOMETRES

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

PREVIOUS AND EXISTING DEVELOPMENTS IN THE BIRDS EFFECTS STUDY AREA FOR THE 2014 BASELINE CONDITION (SPRING TO AUTUMN)

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_087_GIS
DESIGN	LD	15/07/14	SCALE AS SHOWN REV. 0
GIS	DW	03/10/14	MAP 13.4-1
CHECK	LD	03/10/14	
REVIEW	LD	03/10/14	

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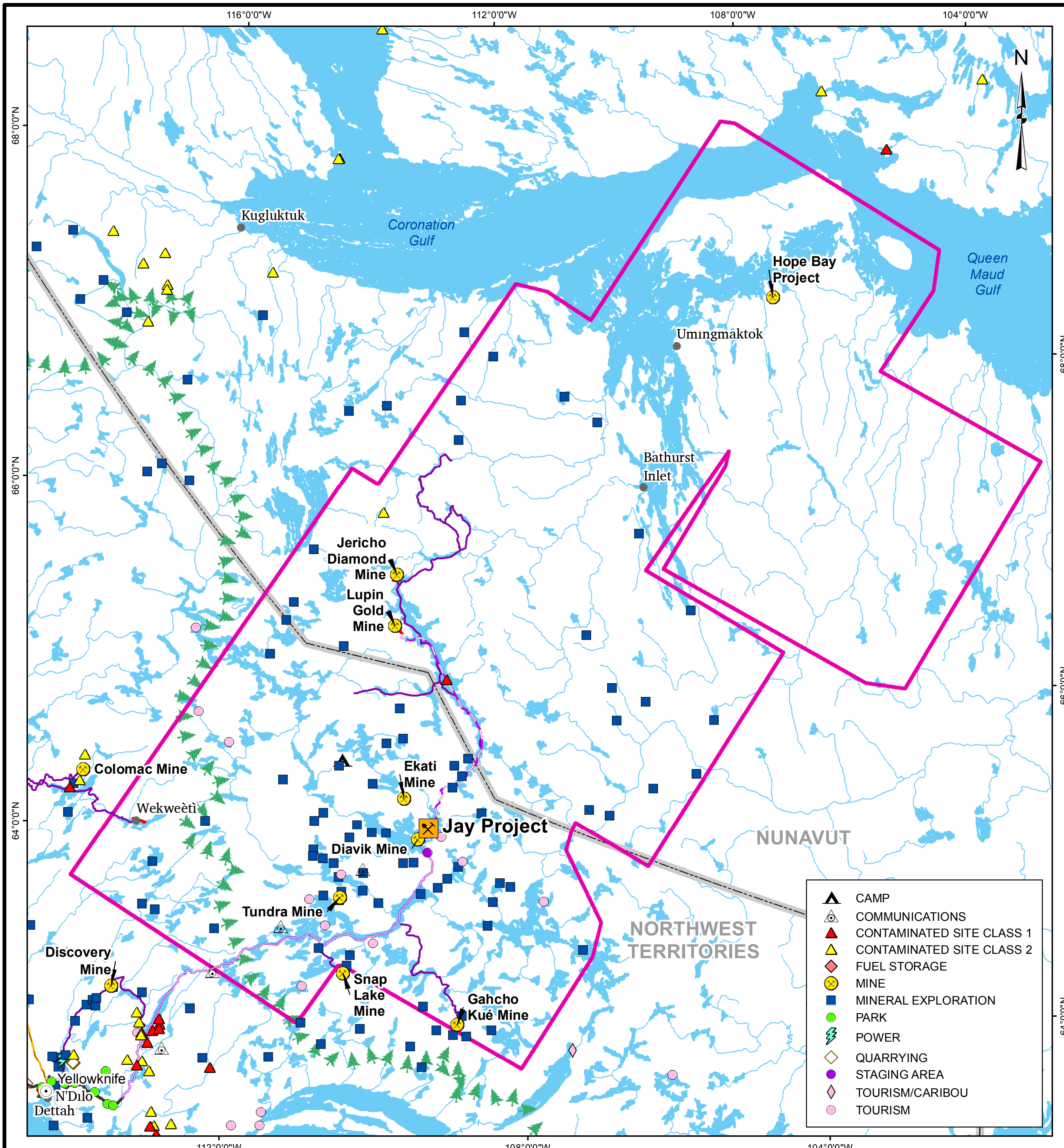

LEGEND

- JAY PROJECT
- TERRITORIAL CAPITAL
- POPULATED PLACE
- HIGHWAY
- ALL-SEASON ROAD
- WINTER ROAD
- TRANSMISSION LINE
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- TERRITORIAL/PROVINCIAL BOUNDARY
- TREELINE
- WATERCOURSE
- WATERBODY
- EFFECTS STUDY

75 0 75

SCALE 1:3,750,000 KILOMETRES

REFERENCE

WATER OBTAINED FROM ATLAS OF CANADA
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
PROJECTION: CANADA LAMBERT CONFORMAL CONIC

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

PREVIOUS AND EXISTING DEVELOPMENTS IN THE GRIZZLY BEAR AND WOLVERINE EFFECTS STUDY AREA FOR THE 2014 BASELINE CONDITION

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_088_GIS	
DESIGN	LD	15/07/14	SCALE AS SHOWN	REV. 0
GIS	DW	03/10/14	MAP 13.4-2	
CHECK	LD	03/10/14		
REVIEW	LD	03/10/14		

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Table 13.4-3 Previous and Existing Developments in the Bird Effects Study Area for the Base Case (Spring to Autumn)

Assessment Case and Type of Development	Footprint Area (ha)	Number of Active Sites	Number of Inactive Sites	Linear Feature Length (km)
All-Season Roads	348	N/A	N/A	70
Mine	4,403	2	0	N/A
Mineral Exploration	382	5	3	N/A
Winter Road Portage	60	N/A	N/A	24
Staging Area	0.2	1	0	N/A
Tourism	0.2	1	0	N/A
Total Disturbance	**5,193**	**9**	**3**	**94**

Note: Overlapping areas were merged together so the area was not counted twice.

Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

ha = hectare; km = kilometre; N/A = not applicable.

Table 13.4-4 Previous and Existing Developments in the Grizzly Bear and Wolverine Effects Study Area for the Base Case (Winter and Spring to Autumn)

Type of Development	Footprint Area (ha)	Number of Active Sites	Number of Inactive Sites	Linear Feature Length (km)
All-Season Road	1,955	N/A	N/A	96
Camp	13	1	0	N/A
Communications	26	2	0	N/A
Community	1,005	3	0	N/A
Contaminated Site[a] - High and Medium Priority for Action	13	1	0	N/A
Mine	8,718	3	3	N/A
Mineral Exploration	5,970	31	43	N/A
Portage	4,507	N/A	N/A	196
Staging Area	13	1	0	N/A
Tourism	129	10	0	N/A
Winter Road	14,335	N/A	N/A	977
Total disturbance	**36,696**	**43**	**46**	**1,269**

a) As defined by the Federal Contaminated Sites Inventory (TBCS 2013)

Note: Overlapping areas were merged together so the area was not counted twice.

Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

ha = hectare; km = kilometre; N/A = not applicable.

13.4.1.4 *Reasonably Foreseeable Future Developments*

Cumulative effects assessment should include all other human activities that substantially affect the environment, including past, present, and reasonably foreseeable future projects (MVRB 2004). Although there is uncertainty in predicting which projects proceed to development, it is a necessary exercise to investigate possible future scenarios from a cumulative effects perspective (Section 13.4.1.2).

For the purposes of this assessment, it was assumed that each of the reasonably foreseeable future projects listed below are carried forward to full development, and their effects have both spatial and temporal overlap with the Project. Note that for projects that have not yet been developed (such as the Izok Corridor Project and Back River Project), locations have been estimated from information that is publicly available. The reasonably foreseeable future projects have been categorized into three tiers, reflecting the level of project information available, status within the regulatory process, and anticipated development schedule. Descriptions of reasonably foreseeable developments are provided in Section 6.5.2.4.

Tier 1 Developments

Tier 1 developments were considered as part of the Base Case (2014 Baseline Condition). That is, an environmental assessment has been completed for the development and it is anticipated to be in construction or operation by 2017 (Map 13.4-1; Map 13.4-2). The following Tier 1 development occurs in the grizzly bear and wolverine ESA and was included in all quantitative analyses:

- Gahcho Kué Project.

Tier 2 Developments

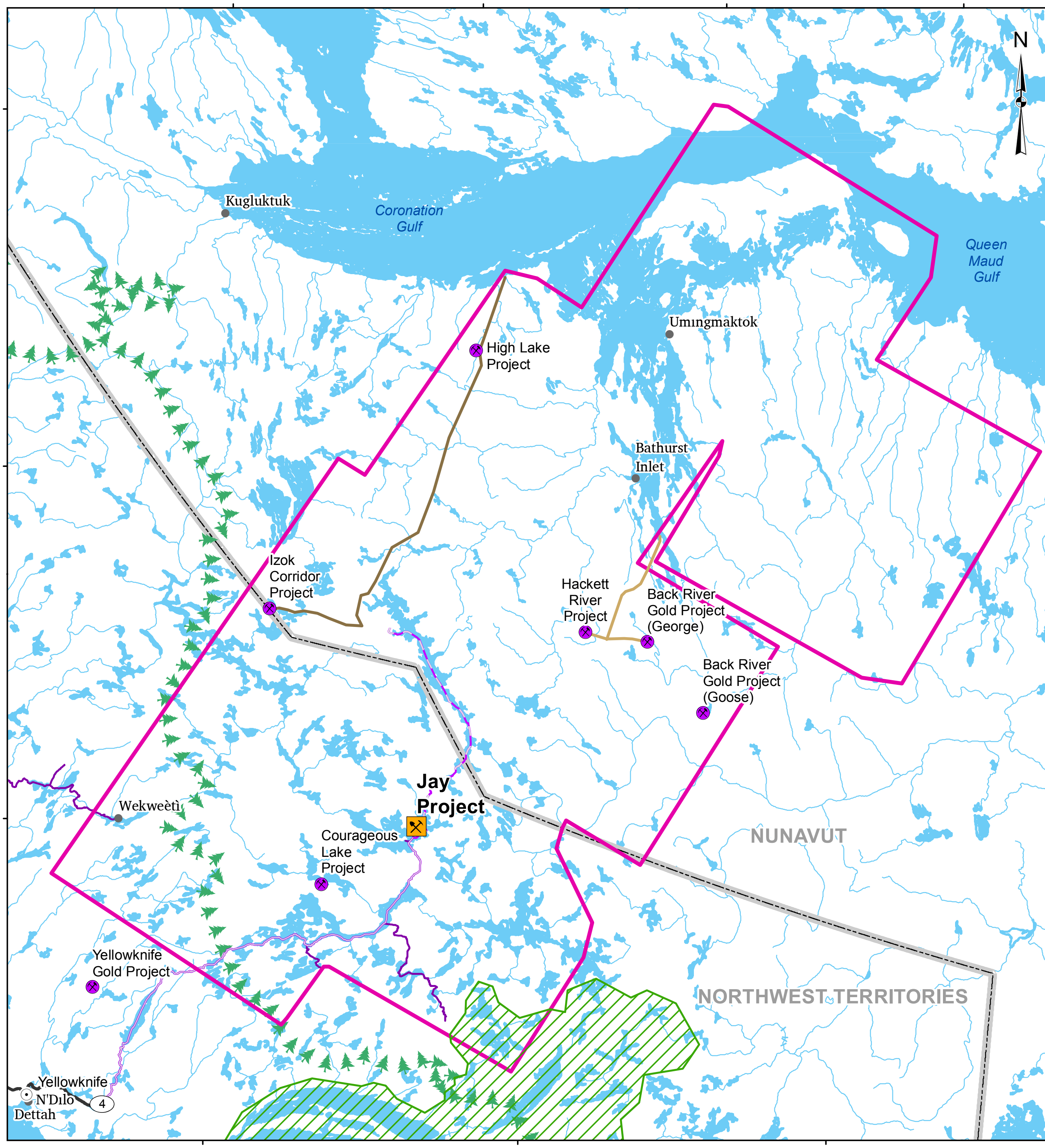
Tier 2 developments were considered as part of the RFD Case. These projects have been formally proposed and details on the physical footprint are publicly available, but the anticipated year of construction or operation is uncertain (Map 13.4-3). The following Tier 2 developments were included in numerical analyses for grizzly bear and wolverine:

- Jericho Mine;
- Hope Bay Project;
- Hackett River Project;
- Back River Project;
- Bathurst Inlet Port and Road (Phase 1 to Back River and Hackett River Projects);
- Izok Corridor Project;
- Lupin Mine;
- Thaidene Nene (East Arm) National Park; and,
- Courageous Lake Project.

Tier 3 Developments

Some reasonably foreseeable developments have not yet been formally proposed and/or do not have detailed information that is publicly available. The following Tier 3 developments are considered in a qualitative assessment of cumulative effects for grizzly bear and wolverine (Section 6.5.2.4):

- Bathurst Inlet Port and Road (Phase 2 to Contwoyto Lake); and,
- Hydroelectric Grid Expansion.



LEGEND

- JAY PROJECT
- TERRITORIAL CAPITAL
- POPULATED PLACE
- HIGHWAY
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- TERRITORIAL/PROVINCIAL BOUNDARY
- TREELINE
- WATERCOURSE
- WATERBODY
- EFFECTS STUDY AREA
- REASONABLY FORESEEABLE FUTURE PROJECT
- BATHURST INLET PORT AND ROAD PROJECT
- IZOK CORRIDOR PROJECT
- THAIDENE NENE (EAST ARM) NATIONAL PARK

75 0 75

SCALE 1:3,750,000 KILOMETRES

REFERENCE

WATER OBTAINED FROM ATLAS OF CANADA
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
PROJECTION: CANADA LAMBERT CONFORMAL CONIC

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

REASONABLY FORESEEABLE DEVELOPMENTS IN THE GRIZZLY BEAR AND WOLVERINE EFFECTS STUDY AREA (WINTER)

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Wild_089_GIS	
DESIGN	LD	15/07/14	SCALE AS SHOWN	REV. 0
GIS	DW	03/10/14	MAP 13.4-3	
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13.4.2 Effects to the Abundance and Distribution of Waterbirds

13.4.2.1 *Habitat Quantity and Fragmentation*

13.4.2.1.1 *Methods*

The incremental and cumulative direct habitat effects to waterbirds from the Project footprint and other previous, existing, and future developments in the birds ESA were analyzed through changes in the area and spatial configuration of habitat types on the landscape (i.e., landscape metrics). Decreases in habitat area can directly influence population size by reducing the carrying capacity of the landscape. Habitat fragmentation can also affect both locally breeding and staging water bird populations (Allen 1952; Ramirez et al. 1993; Leafloor et al. 1996). Therefore, in addition to habitat loss, changes to mean habitat patch area, number of habitat patches, and distance to nearest similar patch (MDNN) were assessed. Changes in habitat area, mean patch area, number of patches, and MDNN are reported for all habitat types (Ecological Landscape Classification [ELC] Map units). The MDNN is calculated as the shortest straight-line Euclidean distance between the centroids of the closest cells of equivalent habitat patches (McGarigal et al. 2012).

Baseline ELC Map units for the birds ESA were obtained from an existing classification developed for the Diavik Mine environmental assessment (DDMI 1997; Golder 1997). The Diavik Mine classification used satellite imagery, air photo interpretation, remote sensing software, and a geographic information system (GIS) to provide information on the relative abundance and distribution of vegetation types. Remote interpretation of a 25 m resolution Landsat Thematic Mapper™ satellite image captured on August 1995 was used for the initial Diavik Mine classification (Golder 1997).

Ground truth data from plots collected as part of the 1996 vegetation field program were used to select training sites for imagery classification to prepare a second mapping iteration (Golder 1997). Based on the spectral signatures and the field validated observation points at the training sites, the remote sensing software assigned a best fit classification to all pixels in the image. The process of selecting training sites and image classification was iterative and balanced the objectives of having as many meaningful land cover classes as possible with a reasonable level of accuracy. The Diavik Mine classification was further refined through manual cross referencing and error checking with vegetation mapping completed using air photo interpretation to produce the final mapping product (Golder 1997).

The Diavik Mine classification identified 14 vegetation classes, with an overall accuracy of 87% (Golder 1997). Vegetation survey plots completed in 2013 confirmed that the existing mapping in the ESA was representative of the vegetation present at the plot locations (Annex VI, Section 2.1). The accuracy assessment results and correlations with field survey locations provided a high degree of confidence in the use of the Diavik Mine classification for this Project. However, the original Diavik Mine classification was slightly offset from the georeferenced orthophoto imagery used for the Project. This offset was corrected by shifting the entire ELC east 70 m and north 30 m to align the ELC with the georeferenced orthophoto imagery. The location of landscape features in the orthophotos (e.g., lakes), along with vegetation ground truth plots completed during the 2013 field survey served as the basis for the spatial correction of the ELC layer.

Additionally, the northern extent of the Diavik Mine classification did not fully encompass the northern border of the ESA. Thus, the West Kitikmeot ELC was used to fill in approximately 21,700 ha of the northern portion of the ESA. The West Kitikmeot ELC (Matthews et al. 2001) also displayed an offset error where the ELC mapping was not aligned with the georeferenced orthophoto imagery used for the Project. The Matthews et al. (2001) ELC coordinate system was re-projected to Universal Transverse Mercator (UTM) North American Datum (NAD) 27 and shifted west 25 m and north 120 m to correct this offset. Two of the West Kitikmeot ELC classes were reclassified to fit with the ELC Map units defined for this Project. The vegetation descriptions for each respective ELC were reviewed and the Matthews et al. (2001) ELC classes were then correlated and assigned to the most appropriate Map units as follows:

- the lichen veneer Map unit from the classification was reclassified as the Heath Tundra 30% to 80% Bedrock; and,
- the spruce forest Map unit from the classification was reclassified as the Riparian Tall Shrub.

Landscape metrics of similar habitat types were determined using the program FRAGSTATS (Version 4.0) (McGarigal et al. 2012) within a GIS platform. The analysis determined the extent of landscape fragmentation by calculating statistical outputs based on the values of each raster cell of the ELC data. Landscape metrics were determined for the Reference Condition, 2014 Baseline Condition, and Application Case in the ESA, and for the spring through autumn period. The Reference Condition represents the initial period of the Base Case conditions (as far back as data are available) (Section 13.4.1.2). Here, the 2014 Baseline Condition includes all previous, existing, and approved developments up to 2014 and the Lynx Project (Table 13.4-3; Map 13.4-1).

For the analysis, the proposed Jay Project infrastructure was buffered by 200 m and the access roads and adjacent pipeline and power line were buffered by 100 m on either side (i.e., 200 m right-of-way) so that a maximum possible extent of disturbance was used in the assessment of effects to wildlife (i.e., the footprint used in the analyses is larger than the actual anticipated Project footprint). The proposed infrastructure that was buffered for the Application Case also includes the expanded WRSA constructed for Lynx (included in Base Case) as it is expected that it will also be used for the Jay Project as an ore stockpile and transfer pad area.

The incremental and cumulative changes from the Project and other developments on the loss and fragmentation of habitat were estimated by calculating the relative difference between the 2014 Baseline Condition and Reference Condition and between the Application Case and 2014 Baseline Condition as follows:

- (2014 Baseline Condition value - Reference Condition value) / Reference Condition value.
- (Application Case value - 2014 Baseline Condition value) / 2014 Baseline Condition value.

The resulting value was then multiplied by 100 to give the percent change in a landscape metric for each comparison. The result provides both the direction and magnitude of the effect. For example, a high negative value for habitat area would indicate a substantial loss of that habitat type. Absolute values per habitat type and assessment case (i.e., Reference Condition, 2014 Baseline Condition, and Application Case) for the ESA are provided in Annex II (Noise Baseline Report) and Appendix 13A (Table 13A-1).

13.4.2.1.2 *Results*

Under the Reference Condition the birds ESA was mainly comprised of heath tundra (37.7%), water (32.9%), and heath tundra 30-80% boulders (12.8%) habitats. Tussock/hummock covered approximately 9.0% of the ESA, while sedge wetland and heath tundra 30%-80% bedrock habitats covered 2.8% and 2.5%, respectively. Birch seep and riparian shoreline shrub habitat covered 1.1% of the ESA. Less than 1% of the ESA was covered by each esker, boulder complex, bedrock complex, and riparian tall shrub habitats.

The area directly disturbed by the Project (with 200 m buffer) is 1,132 ha and is a local scale change. This includes Project-associated infrastructure that will remove terrestrial and aquatic resources. The area of the Project footprint is comprised of 62% terrestrial and 38% aquatic habitats. Approximately 4 ha of esker will be disturbed by the Project (Section 11.4.2.2). Application of the Project will result in a 0.2% decrease in the total area of all habitat types relative to the 2014 Baseline Condition (Table 13.4-5). The largest amount of disturbance from the Project will be a 395 ha (0.2%) reduction of deep water area in the ESA. The magnitude of incremental reduction to any other habitat by the Project will be no greater than 0.3% relative to the 2014 Baseline Condition.

At closure, the area that contains the terrestrial Project footprint is considered a permanent disturbance on the landscape because the time for vegetation to recover in areas of disturbance is unknown. The Ekati Mine ICRP works to facilitate and promote the natural colonization of disturbed areas. Plant cover is expected to be eventually re-established in areas of disturbance; however the time for vegetation to recover is unknown. Following closure and back-flooding of the Jay Pit, waterbirds will likely resume the use of this portion of Lac du Sauvage.

Previous and existing developments have removed 4,916 ha or 0.8% of habitat area in the ESA relative to the Reference Condition. Development through the 2014 Baseline Condition has removed less than 1% of heath tundra 30% to 80% bedrock, heath tundra, riparian tall shrub, birch seep and riparian shoreline shrub, tussock/hummock, sedge wetland, shallow water, and deep water habitats (Table 13.4-5). Approximately 300 ha (3.6%) of esker complex, 37 ha (1.7%) of boulder complex (>80% rock), 830 ha (1.1%) of heath tundra 30% to 80% boulder, and 14 ha (1%) of bedrock complex (>80% rock) has been removed by previous and existing developments including the Lynx Project. The largest areas of habitat reduction from previous and existing developments relative to the Reference Condition are heath tundra (1,840 ha) and deep water (1,064 ha), which are also the most abundant habitats in the ESA.

The cumulative reduction in habitat through application of the Project and previous and existing developments is predicted to remove 6,048 ha or approximately 1.2% of habitat in the ESA (Table 13.4-5). Cumulative changes to heath tundra, riparian tall shrub, birch seep and riparian shoreline shrub, shallow water and deep water will all be less than 1.0% each. The largest magnitudes of cumulative reductions to habitat are 203 ha (3.7%) of esker complex and 49 ha (2.3%) of boulder complex. Cumulative reduction to heath tundra 30% to 80% boulder (1,032 ha), heath tundra 30% to 80% bedrock (160 ha), bedrock complex (17 ha), tussock/hummock (578 ha), and sedge wetland (175 ha) are predicted to be no greater than 1.4% each relative to the Reference Condition in the ESA.

Development of the Project is expected to directly decrease high suitability habitat (i.e., deep water, shallow water, and sedge wetland habitats) in the ESA for waterbirds by 470 ha (0.2%) relative to the 2014 Baseline Condition (Table 13.4-5). The greatest reduction in highly suitable habitat is a 395 ha loss of deep water, which represents a 0.2% reduction. The cumulative direct disturbance to high suitability habitat in the ESA from the Project and other developments is estimated to be 1,860 ha or 0.9%, relative to the Reference Condition (Table 13.4-5).

Table 13.4-5 Change in Area of Ecological Landscape Classification Map Units from Development Within the Birds Effects Study Area

Ecological Landscape Classification (ELC) Map Units	Area					
	Reference Condition (ha)	2014 Baseline Condition (ha)	Change (%) from Reference Condition to 2014 Baseline Condition	Application Case (ha)	Change (%) from 2014 Baseline Condition to Application Case	Change (%) from Reference Condition to Application Case
Upland ELC Map Units						
Esker Complex	5,522	5,322	-3.6	5,319	-0.1	-3.7
Bedrock Complex (>80% rock)	1,316	1,302	-1.0	1,299	-0.3	-1.3
Boulder Complex (>80% rock)	2,140	2,103	-1.7	2,091	-0.6	-2.3
Heath Tundra 30% to 80% Bedrock	14,946	14,825	-0.8	14,786	-0.3	-1.1
Heath Tundra 30% to 80% Boulder	76,041	75,211	-1.1	75,010	-0.3	-1.4
Heath Tundra	223,417	221,577	-0.8	221,326	-0.1	-0.9
Wetland ELC Map Units						
Riparian Tall Shrub	452	449	-0.6	448	-0.2	-0.8
Birch Seep and Riparian Shoreline Shrub	6,428	6,389	-0.6	6,373	-0.2	-0.8
Tussock/Hummock	50,994	50,553	-0.9	50,416	-0.3	-1.1
Sedge Wetland	16,440	16,305	-0.8	16,265	-0.2	-1.1
Non-Vegetated ELC Map Units						
Shallow Water	24,185	23,995	-0.8	23,960	-0.1	-0.9
Deep Water	171,237	170,173	-0.6	169,777	-0.2	-0.9

Note:% change was calculated as the relative incremental change for each habitat from one period to the next (i.e., reference to 2014 baseline, 2014 baseline to Application Case).

ha = hectare;% = percent.

In addition to direct loss of vegetation, the application of the Project will result in the fragmentation of the existing landscape. With the application of the Project, there will be a decrease of 137 highly suitable waterbird habitat patches relative to the 2014 Baseline Condition (Table 13.4-6). Mean patch size will decrease by less than 1 ha for any habitat types in the ESA. Changes to MDNN are anticipated to be less than 1 m for all habitats, with the greatest magnitude of incremental change being 0.3% for bedrock complex.

Previous and existing developments have removed 1,302 and added 518 patches of habitat in the ESA relative to the Reference Condition (Table 13.4-6). For highly suitable habitat types, the number of patches has increased by 47 for deep water and decreased by 231 and 212 for shallow water and sedge wetland, respectively. The relative change in magnitude of the habitats has been less than or equal to 0.7%. Mean patch area has been less than 1 ha for all habitats and less than 1.4% in magnitude for highly suitable habitat. Change of MDNN for all habitats is within 10.6 m of the Reference Condition but, for most habitat types, change in MDNN has been 1 m or less.

The Project and previous and existing disturbance will remove 533 patches, which represents a 0.7% decrease relative to the Reference Condition (Table 13.4-6). Habitat types that are predicted to increase in the number of patches are esker complex (120 patches), heath tundra (45 patches), and deep water (34 patches). Mean patch size will decrease by 1 ha for all habitats. High suitability habitats are expected to decrease by 0.4 ha (1.4%) for deep water, less than 0.1 ha (0.4%) for shallow water and for sedge wetland (0.3%). The MDNN for highly suitable habitats will increase for sedge wetland and shallow water by approximately 0.2 m (0.1% for both), and will decrease by 0.8 m (0.4%) for deep water.

Table 13.4-6 Change in Area and Configuration of Ecological Landscape Classification Map Units from Development Within the Birds Effects Study Area

	Reference Condition	2014 Baseline Condition	Change (%) from Reference Condition to 2014 Baseline Condition	Application Case	Change (%) from 2014 Baseline Condition to Application Case	Change (%) from Reference Condition to Application Case
Patches						
Upland ELC Map Units						
Esker Complex	1,028	1,147	11.6	1,148	0.1	11.7
Bedrock Complex (>80% rock)	3,082	3,051	-1.0	3,043	-0.3	-1.3
Boulder Complex (>80% rock)	4,200	4,150	-1.2	4,131	-0.5	-1.6
Heath Tundra 30% to 80% Bedrock	20,313	20,150	-0.8	20,117	-0.2	-1.0
Heath Tundra 30% to 80% Boulder	55,118	54,763	-0.6	54,687	-0.1	-0.8
Heath Tundra	22,816	22,937	0.5	22,861	-0.3	0.2
Wetland ELC Map Units						
Riparian Tall Shrub	1,109	1,101	-0.7	1,098	-0.3	-1.0
Birch Seep and Riparian Shoreline Shrub	10,027	9,971	-0.6	9,957	-0.1	-0.7
Tussock/Hummock	69,036	68,560	-0.7	68,435	-0.2	-0.9
Sedge Wetland	30,849	30,637	-0.7	30,582	-0.2	-0.9
Non-Vegetated ELC Map Units						
Shallow Water	40,514	40,283	-0.6	40,214	-0.2	-0.7
Deep Water	6,347	6,394	0.7	6,381	-0.2	0.5

Table 13.4-6 Change in Area and Configuration of Ecological Landscape Classification Map Units from Development Within the Birds Effects Study Area

	Reference Condition	2014 Baseline Condition	Change (%) from Reference Condition to 2014 Baseline Condition	Application Case	Change (%) from 2014 Baseline Condition to Application Case	Change (%) from Reference Condition to Application Case
Mean Patch Area (ha)						
Upland ELC Map Units						
Esker Complex	5	5	-14.6	5	-0.2	-14.7
Bedrock Complex (>80% rock)	<1	<1	-0.3	<1	0	-0.3
Boulder Complex (>80% rock)	1	1	-1.2	1	-0.1	-1.3
Heath Tundra 30% to 80% Bedrock	1	1	-0.1	1	-0.1	-0.2
Heath Tundra 30% to 80% Boulder	1	1	-0.6	1	-0.1	-0.7
Heath Tundra	10	10	-1.4	10	0.2	-1.2
Wetland ELC Map Units						
Riparian Tall Shrub	<1	<1	<0.1	<1	<0.1	0.1
Birch Seep and Riparian Shoreline Shrub	1	1	-0.2	1	-0.1	-0.3
Tussock/Hummock	1	1	-0.3	1	-0.1	-0.4
Sedge Wetland	1	1	-0.2	1	-0.1	-0.3
Non-Vegetated ELC Map Units						
Shallow Water	1	1	-0.4	1	<0.1	-0.4
Deep Water	27	27	-1.4	27	<-0.1	-1.4

Table 13.4-6 Change in Area and Configuration of Ecological Landscape Classification Map Units from Development Within the Birds Effects Study Area

	Reference Condition	2014 Baseline Condition	Change (%) from Reference Condition to 2014 Baseline Condition	Application Case	Change (%) from 2014 Baseline Condition to Application Case	Change (%) from Reference Condition to Application Case
Mean Distance to Nearest Neighbour (m)						
Upland ELC Map Units						
Esker Complex	302.9	270.8	-10.6	270.5	-0.1	-10.7
Bedrock Complex (>80% rock)	246.0	245.3	-0.3	246.2	0.3	0.1
Boulder Complex (>80% rock)	280.4	281.5	0.4	282.1	0.2	0.6
Heath Tundra 30% to 80% Bedrock	148.8	149.1	0.2	149.2	0.1	0.3
Heath Tundra 30% to 80% Boulder	94.2	94.4	0.2	94.4	<-0.1	0.2
Heath Tundra	81.7	81.7	<-0.1	81.6	-0.1	-0.1
Wetland ELC Map Units						
Riparian Tall Shrub	742.5	748.4	0.8	748.9	0.1	0.9
Birch Seep and Riparian Shoreline Shrub	227.5	227.4	<-0.1	227.5	0.1	<0.1
Tussock/Hummock	96.2	96.3	0.1	96.3	<0.1	0.1
Sedge Wetland	145.0	145.2	0.1	145.2	<0.1	0.1
Non-Vegetated ELC Map Units						
Shallow Water	108.6	108.7	0.1	108.7	<0.1	0.1
Deep Water	215.0	214.1	-0.4	214.1	<-0.1	-0.4

Note: the bird effects study area is 593,274 ha.
% change was calculated as the relative incremental change for each habitat from one time period to the next (i.e., reference to 2014 baseline, 2014 baseline to Application Case).
Note: values of less than -0.1 approach 0.0.
ha = hectare;% = percent; m = metre; <= less than.

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13.4.2.2 *Habitat Quality, Behaviour, and Movement*

13.4.2.2.1 *Methods*

The Project is situated in the North Slave Region, which encompasses both the Central and Mississippi Flyways of North America. This area represents an important migration corridor between staging areas in the south (i.e., Peace Athabasca Delta and Great Slave Lake), and northern breeding grounds in the central Canadian Arctic.

The birds ESA provides breeding and/or staging habitat for a variety of dabbling ducks, diving ducks, sea ducks, loons, gulls, terns, and waders (e.g., American bittern and shorebirds) comprising approximately 40 waterbird species (range:14 to 27 annually; Section 13.2.1.1.2). These species occupy a wide variety of habitats, but all share strong associations to aquatic habitat. Dabbling ducks and waders occupy littoral and shoreline habitat, while diving ducks and sea ducks use open-water habitat. Lakes in the region provide breeding habitat for loons, gulls, and terns. In the fall, lakes also provide staging habitat during migration to wintering areas.

In addition to direct habitat effects, indirect changes to habitat quality from the Project have the potential to affect the population size and distribution of waterbirds in the ESA through altered movement and behaviour of individuals. To estimate the direct and indirect effects of the Project on waterbirds, habitat suitability index (HSI) models were used to quantify habitat changes between the 2014 Baseline Condition and Reference Condition, and between the Application Case and 2014 Baseline Condition. The HSI models were run using the ELC developed for the waterbird habitat quantity and fragmentation analysis.

Estimates of habitat requirements and suitability for waterbirds are provided in Table 13.4-7. Two HSI models were used. One model classified entire waterbodies as well as upland habitat within 100 m of waterbodies to assess changes to staging habitat. The other model classified shallow and deep water within 100 m of the shore, as well as upland habitat within 100 m of waterbodies to assess changes to breeding habitat.

Table 13.4-7 Habitat Suitability Index Values for Waterbirds in the Effects Study Area

Habitat Type	Habitat Suitability (Index Value; 0 to 3)
Esker Complex	poor (0)
Boulder Complex (>80% rock)	poor (0)
Bedrock Complex (>80% rock)	poor (0)
Heath Tundra	good (2)
Heath Tundra 30%-80% Bedrock	low (1)
Heath Tundra 30%-80% Boulder	low (1)
Birch Seep and Riparian Shoreline Shrub	good (2)
Riparian Tall Shrub	good (2)
Tussock/Hummock	good (2)
Sedge Wetland	high (3)
Shallow Water	high (3)
Deep Water	high (3)
Disturbance	poor (0)

% = percent; >= greater than.

A zone of influence (ZOI) and associated disturbance coefficient was applied to estimate the direct and indirect effects (e.g., fugitive dust deposition, sensory disturbance from noise and human activities, and viewscape) from development footprints on waterbirds. For all development scenarios, habitat quality within all development footprints was reduced to zero (direct effects). To estimate indirect effects, the ZOI and associated disturbance coefficient predicted for waterbirds were based on professional opinion and previous environmental assessments in Nunavut and the NWT (Miramar Hope Bay Ltd. 2005; De Beers 2010a). The ZOI for waterbirds applies to all habitats within 1 km of all active disturbances within the ESA. It reduced all habitats to low, with the exception of poor-quality habitats, which remained as poor.

The 1 km ZOI is considered to be conservative because most noise levels for the Project that are greater than 50 to 55 dBA (construction) and 40 to 45 dBA (operations) are enclosed within this boundary (Appendix 13B; Appendix 13D, Map 13D-1 and Map 13D-2). There are few studies on waterbird response to noise levels. Noise levels greater than 63 dBA may negatively affect some waterbird species (Conomy et al. 1998), although other species have been reported to tolerate noise levels of 55 to 100 dBA (Black et al. 1984).

The relative change in the amount of different quality habitats for the different conditions on the landscape was calculated as follows:

- (2014 Baseline Condition value – Reference Condition value) / Reference Condition value.
- (Application Case value – 2014 Baseline Condition value) / 2014 Baseline Condition value.

13.4.2.2.2 *Results*

Under the Reference Condition, approximately 52.6% of the ESA is suitable (high, good, low) staging habitat for waterbirds and 34.3% of the area represents suitable nesting habitat (Table 13.4-8). For staging habitat, the ESA is predominantly of either poor (47.3%) or high (34.7%) suitability; the areas representing good or low suitability are much less abundant. Poor breeding habitat suitability comprises 65.7% and is the dominant habitat area in the ESA.

Previous and existing developments have reduced the amount of high and good staging habitat by 7,285 ha (3.5%) and 3,464 ha (4.2%), respectively (Table 13.4-8). As well, high and good breeding habitats decreased by 4,392 ha (4.5%) and 3,464 ha (4.2%), respectively, relative to the Reference Condition. Application of the Project will decrease high and good quality staging habitat by 1,339 ha (0.7%) and 245 ha (0.3%), respectively. High and good suitability breeding habitat will be reduced by 424 ha (0.5%) and 245 ha (0.3%), respectively, with the application of the Project. Direct and indirect disturbance by the Project has increased low and poor staging habitats by 971 ha (3.0%) and 612 ha (0.2%), respectively, and for breeding habitat by 349 ha (1.2%) and 320 ha (0.1%), respectively.

From Reference Conditions to the Application Case, high and good quality staging habitats in the ESA are expected to be decreased by 8,623 ha (4.2%) and 3,709 ha (4.5%), respectively (Table 13.4-8). Previous and existing developments, and the Project are predicted to reduce high and good breeding habitats by 4,816 ha (4.9%) and 3,709 ha (4.5%), respectively. Changes to waterbird staging and breeding habitat suitability in the ESA for the Reference Condition, 2014 Baseline Condition, and Application Case are illustrated in Appendix 13C, Maps 13C-1 to 13C-6.

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Table 13.4-8 Relative Changes in the Availability of Different Quality Habitats for Waterbirds from the Reference Condition to Application Case

Model/Habitat Quality	Reference Condition (ha)	2014 Baseline Condition (ha)	Change (%) from Reference to 2014 Baseline Condition	Application Case (ha)	Change (%) from 2014 Baseline Condition to Application Case	Cumulative Change (%) from Reference to Application Case
Staging Habitat (Entire Waterbody Plus Upland Habitat Within 100 m of Waterbodies)						
High	206,310	199,026	-3.5	197,687	-0.7	-4.2
Good	82,192	78,728	-4.2	78,484	-0.3	-4.5
Low	23,960	32,344	35.0	33,316	3.0	39.0
Poor	280,812	283,177	0.8	283,789	0.2	1.1
Breeding Habitat (Shallow and Deep Water Within 100 m of the Shore Plus Upland Habitat Within 100 m of Waterbodies)						
High	97,437	93,046	-4.5	92,621	-0.5	-4.9
Good	82,192	78,728	-4.2	78,484	-0.3	-4.5
Low	23,960	30,045	25.4	30,394	1.2	26.8
Poor	389,685	391,457	0.5	391,777	0.1	0.5

Note:% change was calculated as the relative incremental change for each habitat from one time period to the next (i.e., reference to 2014 baseline, 2014 baseline to Application Case). Cumulative changes may not exactly sum due to rounding.

ha = hectare;% = percent; m = metre.

13.4.3 Effects to the Abundance and Distribution of Raptors

13.4.3.1 *Habitat Quantity and Fragmentation*

13.4.3.1.1 *Methods*

Peregrine falcons, rough-legged hawks, and other raptor species nest on steep cliffs and large boulders in barren-ground tundra environments because terrestrial predators have difficulty accessing these areas (Bechard and Swem 2002; White et al. 2002; Wightman and Fuller 2005; 2006; Booms et al. 2008). Open pits at diamond mines in the NWT also provide suitable nesting habitat for some raptor species, and have been recorded nesting on pit walls (Section 13.2.2.3.1). Fine-scale habitat features, such as large boulders and cliffs could not be identified from the ELC data. Therefore, a broader scale HSI model was used to quantify the incremental and cumulative changes to raptor nest habitat between the 2014 Baseline Condition and Reference Condition and between the Application Case and baseline condition in the birds ESA. The HSI model applied the same 25 m x 25 m ELC data used for the waterbird habitat quantity and fragmentation analysis (Section 13.4.2.1.1), but also considered digital elevation data.

The development of the raptor HSI model followed the approach of Coulton et al. (2013), which considered physical attributes of raptor nest sites in the ESA that were associated with site quality. Nest sites located on high and isolated cliffs are considered to be of high suitability for peregrine falcons and other bird-of-prey species (Court et al. 1988; Poole and Bromley 1988; Wightman and Fuller 2006; Coulton et al. 2013) because they offer protection from weather, nest predators, and competition (Wightman and Fuller 2006). Many of the existing nest sites in the ESA occur on cliffs that overlook lakes. To quantify the suitability of nest sites in the study area, a random sample of available nest sites (n=250) was intersected with GIS raster layers of a Canadian digital elevation model (Natural Resources Canada 2001) and the ELC data. The elevation model was resampled from 15 to 25 m to align ELC and elevation rasters. Random sites were a minimum of 2 km apart to account for neighboring territories (Wightman and Fuller 2005, 2006). Nest site variables of elevation (metres above sea level), slope (degrees) relative to the area immediately adjacent to the site, and percent deep water within a 1 km radius were determined using a GIS platform. A 1 km radius described suitability at a scale beyond the nest site and captured the presence of larger lakes that would provide sites with open views. Open views are important to isolate nests from conspecific intruders and mammalian predators (Wightman and Fuller 2005), and may provide windier conditions that aid flight. The combination of these variables was interpreted to describe a gradient of elevation, elevation gain, and the isolation of suitable nest sites in the study area. To validate the use of these variables as cues used for nest site selection, values of these variables were also determined for and compared to known nest sites monitored in the ESA since 1998 (n=20) (Coulton et al. 2013) and detected during the Project baseline surveys in 2013 (n=17).

Nest site suitability variables of elevation, slope, and percent deep water within a 1 km radius were combined into a single index using principal components analysis. The first principal component (PC1) had an eigenvalue of 1.78 and explained 59.4% of the variance among available (random) sites. The PC1 structural coefficients for elevation, slope, and percent deep water within 1 km of the site were 0.60, 0.50, and -0.63. The PC1 axis reflected a gradient of terrain in ruggedness around the nest site where more positive values indicated higher values of elevation above sea level, greater slope, and less percent deep water within 1 km of the site. For example, random available sites on lake habitat would likely have low elevation and slope and potentially a larger percent of deep water in the surrounding area resulting in more negative PC1 scores and lower suitability as nest habitat. The relationships among variables comprising PC1 are generally consistent with multivariate patterns of raptor nest site selection (high cliffs with open views; Wightman and Fuller 2005); thus, PC1 was considered biologically meaningful. Multivariate analysis of variance detected significant differences in the site variables between random and observed nest sites (multiple analysis of variance [MANOVA], $F_{3,283}=129.7$, $P<0.01$) as did a univariate test of PC1 values (analysis of variance [ANOVA], $F_{1,285}=55.2$, $P<0.01$). Observed nest sites were on average 10.6 m (95%CI: 4.5m to 16.8m, $P<0.01$) lower in elevation, had 6.8° (95%CI: 1.3° to 8.1°, $P<0.01$) greater slope, and were no different in percent deep water within 1 km of the site ($P=0.93$) than random sites. Nest sites PC1 values were on average 1.7 units (95%CI: 1.3 to 2.2, $P<0.01$) higher than the PC1 values of random sites.

The PC1 scores of all sites (ELC units) in the ESA were calculated. PC1 scores were categorized as high, good, low, and poor habitat suitability based on quartile thresholds of nest site scores. Nest scores ranged from -0.76 to 4.29 PC1 units. Suitability thresholds of PC1 scores were greater than 2.6 units for high, 2.6 to 2.1 units for good, 2.1 to 0.5 units for low, and less than 0.5 units for poor nest site quality.

For raptors, the only landscape metric that was calculated was total area of different suitable nest habitats. Decreases in suitable nesting habitat area can directly influence population size by reducing the carrying capacity of the landscape. Mean patch area, patch number, and distance to the nearest similar patch were not expected to affect raptors because they are highly mobile species that regularly fly long distances between suitable habitats (e.g., migration between breeding and winter grounds). Changes in the different habitat suitability types were determined using the program FRAGSTATS (Version 4.0) (McGarigal et al. 2012) within a GIS platform (Section 13.4.2.1.1).

The incremental and cumulative changes from the Project and other developments on the loss of habitat were estimated by calculating the relative difference between the 2014 Baseline Condition and the Reference Condition and between the Application Case and baseline condition as follows:

- (2014 Baseline Condition value – Reference Condition value) / Reference Condition value.
- (Application Case value – 2014 Baseline Condition value) / 2014 Baseline Condition value.

The resulting value was then multiplied by 100 to give the percent change in a landscape metric for each comparison. Appendix 13A (Table 13A-1) contains absolute values per habitat type and assessment case (i.e., Reference Condition, baseline condition, and Application Case) for the ESA.

13.4.3.1.2 *Results*

The development of the Project will lead to a reduction in the quantity and fragmentation of raptor habitat. Raptors tend to have home ranges that encompass a variety of habitat types. This makes it difficult to determine habitat use from raptor surveys. The spatial boundary for the effects assessment for raptors included the ESA, thus the results of loss and fragmentation of different habitat types determined for waterbirds (Section 13.4.2.1.2) will be the same for raptors. However, nest locations are likely the more critical information regarding raptor distribution and abundance in the ESA. An HSI model was used to determine incremental and cumulative disturbance to suitable raptor nest habitat.

The HSI model considered slope, elevation, and the percent of deep water within a 1 km radius around available nest sites as variables correlated with nest habitat suitability (Wightman and Fuller 2005, 2006). Application of the Project is predicted to decrease the total area of suitable nest habitat (i.e., high and good suitability) by 5 ha (less than -0.1%) relative to the 2014 Baseline Condition (Table 13.4-9).

Previous and existing developments in the birds ESA has altered suitable raptor nest habitat by 230 ha or 0.9% of that available (Table 13.4-9). Cumulative effects from the application of the Project and previous and existing developments are predicted to reduce suitable habitat by 0.9% relative to the Reference Condition. Cumulative direct changes to high, good, and low habitats will increase the amount of poor habitat by 2,858 ha or 0.8%.

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Table 13.4-9 Direct Loss of Different Suitable Habitats for Raptors from the Reference Condition to Application Case

Model/Habitat Suitability	Reference Condition (ha)	2014 Baseline Condition (ha)	Change (%) from Reference Condition to 2014 Baseline Condition	Application Case (ha)	Change (%) from 2014 Baseline Condition to Application Case	Cumulative Change (%) from Reference Condition to Application Case
High	10,185	10,121	-0.6	10,120	<-0.1	-0.6
Good	15,233	15,067	-1.1	15,063	<-0.1	-1.1
Low	214,732	212,345	-1.1	212,109	-0.1	-1.2
Poor	353,125	355,743	0.7	355,983	0.1	0.8

Note:% change was calculated as the relative incremental change for each habitat from one time period to the next (i.e., reference to 2014 baseline, 2014 baseline to Application Case).

Values less than -0.1 are approaching 0.0.

ha = hectare;% = percent; <= less than.

13.4.3.2 *Habitat Quality, Behaviour, and Movement*

13.4.3.2.1 *Methods*

Direct and indirect changes to habitat quality from sensory disturbance (e.g., lights, smells, noise, viewscape) associated with the Project have the potential to affect the population size and distribution of raptors in the ESA. Raptors have been shown to exhibit sensitivity to human disturbance during the breeding season (Craighead and Mindell 1981; Richardson and Miller 1997). To estimate the direct and indirect effects of the Project on raptors, a HSI model was used to quantify habitat changes between the 2014 Baseline Condition and Reference Condition and between the Application Case and 2014 Baseline Condition. The HSI model was developed from the 25 x 25 m ELC data used for the waterbird habitat quantity and fragmentation analysis (Section 13.4.2.1.1).

Similar to waterbirds, a ZOI and disturbance coefficients were applied to estimate the direct and indirect effects from development footprints on raptors. For all development scenarios, habitat quality within all development footprints was reduced to zero (direct effects). A ZOI of 800 m to quantify indirect effects was assumed based on recommended set-back distances for peregrine falcon (review by Richardson and Miller 1997). The ZOI for raptors applies to habitats within 800 m from the edge of all active development footprints and reduced the quality of each habitat by a single category (i.e., high to good; good to low; low to poor), except for poor quality habitats, which remained poor. This ZOI is conservative given that recent results from 13 years of raptor monitoring in the ESA could not detect a negative ZOI for either nest use or success (Coulton et al. 2013).

The incremental and cumulative changes from the Project and other developments on habitat quality was estimated by calculating the relative difference between the 2014 Baseline Condition and Reference Condition and between the Application Case and baseline condition as follows:

- (2014 Baseline Condition value – Reference Condition value) / Reference Condition value.
- (Application Case value – 2014 Baseline Condition value) / 2014 Baseline Condition value.

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13.4.3.2.2 *Results*

Suitable raptor habitat (combined high and good quality) comprised 4.2% of available habitat during the Reference Condition, thus higher suitability habitats are limited for raptors in the ESA (Table 13.4-10).

Previous and existing developments have reduced the amount of high and good quality habitat by 340 ha (3.3%) and 604 ha (4.0%), respectively (Table 13.4-10). Direct and indirect disturbance from previous and existing developments in the ESA has increased the amount of poor suitability habitat by 10,650 ha (3.0%) relative to Reference Conditions. The Project will reduce high suitability habitat by 15 ha (0.1%) and good habitat by approximately 10 ha (0.1%). The application of the Project is predicted to increase poor suitability habitat by 592 ha (0.2%) relative to the 2014 Baseline Condition.

The cumulative direct and indirect changes from the Project and previous and existing developments is expected to reduce high and good suitability habitat by 355 ha (3.5%) and 614 ha (4.0%) of that available during the Reference Condition. Changes to raptor habitat suitability in the ESA for the Reference Condition, 2014 Baseline Condition, and Application Case are illustrated in Appendix 13C, Maps 13C-7 to 13C-9.

Table 13.4-10 Relative Changes in the Availability of Different Suitable Habitats for Raptors from the Reference Condition to Application Case

Model/Habitat Suitability	Reference (ha)	2014 Baseline Condition (ha)	Change (%) from Reference Condition to 2014 Baseline Condition	Application Case (ha)	Change (%) from 2014 Baseline Condition to Application Case	Change (%) from Reference Condition to Application Case
High	10,185	9,845	-3.3	9,830	-0.1	-3.5
Good	15,233	14,629	-4.0	14,619	-0.1	-4.0
Low	214,732	205,026	-4.5	204,459	-0.3	-4.8
Poor	353,125	363,775	3.0	364,367	0.2	3.2

Note:% change was calculated as the relative incremental change for each habitat from one time period to the next (i.e., reference to 2014 baseline, 2014 baseline to Application Case).

ha = hectare;% = percent.

13.4.4 Residual Effects Summary for Waterbirds and Raptors

The area directly disturbed by the Project occurs at the local scale and includes 1,132 ha of terrestrial and aquatic habitats. Approximately 38% of the Project footprint will disturb aquatic habitat and 62% will disturb terrestrial habitat. However, the combined direct changes from the Project and other previous and existing developments on habitat extend to the regional populations and communities (including waterbird and raptor species at risk). At closure, the area of terrestrial habitat that contains the Project footprint is considered a permanent disturbance on the landscape. The time for vegetation to recover in arctic ecosystems is slow and it is not known what the reclaimed landscape will look like in the future. Following closure and back-flooding of the Jay Pit, waterbirds are expected to resume the use of this area of Lac du Sauvage. The Ekati Mine ICRP works to facilitate and promote the natural colonization of disturbed areas.

The magnitude of the incremental loss of habitat on the landscape within the ESA from the Project relative to the 2014 Baseline Condition is anticipated to be 0.2%. Development of the Project is expected to directly decrease high suitability habitat for waterbirds (i.e., deep water, shallow water and sedge wetland habitats) in the ESA by 470 ha (0.2%), relative to the 2014 Baseline Condition. The cumulative direct disturbance to high suitability waterbird habitat in the ESA from the Project and other developments is estimated to be 1,860 ha or 0.9%, relative to the Reference Condition.

The physical footprint of the Project is predicted to decrease the total area of suitable raptor nest habitat (i.e., high, good, low suitability) by 240 ha (0.1%) relative to the 2014 Baseline Condition. The largest amount of disturbance by the Project will affect 239 ha (0.2%) of low suitability raptor habitat. The Project is expected to reduce good suitability raptor habitat by 4.0 ha (less than 0.1%) relative to the 2014 Baseline Condition and will directly alter less than 1 ha of highly suitable habitat. Previous and existing developments through 2014 in the ESA has directly altered suitable raptor nest habitat by 2,618 ha or 1.1% of that available. This includes a reduction of 65 ha (0.6%) of high and 167 ha (1.1%) of good suitability habitat that was available in the Reference Condition. Cumulative changes from the application of the Project and previous and existing developments are predicted to directly reduce suitable raptor habitat by 2,858 ha (1.2%) relative to the Reference Condition.

The mean distance to nearest similar habitat patch for vegetation communities (except esker complex) ranged from 96 m to 750 m with no development on the landscape (i.e., the Reference Condition). Distance to similar habitat patches increased from less than 0.1% to 0.8% from reference to the 2014 Baseline Condition. The incremental change in mean distance between similar patches of habitat is predicted to increase by less than 0.1% to 0.3% (all less than 1 m) from application of the Project, and cumulatively from the Reference Condition by less than 0.1% to 0.9%. Overall, the magnitude of incremental and cumulative changes to habitat area and configuration (e.g., number and distance between similar patches) from the Project and previous and existing developments are estimated to be approximately 1.0% relative to a reference landscape.

In addition to direct habitat effects, indirect changes to habitat quality from the Project and other developments have the potential to affect the population size and distribution of waterbirds and raptors (including species at risk) through altered movement and behaviour. To estimate the effects of development on waterbirds, two habitat suitability models quantified staging and breeding habitat changes from the Reference Condition through application of the Project. Because waterbirds are likely to exhibit sensitivity to human disturbance, a 1 km zone of influence and disturbance coefficients were applied to estimate indirect effects (e.g., fugitive dust deposition, sensory disturbance from noise and human activities, and viewscape) from the Project and other active developments in the ESA.
The estimates include the loss of available habitat from direct disturbance associated with physical footprints.

For the 2014 Baseline Condition, direct and indirect (sensory) disturbance from previous and existing developments have reduced the amount of high and good staging habitat for waterbirds by 7,285 ha (3.5%) and 3,464 ha (4.2%), respectively. As well, high and good breeding habitats decreased by 4,392 ha (4.5%) and 3,464 ha (4.2%), respectively, relative to the Reference Condition. Application of the Project will decrease high and good quality staging and breeding habitat by less than 1%. The Project and previous and existing developments are expected to reduce high and good quality staging habitats by 8,623 ha (4.2%) and 3,709 ha (4.5%), respectively. Cumulative changes from the Project and other developments are predicted to reduce high and good breeding habitats by 4,816 ha (4.9%) and 3,709 ha (4.5%), respectively.

To estimate the indirect effects of development on raptors, a habitat suitability model quantified changes from the Reference Condition through application of the Project. None of the reasonably foreseeable developments identified will occur within the birds ESA (Section 13.4.1.3). Because raptors are likely to exhibit sensitivity to human disturbance, an 800 m ZOI and disturbance coefficients were applied to estimate indirect effects from the Project and other active developments in the ESA. The estimates include the loss of available habitat from direct disturbance associated with physical footprints.

Previous and existing developments have reduced the amount of high and good quality raptor habitat by 340 ha (3.3%) and 604 ha (4.0%), respectively. The Project will reduce high suitability habitat by 15 ha (0.1%) and good habitat by approximately 10 ha (0.1%). The cumulative direct and indirect changes from the Project and previous and existing developments is expected to reduce high and good suitability habitat by 355 ha (3.5%) and 614 ha (4.0%) of that available during the Reference Condition.

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 waterbirds and raptors extends to the populations within the ESA (i.e., regional scale). The duration of the effects to waterbird and raptor populations from changes in habitat quality and altered movement and behaviour is predicted to be reversed within 5 to 10 years following the end of closure.

13.4.5 Effects to the Abundance and Distribution of Wolverine

13.4.5.1 *Habitat Quantity and Fragmentation*

13.4.5.1.1 *Methods*

The incremental and cumulative direct habitat effects to wolverine from the Project footprint and other previous, existing, and future developments in the grizzly bear and wolverine ESA were analyzed through changes in the area and spatial configuration of habitat types on the landscape (i.e., landscape metrics). Decreases in habitat area can directly influence population size by reducing the carrying capacity of the landscape. Habitat fragmentation can also affect the wolverine population by influencing movement of individuals across landscapes (Weaver et al. 1996; Cegelski et al. 2003). Therefore, in addition to habitat loss, changes to MDNN were assessed. Changes in habitat area and MDNN are reported for all habitat types. The MDNN is calculated as the shortest straight-line Euclidean distance between the centroids of the closest cells of equivalent habitat patches (McGarigal et al. 2012).

The quantity of wolverine (and grizzly bear) habitat was classified using a remote sensing Land Cover of Canada (1985 to 2000) provided by the Government of Canada in a Geographic Information System (GIS) platform. The land cover dataset was modified from 1,000 m cell sizes to a 25 m resolution, and then joined with esker habitat in 1:50,000 scale national topographic database (NTDB) layers.
The merged database was similar to the dataset used in Johnson et al. (2004, 2005). Upon joining layers, the dataset were re-sampled to 200-m cell sizes using a nearest neighbour algorithm because of computational constraints with generating habitat rasters over the large study area. Finally, the Land Cover of Canada dataset was reclassified into 12 classes similar to Johnson et al. (2004, 2005).
Visual inspections of the distribution of cover data in the areas that overlapped the North Slave Region and Land Cover of Canada guided the reclassification process.

Use of the Land Cover of Canada data set, which is based on a resolution of 1 km cell size, is anticipated to be ecologically relevant and to have a negligible influence on the results for wolverine (and grizzly bears) because wolverines (and grizzly bears) are highly mobile. For example, wolverine can travel up to 40 km per day (Banci and Harestad1990). Female wolverines in the NWT disperse an average of 133 km (range 69 to 225 km) and males an average of 231 km (range 73 to 326 km) (Mulders 2000). Long distance movements of 378 km and 300 km (over 8 and 5 months, respectively) have also been reported (Gardner et al. 1986). Male grizzly bears in the North Slave Region of the NWT travel an average of 7 to 11 kilometres per day (km/day) and females travel an average of 4 to 6 km/day (McLoughlin et al. 1999). The maximum distances recorded for bears in the Lac de Gras region were 8.5 km/day for males and 5.3 km/day for females (ERM Rescan 2014b). Grizzly bear home ranges in the North Slave Region average 6,685 km^2 for males and 2,074 km^2 for females (McLoughlin et al. 1999).

Landscape metrics were determined using the program FRAGSTATS (Version 4.0) (McGarigal et al. 2012) within a GIS platform. The analysis determined the extent of landscape fragmentation by calculating statistical outputs based on the values of each raster cell. For example, road widths are approximately 20 m. However, to include roads in the 200 m ecological land cover layer, roads must have a width of 200 m. Therefore, results determined from the fragmentation analysis are conservative and result in an overestimation of disturbed area within the study area. Landscape metrics were determined for the Reference Condition, 2014 Baseline Condition, Application Case, and RFD Case for the winter period. Landscape metrics were not calculated for the spring through autumn seasons because there is more disturbance on the landscape during the winter (from winter roads). Also, differences between the winter and spring through autumn seasons were negligible.

The Reference Condition represents the initial period of the Base Case (as far back as data are available) (Section 13.4.1.2). The 2014 Baseline Condition includes all previous, existing, and approved developments up to 2014 as well as the Lynx project (Table 13.4-4; Map 13.4-2). Reasonably foreseeable developments in the grizzly bear and wolverine ESA are presented in Table 13.4-4 and illustrated in Map 13.4-3.

The incremental and cumulative changes from the Project and other developments on the loss and fragmentation of habitat were estimated by calculating the relative difference between the 2014 Baseline Condition and Reference Condition, between the Application Case and 2014 Baseline Condition, and between the RFD Case and Application Case as follows:

- (2014 Baseline Condition value – Reference Condition value) / Reference Condition value.
- (Application Case value – 2014 Baseline Condition value) / 2014 Baseline Condition value.
- (RFD Case value – Application Case value) / Application Case value.

Appendix 13A (Table 13A-2) contains absolute values per habitat type and assessment case (i.e., Reference Condition, baseline condition, Application Case, and RFD Case) for the grizzly bear and wolverine ESA.

13.4.5.1.2 *Results*

Under the Reference Condition, the grizzly bear and wolverine ESA is mainly composed of open water (34.3%), heath tundra (22.7%), heath rock (16.0%), and sedge association (10.6%) habitats. Rock association covers approximately 7.4% of the ESA, while lichen veneer habitat covers approximately 3.2%. Low shrub and forest habitats constitute approximately 1.6% and 2.0% of the ESA, respectively. For the Reference Condition, less than 1% of the ESA is covered by each esker, riparian shrub, peat bog, old burn, and young burn habitats.

The Project footprint covers approximately 1,132 ha of the ESA (less than 0.05%). Approximately 62% of the physical footprint is terrestrial habitat and 38% is aquatic habitat. It is estimated that 4 ha of esker will be disturbed by the Project (Section 11.4.2.2). Tundra ecosystems are slow to recover from disturbance. Thus, the terrestrial area that contains the Project footprint is considered a permanent disturbance on the landscape because of the expected long time for vegetation to recover, and it is not known what the reclaimed landscape will look like in the future. The Ekati Mine ICRP works to facilitate and promote the natural colonization of disturbed areas. Plant cover is expected to be eventually re-established in areas of disturbance; however the time for vegetation to recover is unknown. Early successional stages of planted vegetation may provide suitable browse for prey species, which could be available for wolverine.

Wolverine occurrence in the ESA is positively correlated with sedge association, heath rock, and rock association habitats in the winter; positive correlation is also present for sedge association habitat during the summer (Johnson et al. 2004, 2005). Persistent spring snow cover is an important component of wolverine habitat selection because females make their dens in snow (Bianci and Harestad 1990; Copeland et al. 2007, 2010; May et al. 2008, 2010; Schwartz et al. 2009). Wolverine dens are mostly associated with open areas (e.g., sedge association and heath rock habitats) and boulders (e.g., rock association habitat).

Under the 2014 Baseline Condition, human disturbance covers approximately 0.3% of the ESA. Less than or equal to 0.2% of rock association, heath rock, and sedge association habitats in the ESA have been removed by previous and existing developments (Table 13.4-11). The Project is predicted to remove less than 0.1% of preferred wolverine habitats, relative to the 2014 Baseline Condition. Approximately 4 ha of the esker will be disturbed by the Project. Human disturbance is expected to cover 0.4% of the ESA under the RFD Case. Cumulative changes from the Reference Condition to the RFD Case for rock association, heath rock, and sedge association habitats are less than or equal to 0.2%.

Table 13.4-11 Change (percent) in Area and Configuration of Habitat Types Within the Grizzly Bear and Wolverine Effects Study Area During Reference Condition, Baseline Condition, Application Case, and Reasonably Foreseeable Development Case (Winter Period)

Habitat Type	Total Area (ha)	% Change to			Mean Distance to Nearest Neighbour (m)	% Change to		
	Reference	2014 Baseline	Application Case	RFD Case	Reference	2014 Baseline	Application Case	RFD Case
Esker	89,488	-1.3	<-0.1	-0.2	1,071	0.2	<0.1	<0.1
Lichen Veneer	617,004	-0.1	<-0.1	<-0.1	705	0.1	<0.1	<0.1
Rock Association	1,439,420	-0.1	<-0.1	-0.2	687	<0.1	<-0.1	<0.1
Heath Rock	3,102,960	-0.2	<-0.1	-0.1	511	<0.1	<-0.1	<0.1
Heath Tundra	4,397,132	-0.2	<-0.1	-0.1	509	<0.1	<0.1	<0.1
Forest	387,668	-0.2	0.0	<-0.1	778	0.1	0.0	-0.1
Peat Bog	48,192	-0.1	0.0	0.0	750	0.1	0.0	0.0
Riparian Shrub	88,860	-0.1	0.0	<-0.1	987	<0.1	0.0	<-0.1
Low Shrub	318,836	-0.1	<-0.1	-0.1	840	0.1	<0.1	<0.1
Sedge Association	2,049,608	-0.2	<-0.1	-0.1	560	0.1	<0.1	<0.1
Open Water	6,660,344	-0.2	<-0.1	-0.1	486	<0.1	<0.1	<0.1
Old Burn	47,272	-0.1	0.0	0.0	787	<0.1	0.0	0.0
Young Burn	26,036	0.0	0.0	0.0	4,053	0.0	0.0	0.0

Note:% change was calculated as the relative incremental change for each habitat from one time period to the next (i.e., reference to 2014 baseline, 2014 baseline to Application Case, Application Case to RFD Case).

Values of less than -0.1 approach 0.0.

ha = hectare; m = metre;% = percent; RFD = reasonably foreseeable development; <= less than.

Wolverines are highly mobile and can travel up to 40 km per day (Banci and Harestad 1990). Female wolverines in the NWT disperse an average of 133 km (range 69 to 225 km) and males an average of 231 km (range 73 to 326 km) (Mulders 2000). Long distance movements of 378 km and 300 km (over 8 and 5 months, respectively) have also been reported (Gardner et al. 1986). The MDNN for rock association, heath rock, and sedge association habitats ranged from 511 to 687 m under the Reference Condition (Table 13.4-11). The MDNN for habitats preferred by wolverine has decreased by less than or equal to 0.1% (less than 1 m) from the Reference Condition compared to the 2014 Baseline Condition. The Project is expected to increase MDNN for sedge association habitat, and decrease MDNN for rock association and heath tundra habitats; all changes are predicted to be less than 0.1% (less than 1 m), relative to the 2014 Baseline Condition. Cumulative changes to the MDNN for rock association, heath rock, and sedge association habitats are predicted to be less than or equal to 0.1% (less than 1 m), from the Reference Condition to the RFD Case. These small changes in habitat area and fragmentation from physical development features are likely to be ecologically non-measurable for the wolverine population (or metapopulation).

13.4.5.2 *Habitat Quality, Behaviour, and Movement*

13.4.5.2.1 *Methods*

The quality of wolverine habitat in the ESA was classified using resource selection function (RSF) methods. The RSF models were run on the ELC developed for the ESA (described in the Section 13.4.2.1). Using the output from the reclassified dataset, patches of habitat per land cover type were identified such that each patch was a contiguous group of cells. Next, the proportional area of each patch, relative to that available for the related land cover type in a seasonal range (winter and summer), was determined. Based on the resulting raster layers and RSF coefficients and formulas determined for wolverine in the ESA with no development (Johnson 2009; Table 13.4-12), resource selection values were generated per cell (Johnson et al. 2004, 2005). Waterbodies were designated as nil (zero) during the habitat mapping process.

Table 13.4-12 Coefficients and 95% Confidence Intervals from Resource Selection Models for Wolverine of the Canadian Central Arctic (No Development)

Covariate	Winter Coefficient	Lower 95% Confidence Interval	Upper 95% Confidence Interval	Summer Coefficient	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Sedge Association	1.802	1.146	2.458	1.739	0.975	2.504
Riparian Shrub	1.509	-1.173	4.192	-0.687	-4.341	2.966
Peat Bog	n/a	n/a	n/a	-4.949	-13.307	3.408
Heath Tundra	0.445	-0.121	1.011	0.615	-0.001	1.230
Heath Rock	0.749	0.230	1.268	0.181	-0.485	0.847
Rock Association	2.735	1.520	3.950	-0.791	-2.557	0.975
Lichen Veneer	-0.355	-1.715	1.005	-1.484	-3.629	0.660
Esker Complex	-1.541	-4.671	1.590	0.579	-2.600	3.758

Source: Johnson (2009).
n/a = not available; % = percent.

Effects of assumed disturbance, which were based on hypothetical (not modelled) disturbance coefficients and ZOI, were applied to the RSF outputs generated from land cover datasets. Hypothetical disturbance coefficients provide a surrogate to modelled coefficients, and are consistent with previous efforts to estimate effects from development on habitat quality (Johnson et al. 2005; De Beers 2010a). Disturbance coefficients reduce habitat quality within each defined ZOI. For example, a disturbance coefficient of 0.05 implies that habitat quality was reduced by 95% of the original value.

Values of disturbance coefficients and ZOI were guided by the published literature (Table 13.4-13). Correlation among disturbance effects could not be statistically controlled; therefore, the effects of multiple coefficients at the same location were not multiplied. The coefficient with the strongest effect was applied where ZOI overlapped, which increased certainty that the predicted effect would not be under estimated but was likely overestimated. For all closed developments and inactive land use permits, the physical footprint was carried through the entire effects analysis as it was assumed that direct disturbance to the landscape had not yet been reversed. The size of the ZOI was similar for all permitted mines (i.e., 15 km) regardless of the level of activity or size of the development footprint. The ZOIs for developments in the ESA are considered to be conservative because most loud noise (50 to 55 dBA during construction and 40 to 45 dBA during operations) is predicted to be within 1 km of the Project footprint (Appendix 13B; Appendix 13D, Map 13D-1 and Map 13D-2). Also, most effects from human disturbance on large mammal species occur within 5 km from developments (Benitez-Lopez et al. 2010).

After habitat maps and modelling for each seasonal home range were completed, raster cells (ranging from 0 to 1) were divided into four categories (high, good, low, and poor) of approximate equal area (delineated by quartiles). However, the ArcGIS algorithm for this task was constrained by the large study area and distribution of cell values. Thus, category thresholds were manually determined by plotting a histogram of raster cell values, and running the equal area function on a lower range of data without outliers. Larger outlying values were grouped into the top category. The RSF outputs based on only vegetation datasets (i.e., no developments) were used as a Reference Condition within the Base Case.

Table 13.4-13 Disturbance Coefficients and Associated Zones of Influence for Development Activities in the Grizzly Bear and Wolverine Effects Study Area

Type of Development	Feature Type	Footprint Extent (m)	Footprint Disturbance Coefficient	Zone of Influence Range 1[c]	Disturbance Coefficient	Zone of Influence Range 2	Disturbance Coefficient	Zone of Influence Range 3	Disturbance Coefficient
Communications (e.g., microwave towers)	point	200	0.00	0 to 1 km	0.90	n/a	n/a	n/a	n/a
Community	polygon	actual[b]	0.00	0 to 1 km	0.05	1 to 5 km	0.50	5 to 15 km	0.75
Fuel storage	point	200	0.00	n/a	n/a	n/a	n/a	n/a	n/a
Contaminated Site – High and Medium Priority [a]	point	200	0.00	n/a	n/a	n/a	n/a	n/a	n/a
Lodge (outfitters, tourism)	point	200	0.00	0 to 5 km	0.10	n/a	n/a	n/a	n/a
Mine	polygon	actual[b]	0.00	0 to 1 km	0.05	1 to 5 km	0.50	5 to 15 km	0.75
Mineral exploration	point	500	0.00	0 to 1 km	0.50	1 to 5 km	0.75	n/a	n/a
Miscellaneous (e.g., bridge)	point	200	0.00	0 to 1 km	0.90	n/a	n/a	n/a	n/a
Quarry	point	200	0.00	0 to 5 km	0.75	n/a	n/a	n/a	n/a
Staging area / barge landings	point	200	0.00	0 to 5 km	0.75	n/a	n/a	n/a	n/a
Winter and all-season roads	line	200	0.00	0 to 1 km	0.05	1 to 5 km	0.75	n/a	n/a
Winter road portages	line	200	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Transmission line	line	200	0.25	0 to 1 km	0.50	1 to 5 km	0.75	n/a	n/a

a) As classified by the Federal Contaminated Sites Inventory (TBCS 2013).
b) Activities estimated with the exception of mine operations and communities, which were delineated and digitized from remote sensing imagery.
c) From edge of actual or hypothetical footprint.
Note: Values were guided by published literature (Vistnes and Nelleman 2001; Mahoney and Schaefer 2002; Nelleman et al. 2003; Johnson et al. 2005).
n/a = not applicable; m = metre; km = kilometre.

The relative change in the amount of different quality habitats for each seasonal range for different conditions on the landscape was calculated as follows:

- (2014 Baseline Condition value – Reference Condition value) / Reference Condition value.
- (Application Case value – 2014 Baseline Condition value) / 2014 Baseline Condition value.
- (RFD Case value – Application Case value) / Application Case value.

Changes to wolverine abundance and distribution due to changes to caribou movement and migration from increased traffic on the Misery Road and Jay Road, as well as from the above-ground power line along these roads, were assessed using results from the barren-ground caribou KLOI (Section 12.4.2.2).

13.4.5.2.2 *Results*

Wolverine occurrence in the ESA is positively correlated with sedge association, heath rock, and rock association habitats in the winter. Habitat type seems to be less important during the spring through autumn, with a positive correlation only noted for sedge association habitat (Johnson et al. 2004, 2005).

Suitable (combined high and good quality) spring to fall habitats covered 29.0% of the ESA during the Reference Condition, while suitable winter habitats covered 21.2%. Previous and existing developments have removed 3.4% suitable wolverine spring to autumn habitat, relative to the Reference Condition. Specifically, high and good quality habitat decreased by 3.0% and 3.9%, respectively, relative to Reference Conditions (Table 13.4-14). More suitable winter habitat (7.5%) has been removed by previous and existing developments. The Project is predicted to remove 0.1% of both suitable spring to autumn and winter habitats, relative to the 2014 Baseline Condition.

Previous, existing, and reasonably foreseeable future developments, including the Project, are predicted to remove 9.3% of suitable spring to autumn habitats for wolverine. The cumulative loss of high and good quality spring to autumn habitat is estimated to be 8.3% and 10.2%, respectively (Table 13.4-15). The removal of suitable winter habitat from the Reference Condition to the RFD Case is predicted to be 12.3%. Changes to wolverine winter and spring through autumn habitat suitability in the ESA for the Reference Condition, 2014 Baseline Conditions, Application Case, and RFD Case are illustrated in Appendix 13C, Maps 13C-10 to 13C-17.

The cumulative amount of high and good winter habitat removed by human developments is considered to be a conservative estimate. Approximately 7.4% of the total 12.3% cumulative loss of winter habitat is due to seasonal ice roads such as the TCWR and access roads to mine sites (i.e., 59.9% of the area within the ZOI in the ESA is due to winter roads). Disturbance from these roads is considered temporary because winter roads are only active for 8 to12 weeks every year. Additional conservatism was included in the analysis by assuming the section of the TCWR that is north of the Lac de Gras region was active (i.e., buffered by a 5 km ZOI). However, this northern portion of the road has not been constructed since 2008 (Near 2014b). The portion of the TCWR that is north of the Lac de Gras region accounts for 5.8% of the 12.3% loss of high and good quality winter habitat from the Reference Condition to the RFD Case (i.e., 47.1% of the area within the ZOIs in the ESA is from the northern portion of the TCWR).

Roads with high traffic volumes may be a partial barrier to wolverine movement. Carnivores (including wolverine) in Banff National Park were found to cross roads with traffic volumes of 300 to 500 vehicles per day significantly (P≤0.05) fewer times than roads with lower traffic volumes (Alexander et al. 2005). For this assessment, traffic volumes on the Misery and Jay Roads were assumed to be 56 trips per day by road trains (Section 3.5.1.6). Sensory disturbance from this increased traffic may increase avoidance of these roads by wolverines. However, traffic volumes are not anticipated to be high enough to affect wolverine crossing rates of these roads.

In addition to affecting wolverine movement, increased traffic on the Misery and Jay roads, as well as the above-ground power line along these roads (Tyler et al. 2014), may cause caribou to avoid these roads. The caribou energetics model assumed caribou would not cross the Misery or Project roads (i.e., these roads created a barrier effect) and be required to travel using longer alternate routes to continue migration through the Lac de Gras region (Section 12.4.2.3.1). However, results of camera monitoring at Ekati from 2011 to 2013 indicate that caribou do cross the Misery road so it is not acting as an absolute barrier to caribou (and carnivore) movements (ERM Rescan 2014b). There is uncertainty around how caribou and wolverine will respond to the increased traffic on the Misery Road. Dominion Diamond will implement spatially and temporally staged monitoring of the Bathurst caribou herd to track migratory movements via (i) satellite radiocollars, (ii) aerial reconnaissance surveys for caribou approaching roads and (iii) road surveys. The data collected during these monitoring activities will be used to test effects predictions and the success of proposed mitigation for increased traffic on the Misery Road.

Increased traffic on the Misery Road will be mitigated by:

- modified traffic patterns and road closures will be used as necessary to protect wildlife and people; and,
- stockpiling ore to provide supply for processing during road closures.

Table 13.4-14 Relative Changes in the Availability of Different Quality Habitats for Wolverine from the Reference Condition to Application Case

Season/Habitat Quality	Reference (ha)	2014 Baseline Condition (ha)	Change (%) from Reference to 2014 Baseline Condition	Application Case (ha)	Change (%) from 2014 Baseline Condition to Application Case	Cumulative Change (%) from Reference to Application Case
Spring to Autumn						
High	2,815,256	2,731,560	-3.0	2,729,208	-0.1	-3.1
Good	2,809,416	2,700,652	-3.9	2,697,896	-0.1	-4.0
Low	9,082,064	8,761,512	-3.5	8,754,748	-0.1	-3.6
Poor	532,076	1,045,088	96.4	1,056,960	1.1	98.6
Nil (water)	4,174,052	-	-	-	-	-
Winter						
High	2,026,292	1,872,524	-7.6	1,870,352	-0.1	-7.7
Good	2,081,744	1,926,124	-7.5	1,924,372	-0.1	-7.6
Low	9,489,256	8,853,188	-6.7	8,849,064	0.0	-6.7
Poor	1,641,520	2,586,976	57.6	2,595,024	0.3	58.1
Nil (water)	4,174,052	-	-	-	-	-

Note:% change was calculated as the relative incremental change for each habitat category from one time period to the next (i.e., reference to 2014 baseline, 2014 baseline to Application). Cumulative changes may not exactly sum due to rounding.

ha = hectare;% = percent; - = not calculated.

Table 13.4-15 Relative Changes in the Availability of Different Quality Habitats for Wolverine from Reference Condition to Reasonably Foreseeable Development Case

Season/Habitat Type	Reference (ha)	RFD Case (ha)	Cumulative Change (%) from Reference to RFD Case
Spring to Autumn			
High	2,815,256	2,580,320	-8.3
Good	2,809,416	2,522,772	-10.2
Low	9,082,064	8,370,852	-7.8
Poor	532,076	1,764,868	231.7
Nil	4,174,052	4,174,052	0.0
Winter			
High	2,026,292	1,794,308	-11.4
Good	2,081,744	1,806,860	-13.2
Low	9,489,256	8,457,352	-10.9
Poor	1,641,520	3,180,292	93.7
Nil	4,174,052	4,174,052	0.0

Note:% change was calculated as the relative incremental change for each habitat category. Cumulative changes may not exactly sum due to rounding.

ha = hectare;% = percent; RFD = reasonably foreseeable development.

13.4.6 Effects to the Abundance and Distribution of Grizzly Bear

13.4.6.1 *Habitat Quantity and Fragmentation*

13.4.6.1.1 *Methods*

The quantity of grizzly bear habitat in the ESA was calculated using the same methods as for wolverine (Section 13.4.5.1.1)

13.4.6.1.2 *Results*

Under the Reference Condition, the ESA is mainly comprised of open water (34.3%), heath tundra (22.7%), heath rock (16.0%), and sedge association (10.6%) habitats. Rock association covers approximately 7.4% of the ESA, while lichen veneer habitat covers approximately 3.2%. Low shrub and forest habitats cover approximately 1.6% and 2.0% of the ESA, respectively. Less than 1% of the ESA is covered by esker, riparian shrub, peat bog, old burn, and young burn habitats.

Barren-ground grizzly bears in the ESA were found to prefer esker, tussock/hummock tundra (sedge association), lichen veneer, birch seep (low shrub), and tall shrub riparian habitats (McLoughlin et al. 1999, 2002a). Traditional and scientific knowledge suggest that eskers provide important denning habitat for grizzly bears in tundra environments (Section 13.2.3.5.2; McLoughlin et al. 2002b). Approximately 4 ha of esker will be disturbed by the Project (Section 13.4.5.1.2). Traditional and scientific knowledge also suggests that the Lac de Gras region of the NWT contains high quality habitat for grizzly bears (Section 13.2.3.2.2; ERM Rescan 2014b). This may be due the prevalence of eskers for denning, access to food resources including caribou, fish, and forage in riparian zones, and low level of hunting in the area (ERM Rescan 2014b).

Previous and existing developments in the ESA have removed 1.3% of esker habitat relative to the Reference Condition (Table 13.4-11). Less than or equal to 0.2% of sedge association, lichen veneer, low shrub, and riparian shrub habitats have been removed by previous and existing developments. The Project is predicted to remove less than 0.1% of esker, sedge association, lichen veneer, low shrub, and riparian shrub habitats, relative to the 2014 Baseline Condition. Similar to wolverine, natural succession of plant cover may attract prey species, which could be available to grizzly bears. Some types of vegetation may also be consumed by bears (e.g., new emergent grasses and sedges). Cumulative loss of esker habitat in the ESA from the Reference Condition to the RFD Case is predicted to be 1.5%. Cumulative loss of other preferred grizzly bear habitats is predicted to be less than or equal to 0.3%, relative to the Reference Condition.

Grizzly bears are highly mobile. Males in the North Slave Region of the NWT travel an average of 7 to 11 kilometres per day (km/day); females travel an average of 4 to 6 km/day (McLoughlin et al. 1999). The maximum distances recorded for bears in the Lac de Gras Region was 8.5 km/day for males and 5.3 km/day for females (ERM Rescan 2014b). Grizzly bear home ranges in the North Slave Region average 6,685 km^2 for males and 2,074 km^2 for females; these are the largest home ranges recorded for grizzly bears in North America (McLoughlin et al. 1999).

Under the Reference Condition, the mean distance to nearest similar habitat patch for preferred grizzly bear habitats (i.e., esker, lichen veneer, low shrub, riparian shrub, and sedge association) was from 560 to 1,071 m (Table 13.4-11). Previous and existing developments have increased the MDNN for esker habitat by 0.2% (2 m), relative to the Reference Condition. The MDNN for lichen veneer, low shrub, riparian shrub, and sedge association habitats have each increased by 0.1% (less than 1 m), from reference compared to 2014 Baseline Conditions. The Project is predicted to increase the MDNN for esker, lichen veneer, low shrub, riparian shrub, and sedge association habitats by less than 0.1% (less than 1 m), relative to the 2014 Baseline Condition. Cumulative changes in the MDNN for esker, lichen veneer, low shrub, riparian shrub, and sedge association habitats are predicted to be less than or equal to 0.6% (less than or equal to 3 m) from the Reference Condition to the RFD Case. Similar to wolverine, these small changes in habitat area and fragmentation from physical development features are likely to be ecologically non-measurable for the grizzly bear population.

13.4.6.2 *Habitat Quality, Behaviour, and Movement*

13.4.6.2.1 *Methods*

The quality of grizzly bear habitat was classified using resource selection function (RSF) methods, similar to those described for wolverine (Section 13.4.5.2). The RSF models were run on the ELC developed for the ESA (described in Section 13.4.5.1). Based on the resulting raster layers and the application of RSF coefficients and formulas determined for grizzly bear in the ESA with no development (Johnson 2009; Table 13.4-16), resource selection values were generated per cell (Johnson et al. 2004, 2005). Waterbodies were designated as nil (zero) during the habitat mapping process.

Changes to grizzly bear abundance and distribution due to changes to caribou movement and migration from increased traffic on the Misery Road and Jay Road , as well as from the above-ground power line along these roads, were assessed using results from the barren-ground caribou KLOI (Section 12.4.2.2).

Table 13.4-16 Coefficients and 95% Confidence Intervals from Resource Selection Function Models for Grizzly Bear of the Canadian Central Arctic (No Development)

Covariate	Spring Coefficient	Lower 95% Confidence Interval	Upper 95% Confidence Interval	Early Summer Coefficient	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Sedge Association	0.585	0.142	1.029	1.381	0.994	1.768
Riparian Shrub	1.527	0.458	2.595	2.085	1.003	3.167
Low Shrub	1.388	0.849	1.928	1.994	1.484	2.504
Peat Bog	n/a	n/a	n/a	n/a	n/a	n/a
Heath Tundra	0.465	0.169	0.760	0.917	0.644	1.191
Heath Rock	0.626	0.290	0.962	-0.001	-0.354	0.352
Rock Association	0.594	0.133	1.055	0.477	0.016	0.937
Forest	0.440	-1.811	2.692	n/a	n/a	n/a
Lichen Veneer	0.891	0.128	1.654	-0.542	-1.528	0.445
Esker Complex	1.684	0.361	3.008	1.745	0.480	3.011
Covariate	**Late Summer Coefficient**	**Lower 95% Confidence Interval**	**Upper 95% Confidence Interval**	**Autumn Coefficient**	**Lower 95% Confidence Interval**	**Upper 95% Confidence Interval**
Sedge Association	1.269	0.852	1.686	0.631	0.087	1.176
Riparian Shrub	2.164	1.175	3.154	1.364	0.125	2.604
Low Shrub	1.963	1.389	2.537	2.030	1.275	2.785
Peat Bog	1.366	-0.840	3.571	-0.866	-3.533	1.801
Heath Tundra	0.630	0.330	0.930	1.137	0.795	1.479
Heath Rock	0.214	-0.159	0.586	0.126	-0.321	0.572
Rock Association	0.158	-0.369	0.686	-0.072	-0.773	0.629
Forest	-0.131	-2.061	1.799	-0.486	-1.900	0.929
Lichen Veneer	-0.694	-1.718	0.330	-0.223	-1.316	0.870
Esker Complex	4.876	3.812	5.940	1.864	-0.071	3.800

Source: Johnson (2009)
n/a = not available; % = percent.

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13.4.6.2.2 *Results*

Grizzly bears that have home ranges near the Ekati and Diavik mines appear to be concentrated north and east of the mines in a band that reaches from Yamba Lake in the north, along the north shores of Lac de Gras, to Aylmer Lake in the southeast (ERM Rescan 2014b). This area is thought to be highly suitable for grizzly bears because of the abundance of waterbodies, which provide forage and relief from hot weather, and the large number of eskers present in the area (ERM Rescan 2014b). The area north and east of the Ekati and Diavik mines is also considered to be highly suitable for the Bathurst caribou herd during the post-calving and summer periods (Section 12.4.2.2.2). The spring, mid-summer, and fall diet of grizzly bears in the North Slave Region of the NWT is primarily comprised of caribou (Gau et al. 2002).

Based on RSF modelling, suitable (combined high and good quality) grizzly bear spring habitats comprised 16.7% of the ESA under the Reference Condition. Suitable early summer habitat comprised 23.9% of the ESA, while suitable late summer habitats comprised 30.8%. Under the Reference Condition, suitable autumn habitat comprised 21.1% of the ESA.

Previous and existing developments have removed from 2.9% (spring) to 3.7% (autumn) of suitable grizzly bear habitats, relative to the Reference Condition. Specifically, high quality habitat decreased by 1.7% (spring) to 3.1% (autumn), and good quality habitat was reduced by 3.4% (spring) to 4.3% (early summer and autumn) (Table 13.4-17). The greatest increase in poor quality habitat from the Reference Condition to the 2014 Baseline Condition occurred for late summer habitat (81.2%), followed by autumn habitat (38.4%). The Project is predicted to remove less than or equal to 0.1% of high and good quality habitats, relative to the 2014 Baseline Condition. The largest increase in poor quality is predicted for late summer habitat (1.1%), followed by autumn habitat (0.7%).

Previous, existing and reasonably foreseeable developments, including the Project, are predicted to remove from 7.1% (spring) to 8.5% (autumn) suitable habitats, relative to the Reference Condition. Predicted cumulative decreases in high quality habitat ranged from 3.5% (spring) to 7.2% (late summer), while the cumulative reduction in good quality habitat ranged from 8.5% (spring) to 10.0% (early summer) (Table 13.4-18). Changes to spring, early summer, late summer, and autumn grizzly bear habitat suitability in the ESA for the Reference Condition, 2014 Baseline Condition, Application Case, and the RFD Case are illustrated in Appendix 13C, Maps 13C-18 to 13C-33.

Potential effects from increased traffic on the Misery and Jay roads on grizzly bear abundance, distribution, and population connectivity are unclear. Some studies found that grizzly bears avoid roads (McLellan and Shackleton 1988; Kasworm and Manley 1990), while others found no avoidance behavior by grizzly bears (Yost and Wright 2001). Although Alexander et al. (2005) did not assess grizzly bear, road crossing rates for other large carnivores (e.g., gray wolf, cougar [*Puma concolor*]) were significantly ($P \leq 0.05$) decreased when traffic volumes exceeded 300 vehicles per day. At the time of this assessment, road trains were expected to make 56 trips per day on the Misery and Jay Roads (Section 3.5.1.6). Satellite collared grizzly bears within 40 km of the Ekati Mine were found to frequently cross and use areas around the Misery Road (BHP Billiton 2002, 2003, 2004). Sensory disturbance from this increased traffic may increase avoidance of these roads by grizzly bears. However, traffic volumes are not anticipated to be high enough to affect grizzly bear crossing rates of these roads.

In addition to affecting grizzly bear movement, increased traffic on the Misery and Jay roads, as well as the above-ground power line along these roads may cause caribou to avoid these roads (Tyler et al. 2014). The caribou energetics model assumed caribou would not cross the Misery or Project roads (i.e., these roads created a barrier effect) and be required to travel using longer alternate routes to continue migration through the Lac de Gras region (Section 12.4.2.3.1). However, results of camera monitoring at Ekati from 2011 to 2013 indicate that caribou do cross the Misery road so it is not acting as an absolute barrier to caribou (and carnivore) movements (ERM Rescan 2014b). There is uncertainty around how caribou and grizzly bear will respond to the increased traffic on the Misery Road. Dominion Diamond will implement spatially and temporally staged monitoring of the Bathurst caribou herd to track migratory movements via (i) satellite radiocollars (ii) aerial reconnaissance surveys for caribou approaching the roads, and (iii) road surveys. The data collected during these monitoring activities will be used to test effects predictions and the success of proposed mitigation for increased traffic on the Misery Road.

Increased traffic on the Misery Road will be mitigated by:

- modified traffic patterns and road closures will be used as necessary to protect wildlife and people; and,
- stockpiling ore to provide supply for processing during road closures.

Table 13.4-17 Relative Changes in the Availability of Different Quality Habitats for Grizzly Bear from Reference Condition to Application Case

Season/Habitat Quality	Reference Condition (ha)	2014 Baseline Condition (ha)	Change (%) from Reference to 2014 Baseline Condition	Application Case (ha)	Change (%) from 2014 Baseline Condition to Application Case	Cumulative Change (%) from Reference Condition to Application Case
Spring						
High	932,576	916,316	-1.7	916,224	0.0	-1.8
Good	2,315,576	2,237,880	-3.4	2,235,708	-0.1	-3.4
Low	2,155,580	2,081,704	-3.4	2,078,132	-0.2	-3.6
Poor	9,835,080	10,002,912	1.7	10,008,748	0.1	1.8
Nil (water)	4,174,052	-	-	-	-	-
Early Summer						
High	2,174,676	2,129,624	-2.1	2,127,452	-0.1	-2.2
Good	2,466,712	2,360,600	-4.3	2,357,792	-0.1	-4.4
Low	4,128,708	3,985,236	-3.5	3,981,244	-0.1	-3.6
Poor	6,462,092	6,756,728	4.6	6,765,700	0.1	4.7
Nil (water)	4,172,060	-	-	-	-	-

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Table 13.4-17 Relative Changes in the Availability of Different Quality Habitats for Grizzly Bear from Reference Condition to Application Case

Season/Habitat Quality	Reference Condition (ha)	2014 Baseline Condition (ha)	Change (%) from Reference to 2014 Baseline Condition	Application Case (ha)	Change (%) from 2014 Baseline Condition to Application Case	Cumulative Change (%) from Reference Condition to Application Case
Late Summer						
High	2,458,140	2,391,724	-2.7	2,389,460	-0.1	-2.8
Good	3,521,052	3,385,064	-3.9	3,381,236	-0.1	-4.0
Low	8,627,884	8,317,304	-3.6	8,311,224	-0.1	-3.7
Poor	631,736	1,144,720	81.2	1,156,892	1.1	83.1
Nil (water)	4,174,052	-	-	-	-	-
Autumn						
High	2,007,504	1,946,172	-3.1	1,943,820	-0.1	-3.2
Good	2,083,088	1,993,212	-4.3	1,990,332	-0.1	-4.5
Low	9,836,644	9,484,844	-3.6	9,477,912	-0.1	-3.6
Poor	1,311,576	1,814,584	38.4	1,826,748	0.7	39.3
Nil (water)	4,174,052	-	-	-	-	-

Note:% change was calculated as the relative incremental change for each habitat from one time period to the next (i.e., reference to 2014 baseline, 2014 baseline to Application Case). Cumulative changes may not exactly sum due to rounding.

ha = hectare;% = percent; - = not calculated.

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Table 13.4-18 Relative Changes in the Availability of Different Quality Habitats for Grizzly Bear from the Reference Condition to Reasonably Foreseeable Development Case

Season/Habitat Type	Reference Condition (ha)	RFD Case (ha)	Cumulative Change (%) from Reference Condition to RFD Case
Spring			
High	932,576	899,504	-3.5
Good	2,315,576	2,118,412	-8.5
Low	2,155,580	1,963,372	-8.9
Poor	9,835,080	10,257,524	4.3
Nil	4,174,052	-	-
Early Summer			
High	2,174,676	2,046,156	-5.9
Good	2,466,712	2,219,356	-10.0
Low	4,128,708	3,762,236	-8.9
Poor	6,462,092	7,204,440	11.5
Nil	4,172,060	-	-
Late Summer			
High	2,458,140	2,280,576	-7.2
Good	3,521,052	3,194,620	-9.3
Low	8,627,884	7,893,893	-8.5
Poor	631,736	1,869,724	196.0
Nil	4,174,052	-	-
Autumn			
High	2,007,504	1,865,204	-7.1
Good	2,083,088	1,876,148	-9.9
Low	9,836,644	9,014,912	-8.4
Poor	1,311,576	2,482,548	89.3
Nil	4,174,052	-	-

Note:% change was calculated as the relative incremental change for each habitat category. Cumulative changes may not exactly sum due to rounding.

ha = hectare;% = percent; RFD = reasonably foreseeable development; - = not calculated.

13.4.7 Residual Effects Summary for Wolverine and Grizzly Bear

Direct disturbance from previous and existing developments has accounted for small changes to the landscape in the grizzly bear and wolverine ESA. The magnitude of changes to preferred wolverine and grizzly bear habitat quantity and fragmentation metrics for the 2014 Baseline Condition were less than or equal to 1.3%, relative to the Reference Condition. The Project footprint is 1,132 ha (0.05% of the ESA) and is composed of 62% terrestrial habitat and 38% aquatic habitat. Cumulative changes to habitat loss and fragmentation metrics are predicted to be less than or equal to 1.5%, from the Reference Condition to the RFD Case.

The terrestrial area that contains the Project footprint is considered a permanent disturbance on the landscape because of the time for vegetation to recover, and it is not known what the reclaimed landscape will look like in the future. The Ekati Mine ICRP works to facilitate and promote the natural colonization of disturbed areas. Early successional stages of planted vegetation may provide suitable browse for prey species, which could be available for wolverines and grizzly bears. Some types of new emergent vegetation may also be consumed by bears (e.g., grasses and sedges).

Previous and existing developments have reduced the amount of suitable (combined high and good quality) wolverine spring through autumn habitat and winter habitat by 3.4% and 7.5%, respectively. The Project is predicted to result in a 0.1% reduction in high and good quality wolverine habitat, relative to the 2014 Baseline Condition. Cumulative changes to spring through autumn habitat and winter wolverine habitat from previous, existing, and reasonably foreseeable future developments (including the Project) are predicted to be 9.3% and 12.3%, relative to the Reference Condition. Approximately 7.4% of the cumulative 12.3% decrease of suitable winter habitat is due to seasonal ice roads such as the TCWR and access roads to mine sites (i.e., 59.9% of the area within the ZOIs in the ESA is due to winter roads). Disturbance from these roads on the wolverine population is considered temporary because winter roads are only active for 8 to12 weeks every year. The portion of the TCWR that is north of the Lac de Gras region accounts for 5.8% of the 12.3% loss of high and good quality winter habitat from the Reference Condition to the RFD Case (i.e., 47.1% of the area within the ZOIs in the ESA is from the northern portion of the TCWR). This section of the TCWR has not been constructed since 2008.

Previous and existing developments have reduced the amount of suitable grizzly bear habitats in the ESA by 2.9% to 3.7%. The Project is predicted to result in a 0.1% reduction in high and good quality grizzly habitat, relative to the 2014 Baseline Condition. Cumulative changes to suitable grizzly bear habitats from previous, existing, and reasonably foreseeable future developments (including the Project) are predicted to be from 7.1% to 8.5%, relative to the Reference Condition.

There was also a considerable increase in the quantity of poor habitat in the ESA from the Reference Condition to the RFD Case, particularly the late summer season for grizzly bear (196%) and spring through autumn season for wolverine (231.7%). This increase is partially due to the smaller amount of poor quality habitat relative to higher quality habitats on the landscape (i.e., a small absolute increase represents a large proportional change). Except for development footprints, most poor habitat is a result of indirect changes to habitat quality and does not represent inhospitable or hazardous areas for grizzly bear and wolverine. Unlike more rural and urban landscapes that can restrict movement between habitat patches, dispersal across the area, and/or increase mortality risk (Weaver et al. 1996; Fahrig 1997; Cegelski et al. 2003; Swift and Hannon 2010; Proctor et al. 2011), the increase in poor habitat in the ESA is predicted to have a negligible effect on the movement and survival of individual grizzly bears and wolverines.

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 grizzly bear and wolverine extends to the populations within the ESA (i.e., regional scale). The duration of the effects to wolverine and grizzly bear populations from changes in habitat quality and altered movement and behaviour are expected to be reversed within 5 to 10 years following the end of closure.

13.5 Prediction Confidence and Uncertainty

The purpose of the prediction confidence and 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 effects are not worse than expected. Confidence in the residual effects analysis and assessment of environmental significance is related to the following elements:

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

Like all scientific results and inferences, residual effects predictions must be tempered with uncertainty associated with the data and current knowledge of the system. Each of these key elements are discussed in the context of residual effects analysis and assessment for each VC.

It is anticipated that the baseline data are sufficient for understanding current conditions and future changes not related to the Project, and that there is a moderate to high level of understanding of Project-related effects on the ecosystem. There is good information on the magnitude of effects from mining activity on raptors (Golder 2011; Coulton et al. 2013), wolverine (Johnson et al. 2004, 2005; Golder 2007, 2008a, 2014; Boulanger and Mulders 2013), grizzly bear (Johnson et al. 2004, 2005; ERM Rescan 2014b), and waterbirds (DDMI 2013) in the Lac de Gras area. It is understood that development activities will directly and indirectly affect habitat, and the behaviour and movement of wildlife and associated species at risk. However, long-term monitoring studies documenting the time required to reverse effects are lacking.

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 (Walther et al. 2002). For example, both waterbirds and raptors are migratory species and are also under pressures from natural and anthropogenic (e.g., waterfowl harvest) factors on their wintering grounds. Natural factors such as the 2014 forest fires in the NWT can also influence bird and carnivore VCs. The number, frequency, and severity of wildfires in many parts of the world have increased from 1960 to 2013 (Bladon et al. 2014). Climate change and fire suppression practices are thought to be the largest contributors to the trend. A recent prediction for Canada indicates the potential for a 74% to 118% increase in average burn area by the end of this century (Flannigan et al. 2005). Fire alters many components of the environment including air quality, water quality, soil characteristics, vegetation cover, and hydrological processes.

Fire is a natural part of arctic and boreal ecosystems, and soils and plants have adapted to them. Fires are generally larger, more intense, and more severe in forested areas and near the treeline than in open tundra areas (Wein 1976; Gustine et al. 2014) because there is more fuel and fire can generate enough energy to jump streams, lakes and areas of wet or moist vegetation (Wein 1976). Further north in tundra areas the amount of fuel is limited and so fire cannot generate enough energy to burn through moist areas, into the wind, or downhill (Wein 1976). As such, most fires that occur in the tundra are small (less than 1 km^2), although large fires (covering tens of thousands of square kilometres) have occurred (Wein 1976; Gustine et al. 2014). The risk of a large fire near the Project is low because of its northern location in the tundra of the NWT. However, long-range transport of smoke from large fires in the circumpolar boreal forest can change air quality near the Project (Warneke et al. 2010). Atmospheric deposition of soluble gases and particulates produced by boreal fires can change soil and vegetation characteristics, and wildlife habitat (Bobbink et al. 1998; Rusek and Marshall 2000; Jung et al. 2011).

Smoke from boreal forest fires can contain hundreds of different compounds in both the gas and particulate phases (Mahaffey and Miller 1994; Core and Peterson 2001). Smoke composition depends on fuel composition and fire type (e.g., active flaming fires versus smoldering fires), but is dominated by emissions of water vapour, oxides of carbon (CO, CO_2), oxides of nitrogen (NO_x), non-methane hydrocarbons (NMHC), volatile organic compounds (VOCs), and fine particulate matter ($PM_{2.5}$). Atmospheric lifetimes of soluble gases and $PM_{2.5}$ emitted from boreal forest fires are three to ten days. Their emission can create regional hazes that can be transported thousands of kilometres in the lower troposphere (McKeen et al. 2002). Fine particulates serve as cloud condensation nuclei and are removed via wet deposition (e.g., rain or snow). Most soluble gases are also removed by precipitation events. Dry deposition rates are typically low, but can be high close to active fires, and during intense or persistent regional haze events. Overall, changes to air quality from forest fire smoke, especially large fires in the boreal forest, are predicted to result in short-term changes to soil and vegetation quality in the VC effects study areas, and are not anticipated to alter the predictions of effects from the Project on wildlife.

Although quantitative and less biased than models based on expert opinion, HSI and RSF-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 harmful climatic events. However, when considering the predictions of the effects from the Project on bird and carnivore VCs (which include listed species), 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 and RSF models, which together reduce bias and increase precision in predictions.

Several conservative assumptions were implemented in the effects analyses to address uncertainty and improve confidence in predictions. The conservative assumptions used and their implications to effects estimates for waterbirds, raptors, grizzly bear, and wolverine are presented in Table 13.5-1.

Table 13.5-1 Conservative Assumptions Implemented to Reduce Uncertainty and Improve Prediction Confidence for Wildlife Valued Components

Effects Pathway	Conservative Assumption	Implication to Effect	Valued Components
Habitat Quantity and Fragmentation	Undisturbed habitat within Project footprint and other development footprints is unavailable to wildlife	Overestimates habitat loss and fragmentation	Grizzly Bear Wolverine Waterbirds Raptors
	Project footprint was buffered by 200 m	Overestimates habitat loss and fragmentation	Grizzly Bear Wolverine Waterbirds Raptors
	Larger than expected footprint size used when size was not known	Overestimates habitat loss and fragmentation	Grizzly Bear Wolverine Waterbirds Raptors
	Inclusion of winter road portage footprints during non-winter periods	Maximizes the amount of disturbance during non-winter periods	Grizzly Bear Wolverine Waterbirds Raptors
Habitat Quality, Behaviour and Movement	Conservative ZOIs around developments	Overestimates the spatial extent of sensory disturbance	Grizzly Bear Wolverine Waterbirds Raptors
		Captures extent of noise levels from the Project that are greater than 40 to 55 dBA	Grizzly Bear Wolverine Waterbirds Raptors
	The section of the Tibbitt to Contwoyto Winter Road that is north of the Lac de Gras region was assumed to be active (a ZOI was applied in the models), even though this portion of the road has not been constructed since 2008	Overestimates the spatial extent and magnitude of sensory disturbance on habitat quality	Wolverine
	Zone of influence modifiers for HSI and RSF models reduced suitability by a constant regardless of distance from development	Overestimates the magnitude of change from sensory disturbance on habitat quality	Waterbirds Raptors
	The greater disturbance coefficient was used when ZOIs overlapped	Overestimates the magnitude of change from sensory disturbance on habitat quality	Grizzly Bear Wolverine
	Zones of influence duration was for the entire permit period for exploration	Overestimates the duration of sensory disturbance	Grizzly Bear Wolverine Waterbirds Raptors

ZOI = zone of influence; m = metre; dBA = A-weighted decibels; HSI = habitat suitability index; RSF = resource selection function.

To reduce uncertainty associated with changes in habitat, conservative assumptions were implemented to overestimate loss and fragmentation. In the habitat analyses, undisturbed habitat occurring within development footprints was calculated as lost or unsuitable although wildlife may continue to use these areas. For example, waterbirds continue to use mine-altered waterbodies (DDMI 2013), and grizzly bears have also been observed foraging on vegetation at the Diavik Mine (DDMI 2011). Habitat loss was also overestimated by assuming larger than expected footprints. For example, 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. As well, right-of-ways for roads were assumed to be 200 m and power line and surface piping to affect up to 100 m even though actual footprints are expected to be much narrower.

The approach to reduce uncertainty associated with changes in habitat quality, and altered movement and behaviour of wildlife also included assumptions intended to overestimate the magnitude and spatial extent of sensory disturbance. Conservative estimates of the ZOIs and habitat suitability modifier coefficients were applied to the HSI and RSF models. For example, an 800 m ZOI was used for raptors although recent results for raptors nesting in the Lac de Gras area demonstrated that mine-related disturbance to nest success has been negligible (i.e., no detectable ZOI), and that any changes observed are more likely from natural factors (Coulton et al. 2013). As well, habitat suitability modifier coefficients used for waterbirds and raptors decreased suitability by a constant magnitude (i.e., suitability decreased by at least a whole class) regardless of the proximity to the disturbance. A highly suitable habitat was reduced to good regardless of whether it was located adjacent to development or at the maximum extent of the ZOI. In reality, the magnitude of change in habitat suitability from sensory disturbance (e.g., lights, smells, noise, dust, viewscape) will diminish with distance from the source. The duration of activity on the landscape was also overestimated. Zones of influence were also applied to all active exploration sites 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.

The location and timing of construction and operation of some reasonably foreseeable developments is unknown (Section 13.4.1.4). Although the exact location of the Hydroelectric Grid Expansion and the Bathurst Inlet Port and Road Project (Phase 2 to Contwoyto Lake) in the grizzly bear and wolverine ESA is unknown, it is anticipated that these projects will remove a similar amount of habitat regardless of the location (i.e., the development will be approximately the same size as was analysed in this assessment). The uncertainty is around the types of habitats that would be removed. To be conservative and not underestimate effects, all reasonably foreseeable developments known at the time of this assessment were considered in the RFD Case, even if the timing of construction and operation were unknown. This provides a conservative prediction of effects because even if the actual construction and operation of RFDs do not overlap spatially or temporally with the construction and operation of the Project, they were considered to do so in the analysis and assessment of effects on wildlife VCs.

The assumptions applied were designed to overestimate effects from disturbance by creating worse case scenarios. The use of worse case scenarios provides confidence that the analyses are conservative and have not underestimated the incremental and cumulative effects from the Project and other developments on wildlife.

13.6 Residual Impact Classification and Significance

13.6.1 Methods

13.6.1.1 *Residual Impact Classification*

The purpose of the residual impact classification is to describe the incremental and cumulative adverse effects from previous and existing developments, the Project (Application Case), and future developments (RFD Case, if applicable) on wildlife VCs using a scale of common words rather than numbers and units. The use of common words is accepted practice in environmental assessment.

Results from the residual impact classification are then used to determine the environmental significance from the Project and other developments on the assessment endpoint for wildlife VCs. Effects are described using the criteria defined in Table 13.6-1, and reflect the impact descriptors provided in the Terms of Reference (MVRB 2014, Section 4.1). Together, these criteria are used to describe the nature (e.g., severity or intensity of change, and the area and amount of time over which the change occurs) and type (e.g., direction of the change) of an effect on wildlife VCs. The main focus of the DAR is to predict whether the Project is likely to cause a significant adverse (i.e., negative) effect on the environment. Therefore, positive effects are not assessed for significance.

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Table 13.6-1 Effects Criteria Used in the Determination of Significance for Wildlife Valued Components

Criteria	Rating	Definition
Magnitude	Low	Amount of change to measurement indicator results in no measurable effect to population abundance and distribution, or results in a minor measurable residual effect to the population
	Moderate	Amount of change to measurement indicator results in a clearly defined change to population abundance and distribution, but the residual effects are well within the predicted resilience limits and adaptive capacity of the VC
	High	Amount of change to the measurement indicator is sufficiently large that the resulting ranges of residual effects are near or exceeding the predicted resilience limits and adaptive capacity of the VC
Geographic Extent	Local	Predicted maximum spatial extent of direct and indirect effects from changes to measurement indicators due to a project or activity
	Regional	Residual effects from changes to measurement indicator due to a project or activity exceed the local scale and/or can include cumulative effects from other developments in the effects study area
	Beyond Regional	Residual cumulative effects from changes to measurement indicator due to a number of developments extend beyond the effects study area
Duration	Short-term	Residual effect from change to measurement indicator is reversible at end of construction of a project
	Medium-term	Residual effect from change to measurement indicator is reversible at end of operations of a project
	Long-Term	Residual effect from change to measurement indicator is reversible within a defined length of time past closure of a project
	Permanent	Residual effect from change to measurement indicator is irreversible
Frequency	Infrequent	Residual effect from change to measurement indicator is confined to a specific discrete event
	Frequent	Residual effect from change to measurement indicator occurs intermittently
	Continuous	Residual effect from change to measurement indicator occurs continuously
Reversibility	Reversible	Residual effect from change to measurement indicator is reversible within a time period that can be identified when a development or activity no longer influences the population
	Irreversible	Residual effect from change to measurement indicator is predicted to influence the population indefinitely (duration is permanent or unknown)
Likelihood	Unlikely	Residual effect from change to measurement indicator is possible but unlikely (<10% chance of occurrence)
	Likely	Residual effect from change to measurement indicator may occur, but is not certain (10% to 80% chance of occurrence)
	Highly Likely	Residual effect from change to measurement indicator is likely to occur or is certain (80% to 100% chance of occurrence)

Note: resilience is the ability of a population to recover or bounce back from disturbance; it varies among VCs.

VC = valued component; <= less than;% = percent.

Magnitude – Magnitude is a measure of the intensity of a residual effect on a VC. For example, magnitude can represent the degree of change caused by the Project relative to baseline conditions (i.e., effect size). Magnitude is VC-specific and is classified into three scales: low, moderate, and high. For wildlife, magnitude is a function of the numerical and qualitative changes in measurement indicators and the associated influence on the abundance and distribution of VCs. Project-specific (incremental) and cumulative changes in physical (e.g., habitat quantity, quality, and fragmentation) and biological (e.g., survival, reproduction, movement, and behaviour) measurement indicators result in effects on the abundance and distribution of populations. Because the assessment endpoint for wildlife VCs is self-sustaining and ecologically effective populations, the magnitude of residual effects is assessed at the population level. Self-sustaining populations are healthy, robust populations capable of withstanding environmental change and accommodating random demographic processes (Reed et al. 2003). For VCs that have strong effects on ecosystem structure and function (i.e., highly interactive species), the concept of ecologically effective populations also is used (Soulè et al. 2003). An ecologically effective population of a highly interactive species is one that is large enough to maintain ecosystem function.

To provide an ecologically relevant classification of effect sizes of changes in measurement indicators for a particular VC, the assessment of magnitude included the known or inferred ability of the VC to absorb or otherwise accommodate disturbance. The evaluation and classification of magnitude considers the adaptive capacity and resilience of VCs to absorb effects from the Project and other disturbances and continue as self-sustaining and ecologically effective populations. Adaptable VCs can change their behaviour, physiology, or population characteristics (e.g., birth rate) in response to a disturbance such that there is little change in abundance and distribution. For example, behavioural plasticity allows for adaptation to disturbance, high birth rates allow for replacement of harvested individuals, and good dispersal ability allow for connection of fragmented populations (Weaver et al. 1996). Highly adaptable populations also exhibit strong and quick responses to favourable environmental conditions. Less adaptable VCs will be more strongly influenced by human and natural disturbance than VCs with greater adaptive capacity.

A concept closely related to ecological adaptability is ecological resilience. Ecosystems and populations often have inertia and will continue to function after disturbance up to the point where the disturbance becomes severe enough that the system or population changes. Ecological resilience is the capacity of the system to absorb disturbance, and reorganize and retain the same structure, function, and feedback responses (Holling 1973; Gunderson 2000; Curtin and Parker 2014). Population resilience can be considered to share similar features as ecological resilience with adaptability influencing the ability of the population to absorb or recover from change. Highly resilient VCs have the potential to recover quickly after disturbance (i.e., they are also adaptable), whereas VCs with narrower resilience limits will recover more slowly or may not recover at all.

Ideally, effect threshold values for adaptability and resilience limits of a VC would be known, and changes in measurement indicators can be quantified with a high degree of confidence to evaluate whether thresholds are expected to be exceeded. However, critical thresholds such as amount of quality habitat required to maintain a self-sustaining population or the specific number of individuals required for an ecologically effective population size are not available for wildlife VCs in this assessment. Moreover, ecological thresholds vary by species, landscape type, and spatial scale (Fahrig 1997; Swift and Hannon 2010). Consequently, a detailed and transparent account of the predicted effects associated with incremental and cumulative changes to each measurement indicator are provided for each VC using available scientific literature, monitoring data collected from the North Slave region, logical reasoning, and experience of the practitioners completing the assessment (reasoned narrative approach). Because of the uncertainty regarding the effects of development on VCs, magnitude classification was applied conservatively to avoid underestimating effects.

Geographic Extent – Geographic (spatial) extent refers to the area (or distance covered or range) of the effect, and is different from the spatial boundary (i.e., effects study area) for the effects analysis. The study area for the effects analysis represents the maximum area used for the assessment and is related to the spatial distribution and movement of VCs (Section 6.3.1). However, the geographic extent of effects can occur on a number of scales within the spatial boundary of the assessment, and is VC-specific. Geographic extent is categorized into three scales of local, regional, and beyond regional. Effects at the local scale are largely associated with the predicted maximum spatial extent of combined direct and indirect changes from a specific development or activity (e.g., cumulative effects that are specific to the Project). Effects at the regional scale occur within the effects study area, and are associated with incremental and cumulative changes from the Project and other developments. The beyond regional scale includes cumulative residual effects from the Project and other developments that extend beyond the effects study area. The principle applied when using geographic extent to understand magnitude is that local effects from the Project are less severe than effects that extend to the regional or beyond regional scales, all other factors being equal.

Duration – Duration is defined as the amount of time (usually in years) from the beginning of a residual effect to when the residual effect on wildlife populations is reversed. Typically, duration is expressed relative to development phases. Both the duration of individual events and the overall time frame during which the residual effect may occur are considered. Some residual effects may be reversible soon after the effect has ceased, while other residual effects may take longer to be reversed. By definition, residual effects that are short-term, medium-term, or long-term in duration are reversible.

In some cases, available scientific information and professional judgment may predict that the residual effect is irreversible. Alternately, the duration of the residual effect may not be known, except that it is expected to be extremely long and well beyond the temporal boundary of the Project. As such, any number of factors could cause wildlife populations to never return to a state that is unaffected by the Project. In other words, science and logic predict that the likelihood of reversibility is so low that the residual effect is irreversible.

13.6.1.2 *Determination of Significance*

The classification of primary pathways and the associated predicted changes in measurement indicators provide the foundation for determining the significance of incremental and cumulative effects from the Project and other previous, existing, and reasonably foreseeable developments on the assessment endpoint for wildlife. The significance of the contribution of incremental effects from the Project on VCs is provided, but the evaluation is focused on determining the significance of cumulative effects on wildlife.

Magnitude is the primary criterion used to determine environmental significance, while other criteria are used as modifiers and to provide context when assigning magnitude. Geographic extent and duration provide important ecological context for classifying the magnitude of effects to VC assessment endpoints. For example, determining the magnitude of an effect from changes in habitat availability and connectivity on a wildlife VC depends on the spatial extent (amount of area or proportion of the population) and duration of the changes in habitat (how long the population is adversely affected). Duration includes reversibility; a reversible effect from development is one that does not result in a permanent adverse effect on population processes (e.g., survival and reproduction) and properties (e.g., stability and resilience). Frequency and likelihood are also considered as modifiers when determining significance, where applicable.

Duration is also a function of resilience, which is the ability of the population to recover or bounce back from a disturbance (e.g., rate and degree of fluctuation in population abundance and distribution after a disturbance). Resilience is largely a function of demographic and behavioural life history traits such as size and number of litters, age at reproduction, inter-birth interval, age-specific survival rates, lifespan of individuals, habitat selection, and effective dispersal (probability of leaving the natal range and successfully establishing a breeding range and reproducing). The capacity or ability of individuals in a population to change and accommodate disturbance is also related to resilience. For example, some wildlife species that avoid human features in relatively undisturbed landscapes can change their behaviour to accommodate disturbance where it is more prevalent (Martin et al. 2010; Knopff 2011). Other populations may be able to increase reproduction to compensate for harvest mortality.

Resilience can vary with population size, stability, and the likelihood of demographic rescue from neighbouring populations. During periods of low abundance, animal and plant populations can become less resilient to natural environmental and human-related disturbances, which may reduce stability (i.e., trajectory of the population). Stable populations exhibit no long-term increasing or declining trend in abundance outside of natural fluctuations and cycles (e.g., predator-prey cycles). Resilience and stability are properties of a population that influence the amount of risk to VCs from development (Weaver et al. 1996). The duration of development-related effects may be shorter for VCs that are highly resilient and stable.

The evaluation of significance for wildlife considers the entire set of primary pathways that influence the assessment endpoint; thus, significance is not explicitly assigned to each pathway. Rather, the relative contribution of each pathway is used to determine the significance of the Project and other developments on the assessment endpoint, which represents a weight of evidence approach (i.e., evaluating the persuasiveness of evidence indicating that an effect is significant or not significant). For example, a pathway with a high magnitude, a large geographic extent, and a long-term duration is given more weight in determining significance relative to pathways with smaller scale effects. The relative effect from each pathway is discussed; however, pathways that are predicted to have the greatest influence on changes to the assessment endpoint are assumed to contribute the most to the determination of environmental significance.

In accordance with the Terms of Reference (MVRB 2014), for those environmental effects that are determined to be not significant a reasoned narrative is given that provides a potential qualitative significance threshold level. Key factors considered in the determination of environmental significance on wildlife include the following:

- results from the residual impact classification of primary pathways and associated predicted changes in measurement indicators (e.g., loss of habitat, changes to wildlife movement in the ESA);
- magnitude is the primary criterion used to determine significance with geographic extent and duration providing important context for assigning magnitude. Frequency and likelihood act as modifiers for determining significance, where applicable; and,
- the level of confidence in predicted effects, scientific principles (e.g., resilience and stability), and scientific interpretation are also included in the evaluation of determining environmental significance. Where uncertainty was high and the cumulative effect might be either significant or not significant, the assessment conservatively identified the effect as significant and provided additional follow-up actions to reduce uncertainty.

The following definitions are used for predicting the significance of effects to 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 self-sustaining and ecologically effective populations.

Significant – impacts are measurable at the population level and likely to decrease resilience and increase the risk to the maintenance of a self-sustaining and ecologically effective population. Loss of habitat that causes permanent adverse changes to survival or reproduction at the population level would likely be significant. A significant effect may also result from habitat loss and fragmentation that reduces population connectivity to the point that it disrupts demographic rescue between source and sink habitats (or areas).

13.6.2 Results

The cumulative effects from the Project and other developments should not have a significant influence on self-sustaining and ecologically effective waterbird, raptor, wolverine, and grizzly bear populations. For all primary pathways influencing the abundance and distribution of populations, cumulative impacts were determined to be regional in geographic extent (Table 13.6-2; Table 13.6-3), which implies that at least a portion of the population is affected, but likely not the entire population. For incremental impacts from the Project, the geographic extent of pathways ranged from local to regional. Local impacts from habitat loss and alteration were associated with the physical footprint and sensory disturbance from mining activities, and are predicted to influence individuals that travel through or occupy habitats within 800 m to 15 km from the Project site, depending on the VC. Regional effects are a function of incremental and cumulative changes to wildlife habitat, movement, and behaviour from Project-related traffic on the TCWR and human activities from other developments. The likelihood of impacts occurring is expected to be high for all pathways (Table 13.6-2; Table 13.6-3), 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 Project, depending on the VC.

For the assessment of effects to wildlife, physical disturbance to terrestrial habitat from developments was considered permanent. Tundra ecosystems are slow to recover from disturbance, and it is uncertain as to what the revegetated landscape will look like in the future. The Ekati Mine ICRP works to facilitate and promote the natural colonization of disturbed areas. Following closure and back-flooding of the Jay Pit, waterbirds will likely resume the use of this portion of Lac du Sauvage. Early successional stages of planted vegetation may provide suitable browse for prey species, which could be available for wolverines and grizzly bears.

The magnitude for the primary pathways affecting wildlife VCs ranged from low to moderate (Table 13.6-2; Table 13.6-3). For waterbirds and raptors, the area of the cumulative changes from direct habitat loss associated with the Project and previous and existing developments is expected to be approximately 6,048 ha or 1.0% of the ESA. Overall, the magnitude of the cumulative changes to habitat area and configuration (e.g., number and distance between similar patches) from the physical disturbance of the Project and previous and existing developments are estimated to be approximately 1.0% relative to a reference landscape. Waterbird and raptor populations are expected to be resilient to these small changes in habitat.

Changes to landscape metrics for suitable wolverine and grizzly bear habitats were predicted to be less than or equal to 1.3% from the Reference Condition to the Application Case. Incremental changes to habitat area and distance to nearest similar habitat patch from the Project are predicted to be less than or equal to 0.2%. Cumulative direct disturbance from the Project, and previous, existing, and reasonably foreseeable developments in the grizzly bear and wolverine ESA is predicted to be 48,375 ha or 0.4% relative to the Reference Condition. Wolverine and grizzly populations should be resilient to these small changes habitat. Fragmentation can influence individual, population, and community processes, but fragmentation effects have less influence than habitat loss when there is a large proportion of natural habitat on the landscape (Fahrig 1997, 2003; Andrén 1999; Flather and Bevers 2002; Swift and Hannon 2010) as occurs within the effects study areas for grizzly bear, wolverine, waterbirds, and raptors.

Table 13.6-2 Summary of Residual Impact Classification of Primary Pathways and Predicted Significance of Cumulative Effects on Waterbirds and Raptors

Pathway	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Significance for Assessment Endpoint[a]
Direct loss and fragmentation of habitat from the Project footprint leading to changes in abundance and distribution	low	regional	permanent	periodic (migratory species) to continuous (non-migratory species)	irreversible	highly likely	not significant
Sensory disturbance (dust, lights, smells, noise, viewscape) leading to changes to movement and behaviour	low	regional	long-term	periodic (migratory species) to continuous (non-migratory species)	reversible	highly likely	

a) Self-sustaining and ecologically effective wildlife populations.

Table 13.6-3 Summary of Residual Impact Classification of Primary Pathways and Predicted Significance of Cumulative Effects on Wolverine and Grizzly Bear

Pathway	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Significance for Assessment Endpoint[a]
Direct loss and fragmentation of habitat from the Project footprint leading to changes in abundance and distribution	low	regional	permanent	continuous	irreversible	highly likely	not significant
Sensory disturbance (dust, lights, smells, noise, viewscape) leading to changes to movement and behaviour	moderate	regional	long-term	periodic (grizzly bear) to continuous (wolverine)	reversible	highly likely	
Increased traffic on the Misery Road and Jay Road, as well as and the above-ground power line along these roads, may create barriers to wolverine, grizzly bear, and caribou movement, which may affect wolverine and grizzly bear population connectivity, abundance, and distribution	moderate	regional	long-term	periodic (grizzly bear) to continuous (wolverine)	reversible	highly likely	

a) Self-sustaining and ecologically effective wildlife populations.

Calculated changes in habitat area and configuration are predicted to have a non-measurable influence on the abundance and distribution of VC populations.

In addition to direct habitat loss, indirect changes from sensory disturbance (e.g., lights, smells, noise, dust, viewscape) associated with several developments may influence wildlife abundance and distribution by altering movement and behaviour among habitats at the population scale (Habib et al. 2007; Bayne et al. 2008; Boulanger et al. 2012). For waterbirds, direct and indirect (sensory) disturbance from previous and existing developments have reduced the amount of high and good staging habitat by 3.5% and 4.2%, respectively. As well, high and good breeding habitats decreased by 4.5% and 4.2%, respectively, relative to the Reference Condition. Application of the Project will decrease high and good quality staging and breeding habitat by less than 1%. The Project and previous and existing developments are expected to reduce high and good quality staging habitats by 4.2% and 4.5%, respectively. Cumulative changes from the Project and other developments are predicted to reduce high and good breeding habitats by 4.9% and 4.5%, respectively.

For raptors, previous and existing developments have reduced the amount of high and good quality habitat by 3.3% and 4.0%, respectively. The Project will reduce high and good quality habitat by 0.1%. The cumulative direct and indirect changes from the Project and previous and existing developments is expected to reduce high and good suitability habitat by 3.5% and 4.0% of that available during the Reference Condition. Cumulative effects were limited to disturbance through the Application Case for waterbirds and raptors because no reasonably foreseeable developments were identified in the ESA. Each development is predicted to result in local changes in the occupancy, movement and behaviour of waterbirds and raptors, but together should have a negligible measurable influence on the abundance and distribution of the populations. Effects are predicted to be reversible 5 to 10 years following the end of closure (i.e., long-term duration; Table 13.6-2).

Cumulative changes to wolverine and grizzly bear habitat quality were calculated to be larger than changes to habitat loss and fragmentation. Previous, existing, and reasonably foreseeable future developments, including the Project, are predicted to remove 9.3% of suitable (combined high and good quality) spring to autumn habitats for wolverine. The removal of suitable wolverine winter habitat from the Reference Condition through the RFD Case is predicted to be 12.3%. Seasonal ice roads are responsible for 7.4% of the 12.3% cumulative loss of suitable winter habitat for wolverine (i.e., 59.9% of the area within the ZOIs in the ESA is due to winter roads). Disturbance from these roads is considered temporary because winter roads are only active for 8 to12 weeks every year. The Project and other developments in the RFD Case are predicted to remove from 7.1% (spring) to 8.5% (autumn) of suitable grizzly bear habitats. Incremental changes to suitable wolverine and grizzly bear habitats from the Project, for all seasons, are predicted to be less than or equal to 0.1%. The cumulative localized changes from developments on the occupancy, movement and behaviour of grizzly bear and wolverine is predicted to have a measurable influence on the abundance and distribution of populations. However, the effect should be reversible in 5 to 10 years following the end of closure, and within the resilience limits and adaptive capacity of these VCs (i.e., long-term duration; Table 13.6-3).

The amount of traffic on the Misery and Jay roads may increase avoidance of the area by grizzly bear and wolverine and change movement and behaviour. Traffic volumes of 300 to 500 vehicles per day restricted carnivore movements, which included wolverine, in the Canadian Rocky Mountains (Alexander et al. 2005). For the Jay Project, the assessment assumed there would be 56 trips per day made by road trains. Some studies found that grizzly bears avoid roads (McLellan and Shackleton 1988; Kasworm and Manley 1990), while others found no avoidance behavior by grizzly bears (Yost and Wright 2001). Avoidance of roads by grizzly bears may be greater if hunting is allowed along the road (McLellan and Shackleton 1988). However, hunting is not permitting in the Ekati or other mine claim blocks. Grizzly bears may become accustomed to traffic in areas where there are relatively low volumes of traffic or where traffic travels at slow speeds (Gibeau et al. 2002).

In addition to affecting wolverine and grizzly bear movement, increased traffic on the Misery and Jay roads, as well as the above-ground power line along these roads, may cause caribou to avoid these roads (Section 12.4.2.2.2). Results of camera monitoring at Ekati from 2011 to 2013 indicate that caribou do cross the Misery Road so it is not acting as an absolute barrier to caribou (and carnivore) movements (ERM Rescan 2014b). Dominion Diamond will use information made available by GNWT to monitor the Bathurst caribou herd to track migratory movements. The data collected during these monitoring activities will be used to test effects predictions and the success of proposed mitigation for increased traffic on the Misery Road. Changes in the distribution of caribou may alter wolverine and grizzly bear abundance and distribution (Gau et al. 2002; May et al. 2006). Modified traffic patterns and road closures will be used at the Project as necessary to limit effects to caribou, which will also enable the crossing of roads by grizzly bear and wolverine.

The Izok Corridor and Bathurst Inlet Port and Road projects are reasonably foreseeable developments that could affect grizzly bear and wolverine abundance, distribution, and population connectivity by increasing habitat loss and fragmentation, and decreasing habitat quality. The Hydroelectric Grid Expansion also is a future project that proposes to connect the existing Snare and Taltson grids using a 240 kV transmission line around the west side of Great Slave Lake and expanding the grid to service the diamond mines. The expansion of the hydroelectric grid would likely have little influence on wolverine and grizzly bear habitat and populations. Most effects would occur during construction and be related to local avoidance due to sensory disturbance from human activities (e.g., helicopters for tower and conductor installation, temporary work camps). Changes in grizzly bear and wolverine population abundance and distribution associated with direct habitat loss and fragmentation from towers would likely be ecologically non-measurable. In contrast, expansion of the hydroelectric grid could change caribou habitat use and distribution if animals avoid or restrict movements near the transmission lines (Vistnes and Nellman 2008; Tyler et al. 2014). The Izok Corridor and Bathurst Inlet Port and Road projects are located in the spring, post-calving, and autumn ranges of the Bathurst caribou herd (Section 12.4.2.2.2), and would be predicted to adversely influence caribou habitat, abundance and distribution. Changes in caribou abundance and distribution could negatively influence wolverine and grizzly bear populations by altering the temporal and spatial availability of prey for these carnivores (i.e., a decrease in ecological effectiveness).

There is a low 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 suitability for the species. For example, habitat models for waterbirds estimate that the birds ESA is proportionally better as staging habitat than breeding habitat, which is consistent with results of waterbird surveys at Diavik, Snap Lake, and the Gahcho Kué Project indicating higher abundance during spring than summer. Similarly for raptors, a low number of nests have historically been present and monitored in the ESA, which corresponds with the low abundance of high and good suitable nest habitat under the Reference Condition. These observations provide a moderate to high level of confidence in effects predictions. In addition, habitat models contained conservative estimates for influences from development (e.g., footprints, ZOI and suitability modifiers) to increase confidence that the assessment would not underestimate effects. For example, RSF models used in the assessment reduced grizzly bear habitat near the Ekati and Diavik mines to low or poor quality. However, grizzly bears are common along the north shores of Lac de Gras near the Ekati and Diavik mines (ERM Rescan 2014b).

There is low to moderate confidence in the predictions of effects to wolverine and grizzly bear from increased traffic on the Misery and Jay roads. Although traffic volumes of greater than 300 vehicles per day have been found to negatively influence carnivore movement in the Rocky Mountains (Alexander et al. 2005), few other studies have been completed to determine the effect of traffic volume on carnivore movements. Satellite collared grizzly bears within 40 km of the Ekati Mine were found to frequently cross and use areas around the Misery Road (BHP Billiton 2002, 2003, 2004). Other studies have shown that brown bears and cougars have the adaptive flexibility (or capacity) to respond to linear and non-linear developments by modifying habitat selection with the level of human activity (Martin et al. 2010; Knopff et al. 2014). Yet grizzly bear and wolverine in the North Slave Region are highly dependent on barren-ground caribou as a food resource.

There are uncertainties regarding changes to caribou migration paths from increased traffic on the Misery and Jay roads and overhead power lines along these roads (Section 12.4.2.2.2), and how these changes could influence grizzly bear and wolverine abundance and distribution. Although estimates are uncertain, a 2014 reconnaissance survey suggests a further decline in the Bathurst herd since 2012 (Boulanger et al. 2014a), which is likely associated with a decrease in prey for predators and scavengers (i.e., a reduction in the ecological effectiveness of caribou in the system [Section 12.6.2]). Boulanger et al. (2011, 2014b) noted that the demographic trends observed up to 2012 could be explained by reduced recruitment and a constant harvest rate; recovery from the low point in the cycle was thought to be dependent on high calf survival rates and low harvest rates for breeding females. Boulanger et al. (2014b) did not provide a similar interpretation for the 2014 survey results. A GNWT photo survey planned for the summer of 2015 will provide more precise estimates of size and trend for the Bathurst herd.

The existing level of human development (e.g., operating mines and mineral exploration) in the grizzly bear and wolverine ESA and the birds ESA plus the Project should not negatively influence the resilience of wildlife populations. Waterbirds, raptors, grizzly bear, and wolverine display life history traits (e.g., high mobility and ability to eat many types of plants/prey species) that provide flexibility to adapt to different ecozones and rates of human development. Impacts from different projects in the region should be limited to individuals that interact with each footprint, and developments currently represent a small area of the range of each VC population. Minimum distance recommendations to reduce the effects to waterbird behaviour from traffic disturbance are 200 to 300 m (Fruzinski 1977; Mooji 1982; Madsen 1985), although several waterbird species have been found to continue to use areas near development (BHP Billiton 2003; Golder 2008) and with high noise levels (Busnel and Briot 1980; Ronconi et al. 2004). Waterbird abundance and species diversity on the Diavik mine site does not appear to be correlated with mine activity (Golder 2008a).

Most bird species are migratory, and will be influenced by the Project and other developments for four to five 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 enable individuals to have greater accommodation for natural and human-related stressors. Waterbird populations have high reproductive rates and are highly mobile, providing 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 provide adaptability and resilience for populations experiencing different extremes of prey abundance and weather patterns.

Changes to habitat quality are predicted to be within the resilience limits and adaptive capacity of wolverine and grizzly bear populations because both species have large home ranges, long life spans (especially grizzly bears), and high mobility. Although DNA hair sampling surveys noted a decline in wolverine abundance around the Ekati and Diavik mines from 2005 to 2011, the number of animals also decreased at the reference area (Daring Lake) over this same time period (Boulanger and Mulders 2013). The results indicate that changes in the number of wolverine in the region could not be exclusively attributed to mining activity. Similar to migratory birds, grizzly bears hibernate in dens during winter and will be influenced by developments for six to seven months every year. The grizzly bear population in the ESA also appears to be stable or has increased since the late 1990s (ERM Rescan 2014b). This suggests that the grizzly bear population in the North Slave Region of the NWT has the adaptive capacity to be resilient to cumulative changes from development as several mines and mineral explorations have occurred on the landscape during this period.

Hunting is one of the most limiting factors for grizzly bear (McLoughlin et al. 2003b; COSEWIC 2014) and wolverine (Krebs et al. 2004; Lofroth and Ott 2007; Squires et al. 2007) populations because both species have low reproductive rates and it takes several years for individuals to reach breeding age. Female grizzly bears in North Slave region were found to reach breeding maturity at an average 8.1 years of age (McLoughlin et al. 2003b). Litters occur every three years while females are capable of breeding (Schwartz et al. 2003). Wolverines typically reach breeding maturity within three years of birth and litter production occurs approximately every three years (Banci 1994). Barren-ground grizzly bears in the North Slave Region are especially vulnerable to additive mortality effects from hunting because they live at low densities in an area of low productivity and high seasonality (McLoughlin et al. 2003b). Grizzly bears in areas with low primary productivity have delayed age of first parturition, longer birth and reproductive intervals, and smaller litter sizes (McLoughlin et al. 2003b). No hunting is allowed in the Ekati claim block or other mine claim blocks. Thus the Project and other developments will not increase access for harvesting animals and so should not affect the ability of the grizzly bear and wolverine populations to remain self-sustaining and ecologically effective.

For cumulative effects of development to have a significant influence on self-sustaining and ecologically effective wildlife populations there would have to be sufficient changes that wildlife populations would no longer be resilient or have the ability to adapt to natural selection pressures (e.g., weather, competition, and predation). In terms of the measurement indicators used in this assessment (e.g., habitat quantity and quality, movement and behaviour, and survival and reproduction) this might include permanent removal of a habitat or highly productive areas important for survival and reproduction at the population level. For example, nest success and productivity in raptor populations can be highly variable through time (Wightman and Fuller 2006; Coulton et al. 2013) where population maintenance may rely on the long-term consistency of success of nests in higher quality habitats (and occupied by high quality breeding pairs). If higher quality nest sites are no longer available, the population may lose its ability to be self-sustaining over the long term due to poor local recruitment and increased risk from large and sudden changes in environmental conditions (e.g., several years of low food availability and poor weather). For example, increased rainfall and lower temperatures from climate change may decrease raptor resilience to change as they can decrease adult and nestling survival rates (Franke et al. 2010, 2011).

The ability of local populations to remain interconnected over space and time is important to maintaining genetic diversity and avoid inbreeding so that populations remain viable in the presence of environmental variation (Levins 1969; Lacey 1997). Connectivity also enables subpopulations in poorer quality habitats (or areas) to be maintained by immigration of individuals from neighboring higher quality habitats (e.g., demographic rescue [Hanski 1982; Pulliam 1988]). A high degree of habitat fragmentation could isolate breeding individuals from potential mates because habitat patches that contain mates are beyond their dispersal ability or increase demographic risk (i.e., reduce fecundity and/or survival rates). Habitat isolation may also reduce population densities to the point where interactions among wildlife communities (e.g., predator-prey interactions) are no longer ecologically effective at preserving the balance of the ecosystem (Soulè et al. 2003).

Climate change could also negatively impact wolverine populations if contiguous areas of snow cover for dens become smaller and more isolated (Copeland et al. 2010; McKelvey et al. 2011). Changes to the timing of vegetation growth from climate change could adversely affect grizzly bear populations by changing the timing and abundance of spring and autumn forage. Caribou could also be negatively affected by climate change because of increased insect abundance and changes to the timing and abundance of forage (Lenart et al. 2002; Kerby and Post 2013), which can influence carnivores. Importantly, the resilience in the current state of wildlife VCs suggests that the impacts from the Project and existing and future developments should be reversible. Overall, the weight of evidence from the analysis of the primary pathways predicts that incremental and cumulative changes to measurement indicators from the Project and other developments should have no significant adverse effect on self-sustaining and ecologically effective wildlife populations.

13.7 Follow-Up and Monitoring

In the DAR, monitoring programs are proposed to deal with the uncertainties associated with the effect predictions and the performance of environmental design features and mitigation. In general, monitoring is used to verify the effects predictions. Monitoring also is used to identify any unanticipated effects and provide for the implementation of adaptive management to limit these effects. Typically, monitoring includes one or more of the following categories, which may be applied during the development of the Project:

- **Compliance monitoring** – monitoring activities, procedures, and programs undertaken to confirm the implementation of approved design standards, mitigation, and conditions of approval and company commitments (e.g., inspecting the installation of a silt fence, monitoring of mine water discharge quality and volumes).
- **Follow-up monitoring** – programs designed to test the accuracy of effects predictions, reduce/address uncertainties, determine the effectiveness of environmental design features, and/or provide appropriate feedback to operations for modifying or adopting new mitigation designs, policies, and practices (e.g., monitoring of downstream lakes for aquatic effects, wildlife effects monitoring, and socio-economic monitoring). Results from these programs can be used to increase the certainty of effect predictions in future environmental assessments.

These programs form part of the environmental management system for the Project. If monitoring or follow-up detects effects that are different from predicted effects, or the need for improved or modified design features and mitigation, then adaptive management will be implemented. This may include increased monitoring, changes in monitoring plans, or additional mitigation.

Monitoring activities for wildlife currently within the scope of the Ekati Mine WEMP (ERM Rescan 2014a) will be applied to the Project (including construction, operation and post-closure). Wildlife monitoring completed as part of the existing Ekati Mine WEMP measures habitat loss, mine-related wildlife mortalities and interactions with site (including roads), mitigation and waste management effectiveness, pit-wall nesting by raptors, and a ZOI (ERM Rescan 2014a). The wildlife included in these programs are caribou, grizzly bear, wolverine, gray wolf, fox, raptors, waterbirds, and upland birds. The Ekati Mine WEMP is designed to:

- test impact predictions;
- evaluate mitigation effectiveness; and,
- provide evidence for adaptive management.

The existing Ekati Mine WEMP is consistent with wildlife and wildlife habitat monitoring guidelines prepared by the GNWT (GNWT-ENR 2013). In addition to mine-related effects monitoring programs, Dominion Diamond has participated or contributed to regional wildlife monitoring initiatives intended for conservation and management including the GNWT's caribou management strategy (GNWT-ENR 2011), gray wolf den monitoring, the North America Breeding Bird Survey, and also plans to contribute to raptor nest monitoring for the Canadian Peregrine Falcon Survey, which will next occur in 2015. As well, Dominion Diamond has provided monitoring intended to support cumulative effects assessment and management by the Government of the Northwest Territories. Examples of cumulative effects monitoring contributed include regional scale grizzly bear and wolverine hair snagging studies occurring in the North Slave Region.

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13.9 Glossary

Term	Definition
Abundance	The number of individuals in a given area or sample.
All-season road	A road that is motorable all year by the prevailing means of rural transport.
Annual home range	The area traversed by animals in its normal activities of food gathering, mating and caring for young. Occasional sallies outside the area, perhaps exploratory in natures, should not be considered part of the home range. An alternative, statistical explanation is the smallest sub-region which accounts for a specified proportion of its total utilization over the course of the year.
Annual Plants	Plants with a life cycle that lasts only one year. They grow from seed, bloom, produce seeds and die in one growing season. They then need to be replanted each spring. Most annuals bloom for a long time.
Anthropogenic	Human-related, often referring to an activity, development or disturbance on the landscape.
Application Case	The Environmental Impact Assessment (EIA) case including the Project and existing and approved developments or activities.
Babiche	A type of cord or lacing made from rawhide.
Barren Kimberlite	Kimberlite that does not contain diamonds.
Barrenland	The area of the Northwest Territories east of the Mackenzie River valley and north and east of the tree line characterized by a low rolling tundra landscape, continuous permafrost, and low densities of human settlement.
Barrens	A barren tract or tracts of land.
Base Case	The case that includes existing environmental conditions as well as existing and approved projects or activities, before the construction of the Project in question, acts as reference against which data from construction and operational phases of development will be compared.
Baseline	Background or reference; conditions before Project development.
Baseline Study Area	The area where direct effects and small-scale indirect effects from the Project are expected to occur.
Caribou Energetics Model	Modelling approach used to estimate birth rates associated with a number of land-use scenarios across a continuum from no active mines to several times the current area of active mines.
Carnivore	An animal that preys on other animals; especially any mammal of the Order Carnivora including wolves, bears and wolverine.
Carrying Capacity	The maximum population of a given organism that a particular environment or habitat can sustain; implies continuing yield without environmental damage.
Confidence Interval	A range of values so defined that there is a specified probability that the value of a parameter lies within it.
Covariate	An independent variable, or predictor variable, in a statistical model. Also, a secondary variable that can affect the relationship between the dependent variable and independent variables of primary interest in a statistical model.
Dewatering	Removal of water from a natural waterbody by pumping or draining.
Digital Elevation Model	A set of elevation points with known planimetric position and known elevation which, with the use of a mathematical function, comprise a reliably consistent ground surface.
Drawdown	A lowering of the water level in a reservoir or other body of water.
Ecological Landscape Classification (ELC)	A cartographical delineation of distinct ecological areas identified by their geology, topography, soils, vegetation, climate conditions, living species, water resources, and anthropogenic factors.
Ecosystem	Ecological system consisting of all the organisms in an area and the physical environment with which they interact
Emissions	The act of releasing or discharging air contaminants into the ambient air from any source. Release of substances to atmosphere (can be fugitive emission, stack emission, diesel exhaust, mechanical ground disturbance).

Term	Definition
Erosion	(i) The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep. (ii) Detachment and movement of soil or rock by water, wind, ice, or gravity.
Esker	Linear structures of loose sand and gravel, formed by glacial rivers. They provide critical habitat for carnivores and ungulates in the Arctic.
Extirpation	The condition of a species (or other taxon) which ceases to exist in the chosen geographic area of study, although it still exists elsewhere. Local extinctions are contrasted with global extinctions.
Fault Zones	Large faults within the Earth's crust result from the action of plate tectonic forces, with the largest forming the boundaries between the plates, such as subduction zones or transform faults. Energy release associated with rapid movement on active faults is the cause of most earthquakes.
Fauna	The animals of a particular region, habitat, or geological period.
Fly Rock	Material which is projected outside the declared danger zone by a quarry blast. Fly-rock may be caused by poor blast design or unexpected zones of weakness in the rock.
Food Chain	A hierarchical series of organisms each dependent on the next as a source of food.
Footprint	The proposed development area that directly affects the soil and vegetation components of the landscape.
Fugitive dust	Particulate matter suspended in the air by wind action and human activities.
Furbearer	Mammals that have traditionally been trapped or hunted for their fur.
Geographic Information System	Computer system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data.
Glaciofluvial deposits	Glaciofluvial deposits were left behind by rivers that helped drain melting glaciers.
Global Positioning System	A space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.
Ground Truth	The accuracy of the training set's classification for supervised learning techniques. This is used in statistical models to prove or disprove research hypotheses.
Groundwater	That part of the subsurface water that occurs beneath the water table, in soils and geologic formations that are fully saturated.
Habitat	The physical space within which an organism lives, and the abiotic and biotic entities (e.g., resources) it uses and selects in that space.
Habitat Fragmentation	A process by which habitats are increasingly subdivided into smaller units, resulting in their increased restriction as well as an overall loss of habitat area and biodiversity.
Habitat Suitability Index	An index which measures the suitability of habitat based on preference.
Headwater	A tributary stream of a river close to or forming part of its source.
Health tundra	A closed mat plant community that grows on moderate to well drained soils, covering most of the upland areas. Plants generally belong to the heath family, the Ericaceae. The vegetation layer forms a mat of low shrubs dominated by dwarf birch and Labrador tea.
Home Range	The area traversed by an animal during its activities during a specific period of time.
Inuksuk	Although several forms exist, those identified in this study are stacked stone features ranging from columns of flat rock or boulders to anthropomorphic figures of more recent construction. Inuksuit (plural) have been interpreted as guides or markers strategically placed on terrain to mark trails, good hunting and fishing locations, spiritual places, or to help herd caribou during migrations.
Kame	A steep-sided mound of stratified material deposited against an ice-front.
Key Line of Inquiry	Areas of the greatest concern that require the most attention during the environmental impact review and the most rigorous analysis and detail in the DAR. Their purpose is to ensure a comprehensive analysis of the issues that resulted in significant public concern about the proposed development.
Kimberlite	Igneous rocks that originate deep in the Earth's mantle and intrude the Earth's crust. These rocks typically form narrow pipe-like deposits that sometimes contain diamonds.
Kimberlite Pipe	Vertical structures on which kimberlites occur in the Earth's crust.

Term	Definition
Landscape	Mosaic of patches that differ in ecologically important properties.
Laydown Areas	An area that has been cleared for the temporary storage of equipment and supplies. Laydown areas are usually covered with rock and/or gravel to ensure accessibility and safe manoeuvrability for transport and off-loading of vehicles.
Lichens	A simple slow-growing plant that typically forms a low crustlike, leaflike, or branching growth on rocks, walls, and trees.
Lichen veneer	A continuous mat of lichen that appears as a "veneer". These sites are windswept and dry, allowing very little other plant growth. Lichen veneer consists mainly of Iceland moss, several other species of Cetraria, green and black hair lichens, grey mealy lichen, worm lichens and other species.
Littoral	Of, relating to, or situated on the shore of the sea or a lake.
Mean	Average value. The mean is found by adding up all the values and then dividing the sum by the number of values.
Metasediment Rock	Sedimentary rocks that have been modified by metamorphic processes.
Natal den	A lair, typically underground, used for the birthing and initial rearing of young; often occur in esker complexes.
Nitrogen Dioxide (NO_2)	One of the component gases of oxides of nitrogen which also includes nitric oxide. In burning natural gas, coal, oil and gasoline, atmospheric nitrogen may combine with molecular oxygen to form nitric oxide, an ingredient in the brown haze observed near large cities. Nitric oxide is converted to nitrogen dioxide in the atmosphere. Cars, trucks, trains and planes are major source of oxides of nitrogen. Other major sources include oil and gas industries and power plants.
Nitrogen Oxides (NO_x)	Consist of nitric oxide (NO) and nitrogen dioxide (NO_2) and are reported as equivalent NO_2.
Open-water season	Summer season when lakes, rivers and streams are free of ice (generally June or July to October).
Orthohoto	An aerial photograph that has been geometrically corrected (orthorectified) such that the scale of the photograph is uniform, meaning that the photo can be considered equivalent to a map.
Outliers	Data points that fall outside of a given trend line and associated confidence interval, but are part of the original dataset and can have a strong influence on the trend line.
Passerines	Perching birds, mostly small and living near the ground with feet having four toes arranged to allow for gripping the perch; most are songbirds.
Particulate Matter	Any aerosol that is released to the atmosphere in either solid or liquid form.
Patch	A particular unit of habitat with identifiable boundaries that differs from its surroundings in one or more ways. Habitat boundaries can be a function of vegetative composition, structure, age, or a combination of the three.
Peat bog	Sphagnum or forest peat materials formed in an ombrotrophic environment due to the slightly elevated nature of the bog, which tends to disassociate it from the nutrient-rich groundwater or surrounding mineral soils. Characterized by a level, raised or sloping peat surface with hollows and hummocks. Mineral-poor, acidic and peat-forming wetlands that receives water only from precipitation.
Permafrost	Ground (soil or rock and included ice and organic material) that remains at or below 0°C for at least two consecutive years. Permafrost is defined on the basis of temperature. It is not necessarily frozen, because the freezing point of the included water may be depressed several degrees below 0°C; moisture in the form of water or ice may or may not be present.
pH	The negative log of the concentration of the hydronium ion. The pH is a measure of the acidity or alkalinity of all materials dissolved in water, expressed on a scale from 0 to 14, where 7 is neutral, values below 7 are acidic, and values over 7 are alkaline.
Point Count	A circular plot survey where observers spend a prescribed time looking and listening for songbirds.
Polygon	The spatial area delineated on a Map to define one feature unit (e.g., one type of ecosite phase).
Raptor	A carnivorous (meat-eating) bird; includes eagles, hawks, falcons, and owls.
Rare Plant	A native plant species found in restricted areas, at the edge of its range or in low numbers within a province, state, territory or country.

DOMINION DIAMOND

Term	Definition
Reasonably Foreseeable Development Case	The assessment case including existing and approved developments, the Project, and reasonably foreseeable developments that were known as of six months prior to the DAR submission date.
Recruitment	The influx of new organism members into a population due to reproduction (i.e., the number of caribou calves born and surviving to reproductive age).
Resource Selection Models or resource selection functions (RSFs)	Statistical functions that quantify the relationship between the observed distribution of a focal species and covariates representative of habitats and human disturbance. The models are used to identify critical resources for animal populations and to predict species occurrence. Typically, the model consists of several coefficients that quantify selection for or avoidance of an environmental feature.
Relative Abundance	The proportional representation of a species in a sample or a community.
Riparian	Refers to terrain, vegetation or simply a position next to or associated with a stream, floodplain or standing waterbody.
Runoff	The portion of precipitation or irrigation water that moves across land as surface flow and enters streams or other surface receiving waters.
Salinity	The concentration of soluble salts in water measured as total dissolved solids.
Sedges	A grass-like plant with a triangular stem often growing in wet areas. Sedge wetland habitats are typically wet sedge meadows and other sedge associations of non-tussock plant species. Sedge species such as *Carex aquatilis* and *C. bigelowii*, and cotton-grass (*Eriophorum angustifolium*) are the dominant vegetation types. Plant species occupy wet, low lying sites where standing water is present throughout much of the growing season.
Sediment	Solid material that is transported by, suspended in, or deposited from water. It originates mostly from disintegrated rocks; it also includes chemical and biochemical precipitates and decomposed organic material, such as humus. The quantity, characteristics and cause of the occurrence of sediment in streams are influenced by environmental factors. Major factors are degree of slope, length of slope soil characteristics, land usage, and quantity and intensity of precipitation.
Sediment Pond	A containment pond designed to remove suspended sediment from incoming waters.
Seepage	Slow water movement in subsurface. Flow of water from man-made retaining structures. A spot or zone, where water oozes from the ground, often forming the source of a small spring.
Staging Areas (Birds)	Key locations, often wetlands, along the migratory routes of birds, where they concentrate in huge numbers to replenish the body fat and energy reserves needed for their migration.
Standard deviation (SD)	A measure of the spread or dispersion of a set of data. It is calculated by taking the square root of the variance.
Standard error (SE)	A measure of the sampling variability or precision of an estimate. The SE of an estimate is expressed in the same units as the estimate itself. It is calculated as the standard deviation divided by the square root of the number of observations.
Sedge	A grass-like plant with a triangular stem often growing in wet areas. Sedge wetland habitats are typically wet sedge meadows and other sedge associations of non-tussock plant species. Sedge species such as *Carex aquatilis* and *C. bigelowii*, and cotton grass (*Eriophorum angustifolium*) are the dominant vegetation types. Plant species occupy wet, low lying sites where standing water is present throughout much of the growing season.
Sedimentation	The process by which suspended particles in waste water settle to the bottom.
Sensitive	Sites or organisms that are particularly vulnerable to harmful effects. A general status rank for a species with one or more of the following indicators: a small population size or restricted distribution, a declining population trend and/or moderate threats to its population of habitats. In statistics, parameter sensitivity refers to a series of tests in which different parameter values are set to see how a change in the parameter causes a change in the dynamic behaviour of the system in question (e.g., how much does a change in adult female survival affect population growth of a caribou herd).
Species	A group of organisms that actually or potentially interbreed and are reproductively isolated from all other such groups; a taxonomic grouping of genetically and morphologically similar individuals; the category below genus.
Species Abundance	The number of individuals of a particular species within a biological community (e.g., habitat).

Term	Definition
Species Diversity	A description of a biological community that includes both the number of different species and their relative abundance. Provides a measure of the variation in number of species in a region. This variation depends partly on the variety of habitats and the variety of resources within habitats and, in part, on the degree of specialization to particular habitats and resources.
Species Richness	The number of different species occupying a given area.
Sub-Basin	A smaller basin with a regional basin.
Sulphur Dioxide	A colourless gas with a pungent odour. In Alberta, natural gas processing plants are responsible for close to half of the emissions of this gas. Oil sands facilities and power plants are also major sources. Others include gas plant flares, oil refineries, pulp and paper mills, and fertilizer plants.
Terms of Reference	Written requirements governing environmental impact assessment implementation, consultations to be held, data to be produced and form/contents of the environmental impact assessment report.
Thermistors	A device whose electrical resistance, or ability to conduct electricity, is controlled by temperature. Used to measure temperature in soil, bedrock, or various media.
Total Suspended Particulate	A term used to collectively describe tiny airborne particles or aerosols that are less than 100 micrometres in size.
Total Suspended Solids	The amount of suspended substances in a water sample. Solids, found in wastewater or in a stream, which can be removed by filtration. The origin of suspended matter may be artificial or anthropogenic wastes or natural sources such as silt.
Traditional Knowledge	The knowledge, innovations and practices of indigenous people; refers to the matured long-standing traditions and practices of certain regional, indigenous, or local communities.
Treeline	An area of transition between the tundra and boreal forest to the south.
Tundra	A type of ecosystem dominated by lichens, mosses, grasses, and woody plants; a treeless plain characteristic of the Arctic and sub-Arctic regions.
Turbidity	The degree of clarity in the water column typically reflected as the amount of suspended particulate matter in a waterbody.
Tussock - hummock	A tussock is a tuft of grass or grass like plants like sedges. Tussock –hummock refers to a type of tundra consisting of acre upon acre of sedge tussocks, usually located on flat, poorly drained land or gentle slopes.
Ungulate	A hoofed, grazing mammal (e.g., caribou, muskoxen, deer, moose).
Upland areas	Ground elevated above the lowlands along rivers or between hills; highland or elevated land; high and hilly country.
Valued Component	Represent physical, biological, cultural, and economic properties of the social-ecological system that are considered to be important by society.
Vascular Plants	Land plants that have lignified tissues for conducting water and minerals throughout the plant.
Vegetation type	Habitat types classified based on the plant community present.
Waste Rock	Rock moved and discarded in order to access resources.
Waste Rock Storage Area	Engineered landforms in which waste rock from mining activities is stored.
Waterbirds	A bird that frequents water, in the case of this Report one that habitually wades or swims in fresh water.
Waterbody	An area of water such as a river, stream, lake or sea.
Watercourse	Riverine systems such as creeks, brooks, streams and rivers.
Waterfowl	Ducks, geese, or other large aquatic birds, especially when regarded as game.
Watershed	An area or ridge of land that separates waters flowing to different rivers, basins, or seas.
Wetlands	An area of land where the water table is at or above the mineral soil for the entire year.
Wildlife	Under the Species at Risk Act, wildlife is defined as a species, subspecies, variety or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus that is wild by nature and is native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.

Term	Definition
Winter Road	Roads which are built over frozen lakes and tundra. Compacted snow and/or ice is used for embankment construction.
Zone of Influence	The surrounding area of a development site in which animal occurrence is reduced or increased, possibly due to avoidance or attraction.