5.3 Terrestrial Environment

5.3.1 Introduction

5.3.1.1 *Context*

This section of the Phase 1-Meliadine All-weather Access Road (AWAR) Environmental Assessment (the AWAR Project) discusses the terrestrial environment. The Terrestrial Environment section includes a detailed assessment of effects on terrain and soil, vegetation, and wildlife that could potentially be affected by the AWAR Project. There are strong links between terrain, soils, vegetation, and wildlife and wildlife habitat that inhabit the landscape. Terrestrial ecosystem function relies on the interactions between climate, soils, the hydrological cycle, vegetation, and wildlife species. Natural and human-related disturbances can change the interactions between the physical and biological components of the terrestrial environment. Changes in the terrestrial environment can also influence the opportunity for traditional and non-traditional human use of natural resources (e.g., hunting, trapping), which can affect socio-economic components (e.g., accommodation services). As such, related assessments are provided in the following sections:

- Atmospheric and Acoustic Environment (Section 5.1);
- Surface Water Environment (Section 5.2);
- Cultural Environment (Section 6.0); and
- Socio-economic Environment (Section 6.3).

5.3.1.2 *Purpose and Scope*

The purpose of the assessment is to evaluate direct and indirect effects of the AWAR Project on soils, vegetation and wildlife. The effects assessment will evaluate all aspects of the AWAR Project, including construction, operation, and closure and reclamation. Indirect and cumulative effects have been incorporated, where applicable. Information from other components, including air quality, water quality and quantity, and traditional and non-traditional land use, as well as information from existing developments, is incorporated in the effects assessment for terrestrial valued components (VCs).

Valued components represent physical, biological, cultural, social, and economic properties of the environment that are considered important to society. The inter-relationships between components of the biophysical and socio-economic (human) environments provide the structure for a social-ecological system (Walker et al. 2004; Folke 2006). Multiple VCs were selected for vegetation and wildlife to assess the AWAR Project-related effects on the terrestrial environment (Table 5.3.1-1). Factors considered when selecting VCs included the following criteria (Salmo 2006):

- represent important ecosystem processes;
- territorially and federal listed species (CESCC 2011), as well as internationally listed by the IUCN (www.IUCNredlist.org);
- can be measured or described with one or more practical indicators (measurement endpoints);
- allow cumulative effects to be considered; and

- current experience with environmental assessments and effects monitoring programs in Nunavut and the Northwest Territories (NWT).

Table 5.3.1-1: Terrestrial Valued Components

<table>
<tr><th colspan="2">Valued Component</th><th>Rationale for Selection</th></tr>
<tr><td colspan="2">Plant populations and communities</td><td>characterized within Ecological Landscape Classification (ELC) types, especially those with restricted distribution that may be disproportionately affected by the AWAR Project; important for support of ecosystem processes and services, ecosystem resiliency, and spiritual and aesthetic values</td></tr>
<tr><td colspan="2">Listed (rare) plant species</td><td>plant species listed as rare (“At Risk”, “May be at Risk”, “Sensitive”, or “Undetermined”) by Nunavut government or COSEWIC; therefore, may be disproportionately affected by AWAR Project activities</td></tr>
<tr><td>Ungulates</td><td>Caribou</td><td>important subsistence, cultural, and economic species, migratory species with extensive range requirements; may be affected by disturbance during seasonal movements; primary prey species for large carnivores in northern environments</td></tr>
<tr><td rowspan="2">Carnivores</td><td>Northern Gray Wolf</td><td>large home range size linked to caribou migrations; 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; important subsistence and cultural species</td></tr>
<tr><td>Polar bear</td><td>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 Nunavut (CESCC 2011), “Special Concern” in Canada (COSEWIC 2011), and listed as “Vulnerable” by the IUCN (Schliebe et al. 2008)</td></tr>
<tr><td colspan="2">Raptors</td><td>breeding habitat is limited; sensitive to noise disturbance and human activity during nesting; includes Peregrine Falcon and Short-eared Owl, both of which are listed as “Special Concern” by COSEWIC (2011); and the Rough-legged Hawk, Gyrfalcon and Short-Eared Owl, which are “Sensitive” in Nunavut (CESCC 2011)</td></tr>
<tr><td colspan="2">Upland breeding birds</td><td>small territory size and high bird density means large numbers of upland birds may be affected by habitat loss; migratory birds are susceptible to population declines as a result of changing environmental conditions on breeding and overwintering habitats; includes some species with a conservation status in Nunavut (e.g., Snow Bunting, American Pipit; CESCC 2011)</td></tr>
</table>

COSEWIC = Committee on the Status of Endangered Wildlife in Canada

Grizzly bear, muskox, and wolverine were also considered as VCs, but ultimately not selected for the following reasons. The core part of their species home ranges does not overlap with the exploration camp or the AWAR Project (GN 2011). In addition, there have been either no, or very few, observations of animals in close proximity to the Meliadine Advanced Exploration site. Harvest data indicate that there are very few wolverine, grizzly bear, and muskox harvested by the Rankin Inlet community. Arctic fox was considered as a VC, but was not included because the species is listed as secure or common by governmental agencies, and can thrive in and around human developments. Any potential impacts from the AWAR Project on grizzly bear, wolverine, muskox, and Arctic fox populations are predicted to be negligible. Although the AWAR Project may influence the movement or behaviour of an occasional individual(s), the effect would likely not change the demographic performance (i.e., reproduction and survival) of the breeding population. The core of the breeding population for individual muskox, wolverine, and grizzly bear travelling within the regional study area (RSA) is probably located farther west or near the treeline, and would not be influenced by the AWAR Project.

Wildlife and vegetation species are an important cultural and economic resource for the people in the Nunavut. Assessment endpoints represent the key properties of the VC that should be protected for their use by future human generations, while measurement endpoints are quantifiable (i.e., measurable) expressions of changes to assessment endpoints. Assessment and measurement endpoints for the terrestrial VCs are presented in Table 5.3.1-2.

Table 5.3.1-2: Summary of the Valued Components, Assessment, and Measurement Endpoints for the Terrestrial Environment

	Valued Component	Assessment Endpoints	Measurement Endpoints
Wildlife	Caribou Wolf Polar bear Upland breeding birds Raptors	• Persistence of wildlife populations • Continued opportunity for traditional and non-traditional use of wildlife	• Habitat quantity and fragmentation • Habitat quality • Relative abundance and distribution of species • Survival and reproduction
	People		• Access to wildlife • Availability of wildlife
Vegetati on	• Plant populations and communities • Listed (rare) plant species	• Persistence of plant populations and communities • Persistence of plant species at risk	• Plant community health and diversity • Relative abundance and distribution of plant species

5.3.2 Study Area

5.3.2.1 General Setting

The AWAR Project is located north of Rankin Inlet in Nunavut and starts from the existing municipal road that provides access to Iqalugaarjuup Nunanga National Park, just after it crosses the Char River. From this point the AWAR continues north to the Meliadine River, just east of the Territorial Park. After crossing the Meliadine River the AWAR continues north to the Meliadine West Advanced Exploration site.

Although there are rolling hills in the Rankin Inlet area, the relative flatness of the land and the many all-terrain vehicles (ATV) trails provide good access to the tundra (Onalik 1997). The established trails within the RSA extend in all directions from Rankin Inlet: west to the Diana River, north and northeast to the opposite arms of Meliadine Lake, and east to Dry Cove. Cabins are present at all of these destinations. As shown in Plate 3.1-3 of Section 3.0, the existing trail to Meliadine Lake along the route of the proposed AWAR is well used and the resulting damage from the ATV traffic is clear. In winter, access out of Rankin Inlet is made easier still by snowmobile.

The AWAR Project is located in the Maguse River Upland Ecoregion portion of the Southern Arctic Ecozone (Ecological Stratification Working Group 1995). This ecoregion is classified as having a low arctic ecoclimate, with long cold winters and short cool summers with prolonged periods of misty weather. The landscape is dominated by broad, sloping uplands and lowlands of crystalline Archean origin, interspersed by hummocky bedrock outcrops that are covered with discontinuous acidic, sandy, granitic till and prominent fluvio-glacial ridges or eskers (Ecological Stratification Working Group 1995). Areas of continuous permafrost are quite common, and soils are typically composed of Turbic Cryosols, with Organic (Mesisol) and Regosolic soils occurring in areas without permafrost (Ecological Stratification Working Group 1995).

To facilitate the assessment and interpretation of potential effects associated with the AWAR Project, it is necessary to define appropriate spatial boundaries. Spatial boundaries were developed with consideration of soil, vegetation, and wildlife components. The RSA was selected to capture any effects that may extend beyond the immediate AWAR Project area and subsequently to assess potential cumulative effects on terrain and soils, vegetation, and wildlife in the broader regional context. A local study area (LSA) also was defined for all terrestrial components to assess the immediate direct and indirect effects of the AWAR Project on terrain and soils, vegetation, and wildlife.

5.3.2.2 Local Study Area

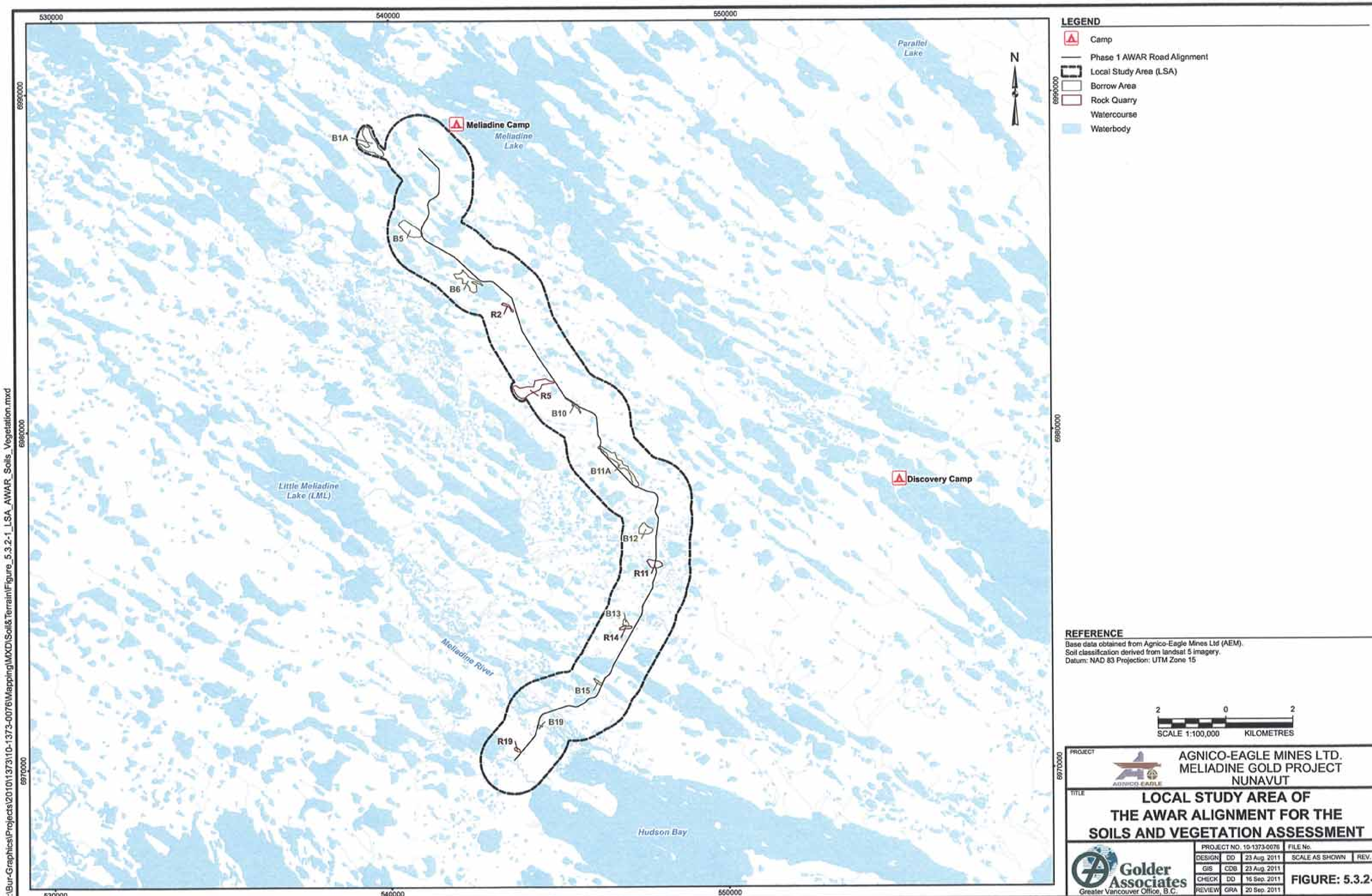
The LSA for the AWAR was defined by the expected limit of direct and indirect effects from the AWAR on the surrounding soils, vegetation, and wildlife. The proposed AWAR joins the AWAR Project to the existing winter road near Rankin Inlet. The LSA for the AWAR Project is defined by a 1000 metre (m) buffer on either side of the anticipated right-of-way surrounding the proposed AWAR alignment and associated borrow pits and rock quarries (Figure 5.3.2-1).

The LSA for the AWAR Project contains vegetation and landscape terrain features that are typical of the regional conditions. However, the AWAR is located primarily on high ground and tends to follow the ridge lines of eskers and bedrock outcrops. As such, vegetation of the affected area tends to be dominated by heath tundra and heath lichen communities.

5.3.2.3 Regional Study Area

The RSA was established to assess the importance of the AWAR Project within a broader regional context, as it forms the foundation for quantifying cumulative effects to regional soil, vegetation, and wildlife habitat resources. The RSA was defined as a 52 kilometre (km) radius from the proposed AWAR Project and covers an area of approximately 850 000 hectares (ha) (Figure 5.3.2-2). The RSA boundary was defined with consideration of the spatial requirements for the wildlife study, as RSA level information will be used as the foundation from which to quantify potential cumulative effects of the AWAR Project on soil, vegetation, and wildlife habitat resources. Thus, the RSA must be of sufficient size to encompass the potential zone of influence on caribou from mining activities (Johnson et al. 2005).

The regional landscape is dominated by an abundance of waterbodies surrounded by uplands with terrestrial vegetation. Open water, including rivers, lakes, and a portion of Hudson Bay, represent a large proportion of the study area. The most common terrestrial plant community in the RSA is heath tundra, which is dominated by low-growing heath shrubs, such as marsh Labrador tea (*Ledum palustre*), bearberry (*Arctostaphylos* sp.), and black crowberry (*Empetrum nigrum*). Drier areas associated with bedrock outcrops and boulder fields are characterized by abundant lichens, with limited vascular plant cover. Poorly drained areas in the regional landscape are predominantly characterized by graminoid tussock-hummock communities, with low shrub communities occurring along riparian areas adjacent to stream, ponds, and lakes. Wetlands account for 25 to 50% of the land area and are predominantly characterized by low- and high-centred polygon fens (Ecological Stratification Working Group 1995).



PROJECT

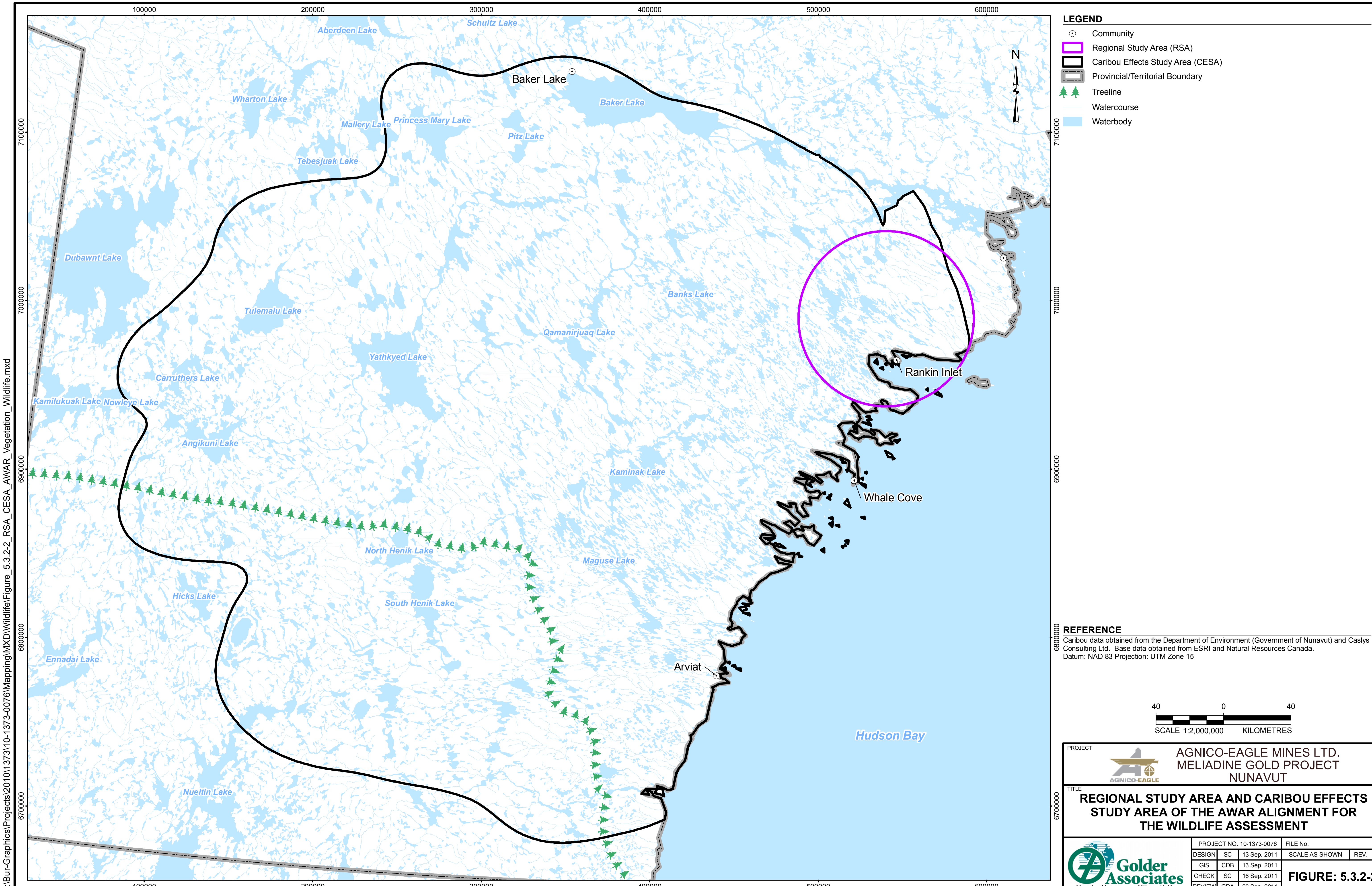
AGNICO-EAGLE MINES LTD.
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

LOCAL STUDY AREA OF THE AWAR ALIGNMENT FOR THE SOILS AND VEGETATION ASSESSMENT

PROJECT NO. 10-1373-0076			FILE No.
DESIGN	DD	23 Aug. 2011	SCALE AS SHOWN REV. 0
GIS	CDB	23 Aug. 2011	
CHECK	DD	16 Sep. 2011	FIGURE: 5.3.2-1
REVIEW	GRA	20 Sep. 2011	

Golder Associates
Greater Vancouver Office, B.C.



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200000
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7100000
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6900000
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Aberdeen Lake
Schultz Lake
Baker Lake
Baker Lake
Wharton Lake
Mallery Lake
Princess Mary Lake
Pitz Lake
Tebesjuak Lake
Dubawnt Lake
Tulemalu Lake
Banks Lake
Qamanirjuaq Lake
Yathkyed Lake
Carruthers Lake
Kamilukuak Lake
Nowleye Lake
Angikuni Lake
Rankin Inlet
Kaminak Lake
Whale Cove
North Henik Lake
Maguse Lake
Hicks Lake
South Henik Lake
Ennadai Lake
Arviat
Hudson Bay
Nueltin Lake
N
LEGEND
Community
Regional Study Area (RSA)
Caribou Effects Study Area (CESA)
Provincial/Territorial Boundary
Treeline
Watercourse
Waterbody
REFERENCE
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PROJECT
AGNICO-EAGLE MINES LTD.
MELIADINE GOLD PROJECT
NUNAVUT
TITLE
REGIONAL STUDY AREA AND CARIBOU EFFECTS STUDY AREA OF THE AWAR ALIGNMENT FOR THE WILDLIFE ASSESSMENT
PROJECT NO. 10-1373-0076
FILE No.
DESIGN SC 13 Sep. 2011
SCALE AS SHOWN
REV. 0
GIS CDB 13 Sep. 2011
CHECK SC 16 Sep. 2011
REVIEW GRA 20 Sep. 2011
FIGURE: 5.3.2-2
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Greater Vancouver Office, B.C.
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5.3.2.4 Caribou Effects Study Area

Barren-ground caribou (Qamanirjuaq and Lorillard herds) and wolf have the potential to interact with the AWAR Project. First, annual and seasonal ranges for Qamanirjuaq and Lorillard herds were calculated using satellite and global positioning system collar data for caribou (courtesy of Government of Nunavut [GN], Department of the Environment). Based on annual and seasonal range estimates, Lorillard Caribou Herd should not be influenced by the AWAR Project in most years. The Lorillard Caribou Herd is a sedentary herd (non-migratory) and their traditional calving grounds are north of Chesterfield Inlet (Section 5.3.3.3). However, the post-calving range of Qamanirjuaq Caribou Herd has the potential to overlap with the AWAR Project (Section 5.3.3.3). The post-calving range was then modified using an 85% percent volume contour to create the caribou effects study area (CESA) for caribou and wolf. This approach for delineating the CESA was deemed a conservative method for including areas around satellite positions where there were likely non-collared caribou (and wolf). In the Kivalliq region, wolves likely migrate with the caribou herds, as do the wolves of the central NWT (see Walton et al. 2001).

5.3.3 Existing Environment

5.3.3.1 Soils

Methods

Soil conditions in the RSA and LSA were classified and mapped using the general principles and methods outlined by the Expert Committee on Soil Survey (1982) and the Mapping Systems Working Group (Agriculture Canada 1981). All soils were classified according to the Canadian System of Soil Classification (Soil Classification Working Group 1998).

The objective of the soil mapping was to describe and characterize the existing soil resources, the distribution across the landscape, and associated soil quality and sensitivities within the RSA and LSA. The approach to classifying and describing soil units involved a review of existing information, and development of soil maps in a Geographical Information System (GIS) platform.

Ikonos imagery and Landsat Thematic Mapper satellite imagery were used to delineate vegetation units for Ecological Landscape Classification (ELC) mapping in the LSA and RSA, respectively. The ELC vegetation units were then used as part of the mapping process to derive correlations between soil and the ELC vegetation types. Due to the resolution of the ELC data, many soil map units were presented as complexes to capture the range of soil types on the landscape and minor components of a soil series (i.e., less than 20% representation within a map unit) were not mapped. The soil map unit delineations were largely inferred from the interpretation of landscape features (i.e., elevation contours and landform), ELC units. Thus, the soil map should be viewed as a predictive model of soil distribution. The information should not be applied for predicting site-specific characteristics without collecting additional field information.

Soil Erosion Risk

Soil erosion risk from water is generally determined by applying the modified Universal Soil Loss Equation as described by Tajek et al. (1985) and Transportation Association of Canada (TAC 2005). Soil erosion risk from wind was determined based on a dimensionless index described by Coote and Pettapiece (1989). Soil sensitivities to wind and water erosion were determined through an interpretation of soil characteristics (e.g., soil texture, soil structure, and soil moisture) and an evaluation of a soil erodability factor based on texture and slope characteristics associated with each soil type. A final soil erosion sensitivity rating was then assigned to each soil map unit based on the most limiting erosion factor (i.e., whether it is predominantly a wind or water erosion sensitivity) and modified based on natural factors specific to the LSA, such as organic or shallow soils and permafrost, using professional judgement.

Results

Bedrock (Bare Ground Rock Outcrop)

The bedrock soil map unit represents areas with limited to no vegetation cover and exposed bedrock with little or no soil. This class is typically associated with eskers, steep sandy slopes, and the tidal and inter-tidal beaches along Hudson's Bay. It can be associated with the sand plant community association at the local scale. The bedrock soil map unit makes up a small proportion of the landbase, covering 12 273 ha (2%) of the RSA (Table 5.3.3-1, Figure 5.3.3-1) and 121 ha (2%) of the LSA (Table 5.3.3-2, Figure 5.3.3-2).

Table 5.3.3-1: Area of Soil Map Units in the Regional Study Area

Soil Map Unit	Area (ha)	% of RSA
Bedrock	19 273	2
Bedrock-Regosols	141 484	17
Organic Cryosols	109 913	13
Organic and Static Cryosols	12 622	2
Static Croyosls	12 414	2
Static Cryosols-Bedrock-Regosols	18 339	2
Static and Turbic Cryosols	273 690	32
Water	261 710	31
Total	**849 484**	**100**

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

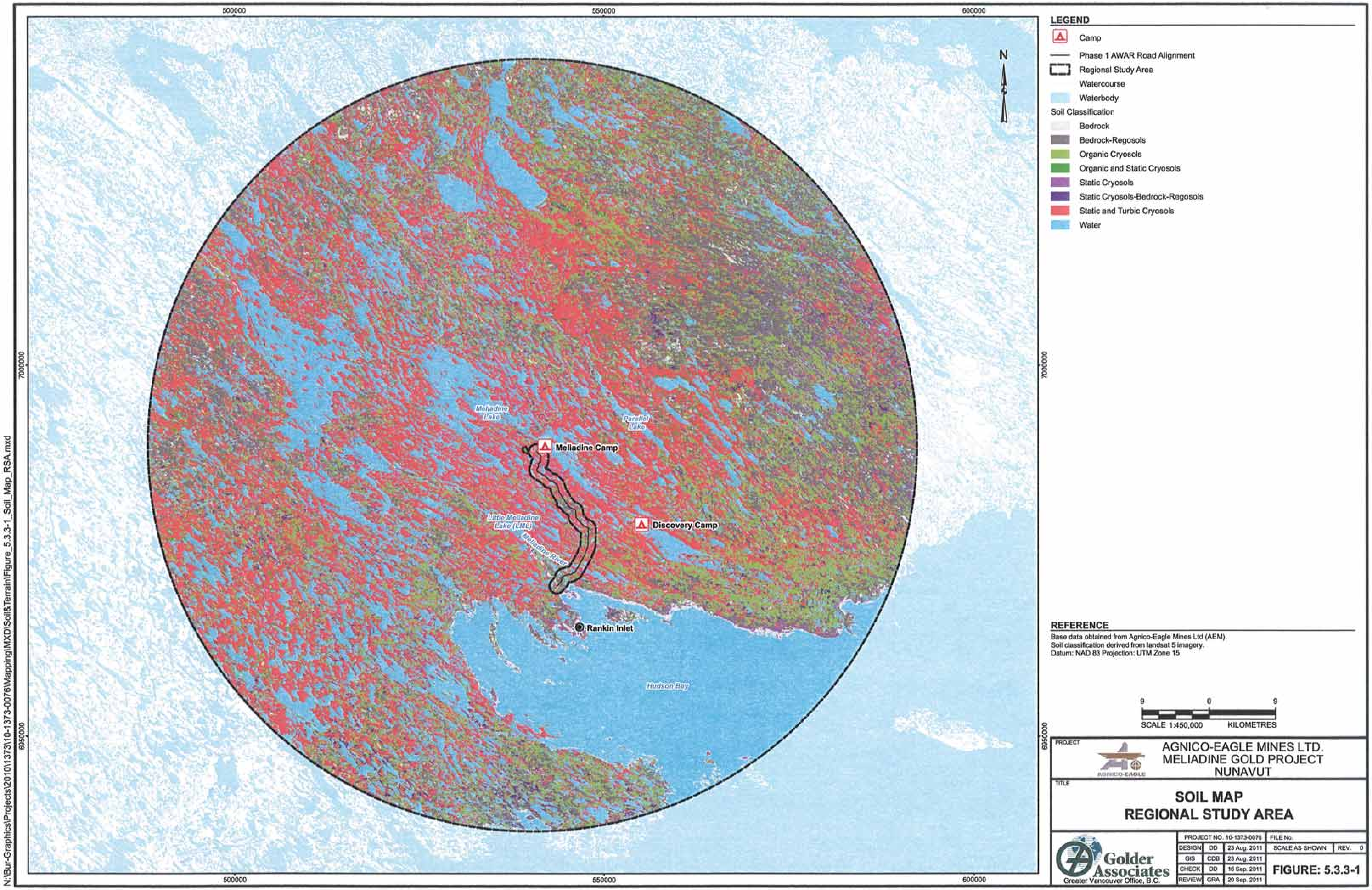
RSA = regional study area; NA = not applicable; % = percent; ha = hectare

Table 5.3.3-2: Area of Soil Map Units in the Local Study Area

Soil Map Unit	Area (ha)	% of LSA
Bedrock	121	2
Bedrock-Regosols	624	12
Organic Cryosols	801	15
Organic and Static Cryosols	13	<1
Static Cryosls	123	2
Static Cryosols-Bedrock-Regosols	84	2
Static and Turbic Cryosols	2740	52
Water	740	14
Total	**5246**	**100**

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

LSA = regional study area; NA = not applicable; % = percent; ha = hectare



500000
550000
600000
7000000
6950000
N
Melliadine Lake
Parallel Lake
Melliadine Camp
Little Melliadine Lake (LML)
Melliadine River
Discovery Camp
Rankin Inlet
Hudson Bay
LEGEND
Camp
Phase 1 AWAR Road Alignment
Regional Study Area
Watercourse
Waterbody
Soil Classification
Bedrock
Bedrock-Regosols
Organic Cryosols
Organic and Static Cryosols
Static Cryosols
Static Cryosols-Bedrock-Regosols
Static and Turbic Cryosols
Water
REFERENCE
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Soil classification derived from landsat 5 imagery.
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SCALE 1:450,000 KILOMETRES
PROJECT
AGNICO-EAGLE MINES LTD.
MELIADINE GOLD PROJECT
NUNAVUT
TITLE
SOIL MAP
REGIONAL STUDY AREA
Golder Associates
Greater Vancouver Office, B.C.
PROJECT NO. 10-1373-0076
FILE No.
DESIGN DD 23 Aug. 2011
GIS CDB 23 Aug. 2011
CHECK DD 16 Sep. 2011
REVIEW GRA 20 Sep. 2011
SCALE AS SHOWN
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FIGURE: 5.3.3-1
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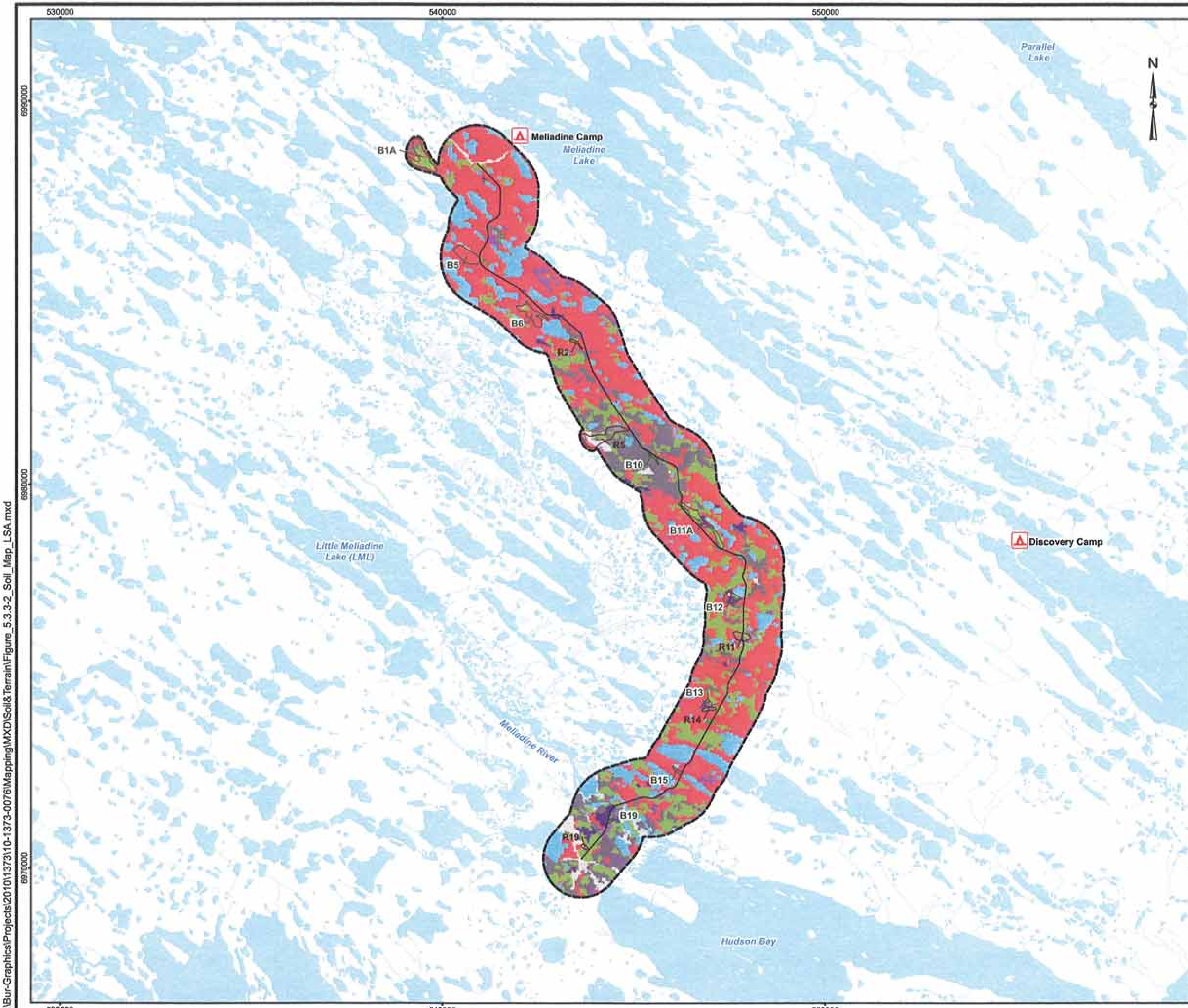

LEGEND

- Camp
- Phase 1 AWAR Road Alignment
- Local Study Area
- Borrow Area
- Rock Quarry
- Watercourse
- Waterbody

Soil Classification

- Bedrock
- Bedrock-Regosols
- Organic Cryosols
- Organic and Static Cryosols
- Static Cryosols
- Static Cryosols-Bedrock-Regosols
- Static and Turbic Cryosols
- Water

REFERENCE

Base data obtained from Agnico-Eagle Mines Ltd (AEM).
Soil classification derived from landsat 5 imagery.
Datum: NAD 83 Projection: UTM Zone 15

2 0 2
SCALE 1:100,000 KILOMETRES

PROJECT

AGNICO-EAGLE MINES LTD.
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

SOIL MAP
LOCAL STUDY AREA

Golder Associates
Greater Vancouver Office, B.C.

PROJECT NO. 10-1373-0076			FILE No.	
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REVIEW	GRA	20 Sep. 2011		

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Bedrock-Regosols (Heath Boulder)

The Bedrock-Regosols soil map unit are associated with the heath boulder land cover class and occur on rapidly to well-drained sites that contain a high proportion of boulder deposits in association with bedrock outcrops. This soil map unit is primarily bedrock outcrops with some Regosolic soils. The characteristic feature of the Regosolic order is that the B horizon is absent or only has limited development (i.e., is less than 5 centimetres [cm] thick).

Soils of the Regosolic order are most commonly associated with landforms where the land surface is (or has recently been) unstable. Because of the unstable surface, the soil has had little time to develop, and hence soil horizons are very weakly expressed if present at all. The instability could be from either erosion of the landsurface or through deposition of sediment and burial of an earlier surface; in some cases, this can occur in different portions of the same landscape.

River floodplains also commonly have Regosolic soils associated with them (Orthic Regosol Fluvial). The parent materials in these landscapes are alluvial (fluvial) sediments. In some locations, the alluvial sediment is deposited with organic material mixed into it, giving a weakly expressed Ah horizon overlying the C horizon developed in the alluvial sediments; in other locations, the C horizon is found at the surface with no organic material mixed in.

Regosolic soils also occur naturally on hillslopes that have high rates of water runoff and where slope processes cause downslope transport of soil. The instability of the surface coupled with low available soil moisture for soil-forming processes limit the amount of soil development.

This soil map unit is more common in the northeastern portion of the RSA, although it does occur in scattered clusters in northern and southern parts of the RSA. The Bedrock-Regosols soil type is dominated by heath tundra vegetation interspersed with the occasional graminoid tussock-hummock community in low-lying wet areas. Typically, vegetation is characterized by heath shrubs, such as marsh Labrador tea, black crowberry, and arctic bell heather (*Cassiope tetragona*), as well as moss campion (*Silene acaulis*) and an abundance of crinkled snow lichen (*Flavocetraria nivalis*). Other species that may be encountered include arctic blueberry (*Vaccinium uliginosum*), purple mountain saxifrage (*Saxifraga oppositifolia*), swamp birch (*Betula glandulosa*), and sweet grass (*Hierochloe sp*). Boulders encrusted with various rock lichens (e.g., *Umbilicaria sp*., *Arctoparmelia sp*., and *Rhizocarpon geographicum*) may cover more than a third of the area in these communities and are often widely distributed across the landscape. This soil type is generally associated with the lichen rock plant association and covers 141 484 ha (17%) of the RSA (Table 5.3.3-1, Figure 5.3.3-1) and 624 ha (12%) of the LSA (Table 5.3.3-2, Figure 5.3.3-2).

Organic Cryosols (Tussock – Hummock)

The organic cryosol soil map unit is typically found in flat to low-lying areas, where soils are poorly to very poorly drained. This soil map unit includes wet sedge meadows, which are too small to be mapped as a separate unit in the RSA. Vegetation associated with the tussock-hummock class tends to be dominated by sedges, including water sedge, as well as various species of cottongrass (*Eriophorum sp*.) that form low-lying hummocks. Sphagnum mosses and Aulacomnium moss species commonly occur between the hummocks. Willow species, swamp birch, and other heath shrubs may occur on hummock tops, but with low abundance. The organic cryosol soil map unit is widely distributed across the RSA covering 109 913 ha (13%) of the RSA (Table 5.3.3-1, Figure 5.3.3-1) and 801 ha (15%) in the LSA (Table 5.3.3-2, Figure 5.3.3-2).

Organic and Static Cryosols (Low Shrub)

The organic and static cryosols soil map unit is associated with imperfectly to poorly drained soils characteristic of riparian areas and depressions. This land cover class is characterized by 2 different plant community types: willow dominated shrub communities along the banks of major streams and waterbodies, and swamp birch shrub communities found in low-lying areas. Typically, various willow species and swamp birch form the dominant vegetation cover in these communities, often forming dense low growing mats over the ground that shade out other plant species. Marsh Labrador tea, black crowberry, arctic blueberry, and mountain cranberry may also occur, but are less common. This land cover class is most strongly associated with the birch seep and willow riparian plant community associations at the local scale. The organic and static cryosols soil map unit is very uncommon on the landscape and only covers 12 622 ha (2%) of the RSA (Table 5.3.3-1, Figure 5.3.3-1) and 13 ha (<1%) of the LSA (Table 5.3.3-2, Figure 5.3.3-2).

Static Cryosols (Heath Lichen – Cetraria)

The static cryosol soil map unit is an uncommon landscape unit that typically occurs on the lower slopes of ridges and eskers or as veneers over flat rocky plains characterized by frost boils. This land cover class is sparsely distributed across the RSA and is primarily concentrated in eastern portions of the RSA, with isolated occurrences along the Hudson's Bay coast. Vegetation is typically composed of abundant lichens, primarily snow lichen and *Alectoria* sp., as well as reindeer lichens (*Cladina* sp.) and *Cladonia* sp., all of which may make up more than 50% of the vegetation cover. Heath shrubs, such as arctic blueberry, mountain cranberry, and arctic bell heather, as well as moss campion, are also common, as well as limited occurrences of forbs, willow, and sedge species. The static cryosol soil map unit covers 12 414 ha (2%) of the RSA (Table 5.3.3-1, Figure 5.3.3-1) and 123 ha (2%) of the LSA (Table 5.3.3-2, Figure 5.3.3-2).

Static Cryosols-Bedrock-Regosols (Heath Lichen – Hair Lichen)

Soils of the Cryosolic order occur throughout northern Canada. These regions are characterized by long, cold winters and short, cool summers. As a consequence, the mean annual soil temperature is at or below 0 degrees Celsius (°C), resulting in permafrost conditions, where the ground remains frozen for 2 or more consecutive years. The frequent freeze-thaw cycles associated with these cold environments contribute not only to the presence of permafrost near the soil surface but also to a suite of soil-forming processes known as cryoturbation. Cryoturbation refers to soil movement that arises from frost action, and is sometimes also referred to as "frost churning". Static Cryosols are generally developed on coarse textures parent materials where cryoturbation is generally absent.

The Static Cryosols-Bedrock-Regosols soil map unit is associated with heath lichen – hair lichen land cover class on eskers and the crests and upper slopes of small ridges with poorly developed, rapidly drained soils. These areas may be associated with bedrock outcrops and tend to be found in isolated pockets that are more prevalent in the eastern portion of the RSA. Much of the vegetation in this area is composed of lichens, particularly *Bryocaulon* sp., *Alectoria* sp., and various rock lichens including *Umbilicaria* sp. and *Rhizocarpon geographicum*. Shrubs, such as swamp birch, mountain cranberry (*Vaccinium vitas-idea*), and black crowberry, are also commonly associated with this land cover class, whereas forbs, grasses, or mosses are uncommon to absent. The abundance of black hair lichen (*Alectoria nigricans*) in these areas has the effect of turning the landscape a dark, almost black colour that is very distinctive from both the air and the ground. The Static Cryosol-Bedrock-Regosol soil map unit covers 18 339 ha (2%) of the RSA (Table 5.3.3-1, Figure 5.3.3-1) and 84 ha (2%) of the LSA (Table 5.3.3-2, Figure 5.3.3-2).

Static and Turbic Cryosols (Heath Tundra)

The static and turbic cryosol soil map unit is found on a range of upland sites, from small ridges to flat plains characterized by well-drained soils. This is the most common soil map unit in the RSA and extends throughout the region, though it is less common in the northeastern sections of the RSA. Vegetation in this class is composed of abundant heath shrubs, including marsh Labrador tea, black crowberry, bearberry, entireleaf mountain-avens (*Dryas integrifolia*), and arctic blueberry. Other plant species that may be found include Arctic crazy-weed or oxytrope (*Oxytropis sp.),* louseworts (*Pedicularis sp*.), and saxifrages, as well as various lichen species such as crinkled snow lichen and *Alectoria sp*. At the local scale, the heath tundra land cover class is equivalent to the heath tundra plant community association. The static and turbic cryosol soil map unit covers 273 690 ha (32%) of the RSA (Table 5.3.3-1, Figure 5.3.3-1) and 2740 ha (52%) of the LSA (Table 5.3.3-2, Figure 5.3.3-2).

5.3.3.2 Vegetation

Methods

Regional Ecological Land Cover Classification

A regional ELC classification map was developed using satellite imagery, remote sensing software, and a GIS to determine the abundance and distribution of primary land cover classes within the RSA for vegetation. The RSA ELC classification was based on cloud-free coverage of LANDSAT 5 satellite spectral imagery with a 30 × 30 m pixel size that was captured on the 23 July 2005. A reconnaissance survey completed in July 2008 was used to verify and finalize the regional ELC classification.

Baseline Vegetation Field Surveys

Prior to undertaking the field surveys, a review of relevant vegetation studies completed in and around Rankin Inlet and the Arctic in general was completed to provide a perspective of available information including the following:

- federal and territorial status documents;
- vascular plant checklists for the NWT (Porsild and Cody 1980); and
- other public rare plant species reports for the NWT (McJannet et al. 1995; McJannet et al. 1993).

Baseline vegetation surveys along the AWAR were carried out in the summer of 2008 (29 to 31 July and 1 to 6 September). All vegetation surveys were completed by a field botanist and a local assistant. To ensure consistent and reliable data collection, an initial training session reviewing applicable data collection protocols and common plant species was implemented prior to commencing the field surveys. Field survey methods followed previously established protocols that were developed for the Diavik Project (Burt 1997) and other projects, including the Meadowbank Gold Project and the Baffinland Iron Mines Mary River Project (unpublished data). Listed plant species were assessed as part of the baseline vegetation surveys; however, no specific rare plant surveys were undertaken along the AWAR.

Results

Regional Ecological Land Cover Classification of the Phase 1-AWAR

The regional ELC classification identifies 8 land cover classes (Table 5.3.3-3). This regional coverage includes 4 heath classes, 2 wetlands and riparian classes, and 2 miscellaneous land cover classes, which together covers an area of 5245 ha in the Phase 1 AWAR LSA. Heath vegetation encompasses 3571 ha (34%) of the AWAR Project LSA, while wetlands and riparian areas are distributed over 813 ha (8%) of the AWAR Project LSA (Table 5.3.3-3). The remaining 861 ha (8%) of the AWAR Project LSA are classified as water (7%), predominantly lakes, and a small percentage (1%) of bare ground and rock outcrops.

Eskers have been identified as occurring in the AWAR Project LSA and tend to be associated with the Heath lichen – hair lichen ELC class, which tends to occur on rapidly drained soils that are characteristic of the tops and upper slopes of esker landforms.

Table 5.3.3-3: Total Area and Percent Cover of Regional Land Cover Classes within the All-weather Access Road Project Local Study Area

Regional Ecological Land Cover Class	Local Study Area	
	Area of LSA (ha)	**Percent (%) of LSA**
Heath		
Heath boulder	624	6
Heath lichen - hair lichen	84	1
Heath lichen - *Cetraria*	123	1
Heath tundra	2740	26
Heath vegetation subtotal	*3571*	*34*
Wetlands/Riparian		
Low shrub	13	<1
Tussock-hummock	801	8
Wetlands /riparian subtotal	*813*	*8*
Miscellaneous		
Bare ground (rock outcrop)	121	1
Water	740	7
Miscellaneous subtotal	*861*	*8*
Total	**5245**	**100**

Note: Some numbers are rounded for presentation purposes; therefore, it may appear that the totals do not equal the sum of the individual values.

ha= hectares; LSA = local study area

Heath Boulder

The heath boulder land cover class occurs on rapidly to well-drained sites that contain a high proportion of boulder deposits in association with bedrock outcrops. The heath boulder land cover class is dominated by heath tundra vegetation interspersed with the occasional graminoid tussock-hummock community in low-lying wet areas. Typically, vegetation is characterized by heath shrubs such as northern Labrador tea, crowberry, and white arctic heather (*Cassiope tetragona*) and an abundance of snow lichen (*Cetraria nivalis*).

Heath Lichen – Hair Lichen

The heath lichen – hair lichen land cover class is found on eskers and the crests and upper slopes of small ridges with poorly developed, rapidly drained soils. Much of the vegetation in this area is comprised of lichens, along with various dwarf shrub species such as dwarf birch, lingonberry (*Vaccinium vitas-idea*), and crowberry area, whereas forbs, grasses, or mosses are uncommon to absent. The abundance of *Alectoria nigrescens* in these areas has the effect of turning the landscape a dark, almost black colour that is very distinctive from both the air and the ground.

Heath Lichen - Cetraria

The heath lichen – *Cetraria* land cover class is an uncommon landscape unit that typically occurs on the lower slopes of ridges and eskers or as veneers over flat rocky plains characterized by frost boils. Vegetation is typically comprised of abundant lichens, primarily snow lichen and *Alectoria* spp., as well as reindeer lichens (*Cladina* spp.). Heath shrubs such as blueberry, lingonberry, and white arctic heather, as well as moss campion are also quite common and with limited occurrences of forbs, willow, and sedge species.

Heath Tundra

The heath tundra land cover class is found on a range of upland sites, from small ridges to flat plains characterized by well-drained soils. Vegetation is comprised of abundant heath shrubs including northern Labrador tea, crowberry, bearberry, northern white mountain avens (*Dryas integrifolia*), and blueberry.

Low Shrub

The low shrub land cover class is associated with imperfectly to poorly drained soils characteristic of riparian areas and depressions. This land cover class is characterized by 2 different plant community types: willow dominated shrub communities along the banks of major streams and waterbodies, and dwarf birch shrub communities found in low-lying areas. Typically, various willow species and dwarf birch form the dominant vegetation cover in these communities, often forming dense low growing mats over the ground that shade out other plant species. Northern Labrador tea, crowberry, blueberry, and lingonberry may also occur, but are less common.

Tussock - Hummock

The tussock-hummock land cover class is typically found in flat to low-lying areas, where soils are poorly to very poorly drained. Vegetation associated with the tussock-hummock class tends to be dominated by sedges, as well as various species of cottongrass (*Eriophorum vaginatum*) that form low-lying hummocks. Sphagnum mosses and *Aulacomnium* moss species commonly occur between the hummocks. Willow species, dwarf birch, and other heath shrubs may occur on hummock tops, but with low abundance.

Bare Ground (Rock Outcrop)

The bare ground land cover class represents areas with limited to no vegetation cover. This class is typically associated with eskers and steep sandy slopes.

Water

The water land cover class represents areas associated with lakes and rivers.

Listed Plant Species

No confirmed rare plant species as listed by the Nunavut Government (CESCC 2011) or federal listed species (COSEWIC 2011; *SARA* 2011) were identified as occurring within the AWAR Project LSA during the 2008 field program. However, a number of territorial listed plant species have the potential to occur in habitats that are present in the AWAR Project LSA (Table 5.3.3-4). These include 14 species listed as Sensitive and one species, wavy bluegrass (*Poa autumnalis* [also *Poa laxa*]), which is listed as status undetermined by the Nunavut Government (CESCC 2011). An undetermined status indicates that there is insufficient information or data available on the species to accurately determine its listing status. The majority of the species that are listed as sensitive are associated with wetland or riparian habitats such as meadows, seeps, marshes, which may be captured by the low shrub and tussock-hummock regional ELC classes.

Table 5.3.3-4: Listed plant species with potential to occur in the All-weather Access Road Project Local Study Area

Scientific Name	Common Name	Strata	Nunavut Rank[a]	Habitat
Salix calcicola (also *S. lanata ssp. Calcicola)*	Woolly willow	shrub	Sensitive	shrub, calcareous rocky, gravelly places
Dendranthema arcticum	arctic daisy	forb	Sensitive	moist, saline meadows, moist gravel, seashores
Montia fontana(also *M. lamprosperma*)	Blink	forb	Sensitive	Damp pond edges
Pinguicula vulgaris	Common butterwort	forb	Sensitive	Wetlands
Ranunculus longirostris (also *R. aquatilis*)	White water buttercup	forb	Sensitive	Shallow water, ponds
Ranunculus pallasii	Pallas' buttercup	forb	Sensitive	Brackish meadows, coast
Sibbaldia procumbens	creeping sibbaldia	forb	Sensitive	sheltered slopes, near snowbanks
Woodsia alpina	northern woodsia	forb	Sensitive	uncommon, rock crevices, calcareous rocks
Astragalus eucosmus	Pretty milkvetch	forb	Sensitive	calcareous gravels, often among willows on sand/gravel bars, sheltered lakeshores
Descurainia sophioides	Tansy-mustard	forb	Sensitive	disturbed sites, dens, roadsides
Pinguicula villosa	Small butterwort	forb	Sensitive	found only in Sphagnum moss, in small hillside seeps
Tripleurospermum maritimum	seashore chamomile	forb	Sensitive	moist sandy seashores, salt marshes
Calamagrostis deschampsioides	circumpolar reedgrass	grass	Sensitive	littoral, damp tundra, low seacoasts
Juncus stygius	moor rush	grass	Sensitive	wet margins of seepages, bog pools, western
Poa autumnalis (also *Poa laxa)*	wavy bluegrass	grass	Undetermined	gravelly, not too dry sites, often pioneering disturbed sites

[a] Government of Nunavut (2005).

5.3.3.3 Wildlife and Wildlife Habitat

Methods Overview

Golder Associates Ltd. (Golder) and Arc Wildlife Services Ltd. completed baseline wildlife surveys at the Meliadine Exploration site and in the vicinity of the proposed AWAR during 1998, 1999, 2000, 2008, and 2009

(Golder 2009). The objective of wildlife studies were to provide baseline data that are necessary to assess the potential effects of the AWAR Project on caribou and other wildlife species, while minimizing uncertainty, and to develop a wildlife mitigation and monitoring plan. The focus of the 2008 and 2009 field program was to gather data to complement the previously collected data that may be required to prepare an environmental effects assessment and to guide project design and environmental mitigation. In some cases, the assessment relies on baseline data collected near the Meliadine Advanced Exploration site for describing general trends in the region, including the AWAR.

Baseline data, collected over the 5 years of surveys, encompassed a suite of species (for more information see Golder 2009). The following terrestrial species or species groups were identified as VCs and may be affected by the AWAR:

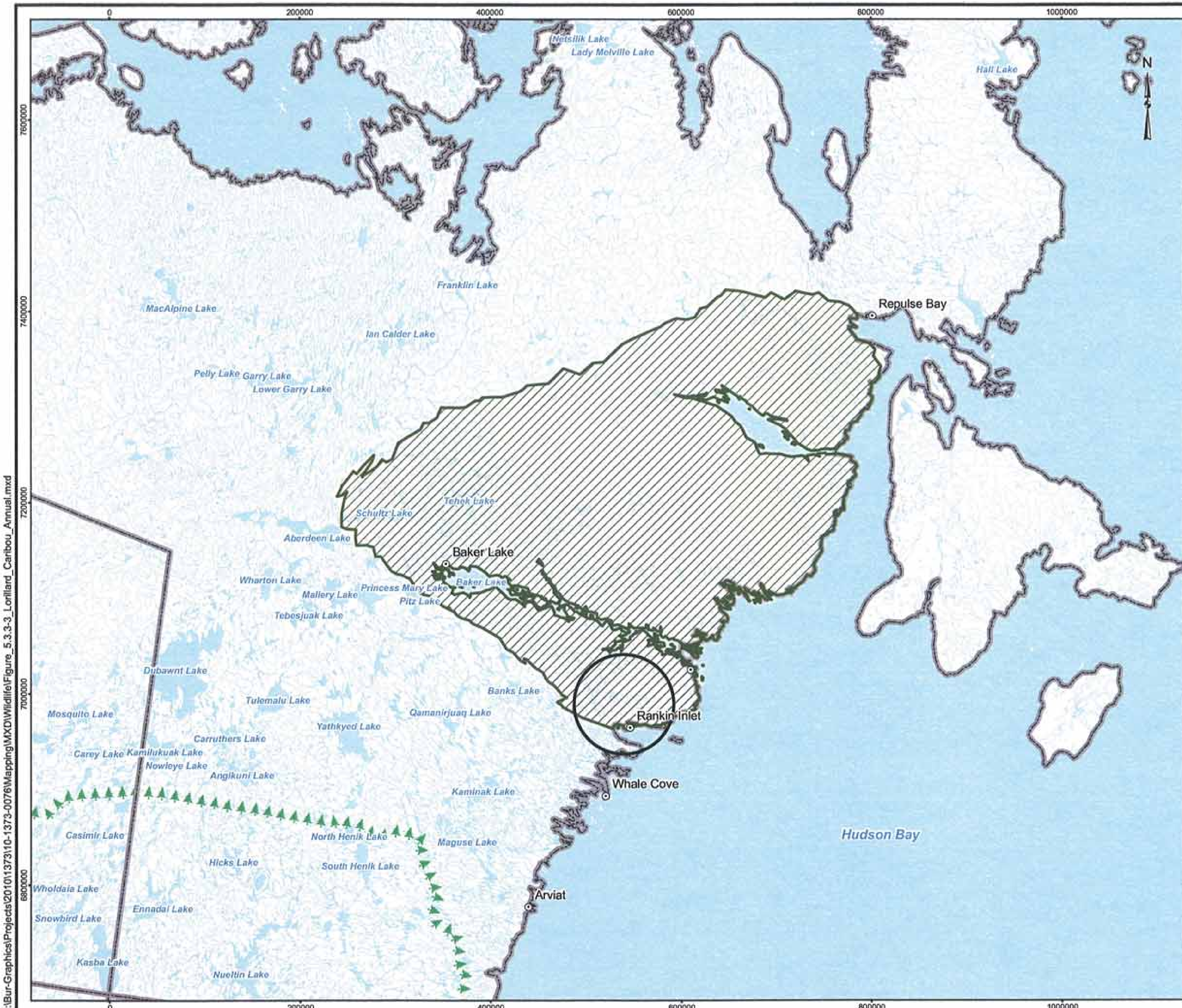
- barren-ground caribou *Rangifer tarandus*;
- carnivores (wolf *Canis lupus* and polar bear *Ursus maritimus*);
- raptors (4 species); and
- upland birds (9 species).

In all study years, aerial surveys for caribou were completed in a 1214 square kilometre (km^2) (1998 to 2000) or 8495 km^2 (2008 to 2009) study area. Raptor nest surveys were conducted along the proposed AWAR to Rankin Inlet in all years. Surveys for upland breeding birds were completed in the AWAR Project area in 2008 and 2009, as well as at the Discovery (Meliadine East) area in 2008.

Incidental wildlife observations were recorded during all visits to the baseline transects and plots at the Meliadine Exploration Project. During all aerial and ground surveys, observations of non-target species were recorded (Golder 2009). In addition, between 1998 and 2000, WMC International Ltd. (WMC) environmental staff and Meliadine Exploration Project staff completed a wildlife sightings log, which provided additional incidental wildlife data. A sightings log was also used in 2008 and 2009, but with little to no participation. Instead, personal communications with camp staff about wildlife observations were recorded and compiled by Golder. A complete list of 'species of conservation concern' is provided in Golder (2009). As of August 2011, the species status has not changed for those on the list since the completion of the baseline report (see www.sararegistery.gc.ca; SARA 2011).

Barren-ground Caribou

Annual home ranges mapped by Nunavut Department of Environment (DoE) show that the proposed AWAR may lie within the annual home ranges of the Lorillard and Qamanirjuaq Caribou Herds (GN 2011; Figures 5.3.3-3 to 5.3.3-8). However, the Lorillard caribou are non-migratory and generally distributed north of Chersterfield Inlet, based on radio-telemetry data collected by the GN and the location of their historical calving grounds (Figure 5.3.3-4). The likelihood of animals of this herd occurring in the RSA is very low. Baseline survey data documenting the distribution of barren-ground caribou during early winter, spring migration and calving, and post-calving through fall migration and rut periods suggest that the RSA lies within the seasonal range of the Qamanirjuaq (Kaminuriak) barren-ground caribou herd (Jalkotzy 1999, 2000a, 2000b; Golder 2008).



N:\Bur-Graphics\Projects\2010\1373\10-1373-0076\Mapping\MXD\Wildlife\Figure_5.3.3-3_Lorillard_Caribou_Annual.mxd

LEGEND

- Community
- Regional Study Area (RSA)
- Lorillard Annual Home Range
- Provincial/Territorial Boundary
- Treeline
- Watercourse
- Waterbody

REFERENCE

Caribou home range shapefiles obtained from the Department of Environment (Government of Nunavut) and Caslys Consulting Ltd. Base data obtained from ESRI and Natural Resources Canada.
Datum: NAD 83 Projection: UTM Zone 15

80 0 80
SCALE 1:4,000,000 KILOMETRES

PROJECT
AGNICO-EAGLE MINES LTD.
MELIADINE GOLD PROJECT
NUNAVUT

TITLE
LORILLARD CARIBOU HERD ANNUAL HOME RANGE (AS DEFINED BY THE GOVERNMENT OF NUNAVUT)

Golder Associates
Greater Vancouver Office, B.C.

PROJECT NO. 10-1373-0076			FILE No.	
DESIGN	CS	13 Sep. 2011	SCALE AS SHOWN	REV. 0
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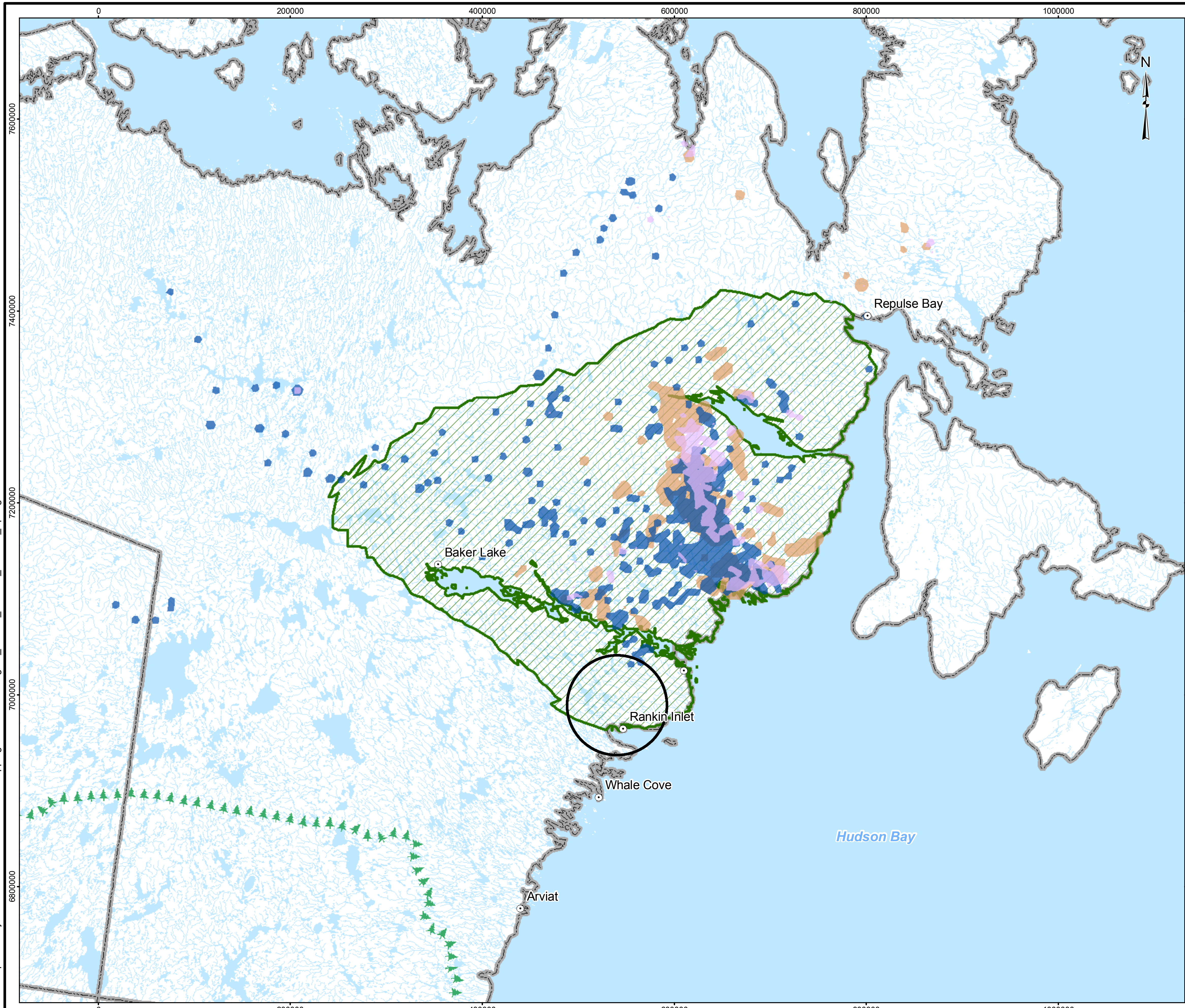
REVIEW	GRA	20 Sep. 2011		



LEGEND

- Development - Point
- Regional Study Area (RSA)
- Lorillard Annual Home Range
- Spring Migration Home Range
- Calving Home Range
- Post-Calving Home Range
- Provincial/Territorial Boundary
- Treeline
- Watercourse
- Waterbody

REFERENCE

Caribou home range shapefiles obtained from the Department of Environment (Government of Nunavut) and Caslys Consulting Ltd. Base data obtained from ESRI and Natural Resources Canada.
Datum: NAD 83 Projection: UTM Zone 15

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SCALE 1:4,000,000 KILOMETRES

PROJECT

AGNICO-EAGLE MINES LTD.
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

LORILLARD CARIBOU SPRING MIGRATION, CALVING AND POST-CALVING HOME RANGES (AS DEFINED BY THE GOVERNMENT OF NUNAVUT)

PROJECT NO. 10-1373-0076			FILE No.	
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GIS	CDB	13 Sep. 2011		
CHECK	CS	16 Sep. 2011	**FIGURE: 5.3.3-4**	
REVIEW	GRA	20 Sep. 2011		

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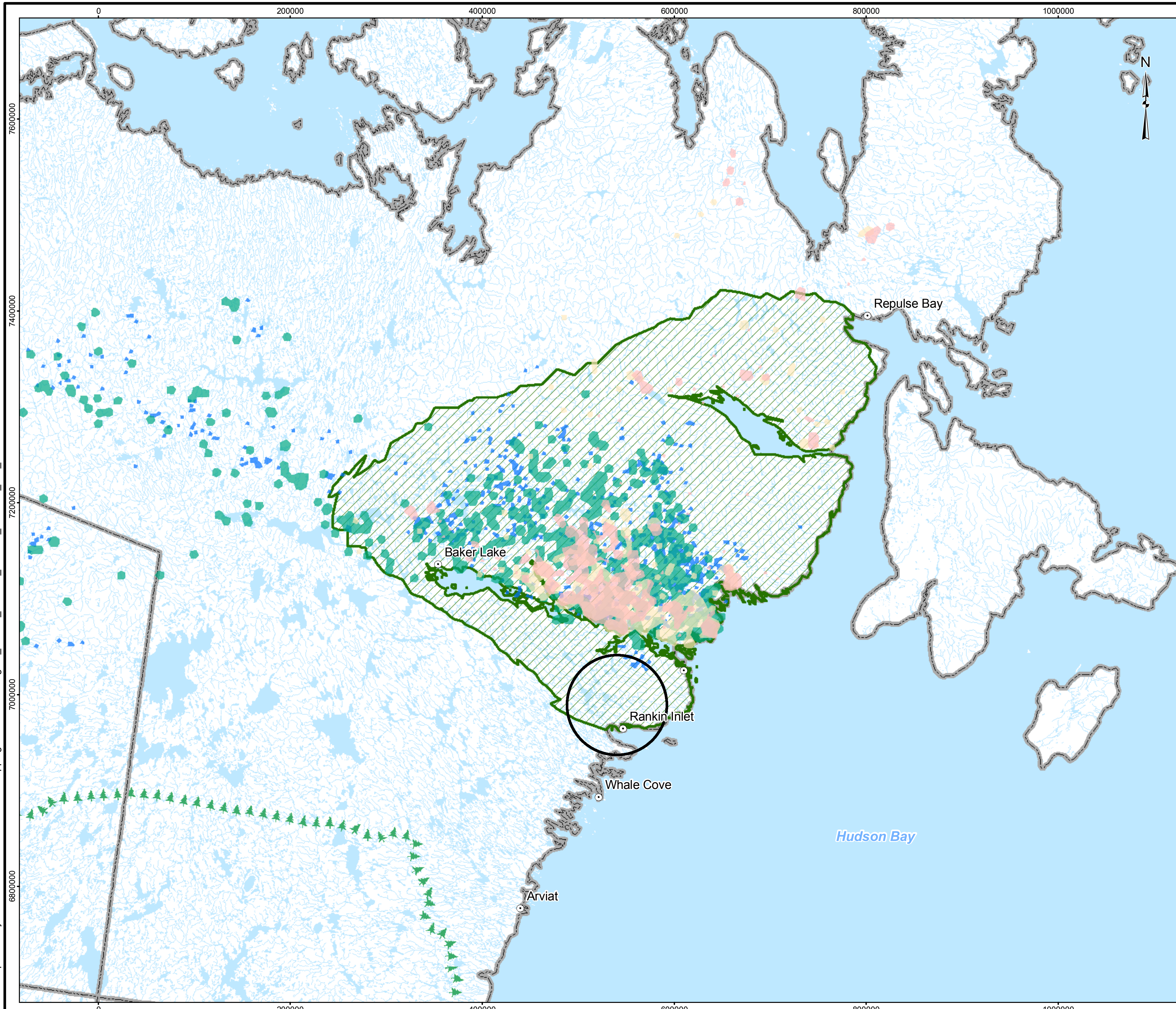

LEGEND

- Community
- Regional Study Area (RSA)
- Lorillard Annual Home Range
- Summer Home Range
- Late Winter Home Range
- Early Winter Home Range
- Fall Home Range
- Provincial/Territorial Boundary
- Treeline
- Watercourse
- Waterbody

REFERENCE

Caribou home range shapefiles obtained from the Department of Environment (Government of Nunavut) and Caslys Consulting Ltd. Base data obtained from ESRI and Natural Resources Canada.
Datum: NAD 83 Projection: UTM Zone 15

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PROJECT
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NUNAVUT

TITLE
LORILLARD CARIBOU SUMMER, FALL, AND EARLY/LATE WINTER HOME RANGES (AS DEFINED BY THE GOVERNMENT OF NUNAVUT)

PROJECT NO. 10-1373-0076			FILE No.	
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REVIEW	GRA	20 Sep. 2011		

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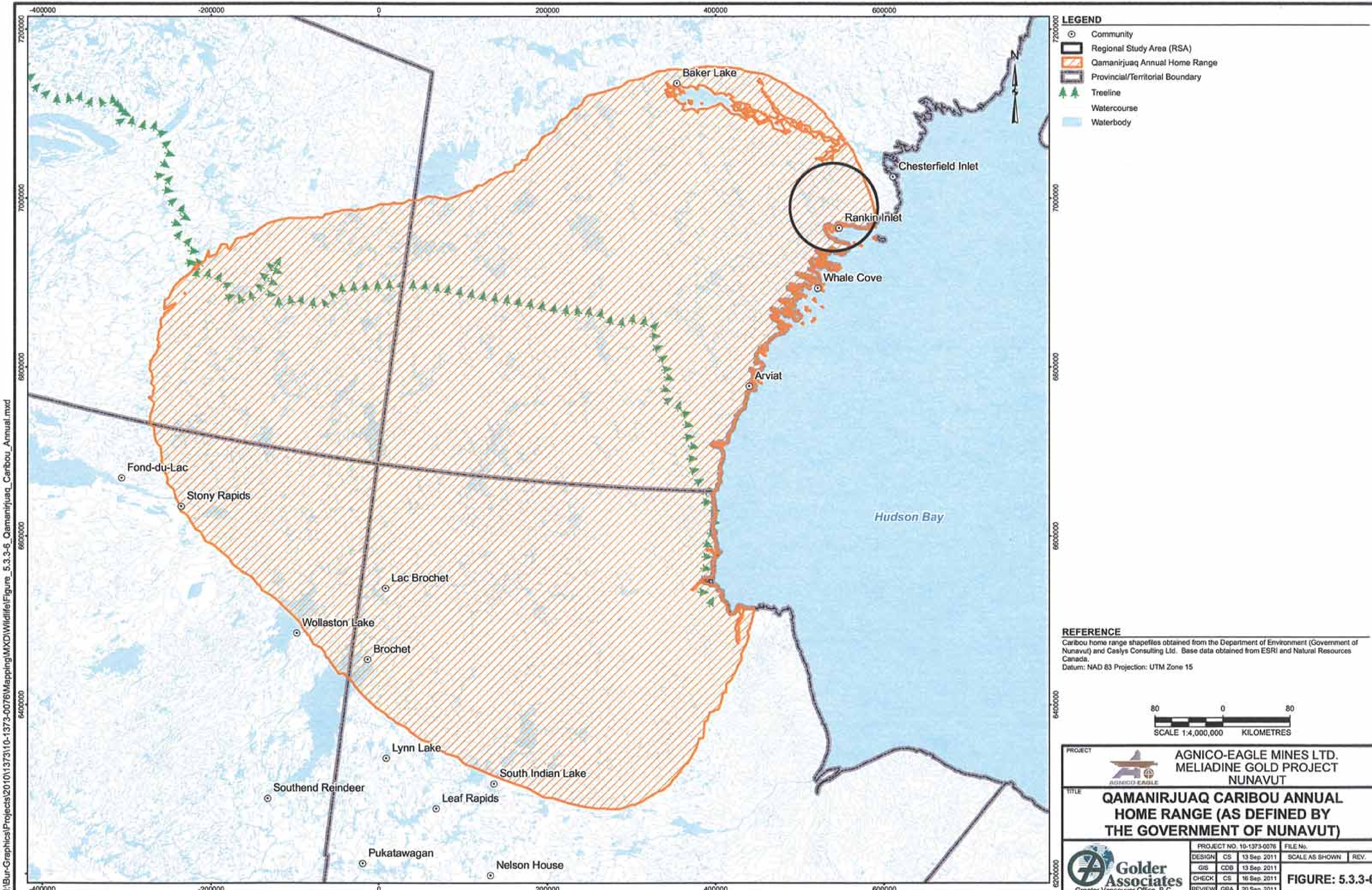
N:\Bur-Graphics\Projects\2010\1373\10-1373-0076\Mapping\MXD\Wildlife\Figure_5.3.3-5_Lorillard_Caribou_Summer_Fall_Winter.mxd



LEGEND
Community
Regional Study Area (RSA)
Qamanirjuaq Annual Home Range
Provincial/Territorial Boundary
Treeline
Watercourse
Waterbody
Baker Lake
Chesterfield Inlet
Rankin Inlet
Whale Cove
Arviat
Hudson Bay
Fond-du-Lac
Stony Rapids
Lac Brochet
Wollaston Lake
Brochet
Lynn Lake
South Indian Lake
Southend Reindeer
Leaf Rapids
Pukatawagan
Nelson House
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AGNICO-EAGLE MINES LTD.
MELIADINE GOLD PROJECT
NUNAVUT
TITLE
QAMANIRJUAQ CARIBOU ANNUAL HOME RANGE (AS DEFINED BY THE GOVERNMENT OF NUNAVUT)
PROJECT NO. 10-1373-0076
FILE No.
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REVIEW GRA 20 Sep. 2011
Golder Associates
Greater Vancouver Office, B.C.
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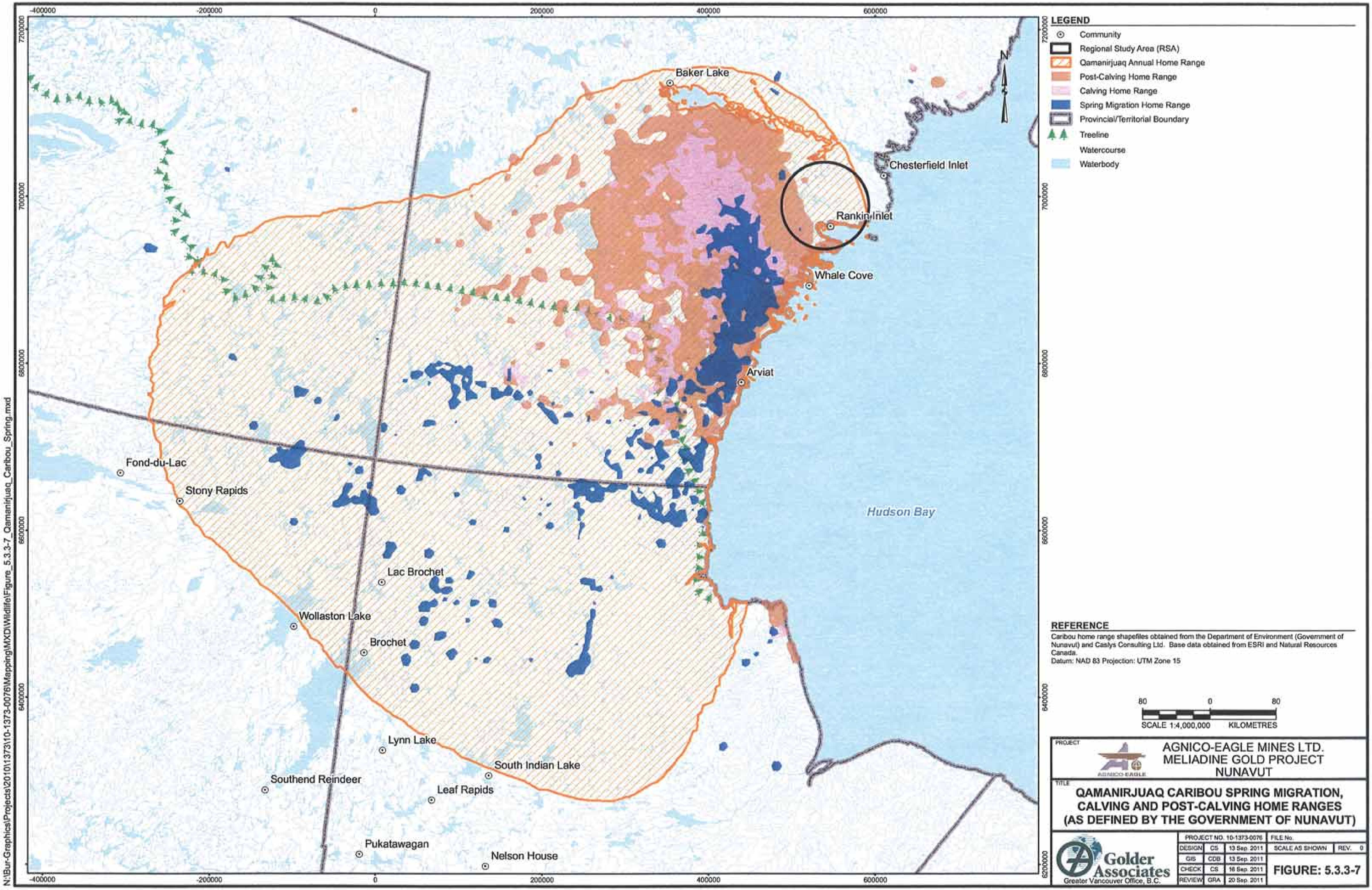

LEGEND
Community
Regional Study Area (RSA)
Qamanirjuaq Annual Home Range
Post-Calving Home Range
Calving Home Range
Spring Migration Home Range
Provincial/Territorial Boundary
Treeline
Watercourse
Waterbody
Baker Lake
Chesterfield Inlet
Rankin Inlet
Whale Cove
Arviat
Hudson Bay
Fond-du-Lac
Stony Rapids
Lac Brochet
Wollaston Lake
Brochet
Lynn Lake
South Indian Lake
Southend Reindeer
Leaf Rapids
Pukatawagan
Nelson House
REFERENCE
Caribou home range shapefiles obtained from the Department of Environment (Government of Nunavut) and Caslys Consulting Ltd. Base data obtained from ESRI and Natural Resources Canada.
Datum: NAD 83 Projection: UTM Zone 15
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PROJECT
AGNICO-EAGLE MINES LTD.
MELIADINE GOLD PROJECT
NUNAVUT
TITLE
QAMANIRJUAQ CARIBOU SPRING MIGRATION, CALVING AND POST-CALVING HOME RANGES (AS DEFINED BY THE GOVERNMENT OF NUNAVUT)
Golder Associates
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PROJECT NO. 10-1373-0076
FILE No.
DESIGN CS 13 Sep. 2011
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CHECK CS 16 Sep. 2011
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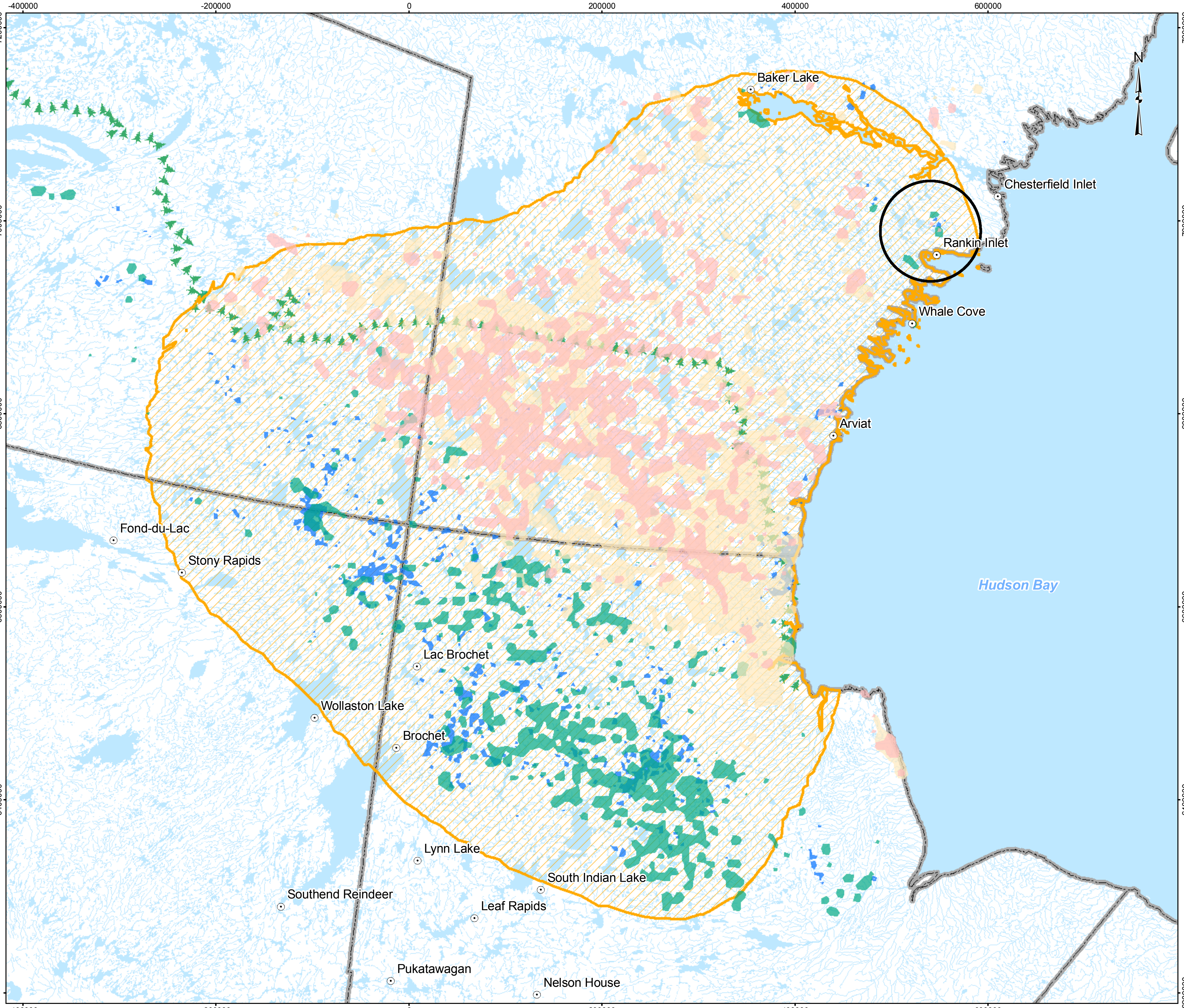

N:\Bur-Graphics\Projects\2010\1373\10-1373-0076\Mapping\MXD\Wildlife\Figure_5.3.3-8_Qamanirjuaq_Caribou_Summer_Fall_Winter.mxd

LEGEND

- Development - Point
- Regional Study Area (RSA)
- Qamanirjuaq Annual Home Range
- Summer Home Range
- Fall Home Range
- Early Winter Home Range
- Late Winter Home Range
- Provincial/Territorial Boundary
- Treeline
- Watercourse
- Waterbody

REFERENCE

Caribou home range shapefiles obtained from the Department of Environment (Government of Nunavut) and Caslys Consulting Ltd. Base data obtained from ESRI and Natural Resources Canada.
Datum: NAD 83 Projection: UTM Zone 15

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SCALE 1:4,000,000 KILOMETRES

PROJECT

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TITLE

QAMANIRJUAQ CARIBOU SUMMER, FALL, AND EARLY/LATE WINTER HOME RANGES (AS DEFINED BY THE GOVERNMENT OF NUNAVUT)

Golder Associates
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PROJECT NO. 10-1373-0076			FILE No.	
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GIS	CDB	13 Sep. 2011		
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REVIEW	GRA	20 Sep. 2011		

The year-round range of the Qamanirjuaq herd occupies an area from northern Manitoba and Saskatchewan in the south to south-western Nunavut and south-eastern NWT in the north (BQCMB 1999, Figure 5.3.3.6). Barren-ground caribou are migratory, and movements and range use varies annually (Wakelyn 1999). The annual distribution and life history of this population has been previously documented (Banfield 1954; Kelsall 1968; Thomas 1969; Parker 1972; Heard 1983). A portion of the Qaminrjuaq herd may pass through the AWAR Project area very quickly in summer but may linger in some years from late October through March (Hubert and Associates 2007).

Migration of the Qamanirjuaq herd from the southern winter range to the calving grounds occurs mid-March to late May (BQCMB 1999). The traditional calving grounds of the Qamanirjuaq herd are located west of the AWAR Project study area, and south of Baker Lake (BQCMB 2008; Figure 5.3.3-7). Specific calving areas can vary from year to year. However, the traditional calving grounds have historically remained in the same general location (BQCMB 2008). After calving in early June, barren-ground caribou form post-calving aggregations and by mid-July move over the tundra landscape en masse. The herds occupy the calving ground and post-calving areas until the end of July when a rapid summer migration to the treeline occurs. It is during this time, the post-calving period, when the herd may interact with the proposed AWAR (Figure 5.3.3-7). The timing of the fall migration south of the treeline occurs from October to December (BQCMB 2008) (Figure 5.3.3-8).

Over 5 years of monitoring have been coordinated around the Meliadine Exploration site. In total, 195 groups of barren-ground caribou were observed during 16 aerial surveys, comprising a total of 10 254 individual animals. Less than 20 caribou were observed during at least 8 of the aerial surveys. The mean density of barren-ground caribou observed across aerial surveys was estimated to range from 0 to 13 caribou per km^2. The highest density was observed during the spring migration/calving survey in 2000 (3926 caribou were observed during 28 March 2000). Although large numbers were observed during the post-calving through fall migration and rut survey in 2009 (5920 caribou in 21 July 2008), the study area was much larger reducing the calculated mean density of barren-ground caribou. It is highly likely that the observed caribou were of the Qamanirjuaq herd based on government deployed collars that monitor movements of barren-ground caribou in the region. Barren-ground caribou were most frequently observed in heath tundra, and were also observed in esker habitat during the post-caving through rut surveys.

The links between demographic variables (e.g., adult and calf survival), environmental factors (e.g., food quality and quantity, insects, hunting, and development), and population growth are not well understood for barren-ground caribou. Although direct losses of habitat (e.g., total mining footprint) are small, and likely have marginal influences on the carrying capacity of the landscape (Johnson et al. 2005), industrial development has the potential to disrupt movements and reduce availability of high-quality habitat. For example, Johnson et al. (2005) showed that Bathurst caribou avoided areas of industrial development, particularly during post-calving movements. Other studies have suggested that caribou can adjust their behaviour (e.g., by feeding more in non-disturbed areas) to accommodate some disturbance (e.g., Colman et al. 2001).

Based on a Nunavut government population survey in 2008, the Qamanirjuaq herd numbers at around 348 000, possibly down by about one-third from the previous estimated herd size of 496 000 in 1994 (BQCMB 2011). This decline is consistent with trends recently observed for other barren-ground caribou herds. Hunters from communities in Nunavut, the NWT, northern Manitoba, and Saskatchewan harvest from this herd. The BQCMB has estimated that up to 14 000 caribou may be harvested from the Qamanirjuaq herd on an annual basis. The total net economic value of this harvest may be well over $20 million. Wildlife harvest statistics for Rankin Inlet indicate that about 1000 caribou are harvested annually from the area (NWMB 2004) (Table 5.3.3-5). This does not include non-traditional harvest from resident or sport hunters. Resident hunters may harvest up to 5 caribou per year, between 15 August and 30 April. Caribou are harvested more than any other mammal in the region, followed by Arctic fox and wolf.

Table 5.3.3-5: Wildlife (Traditional) Harvest Estimates for Rankin Inlet from June 1996 to May 2001

Species	96/97	97/98	98/99	99/00	00/01	5-yr Mean
Caribou	1615	724	982	1128	411	989
Muskox	3	1	6	0	0	2
Polar bear	12	11	13	10	1	9
Wolf	27	17	84	41	0	34
Arctic fox	171	39	33	3	0	49
Wolverine	1	0	5	4	0	2
Arctic hare	11	2	0	0	0	3

Source: NWMB (2004).

Wolf

The grey wolf commonly occurs throughout much of Nunavut. In the Kivalliq region, wolves likely migrate with the caribou herds, as do the wolves of the central NWT (see Walton et al. 2001). Heard and Williams (1992) documented the location of wolf dens in the Kivalliq region, and noted that wolves of the central Canadian barren-grounds generally den near the treeline, where they are able to intercept caribou returning from calving ground in the fall, and when the nutritional demands of the pups are at their greatest.

In Nunavut, the status of the wolf is secure (CESCC 2011), but the national status is not at-risk according to COSEWIC (COSEWIC 2011). The density of wolves in the central Canadian Arctic was estimated at approximately 1 per 100 km^2 but can fluctuate to 1 per 200 km^2 depending on the status of the barren-ground caribou population (Mattson et al. 2009). However, wolves are infrequently observed around the Meliadine Exploration site, and surveys specific to wolves have not been undertaken in the region. An incidental observation of 3 wolves was made during baseline work in 2008.

In the Kivalliq, the hunting season for resident hunters spans from 1 September to 15 May. The 5-year mean harvest of wolf from Rankin Inlet was 34, ranging from none to 84 (for comparison) between 1996/1997 and 2000/2001 (Table 5.3.3-5).

Polar Bear

Polar bears are a circumpolar species, but 55 to 65% of the global population is in Canada, distributed among 13 subpopulations, totalling about 15 500 individuals (GN 2011). The polar bear is also an icon of Canada's wildlife heritage and is of important cultural significance to Inuit. The polar bear was last assessed by COSWEIC in 2008, and the status of "Special Concern" was affirmed despite disagreement by the Nunavut government. Although polar bears are not listed under the federal *Species at Risk Act*, they are considered "Vulnerable" in the Red List of the Species Survival Commission of The World Conservation Union. Also, polar bears are on Appendix II of Convention on International Trade in Endangered Species, meaning that any international shipment of polar bears or parts requires a permit (COSEWIC 2008).

The main limiting factors affecting polar bear distribution and numbers today are availability of food (access to, and abundance of, ice-dependent seals) and human-caused mortality (almost exclusively from hunting). Industrial developments in remote northern landscapes also pose a threat where large carnivores, such as polar bear, can habituate to human activity and develop a dependency on improperly stored food waste and garbage. The attraction to such waste can lead to the removal or euthanization of animals as a measure to avoid human injury and property damage (e.g., Jonkel 1970; CWS 2007; COSEWIC 2008). However, global climate change may pose a more substantial threat to polar bears. Polar bears rely almost entirely on the marine sea ice environment for their survival, so large-scale changes in their habitat will impact the population (Derocher et al. 2004). The polar bear is closely linked to the physical attributes of sea ice (type and distribution) and the density and distribution of ice-dependent seals (mainly ringed seals; *Pusa hispida*). This specialized trait combined with low reproductive rates and naturally occurring low densities precludes the population to declines when there are subtle changes to the environment.

Rankin Inlet lies within the range of the Western Hudson Bay subpopulation. The number of polar bears in Western Hudson Bay has declined from 1194 (95% CI = 1020–1368) to 935 (95% CI = 794, 1076) between 1987 and 2004, a reduction of approximately 22% (Regehr et al. 2007, cited in COSEWIC 2008). Concurrently, but contrary to the scientific re-assessment of abundance, Inuit along the western coast of Hudson Bay reported seeing greater numbers of polar bears, which they interpreted as evidence of an increasing population (COSEWIC 2008; GN 2011). As a result, Nunavut increased its polar bear quota in Western Hudson Bay by 9 bears per year. However, recent scientific evidence suggests the subpopulation is now declining at a substantial rate (COSEWIC 2008), and so, in 2007, the GN reduced the quota for the western Hudson Bay population from 56 to 38. Climate change in connection with over-harvest resulting from a reduction in food carrying capacity is a major threat to the Western Hudson Bay subpopulation (COSEWIC 2008).

Polar bear hunting in Nunavut is largely managed through quota systems and according to Aboriginal treaty rights. Internationally, the management of polar bears is coordinated under the Agreement on the Conservation of Polar Bears, signed by the federal government on behalf of all Canadian jurisdictions in November 1973. Under this agreement, Aboriginal peoples have the exclusive right to harvest polar bear for subsistence. Quotas are allocated exclusively to Aboriginal peoples who may choose to fill part of their quota by offering a guided hunt. However, guided hunts and all other human-caused polar bear mortalities (including problem bears and illegal kills) are considered to be part of the quota (GN 2011).

Polar bears were recorded in the wildlife log of the Meliadine Lake camp on 2 occasions between 1998 and 1999. In December 1998, a female and a single cub were seen travelling north along Meliadine Lake. In August 1999, a single polar bear was seen 18 km north and east of WMC’s camp (Arc Wildlife Services 2000). The polar bear is clearly uncommon to the area. From early winter until break-up of annual sea ice in spring, polar bears are dispersed predominantly over sea ice along the coast. They may range >200 km offshore. Maternal denning sites are generally located on land near the coast, being excavated in snowdrifts and in some places frozen ground (COSEWIC 2008). The length and frequency of seasonal movements undertaken by bears within each subpopulation varies with the size of the geographic area occupied, and the annual pattern of freezing and break-up of sea ice (COSEWIC 2008).

Raptors and Raptor Nests

Raptors, such as falcons, are considered valuable indicators of the environment. For example, research has shown that declines in falcon populations have been a result of nearby human activities and developments

(Newton 1979). However, the value of using raptors for monitoring environmental effects can be limited by their naturally low densities. Further, recent monitoring at northern mines has shown that peregrine falcons and gyrfalcons are tolerant to moderate levels of human disturbance, often nesting near mining activity, in quarries, or on mining structures (BHPB 2010; DDMI 2010). Peregrine falcons have been observed nesting in quarries for the Meadowbank Gold Mine AWAR (Gebauer and Associates 2010).

In 2007, COSEWIC re-assessed the status of all peregrine falcons in Canada, and merged *anatum* and *tundrius* into one entity that was down listed to Special Concern (NWTSAR 2011). Rankin Inlet is the site of a long-term study of peregrine falcons, initiated in 1980. The peregrine falcons of Rankin Inlet have been monitored by government biologists and universities since 1980, resulting in a long-term database describing peregrine diet, organochlorine levels, turnover, recruitment, behaviour, and population dynamics.

Research was motivated initially by the high density of peregrine nests (up to 30 pairs in a 450 km^2 study area) and the need to understand processes responsible for the worldwide decline, most notably caused by DDT. Since then, studies have examined the morphology of breeding adults, recorded the distribution and density of nesting pairs, their arrival on the breeding ground, nesting behaviour, nestling growth and brood reduction, productivity and turnover, and the nature of their migration through satellite telemetry and band returns (ArcticRaptors 2011). Several journal articles have resulted, including Court et al. (1988a), Court et al. (1988b), Bradley et al. (1997), Johnstone et al. (1996), and Franke et al. (2010); see also ArcticRaptors (2011).

Peregrines in this area have been observed to nest on both cliffs and boulders, but generally near substantial waterbodies, both freshwater and saltwater, with the nests ranging in height from 4 to 26 m from the ground (Court et al. 1988a). Fidelity to nesting territories is high, but breeding pairs may change to different locations on the same cliff. The peregrines generally arrive in the breeding area in late May, and chicks fledge by late August. Mean clutch size was 3.6 eggs, generally hatching in early July. The diet included 19 species of birds (including ducks, ptarmigan, shorebirds, and passerines among other types) and 3 species of small mammals (Arctic ground squirrel, collared lemming, and brown lemming) (Court et al. 1988a). Peregrines banded in Rankin Inlet have been identified in the United States and South America (Court et al. 1988a). Snowy owls and rough-legged hawks also nest in the area.

In a review of suggested protections for raptors, Richardson and Miller (1997) listed the 3 effects of human activity to raptors as physically harming eggs, chicks or adults; altering habitats; and disrupting normal behaviour. Further, some peregrine falcons are extremely sensitive and refuse to breed if humans have been in the vicinity of their nests. Sensitivity to disturbance, and certainly the consequence of disturbance, is increased during the breeding season.

There is some available information on the effects of disturbance to raptors. Holmes et al. (1993) argued that raptors are often less sensitive to vehicles than to people on foot. At the Snap Lake Mine (also in a tundra environment), variation in nest site occupancy and success was not strongly related to distance from the mine. Although weather and prey abundance were not highly correlated with nest success, these environmental variables had stronger associations with nest success than did distance from the mine (De Beers 2008). However, spatial and temporal changes in raptor nest occupancy and success in the Lac de Gras region have been observed. Raptor nest success and occupancy increased with distance from the Diavik Diamond Mine, and nest success appeared to decline over time from construction through current operations (Golder 2005). However, the relationships were weak, and spring rainfall also contributed to the variation in nest success (Golder 2005).

Studies of prairie falcon responses to blasting activities found that falcons showed behavioural reactions to blasting in 54% of blasts (Holthuijzen et al. 1990). Incubating or brooding falcons flushed from their aeries in 22% of the blasts, but returned to their nests within an average of 3.4 minutes. The authors suggested that blasting associated with limited human activity does not need to be restricted at distances greater than 125 m from occupied prairie falcon nests, provided that peak noise levels do not exceed 140 decibel (dB) at the aerie and no more than 3 blasts occur on a given day or 90 blasts during the nesting season. Peak air vibration levels at 125 m is estimated to be 136 dBL (see Section 5.1.5.2), which is below the 140 dB threshold value noted in the literature for falcon nests. Studies of flushing distances of wintering bald eagles in a boreal environment by Stalmaster and Newman (1978) suggested that activity be restricted within 250 m to protect wintering grounds.

There are indications that raptors are able to habituate to disturbance. At the Meadowbank Gold Mine, peregrine falcons have moved in to new cliff-like habitat created at quarries along the all-weather access road, successfully rearing young in 2009 (Gebauer and Associates 2010). There have been several attempts by peregrine falcons, gyrfalcons, rough-legged hawks, and common ravens to nest within both active and abandoned open pits at the Ekati and Diavik diamond mines. Peregrine falcons made nesting attempts in open pits at Diavik Diamond Mine in 2005 and 2006 (DDMI 2007). Since 2004, there have been 8 such occurrences among 5 open pits at the Ekati Diamond Mine, and all 5 Ekati pits had nesting birds in 2006 (BHPB 2007). In some cases, young have been detected in these nests (BHPB 2003; BHPB 2007). Nesting on pit walls has become so common at the Ekati Diamond Mine that a monitoring program has been implemented.

The primary objective of the raptor nest surveys was to determine the distribution and occupancy rate of nesting raptors around the Meliadine Exploration site and proposed access road corridor. Ground and aerial surveys were used to search for raptor nesting sites within approximately 10 km of the exploration camp and in close proximity to the proposed AWAR (1998, 1999, 2000, and 2009). In all years, special attention was paid to cliffs, rock outcrops, boulders, and eskers. Two surveys were typically completed during a year of baseline monitoring: the first survey determined occupancy of the historical nest sites and identified new nest sites, while the second survey measured productivity.

Between 1998 and 2000, and in 2008 and 2009, 37 nest sites were observed in the study area. There are 7 potential nesting sites within 500 m of the proposed AWAR alignment, 3 of the nests were located on a small cliff and only one of these 3 supported a breeding pair of raptors (i.e., peregrine falcon) in 2011 (Figure 5.3.3-9). This location was less than 100 m from an existing ATV trail. The 4 remaining nest locations were of areas with minimal topographic relief (i.e., birds either nested on the ground or just above the ground on a small boulder). All of the 27 nests recorded in the RSA belong to one of the following 4 raptor species:

- Rough-legged Hawk (*Buteo lagopus*); “Sensitive” species in Nunavut (CESCC 2011);
- Peregrine Falcon (*Falco peregrinus*); “Special Concern” in Canada (COSEWIC 2011);
- Gyrfalcon (*Falco rusticolus*); “Sensitive” species in Nunavut (CESCC 2011); and
- Short-eared Owl (*Asio flammeus*); “Sensitive” in Nunavut (CESCC 2011), “Special Concern” in Canada (COSEWIC 2011); listed under schedule 3 in Canada (SARA 2011).

Figure 5.3.3-9: An Active Raptor Nest Location (See Arrow; Site F08-02) Facing West over-looking the Proposed Phase 1 All-weather Access Road Alignment)

Cliffs are the main feature of habitat for raptors, particularly falcons. Raptors hunt in a variety of habitat types in relation to areas frequented by their prey, but often have stringent requirements for nesting sites. Typically, raptor and hawk, nesting sites encompass the most rugged terrain available in the area. Their nests are commonly built near water and are well protected against access by predators. Short-eared owls typically nest on the ground in marsh habitat or open tundra. Only one short-eared owl nest has been found to date in the vicinity of baseline surveys around the Meliadine Exploration site and proposed AWAR corridor.

Baseline work has also shown that nest productivity and success can vary considerably between years. Late springs and cold, wet weather can affect nesting success. Variability is likely compounded by natural population fluctuations, which are thought to occur at regular intervals in rough-legged hawk and gyrfalcon populations (Hagen 1969; White and Cade 1977; Swartz et al. 1974; Mindell 1983).

Upland Breeding Birds

Upland breeding birds include passerines (such as sparrows and finches), ptarmigan, and upland breeding shorebirds. The spring migration of birds to the Kivalliq begins in early May and peaks around mid-to-late May.

The breeding season for small perching birds (passerines) typically starts during the first week of June and continues for about 3 weeks. Fall migration begins in mid-August for some species such as sandpipers, and continues through to mid-September for late migrants such as horned larks.

Upland birds provide good indicators of environmental change as they are deemed to be sensitive to human-caused disturbances, are represented by many species covering a wide range of niches, and are easily monitored. However, studies of upland birds at the Ekati mine show that the densities of upland birds are not affected within 1 km of the mine footprint. In fact, species diversity can be slightly higher in plots closer to the mine (Smith et al. 2005). Concurrent studies of Lapland longspurs at the Ekati mine indicated that nest success was unaffected within 300 m of major haul roads (Male and Nol 2004). Specific studies of songbirds along the Meadowbank Gold Project road are proceeding, but an analysis of project effects has not yet been completed (Gebauer and Associates 2010).

The objective of upland bird point count surveys was to determine the composition and abundance of upland bird species in the RSA. In 2008 and 2009, 136 and 145 point counts or plots were completed, respectively, within and immediately adjacent to the potential mine footprint (i.e., around the proposed Meliadine Gold Project area). It was assumed that sampling sites were representative of habitats and conditions that follow the proposed AWAR. Plots radiated out from the potential mine footprint and included the Tiriganiaq and F-Zone areas. Six habitat types were surveyed (heath boulder, heath bedorck, heath tundra, sedge wetland, tussock hummock, and esker). Across both years combined, heath tundra was the most commonly sampled habitat type (54% of plots), followed by tussock hummock (23%), sedge wetland (12%), esker (7%), heath boulder (3%), and heath bedrock (1%).

Upland bird densities in plots ranged from zero to 8.9 individuals per ha. Overall, mean (± SE) densities were highest in heath boulder (1.8 ± 0.8 birds per ha), followed by tussock hummock (1.4 ± 0.2), sedge wetland (1.2 ± 0.3), heath tundra (1.0 ± 0.1), and esker (0.8 ± 0.2). In 2008, 9 species of upland songbirds and shorebirds were recorded within the plots, and 6 species were recorded within the plots in 2009 (Table 5.3.3-6). Seven songbird and 2 shorebird species were recorded within the plots in 2008, whereas 5 species of songbird and one shorebird species were recorded in 2009. Lapland longspurs (*Calcarius lapponicus*), horned larks, and savannah sparrows (*Passerculus sandwichensis*) were the more common birds observed in both years.

Table 5.3.3-6: Mean Density and Total Number of Individual Observations Inside Plots (2008 and 2009)

Species	Scientific Name	Mean Density (Range[a]) [Individuals per Hectare]	Total
Lapland Longspur	*Calcarius lapponicus*	0.3 (0.0 – 3.8)	84
Horned Lark	*Eremophila alpestris*	0.3 (0.0 – 6.4)	84
Savannah Sparrow	*Passerculus sandwichensis*	0.3 (0.0 – 5.1)	65
American Pipit[b]	*Anthus rubscens*	0.1 (0.0 – 3.8)	19
Redpoll species	*Carduelis sp.*	<0.1 (0.0 – 1.3)	1
Snow Bunting[b]	*Plectrophenax nivalis*	<0.1 (0.0 – 3.8)	4
White-crowned Sparrow[b]	*Zonotrichia leucophrys*	<0.1 (0.0 – 1.3)	1
Semipalmated Plover	*Charadruis semipalmatus*	<0.1 (0.0 – 1.3)	2
Least Sandpiper[b]	*Calidris minutilla*	<0.1 (0.0 – 2.5)	4

[a] minimum to maximum values

[b] listed as 'sensitive' in Nunavut (CESCC 2011).

- = not applicable; < indicates less than

5.3.3.4 Traditional and Non-Traditional Land Use

The topography of the Rankin Inlet area is relatively flat and provides good access to the tundra through a network of various trails for hunting and fishing (Onalik 1997). The established trails within the RSA extend in all directions from Rankin Inlet, west to the Diana River, north and northeast to the opposite arms of Meliadine Lake, and east to Dry Cove. Cabins are present at all of these destinations, including at least 8 on Meliadine Lake, and over a dozen at the Diana River. As shown in Plate 3.1-3 of Section 3, the existing trail to Meliadine Lake along the route of the proposed AWAR is well used, resulting in considerable damage from the ATV traffic. In winter, snowmobiles are used to access the land within the RSA. There are about 58 km of existing winter roads in the RSA that connect Rankin Inlet to active exploration camps, including the Meliadine Advanced Exploration Project.

The population of Rankin Inlet is approximately 2300, of which 2000 consider themselves to be Inuit (Statistics Canada 2007), and as such have very little restrictions to their hunting rights. The Nunavut Harvest Study (NWMB 2004), reporting data collected between June 1996 and May 2001, found the average annual caribou harvest by Inuit of Rankin Inlet to be 989. Although harvesting of caribou was found to occur during each month of the year (i.e., by ATV and snowmobile), the harvest appeared most intensive during the late winter. The average annual harvest of wolf and fox over this time was 34 and 49, respectively. Although the location of this harvesting was not provided in the Nunavut Harvest Study report, at least some of this harvesting occurred from the existing trails described above. The 15 km all-season road from Rankin Inlet to the Iqalugaarjuup Nunanga Territorial Park also provides access to hunting and fishing in the RSA.

5.3.4 Effects Analysis

As discussed in Section 4.3, the potential effects pathways for the AWAR Project were analyzed (refer to Section 4.3 for detailed description on pathway analysis). Potential pathways through which the AWAR Project could affect the terrestrial VCs are presented in Table 5.3.4-1.

Table 5.3.4-1: Potential Pathways for Terrestrial Environment

Project Component/ Activity	Terrestrial Component	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment
Phase 1 AWAR footprint	Terrain and Soils	Site clearing, contouring, and excavation at borrows/quarries can cause admixing, compaction, and increase erosion potential of soils.	The Phase 1 AWAR will be as narrow as possible, while maintaining safe construction and operation practices. Erosion control practices will limit wind and water erosion on steep slopes (e.g., vegetation, erosion mats).	Primary
		Physical loss or alteration from the footprint can affect local availability of soils.	The Phase 1 AWAR will be as narrow as possible, while maintaining safe construction and operation practices.	Primary
	Terrain and Soils Vegetation, Wildlife	Loss or alteration of local flows, drainage patterns (distribution), and drainage areas from the Phase 1 AWAR Project footprint can cause changes to soils, vegetation, and affect wildlife habitat.	Use of culverts and other design features that reduce changes to local flows and drainage patterns and drainage areas.	No linkage
	Vegetation and Wildlife	The Phase 1 AWAR footprint will directly affect plant populations and communities, and habitat for caribou, wolf, upland birds, and raptors	The Phase 1 AWAR will be as narrow as possible, while maintaining safe construction and operation practices. Most of the road will be built at the height of land where vegetation is limited.	Primary
	Wildlife	The Phase 1 AWAR footprint may fragment habitat and restrict movement of caribou, wolf, upland birds, and raptors	The Phase 1 AWAR will be as narrow as possible, while maintaining safe construction and operation practices. The road generally will be 1.3 m or less in height	Secondary
		The Phase 1 AWAR footprint will remove habitat and fragment the landscape for polar bear	As above.	Secondary
		The Phase 1 AWAR may increase harvesting of caribou and wolf by improving access to land for hunters from Rankin Inlet	Access to the Phase 1 AWAR will be controlled (gated); public vehicles (cars, trucks) allowed only with special authorization. Access will be limited when large numbers of caribou are crossing the road; this will occur in consultation with the local HTO. Prohibit hunting, trapping, harvesting and fishing by employees and contractors, and enforce this prohibition. Upon consultation with the KIA and HTO, an appropriate “no shooting zone” will be established along the road.	Primary

Table 5.3.4-1: Potential Pathways for Terrestrial Environment (continued)

Project Component/ Activity	Terrestrial Component	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment
Construction and use of Phase 1 AWAR	Soils Vegetation, and Wildlife	Dust deposition can cause changes to the chemical properties of nearby soils, and affect vegetation and wildlife habitat in the region	The Phase 1 AWAR will be as narrow as possible, while maintaining safe construction and operation practices. Posted speed limits of 50 km/h will be maintained and enforced. Potential watering of Phase 1 AWAR surface in key areas (e.g., near camp, over bridge) will suppress dust production. Potential use of chemical dust suppressants in accordance with the Environmental Guidance for Dust Suppression published by the Government of Nunavut Department of Environment. Their use will be limited, as they tend to attract wildlife to the road.	Secondary
	Soils Vegetation, Wildlife	Spills along the All-weather Access Road can affect soils, vegetation, and wildlife habitat	Hazardous materials and fuel will be stored according to regulatory requirements to protect the environment and workers (i.e., Materials and Waste Management Plan). Individuals working on site and handling hazardous materials will be trained in the Transportation of Dangerous Goods and Hazmat. Soils from petroleum spill areas will be excavated, placed into appropriate containers and shipped for remediation. An Emergency Response and Spill Contingency Plan will be implemented. Emergency spill kits will be available wherever hazardous materials or fuel are stored and transferred.	No Linkage
	Vegetation	Introduction of non-native plant species can affect native vegetation	Cleaning of construction equipment/vehicles before delivery to Rankin Inlet	Secondary

Table 5.3.4-1: Potential Pathways for Terrestrial Environment (continued)

Project Component/ Activity	Terrestrial Component	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment
Construction and use of Phase 1 AWAR (continued)	Wildlife	Indirect effects such as sensory disturbance may affect habitat quality and alter the movement and behaviour of caribou, wolf, breeding birds, and raptors	Access to the Phase 1 AWAR and vehicular traffic will be controlled (gated); public vehicles (cars, trucks) will be allowed only with special authorization. Upon consultation with the KIA and HTO, an appropriate "no shooting zone" will be established along the road. Posted speed limits of 50 km/h will be maintained and enforced. Locations of large aggregations of animals must be reported to the road supervisor, who will inform all potentially affected employees and the environmental representative so that appropriate actions can be taken. Speed limit reduced to 30 km/h when 1-50 caribou observed within 100 m of Phase 1 AWAR; access will be limited when large numbers of caribou near to, or are crossing, the road. Caribou and all wildlife will be given right-of-way on the road and must be allowed to pass uninhibited. Where active raptor nests are identified, a nest-specific management plan will be developed to minimize disturbance to nesting activities. To the greatest extent possible, blasting and stockpiling at quarries will be conducted under winter conditions prior to arrival of the nesting birds.	Primary
		Vehicle collisions with wildlife may cause injury or mortality to individual animals crossing the road.	As above.	Secondary

Table 5.3.4-1: Potential Pathways for Terrestrial Environment (continued)

Project Component/ Activity	Terrestrial Component	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment
Construction and use of Phase 1 AWAR (continued)	Wildlife (continued)	Construction may lead to the destruction of bird nests	The Phase 1 AWAR will be as narrow as possible, while maintaining safe construction and operation practices. The bottom rock layer will be added prior to May 1 as part of the road footprint. The road alignment will attempt to avoid potential topographic features that may provide nesting habitat for raptors	No linkage
		Attraction to the Phase 1 AWAR Project may increase human-carnivore interactions and removal of individual animals (e.g., relocation or mortality), which can affect carnivore population sizes (e.g., polar bear, wolf)	Most construction of the Phase 1 AWAR will be based out of Rankin Inlet or the exploration camp eliminating the need for temporary camps along the route. Littering and feeding of wildlife will be prohibited. Education and reinforcement of proper waste management practices to all workers and visitors to the site. Education on the risk associated with feeding wildlife and careless disposal of food garbage. Ongoing review of the efficiency of the waste management program and improvement through adaptive management.	No linkage

The following section discusses the potential pathways relevant to the terrestrial environment.

5.3.4.1 Pathways with No Linkage

A pathway may have no linkage if the activity does not occur (e.g., active nests of breeding migratory birds will not be destroyed) or if the pathway is removed by environmental design features so that the AWAR Project results in no detectable (measurable) environmental change and residual effects to terrain and soils, vegetation, and wildlife relative to baseline (or guideline) values. The following pathways are anticipated to have no linkage to terrain and soils, vegetation, and wildlife, and will not be carried through the effects assessment.

- **Attraction to the AWAR Project may increase human-carnivore interactions and removal of individual animals (e.g., relocation or mortality), which can affect carnivore population size.**

Attraction of wildlife to the AWAR, particularly during the construction phase, may increase the risk of human-wildlife interactions, the risk of accidental mortality of wildlife (e.g., collisions with vehicles), and the need to destroy or relocate problem wildlife. The problem encounters with wildlife are generally exacerbated if the animal is a carnivore (e.g., polar bear, wolf), posing a risk to human health and property. Carnivores can be attracted to Arctic developments and associated food smells and other aromatic compounds, such as petroleum-based chemicals, grey water, and sewage. In addition, infrastructure may also attract carnivores as it can serve as a temporary refuge to escape extreme heat or cold (CWS 2007).

Wildlife have been intentionally relocated or destroyed at existing mines in the NWT and Nunavut. For example, there were 10 Arctic fox either found dead or killed as a result of mining activity, and 4 problem wolves intentionally destroyed at the Meadowbank Gold Mine in 2009 (Gebauer and Associates 2010). There were also 41 relocations of Arctic fox (likely of the same individual in some cases). Some of these mortalities and relocations have been as a result of wildlife attraction to the Meadowbank Gold Mine. Further, many Nunavummiut hunters, elders, and community members have reported an increase in human-bear conflicts, such as bears getting into cabins, food caches, dump sites, and wandering through communities (GN 2011).

Mitigation will be implemented during AWAR construction to limit the attraction of wildlife and the associated increased risk of mortality from human-carnivore interactions (see Table 5.3.4-1). Key among these is that no new camps will be required for construction or operation of the AWAR, careful waste management, and staff education. The only building to be installed will be a temporary emergency shelter at the approximate mid-point of travel along the AWAR. The road itself generally will be less than 1.3 m in height, providing little refuge from heat in the summer and cold. The proposed mitigation and the absence of camps along the road will limit the availability of attractants to carnivores, and as a result, this pathway is broken and classified as a no-linkage pathway. Therefore, this pathway is predicted to have no measurable effect on the persistence of populations of carnivores, such as polar bear and wolf.

- **Spills along the AWAR can affect terrain and soils, vegetation, and wildlife**

AEM has developed an emergency response and spill contingency plan that is designed to minimize the likelihood of accidental spills, or if they do occur, to quickly respond and clean up any spills. AEM will not permit the deposit of chemicals, sediment, wastes, or fuels into any waterbody. During construction, hazardous materials and fuel will be stored according to regulatory requirements to protect the environment and workers. During operation, hazardous materials will be stored at the Meliadine Exploration site. Individuals working on the

AWAR Project and handling hazardous materials will be trained in the Transportation of Dangerous Goods. Emergency spill kits will be readily available.

The implementation of an emergency response and spill plan, and environmental design features, including proper equipment maintenance and driver training, are expected to reduce the frequency and severity of spills. However, it is acknowledged that accidental spills, including vehicular accidents, have the greatest potential to affect soils, vegetation, and water quality and possibly result in adverse environmental impacts. Should a spill occur, contaminated areas will be collected and treated on-site, or shipped off-site for treatment and disposal if not possible to treat on-site.

Based on AEM's experience with the Meadowbank AWAR, accidental spills (e.g., fuel) have occurred, but the volume of spill has been small, and clean-up has occurred with only minor effects to the environment.

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

Water diversions are not required for the development of the AWAR Project road footprint. However, the AWAR will require culvert installations for 8 ephemeral streams and the installation of 3 single span bridges (at Char, Meliadine, and M5.0 watercourses) (see Section 5.2). The installation of these cross-drainage structures to prevent roads from impeding water flow should not affect soils, vegetation, and wildlife habitat. They will provide a design conveyance for 1:25 year event without overtopping the roadway, which will result in minor changes in local stream flows but no measurable affect to broader patterns in drainage and drainage areas. The implementation of appropriate cross-drainage structures is expected to result in minor changes to stream flow velocity in the vicinity of the structures relative to baseline. The alteration to local flows from the cross-drainage structures are predicted to result in no detectable changes to terrain and soils, vegetation, and wildlife habitat. This pathway was determined to have no linkage to effects on the terrestrial environment.

- **Destruction of bird nests can affect abundance and distribution of upland breeding birds and raptor populations.**

The *Migratory Birds Convention Act* (*MBCA* 1994) prohibits the destruction of migratory bird nests (e.g., passerine, waterfowl) during the breeding season. The migratory bird breeding season extends from approximately 15 May to 31 July. Vegetation will be removed/modified with the construction of the construction of borrow / quarry sites and will be covered by the footprint of the AWAR prior to the breeding season. As road construction is not expected to be completed until mid summer, a base layer of rock for the footprint of the road will be added prior to 1 May to reduce the chance of destruction of migratory bird nests. This approach will reduce the risk of disturbing or destroying nests or eggs during the nesting season. These mitigation practices are anticipated to result in no detectable change to the nest success of breeding birds from the AWAR Project relative to baseline conditions (i.e., birds are expected to find new nest locations away from the footprint of the road). Therefore, this pathway was determined have no linkage to upland breeding bird, waterbirds, and raptor population persistence.

5.3.4.2 Secondary Pathways

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

- **Dust deposition can cause changes to the chemical properties of soils and may cover vegetation and lead to physical and/or physiological damage to plants, affecting wildlife habitat.**

Accumulation of dust (i.e., particulate matter and total suspended particulate deposition) produced from traffic on the proposed AWAR may result in a local indirect change on the quality of soil and vegetation within the LSA. Environmental design features and mitigation have been incorporated into the AWAR Project to reduce potential effects from dust deposition (Table 5.3.4-1). For example, volumes of traffic will be managed so that they are at low levels. Daily AWAR Project-related road traffic will be less than 10 to 14 pick-up trucks, 3 cube vans, 2 passenger vans, 2 fuel trucks, and 1 transport truck. Traffic activity will drop during weekends and during the winter months. Key mitigation activities also include the following:

- the watering of roads in select locations during the non-winter period;
- enforcement of the posted speed limit of 50 km/h; and
- restricted public access to the road. AEM will work with the KIA and the Municipality of Rankin Inlet to devise a system for controlling access by non-AEM traffic and will have this in place before construction starts.

Thus, dust deposition from the AWAR is expected to result in minor and localized changes to vegetation and wildlife habitat along the AWAR. Further, the strongest effects from dust are generally confined to the immediate area adjacent to the dust source, such as roads (Walker and Everett 1987). For example, Walker and Everett (1987) reported that effects are confined to a 50 m buffer on either side of the road. Dust deposition from vehicles along the AWAR is predicted to result in negligible residual effects to the persistence of vegetation and wildlife.

- **Introduction of non-native plant species can affect native vegetation.**

The construction and operation of the AWAR Project has the potential to introduce non-native plant species and disrupt native plant communities (Mack et al. 2000; Truscott et al. 2008). Non-native invasive plant species, or weeds, may alter nutrient cycling, competition, and the energy budget of an ecosystem, which may lead to a decrease in native plant community structure and species diversity (Jager et al. 2009), and lower native species survival and abundance (Mack et al. 2000). Invasive plant species are those species whose rapid establishment and spread can adversely affect ecosystems, habitats, and/or other species (Haber 1997). The main contributor to the introduction of invasive and noxious weeds is human transport (Mack et al. 2000). Specific surveys aimed at searching for weeds were not completed during baseline surveys; however, had they been present within vegetation plots, they would have been recorded.

The ground disturbance associated with construction activities can create the type of habitat favoured by invasive plant species. Transportation corridors to and from construction areas provide a means of ingress for invasive plant species, as well as additional habitat in the form of disturbed road edges. Vehicles and machinery can serve as dispersal mechanisms for plant propagules (seeds and/or vegetative parts) that can get lodged in tires, the undercarriage, or mud on the surface of the vehicle.

Effective mitigation strategies are required early in project planning to address the introduction, spread, and effects of invasive species on the environment (Haber 1997). Preventing invasive plant species from entering an area is often more efficient and cost effective than dealing with their removal once established (Clark 2003; Polster 2005; Carlson and Shephard 2007). To mitigate the transport and introduction of non-native plant species into native plant communities, any construction equipment not sourced locally will be cleaned before shipment to Rankin Inlet.

The implementation of mitigation and environmental design features is anticipated to result in minor changes in the abundance and distribution of native plant species relative to baseline conditions. Therefore, the residual effect to vegetation from the introduction of non-native species is predicted to be negligible.

- **Fragmentation of habitat from the physical footprint of the AWAR may alter wildlife movement (i.e., distributions) and behaviour, and affect the carrying capacity of the landscape to support populations of caribou, wolf, upland birds, and raptors.**

Key changes associated with fragmentation include decreases in overall patch size, declines in the number of patches, and increases in isolation (i.e., increases in mean distances to nearest neighbour), as well as increases in the proportion of edge habitat (Fahrig 2003). Increases in habitat inter-patch distances and decreases in habitat patch sizes tend to decrease landscape connectivity (reviewed in Kindlmann and Burel 2008). Although fragmentation can influence individual, population, and community processes, 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).

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

Except at the south end of the RSA near Rankin Inlet, the AWAR will be the only active, linear disturbance within the Meliadine RSA. The AWAR footprint will be as narrow as possible, supporting only one lane for low volumes of traffic. If anything, the road will represent a partial barrier or “leaky barrier” where some animals cross successfully but movements may be restricted to one side of the AWAR for short periods of time, particularly during peak traffic activity (Treweek 1999). However, there should be a negligible measurable effect to populations because of the availability of suitable habitat throughout the landscape, and a suite of mitigation and environmental design features that have been proposed for the road (Table 5.3.4-1).

A key point for caribou is that the traditional calving grounds of the Qamanirjuaq herd are located west of the AWAR Project study area, and south of Baker Lake (BQCMB 2008). Although caribou may come into contact with the AWAR during spring and fall migration periods, the AWAR is at the eastern periphery of the Qamanirjuaq caribou herd home range and the majority of the wintering grounds are located to the west and south of the AWAR (Figure 5.3.3-6 to 5.3.3-8). Caribou, therefore, may be more likely to travel through areas that are to the west of the AWAR as both wintering and calving grounds are west of the AWAR. A similar case can be made for wolf, a species that generally follow and prey upon caribou in the region. Three wolves were observed within the Meliadine study area in 2008.

In summary, habitat fragmentation from the AWAR footprint is expected to result in minor changes to wildlife habitat, but the effect to the carrying capacity of the landscape to support wildlife populations is negligible in magnitude.

- **Direct loss and fragmentation of wildlife habitat can affect the persistence of Western Hudson Bay polar bear population.**

Habitat loss and fragmentation from the AWAR Project are not expected to influence the persistence of the Hudson Bay polar bear population. The AWAR Project footprint is small relative to the home range size of polar bear. The home range of female polar bears can vary from 940 to 540 700 km^2 (Ferguson et al. 1999). Polar bears using land during the ice-free season have larger home ranges than those with year-round access to ice, for example, bears that may occur in the RSA. For comparison, the AWAR Project is expected to be 1.7 km^2, which is less than 1% of a female's home range.

In addition to direct loss of habitat, the AWAR Project may also result in fragmentation of the existing landscape, potentially changing the quality of habitats. Habitat fragmentation is the progressive subdivision of habitat blocks into fragments. Although fragmentation always accompanies habitat loss, it is a different phenomenon (McGarigal and Cushman 2002; Fahrig 2003). Habitat fragmentation effects are lesser in magnitude than direct habitat loss (Andrén 1999; Fahrig 1997, 2003), and species with very specific habitat requirements and low dispersal abilities are more likely to be affected by habitat fragmentation.

During colder months of the year, the physical attribute of sea ice are the primary determinants of the quality of polar bear habitat (COSEWIC 2008); however, during the ice-free season, the polar bear is a habitat generalist when on land (Stirling et al. 2004). They also are highly mobile animals on the landscape. Thus, the total amount of habitat remaining on the study landscape is expected to be more important for survival of these species than the configuration of the remaining habitat (i.e., habitat loss is of greater concern than habitat fragmentation) (Fahrig 1997, 2003; Swift and Hannon 2010).

Baseline studies suggest that the polar bear is not common in the RSA. Polar bears were recorded in the wildlife log of the Meliadine Lake camp on 2 occasions between 1998 and 1999. In December 1998, a female and a single cub were seen travelling north along Meliadine Lake. In August 1999, a single polar bear was seen 18 km north and east of WMC's camp (Arc Wildlife Services 2000). From early winter until break-up of annual sea ice in spring, polar bears are dispersed predominantly over sea ice along the coast. They may range >200 km offshore. Maternal denning sites are generally located on land near the coast, being excavated in snowdrifts and in some places frozen ground (COSEWIC 2008). The length and frequency of seasonal movements undertaken by bears within each subpopulation varies with the size of the geographic area occupied, the annual pattern of freezing and break-up of sea ice (COSEWIC 2008).

The results suggest that the RSA constitutes part of the home range of only a few polar bear. Thus, the AWAR Project is predicted to cause a minor change in the amount and configuration of habitat for these individuals relative to baseline conditions. The estimated decrease in habitat for some individuals is expected to have a negligible residual effect on the persistence of the Western Hudson Bay polar bear population.

- **Physical hazards on the AWAR and collision with AWAR Project vehicles on the proposed road causing injury or mortality to individual wildlife, which can affect population sizes.**

Vehicles on the AWAR may be hazardous to caribou and other wildlife. Caribou have been observed bedding and travelling on roads. Carnivores and raptors may be attracted to road kill (Fahrig and Rytwinski 2009) and carnivore behaviour may be unresponsive to traffic and fail to avoid roads (Dickson and Beier 2002). Raptors, waterbirds, and upland breeding birds can also collide with vehicles, particularly during the breeding season if they are not accustomed to vehicular traffic (Mumme et al. 2000; Clevenger et al. 2003). Juvenile birds are also susceptible to vehicular collisions during their natal dispersal because they are inexperienced with vehicular traffic.

In general, few collisions with wildlife have been reported along mine access roads in the NWT and Nunavut. For example, from 1996 to 2010, there have been only 3 reported vehicle-related wildlife mortalities along the Tibbitt-to-Contwoyto Winter Road; 5 caribou were killed by a grocery truck in 1999 (EBA 2001), a wolverine was killed by a pick-up truck in 1996 (Banci, pers. comm., in EBA 2001), and a red fox was killed in 2009 (Madsen 2010, pers. comm.). No caribou have been killed by vehicle collisions at operating mine site in the NWT and Nunavut, and carnivore-vehicle collisions are low. To date, 2 wolverine, 2 wolves, and 2 foxes have been killed by vehicle collisions on the Ekati, Diavik, Jericho, and Snap Lake mine sites between 1996 and 2010 (Tahera 2007; BHPB 2010; DDMI 2010; De Beers 2010). Between 19997 and 2009, 11 willow ptarmigan, 1 rock ptarmigan, 8 other ptarmigan (species not recorded), 1 green-winged teal (*Anas crecca*), 1 unidentified bird, and 1 rough-legged hawk have been killed by vehicle collisions on the Ekati mine site (BHBP 2008, 2009, 2010). One unidentified duck and approximately 6 rock ptarmigan have been killed by vehicle collisions on the Diavik mine site from 2000 to 2009 (DDMI 2007, 2008, 2009, 2010). No birds have been killed by vehicle collisions on the Snap Lake mine site from 1999 to 2009 (De Beers 2010). Recent road monitoring of wildlife on the AWAR between Baker Lake and the Meadowbank mine show that no more than 2 caribou have been killed during 2009 and 2010 (Gebauer and Associates 2010). One of the caribou bodies was found approximately 80 m from the road and may have been from hunting, not a vehicular collision. Other mortalities on the Meadowbank AWAR include Arctic fox, Arctic hare (*Lepus arcticus*), Arctic ground squirrel (*Spermophilus parryii*), and rock ptarmigan (*Lagopus muta*). There is currently an all-weather road extending from Rankin Inlet to Iqalugaarjuup Nunanga Territorial Park of approximately 10 km; however, the number of wildlife collisions along this road is not monitored.

The likelihood of a collision with wildlife is related, in part, to the occurrences, or activity of local wildlife in the area. The AWAR Project area is on the periphery of the ranges of the Qamanirjuaq and Lorillard caribou herds. Caribou of the Qamanirjuaq herd are regular but transient visitors during their spring migration and calving periods. For the Lorillard herd, telemetry data show very few occurrences of caribou in the AWAR Project area travelling to breeding grounds. No known calving grounds are near the proposed AWAR. Arctic fox are the most common carnivore in the AWAR Project area. Wolves and polar bears, along with muskoxen, were infrequently observed during baseline surveys. Grizzly bear, wolverines, or their sign were not observed during baseline wildlife surveys, although there was on report of a grizzly bear near the Discovery (Meliadine East) Exploration Project during the summer of 2011 (AEM unpublished data).

Traffic speed and volume are the primary factors that contribute to road-related wildlife mortality. 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). To mitigate the increase in injury and mortality risk along the AWAR, several mitigation measures will be implemented (Table 5.3.4-1). Passenger vans will transport workers from Rankin Inlet to site during construction and operation to reduce traffic volume. In addition, the AWAR will be gated and public traffic will require special authorization to use the AWAR. Road safety training will be provided to site personnel and partnerships built to educate the public on road safety. Speed limits will be posted and enforced on the AWAR. The maximum speed will be 50 km/h. Speed limit will be reduced to 30 km/h when 1 to 50 caribou are observed within 100 m of AWAR and traffic may be suspended when 50 or more caribou are observed within 100 m of AWAR. Lower speeds allow the motorist and animal to avoid a collision (van Langevelde et al. 2009). The presence of wildlife will be monitored and communicated to site personnel, and wildlife on the AWAR will be given the right-of-way; vehicles must stop until animals are off the road.

In summary, the AWAR is expected to result in minor changes to injury and mortality rates from wildlife-vehicle collisions relative to baseline conditions, but due to the low incidence of wildlife species in the region, would have a negligible effect on the persistence of wildlife populations.

5.3.5 Effects to Soils

5.3.5.1 Summary of Valid Pathways

Site clearing and soil stripping and storage will occur only at the borrow and quarry sites, whereas soils will be covered with the rock base along the footprint of the AWAR. This will result in changes to soil quantity, distribution, and/or availability. Soil removal will occur at the beginning of the construction phase for the opening of the borrow and quarry sites, but due to the nature of these sites, quantities of soils are expected to be small (i.e., quarries are mainly rock and borrow sites are of till material, with little surface soils). During decommissioning of the road, should acid-generating bedrock be exposed along the roadway or in borrow and quarry sites, these areas will be covered with a minimum 2 m thick layer of non-acid generating soil or rock to direct water away from the surface, and the surface will be re-vegetated.

With appropriate soil salvage and reclamation techniques, soils can be returned to the landscape and support natural plant communities. Terrain can be contoured, to the extent practical, to blend the residual footprint with the surrounding landscape. However, soil can be altered or lost through the following AWAR Project components and activities:

- wind and water erosion during construction and reclamation phases, and
- covering with rock for the footprint of the road.

5.3.5.2 Methods

Changes to soil (i.e., soil map units) and soil quantity and distribution (i.e., soil map units) are assessed for the predicted AWAR Project footprint (application case). Changes to soil distribution directly affected by the AWAR Project were quantified by GIS analysis using the following process:

- the GIS quantified areas of soil map units within the LSA for the baseline case, application case, and closure; and
- the net changes in soil map unit distribution were calculated between the baseline case and closure.

5.3.5.3 Effects Analyses

Effects to Soil Map Units and Distribution

The area of disturbance for each soil map unit is described in relation to the LSA (Table 5.3.5-1). For example, approximately 77 ha (2% of the LSA) of the static and turbic cryosols soil map units within the LSA will be disturbed or covered by the AWAR Project. Following reclamation, the soil map units will be altered and subsequently gained within the reclaimed soil map unit (Table 5.3.5-1). An area of approximately 168 ha (3% of the LSA) within the AWAR Project footprint is expected to be classed as reclaimed following closure (Table 5.3.5-1). The area of residual ground disturbance is predicted to be approximately 0 ha (0% of the LSA) as all areas will be reclaimed at closure.

Table 5.3.5-1: Area of Soil Map Units in the Local Study Area

Soil Map Unit	Baseline Case		Application Case		Closure (ha)	% LSA
	Area (ha)	% of LSA	Area (ha)	% of LSA		
Bedrock	121	2	7	4	114	2
Bedrock-Regosols	624	12	27	<1	597	11
Organic Cryosols	801	15	40	1	761	15
Organic and Static Cryosols	13	<1	1	<1	12	<1
Static Cryosls	123	2	2	<1	121	2
Static Cryosols-Bedrock-Regosols	84	2	13	<1	71	1
Static and Turbic Cryosols	2740	52	77	2	2663	51
Water	740	14	1	<1	739	14
Reclaimed	0	0	0	0	168	3
Total	**5246**	**100**	**168**	**3**	**5246**	**100**

LSA = local study area; ha = hectare

During the processes of soil salvage and stockpiling, and storage of topsoils at borrow sites or quarries, the quantity of soils available for site reclamation may be reduced due to wind and water erosion. Use of standard erosion and sediment control techniques and the short duration of storage (i.e., borrows and quarries would be reclaimed as soon as the construction activities are completed) will result in negligible loss of the stockpiled soils.

Overall, most soil map units in the LSA are rated as having low erosion sensitivity, with the exception of those with special management concerns (i.e., organic or shallow soils, and frozen soils [potential permafrost]). Because erosion is a concern mainly with respect to disturbed soils, the effect will be confined to borrow and quarry sites, as soils will not be disturbed along the main AWAR Project footprint, as construction will involve placing a layer of rock base over the soils in winter frozen conditions. Environmental design features and mitigation (i.e., erosion control practices) will be applied to control wind and water erosion on topsoil and overburden stockpiles.

5.3.5.4 Residual Effects and Significance

Effects to Soil Map Units and Distribution

The effect from the AWAR Project on soil distribution will be confined to the AWAR Project footprint. This effect will be limited to the construction phase. The type and degree of change consists of the spatial extent of change and the shape of the landscape.

The maximum area that will be disturbed during construction and operation is predicted to be approximately 168 ha (3% of the LSA). At closure, the road surface will be ripped to promote natural revegetation, Thus, for the AWAR footprint, there will be a change from the current surficial soil types to a rock/ granular reclaimed soil type.

5.3.5.5 Cumulative Effects

Not every VC requires an analysis of cumulative effects. The key is to determine if the effects from the AWAR Project and one or more additional developments/activities overlap (or interact) with the temporal or spatial distribution of the VC. For soils, Project-specific effects are important and there is little or no potential for cumulative effects, because there is little or no overlap with other developments.

5.3.5.6 Uncertainty

There is a high degree of confidence that surficial materials will be moved, excavated, and re-contoured at borrow and quarry sites, and soils will be disturbed (i.e., covered with rock and granular material) along the road footprint. The areas affected have been determined based on the current project plan. There is uncertainty associated with the location of ice-rich permafrost within the AWAR Project footprint as addressed in Terrain and Permafrost Section 5.4.

5.3.5.7 Monitoring and Follow-up

Monitoring programs implemented during the life of the AWAR Project may be a combination of environmental monitoring to track conditions and implement further mitigation as required (e.g., monitoring for soil erosion during construction), and follow-up monitoring to verify the accuracy of effect predictions and adaptively manage and implement further mitigation as required.

5.3.6 Effects to Vegetation

5.3.6.1 Summary of Valid Pathways

Construction for the AWAR Project, particularly the process of vegetation removal at borrow and quarry sites, as well as the covering of existing vegetation along the road footprint, will result in the physical loss or alteration of plant populations and communities. Direct vegetation effects (removal and covering) will occur mainly during the construction phase of the AWAR Project. The effect on vegetation includes an assessment of the following:

- effects to plant populations and communities as expressed by changes in regional ELC classes; and
- effects to listed plant species;

5.3.6.2 Methods

Due to the inherent sensitivity of the subarctic environment to disturbance, all vegetation ecosystems and associated plants were included in the analysis of effects. Particular emphasis was placed on the effects of the AWAR Project in relation to regional ELC classes or plants considered especially sensitive to disturbance (e.g., wetlands or low shrub communities) and those regional ELC classes with a restricted distribution in the study area. The effects to plant populations and communities were assessed quantitatively using regional land cover information developed for the LSA, field survey data, and the expected AWAR footprint. Effects to listed species are assessed qualitatively, as no confirmed occurrences have been documented in the LSA.

Changes to vegetation are assessed for the maximum predicted AWAR Project footprint, which should have the largest magnitude and geographic extent of effects to vegetation. Existing footprints of human developments in the LSA were not considered (about 18 ha overlaps with road footprint) such that the analysis of incremental effects represents a worst-case scenario. Changes to regional ELC classes directly affected by the AWAR Project were quantified GIS analysis using the following process:

- the GIS quantified areas of regional ELC classes within the LSA for the baseline case, application case, and closure; and
- the net changes in regional ELC classes were calculated between baseline case and closure.

5.3.6.3 Effects Analyses

Effects to Plant Populations and Communities

Construction and operation of the AWAR Project will result in a maximum disturbance of 168 ha (3%) of the LSA, including 118 ha of Health regional ELC classes and 41 ha of wetlands and riparian regional ELC classes (Table 5.3.6-2). All regional ELC classes will be affected by the AWAR Project, resulting in net changes to all classes. Of the Heath regional ELC classes, Heath boulder and Heath tundra will have a net change of 27 ha (<1% of this map unit; 1% of the LSA) and 77 ha (3% of this map unit; 1% of the LSA), respectively. These are the most abundant regional ELC classes in the LSA. Wetlands and riparian regional ELC classes will experience a net change of 41 ha (1% of the LSA). The heath lichen – hair lichen regional ELC class, which is generally associated with eskers, will experience a net loss of 13 ha (15% of this map unit; <1% of the LSA).

Following closure, it is predicted that there will be a net loss of 168 ha (3% of the LSA) of vegetation within the AWAR Project footprint (Table 5.3.6-2). It is currently planned that the road will be closed at the end of the advanced exploration program, or if Phase 2 is constructed (i.e., if the feasibility study currently underway is positive and the proposed Meliadine Gold Project passes the NIRB review and other regulatory requirements), the AWAR will be closed once mining is complete and the mine fully decommissioned, the bridges and culverts removed, the road surface will be ripped, and passive reclamation will occur. Although there will be some colonization and vegetation re-growth on the reclaimed roadbed, there is a high likelihood that the trail would be used by the local communities as an ATV trail, which would limit the extent of vegetation re-growth. Thus, the results presented here represent a conservative approach that assumes permanent losses to vegetation.

Table 5.3.6-2: Distribution of Regional Ecological Land Cover Classes between Baseline Case and Closure Case in the Local Study Area

Regional Ecological Land Cover Class	Baseline Case		Application Case	Closure (ha)	Closure Net Change (ha)	Closure Net Change (% unit)	Closure Net Change (% LSA)
	Area (ha)	% of LSA	Area (ha)				
Heath							
Heath boulder	624	6	27	597	-27	-4	-1
Heath lichen - hair lichen	84	1	13	71	-13	-15	-<1
Heath lichen - *Cetraria*	123	1	2	121	-2	-1	-<1
Heath tundra	2740	26	77	2663	-77	-3	-1
Heath vegetation subtotal	*3571*	*34*	*118*	*3453*	*-118*	*-3*	*-2*
Wetlands/Riparian							
Low shrub	13	<1	1	12	-1	-7	-<1
Tussock-hummock	801	8	40	761	-40	-5	-1
Wetlands /riparian subtotal	*814*	*8*	*41*	*773*	*-41*	*-5*	*-1*
Miscellaneous							
Bare ground (rock outcrop)	121	1	7	114	-7	-6	-<1
Water	740	7	1	739	-1	-<1	-<1
Miscellaneous subtotal	*861*	*8*	*8*	*853*	*-8*	*-1*	*-<1*
Total	**5246**	**100**	**168**	**5007**	**-168**	**n/a**	**-3**

LSA = local study area; ha = hectare

Effects to Listed Plant Species

The majority of the species that are listed as sensitive by the Nunavut Government (CESCC 2011) that have potential to occur in the AWAR Project LSA are associated with wetland or riparian habitats such as meadows, seeps, marshes, which are generally captured by the low shrub and tussock-hummock regional land cover classes. No confirmed listed plant species identified as “At Risk”, “May be at Risk”, or “Sensitive” by the Nunavut Government (CESCC 2011) or federal listed species (COSEWIC 2011) were found in the AWAR Project LSA during the 2008 field surveys. However, this does not preclude the potential for rare plant species to be present in the AWAR Project LSA, and disturbing habitat that may support higher numbers of rare plant species (e.g., low shrub and tussock-hummock regional ELC classes) may negatively affect existing populations.

The alignment of the AWAR and associated borrow / quarry sites has been designed to avoid wetlands and riparian areas as much as possible, which reduces the potential for impacting listed plant species. Wetlands and riparian regional ELC classes will experience a net change of 41 ha (1% of the LSA), with the Tussock- hummock class experiencing the greatest net change from baseline at 40 ha (1% of the LSA).

5.3.6.4 Residual Effects and Significance

The direct effect from the AWAR Project on vegetation will be confined to the AWAR Project footprint. This effect will be limited to the construction phase. Thus, direct impacts to vegetation from the AWAR Project are local in geographic extent, with approximately 3% of the existing regional land cover classes in the AWAR Project LSA being impacted by the AWAR Project footprint. However, the incremental change of each regional land cover class relative to baseline conditions is predicted to be between <1 and 7%, with the exception of Heath lichen - hair lichen, which will be reduced by 15% relative to baseline conditions. Thus, it is expected that esker habitats will also be reduced by 15% relative to baseline conditions, as these landforms tend to be associated with the Heath lichen - hair lichen ELC class.

Therefore, at the local scale, the magnitude of impacts from the AWAR Project footprint on plant communities and populations as defined by the regional ELC classes is predicted to be negligible to low for most classes and moderate for the Heath lichen - hair lichen ELC class. The magnitude of impacts from the AWAR Project footprint on listed plant species is predicted to be negligible to low, as none have yet been identified. The magnitude of impacts from the AWAR Project footprint on esker habitat is predicted to be moderate. The frequency of direct impacts from the AWAR Project to vegetation, including plant populations and communities and listed plant species are considered to be isolated (i.e., covering of plant communities during construction activities will occur only once). Although the standard practice is for reclamation to be integrated into mitigation and management plans for the AWAR Project, subarctic terrestrial ecosystems are slow to recover following disturbance; therefore, the duration of these changes should be long-term, but given adequate time, the impacts are predicted to be reversible assuming that access is restricted and the plant communities are allowed to recover in a disturbance free environment. Research on arctic ecosystems has shown that it can take from 20 to 75 years for vegetation to recover following disturbance (Forbes et al. 2001; Walker and Everett 1991). However, it is not known what the abundance and distribution of plant species and regional ELC classes will be in reclaimed areas following re-vegetation. It is also not certain that listed plant species will be present in the reclaimed landscape in the same proportion and abundance as they are in a future environment that is not influenced by the AWAR Project.

Pathway	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood
Physical loss or alteration of vegetation from the AWAR Project footprint affecting plant populations and communities, including listed plant species	Negative	Negligible to Moderate	Local	Long-term	Isolated	Reversible	Highly Likely

The results indicate that the AWAR Project should not result in significant adverse impacts to the persistence of plant populations and communities, including listed plant species. Changes from the AWAR Project are predicted to result in negligible to moderate local-scale impacts to plant populations and communities, and should be reversible in the long-term (i.e., 50 to 75 years following closure).

5.3.6.5 Cumulative Effects

The existing development footprint in the RSA covers about 1172 ha or 0.14% of the RSA. The direct effect of the AWAR will increase the footprint area by 150 ha (total footprint area = 168 ha where 18 ha overlaps with existing footprint). Phase 2 of the AWAR combined with the construction of the proposed mine will increase the footprint area by about 957 ha. Thus, the cumulative direct effects of development measured as development footprints under the future scenario will be about 2280 ha, or 0.27% of the RSA. As there is limited development in the RSA in the future scenario, the overall cumulative direct and indirect effects to vegetation are predicted to be negligible to low.

5.3.6.6 Uncertainty

Like all scientific results and inference, residual impact predictions must be tempered with uncertainty associated with the data and current knowledge of the system. The confidence in impact predictions is related to the adequacy of baseline data for understanding current conditions, accuracy of the regional ecological land cover classification mapping, the validity of models (e.g., to predict the extent of air emission and dust deposition) and understanding of project-related impacts on the system. The primary sources of uncertainty surrounding the identification of potential effects to subarctic vegetation ecosystems and plants are largely associated with the degree to which effects may occur (e.g., magnitude and duration). It is understood that development activities will disturb plant populations and communities; however, the ecological trajectory and rate at which these communities will recover is somewhat uncertain.

A critical aspect of this assessment is based on regional land cover classes that have been interpreted using high resolution satellite imagery. The regional land cover classification was developed from data collected in the field, supporting literature, as well as professional judgement. In general, this classification represents an accurate interpretation of ground conditions, especially at the local scale. The effects associated with dust deposition have not been extensively studied in subarctic environments and anticipated effects have been extrapolated from studies completed in more temperate climates. The identified sources of uncertainty affect the magnitude and duration components of the predictions. Where uncertainty exists, conservative estimates were used so that impacts were not underestimated.

Uncertainty can be reduced by collecting additional data, which can be used to validate models, and describe previously undocumented processes that are associated with effects from the AWAR Project. Monitoring programs will be designed to reduce uncertainty of effects related to changes from the AWAR Project.

5.3.6.7 Monitoring and Follow-up

A monitoring program will be implemented during regular inspections of the AWAR by the road supervisor and site environmental staff to track conditions and implement further mitigation as required (e.g., monitoring for invasive plant species (weeds) not indigenous to the pre-AWAR area where the plant was introduced as a result of the construction and operation of the AWAR, and implementation of a weed management plan, if required).

5.3.7 Effects to Wildlife and Wildlife Habitat

5.3.7.1 Summary of Valid Pathways

The following pathways were verified to be primary for effects to wildlife (Table 5.3.4-1). Primary pathways are analyzed and classified in the effects assessment.

- Loss of habitat from the physical footprint of the AWAR Project may affect the carrying capacity of the landscape to support populations of wildlife (i.e., caribou, wolf, raptors, upland breeding birds).
- Indirect effects from the AWAR Project, such as sensory disturbance, decreases habitat quantity and alters movement and behaviour of wildlife.
- Increased access from the AWAR for traditional and non-traditional harvesting may increase risk of mortality for caribou and wolf, affecting population sizes.

5.3.7.2 Effects Analyses

5.3.7.2.1 General Approach

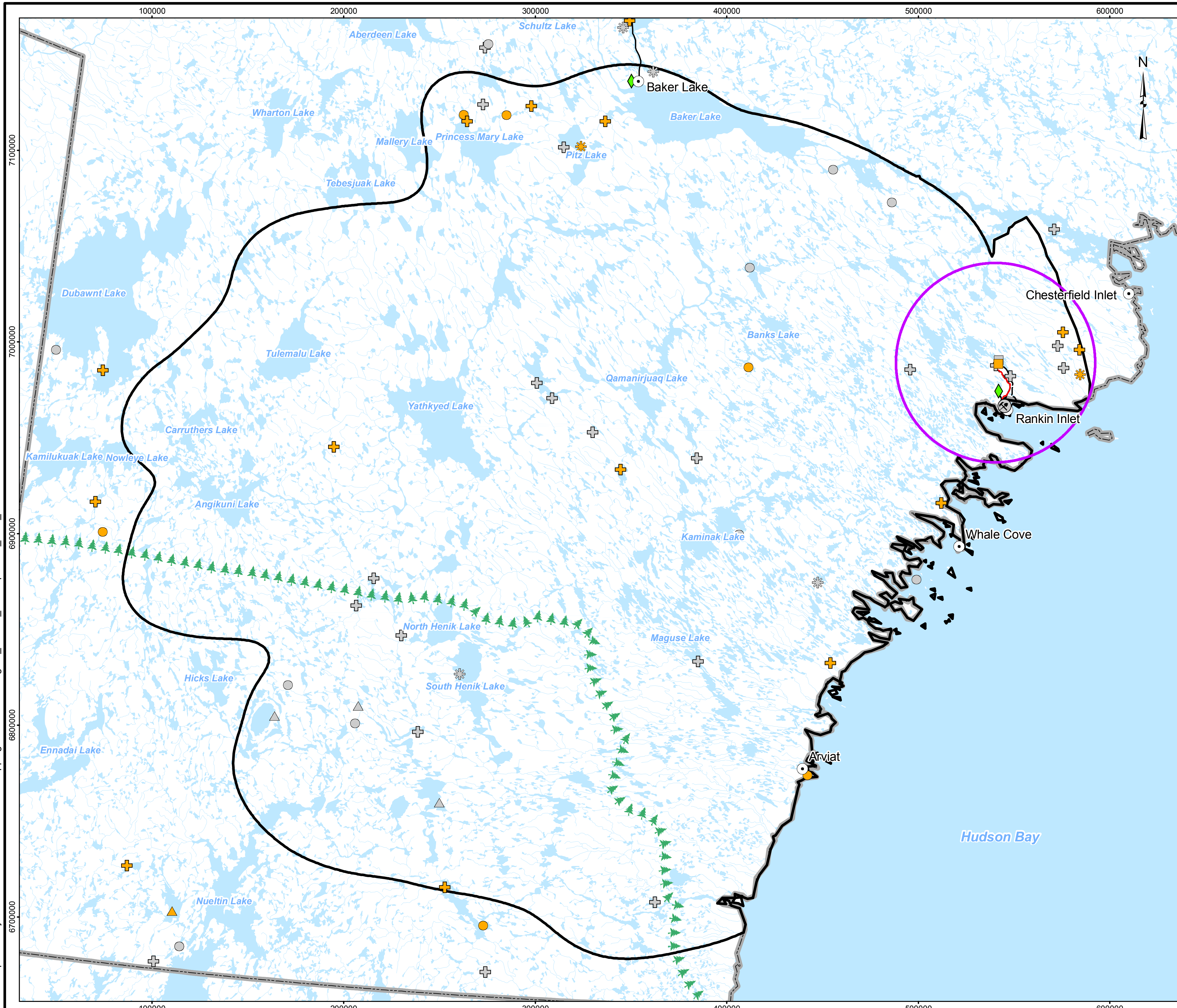
It is anticipated that the AWAR Project will influence the Qamanirjuaq herd based on movements of collared animals and distributions determined from aerial surveys of the region. The AWAR Project might also affect the distribution and abundance of carnivores, such as wolves, as well as raptors and upland birds. However, the AWAR Project should have negligible effects on the Lorillard herd. The AWAR Project will likely alter the behaviour and movement of a few individuals from regional populations that periodically travel through the RSA; however, the frequency and number of animals affected is expected to result in only negligible changes in the persistence of populations relative to current (baseline) conditions. Thus, the effects analysis for wildlife emphasizes the Qamanirjuaq caribou herd, wolf, raptors, and upland songbirds, and excludes uncommon and less abundant species, such as polar bear and the Lorillard caribou herd.

The effects analysis considers all primary pathways that result in expected changes to the persistence of VCs for wildlife from the AWAR Project, after implementing environmental design features and mitigation. Thus, the analysis is based on the residual effects from the AWAR Project. Residual effects to wildlife are analyzed using measurement endpoints (e.g., habitat quantity and quality, survival) and are expressed as effects statements.

The magnitude, spatial extent, and duration of changes in measurement endpoints (e.g., habitat quantity and quality, survival) from the AWAR Project and other developments are expected to be similar to or greater than the actual effects to the persistence of populations. Effects statements may have more than one primary pathway that link an AWAR Project activity with a change in population persistence. For example, the pathways for effects from changes in movement and behaviour include influences from noise, dust deposition, and the presence of vehicles. The combination of direct (physical footprint) and indirect (noise, dust, and other sensory disturbances) effects can create a zone of influence (ZOI) around the AWAR Project that can change the behaviour and occurrence of wildlife, such as caribou (e.g., as described by Johnson et al. 2005).

The spatial scale of the analysis considers the natural and human-related effects that occur across the landscape. For example, for Qamanirjuaq caribou, individuals in the population are predicted to experience the effects from the AWAR Project and other developments while moving around their post-calving range. Therefore, the caribou and wolf study areas were extended outside of the RSA, and defined using the traditional post-calving range of the Qamanirjuaq herd (Figure 5.3.7-1). The temporal scale examines the natural and development-related changes from historical reference conditions through application of the AWAR Project and reasonably foreseeable developments. Baseline conditions represent a range of temporal values on the landscape from reference (little to no development) to existing (2011) conditions. Environmental conditions on the landscape before industrial development (i.e., reference conditions) are considered part of the baseline.

The effects analyses determine both the incremental and cumulative changes from the AWAR Project on the landscape and wildlife. Incremental effects represent the AWAR Project-specific changes relative to baseline values in 2011 (current or existing conditions). Project-specific effects typically occur at the local scale (e.g., habitat loss due to the AWAR Project footprint) and regional scale (e.g., combined habitat loss, dust, noise, and sensory disturbance from AWAR Project activities [i.e., ZOI]).



LEGEND

- Proposed Phase 1 AWAR Road Alignment
- Regional Study Area (RSA)
- Caribou Effects Study Area (CESA)
- Provincial/Territorial Boundary
- Treeline
- Watercourse
- Waterbody

Previous and Existing Development

- Camp (Active)
- Camp (Inactive)
- Community
- Fuel Storage (Active)
- Fuel Storage (Inactive)
- Mine (Inactive)
- Mineral Exploration (Active)
- Mineral Exploration (Inactive)
- Miscellaneous (Active)
- Miscellaneous (Inactive)
- Quarrying (Active)
- Quarrying (Inactive)
- National or Territorial Park
- All-Weather Road
- Winter Road

REFERENCE

Base data obtained from ESRI and Natural Resources Canada.
Datum: NAD 83 Projection: UTM Zone 15

40 0 40

SCALE 1:2,000,000 KILOMETRES

PROJECT

AGNICO-EAGLE MINES LTD.
MELIADINE GOLD PROJECT
NUNAVUT

AGNICO-EAGLE

TITLE

PREVIOUS AND EXISTING DEVELOPMENTS IN THE REGIONAL STUDY AREA AND CARIBOU EFFECTS STUDY AREA

Golder Associates
Greater Vancouver Office, B.C.

PROJECT NO. 10-1373-0076			FILE No.	
DESIGN	CS	07 Sep. 2011	SCALE AS SHOWN	REV. 0
GIS	JP	12 Sep. 2011		
CHECK	CS	16 Sep. 2011	**FIGURE: 5.3.7-1**	
REVIEW	GRA	20 Sep. 2011		

Cumulative effects are the sum of all changes from reference values through application of the AWAR Project (and future developments). In contrast to incremental effects from the AWAR Project, cumulative effects occur across the range of the population (i.e., beyond local and regional scales). This is because species with large home ranges, such as caribou, travel large distances during their seasonal movements and can be affected by the AWAR Project and several other developments. In other words, the combined local and regional effects from the AWAR Project and other developments overlap with the distribution of the population. The objective of the cumulative effects analysis is to estimate the contribution of human-related influences on the persistence of populations of caribou, wolf, raptors and upland birds in context of natural changes in the ecosystem.

Detailed descriptions of the spatial and temporal boundaries, and methods used to analyze residual effects from the AWAR Project on wildlife VCs are provided in the following sections. The analyses were quantitative, where possible, and included data from field studies, scientific literature, government publications, effects monitoring reports, and personal communications. Traditional knowledge and community information were incorporated, where available. Due to the amount and type of data available, some analyses were qualitative and included professional judgement or experienced opinion.

5.3.7.3 Effects to Habitat Quantity

5.3.7.3.1 Methods

Direct Effects

Direct effects from the footprint of the AWAR Project and other previous, existing, and future developments were analyzed through changes in the area of habitat types on the landscape. Decreases in habitat area can directly influence population size by reducing the carrying capacity of the landscape. The quantity of wildlife habitat was classified using a regional ELC classification map. The map was developed using satellite imagery, remote sensing software, and GIS to determine the abundance of primary land cover classes within the RSA for vegetation. The RSA ELC classification was based on cloud-free coverage of LANDSAT 5 satellite spectral imagery with a 30 x 30 m pixel size that was captured on the 23 July 2005. A reconnaissance survey completed in July 2008 was used to verify and finalize the regional ELC classification.

The number and type of previous, existing, and reasonably foreseeable developments in the RSA and CESA are listed in Tables 5.3.7-1 and 5.3.7-2, and are illustrated in Figure 5.3.7-1. Data on the location and type of developments were obtained from the following sources:

- Aboriginal Affairs and Northern Development Canada: permitted and licensed activities within Nunavut;
- Aboriginal Affairs and Northern Development Canada: contaminated sites database;
- Natural Resources Canada: obtained a GIS file of community locations from Natural Resources Canada's GeoGratis website;
- Government of Nunavut: location of parks within the territory;
- individual operators for project-specific information such as component footprints or routes;
- company websites; and
- knowledge of the area and project status.

Table 5.3.7-1: Hypothetical Footprints for Previous, Existing, and Future Developments in the Regional Study Area and Caribou Effects Study Area

Development Type	Feature Type[a]	Footprint Extent
Camp	Point	200 m radius
Community	Polygon	actual
Fuel Storage	Point	200 m radius
Mine[b]	Point	500 m radius
Mineral exploration camp	Point	500 m radius
Miscellaneous	Point	200 m radius
Park (Territorial)	Point	200 m radius
Quarrying	Point	200 m radius
Road, all season	Linear	30 m wide
Road, winter	Linear	30 m wide

[a] Footprints estimated with the exception of communities, which were delineated and digitized from remote sensing imagery.

[b] The footprint of the inactive Rankin Inlet Nickel and Copper Mine was not easily discernible from remote sensing imagery, and thus, a 500 m radius footprint extent was used to create it's footprint polygon in GIS.

m = metre

Table 5.3.7-2: Previous and Existing Developments (Points and Polygons) in the Regional Study Area and Caribou Effects Study Area

	Regional Study Area[a]		Caribou Effects Study Area	
Activity	Active[b]	Inactive	Active[b]	Inactive
Camp			4	6
Community	1		4	
Fuel storage				3
Mine		1		1
Mineral exploration camp	2	5	10	17
Miscellaneous	1		2	3
Park (Territorial)	1		2	
Quarrying	1	1	1	1

[a] There are approximately 58 km of existing (active) winter roads and a 15 km AWAR road from Rankin Inlet to a territorial campground in the RSA.

[b] Active developments refer to those with active or unexpired permits as of 2011; active developments are characterized by a footprint and a zone of influence of 5 km.

Some temporal data were available prior to 1996, but most of the known start and end dates of land use permits for developments were from 1996 through 2011. The file was examined for duplication of information (e.g., a water license and a land use permit for the same development). In cases where 2 or more pieces of location information for the same activity were present, the extra information was deleted from the file so that it contained only one point per development. Data associated with the location attributes (e.g., permit status, feature name) also were edited in some instances to update the information for running modelling scenarios efficiently. The information was used to generate a spatially and temporally-explicit development layer within a GIS platform.

The database contains no information on the size of the physical footprint for developments. For Rankin Inlet, the footprint was digitized from Landsat 7 Imagery from the Government of Canada (NRC 2007). A 500 m radius was used to estimate the area of the footprint for the closed Rankin Inlet Nickel and Copper Mine, as well as for exploration sites and power stations (78.5 ha), which likely overestimates the amount of habitat directly disturbed. For example, exploration programs typically contain temporary shelters for accommodations and storage of equipment, and are elevated to limit the amount of disturbance to the soil and vegetation. Drilling is usually carried out with portable drill rigs (5 x 5 m area) at one location at a time. A 200 m radius (12.6 ha) was used to estimate the size of the remaining point development footprints, such as historical remediated and non-remediated sites, and a 30 m corridor was used for linear features (Table 5.3.7-1).

Direct and Indirect Effects

Sensory disturbance (e.g., moving vehicles, people, lights, smells, and noise) from the AWAR Project will change the amount of different quality habitats in close proximity of the road (i.e., within a ZOI). Indirect effects from disturbance, which were based on hypothetical (not modelled) disturbance coefficients and ZOIs, were determined by applying the development layer to the ELC database (Section 5.3.6.2). Hypothetical disturbance coefficients were consistent with previous efforts to estimate effects from development on habitat quality for wildlife (Johnson et al. 2005). Disturbance coefficients reduce habitat quality within each defined ZOI. For example, a disturbance coefficient of 0.75 implies that habitat quality was reduced by 25% of the original value.

The indirect effects from noise are implicitly included in the ZOI. A previously completed environmental assessment for a new development in the NWT showed that the distance for noise attenuation to background levels for core mining operations (including blasting) is 3.3 km (Fortune 2011). The same assessment showed that the distance for noise attenuation to background for traffic along a proposed all-weather access road is less than 1 km.

The objective of this section was to estimate the potential incremental and cumulative changes in wildlife habitat from the AWAR Project and other developments (direct and indirect effects) using a disturbance coefficient of 0.5 and ZOI of 5 km based on information from empirical studies. This classification was based on the meta-analysis by Benitez-Lopez et al. (2010) who showed that the effect of human infrastructure (e.g., roads) on bird populations extend up to about 1 km, and for mammal populations up to about 5 km. The same ZOI of 5 km was applied per VC in the interest of providing a simple but environmentally conservative assessment (Benitez-Lopez et al. 2010).

Direct and indirect effects from human disturbance were used to quantify changes in the relative availability of different habitats types during baseline conditions (i.e., historical reference, and 2011 baseline), application of the AWAR Project, and future conditions (e.g., proposed mine and Phase 2 of the AWAR). Historical reference conditions were of no development on the landscape with the exception of the footprint for the hamlet of Rankin Inlet. Upon application of each development scenario, the relative quantity of different habitats types were calculated as was done for the reference case. For all closed mines and inactive land-use permits, only the physical footprint was carried through the effects analysis. It was assumed that direct disturbance to the landscape had not yet been reversed upon closure.

Analyses

Two sets of analyses were completed. The first assessed direct effects only and was followed with a second analysis that included both direct and indirect effects from development. Indirect effects measured changes in habitat area as a decline in habitat quality from dust deposition and sensory disturbances (i.e., the ZOI).

The incremental and cumulative effects analysis was conducted at the RSA-scale for all wildlife in the interest of delivering a simple, but environmentally conservative statement on the impacts to all wildlife, including caribou. Further, an incremental and cumulative effects analysis at the RSA-scale for caribou and wolf (rather than at the CESA-scale) was deemed an environmentally conservative approach because the density of developments is higher within the RSA (versus the larger CESA for caribou and wolf). For example, there are 7 mine exploration camps within the 8 495 km^2 RSA (i.e., 1 exploration camp per 1214 ha); versus the 27 mine exploration camps in the CESA, an area of 140 828 km^2 (i.e., 1 exploration camp per 5216 ha).

The following equations were used to estimate the relative change in the amount of habitat types in the RSA for different conditions on the landscape.

- Existing Cumulative Effects = (2011 baseline area – reference area) / reference area x 100
- AWAR Incremental Effects = (application case area – 2011 baseline area) / 2011 baseline area x 100
- Future Incremental Effects = (future case area – application case area) / application case area x 100
- Future Cumulative Effects = (future case area – reference area) / reference area x 100

5.3.7.3.2 Results

Footprints and Zone of Influences

The RSA currently supports the hamlet of Rankin Inlet (and associated infrastructure), 1 territorial campground, 2 active exploration camps, 5 inactive exploration camps, 1 active quarry, and 1 inactive quarry (Table 5.3.7-2). Linear developments include an all-season road extending for 15 km between the community and a nearby territorial campground, as well as about 58 km of active winter roads between Rankin Inlet and active exploration camps.

The existing development footprint in the RSA covers about 1172 ha or 0.14% of the RSA (area of RSA = 849 484 ha). The direct effect of the AWAR will increase the footprint area by 150 ha (total footprint area = 168 ha, where 18 ha overlaps with an existing footprint; see Figure 5.3.7-1). Phase 2 of the AWAR, combined with the construction of the proposed Meliadine Gold Project, will increase the footprint area by about 957 ha. Cumulative direct effects of development measured as development footprints under the future scenario will be about 2280 ha or 0.27% of the RSA.

If considering direct effects (i.e., footprints) and indirect effects (i.e., ZOI) from development, almost 27 240 ha of habitat have been modified for development on the existing baseline landscape (or 3.2% of the RSA). The indirect effect of the AWAR Project will result in a loss or modification of 6 676 ha of habitat. The majority of habitat conversion from the AWAR will be from indirect effects and the ZOI associated with the road (almost 98% from ZOI). Phase 2 of the AWAR combined with the construction of the proposed mine will result in an indirect loss of 6 740 ha of habitat. Cumulative direct and indirect effects measured under the future scenario will be about 41 696 ha or 4.9% of the RSA.

Direct Effects

Water and heath tundra are the dominant habitat classes in the RSA (Table 5.3.7-3). Heath tundra covers 32.2% of the RSA, whereas water covers 30.8% of the RSA. Moderately abundant habitat types in the region included heath boulder (16.7%) and tussock-hummock (12.9%). Less abundant habitat types included bare ground (2.3%), heath lichen – hair lichen (2.2%), low shrub (1.5%), and heath lichen - Cetraria (1.5%). The community of Rankin Inlet and associated infrastructure comprises a 206 ha footprint on the landscape (<0.1% of the RSA).

Table 5.3.7-3: Direct Effects Measured as Change (percent) in Area of Habitat Types from Development Footprints within the Regional Study Area for Vegetation and Wildlife during Baseline, Application, and Future Conditions

	Historical Reference Condition (ha)	Reference to Baseline Cumulative %Change	Baseline to Application Incremental %Change	Application to Future Incremental %Change	Reference to Future Cumulative %Change
Bare Ground	19 123	-0.28	-0.03	-0.03	-0.34
Heath Lichen – Hair Lichen	18 339	-0.11	-0.06	-0.02	-0.19
Heath Boulder	141 462	-0.18	-0.02	-0.01	-0.21
Heath Lichen-Cetraria	12 390	-0.16	-0.02	-0.09	-0.27
Heath Tundra	273 685	-0.12	-0.03	-0.24	-0.38
Low Shrub	12 662	-0.07	-0.01	-0.04	-0.11
Tussock-Hummock	109 913	-0.15	-0.03	-0.06	-0.25
Water	261 704	-0.05	0.00	-0.08	-0.12

Note: In the RSA, the percentage of cover under development footprint for future scenario = 0.3%; approximately 2280 ha will be a development footprint under future scenario.

% = percent; ha = hectares

Direct incremental changes in habitat area are expected to be less than 0.1% per habitat class with the application of the AWAR. Heath lichen – hair lichen is affected the most by the AWAR with a predicted decrease in area of 0.06%. The heath lichen – hair lichen land cover class is found on eskers and the crests and upper slopes of small ridges with poorly developed, rapidly drained soils. Incremental changes are also anticipated with the application of the future scenario. Heath tundra will be affected the most with a 0.24% incremental decrease in area under this scenario. Direct cumulative declines in habitat are expected to the less than 0.4% per habitat class with the application of the future scenario.

Direct and Indirect Effects

Direct and indirect incremental changes are expected to be less than 1.6% per habitat class with the application of the AWAR (Table 5.3.7-4). Heath tundra will be affected the most by the AWAR and it's ZOI, with a predicted decrease in area of 1.5%. Similar incremental changes are anticipated with the application of the future scenario. Heath tundra will be affected the most with a 1.8% decrease in area under this scenario. Other habitat types were characterized by incremental declines of about 1% or less with the application of either the AWAR or the future scenario.

Direct and indirect cumulative changes are expected to be less than 9.7% per habitat class with the application of the future scenario (Table 5.3.7-4). The largest observed cumulative changes in habitat area will be for heath lichen - Cetraria (-9.6%), heath tundra (-5.6%), and tussock-hummock (-4.3%). The relatively large effect size for heath lichen - Cetraria may be an artefact of it being less abundant on the landscape, and its proximity to existing developments.

Table 5.3.7-4: Direct and Indirect Effects Measured as Change (percent) in Area of Habitat Types from Development Footprints and Zones of Influence within the Regional Study Area for Wildlife during Baseline, Application, and Future Conditions

	Historical Reference Condition (ha)	Reference to Baseline Cumulative %Change	Baseline to Application Incremental %Change	Application to Future Incremental %Change	Reference to Future Cumulative %Change
Bare Ground	18 316	-1.53	-0.08	-0.02	-1.63
Heath Lichen – Hair Lichen	18 299	-3.10	-0.28	-0.36	-3.72
Heath Boulder	140 689	-3.39	-0.24	-0.07	-3.70
Heath Lichen-Cetraria	12 223	-8.80	-0.49	-0.44	-9.64
Heath Tundra	273 325	-2.40	-1.51	-1.80	-5.60
Low Shrub	12 661	-1.04	-0.47	-1.05	-2.54
Tussock-Hummock	109 645	-3.24	-0.68	-0.37	-4.25
Water	257 537	-1.37	-0.62	-0.86	-2.82

Note: In the RSA, the percentage of cover under ZOI and footprint for future scenario = 4.9%; approximately 41 696 ha will be ZOI/footprint under the future scenario.

% = percent; ha = hectares

In summary, cumulative direct effects of development measured as development footprints under the future scenario will be about 2280 ha or 0.27% of the RSA. Observed direct incremental and cumulative changes to habitat were all less than 1% per habitat class. The direct and indirect incremental change with the application of the AWAR was also less than 1% per habitat class, with the exception of a 1.5% decline in area of heath tundra. Direct and indirect cumulative effects were in the range of -9.6 to -1.6% per habitat class. The largest observed cumulative change in habitat area will be for heath lichen - Cetraria (-9.6%). Heath tundra and heath lichen - Cetraria are typical forage habitats for barren-ground caribou during the post-calving and summer periods (Griffith et al. 2002; Johnson et al. 2004, 2005). Heath tundra and lichen habitat classes also support modest densities of upland birds (i.e., about one bird per ha; Section 5.3.3.3). Bare ground and heath boulder classes, which best represent nesting habitat for raptors, decrease by 1.6 to 3.7% from reference to application scenarios. However, given the estimated effect sizes in the above analyses, the cumulative effects to all wildlife VCs from the AWAR Project will be either undetectable or detectable but within the range of baseline values. It is important to note that the majority of changes in habitat will be from indirect effects and the assumed ZOI for developments. For example, about 97% of the cumulative changes in cover of heath lichen - Cetraria are from the indirect effects, (e.g., dust deposition and sensory disturbances). Loss of habitat from sensory disturbances is a result of behavioural processes that are discussed in Section 5.3.7.4.

5.3.7.4 Effects to Behaviour and Movement

Caribou and Wolf

Previously completed work in the Canadian Arctic suggests that sensory disturbances from development influence wildlife behaviour, movements, and distributions. For example, long-term monitoring at diamond mines in the NWT have suggested that caribou groups with calves spend less time feeding within 5 km of the footprint (BHPB 2004), and that mines cause changes to caribou distribution leading to lower probability of occurrence within 6 to 14 km (Boulanger et al. 2009). Unfortunately, the mechanism causing these effects are not yet understood, but are likely a combination of direct effects (such as physical footprint) and indirect effects (noise, dust, activity, and smells).

The available evidence regarding the effects of roads to caribou is almost consistently contradictory. For example, some studies have found woodland caribou were displaced within 2 to 4 km of roads (Dau and Cameron 1986; Cameron et al. 2005), whereas other studies have observed that resting and feeding behaviour was common for caribou near airstrips or roads (Gunn et al. 1998; BHPB 2007).

This is not just true for scientific studies, but also holds for traditional knowledge studies. During a recent collaborative study between the Kugluktuk Hunters and Trappers Organization (HTO) and Golder (Golder 2011b), the effects of development to caribou were investigated using both traditional knowledge and an ecological model. Hunters and elder's observations of caribou near roads were a topic of discussion, and shed light on the complex nature of caribou interactions with roads and human developments. Interviewees explained that roads may provide easier access for hunters, create a barrier for caribou to cross, and fragment habitat on the landscape. On the other hand, responses alluded to observation of caribou seeking out roads for insect relief and ease of travel. Some direct quotes from Kugluktuk hunters and elders regarding roads are provided below:

> "Mosquitoes...bug the caribou so much along with the warble flies that they have to look for bug free zones like an esker, road, island, top of hill, mining site wherever there is least amount of mosquitoes or warble flies and where it is windy." (Golder 2011b:45)
>
> "Also the [Ekati Diamond Mine] Misery Road is a long stretch, which has crossing areas for caribou, but caribou tend to look for other areas to cross and do use them once they get on the road as a bug free zone, predators do come around seeing them on the road." (Golder 2011b:46)
>
> "I have watched them come to the BHP Billiton Diamond roads and they were always very cautious and did not cross for some time until one of them crossed or ventured on. When the roads were initially built they made them too high and this was a barrier with lots of big rocks where many caribou got hurt or injured. We have not observed the calves when they were coming through as they did not come by the same way as when they went north. During the fall migration the animals are more wary as they are healthy and have the young with them so this will cause them to travel through quicker." (Golder 2011b:48)
>
> John Ivarluk, who lived and worked for many years at the Lupin Mine, notes "I always see caribou on the road, they prefer it. More smooth to walk on. "(Golder 2011b:49)
>
> "The caribou don't like the road new-built on the ground. They can smell it from 100 yards, 200 yards away... They stay away from it. Sometimes, when the roads at the diamond mines shut down and the camp is covered the smell never goes away. They cover it but the animals stay away" (Golder 2011b:49)

The all-weather Misery Road at the Ekati Diamond mine is of similar length to the proposed AWAR (BHPB 2010). Since 2001, environmental technicians have recorded all caribou observed within 200 m of the road, and note the group composition, behaviour, and distance from the road. The results showed that the proportion of caribou groups feeding did not change with distance from the road, and that the ratio of groups with and without calves didn't change. The data indicated that caribou were observed more frequently on or near roads, although this may be, in part, a function of caribou being more visible when on the road. Caribou on the road tended to be moving rather than resting or showing other energy saving behaviours (BHPB 2010). Overall, the results suggest the Misery Road is not affecting either caribou local distribution or behaviour within the 200 m zone.

In contrast, observations of caribou snow tracks near the Misery Road indicated that 58% of caribou were deflected by the road in winter, indicating that caribou had to find a suitable crossing area. Deflection seemed to be related to the height of the snow bank on the edge of the road, and the size of the group (BHPB 2010). Caribou have also been observed through all seasons along the all-weather private access road linking Baker Lake to the Meadowbank Gold Mine Project (Gebauer and Associates 2009). Although the monitoring is not designed to detect changes in behaviour or distribution from the road, the monitoring does indicate the regular presence of caribou within the 1 km survey area on either side of the road.

The overall implications of sensory disturbances for caribou and wolf population demographics and their regional distributions are difficult to interpret, but depend, in part, on the number of developments of the landscape, the position of the AWAR Project on the landscape, the frequency of encounters, and the number of affected animals. The ZOI created by sensory disturbances around human developments, such as roads, can result in reduced probability of use within close proximity of the roads and human infrastructure. This has been described for bird and mammal distributions where zones of influence typically extend up to 5 km for a variety of road types and sizes (reviewed in Benitez-Lopez et al. 2010; also see Nelleman et al. 2001). Such an effect can be described as habitat loss or fragmentation, reducing the carrying capacity of the landscape to support a population. However, some animals appear to be habituated to some human activity and just as likely to use habitat near, versus far away, from a human development (Golder 2011b). The implications for this behaviour include increased energetic costs and reductions in body condition and parturition rates (Golder 2011b). However, Golder (2011b) contends that a caribou cow must be exposed to hundreds of sensory disturbance events during the post-calving to autumn period to significantly affect parturition rates in late autumn/early winter.

There is reason to argue that the frequency of encounters with development is low given that the total area of the development footprint (including the AWAR Project) is less than 1% of the RSA and CESA. Another point is that the AWAR Project should not intersect with high numbers of caribou and wolves given it's location on the landscape. The AWAR Project area is on the periphery of the range of the Qamanirjuaq caribou herd. Caribou of the Qamanirjuaq herd are regular but transient visitors during their spring migration and post-calving periods. No known calving grounds are near the proposed AWAR. Arctic fox are the most common carnivore in the AWAR Project area. The wolf is less common but likely present depending on the distribution of caribou. A high number of wolves are harvested from Rankin Inlet, which may indicate that they are more common in the RSA than baseline surveys suggest. Other carnivores, such as polar bear, were infrequently observed during baseline surveys. Grizzly bear, wolverines, or their sign were not observed during baseline wildlife surveys, although a grizzly bear was reported from near the Discovery (Meliadine East) exploration site in 2011.

A number of environmental design features and management plans will be implemented to limit olfactory, visual, and auditory disturbances to caribou and carnivores (e.g., traffic will be at low volumes), which should result in minor changes to quality of habitat near the AWAR, relative to baseline conditions. Also, the low density characteristic of wolf populations means that only a few individuals' home ranges should overlap the ZOI of sensory disturbance from the AWAR Project. Therefore, only a small proportion of the wolf population should be affected by sensory disturbances from the AWAR Project. Thus, the AWAR Project will likely alter the behaviour and movement of a few individuals from regional populations of caribou and carnivores that periodically travel through the study area. The effects of incremental and cumulative changes in sensory disturbances are predicted to be undetectable for wolf behaviour and movement, but detectable and within the range of baseline values for the regional caribou population. It is important to emphasize that baseline conditions represent the historical and current environmental selection pressures (natural and human-related) that have shaped the observed pattern for a particular wildlife VC. Baseline conditions are in a constant state of change, and can be described as a distribution of probability values, and the location of a particular value is dependent on which environmental factors are affecting the trajectory of the caribou population.

Breeding Birds

Few studies have focused on the effects of noise and disturbance to upland bird behaviour and movement. Behaviours most likely to be affected are nest site selection, territory selection, mate attraction, and foraging. Noise may also inhibit predator detection and interfere with mate/chick communication (Habib et al. 2007). Many boreal upland breeding bird species have lower abundance in noisy areas than pristine areas (Habib et al. 2007; Bayne et al. 2008).

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

Noise sources from the AWAR Project include blasting and vehicles along the AWAR, and activities at the Meliadine West Advanced Exploration site. Disturbance from blasting should occur infrequently (approximately 6 blasts per week) most of which will occur prior to 1 May when the base layer of rock is added as part of the footprint of the road. Further, the distance to noise attenuation to background for traffic along the AWAR during the construction phase should be less than 1.0 km (Fortune Minerals 2011). The magnitude of the incremental and cumulative effect of sensory disturbances on the behaviour and movement of upland birds adjacent to the AWAR may be undetectable, but will be within the range of baseline values. The majority of effects will be restricted to within 1 km of the footprint and to the construction phase, and during peak periods of truck activity.

Raptors

Peregrines are the most common raptor in the RSA, and have been observed to nest on both cliffs and boulders, and generally nest on rocky outcrops ranging in height from 4 to 26 m above large waterbodies (Court et al. 1988a). Fidelity to nesting territories is high, but breeding pairs may change to different locations on the same cliff. The peregrines generally arrive in the breeding area in late May, and chicks fledge by late August. The AWAR Project could potentially physically harm eggs, chicks or adults of raptors, alter nesting habitats, and disrupt normal breeding behaviour, particularly if the construction phase of the AWAR overlaps with the breeding season. Sensitivity to disturbance, and certainly the consequence of disturbance, is increased during the breeding season (Richardson and Miller 1987). Indeed, some peregrine falcons will not breed if humans have been in the vicinity of their nests. Holmes et al. (1993) argued that raptors are less sensitive to vehicles than to people on foot.

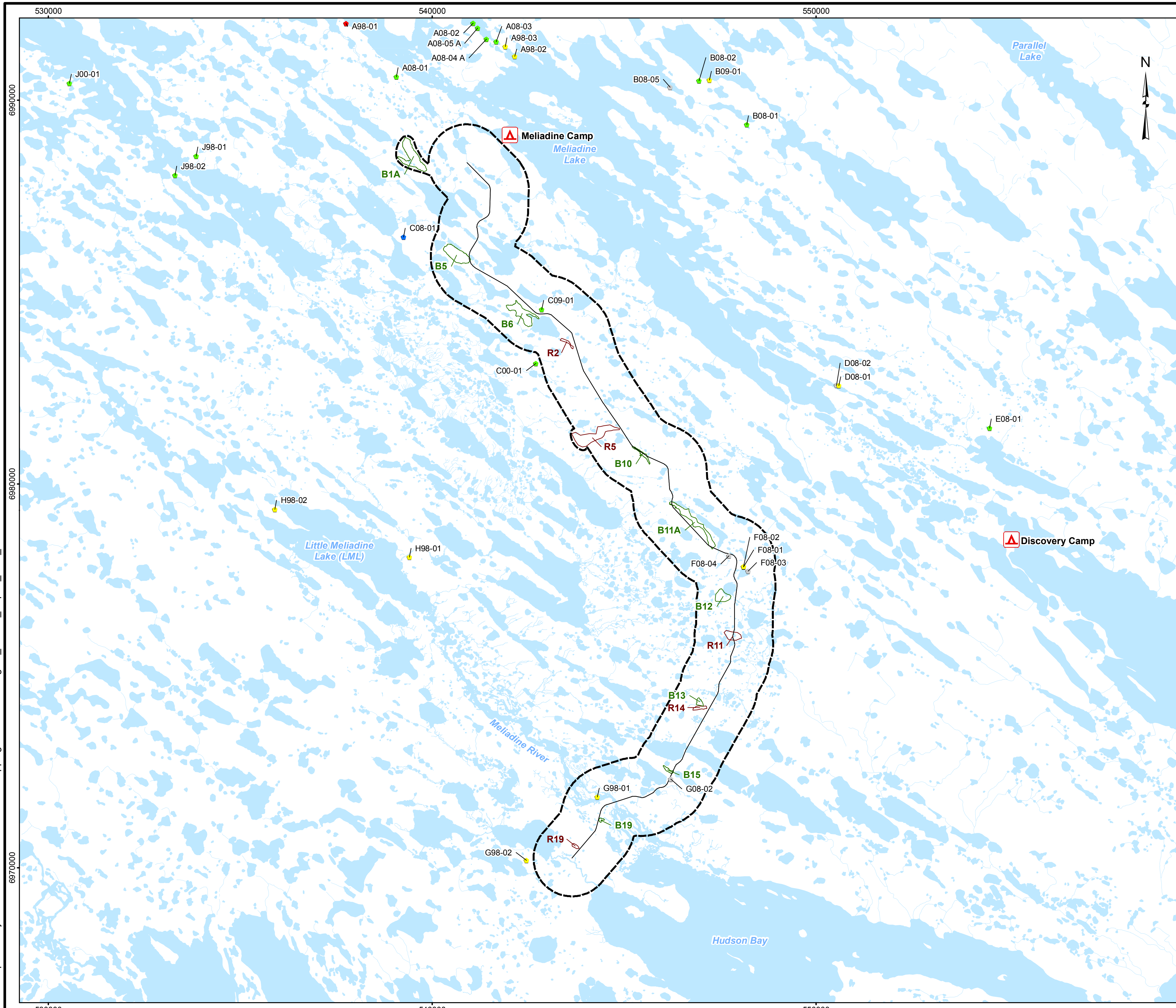
The effect of mining activity on nest site occupancy and success has been observed in the Lac de Gras region, NWT. Raptor nest success and occupancy increased with distance from the Diavik Diamond Mine, and nest success appeared to decline over time from construction through current operations (Golder 2005). However, the relationships were weak, and spring rainfall also contributed to the variation in nest success (Golder 2005). Further, at the Snap Lake Mine (also in a tundra environment), variation in nest site occupancy and success was not strongly related to distance from the mine.

Studies of prairie falcon responses to blasting activities found that falcons showed behavioural reactions to blasting in 54% of blasts (Holthuijzen et al. 1990). Incubating or brooding falcons were flushed from their nests in 22% of the blasts, but returned to their nests within an average of 3.4 minutes. The authors suggested that blasting associated with limited human activity does not need to be restricted at distances greater than 125 m from occupied prairie falcon nests, provided that peak noise levels do not exceed 140 dB at the aerie and no more than 3 blasts occur on a given day or 90 blasts during the nesting season. Studies of flushing distances of wintering bald eagles in a boreal environment by Stalmaster and Newman (1978) suggested that activity be restricted within 250 m to protect wintering grounds.

Buffer zones (i.e., operational set-back distances) are the most commonly used means of protecting raptor nests, and site-specific physical characteristics (such as topography and vegetation) are important variables to consider when establishing buffer zones (Richardson and Miller 1997). As there are no trees to block sound and sight, the peregrines of Rankin Inlet likely require larger buffers than falcons breeding in a boreal environment. Buffers can be shortened or lengthened depending on height of the nest site, and the dates when the buffer is active depends on the local migration and breeding season, are often based on the flushing distance, which is specific to each species and season (Richardson and Miller 1997; Stalmaster and Newman 1978). The spatial buffers identified for peregrine falcons ranged from 800 to 1600 m, with the authors recommending a buffer of 800 m for peregrines (Richardson and Miller 1997). A temporal buffer of 15 May to 15 September would be sufficient to avoid peregrine nesting activity reported in Court et al. (1998a).

It is also important to note that raptors can habituate to disturbance. At the Meadowbank Gold Mine, peregrine falcons have moved in to new cliff-like habitat created at quarries along the all-weather access road, successfully rearing young in 2009 (Gebauer and Associates 2010). There have been several attempts by peregrine falcons, gyrfalcons, rough-legged hawks, and common ravens to nest within both active and abandoned open pits at the Ekati and Diavik diamond mines. Peregrine falcons made nesting attempts in open pits at Diavik Diamond Mine in 2005 and 2006 (DDMI 2007). Since 2004, there have been 8 such occurrences among 5 open pits at the Ekati Diamond Mine, and all 5 Ekati pits had nesting birds in 2006 (BHPB 2007). In some cases, young have been detected in these nests (BHPB 2003, 2007). Nesting on pit walls has become so common at the Ekati Diamond Mine that a monitoring program has been implemented.

The proposed AWAR alignment will avoid most of the previously identified nests of raptors in the study region (Figure 5.3.7-2). Only a small portion of known raptor nest locations have the potential to be affected by the AWAR; 7 (potential) historical nests of the peregrine falcon and rough-legged hawk are within 500 m of the proposed route, but there is only one general location that was active in 2011 (one peregrine falcon pair was observed near F08-01, F08-02, and F08-03), and this area was identified as being high-quality habitat (Figure 5.3.7-2). This location is about 204 m from the proposed road alignment. The 6 remaining locations were in areas of low topographic relief, and in some cases, only a breeding pair of raptors may have been confirmed during surveys, not necessarily the nest itself (e.g., F08-04, C09-01.



LEGEND

- Camp
- Raptor Nest
  - Gyrfalcon
  - Peregrine Falcon
  - Rough-legged Hawk
  - Short-eared Owl
  - Unknown
- Phase 1 AWAR Road Alignment
- Local Study Area
- Borrow Area
- Rock Quarry
- Watercourse
- Waterbody

NOTES

Within the Local Study Area, only F08-02 nest site was active in 2011.

REFERENCE

Wildlife data obtained from field survey. Base data obtained from Agnico-Eagle Mines Ltd (AEM).
Datum: NAD 83 Projection: UTM Zone 15

2 0 2
SCALE 1:100,000 KILOMETRES

PROJECT
AGNICO-EAGLE MINES LTD.
MELIADINE GOLD PROJECT
NUNAVUT

TITLE
HISTORICAL RAPTOR NEST LOCATIONS

PROJECT NO. 10-1373-0076			FILE No.
DESIGN	CS	31 Aug. 2011	SCALE AS SHOWN REV. 0
GIS	CDB	31 Aug. 2011	
CHECK	CS	16 Sep. 2011	FIGURE: 5.3.7-2
REVIEW	GRA	20 Sep. 2011	

Golder Associates
Greater Vancouver Office, B.C.

N:\Bur-Graphics\Projects\2010\1373\10-1373-0076\Mapping\MXD\Wildlife\Figure_5.3.7-2_Raptor_Nest_Locations.mxd

All previously identified nest locations will be monitoring during construction of the AWAR. Where active raptor nests are identified, a nest-specific management plan will be developed (Cumberland Resources Ltd. 2006). For example, construction activities, particularly blasting, will be shifted to non-nesting locations so that disruptions to breeding raptors are kept to a minimum; however, it should be noted that the current construction plan for the AWAR includes most blasting and stockpiling of the rock material at quarries being completed during the winter period prior to migratory birds returning to nest sites. All crew members will be trained to recognize signs that a bird may be nesting in the area.

Thus, effects from incremental changes in sensory disturbances on behaviour and movement of local raptors may be undetectable, but will be within the range of baseline values. It is predicted that the majority of effects will be limited to the construction stages of the AWAR. The magnitude of cumulative effects from the AWAR on local raptors is determined to be within the range of baseline values. Again, it is important to emphasize that baseline conditions represent the historical and current environmental selection pressures (natural and human-related) that have shaped the dynamics of the existing raptor population. Baseline conditions are in a constant state of change, and can be described as a distribution of probability values, and the location of a particular value is dependent on which environmental factors are affecting the trajectory of the raptor population. The anticipated effect on movement and behaviour for raptors, as it relates to population persistence, is anticipated to lie within baseline variation.

5.3.7.5 Effects to Caribou and Wolf Survival

Increased access from the AWAR for traditional and non-traditional harvesting may increase risk of mortality for wildlife, as well as alter movements and behaviour in response to perceived risk. However, the existing network of ATV trails in the region supports hunting activity, primarily for caribou. The baseline harvest for the region was determined from a summary of harvesting from Rankin Inlet over a 5-year period from 1996 to 2001. Specifically, the baseline harvest was determined to be an annual harvest of about 989 caribou (NWMB 2004), which is only a small fraction (<10%) of the entire traditional harvest for the Qamanirjuaq herd, which can approach 14 000 caribou for all traditional hunting in Nunavut (BQCMB 2011). The annual harvest in the Rankin Inlet region is highest for caribou, followed by Arctic fox (49) and wolf (34).

Considering that most residents of Rankin Inlet have few harvesting restrictions, that good access to hunting and fishing areas currently exists in the RSA, and that harvesting currently occurs from existing trails within the RSA, the addition of an AWAR the 23.8 km length of an existing trail to Meliadine Lake is not anticipated to cause significant changes to current land use. Currently there is a 15 km all-weather road from Rankin Inlet to the Iqalugaarjuup Nunanga Territorial Park. Changes to land use have been reported at the Meadowbank Gold Mine Project (Gebauer and Associates 2010), but as a result of a longer 106 km road. Further, the mitigation proposed by AEM, in particular the gating of the road and restricting access to the public, is expected to further mitigate the effects of improved access. AEM indicates that ATVs and snowmobiles can and are expected to circumvent the proposed access controls, but this will only provide faster access to Meliadine Lake rather than new access.

It is anticipated that the use of AWAR by harvesters should result in minor changes to overall annual harvest rate relative to baseline conditions. The AWAR will not open areas previously inaccessible to harvesters as the AWAR Project area is currently accessible by ATV and snowmobile. Access will be improved (travel on maintained road versus over land), thus, the number of harvesters accessing the AWAR Project area may increase. All-terrain vehicle and snowmobile use of the AWAR cannot be totally controlled. The proponent will work with the KIA and the Municipality of Rankin Inlet to devise a system for controlling access by public vehicles (i.e., cars, trucks). The proponent proposes to control access with a gate staffed on a daily basis and restrict public traffic to those who have a legitimate need to use the road to access cabins, or carry out traditional use to prevent spur of the moment, sightseeing or “joy ride” type of access.

In summary, given that the AWAR should not open new areas or increase access to areas for hunting, the incremental effect of the proposed AWAR on caribou and wolf survival rates is expected to be within the range of baseline values (but detectable). Assuming that the herd size for the Qamanirjuaq herd is approximately 348 000, and 14 000 caribou are harvested annually (BQCMB 2011), the baseline harvest rate is only 4% of the population and potentially sustainable (Adamczewski et al. 2009). Wolf populations are typically highly resilient to the effects of harvesting (Hayes and Harestad 2000; Webb et al. 2011). Thus, the magnitude of cumulative effects from AWAR access on caribou and wolf are determined to be detectable and within the range of baseline values.

5.3.7.6 Effects to People

The AWAR Project may affect harvest opportunities for traditional and non-traditional users of wildlife. The assessment of effects considered proposed environmental design features and mitigation, as well as anticipated avoidance of the road by wildlife (i.e., the zone of influence; Section 5.3.7.4). It was determined that the AWAR should not open or increase access to areas for hunting (Section 5.3.7.5), primarily because there is an existing network of trails in the Rankin Inlet Area and because the proponent will work with the KIA and the Municipality of Rankin Inlet to devise a system for controlling access by public vehicles (i.e., cars, trucks). Overall, it is predicted that an increase in hunter access to regions around the AWAR may be detectable, but that hunter access will remain within the range of baseline values.

However, due to the sensory disturbance of road related noise, a measurable shift in the distribution/abundance of wildlife is predicted within about 5 km of the AWAR Project, with the majority of effects predicted to occur within 1 km of the road. Effects should not extend far into Iqaluqaarjuup Nunanga Territorial Park, and should be restricted primarily to the construction phase when noise levels peak. Although the road does not intersect with the boundary of the park, about 5 km of the most southern section of the road runs parallel to, and in close proximity to the south-eastern section of the park (Figure 3.1-1). The decrease in the availability of wildlife for harvesting from AWAR-Project related effects is predicted to be undetectable and within the range of baseline values (i.e., people that hunt and trap in the region should not observe a change in the availability of animals due to effects from the AWAR Project, relative to current natural changes in population sizes). Even if access is noticeably improved and harvest rates increase in the area (i.e., caribou survival rates decrease), current harvest statistics for caribou and wolf indicate that harvesting pressure is unlikely to be a limiting factor for these populations in Kivalliq region of Nunavut.

5.3.7.7 Residual Impacts Summary

Direct incremental impacts from the AWAR Project footprint (i.e., habitat loss) are local in spatial extent. The magnitude of incremental impacts from the footprint on wildlife populations is predicted to be negligible (i.e., the AWAR Project will alter less than 0.02% of the RSA); however, individuals from wildlife populations may interact with other developments and activities in the effects study area (defined as the distribution of these populations, i.e. RSA]). Therefore, the cumulative impacts from direct habitat loss from the AWAR Project footprint and other developments on population size and distribution are expected to be regional in geographic extent (Table 5.3.7-5). Cumulative impacts of direct habitat loss from the AWAR Project and previous, existing, and reasonably foreseeable future developments is expected to be about 0.3% of the RSA (negligible magnitude) (Table 5.3.7-5). Direct impacts from the AWAR Project will be continuous over the duration of the assessment period. Although progressive reclamation will be considered into mitigation and management plans for the AWAR Project, Arctic terrestrial ecosystems are slow to recover from disturbance.

Development of the AWAR Project is expected to cause indirect changes to the amount of habitats for wildlife populations in the region. Based on estimated zones of influence from the literature, habitat quality is predicted to decrease within 5 km from human activities and infrastructure, with the majority of effects restricted to within 1 to 2 km of footprints. These changes are expected to result from a combination of visual and auditory disturbances and possibly changes in vegetation (through dust deposition), and are local to regional in geographic extent (Table 5.3.7-5). Noise levels from road construction and quarry blasting should reach background levels within 3 km of the footprint, based on similar assessments in Arctic. Also, sensory disturbance from vehicles travelling on the road are expected to be undistinguishable from background levels at distances greater than 1 km from the road.

Direct and indirect impacts from the AWAR Project are anticipated to decrease all habitat classes by less than 1% (negligible magnitude), with the exception of heath tundra (by 1.5%; low magnitude). Sensory disturbance effects from the AWAR Project are expected to be negligible-to-low in magnitude for wildlife (Table 5.3.7.5). Relative to historical reference conditions (no development), cumulative direct and indirect impacts from the AWAR Project and previous, existing, and reasonably foreseeable future developments are expected to reduce the heath lichen-cetraria habitat class by 9.6%, heath tundra by 5.6%, and tussock-hummock by 4.3% (low magnitude). All other habitats will be reduced by 1.6 to 2.7% (low magnitude). Thus, the magnitude of cumulative direct and indirect impacts on the abundance and distribution of wildlife populations is expected to be low (Table 5.3.7-5). The percentage of cover under footprints and zones of influence for the future scenario is about 4.9%, the majority of which is zone of influence cover (i.e., about 98%).

Indirect impacts from the AWAR will be temporally isolated or periodic (i.e., limited to one winter and spring season) during construction, but will be continuous during operation (Table 5.3.7-5). The duration of sensory disturbance effects on wildlife from noise and the presence of people, vehicles, and vehicular traffic associated with the AWAR Project should be reversed shortly after closure (medium term), but for caribou, effects could persist for 5 to 10 years following closure for caribou (long-term). Caribou can perceive risk and avoid roads even when they are no longer in use (Nellemann et al. 2001).

With the development of the AWAR road, hunters and trappers may be able to make more use of vehicles (including snowmobiles) to access areas in the region, and be able to access the region for a longer period during harvest seasons. The spatial extent of incremental and cumulative effects from the road on wildlife populations from changes in harvesting pressure is expected to be regional (Table 5.3.7-5). Although the development of the road will increase access into the RSA during the entire year, harvesting of wildlife would likely occur periodically during traditional and non-traditional hunting seasons.

Table 5.3.7-5: Summary of Residual Impact Classification of Primary Pathways for Incremental and Cumulative Effects on Abundance and Distribution of Wildlife Populations and Related Effects to People

Pathway	Direction	Magnitude		Geographic Extent		Duration	Frequency	Reversibility	Likelihood
		Incremental	Cumulative	Incremental	Cumulative				
Physical footprint decreases habitat quantity and carrying capacity of landscape to support caribou, wolf, raptors and upland breeding birds	Negative	Negligible	Negligible	Local	Regional	Long-term to permanent	continuous	reversible to irreversible	highly likely
Sensory disturbances (e.g., noise, presence, lights, smells) combined with other indirect effects (e.g., dust) decreases habitat quality and alters movement and behaviour of wildlife	Negative	Negligible to low	Low	Local to regional	Regional	Medium to long-term	isolated or periodic (construction) to continuous	reversible	highly likely
Improved access for harvesting can affect caribou and wolf population sizes	Negative	Low	Low	Regional	Regional	Medium-term	periodic	irreversible	Likely
Effects on population size and distribution changes the availability of caribou and wolf for traditional and non-traditional use	Negative	Negligible	Low	Regional	Regional	Long-term	continuous	reversible	likely

Current harvest levels in the region appear to be low, and harvest numbers indicate that harvesting pressure is unlikely to be a limiting factor for caribou and wolf populations in the area surrounding the AWAR Project. Although many residents of Rankin Inlet rely on harvesting wildlife for food and income, the region is also sparsely populated. Further, the AWAR should not noticeably open new areas or increase access to existing hunting areas for hunting, primarily because there is an existing network of trails in the Rankin Inlet area and because the proponent will work with the KIA and the Municipality of Rankin Inlet to devise a system for controlling access by public vehicles (i.e., cars, trucks). Overall, it is predicted that the incremental effect of increased hunter access on population survival rates will be low in magnitude (Table 5.3.7-5).

However, a measurable, but small decrease in the abundance of wildlife is predicted within about 5 km of the AWAR Project. The majority of effects should diminish within 1 km of the road and may have a very minor influence on wildlife distributions at the very south-eastern periphery of Iqaluqaarjuup Nunanga Territorial Park, where the proposed road parallels close to the park.

Effects to wildlife will be regional in geographic extent. The magnitude of the incremental (direct and indirect) decrease from the AWAR Project on the amount of habitat is typically less than 1% per habitat class (negligible magnitude).

The decrease in the availability of wildlife for harvesting from AWAR-Project related effects is predicted to be negligible in magnitude (Table 5.3.7-5). In other words, traditional and non-traditional people that hunt and trap in the region should not observe a change in the availability of animals due to effects from the AWAR Project, relative to current natural changes in population sizes. The duration of effects from increased access is predicted to be medium-term if the road is fully decommissioned (e.g., stream crossings removed) shortly after the 2-year lifespan of the road (Table 5.3.7-5).

Significance

The results predict that the incremental and cumulative impacts from the AWAR Project and other developments should not significantly influence the persistence of populations of caribou, wolf, raptors, and upland birds. Thus, impacts are measurable at the individual level, and strong enough to be detectable at the population level, but are not likely to decrease resilience and increase the risk to population persistence. Magnitude, geographic extent, and duration were the principal criteria used to predict significance. Duration of impacts, which includes reversibility, is a function of ecological resilience, and these ecological principles are applied to the evaluation of significance.

Although all primary pathways were classified as local to regional in geographic extent and the footprint pathway was identified as potentially being permanent, this assessment identified negligible to low impacts for wildlife (Table 5.3.4-1). The actual footprint (direct effect) of the AWAR is only 168 ha and when combined with existing and foreseeable future developments on the landscape, the total footprint area amounts to 0.3% of the RSA. If considering indirect effects (i.e., ZOI), the AWAR Project will result in a loss or modification of 6676 ha of habitat. Thus, the majority of habitat conversion from the AWAR will be from indirect effects and the ZOI associated with the road (almost 98% from ZOI). Under the future scenario, approximately 4.9% of the RSA will be lost or modified by direct and indirect effects of developments.

The existing ecosystem in the RSA and beyond may be highly capable to absorb disturbance, and reorganize and retain the same structure, function, and feedback responses under low levels of human activity. The current level of human activity in the region includes only 2 active exploration camps, 1 active quarry, and 1 all-season road between Rankin Inlet and the Territorial Park. The implementation of environmental design features for the road (e.g., narrow road width, restricted road access) should also minimize influences on the resilience of wildlife populations in the RSA.

Some species in the Arctic are resilient to modest levels of environmental change. Although caribou may be adversely affected by disturbance on their post-calving range, responses are generally less severe than other times of the year, such as during calving and the spring migration (Adamczewski et al. 1987; Bergerud et al. 2008). The persistence of caribou herds during large fluctuations in population size indicates that the species has the capability to adapt to different disturbances and environmental selection pressures (Holling 1973; Gunderson 2000; Walker et al. 2004). Migration routes of caribou, their population processes, and their predators (e.g., wolf) appear to have the flexibility to respond to changes through time and across the landscape (Golder 2011b).

Similarly, most bird species are migratory, and will be influenced by the AWAR Project and other developments for less than 4 to 5 months each year during spring to autumn. Although nest productivity can be influenced by human disturbance, this is also a time of year in the region when weather conditions are typically less harsh and food is abundant, which can increase resistance in individuals to natural and human-related stressors. Upland bird populations have high reproductive rates and the flexibility to adapt to different environmental selection pressures (e.g., Male and Nol 2005; Spellerberg and Morrison 1998). Similarly, raptors display life history traits (variation in time between egg laying and hatching of young) that provides adaptability and resilience for populations experiencing different extremes of prey abundance and weather patterns. For example, the ability for Peregrine Falcons to exploit urban landscapes is a testament to their capacity to adapt to changing surroundings.

5.3.7.8 Uncertainty

This section identifies the key sources of uncertainty and discussed how uncertainty has been addressed to increase the level of confidence that impacts are not underestimated. Confidence in the assessment of environmental significance is related to the following elements:

- adequacy of baseline data for understanding current conditions and future changes unrelated to the AWAR Project;
- model inputs (e.g., hypothetical zone of influence and disturbance coefficients from developments);
- understanding of exactly how the AWAR Project will influence wildlife species across different scales of time and space;
- knowledge of the effectiveness of the environmental design features (mitigation) for reducing or removing impacts (e.g., controlled road access).

Key sources of uncertainty are the resilience of wildlife species to development and the time required to reverse impacts. There is a general paucity of long-term monitoring studies on the topic, mostly because resilience is difficult to measure. Resilience is the capacity of the system to absorb disturbance, and reorganize and retain the same structure, function, and feedback responses. There also remains a high degree of uncertainty in the effectiveness and timeframe of vegetation regrowth for reversing the impact from direct changes to habitat. Adding to the challenges of understanding complex systems is the difficulty of forecasting a future that may be outside the range of observable baseline environmental conditions, such as factors related to climate change (Walther et al. 2002).

To reduce uncertainty associated with (indirect) effects to habitat quantity, and altered movement and behaviour of wildlife, conservative estimates of the zones of influence and disturbance coefficients were used for the assessment. For example, zones of influence were applied to all active exploration sites in the RSA for the entire permit period even though activities typically do not occur throughout the year, and some sites may have been abandoned before permit expiration. It was also assumed that all developments that were active in 2011 were also active under future conditions, resulting in measurable losses of habitat from indirect effects. These losses were based on a hypothetical disturbance coefficient of 0.5, which assumed that 50% of the habitat within the ZOI is reduced (i.e., lost). In the field, researchers have only shown modest reductions in the probability of use. Further, reductions in use are typically in close proximity to road developments (e.g., <1 km; Benitez-Lopez et al. 2010).

The above-mentioned conservative attributes provide confidence that the assessment has not underestimated the environmental significance of the incremental and cumulative impacts from the AWAR Project and other developments on wildlife.

5.3.7.9 Monitoring and Follow-up

Once the road is operational, AEM will implement a monitoring program to record on a systematic basis the prevalence of wildlife seen along the AWAR. The program will be developed with the input of the local HTO and with the KIA. AEM will request that all large mammals observed by project related drivers on the road be reported to AEM environmental staff (via the road dispatcher), and recorded in a log book. This is anticipated to include caribou, muskox, grizzly bear, polar bear, and wolf. This information will be provided in an annual report. Information to be recorded will include species, number of individuals, approximate location and distance from the road, and date. In the case of grizzly bear or polar bear observations, the GN Conservation Officer will be contacted. The program, as envisioned by AEM, will be completed weekly and AEM will explore sub-contracting this program to the local HTO in Rankin Inlet.

The objectives of the monitoring plan are as follows:

- implement environmental design features and mitigation to reduce the risks and disturbance to wildlife and wildlife habitat (i.e., speed limits);
- keep environment staff apprised of wildlife activity within the AWAR Project footprint;
- identify and manage the attraction of wildlife to the AWAR Project; and
- avoid human-wildlife interactions.

5.3.7.10 References

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