14 Effects Assessment for Wolves

14.1 Scope of the Assessment for Wolves

The effects assessment on wolves focuses on the changes to denning habitat and health. Wolf numbers and distribution are likely dependent on the seasonal abundance of caribou in the region, so it is likely that most Project effects on wolves can be indirectly assessed through effects on caribou distribution and abundance. However, denning habitat may be based on site-specific features in the Project area that can be directly influenced by the Project footprint or by sensory disturbances from Project activities.

14.1.1 Project-Environment Interactions and Effects

Project activities have the potential to affect the availability of wolf denning habitat within the RAA. Key issues related to effects on wolves include:

- reduced habitat availability from the Project footprint that results in a direct loss of denning habitat
- sensory disturbances that result in an indirect loss of functional denning habitat
- change in population health.

Key Project components that could affect wolves are outlined in Table 14.1-1.

Table 14.1-1 Project-Environment Interactions and Effects on Wolves

Project Component	Project Activities	Environmental Effect	
		Change in Habitat	Change in Health
Construction			
On-Land Construction	Site clearing and pad construction (blasting, earth moving, loading, hauling, dumping, crushing)	2	
Supporting Activities	Transport fuel and construction materials	2	
	Air transport of personnel and supplies	2	
	Explosives storage and use	2	

Table 14.1-1 Project-Environment Interactions and Effects on Wolves

Project Component	Project Activities	Environmental Effect	
		Change in Habitat	Change in Health
Operation			
Mining	Mining ore (blasting, loading, hauling)	2	2
	Mining clean waste (blasting, loading, hauling)	2	2
Milling	Crushing and grinding	2	2
Transportation	Truck transportation		
	General traffic (Project-related)	2	
	Controlled public traffic		
	Air transportation of personnel, goods and supplies	2	
Ongoing exploration	Aerial surveys		
	Ground surveys		
Final Closure			
On-land Decommissioning	Revegetation	2	
NOTES:	Only Project interactions ranked as 2 in Table 11.4-1 are carried forward to this table. A 2 indicates that an activity is likely to contribute to an effect.		

14.1.2 Residual Environmental Effects Criteria for Wolves

Residual effects on wolves were characterized quantitatively using the attributes of direction, magnitude, geographic extent, frequency, duration and reversibility. Table 14.1-2 provides definitions for these attributes.

Table 14.1-2 Residual Environmental Effects Criteria for Wolves

Attribute	Description	Rating	Definition
Direction	The ultimate long-term trend of the environmental effect	Positive	Increased habitat availability relative to baseline conditions
		Neutral	No change in habitat
		Adverse	Decreased habitat availability relative to baseline conditions
Magnitude	Amount of change in a measurable parameter relative to baseline conditions; for health, defined by potential for exposure compared to a toxicity benchmark	Negligible	No anticipated effect on wolf denning habitat or species
		Low	Observable effect on wolf denning habitat or species but not likely to affect wolf sustainability in the LAA
		Moderate	Observable effect on wolf denning habitat or species but not likely to affect wolf sustainability in the RAA
		High	Measurable effect on wolf denning habitat or species that will likely affect wolf sustainability in the RAA
Geographic Extent	The geographic area within which an environmental effect occurs	Local	Effect confined to the LAA
		Regional	Effect extends beyond the LAA but within the RAA
		Territorial	Effect extends beyond the RAA but within Nunavut
		National	Effect extends beyond Nunavut
Frequency	Number of times that an effect may occur over the life of the Project	Once	Effect occurs once throughout the Project
		Sporadically	Effect occurs occasionally but not consistently throughout the life of the Project
		Regularly	Effect occurs repeatedly at regular intervals throughout the life of the Project
		Continuous	Effect occurs continuously throughout the Project
Duration	Length of time over which the effect is measurable	Short term	Less than one year
		Medium term	More than one year, but not beyond the end of the Project.
		Long term	Beyond the life of the Project
Reversibility	Likelihood that a measurable parameter for a VEC will recover from an environmental effect to baseline conditions	Reversible	Will likely recover to baseline conditions after or before the end of the Project.
		Irreversible	Unlikely to recover to baseline conditions after the end of the Project.

14.1.3 Standards or Thresholds for Determining Significance

Habitat — There are no known or definitive habitat loss or disturbance thresholds specific to wolves. Based on experience from other northern projects and the application of the precautionary approach, Project effects on habitat availability are considered significant if more than 10% of denning habitat becomes unsuitable for wolves in the RAA. There was no IQ made available to the assessment that suggested a measure of wolf den habitat effect significance.

Health — For this assessment, the estimated exposure to COPC by wildlife is compared to values that are set to be protective of health and if the exposure is lower than this value then no adverse effects are expected. The estimated dose received by the biota from exposure to radioactivity, considering both baseline and Project emissions, is compared to a level that is protective of mammals. Potential changes in a measurable parameter or VEC resulting from Project or cumulative effects were evaluated against these standards or thresholds, and were rated as either significant or not significant.

14.1.4 Technical Limitation of the Assessment for Wolves

Long-term Project effects on predatory species due to changes in denning habitat are difficult to predict with certainty. Population cycles, prey switching and other predator-prey dynamics are unpredictable over the long-term, particularly when climate change or other unknown factors also affect the KI. Also, there is no indication that denning habitat is a limiting factor to wolf persistence in the region in general.

Project effects on species that occur at low densities in the region are likely limited because of the relative infrequent encounter of the species with the Project. Quantifying effects on low density species, and then monitoring potential effects is difficult because of limited data availability, variability in occurrence, and low sample size upon which to validate results. The unknown distribution of wolf denning in the region and probably high annual variability in den use makes confidence in predictions moderate, and methods of follow-up monitoring to determine Project-related effects difficult.

14.2 Effects Assessment for Wolves

14.2.1 Assessment of Change in Habitat Availability

The Project will result in a loss of potential denning habitat for wolves. Human development can affect denning habitat availability through two pathways:

1. Direct habitat loss due to Project construction (i.e., the Project footprint) will reduce the amount of habitat available
2. Indirect habitat loss from human activity associated with the Project that causes a functional loss of habitat (avoidance due to sensory disturbances such as that associated with noise and dust).

Project effects on habitat could act cumulatively with similar effects from other human activity in the area. The measurable parameter for wolves is available potential denning habitat that is quantified by the denning potential of the various Ecological Land Classification (ELC) units classified in the baseline (Tier 3, Appendix 6C).

14.2.1.1 Analytical Methods for Change in Habitat Availability

Habitat within the RAA was described during the baseline studies by ELC units. ELC units were categorized as High, Moderate, Low and Nil quality habitat for wolf denning based on the attributes those units provide for wolf dens (Table 14.1-2). Non-ELC data, including surficial geology maps of beach deposits (rated as High), were also incorporated into the analysis. Direct loss of wolf denning habitat is assessed by identifying ELC units and beach deposits that will become unavailable because of the footprint of the mine site and the various road options. All ELC units and beach deposits within the Project footprint become Nil quality once the Project is constructed.

Indirect loss of habitat due to the Zone of Influence (ZOI) was assessed by reducing habitat quality (ELC unit quality) adjacent to the mine site and the access roads. There was no literature upon which to predict a ZOI on wolf denning habitat quality; therefore, a conservative estimate of a 2 km ZOI was chosen. Habitat quality within the mine and access road ZOI was reduced by two classes to a minimum of Low within 1 km of the footprint, and by one class to a minimum of Low from 1 to 2 km of the footprint.

To assess the overall loss of wolf denning habitat availability within the RAA, a habitat unit index was developed. The index is based on assigning a ranked value to each habitat class (High=3, Moderate=2, Low=1, Nil=0), and summing the available habitat, measured in hectares and weighted by the value of each class. The difference in the weighted sum between baseline conditions, and the

predicted direct and indirect loss of habitat following Project construction, indicates the expected effect on wolf denning habitat.

Table 14.2-1 Description and Relative Value of ELC Units for Wolf Denning during the Growing Season in the RAA[1].

ELC Unit [2]	Wolf Den Suitability	Reasoning
Water	N	Not suitable
Sand	H	Unconsolidated materials in upland areas suitable for denning
Gravel	H	Unconsolidated materials in upland areas suitable for denning
Rock Association	M	Potential den sites amongst larger rock complexes
Wet Graminoid	N	Ground water levels not suitable for denning
Graminoid Tundra	N	Ground water levels not suitable for denning
Graminoid/ Shrub Tundra	N	Ground water levels not suitable for denning
Shrub Tundra	L	Limited availability of suitable den sites
Shrub/Heath Tundra	L	Limited availability of suitable den sites
Heath Tundra	L	Limited availability of suitable den sites
Heath Upland	L	Limited availability of suitable den sites
Heath Upland/ Rock Complex	M	Potential unconsolidated materials in upland areas suitable for denning
Lichen Tundra	L	Potential den sites amongst larger rock complexes

NOTES:
H = High; M = Moderate; L = Low; Nil = N
[1] Growing season is approximately June 1 to September 30 (four months).
[2] Justification of habitat classification is available in Tier 3, Appendix 6C.

14.2.1.2 Baseline Conditions for Change in Wolf Habitat Availability

Wolves require unconsolidated materials, often found on beach deposits and eskers, to excavate den sites. Because of the general lack of suitable denning areas, the same den sites may be used from year to year. One wolf den was found south of Audra Lake during baseline studies (Tier 3, Appendix 6C, Section 5.8.3).

The ELC units Sand and Gravel are considered to be of high quality for wolf denning. Within the Mine RAA, 1.9% of the habitat is considered to be high quality wolf denning habitat. There is greater availability of high quality wolf denning habitat along the Winter Road, which is likely due to the more extensive beach deposits in close proximity to Baker Lake. Moderate quality habitats that consist of Rock Association or Heath Upland/Rock Complex cover 4.4%, 1.9%, and 5.7% of the Mine/All-Season Road LAA, the Mine/ Winter Road LAA, and the RAA, respectively.

14.2.1.3 Effect Mechanism and Linkages for Change in Wolf Habitat Availability

The Kiggavik Project will reduce habitat availability for wolves within the RAA. The direct habitat loss within the Project footprint will likely provide denning habitat post Project closure, once decommissioning is completed. However, for the purposes of this assessment, the entire footprint is considered long-term habitat loss.

Indirect, or functional, habitat loss is a reduction of habitat effectiveness due to Project activities that cause wolves to avoid habitats. Sensory disturbances are the primary cause of animals avoiding areas closer to disturbing stimuli (Stankowich 2008). For wolves, pups are most vulnerable when they are less mobile and unable to leave the den site (Frame et al. 2007). The age of pups is the best predictor of whether adults will abandon a homesite and move pups (Frame et al. 2007). In one study, pups less than or equal to 3 weeks old were not moved, 4–6 week old pups were likely to be moved, and pups greater than 6 weeks old were always moved in response to two consecutive days of homesite disturbance (Frame et al. 2007). Due to their limited mobility, wolf pups less than 6 weeks old are likely more sensitive to disturbance, potentially making them more vulnerable to abandonment, predation, or accidents (Frame et al. 2007).

14.2.1.4 Mitigation Measures and Project Design for Change in Wolf Habitat Availability

Mitigation measures that will be implemented to reduce Project effects on wolf denning habitat availability include:

- Maintaining Project activities within the surveyed boundaries of the Project footprints, thus keeping habitat loss within expected bounds.
- Managing road activity (e.g., extra speed restrictions, and no stopping zones) if dens are known to exist near roads.
- Progressively reclaiming disturbed areas will advance timing of habitat recovery.

14.2.1.5 Residual Effects for Change in Wolf Habitat Availability

14.2.1.5.1 Mine and All-Season Road

The Kiggavik mine site and the All-Season Road, if implemented, will result in a direct loss of 1,780 ha of potential habitat for wolf denning (Table 14.2-2). The Project is anticipated to reduce 2.8% of the high and 5.3% of the moderate quality habitat in the RAA, with an overall effect of a 0.95% reduction of the habitat units in the RAA (Figure 14.2-1).

Table 14.2-2 Wolf denning habitat baseline and predicted effects for the Mine and All-Season Road

Habitat rating		Baseline ELC	Direct loss[2]	Indirect effect[3]	RAA effect
Class	**SI[1]**	**ha**	**ha**	**ha**	**%**
High	3	18,548	-12	-499	-2.8
Moderate	2	56,129	-97	-2,874	-5.3
Low	1	385,226	-1,130	3,373	0.6
Nil	0	520,351	-540	0	0.2
No Rating		2,474	0	0	0.0
Total area		982,728	-1,780		
Habitat units[4]		553,128	-1,361	-3,872	**-0.95**

Notes:

[1] SI = Suitability Index (used for weighted average calculation of Habitat Units)

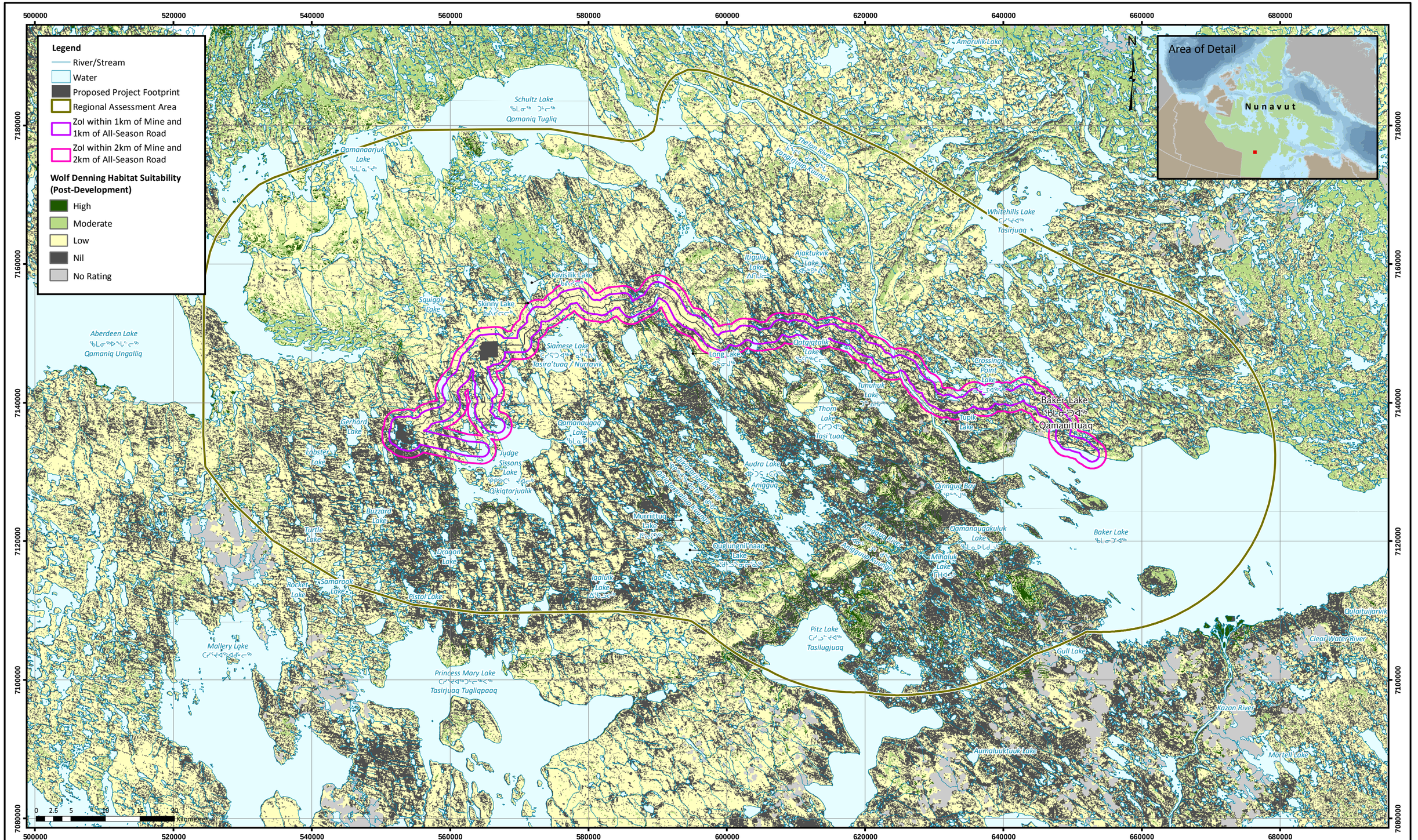
[2] Direct loss is the change in habitat availability due to the footprint of the project.

[3] Indirect effect is the change in habitat availability due to the zone of influence (ZOI) of the project.

[4] Habitat units are the weighted sum of all available habitat (sum [ha * SI]).

14.2.1.5.2 Mine and Winter Road

The Kiggavik mine site and Winter Road will result in a direct loss of 1,583 ha of potential habitat for wolf denning (Table 14.2-3). The Project is anticipated to reduce 7.5% of the high and 0.2% of the moderate quality habitat in the RAA, with an overall reduction of 0.70% of the habitat units within the RAA (Figure 14.2-2).



Projection: NAD 1983 UTM Zone 14N
Creator: CASLYS CONSULTING LTD.
Date: 06/18/2014 Scale: 1:500,000
File: 14.2-1_Habitat_Suitability_Wolf_Denning_PD_All-Season.mxd
Data Sources: *Natural Resources Canada, GeoBase®, National Topographic Database, AREVA Resources Canada Inc., and Gebauer & Associates.*

FIGURE 14.2-1
POST-DEVELOPMENT WOLF DENNING HABITAT SUITABILITY - MINE AND ALL-SEASON ROAD

ENVIRONMENTAL IMPACT STATEMENT
VOLUME 6

Kiggavik Project
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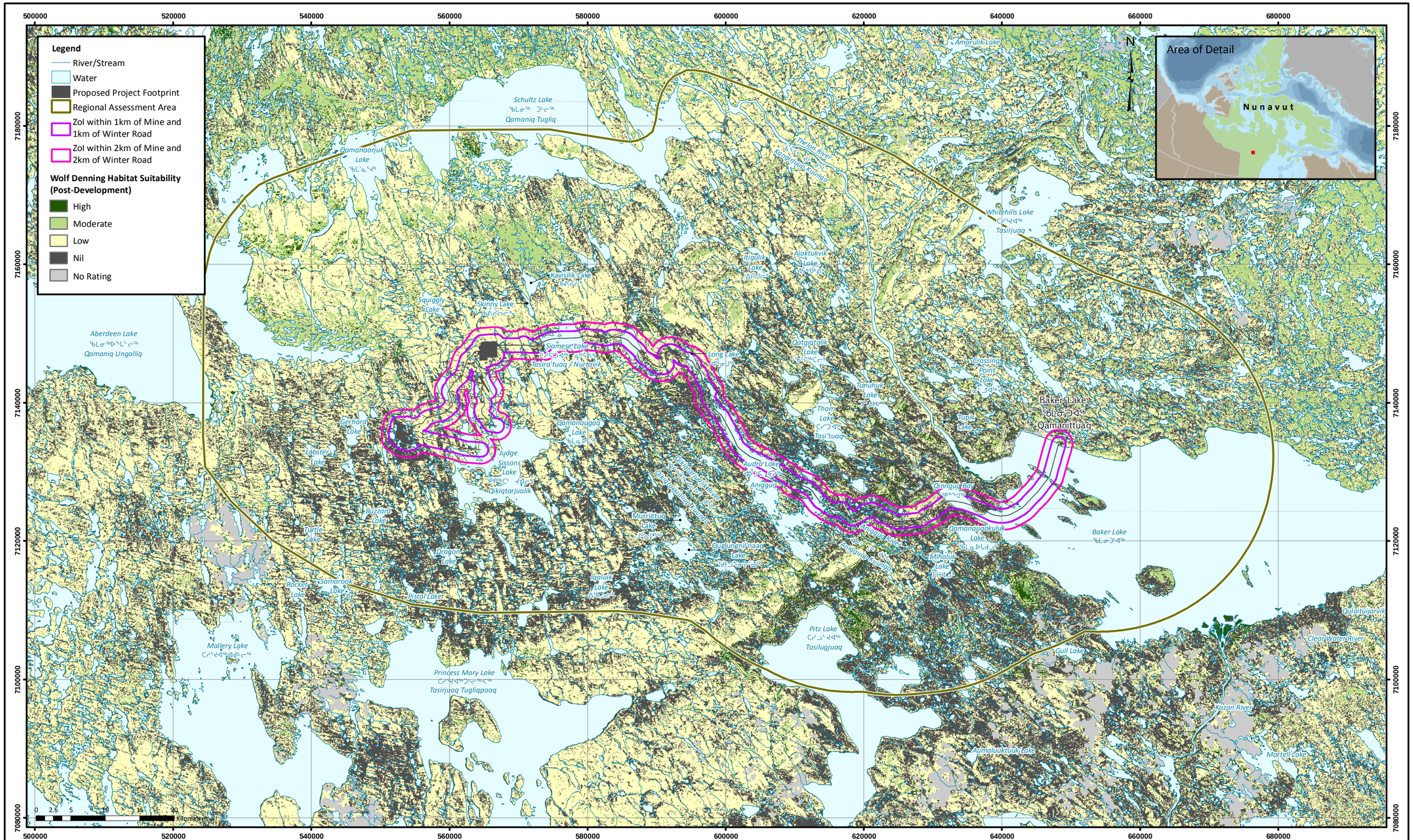

Projection: NAD 1983 UTM Zone 14N
Creator: CASLYS CONSULTING LTD.
Date: 06/18/2014 Scale: 1:500,000
File: 14.2-2_Habitat_Suitability_Wolf_Denning_PD_WinterRd.mxd
Data Sources: *Natural Resources Canada, GeoBase®, National Topographic Database, AREVA Resources Canada Inc., and Gebauer & Associates.*

FIGURE 14.2-2
POST-DEVELOPMENT WOLF DENNING HABITAT SUITABILITY - MINE AND WINTER ROAD

ENVIRONMENTAL IMPACT STATEMENT
VOLUME 6

Kiggavik Project

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Table 14.2-3 Wolf denning habitat baseline and predicted effects for the Mine and Winter Road

Habitat rating		Baseline ELC	Direct loss[2]	Indirect effect[3]	RAA effect
Class	**SI[1]**	**ha**	**ha**	**ha**	**%**
High	3	18,548	-12	-1,370	-7.5
Moderate	2	56,129	-35	-75	-0.2
Low	1	385,226	-970	1,445	0.1
Nil	0	520,351	-566	0	0.2
No Rating		2,474	0	0	0.0
Total area		982,728	1,583	2,889	
Habitat units[4]		553,128	-1,077	-2,815	**-0.70**

Notes:

[1] SI = Suitability Index (used for weighted average calculation of Habitat Units)

[2] Direct loss is the change in habitat availability due to the footprint of the project.

[3] Indirect effect is the change in habitat availability due to the zone of influence (ZOI) of the project.

[4] Habitat units are the weighted sum of all available habitat (sum [ha * SI]).

14.2.1.6 Determination of Significance for Change in Wolf Habitat Availability

The effect of the Project on wolf denning habitat within the RAA is assessed as not significant. Predicted loss of available habitat for wolf denning due to the two Project options is less than 1% of the habitat units in the RAA. The magnitude of adverse effects of the Project on wolf denning habitat availability is rated as low during all Project phases and for both road options. The Project is expected to result in a detectable loss of habitat in the vicinity of the Project, but the reduced effectiveness will be not significant to wolves in the RAA. The loss of habitat is at least partially reversible once operations cease and the disturbed area is reclaimed.

Due to the technical limitations outlined previously, there is some uncertainty in the conclusion about significance, and AREVA is moderately confident in the conclusion. There were few wolf dens located within the RAA during the baseline surveys. The located dens were insufficient to provide empirical data upon which to classify denning habitat or determine wolf response to likely disturbances. Further, the ELC units used to describe high, medium and low quality habitat may not be entirely representative of habitats selected for denning, and den sites may be selected in areas that are not mappable at the scale of the ELC work. Additionaly, the response of wolves to disturbance is not clear in the literature, and there was little suggestion of wolf behavioural

responses, or concerns expressed about wolves, in the IQ interviews and knowledge made available to the assessment.

14.2.1.7 Summary of Project Residual Environmental Effects for Change in Wolf Habitat Availability

Table 14.2-4 summarizes residual environmental effects from the Project on wolf habitat. The magnitude of the Project effects is predicted to be moderate during construction, operation, and final closure phases. While the size of the Project footprint is small at the scale of the affected wolves' likely ranges, mine associated activities may reduce the suitabilty of habitat up to 2 km from the Project footprint resulting in a moderate loss of habitat. After final closure, much of the Project footprint may become useable as denning habitat. Consequently the magnitude of the predicted effect remains low beyond the life of the Project. As noted above, there were too few dens located in the Project area upon which to collect empirical evidence about den site selection, and ultimately the ELC data used to classify denning habitat quality may not sufficiently encompass all factors used by wolves to select denning habitat. Consequently, the confidence in the predicted effect of the Kiggavik Project on wolves is moderate.

The All-Season Road, if implemented, will have the largest footprint and disturbance of the two road options. This will result in a greater reduction in denning habitat compared to the winter road option because of the larger spatial and temporal (eight months) extent of disturbance. The winter road will be active only three months each winter, and activities on the winter road are unlikely to temporally interact with denning wolves because wolves tend den sites May to August (Frame et al. 2008).

14.2.1.8 Compliance and Environmental Monitoring for Change in Wolf Habitat Availability

AREVA will monitor the Project footprint on an annual basis to assess the footprint area for changes in habitat availability. AREVA will also monitor road traffic (e.g. speed) and adherence to no stopping zones, should dens be located near Project roads.

Table 14.2-4 Summary of Residual Environmental Effects for Change in Habitat Availability for Wolves

Project Phase	Mitigation/ Compensation Measures	Direction	Residual Environmental Effects Characteristics						Significance	Likelihood	Prediction Confidence	Recommended Follow-up and Monitoring
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Environmental Context				
Change in Wolf Habitat — Mine with All-Season Road Option												
Construction	Minimize Project footprint; Progressive reclamation	N	M	R	MT	C	R	U	N	N/A	M	None required
Operation		N	M	R	MT	C	R	U	N	N/A	M	None required
Final Closure		N	M	R	MT	C	R	U	N	N/A	M	None required
Change in Wolf Habitat — Mine with Winter Road Option												
Construction	Minimize Project footprint; Progressive reclamation	N	M	R	MT	C	R	U	N	N/A	M	None required
Operation		N	M	R	MT	C	R	U	N	N/A	M	None required
Final Closure		N	M	R	MT	C	R	U	N	N/A	M	None required

KEY

Direction:

P Positive

N Negative

Magnitude:

N Negligible: No anticipated effect on wolf denning habitat or species

L Low: Observable effect on wolf denning habitat or species but not likely to affect wolf sustainability in the LAA

M Moderate: Observable effect on wolf denning habitat or species but not likely to affect wolf sustainability in the RAA

H High: Measurable effect on wolf denning habitat or species that will likely affect wolf sustainability in the RAA

Geographic Extent:

S Site-specific

L Local: Effect confined to the LAA

R Regional - Effect extends beyond the LAA but within the RAA

T Territorial: Effect extends beyond the RAA but within Nunavut

N National: Effect extends beyond Nunavut but within Canada

Duration:

ST Short term: Less than one year

MT Medium term: More than one year, but not beyond the end of Project decommissioning

LT Long term: Beyond the life of the Project

Frequency:

O Once: Effect occurs once

S Sporadically: Effect occurs occasionally but not consistently throughout the life of the Project

R Regularly: Effect occurs at regular intervals throughout the life of the Project

C Continuous: Effect occurs continuously throughout the Project

Reversibility:

R Reversible: Will likely recover to baseline conditions after or before the end of Project decommissioning

I Irreversible: Unlikely to recover to baseline conditions after the end of Project decommissioning

Environmental Context:

U Undisturbed: Area relatively or not adversely affected by human activity

D Developed: Area has been substantially previously disturbed by human development or human development is still present

N/A Not Applicable

Significance:

S Significant

N Not significant

Prediction Confidence:

Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation

L Low level of confidence

M Moderate level of confidence

H High level of confidence

Likelihood of Significant Effects:

Based on professional judgment

L Low probability of occurrence

M Medium probability of occurrence

H High probability of occurrence

14.2.2 Assessment of Change in Wolf Health

As a result of emissions from the Project to the atmosphere and water there is the potential for wolves to be exposed to COPC. The potential for these emissions to cause effects in the wolf population was evaluated.

14.2.2.1 Analytical Methods for Change in Wolf Health

Emissions from the Project can affect the concentrations of COPC in the environment (e.g., water, soil, vegetation) which are consumed by animals, and in turn will affect the exposure of wolves as they consume these animals. The COPC included in the assessment include uranium and the uranium-238 decay series (thorium-230, lead-210, radium-226, and polonium-210), arsenic, cadmium, cobalt, copper, lead, molybdenum, nickel, selenium, and zinc.

Wolves are carnivorous predators that primarily feed on ungulates (e.g., caribou and muskox), but will opportunistically feed on other prey or scavenge. To estimate the exposure by wolves it is necessary to estimate the concentration in all environmental components that will be consumed. Detailed air quality modelling (discussed in Tier 2, Volume 4) and water quality modelling (discussed in Tier 2, Volume 5) are used as inputs to the environmental pathways assessment (Tier 3, Appendix 8A). The concentrations in ungulates were predicted by using transfer factors that relate the concentration in different components (e.g., soil-to-plant). The transfer factors are based on site-specific information (where possible), augmented by published data. The intake of COPC through the diet of caribou and muskox is then multiplied by a separate transfer factor to obtain a concentration within the animal. This concentration is used for the prey consumed by wolves.

The intake of COPC can then be estimated using the predicted concentrations and assumptions about how much a wolf consumes. The amount of time that the wolf spends in the area is also an important factor. It is assumed some wolves may spend 50% of their time in the LAA while other wolves may spend 100% of their time in the RAA. These estimates are based on the home range of wolves in literature. The estimated intakes are compared to benchmarks that are protective of mammals. For estimating radionuclide dose the concentration within the animal of each radionuclide is estimated from the calculated intake through the use of a transfer factor. Dose coefficients are used to estimate the dose from each radionuclide based on the concentration. Radiation effects on biota depend not only on the absorbed dose, but also on the relative biological effectiveness (RBE) of the particular radiation (i.e., alpha, beta or gamma radiation). Recent recommendations have focused on an RBE of 10 for alpha radiation; this value was used in the assessment for consistency with the recommendations in the N288.6 standard (CSA 2012). The total dose, which is based on the baseline plus Project emissions for the sum of the uranium-series radionuclides, is compared to a benchmark that is protective of mammals (2.7 mGy/d).

The bounding scenario carried through the ecological assessment was based on separate discharges from the Kiggavik water treatment plant (WTP) and Sissons WTP, an extended operating period (25 years) followed by a 22-year period of consolidation where water treatment would be required. The assessment accounted for the uncertainty and variability in the emissions and the behaviour in the environment. The details are provided in the Ecological Risk and Human Health Risk Assessment (Tier 3, Appendix 8A).

14.2.2.2 Baseline Conditions for Change in Wolf Health

Under baseline conditions wolves are exposed to COPC as these constituents are present naturally in the environment. Concentrations of COPC in caribou tissue and muskox were measured, and this baseline information was used in the pathways assessment.

14.2.2.3 Effect Mechanism and Linkages for Change in Wolf Health

Changes in the health of wolves can occur if they are exposed to COPC at levels that are associated with an effect. As it is important that the populations are maintained, the potential for COPC to affect the growth and reproduction of these wildlife is examined. The assessment of changes in health of wolves depends on the estimated changes in concentrations of environmental components such as water, vegetation and soil which are derived from the atmospheric and aquatic environment assessments, and subsequent changes in the prey species.

The Project-environment interactions and effects described in the Atmospheric Environment (Tier 2, Volume 4) and Aquatic Environment (Tier 2, Volume 5) form the basis for the effects mechanisms and linkages. The Project air quality effects relate to emissions of air COPC from open pit and underground mining and supporting activities, milling and vehicle traffic on unpaved roads. The Project water quality effects relate to emissions of COPC from WTPs at the Kiggavik and Sissons mine sites. Complete details about the COPC sources and all assumptions used in the assessments were provided in the atmospheric and aquatic environment assessments.

14.2.2.4 Mitigation Measures and Project Design for Change in Wolf Health

Design aspects, operational measures and other mitigation measures have been incorporated into the current Project plans which will minimize Project-associated emissions and/or the potential effect of Project-related emissions.

The Atmospheric Environment report (Tier 2, Volume 4) provides a detailed list of the mitigation measures applied to reduce the changes to ambient air quality. Mitigation measures that have been incorporated to reduce emissions of dust containing COPC include:

- minimizing or reducing vehicle speed on unpaved mine site roads (including pit ramps) and the Kiggavik-Sissons access road and enforce speed limits, where possible
- applying water or another approved dust suppressant to the surfaces of unpaved mine site roads (including pit ramps) and the Kiggavik-Sissons haul road, when possible
- maintaining all unpaved road surfaces via grading or other maintenance practices to minimize the amount of silt (i.e., fine particles) present in the roadbed material
- installing appropriate air pollution controls on the exhaust stacks of the mill complex and acid plant (e.g., wet scrubbers, dust collectors) and
- releasing tailings to the TMFs as a slurry below a water surface to avoid tailings dust emissions

The Kiggavik WTP and Sissons WTP have been designed so that the effluent will meet all appropriate regulations such as the Metal Mining Effluent Regulation (MMER) as well as site-specific discharge limits. Environmental considerations were paramount in the selection of the appropriate technology for the WTP. Further detail on the design of the WTP can be found in Tier 2, Volume 2

14.2.2.5 Residual Effects for Change in Wolf Health

In this study, adverse effects from exposure to COPC were characterized by a simple screening index. This index was calculated by dividing the predicted exposure by the toxicity reference value for each ecological receptor as follows:

$$Screening\ Index = \frac{Exposure}{Toxicity\ Reference\ Value}$$

For the wildlife species, the US EPA risk-based ecological soil screening levels (Eco-SSLs) (US EPA 2010) were used as the primary data source for the derivation of toxicity reference values used to determine the potential for an effect. For this assessment, the lowest observable adverse effect levels (LOAELs) based on growth and reproduction were selected, as these endpoints are considered to be the most relevant for the maintenance and persistence of wildlife populations. For COPC without Eco-SSL data (in this case uranium), literature studies were reviewed and values from long-term (chronic) exposure studies were selected. The Eco-SSL database provides information for a number of different species that could be used as a surrogate for other species with similar diets. For example, for arsenic the value for a dog is used as the surrogate for the wolf. If none of the test species were similar to the ecological receptors selected in this assessment, then the lowest value was selected as the conservative default benchmark for the ecological receptor. The Ecological and

Human Health Risk Assessment report (i.e., Tier 3, Appendix 8A) provides the final selected values along with additional detail on the derivation and rationale for the value.

Screening index values are not estimates of the probability of ecological effect. Rather, the index values are correlated with the potential of an effect (i.e., higher index values imply a greater potential of an effect). The estimated exposure of caribou and muskox includes both the natural baseline levels as well as the effect of the Project emissions. Therefore, a screening index value less than 1.0 indicates that the estimated total exposure is less than the threshold that is associated with a potential adverse effect. The screening index values are shown in Table 14.2-5 for wolf.

Table 14.2-5 Screening Index Values for Wolf

COPC	Screening Index (SI)		
	Baseline	Wolf Present in the LAA	Wolf Present in the RAA
Arsenic	0.003	0.003	0.003
Cadmium	0.003	0.003	0.003
Cobalt	<0.001	<0.001	<0.001
Copper	0.068	0.068	0.068
Lead	<0.001	<0.001	<0.001
Molybdenum	0.003	0.003	0.003
Nickel	<0.001	<0.001	<0.001
Selenium	0.061	0.061	0.061
Uranium	<0.001	<0.001	<0.001
Zinc	0.522	0.522	0.522
Radioactivity	<0.01	<0.01	<0.01

NOTES:

SI values for non-radiological COPC are based on the maximum mean exposure compared to a LOAEL

SI values of radiological effects include the contribution from U-238, Th-230, Ra-226, Pb-210 and Po-210, using an RBE of 10 and compared to a benchmark of 2.7 mGy/d

Details of calculation as well as additional results are provided in Tier 3, Appendix 8A

It is expected that the emissions from the Project will not result in a discernible change in exposure to COPC for wolves in the LAA and RAA. The results show that it is expected that the exposure to wolves will not exceed exposure levels associated with adverse effects.

14.2.2.6 Determination of Significance for Change in Wolf Health

As the level of exposure for wolves to the COPC are not expected to change from baseline and the exposure will remain below exposure levels associated with adverse effects, no residual effects are expected on the health of wolves as a result of exposure to COPC.

14.2.2.7 Compliance and Environmental Monitoring for Change in Wolf Health

No specific monitoring requirements are recommended based on the assessment for change in health of wolves. The monitoring of other environmental components (e.g., air quality, water quality) will provide valuable information for confirming the results of the assessment.

14.3 Cumulative Effects Analysis for Wolves

14.3.1 Screening for Cumulative Environmental Effects

Residual effects on wolf habitat are related to loss of denning habitat. The Project will not result in a measurable or reasonably expected residual environmental effect on the availability of wolf denning habitat in the region. Wolves are expected to continue denning in the RAA. Consequently, no cumulative environmental effects on wolf denning habitat availability are expected.

14.4 Transboundary Effects Assessment for Wolves

There are no transboundary Project effects on wolves. Project effects on wolf habitat and on wolves will not extend beyond the boundaries of the Project's Zone of Influence.

14.5 Summary of Residual Effects on Wolves

14.5.1 Project Effects

The residual Project effects on wolf habitat are assessed as not significant. Few wolf dens were found within the RAA during baseline surveys. Disturbance to denning habitat will be limited to the Project footprint and a 2 km Zone of Influence from mine site infrastructure. There are no known limiting factors to regional availability of wolf denning habitat. The confidence in this conclusion is moderate because of the few den observations in the baseline studies, and difficulty of detecting a change in wolf denning behaviour within the RAA.

14.5.2 Effects of Climate Change on Project and Cumulative Effects on Wolves and Habitat

Climate change will likely affect wolves indirectly through effects on prey populations as opposed to directly affecting habitat. Effects could include changes in prey abundance and changes in prey type (e.g., new species) which could alter the ecology and behaviour of wolves in the RAA and region. Wolves are highly adaptable and resilient animals, which will likely limit potential effects of climate change.

14.6 Summary of Mitigation Measures for Wolves

The preferred Winter Road option is a Project design feature that will reduce the Project potential effects on wolf denning habitat. Minimizing the Project footprint will reduce the overall loss of available denning habitat. Other AREVA environmental policies and mitigation measures that will reduce potential Project effects on wolves denning, should they be found within the Project footprint or the zone of influence, include:

- a policy on wildlife harassment, including no disturbance at den sites
- minimizing the Project footprint
- minimizing Project activities outside of the footprint
- progressively reclaiming disturbed areas
- restricting blasting activities (for road construction) early in the denning period if blasting is within 3 km of a known den site
- restricting land-based activities within a 3 km radius of active den sites
- developing a den site-specific construction mitigation plan which will include territory activity monitoring when construction is occurring within 3 km of a known den site. This can allow operations to be modified should the wolves show adverse reaction to nearby disturbances.
- minimizing the risk of abandonment by prohibiting on-ground visits to active den sites by Kiggavik employees
- minimizing the risk of abandonment by avoiding overflights of known den sites during the early denning period, when possible

14.7 Summary of Compliance and Environmental Monitoring for Wolves

To ensure compliance with mitigation, AREVA will monitor active wolf dens within 3 km of Project infrastructure to determine if wolves continue to use den sites in the Project area. AREVA will monitor the Project footprint on an annual basis to assess the footprint area for changes in habitat availability.

15 Effects Assessment for Raptors

15.1 Scope of the Assessment for Raptors

The raptor effects assessment focuses on peregrine falcon as an indicator species. Peregrine falcons are the most regularly occurring cliff-nesting raptor in the study area, but rough-legged hawk and gyrfalcon can also occur in the study area. The effects assessment and mitigation measures applied to reduce effects on peregrine falcon are also applicable to the other species.

15.1.1 Project-Raptor Interactions and Effects

Construction, operation and closure activities have the potential to affect the habitat, nest productivity and health of raptors within the Kiggavik RAA. Key effects on peregrine falcon can include:

- reduced habitat availability from the Project footprint resulting in a direct loss of foraging habitat, and sensory disturbances that result in an indirect loss of functional habitat
- indirect effects of reduced nest site productivity from sensory disturbances related to construction and mine operations and road traffic at nests close to those activities
- change in health due to radionuclide and metal content transfer through the food chain

Project components and activities related to potential effects on raptors include site clearing (habitat loss), mine operation (reduced habitat effectiveness), road construction (habitat loss) and operation (reduced habitat effectiveness), milling (noise affecting habitat effectiveness and dust affecting forage and ultimately raptor health; Table 15.1-1). When activities occur near nest sites (within auditory or visual range), disturbance of incubating or brooding adults may result in reduced nest productivity. The mining and milling process have the potential to introduce COPC (metals and radionuclides) that can be transferred through the food chain, potentially affecting health of the top predators.

Table 15.1-1 Project-Environment Interactions and Effects on Raptors

Project Component	Project Activities	Environmental Effects		
		Change in Habitat	Change in Productivity	Change in Health
Construction				
On-Land Construction	Site clearing and pad construction (blasting, earth moving, loading, hauling, dumping, crushing)	2		
Supporting Activities	Transport fuel and construction materials		2	
Operation				
Mining	Mining ore (blasting, loading, hauling)		2	2
Milling	Crushing and grinding			2
Ongoing exploration	Aerial surveys		2	

NOTES:

Only Project interactions ranked as 2 in Table 5.7-1 are carried forward to this table. A "2" indicates that an activity is likely to contribute to the effect.

15.1.2 Residual Environmental Effects Criteria for Raptors

Residual effects on raptors and raptor habitat were characterized quantitatively and qualitatively using the following six attributes: direction, magnitude, geographic extent, duration, frequency, and reversibility (Table 15.1-2).

Table 15.1-2 Residual Environmental Effects Criteria for Raptors

Attribute	Description	Rating	Definition
Direction	The ultimate long-term trend of the environmental effect	Positive	Increased habitat availability (cliffs), increased productivity or improvements to health relative to baseline conditions
		Neutral	No change in habitat availability, productivity or health
		Adverse	Reduced habitat quality, productivity and health
Magnitude	Amount of change in a measurable parameter relative to baseline conditions	Negligible	No anticipated effect on wildlife species
		Low	Observable effect on wildlife species but not likely to affect the species' sustainability in the LAA
		Moderate	Observable effect on wildlife species but not likely to affect the species' sustainability in the RAA
		High	Population-level detectable change to habitat availability, productivity and health of the peregrine falcon *tundrius* population
Geographic Extent	The geographic area within which an environmental effect occurs	Local	Effect confined within the LAA
		Regional	Effect extends beyond the LAA but within the RAA
		Territorial	Effect extends beyond the RAA but within Nunavut
		National	Effect extends beyond Nunavut but within Canada
Frequency	Number of times that an effect may occur over the life of the Project	Once	Effect occurs once
		Sporadically	Effect occurs occasionally but not consistently throughout the life of the Project
		Regularly	Effect occurs at regular intervals throughout the life of the Project
		Continuous	Effect occurs continuously throughout the Project
Duration	Length of time over which the effect is measurable	Short term	Less than one year
		Medium term	More than one year, but not beyond the end of Project decommissioning
		Long term	Beyond the life of the Project
Reversibility	Likelihood that a measurable parameter for a VEC will recover from an environmental effect to baseline conditions	Reversible	Will likely recover to baseline conditions after or before the end of Project decommissioning
		Irreversible	Unlikely to recover to baseline conditions after the end of Project decommissioning

15.1.3 Standards or Thresholds for Determining Significance

There are no known published standards or thresholds for determining effect significance on raptor habitat, nest productivity or measures of health. In the absence of legislated or otherwise identified thresholds, the significance of effects are determined based on experience from other northern mining projects that interact with cliff nesting raptors and knowledge of peregrine falcon ecology and behavior in eastern arctic Canada. Determination of whether the Project's residual effect on raptors is significant is based on whether the effect influences the long-term viability of the regional population or delays its recovery. A residual effect is considered not significant if the effect causes a change in the condition of an individual or population (or their habitat) that is within the range of natural variability or does not affect the integrity of a population in a measurable way.

Habitat — There is no known existing standard or threshold for determining the significance of raptor habitat loss. Based on experience from other northern projects and knowledge of raptor ecology, Project effects on habitat availability are considered significant if more than 10% of the habitat units within the RAA are directly affected by the Project.

Productivity — Based on a review by Millsap et al. (1998), the Alberta Peregrine Falcon Recovery Team (2005) considers 1.25 chicks/territorial pair/year to reflect a productive population. A significant effect on productivity is when average productivity for the nests located within the RAA drops below 1.25 chicks/territorial pair/year as a result of Project activities.

Health — There are no generic guidelines for Nunavut or Canada that are applicable to assess the effect of changes in raptors based on their exposure to COPC. For this assessment, the estimated exposure to COPC by birds is compared to values that are set to be protective of health and if the exposure is lower than this value then no effects are expected. The estimated dose received by the biota from exposure to radioactivity, considering both baseline and Project emissions, is compared to a level that is protective of birds.

15.1.4 Technical Limitation of the Assessment for Raptors

Long-term Project effects on predatory species due to changes in occupancy and productivity are difficult to predict with certainty. Population cycles, prey switching and other predator-prey dynamics are unpredictable over the long-term, particularly when climate change or other unknown factors also affect the KI. Also, there is no indication that nesting is a limiting factor to peregrine falcon persistence in the region in general.

Project effects on species that occur at low densities in the region are likely limited because of the relative infrequent encounter of the species with the Project. Quantifying effects on low density species, and then monitoring potential effects is difficult because of limited data availability, variability in occurrence, and low sample size upon which to validate results. Although the methods to

determine occupancy and productivity are established, the probable high annual variability in productivity weakens and likely response to a number of environmental variables beyond the effects of the project weaken confidence in predictions.

15.2 Effects Assessment For Raptors

15.2.1 Assessment of Change in Raptor Habitat Availability

Habitat availability for raptors can be affected by human developments through two pathways:

1. Direct habitat loss caused by development of the Project footprint will reduce habitat availability.
2. Indirect habitat loss from human disturbance associated with the Project that causes a functional loss of habitat.

The Kiggavik Project will result in some loss of raptor habitat from the footprint, and likely reduced effectiveness of other habitat due to disturbances. The Project footprint will reduce the quality of some foraging and nesting habitat for raptors. Habitat effects from the Project could act cumulatively with similar effects from other human activity in the area.

15.2.1.1 Analytical Methods for Change in Raptor Habitat Availability

To assess the overall loss of peregrine falcon habitat availability within the RAA, a habitat unit index was developed. The index is based on assigning a ranked value to each habitat class (high=3, moderate=2, low=1, nil=0), and summing the available habitat, measured in hectares, weighted by the value of each class. The difference in the weighted sum of available habitat from the baseline conditions, and the predicted direct and indirect loss of habitat indicate the expected effect on peregrine falcon habitat.

Direct loss of habitat was determined by overlaying the Project footprint onto the ELC map and calculating the total area affected for each ELC map unit. Indirect loss of habitat was assessed by reducing habitat quality (ELC unit quality) for the growing season within the mine site and access road options. Habitat quality within the mine site and All-Season Road ZOIs were reduced by two categories to a minimum of low within 2 km of the mine footprint, and by one category to a minimum of low at 2–3 km of the mine footprint. The winter road does not result in direct or indirect habitat loss because the road will be decommissioned each year prior to breeding birds arriving in the RAA. Consequently, there will be no human disturbance along the winter road during the growing season. The peregrine falcon ZOI distances were based on published literature of recommended buffer zones for falcon nesting sites. The Ontario Ministry of Natural Resources suggests a setback 600–1000 m for ground activities and restriction of 400–760 m agl for aircraft (OMNR 1987). A setback of

1.6 km is recommended for construction related activities taking place over extended periods (Holthuijzen et al. 1990; Richardson and Miller 1997).

15.2.1.2 Baseline Conditions for Change in Raptor Habitat Availability

Suitable nesting habitat for peregrine falcon includes steep rocky areas and cliffs. Foraging habitat is determined by the density of available prey, which is primarily birds. The most common prey items are passerines (i.e., snow bunting, lapland longspurs, horned lark, and American pipit), but shorebirds, lemmings, and arctic ground squirrels are also taken. A description of the ELC units and their value to peregrine falcons as nesting and foraging habitat is presented in Table 15.2-1.

Peregrine falcons were the most common raptor species encountered during baseline field programs. Nesting birds were associated with steep terrain including cliffs and rock outcrops. Although the entire RAA was not surveyed, observers noted that most suitable peregrine falcon habitats near the mine and All-Season Road were occupied by nesting birds, suggesting that the Kiggavik RAA saturated with nesting falcons.

Table 15.2-1 Description and Relative Value of ELC Units for Peregrine Falcons during the Growing Season within the RAA

ELC Unit	Growing Season Ranking	Reasoning
Water	Moderate	Water provides foraging habitat for raptors during the growing season because of the abundance of waterbirds (i.e., prey) that occur on or around waterbodies
Sand	Moderate	This ELC unit is poorly represented within the Kiggavik RAA, but many potential prey species (e.g., shorebirds) use this habitat type
Gravel	Moderate	This ELC unit is poorly represented within the Kiggavik RAA, but many potential prey species (e.g., shorebirds) use this habitat type
Rock Association	Moderate	Prey such as lemmings and arctic hares use this habitat type during the growing season. Rocks also provide camouflage and perching locations for raptors, and occasionally nest sites
Wet Graminoid	Moderate	Habitat contains prey (i.e., waterbirds, upland birds) for raptors during the growing season
Graminoid Tundra	Moderate	Habitat used by prey (i.e., waterbirds, upland birds) during the growing season.; however, the habitat provides little cover and few perches for raptors
Graminoid/ Shrub Tundra	Moderate	Rated moderate quality habitat for waterbirds and upland birds, so the habitat contains prey for raptors during the growing season
Shrub Tundra	High	Rate high quality habitat for upland birds, so the habitat contains abundant prey for raptors during the growing season
Shrub/Heath Tundra	Moderate	Rated moderate quality habitat for upland birds, so the habitat contains moderate prey for raptors during the growing season

Table 15.2-1 Description and Relative Value of ELC Units for Peregrine Falcons during the Growing Season within the RAA

ELC Unit	Growing Season Ranking	Reasoning
Heath Tundra	High	Rated high quality habitat for upland birds, so the habitat contains abundant prey for raptors during the growing season
Heath Upland	High	Rated high quality habitat for upland birds, so the habitat contains abundant prey for raptors during the growing season
Lichen Tundra	Moderate	Rated moderate quality habitat for upland birds, so the habitat contains prey for raptors during the growing season
Heath Upland/Rock Complex	Moderate	Rated moderate quality habitat for upland birds, so the habitat contains prey for raptors during the growing season

15.2.1.3 Effect Mechanism and Linkages for Change in Raptor Habitat Availability

The Project will result in a direct loss of raptor foraging habitat because of the Project footprint. The Project footprint is expected to provide no usable foraging habitat once the Project is constructed. The Project could also result in an indirect loss of raptor forage habitat because of human disturbance (i.e., noise, movement) near the Project footprint. Although never specifically studied, dust dispersion from road traffic may affect raptor activities at nests adjacent to the All-Season Road. To determine the zones of influence of Project-related activities on raptor habitat, habitat protection guidelines were reviewed. Disturbance setback distance ranged from 0.6–1.6 km (OMNR 1987, Holthuijzen et al., 1990; Richardson and Miller, 1997). As a conservative approach, the assessment of Project effects used a 3 km ZOI, where within the first 2 km of Project activities, habitat suitability was reduced by two classes to a minimum of low, and by one class to a minimum of low from 2–3 km from Project activities.

15.2.1.4 Mitigation Measures and Project Design for Change in Raptor Habitat Availability

AREVA will mitigate potential adverse effects on raptor habitat by taking the following actions:

- minimizing the Project footprint
- minimizing Project activities outside of the footprint
- progressively reclaiming disturbed areas
- providing dust suppression in the mine site area during dry periods to reduce indirect habitat effects

- eliminating dust dispersal from the tailings management facility through subaqueous deposition of tailings
- in the case of the winter road option, reducing the Project footprint will mitigate habitat loss and reduce the likelihood of the Project acting cumulatively with other Projects in the Kivalliq region

15.2.1.5 Residual Effects for Change in Raptor Habitat Availability

Mine and All-Season Road

After mitigation, the mine site and All-Season Road will result in a direct loss of 1,780 ha of previously usable peregrine falcon habitat. The Project is anticipated to reduce the availability of high and moderate quality habitat by 14.5% and 5.9%, respectively, within the RAA (Table 15.2-2). This equates to an overall reduction of 5.9% of the habitat units within the RAA (Figure 15.2-1).

Table 15.2-2 Peregrine Falcon Habitat Baseline and Predicted Effects for the Mine Site and All-Season Road

Habitat rating		Baseline ELC	Direct loss[2]	Indirect effect[3]	RAA effect
Class	**SI[1]**	**ha**	**ha**	**ha**	**%**
High	3	322,216	-1,006	-45,821	-14.5
Moderate	2	657,929	-773	-37,757	-5.9
Low	1	0	0	83,578	0.0
Nil	0	0	0	0	0.0
No Rating		2,583	0	0	0.0
Total area		982,728	1,780	167,156	
Habitat units[4]		2,282,506	-4,566	-129,399	**-5.9**

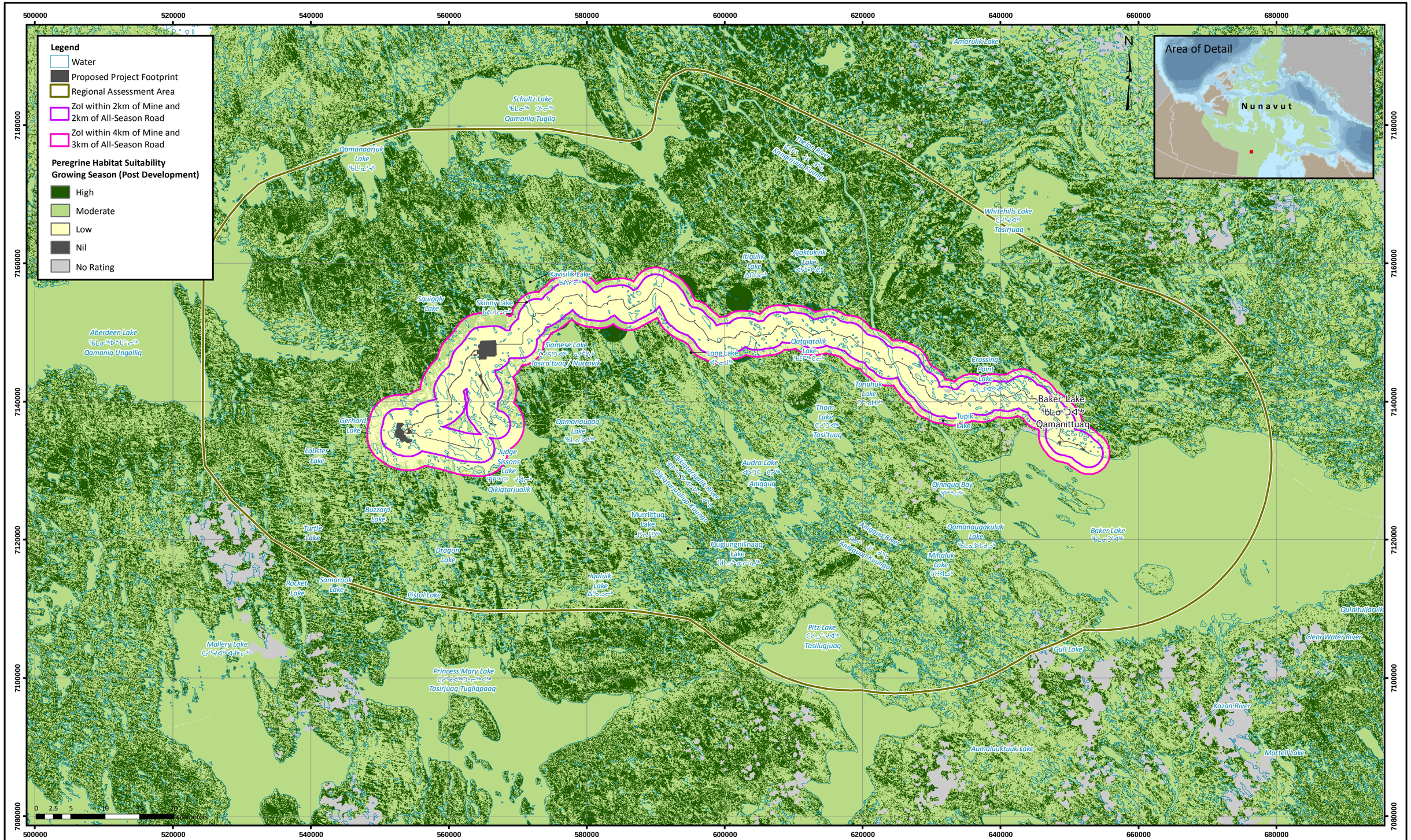
Notes:

[1] SI = Suitability Index (used for weighted average calculation of Habitat Units)

[2] Direct loss is the change in habitat availability due to the footprint of the project.

[3] Indirect effect is the change in habitat availability due to the zone of influence (ZOI) of the project.

[4] Habitat units are the weighted sum of all available habitat (sum [ha * SI]).



Projection: NAD 1983 UTM Zone 14N
Creator: CASLYS CONSULTING LTD.
Date: 07/07/2014 Scale: 1:500,000
File: 15.2-1_Habitat_Suitability_Growing_PD_Peregrine.mxd
Data Sources: *Natural Resources Canada, GeoBase®, National Topographic Database, AREVA Resources Canada Inc., and Gebauer & Associates.*

FIGURE 15.2-1
POST-DEVELOPMENT PEREGRINE HABITAT SUITABILITY - GROWING SEASON
MINE AND ALL-SEASON ROAD

ENVIRONMENTAL IMPACT STATEMENT
VOLUME 6

Kiggavik Project
AREVA

AREVA Resources Canada Inc - P.O. Box 9204 - 817 - 45th Street West - Saskatoon, SK - S7K 3X5

Mine and Winter Road

Residual effects are limited to the mine portion of the Project. The winter road option does not temporally overlap with peregrine falcon presence within the region. All Project effects will be result of direct loss of habitat to the mine footprint and indirect loss of habitat within the mine ZOI because of disturbance associated with Project activities. After mitigation, the Project is anticipated to reduce the availability of high and moderate quality habitat by 4.9% and 2.1%, respectively, within the RAA (Table 15.2-3). This equates to an overall reduction of 2.1% of the habitat units within the RAA.

Table 15.2-3 Peregrine Falcon Habitat Baseline and Predicted Effects for the Mine Site and Winter Road Option

Habitat Rating		Baseline ELC	Direct loss[2]	Indirect effect[3]	RAA effect	
Class	**SI[1]**	**ha**	**ha**	**ha**	**ha**	**%**
High	3	322,218	-768	-15,007	-15,775	-4.9%
Moderate	2	657,936	-610	-13,394	-14,004	-2.1%
Low	1	0	0	28,401	28,401	NA
Nil	0	0	0	0	0	NA
No Rating		2,583	0	0	0	0.0%
Total Area		982,737	-1,378	-56,802		
Habitat Units[4]		2,282,526	-3,524	-43,408	-46,932	**-2.1%**

Notes:

Values in this table were not updated from the DEIS. The reduced Project footprint is 1,102; consequently, the predicted effect described here is a more conservative estimate of Project effects on raptor habitat availability.

[1] SI = Suitability Index (used for weighted average calculation of Habitat Units)

[2] Direct loss is the change in habitat availability due to the footprint of the project.

[3] Indirect effect is the change in habitat availability due to the zone of influence (ZOI) of the project.

[4] Habitat units are the weighted sum of all available habitat (sum [ha * SI]).

15.2.1.6 Determination of Significance for Change in Raptor Habitat Availability

The effect of the Project on raptor habitat within the RAA is assessed as not significant. The magnitude of the residual effects of the Project on raptor habitat availability is rated as low during all Project phases and for both road options. The Project is expected to result in a detectable loss of habitat within the RAA. The loss of habitat will be biologically not significant as all raptors will continue to have abundant suitable habitat available for foraging. The effect will occur regularly during each growing season throughout the life of the Project. Given the size of the expected ZOI, all effects are expected to be confined within the LAA. The loss of habitat is reversible as prey species will likely use reclaimed areas. The road option that will have the greatest effect on raptor habitat is the All-Season Road because of the larger Project footprint, and the activities on that road during the breeding season. The effect of the mine and All-Season Road is predicted to result in loss of 5.9% of available raptor habitat within the RAA.

15.2.1.7 Summary of Project Residual Environmental Effects for Change in Raptor Habitat Availability

Table 15.2-4 summarizes the residual effects of the Project on change in raptor habitat availability. The confidence in the prediction is rated as moderate because there is some uncertainty in the exact size of the ZOI, relative habitat quality ratings, and how disturbance will change raptor foraging behaviour.

15.2.1.8 Compliance and Environmental Monitoring for Change in Raptor Habitat Availability

The extent of the Project footprint will be monitored on an annual basis to assess habitat loss predictions.

Table 15.2-4 Summary of Project Residual Environmental Effects for Change in Habitat Availability for Raptors

Project Phase	Mitigation / Compensation Measures	Direction	Residual Environmental Effects Characteristics						Significance	Likelihood	Prediction Confidence	Recommended Follow-up and Monitoring
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Environmental Context				
Change in Raptor Habitat — All-Season Road												
Construction Operation	progressive reclamation; minimize Project footprint; dust suppression	N	L	L	MT	R	R	U	N	N/A	M	None required
Change in Raptor Habitat —Winter Road												
Construction Operation	progressive reclamation; minimize Project footprint; dust suppression; winter road; tailings management	N	L	L	MT	R	R	U	N	N/A	M	None required

KEY

Direction:

P Positive

N Negative

Magnitude:

N Negligible: No anticipated effect on wildlife species

L Low: Observable effect on wildlife species but not likely to affect the species' sustainability in the LAA

M Moderate: Observable effect on wildlife species but not likely to affect the species' sustainability in the RAA

H High: Population-level detectable change to habitat availability, productivity and health of the Peregrine Falcon *tundrius* population

Geographic Extent:

S Site-specific

L Local: Effect confined to the LAA

R Regional - Effect extends beyond the LAA but within the RAA

T Territorial: Effect extends beyond the RAA but within Nunavut

N National: Effect extends beyond Nunavut but within Canada

Duration:

ST Short term: Less than one year

MT Medium term: More than one year, but not beyond the end of Project decommissioning

LT Long term: Beyond the life of the Project

Frequency:

O Once: Effect occurs once

S Sporadically: Effect occurs occasionally but not consistently throughout the life of the Project

R Regularly: Effect occurs at regular intervals throughout the life of the Project

C Continuous: Effect occurs continuously throughout the Project

Reversibility:

R Reversible: Will likely recover to baseline conditions after or before the end of Project decommissioning

I Irreversible: Unlikely to recover to baseline conditions after the end of Project decommissioning

Environmental Context:

U Undisturbed: Area relatively or not adversely affected by human activity

D Developed: Area has been substantially previously disturbed by human development or human development is still present

N/A Not Applicable

Significance:

S Significant

N Not significant

Prediction Confidence:

Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation

L Low level of confidence

M Moderate level of confidence

H High level of confidence

Likelihood of Significant Effects:

Based on professional judgment

L Low probability of occurrence

M Medium probability of occurrence

H High probability of occurrence

Other Projects, Activities and Actions:

Human disturbance associated with Meadowbank Mine, various exploration operations, and various regional communities

15.2.2 Assessment of Project Residual Effects for Change in Raptor Nest Productivity

A measurable parameter for raptors is the occupancy and productivity of nest sites (territories) currently known to exist within the RAA (summarized in Tier 3, Appendix 6C — Wildlife Baseline). Project activities could reduce nest site (territory) occupancy and productivity through changes in adult activity budgets (reduced foraging time) and potentially result in nest abandonment.

15.2.2.1 Analytical Methods for Change in Raptor Nest Productivity

The assessment is limited to the mine and All-Season Road LAA because 1) the baseline was conducted in this area, and 2) it is anticipated that potential Project effects on raptor nests will be limited to the LAA. It is unknown what the baseline long-term productivity rate is for historic nesting locations within the LAA.

The effects assessment is based on occupancy and productivity averages among known peregrine falcon nest sites/territories. The assessment is territory-based for the following reasons: 1) the limited numbers of sites (nine) found to date; 2) peregrine falcons are philopatric and return to the same nesting territory for many years, and territories are often occupied over many generations; and 3) the relative ease of follow-up monitoring. The assessment is for the mine and All-Season Road option only because the winter road option does not interact with breeding peregrine falcons.

15.2.2.2 Baseline Conditions for Change in Raptor Nest Productivity

There are nine known nest sites that have been active in the RAA (not all were occupied in the same year; Table 15.2-5, Table 15.2-6; Tier 3, Appendix 6C). Surveys were focused on these nests, all of which were located within the All-Season Road LAA (Figure 15.2-2). To avoid disturbance of nesting falcons, nest area productivity (e.g., determining territory occupancy, eggs laid, eggs hatched, chicks fledged; Postupulsky 1974, Court et al. 1988) was not monitored consistently during baseline studies. Baseline productivity data can be enhanced during the pre-construction and construction phase-monitoring.

Nest productivity for peregrine falcons in Alberta is considered successful if occupied territories produce an average of 1.25 chicks/year (Millsap et al. 1998). However, long-term trends from peregrine falcon research in Rankin Inlet Nunavut show productivity rates of only 1.15 ± 0.62 chicks/per territory from 1982 to 2009 (Franke et al. 2010), and productivity in that population may actually be declining (A. Franke, pers. comm).

Table 15.2-5 Peregrine Falcon Nest Productivity in the RAA

Species and Measures	2009	2008	1980[(a)]	1979[(b)]
Total active nests	8	6	6	3
Average clutch size	3.5	3.2	5 (n=5)	3.6
% hatched / % fledged	ND/ND	ND/ND	ND/58	ND/ND
NOTES: [(a)] URG 1981 [(b)] Speller et al. 1979; ND = No data				

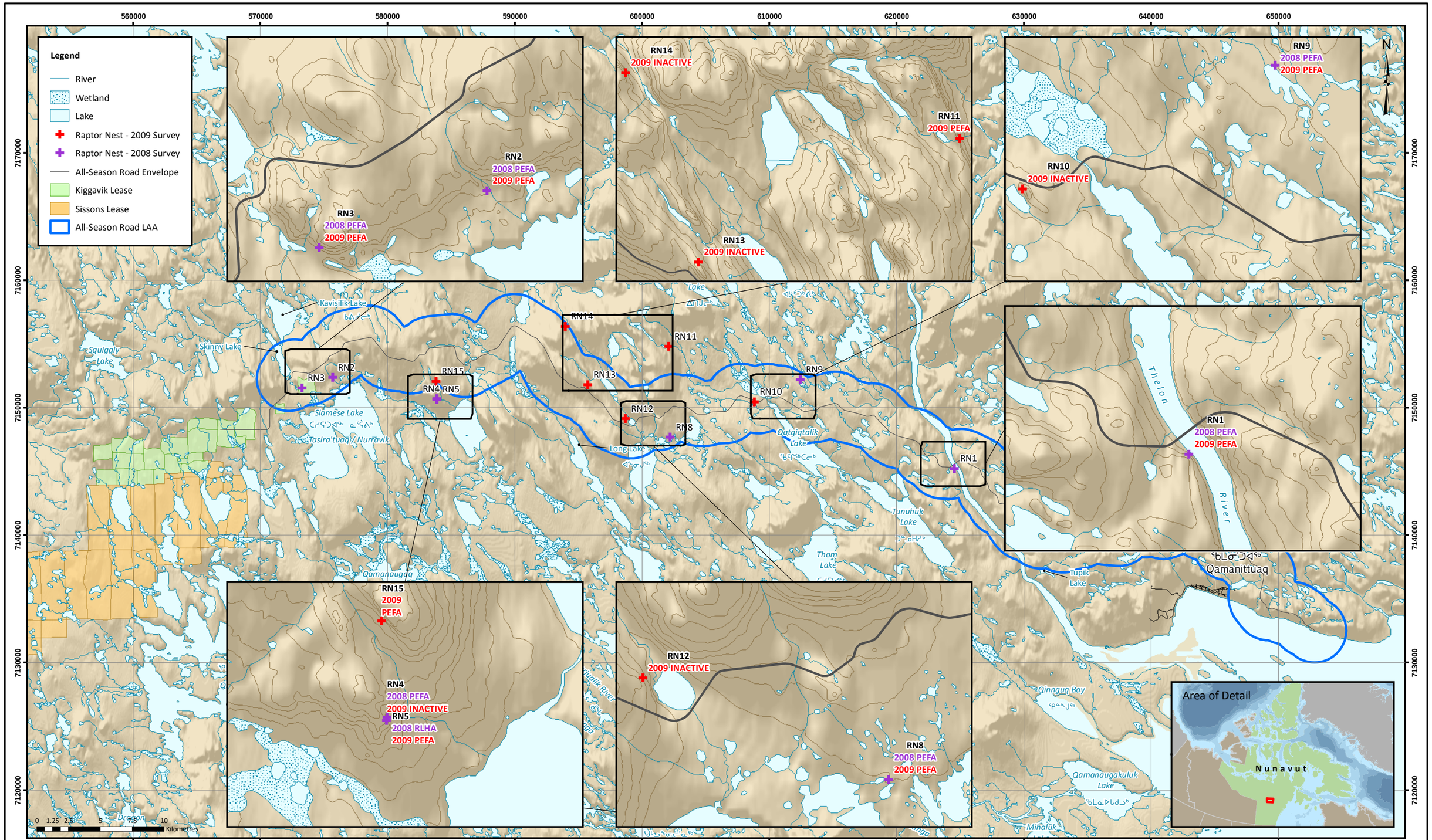
Table 15.2-6 Summary of Raptor Nests in the Kiggavik Local Study Area (2008–2009)

Nest	Species in 2008	Species in 2009	Eggs in 2008	Eggs in 2009	Comments in 2008 and 2009	Metres to proposed project infrasturcture
RN1	PEFA	PEFA	3	3	2008 — Territorial pair 2009 — Nest moved 30 m to SE. Three chicks on August 2	269
RN2	PEFA	PEFA	4	4	2008 — Territorial pair 2009 — Female on territory; no chicks or eggs on July 30	1,278
RN3	PEFA	PEFA	ND	3	2008 — Incubating female 2009 — Female on territory; no birds, chicks or eggs on July 30	1,131
RN4	PEFA	Inactive	3	N/A	2009 — Pair moved to site RN5; No birds, chicks or eggs on July 30	3,384
RN5	RLHA	PEFA	3	4	2009 — Three eggs observed 18 June and four at later date; No birds, chicks or eggs on July 30	3,430

Table 15.2-6 Summary of Raptor Nests in the Kiggavik Local Study Area (2008–2009)

Nest	Species in 2008	Species in 2009	Eggs in 2008	Eggs in 2009	Comments in 2008 and 2009	Metres to proposed project infrasturcture
RN8	PEFA	PEFA	3	0	2008 — Three eggs 2009 — Territorial pair, predated nest	1,709
RN9	PEFA	PEFA	3	4	2009 — Nest site moved 105 m SE on same cliff. No eggs or chicks	2,014
RN10	N/A	Inactive	N/A	N/A	2009 — Abandoned stick nest	111
RN11	N/A	PEFA	N/A	3	2009 — Two chicks and two actively defending adults on July 30th	4,701
RN12	N/A	Inactive	N/A	N/A	2009 — Large stick nest, no eggs.	411
RN13	N/A	Inactive	N/A	N/A	2009 — Old large stick nest, no eggs.	332
RN14	N/A	Inactive	N/A	N/A	2009 — Abandoned stick nest	2,357
RN15	N/A	PEFA	N/A	ND	2009 — Territorial pair, nest not located	2,302

NOTES:
PEFA = Peregrine Falcon, RLHA = Rough-legged Hawk
ND = No data; N/A = Not applicable



Projection: NAD 1983 UTM Zone 14N
Creator: CASLYS CONSULTING LTD.
Date: 07/07/2014 Scale: 1:275,000
File: 15.2-2_Raptor_Nests_All-Season.mxd
Data Sources: *Natural Resources Canada, GeoBase®, National Topographic Database, AREVA Resources Canada Inc., and Gebauer & Associates.*

FIGURE 15.2-2
RAPTOR NESTS ALONG THE ALL-SEASON ROAD

ENVIRONMENTAL IMPACT STATEMENT
VOLUME 6

Nest ID	Zone	UTM East	UTM North
RN1	14	624528.0	7145239.0
RN2	14	575671.0	7152388.0
RN3	14	573268.0	7151576.0
RN4	14	583888.0	7150707.0
RN5	14	583880.0	7150656.0
RN8	14	602197.0	7147702.0
RN9	14	612423.0	7152240.0

Nest ID	Zone	UTM East	UTM North
RN10	14	608808.7	7150480.5
RN11	14	602088.0	7154826.5
RN12	14	598685.8	7149153.6
RN13	14	595733.0	7151818.2
RN14	14	593964.3	7156418.7
RN15	14	583809.5	7152076.2

Kiggavik Project

AREVA

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15.2.2.3 Effect Mechanism and Linkages for Change in Raptor Nest Productivity

Continued exploration activities, construction, and operations have the potential to interact negatively with peregrine falcons. Continued aircraft use at the site has the potential to disturb peregrine falcons. Nesting peregrine falcons show individual and seasonal variation in response to small fixed-wing aircraft and helicopter overflights (Ritchie 1987). The degree of response to disturbance is associated with the stage of the breeding season. Adults were least likely to respond during incubation and most likely to respond during post-brooding and fledging. Aircraft (fixed-wing and helicopter) flown along the Alaska pipeline corridor at 1,066 to 1,585 m from the eyries (nest sites) did not cause a disturbance response. In Arizona, nesting peregrine falcon reaction to military overflights were initially alarm or alert responses but returned to normal activity within a few seconds after the disturbance (Ellis et al. 1991). Nesting peregrines also appear to be less disturbed by the high-frequency whine made by some jet engine helicopters than by low-frequency noise of piston-powered helicopters (White and Sherrod 1973).

Road construction and traffic may have an effect on nesting behaviour, although most research associates disturbances with highway traffic. Highway development can have adverse and beneficial effects on raptor populations (Postovit and Postovit 1987). Additional to habitat modification and increased human disturbance, peregrine falcons have collided with road traffic (Williams and Colson 1987). Detrimental effects include habitat loss/modification for some raptors, and stress due to increased human disturbance. There are no studies of raptor response to roads similar to the Project's proposed All-Season Road.

Mining-related disturbances are generally similar to any relatively permanent and continuous disturbance at a raptor site. In one of the few controlled studies, White and Thurow (1985) found that undisturbed ferruginous hawk (*Buteo jamaicensis)* nests fledged an average of one young more than nests exposed to experimental disturbance (the disturbance was composed of noise, vehicle, and human activity). Disturbed adult birds deserted their nest approximately 30% of the time. A one year correlational study of two areas, one of which was subject to industrial blasting during mining operations, found that the mined area supported fewer raptors (Bednarz 1984). Unfortunately, the reason for the difference was not further investigated. Interestingly, White and Thurow (1985) reported peregrine falcon and golden eagle (*Aquila chrysaetos*) raised young only a few hundred metres from areas where mining and blasting occurred.

Specific to the Project, there are several nest sites that are located near the proposed All-Season Road (RN12, RN13, RN10, and RN1). These will be the key nest sites for follow-up monitoring if the All-Season Road option is implemented for the Project.

15.2.2.4 Mitigation Measures and Project Design for Change in Raptor Nest Productivity

Ontario is the only known jurisdiction to have completed a set of management guidelines for peregrine falcon (OMNR 1987). Given the long-term use of peregrine falcon eyries, a key recommendation of the document is that a nest-specific management plan be prepared for each nest within a 3 km radius of disturbances. A management plan describing buffer zones above (overflights) and horizontal to (ground disturbance) the nest site, restrictions within the buffer zones and scheduling of activities should be prepared for each nest site. A site-specific management plan allows buffers to be varied based on topography, line-of-site, bird response, and history of disturbances at a nest site.

If a pair of nesting falcons is established at an eyrie, the OMNR guidelines suggest that efforts be made to identify hunting areas (e.g., lakes, wetlands). That information can be used to assess the effects of habitat alteration on the prey base. As long as the prey habitat is left undisturbed, it may be possible to change some components of the habitat without affecting the productivity of nesting peregrine falcons.

Key mitigation for ensuring continued occupancy and productive nesting in the LAA includes:

Construction Period — Nesting pairs are most likely to be disturbed during Project construction if the All-Season Road is constructed. Key mitigation measures include the following during the construction period:

- Blasting activities (for road construction) within 3 km of a known nest site will occur outside of the territory occupancy and nesting season (15 May to 15 August).
- Land-based activities within a 3 km radius of active nest sites can be restricted during the nesting season if there is obvious negative reactions to disturbances.
- A nest site-specific construction mitigation plan will be developed and will include territory activity monitoring when construction is occurring within 3 km of a known nest site.

Operation – The bulk of the disturbance to nesting pairs is expected to have occurred during the construction period. Mitigation during operations can include:

- no on-ground visits to active nest sites by Kiggavik employees
- no overflights of known nest sites
- no stopping zones along the road near nest sites

15.2.2.5 Residual Effects for Change in Raptor Nest Productivity

Mine and All-Season Road

Potential Project residual effects on peregrine falcon productivity will be limited to those nests closest to the All-Season Road. Most of the disturbance will be associated with the construction period.

Mine and Winter Road

Winter road construction and operation will not interact with nesting peregrine falcons. Effects of the winter road option is limited to the mine portion of the Project, but nests are not known to occur in this area.

15.2.2.6 Determination of Significance for Change in Raptor Nest Productivity

The effect of the Project on change in raptor nest occupancy and productivity is assessed as not significant, because the Project will interact indirectly with only a few nests of a wide-ranging nesting raptor. The Project footprint does not interact directly with known raptor nest sites and mitigation to reduce disturbance at nest sites during the breeding season should reduce the potential for adverse effects on raptor nest productivity. The expected magnitude of Project effects is rated as moderate during All-Season Road construction, low during operation, and negligible for all other Project components and phases. Project residual effects on peregrine falcon occupancy and productivity will be limited to those nests closest to the All-Season Road and entirely within the LAA. Most of the disturbance will occur during the construction period. During mine operations, very few or no raptors will be exposed to substantial enough disturbance that the productivity of their nest will be affected. Effects will last for the duration of the Project, but will be reversible and will return to baseline conditions upon Project completion.

15.2.2.7 Summary of Project Residual Environmental Effects on Raptor Nest Productivity

Table 15.2-7 summarizes the residual environmental effects for change in raptor nest productivity. The only nests that have been found within the RAA are those near the All-Season Road option. The Winter Road is not anticipated to affect peregrine falcon productivity. Confidence in this prediction during the All-Season Road construction and operation phase is moderate. Detailed engineering and and final road alignment will consider active raptor nests and evaluate road re-alignment where feasible.

Table 15.2-7 Summary of Residual Environmental Effects for Change in Raptor Nest Productivity

Project Phase	Mitigation / Compensation Measures	Direction	Residual Environmental Effects Characteristics						Significance	Likelihood	Prediction Confidence	Recommended Follow-up and Monitoring
			Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Environmental Context				
Change in Peregrine Falcon Productivity — All-Season Road Option												
Construction	Blasting outside of breeding window.	N	M	L	MT	S	R	U	N	N/A	M	Individual nest site monitoring during construction. Annual productivity monitoring.
Operation	No disturbance at nest site policy. No overflights.	N	L	L	MT	C	R	U	N	N/A	H	Annual productivity monitoring

KEY

Direction:

P Positive

N Negative

Magnitude:

N Negligible: No anticipated effect on wildlife species.

L Low: Observable effect on wildlife species but not likely to affect the species' sustainability in the Project area.

M Moderate: Observable effect on wildlife species but not likely to affect the species' sustainability in the region.

H High: Population-level detectable change to habitat availability, productivity and health of the Peregrine Falcon *tundrius* population

Geographic Extent:

S Site-specific

L Local: Effect confined to the LAA

R Regional - Effect extends beyond the LAA but within the RAA

T Territorial: Effect extends beyond the RAA but within Nunavut

N National: Effect extends beyond Nunavut but within Canada

Duration:

ST Short term: Less than one year

MT Medium term: More than one year, but not beyond the end of Project decommissioning

LT Long term: Beyond the life of the Project

Frequency:

O Once: Effect occurs once

S Sporadically: Effect occurs occasionally but not consistently throughout the life of the Project

R Regularly: Effect occurs at regular intervals throughout the life of the Project

C Continuous: Effect occurs continuously throughout the Project

Reversibility:

R Reversible: Will likely recover to baseline conditions after or before the end of Project decommissioning

I Irreversible: Unlikely to recover to baseline conditions after the end of Project decommissioning

Environmental Context:

U Undisturbed: Area relatively or not adversely affected by human activity

D Developed: Area has been substantially previously disturbed by human development or human development is still present

N/A Not Applicable

Significance:

S Significant

N Not significant

Prediction Confidence:

Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation

L Low level of confidence

M Moderate level of confidence

H High level of confidence

Likelihood of Significant Effects:

Based on professional judgment

L Low probability of occurrence

M Medium probability of occurrence

H High probability of occurrence

Other Projects, Activities and Actions:

Human disturbance associated with Meadowbank Mine, various exploration operations, and various regional communities.

15.2.2.8 Compliance and Environmental Monitoring for Change in Raptor Nest Productivity

Monitoring for change in raptor nest productivity will include:

- Individual nest site monitoring during construction to determine when breeding pairs are attempting to establish a territory and select a nesting location; and,
- Periodic Monitoring of territory occupancy, egg laying, egg hatching, and chick fledging (i.e., productivity) of identified nests (i.e., both historic and new nesting locations) to evaluate disturbance.

15.2.3 Assessment of Change in Raptor Health

Emissions from the Project have the potential to expose raptors to COPC. The potential for these emissions to affect peregrine falcon health was evaluated.

15.2.3.1 Analytical Methods for Change in Raptor Health

Emissions from the Project can affect the concentrations of COPC in the environment (e.g., water, soil, small mammals), which in turn can potentially affect raptors. The COPC included in this assessment were uranium and the uranium-238 decay series (thorium-230, lead-210, radium-226, and polonium-210), arsenic, cadmium, cobalt, copper, lead, molybdenum, nickel, selenium, and zinc.

Peregrine falcons prey almost exclusively on birds but will also eat small mammals such as a variety of rodents. To estimate potential exposure to falcons, COPC concentrations in prey was evaluated. Detailed air quality modelling (discussed in Tier 2, Volume 4) and water quality modelling (discussed in Tier 2, Volume 5) were used as inputs to the environmental pathways assessment (Tier 3, Appendix 8A). The concentrations in prey (e.g., songbirds) were predicted by using transfer factors that relate the concentration in different components (e.g., plant-to-bird). The transfer factors are based on site-specific information (where possible), augmented by published data. The intake of COPC through the diet of birds and small mammals is then multiplied by a separate transfer factor to obtain a concentration within the animal. This concentration is used for the prey of the peregrine falcon.

The intake of COPC can be estimated using the predicted concentrations and assumptions regarding how much a peregrine falcon consumes. The duration of time a raptor spends in the area is also an important factor. For peregrine falcon, it is assumed that individuals would be present for four months within the LAA and RAAs. The estimated intakes are compared to benchmarks that are considered safe for avian species. For estimating radionuclide dose, the concentration of each radionuclide is estimated from the calculated intake in the same manner as discussed for the prey species. Dose

coefficients are used to estimate the dose from each radionuclide based on the concentration. Radiation effects on biota depend not only on the absorbed dose, but also on the relative biological effectiveness (RBE) of the particular radiation (i.e., alpha, beta or gamma radiation). Recent recommendations have focused on an RBE of 10 for alpha radiation; this value was used in the assessment for consistency with the recommendations in the N288.6 standard (CSA 2012). The total dose (which is based on the baseline plus Project emissions for the sum of the uranium-series radionuclides) is compared to a benchmark that is considered protective of avian species (2.7 mGy/d).

The bounding scenario carried through the ecological assessment was based on separate discharges from the Kiggavik WTP and Sissons WTP, an extended operating period (25 years) followed by a 22-year period of consolidation where water treatment would be required. The assessment accounted for the uncertainty and variability in the emissions and the behaviour in the environment. The details are provided in the Ecological Risk Assessment (Tier 3, Appendix 8A).

15.2.3.2 Baseline Conditions for Change in Raptor Health

Under baseline conditions, peregrine falcons are exposed to naturally occurring COPC in the environment. Concentrations of COPC in the tissues of sparrows, lemmings and voles (e.g., prey species) were measured, and this baseline information was used in the pathways assessment.

15.2.3.3 Effect Mechanism and Linkages for Change in Raptor Health

Changes in the health of raptors can occur if they are exposed to COPC at levels that are associated with an effect. As it is important that raptor populations are maintained, the potential for COPC to affect the growth and reproduction of raptors is examined. The assessment of changes in health of raptors depends on the estimated changes in COPC concentrations of environmental components such as vegetation and soil, which are derived from the atmospheric and aquatic environment assessments.

The Project-environment interactions and effects described in the Atmospheric Environment report (Tier 2, Volume 4) and the Aquatic Environment report (Tier 2, Volume 5) form the basis for the effects mechanisms and linkages. The Project air quality effects relate to emissions of dust containing COPC from open pit and underground mining and supporting activities, milling and vehicle traffic on unpaved roads. The Project water quality effects relate to emissions of COPC from WTPs at the Kiggavik and Sissons sites. Complete details about the COPC sources and all assumptions used in the assessments were provided in the atmospheric and aquatic environment assessments.

15.2.3.4 Mitigation Measures and Project Design for Change in Raptor Health

Design aspects, operational measures and other mitigation measures have been incorporated into the current Project plans which will minimize Project-associated emissions and/or the potential effect of Project-related emissions.

The Atmospheric Environment report (Tier 2, Volume 4) provides a detailed list of the mitigation measures applied to reduce the changes to ambient air quality. Mitigation measures that have been incorporated to reduce emissions of dust containing COPC include:

- minimizing or reducing vehicle speed on unpaved mine site roads (including pit ramps) and the Kiggavik-Sissons access road and enforce speed limits, where possible to minimize dust generation
- applying water or another approved dust suppressant to the surfaces of unpaved mine site roads (including pit ramps) and the Kiggavik-Sissons haulroad, when possible
- maintaining all unpaved road surfaces via grading or other maintenance practices to minimize the amount of silt (i.e., fine particles) present in the roadbed material
- installing appropriate air pollution controls on the exhaust stacks of the mill complex and acid plant (e.g., wet scrubbers, dust collectors) and
- releasing tailings to the TMFs as a slurry below a water surface to avoid tailings dust emissions

The Kiggavik WTP and Sissons WTP have been designed so that the effluent will meet all appropriate regulations such as the MMER as well as site-specific discharge limits. Environmental considerations were paramount in the selection of the appropriate technology for the WTP. Further detail on the design of the WTP can be found in the Project Description report (i.e., Tier 2, Volume 2).

15.2.3.5 Residual Effects for Change in Health

In this study, adverse effects from exposure to COPC were characterized by a simple screening index. This index was calculated by dividing the predicted exposure by the toxicity reference value for each ecological receptor as follows:

$$Screening\ Index = \frac{Exposure}{Toxicity\ Reference\ Value}$$

For the wildlife species, the US EPA risk-based ecological soil screening levels (Eco-SSLs) (US EPA 2010) were used as the primary data source for the derivation of toxicity reference values used to determine the potential for an effect. For this assessment, the lowest observable adverse effect levels (LOAELs) based on growth and reproduction were selected, as these endpoints are considered to be the most relevant for the maintenance and persistence of wildlife populations. For COPC without Eco-SSL data (in this case uranium), literature studies were reviewed and values from long-term (chronic) exposure studies were selected. The Eco-SSL database provides information for a number of different species that could be used as a surrogate for other species with similar diets. Some scientific judgement is applied in the selection of the appropriate value, For example, selenium information is available for owls; however since it is one study and much higher than other information, the benchmark value for a black-crowned night heron was used as the surrogate for the falcon. If none of the test species were similar to the ecological receptors selected in this assessment, then the lowest value was selected as the conservative default benchmark for the ecological receptor. Appendix 8A of Tier 3 provides the final selected values along with additional detail on the derivation and rationale for the value.

Screening index values are not estimates of the probability of ecological effect. Rather, the index values are correlated with the potential for an effect, (e.g., higher index values imply a greater potential for an effect). The estimated exposure of the peregrine falcon includes both the natural baseline levels as well as the effect of the Project emissions. Therefore, a screening index value less than 1.0 indicates that the estimated total exposure is less than the threshold that is associated with a potential effect. The screening index values for peregrine falcon for are shown in Table 15.2-8.

Table 15.2-8 Screening Index Values for Peregrine Falcon

COPC	Screening Index (SI)		
	Baseline	Falcon Present in the LAA	Falcon Present in the RAA
Arsenic	0.004	0.004	0.004
Cadmium	0.002	0.002	0.002
Cobalt	0.002	0.002	0.002
Copper	0.015	0.015	0.015
Lead	0.003	0.003	0.003
Molybdenum	0.001	0.003	0.003
Nickel	0.004	0.004	0.004
Selenium	0.404	0.414	0.414
Uranium	-	-	-

Table 15.2-8 Screening Index Values for Peregrine Falcon

COPC	Screening Index (SI)		
	Baseline	Falcon Present in the LAA	Falcon Present in the RAA
Zinc	0.093	0.093	0.093
Radioactivity	0.01	0.01	0.01

NOTES:

SI values for non-radiological COPC are based on the maximum mean exposure compared to a LOAEL (lowest observed adverse effects level)

SI values of radiological effects include the contribution from U-238, Th-230, Ra-226, Pb-210 and Po-210, using an RBE of 10 and compared to a benchmark of 2.7 mGy/d

Details of calculation as well as additional results provided in Tier 3, Appendix 8A

15.2.3.6 Determination of Significance for Change in Health

As the level of exposure for peregrine falcon is not expected to change from baseline and the exposure will remain below exposure levels associated with adverse effects, no residual effects are expected on the health of raptors.

15.2.3.7 Compliance and Environmental Monitoring for Change in Health

No specific monitoring requirements are recommended based on the assessment for change in health of raptors because there are no predicted measurable effects on raptor health.

15.3 Cumulative Effects Analysis for Raptors

15.3.1 Screening for Cumulative Environmental Effects

Residual effects on raptor habitat are related to foraging areas, and are more directly related to songbird habitat. Cumulative effects on songbird habitat are addressed in Section 16.3.

The Project will not result in a measurable or reasonably expected residual environmental effect on peregrine falcon occupancy or nest productivity. The effects of the Project on peregrine falcon populations will be not detectable on the species' overall population. In combination with a not significant effect on migratory bird habitat, peregrine falcons are expected to continue productively nesting in the RAA. Consequently, no cumulative environmental effects on raptor productivity are expected.

There are no expected residual effects on raptor health and health is not considered further for cumulative effects.

15.4 Summary of Residual Effects on Raptors

15.4.1 Project Effects

The residual Project effects on peregrine falcon habitat availability, nest productivity, and health are assessed as not significant. Reduced habitat availability caused by the Project is expected to be confined within the mine and All-Season Road LAA. Nesting peregrine falcons are only expected to interact with the Project along the All-Season Road, and productivity is expected to remain unchanged after the construction phase. During construction, when most activity will occur along the road, some peregrine falcon nests could potentially have reduced productivity. No residual effects on peregrine falcon health are anticipated because of exposure the COPCs.

15.4.2 Cumulative Effects

The Project is not anticipated to act cumulatively with other projects to cause a significant reduction of habitat availability within the Kivalliq region. The effects on occupancy, nest productivity and health will be undetectable, and those effects are not expected to act in combination with any other Project-specific effects. Changes in habitat availability are related to availability of prey species, therefore, the effects of the Project are dependent on the effects to songbird habitat. Cumulative effects on songbird habitat are addressed in Section 16.3.

15.4.3 Effects of Climate Change on Project and Cumulative Effects on Raptors

Cumulative effects of climate change on raptors and habitat are expected to be negligible within the lifespan of the mine. If peregrine falcons are affected by climate change, it will occur via indirect effects. A study in nearby Rankin Inlet, Nunavut, found a strong correlation between the highly variable breeding success of peregrine falcons and weather, especially summer rainfall and spring snow storms (Bradley et al. 2005). With possible increased variability in seasonal weather conditions, the long-term reproductive success of peregrine falcons could potentially be compromised. However, this mechanism is expected to occur independently from the Project, and is not expected to act in combination with any other Project-specific effects.

15.5 Summary of Mitigation Measures for Raptors

The winter road option is key Project design feature that will mitigate many of the Project potential effects on raptors and their habitat. Minimizing the Project footprint will reduce the overall loss of available habitat. Other AREVA environmental policies and mitigation measures that will reduce potential Project effects on raptors include:

- Minimizing the Project footprint
- Minimizing Project activities outside of the footprint
- Progressively reclaiming disturbed areas
- No disturbance at raptor nest sites included in a wildlife no-harassment policy
- Providing dust suppression along the mine site roads during dry periods
- Eliminating dust dispersal from the tailings management facility through subaqueous deposition of tailings
- Restricting land-based activities within a 3 km radius of active nest sites
- Developing a nest site-specific construction mitigation plan that will include territory activity monitoring when construction needs to occur within 3 km of a known nest site during the nesting period (15 May to 15 August). This can allow operations to be modified should the breeding raptors show adverse reaction to nearby disturbances.
- Minimizing the risk of abandonment by prohibiting overflights of known nest sites during the breeding season

15.6 Summary of Compliance and Environmental Monitoring for Raptors

- The extent of the Project footprint will be monitored on an annual basis to confirm habitat loss predictions.
- Occupancy and productivity monitoring as outlined in Appendix 6D — Wildife Mitigation and Monitoring Plan.

16 Effects Assessment for Migratory Birds

16.1 Scope of the Assessment for Migratory Birds

The migratory bird effects assessment focuses on the indicator species Lapland longspur, long-tailed duck, and shorebirds. These species are used to characterize and assess potential Project effects for all migratory bird species, excluding raptors. Other bird species occur within the RAA, but assessing effects on all species is neither efficient nor more informative. Many of the bird species that occur in the RAA occur at lower densities than the selected indicators. Small sample sizes mean the information required to predict effects or monitor the change in species ecology from baseline conditions is not available. Further, the proposed measures for mitigating effects on the indicator species would also reduce the potential for other migratory birds to be affected by the Project.

16.1.1 Project-Migratory Bird Interactions and Effects

Key issues for migratory birds include Project-related effects on habitat availability and health. Project components related to these potential effects include road construction (habitat loss), road operation (reduced habitat effectiveness), mine construction (habitat loss), and mine operation (noise affecting habitat effectiveness and dust affecting forage and ultimately bird health). Project activities that could affect migratory birds are outlined in Table 16.1-1.

Table 16.1-1 Project-Migratory Bird Potential Interactions and Effects

Project Component	Project Activities	Lapland longspur		Long-tailed duck		Shorebirds	
		Change in Habitat Availability	Change in Health	Change in Habitat Availability	Change in Health	Change in Habitat Availability	Change in Health
Construction							
In-Water Construction	Construct freshwater diversions and site drainage containment systems (dykes, berms, collection ponds)			2		2	
	Construct in-water/shoreline structures			2		2	
On-Land Construction	Site clearing and pad construction (blasting, earth moving, loading, hauling, dumping, crushing	2		2		2	

Table 16.1-1 Project-Migratory Bird Potential Interactions and Effects

Project Component	Project Activities	Lapland longspur		Long-tailed duck		Shorebirds	
		Change in Habitat Availability	Change in Health	Change in Habitat Availability	Change in Health	Change in Habitat Availability	Change in Health
Supporting Activities	Transport fuel and construction materials						
	Air transport of personnel and supplies	2		2		2	
Operation							
Mining	Mining ore (blasting, loading, hauling)	2	2		2	2	2
Milling	Crushing and grinding		2		2	2	2
Final Closure							
In-water Decommissioning	Remove in-water/shoreline structures			2		2	
On-land Decommissioning	Revegetation	2		2		2	

NOTES:

Only Project interactions ranked as 2 in Table 5.5-1 are carried forward to this table.

A 2 indicates that an activity is likely to contribute to the effect.

16.1.2 Residual Environmental Effects Criteria for Migratory Birds

Residual effects on migratory birds and habitat are characterized quantitatively and qualitatively using the attributes of direction, magnitude, geographic extent, frequency, duration, and reversibility (Table 16.1-2).

Table 16.1-2 Residual Environmental Effects Criteria for Migratory Birds

Attribute	Description	Rating	Definition
Direction	The ultimate long-term trend of the environmental effect	Positive	Increased high quality habitat, or improvements to health relative to baseline conditions
		Neutral	No change in habitat or health from baseline conditions
		Adverse	Reduced amount of high quality habitat, or decrease in health relative to baseline conditions
Magnitude	Amount of change in a measurable parameter relative to baseline conditions; for health, defined by potential for exposure compared to a toxicity benchmark	Negligible	No anticipated effect on wildlife species
		Low	Detectable change to high quality habitat that does not cause a behavioural change in birds, or observable effect on wildlife species but not likely to affect the species' sustainability in the LAA
		Moderate	Detectable change in the amount of high quality habitat that could result in a behavioural response of birds, or observable effect on wildlife species but not likely to affect the species' sustainability in the RAA
		High	A detectable change in high quality habitat across the seasonal range that results in a behavioural change of a population of birds, or measurable effect on wildlife species that will likely affect the species' sustainability in the RAA
Geographic Extent	The geographic area within which an environmental effect occurs	Local	Effect confined to the LAA
		Regional	Effect extends beyond the LAA but within the RAA
		Territorial	Effect extends beyond the RAA but within Nunavut
		National	Effect extends beyond Nunavut but within Canada
Frequency	Number of times that an effect may occur over the life of the Project	Once	Effect occurs once
		Sporadically	Effect occurs occasionally but not consistently throughout the life of the Project
		Regularly	Effect occurs at regular intervals throughout the life of the Project
		Continuous	Effect occurs continuously throughout the Project
Duration	Length of time over which the effect is measurable	Short term	Less than one year
		Medium term	More than one year, but not beyond the end of Project decommissioning
		Long term	Beyond the life of the Project
Reversibility	Likelihood that a measurable parameter for a VEC will recover from an environmental effect to baseline conditions	Reversible	Will likely recover to baseline conditions after or before the end of Project decommissioning
		Irreversible	Unlikely to recover to baseline conditions after the end of Project decommissioning

16.1.3 Standards or Thresholds for Determining Significance

There are no known published standards or thresholds for determining effect significance on migratory birds and habitat. In the absence of legislated or otherwise identified thresholds, the significance of effects is determined based on experience from other northern mining projects (including local experience with the Meadowbank Project), suspected behavioural responses from published literature, and local knowledge or IQ. Determination of whether a Project residual effect on migratory birds is considered significant is based on whether an effect influences the long-term viability of a population or delays its recovery. A residual effect is considered not significant if the effect causes a change in condition of an individual or group of migratory birds (or their habitat) that is within the range of natural variability or does not affect the integrity of a population in a measurable way.

Habitat — There is no known existing standard or threshold for determining a significant loss of habitat for migratory birds. Based on professional opinion, experience from other northern projects, and knowledge of migratory bird ecology, Project-related effects on habitat availability are considered significant if more than 10% of the habitat units within the RAA are affected.

Health — There are no generic guidelines for Nunavut or Canada that are applicable to assess the effect of changes in biota based on their exposure to COPC. For this assessment, the estimated exposure to COPC by birds is compared to values that are set to be protective of health and if the exposure is lower than this value then no adverse effects are expected. The estimated dose received by the biota from exposure to radioactivity, considering both baseline and Project emissions, is compared to a level that is protective of birds.

16.1.4 Technical Limitation of the Assessment for Migratory Birds

Project effects on migratory birds are difficult to predict with certainty. Population cycles and habitat effects in other parts of a species range are unpredictable over the long-term, particularly when climate change or other unknown factors also affect the KI. Also, there is no indication that nesting habitat is a limiting factor to migratory bird persistence in the region in general.

Project effects on species that occur at low densities in the region are likely limited because of the relative infrequent encounter of the species with the Project. Quantifying effects on low density species, and then monitoring potential effects is difficult because of limited data availability, variability in occurrence, and low sample size upon which to validate results. Although the methods to determine occupancy are established, the probable high annual variability in occurrence and likely response to a number of environmental variables beyond the effects of the project weaken confidence in predictions.

16.2 Effects Assessment for Migratory Birds

16.2.1 Assessment of Change in Bird Habitat Availability

The Project will result in a loss of nesting, foraging and post-fledging migratory bird habitat. The Project footprint will make some habitat unavailable for migratory birds, while human activity associated with the Project could cause a functional loss of habitat in a Zone of Influence (ZOI). Effects on habitat from the Kiggavik Project could act cumulatively with similar effects from other human activity in the area.

The migratory bird indicator species selected were Lapland longspur, long-tailed duck, and shorebirds (as a group). Lapland longspurs are an appropriate indicator species because they are a common migratory upland songbird found throughout the RAA during the growing season. Long-tailed ducks are an appropriate indicator species as they are a common migratory waterbird in the area during the growing season. These two species are suitable indicators of upland songbirds and waterbirds that migrate to the area during the growing season. Shorebirds were included in response to the GN's Information Request 26 (Government of Nunavut 2012) and a pre-hearing commitment by AREVA to the GN to include an assessment of shorebird habitat (Nunavut Impact Review Board 2013). The measurable parameter for migratory birds is available habitat measured as the area of high, medium and low quality ecological land classification (ELC) units, and overall average availability of habitat units (detailed below).

16.2.1.1 Analytical Methods for Change in Bird Habitat Availability

Habitat within the LAA and RAA described for birds in the baseline report (Appendix 6C) was based on ELC units. ELC units are categorized into high, moderate, low and nil quality habitat for Lapland longspur and long-tailed duck (Table 16.2-1). Shorebirds were split into two groups: Wetland-associated Shorebirds (WAS) which were the majority of shorebirds, and Upland-Associated Shorebirds (UAS) that consist mostly of the three plover species found within the LAA. Habitat ratings for UAS and WAS are summarized in Table 16.2-2.

A habitat unit index was developed to assess the overall loss of bird habitat availability within the RAA. The index is based on assigning a ranked value to each habitat class (high=3, moderate=2, low=1, nil=0), and summing the available habitat, measured in hectares, weighted by the value of each class. The difference in the weighted sum of available habitat for the baseline conditions, and the predicted direct and indirect loss of habitat indicate the expected magnitude of effect on Lapland longspur, long-tailed duck and shorebird habitat.

Direct loss of habitat is assessed by identifying areas that will become unavailable because of the Project footprint. All ELC units within the Project footprint become “nil” quality once the Project is constructed. The winter road option will not affect breeding bird habitat because the habitat will be available again each summer when the road is decommissioned.

Indirect loss of habitat was assessed by reducing habitat quality for the growing season within the Project footprint. There was little literature upon which to predict a ZOI of the footprint on migratory bird habitat quality. To predict the effect of the Project on bird habitat, a conservative estimate of the ZOI was chosen. Habitat quality within the mine site and road ZOI was reduced by two classes to a minimum of low within 2 km of the mine footprint, and by one class to a minimum of low from 2 to 3 km of the mine footprint. The Winter Road does not result in indirect habitat loss because the road will be decommissioned each year prior to migratory birds arriving in the RAA. Consequently, there will be no human disturbance along the Winter Road during the growing season.

Although the airstrip is contained within the ZOI noted above, an airstrip ZOI was developed specifically for potential disturbance effects to birds. Based on the aircraft likely to be using the Project’s airstrip, the ZOI extends 8 km from the ends of the runway, and 3 km laterally. That ZOI is based on recommendations provided by Environment Canada. For the purposes of this Project’s assessment, all habitat within the airstrip ZOI was reduced to Low quality habitat.

The airstrip ZOI is based on guidelines that Environment Canada developed for the Kendall Island Bird Sanctuary as a submission to the Joint Environmental Review Project for the Mackenzie Valley Gas Pipeline (Environment Canada 2006). Although the Kiggavik Project’s airstrip is outside of a bird sanctuary and known areas of migratory bird concentrations, the Environment Canada airstrip ZOI guidelines are used to identify the potential breadth of effect and to determine if there may be areas of bird concentrations that may be affected by fixed-wing air traffic through the site. Additionally, Environment Canada’s Information Request EC-11(3–5) requested a revision to the airstrip ZOI presented in the Project’s DEIS based on the expected aircraft types using the airstrip, the noise levels generated by each type of aircraft when aircraft will be below an altitude of 650 m during take-off and landing, to provide an updated estimate of habitat indirectly affected by the project for each migratory bird VEC; and to include a figure indicating the revised ZOI for the airstrip.

The airstrip ZOI is based on distance from the airstrip where aircraft would be less than 650 m above ground level and sensory disturbances such as visual and noise levels are presumed to result in disturbance to migratory birds. That altitude was based on an Environment Canada literature review of bird responses to aircraft overflights which identified that birds reacted to aircraft below 650 m in >75% of studies (Environment Canada 2012). In addition to the altitude, EC also recommended a minimum lateral flight distance of 1.5 km during the nesting, brood-rearing and moulting periods for geese, and 3 km lateral distance during the fall staging period to minimize disturbance to geese.

Fixed-wing aircraft expected to use the Project's airstrip include those commonly used on Nunavut airstrips: passenger aircraft such as ATR 42-300, ATR 72-200, and Beechcraft 1900 King Air; and cargo aircraft such as Lockheed L382G and C-130 Hercules. Environment Canada (Environment Canada 2006, 2012) suggested that a Dash 7, which may have approach characteristics similar to the aircraft that will be used for the Project, has a ZOI that extends 8 km from the ends of the runway below which the aircraft may be below 650 m agl. For lateral distances, Environment Canada (Environment Canada 2006) suggested that there may be a 1.5 km lateral buffer during the nesting season and a 3 km lateral buffer during fall-staging, regardless of aircraft type. A 3 km buffer was used as an estimate of the ZOI for the entire migratory bird season. Therefore, the Project's airstrip ZOI includes an area that extends 8 km from the ends of the airstrip with a 3 km lateral buffer.

Table 16.2-1 Description and Relative Value of ELC Habitat Units for long-tailed duck and Lapland longspur in the RAA.

ELC Unit	Long-tailed duck	Lapland longspur
Water	H	L
Sand	M	M
Gravel	M	M
Rock Association	L	M
Wet Graminoid	H	H
Graminoid Tundra	H	H
Graminoid/Shrub Tundra	M	H
Shrub Tundra	L	H
Shrub/Heath Tundra	L	H
Heath Tundra	L	H
Heath Upland	L	H
Heath Upland/Rock Complex	L	M
Lichen Tundra	L	M
NOTES: 1) Growing season is approximately June 1 to September 30 (four months). H = high; M = moderate; L = low 2) Justification of habitat classification is available in Tier 3, Appendix 6C		

Table 16.2-2 Description and relative value of ELC units to wetland-associated shorebirds (WAS) and upland-associated shorebirds (UAS) during the growing season in the RAA[1].

ELC unit [2]	Wetland-associated shorebirds (WAS)	Upland-associated shorebirds (UAS)	Reasoning
Water	L	N	Rated Low for WAS because Red-necked Phalaropes forage in open water areas. All shoreline areas within 25 m of Water rated as High for WAS. UAS do not use Water.
Sand	L	H	Rated Low for WAS because of limited use. Rated High for UAS because used for nesting and foraging during the breeding season.
Gravel	L	H	Rated Low for WAS because of limited use. Rated High for UAS because used for nesting and foraging during the breeding season.
Rock Association	L	L	Limited use by WAS and UAS.
Wet Graminoid	H	M	Most WAS use this unit for foraging and breeding. Some use by UAS for foraging.
Graminoid Tundra	H	M	Most WAS use this unit for foraging and breeding. Some use by UAS for foraging.
Graminoid/ Shrub Tundra	M	M	Some WAS (e.g., Semipalmated Sandpiper – most common shorebird species in study area) use this unit for foraging and breeding. Also use by UAS for foraging.
Shrub Tundra	L	L	Rated Low because most shorebirds do not forage or nest in this habitat.
Shrub/Heath Tundra	L	L	Rated Low because most shorebirds do not forage or nest in this habitat.
Heath Tundra	L	M	Limited use by WAS but suitable foraging habitats for UAS.
Heath Upland	L	M	Limited use by WAS but suitable foraging habitats for UAS.
Heath Upland/ Rock Complex	L	L	Rated Low because most shorebirds do not forage or nest in this habitat.
Lichen Tundra	L	H	Rated Low for WAS because of limited use. Rated High for UAS because used for nesting and foraging during the breeding season.

NOTES:

[1] Growing season is approximately June 1 to September 30 (four months). H = High; M = Moderate; L = Low.

[2] Justification of habitat classification is available in Tier 3, Appendix 6C.

16.2.1.2 Baseline Conditions for Change in Bird Habitat Availability

Lapland longspur — Lapland longspurs forage on seeds and insects in diverse habitats, including vegetated and non-vegetated areas. Foraging habitats are most often wet tundra meadows that are relatively flat; however, they will also use drier vegetated slopes. Nesting habitat is usually well-vegetated meadows. Nests are often found sheltered within tussocks of graminoids or mosses, or beneath overhanging shrubs (Hussell and Montgomerie 2002). ELC unit descriptions, ratings and justification are provided in the wildlife baseline report (Tier 3, Appendix 6C).

Long-tailed duck — Long-tailed ducks select nesting sites that are relatively close to waterbodies. Nests are frequently located on islands or on tundra within 100 m from shorelines. Long-tailed ducks forage almost exclusively on or at the edge of waterbodies where they consume primarily aquatic insects, crustaceans, fish roe and vegetation (Robertson and Savard 2002). ELC unit descriptions, ratings and justification are provided in the wildlife baseline report (Tier 3, Appendix 6C).

Wetland-Associated Shorebirds — Wetland associated shorebirds (WAS) locate their nests and forage in high quality ELC units such as Wet Graminoid and Graminoid Tundra, as well as in all habitats within 25 m of Water (e.g., ponds and lakes), irrespective of habitat type. Within the Mine and All-Season Road LAA, 24% of the area is considered high quality for WAS, while in the RAA, 22% of the area is high quality. Moderate quality habitat, which consists of one ELC unit (Graminoid/Shrub Tundra), is used for nesting and foraging and covers 7.4% and 7.6% of the Mine/Road LAA and RAA, respectively (Tier 3, Appendix 6C), indicating that the habitat in the LAA is representative of what is found in the RAA.

Upland-Associated Shorebirds — Upland-associated shorebirds (UAS) locate their nests and forage in high quality ELC units such as Sand, Gravel and Lichen Tundra. Within the Mine and All-Season Road LAA, 1.8% of the area is high quality for WAS, while in the RAA, 2.5% of the area is high quality. Moderate quality habitats, which consist of several ELC units (Wet Graminoid, Graminoid Tundra, Graminoid/Shrub Tundra, Heath Tundra and Heath Upland) used primarily for foraging, cover 68% and 56% of the Mine/Road LAA and RAA, respectively (Tier 3, Appendix 6C).

16.2.1.3 Effect Mechanism and Linkages for Change in Bird Habitat Availability

The Project footprint will result in a direct loss of bird habitat. The footprint is expected to provide no usable habitat for birds once the Project is constructed. The Project will also result in an indirect loss of breeding bird habitat because of human disturbance (primarily noise) near the Project footprint. Dust settling on vegetation in habitats adjacent to Project facilities can reduce the quality and quantity of forage.

The consequence of noise on migratory birds may be reduced abundance and diversity (Reijnen et al. 1996), and reduced reproductive success (Halfwerk et al. 2011). However, most studies of human

impacts on birds were conducted in areas of intense human activity, not in a remote arctic environment. A study looking at the effects of roads at the Ekati Diamond Mine on Lapland longspur reproductive success found no detectable effects on nest site habitat selection or reproductive success (Male and Nol 2005). There was no published information on a zone of influence of mine activities on birds.

16.2.1.4 Mitigation Measures and Project Design for Change in Bird Habitat Availability

AREVA will mitigate potential adverse effect on migratory bird habitat through:

- minimizing the Project footprint
- limiting Project activities outside of the footprint
- progressively reclaiming disturbed areas
- implementing dust suppression along mine site roads during dry periods
- eliminating dust dispersal from the tailings management facility through subaqueous deposition of tailings
- in the case of the winter road option, maintaining a smaller footprint will mitigate habitat loss relative to the implementation of All-Season Road option

16.2.1.5 Residual Effects for Change in Bird Habitat Availability

Mine and All-Season Road

Lapland longspur — The mine and All-Season Road option will result in a direct loss of 1,780 ha of previously usable habitat for Lapland longspur (Table 16.2-3). The Project is anticipated to reduce the availability of high quality habitat for Lapland longspur by 8.8% within the RAA. This equates to an overall reduction of 4.3% habitat units within the RAA (Figure 16.2-1).

Long-tailed duck — The mine and All-Season Road option will result in a direct loss of 1,780 ha of previously usable habitat for long-tailed duck (Table 16.2-4). The Project is anticipated to reduce the availability of high quality habitat for long-tailed duck by 6.2% within the RAA. This equates to an overall reduction of 2.7% habitat units within the RAA (Figure 16.2-2).

Wetland-Associated Shorebirds — The mine and All-Season Road option will result in a direct loss of 1,780 ha of previously usable habitat for WAS (Table 16.2-5). The Project is anticipated to reduce the availability of high quality habitat for WAS by 8% within the RAA. Using the habitat index, this equates to an overall reduction of 2.3% of habitat units within the RAA (Figure 16.2-3).

Upland-Associated Shorebirds — The mine and All-Season Road option will result in a direct loss of 1,780 ha of previously usable habitat for UAS (Table 16.2-6). The Project is anticipated to reduce the availability of high and moderate quality habitat for UAS by 5% and 9% respectively within the RAA. Using the habitat index, this equates to an overall reduction of 4.0% habitat units within the RAA (Figure 16.2-4).

Table 16.2-3 Lapland Longspur Predicted Habitat Effects for the Mine Site and All-Season Road

Habitat rating		Baseline ELC	Direct loss[2]	Indirect effect[3]	RAA effect
Class	**SI[1]**	**ha**	**ha**	**ha**	**%**
High	3	647,733	-1,620	-55,377	-8.8
Moderate	2	81,306	-136	15,515	18.9
Low	1	251,106	-24	39,863	15.9
Nil	0	0	0	0	0.0
No Rating		2,583	0	0	0.0
Total area		982,728	1,780	110,755	
Habitat units[4]		2,356,917	-5,156	-95,240	**-4.3**

Notes:

[1] SI = Suitability Index (used for weighted average calculation of Habitat Units)

[2] Direct loss is the change in habitat availability due to the footprint of the project.

[3] Indirect effect is the change in habitat availability due to the zone of influence (ZOI) of the project.

[4] Habitat units are the weighted sum of all available habitat (sum [ha * SI]).

Table 16.2-4 Long-tailed Duck Predicted Habitat Effects for the Mine Site and All-Season Road

Habitat rating		Baseline ELC	Direct loss[2]	Indirect effect[3]	RAA effect
Class	**SI[1]**	**ha**	**ha**	**ha**	**%**
High	3	468,401	-341	-28,816	-6.2
Moderate	2	81,521	-213	7,322	8.7
Low	1	430,467	-1,225	21,493	4.7
Nil	0	0	0	0	0.0
No Rating		2,339	0	0	0.0
Total area		982,728	1,780	57,631	
Habitat units[4]		1,998,712	-2,675	-50,309	**-2.7**

Notes:

[1] SI = Suitability Index (used for weighted average calculation of Habitat Units)

[2] Direct loss is the change in habitat availability due to the footprint of the project.

[3] Indirect effect is the change in habitat availability due to the zone of influence (ZOI) of the project.

[4] Habitat units are the weighted sum of all available habitat (sum [ha * SI]).

Table 16.2-5 WAS Predicted Habitat Effects for the Mine and All-Season Road Option.

Habitat rating		Baseline ELC	Direct loss[2]	Indirect effect[3]	RAA effect
Class	**SI[1]**	**ha**	**ha**	**ha**	**%**
High	3	217,295	-317	-17,030	-8.0
Moderate	2	74,911	-209	2,265	2.7%
Low	1	688,183	-1,253	14,765	2.0%
Nil	0	0	0	0	0.0%
No Rating		2,339	0	0	0.0%
Total area		982,728	1,780	34,061	
Habitat units[4]		1,489,891	-2,624	-31,796	**-2.3%**

Notes:

[1] SI = Suitability Index (used for weighted average calculation of Habitat Units)

[2] Direct loss is the change in habitat availability due to the footprint of the project.

[3] Indirect effect is the change in habitat availability due to the zone of influence (ZOI) of the project.

[4] Habitat units are the weighted sum of all available habitat (sum [ha * SI]).

Table 16.2-6 UAS Predicted Habitat Effects for the Mine and All-Season Road Option.

Habitat rating		Baseline ELC	Direct loss[2]	Indirect effect[3]	RAA effect
Class	**SI[1]**	**ha**	**ha**	**ha**	**%**
High	3	24,647	-36	-1,200	-5.0
Moderate	2	546,848	-1,413	-47,514	-9.0
Low	1	157,543	-306	48,713	30.7
Nil	0	251,106	-24	0	0.7
No Rating		2,583	0	0	0.0
Total area		982,728	1,780	97,427	
Habitat units[4]		1,325,183	-3,242	-49,913	**-4.0**

Notes:

[1] SI = Suitability Index (used for weighted average calculation of Habitat Units)

[2] Direct loss is the change in habitat availability due to the footprint of the project.

[3] Indirect effect is the change in habitat availability due to the zone of influence (ZOI) of the project.

[4] Habitat units are the weighted sum of all available habitat (sum [ha * SI]).

Mine and Winter Road

Residual effects are limited to the mine portion of the Project. The winter road option does not temporally overlap with migratory bird presence within the region. All Project effects will be due to direct loss of habitat to the mine footprint and indirect loss of habitat within the mine ZOI because of disturbance associated with Project activities.

Lapland longspur — After mitigation, the Project is anticipated to decrease the availability of high quality habitat by 3.5% and increase availability of moderate quality habitat by 6.5% within the RAA (Table 16.2-7). This equates to an overall reduction of 0.7% of the habitat units within the RAA.

Long-tailed duck — After mitigation, the Project is anticipated to decrease the availability of high quality habitat by 2.5% and increase availability of moderate quality habitat by 1.2% within the RAA (Table 16.2-8). This equates to an overall reduction of 1.2% of the habitat units within the RAA.

Shorebirds — The effect of the mine and Winter Road option was not assessed. After mitigation, the Project is anticipated to reduce the availability of habitat, and the effect will be less than the mine and All-Season Road option. The effect will likely be proportional to the amount of disturbance as the mine site does not affect a particular habitat disproportionately to its availability in the RAA.

Table 16.2-7 Lapland Longspur Predicted Habitat Effects for the Mine and Winter Road Option

Habitat rating		Baseline ELC	Direct loss[2]	Indirect effect[3]	RAA effect
Class	**SI[1]**	**ha**	**ha**	**ha**	**%**
High	3	647,737	-1,316	-21,204	-3.5
Moderate	2	81,308	-40	5,352	6.5
Low	1	251,110	-22	15,851	6.3
Nil	0	0	0	0	0.0
No Rating		2,583	0	0	0.0
Total area		982,738	-1,378	-1	
Habitat units4		2,356,937	-4,050	-37,057	**-1.7**

Notes:

Values in this table were not updated from the DEIS. The reduced Project footprint is 1,102; consequently, the predicted effect errs on the side of precaution of predicting Project effects on Lapland longspur habitat availability.

[1] SI = Suitability Index (used for weighted average calculation of Habitat Units)

[2] Direct loss is the change in habitat availability due to the footprint of the project.

[3] Indirect effect is the change in habitat availability due to the zone of influence (ZOI) of the project.

[4] Habitat units are the weighted sum of all available habitat (sum [ha * SI]).

Table 16.2-8 Long-tailed Duck Predicted Habitat Effects for the Mine and Winter Road Option

Habitat rating		Baseline ELC	Direct loss[2]	Indirect effect[3]	RAA effect
Class	**SI[1]**	**ha**	**ha**	**ha**	**%**
High	3	468,407	-261	-11,277	-2.5
Moderate	2	81,521	-199	1,145	1.2
Low	1	430,471	-918	10,133	2.1
Nil	0	0	0	1,378	NA
No Rating		2,339	0	0	0.0
Total area		982,738	-1,378	-23,933	
Habitat units4		1,998,734	-2,099	-21,408	**-1.2**

Notes:

Values in this table were not updated from the DEIS. The reduced Project footprint is 1,102; consequently, the predicted effect is a more conservative estimate of Project effects on long-tailed duck habitat availability.

[1] SI = Suitability Index (used for weighted average calculation of Habitat Units)

[2] Direct loss is the change in habitat availability due to the footprint of the project.

[3] Indirect effect is the change in habitat availability due to the zone of influence (ZOI) of the project.

[4] Habitat units are the weighted sum of all available habitat (sum [ha * SI]).