Appendix V5-5A

2013 Wildlife Habitat Suitability Baseline

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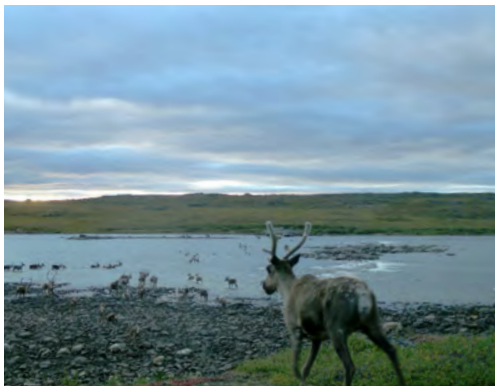
BACK RIVER PROJECT
2013 Wildlife Habitat Suitability Baseline



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November 2013

BACK RIVER PROJECT

2013 WILDLIFE HABITAT SUITABILITY BASELINE

November 2013
Project #0194096-0040

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Prepared for:

Sabina Gold & Silver Corp.

Prepared by:

Rescan Environmental Services Ltd., an ERM company
Vancouver, British Columbia

Executive Summary

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Executive Summary

This report presents the wildlife habitat suitability mapping study conducted for Sabina Gold & Silver Corporation (Sabina) for the Back River Project (the Project). Suitability mapping was completed at two levels, using a Local Study Area (LSA) and a Regional Study Area (RSA).

The goal of the wildlife habitat suitability modelling was to evaluate wildlife habitat in the LSA and RSA. The objectives were to inventory and rate the habitat types for select wildlife species (focal species), quantify suitable habitat available for these focal species, and identify key and important wildlife habitat and habitat features.

Mapping was completed for caribou (*Rangifer tarandus groenlandicus*) calving, post-calving and summer, and fall habitat; muskox (*Ovibos moschatus*) summer to fall and winter to spring habitat; grizzly bear (*Ursus arctos*) spring, summer, fall, and denning habitat; grey wolf (*Canis lupus*) denning habitat; wolverine (*Gulo gulo*) denning habitat; short-eared owl (*Asio flammeus*) nesting habitat, and peregrine falcon (*Falco peregrinus tundrius*) nesting habitat.

The area of mapped habitat within the LSA is approximately 134,369 ha; the RSA measured approximately 1,262,005 ha. Caribou, muskox, grizzly bear, and wolf habitat were rated using a 4-class rating system; wolverine, short-eared owl and peregrine falcon habitat were rated using a 2-class rating system.

Overall, over 75% of the LSA was rated as Highly to Moderately (HSR 1 and 2) suitable habitat for caribou during the calving, post-calving and summer, and fall seasons (75%, 85%, and 83% of the LSA, respectively). The amount of combined HSR 1 and HSR 2 habitat within the RSA varied from roughly half of the RSA during calving (52%) and the fall (49%) to over three-quarters (86%) during the post-calving and summer periods. It is important to note that despite the presence of suitable calving habitat in the LSA and RSA, caribou calving currently occurs northwest of the RSA and does not overlap with the LSA or RSA.

The results of the habitat suitability modelling for muskox reveal that approximately one-third of the LSA (35%) and RSA (38%) were rated as HSR 1 and HSR 2 habitat for muskox in the summer and fall. Similarly, roughly a one-third of the LSA (30%) and RSA (33%) were rated as Highly to Moderately suitable muskox winter and early spring habitat. During the snow-free months (summer and fall), higher rated habitats generally occurred in lower slope positions, such as riparian corridors and in wetland area where preferred forage is plentiful. Higher rated habitats in the winter and early spring were primarily located in higher elevation habitats, such as windswept tundra and ridges.

The LSA and RSA contained similar amounts of Highly to Moderately suitable spring, summer, and fall habitat for grizzly bears. HSR 1 and HSR 2 for grizzly bear in the any season totalled over half the LSA and ranged from 58% in the fall to 76% in the summer. Within the RSA, Highly to Moderately suitable habitats amounted to roughly half of the RSA, and ranged from 43% in the fall to 54% in the summer. Conversely, denning habitat was very limited in both the LSA and RSA, with less than 2% of both study areas rated as High and Moderately suitable denning habitat. These results suggest that the LSA and RSA contain a variety of suitable foraging habitats for grizzly bears during the snow free season. The very low quantity of higher rated denning habitat for grizzly bears was a result of the rarity of eskers and lacustrine deposits, habitats where bears may easily excavate den sites.

The results of the habitat suitability modelling for grey wolf denning habitat suggest that potential denning sites in eskers in both the LSA and RSA are scarce. High and Moderately suitable denning habitats covered less than 3% of the area within the LSA and RSA. However, this may underestimate the total denning potential of the study areas, as wolves may den in other areas, such as in sandy areas along lake banks (lacustrine materials). These areas could not be reliably differentiated from the open water portion of the lake within mapped areas and thus were not included in habitat suitability modelling.

Wolverine denning habitat was rated using a two class system (suitable and not suitable). Suitable wolverine denning habitat was widely distributed across the study areas, covering approximately half of the LSA (48%) and RSA (45%). These suitable habitats were primarily located in rocky habitats where may be a deep and persistent snowpack throughout the winter, thus providing wolverines with opportunities to create snow tunnels down to the ground that would remain stable for long periods of time.

Suitable short-eared owl nesting habitat was mapped across half of the LSA (52%); suitable nesting habitat in the RSA was more limited at around a one-third (32%) of the RSA. Suitable nesting habitat for short-eared owls consisted of lowland tundra with low to tall shrub cover, as short-eared owls are a ground-nesting raptor and select areas with shrub cover to conceal nest sites.

Overall, less than 10% of both the LSA and RSA was modelled as suitable peregrine falcon nesting habitat. The vast majority of this suitable habitat was identified through modelling previously identified nests locations surrounded by a 1 km nesting territory buffer; very little (< 3%) of either the LSA or RSA contained suitable cliff habitats for nesting that were modelled with a Digital Elevation Model (DEM).

Acknowledgements

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BACK RIVER PROJECT
2013 WILDLIFE HABITAT SUITABILITY BASELINE

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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
DEM	Digital Elevation Model
Focal Species	Organism(s) of ecological and/or human value that is of priority interest for management.
GIS	Geographical Information System
HSR	Habitat Suitability Rating: final rating assigned to an ecosystem unit with all assumptions and adjustments taken into account.
Keystone Species	A keystone species is a species that plays a critical role in maintaining the structure of an ecological community and whose impact on the community is greater than would be expected based on its relative abundance or total biomass.
Life Requisite	Specific activities of an animal that are critical for sustaining and perpetuating the species and that depend on particular habitat attributes or conditions. Life requisites include feeding, cover, breeding, migration, hibernation, etc.
LSA	Local Study Area
MBCA	*Migratory Birds Convention Act*
Model	A graphical representation of a species' habitat use over a defined landscape. It is based on the species account and is used to develop the assumptions, rating tables, and adjustments.
NU	Nunavut
NWT	Northwest Territories
Rating	A relative estimate or evaluation; a value assigned to a map unit to express the suitability of that unit to support a wildlife species for a particular life requisite and season. The rating is based on assumptions about the species' habitat requirements as defined in the model.
RISC	Resources Information Standards Committee of British Columbia. RISC establishes standards for collection, storage, analysis, interpretation and reporting of inventory data.
RSA	Regional Study Area

SARA	*Species at Risk Act*
Species Account	A summary of geographic distribution, life requisites, seasonal use of habitats, limiting factors, and habitat attributes for an animal species within a geographic range.
Suitability	Ability of the habitat in its current condition to provide life requisites of an animal.
Umbrella Species	Species selected for making conservation-related decisions, typically because protecting these species indirectly protects the many other species that make up the ecological community of its habitat.
WAPPRIITA	*Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act*
WHR	Wildlife Habitat Rating: preliminary rating assigned to an ecosystem unit.
WKSS	West Kitikmeot/Slave Study

1. Introduction

1. Introduction

The Back River Project (the Project) is a proposed gold project owned by Sabina Gold & Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut (Figure 1-1). This report presents the results of wildlife habitat suitability modelling developed to support the wildlife effects assessment for the draft Environmental Impact Statement (DEIS; Volume 5, Chapters 5 to 10).

This report details the methodology used in the development of habitat suitability models for caribou, muskox, grizzly bear, grey wolf, wolverine, short-eared owl, and peregrine falcon, all of which are wildlife Valued Ecosystem Components (VECs) in the DEIS. Model development included thorough literature searches on species ecology and seasonal habitat use. This background information was then utilized in conjunction with the ecosystem and vegetation maps (Rescan 2013a, Appendix V5-4A) in order to identify and rate each habitat type within the terrestrial wildlife Local Study Area (LSA) and terrestrial wildlife Regional Study Area (RSA) for a specified season. The habitat ratings were also evaluated in the field and adjusted as necessary.

The overall objective of the wildlife habitat suitability modelling was to support the assessment of potential Project effects on wildlife VECs, including the assessment of habitat loss and disturbance due to noise (Volume 5, Chapters 5 to 10). Specifically, the modelling results were used to evaluate how much habitat would be lost due to Project development within the Potential Development Areas (PDAs) and how much habitat beyond that lost due to the Project would be disturbed by noise from Project activities, such as blasting noise and aircraft noise (Volume 5, Chapters 5 to 10).

Figure 1-1

Back River Project Location

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Rescan Engineers & Scientists

2. Background Information

2. Background Information

Wildlife and wildlife habitat are protected by both federal and territorial legislation, including the Nunavut *Wildlife Act* (2003), Nunavut *Land Claims Agreement Act* (1993a), Canadian *Wildlife Act* (1994a), the Canada *Migratory Birds Convention Act* (1994b), the Canada *Species at Risk Act* (SARA; 2002), and the Canada *Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act* (1992b); Table 2-1).

Table 2-1. Relevant Acts or Regulations for Wildlife and Wildlife Habitat

Act or Regulation	Implications for Management
Nunavut *Wildlife Act* (2003)	• Identifies and defines wildlife management strategies for Nunavut, including strategies for conservation, protection and recovery of species at risk, managing nuisance wildlife, and possession of wildlife. The Act provides interpretation of approved and restricted hunting and related activities, including the possession of wildlife and enforcement that will follow should any of the Act's issued sections and corresponding regulations be contravened.
Nunavut Land Claims Agreement Act (1993a)	• Legislation that enforces the Nunavut Land Claims Agreement (NLCA; 1993b). The Nunavut Wildlife Management Board (NWMB) is established under the NLCA with the responsibility to manage wildlife and wildlife habitat in conjunction with the Government of Nunavut Department of Environment (GN DOE). • Within Section 5.2.34 of the NLCA, additional responsibilities for the NWMB are outlined, including the approval of conservation areas, wildlife management zones, wildlife management strategies, species at risk recovery plans, and designation of species of conservation concern and disseminate wildlife management information to appropriate government bodies.
Canada *Wildlife Act* (1994a)	• Identifies and defines wildlife management strategies for Canada, including strategies for managing nuisance wildlife and possession of wildlife. It provides interpretation of approved and restricted hunting and related activities including the possession of wildlife and enforcement that will follow should any of the Acts issued sections and corresponding regulations be contravened.
Canada *Migratory Birds Convention Act* (1994b)	• Prohibits the taking or killing of migratory birds, their nests, and eggs, and the deposition of harmful substances in areas frequented by migratory birds.
Canada *Species at Risk Act* (2002)	• Protects wildlife on federal lands as well as the critical habitat of those species listed on the "List of Wildlife Species at Risk," and protects all SARA-listed migratory birds. • Section 137 amends the *Canadian Environmental Assessment Act* (1992a) to clarify, for greater certainty, that environmental assessments must always consider effects to listed wildlife species, their critical habitat, or the residences of individuals of that species. • Section 79(2) states "the person must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plans."
Canada Wild Animal and Plant Protection and Regulation (1992b)	• Prohibits the import, export, and interprovincial transportation of species on the "Convention on International Trade in Endangered Species of Wild Fauna and Flora" control list; foreign species whose capture, possession, and export are prohibited or regulated by laws in their country of origin, Canadian species whose capture, possession, and transportation are regulated by provincial or territorial laws; and species whose introduction into Canadian ecosystems could endanger Canadian species.

3. Study Area

3. Study Area

3.1 BOUNDARIES

Wildlife habitat suitability studies were conducted within two terrestrial wildlife study areas, a Local Study Area (LSA) and a Regional Study Area (RSA; Figure 3.1-1).

The boundaries of the terrestrial wildlife LSA (hereafter in this report referred to as the LSA) were set to encompass the following:

- the Goose and George Potential Development Areas (PDAs), which contain all proposed Project infrastructure for the Goose and George Property Areas, respectively;
- the Marine Laydown Area (MLA) PDA; and
- the winter roads connecting the Goose, George, and MLA PDAs.

The LSA was the same as the Vegetation and Special Landscape Features LSA (Volume 5; Chapter 4) and is defined by a combination of sub-watershed boundaries and buffers surrounding proposed Project components, including infrastructure and connecting winter roads. A one-kilometre buffer was mapped surrounding the outer boundary of the PDAs associated with the Goose Property Area, George Property Area, and MLA. The LSA covers an area of approximately 134,369 ha.

The terrestrial wildlife RSA (hereafter in this report referred to as the RSA) encompasses the PDAs, the LSA, and a 35 km buffer on either side of all proposed Project infrastructure and winter road corridors between the three Project areas (Goose Property Area, George Property Area, and MLA). The RSA covers an area of approximately 1,262,005 ha. The RSA extends slightly more than 35 km from proposed Project infrastructure on the eastern side, to encompass the Western River.

3.2 ECOLOGICAL OVERVIEW

The National Ecological Framework is a hierarchal system of ecological classification that provides a framework for describing the distribution of ecological patterns across Canada. At its broadest level, this system recognizes two ecozones across Nunavut; the Northern Arctic and the Southern Arctic (Natural Resources Canada 2003). The Project lies within the Southern Arctic Ecozone. The Southern Arctic Ecozone extends across central Nunavut. It is bordered by the tree line to the south and by the Northern Arctic Ecozone to the north. Summers are cool and short with a mean temperature of 5ºC. Winters are long and cold with an average temperature ranging from -28ºC near the MacKenzie Delta to -18ºC in Northern Quebec. Precipitation is limited to about 200 mm per year.

The terrain is comprised of flat and rolling bedrock covered by thin veneers of till, lacustrine and fluvial deposits. Bedrock exposures are common, as repeated glacial advance and recession has removed much of the surficial material. Permafrost is found throughout the region. Although annual precipitation is low, many low-lying areas (as well as low-gradient hillsides) remain permanently saturated. This is due to very low rates of evaporation and transpiration as well as the continual supply of moisture from within the soil profile due to seasonal permafrost melting.

Wetlands are common throughout the region. The occurrence and development of Arctic wetlands is closely connected to the freezing and thawing of soil. The freeze-thaw action results in a number of wetland types depending on the amount of dynamism in the active layer (the mobile layer of soil above

the permafrost, which is subject to periodic thawing), the depth of the surficial organic material, landscape position, and the properties of the subsurface mineral parent material. Many Arctic wetlands are located in depressions, caused by glacial scour, that have filled with water from snowmelt. Kettle and kame topography also promotes wetland development (Gracz 2007).

The southern border of the Southern Arctic Ecozone is defined by a lack of full-size trees along its southern edge. Stunted forms of certain tree species, such as dwarf birch (*Betula nana*), green alder (*Alnus viridis* spp. *crispa*), willow species (*Salix* ssp.) and less commonly, white and black spruce (*Picea glauca* and *P. mariana*) grow throughout the ecozone. Much of the area is dominated by sedge meadows, tussock tundra and heath tundra. Sparsely vegetated areas, such as the wind-swept crests of eskers, are also common.

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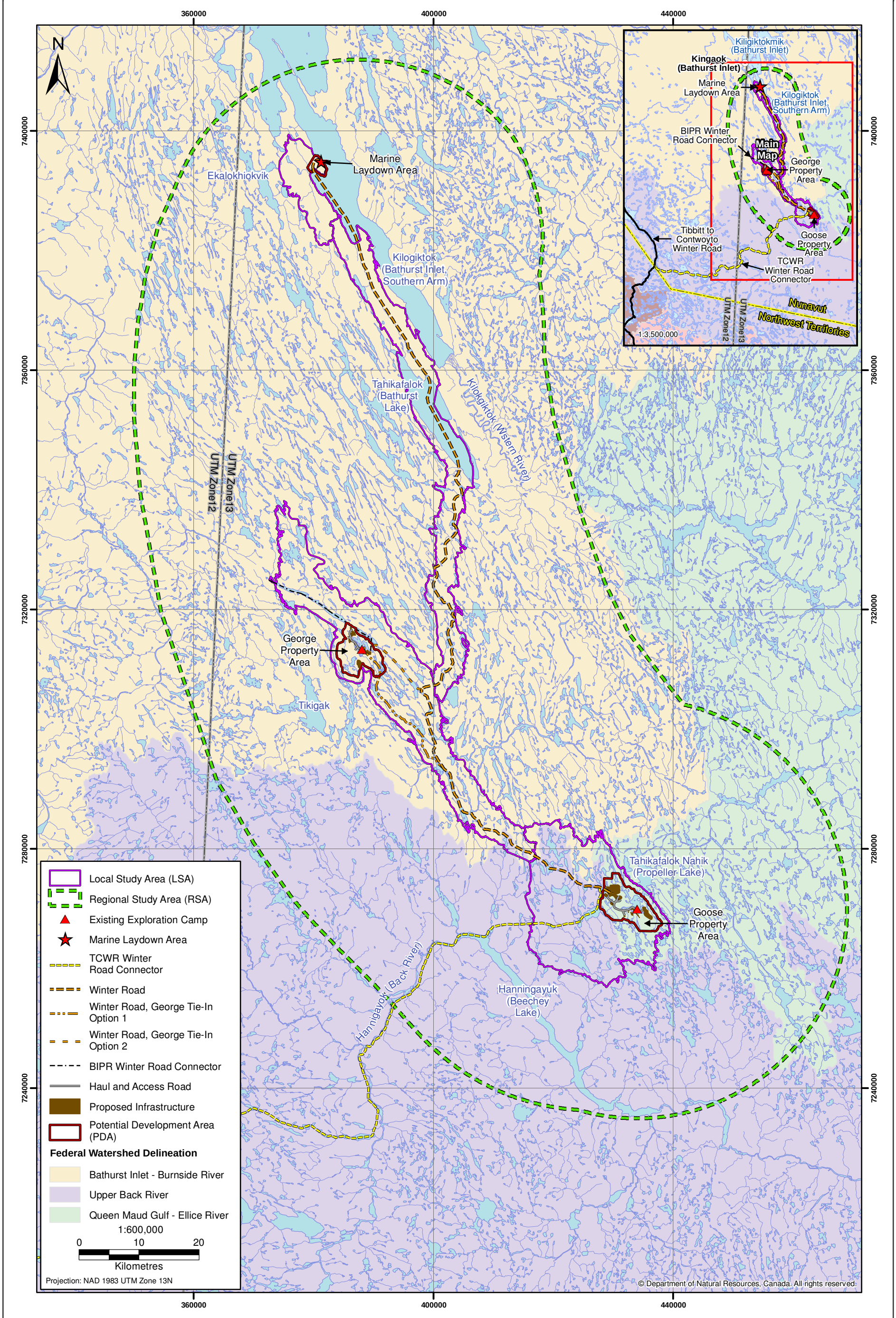

Figure 3.1-1

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Terrestrial Wildlife Local and Regional Study Areas

Figure 3.1-1

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4. Methodology

4. Methodology

4.1 MODELLING APPROACH - OVERVIEW

Modelling wildlife habitat enables the identification of areas that contain suitable habitat for chosen wildlife species. Maps are developed which can be used to assess the effects of development on wildlife habitat. The process of selecting species for habitat suitability modelling relied on identifying species of concern that occur in the RSA based on several factors, including conservation status, biological importance (e.g., keystone species, umbrella species), and economic or social importance to regional governing agencies, Nunavut residents, and the Inuit. Using this rationale, seven species were selected:

- caribou;
- muskox;
- grizzly bear;
- grey wolf;
- wolverine;
- short-eared owl; and
- peregrine falcon.

Habitat suitability modelling methodology was guided by BC Resource Information Standards Committee standards (RIC 1999). BC standards were used because habitat suitability standards are not set for Nunavut and the BC standards are well developed and sufficiently flexible to make them appropriate for tundra ecosystems. As defined by these standards, suitability models identify areas which, in their current condition, provide suitable (i.e., functioning) habitat for a particular species. Suitable habitat generally means that the physical attributes (e.g., elevation, slope, aspect, soil texture, and geographical location) and the biological components (e.g., vegetation species composition, structure, and age) of an area are likely appropriate for the species in question. In summary, these standards guide the interpretation of data derived from ecosystem maps and other biophysical information to spatially inventory wildlife habitat and to facilitate land management planning. While these standards were developed for interpreting wildlife habitat within British Columbia, they have been applied with success to other areas in Canada by Rescan.

The development of the wildlife habitat suitability models requires the following steps:

1. Development of species accounts with description of wildlife species' ecology, including habitat characteristics (variables) appropriate to the LSA and RSA.
2. Development of habitat suitability models for each species of interest using local data such as topography, slope, and vegetation (from the ecosystem maps) and the identified habitat variables.
3. Testing of habitat suitability models against field observations of habitat quality and wildlife use of the area.

4.2 MODEL DEVELOPMENT

4.2.1 Species Accounts

Species accounts are summaries of the geographic distribution, life requisites (i.e., the special requirements of an animal for survival and reproduction), seasonal use of habitat, limiting factors, and habitat attributes for an animal species within a geographic range (RIC 1999). The species accounts were primarily developed from literature reviews with particular emphasis on the ecology of the LSA and RSA. This information helped guide the formulation of Wildlife Habitat Ratings (WHRs) and habitat models. Species accounts are provided in Appendices 1 to 7.

Data from the following reports have been implemented in this wildlife habitat suitability report where applicable:

- *Back River Project: 2011 Wildlife Baseline Report* (Rescan 2012, Appendix V5-5D);
- *Back River Project: 2012 Wildlife Baseline Report* (Rescan 2013b, Appendix V5-5C); and
- *Back River Project: 2012 Ecosystems and Vegetation Baseline Report* (Rescan 2013a, Appendix V5-4A).

4.2.2 Habitat Suitability Models

The second step of model development is to identify suitable habitat used by each species. This step has two stages. In the first stage, ecosystem mapping is used to identify a variety of ecosystems throughout the LSA and RSA, termed ecosystem units. A wildlife habitat rating (WHR) is then assigned to each ecosystem unit, based on the characteristics of each species and season and its requirements for food, security, and thermal protection. The second stage takes the ecosystem units and their assigned WHRs, and may add other important variables specific to the species of interest. These variables include, but are not limited to, elevation, slope, aspect, and distance to a terrain feature or waterbody.

4.2.2.1 Local and Regional Ecosystem Mapping

Mapping of the LSA was conducted using British Columbia Terrestrial Ecosystem Mapping (TEM) procedures (Rescan 2013a, Appendix V5-4A). The classification system used for the TEM is a regional system developed by Rescan for the Back River Project. Ecosystem mapping was conducted in conjunction with ecosystem and vegetation baseline field studies conducted for the Project from 2012 to 2013. Ecosystems were mapped based on the field results and air photo interpretation. A final TEM map was developed for the LSA to identify the spatial distribution and types of ecosystems across the landscape (more details can be found in Rescan 2013a, Appendix V5-4A).

The West Kitikmeot / Slave Study Society (WKSS) ecosystem mapping was used to identify ecosystems within the RSA. The WKSS mapping was completed between 1997 and 2001 using remote sensing and extensive field work (Matthews, Epp, and Smith 2001). The mapping utilized satellite imagery to classify vegetation types over roughly 200,000 km^2 of the West Kitikmeot / Slave Study Area, which stretches from the arctic coast of the Coronation Gulf in the north to the taiga treeline in the south (Matthews, Epp, and Smith 2001). Small portions of the RSA were not covered by the WKSS mapping, so the national Land Cover dataset from GeoBase was used to supplement the WKSS. The Land Cover data was derived from multiple sources including Landsat 5 and 7 imagery from a partnership of provincial, territorial, and federal governments and agencies (GeoBase 2009).

4.2.2.2 Wildlife Habitat Ratings

Wildlife habitat ratings are based on assumptions regarding the habitat requirements of the species throughout the year and are defined in the species-habitat model. WHRs also take into account specific life requisites, or activities, as applicable. For this study, life requisites were divided into three categories: living, reproducing, and travelling. Living refers to habitat used for food, cover, and security. Reproducing refers to habitat used specifically for giving birth to live young, rutting, building nests, laying eggs, incubation, hatching, and feeding non-mobile young. Travel refers to landscape features that target species utilize for migration and predator avoidance. Habitats for each focal species were rated for seasons and life requisites as outlined in Table 4.2-1.

Table 4.2-1. Focal Species, Habitats Rated, and Rating Schemes Used for Habitat Suitability Models

Common Name	Rating Scheme	Season(s) Rated	Life Requisite	Time Period
Caribou	4 class	Calving	Living[1] and Reproducing[2]	June 1 to June 20
		Post-calving	Living[1]	June 15 to July 15
		Summer	Living[1]	July 16 to August 31
		Fall	Living[1], Reproducing[2], and Migrating[3]	September 1 to October 31
Muskox	4 class	Summer	Living[1] - food only	June to September
		Winter	Living[1] - food only	October to May
Grizzly bear	4 class	Denning	Reproducing[2]	October to May
		Spring	Living[1] - food only	May and June
		Summer	Living[1] - food only	June - September
		Fall	Living[1] - food only	September - October
Grey wolf	4 class	Denning	Reproducing[2]	late April to September
Wolverine	4 class	Denning	Reproducing[2]	February to early May
Short-eared Owl	2 class	Nesting	Living[1] and Reproducing[2]	May to July
Peregrine falcon	2 class	Nesting	Living[1] and Reproducing[2]	Late May to August

[1] *Living: food and cover provided by vegetation composition and physical structure of habitat.*
[2] *Reproducing: includes nest locations, changes in home range and forage consumption by pregnant/lactating females.*
[3] *Migration: habitat used for regular, annual travel.*

Ratings were assigned according to either a four class system or a two class system, depending on the level of knowledge of the species ecology and habitat requirements (Table 4.2-1). The four class rating scheme was applied to species where there was an intermediate to good understanding of habitat use within study areas and where the ecosystem mapping was robust (detailed) enough to identify the range of habitats used by the focal species throughout the year. For habitat rated using the four class scheme, ratings are as follows:

- High: ecosystem units representing essential habitat encompassing preferred habitat characteristics, the best habitat available for the species to meet its life requisites (and reproduce where applicable);
- Moderate: ecosystem units that provide some benefit to the species, but may not meet all of their food, security, or thermal requirements;
- Low: ecosystem units that provide little benefit to the species for living (e.g., cover, food); and
- Nil: ecosystem units that are avoided or not used by the species and that have no positive value.

The two class rating system was used for species where there was poor understanding of habitat use in the study areas, or where habitat use by the focal species is very fine scale and the ecosystem mapping was not robust enough to allow for a more detailed interpretation of habitat use. For habitat rated using the two class scheme, ratings are as follows:

- Usable/Suitable (U): ecosystem units that are preferred or represent usable habitat; and
- Likely No Value/Not suitable (X): ecosystem units that have very little or no positive value for the species.

The preliminary WHRs were developed specifically for ecosystem units occurring within the LSA and were later adapted for use for ecosystem units in the RSA. The ecosystem mapping in the RSA was completed at a coarser scale than the TEM mapping in the LSA. Typically, the RSA ecosystem units encompassed one or more LSA vegetation associations. For example, the Wetland (Sedge Meadow) ecosystem unit in the RSA may be equivalent to five different ecosystem units in the LSA, including Raised Bog Complex, Cottongrass Sedge Fen, Water Sedge Marsh, Undifferentiated Fen, and Shallow Open Water Wetland ecosystem units. In these situations the WHR values from the LSA ecosystem units are averaged based on the similarity to RSA characteristics. Where comparisons are not possible, new WHR values were created for the RSA ecosystems.

It is important to note that the WHR is a preliminary rating which may be quite different from the final rating used in the model, based on the number of adjustments made to include important geographic features or results of field evaluations. The final rating is called the Habitat Suitability Rating (HSR).

4.2.2.3 Additional Modelling

Additional modelling inputs were used for the peregrine falcon nesting model. The nesting model was developed by including occupied raptor nesting habitat identified during 2007, 2011, and 2012 baseline studies, as well as modelling cliff habitat using digital elevation models (DEM; see Section 5.8.2.1 for more details).

4.2.3 Field Evaluations

The third step of model development is to test the model in the field. This step is used to evaluate the model's ability to predict actual field conditions (i.e., for the model to predict the suitability of the habitat on the ground for a particular species). Field testing requires the collection of data at a sample of the mapped locations in representative habitat types. The model evaluation can be supplemented with wildlife surveys (e.g., aerial or ground surveys) to evaluate use and local habitat selection. Field evaluations were completed in August and September, 2012. Evaluations involved a biologist performing habitat assessments for each of the target species and life seasons in the LSA and to a lesser extent in the RSA. The field suitability values for each species, season and vegetation association (LSA) or ecosystem type (RSA) were compared to the preliminary WHR at the same location, and the WHRs were then adjusted as necessary to create final HSR values.

4.2.4 Model Adjustments

Model adjustments were required to determine the overall suitability of habitat in the LSA. The output of TEM mapping is ecosystem polygons, which may contain up to three different ecosystem units. In these cases, the percent of a polygon classified as a given ecosystem unit is determined; this percentage is also referred to as the decile. Therefore, ecosystem polygons may contain habitat which is of different value to focal species. To account for these differences in habitat values, the HSRs assigned to ecosystem units were given a numerical value, as outlined in Tables 4.2-2 and 4.2-3.

A weighted average HSR value that accounted for the relative proportion of each ecosystem unit and its value to the focal species was then calculated using the following equation:

$$\text{Weighted Average HSR} = \frac{HSR_{(decile\ 1)}}{Decile\ 1} + \frac{HSR_{(decile\ 2)}}{Decile\ 2} + \frac{HSR_{(decile\ 3)}}{Decile\ 3}$$

Table 4.2-2. Habitat Suitability Ratings and Weighted Averages for Four-class Schemes

HSR	HSR Value	Equivalent Weighted Average HSR Value
High	1	1.0 - 1.7
Moderate	2	1.8 - 2.5
Low	3	2.6 - 3.3
Nil	4	3.4 - 4.0

Table 4.2-3. Habitat Suitability Ratings and Weighted Averages for Two-class Schemes

HSR	HSR Value	Equivalent Weighted Average HSR Value
Suitable	1	1.0 - 1.5
Not-Suitable	2	1.6 - 2.0

The weighted average HSR for the ecosystem polygon was then translated back to final HSR. This conversion was achieved by defining the range of weighted average values that would be equivalent to high, moderate, low, and nil rated habitat (Tables 4.2-2 and 4.2-3). It was important to ensure that polygons that supported high value habitat (HSR 1) were identified and that the process of averaging did not mask the high valued component. As such, the range of weighted average values that defined HSR 1 habitat exceeded the midway mark between HSR 1 and 2 (i.e., 1.5), accounting for the ecological value these habitats represent. This was only performed for species where habitats were rated under the four class scheme.

No model adjustments were required for the regional ecosystem mapping. The WKSS mapping is a raster dataset where each pixel was given a single ecosystem classification (i.e., no deciles as is used in the TEM mapping). Therefore, a single and final HSR value can be assigned to each individual pixel, as defined in Tables 4.2-2 and 4.2-3.

4.3 SOURCES OF ERROR AND LIMITATIONS

Limitations in the resolution of the maps present difficulties in assessing habitat, particularly for species that exploit home ranges and habitat features at smaller spatial scales. Considering the limitations, the habitat suitability maps presented should provide sufficient accuracy to evaluate potential impacts from the Project on the wildlife species at a landscape level of resolution. The maps are not intended to be used for fine scale level management (i.e., for attributes within an ecosystem unit polygon).

One limitation of the methods used is that there is no formal evaluation of the final model fit. Typically, there are two options for evaluating model fit. In the, first option, the modeller can use all of the field data to update and refine the model. This leads to a model that better fits the available data, and the wildlife habitat, but does not allow for a formal evaluation of how well the model fits the data. In the second option, half of the data is used to refine the model, while the other half of the data is used to test the model fit. This second option invariably leads to a less well-fit model, but has

the benefit of providing a formal evaluation of model fit. In this case, the first option was chosen such that the fit of individual models was maximized.

An additional limitation is the WKSS did not cover the entire RSA and that GeoBase Land Cover data were used to fill gaps. The Land Cover data lacks the extensive ground work used to verify the WKSS accuracy. As well, the classification system used for the two remote sensing products differed both in the classification systems used and the interpretation of pixel classification. Therefore, the GeoBase Land Cover may not be as accurate as the WKSS imagery.

5. Results

5. Results

5.1 SUMMARY OF HABITAT SUITABILITY MAPPING RESULTS

In summary, the LSA and RSA contained moderate to large amounts (20-80% of study area) of highly rated (HSR 1) seasonal habitat for caribou. Approximately half of the habitat within the LSA and the RSA was rated as useable/suitable denning habitat for wolverine and useable/suitable nesting habitat for short-eared owl. Conversely, very little habitat within the LSA and the RSA was rated as highly suitable for muskox, grizzly bear, grey wolf, and peregrine falcon. For these species, between 1% and 11% of each study area was rated as highly suitable for any one season and life requisite. The results of habitat suitability mapping are summarized according to TEM mapping within the LSA and WKSS and GeoBase mapping in the RSA; results are also presented in Appendix 8, which also includes habitat suitability mapping according to WKSS and GeoBase mapping within the LSA.

The final HSRs represent the quality of each ecosystem type in providing the seasonal life requisites for the species in question (e.g., forage opportunities for grizzly bears). While additional modelling was completed for peregrine falcon, most HSRs are the same as the WHRs given to the identified ecosystem units within the LSA and RSA for most ecosystem types.

5.2 CARIBOU

5.2.1 Background

Barren-ground caribou (*Rangifer tarandus groenlandicus*) are a biologically and culturally important species in the Arctic. Caribou not only sustain wild predator populations such as wolves, grizzly bear, and wolverine, but also provide an important resource for human populations living in the North, particularly Aboriginal communities. Caribou are most sensitive during calving and post-calving when calves are most susceptible to predation and disturbance (Russell, Kofinas, and Griffith 2002). Calving and post-calving areas are designated as important habitat for caribou in Nunavut (NPC 2012). Three caribou herds have been recorded in the vicinity of the Project: the Bathurst, Beverly, and Dolphin and Union herds. The Dolphin and Union herd are recognized as a distinct subspecies of barren-ground caribou (*R.t. groenlandicus x pearyi*). For the purposes of this study, individual herds are not assessed separately as it is assumed that habitat requirements are similar, if not identical, for all individuals (Gustine et al. 2012).

5.2.2 Habitat Suitability Model Development

Caribou habitat suitability was assessed for calving (June 1 to ca. June 20), post-calving and summer (ca. June 20 to August 31) and the fall (September 1 to October 31).

The calving period refers to the time when cows are giving birth, which is defined both by the initiation of calving and the one week period of "peak calving," when 50% of cows have calved (Russell, Kofinas, and Griffith 2002; A. Gunn and Poole 2009). The dates for the peak calving period can be identified by the relatively slow movement rate of satellite-collared cows during calving (< 4 km/day during calving versus 14-20 km/day before calving, and about 12 km/day after calving), as calves have very limited movement ability in the first days of life (A. Gunn and D'Hont 2002; A. Gunn, Dragon, and Boulanger 2002; A. Gunn and Poole 2009; Nishi et al. 2010). There is annual variability in the dates of initiation of calving and peak calving (A. Gunn, Poole, and Wierzchowski 2008); therefore, an approximate date for end of calving (ca. June 20) is used in this report based on available literature.

Habitat selection for each season was developed from literature searches, local knowledge, previous and concurrent wildlife surveys, and project specific habitat assessments. Table 5.2-1 provides a summary of the seasons and life requisites that were assessed, with the following sections expanding on the habitat preferences for each season and HSR ratings for each vegetation association that occurs in the LSA and RSA.

Table 5.2-1. Seasonal Life Requisites of Caribou

Season	Date	Life Requisite	Habitat Preference
Calving	June 1 to ca. June 20	Reproduction and Living	Variable. Predator avoidance, lichen availability, and early vegetation growth is preferred.
Post-calving and Summer	ca. June 20 to July 15 (post-calving) July 16 to August 31 (summer)	Living	Caribou use eskers for insect and heat relief, lakes for predator avoidance, insect, and heat relief, eat green plants from riparian and sedge communities. Cows require high quality forage to replenish fat reserves.
Fall (including Rut)	September 1 to October 31	Living, Reproduction, and Travel	Caribou travel to southern rutting areas, selecting habitat for ease of travel, predator avoidance, and late season forage.

5.2.2.1 Model Assumptions

Calving

Key characteristics of caribou calving grounds on the tundra are believed to be areas that facilitate predator avoidance, and where forage availability after snowmelt offers females the nutritional requirements they need for lactation (Griffith et al. 2001; Wilson et al. 2012). There appears to exist a trade-off between safety and forage availability; calving females may choose calving grounds that are relatively safe from predators but are not necessarily places where snow melts earlier nor where vegetation biomass is greatest (Wilson et al. 2012). Though forage availability may be lower, it is thought that calving grounds generally are located in areas where forage quality is high (reviewed in Wilson et al. 2012; Griffith et al. 2001). Lichen provides caribou with additional nutrients before green-up (Ferguson, L. Gauthier, and F. Messier 2001). Lichen heath is one of the main vegetation cover types for the Bathurst herd calving grounds (Griffith et al. 2001; Johnson et al. 2005). Willow and cottongrass species can be important forage species during and following calving, where available (Russell, Kofinas, and Griffith 2002).

The following general assumptions were made to define calving WHRs:

- High value calving habitat (primarily assessed for forage) includes ecosystem units that are snow free early, and those that contain a significant cover of lichen and shrubs.
- Moderate value habitat includes a variety of ecosystem units that contain suitable early forage such as cottongrass flower buds, sedges, and various shrub species.
- Low value habitat includes ecosystem units that are more likely to retain snow packs or have limited suitable forage.
- Nil ratings were given to vegetation associations that have a lack of forage, or are disturbed.

Given that lichens may be the typical food source for females on calving grounds but that green spring vegetation may also important whenever available, suitability was based on ecosystem types and vegetation associations that occur in landscape positions that have limited snow packs, lichen cover, and have the potential to green up early in the spring season. Suitability modelling could not account for the trade-off between predator avoidance and forage availability and quality.

Post-calving and Summer Habitat

Access to high quality forage is likely the key driver of habitat selection in the post-calving period (Witter et al. 2012), as females need to acquire adequate nutrient reserves for lactation, which last for about three weeks. Sedge meadows may be an important habitat during this time, due to the highly nutritious cotton grass (*Eriophorum* spp.) and sedges (e.g., *Carex aquatilis*) that grow in these areas. After the post-calving period, females expand their selection of vegetation from sedge meadows to include other vegetation types, but tend to remain in moist habitat where grasses, sedges, and willow and birch shrubs are abundant (Griffith et al. 2001; Thorpe et al. 2001; Wilson et al. 2012; Zamin and Grogan 2012).

In addition to forage, caribou require habitat that provides relief from insects, heat, and predators. Relief is found by moving to windier, cooler places during the daytime, such as on top of eskers, at the edges of large rivers and lakes, and to higher elevation tundra where insects are less dense (Russell, Martell, and Nixon 1993; Skarin et al. 2008; Wilson et al. 2012; Witter et al. 2012). Caribou often gather along lake shorelines, especially late in the day, because they can enter the water to escape predators such as wolves when necessary (Thorpe et al. 2001). In addition, caribou are also often seen swimming in lakes to escape the heat and insects (Thorpe et al. 2001).

Considering the importance of high quality forage during post-calving and the summer, suitability was based on ecosystem types and vegetation associations that could produce abundant and high quality forage. In addition, habitats that provide insect or predator relief were also identified. The following general assumptions were made to define post-calving and summer WHRS:

- High value post-calving/summer habitat includes areas that produce abundant and high quality forage (e.g., sedges and graminoids), in addition to those that provide insect or predator relief (e.g., lakes and esker).
- Moderate value habitat included ecosystem units that provide forage opportunities, but generally have limited insect and heat relief relative to the high value habitat.
- Low value habitat includes barren areas and rock outcrops that have limited vegetation and limited opportunities for relief (e.g., shallow water areas that are not deep enough to provide insect relief).
- Nil rated habitat were those that lacked forage, or are disturbed.

Fall Habitat (including Rut)

Habitat use during the fall and the rut is focused on ease of travel and opportunistic foraging. As herds move south towards wintering grounds, they feed on remaining high quality forage as it is available, such as shrubs, grasses, and lichens. Bathurst caribou, for example, choose lichen veneer for foraging in the fall (Johnson et al. 2005). Eskers, ridges, and other high points are selected for easy travel (Thorpe et al. 2001). The following general assumptions were made to define fall WHRs:

- High ratings were given to vegetation associations that contain a diversity and abundance of forage species, as well as those that contain esker for ease of travel.
- Moderate ratings were assigned to vegetation associations that contain some preferred forage species, but typically have a lower cover of lichens, sedges, and shrub species.
- Low ratings were given to vegetation associations that contained limited forage opportunities.
- Nil ratings were given to vegetation associations that contained sparse vegetation, or where travel was difficult.

5.2.3 Results and Discussion

5.2.3.1 Calving

Roughly half (53%) of the LSA is Highly (HSR 1) rated calving habitat for caribou (Table 5.2-2). Spatially, high rated habitat was distributed across the LSA (Figure 5.2-1). Moderately suitable (HSR 2) habitats accounted for 22% (30,436 ha) of the LSA. HSR 2 habitats represented areas where lichens are present, but green vegetation may be present in lower quantities or would likely be covered by snow well into June. Moderately suitable habitat habitats, like Highly rated habitat, were also well distributed across the LSA. Of the remaining habitat that was rated, 5% was Low and 19% was Nil (Table 5.2-2). These habitats encompass areas of sparse vegetation, lakes, and rivers – areas that provide little to no forage value for caribou.

Table 5.2-2. Caribou Calving Habitat within the Local Study Area and Regional Study Area

	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
Suitability Rating	**Area (ha)**	**% of LSA[1]**	**Area (ha)[2]**	**% of RSA[1]**
High	71,492.97	53	355,417.77	28
Moderate	30,436.22	22	300,905.11	24
Low	7,140.63	5	301,581.58	24
Nil	25,299.49	19	299,248.12	24

[1] For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100%.
[2] Includes LSA. Approximately 4,852.05 ha of the RSA fell in the Unclassified class and was not included in modelling, thus the total amount of habitat modelled in the RSA is 1,257,152.58 ha.

Within the RSA, over a quarter (28%) of the area was rated as Highly suitable calving habitat (Table 5.2-2). Highly rated habitats were distributed for the most part in the southern RSA below the Western River drainage (Figure 5.2-2). The remainder of the RSA was equally distributed between Moderate, Low, and Nil rated habitats (24% each; Table 5.2-2). Most of the Moderate rated habitat was located in the northern RSA surrounding Bathurst Inlet; Moderate rated habitat was also frequently located adjacent to Highly (HSR 1) rated habitat (Figure 5.2-2). Much of the Low suitability habitat was vast boulder fields with little vegetation cover; this habitat type is common to the north of the George Property (Figure 5.2-2). Nil rated habitats encompassed all water and unvegetated ecosystems.

Despite the presence of suitable calving habitat in the LSA, caribou do not currently calve in the LSA or the RSA. Calving grounds for Bathurst and Beverly herds are known to occur northwest and northeast of the RSA, respectively; the Dolphin and Union herd calves on Victoria Island to the north of the Project.

5.2.3.2 Post-calving and Summer

Within the LSA, roughly 19% was rated as Highly (HSR 1) suitable habitat for caribou during post-calving and the summer (Table 5.2-3). Highly rated habitats were present across larger, continuous areas in the central LSA surrounding the George Property and were sparsely distributed across the rest of the LSA in small quantities (Figure 5.2-3). This spatial trend was primarily influenced by the distribution of areas producing high quality forage (e.g., sedge wetlands) or areas that could be used for insect or heat relief (e.g., eskers, ponds); these habitats were generally small and isolated. Two-thirds (66%) of the LSA was rated as Moderate (Table 5.2-3), representing areas where modest amounts of lower quality forage (e.g., shrubby browse) are accessible or where high quality forage may be present in lower quantities because habitat is mixed. The rest of the LSA was rated as Low (15%) and Nil (1%).

PROJECT # 0194096-0040 GIS # BAC-23-244a October 11 2013

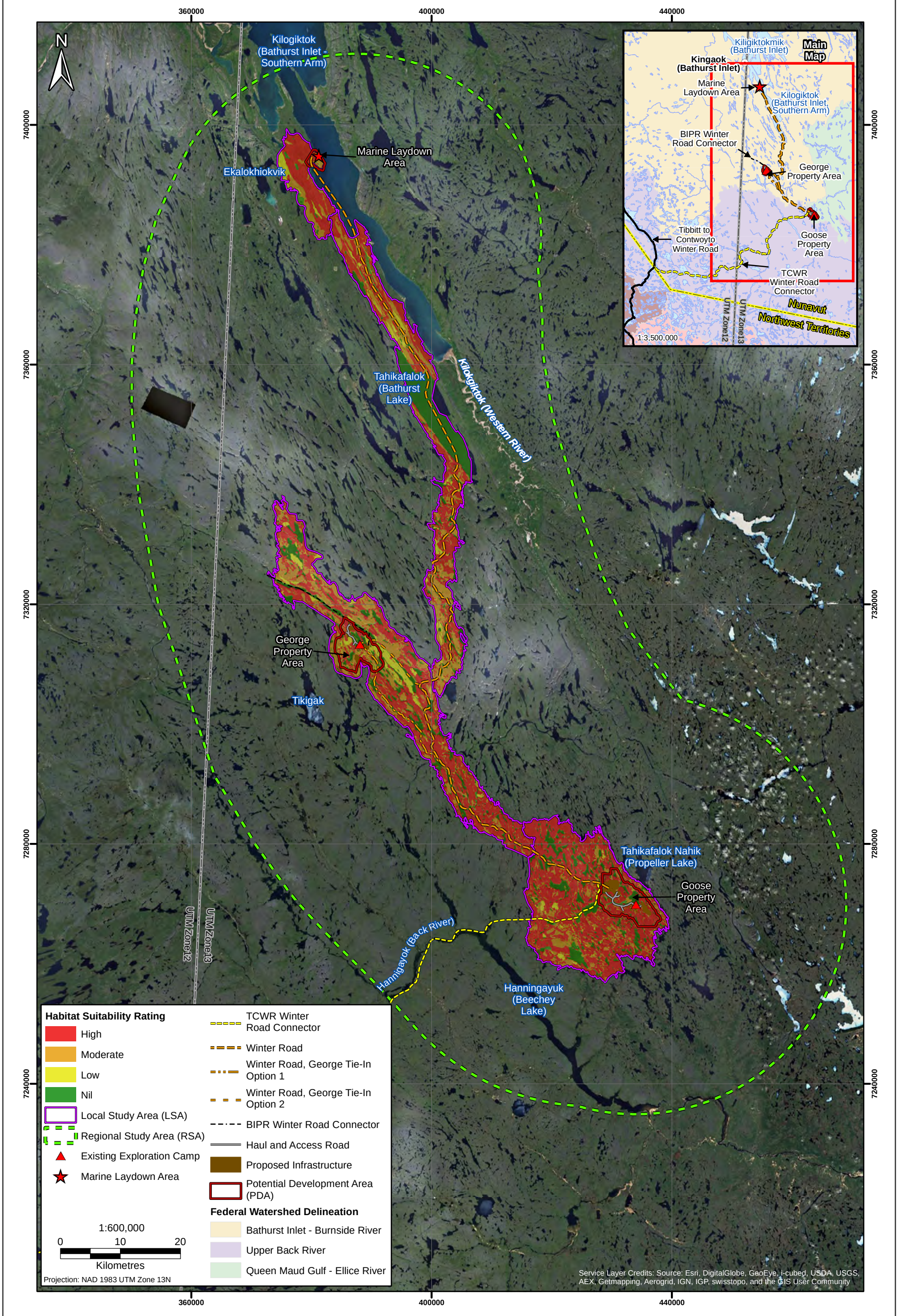

Figure 5.2-1

Sabina GOLD & SILVER CORP

Caribou: Calving Habitat in the Local Study Area

Figure 5.2-1

Rescan an ERM company

PROJECT # 0194096-0040 GIS # BAC-23-244b October 10 2013

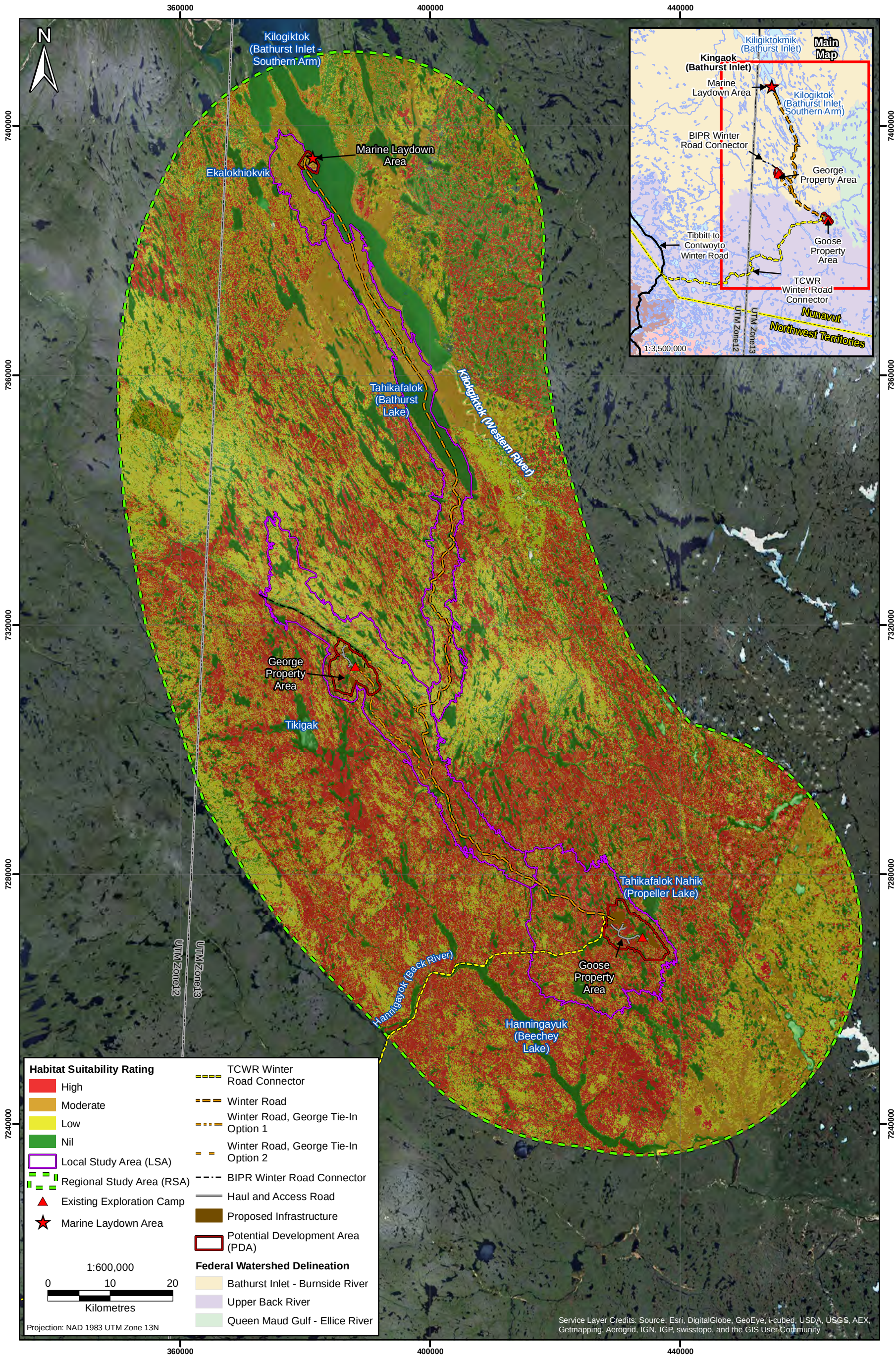

Figure 5.2-2

Sabina GOLD & SILVER CORP.

Caribou: Calving Habitat in the Regional Study Area

Figure 5.2-2

Rescan an ERM company

PROJECT # 0194096-0040 GIS # BAC-23-244c October 10 2013

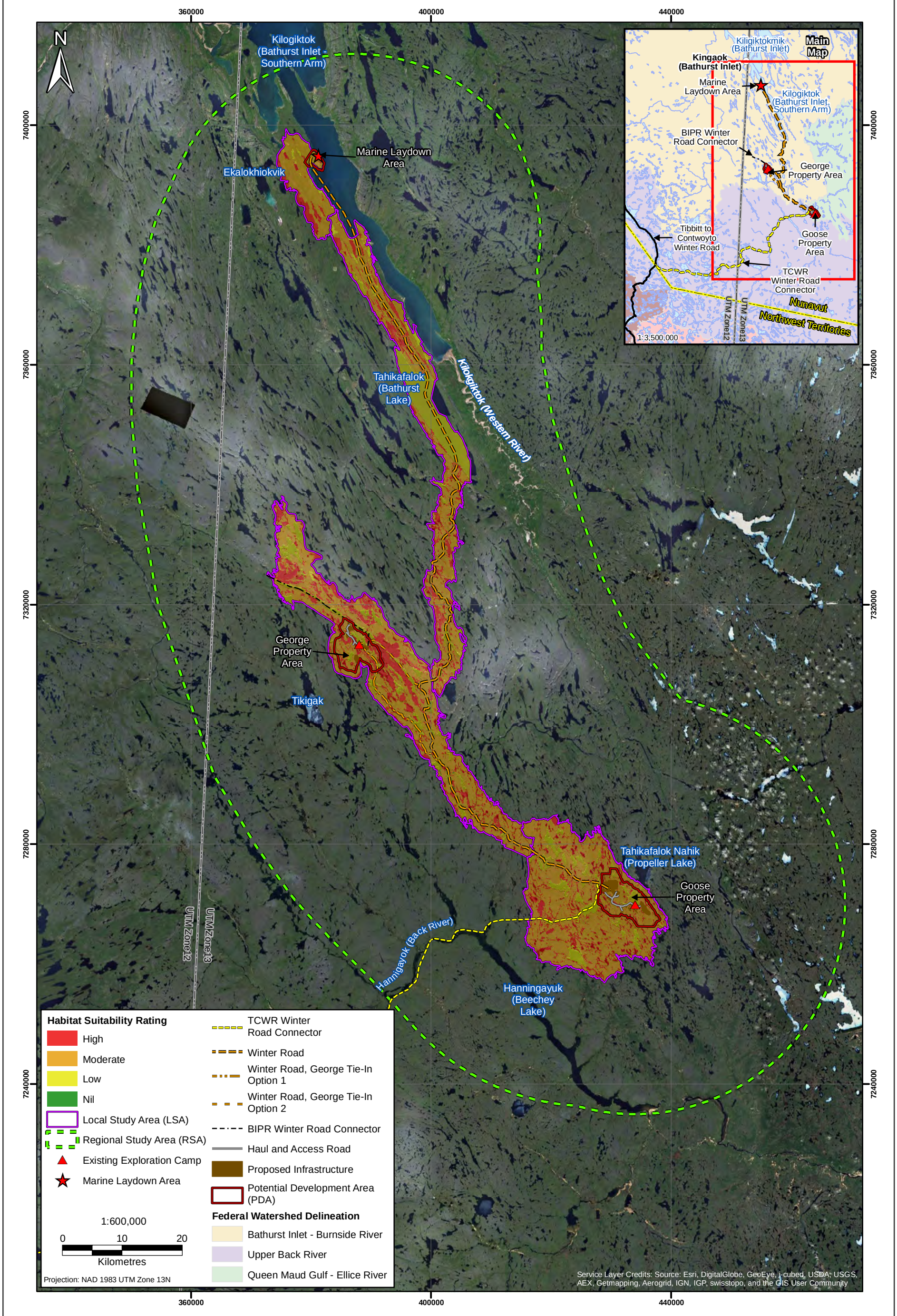

Figure 5.2-3

Sabina GOLD & SILVER CORP.

Caribou: Post-calving and Summer Habitat in the Local Study Area

Figure 5.2-3

Rescan an ERM company

Table 5.2-3. Caribou Post-calving and Summer Habitat within the Local Study Area and Regional Study Area

Suitability Rating	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
	Area (ha)	% of LSA[1]	Area (ha)[2]	% of RSA[1]
High	25,850.80	19	343,578.60	27
Moderate	88,824.94	66	738,800.73	59
Low	19,556.98	15	107,137.87	8
Nil	136.58	1	67,635.37	5

[1] *For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100%.*
[2] *Includes LSA. Approximately 4,852.05 ha of the RSA fell in the Unclassified class and was not included in modelling, thus the total amount of habitat modelled in the RSA is 1,257,152.58 ha.*

The amounts of High, Moderate, Low, and Nil rated habitats were similar between the RSA and LSA. The majority of habitat rated was of Moderate suitability, followed by Highly rated habitat (59 and 27% of the RSA, respectively). No spatial trends were evident in the distribution of Highly and Moderately rated habitats across the RSA (Figure 5.2-4). The remainder of the RSA was rated as Low (8%) and Nil (5%; Table 5.2-3).

5.2.3.1 Fall

Highly rated habitat was widely distributed across the LSA in the fall (Figure 5.2-5); three-quarters (75%) of the LSA was rated as HSR 1 habitat (Table 5.2-4). Fall habitat represents the areas used while caribou migrate southward to fall rutting grounds and onwards to wintering grounds. The large amount of highly suitable fall habitat in the LSA was primarily influenced by the large number of ecosystem polygons that can produce a wide variety of green and shrubby forage in the fall. As caribou are more opportunistic in their feeding habitats later in the year, these habitats represent areas where caribou are likely to browse as they travel south. HSR 1 habitat within the LSA was dominated by ecosystems that can produce forage for caribou as opposed to habitat that may be used for travelling; very little (approximately 1%) of the LSA was mapped as esker habitat (Rescan 2013a, Appendix V5-4A). Low rated habitats covered 18% of the LSA, followed by Moderate (7%) and Nil (less than 1%) rated habitats. Generally, Low to Nil rated habitats were mixed ecosystem polygons that contained higher proportions of low quality foraging areas (e.g., barren and sparsely vegetated tundra, bedrock and boulder fields) relative to habitat that could produce preferred forage, or were represented by lakes, ponds, and rivers. Moderate rated habitats did not have ideal composition and abundance of preferred fall forage, but are still able to produce browse in modest quantity.

Table 5.2-4. Caribou Fall Habitat within the Local Study Area and Regional Study Area

Suitability Rating	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
	Area (ha)[1]	% of LSA[1]	Area (ha)[2]	% of RSA[1]
High	100,265.28	75	562,764.43	45
Moderate	9,795.05	7	178,261.57	14
Low	24,177.80	18	448,491.21	36
Nil	131.17	< 1	67,635.37	5

[1] *For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100%.*
[2] *Includes LSA. Approximately 4,852.05 ha of the RSA fell in the Unclassified class and was not included in modelling, thus the total amount of habitat modelled in the RSA is 1,257,152.28 ha.*

Highly rated fall habitat for caribou covered nearly half (45%) of the RSA (Table 5.2-4). Spatially, Highly rated habitats were widely distributed across the RSA (Figure 5.2-6). Highly rated habitats encompassed lower elevation wetland habitats (which are common in the southern RSA around the Goose Property) where green vegetation may still be available in the fall, as well as the surrounding drier tundra where lichen, some grasses, and shrubby vegetation are common. Similar to the results of the suitability mapping in the LSA, HSR 1 habitat was based primarily on forage quality and quantity as opposed to habitats that may facilitate quick travel, as less than 1% of the RSA was mapped as esker (Rescan 2013a, Appendix V5-4A). Moderately suitable (HSR 2) habitat, totalling 14% of the RSA, was distributed in areas on the west and east side of Bathurst Inlet in the northern RSA and in the southern area; Moderate habitats were generally defined as those with a larger amount of shrub cover in both dry and wet areas. Of the remaining habitat that was rated, a large amount was rated as Low (36%) while a small proportion was rated as Nil (5%). Much of these lower rated habitats were either characterized by large expanses of dry, rocky habitats, or by water. Barren, rocky habitats offer little forage value as the vegetation is sparse, In addition, travel through these area may be challenging.

It should be noted that the Beverly herd uses the RSA during fall, but the Bathurst herd uses an area approximately 150-200 km to the south of the RSA during this period.

5.3 MUSKOX

5.3.1 Background

Muskox are the only other large ungulate species (aside from caribou) that occupy tundra habitats year round (Larter and Nagy 2004); muskox are distributed across most of the Kitikmeot Region of Nunavut (A. Gunn and Adamczewski 2003). Unlike caribou, muskox do not migrate long distances and tend to concentrate habitat use in areas of sedge and willow growth in riparian corridors. Muskox are presently designated as secure in Nunavut (CESCC 2010). Muskox are important prey for carnivores and are highly valued by the Inuit as a source of food, leather, and meat for commercial export. These ungulates also attract tourists to Nunavut for guided sport hunting and wildlife viewing. Muskox were close to extinction in the late nineteenth and early twentieth centuries due to overhunting (Fournier and Gunn 1998; Campbell and Setterington 2001), but numbers have generally increased over the last three decades and the historic range has been recolonized (Fournier and Gunn 1998; Campbell and Setterington 2001). The Inuit have also remarked on the expansion in distribution and numbers of the muskox since the 1960s. Muskox are particularly sensitive to disturbance during the calving season (late March through May), because animals are in their poorest condition at the end of winter and have high energetic demands during calving. Disturbance to herds may culminate in stampeding behaviour that can cause calves to be trampled or abandoned (A Gunn and Case 1984).

5.3.2 Habitat Suitability Model Development

Habitat selection for each season was developed from literature searches, local knowledge, previous and concurrent wildlife surveys, and project specific habitat assessments. Table 5.3-1 provides a summary of the seasons and life requisites that were assessed for muskox, with the following sections expanding on the habitat preferences for each season and habitat ratings for each vegetation association that occurs in the LSA and RSA.

Table 5.3-1. Seasonal Life Requisites of Muskox

Season	Date	Life Requisite	Habitat Preference
Summer/Fall	June to September	Living	Wetlands, shrubby areas, eskers with graminoid cover.
Winter/Early Spring	October to May	Living, Reproducing	Windswept ridges and other areas that have low snow cover allowing for accessibility of forage.

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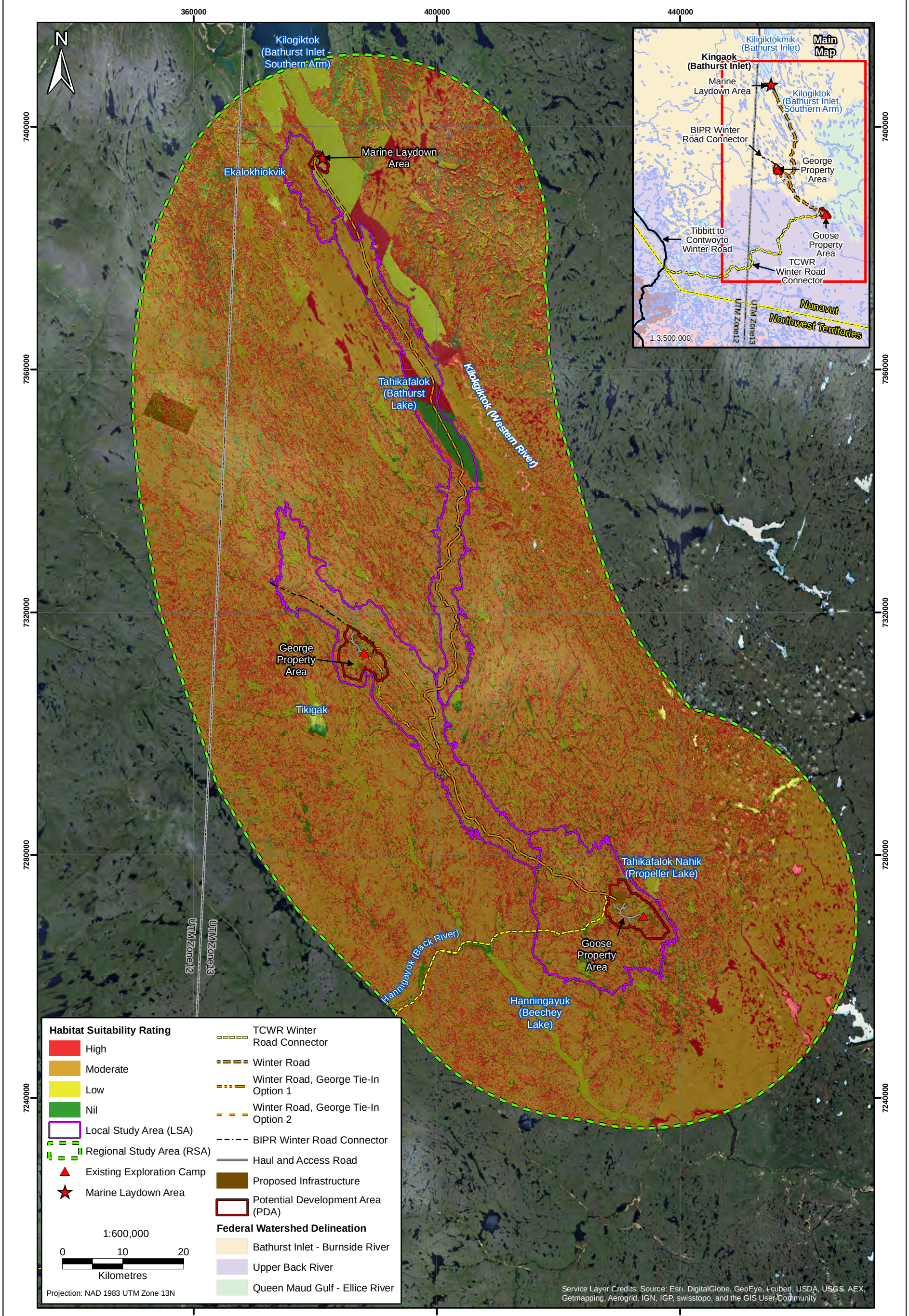

Figure 5.2-4

Sabina GOLD & SILVER CORP.

Caribou: Post-calving and Summer Habitat in the Regional Study Area

Figure 5.2-4

Rescan an ERM company

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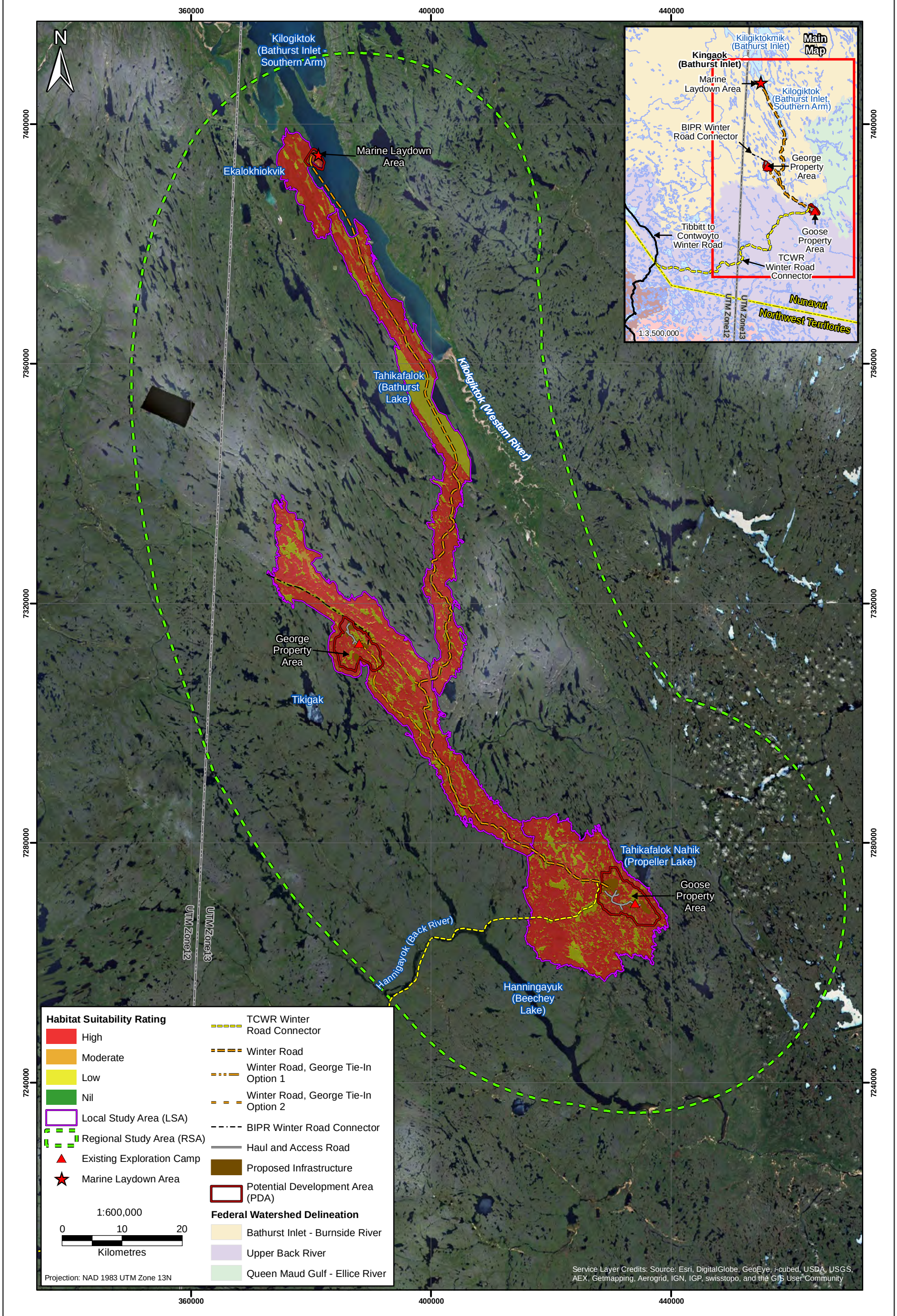

Figure 5.2-5

Sabina GOLD & SILVER CORP.

Caribou: Fall Habitat in the Local Study Area

Figure 5.2-5

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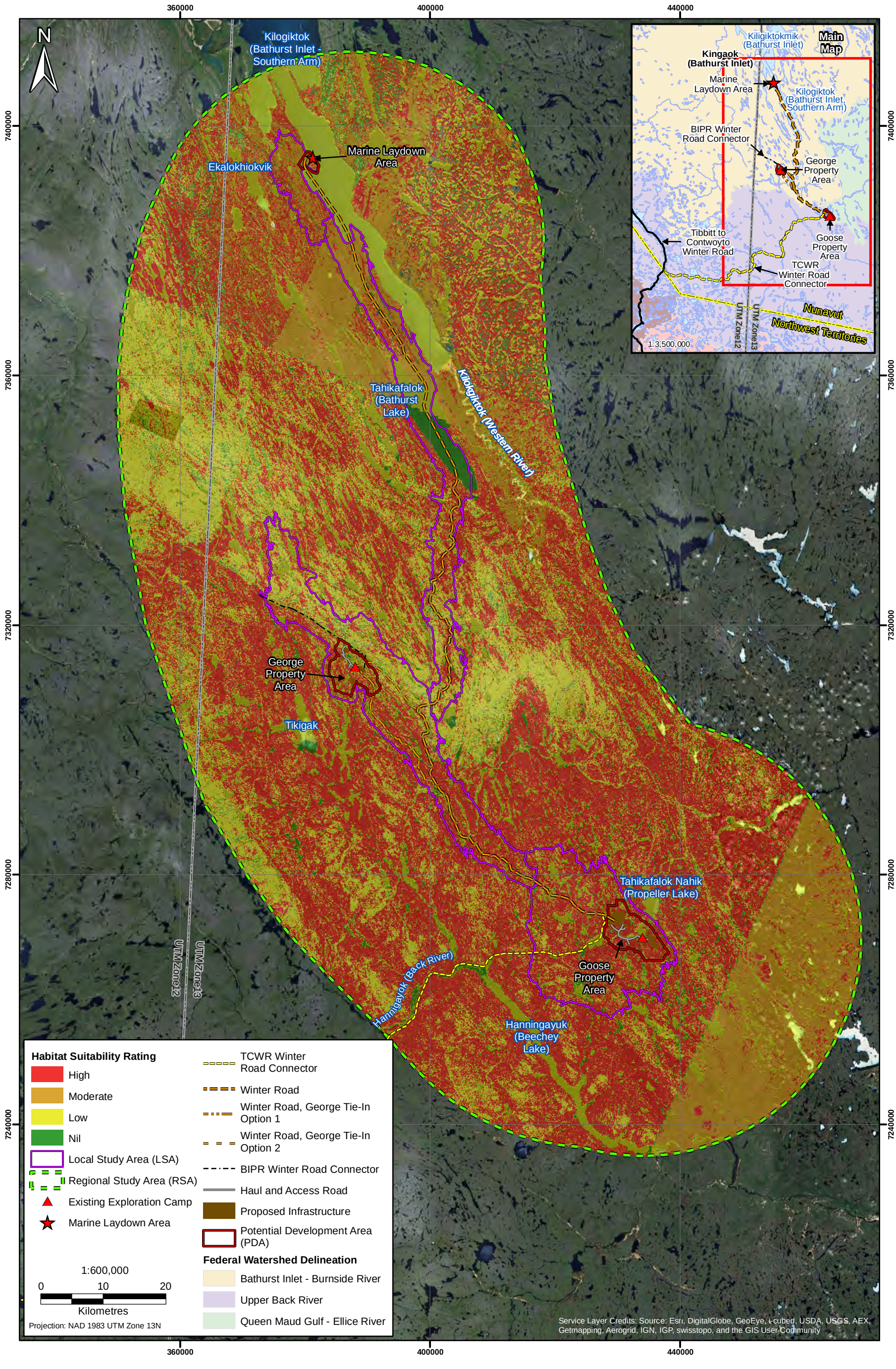

Figure 5.2-6

Sabina GOLD & SILVER CORP.

Caribou: Fall Habitat in the Regional Study Area

Figure 5.2-6

Rescan an ERM company

5.3.2.1 Model Assumptions

Summer/Fall

Early in the summer, muskox are known to feed on sedges as they are greening up (Gunn, 1984). As the summer progresses, the main forage of muskox includes graminoids such as sedges and grasses, willows and forbs which grow quickly, producing rich forage (A. Gunn and Sutherland 1997b; Nellemann and Reynolds 1997; A. Gunn and Adamczewski 2003). Muskox are commonly found near wetland and in wetter, shrubby tundra habitats in the summer (A. Gunn and Sutherland 1997b). Gunn and Sutherland (1997b) also found that single bulls and immature males used the immediate vicinity of water bodies more often than any other age or sex class. The fringes of these water bodies may support muskox forage such as sedges. The following general assumptions were made to define summer habitat ratings:

- High ratings were given to vegetation associations that contain preferred forage species, mainly willow and sedges.
- Moderate ratings were assigned to vegetation associations that contain some preferred forage species, but typically have a lower cover of sedges and willow species.
- Low ratings were given to vegetation associations that contained limited forage opportunities.
- Nil ratings were given to vegetation associations that contained sparse vegetation, or where travel was difficult.

Winter/Early Spring

Habitat use during the winter and early spring is focused on areas that provide accessible forage (e.g., low snowpack or windswept areas) and/or early vegetation growth. Willows are especially selected in spring when willow leaves are emerging (A. Gunn and Sutherland 1997a; Larter and Nagy 2004; Kristensen et al. 2011). Habitat studies have shown that late winter/early spring habitat use is varied, ranging from rugged exposed terrain in the high Arctic, to lowland areas in Alaska, indicating that habitat use may vary from region to region (Schaefer, Stevens, and Messier 1996; Nellemann and Reynolds 1997). Habitat preference is based on the need for low winter fat reserves to be replenished, and for pregnant or lactating cows to access high quality forage (Reynolds, Reynolds, and Shideler 2002). The following general assumptions were made to define winter and early spring habitat ratings:

- High ratings were given to vegetation associations where limited snowpack is likely (e.g., windswept ridges) and areas with a significant amount of early vegetation.
- Moderate ratings assumed that forage opportunities were available, but were not as accessible or available as early in the season as high value vegetation associations.
- Low ratings were given to vegetation associations with limited seasonal forage, or areas where the snowpack likely persists thereby reducing foraging opportunities.
- Nil ratings were given to vegetation associations with sparse vegetation, high disturbance, and those that typically occur in landscape positions where snow packs are deep and persistent.

5.3.3 Results and Discussion

5.3.3.1 Summer/Fall

Very little (7%) of the LSA was rated as Highly suitable summer and fall habitat for muskox (Table 5.3-2). Highly rated habitat was mapped over relatively small areas in the LSA (Figure 5.3-1), as few ecosystem polygons contained high proportions of habitat that could produce large amounts of preferred forage (e.g., sedge wetlands and riparian areas). Moderately suitable habitats, encompassing

28% of the LSA, covered larger geographic areas than Highly rated habitats and were spread across the LSA (Figure 5.3-1; Table 5.3-2). The largest proportion of the LSA was rated as Low (65%). For the most part, Low suitability habitats were those that were almost purely composed of habitats that would produce low quantities of forage (i.e., ecosystem polygons dominated by WHR 3 rated habitats). Less than 1% of the LSA was rated as Nil.

Table 5.3-2. Muskox Summer and Fall Habitat within the Local Study Area and Regional Study Area

	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
Suitability Rating	Area (ha)[1]	% of LSA[1]	Area (ha)[2]	% of RSA[1]
High	9,416.09	7	168,221.76	13
Moderate	37,545.98	28	314,380.74	25
Low	87,203.99	65	702,002.89	56
Nil	203.24	< 1	72,547.20	6

[1] *For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100%.*
[2] *Includes LSA. Approximately 4,852.05 ha of the RSA fell in the Unclassified class and was not included in modelling, thus the total amount of habitat modelled in the RSA is 1,257,152.58 ha.*

High and Moderate rated habitats accounted for 13% and 25% of the RSA, respectively. These habitats represented areas capable of producing large to moderate amounts of high quality summer forage; these higher quality habitat areas appeared to be most abundant in the north RSA surrounding Bathurst Inlet and in the southeastern RSA (Figure 5.3-2). Low rated habitats occupied over two-thirds (56%) of the RSA, covering the vast tracts of drier tundra and boulder fields where little to no forage may be available. A small amount (6%) of the RSA was rated as Nil.

5.3.3.2 Winter/Early Spring

Highly rated winter and early spring muskox habitat, covering 8% of the LSA, is primarily near the George Property Area and northern portion of the LSA (Figure 5.3-3; Table 5.3-3). High rated habitat was sparse within the southern portion of the LSA. Moderate rated habitats accounted for approximately a fifth (22%) of the LSA; these habitats generally had high to modest amounts of shrubby forage over the winter and into the spring but not all forage may be accessible due to deeper snowpack. Moderate rated habitat was mainly located near the George Property Area and northern portion of the LSA. The remainder of the LSA was rated as Low (44%) and Nil (26%; Table 5.3-3). These lower rated habitats encompassed much of the lower elevation habitats in the LSA, such as wetlands and larger water bodies (Figure 5.3-3). Vegetation in wetlands (e.g., sedges and grasses) can be an important food source for muskox in the winter where they can crater through soft snow down to the ground or where the wind exposes these types of habitats. However, it was assumed that the vast majority of wetlands would be covered in a deep and persistent snowpack into the spring because they generally occurred on the lowest slope positions in the study area.

A total of 6% (69,629 ha) of the RSA was rated as Highly suitable habitat for muskox in the winter and early spring (Table 5.3-3). Highly rated habitats were sparsely distributed across the RSA (Figure 5.3-4). Generally these highly rated habitats were windswept tundra and ridges where herbaceous or shrubby forage would be accessible. Moderate rated habitats accounted for 27% of the RSA and represented higher elevation, windswept habitats that have a lower quantity of suitable forage for muskox over winter and into the spring (e.g., rocky heath habitats where lichens are common but grasses and shrubs grow more sparsely). The remaining habitat was rated as Low (26%) and Nil (41%). Low and Nil rated habitats generally encompassed river valleys, water bodies, and surrounding lowland habitats were snowpack would limit foraging opportunities (Figure 5.3-4; Table 5.3-3).

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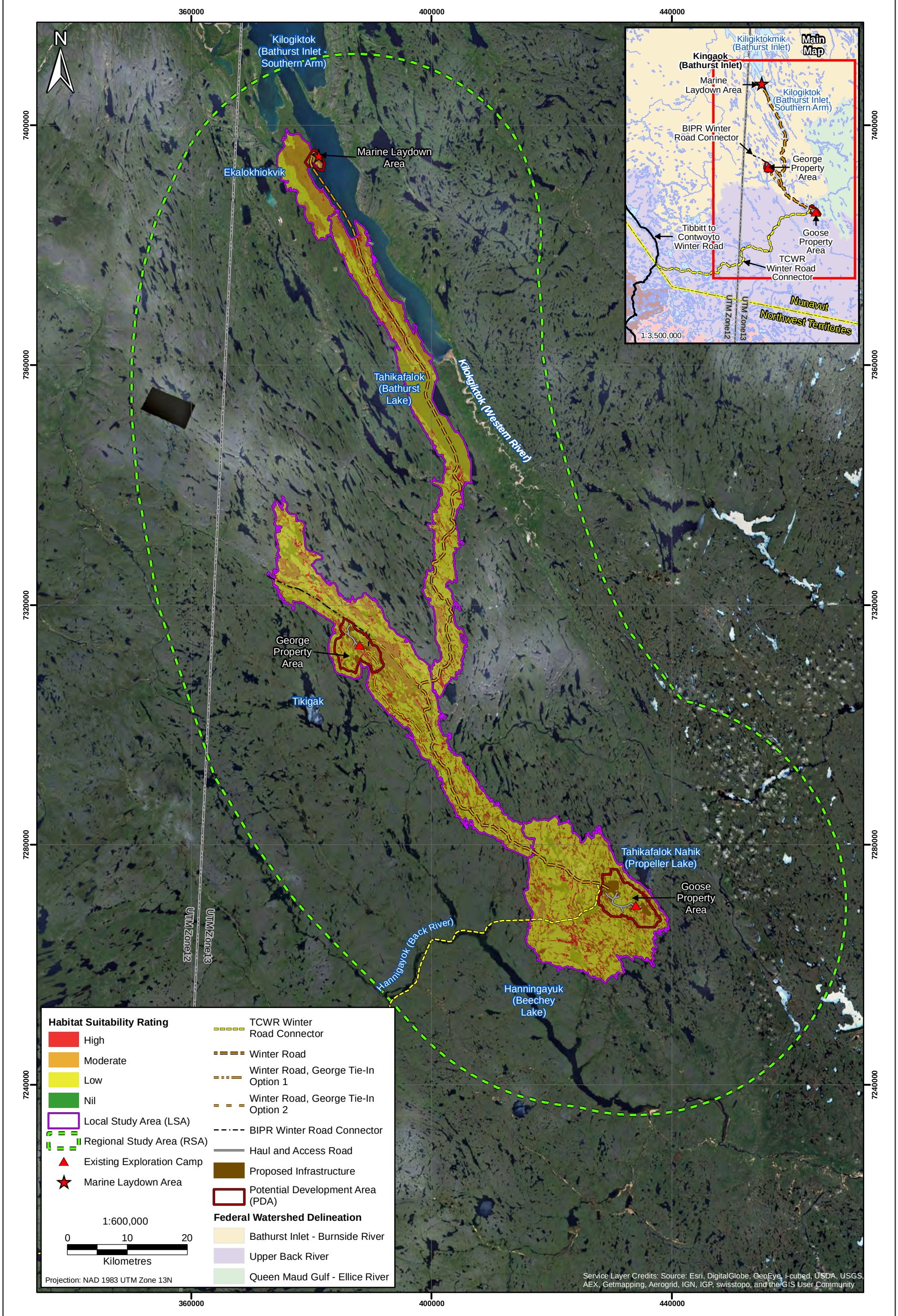

Figure 5.3-1

Sabina GOLD & SILVER CORP.

Muskox: Summer and Fall Habitat in the Local Study Area

Figure 5.3-1

Rescan an ERM company

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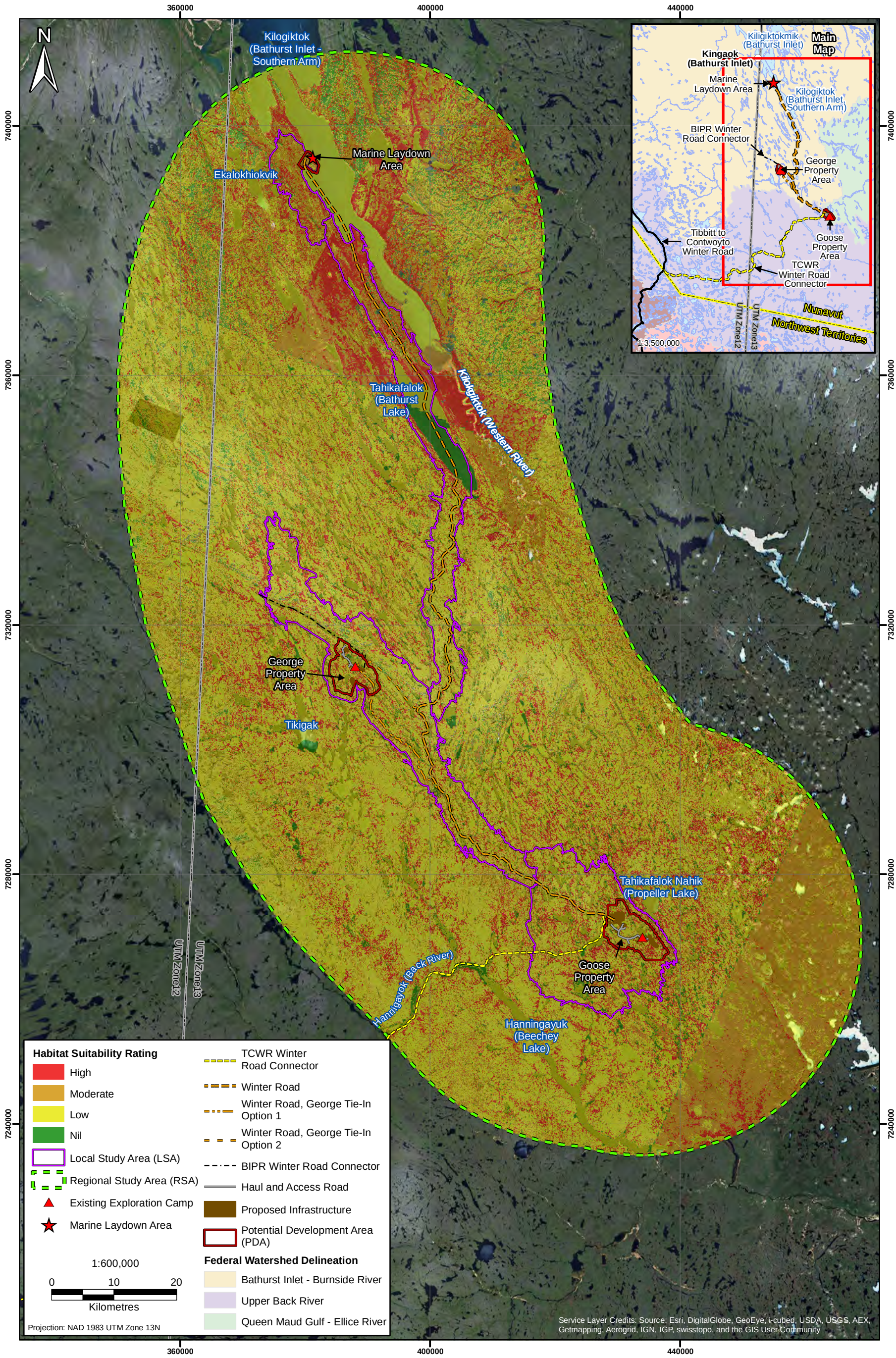

Figure 5.3-2

Sabina GOLD & SILVER CORP.

Muskox: Summer and Fall Habitat in the Regional Study Area

Figure 5.3-2

Rescan an ERM company

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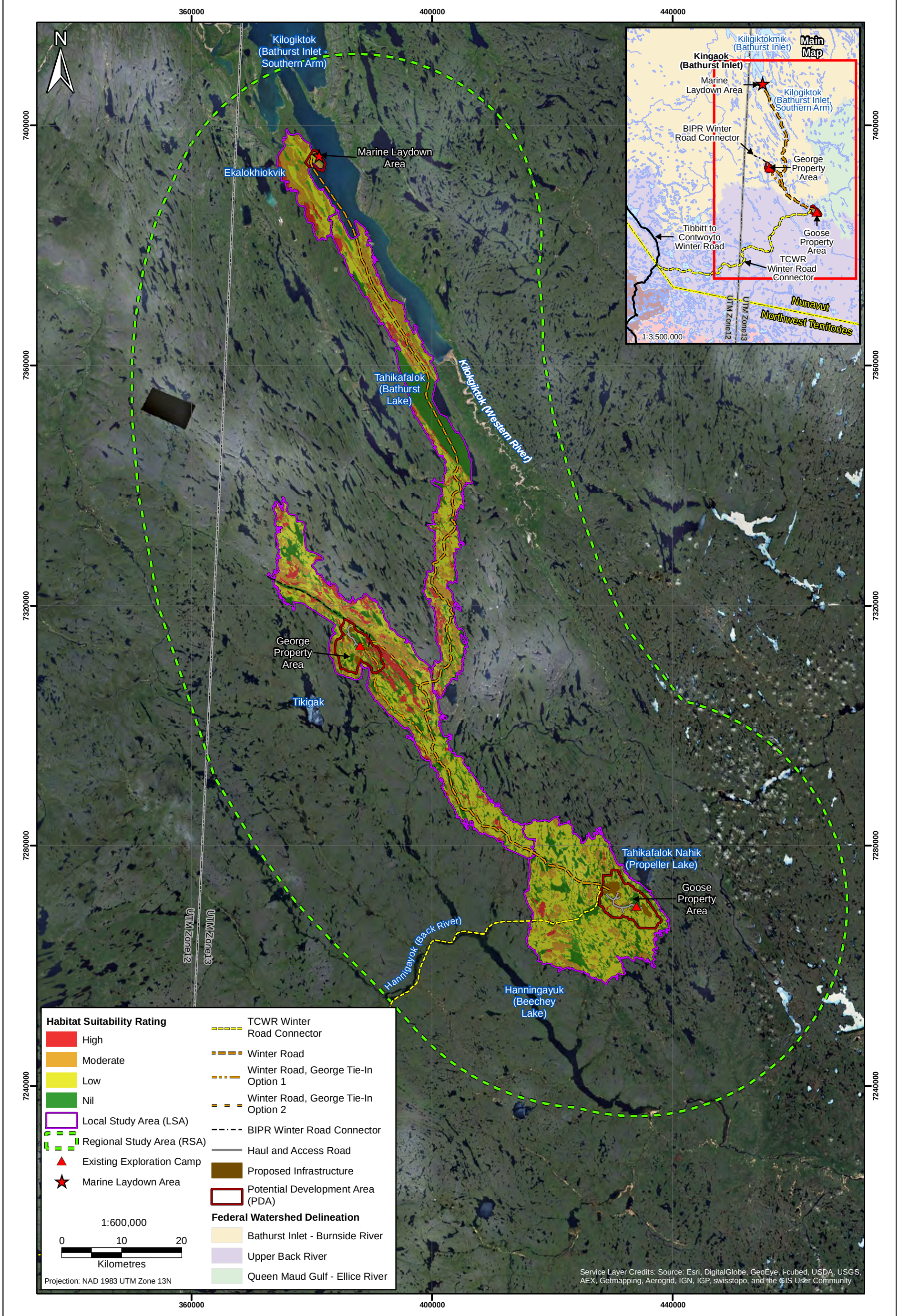

Figure 5.3-3

Sabina GOLD & SILVER CORP.

Muskox: Winter and Early Spring Habitat in the Local Study Area

Figure 5.3-3

Rescan an ERM company

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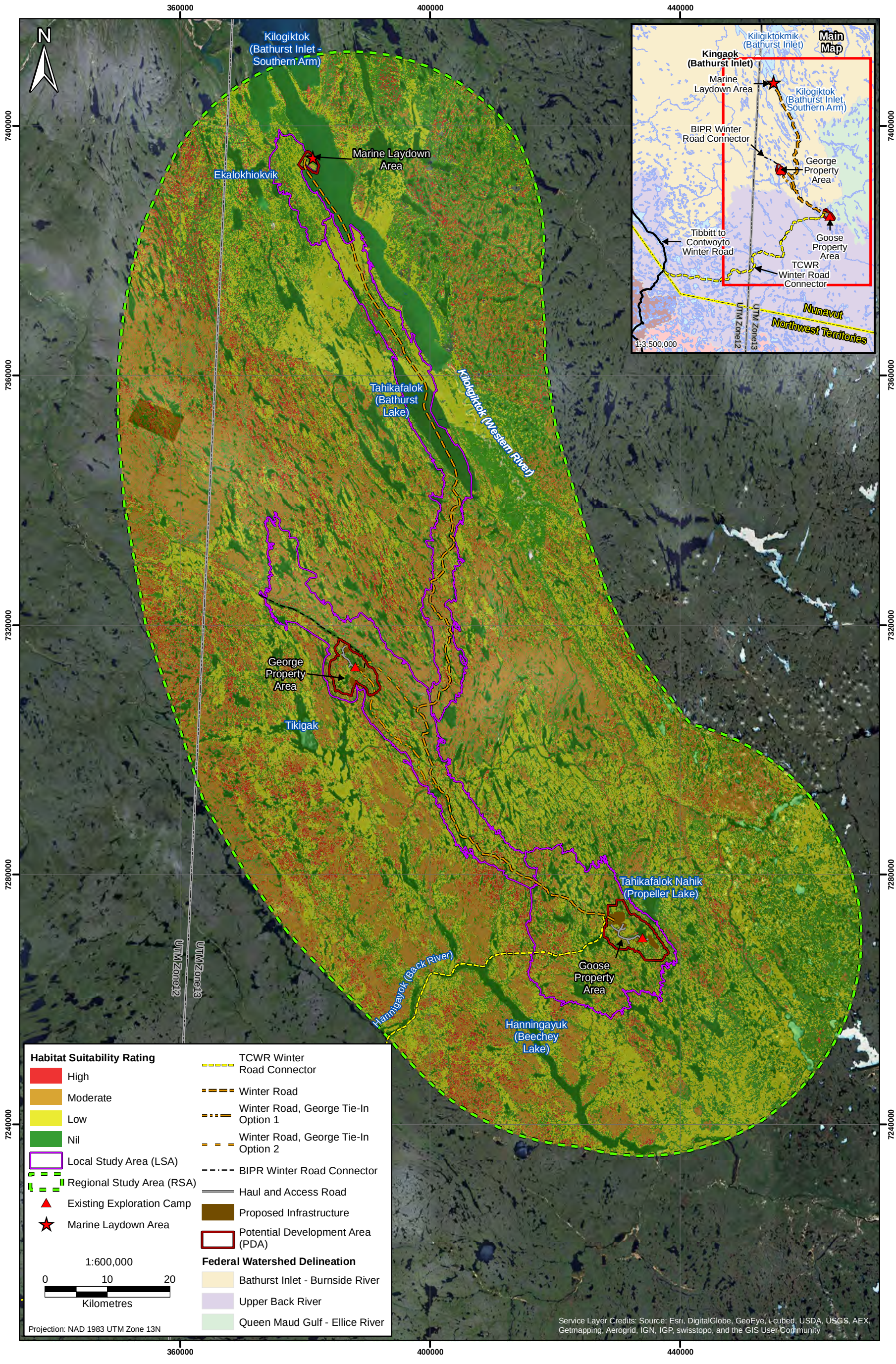

Figure 5.3-4

Sabina GOLD & SILVER CORP.

Muskox: Winter and Early Spring Habitat in the Regional Study Area

Figure 5.3-4

Rescan an ERM company

Table 5.3-3. Muskox Winter and Early Spring Habitat within the Local Study Area and Regional Study Area

Suitability Rating	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
	Area (ha)[1]	% of LSA[1]	Area (ha)[2]	% of RSA[1]
High	10,371.54	8	69,629.33	6
Moderate	29,754.76	22	340,442.43	27
Low	58,950.99	44	330,149.21	26
Nil	35,292.03	26	516,931.61	41

[1] *For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100%.*
[2] *Includes LSA. Approximately 4,852.05 ha of the RSA fell in the Unclassified class and was not included in modelling, thus the total amount of habitat modelled in the RSA is 1,257,152.58 ha.*

5.4 GRIZZLY BEAR

5.4.1 Background

Grizzly bears (*Ursus arctos*) in the Arctic, often referred to as barren-ground grizzly bears, are an important, top-level predator in the Arctic ecosystem. Grizzly bears in the Canadian Arctic belong to the larger, western Canadian population of grizzly bear, which are currently listed as Special Concern under COSEWIC (COSEWIC 2002), and in Nunavut, grizzly bear are considered Sensitive (CESCC 2010).

There is no official estimate on grizzly bear population sizes for Nunavut. However, a crude estimate of 800 grizzly bears was determined for a 200,000 km^2 portion of the northwestern mainland of Nunavut, which includes the Project area (Ross 2002). This estimate assumed a density of four bears per 1,000 km^2 based on grizzly bear densities in nearby areas (Ross 2002). The barren-ground grizzly bear population is stable or slightly increasing, but is considered vulnerable to decline from increased adult mortality (McLoughlin, Taylor, Cluff, Gau, Mulders, Case, Boutin, et al. 2003; McLoughlin, Taylor, Cluff, Gau, Mulders, Case and Messier 2003). Population modelling studies using demographic data of bears in the region show that even slight increases in mortality can precipitate a negative population trend (McLoughlin, Taylor, Cluff, Gau, Mulders, Case and Messier 2003).

Barren-ground grizzly bear occur at the northern and eastern edge of the continental grizzly bear range. These bears have the largest home ranges of any grizzly bear in North America, ranging around 2,100 km^2 for females and 7,245 km^2 for males (McLoughlin, Ferguson, and Messier 2000). These extensive home ranges are necessitated by the lower quality and quantity of suitable foraging habitats in the Arctic. Given the lower productivity and high seasonality of the Arctic environment, the home range of individual grizzly bear overlap more on the tundra than they do in southern, more productive areas (McLoughlin, Ferguson, and Messier 2000).

5.4.2 Habitat Suitability Model Development

Grizzly bear are omnivorous and opportunistic feeders that select habitat largely based on seasonal availability of forage (MacHutchon and Wellwood 2003; Wellwood 2003). Table 5.4-1 presents the seasonal life requisites for grizzly bear used to develop suitability ratings. Ratings focused on living requisites for the spring, summer, and fall seasons, and were based on an assessment of the ecosystem units' abilities to produce forage species. Vegetation phenology was used to rate ecosystem units for target forage species for a given season (e.g., blueberries are absent in the spring, ripen during the summer, and die off during the fall). Prey sources that are strongly associated with specific ecosystem units were included in the ecosystem unit ratings where possible, e.g., Arctic ground squirrel

(*Spermophilus parryii*) colonies located within esker habitats. For the denning season, ratings were geared towards satisfying the reproducing life requisite and focussed on identifying habitats with high potential for denning opportunities (e.g., easily excavated soils).

Table 5.4-1. Seasonal Life Requisites of Grizzly Bear

Season	Date	Life Requisite	Habitat Preference
Spring	May - June	Living	Esker, crowberry, blueberry, sedge, riparian shrub, caribou, ground squirrel
Summer	June - September	Living	Esker, blueberry, sedge, riparian shrub, ground squirrel
Fall	September - October	Living	Esker, blueberry, sedge, riparian shrub, caribou, ground squirrel
Denning	October to May	Reproducing	Eskers, lacustrine deposits

5.4.2.1 Model Assumptions

The assumptions developed for grizzly bear were based on literature reviews, suitability mapping completed for similar projects in Nunavut and the NWT, and field assessments. The main assumptions are that grizzly bears target a variety of vegetation as it becomes available through the short, Arctic growing season, but are strongly influenced by the availability of caribou and other protein sources (e.g., ground squirrels) in the early spring and again in the late summer and fall (Gau et al. 2002). Caribou availability was not included in the rating assumptions as it is not a factor that can be accurately applied (due to the variability in the location and timing of caribou presence). The following sections describe the wildlife habitat rating assumptions and rating for each season for the LSA and RSA.

Spring

Spring habitat provides grizzly bears their first opportunity to feed after emerging from winter hibernation. Important habitat includes areas that become snow-free early, and ecosystem units that contain last season's over-wintered berries, Arctic ground squirrel burrows, winter-weakened ungulates, and early vegetation (Gau et al. 2002; MacHutchon and Wellwood 2003). The following general assumptions were made to define spring WHRs:

- High ratings were assigned to vegetation associations that provide early season food sources. These are upland areas that are generally windswept resulting in low snowpack. Over-wintered berries from the previous season are typically available, as are Arctic ground squirrels.
- Moderate ratings were given to vegetation associations that provide some food sources, but are generally not windswept and have limited over-wintered berries. These vegetation associations also have the potential for some early season forage of sedges and grasses.
- Low ratings were given to vegetation associations that were considered to have low forage potential and are not preferred habitat for prey species.
- Nil ratings were given to vegetation associations that have a lack of forage and prey, or are disturbed.

Summer

Summer habitat use by grizzly bears is highly variable. Grizzlies primarily feed on horsetails, sedges, and cottongrass in the early summer when caribou are scarce, as well as berries if they are available. Caribou calves and Arctic ground squirrels are considered to be their primary prey sources in mid-summer (Gau et al. 2002). Late summer use focuses on areas with high berry production. The following general assumptions were made to define summer WHRs:

- High ratings were given to vegetation associations that provide berries, cottongrass, and sedges which are critical vegetative food sources when caribou are absent from the region. Eskers were included for Arctic ground squirrel availability and ease of travel.
- Moderate ratings were assigned to vegetation associations that provide late summer berry production and those which contain sedges and cottongrass in limited quantities.
- Low ratings were given to vegetation associations that were considered to have low forage potential and are not preferred habitat for prey species.
- Nil ratings were given to vegetation associations that lacked forage and prey, and those that were disturbed.

Fall

The fall season is critical for grizzly bears as they must gain weight rapidly in order to survive the winter. Fall habitat selection is focused on areas of high caribou occurrence (Johnson et al. 2004) and berry availability. The following general assumptions were made to define fall WHRs:

- High ratings were given to vegetation associations that are most likely to contain large quantities of berries and Arctic ground squirrels.
- Moderate ratings were assigned to vegetation associations that may contain limited quantities of berries, and to a lesser extent browning sedge and cottongrass forage.
- Low ratings were given to vegetation associations that were considered to have low forage potential and are not preferred habitat for prey species.
- Nil ratings were given to vegetation associations that lacked forage and prey, and those that were disturbed.

Denning

In general, denning lasts from late October to early May for most bears; some bears, males in particular, may den for shorter periods of time (McLoughlin, Cluff, and Messier 2002). Dens have been found in a wide variety of habitat types. Of 56 dens located by McLoughlin, Cluff, and Messier (2002), most (60%) were found in heath tundra and heath-boulder habitats, and many of the remaining dens were located in riparian tall shrub and birch seep habitats. Although eskers accounted for only seven of 56 den sites studied, this habitat type was selected more than expected given its low availability in the central Arctic. Hence, many habitats appear to have suitable soil texture and structure for denning, but eskers may be selected where available given the ease in which bears may excavate dens. The following general assumptions were made to define denning WHRs:

- High ratings were assigned to vegetation associations that provide terrain features that allow for denning opportunities, specifically parent materials that are easily excavated, have deep permafrost layers, and contain sufficient vegetative root masses to provide soil stability.
- Moderate ratings were given to vegetation associations that are similar to high value habitat, but are more likely to contain limitations in the form of shallow permafrost layer, or consolidated materials.
- Low ratings were given to vegetation associations that were considered to have limited potential for successful den excavations, but recognize that the arctic landscape generally provides few high value denning sites, so sub-optimal sites may be utilized.

- Nil ratings were given to vegetation associations that were not suitable for excavation due to shallow soils, high permafrost layers, organic soils, or other conditions that would make a successful den excavation difficult.

5.4.3 Results and Discussion

5.4.3.1 Spring

Very little (2%) of the LSA was rated as Highly suitable spring habitat for grizzly bear (Table 5.4-2), indicating that few ecosystem polygons contained high proportions of habitat with preferred spring forage and prey species (e.g., windswept areas with low snowpack and over-wintered berries or abundant Arctic ground squirrel colonies). The largest concentrations of Highly rated habitat were mapped northwest of the George Property Area along the LSA boundary (Figure 5.4-1). The majority (65%) of the LSA was rated as Moderately suitable spring habitat for grizzly bear and covered large expanses of most of the LSA (Figure 5.4-1). These areas have higher snowpack and are generally not windswept, so vegetation and over-wintered berries are limited. Approximately a third of the LSA was rated as Low (14%) and Nil (18%) suitability habitats and would provide very limited forage and prey species.

Table 5.4-2. Grizzly Bear Spring Habitat in the Local Study Area and Regional Study Area

	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
Suitability Rating	**Area (ha)**	**% of LSA[1]**	**Area (ha)[2]**	**% of RSA[1]**
High	3,182.31	2	5,457.20	< 1
Moderate	87,405.09	65	637,044.63	51
Low	19,074.53	14	412,168.14	33
Nil	24,707.36	18	202,482.60	16

[1] *For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100%.*
[2] *Includes LSA. Approximately 4,852.05 ha of the RSA fell in the Unclassified class and was not included in modelling, thus the total amount of habitat modelled in the RSA is 1,257,152.58 ha.*

Half of the RSA (51%) contained Moderately suitable spring habitat for grizzly bear and was distributed fairly evenly throughout the area (Table 5.4-2; Figure 5.4-2). Approximately one-third of the RSA was rated as Low suitability habitat (33%). Moderate and Low habitats would represent areas producing average to limited amounts of preferred early season forage and prey species. Nil suitability habitat (16% of RSA) covered much of the water and barren ecosystems, and thus provides limited to no value for foraging or hunting. Very limited portions (less than 1%) in the northern segment of the RSA were rated as Highly suitable spring habitat.

5.4.3.2 Summer

A small amount (9%) of the LSA was rated as Highly suitable summer habitat for grizzly bear. These areas are sparse throughout the LSA with a concentration along the western side of Bathurst Inlet (Figure 5.4-3). Highly suitable summer habitat was generally associated with wetlands, such as marshes or fens, which provide abundant sedges and cottongrass. Two-thirds (67%) of the LSA was comprised of Moderate suitability summer habitat and approximately one-quarter (24%) of the LSA was rated as Low suitability habitat for grizzly bear (Table 5.4-3). Moderate habitats were fairly evenly distributed within the LSA, particularly within and surrounding the Goose Property Area (Figure 5.4-3). These habitats were generally associated with shrubby areas that provide late summer berries. A larger amount of Low suitability habitat was identified near the George Property Area. Low rated habitats were typically associated with dry, sparse tundra with low forage potential and limited prey species.

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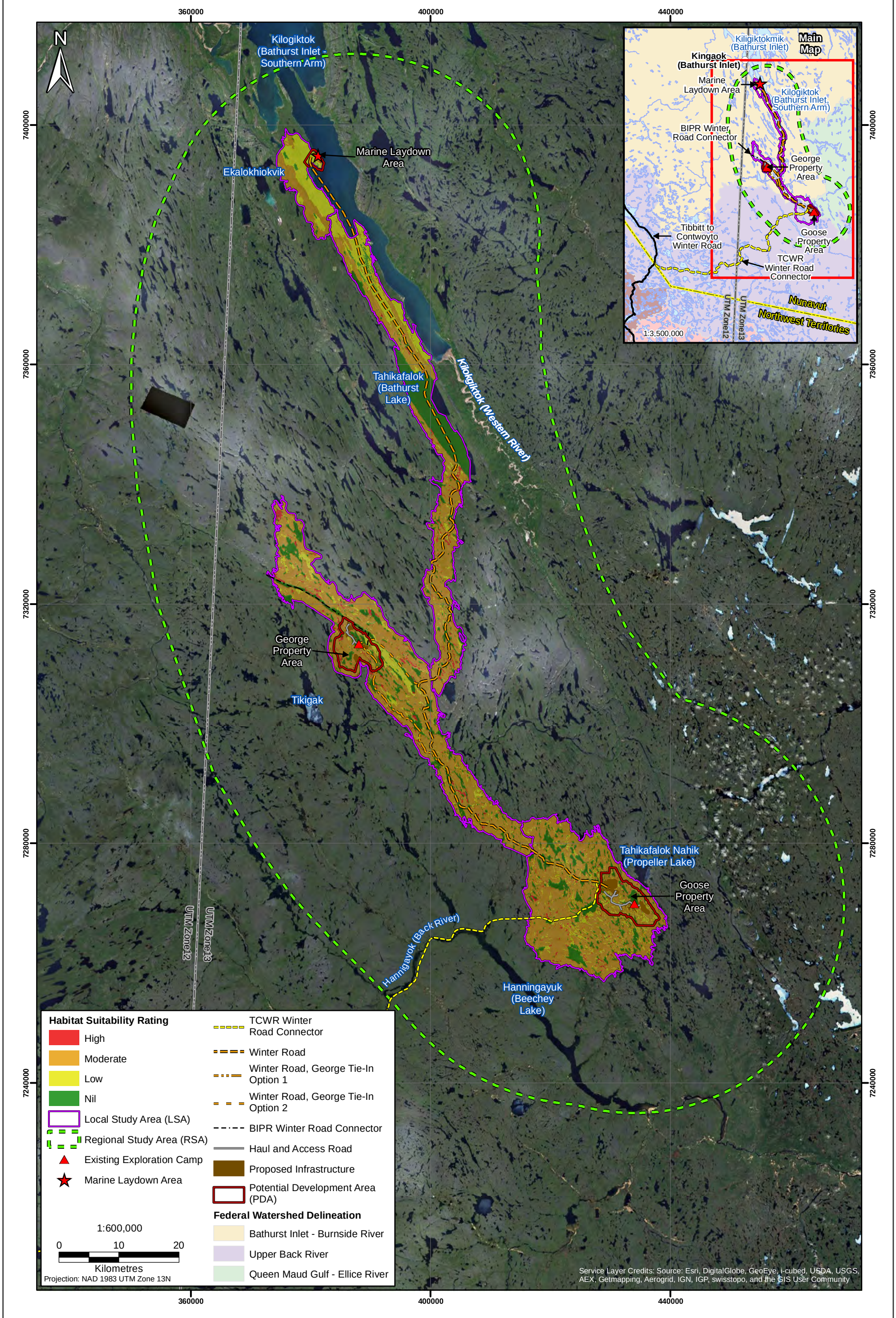

Figure 5.4-1

Sabina GOLD & SILVER CORP.

Grizzly Bear: Spring Habitat in the Local Study Area

Figure 5.4-1

Rescan an ERM company

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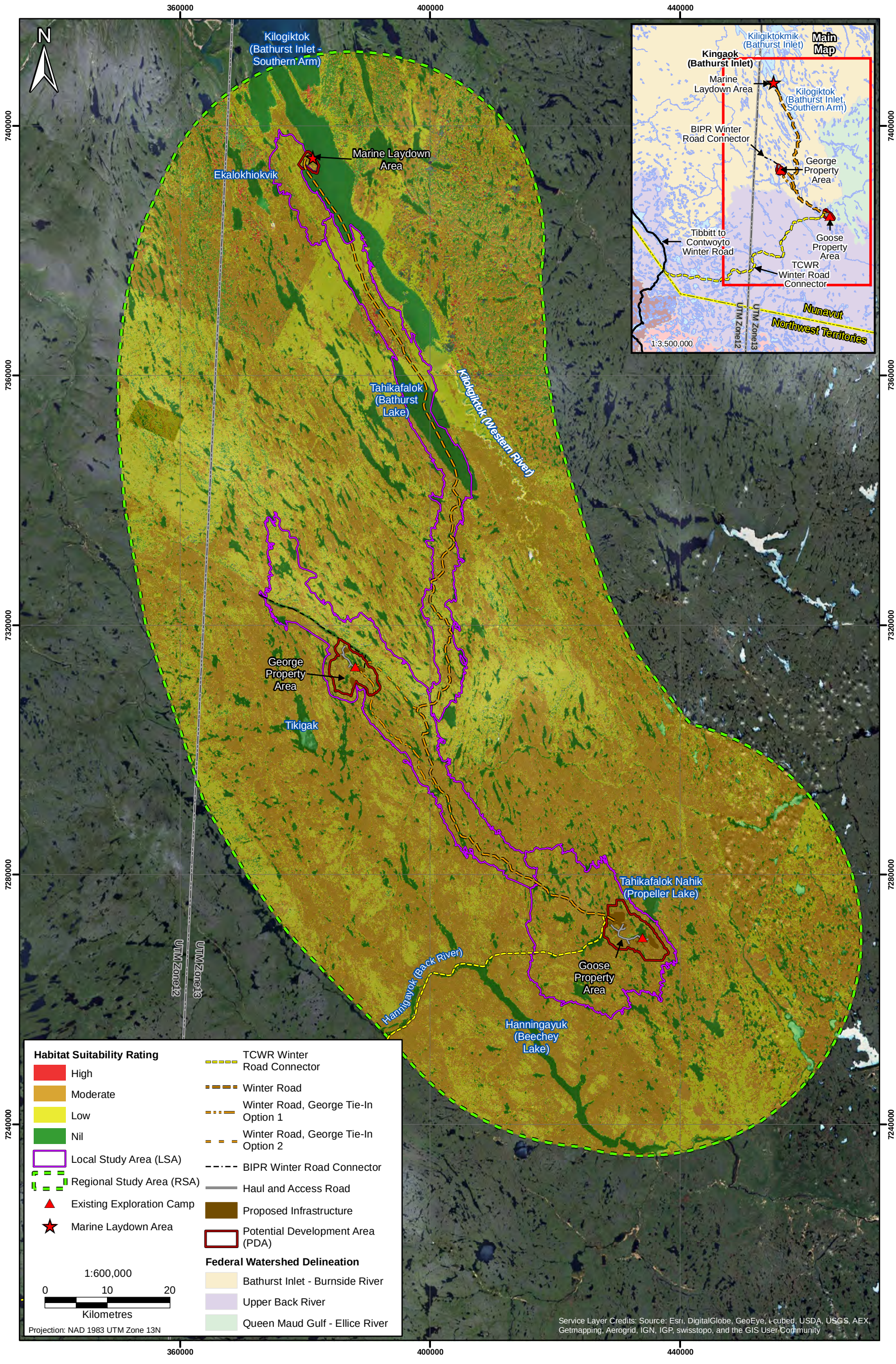

Figure 5.4-2

Sabina GOLD & SILVER CORP.

Grizzly Bear: Spring Habitat in the Regional Study Area

Figure 5.4-2

Rescan an ERM company

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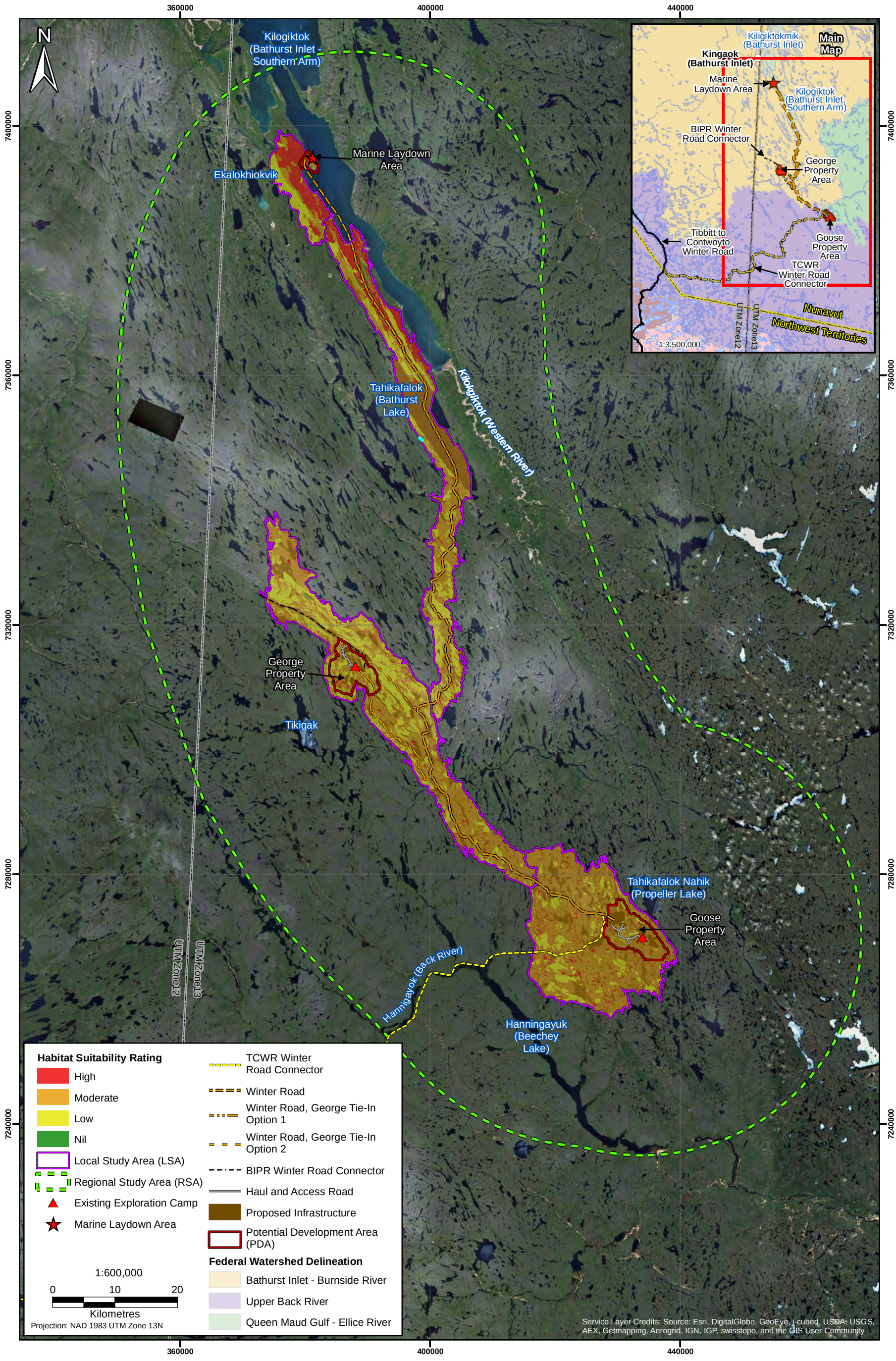

Figure 5.4-3

Sabina GOLD & SILVER CORP.

Grizzly Bear: Summer Habitat in the Local Study Area

Figure 5.4-3

Rescan an ERM company

Table 5.4-3. Grizzly Bear Summer Habitat in the Local Study Area and Regional Study Area

Suitability Rating	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
	Area (ha)	% of LSA[1]	Area (ha)[2]	% of RSA[1]
High	11,887.54	9	137,717.33	11
Moderate	90,219.29	67	540,367.41	43
Low	31,740.05	24	506,521.65	40
Nil	518.18	< 1	72,547.20	6

[1] *For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100%.*
[2] *Includes LSA. Approximately 4,852.05 ha of the RSA fell in the Unclassified class and was not included in modelling, thus the total amount of habitat modelled in the RSA is 1,257,152.58 ha.*

The majority (83%) of the RSA was composed of relatively equal portions of Moderate (43%) and Low (40%) suitability summer habitats for grizzly bear (Figure 5.4-4; Table 5.4-3). Moderate and Low rated habitats consist of shrubby to drier tundra areas with adequate to low forage and prey species. The remaining habitat was comprised of High rated (11%) and Nil rated habitat (6%; Table 5.4-3). Highly suitability habitats were sparsely distributed throughout the RSA and were associated with sedge-meadow wetlands, which would provide both early and late summer forage (Figure 5.4-4).

5.4.3.3 Fall

Limited areas (6%) of the LSA were rated as Highly suitable fall habitat for grizzly bear (Table 5.4-4); Highly rated habitat predominately encompassed shrubby esker areas, particularly along the coasts of Bathurst Inlet (Figure 5.4-5), where there be high berry availability and potentially prey species (e.g., ground squirrels, caribou). The majority of the LSA consisted of Moderately suitable fall habitat for grizzly bear (52%; Table 5.4-4). Moderate habitat was fairly evenly distributed within the LSA, representing areas with lower potential for berry production and late season sedge and graminoid forage. Under half (42%) of the LSA was rated as Low suitability fall habitat and predominately consisted of rocky or dry, sparse tundra with low berry availability. A large portion of Low habitat was mapped around the George Property Area. The remaining area (less than 1%) was rated as Nil suitability habitat.

Table 5.4-4. Grizzly Bear Fall Habitat in the Local Study Area and Regional Study Area

Suitability Rating	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
	Area (ha)	% of LSA[1]	Area (ha)[2]	% of RSA[1]
High	7,347.94	6	5,457.20	< 1
Moderate	70,011.78	52	542,692.12	43
Low	56,448.67	42	636,456.05	51
Nil	556.67	< 1	72,547.20	6

[1] *For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100%.*
[2] *Includes LSA. Approximately 4,852.05 ha of the RSA fell in the Unclassified class and was not included in modelling, thus the total amount of habitat modelled in the RSA is 1,257,152.58 ha.*

Approximately half (51%) of the RSA was rated as Low suitability fall habitat for grizzly bear (Table 5.4-4). Low rated habitat covered large tracts of the RSA and were characterized by rocky heath tundra or boulder fields that produce little to no berry forage (Figure 5.4-6). There was 43% of Moderately suitable fall grizzly bear habitat in the RSA; this habitat is dominated by mesic, shrubby tundra and sedge wetlands. Very little (less than 1%) of the RSA was rated as Highly suitable fall habitat for grizzly bear; this limited High rated habitat was constrained to esker complexes in the northern portion of the RSA (Figure 5.4-6). The remaining habitat was rated as Nil (6%; Table 5.4-4).

5.4.3.4 Denning

Suitable denning habitat was very limited in the LSA and RSA. Both the LSA and RSA were predominately rated as Nil suitability for grizzly bear denning habitat, respectively 97% and 96% (Table 5.4-5; Figure 5.4-7 and Figure 5.4-8). This was expected due to the limited extent of eskers and lacustrine deposits within the LSA and RSA and the dominance of rocky heath tundra and boulder fields. High suitability grizzly bear denning habitat was limited (less than 1%) within both the RSA and LSA and was constrained to shrubby, esker complexes (Figure 5.4-7 and Figure 5.4-8). Spatially, High suitability habitat was very sparse throughout the LSA and was constrained to the northern portion of the RSA.

Table 5.4-5. Grizzly Bear Denning Habitat in the Local Study Area and Regional Study Area

Suitability Rating	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
	Area (ha)	% of LSA[1]	Area (ha)[2]	% of RSA[1]
High	942.09	< 1	5,457.20	< 1
Moderate	532.56	< 1	0.00	0
Low	2,242.55	~2	49,677.98	~4
Nil	130,652.11	97	1,202,017.39	96

[1] For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100%.
[2] Includes area of LSA. Approximately 4,852.05 ha of the RSA fell in the Unclassified class and was not included in modelling, thus the total amount of habitat modelled in the RSA is 1,257,152.58 ha.

5.5 GREY WOLF

5.5.1 Background

The largest member of the *Canis* genus, the grey wolf (*Canis lupus*) was once abundant over much of North America and Eurasia; however, its range has reduced due to habitat destruction and hunting. Wolves are still widespread throughout much of northern Canada, including the West Kitikmeot Region of Nunavut. Populations are stable or increasing within their Canadian range, except in northern Alberta and some parts of the NWT (Hayes and Gunson 1995). In Nunavut, grey wolf is listed as secure (CESCC 2010).

Wolves are the main predators of barren-ground caribou and rely on adequate ungulate densities to maintain wolf population size (Walton et al. 2001; Paquette and Ludwig 2003). As predators of migratory caribou, wolves in the Arctic are also migratory and trail caribou populations through much of the year. Grey wolves overwinter alongside boreal and barren-ground caribou below the treeline and in the spring follow the migration of barren-ground caribou northwards towards their calving grounds. Grey wolves select denning sites on the tundra in late April, which are located to the south of the primary caribou calving grounds. Dens are focal points of wolf activity during the summer, and there is evidence that individual wolves exhibit fidelity to den sites (Cluff, Walton, and Paquet 2002), returning and using the same areas in successive years (Walton et al. 2001). Adults make long distance forays from den sites in search of caribou during the summer, and alternative prey, such as young birds and small mammals, can sustain wolves during periods of low ungulate availability. Wolves begin to follow caribou herds southward towards caribou winter grounds as soon as the young are able to travel with the pack, generally in September. On account of their migratory behaviour, wolves in the Arctic have exceptionally large home ranges (approximately 63,000 km^2 for males and 45,000 km^2 for females) and exhibit fewer territorial behaviours than wolves in other parts of North America (Walton et al. 2001).

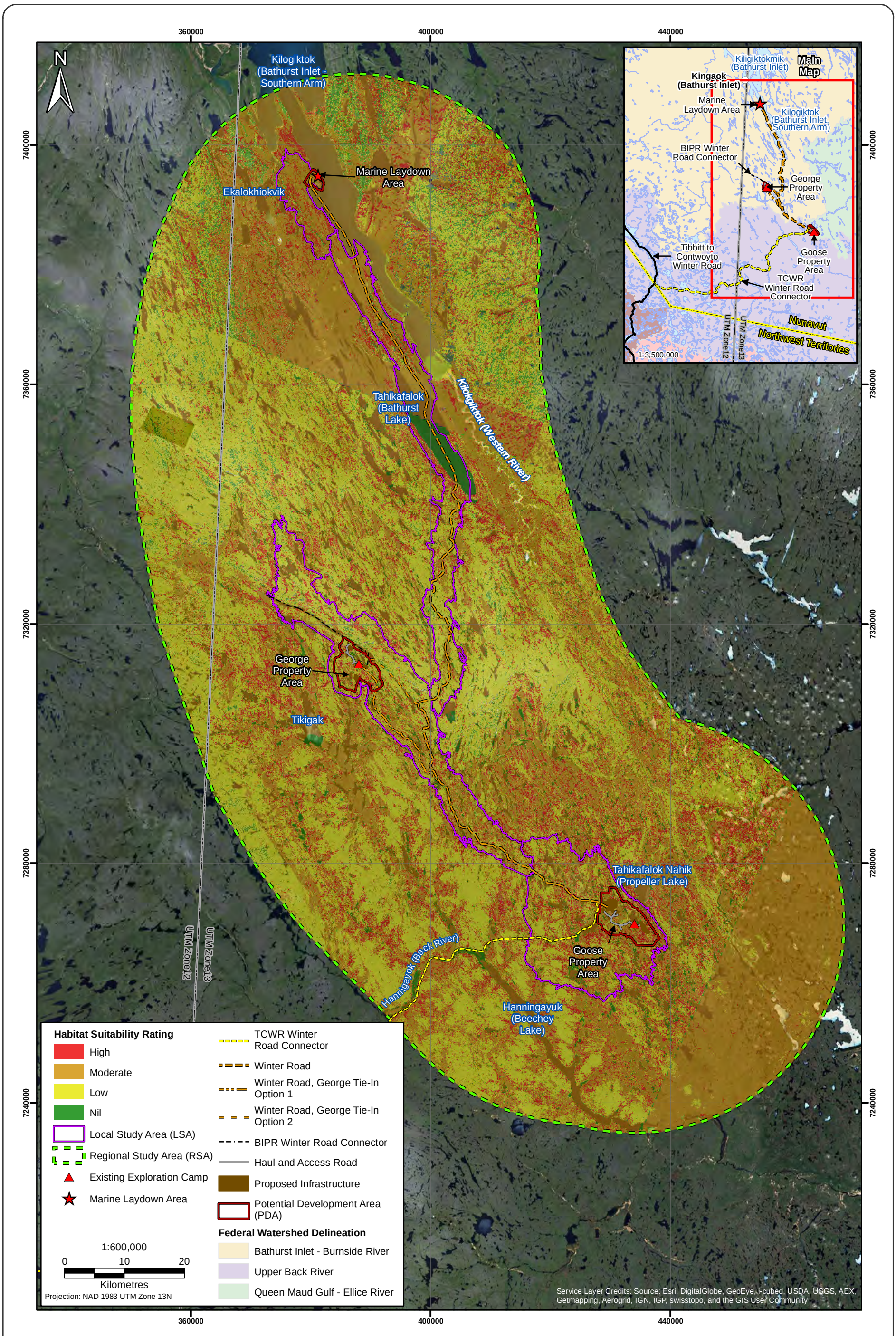

Figure 5.4-4

Sabina GOLD & SILVER CORP.

Grizzly Bear: Summer Habitat in the Regional Study Area

Figure 5.4-4

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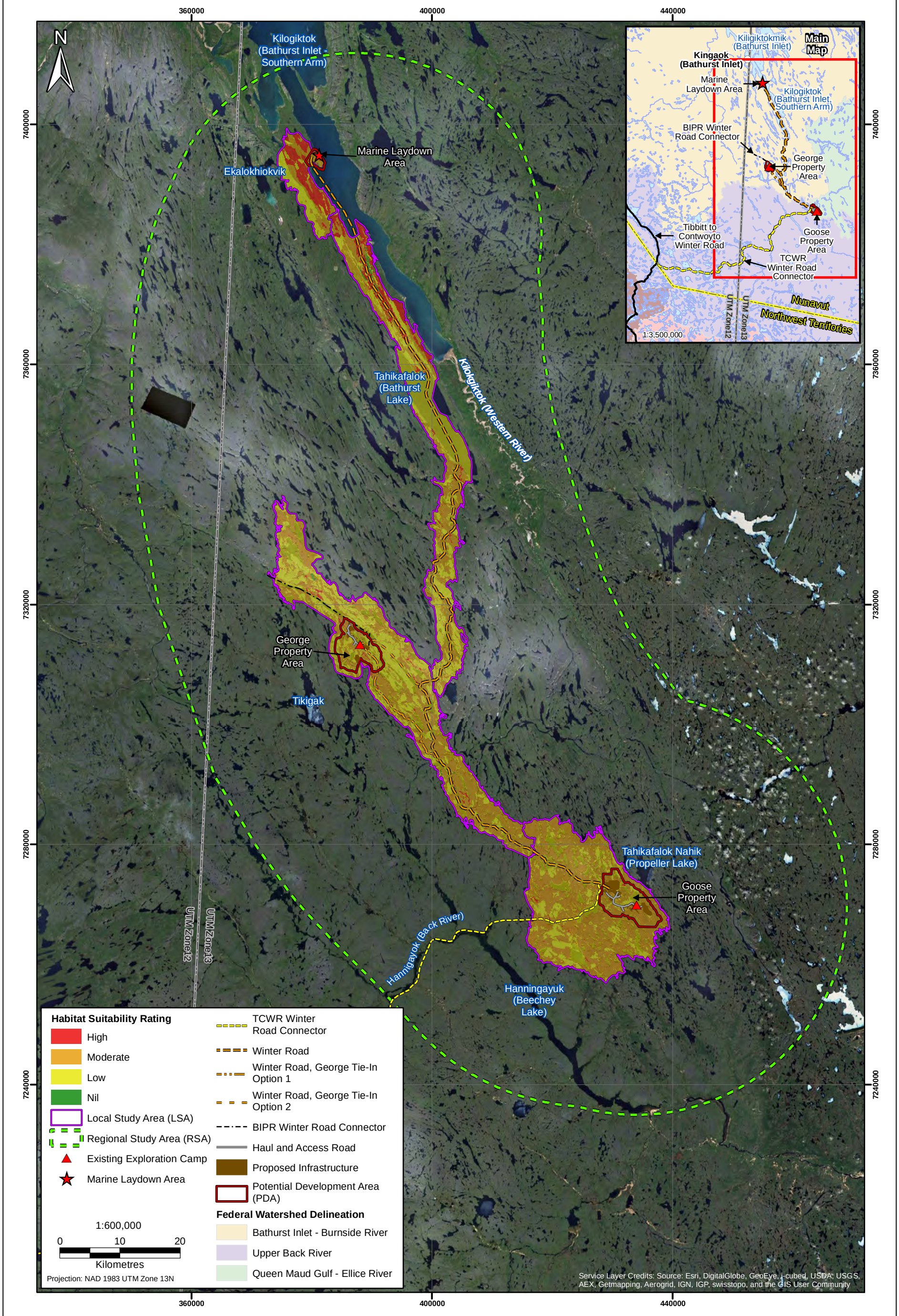

Figure 5.4-5

Sabina GOLD & SILVER CORP.

Grizzly Bear: Fall Habitat in the Local Study Area

Figure 5.4-5

Rescan an ERM company

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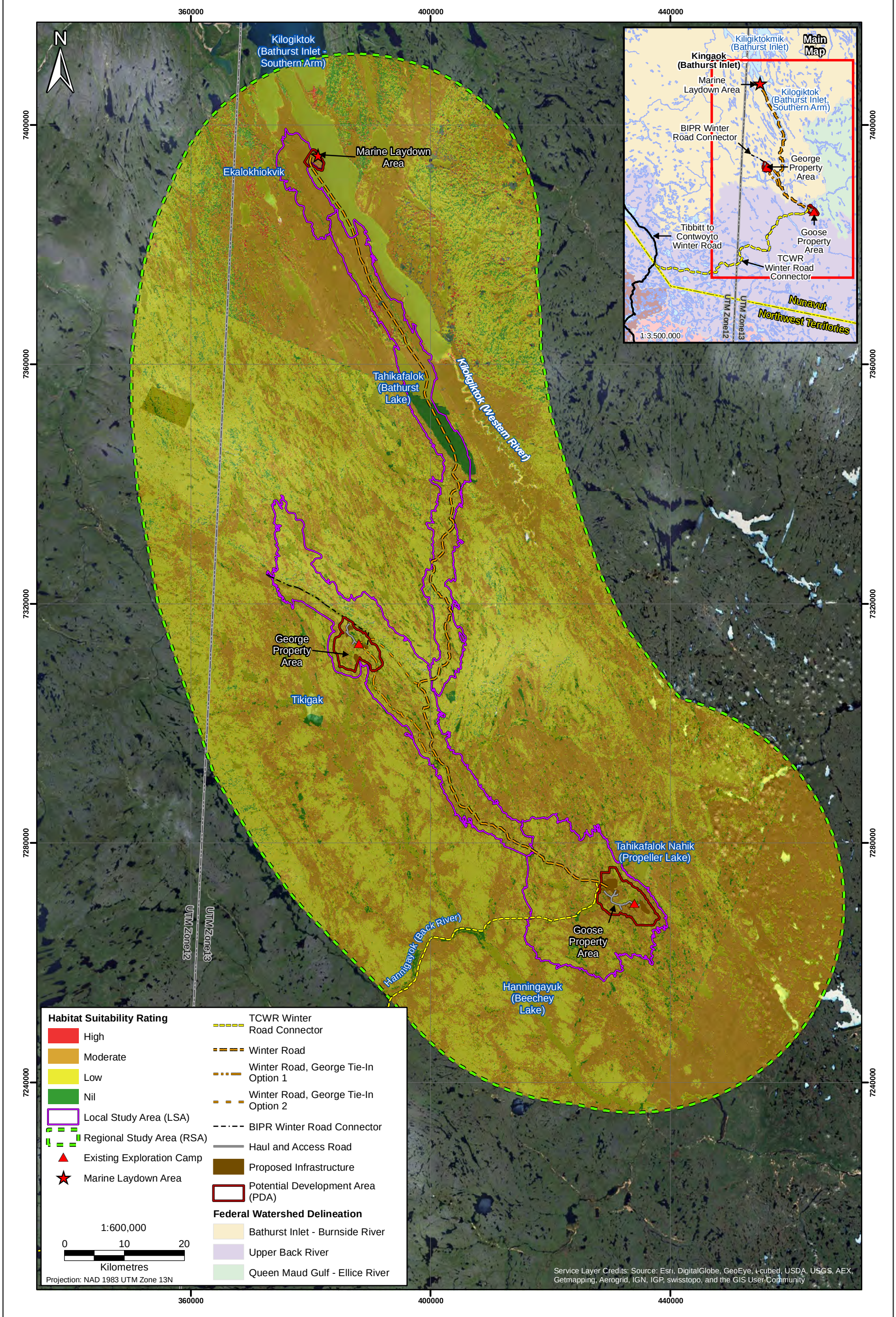

Figure 5.4-6

Sabina GOLD & SILVER CORP.

Grizzly Bear: Fall Habitat in the Regional Study Area

Figure 5.4-6

Rescan an ERM company

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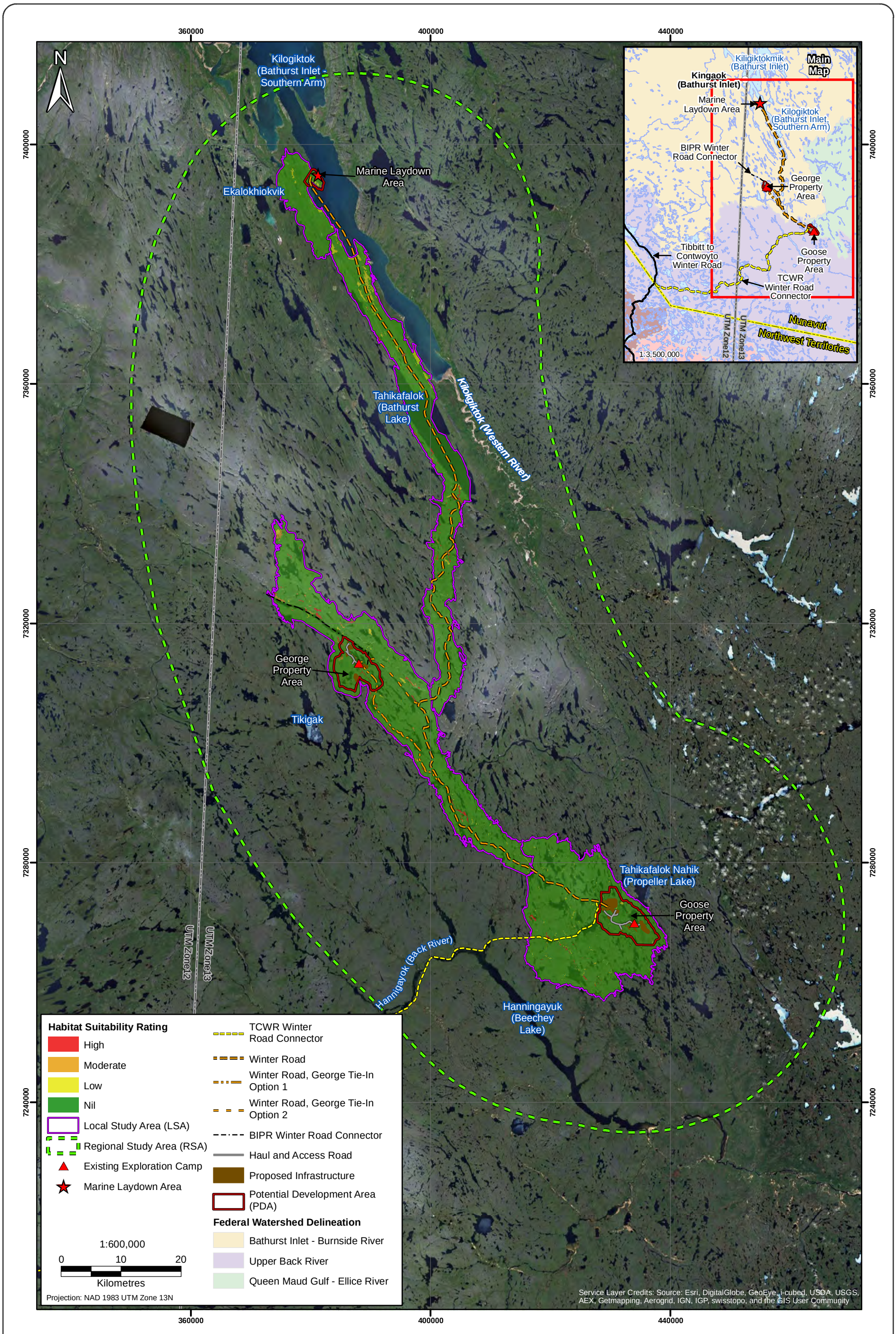

Figure 5.4-7

Sabina GOLD & SILVER CORP.

Grizzly Bear: Denning Habitat in the Local Study Area

Figure 5.4-7

Rescan an ERM company

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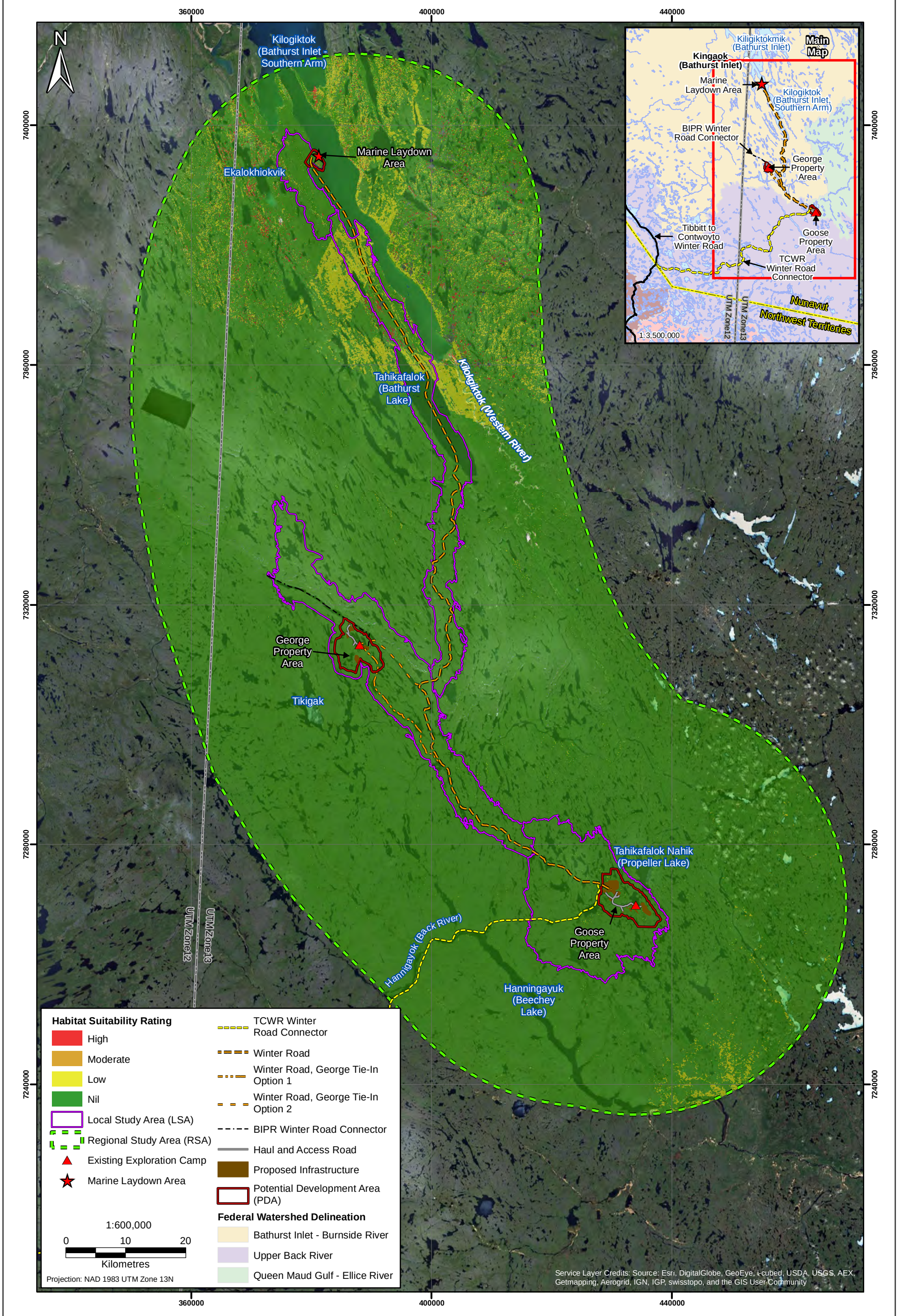

Figure 5.4-8

Sabina GOLD & SILVER CORP.

Grizzly Bear: Denning Habitat in the Regional Study Area

Figure 5.4-8

Rescan an ERM company

5.5.2 Habitat Suitability Model Development

Habitat suitability modelling for grey wolves focussed on identifying suitable denning habitat, satisfying the living and reproducing life requisites in the late spring through fall (Table 5.5-1). Wolves require specific habitat features that allow them to dig denning structures. In the tundra environment, eskers and other glacial deposits provide the best habitat for den sites (Mueller 1995; Rescan 1995; Golder 1998; Walton et al. 2001; Cluff, Walton, and Paquet 2002; McLoughlin et al. 2004). Dens may also occur in other areas that are easy to excavate such as mounds of glacial-fluvial sediment or along lake banks.

Table 5.5-1. Seasonal Life Requisites of Grey Wolf

Season	Date	Life Requisite	Habitat Preference
Denning	Late April to September	Living and Reproducing	Eskers, near prey

5.5.2.1 Model Assumptions

The grey wolf denning model assumed that eskers are the preferred habitats for den construction. Esker habitats are granular and sandy, likely facilitating soil excavation for complex dens sites in a landscape dominated by bedrock, boulders, standing water, and permafrost (McLoughlin et al. 2004). However, habitats that may have denning potential (e.g., gravelly areas where the permafrost layer is deep and soils are relatively loose) were also incorporated into the model where possible. The following general assumptions were made to define denning WHRs:

- High ratings were assigned to vegetation associations that provide terrain features that allow for denning opportunities, specifically parent materials that are easily excavated, have deep permafrost layers, and contain sufficient vegetative root masses to provide soil stability.
- Moderate ratings were given to vegetation associations that are similar to high value habitat, but are more likely to contain limitations in the form of shallow permafrost layer, or consolidated materials.
- Low ratings were given to vegetation associations that were considered to have limited potential for successful den excavations, but recognize that the arctic landscape generally provides few high value denning sites, so sub-optimal sites may be utilized.
- Nil ratings were given to vegetation associations that were not suitable for excavation due to shallow soils, high permafrost layers, organic soils, or other conditions that would make a successful den excavation difficult.

5.5.3 Results and Discussion

Highly suitable denning sites for grey wolves in both the LSA and RSA were scarce (less than 1%), as well as Moderate and Low rated habitats (< 4%; Table 5.5-2). Most of the habitat within the LSA (97%) and RSA (93%) was rated with Nil suitability for grey wolf denning (Table 5.5-2; Figures 5.5-1 and 5.5-2). High rated denning habitat was restricted to esker complexes. In the LSA, high and moderate rated habitat was sparsely distributed (Figure 5.5-1). However, in the RSA, high and moderate rated denning habitat was limited to the northern portion of the RSA; there was also additional moderate rated habitat in the southeastern portion (Figure 5.5-2).

However, even though eskers are generally limited within both the LSA and RSA, the calculated proportion of suitable denning habitat for grey wolves is likely underestimated since additional denning opportunities may occur in areas such as lake banks with lacustrine materials, which were not included in the modelling due to the inability to differentiate between suitable lake banks and open water.

Table 5.5-2. Grey Wolf Denning Habitat in the Local Study Area and Regional Study Area

Suitability Rating	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
	Area (ha)	% of LSA[1]	Area (ha)[2]	% of RSA[1]
High	945.67	< 1	5,457.20	< 1
Moderate	825.07	< 1	33,355.98	3
Low	2,923.58	2	49,677.98	4
Nil	129,674.99	97	1,168,661.41	93

[1] *For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100%.*
[2] *Includes LSA. Approximately 4,852.05 ha of the RSA fell in the Unclassified class and was not included in modelling, thus the total amount of habitat modelled in the RSA is 1,257,152.58 ha.*

5.6 WOLVERINE

5.6.1 Background

Wolverine are the largest member of the mustelid family, which also includes weasels, badgers, and marten. The total population size of wolverines in Nunavut is estimated as 2,000-2,500 individuals (COSEWIC 2003; Slough 2007). The wolverine is ranked as Secure in Nunavut (CESCC 2010), but the western Canadian population (which includes wolverine in Nunavut) was listed as a species of Special Concern by COSEWIC (2003).

The wolverine is an important cultural and economic resource for the Inuit. Wolverine pelts are highly valued for their frost-resistant properties. The Inuit use wolverine pelts as trim and lining for their clothing, including parkas and mittens.

Wolverines in the Arctic are both scavengers and predators, and as such, are largely nomadic throughout the year (excepting the denning period) as they search for food. This lifestyle results in large home ranges; wolverines in the Slave Geologic Province have an estimated home range size of 126 km^2 for adult females and 404 km^2 for adult males (Mulders 2000). The primary food source for wolverines is caribou supplemented with a variety of other species, such as large mammals (muskox or moose), carnivores (wolverine, red fox, Arctic fox, and ermine), small mammals (lemmings, voles, Arctic ground squirrels, and hares), seals, and fish (Mulders 2000).

5.6.2 Habitat Suitability Model Development

Habitat suitability modelling for wolverine focussed on the identification of suitable denning habitat during the late winter (Table 5.6-1), as the availability of adequate security cover (i.e., dens) for kits in winter can affect wolverine reproduction (Banci 1994; Persson 2005).

Table 5.6-1. Seasonal Life Requisites of Wolverine Denning

Season	Date	Life Requisite	Habitat Preference
Denning	February to early May	Living and Reproducing	Landscape features that provide deep, persistent snow packs.

Wolverines use two types of dens for reproduction: 1) natal dens, where the young are born; and 2) maternal dens, where the mother may move the kits if the conditions at the natal den are no longer suitable (Magoun and Copeland 1998). The birth of wolverine kits occurs earlier than other northern non-hibernating carnivores (i.e., wolves and foxes). The peak period for birthing is February through mid-March (Magoun and Copeland 1998; Inman et al. 2012).

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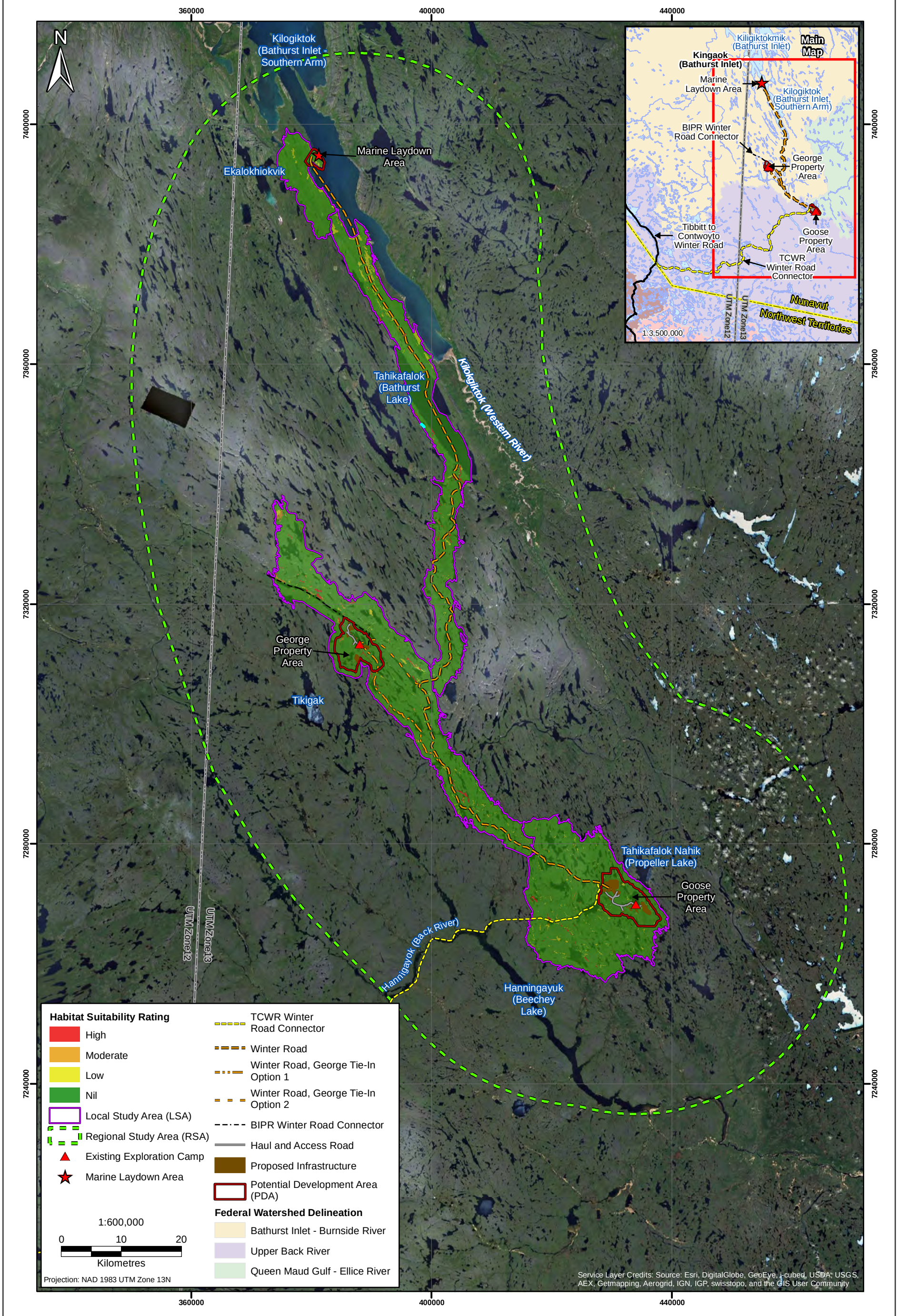

Figure 5.5-1

Sabina GOLD & SILVER CORP.

Grey Wolf: Denning Habitat in the Local Study Area

Figure 5.5-1

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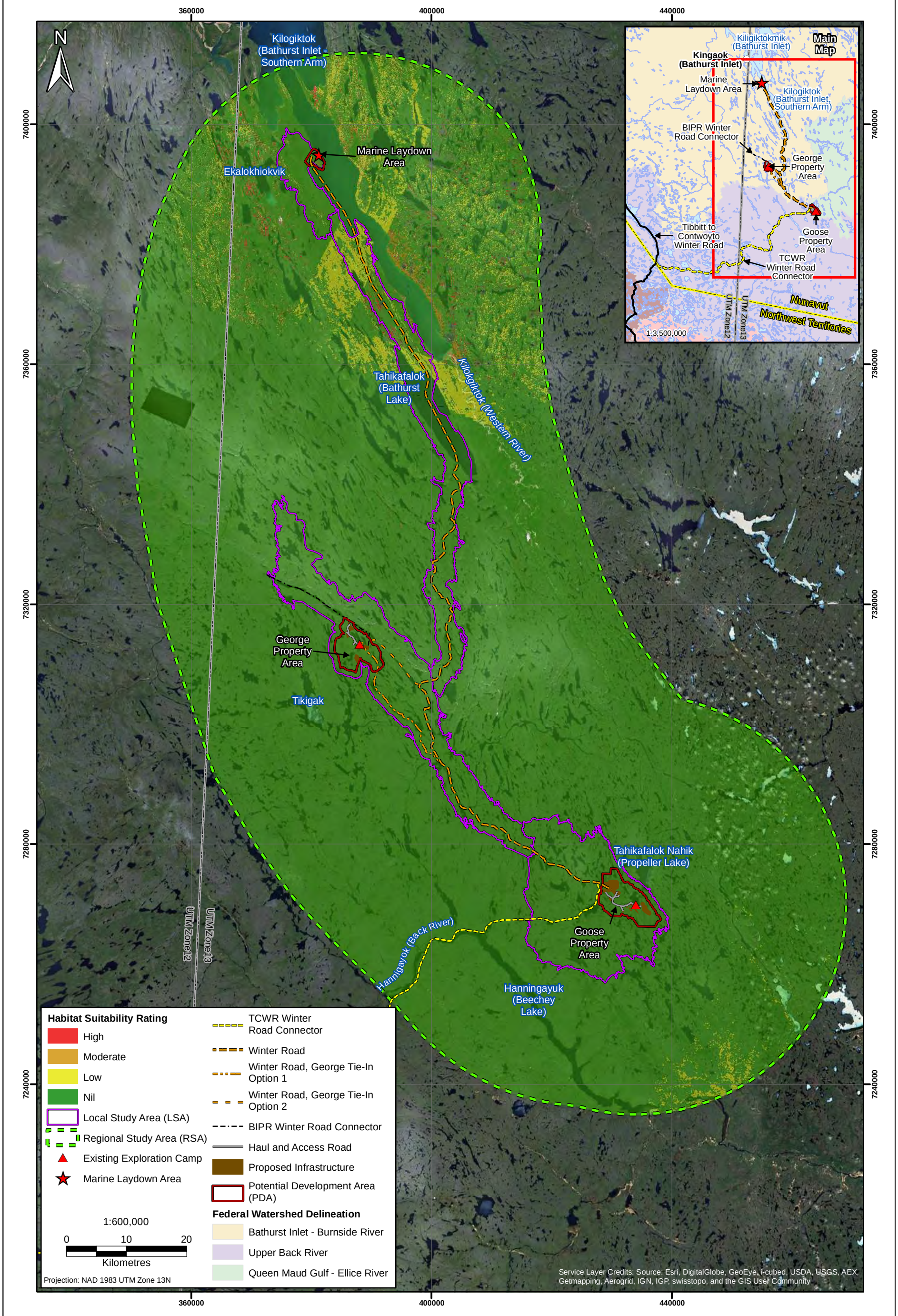

Figure 5.5-2

Sabina GOLD & SILVER CORP.

Grey Wolf: Denning Habitat in the Regional Study Area

Figure 5.5-2

Rescan an ERM company

Rocky outcrops and wind hardened snowdrifts are commonly used sites for wolverine reproductive dens in tundra areas (Magoun and Copeland 1998). Typically, wolverine dens are built under at least 1 – 5 m of snow and consist of long, complex snow tunnels that lead down to boulder fields, rock overhangs, or large cracks in rocks, which are large enough to allow kits to move around and provide additional protection from predators (Magoun and Copeland 1998; Inman et al. 2012; May et al. 2012). Wolverines will often use the same den site or general location (within 1–2 km of the original den site) in multiple years (Lee and Niptanatiak 1996; Magoun and Copeland 1998).

5.6.2.1 Model Assumptions

The following general assumptions were made to define WHRs in the LSA and RSA:

- Suitable denning ratings were limited to vegetation associations that provide potential deep, long-lasting snow packs dues to topography and/or physical structure (tall vegetation, boulders, etc.).
- Not suitable ratings were given to all other vegetation associations due to a lack of features that provide deep snow packs.

5.6.3 Results and Discussion

Roughly half of the LSA and RSA (48% and 45%, respectively) had suitable habitat for wolverine denning (Table 5.6-2). Suitable wolverine denning habitat was more or less evenly distributed throughout the LSA and RSA (Figures 5.6-1 and 5.6-2). In the LSA, suitable denning habitat was more abundant in the central and south portions as compared to the north portion around Bathurst Inlet and the Marine Laydown Area. Denning habitat was generally well distributed within the RSA, with the exception of a small extent on the east side of Bathurst Inlet in the northeastern RSA. The remainder of the LSA and RSA were rated as Not Suitable for denning.

Table 5.6-2. Wolverine Denning Habitat in the Local Study Area and Regional Study Area

	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
Suitability Rating	**Area (ha)**	**% of LSA[1]**	**Area (ha)[2]**	**% of RSA[1]**
Suitable (Useable)	64,127.65	48	562,221.39	45
Not Suitable	70,241.65	52	694,931.19	55

[1] For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100%.
[2] Includes LSA. Approximately 4,852.05 ha of the RSA fell in the Unclassified class and was not included in modelling, thus the total amount of habitat modelled in the RSA is 1,257,152.58 ha.

Due to the variable nature of wolverine denning preferences, these results should be assumed to be a coarse assessment of denning potential where the actual total area of the suitable denning habitat in the LSA and RSA is likely much lower.

5.7 SHORT-EARED OWL

5.7.1 Background

The short-eared owl is a ground-nesting raptor that breeds in the Arctic during the summer and overwinters in southern regions. The short-eared owl listed on Schedule 1 of *SARA* as a species of Special Concern and is considered sensitive in Nunavut by the Canadian Endangered Species Conservation Council (CESCC 2010). Nationally, populations of short-eared owl are decreasing, largely due to sensitivity to anthropogenic disturbance (COSEWIC 2008).

Short-eared owls are found throughout the eastern and western hemispheres (Wiggins, Holt, and Leasure 2006). Populations fluctuate significantly on an approximately three year cycle in response to lemming populations (Ims and Fuglei. 2005). Short-eared owls utilize a variety of habitat that contains enough ground cover to hide nests, as well as areas that support small mammals (their primary food source; Alderfer 2006). Small birds, especially shorebirds, and insects and crustaceans have also been taken as prey (Holt 1993, 1994).

5.7.2 Habitat Suitability Model Development

Habitat suitability modelling for short-eared owl was conducted for the nesting season and for the living and reproducing life requisites during this time (Table 5.7-1). Nests are the focal point of activity until young have fledged (i.e., left the nest site). Though 'nesting' specifically happens earlier in the year when the pair chooses a nest site, the suitability model covers the initial nest construction period and all time following until the young are mobile and can leave the nest site. Thus, the habitat model identifies the areas that may contain suitable habitat for nesting and spans the length of time in which birds may use the nest over the course of the breeding season.

Table 5.7-1. Seasonal Life Requisites of Short-eared Owl

Season	Date	Life Requisite	Habitat Preference
Nesting	May - July	Living and Reproducing	Dense vegetation close to water

Short-eared owls arrive on their breeding grounds in early spring, with female owls beginning to nest in late May to early June (Wiggins, Holt, and Leasure 2006). Short-eared owls make a rudimentary nest on the ground by gathering leaves, feathers, or grass; nests are hidden in dense vegetation, often close to water and under low shrubs. Short-eared owls will often choose a breeding site that is adjacent to more open habitats used for hunting; typical prey species include voles and small mammals (Wiggins, Holt, and Leasure 2006). Females are attentive and stay with the nest until all the young have left the nest (Clark 1975), which generally occurs 24-27 days after hatching (Schmelzer 2005).

5.7.2.1 Model Assumptions

The following general assumptions were made to define ratings for short-eared owl nesting habitats in the LSA and RSA:

- Suitable nesting ratings were limited to vegetation associations that were characterized by substantial low to tall shrub cover and no surface water (including seasonal seepages and inundation). These areas were assumed to provide the necessary cover for nesting sites.
- Not suitable ratings were given to all other vegetation associations due to a lack of nesting cover, presence of water, or disturbance.

5.7.3 Results and Discussion

Over half of the LSA (52%) was rated as suitable nesting habitat for short-eared owls, and was distributed fairly consistently throughout the LSA (Table 5.7-2; Figure 5.7-1). Within the RSA, Approximately one third (32%) was rated as suitable nesting habitat for short-eared owls (Table 5.7-2). Suitable nesting habitat within the RSA was distributed throughout, but had concentrations in the north and southeast portions of the RSA (Figure 5.7-2). The remainder of the study areas were rated as Not Suitable, representing habitats with poor cover for nesting sites.

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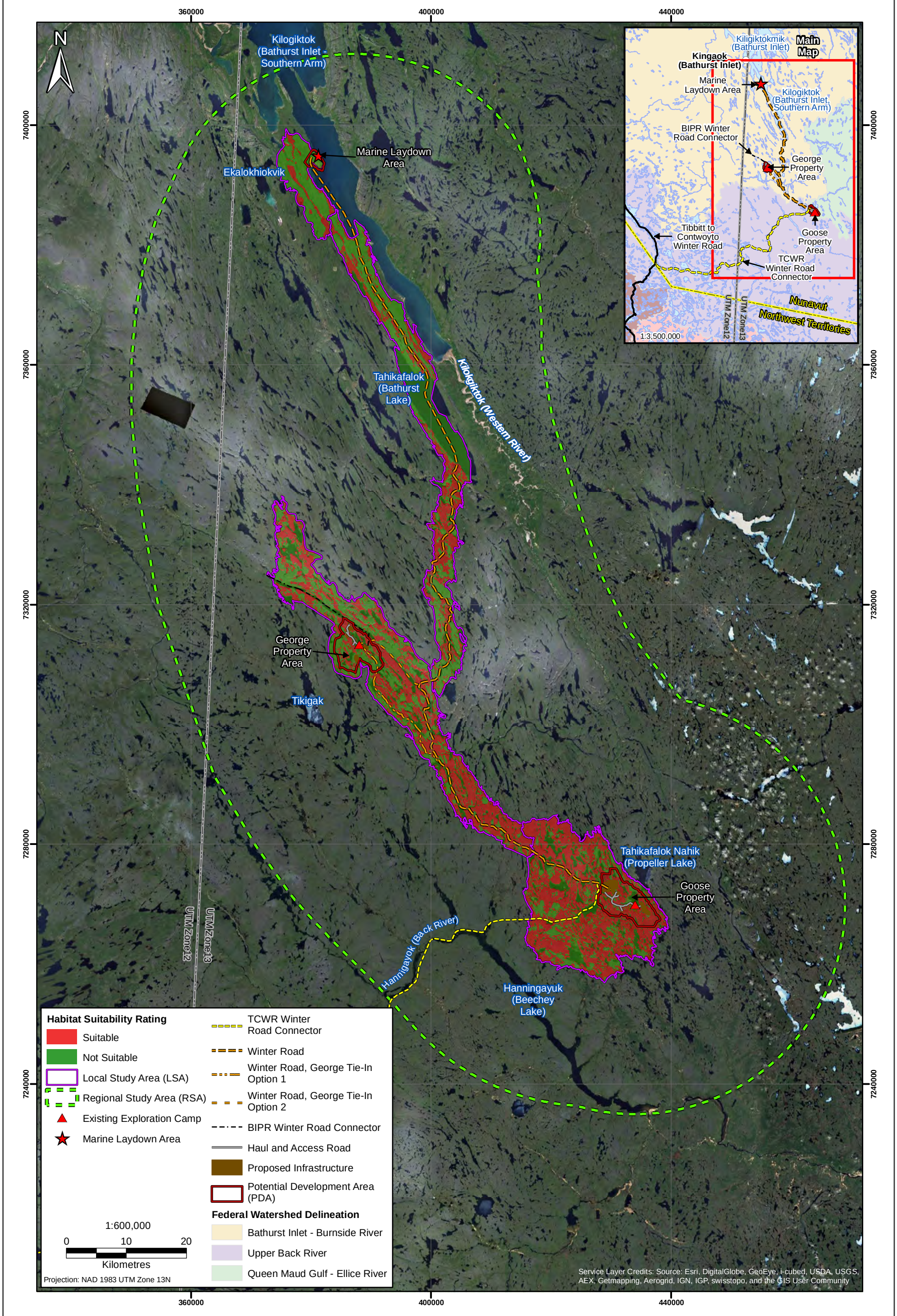

Figure 5.6-1

Sabina GOLD & SILVER CORP.

Wolverine: Denning Habitat in the Local Study Area

Figure 5.6-1

Rescan an ERM company

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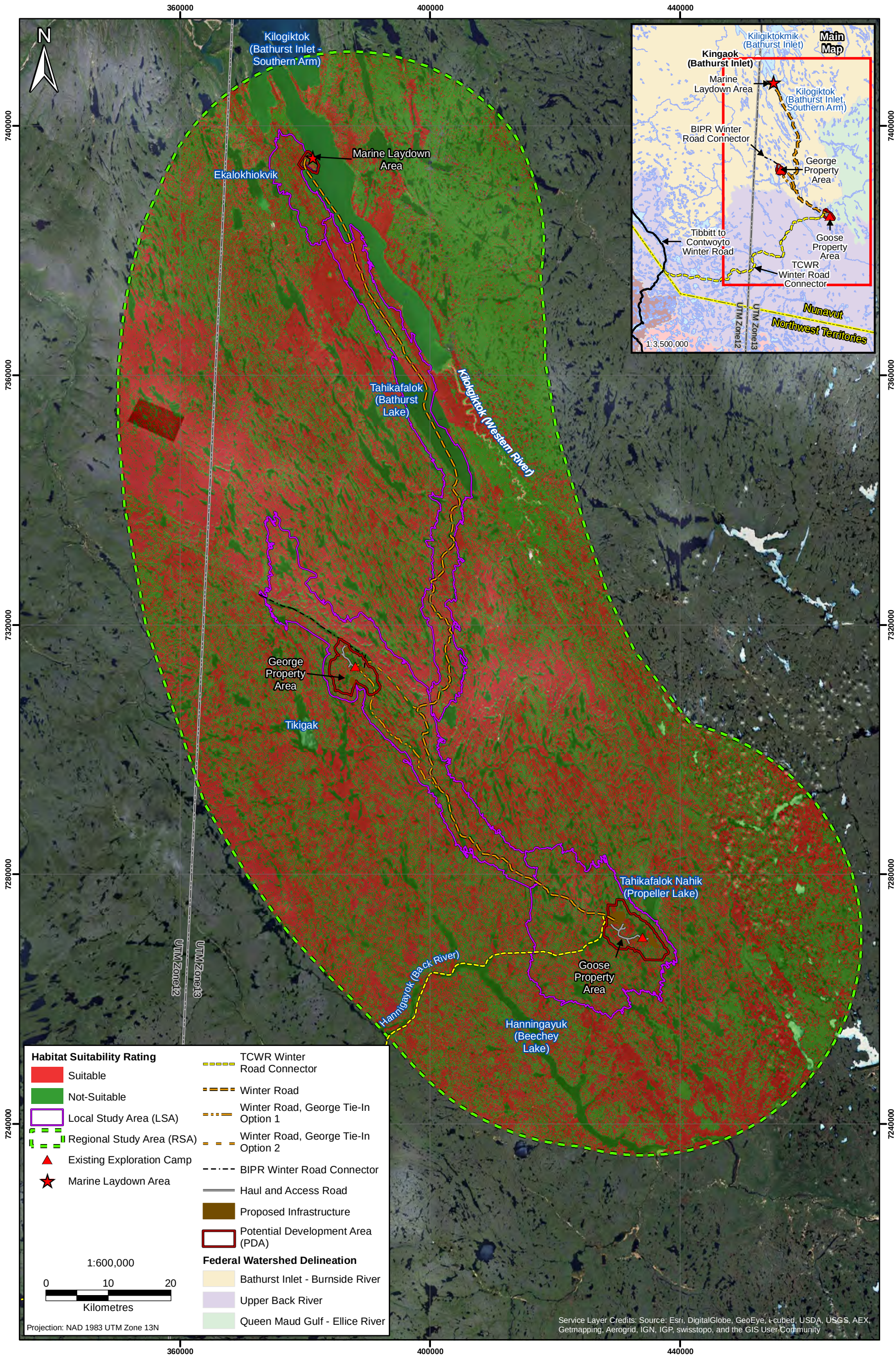

Figure 5.6-2

Sabina GOLD & SILVER CORP.

Wolverine: Denning Habitat in the Regional Study Area

Figure 5.6-2

Rescan an ERM company

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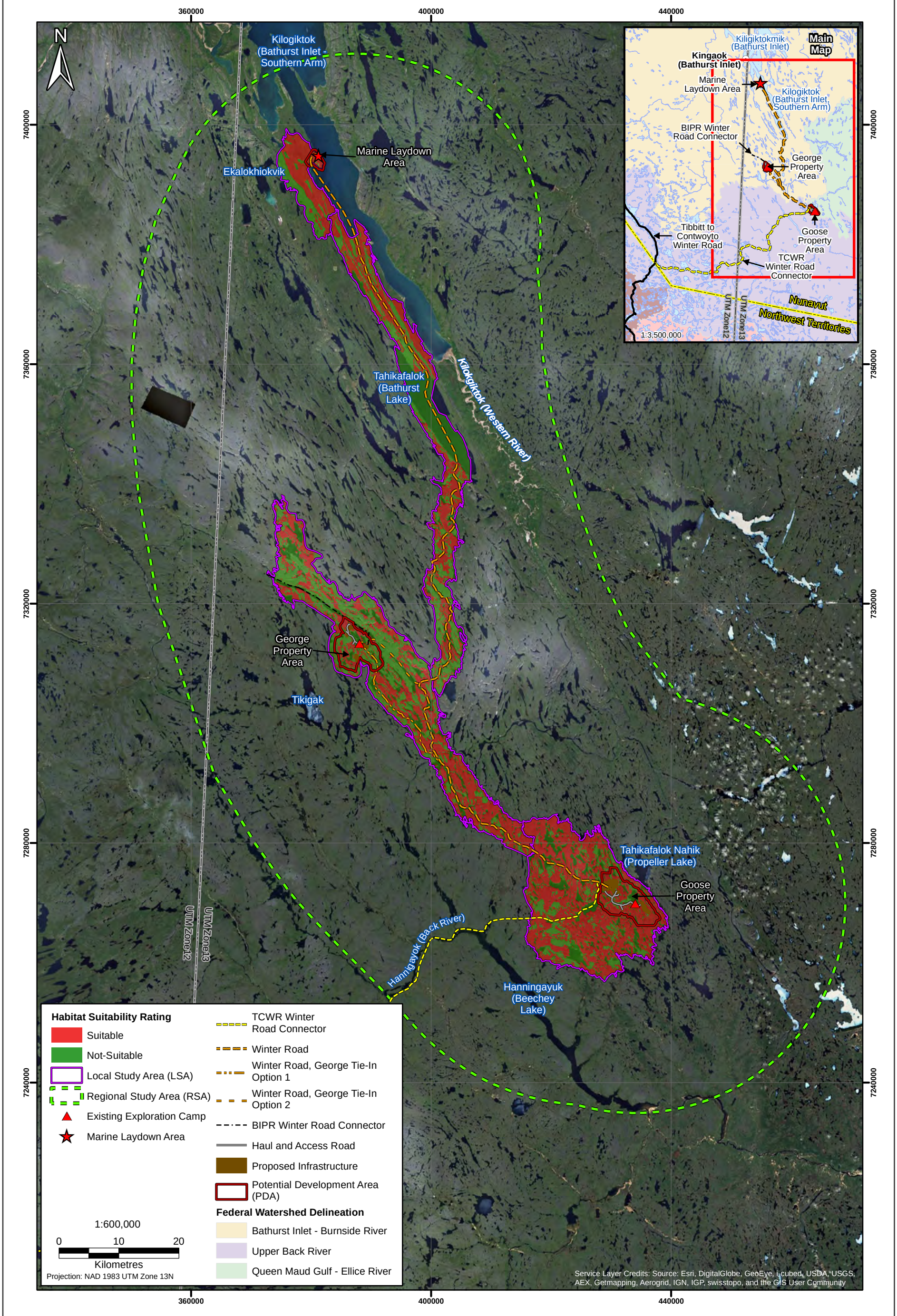

Figure 5.7-1

Sabina GOLD & SILVER CORP

Short-eared Owl: Nesting Habitat in the Local Study Area

Figure 5.7-1

Rescan an ERM company

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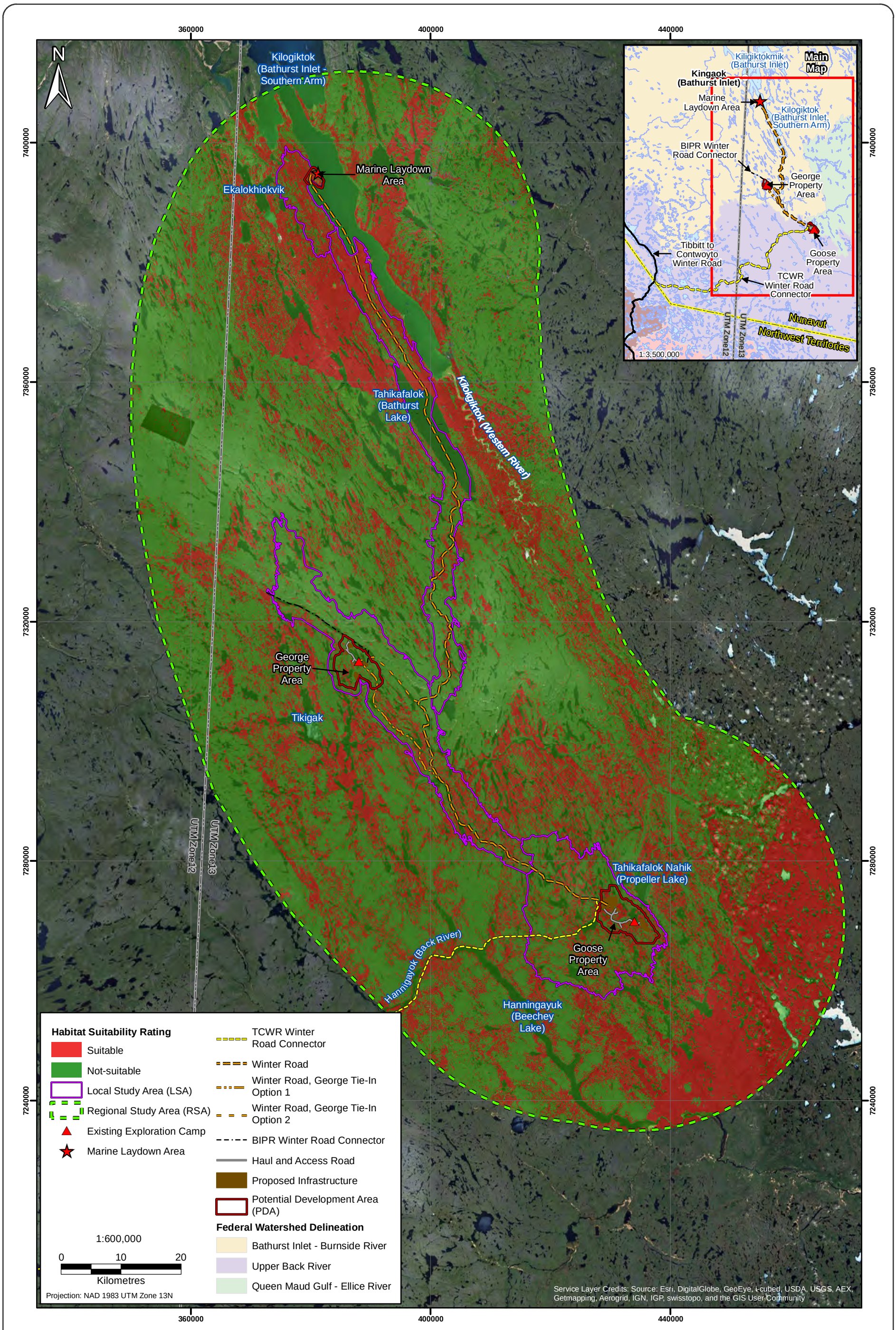

Figure 5.7-2

Sabina GOLD & SILVER CORP.

Short-eared Owl: Nesting Habitat in the Regional Study Area

Figure 5.7-2

Rescan an ERM company

Table 5.7-2. Short-eared Owl Nesting Habitat in the Local Study Area and Regional Study Area

Suitability Rating	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
	Area (ha)	% of LSA[1]	Area (ha)[2]	% of RSA[1]
Suitable (Useable)	69,804.67	52	404,974.79	32
Not Suitable	64,564.63	48	852,177.78	68

[1] *For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100%.*
[2] *Includes LSA. Approximately 4,852.05 ha of the RSA fell in the Unclassified class and was not included in modelling, thus the total amount of habitat modelled in the RSA is 1,257,152.58 ha.*

As the population density of short-eared owls in the arctic is relatively unknown and significantly affected by fluctuations in small mammal populations, the total area of suitable nesting habitat in the LSA is likely much lower.

5.8 PEREGRINE FALCON

5.8.1 Background

Peregrine falcons are a cliff-nesting raptor found throughout the northern hemisphere. There are three subspecies of the peregrine falcon in Canada, each with distinct distributions. The tundra peregrine falcon (*Falco peregrinus tundrius*) is the subspecies that likely breeds in the region; its breeding grounds in Canada spread across the central Arctic and extend west into Alaska and east into Greenland. The species is highly migratory and travels as far south as Argentina and Chile for the winter.

The tundra peregrine falcon is listed nationally as a species of Special Concern under Schedule 3 of *SARA* but is considered Secure in Nunavut (CESCC 2010). The peregrine falcon is also protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), restricting the import and export of birds and eggs (COSEWIC 2007).

5.8.2 Habitat Suitability Model Development

The availability of suitable cliffs for nesting is likely the most critical feature of peregrine falcon breeding habitat and the same cliffs can be occupied and used for decades by this species (Sinclair et al. 2003). Habitat modelling focused on identifying areas that contain suitable nesting habitat that would support both the living and reproducing life requisites for peregrine falcons (Table 5.8-1). Nests are the focal point of activity until young have fledged (i.e., left the nest site). Though 'nesting' specifically happens earlier in the year when the pair chooses a nest site, the suitability model covers the initial nest construction period and all time following until the young are mobile and can leave the nest site. The habitat model identifies the areas that may contain suitable habitat for nesting and spans the length of time in which birds may use the nest over the course of the breeding season.

Table 5.8-1. Seasonal Life Requisites of Peregrine Falcon

Season	Date	Life Requisite	Habitat Preference
Nesting	Late May - August	Living and Reproducing	Southern facing cliffs over 10m, near water.

Peregrine falcons are the latest to nest among other cliff-nesting raptors in the Arctic (e.g., gyrfalcon, golden eagle). Peregrines arrive on their breeding grounds in May and most nests are established and eggs are laid by early June, though some pairs may nest in late May. Peregrine falcons typically nest on cliff edges or in crevices situated near good foraging areas. Nest cliffs range from 7 to 400 m in height;

however, cliffs 50 to 200 m are preferred (Cade 1960; White and Cade 1971; White et al. 2002). Many nest sites have been found on south facing cliffs (Court et al. 1988; White et al. 2002), possibly because these areas become snow free earlier in the year and become accessible nesting sites in comparison to areas with more northern aspects. Southern aspects are generally warmer as well, as they receive greater amounts of sunlight relative to northern aspects, which may be advantageous in keeping adults, eggs, and young birds warm. Young hatch in July and are cared for by both parents; young birds generally fledge by mid to late August (Court et al. 1988). Peregrines occupy nests sites from May onwards to August.

5.8.2.1 Model Assumptions

South facing cliffs and outcrops adjacent to or near bodies of water were assumed to be the most suitable nesting habitat for peregrine falcons in the study area. As cliff habitats were not specifically identified in the local or regional ecosystem mapping, additional modelling techniques were required to select areas with potential nesting ledges.

Digital elevation models (DEM) were obtained from Natural Resources Canada that covered the RSA. These data were used to identify all potential cliff habitats, and was used in conjunction with regional ecosystem mapping to identify suitable habitat. It was assumed that suitable nesting habitats for peregrine were cliffs that were a minimum of 10 m high and were within one kilometre of a waterbody. The one kilometre distance to a water feature was used as research suggests that the area within one kilometre of the nest site is the approximate size of the peregrine's nesting territory, or the area within which the adults actively defend from other peregrine falcons (SARA 2010). Therefore, the most important habitat features in addition to the nest site are likely contained within the nesting territory.

Raptor nests that were found during baseline studies for the Project were also incorporated into the peregrine nesting model (data from 2007, 2008, 2012, and 2013). These areas not only identify where there are cliffs, but also highlight areas that were selected and used by raptors and likely contain all the nesting habitat requirements (e.g., nearby hunting areas). All known raptor nesting sites (regardless of the species observed utilizing it) and the nesting territory (i.e., one kilometre radius from the nest site) were considered to be suitable nesting habitat in the model.

5.8.3 Results and Discussion

Very little (8%) of the LSA was identified as suitable cliff-nesting habitat for peregrine falcon. When modelling the previously identified nest sites and the one kilometre buffer, 6% of the LSA was rated as suitable (Table 5.8-2). A very small portion (2%) of the LSA had cliffs that were rated as suitable (i.e., cliffs modelled with DEM; Table 5.8-2). Suitable habitat was more abundant in the central and northern portions of the LSA; it was also found within both George and Goose Property Areas (Figure 5.8-1). The vast majority of the LSA (~92%) was rated as not suitable for nesting.

Within the RSA, 7% was considered to be suitable nesting habitat (Table 5.8-2). Of this suitable habitat, 4% was identified through modelling the location of known nest sites and surrounding nest territories, and 3% was identified with DEM (Table 5.8-2). Suitable habitat identified from known nesting areas were often clustered together, identifying long ridges of cliff habitat such as those located to the east of the Goose Property Area (Figure 5.8-2). Suitable habitats identified with the DEM were concentrated along the Western River drainage and within the northern RSA near Bathurst Inlet (Figure 5.8-2). Similar to the result in the LSA, the majority of the RSA (94%) was rated as not suitable for peregrine falcon nesting.

PROJECT # 0194096-0040 GIS # BAC-23-244y October 11 2013

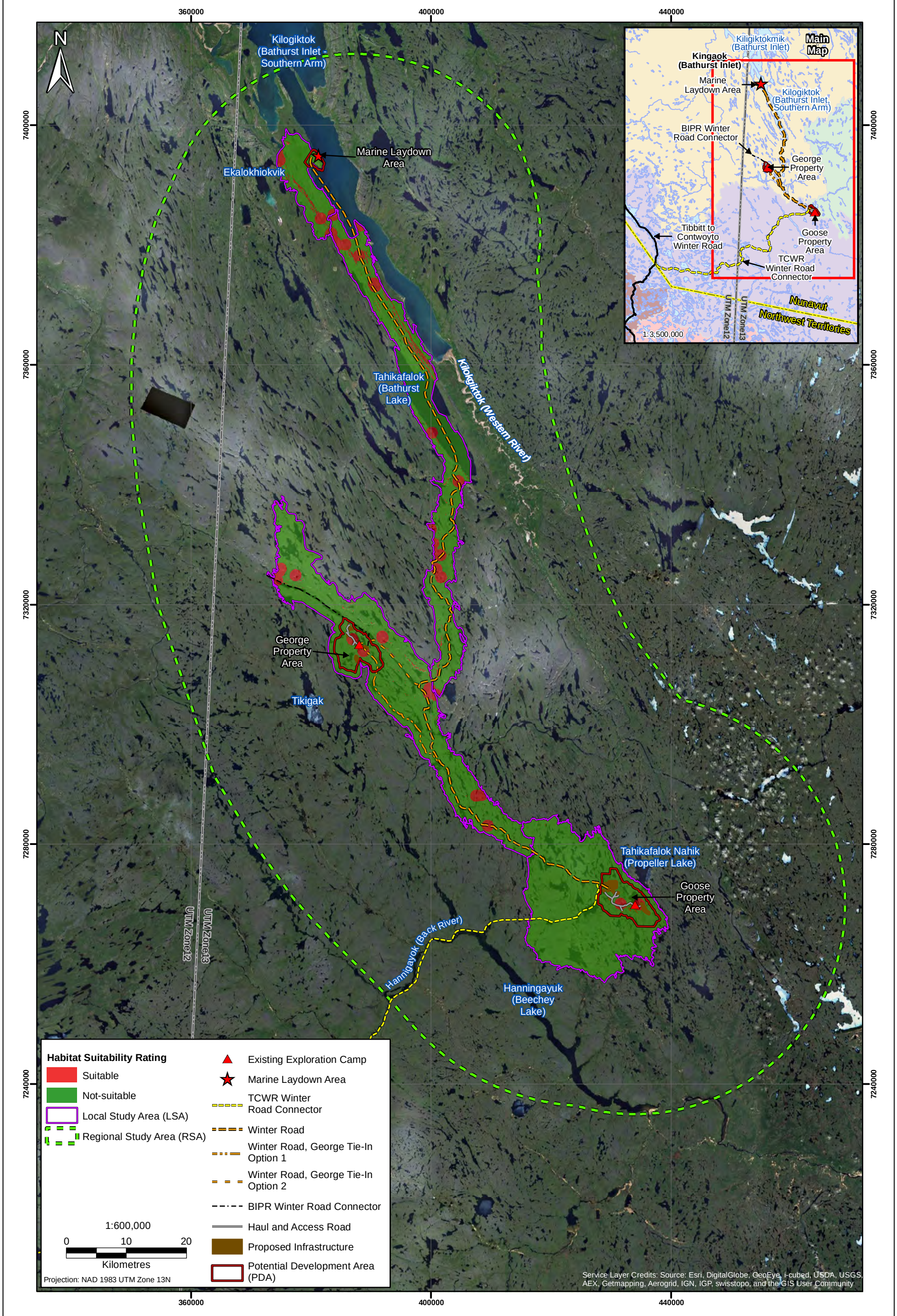

Figure 5.8-1

Sabina GOLD & SILVER CORP.

Peregrine Falcon: Nesting Habitat in the Local Study Area

Figure 5.8-1

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PROJECT # 0194096-0040 GIS # BAC-23-244z October 15 2013

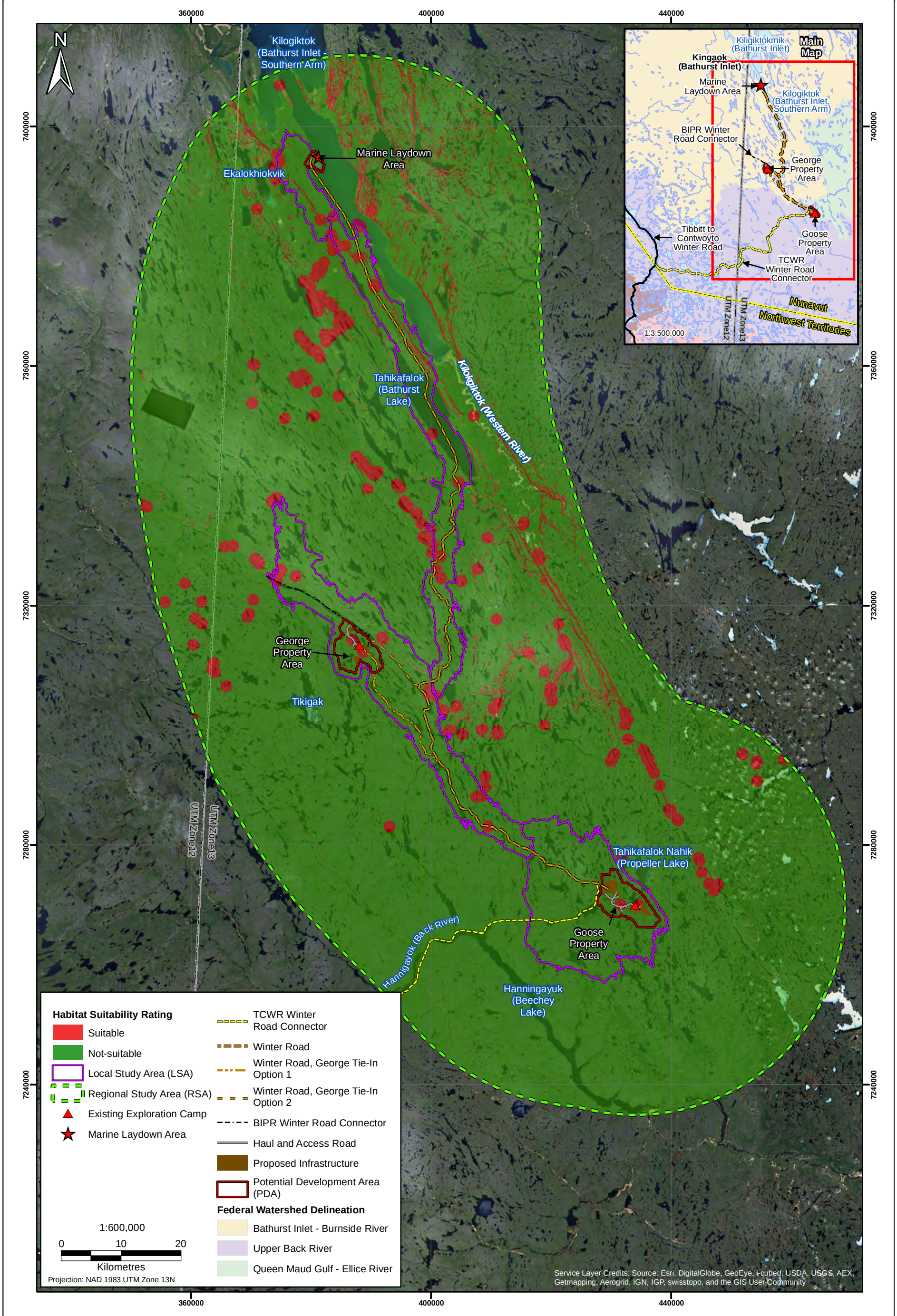

Figure 5.8-2

Sabina GOLD & SILVER CORP.

Peregrine Falcon: Nesting Habitat in the Regional Study Area

Figure 5.8-2

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Table 5.8-2. Peregrine Falcon Nesting Habitat in the Local Study Area and Regional Study Area

Suitability Rating	Model Type	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
		Area (ha)	% of LSA[1]	Area (ha)[2]	% of RSA[1]
Suitable (Useable)	Nest Locations w/ buffer	8,520.45	6	45,673.56	4
	Modelled Cliffs	1,974.98	2	33,413.94	3
Not Suitable		123,873.88	92	1,182,917.13	94

[1] *For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100%.*
[2] *Includes LSA.*

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Appendix 1
Species Account for Caribou

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Appendix 1. Species Account for Caribou

BACKGROUND INFORMATION

Common Name:	Caribou, specifically barren-ground caribou	
Scientific Name:	*Rangifer tarandus groenlandicus*	
Species Code:	M-RATA	
Status:	**Global:**	G5TNR – Globally secure, but subspecies or varieties at the national or subnational level not ranked.
	National:	*R. t. groenlandicus* are not listed at federal level, but Dolphin and Union herd (*R. t. groenlandicus* x *pearyi*) are a population of special concern under Schedule 1 of the *Species At Risk Act* (2002).
	Territorial:	Secure (CESCC 2010).

DISTRIBUTION

Range within Nunavut

Barren-ground caribou are distributed across much of mainland Nunavut, as well as on some islands within the Arctic archipelago. The ranges of several caribou herds are partially or completely contained across mainland Nunavut, including the Ahiak, Bathurst, Beverly, Bluenose-East, Bluenose-West, Dolphin and Union, Qamanarijuaq, Lorillard, Wager Bay (Gunn, Russell, and Eamer 2011). Many of these herds, such as the Bathurst herd, are migratory caribou and travel from wintering areas below the treeline in the Northwest Territories north to calving areas near the coasts in Nunavut. Other herds, such as the Lorillard and Wager Bay herds, are defined as non-migratory caribou, spending the summer and winter above the treeline on the tundra.

Territorial Context

Representing an important component of the regional biodiversity of the Arctic, barren-ground caribou are a keystone species of its ecosystem. They support grizzly bear, wolf and wolverine populations, as well as influence the survival, both economically and culturally, of the Inuit people.

Project Area

Baseline survey data documenting the distribution of caribou during the spring migration, calving, post-calving, summer, and fall periods suggest that the study area lies within the seasonal ranges of the Bathurst and Ahiak caribou herds.

The Bathurst caribou herd winters below the treeline in Northwest Territories and travels north to calving grounds to the west of Bathurst Inlet. Following calving, the herd disperses to the southeast and travel through the study area. The herd then spends the rest of the summer in areas surrounding and south of Contwoyto Lake, located to the southwest of the Project. The Bathurst herd's traditional rutting area, used in the fall, is located near Lac de Gras in the Northwest Territories. Following rutting, the herd then returns to wintering areas at or below the treeline.

The Ahiak caribou herd is thought to be primarily composed of tundra-wintering caribou, though in some years animals may travel south below the treeline during the winter (Gunn, Fournier, and Nishi 2000; Gunn and D'Hont 2002). Wintering areas for Ahiak caribou occur discretely across Nunavut; wintering

Ahiak caribou have been documented around Bathurst Inlet (Gunn, Fournier, and Nishi 2000) and within south of the Thelon Wildlife Sanctuary along border of the Northwest Territories and Nunavut. The calving grounds for the Ahiak herd are located along the coast within the Queen Maud Gulf Migratory Bird Sanctuary. Following calving, the herd slowly travels to the south and in the summer, Ahiak caribou may be found in the study area. The herd then converges in fall grounds located within the Thelon Game Sanctuary, following which they disperse to wintering grounds across the tundra.

The Dolphin and Union herd spends most of the year to the north of the study area. Dolphin and Union caribou winter on the Nunavut mainland along the Coronation Gulf, on the Kent Peninsula, and along the western extent of the Queen Maud Gulf (COSEWIC 2004). This herd migrates across the sea ice to its calving grounds on Victoria Island. These caribou may occasionally travel as far south as the Project area in the winter, though this use is expected to be very infrequent.

POPULATION TRENDS

Bathurst Herd

The size of the Bathurst caribou herd, as estimated from annual counts of the number of calving females, has declined from about 200,000 females in 1986, to 55,000 in 2006, and then to 16,000 in 2009 (Nishi et al. 2010; Boulanger et al. 2011). The results of the 2009 calving ground survey suggested that the total herd size was approximately 31,900 ± 11,000 individuals (GNWT ENR 2009). The population estimates suggest an average annual decline of about 6% per year from 1986 to 2006, and then a very rapid decline of 35% per year between 2006 and 2009 (Adamczewski et al. 2009; Boulanger et al. 2011). These population trends have been attributed to declining calf survival and concomitant declines in adult female fecundity that may have been a result of several factors including environmental conditions and predation; declines in adult survival in winter due to hunting is also postulated to be a source of these population declines (Boulanger et al. 2011). Annual monitoring of calf survival indicates that mean winter calf survival and calf-cow ratios for the Bathurst herd have declined by almost 50% from 2001 to 2004 compared with the 1985 to 1996 period (Gunn, Boulanger, and Williams 2005). More recently (2007-2009), indicators of breeding productivity such as cow-calf ratios, pregnancy rates, and body condition indicate that the environmental conditions have improved for the Bathurst herd (Adamczewski et al. 2009). A survey conducted in 2012 reports that the population has remained stable, or may have increased to 35,000 individuals since 2009 (GNWT 2012).

Ahiak Herd

A systematic calving area survey along the Queen Maud Gulf in 1986 estimated the Ahiak herd size at 40,000 to 60,000 animals (Gunn, Fournier, and Nishi 2000). A decade later the herd increased in size to roughly 200,000 animals (based on a calving female count of 83,134 ± 5,298 caribou; Gunn, Russell, and Eamer 2011). In 2006, 123,000 female caribou were counted on the calving grounds, suggesting that the population increased again from 1996 to 2006 (Gunn, Russell, and Eamer 2011). However, data from satellite-collared cows has revealed that the Beverly herd, which formally calved south of the Ahiak herd, has gradually shifted their calving to the area used by the Ahiak herd (Nagy et al. 2011). Thus, apparent population increases in the Ahiak herd may be due to the gradual shift of the Beverly herd to the Ahiak calving grounds (Gunn, Russell, and Eamer 2011; Nagy et al. 2011).

The Ahiak herd has declined in recent years. Between 2006 and 2009, the number of calving cows counted on the calving grounds declined by 60% (Adamczewski et al. 2009; Gunn, Russell, and Eamer 2011). Similar to that observed for the Bathurst herd, these data likely reveal a fast rate of population decline, possibly due to low recruitment rates in 2008 and poor body condition in 2009 (D. Johnson, Nagy, and Williams 2008; Adamczewski et al. 2009). An aerial survey in 2010 reported a modest increase in the number of caribou counted on the calving grounds (Gunn, Russell, and Eamer 2011).

Dolphin and Union Herd

The Dolphin and Union caribou herd is a genetically distinct population from the mainland barren-ground herds and from the Peary caribou of the Arctic archipelago (COSEWIC 2004). In the early 1900s, the Dolphin and Union caribou herd was estimated at 100,000 animals (COSEWIC 2004). Overhunting and possibly ice storms caused a population crash between 1900 and 1920 to the point where caribou were not observed migrating between Victoria Island and the mainland after about 1930 (Gunn 2005). Beginning in the 1970s, the herd size increased, and in the late 1980s caribou resumed migration between Victoria Island and the mainland (Gunn et al. 1997). In 1993, approximately 7,200 Dolphin and Union caribou were counted on the mainland prior to migrating over the ice in the spring (Gunn et al. 1997). In 1997, the Dolphin and Union herd was estimated at 28,000 ± 3,350 animals (Nishi and Gunn 2004), about one-third of its historic size. A population estimate of 28,000 ± 2,500 in 2007 suggests the population is stable or declining slightly, though still only a third of its historic size (M. Dumond, GN, unpubl. data, cited from Poole et al. 2010).

As a result of population declines, Dolphin and Union caribou are currently listed as a population of special concern on Schedule 1 of the *Species at Risk Act* (*SARA*). Potential threats to this herd's long term viability are climate warming and shipping activity across the herd's migration route (COSEWIC 2004). Climate warming may shorten the amount of time caribou have to overwinter on the mainland. This herd migrates between the mainland and Victoria Island during the spring and fall migrations and this movement is dependent on ice formation. Shipping and icebreaking may weaken or create gaps in the ice in Coronation Gulf and Dolphin and Union Strait that the Dolphin and Union caribou migrate across twice each year, which may increase the chances that caribou fall through the ice or drown during their annual migrations.

HABITAT USE – LIFE REQUISITES AND SEASONS

Overview

The nutritional requirements and the distribution and availability of forage drive the seasonal distribution of caribou. The most critical seasons for barren-ground caribou are calving and post-calving/summer. The late summer and fall seasons are also important times for caribou to acquire necessary nutrient resources before the winter; caribou also breed in the fall, referred to as the rut.

For caribou, habitat suitability was assessed for three periods: calving (June 1 to ca. June 20), post-calving and summer (ca. June 20 to August 31) and the fall (September 1 to October 31). The life requisites assigned to these three periods are provided in Table 1.

Table 1. Seasonal Life Requisites of Caribou

Season	Date	Life Requisite	Habitat Preference
Calving	June 1 to ca. June 20	Reproduction and Living	Variable. Predator avoidance, lichen availability, and early vegetation growth is preferred.
Post-calving and Summer	ca. June 20 to July 15 (post-calving) July 16 to August 31 (summer)	Living	Caribou use eskers for insect and heat relief, lakes for predator avoidance, insect, and heat relief, eat green plants from riparian and sedge communities. Cows require high quality forage to replenish fat reserves.
Fall (including Rut)	September 1 to October 31	Living, Reproduction, and Travel	Caribou travel to southern rutting areas, selecting habitat for ease of travel, predator avoidance, and late season forage.

Calving

Key characteristics of caribou calving grounds on the tundra are believed to be areas that facilitate predator avoidance, and where forage availability after snowmelt offers females the nutritional requirements they need for lactation (Griffith et al. 2001; Wilson et al. 2012). Terrain that may facilitate predator avoidance includes more rugged areas, higher elevations, and proximity to large lakes (Griffith et al. 2001; Wilson et al. 2012). The calves are born during the beginning of June and are dependent on milk until they are about three weeks old (CWS 2005). Cows generally spend two weeks on the calving grounds and then move to high quality forage areas with their calves for the post-calving and summer seasons.

There appears to exist a trade-off between safety and forage availability; calving females may choose calving grounds that are relatively safe from predators but are not necessarily places where snow melts earlier nor where vegetation biomass is greatest (Wilson et al. 2012). For example, though forage availability was higher for Bathurst bulls and juveniles still near treeline than for females that migrated to the calving grounds, wolf densities were much lower on calving grounds (Heard, Williams, and Melton 1996).

Though forage availability may be lower, it is thought that calving grounds generally are located in areas where forage quality is high (Griffith et al. 2001; reviewed in Wilson et al. 2012). Green foliage is rarely available during calving (e.g. in only 3 years between 1985 and 2006) on the Bathurst calving grounds (Chen et al. 2009). Lichen provides caribou with additional nutrients before green-up (Ferguson, L. Gauthier, and F. Messier 2001). Lichen heath is one of the main vegetation cover types for the Bathurst herd calving grounds (Griffith et al. 2001; C. J. Johnson et al. 2005). Bathurst cows appear to compensate for low nitrogen intake on the calving grounds by digging for nitrogen-rich *Oxytropis* rhizomes (Griffith et al. 2001; Thorpe et al. 2001).

Post-Calving/Summer

Following calving, caribou move to their summer ranges. During this time, cows and calves may aggregate into large groups, ranging from hundreds to even thousands at times when populations are large (Gunn and D'Hont 2002). Access to high quality forage is likely the key driver of habitat selection in the post-calving period (Witter et al. 2012), as females need to acquire adequate nutrient reserves for lactation, which last for about three weeks. Later in the season, forage quality and access to habitat that facilitates escape from insects are thought to be the key determinates of habitat selection.

During the post-calving period, caribou select wetland areas for foraging as these areas contain high quantities of protein rich vegetation. Studies in Alaska show that female caribou with calves select areas with a high density of sedge meadows during the post-calving period, where they forage on highly nutritious cotton grass (*Eriophorum sp.*) and *C. aquatilis* (Wilson et al. 2012).

After the post-calving period, females expand their selection of vegetation from sedge meadows to include other vegetation types, but tend to remain in moist habitat where grasses, sedges, and willow and birch shrubs are abundant (Griffith et al. 2001; Thorpe et al. 2001; Wilson et al. 2012; Zamin and Grogan 2012). Inuit Qaujimajatuqangit indicates that cotton grass is important forage for newly weaned calves (Thorpe et al. 2001). Lichens may still be eaten in summer, but to a lesser extent than in winter (Bergerud 1974; Boertje 1984; Barten, Bowyer, and Jenkins 2001). Despite a wider selection during the post-calving period, foraging throughout summer probably predominately occurs in sedge meadows, where caribou can graze up to 50% of the net primary productivity (Jefferies 1992).

Caribou also select habitat that provides relief from insects and heat throughout the post-calving season and summer seasons (Curatolo 1975; Heard and Gray 1989; Russel 1998). Harassment by black and especially oestrid flies can cause significant disturbances to tundra caribou in July and August (Witter et al. 2012). Insects are abundant on warm days when wind speeds are low (Boulanger et al. 2004) especially for the two weeks spanning late June to early July (Thorpe et al. 2001). Caribou compensate for harassment by engaging in avoidance behaviours (on average 5% of the day) such as head tossing and erratic running when insects are active, from about 0800 to 2100 hours (Witter et al. 2012). Caribou are often seen swimming in lakes to escape the heat and insects (Thorpe et al. 2001). Caribou also attempt to avoid insects by moving for some part of the daytime to windier, cooler places, such as on top of eskers, at the edges of large rivers and lakes, and to higher elevation tundra where insects are less dense (Russell, Martell, and Nixon 1993; Skarin et al. 2008; Wilson et al. 2012; Witter et al. 2012).

Protection against predators is also required by caribou, and they often gather along lake shorelines, where they can enter the water to escape predators such as wolves (Thorpe et al. 2001). Habitats with extensive shrub cover (e.g., riparian shrub communities) may increase the vulnerability of caribou to predation because they conceal predators (Curatolo 1975; Heard and Gray 1989); however, caribou select these habitats for the relatively high quality of forage they provide (Axys Environmental Consulting and Penner & Associates 1998).

Fall

During the fall, caribou require habitats that provide abundant forage and facilitate travel. Caribou breed in the fall during the rut but implantation of the fertilized egg is delayed and can be aborted if animal condition is poor during the winter. Hence, high quality forage is important in the fall. Green forage becomes less available as the fall progresses and Bathurst caribou choose lichen veneer for foraging (C. J. Johnson et al. 2005). Sedge wetland and riparian tall shrub habitats may also be used depending on the availability of green forage. However, a habitat modelling study by Johnson et al. (2005) indicated that caribou may avoid areas dominated by sedge, peat bog, and heath tundra during the fall. Eskers, ridges, and other high points are selected for easy travel (Thorpe et al. 2001).

Ratings

A four class rating scheme was used to evaluate the quality of habitat for caribou in the Local Study Area (LSA) and Regional Study Area (RSA).

Rating Assumptions for Calving

Habitat use during the calving season is focused on pregnant and lactating cows searching for nitrogen and protein rich forage. Caribou actively search out emerging vegetation, typically in exposed areas that have early snow melt. Lichens continue to be an important food source. The following generalized assumptions were made to rate ecosystem units for caribou calving:

- High rated habitat (1) includes ecosystem units that are snow free early, and those that contain a significant cover of lichen and shrubs.
- Moderate rated habitat (2) includes a variety of ecosystem units that contain suitable early forage such as cottongrass flower buds, sedges, and various shrub species.
- Low rated habitat (3) includes ecosystem units that are more likely to retain snow packs or have limited suitable forage.
- Nil rated habitat (4) included vegetation associations that have a lack of forage or are disturbed.

Rating Assumptions for Post Calving / Summer

Habitat use during the post-calving/summer season is variable as caribou leave calving grounds and search out preferred habitat. In addition to forage, caribou require habitat that provides relief from insects, heat and predators. During this period forage includes willow, grass, sedges, cottongrass and other green vegetation that provides important protein sources (VanEgmond and Rowell 1998; Griffith, Gunn, and Russel 2001; Thorpe et al. 2001). Cool, moist areas are often selected, including riparian areas and wetlands. Insect and heat relief is important throughout the post-calving season, particularly late June and early July. Relief is found in cool, windy and shaded areas, and includes swimming in ponds and lakes (Thorpe et al. 2001). The following generalized assumptions were made to rate ecosystem units for caribou post-calving and summer:

- High rated habitat (1) includes areas that produce abundant and high quality forage (e.g., sedges and graminoids), in addition to those that provide insect or predator relief (e.g., lakes and esker).
- Moderate rated habitat (2) included ecosystem units that provide forage opportunities, but generally have limited insect and heat relief relative to the high value habitat.
- Low rated habitat (3) includes barren areas and rock outcrops that have limited vegetation and limited opportunities for relief (e.g., shallow water areas that are not deep enough to provide insect relief).
- Nil rated habitat (4) were those that lacked forage, or are disturbed.

Rating Assumptions for Fall Season (Including the Rut)

Habitat use during the fall and the rut is focused on ease of travel and opportunistic foraging. As herds move south towards wintering grounds, they feed on remaining high quality forage as it is available, such as shrubs, grasses, and lichens. Bathurst caribou, for example, choose lichen veneer for foraging in the fall (C. J. Johnson et al. 2005). Eskers, ridges, and other high points are selected for easy travel (Thorpe et al. 2001). The following general assumptions were made to define fall WHRs:

- High rated habitat (1) included vegetation associations that contained a diversity and abundance of forage species, as well as those that contain esker for ease of travel.
- Moderate rated habitat (2) included vegetation associations that contained some preferred forage species, but typically have a lower cover of lichens, sedges, and shrub species.
- Low rated habitat (3) included vegetation associations that contained limited forage opportunities.
- Nil rated habitat (4) included vegetation associations that contained sparse vegetation, or where travel was difficult.

Ratings Table

Caribou habitat models utilized ecosystem mapping and known dominant vegetation composition of the mapped ecosystem units. Table 2 contains habitat suitability ratings for caribou according to the TEM mapping conducted in the LSA, and Table 3 contains habitat suitability ratings for caribou according to the WKSS/GeoBase mapping within the RSA.

Table 2. Ratings Table for Caribou Habitat in the Local Study Area

Ecosystem Class	LSA Vegetation Association	Map Code	Calving	Post-calving and Summer	Fall
Bedrock	Bedrock outcrop	BR	4	2	2
Bedrock	Bedrock-lichen veneer	BL	2	1	1
Bedrock	Cliff	BC	4	4	4
Bedrock	Talus	BT	4	4	4
Bedrock	Blockfield	TB	4	4	4
Disturbed/Barren	Disturbed vegetation	DV	4	4	4
Disturbed/Barren	Exposed soil	ES	3	3	2
Disturbed/Barren	Mine camp	DR	4	4	4
Disturbed/Barren	Road surface	DZ	4	4	4
Esker	Dwarf shrub esker	EH	2	1	1
Esker	Shrubby esker	EW	2	1	2
Esker	Sparsely vegetated esker	EC	2	1	1
Freshwater	Lake	LA	4	3	3
Freshwater	Pond	PD	4	1	3
Freshwater	River	RI	4	1	2
Marine	Marine beach	MB	4	4	4
Marine	Old beach heads	MH	4	2	2
Marine	Saltwater	MW	4	4	4
Riparian	Low bench floodplain	RL	4	2	3
Riparian	Mid bench floodplain	RM	4	2	3
Riparian	Willow riparian	RW	2	1	2
Riparian (Marine)	Marine riparian shrub	MR	2	3	2
Tundra	Dry-sparse tundra	TH	2	2	1
Tundra	Mesic dwarf-shrub tundra	TL	1	2	1
Tundra	Shrubby tundra	TS	1	2	2
Tundra (Marine)	Marine dwarf shrub tundra	MT	1	2	1
Tundra (Marine)	Marine shrubby tundra	MS	1	3	2
Wetland	Cottongrass-sedge fen	WC	2	2	1
Wetland	Raised bog complex	WB	3	2	2
Wetland	Shallow open water	WO	4	1	3
Wetland	Tussock meadow	WT	3	2	2
Wetland	Undifferentiated fen	WF	2	2	2
Wetland	Water sedge marsh	WA	2	1	1
Wetland	Willow-sedge fen	WS	2	1	2
Wetland (Marine)	Saline Fen	MF	2	2	3
Wetland (Marine)	Saline Marsh	MM	2	1	2
Wetland (Marine)	Saline shallow open water	MO	4	3	3

Table 3. Ratings Table for Caribou Habitat in the Regional Study Area

WKSS/GeoBase Land Classification	Calving	Post-calving and Summer	Fall
Bedrock Association	4	4	4
Boulder Association	3	2	3
Heath/Bedrock	2	1	1
Lichen Veneer	2	1	1
Sparsely vegetated bedrock*	2	1	1
Sparsely vegetated till-colluvium*	2	1	1
Bare Ground	3	3	2
Barren/Non-vegetated*	3	4	4
Gravel Deposit	4	4	4
Esker Complex	2	1	1
Deep Water	4	3	3
Shallow Water	4	1	3
Water	4	1	3
Riparian Tall Shrub	2	1	2
Shrub tall*	2	2	2
Bare soil with cryptogam crust - frost boils*	2	1	1
Birch Seep	3	2	2
Heath Tundra	1	2	1
Heath/Boulder	1	2	1
Low Shrub	2	2	2
Moist to dry non-tussock graminoid/dwarf shrub tundra*	1	2	1
Prostrate dwarf shrub*	1	2	1
Shrub low*	2	2	2
Ice and Snow	4	4	4
No data*	N/A**	N/A**	N/A**
Unclassified	N/A**	N/A**	N/A**
Tussock graminoid tundra*	3	2	2
Tussock/Hummock	3	2	2
Wet sedge*	2	1	1
Wetland (Sedge Meadow)	2	1	1
Wetland*	2	1	1

** GeoBase land cover class.*
*** The Unclassified and No data class were not assessed and were excluded from the modelling.*

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Appendix 2

Species Account for Muskox

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Appendix 2. Species Account for Muskox

BACKGROUND INFORMATION

Common Name:	Muskox	
Scientific Name:	*Ovibos moschatus*	
Species Code:	M-OVMO	
Status:	**Global:**	G4 – Apparently Secure, Uncommon but not rare; some cause for long-term concern due to declines or other factors.
	National:	Muskox are not listed at federal level.
	Territorial:	Secure (CESCC 2010).

DISTRIBUTION

Range within Nunavut

Muskox are the only other large ungulates aside from caribou that live in tundra habitats year round. Muskox are found throughout most of Nunavut, with the exception of northeastern and western areas, and Baffin and Southampton Islands. Muskox are generally more abundant on the islands of the Arctic Archipelago relative to mainland Nunavut (Fournier and Gunn 1998).

Territorial Context

Muskox are large herbivores and a key species in the tundra trophic food chain. Muskox comprise an important food source for wolves and to a lesser degree, grizzly bears (Gunn and Miller 1982; Reynolds, Wilson, and Klein 2002; Wiebe et al. 2009; Mech 2010). Muskox are highly valued by the Inuit as a source of food, hides, horns, and wool, as well as for the commercial export of meat. These ungulates also attract tourists to Nunavut for guided sport hunting and wildlife viewing.

Project Area

Muskox are found thought the Project area during all seasons of the year (Dumond 2006).

POPULATION TRENDS

In 2001, muskox numbers in Canada were estimated at 166,000 animals (Gunn and Adamczewski 2003). Populations are generally thought to be increasing on Arctic islands and decreasing on the mainland, potentially due to the parasite *Umingmakstrongylus pallikuukensi* (Dumond 2006).

Muskox were close to extinction in the late nineteenth and early twentieth centuries due to overhunting (Fournier and Gunn 1998; Campbell and Setterington 2001). A hunting moratorium was enacted by the Canadian Government in 1917, and then lifted in 1969 (Giroux et al. 2012). The Inuit have remarked on the expansion in distribution and numbers of muskox since the 1960s. In the last three decades, muskox numbers have increased and most populations have recovered throughout the historic range (Fournier and Gunn 1998; Campbell and Setterington 2001).

HABITAT USE – LIFE REQUISITES AND SEASONS

Overview

Muskox are relatively sedentary and have a relatively small home ranges; on average, summer home ranges are 223 km^2 and winter home ranges are 70 km^2. Muskox do not travel long distances between calving, rutting, and wintering habitats, and generally prefer areas with little terrain variation, at low altitude and with a southerly exposure throughout the year (Thing et al. 1987).

Seasonality of the arctic environment in combination with changing needs for energy and nutrients strongly influences muskox range relationships and grazing behaviour (Jingfors 1982). Muskox are found where amounts of plant biomass are limited through the long and hard winters (Klein and Bay 1990). Selection of actual feeding and resting/rumination sites by the animals is influenced by aspect and slope, floristic composition, vegetation distribution and diversity, insect harassment, duration of winter and depth of snow pack (Jingfors 1982; Thing et al. 1987; Nellemann and Reynolds 1997).

Muskox have adopted an energy-conservative lifestyle (Klein and Bay 1994). They have adapted to the foraging constraints of arctic winters by digesting low quality graminoid more efficiently than would other grazers and by maintaining body mass at lower intake (Adamczewski et al. 1994; Klein and Bay 1994). There is some evidence that high densities of grazers have a positive effect on plant productivity and possibly herbivores in Arctic ecosystems (Larter and Nagy 2001a).

For muskox, habitat suitability was assessed for winter and early spring (April to June) and summer and fall (rutting) seasons (August through September). Table 1 summarizes the seasonal life requisites of muskox used in the model development.

Table 1. Seasonal Life Requisites of Muskox

Season	Date	Life Requisite	Habitat Preference
Summer and Fall	June to September	Living	Wetlands, shrubby areas, eskers with graminoid cover.
Winter and Early Spring	October to May	Living, Reproducing	Windswept ridges and other areas that have low snow cover allowing for accessibility of forage.

Winter / Early Spring

Muskox rely on important adaptions such as a large rumen capacity and slow passage rates to survive winter foraging conditions in the Arctic (Adamczewski et al. 1994; Ihl and Barboza 2007). Old age, worn teeth, heavy parasite infestation, or bad weather conditions can result in death by starvation (CWS 1990). It is known that their body weight will decrease over the winter, yet they will still possess a considerable amount of unused fat reserves at the beginning of calving (Thing et al. 1987).

During winter months, muskox select for thin or soft snow cover with high food abundance (Schaefer and Messier 1995). In late winter, they prefer either foraging for sedge in rugged terrain, as snow cover tends to be shallower there, making foraging easier (Klein and Bay 1994; Nellemann and Reynolds 1997; Larter and Nagy 2001b), or foraging in willow communities (Raillard and Svoboda 2000; Tolvanen and Henry 2000). They may sometimes eat moss in winter, but moss is poorly digestible for them, and its consumption may result in a net loss of nutrients (Ihl and Barboza 2007). In late winter, wind-exposed, dry dwarf shrub heaths are also extremely important as feeding habitat (Thing et al. 1987).

Calving takes place in the early spring (between late March and late May), often before the snow has melted completely and vegetation has begun to green. Similar to caribou, muskox also show a high

degree of selectivity for moist sedge meadow during the calving and post-calving periods; upland shrubs are also selected during this time, when emergent willow leaves are more nutritious than later in the season (Reynolds, Wilson, and Klein 2002).

Summer and Fall

Muskox must accumulate sufficient fat reserves during the summer and early fall months to survive the following winter (Reynolds, Wilson, and Klein 2002). The rut begins in late summer, when bulls challenge each other by engaging in fights to determine dominance and possession of a herd. Dominant males spend more time engaged in rutting activities than other bulls (Jingfors 1982). Pregnancy success is likely positively related to the fat reserves accumulated by a female during these months (White, Holleman, and Tiplady 1989; Adamczewski et al. 1998). As part of the natural weaning process, calves gradually acquire foraging activities similar to older individuals, after spending much of their time lying or suckling during their first week of life (Jingfors 1982). They are able to feed on vegetation, although milk may be part of their diet throughout the first year (CWS 1990).

During summer months and the rutting period, muskox keep using their preferred wet, highly productive sedge habitats. In addition, muskox may forage on graminoids such as grasses, willows and forbs which grow quickly, producing rich forage (Gunn and Sutherland 1997; Nellemann and Reynolds 1997; Gunn and Adamczewski 2003). Feeding and total active times in summer usually increase with latitude (Klein and Bay 1990).

Ratings

A four class rating system was used to evaluate muskox habitat within the Local Study Area and Regional Study Area.

Rating Assumptions for Winter / Early Spring

Habitat use during the winter/early spring season is focused on areas that provide accessible forage (e.g., low snowpacks and windswept areas) and/or early vegetation growth. Habitat studies have shown that actual late winter/early spring use is varied, ranging from rugged exposed terrain in the high Arctic, to lowland areas in Alaska, indicating that use may be site specific in a given landscape (Schaefer, Stevens, and Messier 1996; Nellemann and Reynolds 1997). Habitat preference is based on the need for low winter fat reserves to be replenished, and for pregnant or lactating cows' requirement for high quality forage (Reynolds, Wilson, and Klein 2002). The following general assumptions were made to rate muskox winter and early spring habitat:

- High rated habitat (1) included ecosystem units where limited snow packs are likely (e.g., windswept ridges) and areas with a significant amount of early vegetation.
- Moderate rated habitat (2) included habitats where foraging opportunities were available, but either were not as accessible or early in the season as ecosystem units rated as high.
- Low rated habitat (3) included habitat with limited with seasonal forage, or areas where the snowpack likely persists reducing foraging opportunities.
- Nil rated habitat (4) included ecosystem units with sparse vegetation including beach and marine, exposed soils, and disturbed areas, as well as those that occur in landscape positions that have a persistent snowpack.

Rating Assumptions for Summer / Fall

During the summer and fall, preference is given to habitat that provides abundant forage, primarily wetter areas dominated by sedges and willows. Muskox are commonly found near wetland and in wetter, shrubby tundra habitats in the summer (Gunn and Sutherland 1997). Gunn and Sutherland (1997) also found that single bulls and immature males used the immediate vicinity of waterbodies more often than any other age or sex class. The fringes of these waterbodies may support muskox forage such as sedges. By September snowfall may occur, requiring muskox to seek habitat with low snow cover that does not impact movement or feeding. The following general assumptions were made to rate muskox summer and fall habitat:

- High rated habitat (1) included ecosystem units characterized by an abundance of shrubs (particularly willow) and sedges.
- Moderate rated habitat (2) included habitat that provided ample foraging opportunities, but were assumed to have less abundant cover of preferred forage species, or where forage was not available in later parts of the season.
- Low rated habitat (3) included ecosystem units that contain limited forage opportunities.
- Nil rated habitat (4) were those that provide no forage for muskox, e.g., sparsely vegetated.

Ratings Table

Muskox habitat models utilized ecosystem mapping and known dominant vegetation composition of the mapped ecosystem units. Table 2 contains habitat suitability ratings for muskox according to the TEM mapping conducted in the LSA, and Table 3 contains habitat suitability ratings for muskox according to the WKSS/GeoBase mapping within the RSA.

Table 2. Ratings Table for Muskox Habitat in the Local Study Area

Ecosystem Class	LSA Vegetation Association	Map Code	Summer and Fall	Winter and Early Spring
Bedrock	Bedrock outcrop	BR	3	2
Bedrock	Bedrock-lichen veneer	BL	2	1
Bedrock	Cliff	BC	4	4
Bedrock	Talus	BT	4	4
Bedrock	Blockfield	TB	4	4
Disturbed/Barren	Disturbed vegetation	DV	4	4
Disturbed/Barren	Exposed soil	ES	4	3
Disturbed/Barren	Mine camp	DR	4	4
Disturbed/Barren	Road surface	DZ	4	4
Esker	Dwarf shrub esker	EH	1	1
Esker	Shrubby esker	EW	1	1
Esker	Sparsely vegetated esker	EC	2	1
Freshwater	Lake	LA	3	4
Freshwater	Pond	PD	2	4
Freshwater	River	RI	2	4
Marine	Marine beach	MB	4	4
Marine	Old beach heads	MH	3	2

(continued)

Table 2. Ratings Table for Muskox Habitat in the Local Study Area (completed)

Ecosystem Class	LSA Vegetation Association	Map Code	Summer and Fall	Winter and Early Spring
Marine	Saltwater	MW	4	4
Riparian	Low bench floodplain	RL	2	4
Riparian	Mid bench floodplain	RM	2	4
Riparian	Willow riparian	RW	1	3
Riparian (Marine)	Marine riparian shrub	MR	1	3
Tundra	Dry-sparse tundra	TH	3	2
Tundra	Mesic dwarf-shrub tundra	TL	3	3
Tundra	Shrubby tundra	TS	2	3
Tundra (Marine)	Marine dwarf shrub tundra	MT	2	2
Tundra (Marine)	Marine shrubby tundra	MS	2	3
Wetland	Cottongrass-sedge fen	WC	1	4
Wetland	Raised bog complex	WB	2	4
Wetland	Shallow open water	WO	2	4
Wetland	Tussock meadow	WT	2	4
Wetland	Undifferentiated fen	WF	2	4
Wetland	Water sedge marsh	WA	1	4
Wetland	Willow-sedge fen	WS	1	4
Wetland (Marine)	Saline Fen	MF	2	4
Wetland (Marine)	Saline Marsh	MM	1	4
Wetland (Marine)	Saline shallow open water	MO	2	4

Table 3. Ratings Table for Muskox Habitat in the Regional Study Area

WKSS/GeoBase Land Classification	Summer and Fall	Winter and Early Spring
Bedrock Association	4	4
Boulder Association	3	2
Heath/Bedrock	2	1
Lichen Veneer	2	1
Sparsely vegetated bedrock*	2	1
Sparsely vegetated till-colluvium*	2	1
Bare Ground	4	3
Barren/Non-vegetated*	4	4
Gravel Deposit	4	4
Esker Complex	2	1
Deep Water	3	4
Shallow Water	2	4
Water	3	4
Riparian Tall Shrub	1	3
Shrub tall*	1	3
Bare soil with cryptogam crust - frost boils*	2	1

(continued)

Table 3. Ratings Table for Muskox Habitat in the Regional Study Area (completed)

WKSS/GeoBase Land Classification	Summer and Fall	Winter and Early Spring
Birch Seep	2	3
Heath Tundra	3	3
Heath/Boulder	3	2
Low Shrub	2	3
Moist to dry non-tussock graminoid/dwarf shrub tundra*	3	3
Prostrate dwarf shrub*	3	2
Shrub low*	2	3
Ice and Snow	4	4
No data	NA	NA
Unclassified	NA	NA
Tussock graminoid tundra*	2	4
Tussock/Hummock	2	4
Wet sedge*	1	4
Wetland (Sedge Meadow)	1	4
Wetland*	1	4

** GeoBase land cover class.*

*** The Unclassified and No data class were not assessed and were excluded from the modelling.*

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Appendix 3

Species Account for Grizzly Bear

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Appendix 3. Species Account for Grizzly Bear

BACKGROUND INFORMATION

Common Name:	Grizzly Bear, western population	
Scientific Name:	*Ursus arctos*	
Species Code:	M-URAR	
Status:	**Global:**	G4 – Apparently Secure, Uncommon but not rare; some cause for long-term concern due to declines or other factors.
	National:	Listed as a population of Special Concern under COSEWIC (COSEWIC 2002), currently not listed under the Species at Risk Act.
	Territorial:	Secure (CESCC 2010).

Grizzly bears have low ecological resiliency, are sensitive to human activity and are frequently displaced by industrial developments (McLellan 1990; Weaver, Paquet, and Ruggiero. 1996; Ross 2002).

DISTRIBUTION

Range within Nunavut

Barren-ground grizzly bears of Nunavut are at the northern most range of grizzly bear populations in North America. Their range within Nunavut includes the Kivalliq, the Kitikmeot, and Baffin regions.

Territorial Context

Average annual ranges of male and female grizzly bears are approximately as 7,245 km^2 and 2,100 km^2, respectively (McLoughlin, Ferguson, and Messier 2000). Bears living in the central Canadian Arctic may be at relatively elevated risk of disturbance because they naturally occur at low densities and may be more vulnerable to disturbance on the open tundra landscape (Ross 2002; R. Mulders pers. comm.).

Project Area

Grizzly bears are known to occur within the RSA and LSA from satellite-collar data and observations made during baseline studies.

POPULATION TRENDS

There is no official estimate on grizzly bear population sizes for the West Kitikmeot region of Nunavut, which the Project is located within. However, a crude estimate of 800 grizzly bears was determined for a 200,000 km^2 portion of the northwestern mainland of Nunavut, which does includes the Project area (Ross 2002). This estimate assumed a density of 4 bears per 1,000 km^2 based on grizzly bear densities in nearby areas (Ross 2002).

Barren-ground grizzly bears inhabit the northern edge of the grizzly bear range in North America. Habitats at these high latitudes are relatively low in productivity and quality. As a result, barren-ground grizzly bears utilize large home ranges and exist at low densities compared to other grizzly bear populations in more productive ecosystems. Average home range sizes vary from 2,100 km^2 for females to 7,245 km^2 for males, and home range overlap is relatively high (McLoughlin, Ferguson, and Messier 2000).

Grizzly bears in the Arctic exhibit low reproductive rates due to a late age of maturity, small litter sizes and long intervals between litters. Barren-ground grizzly bears would be expected to have relatively lower reproductive rates because they occupy areas of low productivity and high seasonality (Ferguson and McLoughlin 2000; McLoughlin, Ferguson, and Messier 2000). However, while barren-ground grizzly bears have a later age of maturity than other grizzly bear populations, they have larger litter sizes and higher birth rates (Case and Buckland 1998; McLoughlin et al. 2003). Furthermore, barren-ground grizzly bears have shorter intervals between litters than most northern populations and similar intervals to southern interior populations (McLoughlin et al. 2003)

HABITAT USE – LIFE REQUISITES AND SEASONS

The life requisites that will be rated for grizzly bear are living, reproducing, and hibernating. The specified seasons that will be rated for are spring, summer, fall, and denning (Table 1). Food is the most important aspect for this species during each of these seasons (except denning) and will be the focus of the ratings.

Table 1. Seasonal Life Requisites of Grizzly Bear

Season	Date	Life Requisite	Habitat Preference
Spring	May - June	Living	Esker, crowberry, blueberry, sedge, riparian shrub, caribou, ground squirrel
Summer	June – September	Living, Reproducing	Esker, blueberry, sedge, riparian shrub, ground squirrel
Fall	September - October	Living	Esker, blueberry, sedge, riparian shrub, caribou, ground squirrel
Denning	October - May	Hibernating, Reproducing	Eskers, lacustrine deposits

Overview

Habitat selection by barren-ground grizzly bears primarily reflects the availability and abundance of a wide variety of food items (McLoughlin et al. 2003). Habitat selection occurs at two spatial scales. On the landscape scale, grizzly bears select home ranges that have a higher proportion of eskers, tussock/hummock tundra, lichen veneer, birch seep, and riparian tall shrub habitat than surrounding areas. Habitat selection within the home ranges of grizzly bears varies by season, sex/reproductive status (McLoughlin et al. 2003). Females with cubs tend to avoid the most preferred habitats by males; females without cubs tend to prefer the same habitats as males. Research on the dietary patterns of barren-ground grizzly bears indicates that four time periods correlate with seasonal changes in resource selection (Table 2; Gau et al. 2002; Johnson et al. 2005): spring, summer, late summer, fall. Denning is assumed to take place outside of the dates defined by Gau et al. (2002) and Johnson et al. (2005).

Table 2. Timing of Grizzly Bear Resource Selection

Season	Start Date	End Date
Spring	16-May	20-Jun
Summer	21-Jun	31-Jul
Late Summer	01-Aug	09-Sep
Fall	10-Sep	15-Oct

Note: Dates used in habitat suitability modelling by Johnson et al. (2005) based on studies by Gau et al. (2002). Dates reflect shifts in grizzly bear diet throughout the season.

Barren-ground grizzly bears are opportunistically omnivorous, meaning that they eat a variety of vegetation and meat items depending on their availability and the physiological requirements of the bear. Caribou is the primary food item of barren-ground grizzly bears and grizzly bears may be proficient hunters of caribou (Gau et al. 2002). Berries (e.g., crowberry, *Empetrum nigrum*; blueberry, *Vaccinium uliginosum*; cranberry, *V. vitis-idaea*) are mostly consumed in spring and late summer when they are abundant. The summer diet of grizzly bears consists largely of emergent vegetation. Ground squirrels have varying importance in the diets of grizzly bears, depending on the time of year (Gau et al. 2002).

Habitat selection by barren-ground grizzly bears reflects the abundance and availability of the aforementioned food items. Overall, grizzly bears prefer eskers and riparian tall shrub habitats throughout the year (McLoughlin et al. 2002). Lichen veneer is selected by bears in the spring and fall seasons. Males prefer tussock/hummock tundra at varying times during the year. Females with cubs tend to avoid habitats that are ranked the highest for males in spring (e.g., tussock/hummock tundra), late summer (e.g., esker) and fall (e.g., riparian tall shrub; McLoughlin et al. (2002). Females may avoid habitats where there are higher chances of encountering males to avoid competition, or to protect cubs from occasional infanticide committed by males (McLellan 1994). The latter argument is supported by the fact that females without cubs tend not to avoid habitats preferred by males in the way that females with cubs do (McLoughlin et al. 2002).

Spring (May 14 to June 20)

Spring habitat is important because it provides the first forage for grizzly bears following winter hibernation. Upon emerging from dens, barren-ground grizzly bears feed primarily on caribou migrating north to their calving grounds (Gau et al. 2002). Overwintered berries and Arctic ground squirrels are also important food sources during this period, but are consumed to a lesser extent than are caribou (Gau et al. 2002).

Grizzly bears, including males, females with cubs and females without cubs, show the greatest preference for esker habitat during the spring. Lichen veneer and exposed bedrock habitats are also preferred by grizzly bears during this time (McLoughlin et al. 2002; Johnson et al. 2005). These habitat types provide relatively abundant sources of caribou, Arctic ground squirrel and over-wintered berries. Migrating caribou select eskers and lichen veneers for ease of travel and forage and Arctic ground squirrels preferentially burrow in eskers. Over-wintered berries are most accessible in eskers and exposed bedrock habitat because these habitats are the first to become snow-free in the spring. Male grizzly bears show an additional preference for tussock/hummock tundra, while females without cubs show additional preference for riparian tall shrub habitat (McLoughlin et al. 2002; Johnson et al. 2005).

Summer (June 21 to September 9)

The summer diet of barren-ground grizzly bears is highly variable. Early in the season, when caribou are scarce, grizzly bears feed primarily on horsetails, Arctic cottongrasses, and sedges. By mid-summer, caribou becomes the primary component of the grizzly bear diet as post-calving herds move southward. However, vegetation is still an important source of food. Grizzly bears resume consumption of Arctic ground squirrels in mid-summer (Gau et al. 2002).

During the summer, female grizzly bears (with and without cubs) show preference for eskers and riparian tall shrub habitat. Riparian tall shrub habitat is selected for its abundant vegetation and caribou. Females with young also prefer heath tundra. Males continue to show preference for tussock/hummock tundra in the summer (McLoughlin et al. 2002). A habitat modelling study by Johnson et al. (2005) shows that grizzly bears select esker and low shrub habitats in the summer.

In late summer, barren-ground grizzly bears increase foraging in order to fatten up for the winter denning season (Gau 1998). During this time, berries are the primary component of the grizzly bear diet and are essential for fat deposition. Caribou continue to be an important source of food during the late summer and Arctic ground squirrels are consumed to some extent (Gau et al. 2002).

Barren-ground grizzly bears prefer eskers and riparian tall shrub habitat in late summer (McLoughlin et al. 2002; Johnson et al. 2005). These habitats provide an abundance of fresh berries and caribou. Differences in habitat use among males, females with cubs and females without cubs are pronounced in late summer. Males and females without cubs prefer eskers, while females with cubs avoid this habitat type (McLoughlin et al. 2002). Males also continue to prefer tussock/hummock successional tundra and, to some extent, females with cubs express some preference for this. Females with cubs show preference for heath bedrock, while males and females without cubs avoid it. Generally, females with cubs are segregated from other demographic groups during the late summer period.

Fall (September 10 to October 15)

Fall is a critical season for barren-ground grizzly bears because individuals must gain weight rapidly in order to survive winter hibernation (Zager and Jonkel 1983). The fall diet of grizzly bears is similar to the spring diet. Barren-ground grizzly bears feed primarily on caribou that are migrating south towards the treeline for winter. Arctic ground squirrels are also an important food source. However, fewer berries are consumed in fall compared to the spring and summer seasons (Gau et al. 2002).

Important grizzly bear habitat in fall includes lichen veneer (by all groups), riparian tall shrub habitat for males and females without young (females with young significantly avoid this habitat), and eskers for females without young (McLoughlin et al. 2002). However, females with cubs significantly avoid riparian tall shrub habitat and select bedrock habitats, which are avoided by males. Again, habitats that provide grizzly bear with a relatively abundant source of caribou strongly influence their selection (Johnson et al. 2005). A habitat modelling study by Johnson et al. (2005) shows that fall habitat selection by grizzly bears is strongly influenced by the presence of esker, heath rock, low shrub, and peat bog vegetation types.

Denning (October 16 to May 14)

In general, denning lasts from late October to early May for most bears; some bears, males in particular, may den for shorter periods of time (McLoughlin, Cluff, and Messier 2002). McLoughlin, Cluff, and Messier (2002) visited 56 grizzly bear den sites to record physical characteristics of the den site such as the presence of vegetation and soil characteristics. Most den sites (60%) were located in heath tundra and heath-boulder habitats, with most of the remaining dens in riparian tall shrub and birch seep habitats. Although eskers accounted for only seven of 56 den sites studied, this habitat type was selected more than expected, given its low availability in the central Arctic.

Grizzly bear den sites in the study most commonly faced south (45%), followed by west (38%); dens facing east (18%) and north (14%) (McLoughlin, Cluff, and Messier 2002). Other researchers who have studied denning in Arctic grizzly bears have also found a pronounced tendency for den sites to have a more southerly aspect (Reynolds, Curatalo, and Quimby 1976; Banci and Moore 1997). The benefit of a southern exposure may be insulation (i.e., warmth) at emergence in the spring (and possibly at denning in the fall) or the accumulation of an insulating layer of snow that would result from the prevailing northerly winds.

Grizzly bears also select den sites based on slope. McLoughlin, Cluff, and Messier (2002) reported that grizzly bears chose den sites on relatively steep slopes, averaging 25°. Steep slopes may permit the bears to construct horizontal or even upward-sloping tunnels, which would result in a warm air “trap” in the hibernation chamber (Harding 1976).

The substrates of den sites are well-drained and contain a large amount of sand and coarse material, including cobble and boulder sized stones. The structural integrity of den sites is maintained through root mats from dwarf birch and other shrubby vegetation located in the ceilings of dens. The grizzly bear dens studied by McLoughlin, Cluff, and Messier (2002) did not last long; by mid-summer, about 80% (44/56) had partially or completely collapsed. Thus, it appears that bears usually dig new dens each year.

Ratings

A four class rating system was used to evaluate grizzly bear habitat within the Local Study Area and Regional Study Area.

Rating Assumptions for Spring

Spring habitat provides grizzly bears their first opportunity to feed after emerging from hibernation. Important habitat includes areas that become snow-free early, ecosystem units that contain last season's over-wintered berries, Arctic ground squirrel burrows, migrating caribou, and early vegetation (Gau et al. 2002; MacHutchon and Wellwood 2003). The following general assumptions were made to evaluate habitat for grizzly bears during the spring:

- High rated habitat (1) included ecosystem units that provided early season food sources, particularly those associated with upland areas that are generally windswept resulting is low snow packs. Overwintered berries from the previous season are available in these areas, as are Arctic ground squirrels.
- Moderate rated habitat (2) included vegetation associations that provide some food sources, but are generally not windswept and have limited over-wintered berries. Moderate ratings were also assigned to some wetland ecosystems based on a high occurrence of early forage production, winter weakened caribou, and caribou calves (as caribou forage within wetland areas post-calving).
- Low rated habitat (3) included vegetation associations that were considered to have low forage potential and was not preferred habitat for prey species.
- Nil rated habitat (4) were habitats that have a lack of forage and prey, or are disturbed.

Rating Assumptions for Summer

Summer habitat use by grizzly bears is highly variable. Grizzlies primarily feed on horsetails, sedges and cottongrass in the early summer when caribou are scarce, as well as berries if available. Caribou are considered to be their primary food source by mid-summer, as well as Arctic ground squirrels (Gau et al. 2002). Late summer use focuses on areas with high berry production. The following general assumptions were made to evaluate habitat for grizzly bears during the summer:

- High rated habitat (1) included shrub dominated ecosystem units, wetlands, and eskers based on the availability of forage. Important forage species in these ecosystem units include an abundance of berries, cottongrass and sedges which are important food sources when caribou are absent from the region.
- Moderate rated habitat (2) included areas where sedges and cottongrass are present in limited quantities, or where berries are only present later in the season (e.g., blueberries, bearberries).

- Low rated habitat (3) included areas that have low forage potential and are not preferred habitat for prey species.
- Nil rated habitat (4) represented habitat where suitable summer forage is limited or absent, such as habitats characterized by exposed soils, were barren, or encompassed lakes and rock outcrops.

Rating Assumptions for Fall

The fall season is critical for grizzlies as they must rapidly gain weight in order to survive the winter. Fall habitat selection is focused on areas of high caribou occurrence (Johnson et al. 2005). The following general assumptions were made to evaluate habitat for grizzly bears during the fall:

- High rated habitat (1) included ecosystem units that retain late season berries and have a relative high abundance of caribou.
- Moderate rated habitat (2) included areas that may contain limited quantities of berries, and to a lesser extent browning sedge and cottongrass forage.
- Low rated habitat (3) included habitat that had sparse vegetation cover, and thus would have low forage and hunting potential.
- Nil rated habitat (4) included vegetation associations that lacked forage and prey, and those that were disturbed.

Rating Assumptions for Denning

Based on the results of McLoughlin, Cluff, and Messier (2002), many habitats appear to have suitable soil texture and structure for denning, but eskers may be selected where available given the ease in which bears may excavate dens. Therefore, the following general assumptions were made to evaluate habitat for grizzly bears during the denning period:

- High rated habitat (1) included vegetation associations that provide terrain features that allow for denning opportunities, specifically parent materials that are easily excavated, have deep permafrost layers, and contain sufficient vegetative root masses to provide soil stability.
- Moderate rated habitat (2) included areas that are similar to high value habitat, but are more likely to contain limitations in the form of shallow permafrost layer or consolidated materials.
- Low rated habitat (3) was considered to have limited potential for successful den excavations (e.g., prevalence of boulders in soil).
- Nil rated habitat (4) included areas that were not suitable for excavation due to shallow soils, high permafrost layers, organic soils, or other conditions that would make a successful den excavation difficult.

Ratings Table

Grizzly bear habitat models utilized ecosystem mapping and known dominant vegetation composition of the mapped ecosystem units. Table 3 contains habitat suitability ratings for grizzly bear according to the TEM mapping conducted in the LSA, and Table 4 contains habitat suitability ratings for grizzly bear according to the WKSS/GeoBase mapping within the RSA.

Table 3. Ratings Table for Grizzly Bear Habitat in the Local Study Area

Ecosystem Class	LSA Vegetation Association	Map Code	Spring	Summer	Fall	Denning
Bedrock	Bedrock outcrop	BR	3	3	3	4
Bedrock	Bedrock-lichen veneer	BL	2	3	3	4
Bedrock	Cliff	BC	4	4	4	4
Bedrock	Talus	BT	4	4	4	4
Bedrock	Blockfield	TB	4	4	4	4
Disturbed/Barren	Disturbed vegetation	DV	4	4	4	4
Disturbed/Barren	Exposed soil	ES	4	4	4	4
Disturbed/Barren	Mine camp	DR	4	4	4	4
Disturbed/Barren	Road surface	DZ	4	4	4	4
Esker	Dwarf shrub esker	EH	1	2	1	1
Esker	Shrubby esker	EW	1	2	1	1
Esker	Sparsely vegetated esker	EC	1	2	2	1
Freshwater	Lake	LA	4	2	3	4
Freshwater	Pond	PD	4	2	3	4
Freshwater	River	RI	3	2	2	4
Marine	Marine beach	MB	3	2	2	3
Marine	Old beach heads	MH	4	4	4	3
Marine	Saltwater	MW	4	4	4	4
Riparian	Low bench floodplain	RL	3	3	3	4
Riparian	Mid bench floodplain	RM	3	2	2	3
Riparian	Willow riparian	RW	3	2	2	3
Riparian (Marine)	Marine riparian shrub	MR	3	2	2	3
Tundra	Dry-sparse tundra	TH	2	3	3	4
Tundra	Mesic dwarf-shrub tundra	TL	2	2	2	4
Tundra	Shrubby tundra	TS	3	2	2	4
Tundra (Marine)	Marine dwarf shrub tundra	MT	3	1	1	4
Tundra (Marine)	Marine shrubby tundra	MS	3	1	2	3
Wetland	Cottongrass-sedge fen	WC	2	2	2	4
Wetland	Raised bog complex	WB	2	2	2	4
Wetland	Shallow open water	WO	3	3	3	4
Wetland	Tussock meadow	WT	2	2	2	4
Wetland	Undifferentiated fen	WF	2	2	2	4
Wetland	Water sedge marsh	WA	1	1	2	4
Wetland	Willow-sedge fen	WS	3	2	3	4
Wetland (Marine)	Saline Fen	MF	3	2	3	4
Wetland (Marine)	Saline Marsh	MM	3	2	3	4
Wetland (Marine)	Saline shallow open water	MO	4	3	3	4

Table 4. Ratings Table for Grizzly Bear Habitat in the Regional Study Area

WKSS/GeoBase Land Classification	Spring	Summer	Fall	Denning
Bedrock Association	4	4	4	4
Boulder Association	3	3	3	4
Heath/Bedrock	2	3	3	4
Lichen Veneer	2	3	3	4
Sparsely vegetated bedrock*	2	3	3	4
Sparsely vegetated till-colluvium*	2	3	3	4
Bare Ground	4	4	4	4
Barren/Non-vegetated*	4	4	4	4
Gravel Deposit	4	4	4	3
Esker Complex	1	2	1	1
Deep Water	4	2	3	4
Shallow Water	3	3	3	4
Water	4	2	3	4
Riparian Tall Shrub	3	2	2	3
Shrub tall*	3	2	2	3
Bare soil with cryptogam crust - frost boils*	2	3	3	4
Birch Seep	3	2	2	4
Heath Tundra	2	2	2	4
Heath/Boulder	2	3	3	4
Low Shrub	3	2	2	4
Moist to dry non-tussock graminoid/dwarf shrub tundra*	2	2	2	4
Prostrate dwarf shrub*	2	3	3	4
Shrub low*	3	2	2	4
Ice and Snow	4	4	4	4
No data	NA	NA	NA	NA
Unclassified	NA	NA	NA	NA
Tussock graminoid tundra*	2	2	2	4
Tussock/Hummock	2	2	2	4
Wet sedge*	2	1	2	4
Wetland (Sedge Meadow)	2	1	2	4
Wetland*	2	1	2	4

* *GeoBase land cover class.*
** *The Unclassified and No data class were not assessed and were excluded from the modelling.*

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Personal Communication

Robert Mulders, GNWT ENR, personal communication

Appendix 4

Species Account for Grey Wolf

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Appendix 4. Species Account for Grey Wolf

BACKGROUND INFORMATION

Common Name:	Grey wolf (northern grey wolf)	
Scientific Name:	*Canis lupus occidentalis*	
Species Code:	M-CALU	
Status:	**Global:**	G4 – Apparently Secure, Uncommon but not rare; some cause for long-term concern due to declines or other factors.
	National:	Grey wolf is listed as Not at Risk by COSEWIC (2009).
	Territorial:	Secure (CESCC 2010).

DISTRIBUTION

Range within Nunavut

The grey wolf is widespread throughout northern Canada, including Nunavut.

Territorial Context

Arctic wolves rely on migratory prey (i.e., barren-ground caribou) rather than resident prey (Walton et al. 2001; Cluff, Walton, and Paquet 2002). As a result, the annual home ranges of wolves in the Arctic are considerably larger than in more southerly latitudes. Typically, their patterns of distribution, densities, territory boundaries and dispersal movements will all be influenced by prey abundance and distribution and also interactions between packs.

Project Area

Numerous wolves and wolf dens have been observed in areas surrounding the Project area during baseline studies (Rescan 2012, 2013, 2014).

POPULATION TRENDS

Wolves are found in 90% of their original Canadian range, which is home to an estimated 60,000 individuals (Walton et al. 2001). Nunavut. Populations are stable or increasing across the majority of their Canadian range, except in northern Alberta and some areas of the Northwest Territories where they are experiencing declines (Hayes and Gunson 1995). In Nunavut, wolf populations are stable or increasing within their range (Hayes and Gunson 1995). Estimates of wolf numbers in Nunavut have not been made recently.

HABITAT USE – LIFE REQUISITES AND SEASONS

Overview

The specific habitat being rated for the grey wolf is living and reproducing and the respective season is denning (Table 1). Wolves breed once per year, typically during March or April. After a nine-week gestation period, litters remain in dens for up to two weeks. Throughout the late spring and early summer pups remain close to dens, while adults hunt nearby. By late summer to early fall they join the pack as it follows caribou and begin to participate in hunting activities.

Table 1. Seasonal Life Requisites of Grey Wolf

Season	Date	Life Requisite	Habitat Preference
Denning	Late April to September	Living and Reproducing	Eskers, near prey

Habitat Use and Diet

A study in the central Canadian Arctic estimated annual home range sizes of approximately 63,000 km^2 for males, and 45,000 km^2 for females (Walton et al. 2001). Winter ranges are much larger than summer ranges and show a clear seasonal separation from summer denning areas (Walton et al. 2001). The reason for these extraordinary home range sizes is that Wolves in the Canadian Arctic make long seasonal migrations every year to follow barren- ground caribou (Heard and Williams 1992; Walton et al. 2001; Frame et al. 2004). Satellite-collared wolves in the central Arctic showed a distinct migratory pattern whereby they leave the tundra denning areas in the fall, move over large areas throughout the winter, and then return to the tundra to give birth in the early spring (Walton et al. 2001). Wolves follow the caribou for most of the year, except while giving birth to pups in mid to late May, and until pups are able to travel with their mother in September to October. Between these periods, wolf movements are restricted to areas surrounding the den site with individuals often travelling large distances in search of prey (Frame et al. 2004).

At the level of the home range, tundra grey wolves in the central Canadian Arctic have shown to have a selective preference for eskers (McLoughlin et al. 2004). Although this link between habitat selection and ecosystem type was not conclusive when examined within the home range, the findings suggest that suitable denning habitat (i.e., eskers) may be an important limiting factor affecting habitat selection of arctic grey wolves (McLoughlin et al. 2004). Given that tundra wolves also hunt primarily migrating caribou would suggest why they tend to show no relative preference for habitat types within the home range.

The primary prey of wolves of this region and inhabiting the study area is barren-ground caribou, which they follow for hundreds of kilometres every year (Frame 2005). Caribou in the Canadian Arctic are the only species that occur at densities sufficient enough to support the wolf population (Walton et al. 2001). Tundra wolves also feed on muskox, small mammals such as hares, foxes, rodents, and even small amounts of plant material.

Denning Ecology

Wolves arrive at denning sites in mid- to late- May and give birth shortly thereafter. Pups are weaned in the den and the immediate area surrounding the den. Wolves leave the den site when the young are able to travel with adults, usually sometime between September and October (Walton et al. 2001). After migrating long distances to follow caribou, wolves often return to the same den in subsequent years (Ballard and Dau 1983; Mech and Packard 1990).

Eskers are the preferred habitats for wolf den construction. Esker habitats are granular and sandy, facilitating soil excavation (McLoughlin et al. 2004). In the Canadian Arctic tundra, esker habitat only comprises about 1 to 2% of the landscape, therefore, suitable denning habitat for these wolves is likely a limiting factor and eskers should be considered ecologically sensitive (McLoughlin et al. 2004).

Ratings

A four class rating system was used to evaluate grey wolf habitat within the Local Study Area and Regional Study Area.

Rating Assumptions for Denning

The denning season is focused on the location of suitable dens (eskers and other surficial material such as gravel where the permafrost layer is deep and soils are relatively loose). Though the presence of suitable hunting habitat near the den is also important, it was not accounted for in the model. Wolves are known to make long distance forays for food during the denning period. The following general assumptions were made to evaluate habitat for wolf denning:

- High rated habitat (1) was restricted to eskers.
- Moderate rated habitat (2) included habitat similar to high value habitat, but that contain limitations in the form of shallow permafrost layer or consolidated materials.
- Low rated habitat (3) included vegetation associations that were considered to have limited potential for successful den excavations, such as dry upland shrubby areas.
- Nil rated habitat (4) included areas not suitable for excavation due to shallow soils, high permafrost layers, organic soils, or other conditions that would make a successful den excavation difficult.

Ratings Table

Grey wolf habitat models utilized ecosystem mapping and known dominant vegetation composition of the mapped ecosystem units. Table 2 contains habitat suitability ratings for grey wolf according to the TEM mapping conducted in the LSA, and Table 3 contains habitat suitability ratings for grey wolf according to the WKSS/GeoBase mapping within the RSA.

Table 2. Ratings Table for Grey Wolf Habitat in the Local Study Area

Ecosystem Class	LSA Vegetation Association	Map Code	Denning
Bedrock	Bedrock outcrop	BR	4
Bedrock	Bedrock-lichen veneer	BL	4
Bedrock	Cliff	BC	4
Bedrock	Talus	BT	4
Bedrock	Blockfield	TB	4
Disturbed/Barren	Disturbed vegetation	DV	4
Disturbed/Barren	Exposed soil	ES	4
Disturbed/Barren	Mine camp	DR	4
Disturbed/Barren	Road surface	DZ	4
Esker	Dwarf shrub esker	EH	1
Esker	Shrubby esker	EW	1
Esker	Sparsely vegetated esker	EC	1
Freshwater	Lake	LA	4
Freshwater	Pond	PD	4
Freshwater	River	RI	4
Marine	Marine beach	MB	3
Marine	Old beach heads	MH	3
Marine	Saltwater	MW	4
Riparian	Low bench floodplain	RL	4
Riparian	Mid bench floodplain	RM	3

(continued)

Table 2. Ratings Table for Grey Wolf Habitat in the Local Study Area (completed)

Ecosystem Class	LSA Vegetation Association	Map Code	Denning
Riparian	Willow riparian	RW	2
Riparian (Marine)	Marine riparian shrub	MR	2
Tundra	Dry-sparse tundra	TH	4
Tundra	Mesic dwarf-shrub tundra	TL	4
Tundra	Shrubby tundra	TS	4
Tundra (Marine)	Marine dwarf shrub tundra	MT	4
Tundra (Marine)	Marine shrubby tundra	MS	3
Wetland	Cottongrass-sedge fen	WC	4
Wetland	Raised bog complex	WB	4
Wetland	Shallow open water	WO	4
Wetland	Tussock meadow	WT	4
Wetland	Undifferentiated fen	WF	4
Wetland	Water sedge marsh	WA	4
Wetland	Willow-sedge fen	WS	4
Wetland (Marine)	Saline Fen	MF	4
Wetland (Marine)	Saline Marsh	MM	4
Wetland (Marine)	Saline shallow open water	MO	4

Table 3. Ratings Table for Grey Wolf Habitat in the Regional Study Area

WKSS/GeoBase Land Classification	Denning
Bedrock Association	4
Boulder Association	4
Heath/Bedrock	4
Lichen Veneer	4
Sparsely vegetated bedrock*	4
Sparsely vegetated till-colluvium*	4
Bare Ground	4
Barren/Non-vegetated*	4
Gravel Deposit	3
Esker Complex	1
Deep Water	4
Shallow Water	4
Water	4
Riparian Tall Shrub	3
Shrub tall*	3
Bare soil with cryptogam crust - frost boils*	4
Birch Seep	4
Heath Tundra	4
Heath/Boulder	4
Low Shrub	4

(continued)

Table 3. Ratings Table for Grey Wolf Habitat in the Regional Study Area (completed)

WKSS/GeoBase Land Classification	Denning
Moist to dry non-tussock graminoid/dwarf shrub tundra*	4
Prostrate dwarf shrub*	4
Shrub low*	4
Ice and Snow	2
No data	NA
Unclassified	NA
Tussock graminoid tundra*	4
Tussock/Hummock	4
Wet sedge*	4
Wetland (Sedge Meadow)	4
Wetland*	4

** GeoBase land cover class.*
*** The Unclassified and No data class were not assessed and were excluded from the modelling.*

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Appendix 5
Species Account for Wolverine

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Appendix 5. Species Account for Wolverine

BACKGROUND INFORMATION

Common Name:	Wolverine	
Scientific Name:	*Gulo gulo*	
Species Code:	M-GUGU	
Status:	**Global:**	G4 – Apparently Secure, Uncommon but not rare; some cause for long-term concern due to declines or other factors.
	National:	Listed as population of Special Concern by COSEWIC (COSEWIC 2003).
	Territorial:	Secure (CESCC 2010).

DISTRIBUTION

Range within Nunavut

In North America, the geographic range of the wolverine extends from Alaska throughout most of northern and western Canada, including the West Kitikmeot region of Nunavut (COSEWIC 2003; Slough 2007). Wolverines in Nunavut are at the northern most range of populations in North America. Their range within Nunavut includes the Kivalliq and the Kitikmeot regions, and all but the highest arctic islands in the Baffin region.

Territorial Context

Average home range size for wolverines on the tundra are 73-126 km^2 for breeding females and 404-666 km^2 for male (Magoun 1985; Mulders 2000). Home ranges of male wolverine are on average at least four times larger than female home ranges (Mulders, Boulanger, and Paetkau 2007; Persson, Wedholm, and Segerstrom 2010) and over-lap those of several females, in accordance with a polygynous mating system, but adult male-male and female-female home ranges rarely overlap, in accordance with territoriality (Persson, Wedholm, and Segerstrom 2010).

Project Area

Baseline studies indicate wolverine occur within the RSA and LSA. Additionally, Inuit TK indicates that wolverines use the Project area extensively. The southern end of the RSA near Contwoyto Lake is an important area for wolverines. Wolverines are also known to use the southern end of Bathurst Inlet.

POPULATION TRENDS

Wolverine populations in the central Arctic appear to be stable, though recent estimates are lacking (COSEWIC 2003). Population density is thought to be relatively high in the western Arctic (e.g., Yukon and NWT), moderate in western Nunavut (including the Kitikmeot region), and low in eastern Nunavut and on Arctic islands (Slough 2007). The total population size of wolverines in Nunavut is estimated as 2,000-2,500 individuals (COSEWIC 2003; Slough 2007).

Due primarily to low reproductive rates and low population densities, wolverines are susceptible to population declines (Slough 2007; Inman et al. 2012). For example, the eastern population may be near extinction, and wolverines have likely been extirpated from Vancouver Island (Slough 2007). Despite high pregnancy rates, fewer than half of pregnant females produce cubs – most females do not

reproduce in consecutive years (Persson 2005; Inman et al. 2012). Reproductive failure occurs early, during gestation or just after birthing, and is thought to result primarily from poor nutritional status of females (Inman et al. 2012). Thus, food availability, especially during winter, is thought to be the main factor limiting reproduction and structuring the population dynamics of wolverines (Persson 2005). In some populations, mortality due to starving is also an important factor (Inman et al. 2012). Population modeling suggests that viable wolverine populations require at least 45 sexually mature females (> 3 years of age; Persson 2005).

HABITAT USE – LIFE REQUISITES AND SEASONS

Overview

Habitat suitability modelling for wolverine focussed on the identification of suitable natal and maternal denning habitat during the late winter (Table 1). Wolverines mate in the summer but implantation of the fertilized egg is delayed. The fertilized eggs do not implant into the wall of the uterus until sometime between November and March; the eggs will not implant if the female is in poor physical condition. The active period of gestation, or pregnancy, lasts 30 to 40 days following implantation. Birth occurs between February and May.

Table 1. Seasonal Life Requisites of Wolverine

Season	Date	Life Requisite	Habitat Preference
Denning	February to early May	Living and Reproducing	Landscape features that provide deep, persistent snow packs.

Habitat Use and Diet

Wolverine distribution and habitat selection are likely influenced mostly by the availability of food for females, and of food and mates for males (Banci 1994; Mulders, Boulanger, and Paetkau 2007; Persson, Wedholm, and Segerstrom 2010).

Wolverines are both scavengers and predators, and feed on a wide variety of prey and carrion throughout the year. Food caching is an important survival strategy, especially in winter, and may be one of the most critical factors affecting reproduction (Magoun 1987; Mulders 2000; Thorpe et al. 2001; Inman et al. 2012). Characteristics of good cache sites are structures that prevent access by competitors, and allow cold storage to prevent rot in spring and summer. Though wolverines use a variety of habitats while ranging over large tracts of land in search of food (Mulders 2000; Thorpe et al. 2001; COSEWIC 2003), they are often associated with rocky boulder fields which provide good sites for caching food (Johnson et al. 2005; Inman et al. 2012).

Adult ungulates (caribou and muskox) are eaten mostly in the form of carrion, but wolverines are the main predator of caribou calves in some regions (e.g., British Columbia; Gustine et al. 2006). The summer diet of wolverines is more varied than their winter diet, and contains more freshly killed prey (Magoun 1987). It is thought that wolverine foraging strategies switch from mostly scavenging and caching during winter, to hunting for birds and small mammals during summer (Inman et al. 2012). However, scavenging likely remains a key foraging strategy during summer, and is not limited to wolf kills as wolverine have been observed stealing goose carcasses from fox dens (Samelius et al. 2002). On the tundra during the summer, wolverine hunt mainly ground squirrels, Arctic hare, ptarmigan, geese and their eggs (Magoun 1987; Samelius et al. 2002).

Denning Ecology

Wolverines are unique among northern non-hibernating carnivores because they birth very early in the year (February to early April; Inman et al. 2012). Females usually move cubs from natal dens (where cubs were born) to one or more maternal dens (where cubs are nursed) until they are weaned at 7-10 weeks of age. Wolverines usually choose den sites within rocky boulder fields in snowdrifts where a deep insulating layer of snow will be maintained throughout the denning period (February to April); dens and den sites are often used for consecutive years (Lee and Niptanatiak 1996; May et al. 2012). The importance of sites with delayed snow melt in spring for denning is revealed by the strong relationship of wolverine distribution with snow cover – 100% of 562 den sites in North America and Fennoscandia were in sites where snow melted later during spring (Copeland et al. 2010). A den usually consists of snow tunnels within boulder fields terminating in a crevice. Proximity to habitat that provides small mammal prey for cubs also may be an important factor in den site selection (Magoun and Copeland 1998).

Ratings

A two class rating scheme was used to evaluate wolverine denning habitat in the Local Study Area and Regional Study Area.

Rating Assumptions for Late Winter/Denning

Wolverines have specific habitat requirements for den sites and often use dens for consecutive years (Lee and Niptanatiak 1996). Reproductive dens are found in rocky outcrops or snowdrifts, which must maintain a deep insulating layer of snow throughout the denning period (e.g., a snow tunnel within a boulder field terminating in a crevice; Magoun and Copeland 1998). Reproductive dens may be classified as either natal or maternal. Natal dens are used during parturition, while maternal dens are used subsequent to the natal den and before weaning (Magoun and Copeland 1998). Denning sites are located away from predators such as grizzly bears, wolves and other wolverines. Proximity to kit-rearing habitat is also an important factor in den site selection (Magoun and Copeland 1998). In general, the most important factors during this time period are denning and locating adequate food sources. The following general assumptions were used to evaluate habitat for wolverine denning:

- Suitable habitat (U) was limited to vegetation associations that provide potential deep, long-lasting snow packs dues to topography and/or physical structure (tall vegetation, boulders, etc.)
- Not suitable habitat (X) was all other vegetation associations due to a lack of features that provide deep snow packs.

Ratings Table

Wolverine habitat models utilized ecosystem mapping and known dominant vegetation composition of the mapped ecosystem units. Table 2 contains habitat suitability ratings for wolverine according to the TEM mapping conducted in the LSA, and Table 3 contains habitat suitability ratings for wolverine according to the WKSS/GeoBase mapping within the RSA.

Table 2. Ratings Table for Wolverine Habitat in the Local Study Area

Ecosystem Class	LSA Vegetation Association	Map Code	Denning
Bedrock	Bedrock outcrop	BR	U
Bedrock	Bedrock-lichen veneer	BL	X
Bedrock	Cliff	BC	X
Bedrock	Talus	BT	U

(continued)

Table 2. Ratings Table for Wolverine Habitat in the Local Study Area (completed)

Ecosystem Class	LSA Vegetation Association	Map Code	Denning
Bedrock	Blockfield	TB	U
Disturbed/Barren	Disturbed vegetation	DV	X
Disturbed/Barren	Exposed soil	ES	X
Disturbed/Barren	Mine camp	DR	X
Disturbed/Barren	Road surface	DZ	X
Esker	Dwarf shrub esker	EH	U
Esker	Shrubby esker	EW	U
Esker	Sparsely vegetated esker	EC	X
Freshwater	Lake	LA	X
Freshwater	Pond	PD	X
Freshwater	River	RI	X
Marine	Marine beach	MB	X
Marine	Old beach heads	MH	X
Marine	Saltwater	MW	X
Riparian	Low bench floodplain	RL	X
Riparian	Mid bench floodplain	RM	U
Riparian	Willow riparian	RW	U
Riparian (Marine)	Marine riparian shrub	MR	U
Tundra	Dry-sparse tundra	TH	X
Tundra	Mesic dwarf-shrub tundra	TL	U
Tundra	Shrubby tundra	TS	U
Tundra (Marine)	Marine dwarf shrub tundra	MT	X
Tundra (Marine)	Marine shrubby tundra	MS	U
Wetland	Cottongrass-sedge fen	WC	X
Wetland	Raised bog complex	WB	X
Wetland	Shallow open water	WO	X
Wetland	Tussock meadow	WT	X
Wetland	Undifferentiated fen	WF	X
Wetland	Water sedge marsh	WA	X
Wetland	Willow-sedge fen	WS	X
Wetland (Marine)	Saline Fen	MF	X
Wetland (Marine)	Saline Marsh	MM	X
Wetland (Marine)	Saline shallow open water	MO	X

Table 3. Ratings Table for Wolverine Habitat in the Regional Study Area

WKSS/GeoBase Land Classification	Denning
Bedrock Association	U
Boulder Association	U
Heath/Bedrock	X
Lichen Veneer	X

(continued)

Table 3. Ratings Table for Wolverine Habitat in the Regional Study Area (completed)

WKSS/GeoBase Land Classification	Denning
Sparsely vegetated bedrock*	X
Sparsely vegetated till-colluvium*	X
Bare Ground	X
Barren/Non-vegetated*	X
Gravel Deposit	X
Esker Complex	U
Deep Water	X
Shallow Water	X
Water	X
Riparian Tall Shrub	U
Shrub tall*	U
Bare soil with cryptogam crust - frost boils*	X
Birch Seep	U
Heath Tundra	U
Heath/Boulder	X
Low Shrub	U
Moist to dry non-tussock graminoid/dwarf shrub tundra*	U
Prostrate dwarf shrub*	X
Shrub low*	U
Ice and Snow	X
No data*	NA
Unclassified	NA
Tussock graminoid tundra*	X
Tussock/Hummock	X
Wet sedge*	X
Wetland (Sedge Meadow)	X
Wetland*	X

** GeoBase land cover class.*
*** The Unclassified and No data class were not assessed and were excluded from the modelling.*

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Appendix 6

Species Account for Short-eared Owl

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Appendix 6. Species Account for Short-eared Owl

BACKGROUND INFORMATION

Common Name:	Short-eared Owl	
Scientific Name:	*Asio flammeus*	
Species Code:	B-SEOW	
Status:	**Global:**	G5 – Globally secure; common, widespread, and abundant
	National:	Listed as a population of Special Concern on Schedule 1 of SARA (2002).
	Territorial:	Sensitive (CESCC 2010).

DISTRIBUTION

Range within Nunavut

Short-eared owls are present in all provinces and territories in Canada. The specific range of short-eared owl within Nunavut is not known, but the Arctic coast is an important breeding area in general. They are thought to be widely distributed in the NWT and Nunavut, with greater breeding numbers during years of abundant lemmings (COSEWIC 2008).

Territorial Context

The specific range of short-eared owl within Nunavut is not known. They occur throughout the territory during the breeding season, but are most abundant in flat, rolling coastal areas (COSEWIC 2008).

Project Area

Short-eared owls have been observed throughout the Project area. Active nesting sites are rarely found, as they are well concealed with shrub cover on the ground.

POPULATION TRENDS

Data on the population status and trends are not available in the NWT or Nunavut. The Canadian population of short-eared owls is estimated to be about 50,000, with an annual decline of 3.07% over the last 40 years, and a 27% decline over the last decade (COSEWIC 2008). Habitat loss and degradation, particularly on the wintering grounds, are believed to be the major threat to short-eared owl populations in North America (COSEWIC 2008).

In the Arctic, populations of short-eared owls fluctuate in numbers in cycles of about 4 years, along with populations of lemmings and voles (Clark 1975; Village 1987; Korpimaki and Norrdahl 1991; Oksanen and Henttonen 1996; Norrdahl and Korpimaki 2002a, 2002b). Climate change, through impacts on lemming and vole populations, may also threaten short-eared arctic populations in the future (Ims and Fuglei 2005).

HABITAT USE – LIFE REQUISITES AND SEASONS

Overview

Habitat suitability modelling for short-eared owl was conducted for the nesting season and for the living and reproducing life requisites during this time (Table 1). Nests are the focal point of activity until young have fledged (i.e., left the nest site).

Table 1. Seasonal Life Requisites of Short-eared Owl

Season	Date	Life Requisite	Habitat Preference
Nesting	May - July	Living and Reproducing	Dense vegetation close to water

Habitat Use and Diet

Short-eared owls are largely diurnal (Village 1987) and regularly hunt during crepuscular hours (Taylor 1984; Schmelzer 2005). They are small mammal specialists with a narrow, mainly mammalian, food niche made up almost exclusively of voles and lemmings, especially in the non-breeding season (Clark 1975; Taylor 1984; Holt 1993). Small birds, especially shorebirds, and insects and crustaceans have also been taken as prey (Holt 1993, 1994). Populations on islands feed more heavily on seabirds, while populations in the interior of the Arctic tundra rely more heavily on lemmings and voles (Holt 1993; Schmelzer 2005). Males usually do all the hunting, and bring back the food to the nest where the females will incubate the eggs or feed offspring (Clark 1975).

Breeding density and success of short-eared owls are linked to lemming cycles (Ims and Fuglei 2005). During the low phase of the lemming cycle, very few owls (or none at all) appear on the breeding grounds, while the opposite happens in lemming peak years (Ims and Fuglei 2005). The birds are nomadic, and they will move over vast areas in search of regions with high peak lemming populations (Gauthier et al. 2003), or drift through as non-breeders (Pitelka 1974).

Nesting

Short-eared owls live in open habitats and nest on the ground (Snyder and Wiley 1976). Female owls make a rudimentary nest on the ground by gathering leaves, feathers, or grass (Wiggins, Holt, and Leasure 2006). Nests are hidden in dense vegetation, often close to water, under low shrubs, reeds and grasses. The nestlings are nidicolous (Holt, Melvin, and Steele 1992). Females are attentive and stay with the nest until all the young have left (Clark 1975).

Courtship begins as early as April in Nunavut, and clutch sizes are larger when food is abundant (Schmelzer 2005). The nestlings leave the nest and begin flying after 24-27 days, but depend on their parents for feeding for about seven weeks.

Severe weather, changes in prey density and habitat alterations have all contributed to variations in nest productivity in North America (Holt and Leasure 1993).

The young are entirely dependent upon the parents for food even after they have fledged (Clark 1975). They begin to fly between 27 to 36 days after they hatch (Schmelzer 2005). Parental care patterns are poorly understood, but it appears that females brood and feed the young, while the males hunt and provide the majority of the food (Schmelzer 2005). The pair stay together until the young can fly and are self-sufficient and likely last for a single season only (Holt and Leasure 1993).

Ratings

A two class rating scheme was used to evaluate the quality of habitat for short-eared owl in the Local Study Area (LSA) and Regional Study Area (RSA).

Rating Assumptions for Nesting

The presence of shrub low or tall cover was assumed to be the most important characteristic for short-eared owl nesting habitat. However, this cover type is relatively abundant across the landscape. Thus, the habitat model for short-eared owl is acknowledged to overestimate the amount of usable habitat for owls. The following general assumptions were made to evaluate habitat for short-eared owl nesting:

- Suitable habitat (U) was limited to vegetation associations that were characterized by substantial low to tall shrub cover and no surface water (including seasonal seepages and inundation) to ensure nesting area nesting remained dry through the nesting period.
- Not suitable habitat (X) ratings was all other vegetation associations due to a lack of nesting cover, presence of water, or disturbance.

Ratings Table

Short-eared owl habitat models utilized ecosystem mapping and known dominant vegetation composition of the mapped ecosystem units. Table 2 contains habitat suitability ratings for short-eared owl according to the TEM mapping conducted in the LSA, and Table 3 contains habitat suitability ratings for short-eared owl according to the WKSS/GeoBase mapping within the RSA.

Table 2. Ratings Table for Short-eared Owl Habitat in the Local Study Area

Ecosystem Class	LSA Vegetation Association	Map Code	Nesting
Bedrock	Bedrock outcrop	BR	X
Bedrock	Bedrock-lichen veneer	BL	X
Bedrock	Cliff	BC	X
Bedrock	Talus	BT	X
Bedrock	Blockfield	TB	X
Disturbed/Barren	Disturbed vegetation	DV	X
Disturbed/Barren	Exposed soil	ES	X
Disturbed/Barren	Mine camp	DR	X
Disturbed/Barren	Road surface	DZ	X
Esker	Dwarf shrub esker	EH	X
Esker	Shrubby esker	EW	U
Esker	Sparsely vegetated esker	EC	X
Freshwater	Lake	LA	X
Freshwater	Pond	PD	X
Freshwater	River	RI	X
Marine	Marine beach	MB	X
Marine	Old beach heads	MH	X
Marine	Saltwater	MW	X
Riparian	Low bench floodplain	RL	X

(continued)

Table 2. Ratings Table for Short-eared Owl Habitat in the Local Study Area (completed)

Ecosystem Class	LSA Vegetation Association	Map Code	Nesting
Riparian	Mid bench floodplain	RM	X
Riparian	Willow riparian	RW	U
Riparian (Marine)	Marine riparian shrub	MR	U
Tundra	Dry-sparse tundra	TH	X
Tundra	Mesic dwarf-shrub tundra	TL	U
Tundra	Shrubby tundra	TS	U
Tundra (Marine)	Marine dwarf shrub tundra	MT	U
Tundra (Marine)	Marine shrubby tundra	MS	U
Wetland	Cottongrass-sedge fen	WC	X
Wetland	Raised bog complex	WB	U
Wetland	Shallow open water	WO	X
Wetland	Tussock meadow	WT	U
Wetland	Undifferentiated fen	WF	X
Wetland	Water sedge marsh	WA	X
Wetland	Willow-sedge fen	WS	U
Wetland (Marine)	Saline Fen	MF	X
Wetland (Marine)	Saline Marsh	MM	X
Wetland (Marine)	Saline shallow open water	MO	X

Table 3. Ratings Table for Short-eared Owl Habitat in the Regional Study Area

WKSS/GeoBase Land Classification	Nesting
Bedrock Association	X
Boulder Association	X
Heath/Bedrock	X
Lichen Veneer	X
Sparsely vegetated bedrock*	X
Sparsely vegetated till-colluvium*	X
Bare Ground	X
Barren/Non-vegetated*	X
Gravel Deposit	X
Esker Complex	X
Deep Water	X
Shallow Water	X
Water	X
Riparian Tall Shrub	U
Shrub tall*	U
Bare soil with cryptogam crust - frost boils*	X
Birch Seep	U
Heath Tundra	U

(continued)

Table 3. Ratings Table for Short-eared Owl Habitat in the Regional Study Area (completed)

WKSS/GeoBase Land Classification	Nesting
Heath/Boulder	X
Low Shrub	U
Moist to dry non-tussock graminoid/dwarf shrub tundra*	U
Prostrate dwarf shrub*	X
Shrub low*	U
Ice and Snow	X
No data	NA
Unclassified	NA
Tussock graminoid tundra*	U
Tussock/Hummock	U
Wet sedge*	X
Wetland (Sedge Meadow)	X
Wetland*	X

** GeoBase land cover class.*
*** The Unclassified and No data class were not assessed and were excluded from the modelling.*

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Appendix 7

Species Account for Peregrine Falcon

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Appendix 7. Species Account for Peregrine Falcon

BACKGROUND INFORMATION

Common Name:	Peregrine falcon *tundruis* subspecies	
Scientific Name:	*Falco peregrinus tundrius*	
Species Code:	B-PEFA	
Status:	**Global:**	G4T3 – Peregrine falcon is considered Apparently Secure; however, the tundrius subspecies is considered Vulnerable.
	National:	The tundruis subspecies is listed as Special Concern under Schedule 3 of *Species At Risk Act* (2002).
	Territorial:	Secure (CESCC 2010).

DISTRIBUTION

Range within Nunavut

There are three subspecies of peregrine falcon in Canada, each with distinct distributions. The highly migratory *tundrius* subspecies breeds in the tundra regions of Canada, Alaska and Greenland (SARA 2010). This subspecies travels as far south as Argentina and Chile and it has been found that the farther north a bird breeds, the farther south it migrates.

Territorial Context

The peregrine falcon occupies approximately 61 percent of Nunavut (Beckett et al. 2008). Nesting typically occurs along the coast and shore lines and the total number of nesting pairs known for Nunavut is at least 250 (Beckett et al. 2008).

Project Area

Peregrine falcons are known to occur in the RSA and LSA based on observations. Numerous active and abandoned nests are known to occur.

POPULATION TRENDS

The minimum population size for the tundra peregrine falcon is 199, based on 2005 national survey data by COSEWIC (2007), though the actual population is likely larger.

Peregrine falcon underwent a dramatic population decline during the mid to late 1900's. The primary factor contributing to the historic population decline was the use of organochlorine pesticides, most notably DDT, which would bioaccumulate in the falcon's tissue and affect reproductive survival and breeding (COSEWIC 2007; SARA 2010). Fortunately, populations appear to have recovered as the prolific use of DDT has since been restricted drastically, though the pre DDT population numbers are not well known.

HABITAT USE – LIFE REQUISITES AND SEASONS

Overview

The life requisites that will be rated for peregrine falcon are living and reproducing. The specified seasons that will be rated for are nesting (Table 1). These periods represent the majority of the time that this migratory species is present within the region.

Table 1. Seasonal Life Requisites of Peregrine Falcon

Season	Date	Life Requisite	Habitat Preference
Spring (Nesting	Late May - August	Living and Reproducing	Southern facing cliffs over 10 m, near water

The main habitat requirements for this species described by SARA (2010) are the nest site (most commonly scrapes on cliff ledges), the nesting territory (the defended area of approximately 1 km from the nest site), and the home range (the non-defended area in which the species hunts for food outside of the defended territory and can extend to 27 km from the nest site). The focus of the habitat model is the nest site and territory.

Habitat Use and Diet

Peregrines prey primarily on birds, which include waterfowl, seabirds, shorebirds, songbirds, and pigeons (COSEWIC 2007), and the avian diet is highly variable. Court et al. (1988) concluded that no one avian species constituted the majority of the arctic peregrine's diet. In the arctic, the local populations of avian species, and in some cases other taxa such as arctic ground squirrels (*Spermophilus parryii*) or lemmings (*Dicrostonyx torquatus*), are determinant of what constitutes a falcons diet (Court et al. 1988). For example, in a study near Rankin Inlet, the most common passerines and ptarmigans were the most important prey items (Court et al. 1988).

Nesting Ecology

Tundra peregrine falcons typically nest on cliff edges or in crevices situated near good foraging areas (i.e., water). Near Rankin Inlet, Nunavut, nest sites of peregrines located on 21 of 29 cliffs (72%) were bordered on the ocean or within 150 m of the shoreline (Court et al. 1988). The remaining cliffs were all within 300 m of a water body (Court et al. 1988). Nest cliffs have been found to range from 7 to 400 m in height; however, cliffs 50 to 200 m are typically preferred (Cade 1960; White and Cade 1971; White et al. 2002). Nest sites near Rankin Inlet were most commonly between 7 and 30 m in height and nests located on cliff faces typically had southern exposure (69%), although it was noted that the majority of cliffs regardless of nesting activity had southern exposure. However, other sources also report southern exposures as common in the tundra peregrine falcon (White et al. 2002). Selection for southern aspect has many advantages. South facing cliffs are snow free earlier in the year and become accessible nesting sites in comparison to areas with more northern aspects. Southern aspects are generally warmer as well, as they receive greater amounts of sunlight relative to northern aspects, which may be advantageous in keeping adults, eggs, and young birds warm.

In Nunavut, both sexes will typically arrive at nest sites in approximately mid-May (Court et al. 1988). Nests consist of scrapes in substrates usually consisting of dirt, sand, or fine gravel (White et al. 2002). Sometimes decomposed fecal material or decomposed lining materials of old stick nests of other birds, such as common raven (*Corvus corax*) and rough-legged hawk (*Buteo lagopus*), are used. Males will scrape the nest, sometimes making several options on the same ledge for the female to choose from. If a pair does not reuse a previous years nest, an alternative nest site is often selected on the same cliff or within a few kilometres (White et al. 2002). Other locations of nest sites may include tops of

pingos (hills of soil covered ice in permafrost), road cuts, stone quarries, open pit mine, and on other anthropogenic structures (Cade 1960; White and Cade 1971; White et al. 2002)

On average, tundra peregrine falcons in Nunavut lay eggs in early to mid-June (Court et al. 1988; White et al. 2002). Clutch size in the arctic is typically 3 eggs per nest with an average hatch date of July 9 in Nunavut (62°N) (White et al. 2002). This species has only one brood per season and was not reported to re-nest in the northern latitudes.

Hatching of eggs in the region occurs between the beginning and latter part of July (the mean reported by Court et al. (1988) is July 9th, near Rankin Inlet, Nunavut). The female does the majority of the incubating, although it was been reported by White et al. (2002) that males will incubate a significant portion (33%). In the Alaskan interior adults were observed at the ledge of the nest 99% of the time until the young were 11 days old, after which most ledge visits were to deliver food or feed young (White et al. 2002).In Greenland, the estimated time for brooding ranged from 10 to 20 days (White et al. 2002). The female does the majority of the brooding and the fledglings leave the nest in approximately 40 days (SARA 2010). In Rankin Inlet, Court et al. (1988) reported that fledglings were seen in the air as early as August 19. The young may stay in the nest for another four to six weeks after fledging (COSEWIC 2007).

Ratings

A two class rating scheme was used to evaluate peregrine falcon habitat in the Local Study Area and Regional Study Area.

South facing cliffs and outcrops adjacent to or near bodies of water were assumed to be the most suitable nesting habitat for peregrine falcons in the study area. As cliff habitats were not specifically identified in the local or regional ecosystem mapping, additional modelling techniques were required to select areas with potential nesting ledges.

Digital elevation models (DEM) were obtained from Natural Resources Canada that covered the RSA. These data were used to identify all potential cliff habitats, and was used in conjunction with regional ecosystem mapping to identify suitable habitat. It was assumed that suitable nesting habitats for peregrine were cliffs that were a minimum of 10 m high and were within one kilometre of a waterbody. The one kilometre distance to a water feature was used as research suggests that the area within one kilometre of the nest site is the approximate size of the peregrine's nesting territory, or the area within which the adults actively defend from other peregrine falcons (SARA 2010). Therefore, the most important habitat features in addition to the nest site are likely contained within the nesting territory.

Raptor nests that were found during baseline studies for the Project were also incorporated into the peregrine nesting model (data from 2007, 2008, 2012, and 2013). These areas not only identify where there are cliffs, but also highlight areas that were selected and used by raptors and likely contain all the nesting habitat requirements (e.g., nearby hunting areas). All known raptor nesting sites (regardless of the species observed utilizing it) and the nesting territory (i.e., one kilometre radius from the nest site) were considered to be suitable nesting habitat in the model.

The remainder of habitat in each study area was assumed to be not suitable.

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Appendix 8

Summary of Amounts of Habitat Rated per Species per Season According to Local and Regional Ecosystem Mapping

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Appendix 8. Summary of Amounts of Habitat Rated per Species per Season According to Local and Regional Ecosystem Mapping

	Amount of Habitat in the LSA				Amount of Habitat in the RSA	
	Local (TEM) Ecosystem Mapping		Regional (WKSS/GeoBase) Ecosystem Mapping		Regional (WKSS/GeoBase) Ecosystem Mapping	
Suitability Rating	Area (ha)	% of LSA	Area (ha)	% of LSA	Area (ha)	% of RSA
Caribou						
Calving						
High	71,492.97	53.2	38,466.69	28.7	355,417.77	28.3
Moderate	30,436.22	22.7	34,983.13	26.1	300,905.11	23.9
Low	7,140.63	5.3	27,683.85	20.7	301,581.58	24.0
Nil	25,299.49	18.8	32,796.64	24.5	299,248.12	23.8
Post-calving and Summer						
High	25,850.80	19.2	38,203.10	28.5	343,578.60	27.3
Moderate	88,824.94	66.1	75,805.34	56.6	738,800.73	58.8
Low	19,556.98	14.6	9,725.34	7.3	107,137.87	8.5
Nil	136.58	< 1	10,196.52	7.6	67,635.37	5.4
Fall (rut)						
High	100,265.28	74.6	63,053.51	47.1	562,764.43	44.8
Moderate	9,795.05	7.3	15,191.93	11.3	178,261.57	14.2
Low	24,177.80	18.0	45,488.34	34.0	448,491.21	35.7
Nil	131.17	< 1	10,196.52	7.6	67,635.37	5.4
Muskox						
Summer and Fall						
High	9,416.09	7.0	23,880.20	17.8	168,221.76	13.4
Moderate	37,545.98	27.9	25,921.18	19.4	314,380.74	25.0
Low	87,203.99	64.9	73,814.73	55.1	702,002.89	55.8
Nil	203.24	< 1	10,314.20	7.7	72,547.20	5.8
Winter and Early Spring						
High	10,371.54	7.7	5,119.91	3.8	69,629.33	5.5
Moderate	29,754.76	22.1	34,839.45	26.0	340,442.43	27.1
Low	58,950.99	43.9	37,032.33	27.7	330,149.21	26.3
Nil	35,292.03	26.3	56,938.61	42.5	516,931.61	41.1
Grizzly Bear						
Spring						
High	3,182.31	2.4	386.53	< 1	5,457.20	< 1
Moderate	87,405.09	65	67,341.78	50.3	637,044.63	50.7
Low	19,074.53	14.2	43,427.71	32.4	412,168.14	32.8
Nil	24,707.36	18.4	22,774.28	17.0	202,482.60	16.1
Summer						
High	11,887.54	8.8	19,466.91	14.5	137,717.33	10.9
Moderate	90,219.29	67.1	54,436.06	40.6	540,367.41	43
Low	31,740.05	23.6	49,713.13	37.1	506,521.65	40.3
Nil	518.18	< 1	10,314.20	7.7	72,547.20	5.8
Fall						
High	7,347.94	5.5	386.53	< 1	5,457.20	< 1
Moderate	70,011.78	52.1	61,056.36	45.6	542,692.12	43.2
Low	56,448.67	42	62,173.21	46.4	636,456.05	50.6
Nil	556.67	< 1	10,314.20	7.7	72,547.20	5.8
Denning						
High	942.09	< 1	386.53	< 1	5,457.20	< 1
Moderate	532.56	< 1	0.00	0.0	0	0
Low	2,242.55	1.7	4,833.97	3.6	49,677.98	3.9
Nil	130,652.11	97.2	128,709.80	96.1	1,202,017.39	95.6
Wolf						
Denning						
High	945.67	< 1	386.53	< 1	5,457.20	< 1
Moderate	825.07	< 1	8,598.22	6.4	33,355.98	2.6
Low	2,923.58	2.2	4,833.97	3.6	49,677.98	3.9
Nil	129,674.99	96.5	120,111.58	89.7	1,168,661.41	93
Wolverine						
Denning						
Suitable (Useable)	64,127.65	47.7	61,366.50	45.8	562,221.39	44.7
Not Suitable	70,241.65	52.3	72,563.80	54.2	694,931.19	55.3
Short-eared Owl						
Nesting						
Suitable (Useable)	69,804.67	51.9	41,589.45	31.1	404,974.79	32.2
Not Suitable	64,564.63	48.1	92,340.85	68.9	852,177.78	67.8

Peregrine Falcon is not presented here because the habitat model for peregrine falcon did not use local or regional ecosystem mapping.

Appendix V5-5B

2013 Habitat Selection by Bathurst Caribou during the Post-calving and Summer Periods

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2013 Habitat Selection by Bathurst Caribou during the Post-calving and Summer Periods

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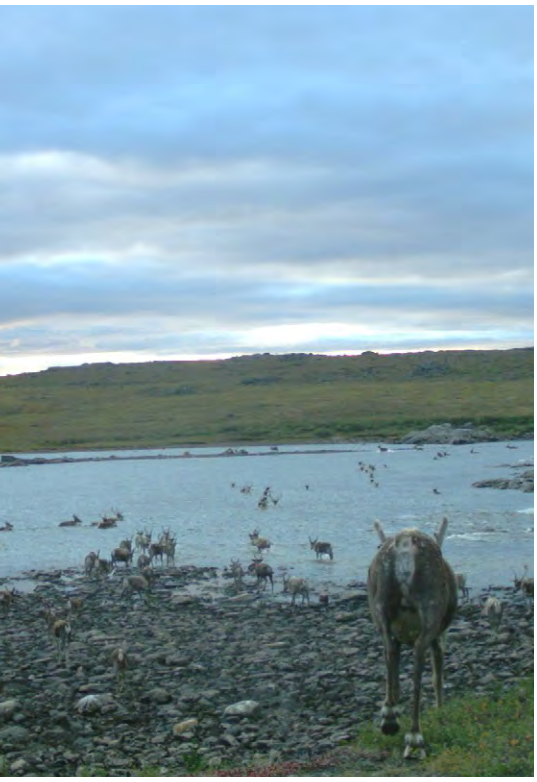

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BACK RIVER PROJECT

2013 HABITAT SELECTION BY BATHURST CARIBOU DURING THE POST-CALVING AND SUMMER PERIODS

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Executive Summary

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Executive Summary

The Back River Project (the Project) is a proposed gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut. The Project consists of three main areas: the Goose Property Area, the George Property Area, and a Marine Laydown Area located on the southern part of Bathurst Inlet.

Caribou were selected as a VEC for the Draft Environmental Impact Statement (DEIS) for the Project. Three herds of caribou may occur in the terrestrial wildlife Regional Study Area (RSA) including the Bathurst herd, the Beverly herd, and Dolphin and Union herd. As outlined in the EIS guidelines (NIRB 2013), the Minister of Aboriginal Affairs and Northern Development Canada highlighted the importance of the Bathurst herd caribou in the region and identified the need to conduct a cumulative effects assessment for this herd (letter dated December 17, 2012). This herd primarily occurs in the wildlife RSA during the post-calving season. In order to address the potential cumulative effects on Bathurst herd caribou, resource selection function (RSF) modelling was conducted for this herd on their post-calving and summer ranges as these ranges have been identified as providing nutritional resources important to the survival of overwintering caribou and calving success in the following year.

Recent work conducted by the Canadian Centre for Remote Sensing has correlated the greenness of vegetation on the summer grounds of the Bathurst herd with overwinter survival of calves – suggesting that summer forage availability may be driving recruitment success (the number of new animals added to the population) and hence the population of this herd. Hence, this report summarizes the use of summer habitat by Bathurst caribou and evaluates whether vegetation greenness and other habitat features influence the locations of caribou during this period. Vegetation greenness was calculated using a simple ratio vegetation index (SRVI). Other variables evaluated in the analysis include vegetation class (using 12 landcover types), water, predators (wolves and bears), topographic features, eskers and existing camps and mining projects to evaluate if these features influenced distribution of caribou.

Four pooled RSF models were generated covering the period 2004-2010 during two seasons when caribou are most likely to interact with the Project, including post-calving within the 95% kernel herd range (PC95), post-calving within the 50% core herd range (PC50), summer within the 95% herd range (S95), and summer within the 50% core range (S50). A total of 24 models were generated and compared by Akaike's Information Criterion (AIC_c) to describe seasonal range use by caribou. With the exception of S50, ΔAIC and AIC weights indicated that a saturated model of the form *Habitat* + *RVI* + *Water* + *Industry* + *Predators* was the most likely model amongst the suite of candidate models. Predators were not a significant component in the S50 final model. Parameter coefficients were averaged from the top two candidate models in PC50 and PC95.

Selection for high RVI, a vegetation metric used as a broad scale index of habitat productivity, was consistent across both seasons and range extents.

There was variability in the use of specific landcover types. For example, within post-calving 95, caribou avoided non-vegetated, sparsely vegetated, and prostrate dwarf shrub cover types while selecting for tall shrub and forested areas. Caribou selected areas that were ranked as having low suitability for wolves, and avoided areas of low suitability for grizzly bears. Caribou were also generally found further from industrial development relative to random locations. Caribou in post-calving 50 similarly avoided dwarf shrub habitats, and tended to be found closer to operating mines but further from closed mines and exploration camps relative to random locations.

During the summer period, caribou selected sparsely vegetated, bryoid, graminoid tussock and non-tussock tundra, and all shrub cover types, while avoiding wetlands and forested cover types within the 95% seasonal range. Predators were an important factor during this season, as indicated by significant selection coefficients for habitats ranked as high value for wolves and concurrent avoidance of habitats ranked as high and moderate value for grizzly bears. Caribou additionally selected low and nil value habitat for grizzly bears, and avoided moderate, low, and nil valued habitat for wolves. The selection coefficient for operating mines was non-significant, but caribou tended to be found further from closed mines and exploration camps relative to random locations. Caribou in the core summer range selected sparsely vegetated, tall shrub, and graminoid tussock and non-tundra cover types, and avoided non-vegetated, low and dwarf shrub, and forested cover types. Caribou tended to be found further from operating and closed mines, but closer to exploration camps relative to random locations in the core summer range.

TK/IQ indicates that the Contwoyto Lake and Nose Lake regions have been important post-calving and summer ranges for the Bathurst herd since before development and prior to the deployment of radio collars on the Bathurst herd. The RSF model, which provides a spatial surface that indicates the likelihood of detecting caribou across the landscape, indicates that these areas continue to be important to the Bathurst herd. These results suggest that under the current distribution of existing and proposed developments, impacts to habitat conditions on the post-calving and summer ranges are expected to be minimal provided that the integrity of the Contwoyto Lake and Nose Lake region is maintained, and that movements along the Burnside, Mara, and Hackett River corridors are not impeded.

TK indicates that the Contwoyto Lake and Nose Lake regions have been important post-calving and summer ranges for the Bathurst herd since before development and prior to the deployment of radio collars on the Bathurst herd. The RSF model, which provides a spatial surface that indicates the likelihood of detecting caribou across the landscape, indicates that these areas continue to be important to the Bathurst herd.

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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

CESCC	Canadian Endangered Species Conservation Council
COSEWIC	Committee on the Status of Endangered Wildlife in Canada - A federal committee of experts that assesses and designates the level of threat to wildlife and vegetation species in Canada
Ecosystem (terrestrial)	A volume of earth-space that is composed of non-living parts (climate, geologic materials, groundwater, and soils) and living or biotic parts, which are all constantly in a state of motion, transformation, and development. No size or scale is inferred.
GIS	Geographical Information System
Glacial-fluvial	Sediments deposited by glacial meltwater that form stratified layers of sand, gravel, and fines.
GN DOE	Government of Nunavut Department of Environment
GPS	Global Positioning System
Habitat	Land and water surface used by wildlife. This may include biotic and abiotic aspects such as vegetation, exposed bedrock, water and topography.
Hectare (ha)	10,000 m^2 or 0.01 km^2 or 2.47 acres
Migration	The regular seasonal or daily movement of animal populations to and from different areas, often considerable distances apart. Migration often occurs in corridors between preferred habitat types.
NLCA	Nunavut Land Claims Agreement
NPC	Nunavut Planning Commission
NWMB	Nunavut Wildlife Management Board
NWT	Northwest Territories
SARA	*Species at Risk Act* (2002) - A Canadian federal statute which is designed to meet one of Canada's commitments under the International Convention on Biological Diversity. The goal of the Act is to protect endangered or threatened organisms and their habitats. It also manages species which are not yet threatened, but whose existence or habitat is in jeopardy.
Slave Geological Province	A geological formation extending from Great Slave Lake to the Coronation Gulf, which lies between Victoria Island and mainland Nunavut
Standard Deviation (SD)	A statistical measure of the spread or variability of a set of data.
Standard Error (SE)	A statistical measure of the spread or variability of a set of data, equal to the standard deviation divided by the square root of the sample size.
The Project	The Back River Project

Topography	The configuration of a surface, including its relief and the position of its natural and person-made features.
UD	Utilization distribution
Universal Transverse Mercator (UTM)	A mapping system where the standard unit of measure is the metre.
Wetland	Sites dominated by hydrophytic vegetation where soils are water-saturated for a sufficient length of time such that excess water and resulting low soil oxygen levels are principal determinants of vegetation and soil development (MacKenzie and Moran 2004).

1. Introduction

1. Introduction

The Back River Project (the Project) is a proposed gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut (Figure 1-1). This report presents the results of the Resource Selection Function Modelling of the Bathurst caribou herd post-calving and summer ranges developed in support of the caribou cumulative effects assessment for the Draft Environmental Impact Statement (DEIS; Volume 5; Chapter 5).

In order to support the potential cumulative effects assessment for caribou in the DEIS for the Project, a broad-scale Resource Selection Function (RSF) model was developed for the Bathurst caribou herd on their post-calving and summer ranges. The RSF model, which provides a spatial surface, indicates the likelihood of detecting caribou across the landscape. Results from this model are useful in determining where caribou are typically found in their ranges, what types of habitat they use while in these ranges, and deriving habitat quality ratings for various vegetation types on these ranges. In addition, results may indicate how caribou may interact with various industrial developments on their post-calving and summer ranges.

Specific objectives of the RSF modeling were to:

- assess habitat use by caribou during post-calving and summer;
- identify important features across the landscape that drive caribou habitat use during post-calving and summer such as lakes, eskers, vegetation communities and industrial sites; and
- provide baseline information that will contribute to cumulative effects assessment on caribou.

In Nunavut, companies have been asked to conduct research that addresses “holistic and cumulative” objectives, in lieu of conducting local-area programs for caribou such as aerial surveys. In lieu of aerial surveys, companies may opt to fund a caribou research program defined by the Government of the Northwest Territories Department of Environment and Natural Resources (ENR) and the Government of Nunavut Department of Environment (GN-DOE). One approach is to conduct resource selection function modeling using suite of model variables that describe habitat use by the Bathurst caribou herd across spatial and temporal scales.

Figure 1-1

Back River Project Location

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2. Background Information

2. Background Information

Barren-ground caribou (*Rangifer tarandus groenlandicus*) are a biologically and culturally important species in the Arctic. Caribou not only sustain wild predator populations such as wolves, grizzly bear and wolverine, but also provide a critical resource for human populations living in the North, particularly Aboriginal communities. Hunting, disease, and environmental variability can all affect caribou numbers, and the effects from industrial activities occurring within the species range are monitored for management of caribou.

Three barren-ground caribou herds have been identified, whose ranges overlap the area of the Project. The Bathurst herd is found in the wildlife Regional Study Area (RSA), primarily during the post-calving period. The Beverly herd (also known as the Ahiak herd) is found in the RSA, primarily during the late summer. The winter distribution of Dolphin and Union caribou likely overlaps the marine RSA to a small extent during the winter. This report focuses on the Bathurst caribou herd.

Bathurst caribou winter below the treeline and migrate to calving grounds currently to the west of Bathurst Inlet, the herd's namesake. The size of the Bathurst caribou herd, as estimated from annual counts of the number of calving females, has declined from about 200,000 females in 1986 to 55,000 in 2006 (Nishi et al. 2010; Boulanger et al. 2011). The results of the 2009 calving ground survey suggests that the total herd size had declined to approximately 31,900 ± 11,000 individuals (GNWT ENR 2009). The population estimates suggest an average annual decline of about 6% per year from 1986 to 2006, and then a very rapid decline of 35% per year between 2006 and 2009 (Adamczewski et al. 2009; Boulanger et al. 2011).

These population trends have been attributed to declining calf survival, and concomitant declines in adult female fecundity, and survival in winter due to hunting (Boulanger et al. 2011). Annual monitoring of calf survival indicates that mean winter calf survival and calf-cow ratios for the Bathurst herd have declined by almost 50% from 2001 to 2004 compared with the 1985 to 1996 period (Gunn, Boulanger, and Williams 2005). More recently (2007-2009), indicators of breeding productivity such as cow-calf ratios, pregnancy rates, and body condition show improved conditions for the Bathurst herd (Adamczewski et al. 2009). A survey conducted in 2012 under ideal conditions reports that the population has remained stable, or may have increased to 35,000 individuals since 2009 (GNWT 2012).

Caribou abundance is thought to fluctuate with a periodicity of between 40 and 70 years (Gunn 2003). While the decline in caribou numbers may be a consequence of natural population cycles, current low numbers make the populations vulnerable to human harvest, disturbance, disease, and weather events. Caribou vary in their response to disturbances based on the time of year and age of calves. Caribou are most sensitive to population-level effects during calving and post-calving when calves are most susceptible to predation and disturbance (Russell, Kofinas, and Griffith 2002). Calving and post-calving areas are designated as important habitat for caribou in Nunavut (NPC 2012).

Since 1966 when the calving distribution started to be mapped during aerial surveys, the Bathurst calving grounds have had two periods totalling 30 years when the predictability of the calving ground's location was high. The two periods were separated by a 11-year period when the locations shifted from east to west of Bathurst Inlet (1986-1996) where calving had been recorded in the 1950s. Since 1996, the location of the calving ground has been relatively predictable and the annual use of post-calving and summer ranges based on the movements of satellite-collared cows has not shifted. The fall and winter ranges are the largest seasonal ranges and the least predictable on an annual basis. Since 1998, the southern boundary of the winter range has contracted.

Recent evidence suggests that over-winter survival of calves may be related to conditions on the summer range. Inadequate leaf biomass, late start date and early end date of green leaf biomass, and poor quality of leaf biomass in the summer range are generally believed to be detrimental to caribou growth and pregnancy rate during the summer-fall period and calf:cow ratio in the next year. By calculating a simple ratio vegetation index (SRVI) from broad scale advanced very high resolution radiometer data (AVHRR) over the summer range and correlating it to several demographic parameters of the Bathurst herd, Chen et al. (2013a) demonstrated that productivity on the summer range explains a significant portion of the variation in caribou birth rate (86%), net productivity (56%), and calf survival rate (52%), but not cow survival rate. Lag times were found to be one year for birth rate and calf survival rate, and two years for net productivity.

Given the vulnerability of calves during the post-calving period and the relationship between habitat quality and caribou demographics, there is interest in determining whether industrial activity on the post-calving and summer ranges contribute additional pressures on caribou. Understanding the relative contributions of natural and anthropogenic factors to population level changes in the Bathurst caribou herd is the goal of cumulative effects assessment, and fundamental to developing sound management practices to promote the long-term sustainability of the herd.

Satellite collar data is available for the Bathurst herd dating back to 1996. In the context of cumulative effects assessment and understanding herd-level population dynamics, it is important that habitat selection by caribou is modelled according to their seasonal ranges in relation to such factors as climate, changing habitat quality and productivity across regional scales, and the progression of development across the landscape.

Resource Selection Functions (RSF) are based on logistic regression equations that utilize use-availability data to infer habitat selection, or the likelihood of use. The method is particularly robust in being able to incorporate both categorical and continuous data. This is considered an important first step in identifying caribou-habitat relationships and developing linkages between habitat use and movement patterns with progressive development and changes in habitat quality associated with climate change throughout the Bathurst range.

RSFs are increasingly being used to provide information on essential resources needed to manage and conserve rare, threatened, and endangered species in complex socio-environmental landscapes (Johnson et al. 2006). RSFs provide an objective and explanatory framework to assess habitat selection and relative habitat quality at multiple scales and across individuals and populations (Johnson et al. 2006). RSF models rely heavily on geographic information systems (GIS) and satellite imagery that are available across large spatial extents.

The modeling exercise focused on Bathurst caribou GPS collar data between 2004 to 2010, and represents the most recent information on caribou seasonal habitat use since Johnson et al. 2005. The modeling effort also focused on the post-calving and summer ranges as these periods are when caribou are most likely to be present in the terrestrial wildlife RSA.

3. Methods

3. Methods

3.1 THE PROCESS OF RESOURCE SELECTION FUNCTION MODELLING

Resource Selection Functions (RSFs) provide a means to describe the inherently complex patterns of habitat use by the Bathurst herd across spatial and temporal scales. To do this, data were acquired that relate habitat characteristics within the extent of historic caribou seasonal ranges. These characteristics include vegetation indices of productivity, land cover, topographic features, predation, and industrial development. The data are a compilation of original data and data derived from pre-existing datasets. Vector data was downloaded from online repositories and AVHRR satellite data products were provided by the Canadian Centre for Remote Sensing under a data sharing agreement between Sabina and Natural Resources Canada.

For each habitat characteristic, a spatial data layer was generated with coverage over the entire study area. Then, both caribou collar locations ('use points') and a set of random points ('availability points') were overlain onto the data layers and a value for each of the habitat characteristics was extracted for each of the data points. The motivation behind RSF modeling is to contrast environmental characteristics at locations where caribou were observed with characteristics at random points in the surrounding area. By comparing the habitat characteristics for these two datasets, models were developed that best represent habitat selection preferences using Akaike's Information Criterion (AIC_c). These models were then used to generate maps reflecting the relative likelihood of detecting caribou over their seasonal ranges with relatively large spatial extents.

The general steps involved in deriving likelihood of habitat use with RSFs were:

1. Identify the study area using historic caribou GPS locations;
2. Acquire data which reflect habitat characteristics (predictor variables) that are most likely to influence caribou habitat use and distribution;
3. For each predictor variable, generate a spatial data layer with coverage over the entire study area;
4. Assign a value for each predictor variable to each caribou collar location;
5. Create a dataset of random points and assign a value for each predictor variable to each random point;
6. Generate a series of models that consist of combinations of predictor variables;
7. Select the most appropriate resource selection model from the suite of candidate models using Akaike's Information Criterion (AIC_c);
8. Create a raster layer for each predictor variable; and,
9. Apply the model coefficients to each raster layer over the entire study area to create maps that represent the relative probability or likelihood of detecting caribou.

3.2 SOURCES OF DATA

Data for RSF modeling were acquired and calculated from a variety of sources, including:

1. Collar data from the Government of the Northwest Territories, Department of Environment and Natural Resources, under a data sharing agreement between Rescan and GNWT ENR;

2. AVHRR satellite data provided by the Canadian Centre for Remote Sensing under a data sharing agreement between Sabina and Natural Resources Canada;
3. Land cover data based upon mapping by Agricultures and Agri-Food Canada (AAFC), Canada Centre for Remote Sensing (CCRT), and Canadian Forest Service (CFS);
4. Digital elevation models from Canadian Digital Elevation Data;
5. Esker delineation included in CanVec vector data produced by Natural Resources Canada;
6. Predator modelling carried out by Taara Environmental; and,
7. The locations of existing and proposed mining development from publicly available sources.

3.3 SPATIAL BOUNDARIES

3.3.1 Cumulative Effects Assessment Boundary

The spatial boundary for the cumulative effects assessment for Bathurst herd caribou is based on the post-calving and summer seasonal range of this herd (see Section 5.6 of Volume 5, Chapter 5).

Recent research by the Canadian Centre for Remote Sensing has examined the food availability on the post-calving and summer range of the Bathurst caribou herd. This research suggests that the forage availability on the post-calving and summer range may drive natural population change for the Bathurst herd. In years with poor biomass availability, the overwinter survival of calves the following winter is reduced and the growth rate of the herd declines or is negative (Chen et al. submitted). This work does not include the influence of hunting.

In order to examine the effects of habitat removal, disturbance, and other factors, the cumulative effects area was set to encompass the post-calving and summer range of the Bathurst herd (Figure 3.3-1). This area comprises approximately 8,100,050 hectares. With evidence that forage availability on the post-calving and summer range may drive the population growth rate of the Bathurst herd, this area was used to evaluate cumulative effects of all projects that occur in this area.

3.3.2 Defining the Spatial Boundaries for RSF Modelling

Resource selection function modelling was conducted within the cumulative effects assessment boundary for Bathurst caribou on the post-calving and summer ranges. The boundaries were defined based upon the distribution of collar data for the post calving and summer time periods and were further refined to the extent of the satellite imagery dataset.

The first step in the RSF modelling was to identify the area to be modelled using kernel utilization distributions (UDs) for the areas that contain 50% and 95% of the collar points and henceforth referred to as 50% and 95% kernel UDs. The kernel UDs were conducted for both post calving (Figures 3.3-2a and 3.3-2b and summer ranges (Figures 3.3-3a and 3.3-3b).

Fixed kernel density estimators were used to spatially define the post-calving and summer ranges of collared caribou based on pooled GPS collar data since 1996. The kernel density estimator is a non-parametric method that produces a probability distribution that estimates the likelihood of finding an animal at any particular location within its home range (Worton 1989). This method is a useful tool for ecologists to interpret wildlife habitat use from satellite collar data. The probability distribution produced through kernel methods provides an estimate of the true utilization distribution for an animal, which is described as the relative use of space or the relative amount of time that an animal spends in any place (Seaman and Powell 1996).

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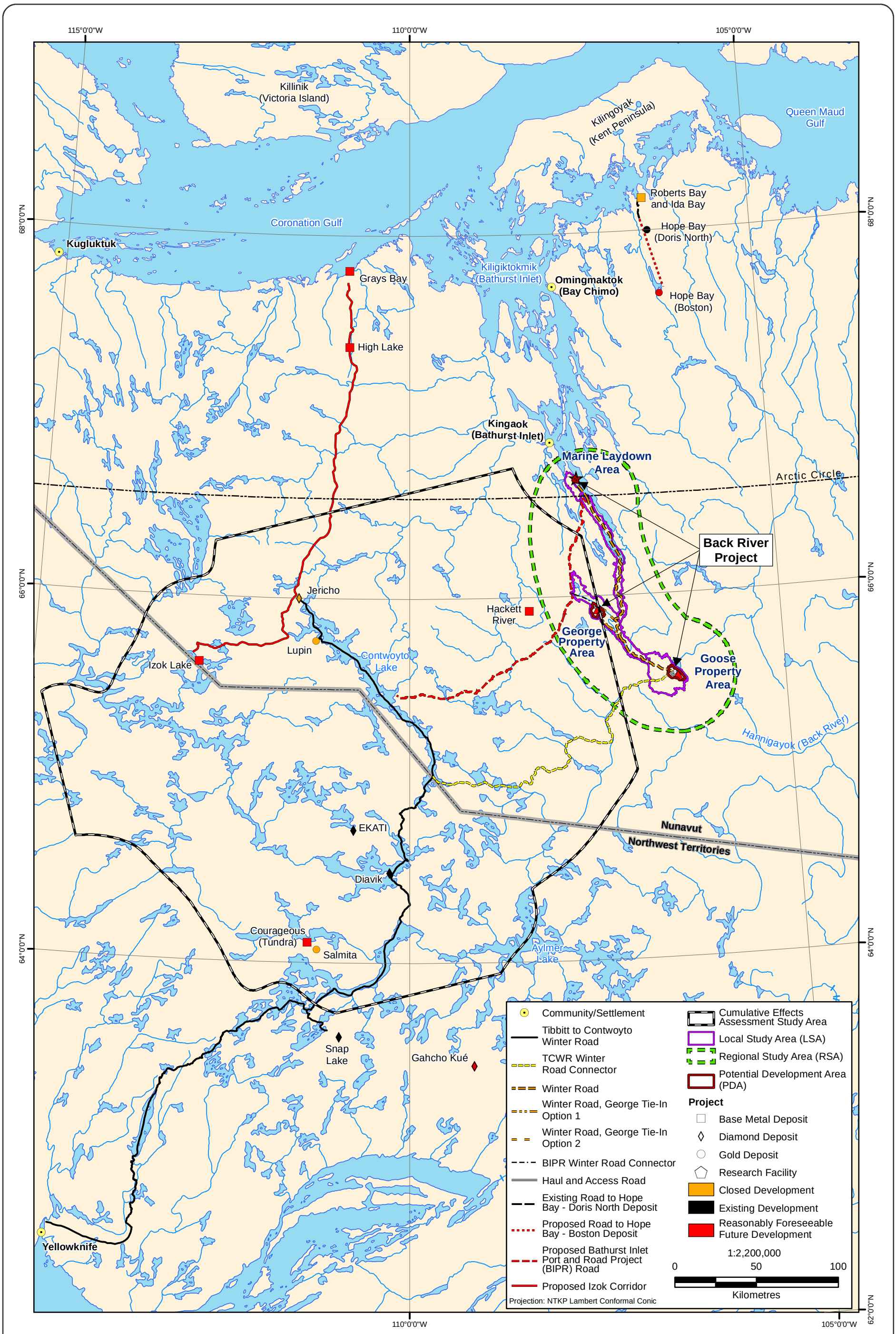

Figure 3.3-1

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Spatial Boundary for Bathurst Caribou Cumulative Effects Assessment

Figure 3.3-1

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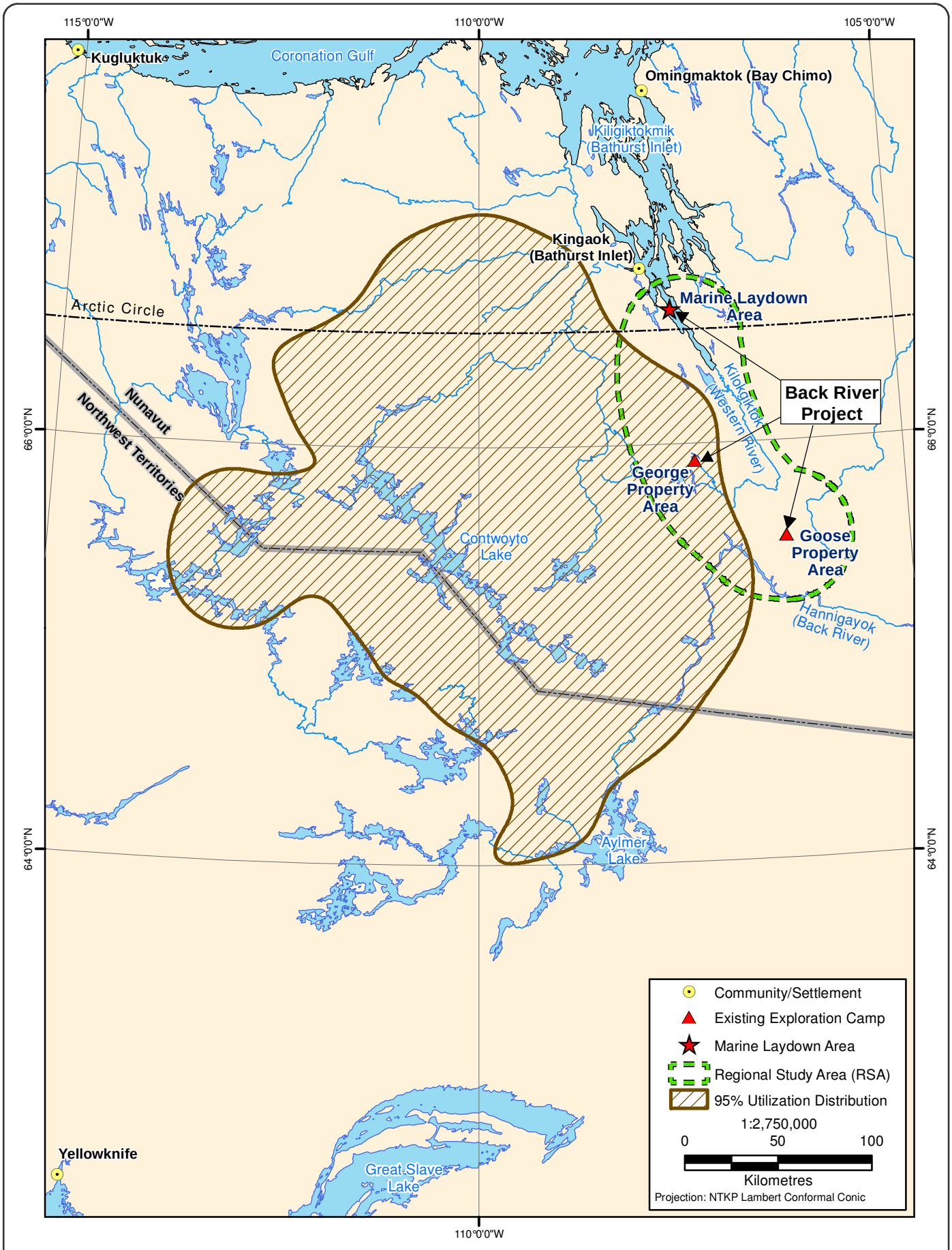

Figure 3.3-2a

Post-Calving 95% Utilization Distribution

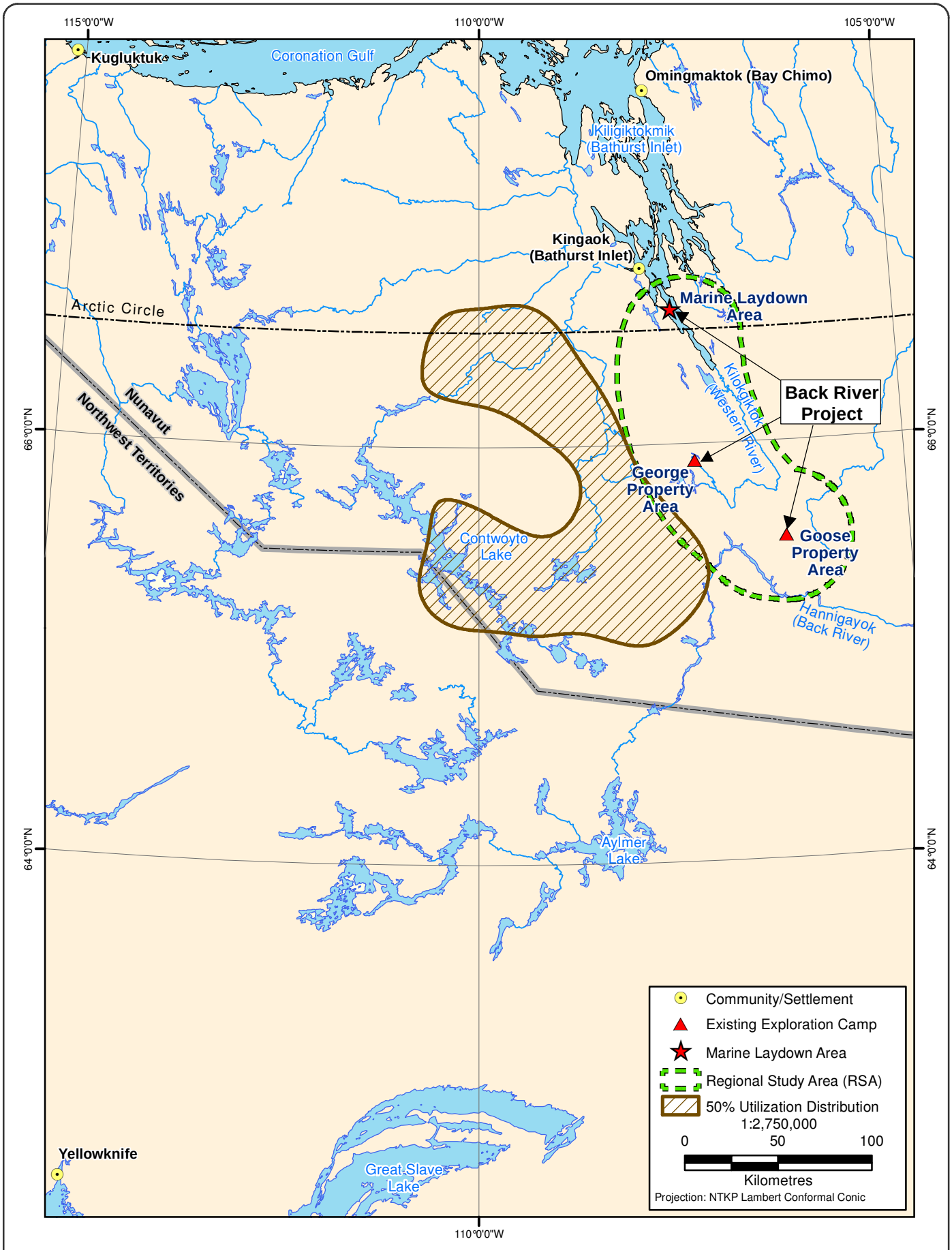

Figure 3.3-2b

Post-Calving 50% Utilization Distribution

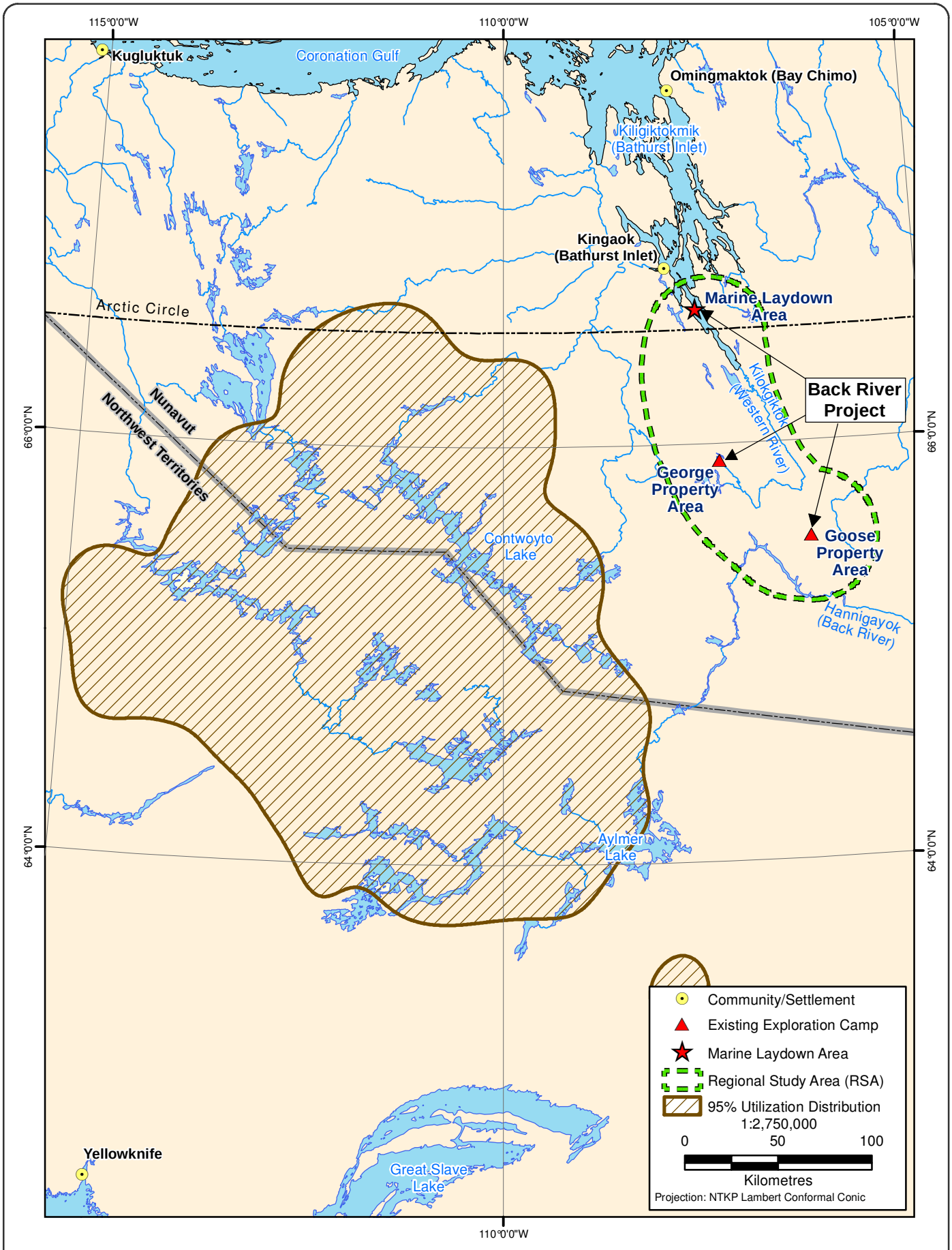

Figure 3.3-3a

Summer 95% Utilization Distribution

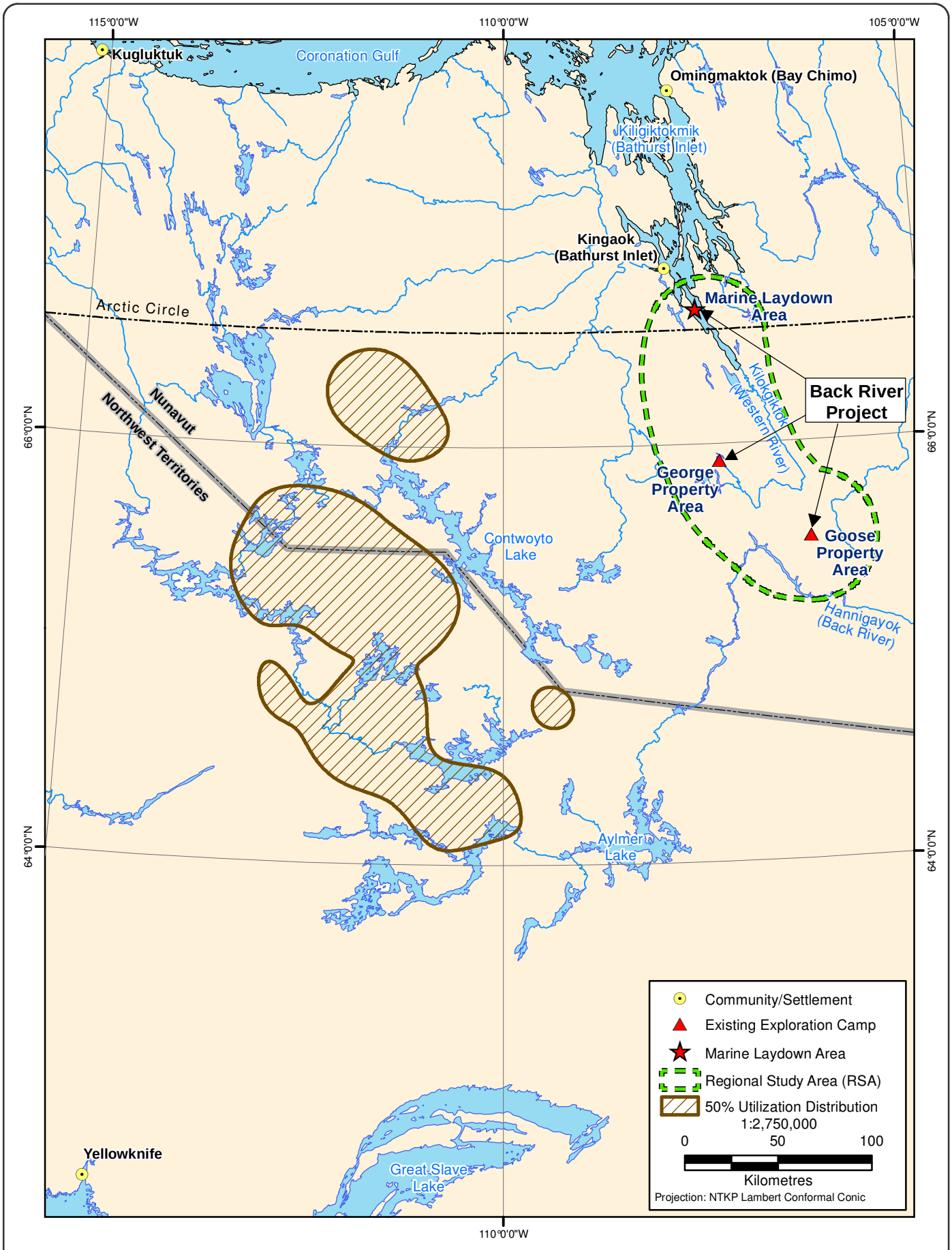

Figure 3.3-3b

Summer 50% Utilization Distribution

The 50% kernel UD encompasses the smallest area within which 50% of the overall density of the utilization distribution can be contained. In an ecological sense, it depicts the area within which there is a 50% likelihood of finding a collared caribou location across the entire distribution of collar location points (i.e., the area where collared caribou spend 50% of their time; Hemson et al. 2005). This represents an area where most location data points are clustered together (and therefore the chances of detecting caribou within that area are quite high). The 50% volume contour was used to delimit the "core use" area, as they appear to be used intensively based on the distribution of location points. The 95% kernel UD encompasses the areas surrounding the core use areas. It delimits the area within which there is a 95% likelihood of finding collared caribou. Selecting the 95% kernel UD eliminates location data point outliers that do not represent a consistent pattern of habitat use for the species (e.g., Powell 2000). Therefore, the 95% kernel UD is an estimate of the "range" of collared caribou.

Kernel density distributions, or alternatively kernel utilization distributions (UDs), were generated using Home Range Tools for ArcGIS 9. All estimations were generated using a fixed search radius, or bandwidth, to generate the density values for data points and grid cells. A raster output of each kernel UD was generated to show the overall density of collar locations. For this study, the kernel UDs contained within 50% and 95% volume contours were calculated for both the post-calving and summer seasons and used to delineate the maximum extent for modeling caribou habitat use.

3.4 COLLAR DATA

Collaring programs for several caribou herds in the Canadian Arctic have been established by the Government of Northwest Territories Department of Environment and Natural Resources (ENR) and Government of Nunavut Department of Environment (DOE). Satellite collars are fitted on female caribou, usually during the winter. A collaring program for the Bathurst herd has been in place since 1996 (GNWT ENR 2010). The number of collars that can be placed on Bathurst herd female caribou is restricted to 20. The data generated from these programs allow researchers to investigate seasonal trends in habitat use as well as track real time movement patterns of caribou herds. Unpublished satellite collar data from the Bathurst herd were obtained from GNWT ENR for analysis of habitat selection. Data were acquired from the GNWT ENR Wildlife Management Information System (WMIS) from 1996 to the end of September 2012.

Telemetry locations were used to estimate resource use, and compared to randomly sampled locations using logistic regression (Boyce and MacDonald 1999; Manly et al. 2002). Availability was defined as the 50% and 95% kernel UDs for the post-calving and summer ranges. To characterize availability, five availability points per individual use point (e.g., Gustine et al. 2006) were randomly generated within each seasonal kernel UD using a random point generator in ArcGIS. The post-calving period was defined as June 16 to July 20 and the summer period was defined as July 21 to August 31.

3.5 GIS AND REMOTE SENSING

Inputs to the RSF are predictor variables hypothesized to influence population distribution or those identified as important habitat characteristics in the literature. These variables include vegetation indices of productivity, land cover, topographic features, predation, and industrial development. The layers are a compilation of original data and data derived from pre-existing datasets. Most layers were comprised of multiple scenes or panels which were stitched together into a single image to provide coverage over the entire area of interest.

Patterns of selection or avoidance are defined relative to what is available to an animal. The use of resources proportionately more than might be expected based on availability is termed selection. The use of resources less than expected based on what is available is termed avoidance.

3.5.1 Simple Ratio Vegetation Index (SRVI)

In order to assess habitat quality and forage availability, vegetation productivity was quantified using a vegetation index. Vegetation indices provide a useful means to quantify vegetation quality and quantity and are typically derived from differences in reflectance in the visible and Near Infrared (NIR) wavelengths. In this study, the simple ratio vegetation index (SRVI) was used as an indicator of vegetation productivity, which has been shown to reasonably characterize Arctic vegetation (Chen et al. 2013a). The SRVI is based upon the observation that the spectral signature of healthy, dense vegetation is characterized by high near-infrared reflectance and comparatively lower red reflectance while bare surfaces or sparse vegetation is lower in the near-infrared wavelengths. The SRVI is calculated as:

$$SRVI = \frac{\rho_{NIR}}{\rho_R}$$

where ρ_{NIR} is the near-infrared reflectance and ρ_R is the red reflectance.

Higher SRVI values correspond to pixels representing more dense, green vegetation while low values correspond to pixels representing unvegetated or sparsely vegetated conditions.

SRVI maps were derived from Advanced Very High Resolution Radiometer (AVHRR) satellite imagery using the near infrared and red bands. AVHRR data has been widely used to monitor vegetation productivity and phenology due to its 1.1 km resolution and a data record that dates back to the 1980s (Myneni et al 1997; Tucker et al 2001; Stow et al 2007; Jia et al 2009; Beck and Goetz 2011). A robust AVHRR dataset was made available by the CCRT, which included a satellite image acquired every 10-days from May to November between 1985 and 2011. This dataset included 616 images, each providing coverage of an area of 2400 by 6400 kilometers. The AVHRR dataset was filtered to extract only images that were acquired during the post-calving and summer time periods. Only those images acquired after 1995 were used to minimize the influence of vegetation changes that may have occurred at the landscape level; therefore, SRVI layers were generated from 143 AVHRR scenes collected from 1996 to 2011 during the post-calving and summer (e.g., Figure 3.5-1) months (June to August). We chose to exclude 2011 and 2012 from the RSF study due to incomplete datasets for these years.

Image processing was carried out based upon methods described by Chen et. al. (2013b). To reduce errors associated with clouds and aerosols, pixels from each image that were associated with heavy cloud cover were removed. To do this a unique cloud mask was created for each individual AVHRR image based upon a cloud layer provided by the CCRT. The cloud layer represents the probability of cloud contamination of a given pixel. Pixels with a cloud contamination probability greater than 50% were removed (Chen et. al. 2013b). The resulting scenes were comprised of pixels minimally influenced by clouds but may also include some image gaps in the scene due to the removal of pixels with extensive cloud cover at the time of image acquisition.

Collar locations were matched with the AVHRR scene corresponding to the closest time period. In many cases, AVHRR data was not available on the day the collar location was recorded due to removal of cloud contaminated pixels or as a result of the 10 day return interval of the AVHRR satellite. In these cases, collar data points were matched with SRVI values that corresponded to the nearest AVHRR time step at the pixel location.

To derive the final probability maps, a representative AVHRR-derived SRVI image was chosen for both the post-calving and summer time periods. The images were chosen based on quality of data and extent of coverage following cloud removal. The post-calving period was represented by a SRVI scene acquired on June 21, 2006, and summer was represented by a scene acquired on August 1, 2006. Both images required bilinear resampling to the 30 m resolution of the Landsat basemap.

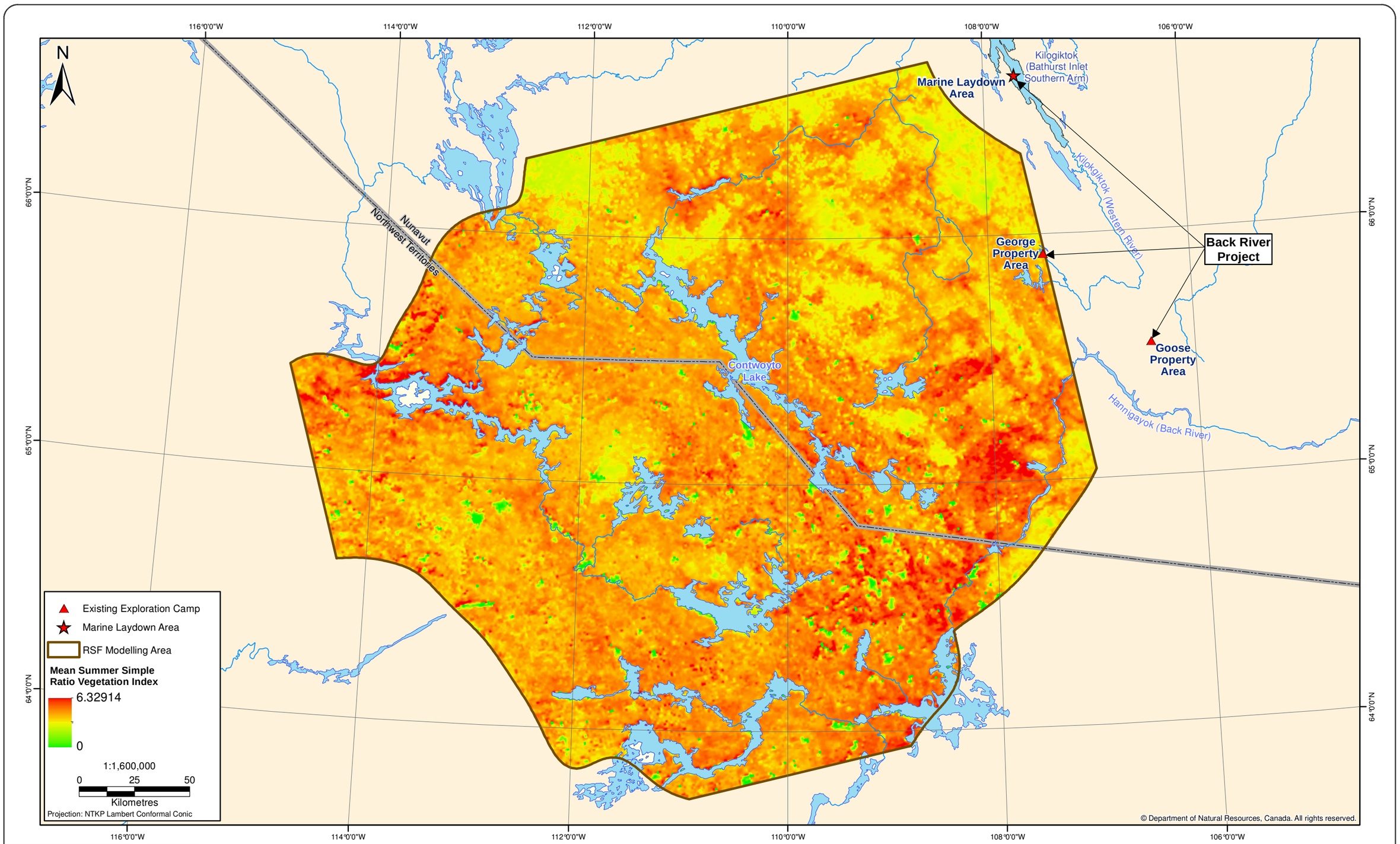

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Figure 3.5-1

Mean Summer Simple Ratio Vegetation Index in the RSF Modelling Area

3.5.2 Land Cover

Though the SRVI provides information regarding the productivity of an area, it does not distinguish between different surface cover types that may influence caribou habitat selection. As a result, land cover was also used as a predictor of caribou habitat use. Land cover information was derived from vectorized classification of satellite imagery. This classification was based upon 30 m resolution Landsat imagery collected in 2000. These land cover maps were generated by Agricultures and Agri-Food Canada (AAFC), Canada Center for Remote Sensing (CCRT), and Canadian Forest Service (CFS).

Within the RSF study area, land cover for Nunavut and the northern regions of Northwest Territories was classified by the CCRT. Land cover in the forested regions of the Northwest Territories was derived from forest cover mapping during the Earth Observation for Sustainable Development project (EOSD). Though a harmonized legend was created for the multiple data sources, some discrepancies and discontinuities exist due to differences in classification methods.

The original mapping was divided into 44 land cover codes that were consolidated into 12 land cover classes for this study (Table 3.5-1; Figure 3.5-2).

Table 3.5-1. Land Cover Classification Used to Model Habitat Use by Bathurst Caribou during Post-calving and Summer

RSF Land Cover Class	CCRT Land Cover Classes	Cover class description
Barren – Non-vegetated	Barren/Non-vegetated	Unvegetated; may include ice, snow, bedrock, soils, or developed regions
	Snow/ice	Glacier or snow
	Rock/rubble	Bedrock or other unconsolidated rock units
	Exposed land	Exposed soils or sediments
	Developed	Anthropogenically influenced areas
Sparsely Vegetated	Sparsely vegetated bedrock	<20% vegetation or bryoid cover on bedrock or boulder fields
	Sparsely vegetated till-colluvium	<20% vegetation or bryoid cover on till, colluvium, or other unconsolidated material
	Bare soil with cryptogam crust-frost boils	Bare or sparsely vegetated ecosystem with exposed, circular mineral soil upwellings due to upheaval from frost heave and cryoturbation; where present, vegetation typically consists of a thin layer of lichens, bryophytes and/or fungi
Bryoids	Bryoids	> 20% bryophytes or lichen
Tall Shrub	Tall Shrub	>20% shrub cover over 2m tall; often includes dwarf birch, Labrador tea, other dwarf shrubs, and lichens
Low Shrub	Low Shrub	>20% shrub cover under 2m tall; often includes dwarf birch, Labrador tea, bog blueberry, willows, and lichens
Prostrate Dwarf Shrub	Prostrate Dwarf Shrub	Comprised of mats of low growing shrubs with patches of bare soil; species include northern Labrador tea and scrub birch with forbs, grasses, and sedges also present
Wetlands	Wetland	Dominated by wetland or aquatic processes due to near surface water table; includes fens, bogs, and marshes
	Wetland - treed	Dominated by wetland or aquatic processes due to near surface water table with a canopy comprised of white spruce, paper birch, black spruce, or tamarack

(continued)

Table 3.5-1. Land Cover Classification Used to Model Habitat Use by Bathurst Caribou during Post-calving and Summer (continued)

RSF Land Cover Class	CCRT Land Cover Classes	Cover class description
Wetlands *(cont'd)*	Wetland - shrub	Dominated by wetland or aquatic processes due to near surface water table with a shrub layer of tea-leaved willow, Labrador tea, scrub birth, and/or bog blueberry
	Wetland - herb	Dominated by wetland or aquatic processes due to near surface water table with primarily sedges communities
Tussock Graminoid Tundra	Tussock Graminoid Tundra	Moist cottongrass and tussock tundra
Moist to Dry non-Tussock Graminoid Tundra	Moist to Dry non-Tussock Graminoid Tundra	Mesic tundra and meadow which may include willow, health, or sedge species
Forested (Conifer)	Coniferous forest	Conifers represent >75% of basal area, typically includes white spruce, black spruce, jack pine, and paper birch
	Coniferous dense	Conifers represent >75% of basal area and have >60% crown closure typically includes white spruce, black spruce, jack pine and paper birch
	Coniferous open	Conifers represent >75% of basal area and have 26-60% crown closure; commonly includes jack pine- lichen or spruce-alder dominated ecosystems
	Coniferous sparse	Conifers represent >75% of basal area and have 10-25% crown closure; commonly includes jack pine- lichen or spruce-alder dominated ecosystems
Forested (Broadleaf)	Deciduous forest	Broadleaf trees represent >75% of basal area; may include paper birch, scrub birch, as well as minor components of conifer species
	Broadleaf dense	Broadleaf trees represent >75% of basal area and have >60% crown closure; may include paper birch, scrub birch, as well as minor components of conifer species
	Broadleaf open	Broadleaf trees represent >75% of basal area and have 26-60% crown closure; may include paper birch, scrub birch, as well as minor components of conifer species
	Broadleaf sparse	Broadleaf trees represent >75% of basal area and have 10-25% crown closure, may include paper birch, scrub birch, as well as minor components of conifer species
Forests (Mixed)	Mixedwood forest	Forests where neither conifers nor broadleaf represent >75% of basal area; may include canopy of white spruce, black spruce, jack pine, or paper birch
	Mixedwood dense	Forests where neither conifers nor broadleaf represent >75% of basal area and have >60% crown closure; may include canopy of white spruce, black spruce, jack pine, or paper birch
	Mixedwood open	Forests where neither conifers nor broadleaf represent >75% of basal area and have 26-60% crown closure; may include canopy of white spruce, black spruce, jack pine, or paper birch
	Mixedwood sparse	Forests where neither conifers nor broadleaf represent >75% of basal area and have 10-25% crown closure; may include canopy of white spruce, black spruce, jack pine, or paper birch

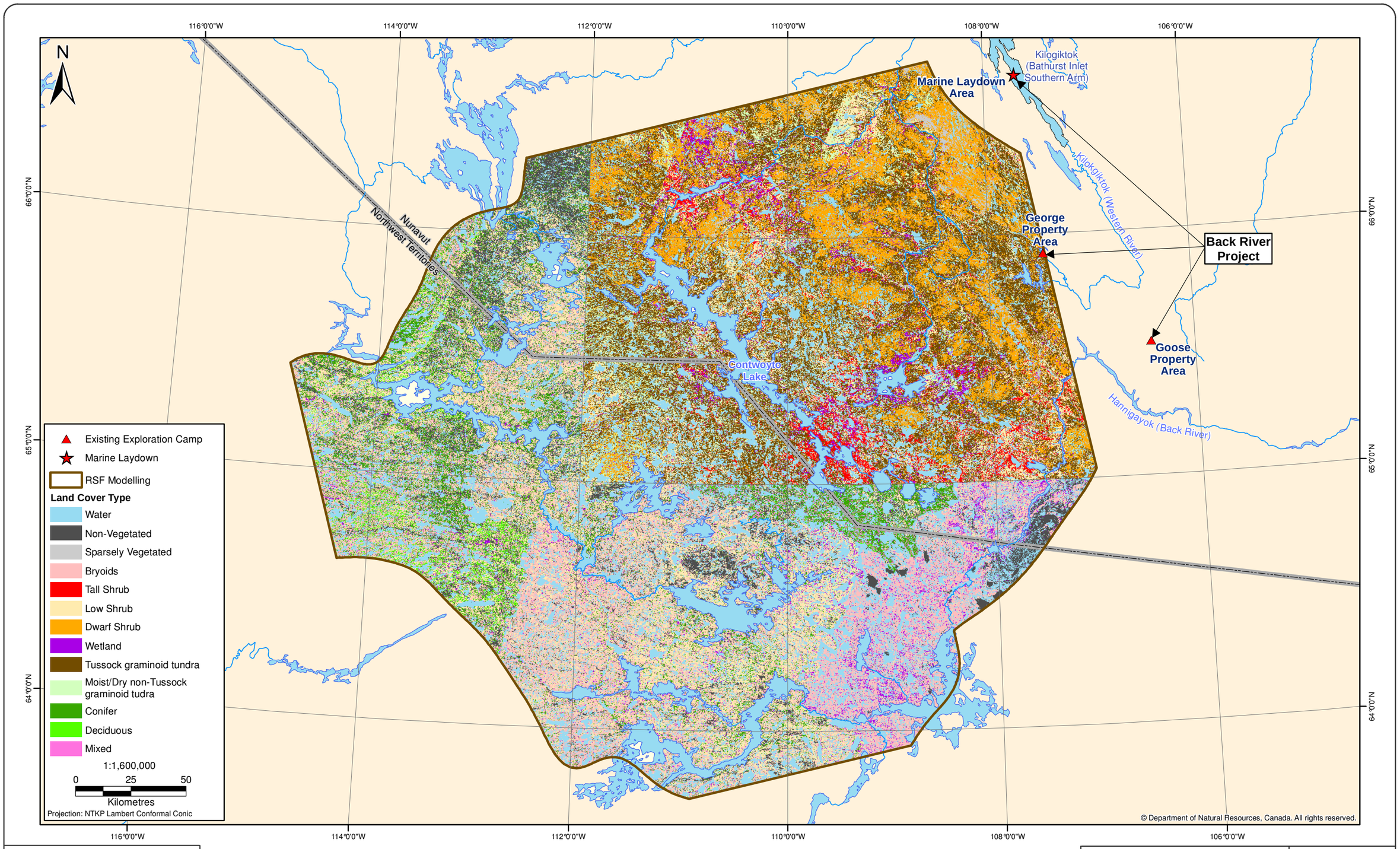

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Figure 3.5-2

Land Cover Types in the RSF Modelling Area

A total of 23 map sheets were required to provide coverage over the entire study area. These map sheets were mosaicked and clipped to create a single land cover layer. A total of 1,029,814 individual land cover polygons are present within the study area. These land cover polygons ranged in size from less than one hectare to nearly 97,000 hectares (Contwoyto Lake).

A spatial join was used to assign a single land cover class to each collar location and random point. The land cover layer was then rasterized for use in the derivation of the final habitat use map. The vector land cover layer was converted to raster with a spatial resolution of 30 m and a grid based upon a Landsat composite basemap. From the rasterized land cover layer a binary mask for each of the 12 land cover classes was created. The masks were designed such that each pixel representing a particular land cover class was assigned a 1 and all other pixels were assigned a 0.

3.5.3 Topographic Features

Also considered were topographic factors that may influence the use of resources, including elevation, slope, and aspect. The elevation at each caribou observation was determined using digital elevation models (DEMs) from Canadian Digital Elevation Data. These were generated from 1:50,000 National Topographic Data Base maps and other available territorial data. Eighteen National Topographic Survey (NTS) map sheets were merged into a single DEM with spatial coverage over the area of interest (Figure 3.5-3) and a spatial resolution ranging from 8 to 23 meters. On the merged DEM some seams are visible, particularly on lakes, as a result of differing data sources.

From the merged DEM, slope (Figure 3.5-4), eastness (Figure 3.5-5), and northness (Figure 3.5-6) were calculated using ArcGIS. Slope served as the basis for determining both eastness and northness which relate to slope aspect. They were calculated as:

$$Eastness = \sin\frac{a \cdot \pi}{180}$$

and

$$Northness = \cos\frac{a \cdot \pi}{180}$$

where *a* is the aspect in degrees.

Preliminary analyses indicated that topographic features were not a significant component of resource use, likely due to the relatively uniform relief across the landscape; therefore, topographic features were omitted from the final model iterations.

3.5.4 Esker

Eskers were identified as a potentially important habitat feature due to their use as a travel corridor and for insect and heat relief. Esker locations are included in the relief and forms CanVec vector data produced by Natural Resources Canada. This vector data is consistent with overlapping regions of the terrain mapping for the Project LSA and RSA conducted as part of the baseline study program (Rescan 2013). From the CanVec esker delineation (Figure 3.5-7), a binary esker mask was generated using a 75 meter buffer. Regions within 75 meters of a mapped esker were classified as esker while areas further than 75 meters from mapped eskers were classified as non-esker features.

Preliminary analyses indicated zero use of eskers by caribou during the post-calving and summer periods (consistent with camera monitoring data); therefore, eskers were omitted from the final model iterations though eskers were incorporated into the predator habitat suitability index.

3.5.5 Water

Proximity to water (Figure 3.5-8) is used as a predictor variable because lakes have been found to provide caribou with relief from heat and insects. The availability of water across the landscape was quantified using the position and spatial extent of waterbodies. The waterbodies were defined based upon the water class in the land cover data.

A total of 70,399 lakes, rivers, ponds, and other waterbodies were identified within the study area. These ranged in size from <1 ha to the almost 97,000 hectare Contwoyto Lake. Polygons that were split as a result of imagery seams were manually merged when encountered. It some cases it was necessary to merge polygons representing water with polygons identified as ice when lakes were frozen at the time of mapping.

For each collar data point, the distance to the nearest body of water and its surface area was calculated using a spatial join. Each point is therefore associated with a single distance to the nearest water polygon and the area of that polygon. Where collar locations fell within a mapped body of water, the distance to water is zero. For these calculations, the waterbody data layer was clipped to 2 km beyond the study area boundary to minimize any edge effects.

Preliminary analyses indicated that the size of the nearest lake was not a significant component of resource use and thus the size of the lakes were not used in the final model iterations; therefore, a raster layer was generated representing the distance to the nearest waterbody using the Euclidean distance tool in ArcGIS 10.

3.5.6 Predators

Predation is considered an important component of caribou population dynamics. To incorporate predation risk as a predictor of caribou habitat use across the landscape, habitat suitability indices (HSI) were generated for 2 predator species during each modelled season. Predator modelling was completed for wolves [spring (Figure 3.5-9) and summer (Figure 3.5-10)] and grizzly bears [spring (Figure 3.5-11) and summer (Figure 3.5-12)]. The predator modelling used as a predictor variable is consistent with general trends presented in the grizzly bear assessment (DEIS; Volume 5; Chapter 6) and the wolverine and furbearers assessment (DEIS; Volume 5; Chapter 8). A four-class suitability rating system was used where:

- High suitability habitats were ecosystem and terrain types that were considered to have abundant hunting and/or foraging opportunities, as well as areas such as eskers that provide easy movement corridors.
- Moderate suitability habitats were ecosystem and terrain types that were considered to have some hunting or forage potential, but were not areas that the target species would actively seek.
- Low suitability habitats were ecosystem and terrain types that were considered to have limited hunting and forage potential that were generally avoided.
- Nil suitability habitats were areas that do not provide hunting or foraging opportunities, or contain features such as lakes, ocean and cliffs that obstruct movement.

There were also ranks of 0 for polygons that were unclassified or were called cloudy.

Land cover and a buffered (50 metre) esker polyline were obtained from the GeoBase National Landcover Data. Suitability ratings were applied to each ecosystem type and the esker buffer for both species and seasons based on wildlife suitability mapping and field surveys completed by ERM Rescan for multiple projects completed between 2009 and 2013 in Nunavut and NWT, including large portions of the RSF study area.

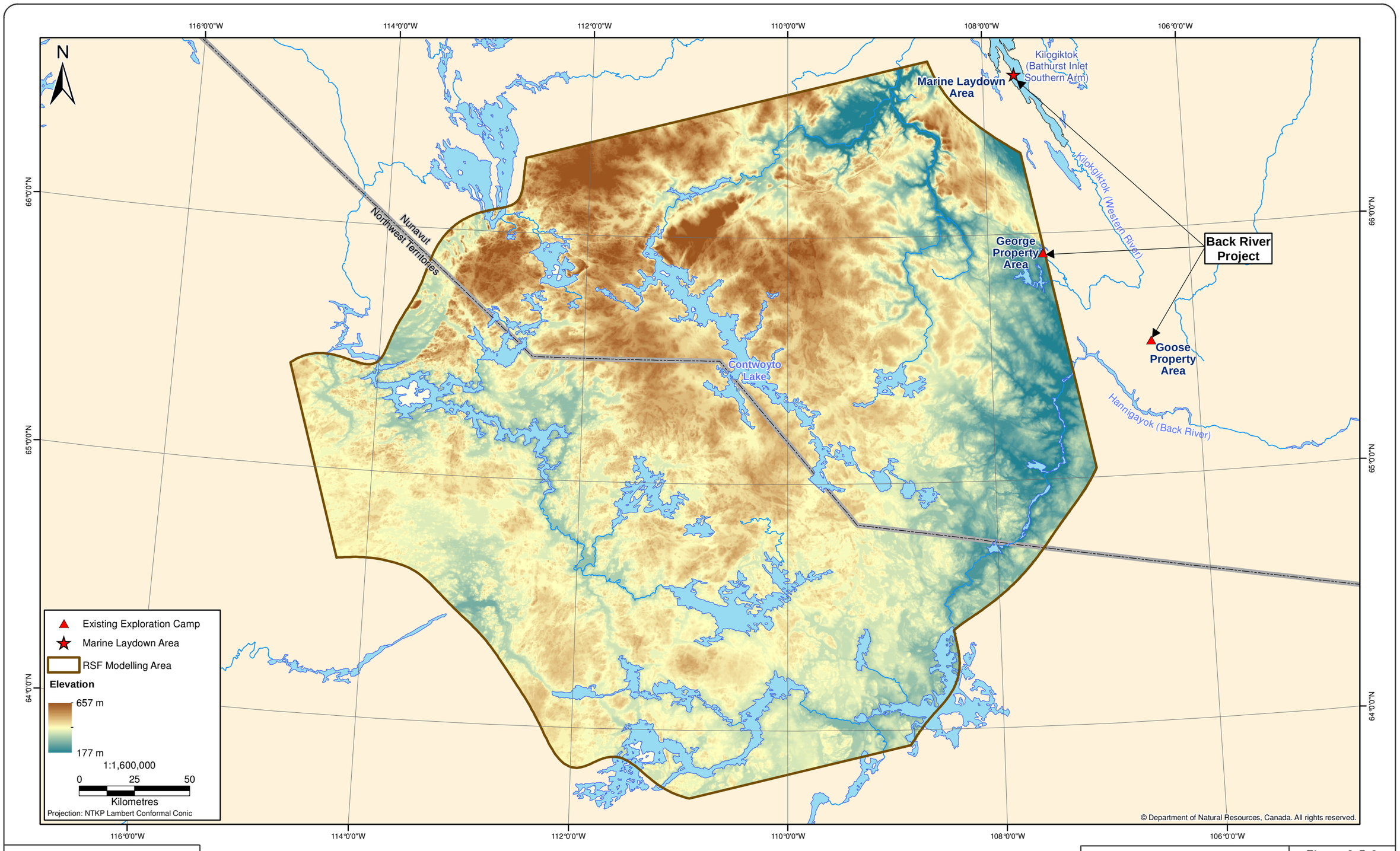

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Figure 3.5-3

Digital Elevation Model of the RSF Modelling Area

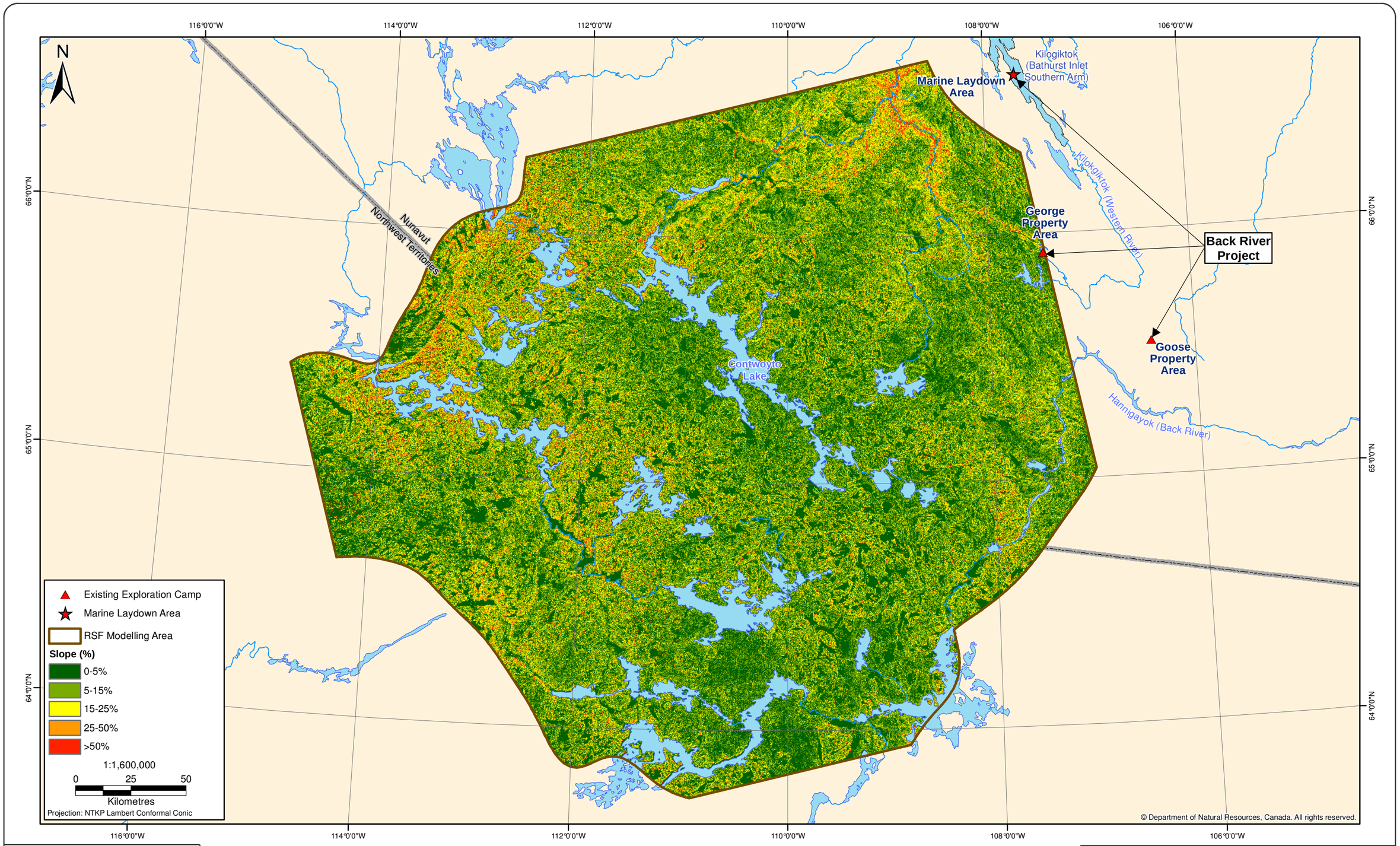

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Figure 3.5-4

Slope in the RSF Modelling Area

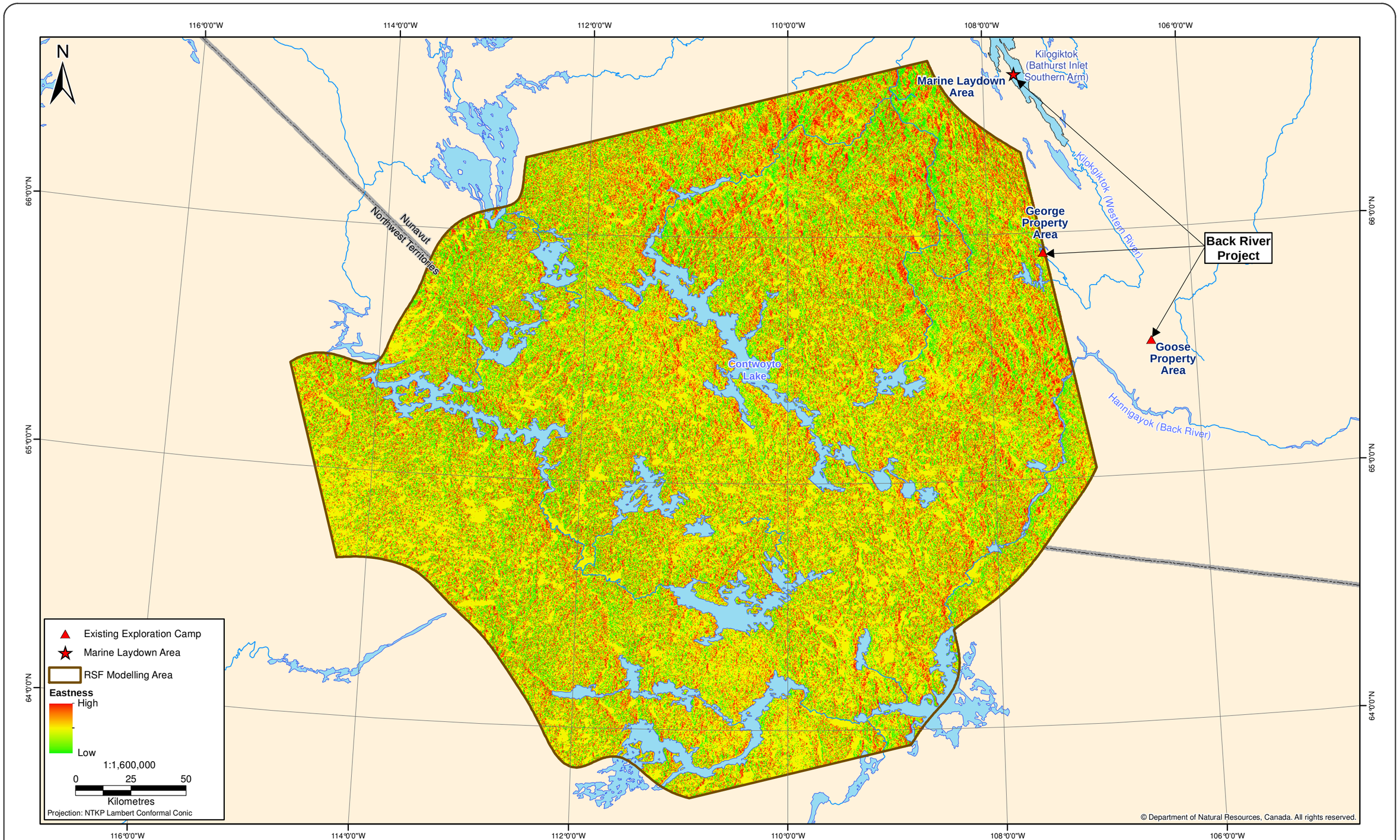

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Figure 3.5-5

Eastness in the RSF Modelling Area

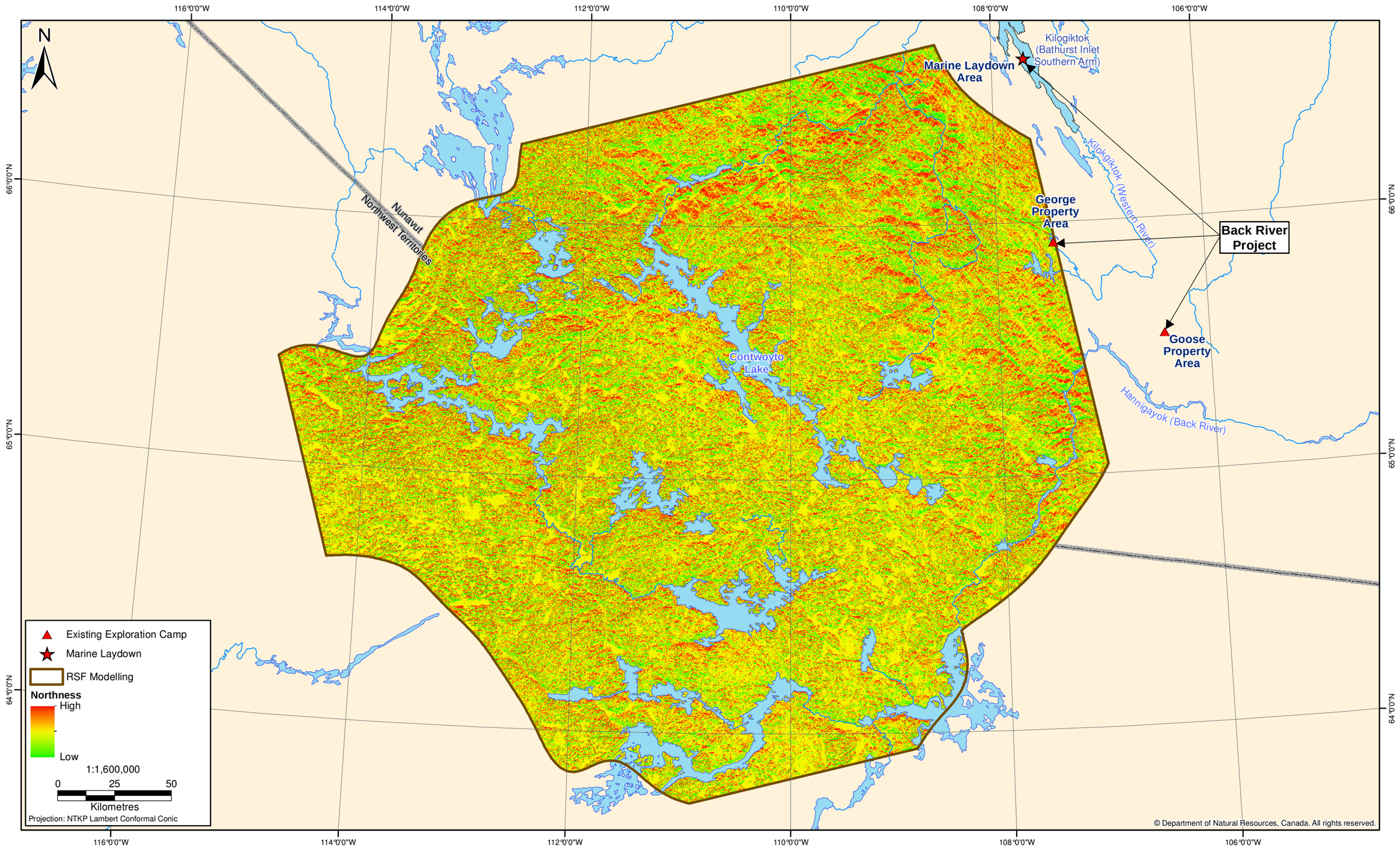

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Figure 3.5-6

Northness in the RSF Modelling Area

PROJECT # **0194096-0039** GIS # **BAC-23-253m**

November 01, 2013

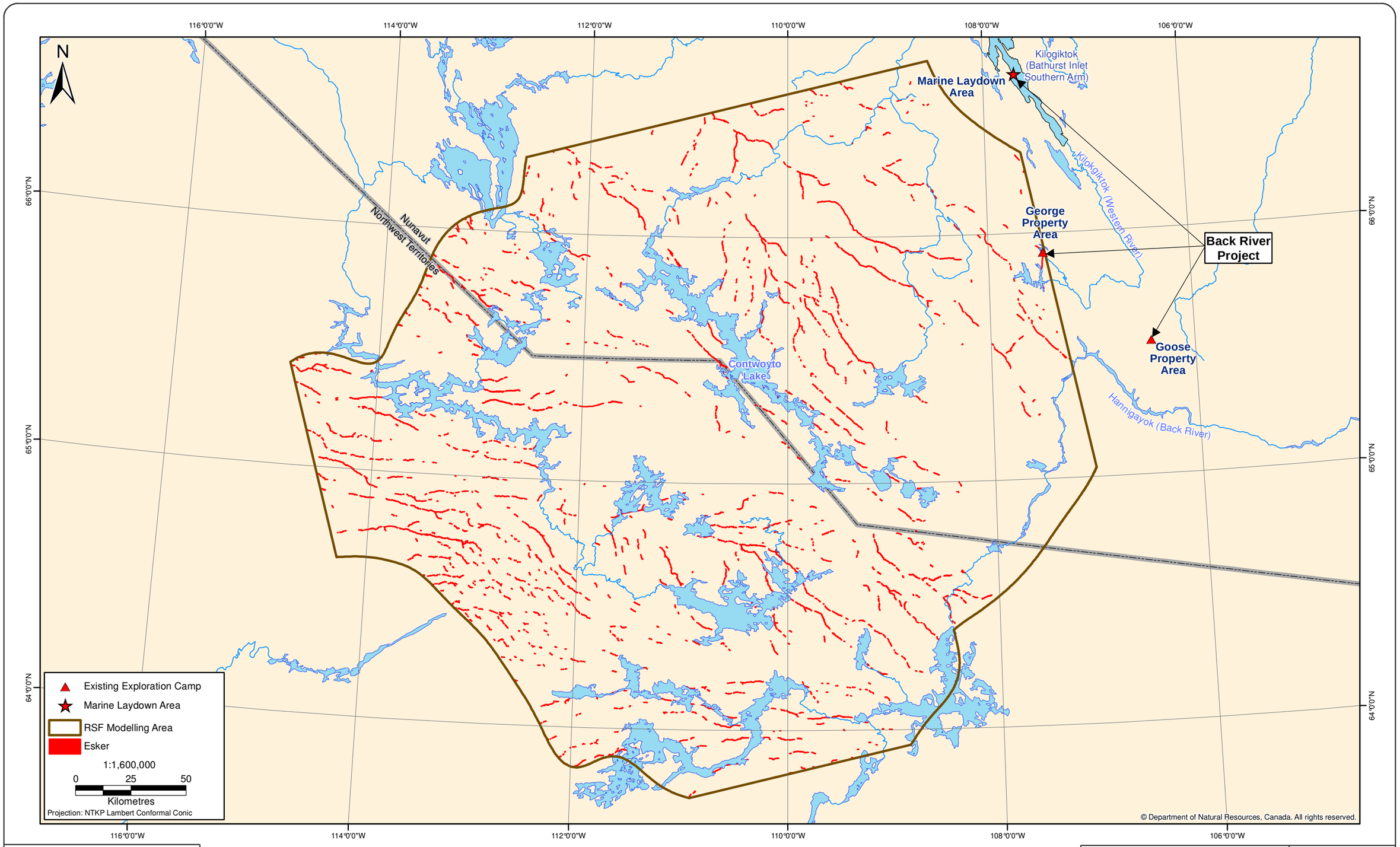

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Figure 3.5-7

Eskers in the RSF Modelling Area

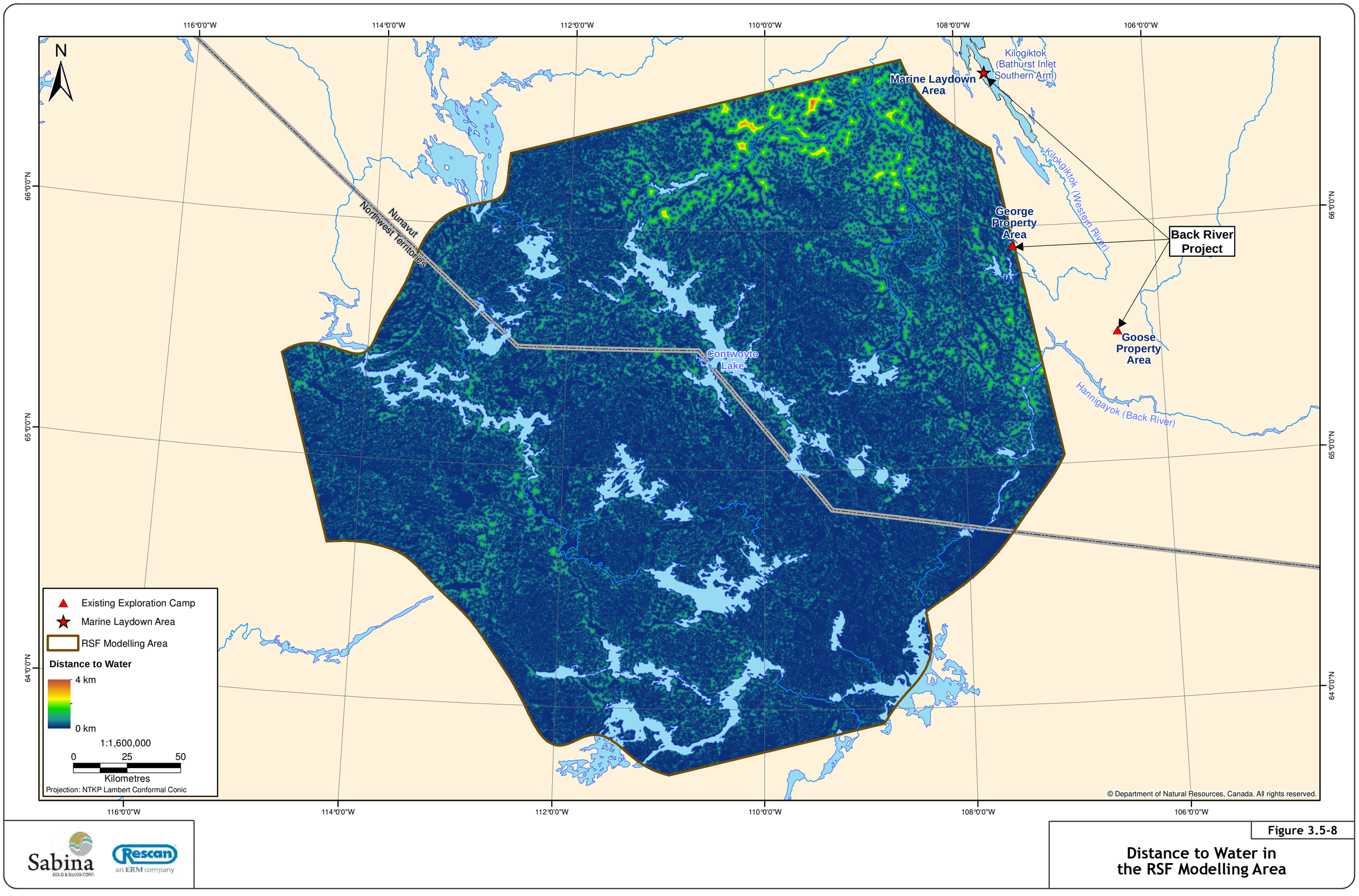

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Figure 3.5-8

Distance to Water in the RSF Modelling Area

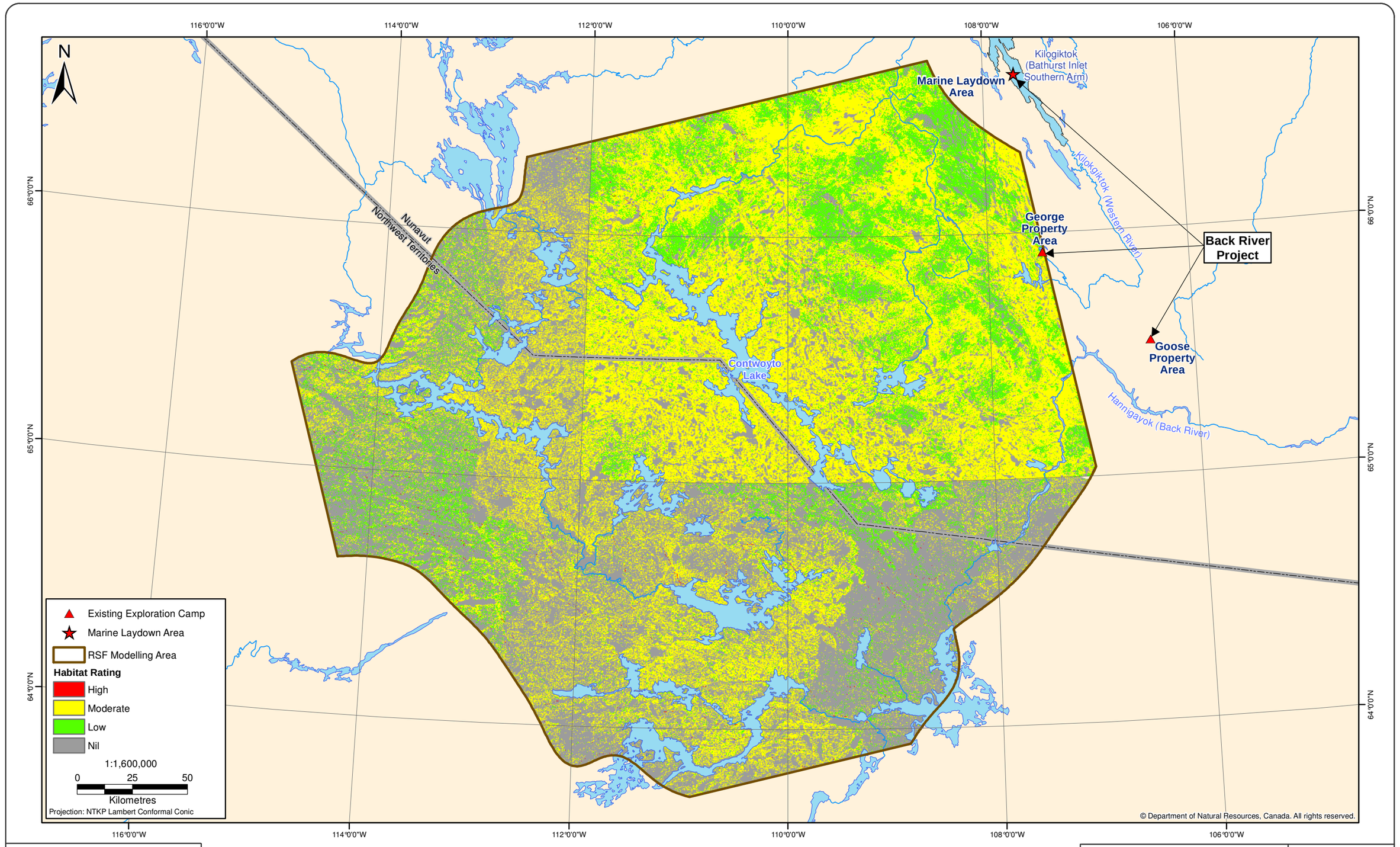

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Figure 3.5-9

Wolf Habitat Rating during Post-Calving in the RSF Modelling Area

PROJECT # **0194096-0039** GIS # **BAC-23-253h**

November 01, 2013

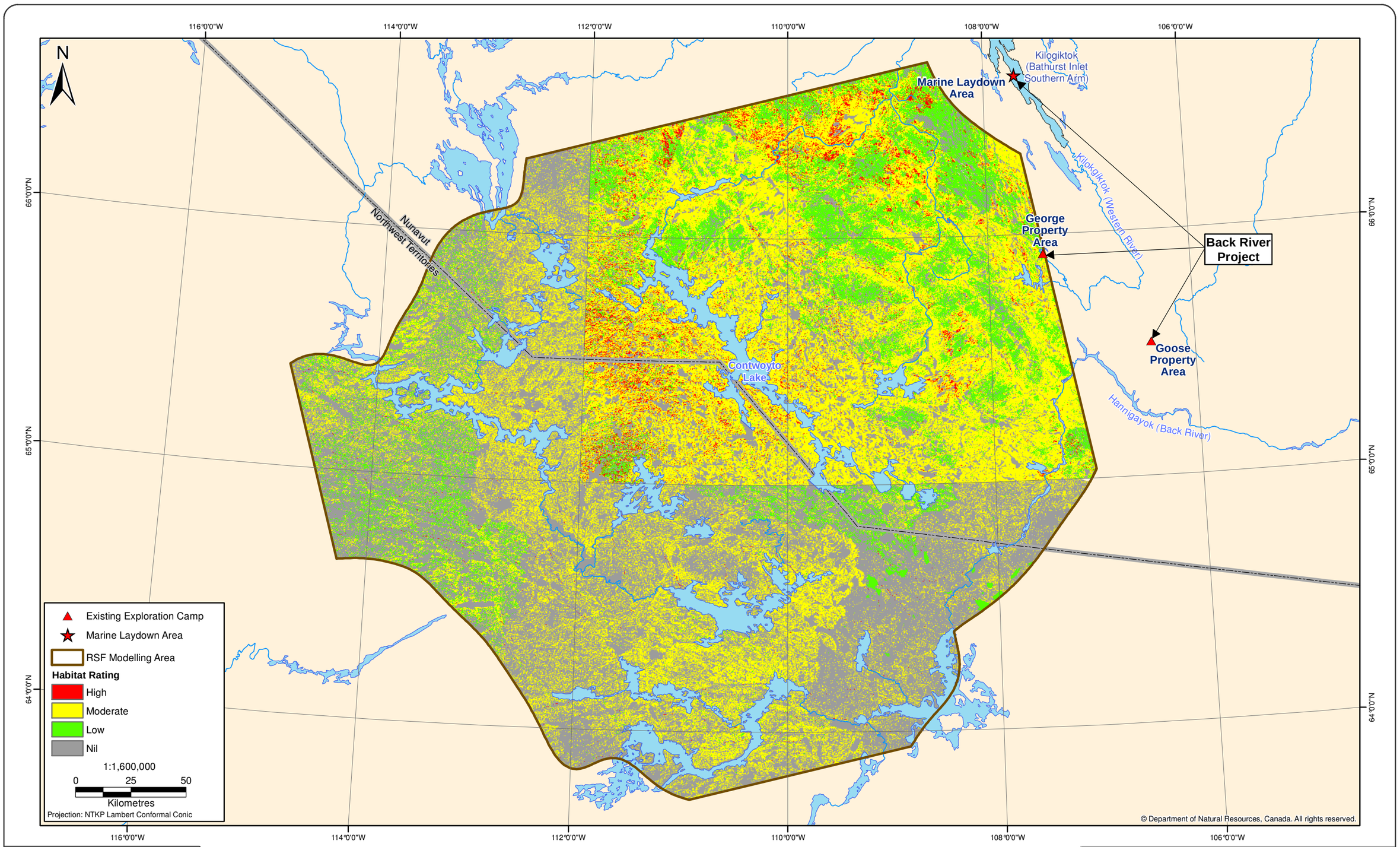

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Figure 3.5-10

Wolf Habitat Rating during Summer in the RSF Modelling Area

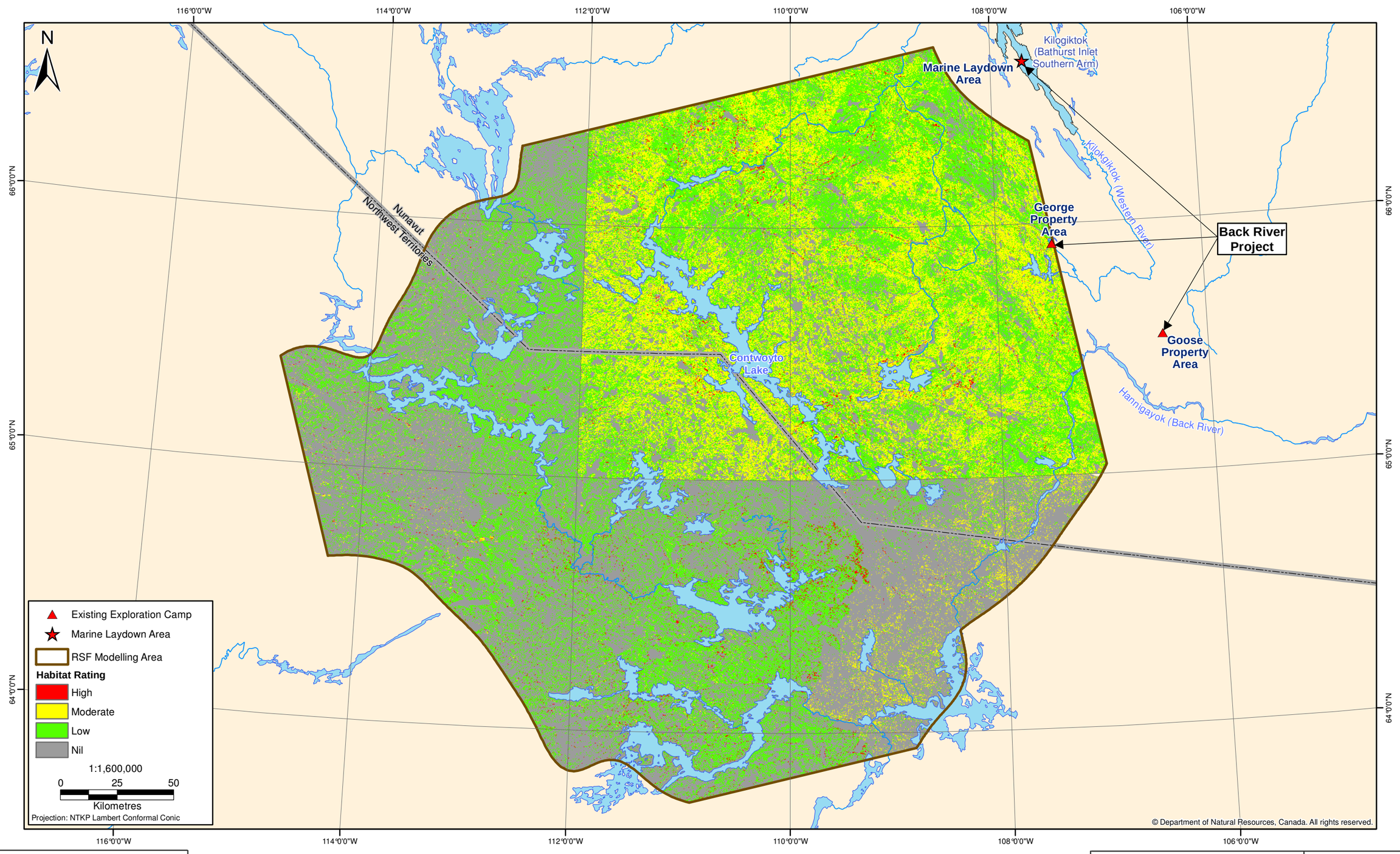

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Figure 3.5-11

Grizzly Bear Habitat Rating during Post-Calving in the RSF Modelling Area

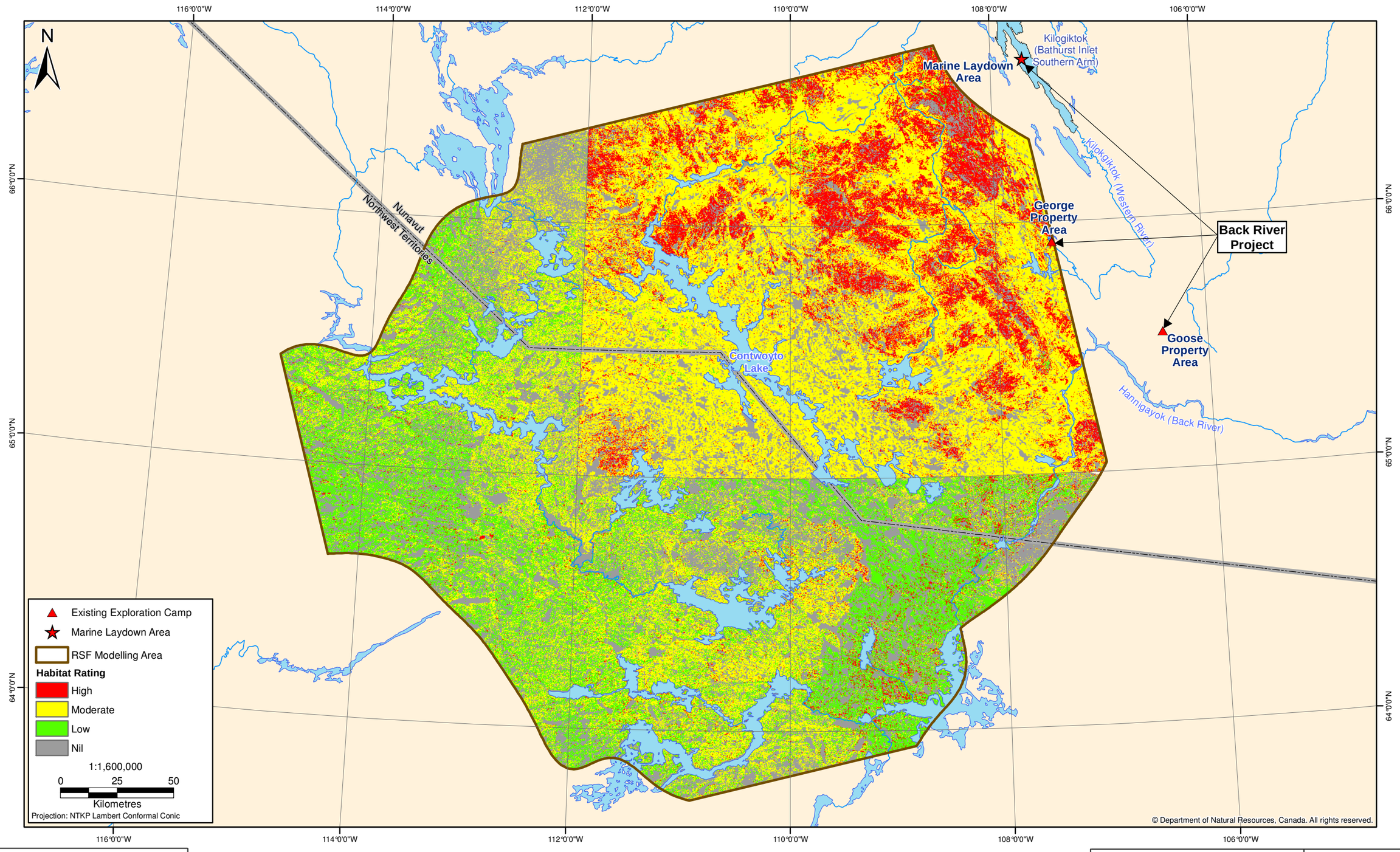

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Figure 3.5-12

Grizzly Bear Habitat Rating during Summer in the RSF Modelling Area

3.5.7 Mining Development

A development layer (Figure 3.5-13) was created to encompass the influence of mining activities, including drilling, camp, and helicopter disturbances. Development within the cumulative effects assessment boundary was divided into operating mines, closed mines, and exploration camps based on the assumption that each type of development is likely to interact with the herd in different ways. Through a literature search, the status of all camps and mines in the study area from 1996 to 2010 was determined (Table 3.5-2). At each collar data point, the distance to the nearest mine or camp was calculated for each of these development classes using the Euclidean Distance tool in ArcGIS 10.

Table 3.5-2. Summary of Mines and Camps Located in Study Area

Time Period	Number of Exploration Camps	Number of Open Mines	Number of Closed Mines
1996 to 2001	1	2	4
2002 to 2003	2	2	4
2004 to 2010	3	2	4

3.6 MODELLING PROCEDURES

An information theoretic approach was used to evaluate selection models (Burnham and Anderson 2002). Global models were constructed for each season and UD by pooling GPS locations across years. Categorical variables were coded with deviation contrasts (Menard 2002). To avoid inflating selection coefficients and associated standard errors (Menard 2002), collinearity among habitat variables was assessed. Given the high number of parameters in the model sets and the number of models generated, a conservative tolerance score of <0.3 was used to assess collinearity (Sokal and Rohlf 2000). No collinearity was identified.

Akaike's Information Criterion (AIC_c) corrected for small sample sizes (n/K < 40) to rank the model sets for caribou in each season and UD. The differences in AIC_c (Δ_i) provide an estimate of the distance that a candidate model is from the true model (Burnham and Anderson 2002). Akaike's weights (w_i) provide an estimate of the relative probability that the top model is the best amongst the suite of candidate models. A single model was selected as the likely top model if its $w_i \geq 0.90$. If the top model had an associated w_i < 0.90, selection coefficients were averaged from the suite of top models for which the sum of their respective w_i's was ≥ 0.95 (Burnham and Anderson 2002). A *k*-fold cross validation procedure averaged across five random subsets and a Spearman's rank correlation (r_s) was used to determine the predictive ability of each top model; values of r_s > 0.70 indicate good model performance (Boyce et al. 2002).

3.7 FINAL PROBABILITY MAPS

A series of maps that represent the likelihood of habitat use by caribou were produced based on parameter coefficients from the top models. Models of resource selection are based on logistic regression, which takes the form:

$$W(x) = \frac{\exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots)}{1 + \exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots)}$$

In each equation, the habitat use probability surface ($W(x)$) is defined by a series of habitat characteristics (x) and associated coefficients (β). To produce the probability surface, the raster layers for each of the predictor variables were projected to a common 30 m raster size and Albers Equal Area Conical coordinate system. Each respective raster data layer was multiplied by its respective coefficient that was derived during model development. Each pixel has a value defined by the logistic regression equation.

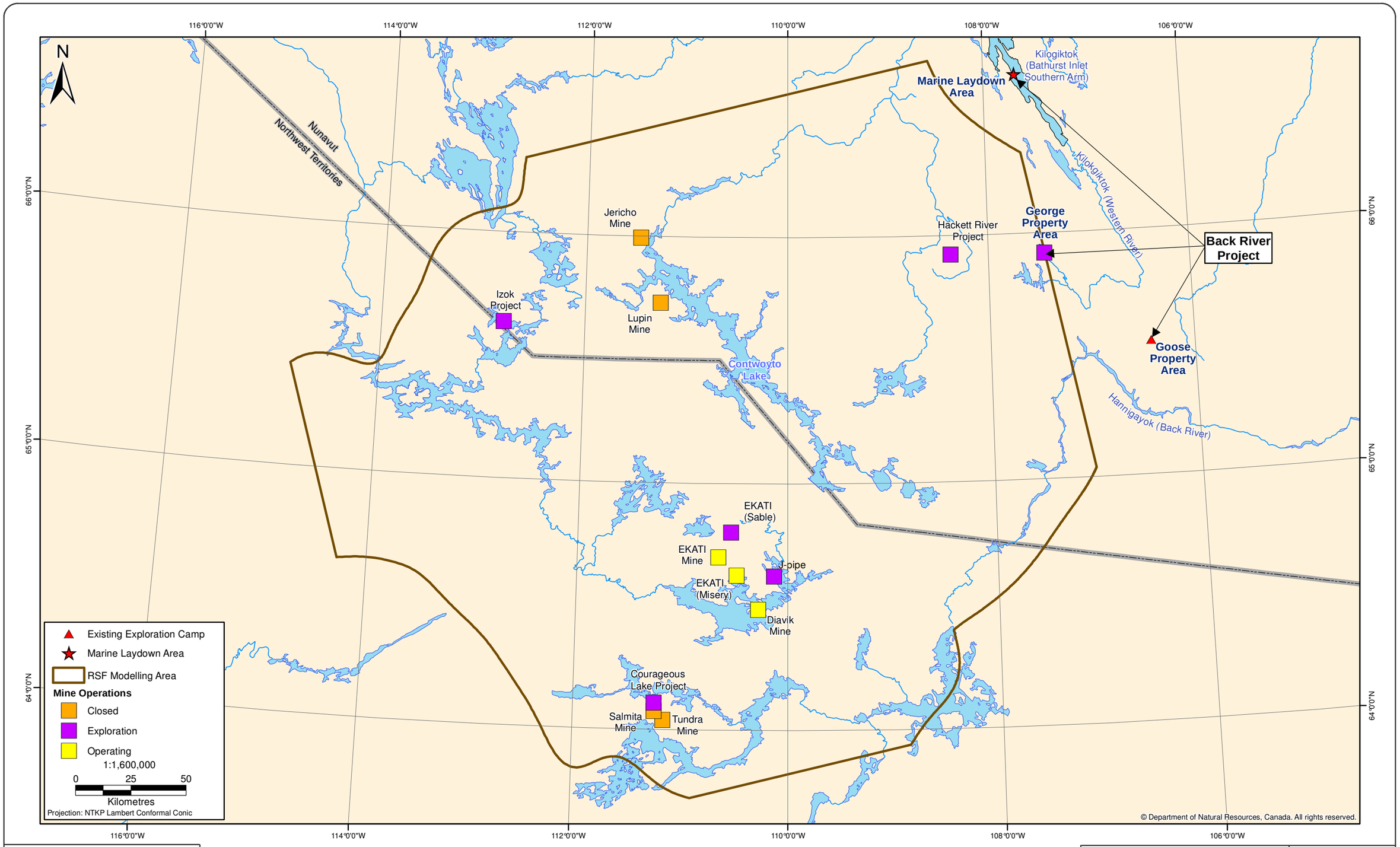

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Figure 3.5-13

Mine Operations in the RSF Modelling Area

4. Results

4. Results

4.1 RSF OUTPUTS

A total of 41,097 GPS locations were acquired from satellite collars deployed on 102 female caribou in the Bathurst herd. These locations were specific to the post calving and summer periods between 2004 and 2010. Gaps in GPS information and remote sensing imagery precluded the inclusion of 2011 and 2012 data. Statistically significant selection for SRVI was consistent across the post-calving and summer seasons. Seasonal differences in selection of different cover types and habitat use relative to industrial sites was also evident. All final models had values of $r > 0.70$ indicating good model performance.

4.1.1 Post Calving

Global models that best described resource selection by caribou within the post calving range (95% UD) included land cover class, habitat productivity as measured by SRVI, distance to industrial activity, and a measure of predation risk (Table 4.1-1). Water was included in the final model, but its coefficient was not statistically significant.

Table 4.1-1. Top Three Candidate Models Describing Habitat Selection by Bathurst Caribou during Post-calving

Model	AIC	ΔAIC	AIC *w*
95% UD			
*Land Cover + SRVI + Water + Industry + Predator	15425.89	0	0.68
*LandCover + SRVI + Industry + Predator	15427.47	1.58	0.31
Land Cover + SRVI + Water + Industry	15436.11	10.22	0.004
50% UD			
*Land Cover + SRVI + Industry + Predators	8792.66	0	0.52
*Land Cover + SRVI + Water + Industry + Predators	8792.81	0.14	0.48
SRVI + Industry + Predators	8805.64	12.98	0.001

Across the post calving range, caribou tended to avoid barren and sparsely vegetated cover types, as well as prostrate dwarf shrub and tussock graminoid tundra areas, relative to the availability of these cover types (Table 4.1-2). In contrast, caribou tended to select tall shrub and forested habitats. Habitat suitability for predators, used as an indicator of potential predation risk, was included in the final model. There was evidence for selection of low quality wolf habitat and avoidance of low quality grizzly bear habitat. There was zero use of high quality wolf habitat, which resulted in the removal of this parameter from the final model.

Selection coefficients across industrial activities imply some level of influence of these activities on caribou habitat use at the herd scale relative to random locations; however, while statistically significant, the magnitude of the coefficients suggests industrial effects cannot be considered in isolation of other factors. For example, the raw averages indicate the caribou tend to be slightly further from closed mines (101.1 km) compared to random locations (98.3 km), but closer to operating mines (116.5 km) and exploration camps (86.8 km) compared to random use points (133.9 km and 89.3 km, respectively).

Table 4.1-2. Model Parameters and Selection Coefficients Describing Habitat Selection by Bathurst Caribou during Post-calving

Parameter	[1]Post-Calving 95% UD	[1]Post-Calving 50% UD
Barren – Non-vegetated	-1.08 ± 0.25*	-
Sparsely Vegetated	-0.95 ± 0.23 *	0.73 ± 0.42
Bryoids	-0.03 ± 0.19	-
Tall Shrub	0.52 ± 0.20*	0.02 ± 0.25
Low Shrub	0.26 ± 0.19	-0.37 ± 0.24
Prostrate Dwarf Shrub	-0.86 ± 0.20*	-0.57 ± 0.23*
Wetlands	-0.47 ± 0.35	0.34 ± 0.33
Tussock Graminoid Tundra	-0.68 ± 0.21*	0.04 ± 0.20
Moist to Dry non-Tussock Graminoid Tundra	0.18 ± 0.21	-0.19 ± 0.25
Forested – Conifer	0.43 ± 0.24	-
Forested – Deciduous	1.69 ± 0.36*	-
Forests – Mixed	1.77 ± 0.26*	-
RVI	0.26 ± 0.02*	0.35 ± 0.09*
Water	-0.01 ± 0.004*	-0.005 ± 0.003
Distance to Operating Mine	-0.008 ± 0.001*	0.006 ± 0.001*
Distance to Closed Mine	-0.003 ± 0.001*	-0.01 ± 0.001*
Distance to Exploration Camp	-0.012 ± 0.001*	-0.02 ± 0.001*
Wolf Moderate Habitat	-0.28 ± 0.24	0.15 ± 0.19
Wolf Low Habitat	0.28 ± 0.12*	-0.15 ± 0.19
Wolf Nil Habitat	-0.001 ± 0.28	-
Bear High Habitat	0.53 ± 0.29	-0.46 ± 0.34
Bear Moderate Habitat	0.16 ± 0.14	0.11 ± 0.16
Bear Low Habitat	-0.56 ± 0.15*	0.35 ± 0.26
Bear Nil Habitat	-0.13 ± 0.31	-
Intercept	0.57 ± 0.21*	-0.76 ± 0.38*

[1]:model coefficients are the weighted average of the top two models.
** Indicates statistically significant coefficient.*

Similarly to the 95% UD, global models that best described resource use by caribou in the core post-calving range (50% UD) was an averaged saturated model with 18 parameters, including land cover, RVI, water, industrial activities, and habitat quality for predators (Table 4.1-1).

In the post-calving core range, caribou tended to select for highly productive areas, as indicated by the significant positive coefficient for RVI, and avoided prostrate dwarf shrub cover types (Table 4.1-2). As with the 95% UD, industrial activity was a significant component of the model and suggests avoidance activity, but the magnitude of the coefficients points to a small overall effect size. For instance, raw averages indicate that caribou were on average closer to closed (100.4 km) and operating mines (67.2 km) compared to random locations (110.6 km and 93.2 km, respectively), and further away from exploration camps (134.8 km versus 112.8 km). These results indicate that industrial activity is a significant component of herd level selection within the seasonal range, but their effects cannot be considered in isolation of other concurrent factors across the landscape.

The RSF model found a response curve (an increase in the probability of detection of caribou with distance from disturbance) of approximately 35 km from operating mines during the post-calving season, comparable to Johnson et al. (2005), which is likely beyond the sensory limits of caribou. While the direction of selection coefficients suggest some avoidance, the size of the selection coefficients and similar mean distances from disturbance between collar and random locations suggest that the response curves may be more a function of the number of collar locations combined with a low density of developments relative to the size of the study area. With a similar result, Johnson et al (2005) concluded the influence with industry warranted further investigation.

The respective coefficients for the post-calving range (95% UD) and the post-calving core use area (50% UD) were combined to generate habitat selection surfaces that represent the relative likelihood of detecting caribou across the landscape. These maps are not interpreted in the same way as habitat suitability. Rather, they are intended to describe the anticipated distribution of caribou given the relative availability of features thought to influence caribou habitat use within the identified spatial extent. Note that the 95% UD and 50% UD selection surfaces are not directly comparable. As the spatial boundary changes, so too does the suite of use points and the underlying availability of predictor variables.

Across the post-calving range, caribou are most likely to occur around the Contwoyto Lake region, with the highest likelihood of detection located in an area bounded by Contwoyto Lake, Lac de Gras, and Exeter Lake (Figure 4.1-1a). This pattern is consistent with observed movements of caribou from recent GPS collar data, as well as incidental observations recorded during monitoring programs of several mining projects in the region that suggest areas around Contwoyto Lake may provide important staging areas for the Bathurst herd prior to its southern migration to the wintering grounds (e.g., Ekati, Rescan 2013). Within the core use area where 50% of all GPS locations between 2004 and 2010 were found, caribou are most likely to be detected south of the Burnside River, and particularly along the Mara River and Hackett River corridors (Figure 4.1-1b). Movement patterns from GPS collar data indicate that the Mara River provides an important movement corridor for caribou as they travel southeast off the calving grounds (e.g., BIPR, Rescan 2012, unpub. data).

4.1.2 Summer

The global model that best described resource selection by caribou within the summer range (95% UD) was a saturated model that included all the predictor variables and 26 parameters (Table 4.1-3). Within the core summer range (50% UD), all predictor variables were included, with the exception of habitat suitability for predators, which was used as an index of predation risk. Water was included in both final models, and in contrast to the post-calving models, its coefficient was statistically significant.

Table 4.1-3. Top Three Candidate Models Describing Habitat Selection by Bathurst Caribou during Summer

Model	AIC	ΔAIC	AIC *w*
95% UD			
Habitat + RVI + Water + Industry + Predators	17992.97	0	1
Habitat + RVI + Industry + Predators	18045.95	52.98	$3x10^{-12}$
Habitat + Water + Industry + Predators	18126.94	133.97	$8x10^{-30}$
50% UD			
Habitat + RVI + Water + Industry	6518.59	0	0.92
Habitat + RVI + Water + Industry + Predators	6523.43	4.84	0.08
Habitat + RVI + Industry	6550.17	31.58	$1.3x10^{-07}$

Across the entire summer range (95% UD), caribou tended to select for areas with low lying vegetation relative to their availability across the landscape, such as barren and sparsely vegetated areas (which may include eskers) and shrub cover types (Table 4.1-4). Caribou tended to avoid wetter areas, such as wetlands and moist non-tussock graminoid tundra, and forested cover types. In the core use area (50% UD), caribou tended to avoid barren and bryoid cover types, low and dwarf shrub areas, and forested areas, but selected for sparsely vegetated (including eskers) cover types, tall shrub areas, and graminoid tundra cover types.

Table 4.1-4. Model Parameters and Selection Coefficients Describing Habitat Selection by Bathurst Caribou during Summer

Parameter	[1]Summer 95% UD	[1]Summer 50% UD
Barren – Non-vegetated	0.72 ± 0.29*	-1.29 ± 0.16*
Sparsely Vegetated	0.68 ± 0.21*	1.56 ± 0.24*
Bryoids	0.41 ± 0.19*	-0.81 ± 0.09*
Tall Shrub	1.23 ± 0.12*	1.63 ± 0.17*
Low Shrub	0.87 ± 0.10*	-0.65 ± 0.08*
Prostrate Dwarf Shrub	0.77 ± 0.24*	-0.49 ± 0.14*
Wetlands	-0.25 ± 0.18	0.09 ± 0.22
Tussock Graminoid Tundra	0.85 ± 0.10*	0.54 ± 0.07*
Moist to Dry non-Tussock Graminoid Tundra	-4.25 ± 0.38*	0.72 ± 0.11*
Forested – Conifer	-0.34 ± 0.16*	-1.30 ± 0.17*
Forests – Mixed	-0.70 ± 0.36	-
RVI	0.17 ± 0.01*	0.46 ± 0.02*
Water	-0.09 ± 0.01*	-0.08 ± 0.008*
Distance to Operating Mine	-0.001 ± 0.001	-0.009 ± 0.001*
Distance to Closed Mine	-0.004 ± 0.001*	-0.018 ± 0.002*
Distance to Exploration Camp	-0.02 ± 0.001*	0.004 ± 0.001*
Wolf High Habitat	3.99 ± 0.35*	-
Wolf Moderate Habitat	-0.15 ± 0.22	-
Wolf Low Habitat	-1.74 ± 0.22*	-
Wolf Nil Habitat	-2.1 ± 0.28*	-
Bear High Habitat	-0.55 ± 0.20*	-
Bear Moderate Habitat	-1.23 ± 0.27*	-
Bear Low Habitat	1.36 ± 0.19*	-
Bear Nil Habitat	0.43 ± 0.34*	-
Intercept	1.17 ± 0.20*	-1.89 ± 0.32*

[1]: Model coefficients are the weighted average of the top two models.
** Indicates statistically significant coefficient.*

Selection coefficients for industrial activities suggest some level of influence on habitat use by caribou in both the core use area and across the entire summer range. As with the post-calving models, the magnitude of the coefficients and the distances being considered suggest that the influence of mining activities may occur at broad scales (as opposed to a "zone of influence" around a particular project, for example) and cannot be considered in isolation of other factors. Relative to the entire range, there was no difference in distances to closed mining operations (57.5 km) compared to random locations (57.2 km). Raw averages show caribou further from operating mines (95.8 km) relative to random points (91.7 km), and closer to exploration camps (138.6 km) compared to random locations (177.2 km).

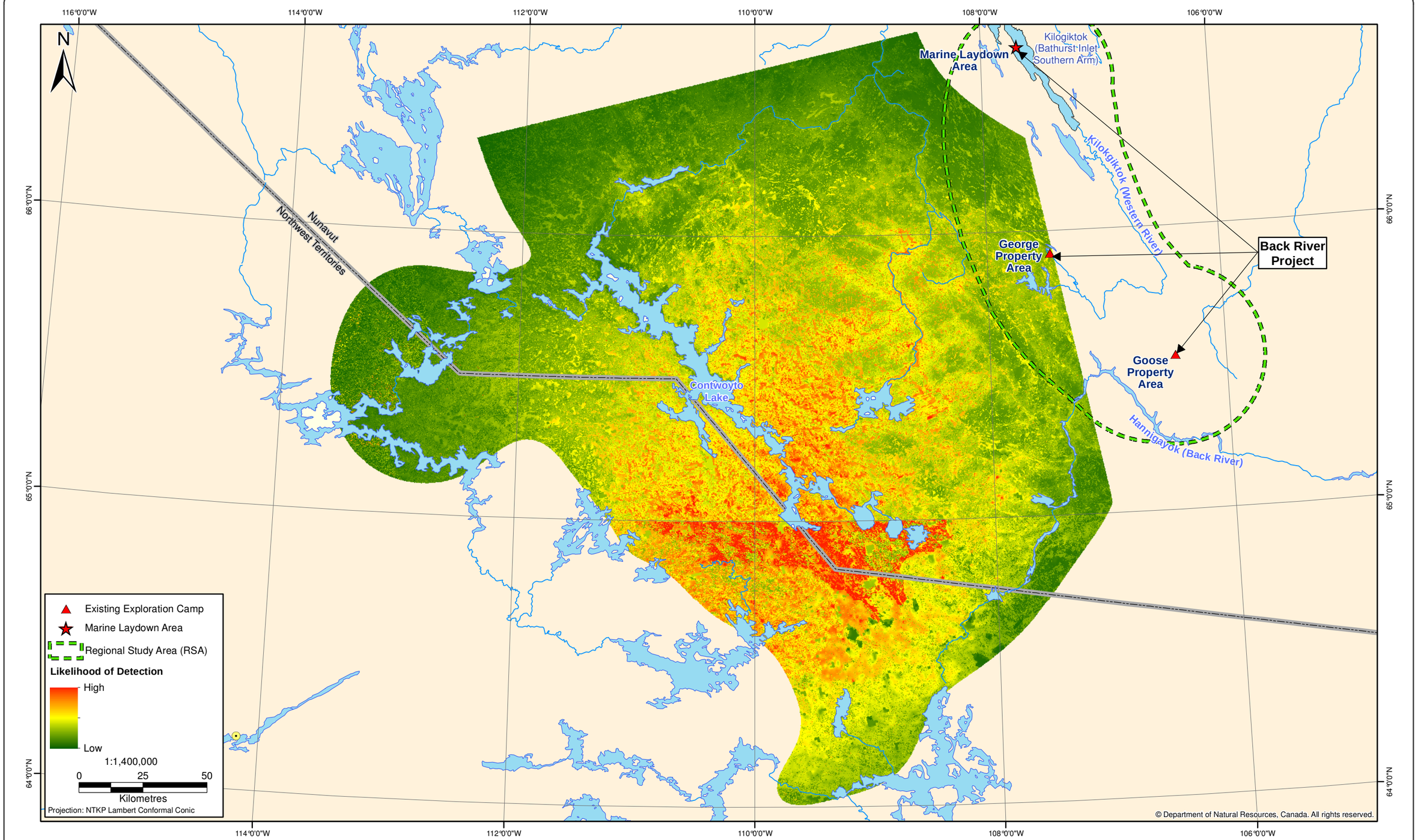

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Figure 4.1-1a

Habitat Selection Surface for Bathurst Caribou during Post-Calving, 95% Kernel

PROJECT # **0194096-0039** GIS # **BAC-23-243b**

October 28, 2013

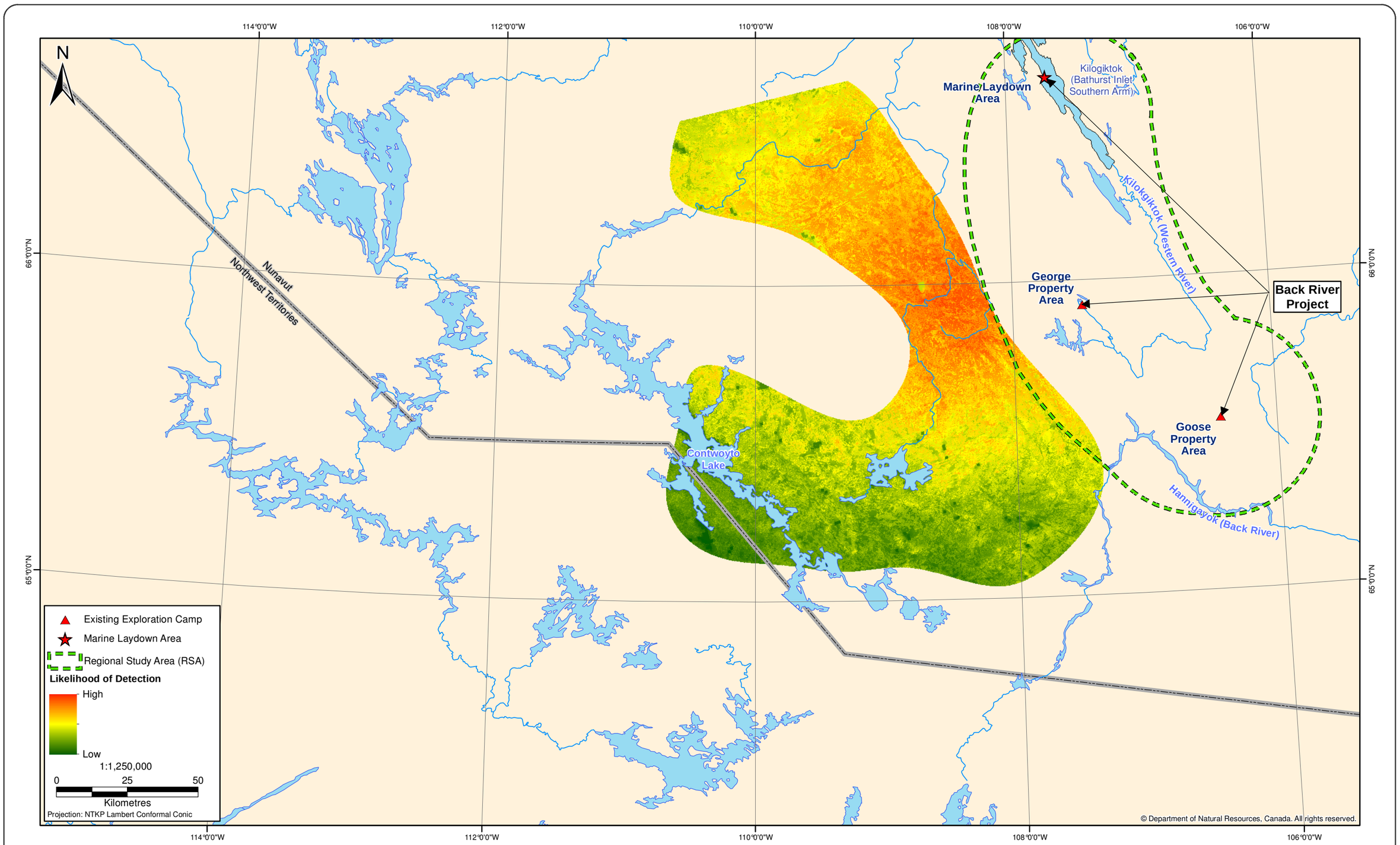

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Figure 4.1-1b

Habitat Selection Surface for Bathurst Caribou during Post-Calving, 50% Kernel

The RSF model found a response curve (an increase in the probability of detection of caribou with distance from disturbance) of approximately 50 km from operating mines during the summer, which is likely beyond the sensory limits of caribou. While the direction of selection coefficients suggest some avoidance, the size of the selection coefficients and similar mean distances from disturbance between collar and random locations suggest that the response curves may be more a function of the number of collar locations combined with a low density of developments relative to the size of the study area.

There was evidence for strong selection for high quality wolf habitat and strong avoidance of both high and moderate value grizzly bear habitats by caribou across the full summer range. Habitat quality for predators, as an indicator of predation risk, was not a component of the final model describing habitat use by caribou in the summer core use area.

The respective coefficients for the entire summer range (95% UD) and the summer core use area (50% UD) were combined to generate habitat selection surfaces that represent the relative likelihood of detecting caribou across the landscape. These maps are not interpreted in the same way as habitat suitability. Rather, they are intended to describe the anticipated distribution of caribou given the relative availability of features thought to influence caribou habitat use within the identified spatial extent. As with the post-calving selection surfaces, the 95% UD and 50% UD selection surfaces are not directly comparable. As the spatial boundary changes, so too does the suite of use points and the underlying availability of predictor variables.

As with the post-calving results, the Contwoyto Lake region continues to be an area where caribou are most likely to be detected during the summer period relative to their historic range (Figure 4.1-2a). This result is consistent with their current known summer distribution. The habitat surface for the core summer use area, the boundary for which was based on pooled historic data covering 1996-2012, illustrates a high likelihood of detection in several areas, including McKay Lakes and Lac de Gras in the southern portion, an area north of Exeter Lake and west of Contwoyto Lake, and at the west end of the Burnside River (Figure 4.1-2b).

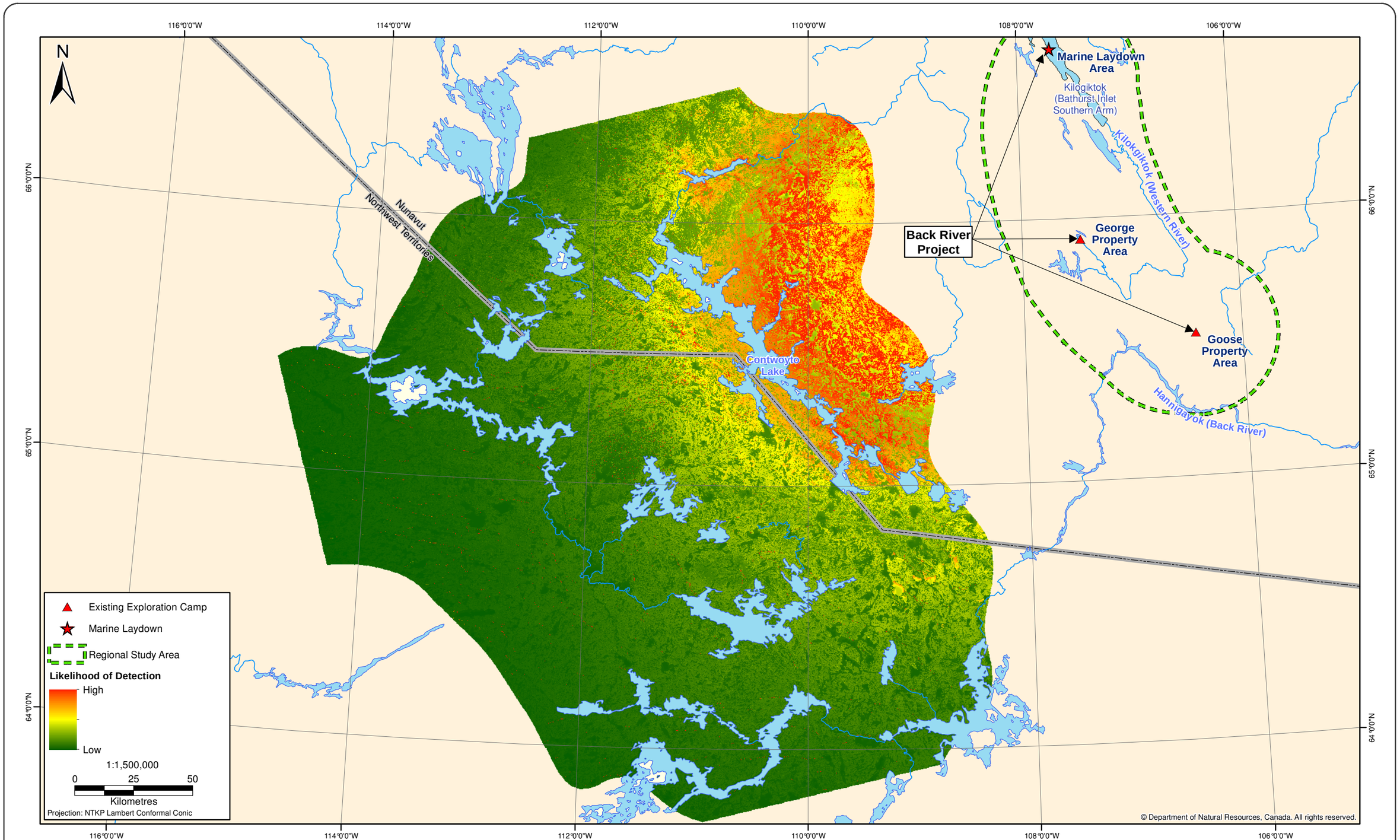

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Figure 4.1-2a

Habitat Selection Surface for Bathurst Caribou during Summer, 95% Kernel

PROJECT # **0194096-0039** GIS # **BAC-23-243d** *October 28, 2013*

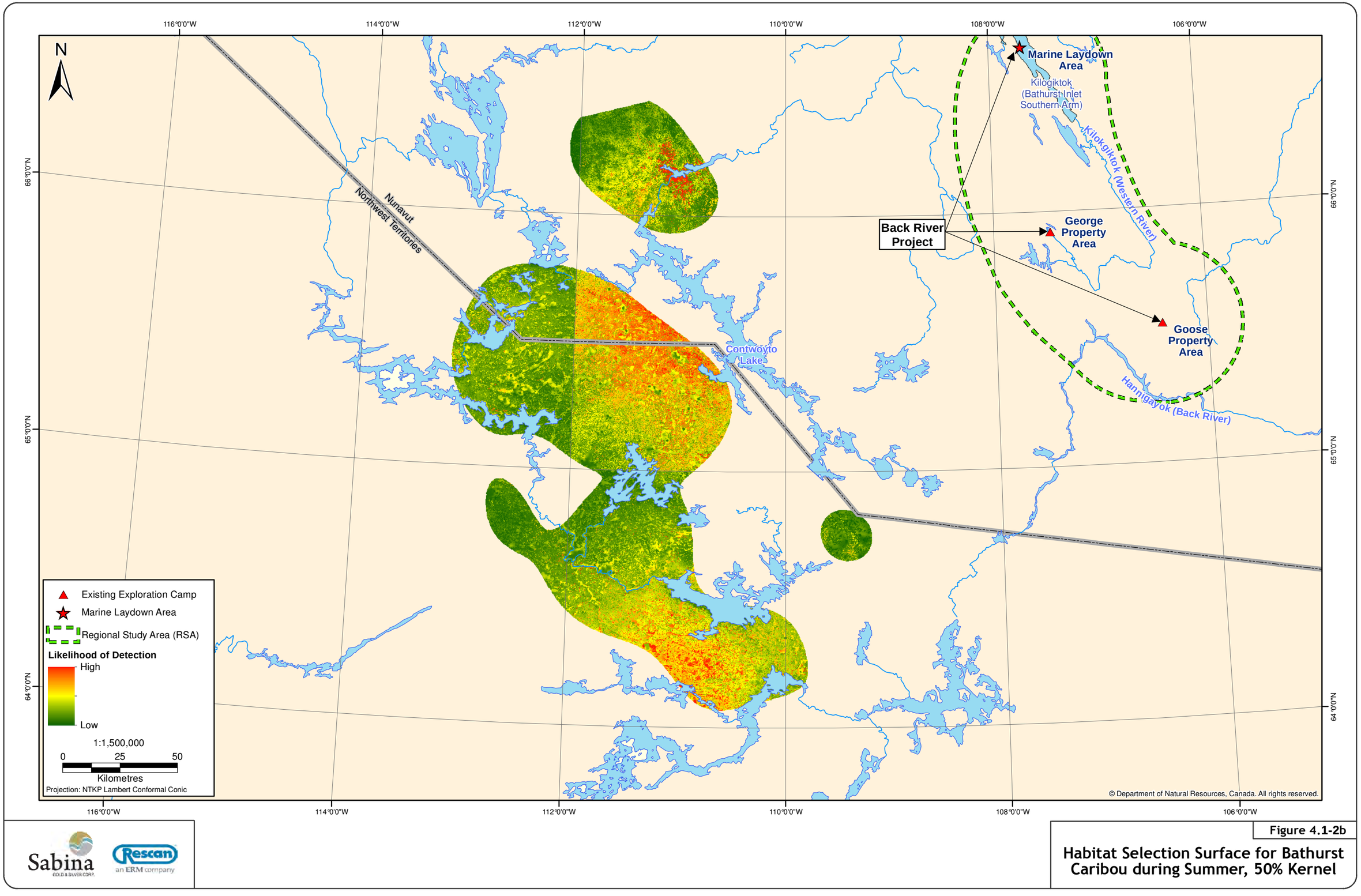

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Figure 4.1-2b

Habitat Selection Surface for Bathurst Caribou during Summer, 50% Kernel

5. Discussion

5. Discussion

The social, cultural, and economic value of barren-ground caribou to residents of Nunavut (NU) and the Northwest Territories (NWT) is immense. Across the Arctic, barren-ground caribou herds in the NWT declined between 26 and 91% from the 1990's to the late 2000's. The Bathurst herd of barren-ground caribou was one of the largest herds of migratory tundra caribou in northern Canada in the 1980's. The Bathurst herd appears to have stabilized in recent years; however, to ensure the long term sustainability of this herd (and barren-ground caribou in general) requires an understanding of the underlying mechanisms that influence movement patterns and habitat use across spatial and temporal scales. Quantifying the relative contribution of a suite of factors enables effective cumulative effects assessment that in turn provides potential management scenarios.

This model assessed habitat use and selection by the Bathurst caribou herd at a broad spatial scale during the post-calving and summer seasons to support the potential cumulative effects assessment for the DEIS (Volume 5, Chapter 5). It is one of the most recent studies of this scope on the Bathurst herd since Johnson et al. (2005), which assessed cumulative effects on caribou and their predators covering the period 1995-2000. The Back River Project is currently located outside both the 50% and 95% UD post-calving and summer range boundaries as determined from pooled GPS collar location data collected between 1996 and 2012. Although GPS locations and predictor variables were matched by year (with the exception of land cover), individual or annual variation was not examined because fidelity to the post-calving and summer ranges has been relatively consistent and predictable since 1996, unlike migration routes and winter ranges that can be highly variable (Gunn et al. 2008). Changes in land cover are likely to have occurred since the last land cover classification in the early 2000's, but those changes were assumed to be minimal relative to the size of the study areas. During the preparation of this report, the Canadian Centre for Remote Sensing was in the process of developing an updated land cover classification for Arctic Canada, which will be a useful tool to examine changes in habitat use.

During both the post-calving and summer periods, the Contwoyto Lake region was identified as an area that is heavily used by caribou based on models that included habitat, SRVI (an index of habitat productivity), distance to industrial activities, distance to water, and habitat quality ratings for predators (used as an index of predation risk). This result assumes that the current post-calving and summer distributions can be explained by pooled GPS collar data spanning 2004-2010, and that changes in land cover types are unlikely to have changed significantly since the land cover classification developed in the late 1990's. The selection surfaces are consistent with current GPS collar data as well as anecdotal evidence collected during regional monitoring programs at other mining operations (e.g., Rescan 2013).

A steep decline in the Bathurst herd in the 2000's corresponded to reduced calf survival, fecundity, and adult female survival (Boulanger et al. 2011). Chen et al. (2013a) demonstrated these patterns could at least partially be explained by broad patterns of habitat productivity on the summer range. Strong and consistent selection for high SRVI, an indicator of overall habitat productivity, supports the hypothesis that caribou require high habitat quality during the post-calving and summer periods. During these times, female caribou are nutritionally stressed, recovering from pregnancy and parturition, and requiring added resources during nursing and preparing for the upcoming winter. Focusing on areas with high quality forage will maximize opportunities to meet energy demands, and may potentially buffer years of high insect harassment. In Alaska, the condition of cows and calves of the Porcupine herd at the end of June predicts their condition during the autumn breeding season. If animals are in poor condition in fall, then pregnancy rate is reduced, age of first reproduction may be delayed, and winter mortality will increase (Russell and McNeil 2005). In northern Quebec, significant differences in body condition and subsequent demographic parameters were found between the Riviere George and Riviere aux Feuilles herds related to density-dependent habitat conditions on the respective summer ranges (Crete and Huot 1993).

Post-calving habitat use was characterized by avoidance of barren areas and selection for tall shrub and forested cover types. During summer, habitat use shifted to selection of a broad suite of cover types and avoidance of wetter and forested habitat types. During post-calving, caribou females may be seeking security cover at a time when calves may not yet be as mobile as adults. As the season progresses to the summer, nutritional requirements necessitate access to forage opportunities to recover body condition, as well as cover types that may provide some insect relief (e.g., barren or sparsely vegetated areas that may include eskers).

Johnson et al. (2005) modeled habitat selection by caribou during the post-calving period from 1995-2000. Comparable to this study, they found that the model that best explained habitat use by caribou included vegetation patch (individual cover types), vegetation density (regional distribution of cover types), major development, and mineral exploration. Predation risk was not included as a predictor variable. Their study included 190,000 km^2 of the Taiga Shield and Southern Arctic ecozones, approximately twice the size of the spatial extent used in this study. In addition, their combination of cover types differed from this study, resulting in 10 broad vegetation classes, including esker. These difference make direct comparisons difficult; however, there were some similarities. For example, Johnson et al. (2005) reported strong selection for riparian shrub patch and density, analogous to the tall shrub class used here. In contrast, they found avoidance of forested cover types. This difference is primarily due to the lower proportion of available forested cover relative to their larger study area.

One of the important results from this study is the influence of apparent predation risk on caribou habitat use across the summer range. Strong selection for high quality wolf habitat (which includes eskers for insect relief) may be counter intuitive; however, during this time, wolves are typically attending to pups at the den and may be more opportunistic in their hunting strategies (e.g., focusing on small mammals) than at other times of the year when they may follow the herd. Grizzly bears are known to frequent the calving and summer ranges of caribou (Russell and McNeil 2005), and recent DNA evidence from the Lac de Gras region in NWT and in Nunavut indicate that grizzly bear densities north of Lac de Gras (i.e., throughout the Bathurst herd summer range) may be relatively high compared to neighboring areas. Avoidance of high and moderate quality grizzly bear habitat may be a strategy used by caribou to minimize encounters.

Potential effects associated with industrial development are difficult to quantify. There is growing evidence to support the assertion that caribou respond negatively to human disturbance (sic. Johnson et al. 2005); however, the extent of potential effects is unclear because the implications to vital rates and ultimately to populations are not well understood (Wolfe et al. 2000), caribou can adjust behaviorally to accommodate some levels of disturbance (Colman et al. 2001), and disturbance responses do not always infer considerable energetic costs (Tyler 1991). This study demonstrated general apparent avoidance of industrial activities, but an examination of the raw data suggests this result may in part be due to the definition of availability. It is unlikely that caribou respond to development in a strictly linear fashion, as was defined for this study. Rather, disturbance is likely apparent out to a certain distance or threshold, beyond which sensory effects no longer apply. Johnson et al. (2005) similarly found avoidance of major developments across seasons, which included towns and large mining operations, and less equivocal results for mineral explorations. They attributed the weak relationship to the low density of developments and the poor collar coverage relative to the size of the study area. The mechanistic links to industry bears further investigation given that the current post-calving and summer ranges are centred on a relatively pristine and highly productive area encircled at some distance by operating mines and exploration activities.

It should be noted that this study cannot separate two hypotheses describing caribou distribution relative to industrial activity: 1) caribou are avoiding industrial activity on a landscape scale, or 2) caribou prefer the Contwoyto Lake and Nose Lake regions due to vegetation quantity and quality and industry is not

located in these areas. Both hypotheses have the same predictions – that caribou will be further from industrial activity than average in the study area. One of the confounding features in the data is that most camps and active mines predate the existing high quality GPS collar information, so the distribution of caribou before and after industrial activity cannot be compared.

TK indicates that the Contwoyto Lake and Nose Lake regions have been important post-calving and summer ranges for the Bathurst herd since before development and prior to the deployment of radio collars on the Bathurst herd. The RSF model, which provides a spatial surface that indicates the likelihood of detecting caribou across the landscape, indicates that these areas continue to be important to the Bathurst herd. A portion of the terrestrial wildlife RSA overlaps the eastern edge of the post-calving range, and only the George property is found at the edge of the range, which is comprised or primarily low and moderate value habitat (i.e., lower detection rates relative to the rest of the range). During summer there is no overlap by any components of the Back River Project, either in the total range or the core use area.

Other projects in the region have the potential to influence post-calving and summer habitat conditions and subsequent distribution and habitat use by caribou. Current ranges and habitat use are likely integrated over time by conditions on the landscape. The Ekati and Diavik diamond mines are the only operators in the region, and occur at the edge of very high value habitat during post-calving, and in the centre of moderate and high value habitat during summer, but falls outside the core use areas during both seasons. Amongst potential future developments, the neighboring proposed Hackett River project is found within both the post-calving range and the post-calving core use area, but not in the summer range or core use area. The Courageous Lake property does not occur in the post-calving range or core use area. Both the Courageous Lake and Izok properties are located in low to moderate value habitat relative to the entire summer range, and only Izok is located in moderate valued core summer habitat (relative to the rest of the core use area).

Caribou populations fluctuate on decadal cycles (Gunn et al. 2008), and the Bathurst herd appears to have stabilized at their current low levels. The causes of population variation in Arctic ungulate populations are complex (Joly et al. 2011), which can confound cumulative effects assessment. Population trajectories are thought to respond to summer range condition (Chen et al. 2013a), winter range condition (Parker et al. 2005), predation rates (Bergerud 1980), snow conditions (Dau 2005), human activity (Vors and Boyce 2009), disease, parasites, and insect harassment (Hughes et al. 2009), stochastic events (Hummel and Ray 2008), density-dependent factors (Couturier et al. 2009), and density independent factors (Vors and Boyce 2009). Climate is thought to be the primary driver that can influence all of these factors, but the influence of climate will not impact caribou populations uniformly (Joly et al. 2011).

Changes in the distributions of the Bathurst herd were found in response to climate change variables (McNeil et al. 2005). For the Bathurst herd, the summers have become slightly warmer and wetter (Zhang et al. 2000). With an increase in temperate and precipitation, insect harassment on caribou is expected to increase. As a consequence, McNeil et al. (2005) speculated that more Bathurst caribou would be exposed to mining developments, such as the Ekati-Diavik mining zone, for possible insect relief, which may require additional monitoring and mitigation measures by mining operations. Large scale climate oscillations, such as the Arctic Oscillation (AO) and the Pacific Decadal Oscillation (PDO), have been linked to population trends of caribou herds in Arctic Alaska through corresponding effects on several important aspects of caribou ecology, including snow depth, icing, predation rates, and forage quantity and quality during both summer and winter (Jolly et al. 2011). The AO and PDO can also affect the frequency of wildfires (Duffy et al. 2005), the summer growing conditions of winter forage (e.g. lichen) (Joly et al. 2007), and the levels of insect harassment and infestations of parasitic flies (Callaghan et al. 2004).

6. Conclusions

6. Conclusions

Estimating resource selection patterns for a herd can reveal what habitat features are selected or avoided on the landscape. RSFs are a valuable tool for identifying important areas for a population so that the quantity and distribution of those areas across a population's range can be assessed (Wilson et al. 2012). Results from RSFs can then be used to help predict and minimize potential negative effects to caribou habitat from development, especially during periods of enhanced sensitivity to human activity associated with development (Cameron et al. 2005). If RSF-based studies are conducted, it is important that they be estimated before development begins because patterns of resource selection can be altered in the presence of infrastructure (Harju et al. 2011). Estimates obtained prior to development can be used to assess how patterns change once development exists (Wilson et al. 2012).

This study demonstrated that several large scale processes may be interacting to influence the post calving and summer distributions of Bathurst caribou, and that the Contwoyto Lake region may be particularly important to the long-term persistence of the herd. This study expanded on earlier work by Johnson et al. (2005) to include more recent information, and differed from that study by examining habitat use within seasonal ranges specific to the Bathurst herd as defined by their GPS collar locations. The methods and results presented here provide a meaningful contribution to understanding the dynamics of the Bathurst herd at broad spatial scales. The information was used to support the Bathurst herd cumulative effects assessment in the DEIS (Volume 5, Chapter 5).

Access to high quality forage at a time when cows are nutritionally stressed appears to be one of the most important components to the sustainability of Bathurst caribou. Consistent selection for habitat productivity by Bathurst caribou, as indexed by the Simple Ratio Vegetation Index (SRVI), during post calving and summer supports this conclusion. Selection and avoidance of different habitat types by season and range extent suggests shifts in habitat use patterns in response to nutritional and security requirements. The distribution of high quality forage and subsequent habitat use by caribou can be moderated by predation, hunting, industrial activities, and climate. The weak avoidance of industrial activities at broad spatial scales may be a function of available collar data and the low density of industrial activity relative to the size of the seasonal range. Nevertheless, whether the distribution of caribou around the Contwoyto Lake region is a function of pre-existing preference for high quality forage in the area relative to other areas, or whether the distribution is the result of increasing human activity cannot currently be distinguished with these data, although Inuit TK suggests that Contwoyto and Nose Lakes have long been important for the herd.

It has been suggested that habitat productivity and climate change may ultimately be the most important components that drive caribou distribution and habitat use in the Arctic (Joly et al. 2011). Habitat productivity has recently been linked to changes in demographic indicators at the population level (Chen et al. 2013a). Under the current distribution of existing and proposed developments, potential effects to habitat conditions on the post-calving and summer ranges are expected to be minimal provided that the integrity of the Contwoyto Lake and Nose Lake region is maintained, and that movements along the Burnside, Mara, and Hackett River corridors are not impeded.

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Appendix V5-5C

Back River Project: Wildlife Baseline Report 2012

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BACK RIVER PROJECT
Wildlife Baseline Report 2012

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BACK RIVER PROJECT
WILDLIFE BASELINE REPORT 2012

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Prepared for:

Sabina Gold & Silver Corp.

Prepared by:

Rescan Environmental Services Ltd., an ERM company
Vancouver, British Columbia

Executive Summary

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Executive Summary

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut. For 2012, Sabina contracted Rescan Environmental Services (Rescan) to conduct a comprehensive baseline program that covered the geographical area of the Goose Property, the George Property, and a Marine Laydown Area located on the southern part of Bathurst Inlet.

This report presents the results of the wildlife baseline portion of the 2012 baseline program, which included both terrestrial and marine wildlife. The objective of the 2012 Wildlife Baseline Program was to characterize the avian and mammal communities within various study areas around the Goose and George Properties as well as the Marine Laydown Area. Field surveys in 2012 focused on raptors, upland breeding birds, waterbirds, marine birds, marine mammals, carnivores and their denning habitat, caribou, and incidental observations of ungulates (muskox and moose). Surveys for individual species groups were conducted within Field inventories were also conducted to collect hair samples from wolverine and grizzly bear as part of a DNA-based population assessment and are presented in a separate report (Rescan 2013a).

Surveys were conducted in two study areas, a terrestrial Regional Study Area (RSA) that included the marine laydown area and both Goose and George properties and a 35 km buffer surrounding them, and a Marine Regional Study Area (MRSA) that included the marine laydown area and the majority of Bathurst Inlet. Depending on the density and mobility of the species being investigated, surveys occurred either through the RSA or MRSA or within smaller surveys blocks within the RSA or MRSA.

A total of 52 bird species, two marine mammals, and eight terrestrial mammals were confirmed to occur within the wildlife RSA. Of these species, 18 birds are identified as species of conservation concern at the territorial or federal level (golden eagle, gyrfalcon, rough-legged hawk, peregrine falcon, short-eared owl, American golden-plover, American pipit, American tree sparrow, Harris' sparrow, hoary redpoll, least sandpiper, red-necked phalarope, semipalmated sandpiper, white-crowned sparrow, long-tailed duck, Arctic tern, glaucous gull, and common eider) and two mammals (grizzly bear and Dolphin Union caribou). In addition, ringed seals are high priority, and bearded seals are medium priority candidates on the Species Specialist Subcommittees' (SSC) candidate list and the COSEWIC candidate list for reassessment in fall of 2013 (COSEWIC 2012).

Surveys for cliff-nesting raptors were conducted in the RSA in May and July 2012 to locate active nest sites, and to measure occupancy and productivity rates. Eight raptor species and the common raven were detected either during the surveys or incidentally (golden eagle, gyrfalcon, peregrine falcon, rough-legged hawk, bald eagle, northern harrier, snowy owl, and short-eared owl). In total, 67 nest sites were surveyed, 40 of which were occupied by breeding raptors. The overall occupancy rate of nest sites surveyed in May, 2012, was 60%. Breeding performance measured as the proportion of nest sites occupied in spring at which pairs were brooding young in July ranged between 20% and 38% for the golden eagle, rough-legged hawk, and peregrine falcon. Mean brood size for peregrine falcons was three young (± 0.32 (SE), n = 5 nests, range 2-4). One golden eagle nest contained two young, one gyrfalcon nest contained three young, and one rough-legged hawk nest contained one young, and the other contained two young.

Upland breeding bird surveys were conducted in June, 2012, in each Focused Bird Survey Area and Reference Bird Survey Area surrounding the Goose and George properties as well as in the 2012 Focused

Marine Survey Area (FMSA) adjacent to Bathurst Inlet to characterize the abundance, distribution, habitat associations, and breeding productivity of upland breeding birds. A total of 20 species were detected either during these surveys or observed incidentally during other baseline environmental studies. Overall, species richness and relative abundance was higher in lowland habitat relative to upland habitat. The FMSA at Bathurst Inlet supported a richer and more abundant community of upland breeding birds, particularly of species of conservation concern, compared to the other study areas, while lowland habitat in the George Lake reference bird survey area had lower species richness, and supported fewer territories of upland breeding birds compared to the other study areas. The majority of upland breeding bird females had initiated incubation by the second week of June in 2012. Breeding was observed for six species (American golden plover, horned lark, Lapland longspur, least sandpiper, redpoll spp. and savannah sparrow); average breeding productivity for these species was 4.42 ± 0.20 eggs per nest.

Four waterbird surveys were conducted in each focused bird survey area and reference bird survey area surrounding the Goose and George properties as well as two marine surveys conducted in the FMSA to document species presence, distribution, and habitat use of waterbirds during staging and breeding periods. Overall, 19 waterbird species were observed during these surveys and four additional species were observed incidentally during other baseline studies. Overall abundance of waterbirds was lowest during the spring staging survey and increased during each subsequent survey with the highest abundance of waterbirds occurring during the fall staging survey. Spring staging habitat for geese occurred in the Goose focused bird survey area and the reference bird survey area, but primarily in large lakes in the Goose reference bird survey area. Groups of eiders were observed within the Focused Marine Survey Area (FMSA) and Marine Regional Survey Area (MRSA) during spring staging. In the fall, staging habitat for geese, as well as a number of duck species, was documented throughout all study areas. During the breeding surveys, the majority of breeding pairs observed were of long-tailed duck, and occurred on medium sized lakes in both the Goose focused and reference bird survey areas. However, direct evidence of breeding (eggs or chicks) were only documented for Canada geese during the brood survey and documented incidentally for sandhill crane in both the Goose focused and reference bird survey areas.

Marine mammal surveys were conducted in the MRSA to document the presence and abundance of marine mammals, to determine the spatial use of ice habitat during the spring moulting period, and to identify potentially important habitat for marine mammals using the FMSA and the MRSA. A total of 284 ringed seals and nine bearded seals were recorded in the MRSA during these surveys. The density of ringed seals in the MRSA using seal count data was estimated to be 2.05 seals/km^2. The density of seals in the FMSA was lower than that in the MRSA, however, densities of ringed seals were correlated to ice conditions with highest densities occurring in areas with less advanced melt (such as in the MRSA) relative to areas with more advanced ice melt (e.g., in the FMSA). Of the ringed seals observed during the survey, seventeen were identified as pups, indicating that there may be potential for ringed seals to build lairs and raise pups within the MRSA. Bearded seals were most often associated with cracked ice and ice with melt water in areas that were fairly shallow (< 150 m).

Carnivore den surveys were conducted to identify the number and distribution of existing dens within the RSA, to identify dens that are active, and to identify predominant resident carnivore species utilizing the RSA. A total of 16 dens belonging to five species including grizzly bear, wolf, Arctic fox, red fox, and wolverine were documented in the RSA during these surveys and incidentally during other baseline studies. Dens were mainly distributed in the northwest portion of the RSA near large lakes and eskers. Half of the dens observed were located within 2 km of proposed Project infrastructure. Seven dens were confirmed as active, four were considered inactive, and five had unknown activity status. Active dens were observed along eskers or glacial-fluvial benches and were south or northeast facing. One active red fox den was confirmed to be productive, as two kits were observed at the den site, and three additional wolf and fox dens were likely productive in 2012 as recent prey remains were found near the den sites.

The distribution of the Beverly, Bathurst, and Dolphin and Union caribou herds near the Project was assessed through an analysis of collared caribou data, the use of remote digital cameras, and incidental observations during other field surveys. Note that the naming convention for the Beverly caribou is equivocal, with researchers proposing that the Ahiak and Beverly herds have merged and should be referred to as the Beverly herd. This document uses this naming convention. Collar data suggests that Beverly caribou are most commonly present around the Goose Property in the summer (mid-July to the end of August) and Bathurst caribou are most commonly present during the post-calving period (mid-June to mid-July) around the George Property. Desk based literature review suggests that Dolphin and Union caribou may be present predominantly around the Marine Laydown Area in the winter.

Fixed kernel utilization distributions (UDs) for collared Bathurst and Beverly caribou indicated that both the Bathurst and Beverly herds use habitat within the RSA on an annual basis. Bathurst caribou were consistently present in the western edge of the RSA during the post-calving period (June 16 to July 20), around the George Property, but west of the FMSA and Goose Property. Annual movement paths for collared caribou showed that Bathurst caribou infrequently migrated through the western edge of the RSA during the spring (May) on their way to their calving grounds located north-west of the RSA. Seasonal ranges (as defined by the 95% kernel UDs) for Beverly caribou overlap with the RSA in all seasons except during post-calving. Most notably, collared Beverly caribou were consistently present within the RSA around both the Goose and George properties during the summer (July 16 to August 31). Collared Beverly caribou passed through the eastern edge of the RSA on their way to the calving grounds located north-east of the RSA during spring migration (May).

Sixty remote digital cameras were set out between May and August, 2012 (30 in the RSA and 30 west of the RSA) in the Combined Camera Study Area to non-invasively monitor the seasonal movement of caribou in the RSA, and west of the RSA, and to detect core habitat use by caribou. A total of 2,573 caribou were detected by remote camera within the Combined Camera Study Area during spring and summer of 2012. Eight large groups (> 100 individuals) of caribou were observed by remote camera during the caribou post-calving and summer life history phases (June through August); six groups west of the RSA in late June and early July, and two groups in the RSA in late July and August. The highest number of caribou detected by remote cameras in the RSA was in July (N > 200) and August (N > 200), coinciding with post-calving and summer life history phases, respectively. Moderate sized groups of caribou (50 – 100 individuals) were also observed west of the RSA. Caribou were most commonly recorded within freshwater/riparian habitat followed by tundra habitat, with lowest detection rates of caribou in esker habitat. Detection of caribou by remote cameras at proposed Project infrastructure sites was lower relative to other sites within the RSA.

Incidental observations of muskox and moose were documented during wildlife field inventories in 2012. A total of 117 individuals (114 muskox and three moose) were observed incidentally, some of which may be the same individuals. The timing of incidental observations coincides with the wildlife baseline field surveys, which were most often conducted in the spring and the summer, thus, the number of observations collected during those seasons is reflective of surveyor effort and not seasonal abundance. Muskox were detected throughout the RSA 10 times, while moose were observed on two occasions near the Western River south of the FMSA. Two muskox and muskox tracks were observed in late winter (April) west of the Goose Property and may indicate that muskox potentially use these areas throughout the year.

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WILDLIFE BASELINE REPORT 2012

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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

Avian	Of, relating to, or characteristic of birds
CESCC	Canadian Endangered Species Conservation Council
COSEWIC	Committee on the Status of Endangered Wildlife in Canada - A federal committee of experts that assesses and designates the level of threat to wildlife and vegetation species in Canada
DFO	Department of Fisheries and Oceans, Canada
Ecosystem (terrestrial)	A volume of earth-space that is composed of non-living parts (climate, geologic materials, groundwater, and soils) and living or biotic parts, which are all constantly in a state of motion, transformation, and development. No size or scale is inferred.
FMSA	Focused Marine Survey Area
GIS	Geographical Information System
Glacial-fluvial	Sediments deposited by glacial meltwater that form stratified layers of sand, gravel, and fines
GN DOE	Government of Nunavut Department of Environment
GPS	Global Positioning System
Habitat	Land and water surface used by wildlife. This may include biotic and abiotic aspects such as vegetation, exposed bedrock, water and topography.
Hectare (ha)	10,000 m^2 or 0.01 km^2 or 2.47 acres
IUCN	International Union for Conservation of Nature
Migration	The regular seasonal or daily movement of animal populations to and from different areas, often considerable distances apart. Migration often occurs in corridors between preferred habitat types
***Migratory Birds Convention Act* (1994b)**	A federal government commitment established in 1917 to protect most migrating birds found in Canada. The Act fulfilled the terms of the Migratory Birds Convention of 1916 between Canada and the US. The Canadian government has the authority to pass and enforce regulations to protect those species of migratory birds that are included in the Convention
MRSA	Marine Regional Survey Area
NLCA	Nunavut Land Claims Agreement
NPC	Nunavut Planning Commission
NWMB	Nunavut Wildlife Management Board
NWT	Northwest Territories

PRISM	Program for Regional and International Shorebird Monitoring
RA	Reference Area
RSA	Regional Study Area
SARA	*Species at Risk Act* (2002a) - A Canadian federal statute which is designed to meet one of Canada's commitments under the International Convention on Biological Diversity. The goal of the Act is to protect endangered or threatened organisms and their habitats. It also manages species which are not yet threatened, but whose existence or habitat is in jeopardy.
Slave Geological Province	A geological formation extending from Great Slave Lake to the Coronation Gulf, which lies between Victoria Island and mainland Nunavut
Standard Deviation (SD)	A statistical measure of the spread or variability of a set of data
Standard Error (SE)	A statistical measure of the spread or variability of a set of data
Topography	The configuration of a surface, including its relief and the position of its natural and person-made features
UD	Utilization distribution
Universal Transverse Mercator (UTM)	A mapping system where the standard unit of measure is the metre
Waterbird	Umbrella term used to encompass all birds that exclusively use water habitat for foraging, breeding, or staging during the year
Wetland	Sites dominated by hydrophytic vegetation where soils are water-saturated for a sufficient length of time such that excess water and resulting low soil oxygen levels are principal determinants of vegetation and soil development (MacKenzie and Moran 2004)

1. Introduction

1. Introduction

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut. Exploration programs were run out of both the Goose and George camps in 2012 (Figure 1-1).

For 2012, Sabina contracted Rescan Environmental Services (Rescan) to conduct a comprehensive baseline program that covered the geographical area of the Goose Property, the George Property, and a Marine Laydown Area located on the southern part of Bathurst Inlet. The following components were included in the 2012 baseline program:

- Meteorology;
- Air Quality and Dust;
- Noise;
- Hydrology and Bathymetry;
- Freshwater Water Quality, Sediment Quality, Aquatic Biology;
- Freshwater Fish and Fish Habitat;
- Marine Water Quality, Sediment Quality, Aquatic Biology;
- Marine Fish and Fish Habitat;
- Wildlife (Terrestrial and Marine);
- Wildlife DNA Study (Grizzly Bear and Wolverine);
- Ecosystem Mapping;
- Vegetation and Wetlands (including Rare Plants);
- Soils and Terrain;
- Country Foods;
- Archaeology;
- Socio-Economics;
- Land Use; and
- Metal Leaching/Acid Rock Drainage (ML/ARD).

The 2012 baseline program was designed around potential infrastructure and known deposits at the Goose Property, the George Property, and the Marine Laydown Area. It was assumed that access from the Marine Laydown Area to George and Goose properties would be by winter road, and that access between the George and Goose properties would also be by winter road.

This report presents the results from the Wildlife (Terrestrial and Marine) portion of the 2012 baseline program. A number of desk-based and field inventory studies were undertaken to collect baseline data on wildlife within the Project area. These studies included a literature review for existing relevant information on wildlife and wildlife habitats within the area and a desk-based evaluation of the potential presence of species at risk (according to the federal Species at Risk Act). Field studies focused on raptors, upland breeding birds, waterbirds, marine mammals, carnivores and their dens, and caribou monitoring using remote digital cameras in the area around the Goose and George properties, and the marine and terrestrial areas near the potential laydown areas at Bathurst Inlet.

LEGEND:
- Gold Deposit
- Base Metal Deposit
- Diamond Deposit
- Operating Mine
- Proposed BIPR Port

Figure 1-1

Back River Project Location

Sabina GOLD & SILVER CORP.

Rescan™ Engineers & Scientists

2. Background Information

2. Background Information

2.1 APPLICABLE LEGISLATION

Wildlife and wildlife habitat are protected by both federal and territorial legislation, including the Nunavut *Wildlife Act* (Ha et al. 2003), Nunavut *Land Claims Agreement Act* (1993a), Canadian *Wildlife Act* (1994a), the Canada *Migratory Birds Convention Act* (1994b), and the Canada *Species at Risk Act* (SARA; 2002b; Table 2.1-1).

Table 2.1-1. Relevant Acts or Regulations for Wildlife and Wildlife Habitat

Act or Regulation	Implications for Management
Nunavut *Wildlife Act* (2003; Ha et al. 2003)	• Identifies and defines wildlife management strategies for Nunavut, including strategies for conservation, protection and recovery of species at risk, managing nuisance wildlife, and possession of wildlife. The Act provides interpretation of approved and restricted hunting and related activities, including the possession of wildlife and enforcement that will follow should any of the Act's issued sections and corresponding regulations be contravened. • Pertaining NU *Wildlife Act* Regulations are as follows: Birds of Prey Regulations, Wildlife General Regulations, and Wildlife Licenses and Permits Regulations.
Nunavut *Land Claims Agreement Act* (1993a)	• Legislation that enforces the Nunavut Land Claims Agreement (NLCA; 1993b). The Nunavut Wildlife Management Board (NWMB) is established under the NLCA with the responsibility to manage wildlife and wildlife habitat in conjunction with the Government of Nunavut Department of Environment (GN DOE). • Within Section 5.2.34 of the NLCA, additional responsibilities for the NWMB are outlined, including the approval of conservation areas, wildlife management zones, wildlife management strategies, species at risk recovery plans, and designation of species of conservation concern and disseminate wildlife management information to appropriate government bodies.
Canada *Wildlife Act* (1994a)	• Identifies and defines wildlife management strategies for Canada, including strategies for managing nuisance wildlife and possession of wildlife. It provides interpretation of approved and restricted hunting and related activities including the possession of wildlife and enforcement that will follow should any of the Acts issued sections and corresponding regulations be contravened.
Canada *Migratory Birds Convention Act* (1994b)	• Prohibits the taking or killing of migratory birds, their nests, and eggs, and the deposition of harmful substances in areas frequented by migratory birds. • Species protected include waterfowl, cranes, rails and coots, shorebirds including gulls and terns, pigeons and doves, insectivorous songbirds (excluding blackbirds), seabirds, loons, grebes, herons, egrets, and bitterns.
Canada *Species at Risk Act* (2002b)	• Protects wildlife on federal lands as well as the critical habitat of those species listed on the "List of Wildlife Species at Risk," and protects all SARA-listed migratory birds. • Section 137 amends the *Canadian Environmental Assessment Act* (1992) to clarify, for greater certainty, that environmental assessments must always consider effects to listed wildlife species, their critical habitat, or the residences of individuals of that species. • Section 79(2) states "the person must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plans."

(continued)

Table 2.1-1. Relevant Acts or Regulations for Wildlife and Wildlife Habitat (completed)

Act or Regulation	Implications for Management
Canada Wild Animal and Plant Protection and Regulation (1992c)	• Prohibits the import, export, and interprovincial transportation of species on the "Convention on International Trade in Endangered Species of Wild Fauna and Flora" control list; foreign species whose capture, possession, and export are prohibited or regulated by laws in their country of origin, Canadian species whose capture, possession, and transportation are regulated by provincial or territorial laws; and species whose introduction into Canadian ecosystems could endanger Canadian species.

2.2 PAST ENVIRONMENTAL STUDIES IN THE PROJECT AREA

Over the past decade, several environmental studies have been conducted within and surrounding the Back River Project area. Wildlife studies, including surveys for ungulates, carnivore dens, small mammals, raptors, and waterbirds, were conducted along the proposed road alignment between Contwoyto Lake and Bathurst Inlet and within Bathurst Inlet for the Bathurst Inlet Port and Road (BIPR) Project in 2001 and 2002 (Rescan 2007a). Additional surveys for ungulates and upland breeding birds were conducted in 2007 for the BIPR project (Rescan 2007b, 2007c). Three years of wildlife studies were conducted in the Hackett River area approximately 100 km to the west of the Back River Property, including surveys for ungulates, carnivores dens, small mammals, raptors, waterbirds, and upland breeding birds in 2007 and 2008 and ungulate surveys in 2010 (Rescan 2008a, 2008b, 2011). Wildlife baseline studies were conducted in 2007 directly within and surrounding the Back River Project area, and included surveys for ungulates, carnivores dens, raptors, and upland breeding birds (Gartner Lee Ltd. 2008). Where feasible, the results of these studies are integrated into the current report.

There is a data sharing agreement between the Back River Project (Sabina) and the Hackett River Project (Xstrata) through which all the data collected for the grizzly bear and caribou baseline studies will be jointly shared in order to supplement each project's baseline reporting.

3. Study Areas

3. Study Areas

There are several wildlife study areas within the terrestrial environment (Figure 3-1) and the marine environment (Figure 3-2) that were developed to direct wildlife baseline studies for the Back River Project in 2012.

In the terrestrial environment, the Goose Property and George Property each have a focused bird survey area measuring 16 km by 16 km (256 km^2) which are roughly centered over the Goose and George properties, and a reference bird survey area, also measuring 16 km by 16 km placed adjacent to each focused bird survey area (Figure 3-1). These study areas facilitate the future comparison of potential effects on wildlife. Upland breeding bird and waterbird surveys were conducted in the Goose and George focused bird survey areas and reference bird survey areas. In addition to these four study areas, a Regional Study Area (RSA), encompassed the terrestrial area surrounding the Goose and George properties and the proposed Marine Laydown Area (Figure 3-1). The RSA, extends 35 km from the Goose and George properties, the Marine Laydown Area, and the potential winter road, and was designed to reflect a larger area anticipated to provide habitat for raptors and carnivores and caribou, which have larger home ranges. Raptor nest and carnivore den surveys were conducted within the RSA. The Combined Camera Study Area encompasses an area larger than the regional study area and was bordered by the Western River to the east of the Project and from Contwoyto Lake and Burnside River to the west of the Project. The north and south boundaries of the Combined Camera Study Area include the Back River at the south-east corner and Lake Contwoyto at the southwest corner (delineating the southern border), and the Burnside River and the tip of the peninsula where the proposed Marine Laydown Area is located at the northern border.

In the marine environment, two additional study areas were designated including the Bathurst Inlet Focused Marine Survey Area (FMSA), which encompasses the proposed Marine Laydown Area, and the Marine Regional Survey Area (MRSA) which extends from the bottom of Bathurst Inlet to approximately 15 km north to Omingmaktok and is approximately 75 km in width (Figure 3-2). Within the FMSA were two potential marine lay down areas that were included in the 2012 program – Option 4 and Option 6 (Figure 3-2). Waterbird and marine bird surveys were conducted in the FMSA and marine mammal surveys were conducted within the MRSA and FMSA.

The wildlife study areas are all located within the Southern Arctic Ecozone. Ecozones are broad scale landscape units with similar abiotic and biotic factors including climate, geography, and vegetation (Strong and Zoltai 1989; Environment Canada 2000). The Southern Arctic Ecozone extends across much of the southern portion of continental Nunavut, and is bordered by the Northern Arctic Ecozone to the north. The southern border of the Southern Arctic Ecozone is defined by a lack of full-size trees. Stunted forms of tree species, such as dwarf birch (*Betula nana*), green alder (*Alnus viridis* spp. *crispa*), and many species of willow (*Salix* sp.) grow throughout the ecozone, with stunted white (*Picea glauca)* and black spruce (*P. mariana)* present more towards the south. Much of the area is dominated by sedge fens, cottongrass tussock tundra, and heath. Sparsely vegetated areas, such as the wind-swept crests of eskers, are also common (NRC 2007).

PROJECT # 833-002-05 GIS # BAC-23-080 March 18, 2013

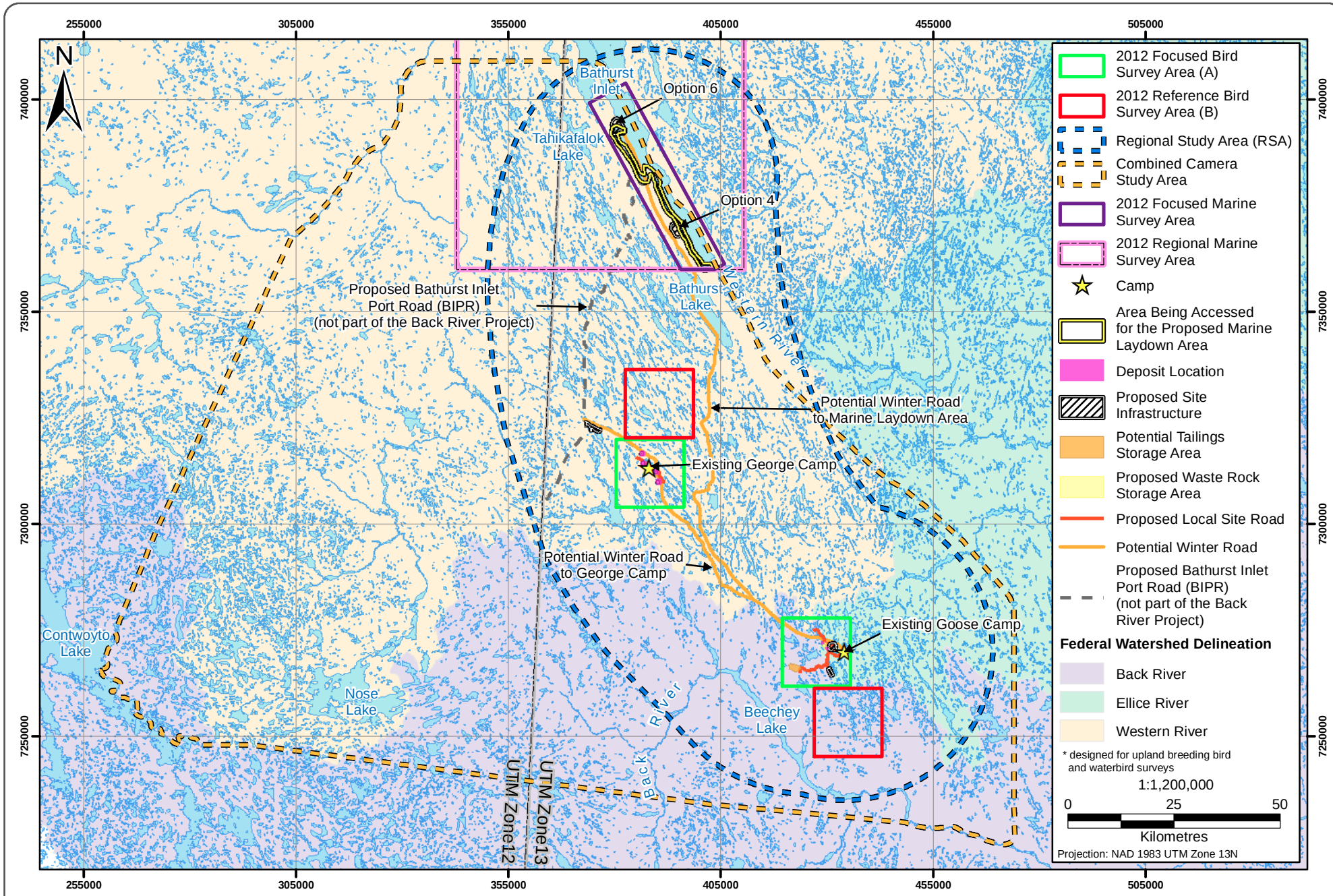


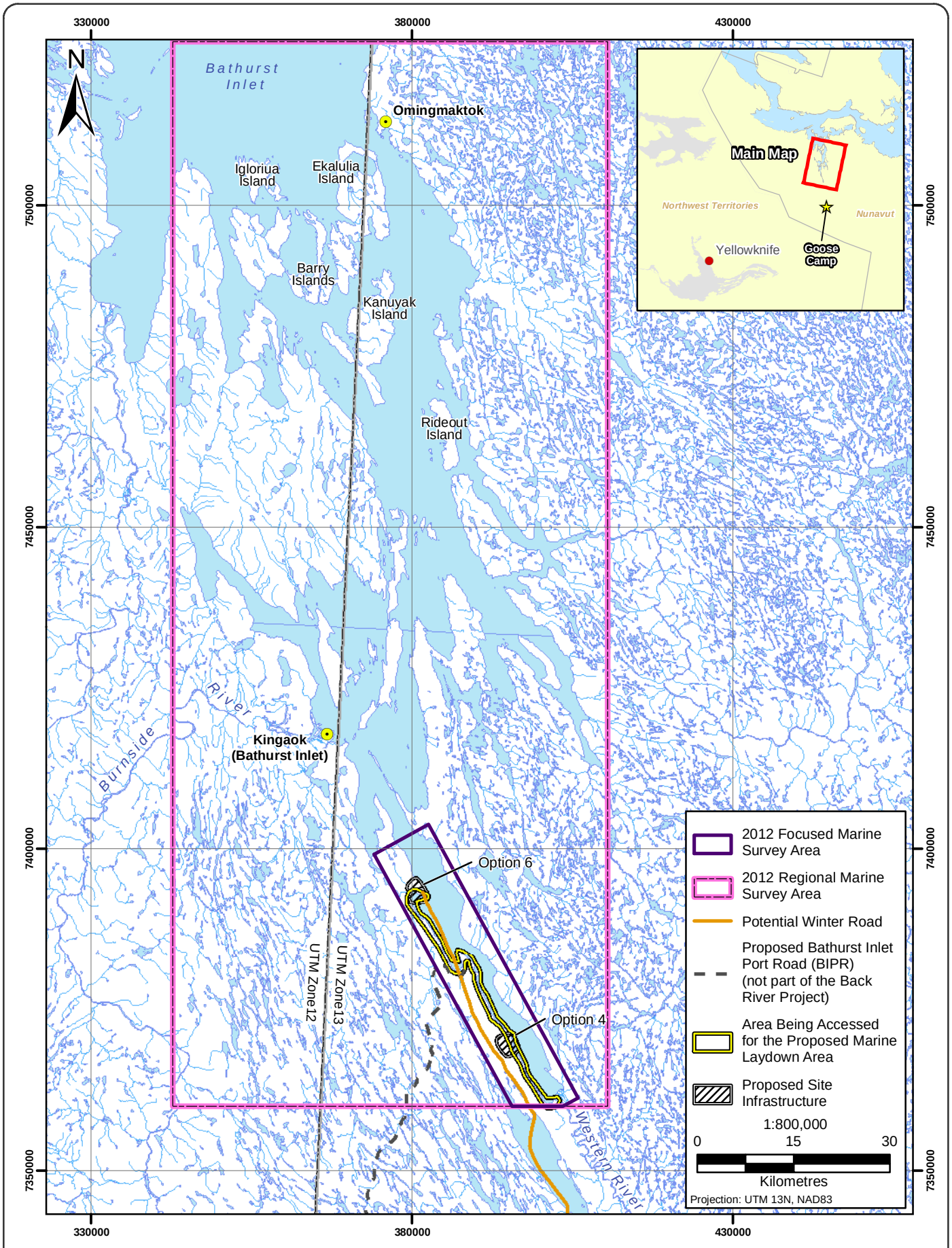
Figure 3-1

Sabina GOLD & SILVER CORP

Wildlife Terrestrial Baseline Study Areas, Back River Project, 2012

Figure 3-1

Rescan™ Engineers & Scientists



Sabina Gold & Silver Corp.

Wildlife Marine Baseline Study Areas, Back River Project, 2012

Figure 3-2

Rescan Engineers & Scientists

4. Species of Conservation Concern

4. Species of Conservation Concern

A desk-based literature and database search was conducted to develop a list of wildlife species of conservation concern that potentially occur within the RSA and MRSA. The likelihood of occurrence was based on distribution and habitat requirements according to multiple sources (Sibley 2000; National Geographic Society 2002; Alderfer 2006; F. A. Reid 2006; Richards and White 2008; NatureServe 2011a). The likelihood of occurrence was placed into three categories of each potentially occurring species: likely, possible, and unlikely (Table 4-1).

Table 4-1. Criteria for Assessing the Likelihood of Occurrence in the Wildlife Study Areas

Category	Definition and Criteria for Assessment[1]
Likely (L)	Species that are likely to occur. Species in this category have overlapping seasonal ranges with the RSA and/or MSA, are known to occur in the Southern Arctic Ecozone, and seasonal habitat requirements are met within the RSA and/or MRSA.
Possible (P)	Species that possibly occur. Species in this category may or may not have overlapping seasonal ranges with the RSA and/or MRSA, seasonal habitat requirements may or may not be met within the either study area, but have been detected in Southern Arctic Ecozone or within two ecozones to the north of the in Southern Arctic Ecozone (Northern Arctic, Arctic Ocean). Many migratory bird species can be placed in this category as species are expected to pass over or near the RSA and/or MSA during spring and fall migrations, and as such, their presence would be possible but infrequent. In addition, species where the northern edge of their range overlaps within the Southern Arctic Ecozone are placed in this category as their presence would also be possible but infrequent.
Unlikely (U)	Species that are unlikely to occur. Species in this category have seasonal ranges that occur near the RSA and/or MRSA (within 150 km) and may or may not have been detected in either the Southern Arctic, Northern Arctic, or Arctic Ocean ecozones. However, seasonal habitat requirements are not met within the RSA and/or MRSA. Species with low population sizes are also placed in this category.

[1] *Likelihood that species occur in the region was based upon range maps and ecological information according to various sources (Sibley 2000; National Geographic Society 2002; Alderfer 2006; F. A. Reid 2006; Richards and White 2008; NatureServe 2011a).*

The conservation status of potentially occurring wildlife species was assessed according to territorial (Canadian Endangered Species Conservation Council; CESCC), federal (Committee on the Status of Endangered Wildlife in Canada [COSEWIC]; *Species at Risk Act*), and international (NatureServe; International Union for Conservation of Nature [IUCN]) assessment bodies (Tables 4-2 to 4-4). Species are ranked under the General Status Programme administered by the Government of Nunavut, Department of Environment. However, these rankings have not yet been reviewed by the NWMB and so remain in draft form. Thus the CESCC designations for Nunavut were used in this report to assess the status of wildlife in the territory (CESCC 2010). Species of conservation concern include species or populations that are 1) territorially ranked as At Risk, May Be At Risk, or Sensitive, 2) classified as Endangered, Threatened, or Special Concern, as designated by COSEWIC, 3) on Schedule 1 of *SARA*, 4) globally ranked as Imperilled or Vulnerable by NatureServe, or 5) listed as Critically Endangered, Endangered, Vulnerable, or Near Threatened by IUCN.

A total of 108 birds and 45 mammals potentially occur within the RSA and/or MRSA (Appendix 4-1). Of these species, 49 (37 birds and 13 mammals) are identified as species of conservation concern (Appendix 4-1). Overall, 35 species of conservation concern were considered likely occurring or possibly occurring within the study areas. Twenty of these species (18 birds and 2 mammals) were identified in the RSA and/or MRSA during 2012 baseline studies (Table 4-5).

Table 4-2. CESCC Conservation Statuses and Definitions (for Nunavut)

Rank	General Status	Definition
0.2	Extinct	Species that are extirpated worldwide (i.e., they no longer exist anywhere).
0.1	Extirpated	Species that are no longer present in a given geographic area, but occur in other areas.
1	At Risk	Species for which a formal assessment (i.e., COSEWIC, Nunavut assessment body) has been completed and that were determined to be at risk of extirpation or extinction.
2	May Be At Risk	Species that may be at risk of extirpation or extinction and are therefore candidates for a detailed risk assessment by COSEWIC or the Nunavut assessment body.
3	Sensitive	Species that are not believed to be at risk of immediate extirpation or extinction but may require special attention or protection to prevent them from becoming at risk.
4	Secure	Species that are not believed to belong in the categories Extinct, Extirpated, At Risk, May Be At Risk, Sensitive, Accidental or Exotic.
5	Undetermined	Species for which insufficient data, information, or knowledge is available with which to reliably evaluate their general status.
6	Not accessed	Species that are known or believed to be present regularly in the geographic area in Canada to which the rank applies, but have not yet been assessed by the general status program.
7	Exotic	Species that have been moved beyond their natural range as a result of human activity.
8	Accidental/Vagrant	Species occurring infrequently and unpredictably, outside their usual range.

Source: CESCC (2011).

Table 4-3. Federal Conservation Statuses and Definitions

COSEWIC		
Status		**Definition**
E:	Endangered	A species facing imminent extirpation or extinction
T:	Threatened	A species that is likely to become endangered if limiting factors are not reversed
SC:	Special Concern	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events
NAR:	Not at Risk	A species that has been evaluated and found not to be at risk
DD:	Data Deficient	A species for which there is insufficient scientific information to support status designation
SARA		
Schedule		**Definition**
1:		Protected under SARA as of proclamation in June 2003. These species were assessed by COSEWIC using the revised assessment criteria. The list classifies the species as either being extirpated, endangered, threatened, or of special concern.
2 and 3:		Assessed prior to October 1999 and require re-assessment using the revised criteria, after which the Governor in Council may, on the recommendation of the Minister, add the species to the Federal List of Wildlife Species at Risk.

Source: COSEWIC (2010); Government of Canada (2010).

Table 4-4. International Conservation Statuses and Definitions

NatureServe (global rank)		
Rank		**Definition**
G#G#:	Range Rank	A numeric range rank (e.g., G2G3) is used to indicate the range of uncertainty about the status of the species or community
G2:	Imperilled	At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors
G3:	Vulnerable	At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors
G4:	Apparently Secure	Uncommon but not rare; some cause for long-term concern due to declines or other factors
G5:	Secure	Common; widespread, and abundant
T:	Infraspecific Taxon (trinomial)	The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank; e.g., the global rank of a critically imperilled subspecies of an otherwise widespread and common species would be G5T1
IUCN		
Category		**Definition**
EX:	Extinct	Species where there is no reasonable doubt that the last individual has died
EW:	Extinct in the Wild	Species only known to survive in cultivation, in captivity, or as a naturalized population (or populations) well outside the past range
CR:	Critically Endangered	Species considered to be facing an extremely high risk of extinction in the wild, with high population declines over the last 10 years and extremely small ranges and population size
EN:	Endangered	Species considered to be facing an extremely high risk of extinction in the wild, with moderate to high population declines over the last 10 years and small ranges and population size
VU:	Vulnerable	Species considered to be facing an extremely high risk of extinction in the wild, with moderate population declines over the last 10 years and small to moderate ranges and population size
NT:	Near Threatened	Species that has been evaluated and does not currently qualify for Critically Endangered, Endangered, or Vulnerable categories, but is close to qualifying for or is likely to qualify for a threatened category (CR, EN, or VU) in the near future
LC:	Least Concern	Species that has been evaluated and does not qualify for any of the above categories and is widespread and abundant
DD:	Data Deficient	Species for which there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status
NE:	Not Evaluated	Species that has not yet been evaluated against the IUCN criteria

Source: IUCN (2001); NatureServe (2011b).

Table 4-5. Wildlife Species of Conservation Concern Detected in the RSA and MRSA

		Conservation Status[1]				
Common Name	**Scientific Name**	**NU Status**	**COSEWIC**	**SARA**	**Global Rank**	**IUCN Red List**
Birds						
American golden-plover	*Pluvialis dominica*	Sensitive			G5	Least Concern
American pipit	*Anthus rubescens*	Sensitive			G5	Least Concern
American tree sparrow	*Spizella arborea*	Sensitive			G5	Least Concern

(continued)

Table 4-5. Wildlife Species of Conservation Concern Detected in the RSA and MRSA (completed)

Common Name	Scientific Name	Conservation Status[1]				
		NU Status	COSEWIC	SARA	Global Rank	IUCN Red List
Birds (cont'd)						
Arctic tern	*Sterna paradisaea*	Sensitive			G5	Least Concern
Common eider*	*Somateria mollissima*	Sensitive			G5	Least Concern
Glaucous gull*	*Larus hyperboreus*	Sensitive			G5	Least Concern
Golden eagle	*Aquila chrysaetos*	Sensitive	NAR		G5	Least Concern
Gyrfalcon	*Falco rusticolus*	Sensitive	NAR		G5	Least Concern
Harris's sparrow	*Zonotrichia querula*	Sensitive			G5	Least Concern
Hoary redpoll	*Carduelis hornemanni*	Sensitive			G5	Least Concern
Least sandpiper	*Calidris minutilla*	Sensitive			G5	Least Concern
Long-tailed duck	*Clangula hyemalis*	Sensitive			G5	Least Concern
Peregrine falcon	*Falco peregrinus*	Secure	TH/SC	1/3	G4	Least Concern
Red-necked phalarope	*Phalaropus lobatus*	Sensitive			G4G5	Least Concern
Rough-legged hawk	*Buteo lagopus*	Sensitive	NAR		G5	Least Concern
Semipalmated sandpiper	*Calidris pusilla*	Sensitive			G5	Least Concern
Short-eared owl	*Asio flammeus*	Sensitive	SC	3	G5	Least Concern
White-crowned sparrow	*Zonotrichia leucophrys*	Sensitive			G5	Least Concern
Mammals						
Grizzly bear	*Ursus arctos*	Sensitive	SC		G4	Least Concern
Wolverine	*Gulo gulo*	Secure	SC		G4	Vulnerable

[1] *See Tables 4-2 to 4-4 for Conservation Status definitions.*
[2] *See Table 4-1 for Likelihood of Occurrence definition.*
* *Species that only have the potential to occur within marine areas in Bathurst Inlet and the Arctic ocean.*

5. Raptors

5. Raptors

5.1 INTRODUCTION

Breeding raptors can serve as indicators of the effects of human activities on ecosystem health. As top predators in the food chain, raptors are sensitive to environmental conditions (Sergio et al. 2008). Raptors bio-accumulate environmental toxins, which in previous decades caused hatching failure of eggs and subsequent major population crashes in some species, resulting in the worldwide banning of DDT organochlorine pesticides (Newton 1995). Raptors and their nests are legally protected from destruction and disturbance under the *Nunavut Wildlife Act* (2003).

Five species of cliff nesting raptors are expected to occur in the Project area: peregrine falcon (*Falco peregrinus tundrius*), gyrfalcon (*Falco rusticolus*), rough-legged hawk (*Buteo lagopus*), golden eagle (*Aquila chrysaetos*), and bald eagle (*Haliaeetus leucocephalus*). Common ravens (*Corvus corvax*) are also included in this baseline study. Common ravens are considered to be 'functional raptors' because they use similar food and breeding resources as cliff-nesting raptors, and construct stick nests that are used by falcon species for nesting (Poole and Bromley, 1988; Poole 2011). Four of these cliff-nesting species are of conservation concern. The golden eagle, gyrfalcon, and rough-legged hawk are listed as Sensitive in Nunavut by the Canadian Endangered Species Conservation Council (CESCC). The peregrine falcon *tundrius* subspecies, while listed as Secure in Nunavut by the CESCC (2010), is federally listed on Schedule 1 as a subspecies of Special Concern under the *Species at Risk Act* (SARA; Government of Canada 2011).

Three species of ground-nesting raptors likely occur in the Project area: snowy owl (*Bubo scandiacus*), short-eared owl (*Asio flammeus*), and northern harrier (*Circus cyaneus*). The short-eared owl is listed as Sensitive in Nunavut, and is also listed on Schedule 1 of *SARA* as a species of Special Concern (CESCC 2010; Government of Canada 2012).

5.2 OBJECTIVES

Surveys were conducted in 2012 to assess the relative abundance, distribution, and breeding productivity of cliff nesting raptor species within the RSA. Specifically, the objectives were to:

- Identify the locations of raptor nests on cliffs, especially nests of species of conservation concern;
- Conduct an occupancy survey to determine the number and spatial distribution of nest sites used by raptors for breeding in 2012;
- Conduct a productivity survey to measure breeding performance of nesting pairs; and,
- Derive estimates of relative abundance of cliff-nesting raptors using survey results and incidental observations, including those of ground-nesting species.

5.3 METHODS

Locations of raptor nest sites within 30 km of the George and Goose Property Areas were obtained from two previous baseline surveys conducted in the RSA (in 2007: (Gartner Lee Ltd. 2008); in 2011: (Rescan 2012b)). Within this survey area, all nest sites mapped in 2007 and 2011 were re-surveyed, and all

suitable cliff habitat was searched to determine raptor occupancy. Raptor occupancy surveys were conducted on May 26 and May 27, 2012. Productivity surveys were conducted July 27 and 28, 2012.

Raptor surveys were conducted in cliff nesting habitat (Plate 5.3-1) within the RSA by flying horizontally along cliff faces in a Bell 407 helicopter. If the cliff was greater than 30 m high, two flight passes were taken (one at the top level and one at the lower level) to ensure that no nests were missed. To prevent surprising nesting raptors, cliffs were approached as directly as possible. In suitable nesting habitat, observers searched for signs of raptor use (e.g., stick nests, orange lichen on cliff faces, whitewash [feces], and raptor adults, eggs, or young).

Plate 5.3-1. Raptor cliff nesting habitat within the RSA, July 27, 2012.

At each occupied nest site, the following information was recorded: UTM coordinates, cliff height, cliff aspect, number and substrate of nearby inactive nests, and for the active nest - raptor species, number of adults, number of eggs or young, % overhang, nest substrate and height. Habitat information was collected, where possible, to describe raptor nesting habitat within the RSA. Less than one minute was spent at active nests in order to minimize disturbance to birds.

5.3.1 Raptor Occupancy Surveys

A raptor occupancy survey was conducted by helicopter in late May, 2012 to identify the location of occupied nest sites within the RSA. The locations of new nests found during the May 2012 survey were geo-referenced using a handheld Garmin GPS Map62s (accuracy 3 to 15 m).

An occupied nest site is defined as a raptor nest where a single adult or pair of adults was observed displaying territorial behaviour during the nesting season, or where eggs or young were observed (Poole and Bromley 1988; Steenhof and Newton 2007). The presence of eggs or young was inferred at nests on which adults sat in incubation posture.

A nest site is defined as a traditional nesting area which may contain several alternate nests, though only one nest is used during a given year. Applying this method, clusters of adjacent nest belonging to the same species found during the baseline survey years (2007, 2011, 2012) were grouped into distinct nest sites. For example, if an unoccupied nest site adjacent to an occupied one was subsequently occupied by another pair of the same species the following year, then these two adjacent nest sites were labelled as two distinct nest sites. A nesting territory is a confined locality within the home range of a breeding pair containing one or more nest sites, defended by the occupying pair, and used to raise young by only one pair of a particular species per year (Steenhof and Newton 2007) (Newton 1979). Several years of monitoring data are required to identify which nest sites (i.e., on different cliffs) belong to the same territory. Therefore, data presented in this report refer to nest sites, not nest territories. However, the database of nest sites probably represents the majority of breeding territories found within the surveyed areas of the RSA, though some portion of nest sites may belong to the same breeding territories.

5.3.2 Raptor Productivity Surveys

A productivity survey was conducted by helicopter in late July, 2012 to record breeding performance and brood size of pairs that had occupied nests in May. All occupied nest sites were re-visited in July. Mean brood size was calculated as the average number of young among nests with young at which complete counts were made.

The survey occurred after the fledging period for common ravens and most gyrfalcons, and before young in most nests of the golden eagle and rough-legged hawk, and all peregrine falcon young had reached 80% of fledging age. Thus, breeding productivity was not measured, as this measure for raptors requires that surveys be timed so that the number of young per nest can be counted when they are at least 80% of their fledging age (Steenhof and Newton 2007. Productivity is defined as the average number of young that fledge from nests at which pairs attempted to breed; it is assumed that young that reach 80% of the age at which they typically leave the nest will successfully fledge from the nest (Steenhof and Newton 2007).

Nest success is estimated as the proportion of the total number of occupied nest sites at which at least one young raptor fledged (Steenhof and Newton 2007). Nest success was estimated for common raven and gyrfalcon only, since young of these species had reached 80% of fledging age or had already fledged by the time of the productivity survey. Empty nests of common ravens and gyrfalcons with an abundant accumulation of feces and prey remains were assumed to have fledged. Breeding failure was assumed for empty common raven and gyrfalcon nests where there was no evidence of fledging.

Breeding performance for all species was measured as the proportion of occupied nests at which breeding pairs produced young of any age that were alive at the time of the productivity survey. For all species, breeding failure was recorded at nests sites where at least one addled (dead) egg or one dead chick were observed in abandoned nests. Abandoned nests or ledges at nest sites for rough-legged hawk, golden eagle, and peregrine falcon were used to indicate nest failure, since the survey occurred prior to the fledging period for these species.

5.3.3 Raptor Nesting Habitat

Data on nest characteristics at nest sites was collected during the May and July surveys where possible. Habitat data was recorded at active and alternate nests (n=100) observed at each nest site. Data was not recorded at all alternate nests observed due to logistical safety concerns or to minimize disturbance to raptors. Substrate type, overhang percentage, nest height and aspect, and cliff height were collected at nests. These data were summarized to describe nest site habitat for each species.

5.3.4 Incidental Observations

Observations of raptors, including ground-nesting raptors, and their nests were geo-referenced when observed incidentally during other wildlife or environmental field inventories. In addition, incidental observations of raptors were compiled from images captured on remote digital cameras used in baseline studies of wolverine from March to early May, 2012 (Rescan 2013a) and of caribou late May to August, 2012 (Section 10.3.2). For each raptor photo, the following data were recorded: date, time of day, species, number of individuals in the frame, and behaviour. The maximum count per species for each 24 hour period was determined from the photo frame with the highest count of individuals. When it was not possible to distinguish individual raptors based on plumage or other characteristics, photos of individual birds taken within the same 24 hour period were considered to be of the same individual.

5.4 RESULTS

In 2012, four of the five cliff-nesting raptor species expected to occur in the study area were observed nesting on cliff ledges during the raptor occupancy and productivity surveys: golden eagle, gyrfalcon, peregrine falcon, and rough-legged hawk. The common raven was also observed nesting on cliff ledges. The fifth raptor species that may nest on cliffs - the bald eagle - was observed incidentally during other 2012 baseline surveys, but was not observed breeding. Three ground-nesting species were observed incidentally - the northern harrier, snowy owl, and short-eared owl. Thus, occurrence within the RSA of all five raptor species of conservation concern was confirmed - golden eagle, gyrfalcon, rough-legged hawk, peregrine falcon, and short-eared owl.

5.4.1 Raptor Occupancy Survey

The majority of occupied nest sites were found either in the northern, central, or south-east portion of the RSA; whereas, most of the unoccupied nest sites occurred in the north-west portion where snow covered about 25% of the nest sites (Figure 5.4-1; Plates 5.4-1 to 5.4-5). Only one raptor nest site was found within 1.5 km of George or Goose properties or proposed site infrastructure during the occupancy survey. This nest was a gyrfalcon nest and was found on a ledge within 1.5 km of proposed site infrastructure west of Goose Camp (Figure 5.4-1).

A total of 67 raptor nest sites were surveyed, of which 40 were occupied by raptors in May 2012 (Table 5.4-1; Appendix 5-1). These were comprised of 43 nest sites that had been occupied by raptors in the 2007 and 2011 surveys, 4 unoccupied nest sites found in 2007, and 20 nest sites found in 2012 (17 occupied nest sites, 3 unoccupied nest sites with stick nests). Of the 43 nest sites occupied by raptors in previous survey years, 19 (44%) were re-occupied by raptors in 2012. The four nest sites that were not occupied in 2007 were occupied by raptors in 2012.

Table 5.4-1. Number[1] and Breeding Status of Raptor Nests on Cliffs Surveyed May 26 and 29, 2012

Species	Occupied					Unoccupied Inactive
	1 Adult Observed	2 Adults Observed	With Eggs	With Young	Total Occupied	
Common raven			3	1	**4**	
Gyrfalcon	1	1	6	1	**9**	
Golden eagle			4		**4**	
Rough-legged Hawk			10		**10**	
Peregrine falcon	3	7	3		**13**	
Total	**4**	**8**	**26**	**2**	**40**	**27**

[1] *All numbers in table columns refer to counts of nests.*

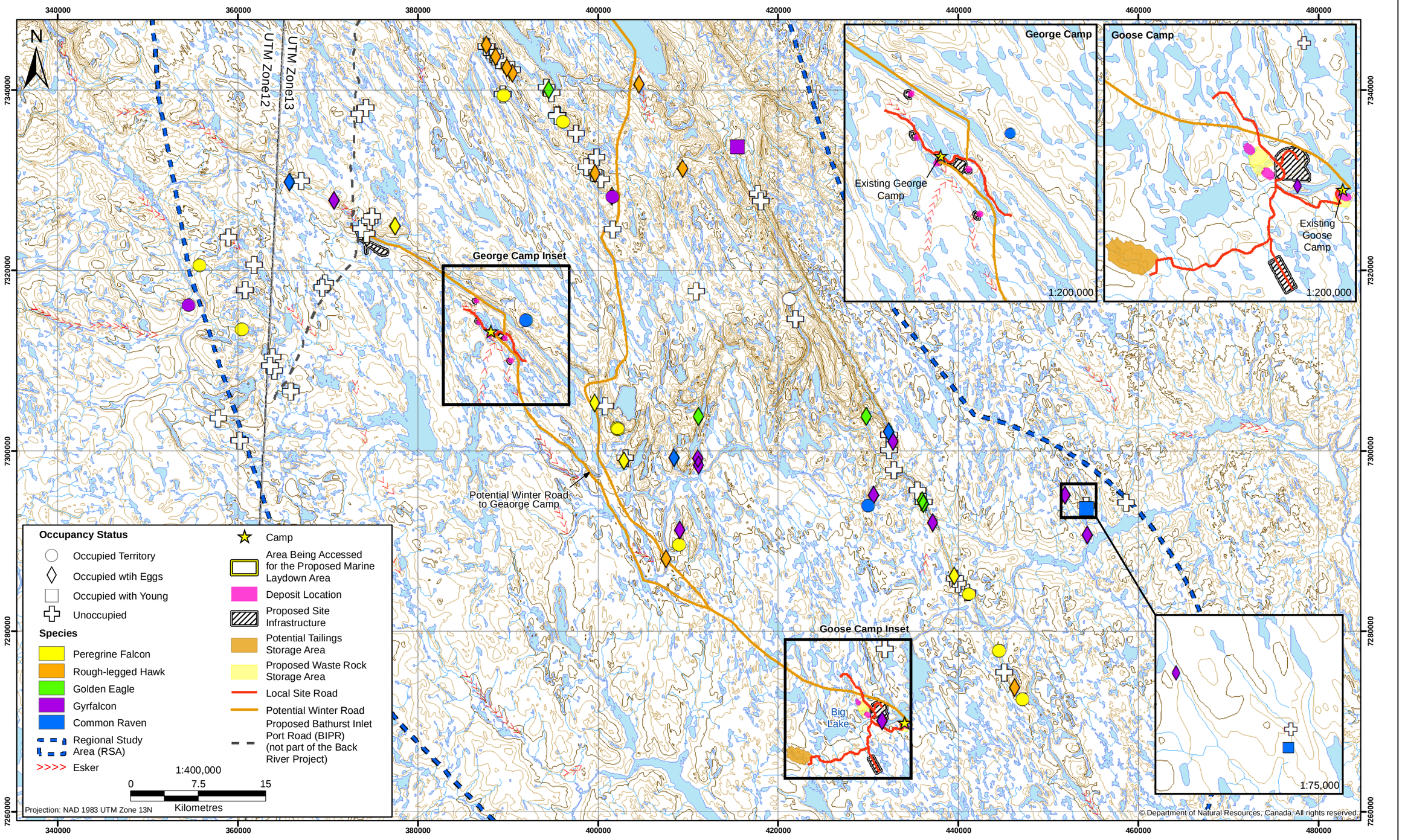


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Figure 5.4-1

Status of Raptor Nests during Occupancy Surveys, May 2012

Plate 5.4-1. Gyrfalcon nest with an incubating adult, May 26, 2012.

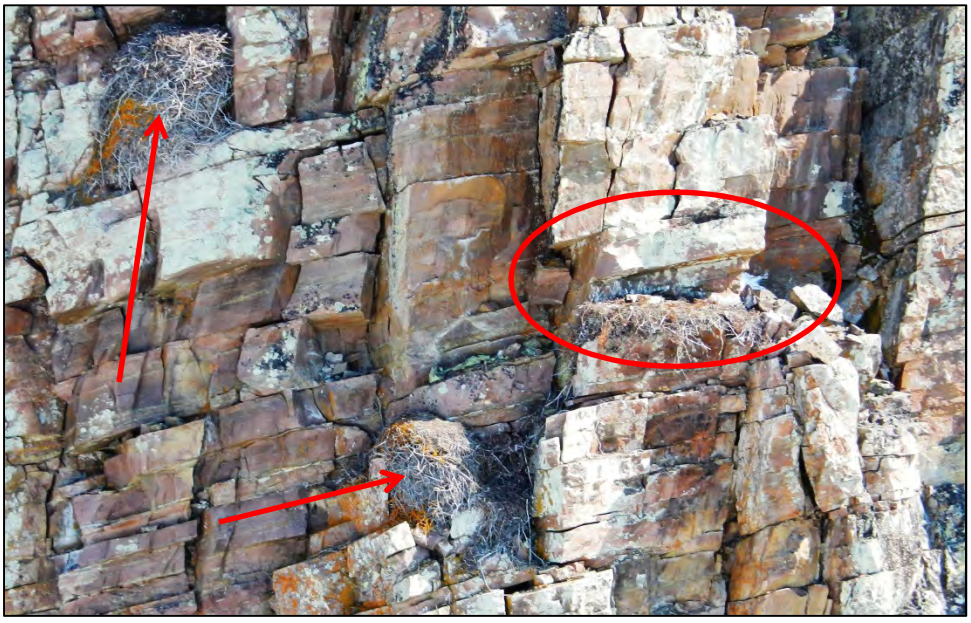

Plate 5.4-2. Golden eagle nest with an incubating adult next to two alternate golden eagle nests (indicated by red arrows), May 26, 2012.

Nest sites occupied by peregrine falcon were the most frequently observed (33% of 40 occupied nest sites). Occupied nest sites of the rough-legged hawk and gyrfalcon were found in approximately equal abundance (25% and 23%, respectively). Nests of the golden eagle and common raven comprised only 10% respectively of the total number of occupied nest sites (Table 5.4-1).

Plate 5.4-3. Common raven nest with three eggs and one recently-hatched young, May 26, 2012.

Plate 5.4-4. Incubating rough-legged hawk adult (light morph), May 26, 2012.

Plate 5.4-5. Abandoned peregrine falcon nest with one addled egg (indicated by red arrow), July 27, 2012.

For all species except peregrine falcons, pairs had initiated egg-laying by the time of the survey (Table 5.4-1). Only 23% of peregrine falcon pairs had initiated egg-laying by late May – adult birds and no eggs were observed at 10 of 13 occupied nest sites. Eggs were not observed at two nest sites occupied by gyrfalcons. Only one adult was observed at one site, which may have been an unpaired bird (Table 5.4-1). At the other site, the nest of the gyrfalcon pair may have already failed, or the female had failed to produce eggs. It is also possible that observers failed to detect eggs that were present at the peregrine falcon nest sites, and eggs and young that were present at both gyrfalcon nest sites.

5.4.2 Raptor Productivity Survey

The breeding performance of raptors that occupied nests in May was determined by visiting nests on July 27 through 29, 2012 (Plates 5.4-6 to 5.4-8). Of the 40 occupied nests surveyed in May, evidence of successful breeding or continued breeding was observed at 13 nests (occupancy rate of 33%, Table 5.4-2). Half of common raven and one third of gyrfalcon pairs successfully produced at least one fledgling (Table 5.4-2). Breeding performance measured as the proportion of nest sites occupied in spring at which pairs were brooding young in July ranged between 20% and 38% for the golden eagle, rough-legged hawk, and peregrine falcon (Table 5.4-2).

Sample sizes were high enough to derive a mean estimate of brood size for peregrine falcons, but not for the other species. Mean brood size for peregrine falcons was three young (± 0.32 (SE), n = 5 nests, range 2-4). One golden eagle nest contained two young, one gyrfalcon nest contained three young and one rough-legged hawk nest contained one young, and the other contained two young.

One raptor nest was found within 1.5 km of George or Goose properties during the July productivity survey. This nest belonging to a peregrine falcon pair nest was found on a ledge near George Camp, and contained four young that were raised to at least two weeks of age (Figure 5.4-2). Observations made during the productivity survey revealed that the gyrfalcon pair observed nesting near a potential Project infrastructure site west of Goose Camp during the occupancy survey failed to breed in 2012.

Table 5.4-2. Number[1] and Breeding Status of Raptor Nests on Cliffs Surveyed July 27 and 29, 2012

		Breeding Failure					Breeding Performance				
	Total Occupied	Dead Eggs	Dead Young	Assumed Failed	Total Failed	% Failed	Nests With Young	Productive[2]	Assumed Productive[3]	% Productive[4]	% Produced Young
Common raven	4		1	1	**2**	**0.5**			2	**0.50**	**0.50**
Gyrfalcon	9	1	3	2	**6**	**0.67**		1	2	**0.33**	**0.33**
Golden eagle	4		2	1	**3**	**0.75**	1				**0.25**
Rough-legged Hawk	10	1		7	**8**	**0.8**	1	1			**0.2**
Peregrine falcon	13			8	**8**	**0.62**	5				**0.38**

[1] *All numbers in table columns refer to counts of nests.*
[2] *Number of nests in which young were observed to be at least 80% of fledging age based on plumage.*
[3] *Number of empty nests for which fledging was assumed to have occurred based on evidence at the nest (e.g. abundant accumulation of feces and prey remains).*
[4] *Also referred to as nest success.*

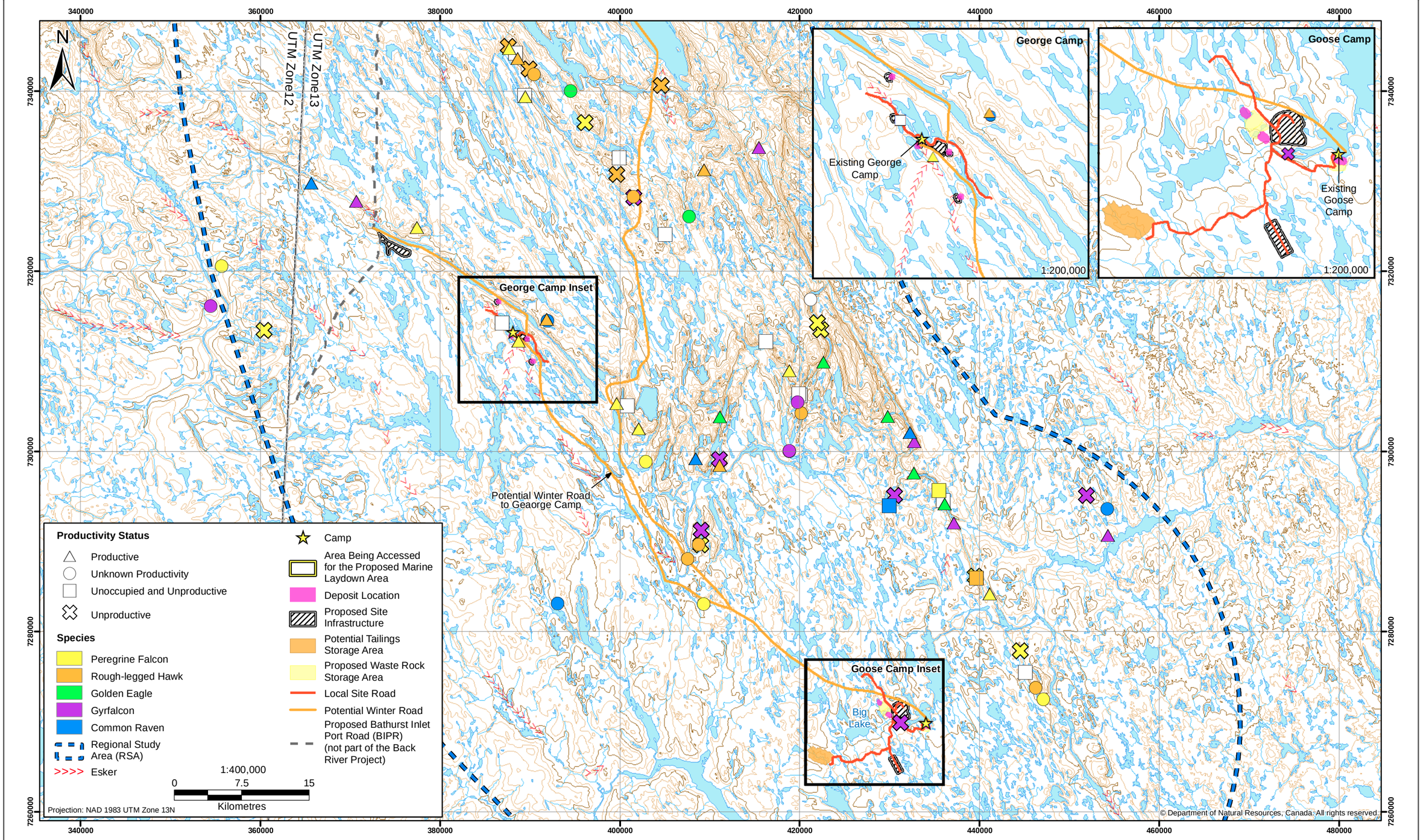

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Figure 5.4-2

Status of Raptor Nests during Productivity Surveys, July 2012

Plate 5.4-6. Productive gyrfalcon nest with three young close to fledging, July 28, 2012.

Plate 5.4-7. Peregrine falcon nest with two chicks, July 28, 2012.

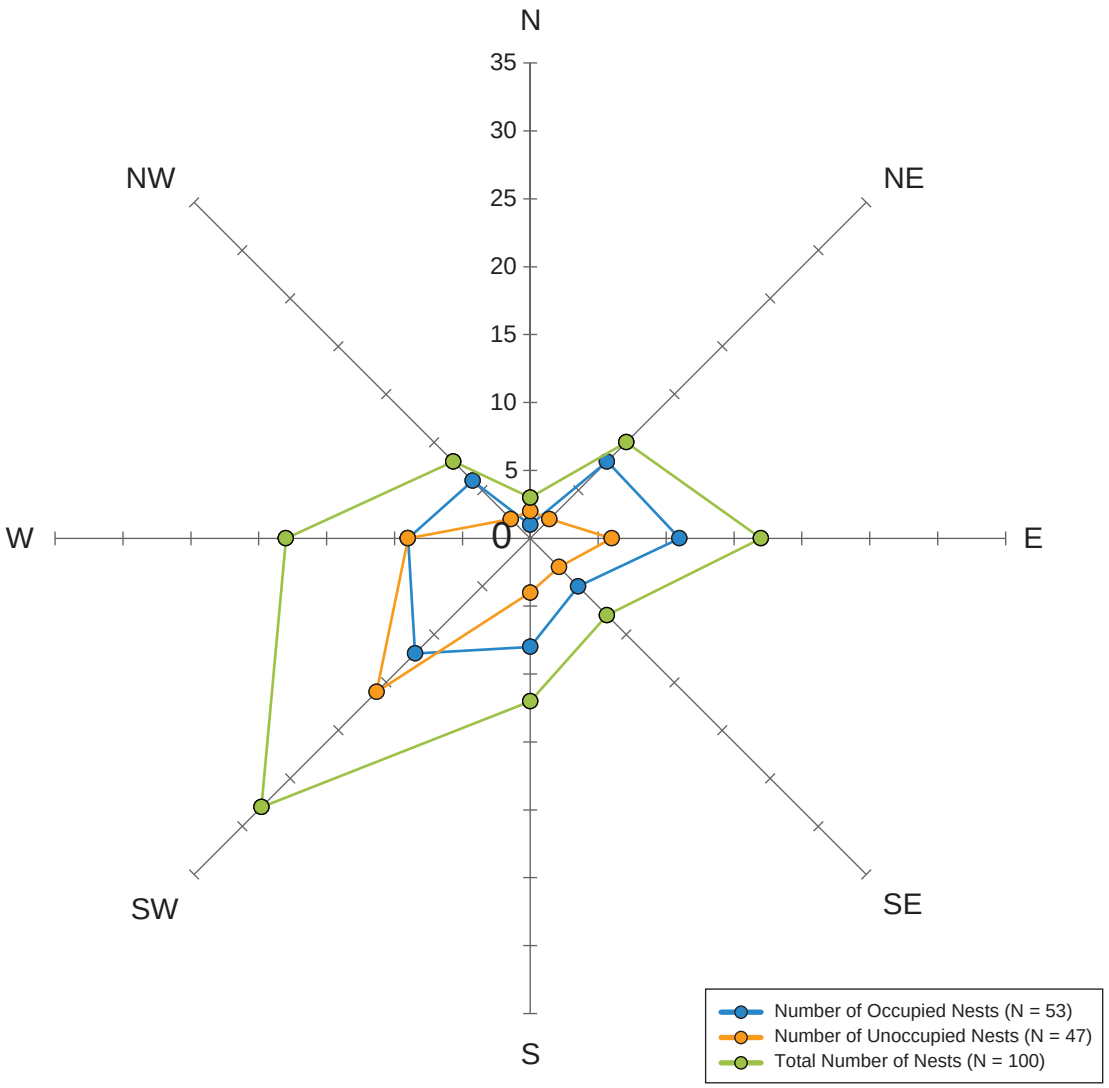
Plate 5.4-8. Golden eagle nest with one chick, July 29, 2012.

5.4.3 Raptor Nesting Habitat

The common raven, golden eagle, and rough-legged hawk nested in stick nests on cliff ledges (Table 5.4-3, Plate 5.4-9). All gyrfalcon pairs nested in stick nests, except for one pair which nested on a grassy ledge. All peregrine falcon pairs nested on grassy ledges (Plate 5.4-10), except for two pairs which nested in stick nests. Peregrine falcons and rough-legged hawks nested on cliff ledges with less than 10% overhang. Nests of the common raven, golden eagle, and gyrfalcon were found on cliff ledges where overhand ranged on average from 35% to 46% (Table 5.4-3). Twice as many raptor nests faced a south-west aspect than would be expected if raptor nests were evenly distributed across the eight aspects (Table 5.4-3; Figure 5.4-3). Nests were located on cliffs that ranged in height from 9 m to 100 m.

Plate 5.4-9. A stick nest (indicated by red arrow) with a north-east facing aspect occupied by an incubating golden eagle, July 28, 2012.

Distribution of Raptor Nests by Aspect



Note: Aspect was not recorded for 22 nests due to logistical safety concerns and/or to minimize disturbance to nesting raptors.

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Raptor Nesting Habitat, 2012

Figure 5.4-3

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Table 5.4-3. Summary of Raptor Nesting Habitat

Species	Total Nests	Substrate Type		Average % Overhang	Aspect							
		Grassy Ledge	Stick Nest		N	NE	E	SE	S	SW	W	NW
Common Raven	5	-	5	35	-	1	2	-	-	-	1	1
Golden Eagle	9	-	9	42	-	2	1	1	-	2	1	2
Gyrfalcon	12	1	11	46	-	2	2	-	3	3	1	1
Peregrine Falcon	15	13	2	3	1	2	3	2	2	3	2	-
Rough-legged Hawk	12	-	12	9	-	-	-	-	3	5	3	1
Total Occupied	53	14	39	-	1	7	8	3	8	13	8	5
Unoccupied	47	12	35	30	2	2	8	4	5	14	9	3
Total	**100**	**26**	**74**		**4**	**16**	**24**	**10**	**21**	**40**	**25**	**13**

Plate 5.4-10. A grassy ledge (indicated by red arrow) with a south-west facing aspect occupied by an incubating peregrine falcon, May 27, 2012

5.4.4 Incidental Observations of Raptors

5.4.4.1 Incidental Detections of Raptors by Observers during Other Baseline Surveys

A total of 45 individuals of all eight raptor species expected to occur in the area, and the common raven, were observed incidentally by field crews during other baseline field surveys conducted in 2012 (Figure 5.4-4; Table 5.4-4; Appendix 5-2). One nest with an incubating peregrine falcon and one active gyrfalcon nest were observed incidentally, in addition to three inactive stick nests on cliffs (Figure 5.4-4).

Table 5.4-4. Incidental Detections of Raptors during Other Baseline Field Surveys, 2012

Species	No. Birds Observed
Bald Eagle	7
Common Raven	10
Golden Eagle	8
Gyrfalcon	4
Northern Harrier	4
Peregrine Falcon	4
Rough-legged Hawk	5
Short-eared Owl	2
Snowy Owl	1
Total	**45**

5.4.4.2 Incidental Detections of Raptors on Digital Photos Taken by Remote Cameras

The common raven (N = 52 individuals) and snowy owl (N = 2 individuals) were the only raptor species observed on photos taken by digital cameras used to remotely monitor wolverines between March to early May 2012 (Figure 5.4-4; Plate 5.4-11). Four raptor species were detected from May to August 2012 by remote digital cameras used for caribou monitoring; bald eagle, common raven, peregrine falcon, and short-eared owl (Table 5.4-5; Figure 5.4-4; Plate 5.4-12).

Plate 5.4-11. Common raven observed April 7, 2012 and snowy owl observed May 17, 2012 at digital cameras used to remotely monitor wolverines.

PROJECT #0833-002-05 GIS # BAC-23-059 March 18 2013

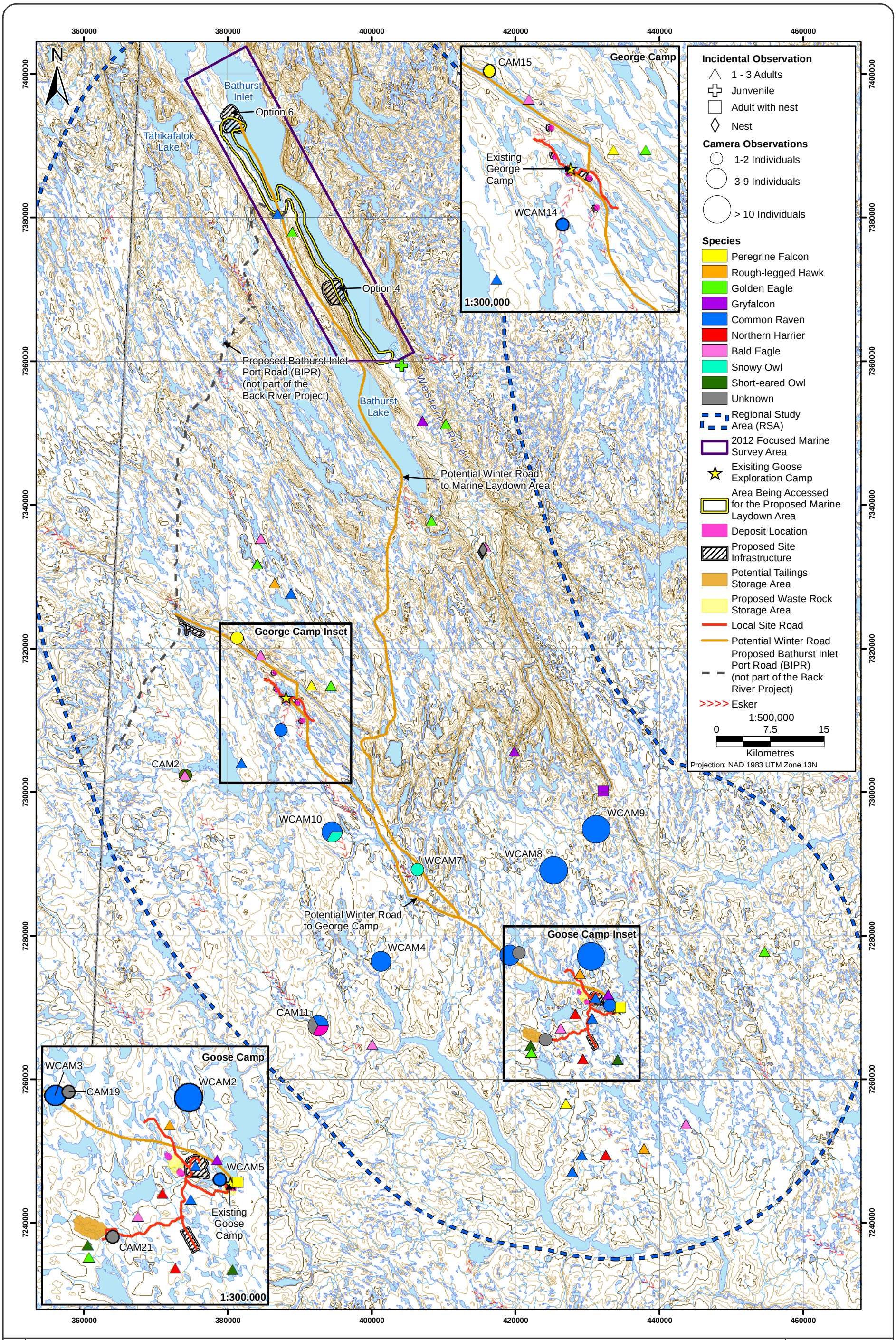

Figure 5.4-4

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Incidental Detections of Raptors and Raptor Nests, 2012

Figure 5.4-4

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Plate 5.4-12. A bald eagle observed from a digital photo taken by a camera used for remote monitoring of caribou, June 19, 2012.

Table 5.4-5. Raptor Species Observed on Digital Photos Taken by Remote Cameras, 2012

Species	No. Camera Observations*	
	March - Early May	Late May - August
Bald Eagle	-	1
Common Raven	52	1
Peregrine Falcon	-	1
Short-eared Owl	-	1
Snowy Owl	2	-
Unknown species	-	3
Total	**54**	**7**

5.5 DISCUSSION

Surveys for cliff-nesting raptors were conducted in May and July 2012 to locate nest sites occupied by raptors and to measure their breeding performance, especially for species of conservation concern. In total, 67 nest sites were surveyed, 40 of which were occupied by breeding raptors. Four raptor species and the common raven were identified during the occupancy and productivity surveys. An additional four raptor species were observed incidentally – the cliff-nesting bald eagle, and the ground-nesting northern harrier, snowy owl, and short-eared owl. Of these species, five are species of conservation concern: peregrine falcon, gyrfalcon, golden eagle, rough-legged hawk, and short-eared owl.

Most unoccupied nest sites occurred in the northwest portion of the study area where snow still covered the ledges. Studies have shown that nesting raptors have been observed to abandon nests or decrease nest attendance due to disturbance from human activities, and thus buffer distances of up to

1.5 km have been recommended to minimize disturbance (Richardson and Miller 1997). With the except of one peregrine falcon nest on a cliff ledge near George Camp where a pair brooded four young in July, and one gyrfalcon nest that failed near Goose Camp, no other raptor nests were found within 1.5 km of George or Goose properties.

Raptors in the Arctic re-use nest sites for decades, centuries, and millenia (Burnham, Burnham, and Newton 2009). Occupancy rates of raptor territories can provide an index of population size, but may more accurately provide an index of the number of pairs that attempt to breed in a given year (Selas and Kalas 2007). Either index can be used to measure the health of raptor populations (Steenhof and Newton 2007). In this study, nearly one half (44%) of previously occupied nest sites were re-used by raptors in 2012. This re-use rate of nest sites is similar to occupancy rates of nesting territories observed elsewhere in the Arctic (e.g. 41% in Alaska, (Bente 2011).

For many raptor species breeding in the Arctic, breeding productivity has been found to fluctuate annually with prey availability (reviewed in Mcintyre and Schmidt 2012). For example, breeding productivity of rough-legged hawks in Bathurst Inlet was positively correlated with lemming abundance (K. G. Poole and Bromley 1988). Due to the timing of the survey, productivity was not measured in this study. However nest success measured as the proportion of occupied sites that were productive was estimated as 50% and 33% for the common raven and gyrfalcon. Breeding performance measured as the proportion of nest sites occupied in spring at which pairs were brooding young in July ranged between 20% and 38% for the golden eagle, rough-legged hawk, and peregrine falcon. These estimates indicated that approximately 50% to 80% of raptor pairs that attempted breeding in the spring failed to produce live young by July within the study area.

Five peregrine falcon pairs brooded on average three young in July. If it is assumed that all of these 15 young fledged from the nest, then the maximum productivity of peregrine falcons in the study area in 2012 was 1.15 young fledged per occupied nest, which is equal to the mean productivity of peregrine falcons measured from 1982 to 2009 in Rankin Inlet, Nunavut (Franke et al. 2010; 1.15 ± 0.62 young fledged per pair of that attempted to breed each year).

Gyrfalcons and peregrine falcons do not build nests (Burnham, Burnham, and Newton 2009). Nest sites used by both species in this study are typical of Arctic-breeding populations. The majority of peregrine falcon nests in this study were found on exposed cliff ledges with very little overhang, while those of gyrfalcons were primarily in sheltered stick nests, most of which were likely built by common ravens (Burnham, Burnham, and Newton 2009). Overhang is an important habitat characteristic, especially for gyrfalcons that initiate breeding early in the year when weather can limit breeding productivity (reviewed in Cade and Bird 2011).

6. Upland Breeding Birds

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6. Upland Breeding Birds

6.1 INTRODUCTION

Avian species such as upland breeding birds are often selected for use in monitoring programs because they represent an abundant and diverse group that can be surveyed with relative ease. These attributes facilitate the collection of data that can be analyzed statistically to provide a quantitative measure of avian population and community health. In addition, bird monitoring can provide information on the availability of prey for larger animals that rely on birds as a food source. For the purposes of this report, upland breeding birds are defined as songbirds, shorebirds, ptarmigan, and jaegers. Because jaegers are nest predators of other upland bird species, observations of jaegers and other nest predators are considered separately in this section of the report.

6.2 OBJECTIVES

Baseline studies were designed to describe the upland breeding bird community within the George and Goose focused bird survey areas and reference bird survey areas and the focused marine survey area (FMSA) near Bathurst Inlet. Specifically, the study objectives were to:

- characterize the relative abundance and distribution of upland breeding birds in the study areas, including species of conservation concern;
- compare bird abundance and species richness between focus and reference bird survey areas;
- derive estimates of bird abundance in dry upland versus low wetland habitat;
- describe associations of commonly-detected species with vegetation cover;
- collect data on nest productivity and the timing of breeding; and
- summarize detection rates of nest predators of upland breeding birds.

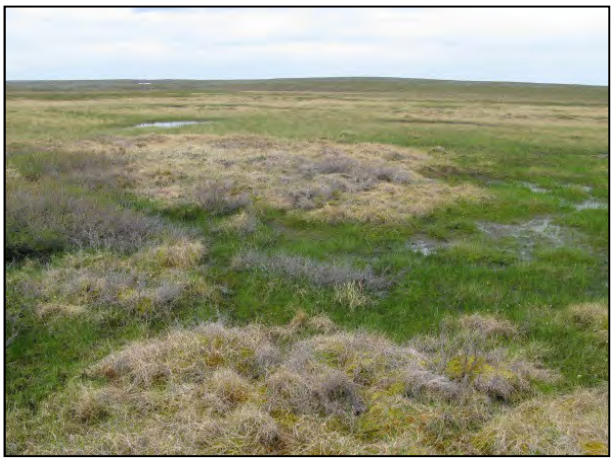
6.3 METHODS

6.3.1 Study Design

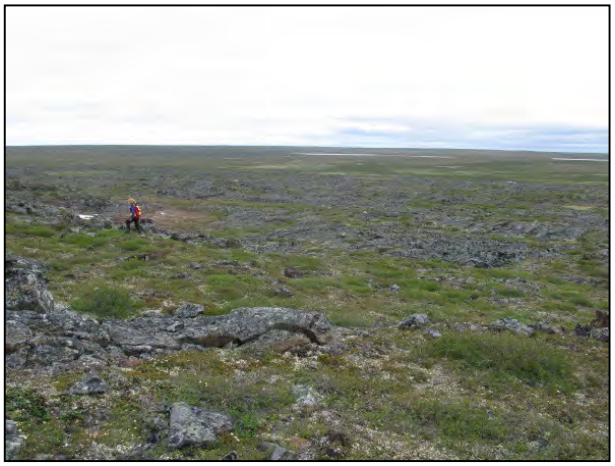
The Program for Regional and International Shorebird Monitoring (PRISM) is a comprehensive approach to monitor shorebirds in the United States and Canada. One of the main goals of the program is to monitor population trends to address concerns over apparent declines in many shorebird populations (Bart 2006). Though the PRISM method was developed to monitor shorebirds, the approach can be used to derive reliable population data for the other types of upland breeding birds as well (e.g. Matsuoka, Shaw, and Johnson 2010).

To adapt the PRISM method to survey for all types of upland breeding birds, a wide range of habitat types were sampled, including dry upland tundra. Stratified random sampling was used to choose plot locations within five study areas including in the shoreline of the FMSA in Bathurst Inlet, the George focused bird survey area, the George reference bird survey area, the Goose focused bird survey area, and the Goose reference bird survey area (Figure 6.3-1). Satellite imagery was used to delineate upland from lowland habitat within each study area. All possible plot locations were then mapped according to three criteria. First, plots were spaced more than 300 m apart to avoid counting the same birds on different plots. Second, all plots (except two) were positioned so that plots contained more than 80% of either upland or lowland habitat. Lowland plots were positioned so that plots were at least 30% covered by contiguous wetland and water, with at least an additional 50% cover of moist

hummock, shrub, and wet sedge meadow complexes. Upland plots were at least 30% covered by contiguous dry boulder-bedrock or heath lichen, with at least an additional 50% cover of dry to moist habitat complexes (Plate 6.3-1). Two 'mixed' plots in the Goose focused bird survey area contained approximately equal portions of lowland and upland areas. Lastly, plots were located to ensure adequate spatial coverage in all of the study areas. From all possible plot locations, plot locations were chosen using random selection of numbered plots, which resulted in 54 plots (29 lowland, 23 upland, and two mixed; Table 6.3-1; Figure 6.3-1). Six of these plots were surveyed in 2011 and were re-surveyed in 2012.



a) Lowland habitat: Sedge wetland, June 13, 2012.



b) Upland habitat: Rocky heath, June, 14 2012.

Plate 6.3-1. Examples of PRISM plot habitats surveyed for upland breeding birds in June, 2012.

Table 6.3-1. Number of PRISM Plots Surveyed, 2012

Region	Study Area	Habitat	Number of PRISM Plots
Marine Laydown Area	Focused Marine Survey Area	Lowland	3
		Upland	2
Total			**5**
George Property	Focused Bird Survey Area	Lowland	9
		Upland	7
	Reference Bird survey Area	Lowland	6
		Upland	8
Total			**30**
Goose Property	Focused Bird Survey Area	Lowland	9
		Upland	4
		Mixed	2
	Reference Bird Survey Area	Lowland	2
		Upland	2
Total			**19**
Grand Total			**54**

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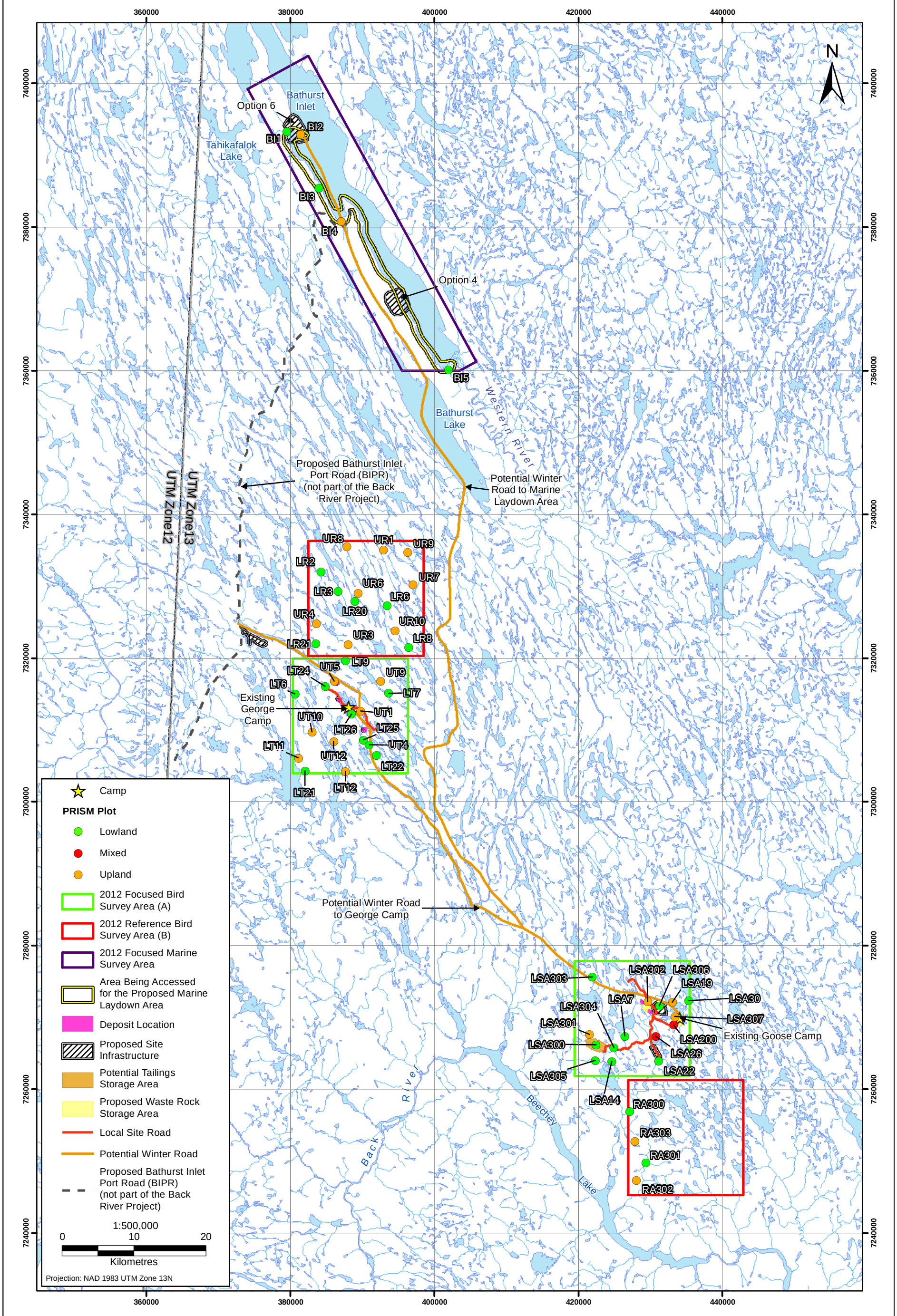

Figure 6.3-1

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PRISM Plot Locations for Upland Breeding Bird Surveys, 2012

Figure 6.3-1

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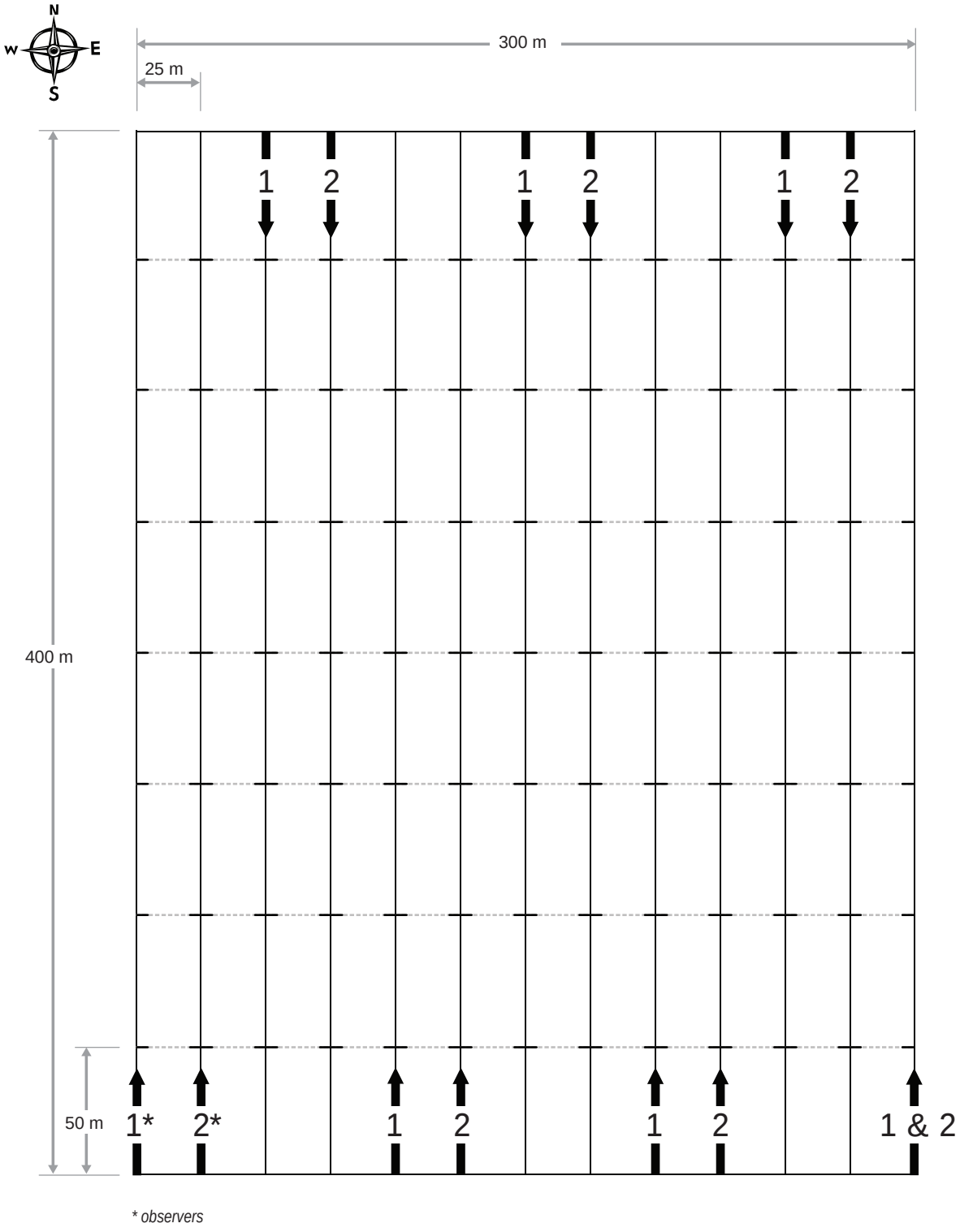
6.3.2 PRISM Surveys

The nesting season for upland breeding birds in Nunavut begins in early June and ends in July. In 2012, field surveys for upland breeding birds were conducted throughout the day during the nesting period. Weather (wind speed and direction, temperature, and cloud cover) was recorded at every plot. To minimize bias in detecting birds, surveys were not conducted during periods of heavy rain or strong wind (>30 km/h). Survey time per plot was 1.5 hours on average (range 1.2 - 2 hours).

Surveys for upland breeding birds were conducted using standard inventory methods for upland breeding birds in tundra or grassland habitats (Ralph et al. 1993; Environment Canada 2004). A team of two qualified observers conducted surveys following the PRISM protocol outlined by the CWS (CWS 2010). Observers arrived by helicopter at least 200 m from PRISM plots to minimize disturbance to birds. PRISM plots were 400 X 300 m (12 ha) in size and, for ease of navigation, were located with the longer side (400 m) oriented north-south. Observers systematically surveyed the plot starting from the south-west corner using handheld Garmin GPS Map62s units for navigation (advertised accuracy 3 to 15 m). The team walked in tandem along north-south transects approximately 25 m from one another. At the end of each 400 m long transect, each observer walked 50 m east to the next transect line, and walked through the plot again. This was repeated until each observer had walked six transect lines, for a total of 12 transect lines per plot (Figure 6.3-2).

During each PRISM survey, the team mapped all upland breeding birds within the plot area according to species and when possible, to sex. Observers focused on recording the location of active nests as well as using behavioural cues to estimate the location of nest territories within the plot. Nests of upland breeding birds are normally well hidden or camouflaged, making them difficult to find. However, observations of bird behaviour (e.g., rapid flushing from nest sites when incubating females are disturbed) can be used to find nests, or to pinpoint the approximate location of nest sites. Behavioural cues included observations of close association and copulation between individuals assumed to be paired, and territorial displays among males. Evidence of nesting was noted, including flushing from nests, and carrying of nest material and food, alarm-calling, and distraction displays. The locations (UTM) of active nests were geo-referenced using a handheld Garmin GPS Map62s, and nest productivity was recorded (number of eggs and nestlings). Territorial behaviour cues and nests were combined for each species to generate counts of the number of bird territories per PRISM plot.

In addition, one observer characterized and mapped the habitat types and prominent habitat features within each plot area - each territory was judged to be centred within one mapped habitat type. Observers recorded nine habitat types within PRISM plots, across the moisture gradient from dry to wet: Dry: beach, esker, rocky heath, heath lichen; Moist: heath hummock, short shrub, tall shrub; and Wet: sedge wetland, and water. These habitat types were derived from descriptions of vegetation communities to which upland breeding birds have been found to respond (e.g. Latour et al. 2005). Summaries are provided for upland breeding birds that flew over, occurred in flocks, or were seen or heard outside PRISM plots. Those that were recorded as ‘incidentals’ during other baseline environmental work conducted for the Project in 2012 are reported as ‘incidentals’ and reported in Appendix 5-2. Upland breeding birds that were observed outside PRISM plot boundaries or incidentally were not included in upland breeding bird data analyses. Detections of nest predators (gulls, ravens, jaegers, and foxes) made during PRISM surveys are reported in Section 6.4-5. Observations of all other bird and mammal species recorded during PRISM surveys are reported as ‘incidentals’ in respective sections of this report.



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Schematic of PRISM Plot and Survey Methodology

Figure 6.3-2

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6.3.3 Data Summary and Analysis

To describe broad patterns in the distribution of the upland breeding bird community, the total number of species detected (i.e., species richness), and total counts of territories across all species were averaged for upland and lowland habitats across all study areas. To show regional differences, these measures were averaged for upland and lowland habitats within each study area. Relative abundance was compared among songbirds, shorebirds, and ptarmigan by calculating average territory counts within upland and lowland habitat. To derive indices of abundance for each species, territory counts were averaged across lowland and upland habitats within each study area. Relative abundance for each species was also measured as frequency of occurrence: the proportion of PRISM plots with detections out of the total number of plots surveyed. To show spatial patterns in the distribution of Species of Conservation Concern (SCC), territory counts were summed across all SCC per plot and then averaged across upland and lowland plots within each study region and area. This analysis excluded the hoary redpoll, because it was difficult to distinguish from the common redpoll.

The distribution of common-detected species with respect to broad habitat types was quantified by calculating average territory counts within upland and lowland plots. Habitat associations for commonly-detected species (detected at > 10% of plots) at smaller spatial scales were described by summing territory counts per habitat type across all surveyed plots. These tallies describe the relative habitat associations among species, but may not reflect habitat selection per se, because the tallies reflect the sampling frequency rather than availability of each habitat type.

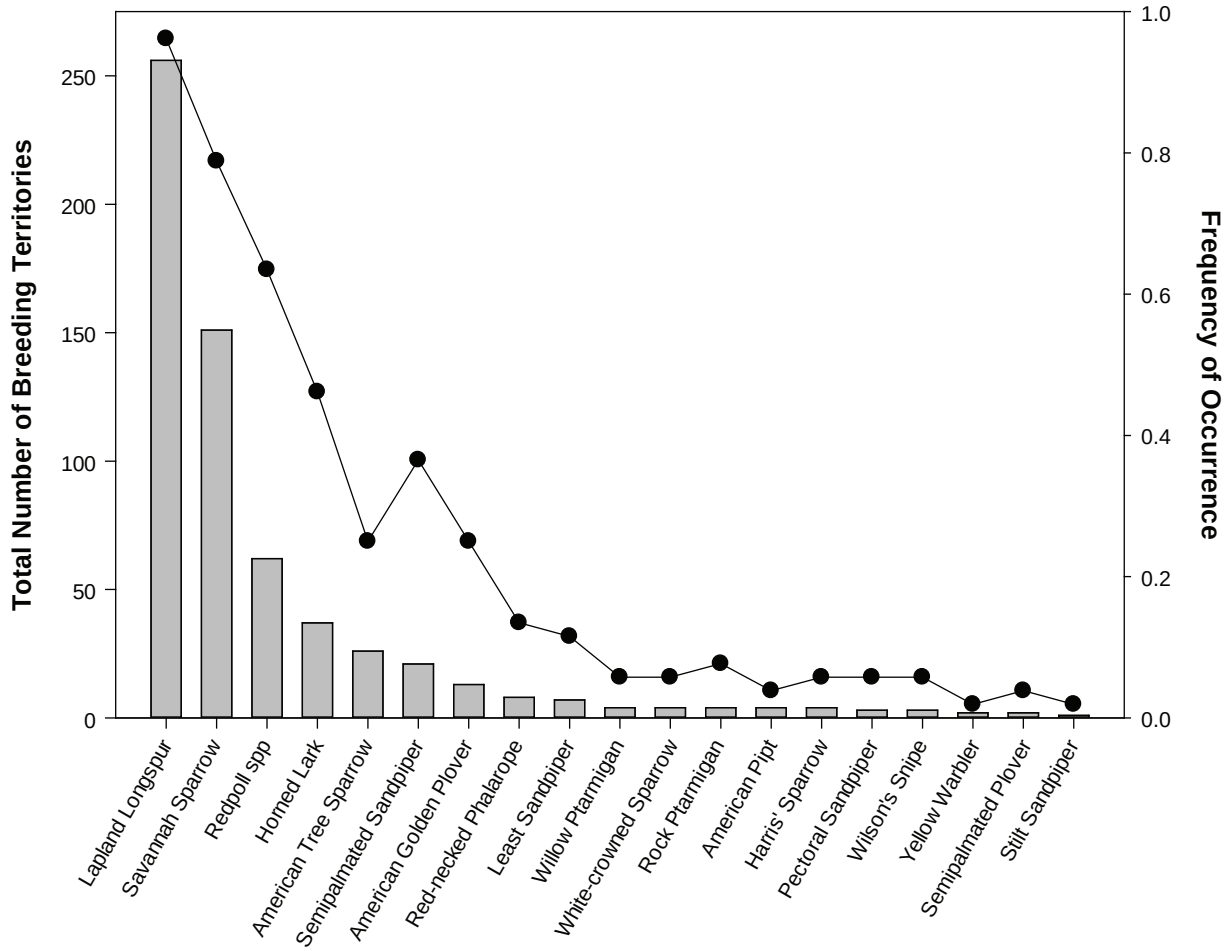
6.4 RESULTS

6.4.1 Species Observed

Fifty-four PRISM plots were surveyed from June 6 to June 27, 2012 (Figure 6.3-1; Table 6.3-1; Appendix 6-1). Thirty plots were surveyed in the George Property area (N = 16 in Focused Bird Survey Area; N = 14 in Reference Bird Survey Area) between June 6 and June 18, five were surveyed on June 17 and June 20 on the shores of the proposed marine laydown area in Bathurst Inlet, and 19 were surveyed in the Goose Property area (N = 13 in Focused Bird Survey Area; N = 4 in Reference Bird Survey Area) between June 22 and June 27, 2012.

A total of 920 individuals (Appendix 6-2) representing 625 nesting territories of 20 upland breeding bird species were counted within PRISM plot boundaries (Table 6.4-1 and Table 6.4-2; Figure 6.4-1). Observations of the 920 individuals comprised 95% of all detections; the remaining detections (46 individuals) could not be used to infer breeding territories because they were observations of groups of birds. Singing males and territorial and distraction displays were the most common ways of identifying territories, but other cues like flushing from nests were also used. An additional 294 individuals (17 of the 20 species) were counted outside PRISM plot boundaries (Table 6.4-1; Appendix 6-3) just before, during, or just after conducting PRISM surveys but were not included in further analyses. One flock of seven redpolls and seven groups (four to seven birds per group) of male Lapland longspurs were observed.

The 20 species observed represent 87% of the total number of upland breeding bird species that likely breed regularly within the region (“L” in “likelihood of Occurrence” column of Appendix 4-1), indicating that sampling effort was adequate to describe baseline conditions. Of the 20 species observed, nine are listed as “Sensitive” in Nunavut by the CESCC (CESCC 2010). These include: American golden-plover, American pipit, American tree sparrow, Harris’ sparrow, hoary redpoll, least sandpiper, red-necked phalarope, semipalmated sandpiper, and white-crowned sparrow (Table 4-5).



Note: Abundance is represented by bar graph.
Frequency is represented by line graph.

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Abundance and Frequency of Occurrence of Breeding Territories Observed per Species

Figure 6.4-1

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Table 6.4-1. Upland Breeding Birds Counted During PRISM Surveys, 2012*

			PRISM – Breeding Bird Territories						Outside PRISM Plot - Individuals			
		Scientific Name	George		Goose		Bathurst	Total				
Group	Species	# PRISM Plots	Focused Area 16	Reference Area 14	Focused Area 15	Reference Area 4	5	54	George	Goose	Bathurst	Total
Ptarmigan	Rock ptarmigan	*Lagopus mutus*	2	-	-	2	-	**4**	1	-	-	**1**
	Willow ptarmigan	*Lagopus lagopus*	2	-	1	-	1	**4**	-	-	-	**0**
Total Ptarmigan			**4**	**0**	**1**	**2**	**1**	**8**	**1**	**0**	**0**	**1**
Shorebird	**American golden plover**	*Pluvialis dominica*	3	5	3	1	1	**13**	6	5	-	**11**
	Least sandpiper	*Calidris minutilla*	1	2	4		-	**7**	-	3	-	**3**
	Pectoral Sandpiper	*Calidris melanotos*	-	2	-	1	-	**3**	-	-	-	**0**
	Red-necked phalarope	*Phalaropus lobatus*	3	-	4	1	-	**8**	-	1	2	**3**
	Semipalmated plover	*Charadrius semipalmatus*	-	-	-	-	2	**2**	-	-	2	**2**
	Semipalmated sandpiper	*Calidris pusilla*	8	6	4	-	2	**20**	4	2	7	**13**
	Stilt sandpiper	*Calidris himantopus*	-	-	2	-	-	**2**	-	1	-	**1**
	Wilson's snipe	*Gallinago delicata*	1	-	1	-	1	**3**	-	1	2	**3**
Total Shorebird			**16**	**15**	**18**	**3**	**6**	**58**	**10**	**13**	**13**	**36**
Songbird	**American pipit**	*Anthus rubescens*	-	3	-	1	-	**4**	1	-	-	**1**
	American tree sparrow	*Spizella arborea*	-	-	8	4	14	**26**	-	7	6	**13**
	Harris's sparrow	*Zonotrichia querula*	1	1	-	2	-	**4**	3	2	-	**5**
	Horned lark	*Eremophila alpestris*	13	12	7	4	3	**39**	17	6	-	**23**
	Lapland longspur	*Calcarius lapponicus*	82	71	82	17	11	**263**	40	27	1	**68**
	Redpoll spp.**	*Carduelis* spp.	14	6	18	11	14	**63**	43	31	17	**91**
	Savannah sparrow	*Passerculus sandwichensis*	44	18	50	17	25	**154**	20	24	8	**52**
	White-crowned sparrow	*Zonotrichia leucophrys*	-	-	-	1	3	**4**	-	-	1	**1**
	Yellow warbler	*Setophaga petechia*	-	-	-	-	2	**2**	-	-	-	**0**
Total Songbird			**154**	**111**	**165**	**57**	**72**	**559**	**124**	**97**	**33**	**254**
Total of All Species			**174**	**126**	**184**	**62**	**79**	**625**	**135**	**110**	**46**	**291**

**Species of Conservation Concern shown in bold type. **Hoary ("Sensitive Species") and common redpolls were visually confirmed to be present in the study areas, but these species are difficult to distinguish by sound. Counts of redpolls were summed across detections for which species identification was and was not confirmed.*

Table 6.4-2. Territory Counts of Upland Breeding Birds in PRISM Plots, 2012

Species	Territories Counted in PRISM Plots			Frequency of Occurrence*	Percent of Total Territories Counted
	Lowland Plots (N=29)	Upland Plots (N=23)	Total		
Lapland Longspur	145	111	256	0.96	0.42
Savannah Sparrow	125	26	151	0.79	0.25
Redpoll spp.	39	23	62	0.63	0.10
Horned Lark	8	29	37	0.46	0.06
American Tree Sparrow	19	7	26	0.25	0.04
Semipalmated Sandpiper	16	5	21	0.37	0.03
American Golden Plover	7	6	13	0.25	0.02
Red-necked Phalarope	8	0	8	0.13	0.01
Least Sandpiper	5	2	7	0.12	0.01
Willow Ptarmigan	4	0	4	0.06	0.01
White-crowned Sparrow	3	1	4	0.06	0.01
Rock Ptarmigan	1	3	4	0.08	0.01
American Pipit	0	4	4	0.04	0.01
Harris's Sparrow	0	4	4	0.06	0.01
Pectoral Sandpiper	3	0	3	0.06	0.00
Wilson's Snipe	3	0	3	0.06	0.00
Yellow Warbler	2	0	2	0.02	0.00
Semipalmated Plover	1	1	2	0.04	0.00
Stilt Sandpiper	1	0	1	0.02	0.00
***Total**	**390**	**222**	**612**	**-**	**-**

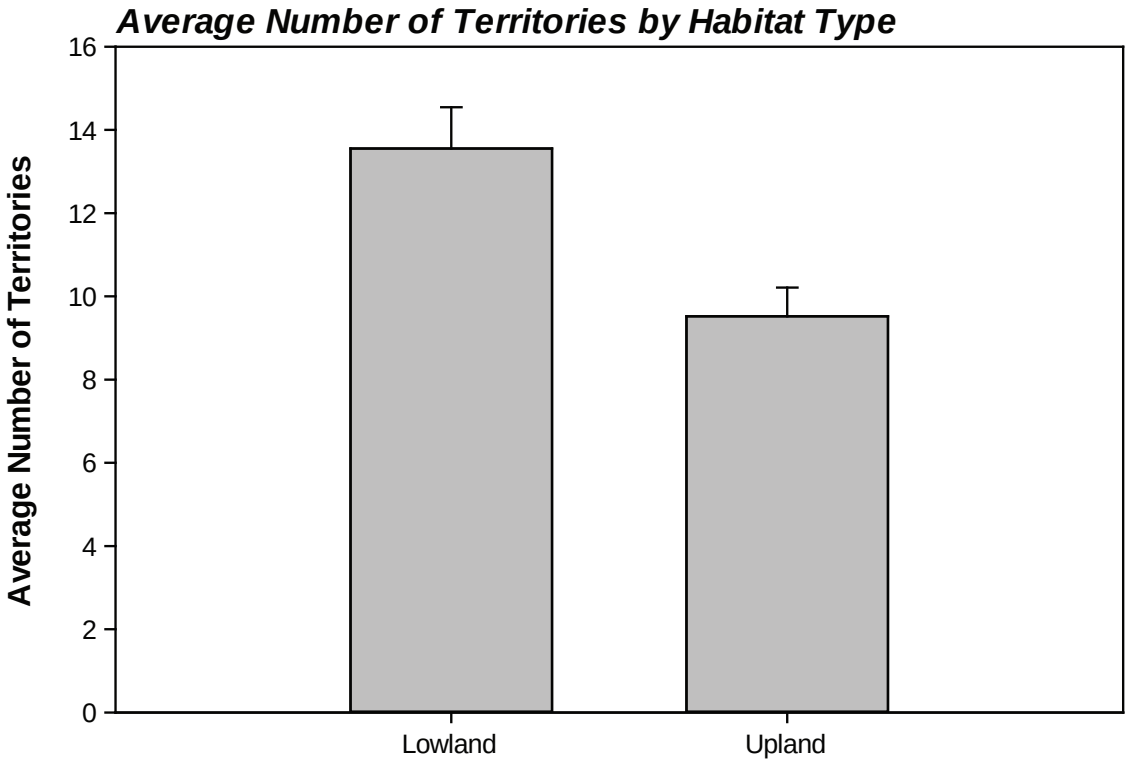
**Proportion of plots with territories. Fewer counts than those presented in Table 6.4-1 result from exclusion of counts made in two 'mixed' plots.*

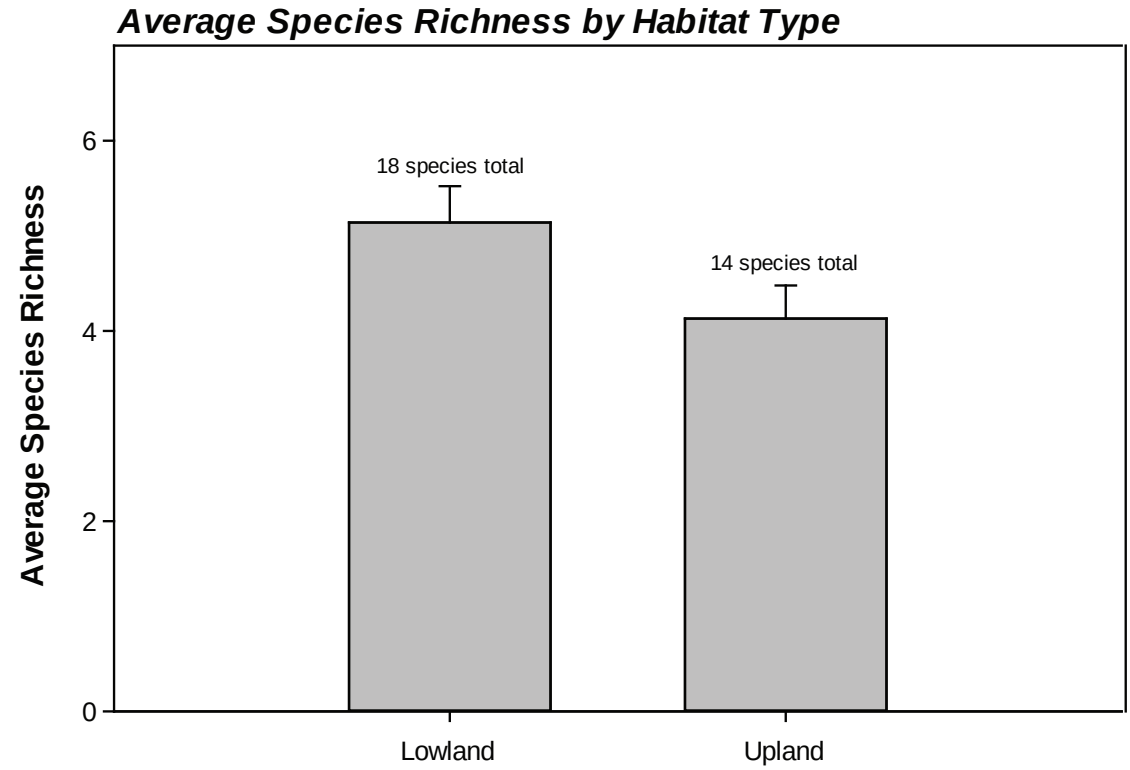
Territory counts of four songbird species – Lapland longspur, savannah sparrow, hoary and common redpolls (redpoll spp.) - comprised 77% (482 of 626) of all counts of upland bird territories (Figure 6.4-1; Table 6.4-1; Table 6.4-2). Each of these species occurred across more than 60% of PRISM plots (Table 6.4-2). The Lapland longspur was the most abundant and widely distributed species (96% frequency of occurrence); it occurred across all plots except two and comprised 42% of all territory counts (Table 6.4-2). Relative to the 10 species of songbirds observed, territory counts for eight species of shorebirds were relatively infrequent, comprising only 9.4% (59 of 626 territories) of all territories (Table 6.4-1).

6.4.2 Broad Patterns in Distribution of the Upland Breeding Bird Community

Lowland areas supported more upland breeding bird species and their territories compared to upland areas (Table 6.4-2; Figure 6.4-2). On average, observers recorded approximately one more species (1.01 ± 0.05[1]) and four more breeding territories (4.03 ± 1.21) of birds in lowland plots compared to upland plots (Figure 6.4-2). In total, four more species were observed in lowland plots relative to upland plots, but two species, the American pipit and Harris's sparrow, were only observed in upland plots (Table 6.4-2). Four shorebird species and willow ptarmigan were only observed in lowland plots.

[1] ± Standard Error (SE). All subsequent variation is reported in SE unless otherwise stated.





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Distribution of the Upland Breeding Bird Community in Broad Habitats

Figure 6.4-2

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By dividing average counts of territories per plot by plot size (12 ha), these counts were transformed to territory counts per hectare. Because observers rarely count all birds present, these counts represent minimum densities of territories. On average, lowland habitat supported at least 1.13 breeding pairs of upland birds per hectare; upland habitat supported at least 0.70 breeding pairs per hectare. Territory counts of songbirds and shorebirds were higher in lowland relative to upland habitat, while a similar number of Ptarmigan territories were counted in lowland and upland habitat (Figure 6.4-3). Lowland habitat supported on average three more songbird territories (2.93 ± 1.12) than upland habitat (0.98 versus 0.74 territories/ha, respectively; Figure 6.4-3).

Shorebird relative abundance was similar in lowland compared to upland habitat (0.16 and 0.12 territories/ha, respectively). However, this result was due to higher counts in upland habitat of just one shorebird species, the American golden plover. Relative abundance of all other shorebird species was about four times higher in lowland habitat (1.27 ± 0.23 territories in lowland; 0.32 ± 0.09 territories in upland). Ptarmigan territories were counted with similar frequencies in upland and lowland habitats (0.10 and 0.08 territories/ha, respectively; Figure 6.4-3).

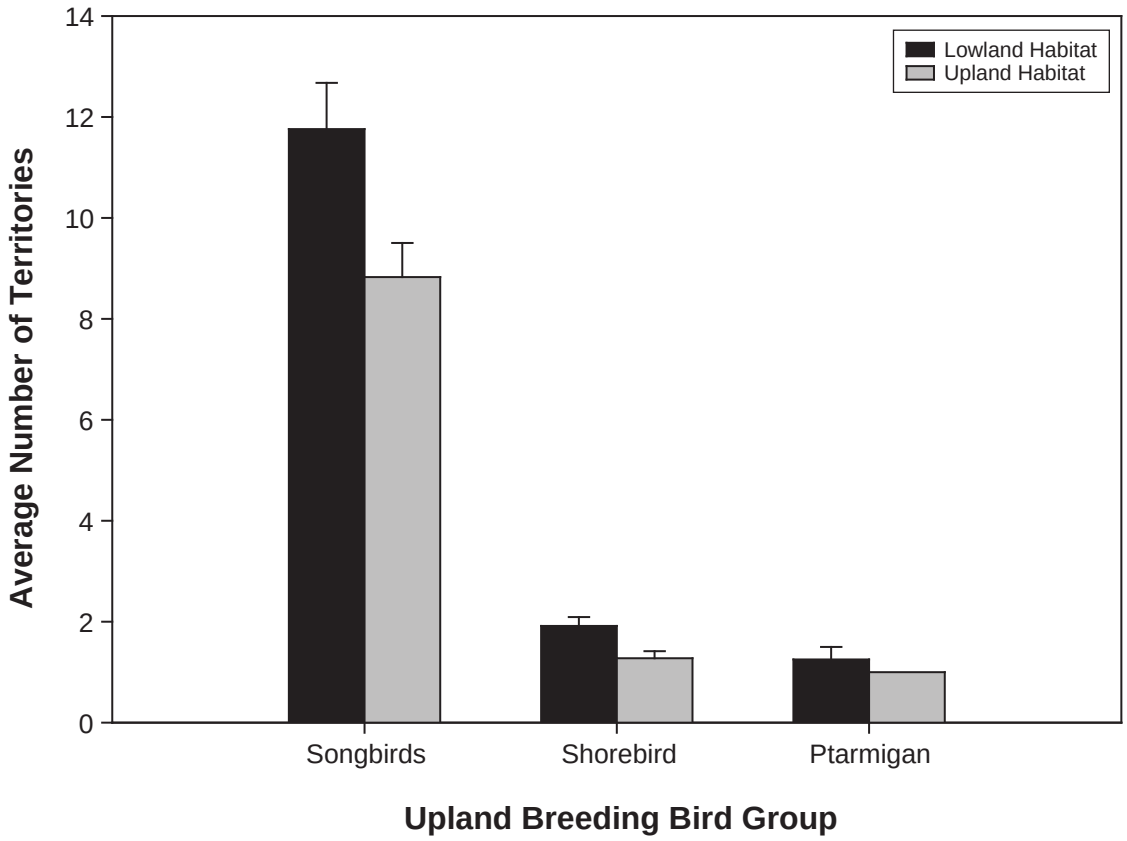
Species richness and counts of territories in upland habitat were similar across the three study regions (Figure 6.4-4; Figure 6.4-5; Figure 6.4-6; Figure 6.4-7). Counts of species and territories were similar in lowland habitat across all study areas except the George Lake RA, where low counts were consistent across all plots (indicated by small error bars, Figure 6.4-4). In lowland habitat, 1.25 ± 0.51 fewer species and 5.48 ± 1.10 fewer territories were counted on average in the George Lake RA, compared to the George Lake focused bird survey area and the other study regions combined. On average, PRISM plots in Bathurst Inlet contained approximately four breeding territories of species of conservation concern per plot, which was about twice the number counted elsewhere (Table 6.4-3, Figure 6.4-8). However, relatively high territory counts in Bathurst Inlet resulted from high counts of just one species, the American tree sparrow (Table 6.4-3).

Table 6.4-3. Territory Counts of Eight Species of Conservation Concern

	Marine Laydown Area	George Property		Goose Property		
Species	Focused Marine Survey Area (N=5 plots)	Focused Area (N=16 plots)	Reference Area (N=14 plots)	Focused Area (N=15 plots)	Reference Area (N=4 plots)	Total
American Golden Plover	1	3	5	3	1	**13**
American Pipit	-	-	3	-	1	**4**
American Tree Sparrow	14	-	-	8	4	**26**
Harris's Sparrow	-	1	1	-	2	**4**
Least Sandpiper	-	1	2	4	-	**7**
Red-necked Phalarope	-	3	-	4	1	**8**
Semipalmated Sandpiper	2	8	7	4	-	**21**
White-crowned Sparrow	3	-	-	-	1	**4**
Total	**20**	**16**	**18**	**23**	**11**	**88**

6.4.3 Broad and Small Scale Habitat Associations of Species

On average, territories of savannah sparrows, American tree sparrows, and semipalmated sandpipers were counted more frequently (greater than twice) in lowland relative to upland habitat (Figure 6.4-9; bars display average counts – uncorrected densities are shown above bars). In contrast, territories of horned lark pairs were counted more frequently (approximately three times) in upland habitat (Figure 6.4-9). Territories of red-necked phalaropes ("Sensitive" species) were only detected in the sedge meadows and small pools of sedge wetlands in lowland habitat (Figure 6.4-9, Table 6.4-4).



Note: Error bars represent standard error of the mean.

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Average Territory Counts of Songbirds, Shorebirds, and Ptarmigan in Broad Habitats

Figure 6.4-3

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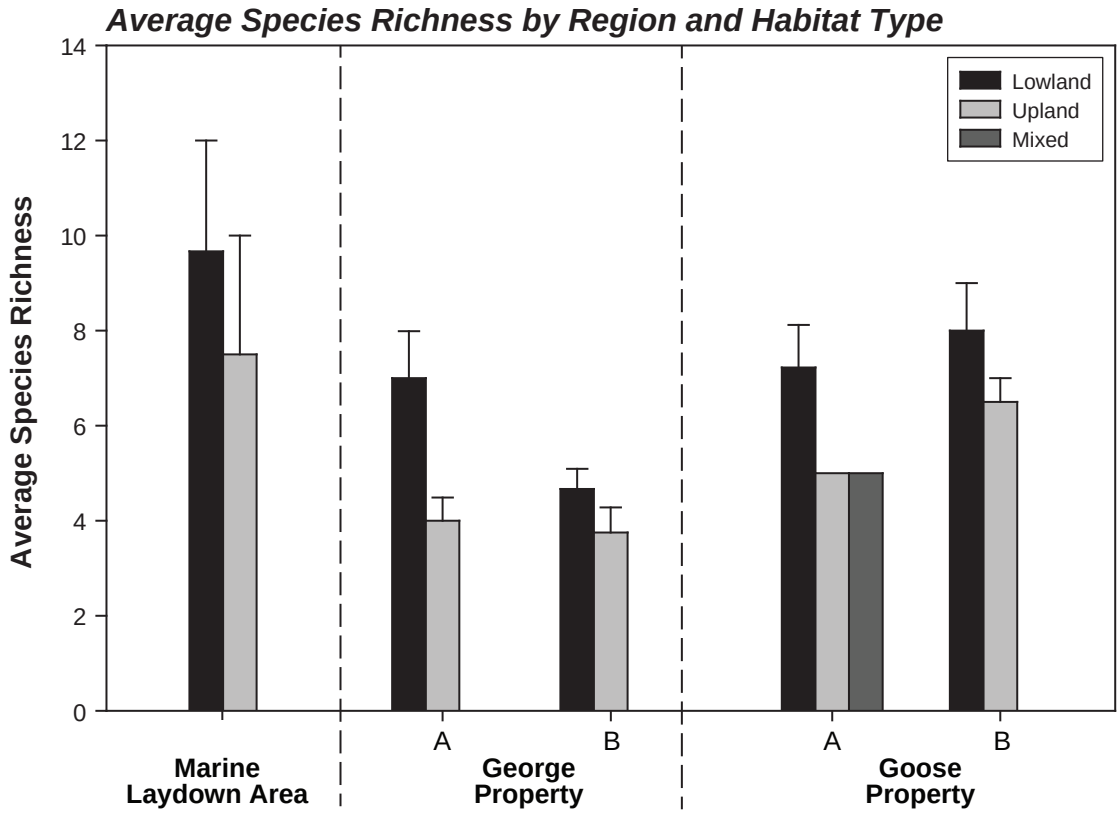

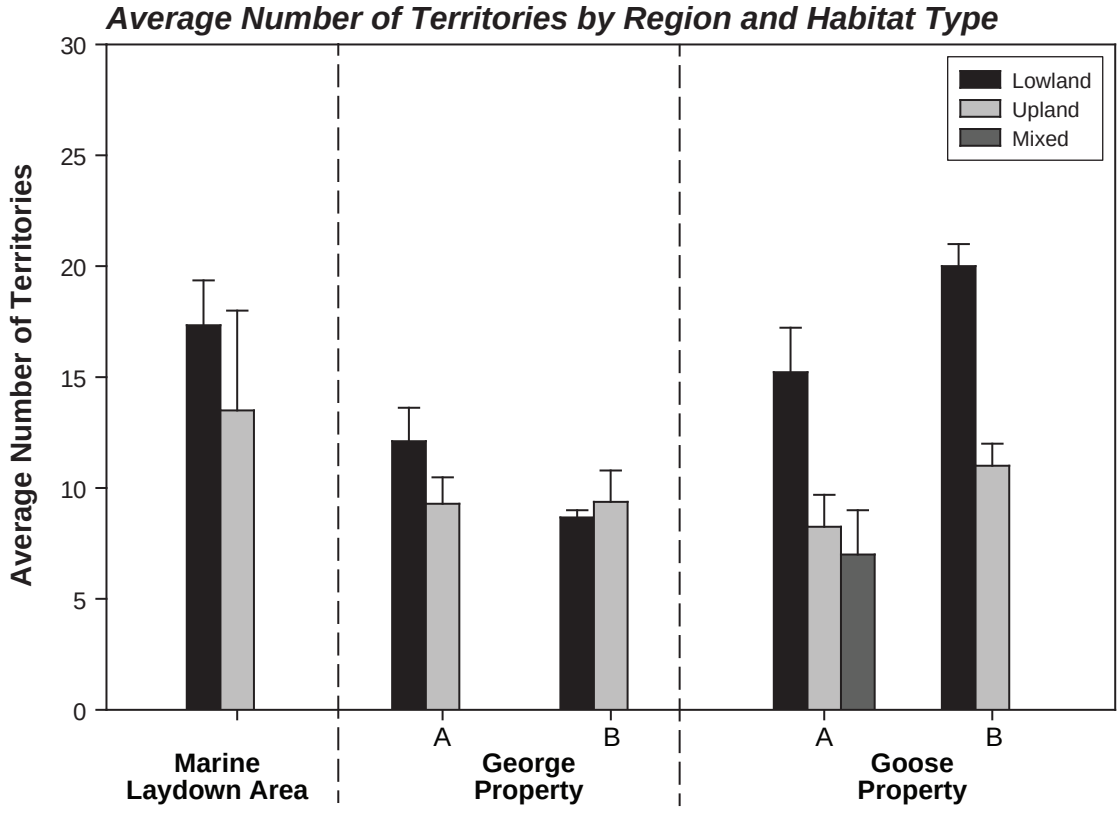

Note: "A" = 2012 Focused Bird Survey Area and "B" = 2012 Reference Bird Survey Area

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Regional Distribution of Upland Breeding Birds

Figure 6.4-4

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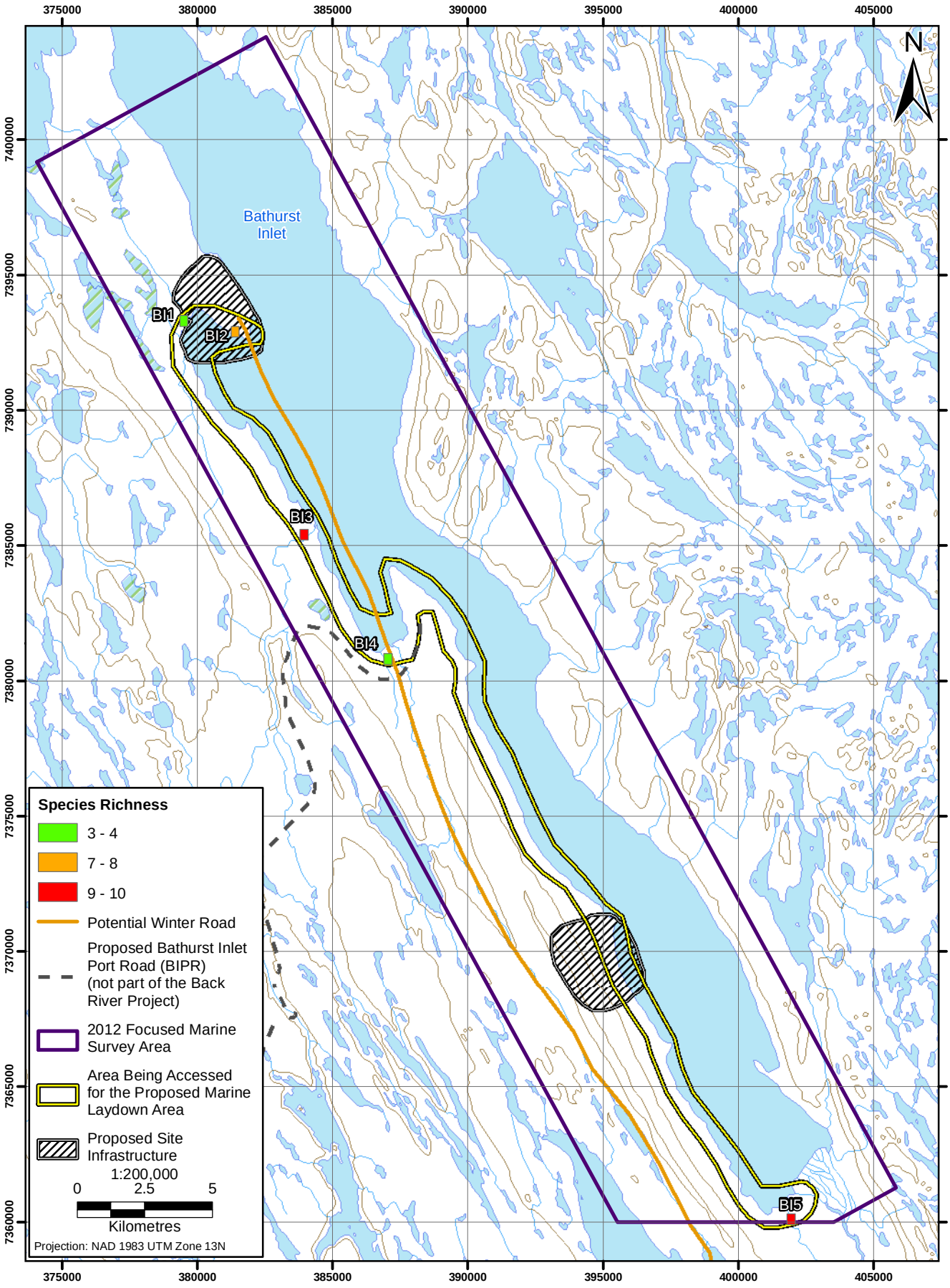

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Figure 6.4-5

Species Richness Recorded in PRISM Plots, 2012 - Marine Laydown Area

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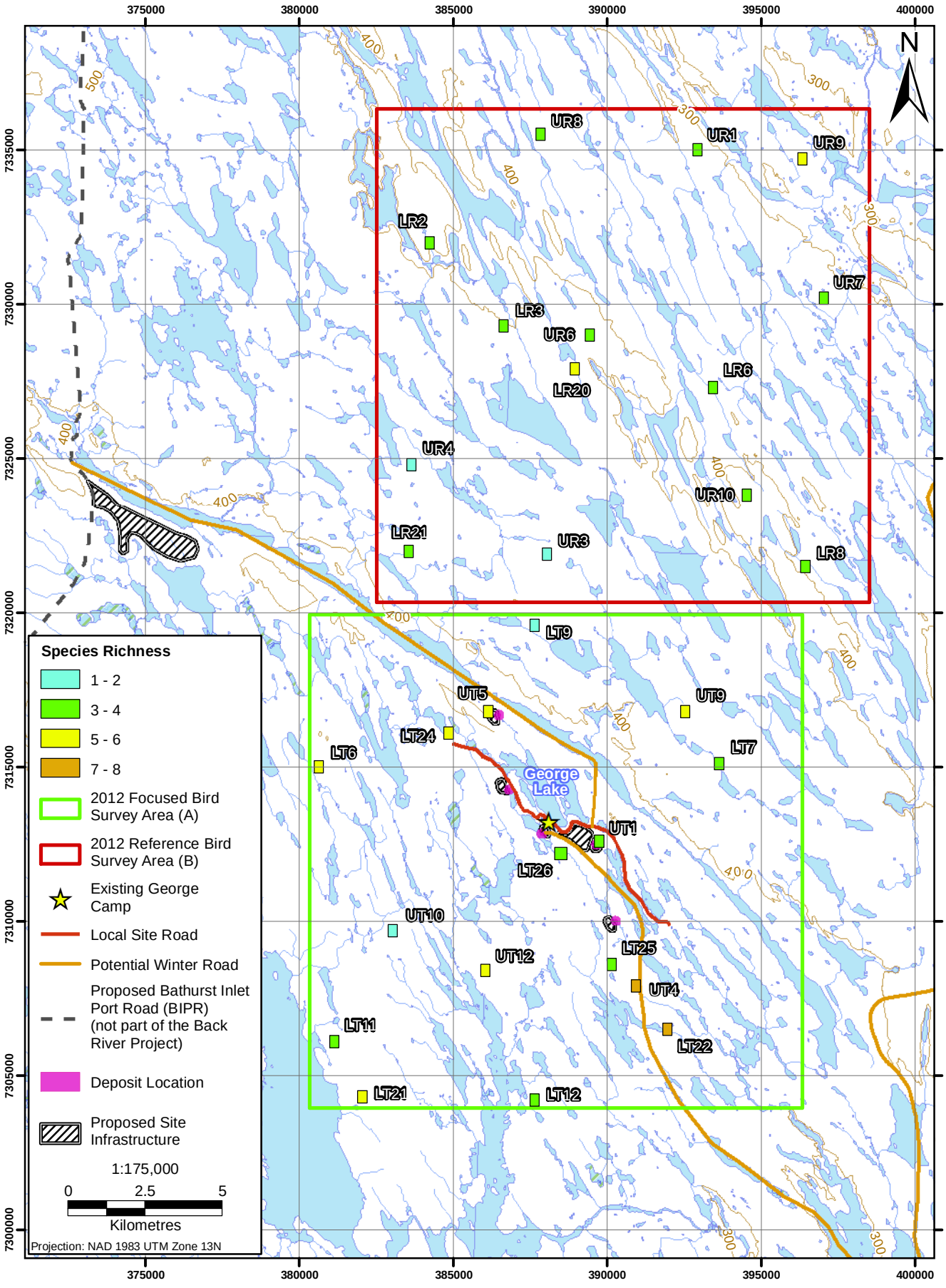

Figure 6.4-6

Species Richness Recorded in PRISM Plots, 2012 - George Area

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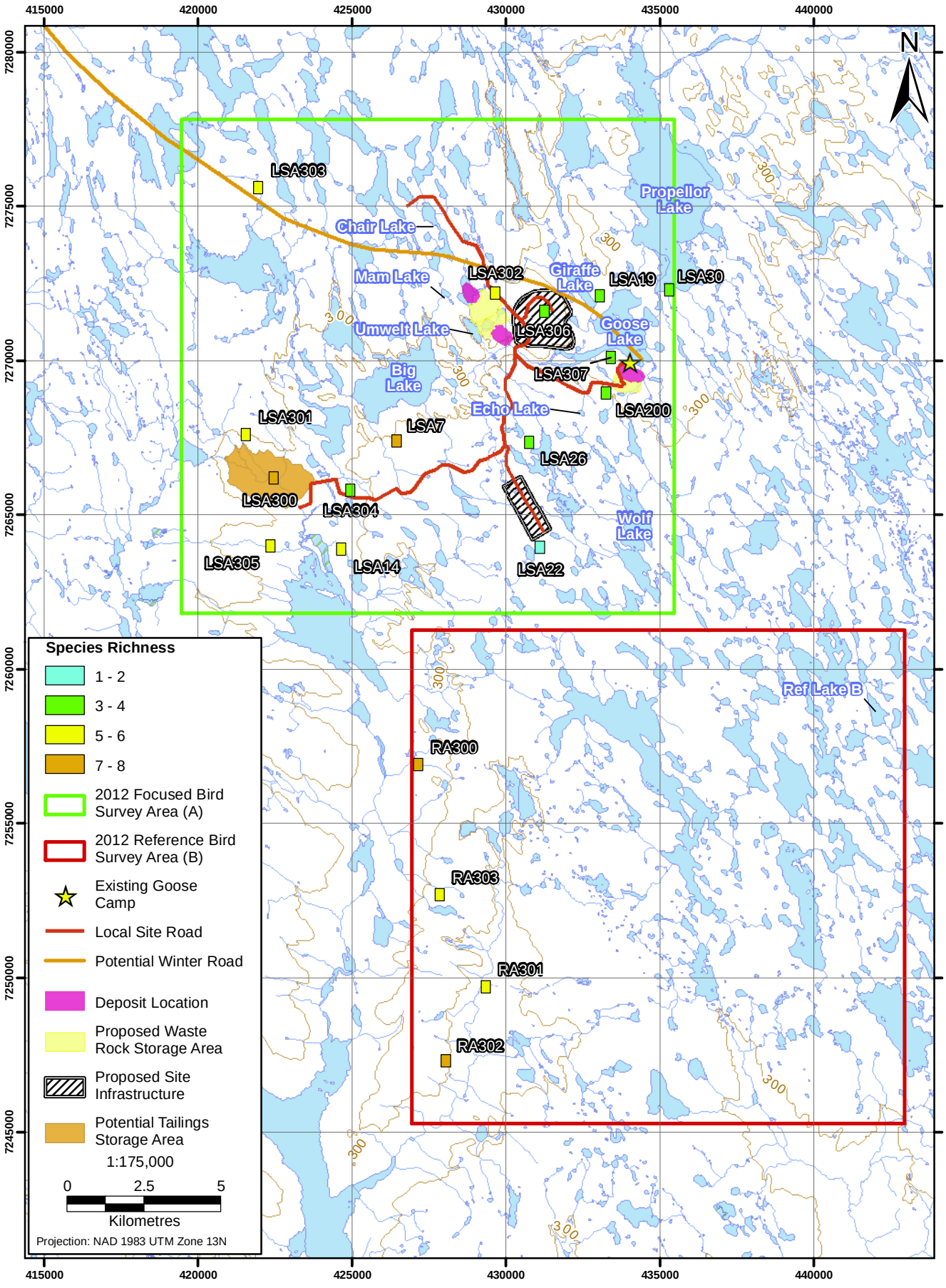

Figure 6.4-7

Species Richness Recorded in PRISM Plots, 2012 - Goose Area

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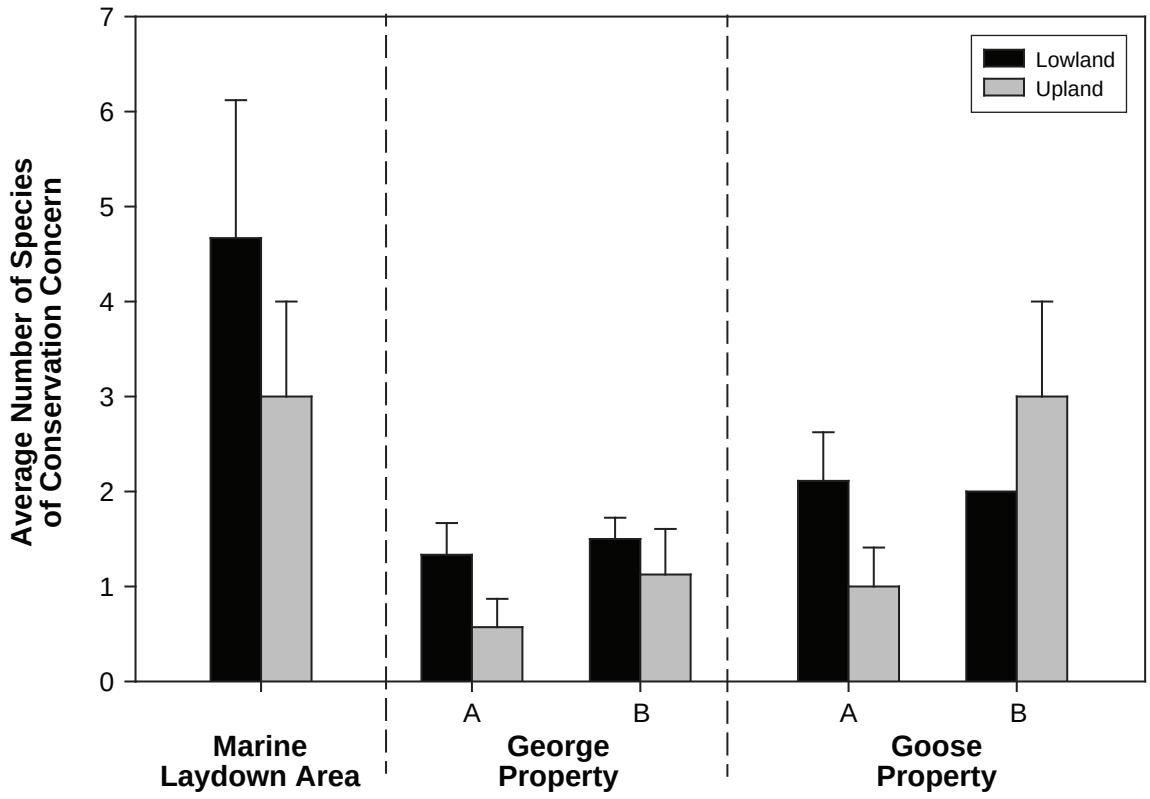

Notes: The eight species of conservation concern include: American golden-plover, American pipit, American tree sparrow, Harris's sparrow, least sandpiper, red-necked phalerope, semiplamated sandpiper, and white-crowned sparrow. The hoary redpoll (also a species of conservation concern) was not included as it was indistinguishable from the common redpoll (not a species of conservation concern).
"A" = 2012 Focused Bird Survey Area and "B" = 2012 Reference Bird Survey Area.

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Regional Distribution of Eight Species of Conservation Concern

Figure 6.4-8

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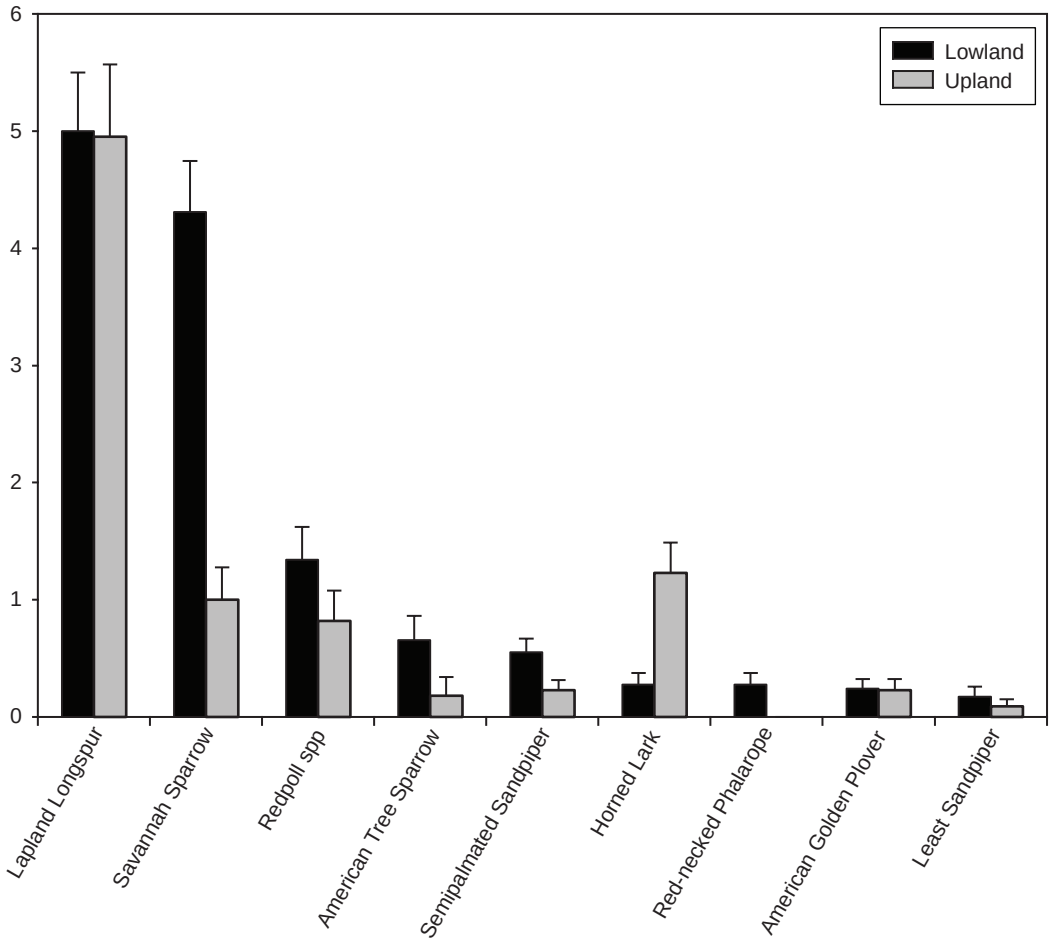

Note: Only commonly detected (detected in >20% of plots) were included.

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Distribution of Upland Breeding Bird Species in Broad Habitat Types

Figure 6.4-9

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Table 6.4-4. Territories of Upland Breeding Bird Species Counted in Dry, Moist, and Wet Habitats

	Dry Upland				Moist			Wet Lowland		
Species	**Beach**	**Esker**	**Rocky Heath**	**Heath Lichen**	**Heath Hummock**	**Short Shrub**	**Tall Shrub**	**Sedge Meadow**	**Water**	**Total**
Ptarmigan										
Rock Ptarmigan	-	-	3	-	1	-	-	-	-	4
Willow Ptarmigan	-	-	-	-	1	1	1	1	-	4
Shorebirds										
Semipalmated Sandpiper	-	-	-	-	3	-	-	18	-	21
American Golden Plover	-	-	6	4	2	-	-	1	-	13
Red-necked Phalarope	-	-	-	1	-	-	-	3	4	8
Least Sandpiper	-	-	-	-	-	-	-	7	-	7
Pectoral Sandpiper	-	-	-	1	-	-	-	2	-	3
Wilson's Snipe	-	-	1	-	-	-	-	2	-	3
Semipalmated Plover	-	-	-	1	-	-	-	-	1	2
Stilt Sandpiper	-	-	-	-	-	-	-	2	-	2
Songbirds										
Lapland Longspur	-	-	47	66	63	18	-	67	-	261
Savannah Sparrow	2	-	1	5	22	23	2	98	-	153
Redpoll spp.	-	1	16	16	1	15	4	10	-	63
Horned Lark	1	-	22	10	6	-	-	-	-	39
American Tree Sparrow	-	-	-	-	1	14	6	5	-	26
American Pipit	-	-	4	-	-	-	-	-	-	4
Harris's Sparrow	-	-	4	-	-	-	-	-	-	4
White-crowned Sparrow	-	-	-	-	-	1	2	1	-	4
Yellow Warbler	-	-	-	-	-	-	2	-	-	2
Total	**3**	**1**	**104**	**104**	**100**	**72**	**17**	**217**	**5**	**623**

Relative to territory counts in other small scale habitat types, all or most territories of semipalmated and least sandpipers ("Sensitive" species) and savannah sparrows were centered in wet sedge meadow, while most territories for American golden plovers ("Sensitive" species) and horned larks were found in dry upland habitat (Table 6.4-4; Figure 6.4-10). The American pipit and Harris's sparrow were only observed in dry rocky heath (Figure 6.4-10). Territories of the American tree sparrow and white-crowned sparrow ("Sensitive" species) were most often associated with short and tall shrub habitat (Figure 6.4-10). The hoary and common redpolls, like the Lapland longspur, were distributed relatively evenly across the moisture regime from dry to wet habitats (Figure 6.4-10).

6.4.4 Nest Productivity and Phenology

In total, 23 nests belonging to six species – Lapland longspur, savannah sparrow, American golden plover, horned lark, least sandpiper, and redpoll spp. - were found during PRISM plot surveys (Table 6.4-5; Plate 6.4-1). The nest sites of two species - Lapland longspur and savannah sparrow - accounted for 77% (20 of 26) of the nest sites found. At three territories, the nest site was indicated by the presence of a newly-fledged bird (Table 6.4-5).

Table 6.4-5. Productivity of Nesting Pairs of Upland Breeding Birds, 2012

	Egg Stage		Nestling Stage		Fledgling Stage	
Species	Number of Nests Found	Number of Eggs	Number of Nests Found	Number of Nestlings	Number of Nest Sites Found	Number of Fledglings
Lapland Longspur	10	5*	4	4.25*	1	1
Savannah Sparrow	5	4.5*	-	-	-	-
American Golden Plover	1	4	-	-	-	-
Horned Lark	1	4	-	-	-	-
Least Sandpiper	1	4	-	-	-	-
Redpoll spp.	1	5	-	-	2	1*
Total	**19**	**NA**	**4**	**NA**	**3**	**NA**
Average	**NA****	**4.42 ± 0.20**	**NA**	**4.25**	**NA**	**1**

**Average across all nest sites found per species. **NA = not assessed.*

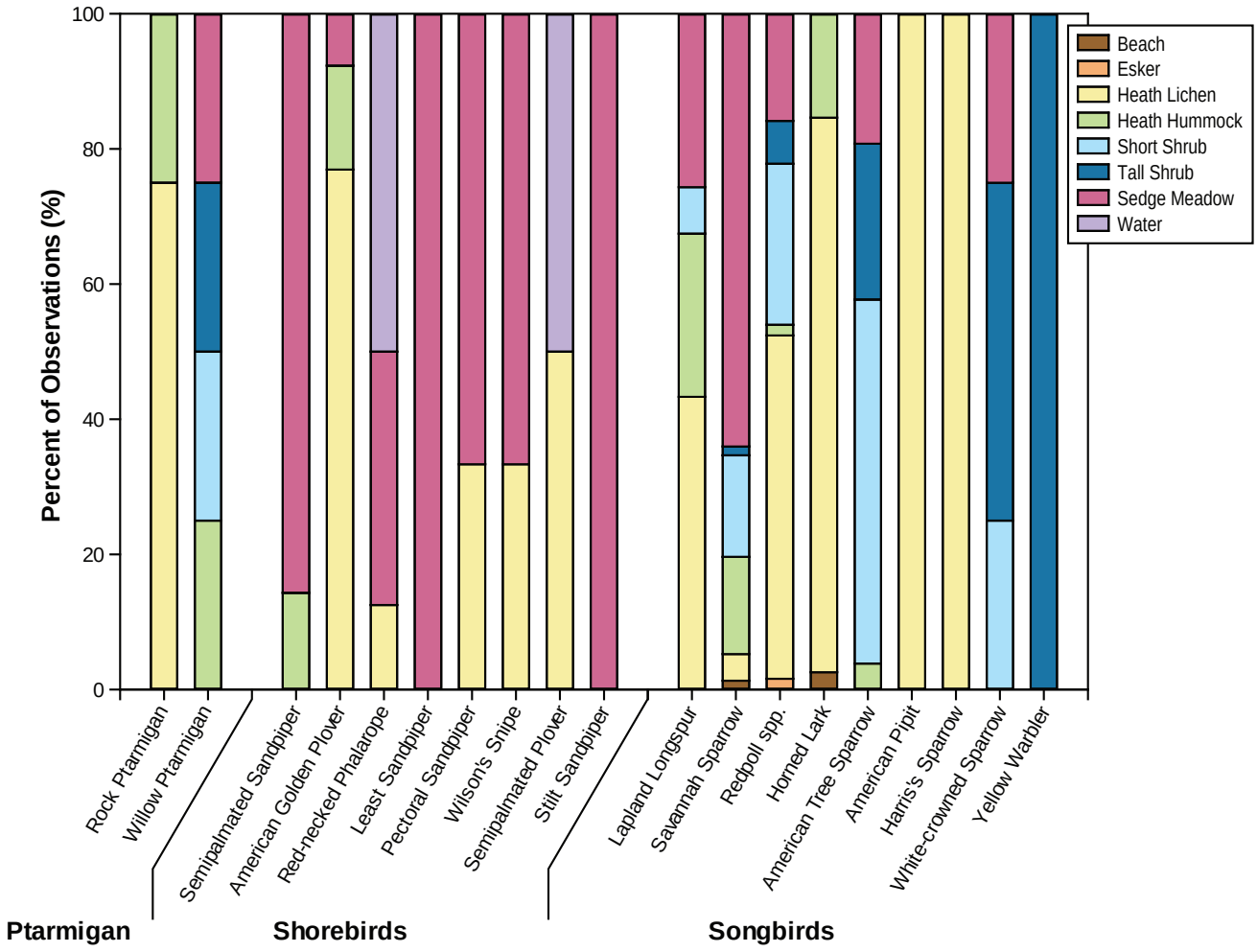
Averaged across all six species of upland breeding birds where eggs were found, nest productivity equalled 4.42 ± 0.20 eggs per nest (range four to five eggs, Table 6.4-5). All nests in the egg stage, except for two, were found from June 9, 2012 (the first date of surveying), until June 18, 2012; June 27 was the latest date that nests with eggs were found. All nests in the nestling stage were found after June 20, 2012. Three fledglings of two species were observed on June 26 and June 27, 2012.

6.4.5 Detections of Nest Predators

Gulls were the most frequently detected nest predators recorded during PRISM surveys (Table 6.4-6). Across a total survey time of approximately 81 hours (average of 1.5 hours per 54 plots), the detection rate of nest predators was 0.41 per hour, or about one predator every two hours and fifteen minutes.

Table 6.4-6. Number of Individuals of Nest Predators Detected during PRISM Surveys, 2012

Region	Marine Laydown Area	George Property	Goose Property	Total
Common Raven	1	5	3	9
Glaucous Gull	5	-	-	5
Herring Gull	-	3	6	9
Long-tailed Jaeger	-	2	2	4
Parasitic Jaeger	-	3	2	5
Red Fox	-	1	-	1
Total	**6**	**14**	**13**	**33**



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Summary of Upland Breeding Bird Small Scale Habitat Associations, 2012

Figure 6.4-10

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Common redpoll

Savannah sparrow

Lapland longspur

Willow ptarmigan

American golden-plover

Nestlings (Lapland longspur)

Plate 6.4-1. Nests of upland breeding birds observed in PRISM plots in June, 2012.

6.5 DISCUSSION

Surveys for upland breeding birds were conducted in June, 2012 in the FMSA in Bathurst Inlet, and in the George and Goose focused and reference bird survey areas using the PRISM method to characterize the abundance, distribution, habitat associations and breeding productivity of upland breeding birds in these areas. A total of 20 upland breeding bird species were detected in these areas, and while none of the 20 species observed during surveys are federally listed under the *SARA*, nine are listed as "Sensitive" in Nunavut by the CESCC (CESCC 2010): American golden-plover, American pipit, American tree sparrow, Harris' sparrow, hoary redpoll, least sandpiper, red-necked phalarope, semipalmated sandpiper, and white-crowned sparrow. For some of these species, a significant portion of the global population breeds within Nunavut (e.g., American tree sparrow, Harris' sparrow), while other species (e.g. least sandpiper) have experienced population declines (Morrison et al. 2006). Species richness and relative abundance was higher in lowland habitat, and similar across all study areas except two. The FMSA in Bathurst Inlet supported a richer and more abundant community of upland breeding birds, particularly of species of conservation concern. Lowland habitat in the George reference bird survey area had low species richness, and supported fewer territories of upland breeding birds. The majority of upland breeding bird females had initiated incubation by the second week of June in 2012; average breeding productivity for six species of upland breeding birds was 4.42 ± 0.20 eggs per nest.

Relatively high counts of breeding territories of four songbird species were observed, the most abundant of which were Lapland longspur (42% of observed territories) followed by savannah sparrow (25%), and redpoll spp. (common and hoary species; 10%). The other 16 species of upland breeding birds comprised only 23% of all detections. These results parallel findings in other studies, which together show that across the Arctic the upland breeding bird community is dominated by the Lapland longspur, along with a small group of other species, of which the composition varies regionally (Liebezeit, White, and Zack 2011; EDI 2012).

Detection rates of upland breeding birds in this study (1.13 and 0.70 pairs counted per hectare in lowland and upland habitat, respectively) were generally higher than those observed on the tundra using point counts (e.g., 0.36 ± 1.49 birds per hectare in lowland habitat on Baffin Island (EDI 2012), but very similar to rates observed using survey methods comparable to the PRISM protocol (e.g. 1.00 ± 0.06 nests per hectare in coastal Arctic Alaska (Liebezeit, White, and Zack 2011); 0.95 ± 0.11 in wetland habitat in the Canadian high Arctic (Latour, Machtans, and Beyersbergen 2005).

Songbirds were detected on average about five times more often than shorebirds and ptarmigan. While the differences found in this study probably reflect 'true' differences in abundance among these bird groups, it is also possible that the differences reflect lower detectability of shorebirds and ptarmigan. Male songbirds sing frequently during the breeding season, and so are relatively easy to detect. In contrast, shorebirds and ptarmigan usually vocalize and move only when nests are threatened. The PRISM method was designed to improve detectability of shorebirds, but detectability is almost never 100% (Bart 2006). Differences in detectability are an important consideration when using PRISM survey data to infer the relative abundance of bird groups across Arctic tundra.

This study was designed to derive estimates of upland breeding bird abundance in upland and lowland habitat. These data will be useful in future assessment, monitoring, and mitigation. The largest differences in the upland breeding bird community likely occur between these two habitat types. Importantly, estimates of bird abundance per habitat type can be used to statistically control for the effects of habitat type, and thus derive stronger inferences from tests for development effects.

The results show that lowland habitat supported on average one more species of upland breeding bird, and approximately four more breeding territories per 12 hectares of tundra relative to upland habitat.

Shorebird species, except the American golden plover, nested more often in lowland habitat. This result is similar to the findings of other studies showing the preference of shorebird species for nesting in lowland wet sedge marshes and meadows (Latour, Machtans, and Beyersbergen 2005; S. Brown et al. 2007; Ashenhurst and Hannon 2008; Liebezeit, White, and Zack 2011). Because wetlands are used by many insect species for breeding, lowland habitats likely support higher availability of insects, which are the primary food source of upland breeding birds. Though these patterns in the distribution of upland breeding birds suggest a relatively greater contribution of lowland habitat to the whole community, disturbances to upland habitat will likely affect some species like the American golden plover and horned lark that show preferences for upland habitat. Thus, both habitat types are necessary to support the full diversity and abundance of the upland breeding bird community.

Differences in detection rates across small scale habitat types observed in this study reflect statistical relationships that have been quantified in other Arctic studies (Rescan 2007c). In this study, the savannah sparrow and the American tree sparrow were two common songbird species showing stronger association with lowland than with upland habitat. The majority of detections (64%) of savannah sparrows were in lowland sedge meadows, and most American tree sparrows (77%) were counted in short and tall riparian shrubs in lowland habitat. These observations reflect the finding that upland breeding birds can be divided into three distinct communities based on vegetation preferences (Rescan 2007). One community, which includes the savannah sparrow and most shorebirds species, prefers to nest and forage primarily in sedge meadow. A second community, including the American tree sparrow, white-crowned sparrow, and yellow warbler, prefer to breed in habitat with tall shrubs which provide foraging substrate and cover for nests (Rescan 2007). Unlike the other two, the third distinct community is associated with dry upland heath habitat (Rescan 2007), and includes species like the American golden-plover, American pipit, and Harris's sparrow, all of which were observed in this study at least 75% of the time in upland heath lichen.

The results of this study suggest that most upland breeding bird females had finished egg-laying, and had initiated incubation by the second week of June in 2012. Nest productivity and phenology are sensitive to environmental changes like habitat disturbances, and seasonal variability in weather, especially when these occur over the long term due to climate change. Thus, estimates of nest success, clutch size, the number of nestlings and fledglings, and the timing of reproductive events like egg-laying and incubation, can provide valuable information useful in monitoring disturbances to birds over time. Average breeding productivity for six species of upland breeding birds was 4.42 ± 0.20 eggs per nest.

In this study, the detection rate of nest predators was 0.41 per hour, or about one nest predator detected every two hours and fifteen minutes. However, jaegers and the red fox were the only predators that may have been actively hunting for upland birds and their nests during the survey, as observations of ravens and gulls were of birds in fast or soaring flight. These data are relevant toward testing the hypothesis that one of the main impacts of industrial activity on upland breeding birds in the Arctic is lower nesting success from higher rates of nest predation by Arctic fox, gulls, jaegers, and the common raven (Liebezeit et al. 2009). Populations of these nest predators may be increasing because industrial activities provide supplemental food, and additional structures for nesting and denning. Baseline information on the abundance of nest predators can be used to inform monitoring efforts.

7. Waterbirds and Marine Birds

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7. Waterbirds and Marine Birds

7.1 INTRODUCTION

The lakes and wetlands of Nunavut support a large number of waterbirds, some of which are summer residents and others, transient migrants. Migratory species depend on northern habitats for a continued existence across the continent. Migratory waterbirds and marine birds receive protection under the federal *Migratory Birds Convention Act* (1994c), which includes regulations that prohibit the killing, capturing, injuring, taking, or disturbing of migratory birds, or the damaging, destroying, removing, or disturbing of nests (Canadian Wildlife Service 1991). Identifying species of conservation concern is imperative to meet the obligations of the *Species At Risk Act* (SARA; 2002a), which protects threatened and endangered species and their habitats. In Nunavut, several species of waterbird and marine bird are listed as sensitive and are likely to occur in the Back River RSA and/or the MRSA including: long-tailed duck, Arctic tern, glaucous gull, Thayer's gull, common eider, and king eider.

The term waterfowl has been used interchangeably with waterbirds; however, waterfowl refers only to species of dabbling and diving ducks, geese, and swans in the family Anatidae; whereas, waterbirds include waterfowl and other species that utilize wetland habitats such as gulls, loons, and grebes. For the purposes of this report, the term "waterbird" is used as an umbrella term to encompass birds that exclusively use water habitat for foraging, breeding, or staging during the year.

The presence of waterbirds is an indication of the availability of functional habitat. Lake attributes such as size, shape, food resources such as fish and aquatic invertebrates, and emergent vegetation structure and composition are important for waterbird nesting territories, transient staging, and protection from predators (Hoyer and Canfield 1994; Sovada, Anthony, and Batt 2001). Different species of waterbirds may use differing lake habitats during different breeding and staging phases (Nummi and Poysa 1993). In addition, for any one species, lakes used for staging and courting may represent different habitat features than lakes used by waterbirds with broods (Nummi and Poysa 1993). Thus, an understanding of habitat use during multiple life-requisite stages (e.g., staging and breeding) can provide insight into important habitat features for each waterbird species.

Marine birds include seabirds, seaducks, shorebirds, and some waterbird species that are reliant on marine environments during various life history stages, such as foraging or staging (Gill et al. 1996). The Queen Maud Gulf Migratory Bird Sanctuary is approximately 200 km east of Bathurst Inlet. The sanctuary is an important bird area with about 60 goose colonies and more than 12 species of waterbirds within the sanctuary. It is possible that in addition to locally breeding waterbirds some of the breeding species from the sanctuary could use Bathurst Inlet as a staging area prior to fall migration.

7.2 OBJECTIVES

Baseline studies were designed to investigate the presence and distribution of waterbird and marine bird communities within the Goose and George focused and reference bird survey areas, and within the FMSA located in the southern end of Bathurst Inlet. Specifically, the study objectives were to:

- characterize diversity, distribution, and seasonal extent of use within the Back River study area;
- to compare baseline conditions of each focused bird survey area to a reference area (reference bird survey area);

- identify important habitats (e.g., breeding or staging sites); and
- identify species of conservation concern in the area.

7.3 METHODS

Aerial surveys for waterbirds and marine birds were conducted in 2012 during baseline studies for the proposed Project. Aerial surveys were conducted using a Bell 206 helicopter with one pilot, two observers, and an additional person as data recorder for some surveys.

7.3.1 Waterbird Surveys

In 2012, a total of four aerial surveys were conducted in the George and Goose focused and reference survey areas for waterbirds according to established protocols described by the Canadian Wildlife Service (CWS) and the United States fish and Wildlife Service (USFWS; CWS and USFWS 1987). Survey dates were selected to: a) assess the extent of habitat use by migrating birds (staging surveys conducted in spring and fall), and b) collect evidence of breeding and reproduction (breeding surveys) by documenting the presence of breeding pairs (spring pair survey) and young birds (summer brood survey).

Aerial surveys were flown by helicopter at speeds of 40 km/hour (faster over land) and at an altitude of approximately 30 to 50 m within four survey strata: the Goose focused bird survey area, Goose reference bird survey area, George focused bird survey area, and George reference bird survey area (Figure 7.3-1). Survey strata were flown once for each of the four aerial surveys and consisted of eight transects arranged latitudinally. Transect lines were 16 km long, and spaced 2 km apart. The aircraft followed transect lines using an onboard Garmin global positioning system (GPS).

Data were collected by two observers – for some surveys an additional person recorded data. One observer sat next to the pilot on the left side of the aircraft, and the second observer sat behind the pilot on the right side facing forward and the data recorder sat directly behind the first observer on the left side facing forward. Observers searched lake surfaces and wetlands for waterbirds and/or waterbird broods. Whenever waterbirds were observed they were identified to the species level, when possible. Additionally, habitat information and coordinates of the observations were recorded using a handheld Garmin GPS Map62s. Habitat was categorized into six types of habitat: lake, pond, river, wetland, shoreline, and heath tundra. Lakes were further classified into small (<0.5 ha), medium (0.5 to 2 ha), and large (>2 ha) size designations. Data on lake size class were verified using GIS approximations of lake size.

7.3.1.1 Staging Surveys

Two staging surveys were conducted in 2012: a spring staging survey conducted in late May and a fall staging survey conducted in late August. For both staging surveys, observers identified waterbirds within 400 m on either side of the aircraft using binoculars. Observations of birds at greater distances from the aircraft were noted separately as “off transect” observations. The behaviour of the birds, e.g., flying, was also noted at the time of observation.

7.3.1.2 Breeding Surveys

Two aerial surveys were conducted during the breeding period: a spring pair survey conducted in the courting (pre-egg-laying) period in June and a summer brood survey conducted in mid-July after the egg-hatching. The aerial survey methodology used for breeding surveys was very similar to that used for staging surveys with two exceptions. Firstly, observers identified waterbirds within 200 m on either side of the aircraft rather than 400 m. Birds observed greater than 200 m from the aircraft noted separately as “off transect” observations. Secondly, observers focused on recording evidence of breeding using physical or behavioural cues. During the pair survey, observers noted whether male and

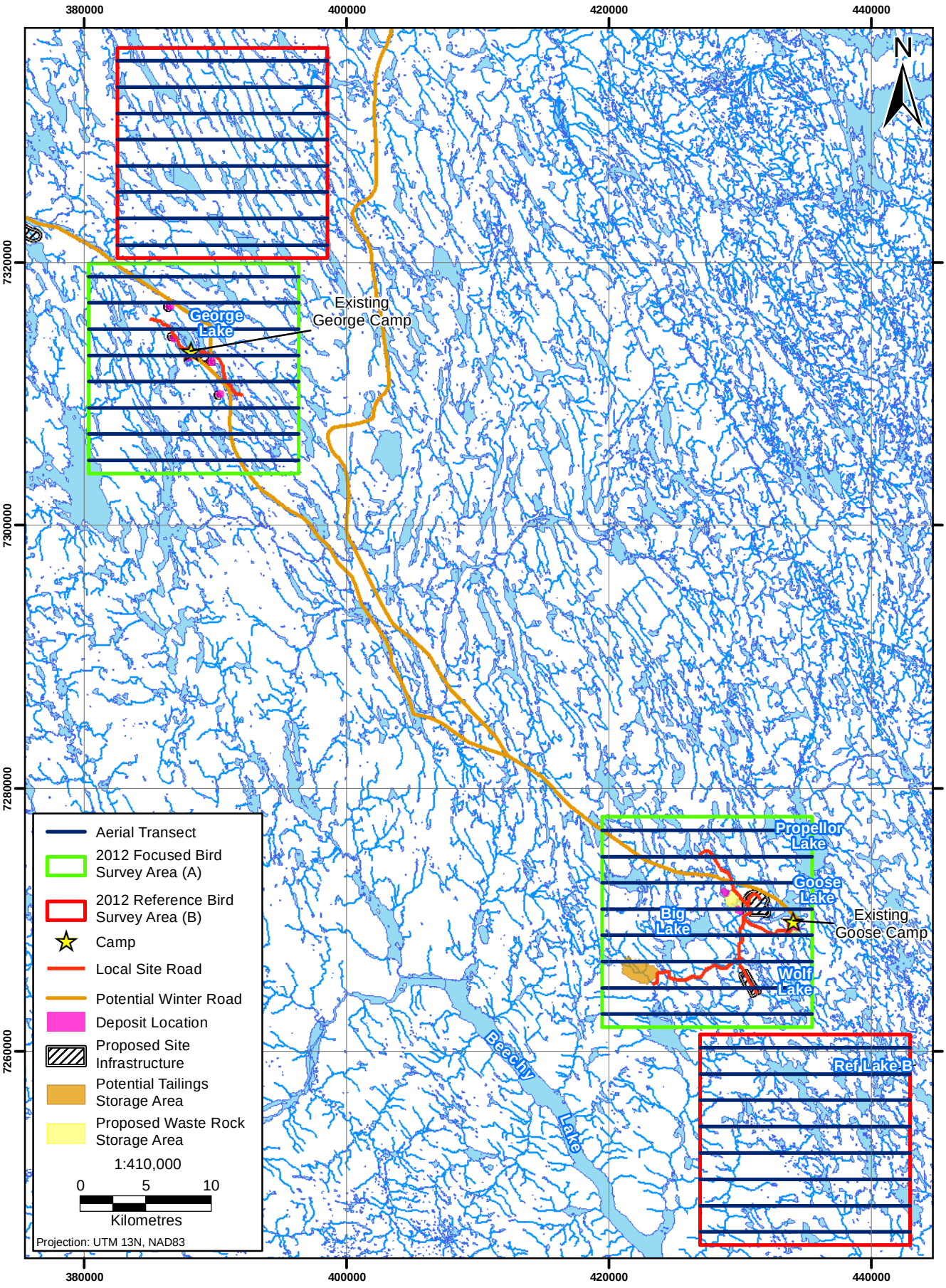

Figure 7.3-1

Waterbird Aerial Survey Strata and Transects, 2012

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females were paired as behavioural evidence of breeding. For sexually dimorphic species (i.e., where males and females look different), wherever a male and female were observed in close proximity they were considered to be a pair; in species where sexes look alike, the same distinction was made when only two individuals were observed in close proximity. During the summer brood survey, observers recorded the presence of broods and also estimated the age of the young birds using brood class (Table 7.3-1). Although brood classes were developed specifically for ducks, geese, and swans, they can also be applied to some non-waterfowl species, such as loons, as plumage development is similar in these species. The behaviour of the birds, e.g., flying, was also noted at the time of observation.

Table 7.3-1. Brood Class Descriptions for Waterbirds

Brood Class	Description
IA	Young are covered in bright down, neck and tail not prominent; 1-7 days old
IB	Young are covered in fading down, neck and tail not prominent; 8-13 days old
IC	Young are downed-covered, but colour faded, body elongated; 14-18 days old
IIA	First feathers appear, replacing down on sides and tail; 19-27 days old
IIB	Over half of body covered with feathers; 28-42 days old
IIC	Small amount of down remains, among feathers of back; 28-42 days old
III	Fully feathered but incapable of flight; 43-55 days of age, flying at 56-60 days old

Source: Bellrose (1980).

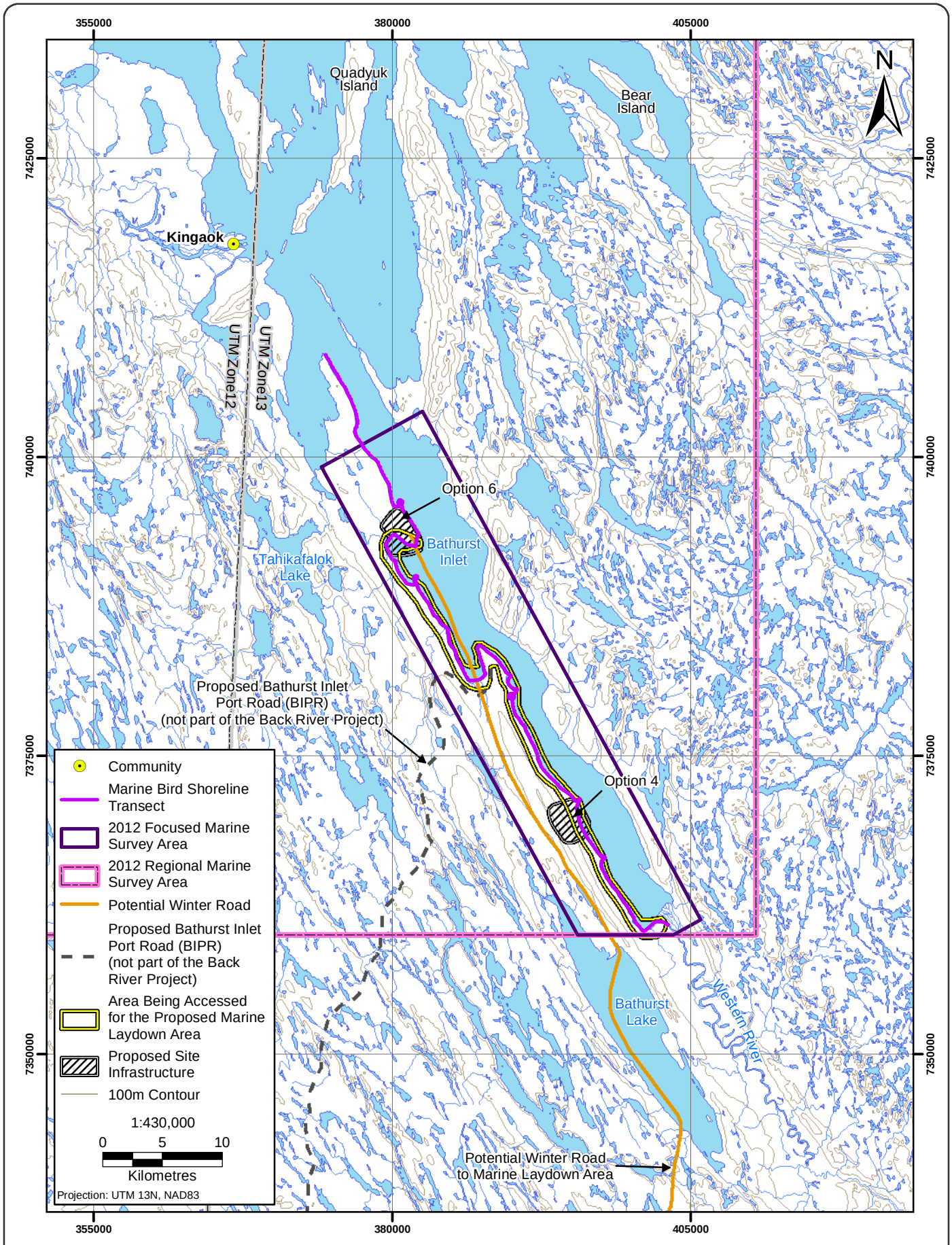
7.3.1.3 Data Analysis

Waterbird data were analyzed and summarized according to abundance and species richness across the four survey strata. Abundance is a count of the individuals seen and species richness is the total number of species observed. For analysis purposes, only data that were collected on survey were used in calculations. This included all observations of waterbirds within 400 m of either side of the aircraft during aerial staging surveys and within 200 m during aerial breeding surveys. Birds beyond the focal area for the survey were included as "off transect" or incidental observations.

7.3.2 Marine Surveys

A total of two aerial surveys for marine birds and waterbirds using Bathurst Inlet were conducted in the FMSA in 2012. Survey dates in 2012 for marine surveys were selected to establish baseline information for marine bird and waterbird presence and relative abundance during breeding (July) and early fall staging (August).

Aerial surveys were conducted along a single shoreline transect approximately 400 m east of the western shoreline extending from the southern tip of Bathurst Inlet to approximately 6 km north of the FMSA (Figure 7.3-2). Flight altitude during all aerial marine bird surveys was approximately 50 m (164 ft) at a flight speed of 40 km/hour. Data were collected by two observers – for some surveys an additional person recorded data. One observer sat next to the pilot on the left side of the aircraft. The second observer sat directly behind the pilot on the right side of the plane facing forward, while the recorder sat directly behind the first observer and faced forward. Observers searched an area of approximately 400 m on either side of the aircraft for marine birds. Whenever a marine bird or waterbird was observed, the species, number of individuals, and behaviour were recorded, as well as the location of the sighting using a handheld Garmin GPS Map62s. All habitat information for marine species was recorded as "marine" unless birds were observed on the shore in which case was recorded as "shoreline" or "heath tundra".



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Shoreline Transect for Aerial Surveys of Marine Birds and Waterbirds in the Marine Laydown Area, 2012

Figure 7.3-2

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7.3.2.1 Data Analysis

Marine bird data were analyzed and summarized according to abundance and species richness across the FMSA. For analysis purposes, only data that were collected on survey were used in calculations. This included all observations of marine birds within 400 m of either side of the aircraft during aerial surveys. Birds beyond the focal area for the survey were included as incidental observations.

7.3.3 Incidental Observations of Waterbirds and Marine Birds

Incidental observations of waterbirds were geo-referenced before and after waterbird surveys, off-transect during surveys, and opportunistically during other wildlife surveys and baseline studies in other disciplines in the RSA (Figure 3-1) and MRSA (Figure 3-2) during 2012. Whenever possible, waterbirds and marine birds were identified to the species level, sex, and age (young vs. adult), and habitat type identified. Incidental data are useful to determine the presence of species in the area, but cannot be used for assessment and monitoring because the observations cannot be standardized by effort. Thus, incidental observations were summarized by not included in any data analyses.

7.3.3.1 Remote Digital Cameras

Incidental observations of waterbirds were also recorded by remote digital cameras during the wolverine DNA study (Rescan 2013a) and the caribou baseline studies (Section 10). Remote digital cameras for the wolverine DNA study recorded observations from March to early May 2012 and cameras used for the caribou baseline studies recorded observations from late May to August 2012. For each photo where waterbirds were present, the following data were recorded: camera number, type of photo (motion or triggered), photo number, date, time of day, species, number of animals in the frame, behaviour, and any additional relevant information.

When photos were taken by successive triggers, the photos produced by the second and subsequent triggers were recorded as part of the same series if the photos were taken less than five minutes apart. If both timed and triggered photos were taken within five minutes of each other, they were initially recorded separately but were then combined and reviewed to remove any duplicates. All data were reviewed a second time to eliminate any possible duplicate recordings of the same individual, as waterbirds may spend more than five minutes at a site. If a photo series (motion or time triggered) was taken less than 24 hours apart, the photos were reviewed and analyzed to determine if they were of a unique animal based on visual characteristics. Observations of waterbirds were considered a duplicate if it was not possible to tell individuals apart within the 24 hour period and the maximum number of animals observed in an individual frame was considered the final animal count for that series.

7.4 RESULTS

7.4.1 Summary

A total of 19 waterbird species and 6,171 individuals were observed during the four waterbird surveys conducted in the Goose and George strata and the two marine bird surveys conducted in the FMSA (Table 7.4-1), 5,925 of which were observed on transect. An additional four species and 2,621 individuals were observed incidentally during other baseline studies. Overall, four confirmed species of conservation concern listed as sensitive in Nunavut were detected, including long-tailed duck (detected in the Goose and George focused and reference bird survey areas, Arctic tern (detected in the George reference bird survey area and in the Goose focused and reference bird survey areas), glaucous gull (detected in the Goose and George reference bird survey area and the 2012 focused marine survey area), and common eider (detected in the FMSA and MRSA). Geese (particularly Canada geese) were the most commonly observed species group across all surveys, including incidental observations. Large flocks of geese

Table 7.4-1. Waterbird Species Observed, 2012

			Spring Staging		Fall Staging		Spring Pair		Summer Brood		Marine Summer		Marine Fall		
Group	**Species**	**Scientific Name**	**On**	**Off**	**On**	**Off**	**On**	**Off**	**On**	**Off**	**On**	**Off**	**On**	**Off**	**Total**
Geese and Swans	Canada Goose	*Branta canadensis*	162	8	1,815	40	739	98	1,637	113	-	-	240	-	4,852
	Greater White-fronted Goose	*Anser albifrons*	183	14	-	-	3	4	5	-	-	-	-	-	209
	Snow Goose	*Chen caerulescens*	201	2	-	-	-	-	1	-	-	-	-	-	204
	Tundra Swan	*Cygnus columbianus*	2	-	2	-	-	-	-	-	-	-	-	-	4
	Unknown Goose		10	5	-	-	-	-	-	-	-	-	-	-	15
Dabbling Duck	Gadwall	*Anas strepera*	2	-	-	-	-	-	-	-	-	-	-	-	2
	Northern pintail	*Anas acuta*	5	1	20	-	8	-	-	-	-	-	-	-	34
	Unknown Duck		1	2	-	8	3	-	34	13	-	-	-	-	61
Diving Duck	Black scoter	*Melanitta nigra*	-	-	-	-	-	-	14	-	-	-	-	-	14
	Greater Scaup	*Aythya marila*	-	-	45	5	14	5	8	-	-	-	107	-	184
	*Long-tailed Duck	*Clangula hyemalis*	-	-	73	2	54	6	8	-	-	-	-	-	143
	Red-breasted Merganser	*Mergus serrator*	2	-	28	36	10	4	2	-	1	-	52	-	135
	Unknown Diver		-	-	10	1	-	-	43	-	1	-	-	-	55
Loon	Pacific Loon	*Gavia pacifica*	-	-	8	-	-	-	5	-	-	-	-	-	13
	Red-throated Loon	*Gavia stellata*	-	-	1	-	-	-	7	-	-	-	9	-	17
	Yellow-billed Loon	*Gavia adamsii*	-	-	5	-	2	-	4	-	1	-	-	-	12
Gulls/Terns	*Arctic Tern	*Sterna paradisaea*	-	-	-	-	6	-	3	-	-	-	-	-	9
	*Glaucous Gull	*Larus hyperboreus*	9	-	-	-	-	-	-	-	-	-	14	-	23
	Herring Gull	*Larus argentatus*	10	2	18	-	13	3	3	-	-	-	7	-	56
	Unknown Gull		-	-	-	-	-	-	4	-	16	-	-	-	20
Jaegar	Long-tailed Jaeger	*Stercorarius longicaudus*	-	-	-	-	-	-	1	-	-	-	-	-	1
	Parasitic Jaeger	*Stercorarius parasiticus*	1	1	-	1	2	-	-	-	-	-	-	-	5
Crane	Sandhill Crane	*Grus canadensis*	1	3	2	3	-	1	2	-	-	-	-	-	12
Waterbird	Unknown Waterbird		-	-	-	-	-	-	65	-	1	25	-	-	91
Total			**589**	**38**	**2,027**	**96**	**854**	**121**	**1,846**	**126**	**20**	**25**	**429**	**0**	**6,171**

**Species of conservation concern*
On = Observed on transect
Off = Observed off transect and included as an incidental

including snow geese, greater white-fronted geese, and Canada geese were observed during the spring staging surveys. Large flocks of Canada geese, long-tailed duck, red-breasted merganser, northern pintail, and greater scaup were detected during the fall staging surveys. All flocks primarily occurred on large lakes during both staging surveys and were located primarily in the Goose reference bird survey area during spring staging and throughout all four Goose and George strata during fall staging. In addition, several small flocks of greater scaup, red-breasted merganser, and Canada geese were observed in the FMSA during the marine fall staging survey. During the spring pair surveys, a total of 18 pairs were detected for three species including long-tailed duck, red-breasted merganser, and greater scaup with the majority consisting of long-tailed duck pairs occurring in large and medium sized lakes in the Goose strata (focused and reference bird survey areas). Evidence of breeding (confirmed broods) was detected for two species including Canada goose in both the Goose focused and reference bird survey areas and sandhill crane (detected incidentally) in the Goose focused bird survey area. All broods were observed in large lakes.

7.4.2 Waterbird Surveys

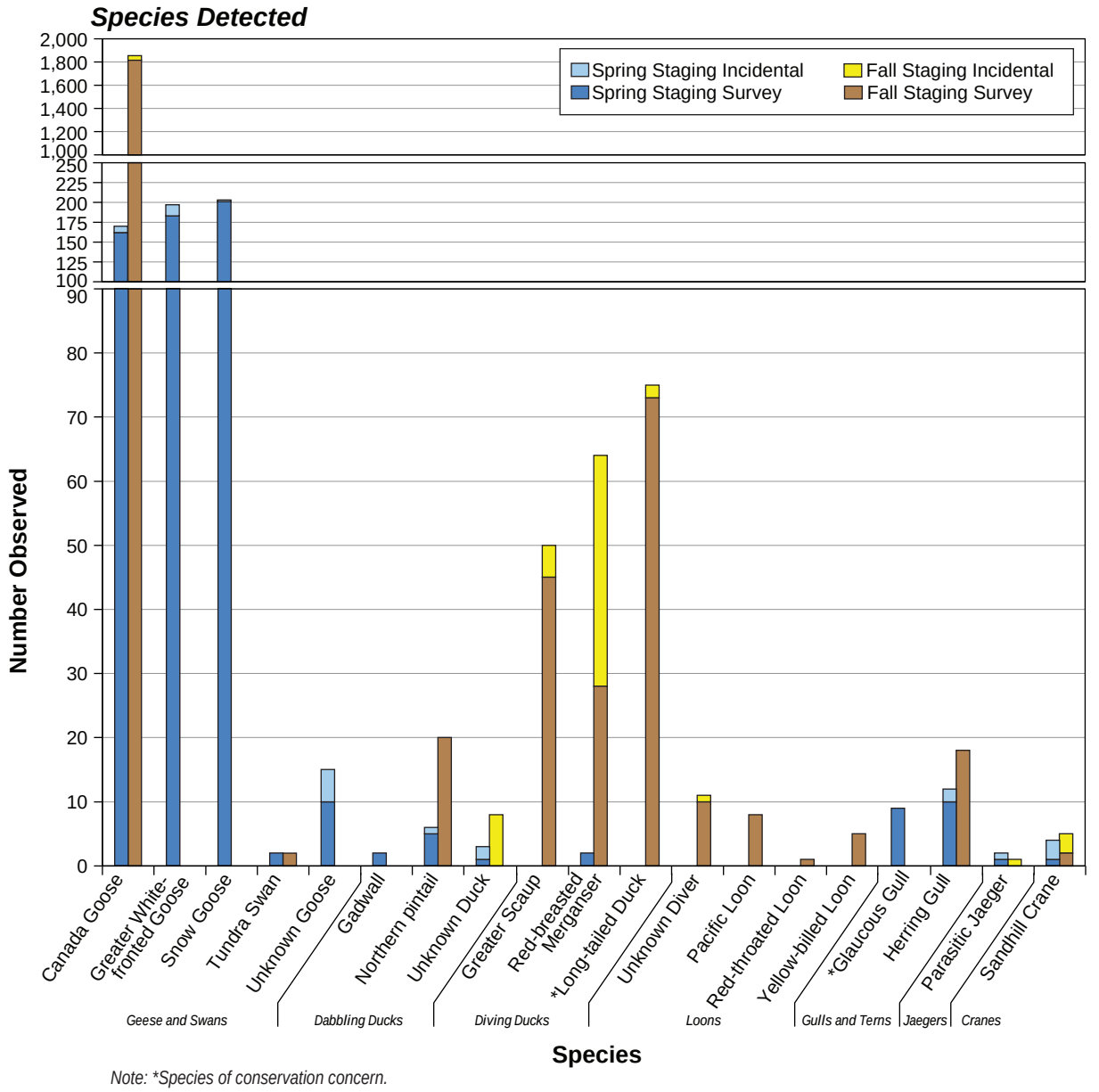
7.4.2.1 Staging Surveys

Two staging surveys were conducted in four survey strata (Goose focused bird survey area, Goose reference bird survey area, George focused bird survey area and George reference bird survey area): one conducted during spring migration, on May 29, 2012, and the second conducted during fall migration on August 25, 2012 (Appendix 7-1). Survey effort was similar across all survey strata and between the two staging surveys (Table 7.4-2).

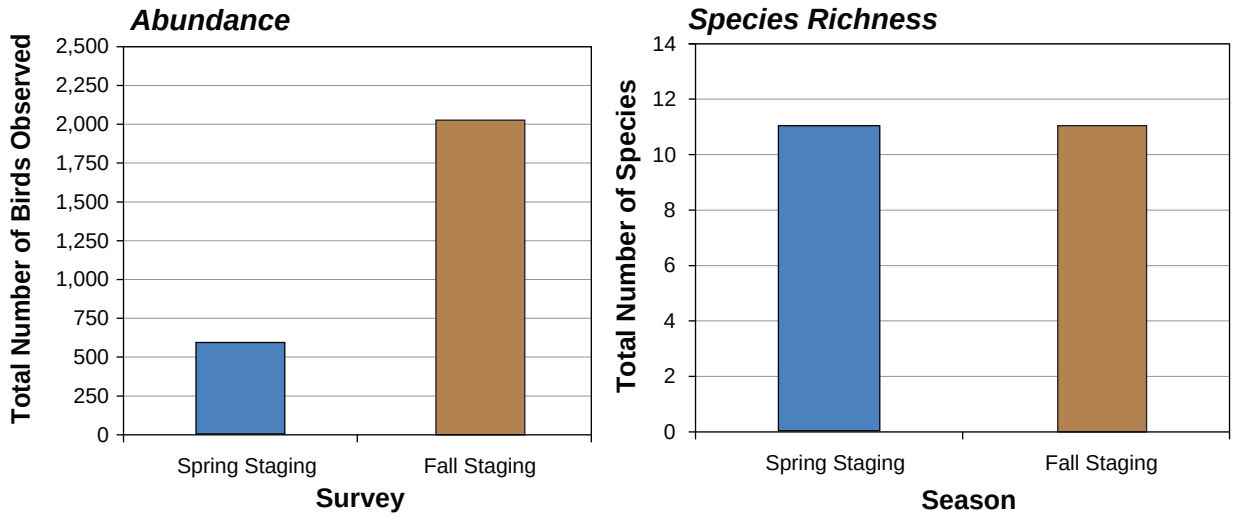
Table 7.4-2. Summary of Survey Effort for Waterbird Surveys Conducted in the Goose and George Strata

		Survey Effort (minutes)			
		Goose Bird Survey Areas		George Bird Survey Areas	
Survey	Date	Focused	Reference	Focused	Reference
Spring Staging	May 29, 2012	58	59	60	69
Fall Staging	August 25, 2012	68	68	75	63
Spring Pair	June 22 and 23, 2012	65	65	62	62
Summer Brood	July 14 and 15, 2012	61	75	65	64

A total of 16 species and 2,616 individuals were detected on transect during staging surveys with an additional 134 individuals recorded off-transect (Figure 7.4-1; Table 7.4-1). Waterbird abundance was higher in fall (2,027 individuals) relative to spring (589 individuals; Figure 7.4-1), and higher in the Goose focused and reference bird survey areas (515 and 1,218 individuals for spring and fall staging, respectively) relative to the George focused and reference bird survey areas (74 and 809 individuals for spring and fall staging, respectively; Figure 7.4-2). Species richness was similar between spring and fall surveys (11 species observed during both surveys; Figure 7.4-1) and was highest in the Goose reference bird survey area during both spring and fall staging surveys (10 and eight species, respectively; Figure 7.4-2). Species richness in the George focused bird survey area was higher relative to the George reference bird survey area in both spring and fall staging surveys. A greater diversity of geese species were recorded during spring staging surveys although abundance of geese was greater during the fall. The abundance and diversity of ducks and loons was highest during fall staging relative to spring staging surveys. Waterbirds were distributed throughout all survey strata, and no spatial patterns were evident within each survey strata during spring or fall staging (Figure 7.4-3 and 7.4-4).



*Note: *Species of conservation concern.*



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Waterbird Species Detected and Species Abundance and Richness Recorded during Staging Surveys, 2012

Figure 7.4-1

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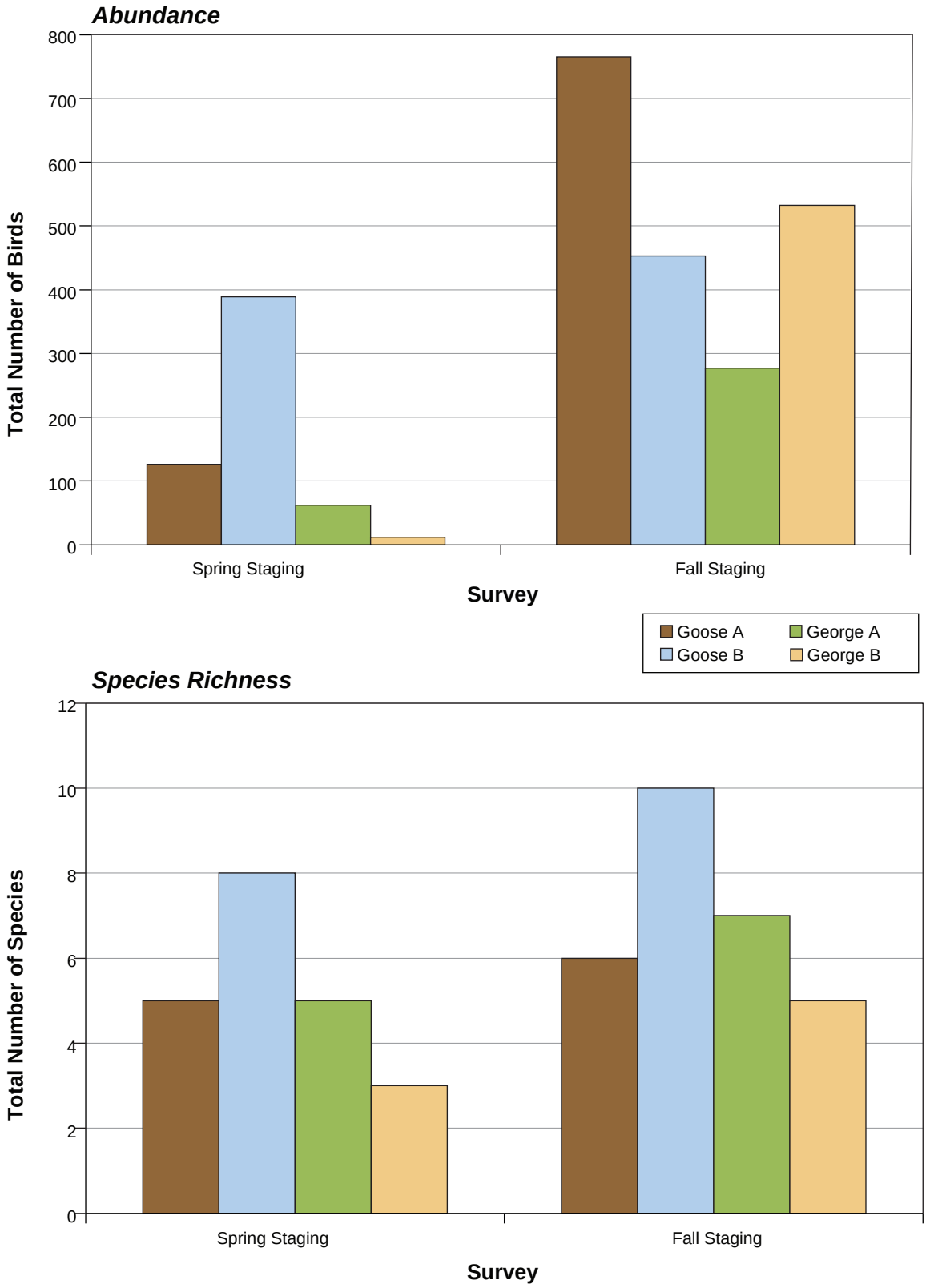

Note: "A" = 2012 Focused Bird Survey Area and "B" = 2012 Reference Bird Survey Area

Sabina GOLD & SILVER CORP.

Waterbird Abundance and Species Richness by Survey Strata during Staging Surveys, 2012

Figure 7.4-2

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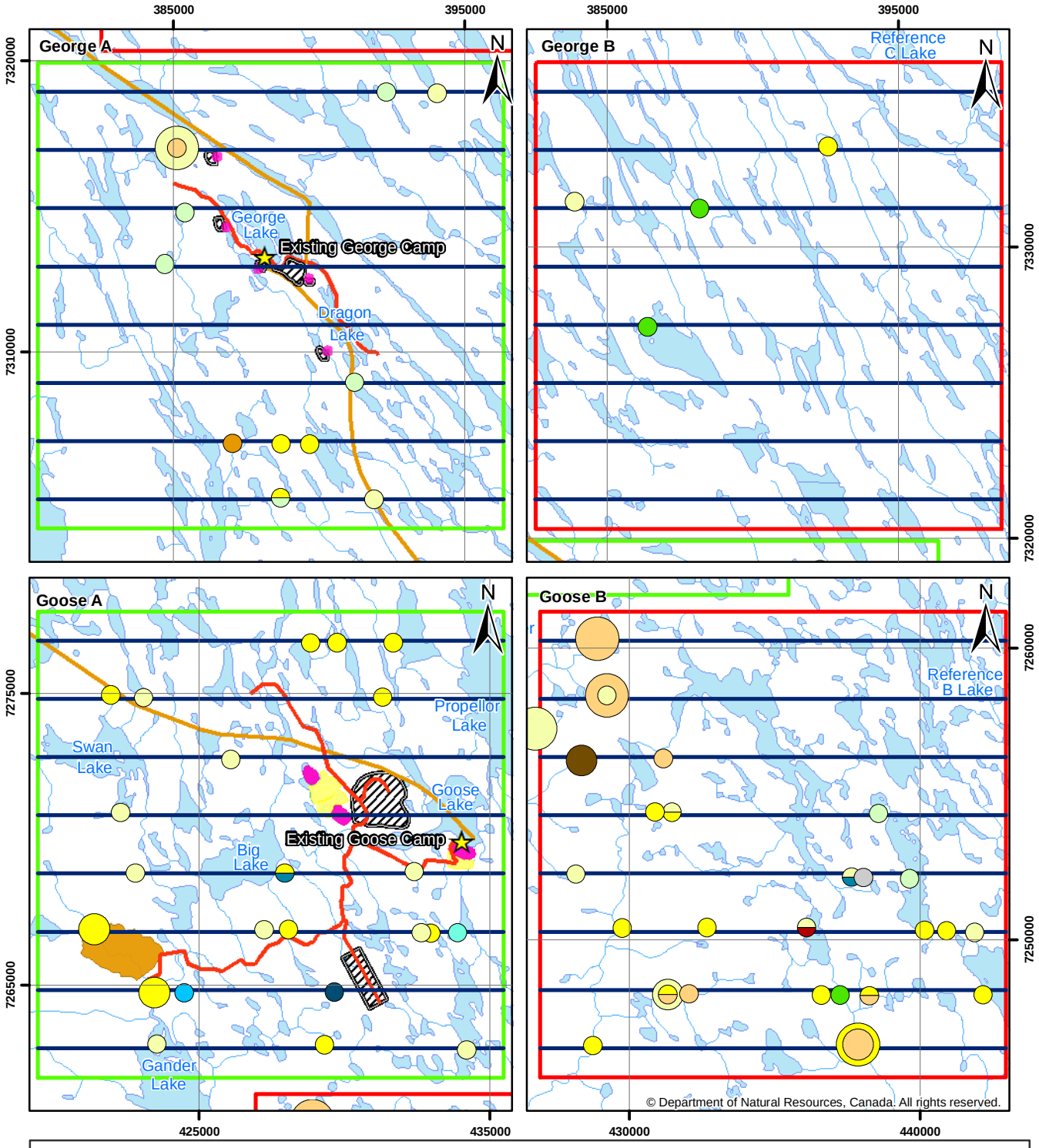


A: 2012 Focused Bird Survey Area
B: 2012 Reference Bird Survey Area
Aerial Transect
Camp
Local Site Road
Potential Winter Road
Deposit Location
Proposed Site Infrastructure
Potential Tailings Storage Area
Proposed Waste Rock Storage Area

Number Observed
1-10 Birds
11-25 Birds
26-100 Birds

Crane
Sandhill Crane

Dabbling Duck
Gadwall
Northern Pintail
Unknown Duck

Diving Duck
Red-breasted Merganser

Goose/Swan
Canada Goose
Greater White-fronted Goose
Snow Goose
Tundra Swan
Unknown Goose

Gull/Tern
Herring Gull
Glaucous Gull*

Jaeger
Jaeger (Long-tailed or Parasitic)

* Species of Conservation Concern

NOTE: Pie charts are not proportions but rather species presence in the abundance classifier indicated by the outer edge of the circle

1:200,000
0 5 10
Kilometres

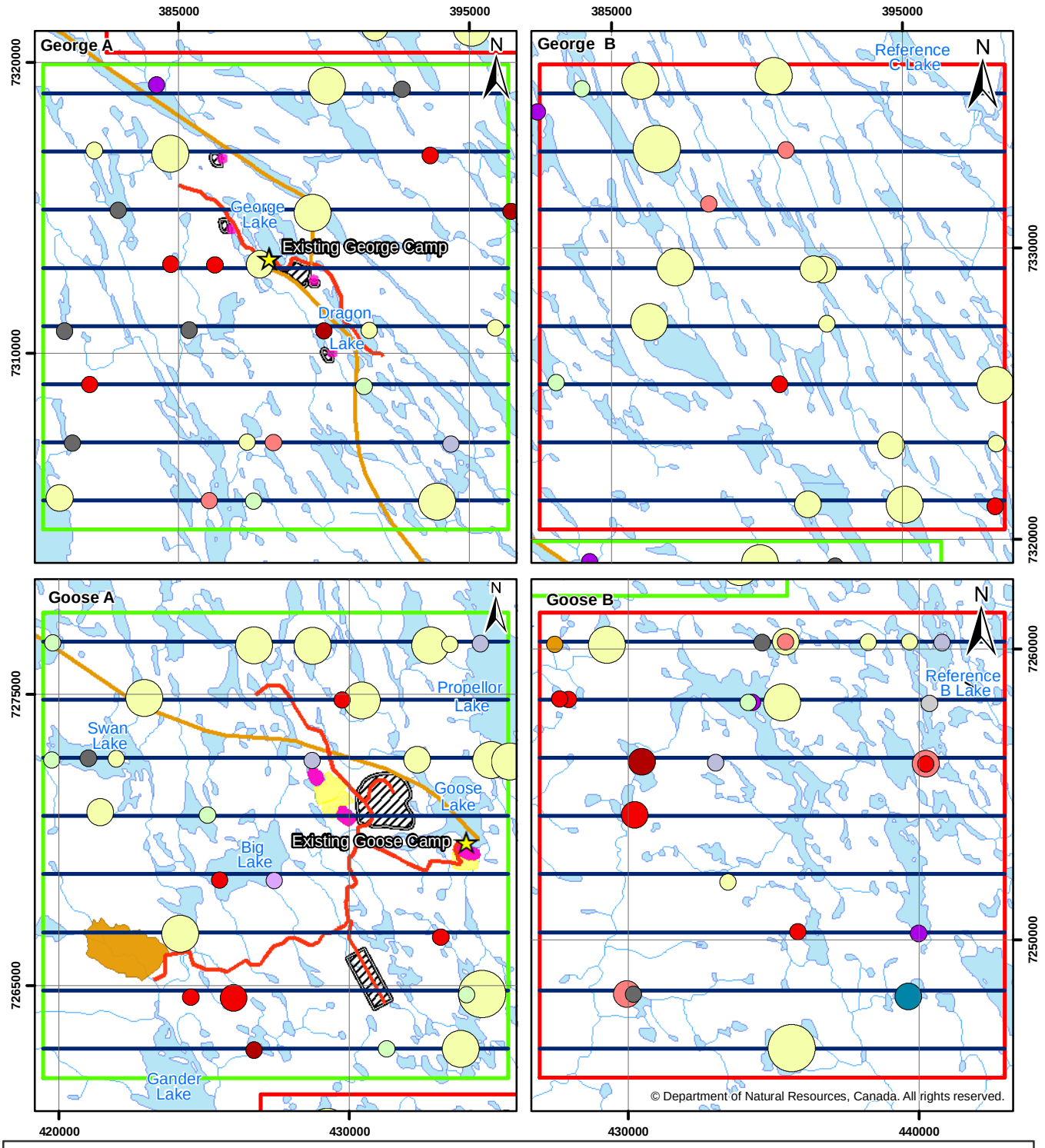
Projection: UTM13, NAD83

Sabina Gold & Silver Corp.

Distribution of Waterbirds during Spring Staging Surveys, 2012

Figure 7.4-3

Rescan Engineers & Scientists



A: 2012 Focused Bird Survey Area
B: 2012 Reference Bird Survey Area
Aerial Transect
Camp
Local Site Road
Potential Winter Road

Deposit Location
Proposed Site Infrastructure
Potential Tailings Storage Area
Proposed Waste Rock Storage Area

1:200,000
0 2.5 5
Kilometres

Projection: UTM13, NAD83

Number Observed
1-10 Birds
11-25 Birds
26-100 Birds
>100 Birds

NOTE: Pie charts are not proportions but rather species presence in the abundance classifier indicated by the outer edge of the circle

Crane
Sandhill Crane
Dabbling Duck
Northern Pintail
Diving Duck
Greater Scaup
Long-tailed Duck*
Red-breasted Merganser
Unknown Diver

Goose/Swan
Canada Goose
Tundra Swan
Gull/Tern
Herring Gull
Loon
Pacific Loon
Red-throated Loon
Yellow-billed Loon

* Species of Conservation Concern

Sabina GOLD & SILVER CORP.

Distribution of Waterbirds during Fall Staging Surveys, 2012

Figure 7.4-4

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Two species of conservation concern were observed during staging surveys: glaucous gulls and long-tailed ducks. Glaucous gulls are listed as Sensitive in Nunavut and were observed in both the Goose and George reference bird survey area during spring staging surveys (Figure 7.4-3). Glaucous gulls were most frequently observed resting on rocks in the lakes. Long-tailed ducks are also listed as Sensitive in Nunavut and were the most commonly observed species of duck recorded and distributed fairly evenly in all survey strata during fall staging surveys (Figure 7.4-4 and Table 7.4-1).

The Goose strata support a high number of geese during spring and fall staging, relative to the George strata. During the spring survey, abundance of geese was highest in the north-west section of the Goose reference bird survey area followed by the Goose focused bird survey area (throughout the stratum), and lower in the George focused and reference bird survey areas, with only a few observed in the north section of the George reference bird survey area (Figure 7.4-2 and Figure 7.4-3). During spring staging surveys snow geese (N= 201), greater white-fronted geese (N = 183) and Canada geese (N = 162) made up the majority (93%) of observations (Table 7.4-1; Figures 7.4-1 and 7.4-3). Snow geese and greater white-fronted geese were almost exclusively observed during spring staging surveys.

In the fall, abundance of geese was highest in the northern half of the Goose focused bird survey area, within 2 km of Goose Lake and Propellor Lake (Figure 7.4-4). A high abundance of geese was also observed in the George reference bird survey area. In addition to geese, flocks of greater scaup, long-tailed duck, northern pintail (Plate 7.4-1), and red-breasted merganser were recorded during the fall survey. These observations were predominantly observed in the Goose strata, particularly in the Goose reference bird survey area (Figure 7.4-4). Canada geese were the most commonly detected species (N = 1,815) recorded during fall staging surveys consisting of 89% of observations (Table 7.4-1; Figures 7.4-1 and 7.4-4).

Plate 7.4-1. A flock of northern pintails observed during fall staging surveys, August 25, 2012

Large lakes represent important staging habitat for waterbirds. The majority of waterbird observations during the spring staging surveys were detected on heath tundra (40.4%), large lakes (30.2%), and rivers (17.0%; Table 7.4-3). The majority of observations on heath tundra were of geese. Dabbling ducks were observed on all lake sizes while diving ducks were observed only on large lakes. All large flocks of waterbirds during the spring staging survey were observed in large lakes or flying over heath tundra with the exception of one flock of greater white-fronted geese which was observed in a small lake (Figure 7.4-3; Appendix 7-2).

Table 7.4-3. Number of Waterbirds Associated with Each Habitat Type during Staging Surveys

Habitat	Geese		Dabbling Ducks		Diving Ducks		Loons		Gulls/Terns		Jaegers		Cranes		Unknown Waterbird		Total	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Lake (Lg)	162	1,382	2	20	2	150	-	14	11	16	-	-	1	2	-	-	178	1,584
Lake (Med)	11	6	2	-	-	4	-	-	6	-	-	-	-	-	-	-	19	10
Lake (Sml)	32	46	4	-	-	2	-	-	-	-	-	-	-	-	-	-	36	48
Pond	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0
River	100	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	30
Wetland	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	0
Shoreline	12	54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	54
Heath Tundra	235	299	-	-	-	-	-	-	2	2	1	-	-	-	-	-	238	301

During the fall staging survey, most observations of waterbirds (78%) were detected on large sized lakes (Table 7.4-3). Geese were primarily observed in large lakes, followed by heath tundra, but were also observed in a variety of other habitat types (Table 7.4-3). Dabbling ducks and loons were only observed in large lakes during the fall staging surveys and diving ducks were observed in lakes of all sizes, although primarily in large lakes.

7.4.2.2 Breeding Surveys

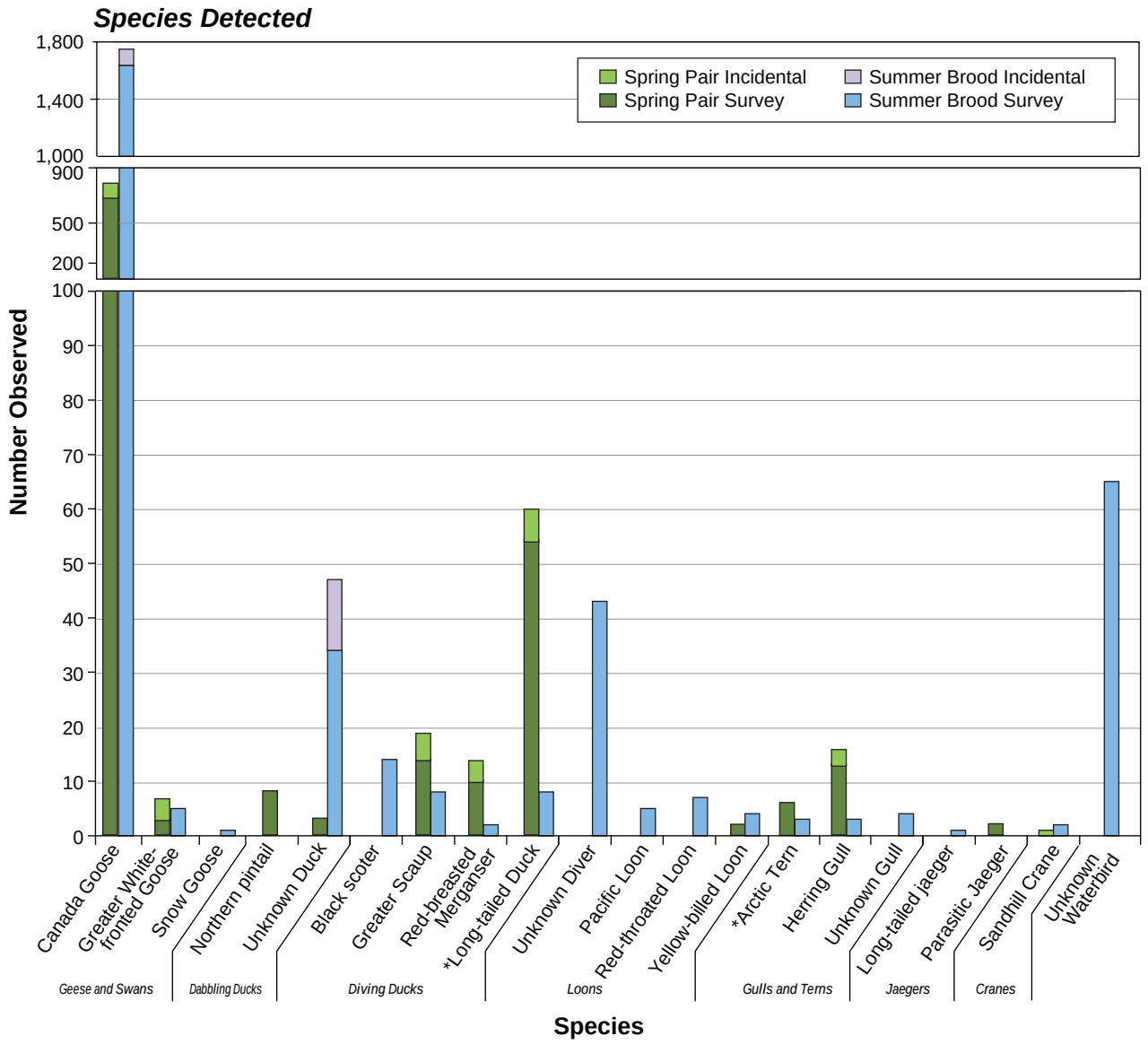
Two breeding surveys were conducted in the four survey strata: a spring pair survey conducted between June 22 and June 23, 2012 to document the presence of breeding pairs; and a summer brood survey conducted between July 14 and July 15, 2012 to document reproduction and the presence of young birds (Appendix 7-2). Survey effort was similar across all survey strata and between the two breeding surveys (Table 7.4-2).

A total of 16 species and 2,700 individuals were detected on transect during breeding surveys with an additional 247 individuals recorded off transect (Table 7.4-1; Figure 7.4-5). Waterbird abundance was higher during the summer brood survey (1,846 individuals) relative to the spring pair survey (854 individuals; Table 7.4-1; Figure 7.4-5). During both breeding surveys, abundance of waterbirds was higher in the Goose strata relative to the George strata, with the highest abundance in the Goose reference bird survey area during both breeding surveys (Figures 7.4-6, 7.4-7, and 7.4-8). Within the George strata, the George focused bird survey area had higher abundance relative to the George reference bird survey area during both breeding surveys (Figures 7.4-6, 7.4-7, and 7.4-8).

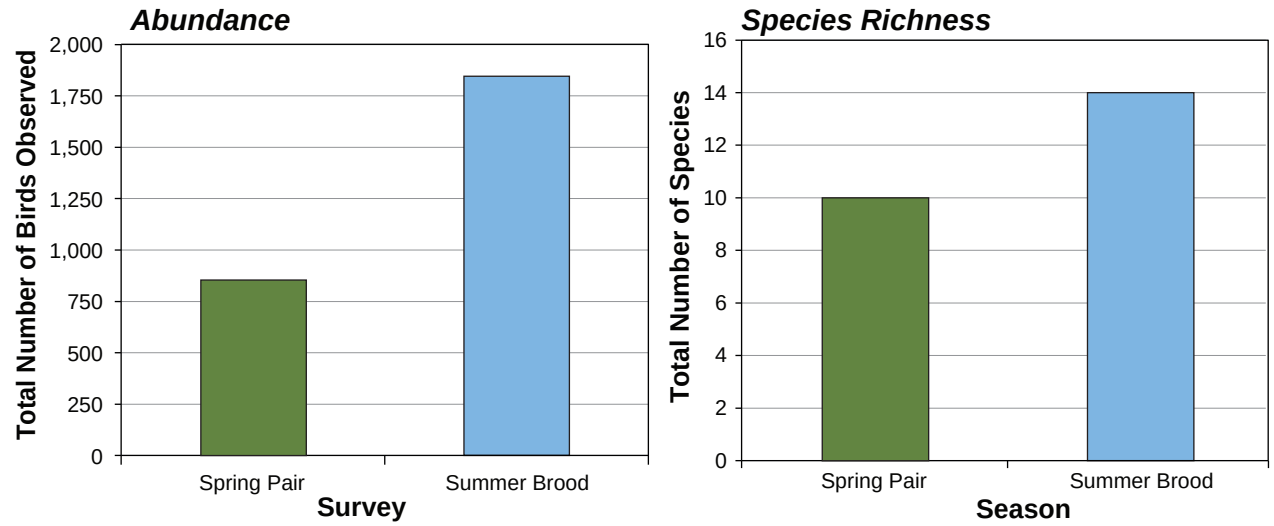
Species richness was also higher during the summer brood survey (14 species) relative to the spring pair survey (10 species; Figure 7.4-5) and highest in the Goose reference bird survey area, relative to the other strata in both breeding surveys (Figure 7.4-6). During spring pair surveys, nine species were observed in the Goose reference bird survey area and seven species in the Goose focused bird survey area, while during summer brood surveys, 12 species were observed in the Goose reference bird survey area and five species in the Goose focused bird survey area. Within the George strata, species richness was the same between the George focused bird survey area and George reference bird survey area during spring pair surveys (six species), but was higher in the George focused bird survey area (nine species) relative to the George reference bird survey area (three species) during summer brood surveys (Figure 7.4-6).

The most widely distributed waterbird group during breeding surveys was represented by geese and swans. The greatest abundance of geese was observed in the Goose reference bird survey area during both spring pair and summer brood breeding surveys (396 and 914 geese, respectively; Figure 7.4-6). Canada geese represent >99% of all geese observed during both of these surveys (Table 7.4-1).

In addition to Canada geese, a large number of long-tailed ducks, a species of conservation concern in Nunavut, was observed during spring pair surveys, with observations in all strata during the spring pair survey (Figure 7.4-7). The majority of long-tailed ducks were observed in the Goose strata and primarily in the Goose focused bird survey area (Figure 7.4-7). A large number of unknown ducks and unknown diving ducks were observed during the summer brood survey (Figure 7.4-5; Figure 7.4-8), which may include long-tailed ducks. Other diving duck species observed during breeding surveys including red-breasted mergansers, greater scaup, and black scoter (Table 7.4-1; Figure 7.4-5; Figure 7.4-7; Figure 7.4-8). Observations of loons were more common during the summer brood survey relative to the spring pair survey (Table 7.4-1).

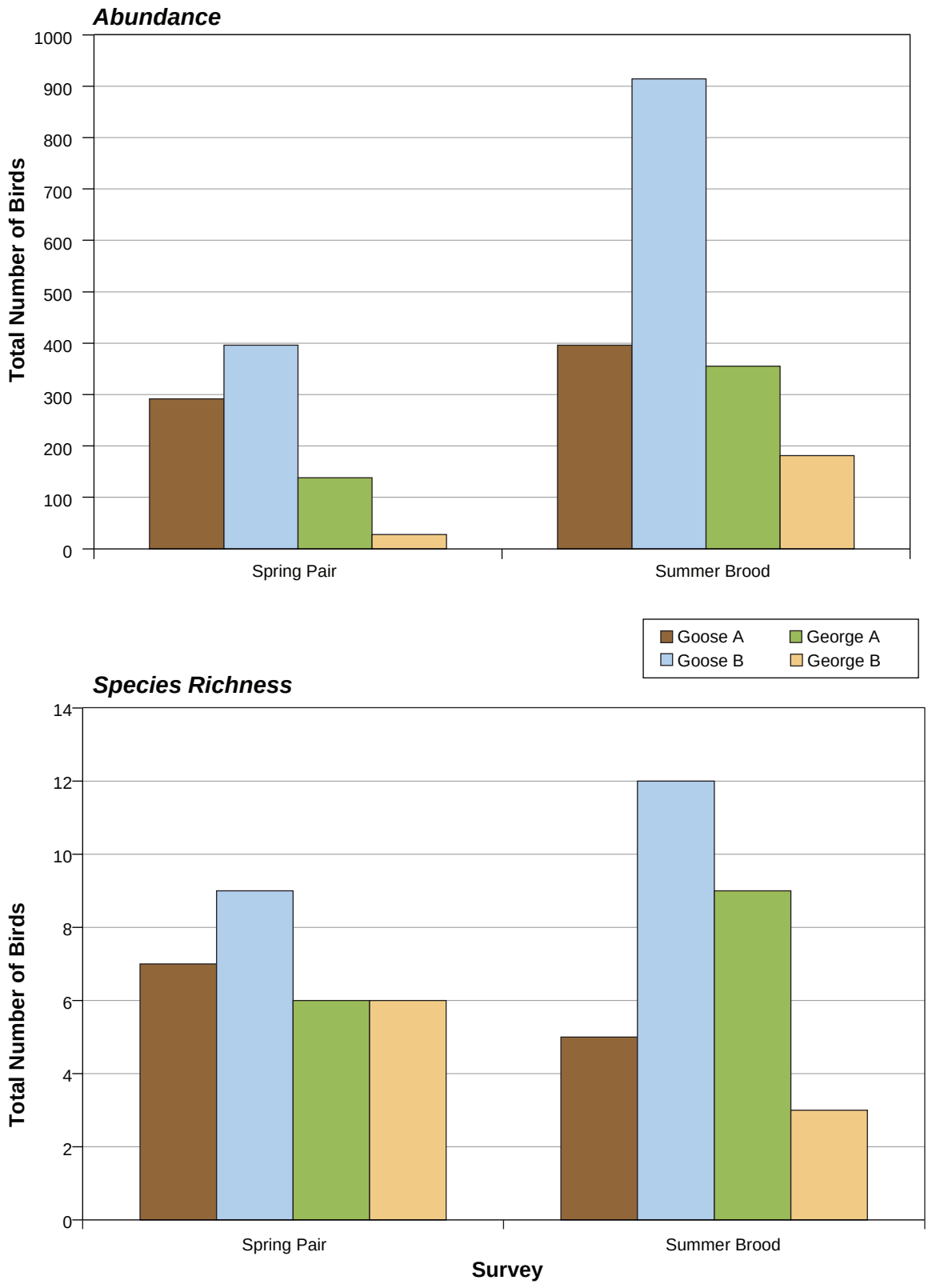


*Note: *Species of conservation concern.*



Waterbird Species Detected and Species Abundance and Richness Recorded during Breeding Surveys, 2012

Figure 7.4-5



Note: "A" = 2012 Focused Bird Survey Area and "B" = 2012 Reference Bird Survey Area

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Waterbird Abundance and Species Richness by Survey Strata during Breeding Surveys, 2012

Figure 7.4-6

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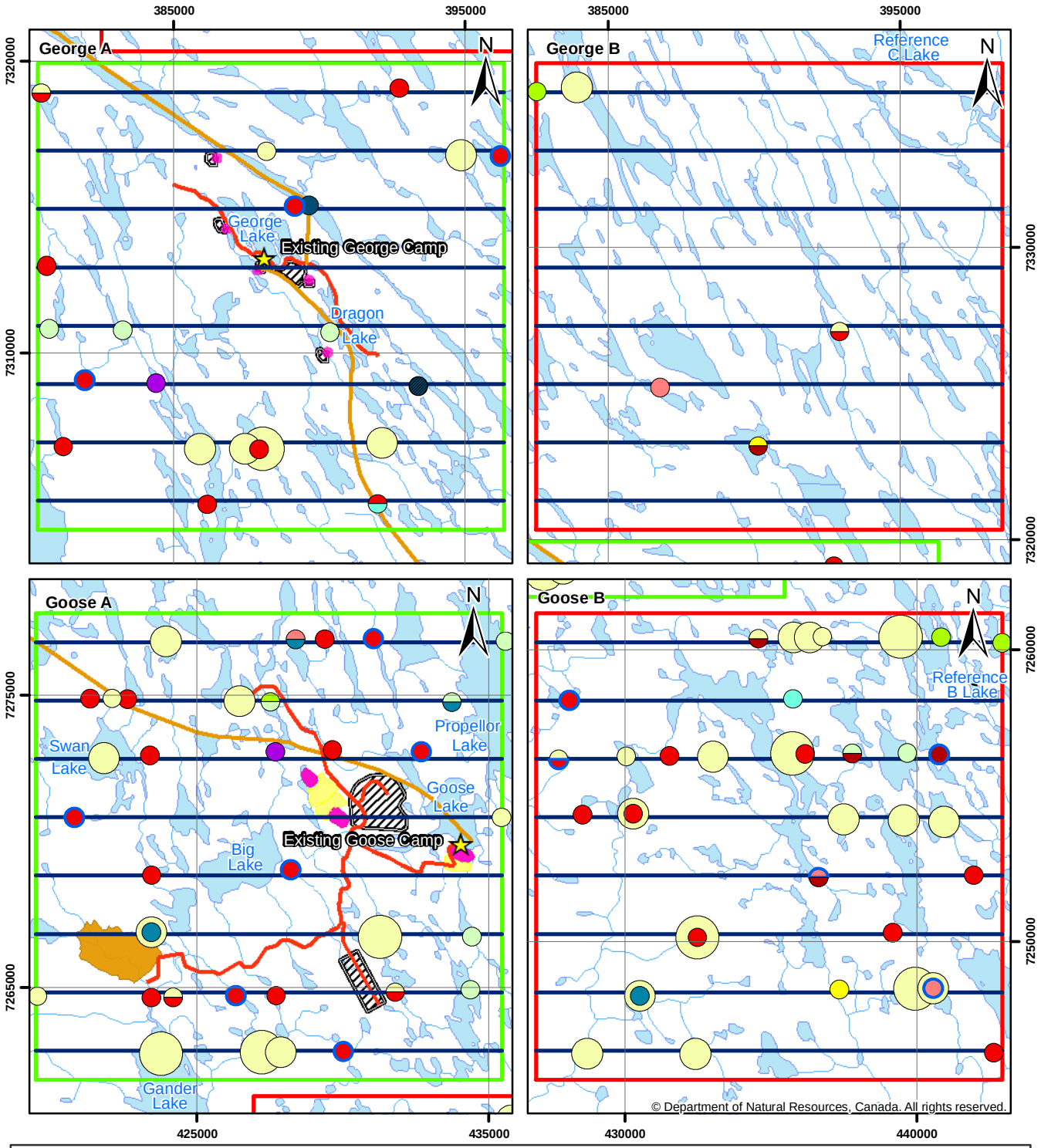

A: 2012 Focused Bird Survey Area
B: 2012 Reference Bird Survey Area
Aerial Transect
Camp
Local Site Road
Potential Winter Road
Deposit Location
Proposed Site Infrastructure
Potential Tailings Storage Area
Proposed Waste Rock Storage Area

Number Observed
1-10 Birds
11-25 Birds
26-100 Birds

Pair

Dabbling Duck
Northern Pintail
Unknown Duck

Diving Duck
Greater Scaup
Long-tailed Duck*
Red-breasted Merganser

Goose/Swan
Canada Goose
Greater White-fronted Goose

Gull/Tern
Herring Gull
Arctic Tern*

Jaeger
Jaeger (Long-tailed or Parasitic)

Loon
Yellow-billed Loon

* Species of Conservation Concern

NOTE: Pie charts are not proportions but rather species presence in the abundance classifier indicated by the outer edge of the circle

1:200,000
0 5 10
Kilometres

Projection: UTM13, NAD83

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Distribution of Waterbirds during Spring Pair Surveys, 2012

Figure 7.4-7

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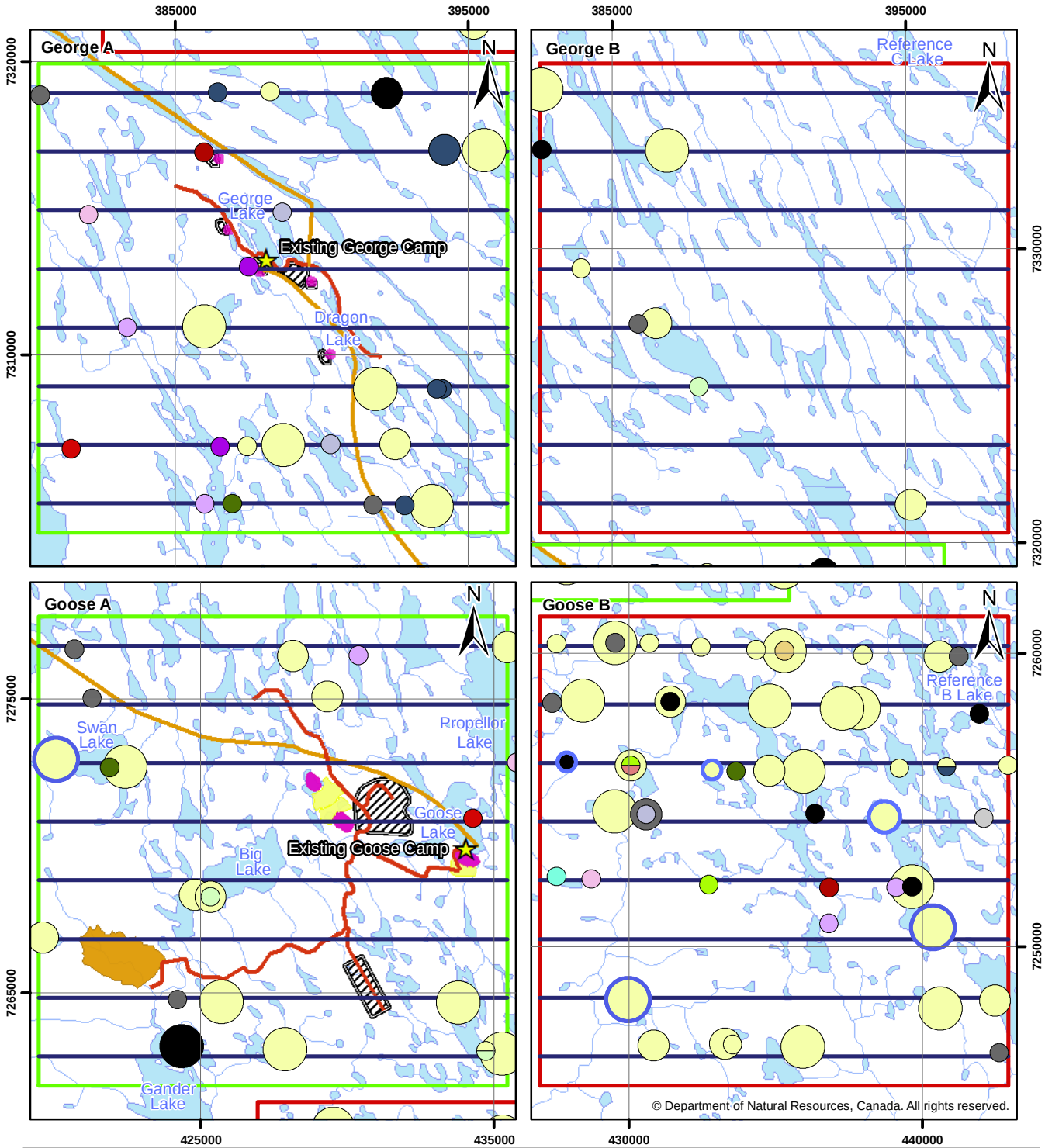

A: 2012 Focused Bird Survey Area
B: 2012 Reference Bird Survey Area
Aerial Transect
Camp
Local Site Road
Potential Winter Road
Deposit Location
Proposed Site Infrastructure
Potential Tailings Storage Area
Proposed Waste Rock Storage Area
Breeding Confirmed

Number Observed
1-10 Birds
11-25 Birds
26-100 Birds

Crane
Sandhill Crane

Dabbling Duck
Unknown Duck

Diving Duck
Scoter (Black or Unidentified)
Greater Scaup
Long-tailed Duck*
Red-breasted Merganser
Unknown Diver

Goose/Swan
Canada Goose
Greater White-fronted Goose
Snow Goose

Gull/Tern
Herring Gull
Arctic Tern*
Unknown Gull

Waterbird
Unknown Waterbird

Jaeger
Jaeger (Long-tailed or Parasitic)

Loon
Pacific Loon
Red-throated Loon
Yellow-billed Loon

1:200,000
0 2.5 5
Kilometres

NOTE: Pie charts are not proportions but rather species presence in the abundance classifier indicated by the outer edge of the circle

* Species of Conservation Concern

Projection: UTM13, NAD83

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Distribution of Waterbirds during Summer Brood Surveys, 2012

Figure 7.4-8

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During the spring pair survey, waterbird pairs were observed in all survey strata except the George reference bird survey area, with a total of 18 confirmed pairs (Table 7.4-4). Pairs were observed for three species including long-tailed duck, greater scaup, and red-breasted merganser. Long-tailed duck pairs were the most commonly observed (N = 11), followed by greater scaup (N = 5; Table 7.4-3). The highest numbers of breeding pairs across all species were observed in the Goose reference bird survey area followed by the Goose focused bird survey area (Table 7.4-4). As most Canada geese observed were in large flocks, it was difficult to assess pair behaviour and to determine the number of pairs of this species.

Table 7.4-4. Observations of Waterbird Pairs during the Spring Pair Survey, 2012

	No. Pairs Detected				
	George		Goose		
Species	Focused Area	Reference Area	Focused Area	Reference Area	Total
Long-tailed Duck	3	-	6	2	11
Greater Scaup	-	-	-	5	5
Red-breasted Merganser	-	-	-	1	1
Unknown dabbling duck	1	-	-	-	1
Total	**4**	**0**	**6**	**8**	**18**

The Goose strata provide breeding habitat for Canada geese. Six broods of Canada geese were identified in the Goose strata, with the majority occurring in the Goose reference bird survey area (Table 7.4-5; Figure 7.4-8). One additional brood of an unknown waterbird species was observed in the northwest section of the Goose reference bird survey area (Figure 7.4-8). Brood sizes for Canada goose ranged from three to six chicks and most chicks were approximately 43 to 55 days old, and not quite capable of flight (Table 7.4-5).

Table 7.4-5. Observations of Waterbird Broods during the Summer Brood Surveys, 2012

Species	Brood Size*	Brood Class
Canada Goose	6, 4, 4, 3, 4, 3	III, III, III, III, III, IIc
Unknown Waterbird	4	IIc

**Different broods are separated by a comma.*

Most observations of waterbird species during the breeding surveys were detected on large lakes (Table 7.4-6). During the spring pair survey, the majority of geese were observed in large lakes with some geese observed in medium sized lakes ponds and rivers. In addition to large lakes, dabbling ducks and diving ducks were observed in medium and small sized lakes as well as ponds. Loons were only observed in large lakes. All observations of waterbirds in pairs were recorded in large and medium sized lakes (Figure 7.4-7; Appendix 7-2). During the summer brood survey, geese, dabbling ducks, and loons were almost exclusively (99.5%, 100%, and 100% respectively) observed on large lakes. Some observations of diving ducks were recorded on small and medium sized lakes (Table 7.4-6). All observations of broods were detected on large lakes (Figure 7.4-8; Appendix 7-2).

7.4.3 Marine Surveys

Two surveys were conducted for marine birds and waterbirds in the FMSA in Bathurst Inlet. One survey was conducted on July 15, 2012 corresponding to the waterbird summer brood survey, and the second was conducted on August 27, 2012 corresponding to the fall staging survey for waterbirds

(Appendix 7-2). Survey effort was 22 minutes during the summer survey and 92 minutes during the survey conducted in the fall.

Table 7.4-6. Number of Waterbirds Associated with Each Habitat Type during Breeding Surveys

Habitat Type	Geese/Swans		Dabbling Duck		Diving Duck		Loon		Gull/Tern		Jaeger		Crane		Unknown Waterbird		Total	
	Pair	Brood	Pair	Brood	Pair	Brood	Pair	Brood	Pair	Brood	Pair	Brood	Pair	Brood	Pair	Brood	Pair	Brood
Lake (Lg)	687	1,631	9	34	64	72	2	16	13	9	-	1	-	-	-	65	775	1,828
Lake (Med)	21	-	-	-	9	2	-	-	1	-	-	-	-	-	-	-	31	2
Lake (Sml)	-	8	1	-	2	1	-	-	-	-	-	-	-	-	-	-	3	9
Pond	22	-	1	-	3	-	-	-	-	-	-	-	-	-	-	-	26	-
River	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-
Wetland	1	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	1	2
Shoreline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heath Tundra	-	-	-	-	-	-	-	-	5	1	2	-	-	-	-	-	7	1

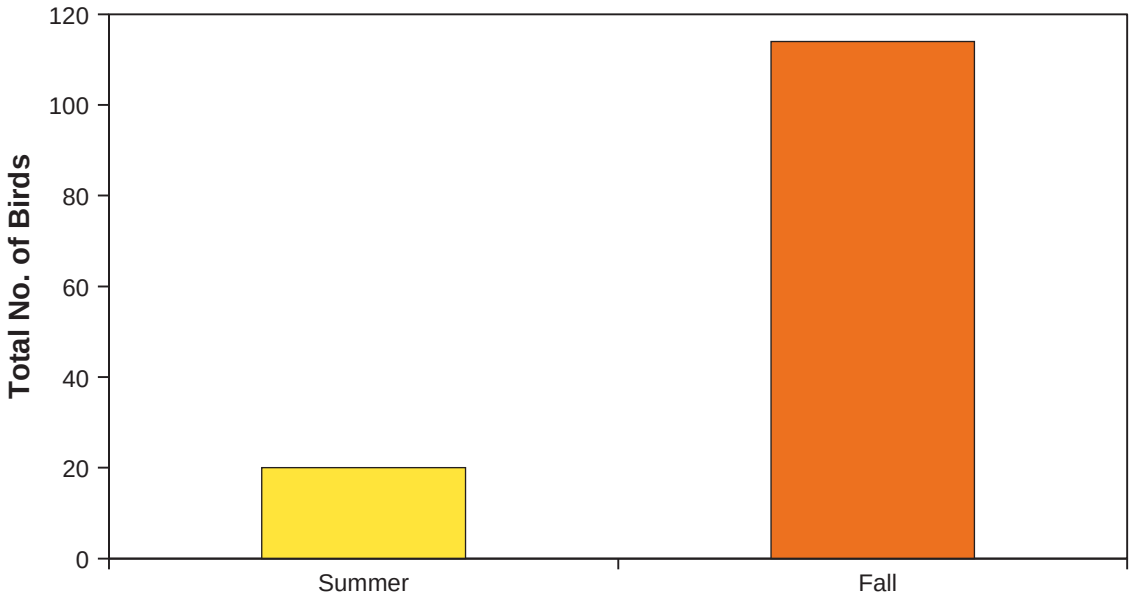
A total of seven species and 449 individuals were detected on transect during marine bird surveys with an additional 25 individuals recorded off transect (Table 7.4-1; Figure 7.4-9). Species richness and abundance were greater during the fall staging survey (six species; 429 individuals) relative to the summer brood survey (three confirmed species; 20 individuals) with most birds observed towards the northern end of the surveyed area near Option 6 (proposed laydown area) during both surveys (Figure 7.4-10). One species of conservation concern was observed during the fall marine bird surveys south of Option 6: glaucous gull (Figure 7.4-10). A number of unknown gulls were also observed during summer marine surveys (Figure 7.4-10).

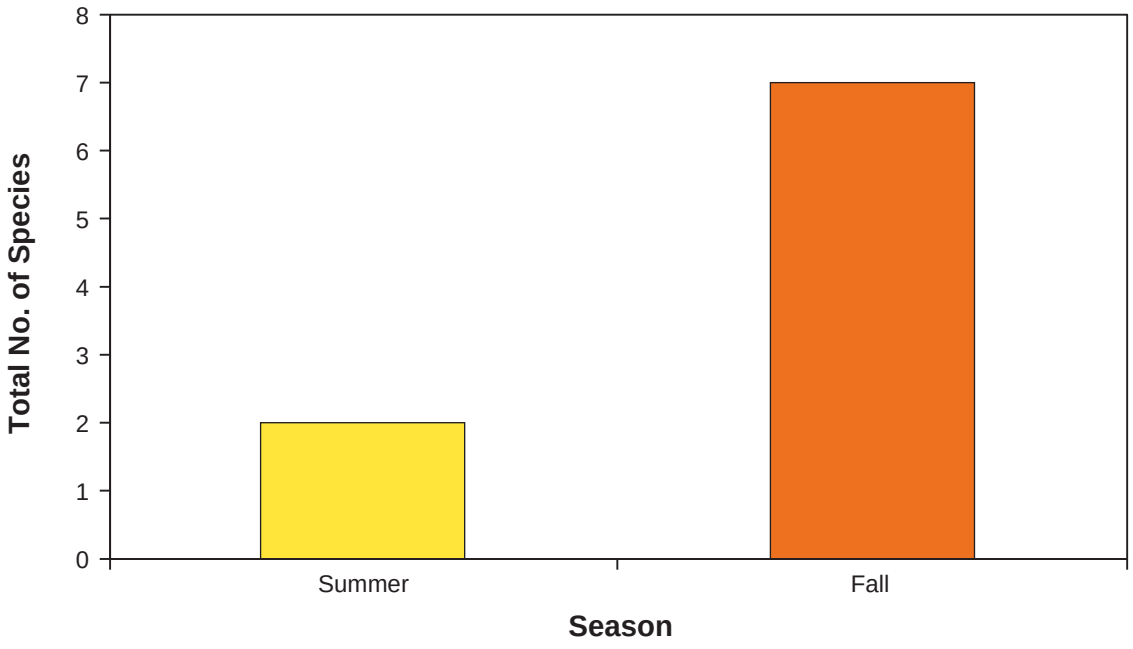
No breeding pairs or broods were observed during the marine bird survey in the summer (Appendix 7-2). During the summer brood survey, the majority of birds detected were gulls (Table 7.4-1; Figure 7.4-10). Two additional species were detected with very low abundance including red-breasted merganser (N=1) and yellow-billed loon (N=1; Table 7.4-1), both located near Option 6 (proposed site infrastructure; Figure 7.4-10). An unknown species of diving duck was also observed near Option 4.

The FMSA provides fall staging habitat for waterbirds. The majority of birds observed during the fall marine survey were detected within 7 km of Option 6 along the north end of the marine bird shoreline transect (Figure 7.4-10). In the fall, the most abundant species observed were Canada geese (N = 240) followed by greater scaup (N = 107), and red-breasted merganser (N = 52; Table 7.4-1). Canada geese were observed in a large flock of approximately 200 birds along the shoreline near Option 6 and a smaller flock consisting of 25 birds in the water further south (Figure 7.4-10). Two flocks of greater scaup were observed near Option 6. Both of these flocks were comprised primarily of male scaup with one flock consisting of approximately 90 individuals (Plate 7.4-2). Red-breasted mergansers were observed in smaller flocks consisting of seven to 16 birds (Appendix 7-2).

7.4.4 Overall Waterbird Habitat Use

Of the seven habitat types noted during surveys, 81.5% of species observations occurred on lakes (Table 7.4-7) with the majority of waterbird species observed in large lakes (Figure 7.4.11). Ten percent of observations occurred in heath tundra, and 8.5% distributed between the remaining five habitat categories (Table 7.4-7).



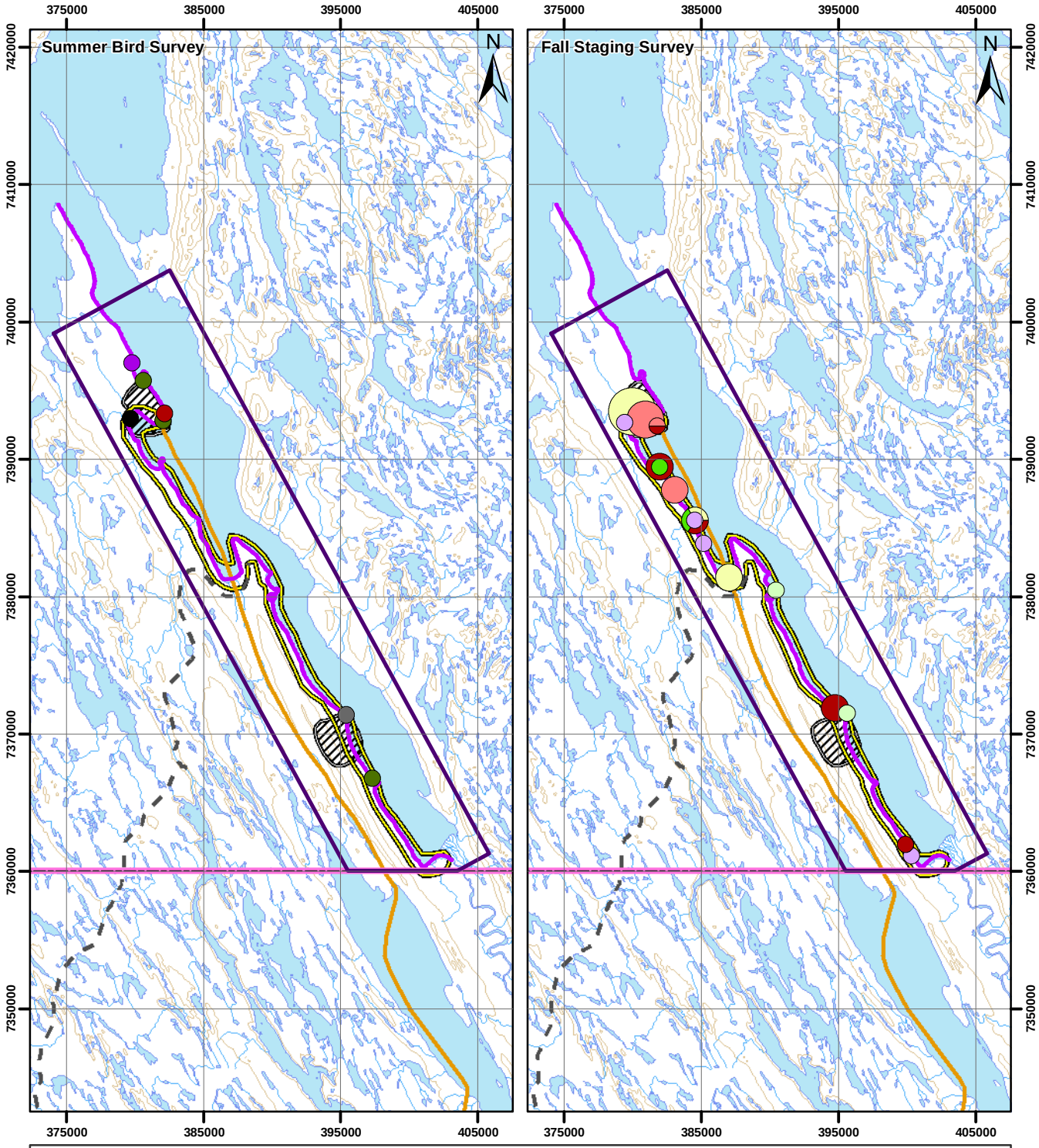


Sabina GOLD & SILVER CORP.

Seasonal Abundance and Species Richness during Marine Surveys, 2012

Figure 7.4-9

Rescan™ Engineers & Scientists



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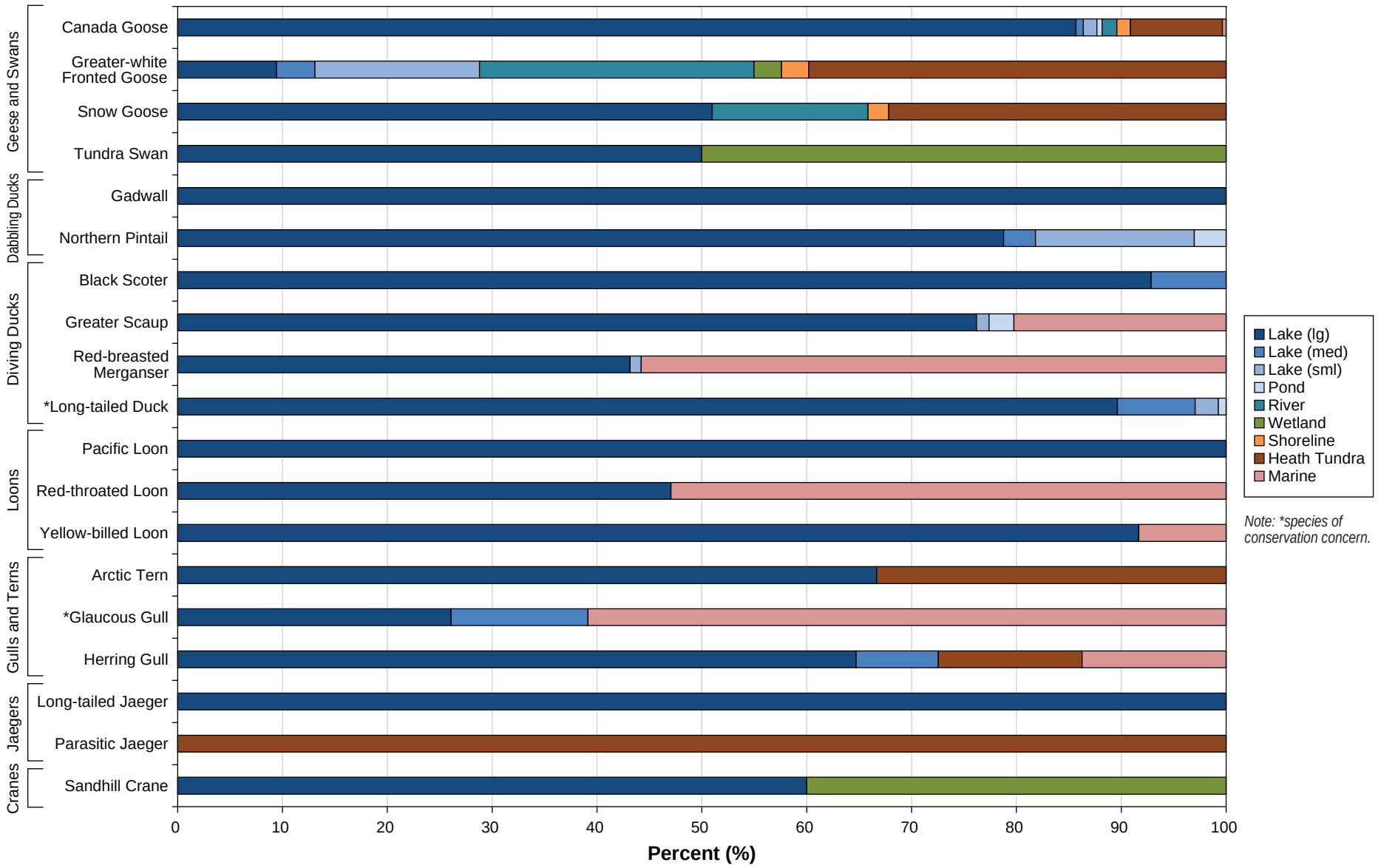
Distribution of Waterbirds during Marine Bird Surveys, 2012

Figure 7.4-10

Rescan™ Engineers & Scientists



*Note: *species of conservation concern.*

Figure 7.4-11

Sabina GOLD & SILVER CORP.

Overall Habitat Use by Species during all Waterbird and Marine Bird Surveys, 2012

Figure 7.4-11

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Plate 7.4-2. A flock of greater scaup observed in Bathurst Inlet near proposed marine laydown area, Option 6, August 25, 2012

Table 7.4-7. Waterbird Habitat Use, 2012

	Goose		Dabbling Duck		Diving Duck		Loon		Gull/Tern		Jaeger		Crane		Unknown Waterbird		All Species	
Habitat	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Lake	3,986	81.8	72	98.6	308	65.2	32	76.2	56	54.4	1	25.0	3	60.0	65	98.5	8,975	81.5
Pond	22	0.4	1	1.4	3	0.6	-	-	-	-	-	-	-	-	-	-	52	0.5
River	141	2.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	282	2.6
Wetland	7	0.1	-	-	-	-	-	-	-	-	-	-	2	40.0	-	-	14	0.1
Shoreline	66	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	132	1.2
Heath Tundra	534	10.9	-	-	-	-	-	-	10	9.7	3	75.0	-	-	-	-	1,094	9.9
Marine	115	2.4	-	-	161	34.1	10	23.8	37	35.9	-	-	-	-	1	1.5	457	4.1
Total	4,871		73		472		42		103		4		5		66		11,006	

Almost all of the dabbling duck observations were recorded in lakes with the majority occurring in large lakes (Figure 7.4-11). Jaegers were most often recorded on heath tundra (Table 7.4-7), with 100% of parasitic jaeger observations in heath tundra (Figure 7.4-11). Only two species were recorded in wetland habitat - tundra swan and sandhill crane (Figure 7.4-11). Several species were recorded in marine habitat including gulls, loons, greater scaup, and red-breasted mergansers (Table 7.4-7; Figure 7.4-11).

All marine birds and waterbirds observed during marine surveys were classified as being in marine habitat.

7.4.5 Incidental Observations of Waterbirds and Marine Birds

7.4.5.1 Waterbirds and Marine Birds Observed During Other Baseline Surveys

Incidental observations of waterbirds and marine birds were collected during the waterbird and marine bird aerial surveys and during other baseline surveys conducted in 2012 (Appendix 5-2). A total of

20 species and 2,621 individuals were observed incidentally (Table 7.4-8). Four species observed incidentally were not detected during the waterbird and marine bird aerial surveys, including common eider (a species of conservation concern), American green-winged teal, northern shoveler, and an unknown species of scoter (Table 7.4-8). These species were primarily observed in the FMSA and MRSA (Figure 7.4-12a). Geese and swans were the most common species group observed incidentally (Table 7.4-8; Plate 7.4-3) with Canada geese (N = 1,227) consisting of the majority (~85 %) of these observations. Large numbers of unknown eiders (N = 336) and glaucous gulls (N = 127) were also observed, although the majority of these observations were noted during marine mammal surveys conducted in mid-June (Chapter 8) and concentrated in areas of open water (areas not covered by ice) in Bathurst Inlet outside of the FMSA (Figure 7.4-12a). The majority of incidental observations recorded in the RSA were concentrated near the lakes near the Goose and George properties (Figure 7.4-12b). Two sandhill crane chicks were observed along with the adult pair in the Goose focused bird survey area on July 21, 2012 (Figure 7.4-12b; Plate 7.4-4; Appendix 5-2).

Plate 7.4-3. A flock of greater white-fronted geese observed incidentally during staging surveys, August 25, 2012.

7.4.5.2 Waterbirds Observed on Remote Digital Camera

Remote digital images of waterbirds were recorded at two of the 15 remote camera stations set up for the wolverine DNA study (Rescan 2013a) and at five of the 30 remote camera stations set up for the caribou baseline studies (Figure 7.4-12b). A total of three species and 246 waterbirds were recorded at these cameras between May and August 2012 (Table 7.4-9). Some individuals may be double counted, as they may have been observed on more than one occasion at the same camera. The majority of waterbird photos taken by the remote cameras were recorded in May, followed by August (Table 7.4-9). The most commonly observed species was Canada goose, particularly in August (Table 7.4-9; Plate 7.4-5 and Plate 7.4-6). Geese also constituted the majority of observations in May, but the species was not distinguishable from the images. There were three observations of large flocks of unknown geese in late May at a camera station located along Beechey Lake (Camera #30; Figure 7.4-12b).

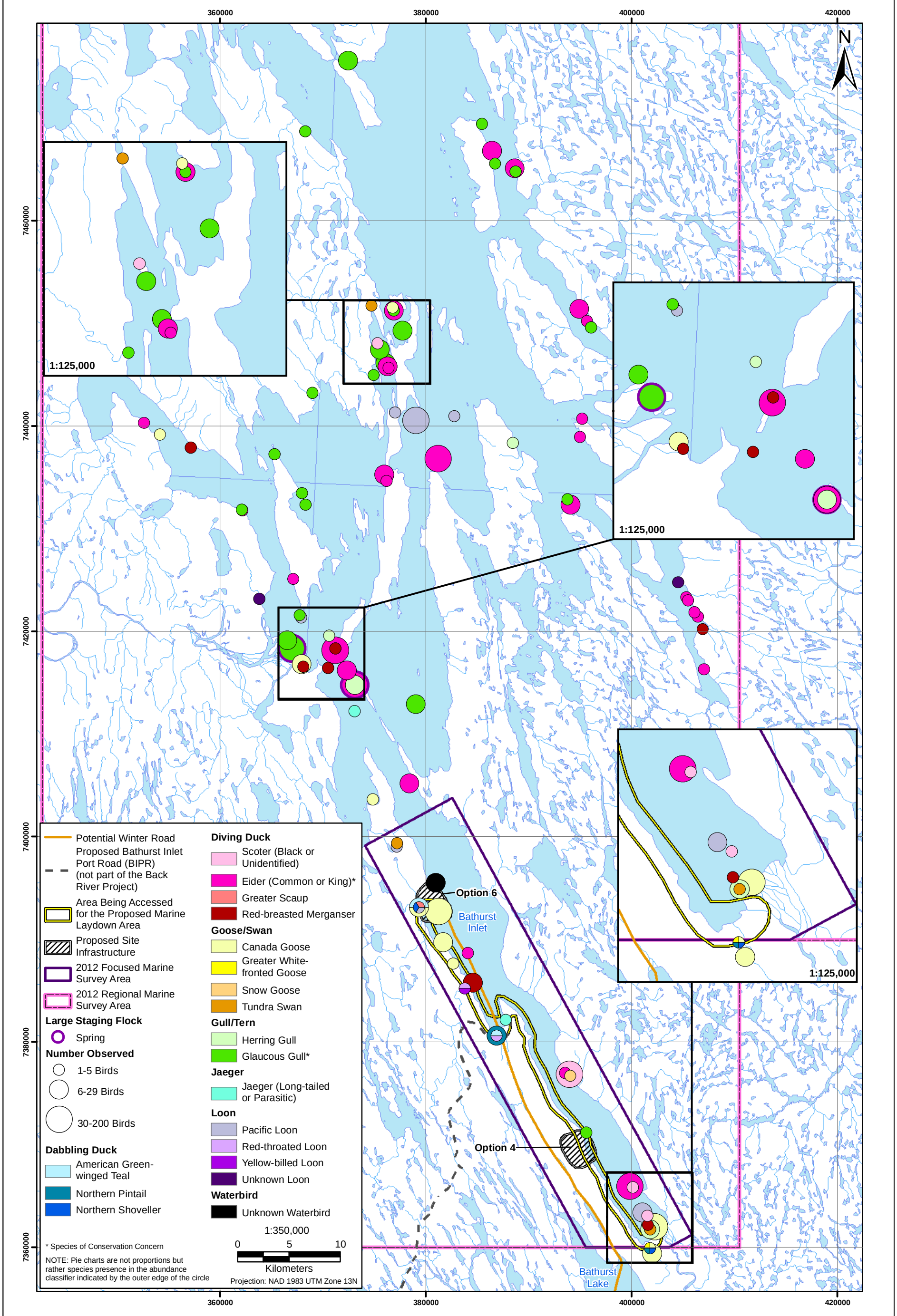

Figure 7.4-12a

Sabina GOLD & SILVER CORP.

Incidental Observations of Waterbirds and Marine Birds in the MLSA and MRSA, 2012

Figure 7.4-12a

Rescan™ Engineers & Scientists

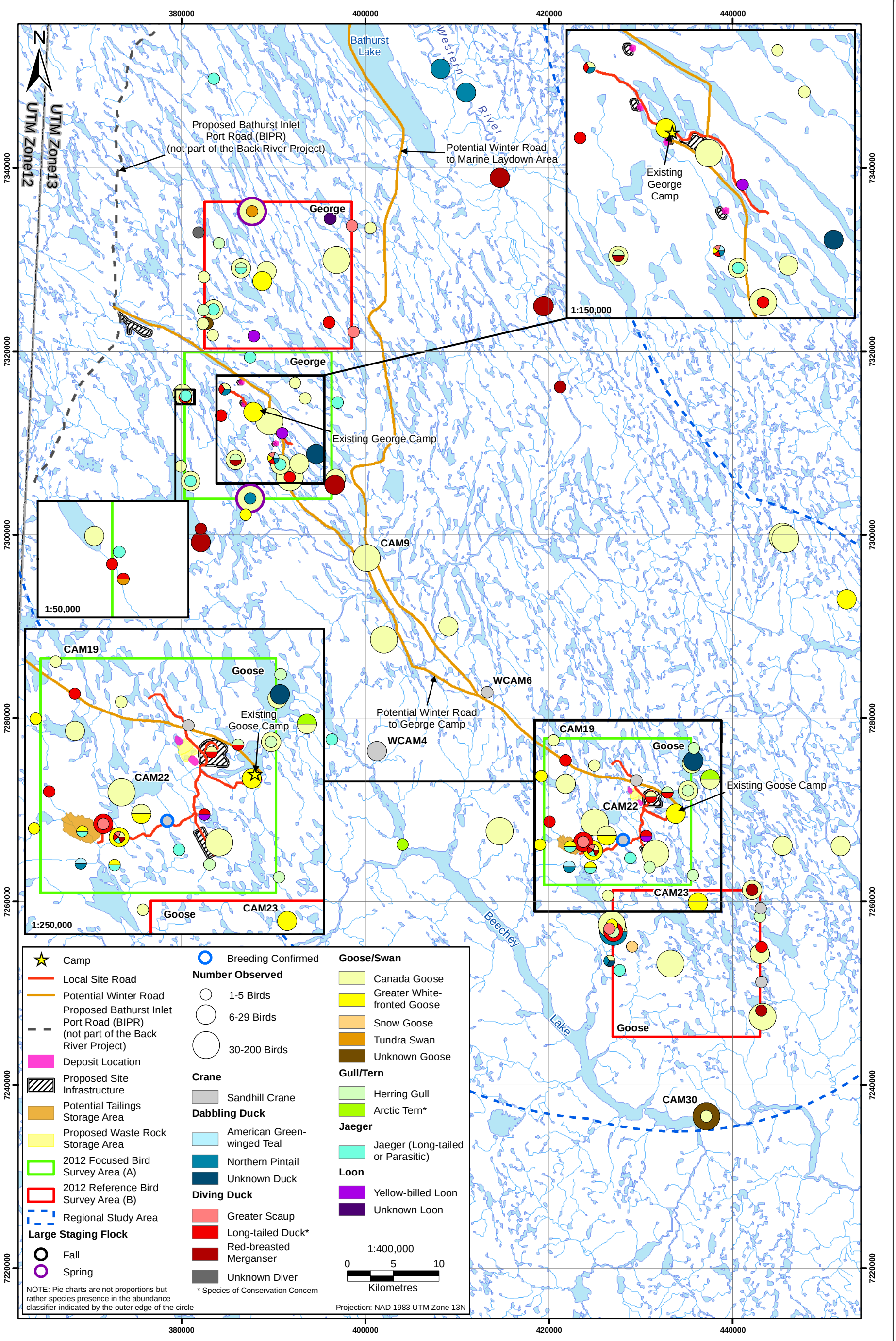

Figure 7.4-12b

Sabina GOLD & SILVER CORP.

Incidental Observations of Waterbirds and Marine Birds in the RSA, 2012

Figure 7.4-12b

Rescan™ Engineers & Scientists

Table 7.4-8. Incidental Observations of Waterbirds and Marine Birds, 2012

Group	Species	Scientific Name	Marine Mammal Surveys	No. of Waterbirds or Marine Birds Observed			
				Breeding Bird Surveys	Remote Camera Surveys	Other Baseline Surveys	Total
Geese and Swans	Canada Goose	*Branta canadensis*	110	-	86	772	968
	Greater-white Fronted Goose	*Anser albifrons*	-	25	7	28	60
	Snow Goose	*Chen caerulescens*	1	-	-	-	1
	Tundra Swan	*Cygnus columbianus*	4	4	-	-	8
	Unknown Goose	-	-	130	-	135	265
Dabbling Ducks	American Green-winged Teal	*Anas carolinensis*	-	13	-	-	13
	Northen Pintail	*Anas acuta*	-	62	-	39	101
	Northern Shoveler	*Anas clypeata*	-	9	-	-	9
	Unknown Duck		-	-	-	-	-
Diving Ducks/ Sea Ducks	*Common Eider	*Somateria mollissima*	60	-	-	-	60
	Greater Scaup	*Aythya marila*	-	6	-	1	7
	*Long-tailed Duck	*Clangula hyemalis*	-	25	-	15	40
	Red-breasted Merganser	*Mergus serrator*	22	5	-	31	58
	*Unknown Eider	*Somateria sp.*	336	-	-	-	336
	Unknown Scoter	*Melanitta sp*	33	-	-	-	33
	Unknown Diver		-	-	-	-	-
Loons	Pacific Loon	*Gavia pacifica*	56	2	-	-	58
	Red-throated Loon	*Gavia stellata*	-	3	-	-	3
	Yellow-billed Loon	*Gavia adamsii*	-	3	-	2	5
	Unknown Loon	*Gavia sp.*	2	1	-	3	6
Gulls and Terns	*Arctic Tern	*Sterna paradisaea*	-	-	-	8	8
	*Glaucous Gull	*Larus argentatus*	212	5	-	-	217
	Herring Gull	*Larus hyperboreus*	24	9	-	-	33
Jaegars	Long-tailed Jaegar	*Stercorarius longicaudus*	-	4	-	2	6
	Parasitic Jaegar	*Stercorarius parasiticus*	-	5	-	5	10
	Unknown Jaegar	*Stercorarius sp.*	8	-	-	-	8
Crane	Sandhill Crane	*Grus canadensis*	-	10	23	4	37
Waterbird	Unknown Waterbird		-	-	-	-	-
Total			**868**	**191**	**246**	**1,045**	**2,621**

**Species of conservation concern*

Plate 7.4-4. A pair of sandhill cranes with two chicks (chicks are not visible) observed incidentally on July 21, 2012.

Plate 7.4-5. A small flock of Canada geese detected at Camera 22 August 20, 2012.

Plate 7.4-6. A pair of Canada geese detected at Camera 30 June 12, 2012.

Table 7.4-9. Incidental Observations of Waterbirds at Remote Camera Stations, 2012

Species	Number of Waterbirds Detected				
	May	June	July	August	Total
Sandhill Crane	23	-	-	-	23
Canada Goose	-	4	10	72	86
Greater-white Fronted Goose	-	-	7	-	7
Unknown Goose	130	-	-	-	130
Total	**153**	**4**	**17**	**72**	**246**

7.4.6 Species of Conservation Concern

Four species of conservations concern listed as sensitive at the territorial level in Nunavut were observed in the Back River area: long-tailed duck, Arctic tern, glaucous gull, and common eider. No evidence of breeding was observed for any of these species during waterbird and marine surveys or incidentally during other surveys. A total of 143 long-tailed ducks were observed during waterbird surveys (Table 7.4-1) and 40 were observed incidentally during other surveys (Table 7.4-8). These observations occurred in all four survey strata (Goose focused bird survey area, Goose reference bird survey area, George focused bird survey area, and George reference bird survey area) during waterbird surveys and in the RSA during other baseline surveys. Arctic tern were observed in the Goose strata during spring pair and summer brood waterbird surveys (Figure 7.4-7 and Figure 7.4-8) and in the RSA during other baseline studies conducted in the summer of 2012 (Figure 7.4-12b). Glaucous gulls were observed most frequently (88% of total observations) in the MRSA during marine mammal studies conducted in mid-June, 2012 (Figure 7.4-12a). Several observations of glaucous gulls were observed in the Goose reference bird survey area and George reference bird survey area during spring staging surveys (Figure 7.4-3) and in the FMSA during the marine fall staging survey (Figure 7.4-10). A total of

60 common eiders and 336 unknown eiders were observed in the spring during marine mammal baseline surveys in the MRSA (Table 7.4-8; Figure 7.4-12a). King eider is also a species of conservation concern listed as sensitive in Nunavut. Unknown eiders could be either common eiders or king eiders.

7.5 DISCUSSION

Four waterbird surveys were conducted within the Goose and George strata and two marine surveys were conducted in the FMSA to document species presence and distribution of waterbirds during staging and breeding periods. Overall, 19 waterbird species were observed during these surveys and four additional species were observed incidentally during other baseline studies. Species of conservation concern (listed as Sensitive in Nunavut) that were detected during these surveys included long-tailed duck, Arctic tern, and glaucous gull. In addition, eiders (either common or king) were observed incidentally in the FMSA and MRSA.

These data will be useful for future assessment and monitoring within a Before-After-Control-Impact study design. Despite the large differences in waterbird abundance between focus and reference areas, inferences of effects of development on waterbirds can be made if average abundances per species across sample units (i.e. line transects) decline in focus areas, but not in reference areas, after development occurs.

Overall abundance of waterbirds was lowest during the spring staging survey and increased during each subsequent survey with the highest abundance of waterbirds occurring during the fall staging survey. Staging habitat for geese occurred in the Goose strata during the spring staging survey, primarily within large lakes in the Goose reference bird survey area. In addition, the FMSA and MRSA may provide important early season staging habitat for eiders. In the fall, staging habitat for geese, as well as a number of duck species, was documented in all strata surveyed in the Goose and George study areas and in the focused marine survey area. During the breeding surveys, the majority of breeding pairs observed were of long-tailed duck, a species of conservation concern, and occurred on medium sized lakes in the Goose strata. However, direct evidence of breeding (eggs or chicks) were only documented for Canada geese during the brood survey and documented incidentally for sandhill crane. All broods were observed in large lakes and occurred mostly in the Goose reference bird survey area with the exception of one brood in the Goose focused bird survey area.

The Back River Project area may represent important staging habitat for waterbirds. Both the spring and fall staging surveys were well timed to catch the large flocks of waterbirds passing through the bird survey areas. During the spring, large abundances of geese were observed, particularly in the Goose reference bird survey area. A large diversity of geese were recorded in the spring relative to the fall staging period, and may represent large flocks of snow geese and greater white-fronted geese moving through the Goose reference bird survey area on their way to northern breeding areas. While no spring staging surveys were conducted in the FMSA in June, the large aggregations of eiders, scoters, glaucous gulls, Pacific loons, and geese observed incidentally during the marine mammal survey in early June suggests that the FMSA and MRSA in Bathurst Inlet may provide suitable early staging habitat for these species. Both the common and king eider are species of conservation concern listed as “Sensitive” in Nunavut. The spring staging survey however, had a lower abundance of waterbirds relative to any of the other waterbird surveys. This lower abundance may suggest a longer spring migration period (spanning a few weeks) relative to fall staging due to differences in spring staging timing among species.

During the fall staging period, high abundances of waterbirds, primarily consisting of Canada geese, long-tailed duck, red-breasted merganser, greater scaup, and northern pintail were observed. Abundance of waterbirds recorded during the fall staging survey was nearly four times that recorded during the spring staging survey. Of all the strata surveyed, the Goose focused bird survey area had the

highest abundance of waterbirds in the fall, but abundance was also high in the Goose reference bird survey area and the George reference bird survey area. In addition, abundance and flocks of waterbirds using the George strata was much higher in the fall relative to the spring. The FMSA also represented an important staging area for several species of waterbird during the fall. In addition to two large flocks of Canada geese, two flocks of greater scaup and four smaller flocks of red-breasted mergansers were observed in the FMSA during the fall staging period. The observation of the flocks of scaup are notable, because these flocks consisted almost entirely of male birds, indicating that the FMSA may be used by this species for protection from predators during the moulting phase prior to fall migration. Male greater scaup typically migrate prior to females and young during the fall migration (NAS 2013).

Prior to migrating south, many species of waterbirds and marine birds congregate at staging areas where they build fat and protein stores critical for their survival during migration (Ankney and MacInnes 1978). Most flocks of waterbirds were observed in the Goose strata during the staging surveys, indicating that this area may provide more suitable staging and potential foraging habitat relative to the George strata, especially during the spring. The highest abundance of waterbirds occurred in the Goose reference bird survey area for all waterbird surveys except the fall staging survey, where the Goose focused bird survey area had the highest abundance. The Goose reference bird survey area also consistently had the highest species richness among the strata surveyed indicating that there is suitable habitat in the Goose reference bird survey area to support a number of species during staging periods.

Evidence of breeding was relatively low in the bird survey areas but was confirmed for Canada geese in both of the Goose strata during the summer breeding survey. Brood size was generally high for Canada geese and most young observed were close to fledging. Fledging of Canada geese typically occurs six to seven weeks after hatching in the central Arctic (Mowbray et al. 2002), which suggests that most geese breeding in the area start nesting and incubating in early June. In addition to Canada geese, evidence of breeding was confirmed incidentally in July for a pair of sandhill cranes with two chicks in the Goose focused bird survey area. Brood size is generally lower for sandhill cranes with an average of two (1 – 3) eggs laid (Ehrlich, Dobkin, and Wheye 1988). During the breeding period, many waterfowl species incubate their young for several days after they hatch and very young birds, when mobile, usually do not venture very far from the nest (Batt et al. 1992; Baldassarre and Bolen 2006). Thus, it is possible that additional broods were not detected during aerial surveys.

While evidence of breeding was only observed for two species in the Goose and George strata, a large diversity of ducks and loons were observed during breeding surveys. Many of these observations were of pairs of waterbirds. Long-tailed duck, a species of conservation concern, were observed most frequently in pairs during the spring pair survey. Several pairs of other species of ducks and loons were also observed during the spring and summer breeding surveys. These observations indicate that these species may be breeding in the area and using the area for courting and/or resting, although evidence of breeding was not confirmed. In addition, survey timing, predation on young or eggs, and young being well hidden and not visible during the summer brood surveys may also be factors into the lack of observations of broods of these species.

No confirmed evidence of breeding was recorded in the FMSA during summer brood surveys. Species abundance and richness were relatively low in the FMSA during the summer marine survey corresponding to the breeding period. Although many breeding marine birds retreat to lakes to rear their broods, three waterfowl species may nest in close proximity to the coast of Bathurst Inlet: Brant geese, common eiders, and red-breasted mergansers (Reed et al. 1998; Titman 1999; Goudie, Robertson, and Reed 2000). The lack of observed sightings of broods may suggest that these species are not using this area for breeding, or may reflect the difficulty of observing broods in the marine environment. Other species are reliant on the marine environment and are likely using Bathurst Inlet as a main foraging location during the breeding season. These species include the red-throated loon,

yellow-billed loon, Brant goose, greater scaup, common eiders, scoters (black, white-winged, and surf), and red-breasted mergansers (North 1994; Bordage and Savard 1995; P. W. Brown and Fredrickson 1997; Reed et al. 1998; Savard, Bordage, and Reed 1998; Titman 1999; Barr, Eberl, and McIntyre 2000; Goudie, Robertson, and Reed 2000; Kessel, Rocque, and Barclay 2002). The majority of waterbirds observed in the FMSA during the summer marine surveys consisted of gulls. In 2011, a much larger abundance of geese, diving ducks, and loon were observed in the same are in early July (Rescan 2012b), indicating that survey timing and conditions may not have been ideal for summer brood surveys in the FMSA in 2012. However, one long-tailed duck, one red-breasted merganser, and one yellow billed loon were observed near in the FMSA near Option 6 during the marine summer survey indicating that these species may still use the area.

8. Marine Mammals

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8. Marine Mammals

8.1 INTRODUCTION

Marine mammals fall under the jurisdiction of the Department of Fisheries and Oceans Canada (DFO), and are protected under the federal *Fisheries Act* (1985). Although cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals and sea lions) are mammals, their inclusion in this Act reflects the fact that they were once managed and harvested as "fish" stocks. Section 35 (1) of the federal *Fisheries Act* protects marine mammals and their habitat from alteration, disruption, or destruction. Section 7 of the Marine Mammal Regulations protects marine mammals from being disturbed.

8.1.1 Bathurst Inlet Marine Ecosystem

Bathurst Inlet is a deep inlet connected to the Arctic Ocean. It is located along the northern coast of the Canadian mainland into which the Burnside River and Western River empty. During the winter and spring, Bathurst Inlet is icebound. Ice typically begins to break up in June, and the Inlet contains open water during a period between July and September. However, ice break-up may occur earlier in the future due to climate change (IUCN 2009). Ice cover in Bathurst Inlet is important for a number of species including marine mammals and caribou. The Dolphin Union caribou herd uses the ice to cross Coronation Gulf on their spring and fall migration to and from Victoria Island (Gunn 2005). Ice cover is also important for several species of marine mammals such as ringed seals that use the ice for breeding and moulting purposes (T.G. Smith 1987).

8.1.2 Species Biology

There are two marine mammals that are resident in Bathurst Inlet: the ringed seal (*Phoca hispida*) and the bearded seal (*Erignathus barbatus*). In summer, when the water is open, belugas (*Delphinopterus lecuas*) may additionally be seen on rare occasion in Bathurst Inlet (LGL Limited 2005).

8.1.2.1 Ringed Seal (Phoca hispida)

Ringed seals are found throughout the circumpolar regions of the Northern Hemisphere. They are usually associated with areas of seasonal sea ice. In Canada, their distribution is centered in the Arctic Archipelago, but they range from Newfoundland to the Beaufort Sea. Canadian populations of ringed seals were designated as Not at Risk (COSEWIC 2002c). However, ringed seals are high priority candidates on the Species Specialist Subcommittees' (SSC) candidate list and the COSEWIC candidate list for reassessment in fall of 2013 (COSEWIC 2012). The SSC candidate list comprises a list of wildlife species that it considers at risk of extinction or extirpation nationally and each species on the list is then prioritized for assessment by COSEWIC. Ringed seals have been prioritized as high priority based on new evidence that climate change poses a serious threat to ringed seals given the expected and extensive loss of sea ice (Learmonth et al. 2006; Kovacs and Lydersen 2008; Kovacs et al. 2010).

Ringed seals are traditionally the most abundant marine mammal in the Canadian Arctic, although it is difficult to accurately estimate population sizes. Population size estimates are usually conducted in the spring during the moulting season when they are hauled out on the sea ice making them visible during aerial surveys. However, these estimates may substantially underestimate the actual size of the populations as some seals will undoubtedly be in the water or under the ice during these surveys. Surveys for ringed seals have been conducted in several areas in the Canadian Arctic and include: approximately 40,000 ringed seals in the Canadian Beaufort Sea (Stirling, Kingsley, and Calvert 1981); 50,000 in northern Amundsen Gulf (Kingsley 1990); 49,000 in Prince Albert Sound (Kingsley 1990); and

90,000 in the Canadian High Arctic (Kingsley, Stirling, and Calvert 1985; 1990). Densities of seals in these areas ranged from 0.06 – 0.85 seals/ km2 with higher densities reported for floe ice relative to fast ice.

Currently, there are no population estimates reported for Coronation Gulf and Bathurst Inlet, however, surveys to estimate seal densities were conducted in 2007 in both Coronation Gulf and Bathurst Inlet (LGL Limited 2007) and indicated that densities of seals in these areas (0.3 seals/km^2) were within range of those reported for other areas. However, there can be large natural variations in the numbers of ringed seals in an area over a period of a few years (Stirling, Archibald, and DeMaster 1977). For example, a marked decrease in the abundance and productivity of seals in the Canadian Beaufort Sea and Amundsen Gulf was observed between 1974 and 1975 (Stirling, Archibald, and DeMaster 1977; T.G. Smith and Stirling 1978) and between 1982 and 1985 (Harwood and Stirling 1992).

The peak mating season for ringed seals occurs in April with delayed embryo development of 81 days followed by a 9-month gestation period. Seal pups are born from mid-March through April in birth lairs scratched out of the snow (subnivean) above the breathing hole in the ice. The lair provides protection and warmth for a single pup during a five to eight week nursing period (T.G. Smith, Hammill, and Taugbol 1991). Pups use the maintained breathing holes and enter water for predator avoidance, however, time in water is minimized and they must return to the birth lair to prevent hypothermia (T.G. Smith, Hammill, and Taugbol 1991). Pup care is solely maternal and pups are abandoned when the ice breaks up.

In late spring, as temperatures increase in May and June, ringed seals abandon their lairs either as the snow collapses or by tunnelling their way through the snow and haul out to bask in the sun for their annual moult (shedding of winter fur) on the surface of the ice near breathing holes, lairs, or natural cracks or leads in the ice cover (T.G. Smith 1973; T. G. Smith and Hammill 1981). Higher temperatures during late spring and longer days promote higher skin temperatures which facilitates epidermal growth (Feltz and Fay 1966).

Ringed seals are capable of travelling distances of greater than 1,000 km during the summer, although they tend to show site fidelity (Teilmann, Born, and Acquarone 1999; B. P. Kelly et al. 2010). During the summer when the landfast ice breaks up, radio tracking and satellite telemetry studies have provided direct evidence of ringed seals dispersion to offshore areas where they are generally scattered in low densities (Heide-Jørgensen, Stewart, and Leatherwood 1992; B.P. Kelly 1996; B. P. Kelly et al. 2010). This behaviour likely represents the dispersal of food sources. Ringed seals feed primarily on fish (especially Arctic cod) and large crustaceans and zooplankton such as amphipods, euphausiids, epibenthic mysids, and decapods (Lowry, Frost, and Burns 1980; Bradstreet et al. 1986; T.G. Smith 1987). In areas where seasonal concentrations of seals have been observed aggregations of seals were related to local food sources (Harwood and Stirling 1992).

Ringed seals represent an important resource for Inuit people. Traditional knowledge of the presence, location, and structure of the breathing holes and subnivean lairs permitted the Inuit hunters to exploit this abundant resource throughout the frozen ice season. Ringed seal harvests are reported for four communities on Coronation Gulf including Kugluktuk, Cambridge Bay, Bathurst Inlet and Omingmaktok from 1996 to 2001 (Priest and Usher 2004; Rescan 2013b). The smallest harvests were recorded in the communities of Bathurst Inlet and Omingmaktok which are smaller in size compared to the other two communities. Kugluktuk recorded the largest harvests with an average of approximately 280 seals per year. The majority of these seals (76%) were harvested in August and September, and smaller numbers harvested in the other months. In Cambridge Bay harvests were on average 277 seals per year in 2000/2001. Most of these animals (68%) were harvested in July through September.

8.1.2.2 Bearded Seal (Erignathus barbatus)

Bearded seals are distributed throughout the circumpolar regions of the Northern Hemisphere. They are found in relatively low densities in the Canadian Arctic. This species is sparsely distributed throughout the central High Arctic, primarily in coastal areas. Bearded seals generally prefer areas of moving ice and open water in shallow-bottomed areas, and avoid areas of thick shorefast and coastal pack ice habitats commonly utilized by ring seals (Burns 1981; Kingsley and Stirling 1991). Canadian populations are designated data deficient (COSEWIC 2002b) and are listed as mid priority candidates on the SSC candidate list, but have not yet been scheduled for reassessment by COSEWIC (COSEWIC 2012).

The global population of bearded seals has not been assessed, but probably number in the hundreds of thousands (Kovacs and Lydersen 2006). There are no formal population estimates for the bearded seals in Coronation Gulf area and Bathurst Inlet. However, a low number of bearded seals (42) were reported in 2007 and were much less common than ringed seals on the same survey (LGL Limited 2007). Uncorrected estimates of the number of bearded seals in other areas such as eastern Lancaster Sound and western Baffin Bay ranged from 7,400 to 9,500 (Koski 1980a) and maximum densities in that region ranged from 0.05 to 0.24 seals/km^2 (Finley 1976; Koski and Davis 1979; Koski 1980a, 1980b; Koski and Davis 1980; Kingsley, Stirling, and Calvert 1985).

Bearded seals are permanent residents of the Arctic and are generally found as solitary individuals in areas of thin, broken or rotten, and moving ice over shallow water (Burns and Frost 1979; Stirling, Kingsley, and Calvert 1981; Burns and Frost 1983; Kingsley, Stirling, and Calvert 1985). Bearded seals are primarily benthic feeders and feed on a variety of small prey found along the ocean floor, including clams, squid and fish. Adults tend to feed in shallow coastal areas no more than 200 m deep (Burns and Frost 1983; Finley and Evans 1983), thus bearded seals are most abundant in areas where they can reach the bottom to feed.

Bearded seals depend on sea ice and snow to survive. They rely on sea ice for extended periods during moulting, and live on sea ice during critical months for breeding, whelping, and nursing. Bearded seals only have a limited capability to maintain breathing holes in ice thus, tend to avoid areas of fast ice during the winter and undertake seasonal migrations in response to the advance and retreat of fast ice (Martell, Dickinson, and Casselman 1984). However, in some areas, bearded seals maintain breathing holes in landfast ice throughout the winter (Mansfield 1967), likely because the ice in those areas freezes late and breaks up early.

Bearded seals give birth in the spring and in the Canadian Arctic seal pupping occurs in May. Pups are born on small drifting ice floes in shallow waters and usually weigh approximately 30-40 kg at birth. They enter the water only hours after they are born, and quickly become proficient divers. Maternal care for pups occurs in the first 18 to 24 days, during which time pups grow on average 3.3 kg per day. A new mating cycle takes place just before the pups are weaned and implantation is delayed until July. Total gestation period is approximately eleven months, though active gestation is only nine months long after a two month delay in gestation.

Bearded seal harvests were reported for three communities on Coronation Gulf including Kugluktuk, Omingmaktok, and Bathurst Inlet between 1996 and 2001 (Priest and Usher 2004). The number of seals harvested in all communities was small. Kugluktuk had the highest number of seals harvested with an average of two bearded seals per year. These harvests occurred between May and September with the majority (50%) of bearded seals harvested in July. The tough flexible hide of the bearded seal is valued for utilitarian purposes, such as lines, traces, kayak coverings and kamik (boot) soles. The meat is suitable for consumption by humans and dogs.

8.2 OBJECTIVES

Baseline studies for marine mammals were conducted in the Focused Marine Survey Area (FMSA) and Marine Regional Survey Area (MRSA) to:

- document the presence and abundance of marine mammals using the FMSA and MRSA during the ice covered period;
- determine the spatial extent of use of habitat within the FMSA and MRSA; and
- identify potentially important habitat for marine mammals in the FMSA and MRSA.

8.3 METHODS

Marine mammal surveys were conducted in the spring from a fixed wing aircraft in mid-June, 2012. Strip transect methodology was used following previously established methods (Stirling, Kingsley, and Calvert 1982; Kingsley, Stirling, and Calvert 1985; Lunn, Stirling, and Nowicki 1997; Frost et al. 2002). These methodologies are standard for surveys of ringed and bearded seals in Alaska and Hudson Bay.

8.3.1 Survey Design

Ringed and bearded seals are most easily counted when they are hauled out onto sea ice in late spring and early summer during their annual moult. A greater number of seals generally haul out in clearer and warmer weather (T.G. Smith 1973; Finley 1979; T. G. Smith and Hammill 1981; Stirling, Kingsley, and Calvert 1982; Kingsley, Stirling, and Calvert 1985) and maximum number of animals hauled out on the sea ice each day usually occurs in early to mid-afternoon (Burns and Harbo 1972; T.G. Smith 1973; T. G. Smith and Hammill 1981).

The baseline surveys of the seal populations in Bathurst Inlet were designed to:

- Coincide with the peak period of seal haul-out in June during the spring moulting period;
- Cover the immediate area of the proposed Marine Laydown Area, an area beyond where seals may be disturbed, and a reference (control) area; and
- Sample the seal population quantitatively in a manner that would be repeatable.

Surveys covered an area that extended from the extreme south of Bathurst Inlet where the waters of the Western River meet the Ocean, north along the eastern channel to Omingmaktok at ~67.4°N and west, through the channel north of Kanuyak Island (Figure 8.3-1).

8.3.2 Survey Procedures

Aerial surveys were conducted using standard census techniques for marine mammals (Stirling, Kingsley, and Calvert 1982; Kingsley, Stirling, and Calvert 1985; Lunn, Stirling, and Nowicki 1997). The survey was flown in a twin-engine aircraft (DeHavilland Twin Otter) at an altitude of 91 m (300 ft) above sea level and at a ground speed of 130-157 km/h (70-85 knots). Surveys were conducted along pre-determined transect lines within the MSA (Figure 8.3-1). Transect lines were for the most part parallel, and at a distance of 1 km apart in southern Bathurst Inlet, covering the FMSA and 2 km apart in all other areas surveyed. Transect lines for the aerial surveys were generally oriented in a north-south direction, but also east-west in some channels between the islands in Bathurst Inlet. Surveys were conducted under research permit number S-12/13-1008-NU (Licence to Fish for Scientific Purposes) issued pursuant to Section 52 of the Department of Fisheries and Oceans Fishery Regulations.

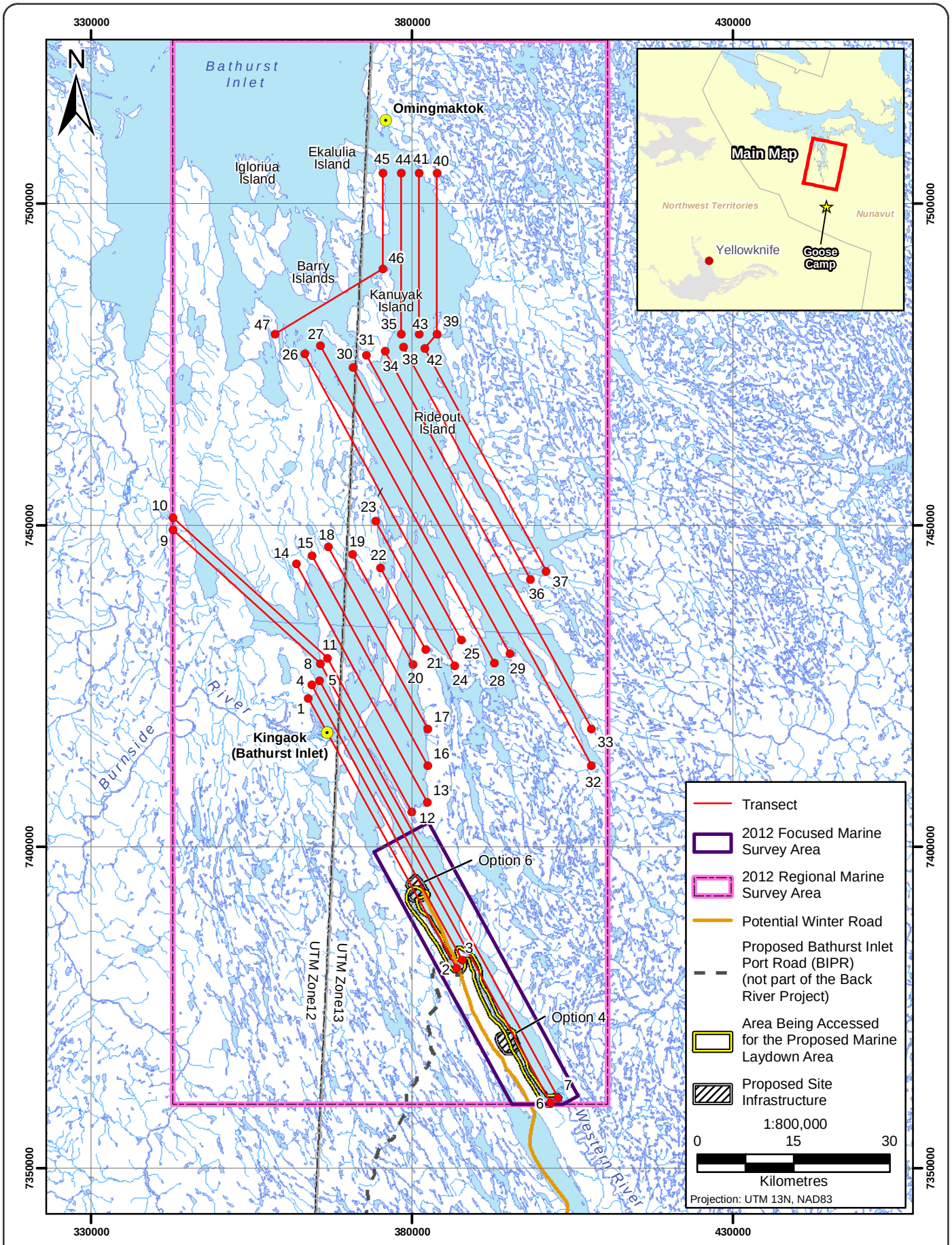

Figure 8.3-1

Marine Mammal Survey Transect Lines Flown during Aerial Surveys of Ringed and Bearded Seals in June, 2012

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Four observers were in the aircraft including two experienced wildlife biologists, and two assistants, one of which was an Inuit observer. Both assistants were trained by the wildlife biologists. The two experienced biologists (primary observers) sat on opposite sides of the aircraft, one person was two seats behind the pilot (left side) and the other two seats behind the co-pilot (right side) respectively. The two assistants sat one seat behind the biologists on either side of the aircraft.

The aircraft followed transect lines using an onboard Garmin global positioning system (GPS). The strip width of the survey transect was 500 m on either side of the airplane. Each observer calibrated this distance before the survey by having the airplane fly over the runway at survey elevation (300 ft) and past a marker spaced 500 m from the runway. The observers applied tape on the aircraft's windows at the appropriate angles to mark strip boundaries. Sightings of seals beyond 500 m were recorded as off-transect sightings. However, seals that were directly under the plane to approximately 200 m from the centerline on either side of the aircraft were not visible to the observers, thus the effective survey strip was ~400 m wide on each side of the aircraft. The surveys were flown during mid-day during good conditions, when visibility is optimal and the numbers of seals hauled out on the ice were expected to be highest.

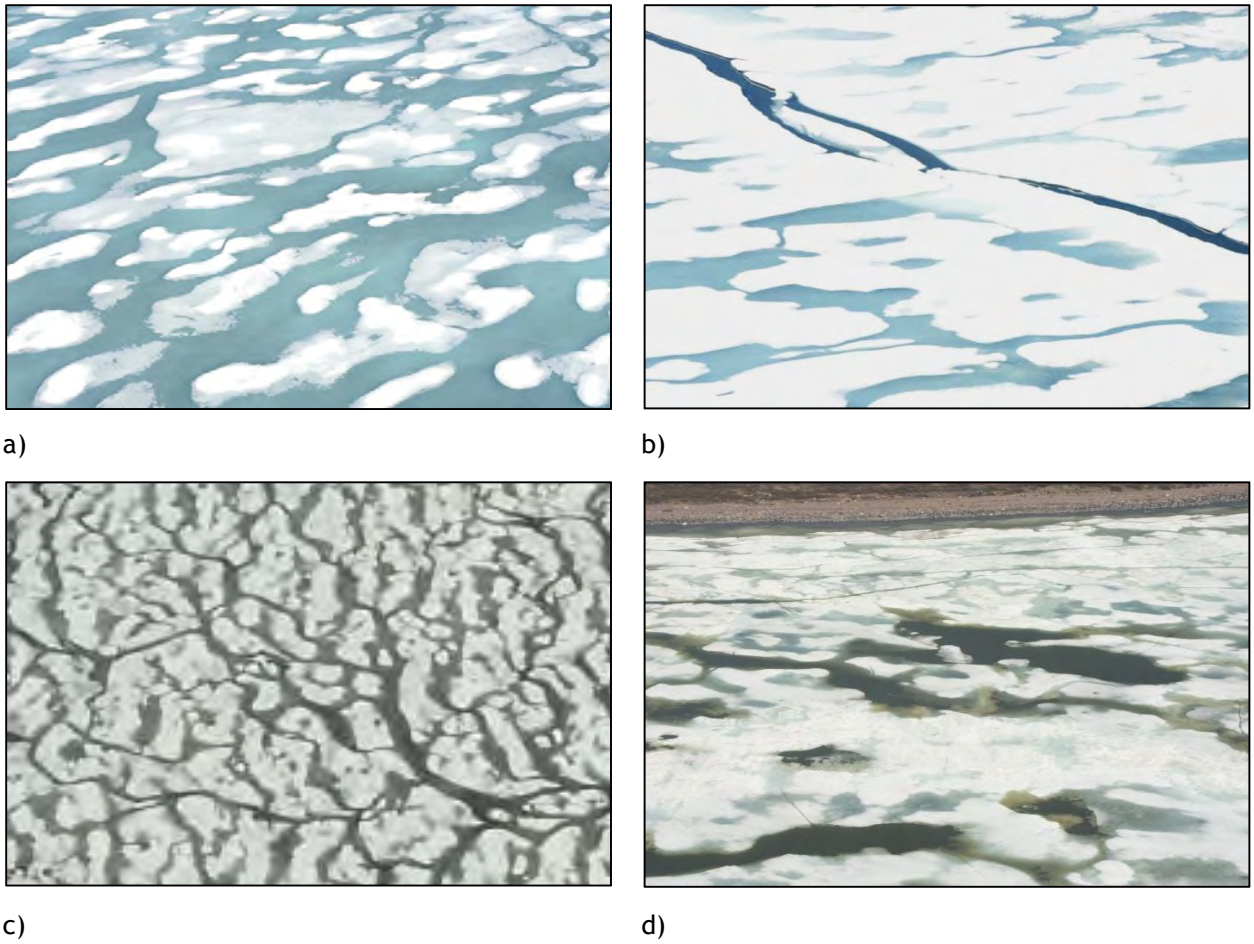
8.3.3 Data Collection Procedures

During survey flights, observers noted the number of seal breathing holes and if animals were present, the species, age (adult or pup), number of seals observed, and the approximate distance that the animals were from the aircraft in 100 m increments (termed distance bins). The location and extent and value of ice cover were also noted. All seals and breathing holes observed off-transect (greater than 500 m from the aircraft or during ferry flights) were recorded as off-transect sightings.

Environmental conditions were noted during the survey flight, including the ice cover, ice condition, air temperature, wind speed, visibility, and survey time. Ice cover was classified by amount of ice cover and condition of ice (Table 8.3-1; Plate 8.3-1). Data on ice condition were recorded by GPS for every change in cover and condition type.

Table 8.3-1. Survey Condition Data Recorded During Survey Flight

	Value	Description
Ice Condition	Fast (Solid Ice)	Solid ice, no breakup
	Cracked Ice	Ice starting to crack, leads or cracks 5-20 km apart
	Melt Ice	Fast ice that is covered with melt water
	Broken Ice	Ice that is broken up into small floes (< 0.5 km in size)
	Open Water	Free of ice
Cloud Cover	Clear	No cloud shadow on or near transect line
	Scattered	Up to 50% cloud shadow on or near transect line
	Partly Cloudy	50-90% cloud shadow on or near transect line
	Overcast	No sunshine on or near transect line
Wind Speed	0	No wind
	1	1-9 km/h
	2	10-19 km/h
	3	20-29 km/h
	4	30-39 km/h



a) b)

c) d)

Plate 8.3-1. Ice condition classification for marine mammal surveys June 13, 2012 showing: a) solid ice, b) cracking ice, c) ice covered with various amounts of melt water, and d) broken ice consisting of small floes.

Incidental observations of other wildlife that could be identified from the aircraft were also recorded. Species, numbers of adults and/or offspring, GPS location, and habitats in which they were observed were documented whenever possible.

8.3.4 Data Analysis Procedures

8.3.4.1 Survey Effort and Ice Cover

Survey effort was calculated using GIS software by summing the total length of transects surveyed. Total survey time was the sum of the time spent on each transect. Average speed was determined by dividing the total survey time by the total length of transects surveyed. GIS software was used to map ice cover in Bathurst Inlet by plotting the GPS data points recorded for every change in ice cover on each transect. Ice condition boundaries were drawn in and verified against map drawings created in the field.

8.3.4.2 Data Analysis

Ringed seal data was analyzed using distance sampling. Distance sampling is a common method used to estimate detection probabilities and derive density estimates (Buckland et al. 2001; Thomas et al. 2010). Distance sampling allows for estimation of the numbers of distant animals not detected within

the effective survey area. The ability of observers to detect animals usually varies with habitat type, observer experience, season, species, and other factors. In order to derive density estimates, counts of animals made during surveys are multiplied by a 'correction factor' – the inverse of the detection probability *p*, the proportion of animals detected of the total present. For example, if 140 animals are counted, and it is estimated that 80% of the animals were detected, then the count is adjusted by 1/0.80 = 1.25 (140 x 1.25 = 175). Corrected counts can then be used to more accurately relate species to habitat. As it is not possible to determine the proportion of seals in the water at the time seals are counted on the sea ice, the corrected density estimate is for seals on ice only and not those in the water.

Distance sampling requires that the distance from the survey aircraft be recorded. Histograms (frequency plots) of detection distances then can be used to determine detection probabilities. A line, also called the 'detection function', is fit to the frequency plot of detection distances. The area under the line corresponds to the proportion of the total number of animals that were detected, and is thus an estimate of the detection probability (Thomas et al. 2010).

Detection distances collected during marine mammal aerial surveys were used to derive a detection function using the program Distance (version 5.0; Buckland et al. 2001; Thomas et al. 2006). Counts of ringed seals in various ice types were used to derive density estimates for each ice type. Detection probabilities were similar across ice types so a global model was used. In order to improve model fit, recommended procedures were followed, including left truncation. Data were truncated at 200 m (elimination of counts within 200 m) due to decreased detection of seals underneath the aircraft where visibility was limited.

8.4 RESULTS

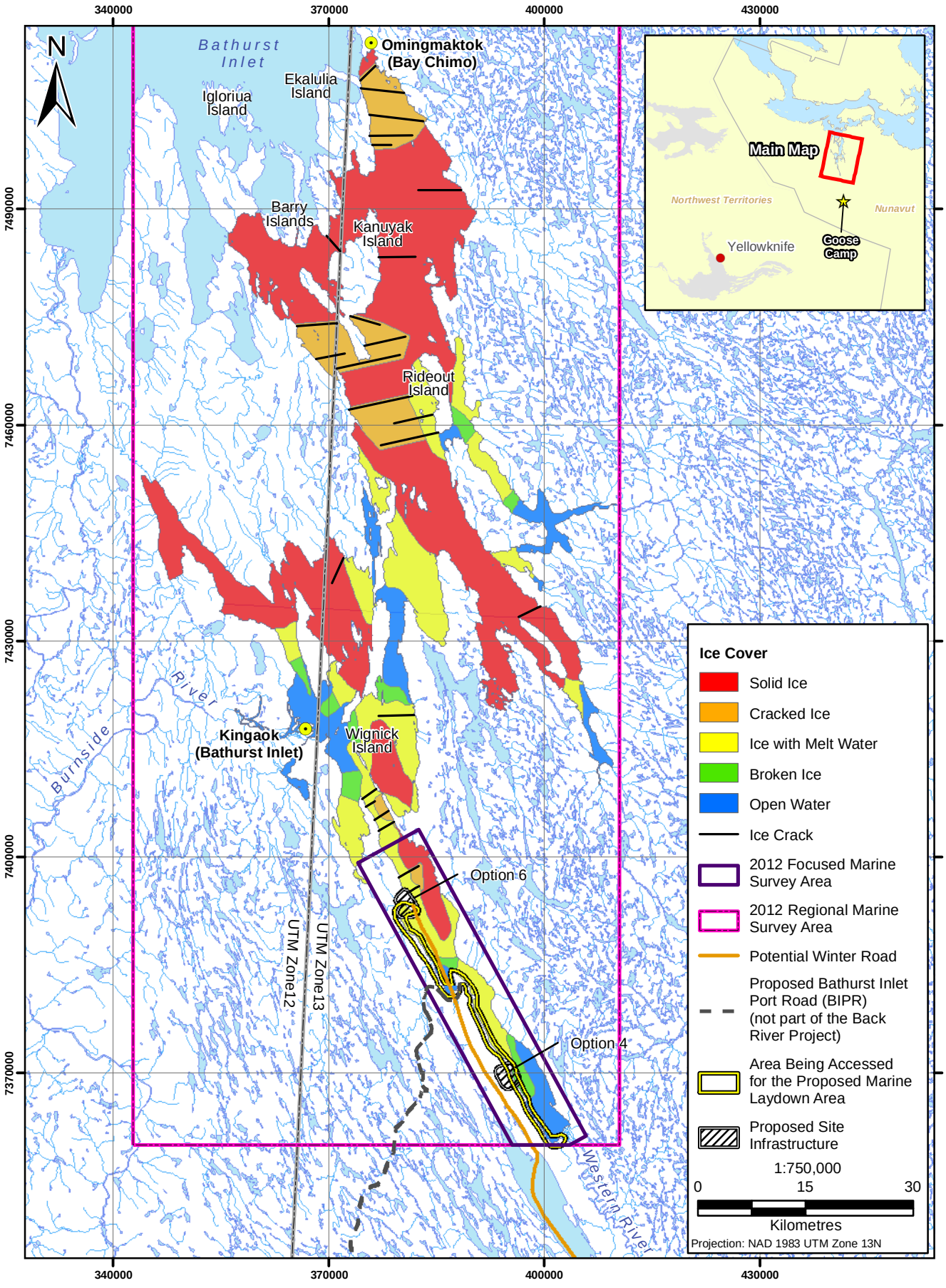
8.4.1 Survey Effort and Ice Cover

Two marine mammal surveys were flown, one on June 13th and the second on June 16th, 2012. A gap of three days existed between surveys due to unfavourable flying conditions. Transects located in the FMSA and in the lower part of the MRSA (Transect points 1-24) were surveyed on June 13th, 2012, and those located in the northern regions of the MRSA (Transects points 25-47) were surveyed on June 16th, 2012 (Figure 8.3-1). Survey effort and flying conditions are summarized in Table 8.4-1. The total survey effort comprised 7.3 hours and 1,001.75 km of transect lines flown (Table 8.4-1).

Table 8.4-1. Summary of Survey Effort and Conditions for Marine Mammal Surveys Conducted in Bathurst Inlet in 2012

Date	Survey Effort		Average Speed (km/h)	Cloud Cover	Wind Speed (km/h)	Temperature (°C)
	Time (h)	Distance (km)				
13-Jun	3.7	511.21	142.6	Scattered	20	3
16-Jun	3.6	490.54	138.1	Clear	15	14
Total	7.3	1001.75				

The ice cover in Bathurst Inlet was in various stages of break up during surveys conducted in June, 2012 (Table 8.4-2; Appendix 8-1). Rivers were completely free of ice and open water was present around the mouths of the larger rivers, including the Western River at the southern tip of the Inlet, the Burnside River near Kingaok, and in several narrow channels between islands (Figure 8.4-1; Plate 8.4-1). In addition, several large areas of nearshore ice located near the Western and Burnside Rivers were covered by floodwater from these rivers.



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Distribution of Ice Cover in the MLSA and MRSA during Marine Mammal Aerial Surveys, 2012

Figure 8.4-1

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Table 8.4-2. Percent of Area Surveyed in the FMSA and MRSA by Ice Type

Ice Type	FMSA Transect Length	FMSA %	MRSA Transect Length	MRSA %	Total Transect Length	Total %
Open Water	26.80	24.09	67.93	10.79	94.73	12.79
Broken Ice	10.73	9.64	29.12	4.63	15.36	2.07
Ice with Melt Water	52.79	47.45	126.61	20.12	179.40	24.22
Cracked Ice	2.58	2.32	67.89	10.79	70.47	9.51
Solid Ice	18.37	16.51	337.84	53.68	356.21	48.09
Total	111.27	100.00	629.39	100	740.66	100

a) b)

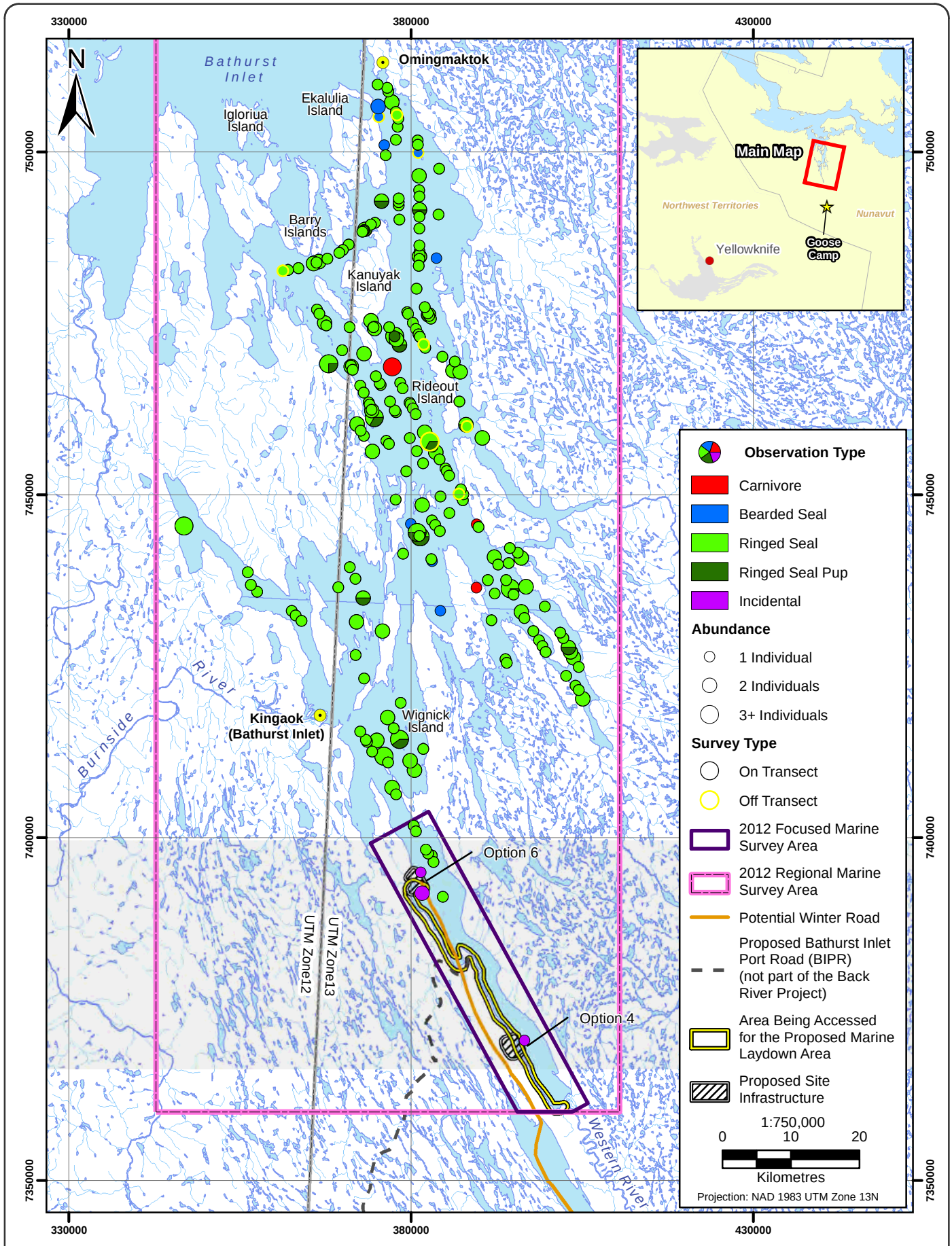
Plate 8.4-1. Areas of open water around the mouth of a) the Western River and b) the Burnside River surveyed June 13, 2012.

Ice condition differed between the FMSA and MRSA (Figure 8.4.1; Table 8.4-2; Appendix 8-1). There was a greater proportion of solid ice cover in the MRSA relative to the FMSA and a greater proportion of open water, broken ice, and melt water in the FMSA relative to the MRSA (Table 8.4-2).

8.4.2 Ringed Seals

8.4.2.1 Abundance

A total of 284 ringed seals were observed on transect during the surveys. Seventeen of these observations were of pups (approximately 10 weeks of age; Figure 8.4-2). The surveys covered a total of 741 km^2 of potential habitat (not including land). The observed overall uncorrected density of seals was 0.38/km^2. However, uncorrected densities do not consider the proportion of seals that were hauled out on the ice but missed during the survey (detection bias) or those that were in the water under the ice (availability bias). Corrected density estimates were calculated using Distance to correct for detection bias using the half normal cosine model as it fit the data best (lowest AIC criteria). The corrected density of ringed seals in Bathurst Inlet was estimated to be 2.05/km^2.



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Seal Distribution and Carnivore Observations Recorded in the MLSA and MRSA during Marine Mammal Aerial Suveys, 2012

Figure 8.4-2

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8.4.2.2 Distribution

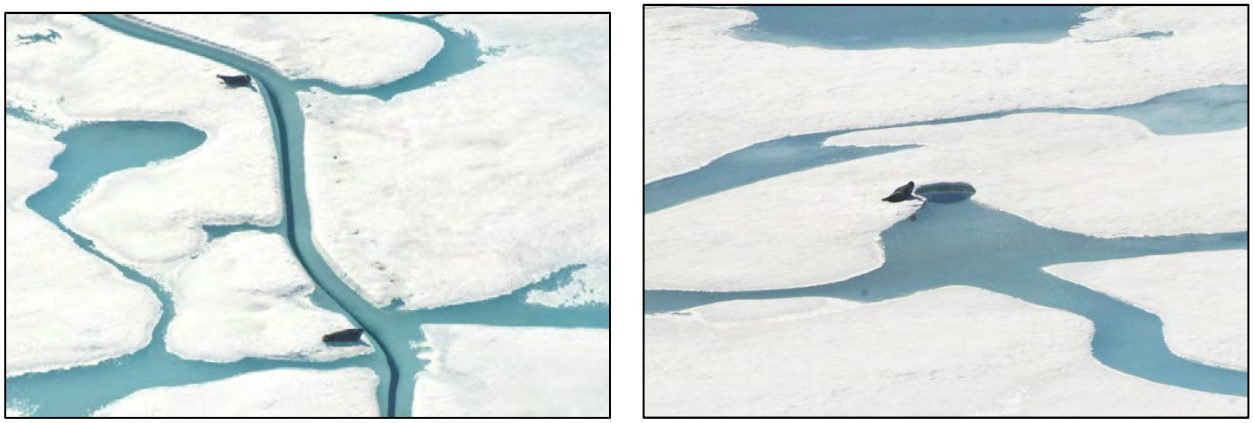
Ringed seals were widely distributed throughout Bathurst Inlet during the study period (Figure 8.4-2). Ringed seals occurred in most parts of the inlet, but density was considerably lower in the FMSA (corrected density = 0.2 seals/km^2), especially in the southern part of the inlet south of the proposed Option 6, relative to the MRSA (corrected density = 2.4 seals/km^2). However, ice melt in the FMSA was further advanced than in the MRSA (Figure 8.4-1). Only seven ringed seals were observed in the FMSA during marine mammal surveys, one of which occurred south (~ 3.5 km south) of the proposed Option 6 laydown area (Figure 8.4-2). Four additional seals were observed east of Option 6 in the proposed laydown area, and two seals north of Option 6 (Figure 8.4-2). The closest seal was approximately 2 km from the proposed Project infrastructure (Option 6 laydown area).

Ringed seal densities were also differentiated by ice condition (Table 8.4-3). The highest density of ringed seals occurred on cracked ice followed by solid ice (Table 8.4-3; Plate 8.4-2). Densities were significantly lower in areas with high ice deformation and extensive melt water indicating a strong preference for dry ice during the annual moult. Only one seal was observed on a piece of floating ice (broken up ice) near the open water.

Table 8.4-3. Seal and Carnivore Observations by Ice Type

Ice Condition	Area Surveyed	# Ringed Seals	Uncorrected Density of Ringed Seals (seals/km^2)	[a]Corrected Density of Ringed Seals (seals/km^2)	# Bearded Seals	# Carnivores
Open Water	94.73	0	0.00	*NA	0	0
Broken Ice	39.84	1	0.02	*NA	0	0
Ice with Melt water	179.40	39	0.22	0.99	3	0
Cracked Ice	70.47	57	0.81	4.80	5	0
Solid Ice	356.21	187	0.53	2.41	1	6
Total	740.65	284	0.38	2.05	9	6

[a]* *Distance was not able to calculate a corrected density estimate due to insufficient data*



a) b)

Plate 8.4-2. Ringed seals observed June 16, 2012 during marine mammal aerial surveys hauled out next to a) a crack and b) a breathing hole.

8.4.2.3 Breathing Holes

A total of 1,709 breathing holes were observed during surveys conducted in June 2012 (Figure 8.4-3). These breathing holes included those that were unoccupied (Plate 8.4-3) and holes that had one or more seals basking on the ice beside the hole. There were approximately six times more breathing holes than ringed seals observed during the surveys. Breathing holes were fairly evenly distributed, although a higher density of holes were observed in the MRSA relative to the FMSA, corresponding to the advanced ice melt in the FMSA relative to the MRSA (Table 8.4-2; Figure 8.4-3). The uncorrected density of breathing holes in Bathurst inlet was 2.31/km^2. The density estimate corrected for detection bias was estimated at 14.69/km^2 with the highest density of breathing holes in solid ice (19.98 holes/km^2) followed by cracked ice (17.45 holes/km^2), melted ice (11.44 holes/km^2), and the lowest density in broken ice (9.89 holes/km^2).

Plate 8.4-3. Breathing holes observed during marine mammal surveys, June 13, 2012.

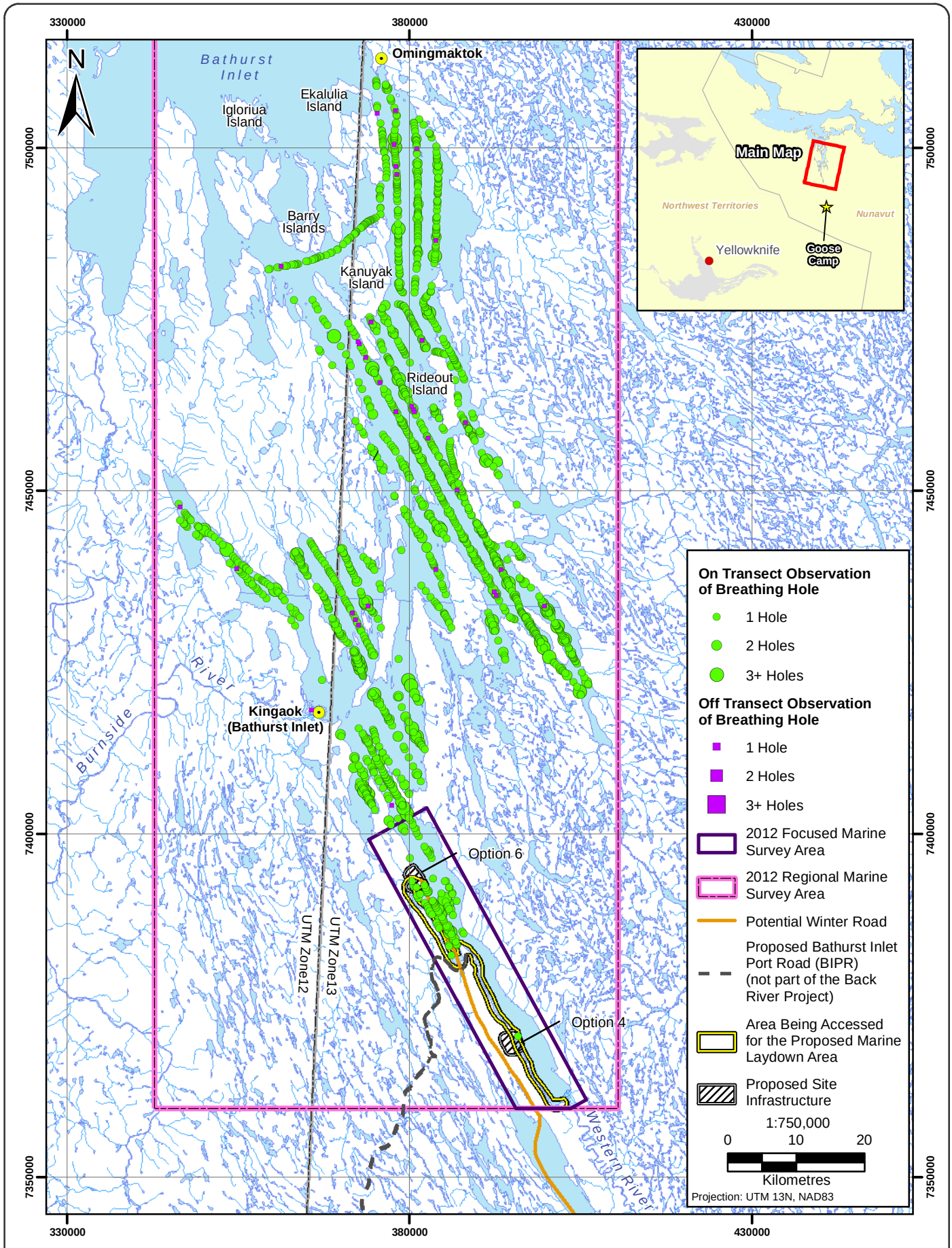
8.4.2.4 Incidental Sightings of Ringed Seals

Four ringed seals were observed incidentally during other environmental baseline studies. Two ringed seals were observed on the ice near Option 6 in early June during breeding bird PRISM studies. Two additional ringed seals were observed in July from a boat during fisheries surveys (Plate 8.4-4; Rescan 2012a). These two seals were swimming in the waters of Bathurst Inlet, one observed in the waters near Option 6 on July 13, 2012, and the other observed at Option 4 over several days in July (July 14 – July 17). It is possible that the two observations in July were of the same seal.

8.4.3 Bearded Seal

8.4.3.1 Abundance

A total of eight sightings and nine bearded seals were observed during all marine mammal surveys (Figure 8.4-2). One sighting included two animals, with the remainder as sightings of single individuals. Density calculations and further analysis were not conducted because of the limited number of bearded seals observed during surveys.



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Distribution of Breathing Holes Observed in the MLSA and MRSA during Marine Mammal Aerial Surveys, 2012

Figure 8.4-3

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a)

b)

Plate 8.4-4. Ringed seals observed incidentally between July 13 and July 17, 2012 swimming in the waters near proposed marine laydown a) Option 4 and b) Option 6.

8.4.3.2 Distribution

All bearded seal observations occurred outside of the FMSA with the majority of animals (five) located near Ekalulia Island in the northern portion of the MRSA (Figure 8.4-2). One animal was observed east of Kanuyak Island and three additional animals were observed south of Kanuyak Island (Figure 8.4-2). All animals were located less than 2 km from shore and found in shallow water (<150 m) with the majority occurring at water depths of less than 100 m (Table 8.4-4) georeferenced from nautical charts numbers 7791 and 7792 (CHS 2012). In addition, the majority of bearded seals were observed on cracked ice, with three seals located on ice with melt water (Table 8.4-4). Only one bearded seal was observed on solid ice cover.

Table 8.4-4. Bearded Seal Observations, Depth Profile where Observed, Approximate Distance to the Nearest Shore, and Ice Condition

Bearded Seal ID	Approx. Depth under Ice*	Approx. Distance from Shore	Ice Condition
BS 1	130	1.8	Melted Ice
BS 2	< 100	1.9	Melted Ice
BS 3	< 100	1.4	Melted Ice
BS 4	150	1.2	Solid Ice
BS 5	< 100	0.6	Cracked Ice
BS 6&7	150	0.7	Cracked Ice
BS 8	75	0.3	Cracked Ice
BS 9	50	0.3	Cracked Ice

**Depth data was georeferenced from chart number 7791 and 7792 (CHS 2012).*

8.4.4 Incidental Sightings of Carnivores on Landfast Ice

Three sightings of carnivores on landfast ice were observed during marine mammal surveys (Table 8.4-5). One grey wolf was observed running on the ice on June 13th, and one wolverine was observed walking on the ice on June 16th. Wolves and wolverines are known predators of ringed seals typically preying on young animals (SEAL 2011). In addition, a group of four grizzly bears, consisting of one adult and three cubs was observed sitting on the ice at a crack (Plate 8.4-5).

Table 8.4-5. Incidental Sightings of Carnivores Observed during Marine Mammal Surveys

Date	Species	Total	Adult	Juvenile
June 13, 2012	Grey Wolf	1	1	0
June 16, 2012	Wolverine	1	1	0
June 16, 2012	Grizzly bear	4	1	3

Plate 8.4-5. Four grizzly bears observed incidentally during marine mammal surveys sitting at a crack on the ice June 16, 2012.

8.5 DISCUSSION

Marine mammal surveys were conducted in the MRSA to document the presence and abundance of marine mammals, to determine the spatial use of ice habitat during the spring moulting period and to identify potentially important habitat for marine mammals using the FMSA and MRSA. Uncorrected densities of ringed seals in the MRSA were similar to those reported in the area in 2007 (Cross and Elliott 2007). Corrected density of ringed seals in the MRSA (using Distance software) was 2.05 seals/km^2. However, the density of seals calculated via the number of breathing holes observed in the MRSA was approximately twice that of the corrected density calculation. Thus, a low and high estimate of seal abundance in the MRSA was determined to be between 1,250 and 2,600 ringed seals. The density of seals in the FMSA was lower than that in the MRSA, however, densities of ringed seals were distributed based on ice conditions with highest densities occurring in areas with less advanced melt (such as in the MRSA) relative to areas with more advanced ice melt (e.g. in the FMSA). Of the ringed seals observed during the survey, seventeen were identified as pups, indicating that there may be potential for ringed seals to build lairs and raise pups within the MRSA. In addition to ringed seals, several bearded seals were observed during surveys in the MRSA and were most often associated with cracked ice and ice with melt water in areas that were fairly shallow (< 150 m). Other than marine mammals, three carnivore species including wolf, wolverine and grizzly bear were observed during the marine mammal surveys in the MRSA and may prey on seals, especially pups, while the ice is still passable.

The uncorrected density of 0.38 seals/km^2 hauled out on the ice of Bathurst Inlet during the survey was similar to uncorrected densities reported in 2007 for the same area (Cross and Elliott 2007) and in the range (0.06-1.72 seals/km^2) of those reported from studies in other areas of the Canadian Arctic and Alaska (Finley 1976; Kingsley, Stirling, and Calvert 1985; Lunn, Stirling, and Nowicki 1997; Frost et al. 2002; Moulton et al. 2005). Densities corrected for detection bias, calculated using Distance software, indicate that the actual density of seals in Bathurst Inlet is much greater (2.05 seals/km^2) than uncorrected densities suggest. Using corrected density calculations in iced areas of Bathurst Inlet the abundance of ringed seals within the area surveyed in Bathurst Inlet is estimated to be ~1,250 seals. However, corrected density calculations using Distance only correct for detection bias and do not account for seals that were not detected because they were in the water under the ice. Thus, the abundance of ringed seals in the area surveyed is likely to be even greater.

A large number of breathing holes were observed during the marine mammal surveys conducted in the MRSA. The uncorrected density of seal holes observed during this study (2.31 holes/km^2) was approximately twice that observed in a study conducted in 2007 (Cross and Elliott 2007). Ringed seals maintain on average 3.4 breathing holes per adult seal (Hammill 2009). Using the corrected density of seal holes in Bathurst Inlet (14.69 holes/km^2), and the ability for a single adult ringed seal to maintain on average 3.4 breathing holes per seal, the density of adults seals expected to occur in the area surveyed is 4.32 seals/km^2, which is approximately twice the corrected density of seals that was calculated using Distance software (2.05 seals/km^2). Multiplying the area surveyed by the corrected density (4.32 seals/km^2 based on the number of breathing holes) suggests an upper population estimate 2,600 ringed seals in Bathurst Inlet. However, this estimate is based on breathing holes that were observed in all ice types, and those that are located on ice flooded with melt water may no longer be used. Thus, a total abundance based on the presence of breathing holes alone would overestimate the population of ringed seals and the actual number of seals using the surveyed area of Bathurst Inlet is somewhere between 1,250 to 2,600 ringed seals.

The density of ringed seals in the FMSA was much lower than that in the MRSA. However, the density of seals was correlated to ice condition with larger densities of ringed seals associated with cracked ice and solid ice. The ice cover in the FMSA consisted primarily of melted ice with large areas of open water and broken ice floes. The one ringed seal observed south of the proposed Option 6 laydown area within the FMSA was associated with a small portion of solid ice in the FMSA. The four seals east of the proposed Option 6 were either associated with solid ice or cracked ice. Thus, it is likely that the density of ringed seals was much lower in the FMSA relative to the MRSA because the ice breakup and melt in the FMSA was much further advanced than in the larger MRSA. Several old breathing holes were observed in the ice covered in melt water in the FMSA suggesting that ringed seals likely used this area more frequently when the ice cover was more solid. In addition, incidental observations of ringed seals in the FMSA during the spring when ice was still present and during the summer when the inlet was free of ice, suggest that this area is not avoided by ringed seals and may be used as an important area for feeding and moulting purposes. Currently there are no marine mammal studies reported in the literature that have been conducted in the summer months in Bathurst Inlet.

While conditions during marine mammal surveys conducted in 2012 were similar to those conducted at the end of June in 2007 by others (Cross and Elliott 2007), ice melt was approximately two weeks advanced in 2012 relative to 2007 in Bathurst Inlet. This effect was particularly apparent in the FMSA where only 13.4% of the area surveyed consisted of solid ice and the majority (~44%) was ice covered with melt water, with large areas of open water and broken up ice (Figure 8.4-1). In the MRSA, the majority of the area surveyed consisted of solid ice (53.2%) or cracked solid ice (10.9%), with ice covered with melt water, broken up ice or open water consisting only smaller portions. The cause for earlier melt in 2012 relative to 2007 is not known, however, it may be related to a warm year effect in 2012 (ArcticNet 2012), or to the effects of climate change. Climate change is a possible threat to

ringed seal populations that are dependent on ice for reproduction and moulting and is cited as the reason for reassessment of the status of ringed seals by COSEWIC.

Seventeen ringed seal pups were observed during marine mammal surveys. Pups represented 6% of the ringed seal observations recorded during these surveys. Pups observed during survey were approximately 10 to 12 weeks of age and are fully weaned and independent at this age. Pups were documented based on their smaller size relative to most seal observations. At weaning (approximately 40 days), ringed seal pups are approximately 20-30% of the mother's mass and are abandoned (Hammill et al. 1991). Pups observed during the surveys were likely using the ice to rest. While observations of pups do not necessarily confirm evidence of ringed seal breeding in Bathurst Inlet, the observations of pups may indicate that this area may be used for breeding purposes by ringed seals. Adult seals return to the same breeding territories each year, but it is unknown if young seals return to their birth region when they are old enough to breed (B. P. Kelly et al. 2010). In addition, Bathurst Inlet may represent an important breeding area for ringed seals as there may be fewer predators in this area during the pupping timing window, and polar bears do no inhabit this area as they are typically restricted to areas that contain sea ice throughout most of the year.

A total of nine bearded seals were recorded during 2012 marine mammal baseline surveys. None of these seals were observed in the FMSA. Although few in number, observations and density of bearded seals in Bathurst Inlet during 2012 surveys were consistent with those observed in 2007 (Cross and Elliott 2007). All observations were recorded in areas with a depth of 150 m or less under the ice cover. Eight of the bearded seal observations occurred on either cracked ice or ice covered with melt water, with only one observation occurring on solid ice. This observation is consistent with literature suggesting that bearded seals generally avoid thick shorefast ice and prefer areas near open water and areas which are shallow (Burns 1981; Kingsley and Stirling 1991).

The main predators of seals, other than polar bear, include Arctic fox, walrus, wolves, dogs, wolverine, sharks, gulls, and humans. In the Bathurst area, the most likely predators include Arctic fox, wolves, and wolverine. During marine mammal surveys conducted in June, three species of carnivores were observed on the ice including wolf, wolverine, and grizzly bear. While grizzly bears have not been documented as ringed seal predators, recent research indicates that grizzly bears are increasingly documented on sea ice. It has been suggested that in the absence of caribou in the early springtime, when animals emerge from their dens, grizzly bears may be compensating by searching for other meat sources such as seals (Struzik 2006).

9. Carnivore Dens

9. Carnivore Dens

9.1 INTRODUCTION

This section presents the results of carnivore den baseline studies and carnivore observations in 2012. These studies were conducted to identify carnivore species inhabiting the Regional Study Area (RSA; Figure 3-1), and to determine the distribution and status (e.g. active, abandoned) of their dens.

9.1.1 Carnivore Species and Denning Ecology

The predominant mammalian carnivores that occur on the tundra within the RSA are grizzly bears (*Ursus arctos)*, grey wolves (*Canis lupus*), Arctic foxes (*Alopex lagopus*), red foxes (*Vulpes vulpes*), and wolverines (*Gulo gulo*). Dens belonging to these species likely occur in the RSA. Carnivore dens belonging to foxes and wolves are often excavated in eskers because the substrate is suitable for digging the dens. Dens are usually found in close proximity to food resources, such as berries, fish, and small mammals (Plate 9.1-1). A brief description of resident carnivore species that inhabit the RSA and the typical characteristics of their dens is provided below.

Plate 9.1-1. Suitable esker denning habitat in the RSA, August 14, 2012.

Grizzly Bears

Grizzly bears area known to occur within the RSA, as they have been documented during baseline studies conducted in 2011 (Rescan 2012b). The barren-ground grizzly bear population in Canada's central Arctic is near the northern- and eastern-most extent of their North American range. They are characterized by relatively low density in an area of low vegetative productivity and high seasonality (i.e. the monthly variability in evapotranspiration – the movement of water to the air from the soil, waterbodies, and/or plants) (Ferguson and McLoughlin 2000; P. D. McLoughlin, Ferguson, and Messier 2000). The population of barren-ground grizzly bears in the Slave Geological Province, near the south end of the RSA, was estimated at 800 (± 200 SE) individuals in 2003. Annual adult survival for this population is >97%, and annual home ranges are the largest (female: 2,100 km^2; male 7,200 km^2) in North America (P. D. McLoughlin, F. Messier, et al. 2003; P. D. McLoughlin, M. K. Taylor, et al. 2003). Grizzly bears are listed as special concern by COSEWIC (COSEWIC 2002a; Government of Canada 2013) and as sensitive in Nunavut by Canadian Endangered Species Conservation Council (CESCC 2010).

In the region of the RSA, grizzly bears den primarily in heath tundra and heath-boulder habitats (60% of surveyed dens), and less commonly in riparian tall shrub and birch seep habitats (McLoughlin et al. 2002). Denning occurs in eskers more often than expected based on the availability of eskers, suggesting that grizzly bears preferentially select eskers for denning (McLoughlin et al. 2002).

Although grizzly bear den sites are widely distributed throughout the Slave Geological Province (P.D. McLoughlin et al. 2003), the locations of dens tend to be clustered (Banci and Moore 1997) and bears tend to den in the same denning areas year after year (LeFranc et al. 1987).

Grey Wolves

Wolves are known to occur within the RSA and have been documented during baseline studies conducted in 2011 (Rescan 2012b). Wolves are the predominant predators of barren-ground caribou and rely primarily on adequate ungulate densities to maintain wolf population size (Walton et al. 2001; Paquette and Ludwig 2003). Alternative prey, such as birds and small mammals, can sustain wolves during periods of low ungulate availability.

During the spring, wolves follow the caribou herds north of the treeline and choose den sites south of the Bathurst herd calving grounds. This strategy likely optimizes the availability of caribou and alternative food resources for rearing pups (D.C. Heard and Williams 1992). Wolf pups usually leave the natal den in early August, but do not leave their summer range until October. As predators of migratory caribou, wolves within the Back River area have larger home ranges and exhibit fewer territorial behaviours than wolves in other parts of North America (Walton et al. 2001). Wolves require specific habitat features that allow them to dig denning structures. In the tundra environment, eskers and other glacial deposits provide the best habitat for den sites (Mueller 1995; Rescan 1995; Golder 1998; Walton et al. 2001; Cluff, Walton, and Paquet 2002; P.D. McLoughlin et al. 2004). Dens may also occur in other areas that are easy to excavate such as mounds of glacial-fluvial sediment or along lake banks. Dens are focal points of wolf activity during the summer, and there is evidence that individual wolves exhibit fidelity to den sites (Cluff, Walton, and Paquet 2002), returning and using the same areas in successive years (Walton et al. 2001).

Foxes

Arctic foxes and red foxes both occur within the Arctic (Cypher 2003; G. A. Feldhamer, B. C. Thompson, and J. Chapman 2003) and within the RSA (Rescan 2012b). Both fox species were documented in the RSA during baseline studies conducted in 2011 (Rescan 2012b). Annual density fluctuations of foxes are often related to prey availability, particularly lemmings (D. G. Reid, Krebs, and Kenney 1997; Angerbjörn, Tannerfeldt, and Erlinge 1999; G. Feldhamer, B. Thompson, and J. Chapman 2003). There is often a lag effect observed between the abundances of foxes and rodents, with the peak fox population following the peak rodent population by one to two years.

Foxes are habitat generalists that use earthen dens primarily for reproduction and cover during bad weather events (Eberhardt, Garrott, and Hanson 1983). Fox dens can typically be found in open tundra, talus slopes, rock outcrops, and under boulder piles. Dens are generally in mounds, close to streams, in locations with low snow cover, and where ground temperatures and depths of loose soil are high (Smits, Smith, and Slough 1988; Szor, Berteaux, and Gauthier 2008). Similar to other carnivore dens, fox dens are usually located on steep slopes with a southerly aspect, and in sandy soils (Smits, Smith, and Slough 1988; Szor, Berteaux, and Gauthier 2008). Foxes may dig many dens, but those used for reproduction tend to be in areas with sufficient food resources and far from other dens (Szor, Berteaux, and Gauthier 2008). Foxes show strong den fidelity returning to the same sites in successive years (Cypher 2003). This fidelity is exhibited by breeding adults even when rodent availability is low (Strand et al. 2000; Feldhamer, Thompson, and Chapman 2003).

Wolverine

Wolverines were documented in the RSA during baseline studies conducted in 2010, although no observations were reported in baseline studies conducted in 2011. Wolverines in the Slave Geologic Province have an estimated home range size of 126 km^2 for adult females and 404 km^2 for adult males (Mulders 2000).

Wolverines use two types of dens for reproduction – natal dens, where the young are born, and maternal dens, where the mother may move the kits if the conditions at the natal den are no longer suitable (Magoun and Copeland 1998). It is not known with certainty why a mother may shift from a natal den to a maternal den; however, human disturbance and warming temperatures above freezing, which decreases snow pack, have been shown to be contributing factors to den abandonment (Magoun and Copeland 1998; May et al. 2012). Distinguishing between the two den types is difficult as both types of dens will be similar in structure and appearance. In addition, determining initiation of denning and the birthing of kits requires consistent tracking of females, which is time consuming and expensive (Magoun and Copeland 1998). The birth of wolverine kits occurs earlier than other northern non-hibernating carnivores (i.e. wolves and foxes). The peak period for birthing is February through mid-March (Magoun and Copeland 1998; Inman et al. 2012).

Rocky outcrops and wind hardened snowdrifts are commonly used sites for wolverine reproductive dens in tundra and alpine areas (Magoun and Copeland 1998). Typically, wolverine dens are built under at least 1 – 5 m of snow and consist of long, complex snow tunnels that lead down to boulder fields, rock overhangs, or large cracks in rocks, which are large enough to allow kits to move around and provide additional protection from predators (Magoun and Copeland 1998; Inman et al. 2012; May et al. 2012). Wolverines will often use the same den site or general location (within 1 – 2 km of the original den site) in multiple years (Lee and Niptanatiak 1996; Magoun and Copeland 1998). The protection of wolverine denning habitat, especially natal denning habitat, from human disturbance may be critical for the persistence of wolverine populations (Magoun and Copeland 1998).

Prey remains are commonly found at wolverine dens. Their primary food source is caribou supplemented with a variety of other species, such as large mammals (muskox or moose), carnivores (wolverine, red fox, Arctic fox, and ermine), small mammals (lemmings, voles, Arctic ground squirrels, and hares), marine mammals, and fish (Mulders 2000). Wolverine reproduction has been shown to be limited by winter food availability, especially of ungulate carrion, and dependent on adequate security cover (i.e. dens) for kits in winter (Banci 1994; Persson 2005).

9.2 OBJECTIVES

No carnivore dens were observed during 2011 baseline studies (Rescan 2012b); however, incidental observations of female grizzly bears with cubs and other juvenile carnivores such as wolves during 2011 baseline studies suggest evidence of breeding in the RSA during 2011. The objectives of the carnivore den surveys in 2012 were to determine the location, number, and status of grizzly bear, wolf, and fox dens within the RSA. In addition, incidental observations of carnivores were recorded during the 2012 baseline studies within the RSA and MRSA to document the presence of carnivore species occurring in the area.

9.3 METHODS

Aerial surveys were conducted using a Bell 206 helicopter to identify carnivore dens within the RSA. Surveys were flown at an altitude of 50 to 100 m above the terrain and at ground speeds between 30 to 80 km/h to minimize disturbance to carnivores in the area but to maintain an effective height and speed for observers to effectively find dens and signs of activity (i.e. animals, scat, tracks, or prey remains).

To minimize the potential for disturbances caused by low-level helicopter flights to migrating caribou, pilots increased altitude to 300 m when individual caribou were observed. No herds of migrating caribou were observed during carnivore den surveys, likely because the majority of migration routes of Bathurst and Beverly Caribou occur outside the RSA (Figure 10.4-2).

9.3.1 Occupancy Surveys

Carnivore den occupancy surveys were conducted in late May 2012 to locate dens within the RSA, to determine which species were using each den, and to determine den status (active, inactive, or unknown). Den sites were classified as active based on observations of adults at the den sites, or signs of recent use, such as fresh excavations, tracks, or scat. When dens were found to be active and species were positively identified, the helicopter immediately left the area to minimize disturbance to the animals. Dens were classified as inactive when no recent signs of use were found. Dens were classified as of 'unknown' status, when it was difficult to determine whether signs of use (e.g. scat, bones) were recent.

Areas with esker and glacial-fluvial habitat features were prioritized for surveying, as dens are typically associated with these features. The results of previously conducted den surveys in 2007 (Gartner Lee Ltd. 2008) in the Back River area were also used to guide these surveys (Appendix 9-1). All den sites identified in 2007, including those that were not occupied by carnivores at the time, were re-surveyed during the spring occupancy survey in 2012.

9.3.2 Productivity Surveys

Productivity surveys were conducted on July 27, 2012 at dens identified as active during the 2012 occupancy survey, and at den sites incidentally observed during other 2012 environmental baseline surveys. Active dens were classified as either 'active', if adults were observed at the den but no young were observed, or 'productive' if young were observed. When neither adults nor young were observed, a ground survey was conducted to assess the status of the den. A den was confirmed to be active if recent prey remains, tracks, or scat were found near the den, since carnivores bring food back to the den to feed their young. Dens were classified as inactive if there were no recent signs of use, or of 'unknown' status when it was difficult to determine whether signs of use (e.g. scat, bones) were recent. In order to minimize disturbance at active dens, a detailed productivity assessment across multiple visits was not conducted. .

9.3.3 Incidental Observations

Incidental observations of carnivore den sites and carnivores with and without young were recorded during wildlife field inventories in 2012. Incidental observations of carnivores were also documented by field staff in other disciplines. Date, species, number of individuals, sex, age, behaviour, location, and habitat were documented whenever possible.

Remote Digital Cameras

Incidental observations of carnivores were also recorded by remote digital cameras used to supplement the wolverine DNA study (Rescan 2013a) and the caribou baseline studies (Section 10). Remote digital cameras for the wolverine DNA study recorded observations from March to early May 2012 and cameras for the caribou baseline studies recorded observations from late May to August 2012. For each photo where carnivores were present, the following data were recorded: camera number, type of photo (motion or triggered), photo number, date, time of day, species, number of animals in the frame, behaviour, and any additional relevant information. When photos were taken by successive triggers, the photos produced by the second and subsequent triggers were recorded as part of the same series if the photos were taken less than 5 minutes apart. If both timed and triggered photos were taken within 5 minutes of each other, they were initially recorded separately but were then combined and reviewed

to remove any duplicates. All data was reviewed a second time to eliminate any possible duplicate recordings of the same individual as carnivores may spend more than 5 minutes at a site. If a photo series (motion or time triggered) were taken less than 24 hours apart, the photos were reviewed and analyzed to determine if they were of a unique animal. Observations of carnivores were considered a duplicate if it was not possible to tell individuals apart within the 24 hour period and the maximum number of animals observed in an individual frame was considered the final animal count for that series.

9.4 RESULTS

9.4.1 Summary

A total of 16 dens were observed during baseline surveys in 2012; 13 dens were observed during the carnivore den occupancy and productivity surveys and 3 dens were observed incidentally. Eleven dens were surveyed during the occupancy survey, three of which were resurveyed during the productivity survey. Two additional dens, one observed incidentally during other environmental baseline studies conducted in 2012 and another identified during the productivity surveys were visited during the productivity surveys (Table 9.4-1 and Figure 9.4-1). In addition, two wolverine dens and one grizzly bear den were observed incidentally during other 2012 wildlife baseline surveys but were not visited during the occupancy or productivity surveys (Table 9.4-1). Dens were mainly distributed in the north-west portion of the RSA near large lakes and eskers (Figure 9.4-1).

The dens of five species were identified and assessed during 2012 including: grizzly bear, wolf, Arctic fox, red fox, and wolverine (Table 9.4-1; Appendix 9-2). Seven dens were confirmed as active (two dens that were active in the occupancy survey were also active in the productivity survey), four were determined to be inactive, and status was unknown for four dens (Table 9.4-1). Three additional dens, two wolverine dens that were active in the spring, and one grizzly bear den were observed during other baseline studies conducted in 2012 (Appendix 5-2). Active dens were observed along the south- or north-east sides of eskers or glacial-fluvial benches (Table 9.4-2).

Table 9.4-1. Back River Carnivore Den Survey Results, 2012

Species	Number of Dens Recorded in RSA, 2012	Number of Active Dens	Den Status in May			Den Status in July			
			Active	Inactive	Unknown	Active	Productive	Inactive	Unknown
Grizzly Bear	2[1]	0	n/a	n/a	n/a	n/a		n/a	n/a
Fox	4	2	1	1	1	2	1	0	0
Wolf	2	2	1	0	1	2	1	0	0
Wolverine	2[2]	2	n/a	n/a	n/a	n/a		n/a	n/a
Unknown Species	6	0	0	3	3	0	0	0	0
Total	**16**	**6**	**2**	**4**	**5**	**5**	**2**	**0**	**0**

[1] *One grizzly bear den was incidentally observed in June 2012 during the grizzly bear DNA collections near a grizzly bear DNA post.*
[2] *These wolverine dens were found incidentally during other baseline surveys and were active in the spring, 2012.*

Table 9.4-2. Status and Habitat of Carnivore Dens

Den ID	Species	Type of Survey*	Den Status[1]	Evidence of Use	No. Holes	Diameter of Holes (cm)	Habitat Type	Slope Position	Slope %	Aspect	Soil Texture	No. Animals	Comments
1	Unknown Species	Occupancy	NA				Esker	Mid-slope	10	NE	Sandy		
2	Fox	Occupancy	U				Esker	Lower-slope	10	SE	Sandy		Some scat around holes
3	Unknown Species	Occupancy	U				Esker	Lower-slope	5	N	Sandy		Old wolf scat
4	Unknown Species	Occupancy	U				Esker	Lower-slope	5	W	Sandy		Appears inactive, bones nearby
5	Unknown Species	Occupancy	NA				Esker	Top	-	-	Sandy		Lots of old activity, bones everywhere
6	Unknown Species	Occupancy	NA				Esker	Lower-slope	5	W	Sandy		
7	Unknown Species	Occupancy	U				Glacial-fluvial	Top	-	-	Sandy		Sik sik dens or potentially fox; lots of wolf tracks too
8	Fox	Occupancy	NA				Glacial-fluvial	Upper-slope	5	S	Rock / Sand		
9	Grizzly Bear	Productivity	n/a	Fox skull, wolf scat	1	100	Glacial-fluvial	Top		S	Sandy		One large collapsed hole; den observed near grizzly bear DNA post
10	Red Fox	Productivity and Incidental	A/P	Some bones	6	10 - 15	Esker	Top			Sandy		2 kits seen 3 weeks prior to survey, 2 adults seen regularly in camp
11	Wolf	Occupancy and Productivity	A/P	Scat, caribou bones, digs, and hair	5	15 - 20	Esker	Lower-slope	5	NE	Sandy	2	Pregnant pair of wolves
12	Arctic Fox	Occupancy and Productivity	A	Scat, fur, digs, and bones (hare)	5	10 - 15	Esker	Upper-slope	5	SE	Sandy		Wolf scat around den

(continued)

Table 9.4-2. Status and Habitat of Carnivore Dens (completed)

Den ID	Species	Type of Survey*	Den Status[1]	Evidence of Use	No. Holes	Diameter of Holes (cm)	Habitat Type	Slope Position	Slope %	Aspect	Soil Texture	No. Animals	Comments
13	Wolf	Occupancy and Productivity	A	Lots of large scat, bones, and excavations	5	20 - 30	Esker	Mid-slope	5	S	Sandy loam	2	
14	Wolverine	Incidental	A	Tracks in the snow			Rock overhang				Rock / boulder		Observed during wolverine DNA study
15	Wolverine	Incidental	A	Scat and prey remains			Rocky boulder area				Rock / boulder		Observed during breeding bird surveys
16	Grizzly Bear	Incidental	U				Glacial-fluvial						Observed during grizzly bear DNA collection surveys

**Refers to when a den was either first observed or re-visited. [1]NA = Inactive, U = Unknown, A = Active, and P = Productive*

9.4.2 Occupancy Surveys

A total of 11 dens were surveyed during the carnivore den occupancy surveys conducted in 2012 (Table 9.4-2). Seven dens were visited that were previously surveyed in 2007 (Gartner Lee Ltd. 2008) and three new dens (Dens 11, 12, and 13) were identified during the occupancy surveys (Table 9.4-2 and 9.4-3). Of the seven dens surveyed in 2007 and 2012, all were either inactive or had unknown activity status in 2012 (Table 9.4-3).

Table 9.4-3. Dens Surveyed in 2007 and 2012 during Occupancy Surveys

Den ID	Species in 2007	Den Status in 2007	Species in 2012	Den Status in 2012
1	Wolf	Active	Unknown Species	Inactive
2	Red Fox	Active	Fox	Unknown Activity
3	Wolf	Active	Unknown Species	Unknown Activity
4	Wolf	Unknown Activity	Unknown Species	Unknown Activity
5	Wolf	Inactive	Unknown Species	Inactive
6	Wolf/Fox	Inactive	Unknown Species	Inactive
7	Wolf	Inactive	Unknown Species	Unknown Activity
8	-	-	Fox	Inactive
11	-	-	Wolf	Active
12	-	-	Fox	Active
13	-	-	Wolf	Active

Two dens were identified as active during the occupancy surveys and four dens as inactive (Table 9.4-2). Five dens were classified as unknown status as it was difficult to determine whether signs of use were recent (Table 9.4-2).

Grey Wolf

Two dens were identified as wolf dens during the 2012 occupancy surveys, and both were newly identified dens. One of these dens (Den 11) was considered active during the occupancy survey and the other (Den 13) was later upgraded to active from unknown status during the productivity survey (Table 9.4-2 and 10.4-3 ;Figure 9.4-1). Both dens had observations of adult wolves at the den site (Plate 9.4-1), and the pair observed at Den 11 appeared to include a pregnant female (Plate 9.4-2). Both dens were situated on or near eskers, had sandy soil texture, and had entrance holes greater than 15 cm in diameter (Table 9.4-2). Both wolf dens were at least 30 km away from Goose and George properties; Den 11 was approximately 30 km south of George Camp and Den 13 was approximately 43 km north-east of Goose Camp (Figure 9.4-1).

Fox

Three dens observed during the occupancy survey were identified as fox dens but were not identified to the species level as no animals were observed near the dens (Table 9.4-2). Two fox species are known to occur in the RSA, including the red fox and the Arctic fox. Of the three fox dens, one den (Den 2) was previously surveyed in 2007 (Gartner Lee Ltd. 2008) and the other two (Dens 8 and 12) were newly identified in 2012 (Table 9.4-3).

PROJECT #0833-002-05 GIS # BAC-23-049 March 05 2013

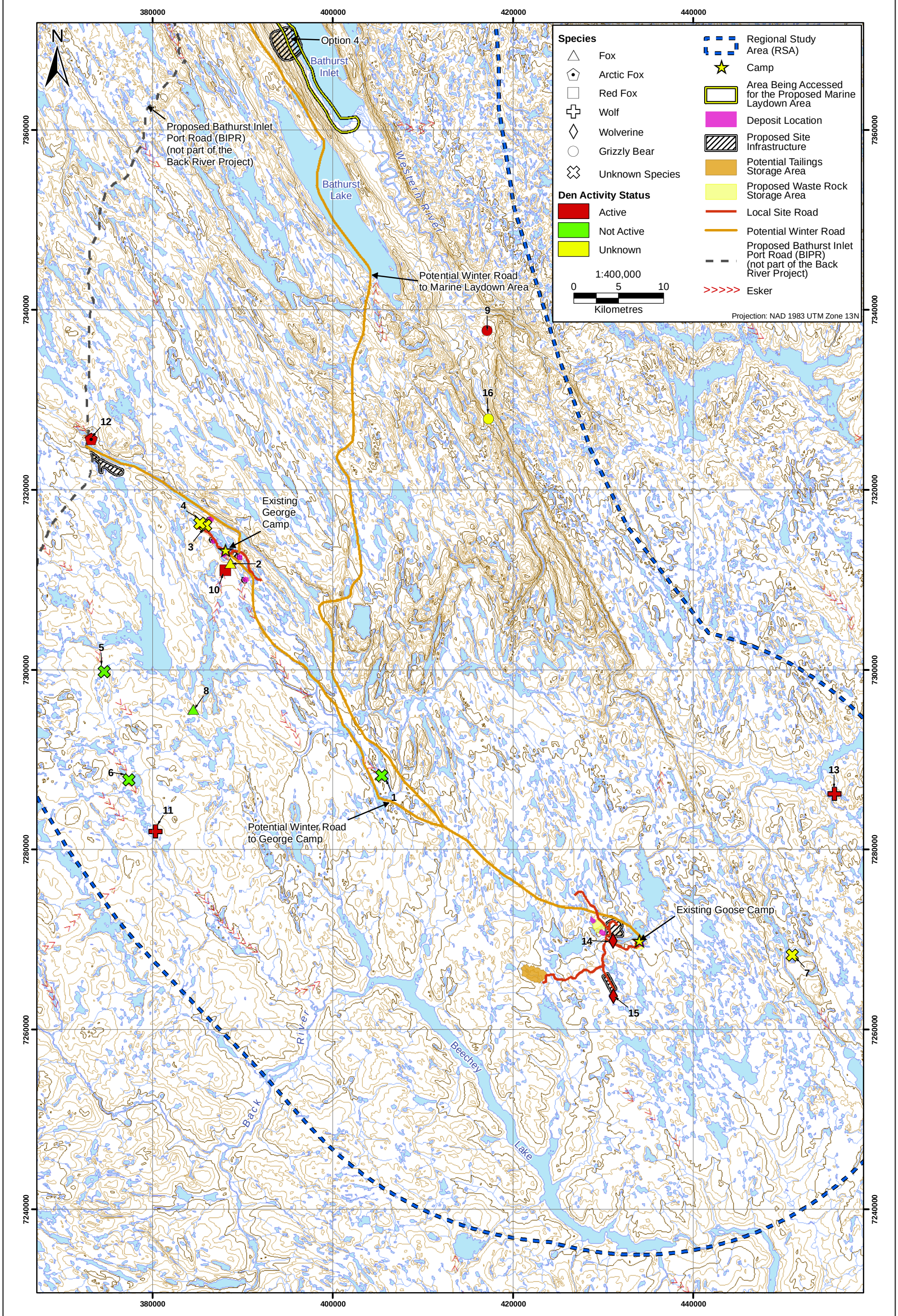

Figure 9.4-1

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Carnivore Dens and Locations Observed During 2012 Occupancy and Productivity Surveys

Figure 9.4-1

Rescan™ Engineers & Scientists

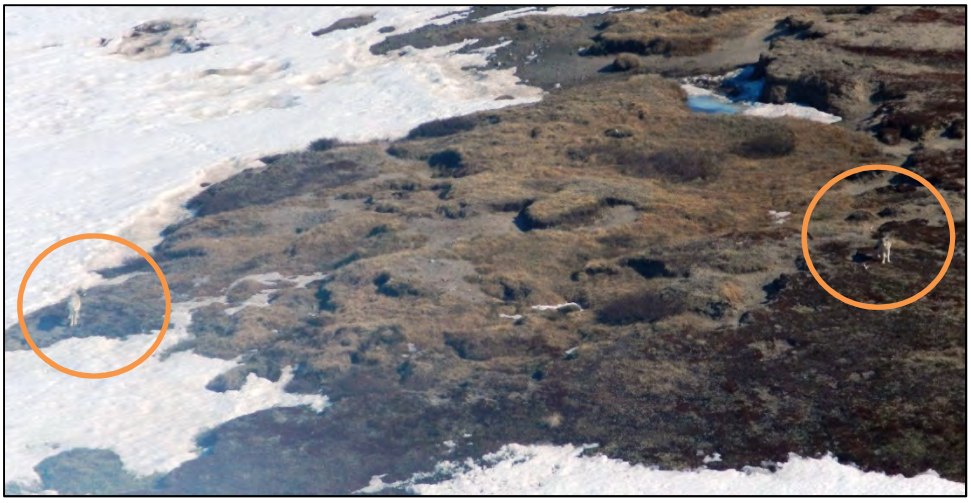

Plate 9.4-1. Den site 11 with a pair of wolves observed (circled in orange), May 27, 2012.

Plate 9.4-2. Potential pregnant female observed at Den 11, May 27, 2012.

Of the newly identified dens, one den (Den 12) was considered active due to the presence of scat and recent digging, and the other (Den 8) was considered inactive (Table 9.4-2). The den previously identified in 2007 (Den 2) had unknown activity status in 2012 (Table 9.4-2 and Plate 9.4-3). All the dens were situated on a moderate slope with a southerly aspect in sandy soil on either esker or glacial-fluvial habitat. The active den (Den 12) was approximately 1 km away from proposed site infrastructure, while the inactive den (Den 8) was about 20 km from the George Property, and the den with unknown activity status (Den 2) was located about 1 km outside of George Camp (Figure 9.4-1).

Plate 9.4-3. Den 2 was a fox den with unknown activity status, May 27, 2012.

Unknown Carnivore Species

Accurate species identifications were not determined for six dens during occupancy surveys in 2012, due to a lack of any defining species den characteristics or sign at the time of the survey. All six dens were previously surveyed and identified as wolf dens in 2007 (Table 9.4-3). Three of these dens were identified as inactive while the other three had unknown activity status in 2012 (Table 9.4-1 and Table 9.4-2).

The majority of unknown carnivore dens were situated on esker habitat in sandy soil and had evidence of old activity, such as dried scat and old prey remains (Table 9.4-2 and Plate 9.4-4). The three dens with unknown activity status are assumed to be old carnivore dens that have been taken over by Arctic ground squirrels. For instance, one den (Den 7) showed signs that it might have been an old fox or wolf den taken over by ground squirrels due to the number of small holes at the den site and recently investigated by wolves due to signs of digging and wolf scat (Table 9.4-2).

Plate 9.4-4. Den 5 was identified as unknown with inactive status; however, old bones and scat were observed (indicated by orange arrows), May 27, 2012.

9.4.3 Productivity Surveys

Productivity surveys were conducted at carnivore dens identified with active status during the 2012 occupancy surveys and at dens incidentally observed during other 2012 wildlife baseline surveys. It was possible to assign activity status to all of these dens – none were classified as of unknown status (Table 9.4-1). Two dens that were active and one den that had unknown status during the occupancy survey (Den 11, 12, and 13) were re-visited during the productivity survey; one of these dens (Den 11) was productive; pups were not observed at the other two dens so productivity was not known. Two additional dens (Den 9 and 10) observed incidentally during other wildlife-related surveys were also visited. Both of these dens were determined to have been active during 2012 prior to the productivity survey (Table 9.4-2). One of these dens (Den 10) was productive and the other den (Den 9) had unknown productivity.

The results of the productivity surveys at active den sites where no young were observed do not necessarily signify that those den sites were non-productive as multiple site visits at active sites were not conducted during the productivity assessment. Rather, results of active dens with no observations of young indicate that in 2012, productivity at these sites was not confirmed resulting in an unknown productivity status.

Grizzly Bear

One grizzly bear den (Den 9) was newly identified and surveyed during the productivity survey, and determined to have been active during this year (Figure 9.4-1; Table 9.4-2; Plate 9.4-5). The den site was a large, recently collapsed hole 100 cm in diameter dug into sandy soil in glacial-fluvial habitat with a south facing aspect along the Western River (Table 9.4-2 and Plate 9.4-5).

a) b)

Plate 9.4-5. a) Grizzly bear den (Den 9) identified during the productivity survey along the Western River, July 27, 2012. b) Old wolf scat observed near the grizzly bear den, July 27, 2012.

Grey Wolf

Productivity surveys were conducted at two wolf dens (dens 11 and 13) identified as active during occupancy surveys. Productivity was confirmed at one den (den 11) but not at the other (den 13). No animals were observed at these dens during the productivity survey but adults with pups were observed at one den (den 11) on several occasions prior to the productivity survey by a Northern Air Support

helicopter pilot (G. Tate, pers. comm.). Abundant wolf scat, prey remains, and hair were observed near the dens indicating recent activity and potential productivity (Plates 9.4-6 and 9.4-7).

a)

b)

Plate 9.4-6. a) Den entrance to wolf Den 11, July 27, 2012. b) Caribou bones near the den site, July 27, 2012.

a)

b)

Plate 9.4-7. a) Multiple entrances to Den 13, July 27, 2012. b) Bones of prey were found near the den entrance (orange arrow), July 27, 2012.

Fox

Productivity surveys were conducted at two fox dens in 2012; one identified during the occupancy survey (Den 12) and a new one identified during other baseline surveys in June 2012 (Den 10). One of these dens (Den 12) was identified as an active fox den in the occupancy survey and was located within 2 km of proposed Project infrastructure (Figure 9.4-1). This den may have belonged to an Arctic fox pair, based on the presence of white fox hair at the den; red foxes have much less white hair (Plate 9.4-8). No animals were observed at this den site, thus, productivity was unknown.

a)

b)

Plate 9.4-8. a) Den 12 was identified as an active fox den, July 27, 2012. b) White hair, possibly that of an Arctic fox, was found at the den site, July 27, 2012.

The second fox den (Den 10) was incidentally observed in June 2012 and was located within 2 km from the George Camp (Figure 9.4-1). Two kits were seen at this den three weeks prior to the productivity surveys and two adults were regularly observed in camp indicating that this den was productive in 2012; however, no animals were observed at the den site during the productivity surveys. The den was dug into sandy soil situated in esker habitat and had multiple entrances which were at least 10 cm in diameter (Table 9.4-2).

9.4.4 Incidental Observations of Carnivore Dens

Two wolverine dens were observed incidentally but not visited during occupancy and productivity surveys. One active wolverine den (Den 14) was incidentally observed in March 2012 during the wolverine DNA study (Figure 9.4-1; Appendix 5-2). An adult wolverine was observed by Rescan and Sabina staff and tracked to its den on snowmobile. Fresh tracks were observed around the entrance to the den and a snow tunnel was dug under a rock overhang (Plate 9.4-9). A second active wolverine den (Den 15) was observed incidentally in June 2012 during breeding bird surveys (Figure 9.4-1; Plate 9.4-10; Appendix 5-2). Prey remains, scat, and tufts of hair were found near the small rock overhang (Plate 9.4-10). Both wolverine dens were found in rocky boulder areas and located within 1 km of proposed site infrastructure; one of which (Den 14) was approximately 2 km away from Goose Camp in the 'goose neck' of Goose Lake (Figure 9.4-1).

a)

b)

Plate 9.4-9. a) Entrance to wolverine den (Den 14) under rock overhang, March 1, 2012. b) Fresh wolverine tracks observed near the den entrance, March 1, 2012.

Plate 9.4-10. Den 15 was also under a rock overhang with recent scat and prey remains of bones and hair (indicated by orange arrow), June 2012.

One grizzly bear den (Den 16) was incidentally observed in June 2012 during the grizzly bear DNA collections near a grizzly bear DNA post along the Western River approximately 15 km south-east of Bathurst Lake (Figure 9.4-1 and Plate 9.4-11). Two female grizzly bears with cubs were captured on a remote digital camera that was placed near the den site (Plate 9.4-12).

9.4.5 Incidental Observations of Carnivores

Incidental Observations of Carnivores during Field Surveys

Five carnivore species including grizzly bear, wolf, Arctic fox, red fox and wolverine (N = 61 individuals), were observed incidentally during baseline field surveys conducted in 2012 (Figure 9.4-2; Table 9.4-4). Grizzly bears and wolves were the most commonly observed carnivores during baseline field surveys in 2012 (Plate 9.4-13). Incidental observations of carnivores occurred throughout the RSA typically near large lakes, rivers or eskers. Most incidental observations of carnivores occurred within 15 km of the exploration camps or proposed Project infrastructure, likely due to the higher number of people in these areas recording sightings (Figure 9.4-2).

Table 9.4-4. Incidental Observations of Carnivores, 2012

Species	Number of Animals Observed
Arctic Fox	3
Grizzly Bear	35 (19 adults; 16 cubs)
Red Fox	3
Wolf	16
Wolverine	4
Total	61

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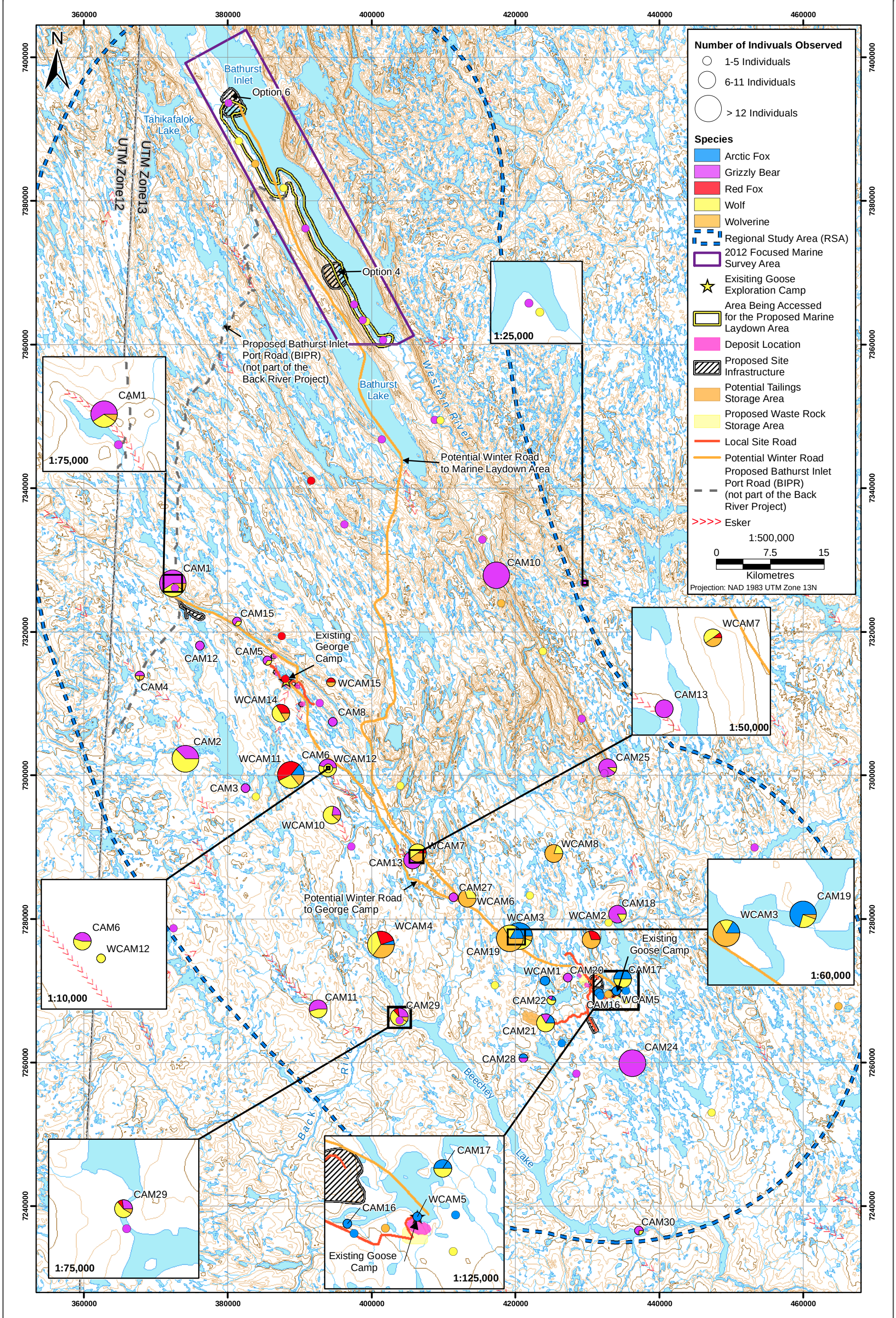

Figure 9.4-2

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Incidental Observations of Carnivores, 2012

Figure 9.4-2

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Plate 9.4-11. Grizzly bear den (Den 16) incidentally observed during grizzly bear DNA collection surveys, June 9, 2012.

a) b)

Plate 9.4-12. a) Mother grizzly bear with cub observed July 2, 2012 at Camera 10 near Den 16. b) Mother grizzly bear (not in view but seen in the photo series) with three young cubs observed July 5, 2012 at Camera 10.

There were six incidental observations of carnivore productivity in 2012; all which were of grizzly bears. There were five observations of female grizzly bears with cubs (Figure 9.4-3); two observations of a mother with two cubs and three observations of a mother with three cubs. There were a total of six adult females and 16 cubs observed incidentally, the other 13 bears observed were not identified to sex (Table 9.4-4). Most of these incidental observations of female grizzly bears with cubs in 2012 occurred near large lakes, rivers, or eskers (Figure 9.4-3). Large concentrations of female bears with cubs occurred in the north-east portion of the RSA along the Western River (Figure 9.4-3). In the previous year (2011), there were two observations of a female grizzly bear with two cubs and one observation of four yearling wolves.

Plate 9.4-13. A wolf observed incidentally during the grizzly bear DNA collection surveys, August 14, 2012.

Remote Digital Cameras

Remote digital images of carnivores were recorded at 13 (87%) of the 15 remote camera stations set up for the wolverine DNA study and at 25 (83%) of the 30 remote camera stations set up for the caribou baseline studies (Figure 9.4-2). A total of 258 observations of carnivores were recorded at these cameras including a total of 292 animals observed between late March and August 2012 (Table 9.4-5; Figure 9.4-2; Plate 9.4-14). Some individuals detected may have been repeated observations at the same camera or multiple cameras. The highest number of observations was recorded during April, July, and August (Table 9.4-5). Grizzly bears, wolves, and wolverine were the most commonly observed carnivores on remote cameras, particularly in April, July, and August (Table 9.4-4). Wolverine activity was primarily observed in April and declined in subsequent months; whereas, grizzly bear and wolf activity increased or remained consistent over the six months (Table 9.4-4).

Table 9.4-5. Incidental Observations of Carnivores at Remote Camera Stations, 2012

Species	No. of Observations at Cameras	Number of Animals Detected*						
		March	April	May	June	July	August	Total
Arctic Fox	29	3	4	4	6	8	5	30
Grizzly Bear	85	-	-	2	20	42	37	101
Red Fox	19	3	5	11	-	-	-	19
Wolf	74	16	14	9	7	17	29	92
Wolverine	51	6	35	5	2	-	3	51
Total	**258**	**28**	**58**	**31**	**35**	**67**	**74**	**292**

**Some individuals detected may have been repeated observations at the same camera or multiple cameras.*

There were a total of ten observations of grizzly bear productivity (i.e. females with cubs or two juveniles) detected at seven cameras (cameras 1, 10, 11, 13, 18, 24, and 29) with a total of eight females and 17 cubs observed (Figure 9.4-3). Most of these cameras were located near eskers or large lakes and rivers. The cameras with the greatest number of bears with cubs detected were cameras 10, 24, and 18 (Figure 9.4-3).

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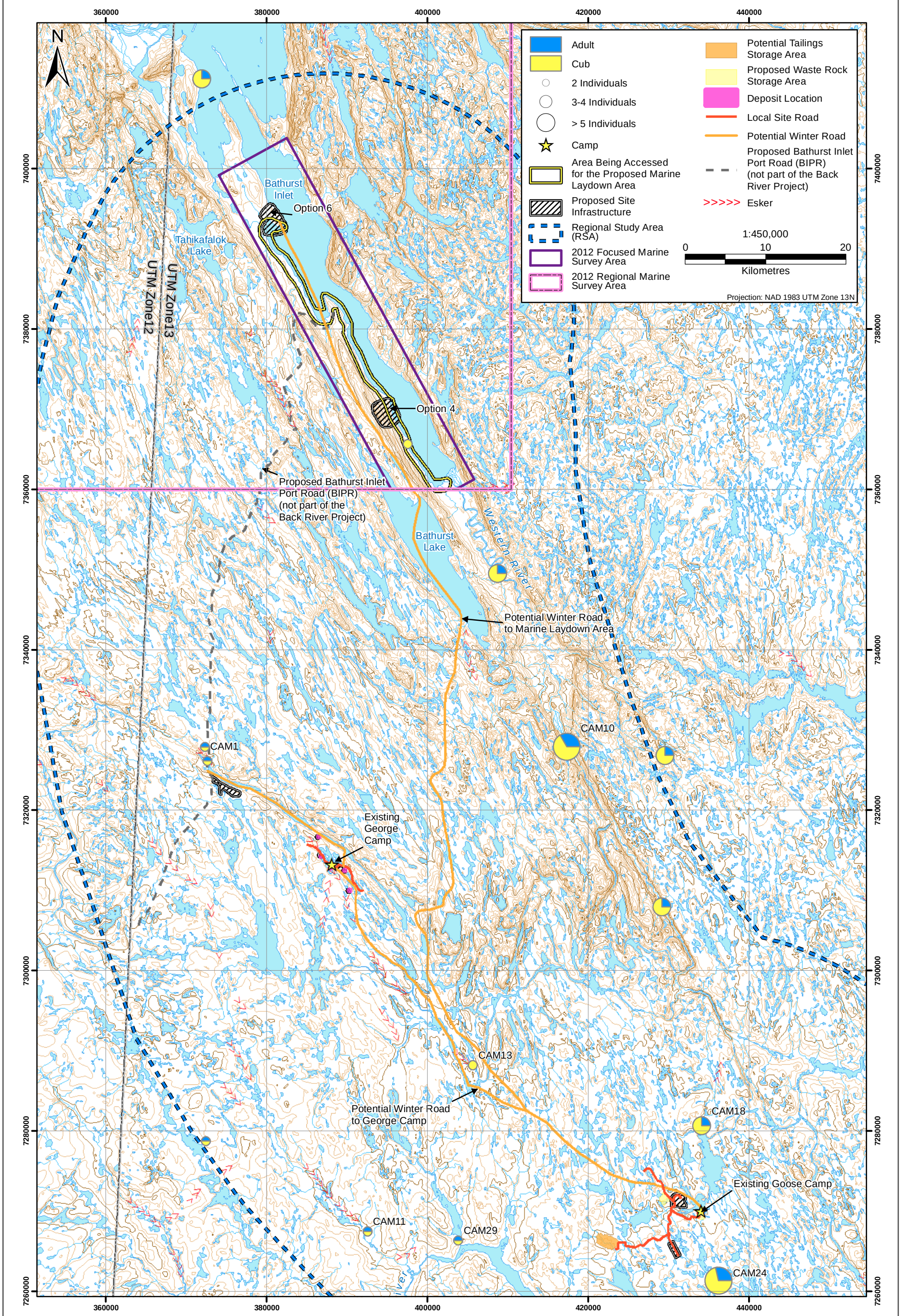

Figure 9.4-3

Sabina GOLD & SILVER CORP.

Incidental Observations of Female Grizzly Bears with Cubs, 2012

Figure 9.4-3

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a)

b)

c)

d)

e)

f)

Plate 9.4-14. Carnivores observed at the remote digital cameras included: a) wolf, June 1, 2012, b) Arctic fox, June 5, 2012, c) grizzly bear, August 1, 2012, d) wolverine, March 28, 2012, e) red fox, March 29, 2012, and f) wolf, April 3, 2012.

Discussion

Carnivore den baseline studies were conducted to identify: a) the number and distribution of existing dens within the RSA, b) dens that are active, and c) the predominant resident carnivore species utilizing the RSA.

A total of 13 dens were surveyed during the occupancy and productivity surveys. Three additional carnivore dens were incidentally observed during other wildlife baseline surveys in 2012. Approximately half (N=7) of the observed dens were considered active during 2012 with dens belonging to a total of five carnivore species including grizzly bear, Arctic fox, red fox, grey wolf, and wolverine. Even though more than half of the dens observed during 2012 had inactive (N=4) or unknown activity (N=5), these dens may still be used in subsequent years by the same species or by other species. Of the five active dens observed during carnivore den surveys, two (Den 10) were identified as productive since two adults with kits or pups were observed at the den sites prior to the productivity surveys; however, no young or adults were observed at the den during the productivity surveys. Productivity status was unknown for the other three active dens (Dens 9, 12, and 13). However, the wolf and fox dens (Dens 11, 12, and 13) were likely productive in 2012 as recent prey remains were found near the den sites and prey is usually brought back to the den to feed young.

Few grizzly bear dens were found during the occupancy and productivity surveys; however, there were numerous incidental observations of grizzly bear sows with cubs indicating that the areas around the Goose and George Properties, and the marine laydown areas may be productive breeding and denning areas (Figure 9.4-3 and Plate 9.5-1). Even though both grizzly bear dens (Dens 9 and 16) had little to no productive evidence at the den sites, they may have been productive as grizzly bear sows with cubs were incidentally observed near the den sites during other baseline surveys or at a camera trap (Camera 10) near the den site (Den 16).

a)

b)

Plate 9.5-1. a) Two juvenile grizzly bear cubs observed at Camera 13, June 7, 2012. b) Mother grizzly bear with cub observed at Camera 29, June 18, 2012.

Although productivity was not confirmed for most of the active dens during the productivity survey, the large number of incidental observations of carnivores, some within 1 to 20 km of the 15 den sites, indicates that the RSA is a reproductive area and frequently used by carnivores. Most carnivores were observed within 10 km of Project infrastructure sites from north-west to south-east (Figure 9.4-2); however, this is may be due to the higher number of people and cameras in these areas recording observations. Large lakes, rivers, and eskers appear to be the preferred denning habitat features selected by carnivores and these features are commonly found throughout the RSA.

Two wolverine dens were incidentally observed and ground inspected during other 2012 wildlife baseline surveys. Both dens were active this year and were likely productive as an animal was observed entering one of the dens (Den 14) and prey remains and scat were found near the other den site (Den 15). In addition, both dens were within 2 km of proposed Project infrastructure or the Goose Camp.

The majority of dens surveyed were found primarily in the north-west portion of the RSA in esker habitat. Eskers are commonly selected for denning because they provide suitable substrate for digging holes compared to the otherwise rock-covered landscape of the RSA. Therefore, survey effort was focused within esker habitat and this habitat was commonly found in the northern portion of the Project area.

Half of the dens observed (N=7) were at least 15 km away from any proposed site infrastructure whereas the other half (N=8) were located within 2 km of proposed Project infrastructure (Figure 9.4-1). Four dens with active status were within 1 km of proposed site infrastructure, one den with inactive status was within 1 km of the proposed winter road to George Camp, and three dens with unknown status were within 2 km of George Camp (Figure 9.4-1).

10. Caribou

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10. Caribou

10.1 INTRODUCTION

Barren-ground caribou (*Rangifer tarandus groenlandicus*) are a biologically and culturally important species in the Arctic. Caribou not only sustain wild predator populations such as wolves, grizzly bear and wolverine, but also provide a critical resource for human populations living in the North, particularly Aboriginal communities. Hunting, disease, and environmental variability can all affect caribou numbers, and the effects from industrial activities occurring within the species range are monitored for management of caribou. Three caribou herds have been recorded in the vicinity of the Project: the Bathurst, Beverly, and Dolphin and Union herds (Figure 10.1-1). The Dolphin and Union herd is considered to be a genetically distinct population of barren-ground caribou (*R. t. groenlandicus x pearyi*).

Bathurst caribou are a well-studied population of caribou that winters below the treeline and migrates to calving grounds currently to the west of Bathurst Inlet, the herd's namesake. The size of the Bathurst caribou herd, as estimated from annual counts of the number of calving females, has declined from about 200,000 females in 1986, to 55,000 in 2006, and then to 16,000 in 2009 (Nishi et al. 2010; Boulanger et al. 2011). The results of the 2009 calving ground survey suggests that the total herd size was approximately 31,900 ± 11,000 individuals (GNWT ENR 2009). The population estimates suggest an average annual decline of about 6% per year from 1986 to 2006, and then a very rapid decline of 35% per year between 2006 and 2009 (Adamczewski et al. 2009; Boulanger et al. 2011). These population trends have been attributed to declining calf survival, and concomitant declines in adult female fecundity, and survival in winter due to hunting (Boulanger et al. 2011). Annual monitoring of calf survival indicates that mean winter calf survival and calf-cow ratios for the Bathurst herd have declined by almost 50% from 2001 to 2004 compared with the 1985 to 1996 period (Gunn, Boulanger, and Williams 2005). More recently (2007-2009), indicators of breeding productivity such as cow-calf ratios, pregnancy rates, and body condition show improved conditions for the Bathurst herd (Adamczewski et al. 2009). A survey conducted in 2012 under ideal conditions reports that the population has remained stable, or may have increased to 35,000 individuals since 2009 (GNWT 2012).

The Ahiak herd was first described as a separate herd in 1986 (Gunn and D'Hont 2002). The results from early aerial surveys suggested that Ahiak caribou were predominately tundra-wintering caribou (i.e., do not migrate south for the winter), although in some years caribou moved below the treeline (Gunn, Fournier, and Nishi 2000; Gunn and D'Hont 2002). A systematic calving area survey along the Queen Maud Gulf in 1986 estimated the Ahiak herd size at 40,000 to 60,000 animals (Gunn, Fournier, and Nishi 2000). A decade later the herd increased in size to roughly 200,000 animals (based on a calving female count of 83,134 ± 5,298 caribou; Gunn, Russell, and Eamer 2011). In 2006, 123,000 female caribou were counted on the calving grounds, suggesting that the population increased again from 1996 to 2006 (Gunn, Russell, and Eamer 2011). However, data from satellite-collared cows has revealed that the Beverly herd, which formally calved south of the Ahiak herd, has gradually shifted their calving to the area used by the Ahiak herd (Nagy et al. 2011). Thus, apparent population increases in the Ahiak herd may be due to the gradual shift of the Beverly herd to the Ahiak calving grounds (Gunn, Russell, and Eamer 2011; Nagy et al. 2011). These combined herds are now known as the Beverly herd and referred to as such in this document. In some cases, the Ahiak herd is discussed separately when referring to this herd prior to the merger of the Ahiak and Beverly.

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Annual Ranges of the Bathurst, **Beverly**, and Dolphin and Union Caribou Herds

Figure 10.1-1

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The Beverly herd has declined in recent years. Between 2006 and 2009, the number of calving cows counted on the calving grounds declined by 60% (Adamczewski et al. 2009; Gunn, Russell, and Eamer 2011). Similar to that observed for the Bathurst herd, these data likely reveal a fast rate of population decline, possibly due to low recruitment rates in 2008 and poor body condition in 2009 (D. Johnson, Nagy, and Williams 2008; Adamczewski et al. 2009). An aerial survey in 2010 reported a modest increase in the number of caribou counted on the calving grounds (Gunn, Russell, and Eamer 2011).

The Dolphin and Union caribou winter on the mainland coasts of Nunavut and migrate across the Dolphin and Union strait to calve on Victoria Island. This herd is a genetically distinct population from the barren-ground herds and the Peary caribou of the Arctic archipelago (COSEWIC 2004). In the early 1900s, the Dolphin and Union caribou herd was estimated at 100,000 animals (COSEWIC 2004). Overhunting and possibly also ice storms caused a population crash between 1900 and 1920 to the point where caribou were not observed migrating between Victoria Island and the mainland after about 1930 (Gunn 2005). Beginning in the 1970s, the herd size increased, and in the late 1980s caribou resumed migration between Victoria Island and the mainland (Gunn et al. 1997). In 1993, approximately 7,200 Dolphin and Union caribou were counted on the mainland prior to migrating over the ice in the spring (Gunn et al. 1997). In 1997, the Dolphin and Union herd was estimated at 28,000 ± 3,350 animals (Nishi and Gunn 2004), about one-third of its historic size. A population estimate of 28,000 ± 2,500 in 2007 suggests the population size is stable or declining slightly, though still only a third of its historic size (M. Dumond, GN, unpubl. data, cited from Poole et al. 2010).

As a result of population declines, Dolphin and Union caribou are currently listed as a population of special concern on Schedule 1 of the *Species at Risk Act* (SARA). Potential threats to this herd's long term viability are climate warming and shipping activity across the herd's migration route (COSEWIC 2004). Climate warming may shorten the amount of time caribou have to overwinter on the mainland, as they migrate from the mainland and Victoria Island during the spring and fall migrations and this movement is dependent on ice formation. Shipping and icebreaking make Dolphin and Union caribou "vulnerable to die-offs similar to those that have affected Peary caribou" (COSEWIC 2004).

Caribou abundance is thought to fluctuate with a periodicity of between 40 and 70 years (Gunn 2003). While the decline in caribou numbers may be a consequence of natural population cycles, current low numbers make the populations vulnerable to human harvest, disturbance, disease, and weather events. Caribou vary in their response to disturbances based on the time of year and age of calves. Caribou are most sensitive to population-level effects during calving and post-calving when calves are most susceptible to predation and disturbance (Russell, Kofinas, and Griffith 2002). Calving and post-calving areas are designated as important habitat for caribou in Nunavut (NPC 2012).

10.2 OBJECTIVES

Baseline studies for caribou were conducted in the Combined Camera Study Area to determine temporal and spatial use by caribou within and outside the RSA. Specifically, the objectives were to:

- measure seasonal distribution and movements of collared Bathurst and Beverly caribou in the RSA;
- record temporal and spatial distribution of caribou in the Combined Camera Study Area using remote cameras;
- assess habitat use by caribou in the Combined Camera Study Area using remote cameras; and
- assess proposed Project infrastructure site use by caribou in the RSA using remote cameras.

10.3 METHODS

Aboriginal communities and government agencies raised concerns over the potential effects of multiple development groups conducting repeated small-scale aerial surveys on caribou populations and the possible effect of cumulative disturbance on the Bathurst herd. In order to minimize disturbance to caribou, alternative methods were used in lieu of traditional limited aerial reconnaissance surveys to assess the movement patterns and distribution of caribou through the RSA. These alternative methods included: a) the analysis of existing, unpublished satellite collar data for the Bathurst and Beverly herds from the NWT Government, b) the use of remote digital cameras to document caribou presence, and c) recording incidental observations of caribou during field surveys.

10.3.1 Distribution of Collared Caribou

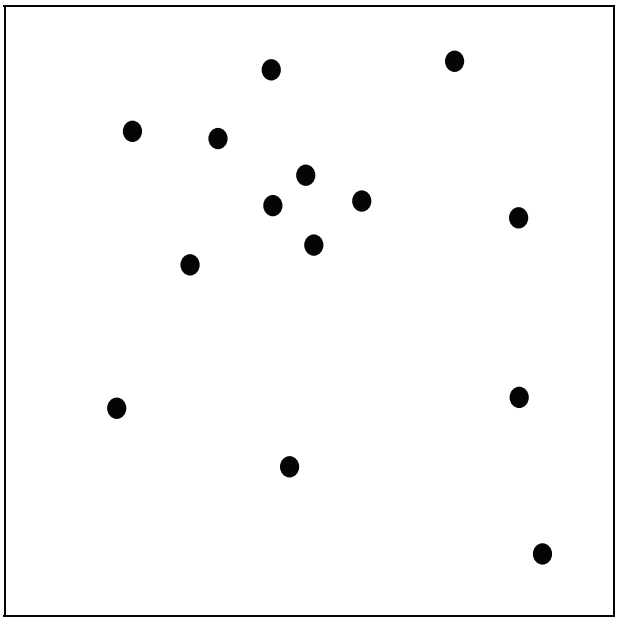
Collaring programs for several caribou herds in the Canadian Arctic have been established by the Government of Northwest Territories Department of Environment and Natural Resources (GNWT ENR) and Government of Nunavut Department of Environment (GN DOE). Satellite collars are fitted on female caribou, usually during the winter. A collaring program for the Bathurst herd has been in place since 1996 (GNWT ENR 2010). The number of collars that can be placed on Bathurst herd female caribou is restricted to 20.

A small number of caribou (five individuals) from the Ahiak herd were collared in 1996; this study ran for two years. Collaring programs involving larger numbers of caribou from the Beverly/Ahiak herd began in 2006. Satellite collars were first placed on caribou from the Dolphin and Union herd in 1987; no collars on Dolphin and Union caribou have been functioning since 2006.

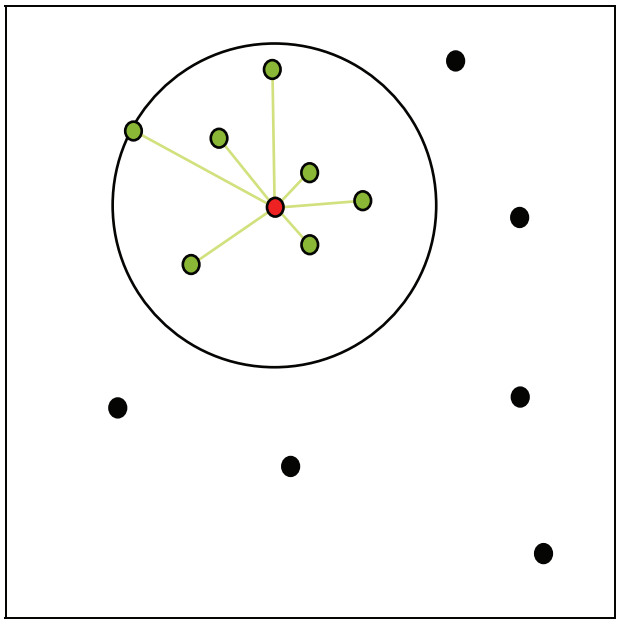
The data generated from these programs allow researchers to investigate seasonal trends in habitat use as well as track real time movement patterns of caribou herds. Unpublished satellite collar data from the Bathurst and Beverly herds were obtained from GNWT ENR for analysis of the distribution of these herds relative to the RSA. As the Dolphin and Union herd has a minimal chance to interact with habitat in the RSA, no analysis of satellite collar data was conducted for this herd. Data were acquired from the GNWT ENR Wildlife Management Information System (WMIS) from 1996 to the end of September 2012 for the Bathurst herd and from 2001 to the end of 2012 for the Beverly herd (GNWT ENR, *unpublished data*). There is overlap between the wintering grounds of Bathurst and Beverly caribou and adjacent herds including the Bluenose East and Beverly herds (Gunn, D'Hont, and Williams 2005; GNWT ENR 2010). Therefore, there is the potential for caribou to be assigned to a herd based on the occupation of wintering area but belong to an adjacent herd. This is particularly true in the case of Ahiak and Beverly caribou.

Fixed kernel density estimators were used to contextualize the spatial distribution of collared caribou relative to the RSA. The kernel density estimator is a non-parametric method that produces a probability distribution that estimates the likelihood of finding an animal at any particular location within its home range (Worton 1989). This method is a useful tool for ecologists to interpret wildlife habitat use from very high frequency or satellite collaring data. The probability distribution produced through kernel methods provides an estimate for an animal's true utilization distribution, which is described as an individual's relative use of space or the relative amount of time that an animal spends in any place (Seaman and Powell 1996).

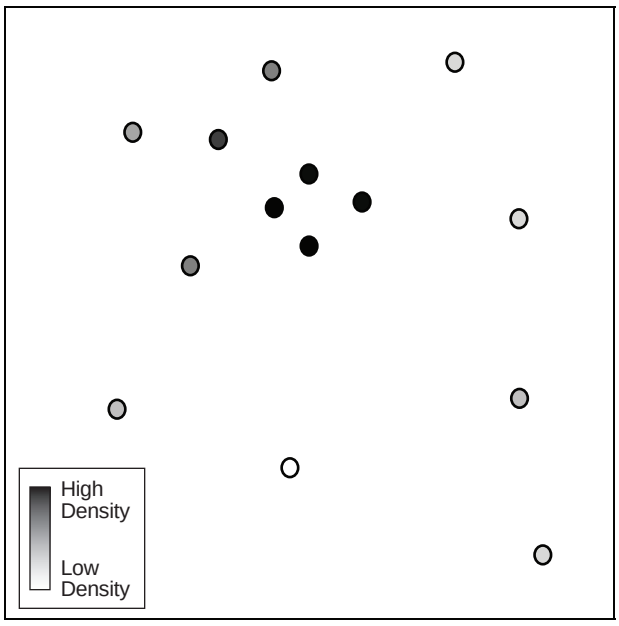
Kernel density distributions, henceforth referred to as kernel utilization distributions (UDs), were generated using Home Range Tools for ArcGIS 9. The iterative processes and steps of generating utilization distributions are shown in Figures 10.3-1 and 10.3-2. All estimations were generated using a fixed search radius, also referred to as the bandwidth, to generate the density values for data points and grid cells. A raster output of each kernel UD, like the one shown in Figure 10.3-2d, was generated to show the overall density of collar locations for each estimation. In addition, the kernel UDs contained within 50% and 95% volume contours, henceforth referred to as 50% and 95% kernel UDs, respectively, were calculated.



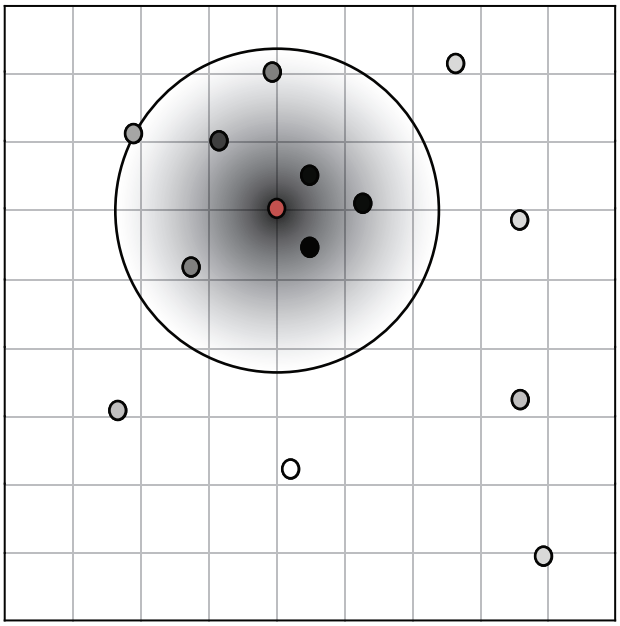
a) A hypothetical distribution of location data points from an animal within a focal study area.



b) A data point is selected as an evaluation point (red point) and points within a fixed radius of the evaluation point are selected. Based on all of the distances from neighboring points, a cumulative value is assigned to the evaluation point.



c) The process is then repeated until each point within the dataset is assigned a value based on the distances from their nearest neighbours within the search radius. These values are then translated into a density value (high density in black, low density in grey, no density in white).



d) A grid is then overlain on the point distribution to build a density surface. Each point is then selected as an evaluation point (red point) like in the previous steps, and a kernel density function is plotted over the evaluation point.

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Initial Steps in Generating Fixed Kernel Utilization Distributions

Figure 10.3-1

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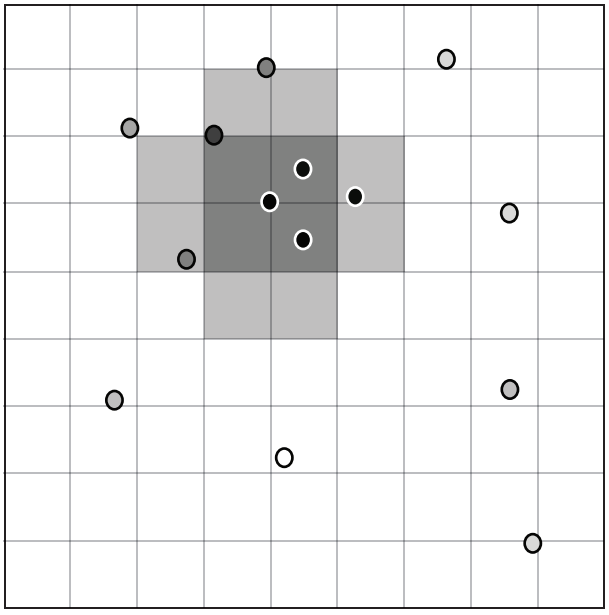
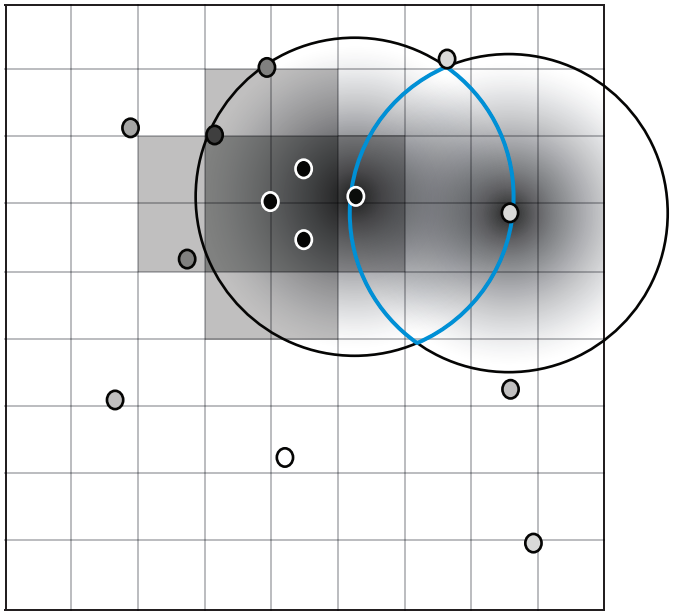
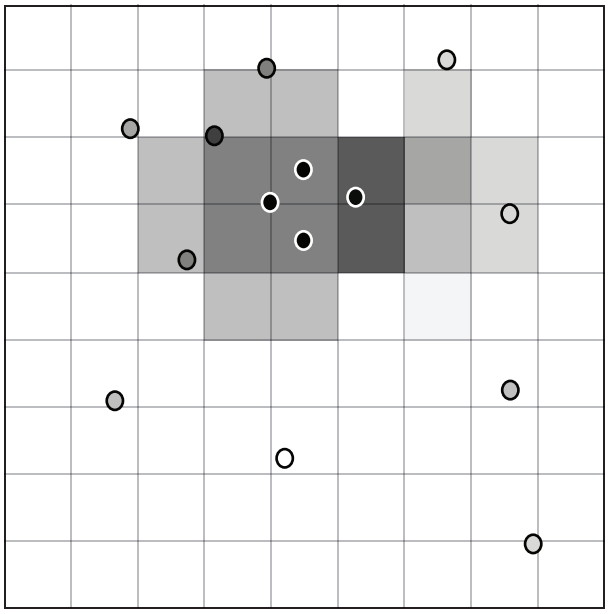


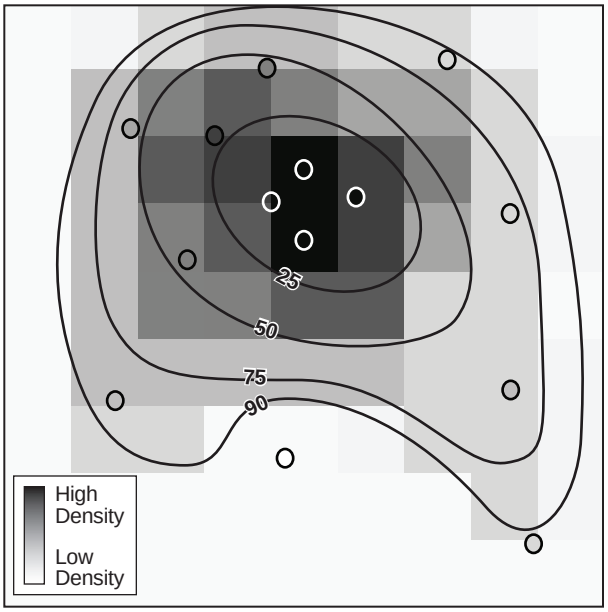
a) The surrounding grid cells are assigned density values based on their proximity to an evaluation point within the specified search radius.



b) Where points are clustered together, the search radius of neighbouring evaluation points will overlap (blue area).



c) Within the area of overlap, the density values assigned to each grid cell is calculated cumulatively.



d) The process is repeated until each grid cell has been assigned a density value, and the resultant surface is an estimate of a density of the total point distribution. Contours can then be plotted upon the surface at specified volumes to give a percentage of the density distribution. For example, the 50% volume contour represents the smallest area that can enclose 50% of the density of the total surface, thus depicting the area where most location points are clustered together.

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End Process of Generating Fixed Kernel Utilization Distributions

Figure 10.3-2

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The 50% kernel UD encompasses the smallest area within which 50% of the overall density of the utilization distribution can be contained. In an ecological sense, it depicts the area within which there is a 50% likelihood of finding a collared caribou location across the entire distribution of collar location points (i.e., the area where collared caribou spend 50% of their time; Hemson et al. 2005). As seen in Figure 10.3-2d, this represents an area where most location data points are clustered together (and therefore the chances of detecting caribou within that area are quite high). The 50% volume contour was used to delimit the "core use" area, as they appear to be used intensively based on the distribution of location points. The 95% kernel UD encompasses the areas surrounding the core use areas. It delimits the area within which there is a 95% likelihood of finding collared caribou. Selecting the 95% kernel UD eliminates location data point outliers that do not represent a consistent pattern of habitat use for the species (e.g., Powell 2000). Therefore, the 95% kernel UD is an estimate of the "range" of collared caribou. Data were analyzed by general life history stage, as presented in Table 10.3-1. These stages are loosely defined by higher or lower movement rates for migrations vs. winter and summer ranges (C. J. Johnson et al. 2005). The peak of calving (the day when 50% of the caribou have calved) and the weaning of calves used to define the calving period and post-calving periods, respectively. Calves are typically weaned three to five weeks after they are born (Russell, Kofinas, and Griffith 2002). It is acknowledged that these life history stages vary seasonally, particularly dates defining calving and post-calving; thus, a wider spread in dates is used here than in more recent studies (e.g., Flanders et al. 2009).

Table 10.3-1. General Life History Stage Dates for Bathurst and Beverly Caribou

Life History Stage	Bathurst	Beverly	Collar Data Analysis Type
Winter	November 1 to April 14	November 1 to April 14	Fixed Kernel UD
Spring Migration	April 15 to June 4	April 15 to June 4	Movement Path
Calving	June 5 to June 15	June 5 to June 20	Fixed Kernel UD
Post-calving	June 16 to July 20	June 21 to July 15	Fixed Kernel UD
Summer	July 21 to August 31	July 16 to August 31	Fixed Kernel UD
Fall (Migration and Rut)	September 1 to October 31	September 1 to October 31	Fixed Kernel UD

The type of collar data, as well as the number of caribou collared, varied across years. Up until 2008, all collars deployed on Bathurst and Beverly caribou were satellite collars, which typically provided one location every one to five days (depending on programming and season), with each location having an associated error of between 150 m and 1000 m depending upon the location class (C. J. Johnson and Gillingham 2005). Beginning in 2008, GPS collars with satellite uplink were deployed, resulting in three to six locations provided daily with much greater location accuracy (generally <15-25 m). In addition, the number of caribou collared, and the number of collars that continued to function after deployment, was low for both herds before 2006 (less than 15 collars for Bathurst and less than 10 collars for Beverly). After 2006, the number of collars generally increased to 20 collars, or more in the case of caribou from the Beverly herd. The number of collared females by herd by year, in addition the number of locations per year, is summarized in Appendix 10-1.

All collar data were analyzed across the years within a particular season. As a result, kernel UDs have a stronger contribution of more recent and more accurate location data from 2008 to 2012 relative to data from earlier years. In addition, there were larger sample sizes of locations from 2006 to 2012 for both herds as more females were collared from 2006 onwards. Therefore, kernel UDs portray more recent trends in caribou distribution and may mask more historical trends in seasonal distribution.

Kernel distributions were considered to be inappropriate for the spring migration, as this event is linear in nature and is undertaken at a rapid pace relative to other life history stages, including the fall migration. Therefore, the spring migration was mapped using movement paths for individual collared caribou, which were generated using the Points to Line tool for ArcGIS 10.1 (Table 10.3-1).

It should be noted that kernel UDs and movement paths are based only on data from collared females, the number of which vary between years. Therefore, these data do not represent the entire distribution of Bathurst and Beverly caribou during the various life history stages. Pregnant females migrate to calving grounds in the spring more quickly than yearlings and males which take advantage of succulent spring and summer vegetation as it emerges across the tundra (GNWT ENR 2010). Females and their newly born young typically reunite with the rest of the herd during the late summer, when they travel to rutting areas and then return to wintering grounds. However, as females are the only herd members that travel from wintering grounds to calving grounds and back again, using collar data from females provides a reasonable estimation of areas used by the whole herd (winter, summer, and fall) while highlighting areas of particular importance to calving females (calving and post-calving).

10.3.2 Remote Digital Cameras

Reconyx PC800 Professional digital cameras were used to monitor the presence of caribou within the Combined Camera Study Area (Figure 10.3-3; Appendix 10-2). Remote digital cameras are a reliable method for examining ungulate migratory timing and habitat associations (Cutler and Swann 1999; Noel et al. 2006), particularly within the Combined Camera study Area given the landscape's short vegetation and features such as eskers and river crossings that direct caribou movement through the landscape (Plate 10.3-1).

Plate 10.3-1. Barren-ground caribou detected in the RSA, June 26, 2012.

During late May and early June, 2012, 60 remote cameras were deployed within the remote camera study area (30 in the RSA, and 30 outside of the RSA) to monitor caribou migratory timing and habitat use. These cameras were maintained to actively survey these areas through until late August. Remote cameras were placed within dry habitat types such as boulder and bedrock associations, heath tundra, and eskers, as well as in wetter habitats such as sedge wetlands and freshwater/riparian areas along river drainages. In addition, cameras were placed near potential infrastructure (Appendix 10-2).

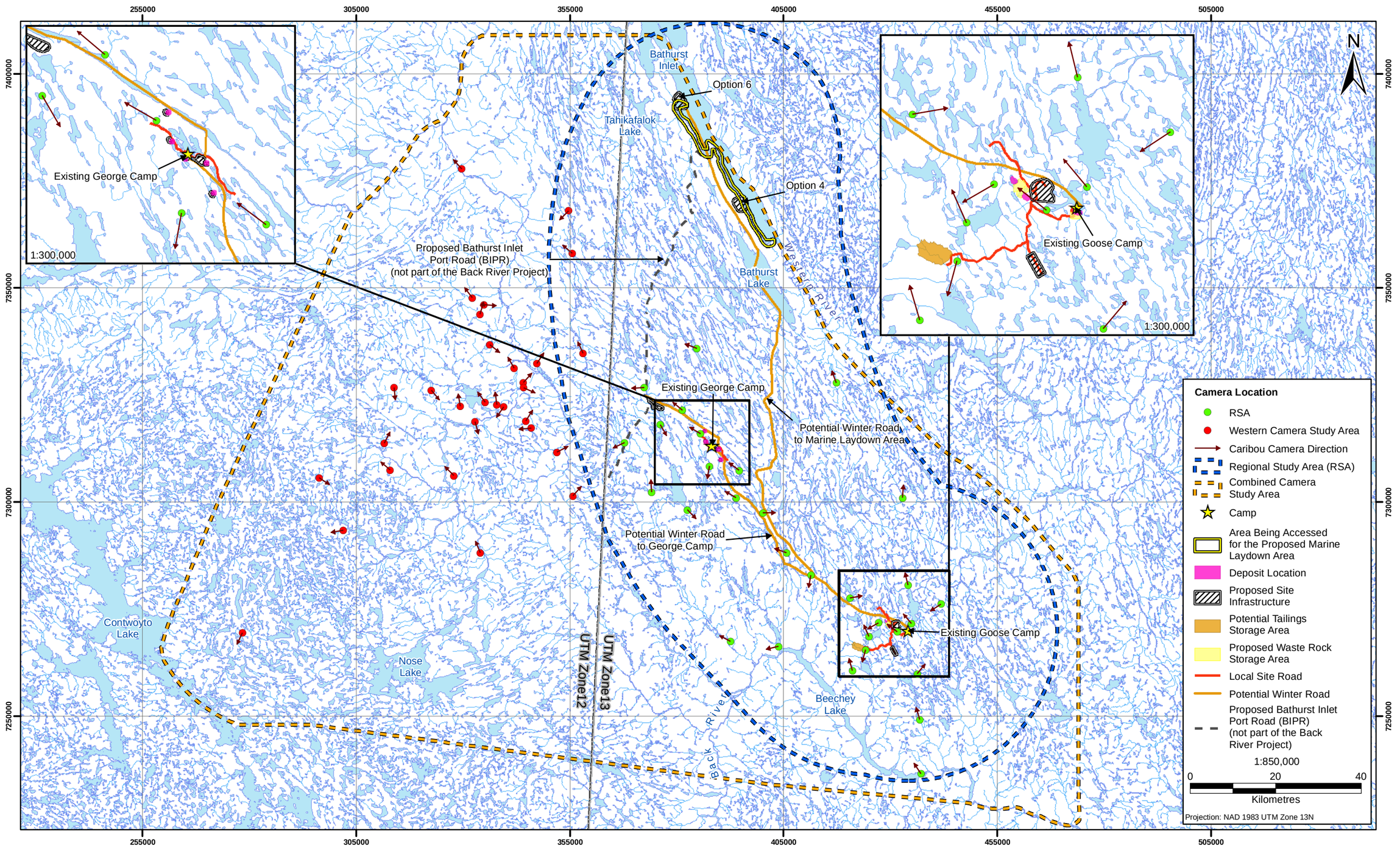

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Figure 10.3-3

Caribou Camera Locations and Orientation, 2012

Remote cameras were mounted inside a heavy-duty security enclosure to prevent damage from wildlife. The cameras were mounted on a wooden tripod, which was secured with rocks to prevent it from being knocked over when encountered by wildlife. Cameras were covered with a plywood cap to reduce rain and snow infiltration, and with bird spikes to deter birds from nesting on the platforms (Plate 10.3-2). Energizer® Lithium batteries were used to maintain camera performance at low-temperatures. Each camera was programmed to take a photograph every 30 minutes during deployment, in addition to being triggered by motion in the infrared spectrum. Motion in front of the camera would trigger the camera to take 10 photos at 1-second intervals. Along with each photo, the cameras would record the date, time, type of trigger (i.e., time [T] or motion [M]), number of triggered photos taken (i.e., 1/10 - 10/10), temperature, and camera number. Cameras were programmed to immediately start a second triggered set of 10 photos upon re-triggering. Based on evidence collected by Rescan on other remote camera studies, the trigger range of the remote cameras is approximately 25 to 30 m, depending on the size of animal moving through the camera's field of view.

Plate 10.3-2. Remote digital camera and support tripod, August 18, 2012.

Memory cards from the cameras were retrieved and downloaded at the end of August. In order to assess migratory timing and habitat use for caribou, each camera's photo-set, over the entire deployment period, was scanned for wildlife observations using either Reconyx software, or PC and MAC photo viewing software. For each photo that included a wildlife observation the following data were recorded: date, time (including start and end times for motion-triggered photo sets), photo type (i.e., T- or M-triggered), photo number (including start and end photo numbers for M-triggered photo sets), number of photos, number of triggers, species, number of animals, and their behaviour (i.e., resting, foraging, traveling). Individual caribou that were recorded 30 minutes apart in T-triggered photos were considered different individuals, unless behaviour suggested that they were the same individual (i.e., individuals resting on the tundra). M-triggered photo-sets detected individual caribou that were traveling, sometimes in small numbers and at other times in large herds of hundreds of individuals. For small numbers of caribou observed by M-triggered photos, the exact number of individuals was easily determined. For large numbers of caribou in herds, the number of individuals was determined over entire M-triggered photo sets where the greatest number of individuals observed was

recorded for that time period. All photo observations of caribou were checked by a second observer to ensure that the number of individuals was recorded accurately.

10.3.2.1 Analysis of Remote Camera Data

In order to assess the temporal and spatial distribution of caribou within the Combined Camera Study Area, numbers of caribou were summed by day (temporal trends) and camera (spatial trends) with both results pooled by month to qualitatively assess associations with approximate caribou life history stages (Table 5.2-1) such as calving (June), post-calving (July), and summer (August).

In order to assess the relative size of groups of caribou within the Combined Camera Study Area, the total number of caribou per camera was compared with the total number of independent observations per camera. Large groups of caribou were characterized by larger total numbers of individuals (> 100 caribou), in association with a small number of independent photo observations. Moderate sized groups of caribou (50 – 100 individuals) were characterized by larger total numbers of individuals in association with a smaller number of independent photo observations. Small groups of caribou (2 - 49 individuals) were characterized by a smaller total numbers of individuals, in association with a larger number of independent photo observations, and individuals were always observations of single caribou.

In order to assess habitat use by caribou within the Combined Camera Study Area and the use of proposed infrastructure sites within the RSA only, camera effort in days of active deployment was first calculated. Within the R language statistical environment (2012), date and time stamps of the first and last photo within each camera's photo-set was defined using the *as.POSIXlt* function to structure data as a calendar date and time, then the *difftime* function (units = days) was used to calculate total elapsed decimal days for the entire deployment period. For each camera, date and time stamps of any inactive periods (e.g., wildlife encounters knocking a camera over resulting in a change in camera angle) were collated and elapsed time of inactivity was calculated using the same functions in R. These periods of inactivity were then subtracted from each camera's total elapsed time to generate an estimate of camera effort in terms of active deployment days. Caribou detection rates were calculated using the following equation:

Caribou Detection Rate (caribou/day) = Total Caribou Observed per Camera / Camera Effort in Days

To assess habitat use by caribou, mean caribou detection rates and associated standard errors were calculated for bedrock (n = 7 cameras), esker (n = 15 cameras), freshwater/riparian (n = 3), tundra (n = 31 cameras), and wetland (n = 4 cameras) habitats using the *mean* function in R, in addition to a standard error calculation defined as the (sample standard deviation / square root (sample size)). All cameras within the Combined Camera Study Area were used in the analysis (n = 60 cameras total; Figure 10.3-3).

To assess potential Project infrastructure site use by caribou, mean caribou detection rates and associated standard errors (as defined previously) were calculated for cameras located on potential Project infrastructure sites compared to all other cameras within the RSA (n = 30 cameras total; Figure 10.3-3; Appendix 10-2)

10.3.3 Incidental Observations of Caribou

Caribou that were observed incidentally during other wildlife field inventories in 2012 were recorded, as well as during remote camera studies for wolverine conducted in March and April, 2012. Observations of caribou were also documented by field staff conducting other aspects of the 2012 baseline program.

10.4 RESULTS

10.4.1 Distribution of Collared Caribou

10.4.1.1 Summary

Fixed kernel utilization distributions (UDs) for collared Bathurst and Beverly caribou showed that both herds use habitat in the RSA. Seasonal ranges for Beverly caribou overlap with the RSA in all seasons except during post-calving. Most notably, collared Beverly caribou were consistently present within the RSA during the summer; a large summer core use area falls over the George and Goose camps. Collared Bathurst caribou were mostly present in the RSA during the post-calving period, where they migrate in a south-east direction past the George Camp. Annual movement paths for collared caribou showed that Bathurst caribou generally migrated through the western RSA on their way to their calving grounds. Beverly caribou, on the other hand, tended to pass through the eastern edge of the RSA on their way to the calving grounds.

The number of collared caribou included in each fixed kernel UD dataset varied between seasons and years, based on data provided by the GNWT. Sample sizes for each kernel UD by season and herd is presented in Table 10.4-1. The total sample size of collar locations and number of caribou included in the analyses is presented in Appendix 10-1. As discussed in Section 10.3.1, there were larger numbers of Bathurst and Beverly females collared from 2006 to 2012 relative to previous years. In addition, the type of collars deployed on caribou switched in 2008 from satellite to GPS-uplink collar; GPS collars collect more accurate and frequent locations than satellite collars. As all data was analyzed together across seasons, there is a disproportionate contribution of collar locations from more recent years. Therefore, results should be interpreted as a depiction of the most recent trends in caribou distribution.

Table 10.4-1. Sample Sizes for Fixed Kernel UDs

Herd	No. of Location Data Points (No. collared caribou) Used for Generating Kernel UDs by Season				
	Winter	Calving	Post-calving	Summer	Fall
Bathurst	8,983 (107)	1,862 (111)	3,465 (99)	6,537 (113)	8,028 (110)
Beverly	29,651 (80)	4,231 (74)	7,012 (76)	11,845 (76)	10,779 (77)

10.4.1.2 Winter

Bathurst

Collared Bathurst caribou generally do not winter near the RSA, based on data from 1996 to 2012 (Figure 10.4-1a). Collared Beverly caribou, on the other hand, have wintered in areas surrounding the RSA from 2001 to 2012 (Figure 10.4-1b). The wintering range of collared Bathurst and Beverly caribou (95% kernel UD) overlaps one another around the east arm of Great Slave Lake.

Collared caribou from the Bathurst herd winter far to the south of the RSA. The wintering range for Bathurst caribou is widely spread east to west from Great Bear Lake to Great Slave Lake, bordered by the treeline in the north (Figure 10.4-1a). The main core use area (50% kernel UD) within the winter range stretches from the shores of the east arm of Great Slave Lake west to Rae Lake, bordered by two smaller core use areas to the north and west. The highest density of collar locations was centred around the community of Wekweètì.

Beverly

Collared Beverly caribou exhibit a more north-south distribution in the winter as compared to collared Bathurst caribou, with wintering occurring both below and above the treeline (Figure 10.4-1b). The 2001 to 2012 winter range spans a large area from Bathurst Inlet south to Lake Athabasca, overlapping with the majority of the RSA. There appears to be one main core use area for collared Beverly caribou, reaching from Aylmer Lake in the north to the Saskatchewan border in the south (Figure 10.4-1b).

10.4.1.3 Spring Migration

Bathurst

Collared Bathurst caribou generally do not migrate through the RSA on their way to their current calving grounds. Approximately five of over 230 spring migration routes generated from collar data from 1996 to 2012 have passed through the RSA (Figure 10.4-2a). Caribou that migrated through the RSA were primarily those that overwintered on the east side of Great Slave Lake and move in a roughly northward direction through the RSA towards their calving grounds.

Collared Bathurst caribou migrate in a northerly to a north-east direction to the calving grounds in the spring, the directionality of which depending on where the female overwintered (Figure 10.4-2a). Females that overwinter to the west of Great Slave Lake generally moved in a north-east direction towards the calving grounds, while females wintering to the east of Great Slave Lake travel either directly north or north-west during the spring migration. Migration paths show that, for the most part, collared females make a very straight and direct migration from the wintering grounds to the calving grounds.

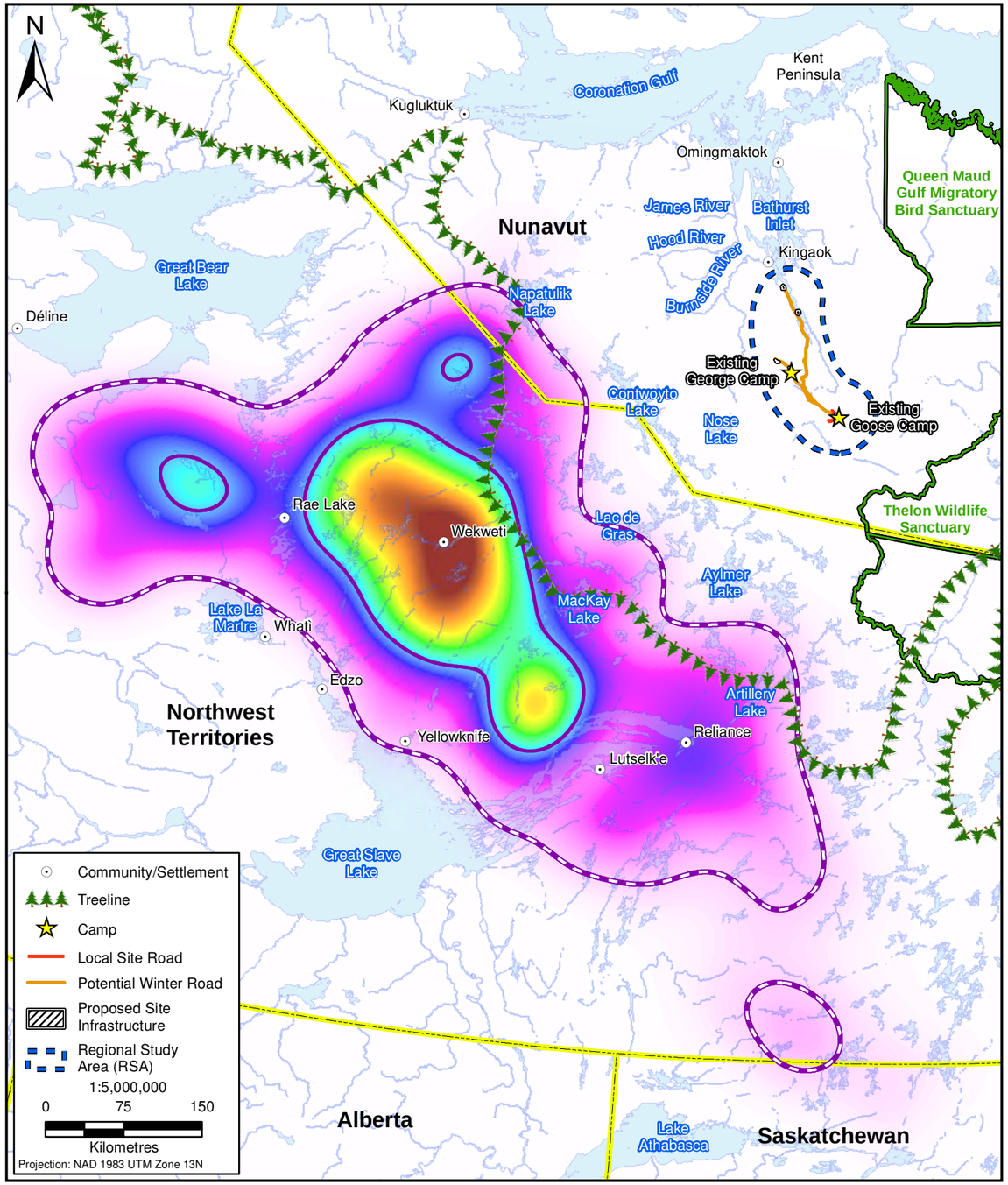
Beverly

Collared Beverly caribou have frequently been recorded passing through the RSA, particularly the southern RSA, during spring migration. Roughly 25 collared caribou have travelled through the RSA since 2001, most of which travelled through during the spring migration of 2008.

The spring migration route for collared Beverly caribou generally passes to the east of Bathurst Inlet in a generally northerly direction from wintering grounds (Figure 10.4-2b). The main body of migrating Beverly caribou appear to begin their migration from below the treeline to the east of Great Slave Lake; however, several collared females since 2001 have overwintered to the west of Great Slave Lake (presumably with Bathurst caribou) or have wintered on the tundra near Bathurst Inlet. These females travel in a more north-east to easterly direction than the main body (Figure 10.4-2b). Similar to collared Bathurst caribou, collared Beverly females moved in a very direct manor towards the calving ground.

The large number of collared Beverly caribou migrated through the RSA in 2008 and 2009 from wintering areas below the treeline, passing northwards through the south-eastern RSA. The remainder of caribou that migrated through the RSA were caribou overwintering on the west side of Bathurst Inlet or those that wintered within the winter range of Bathurst caribou; these females migrated in an easterly direction through the northern RSA.

a) Bathurst Winter (Nov. 1 to April 14) Distribution, 1996 to 2012



b) Ahiak Winter (Nov. 1 to April 14) Distribution, 2001 to 2012

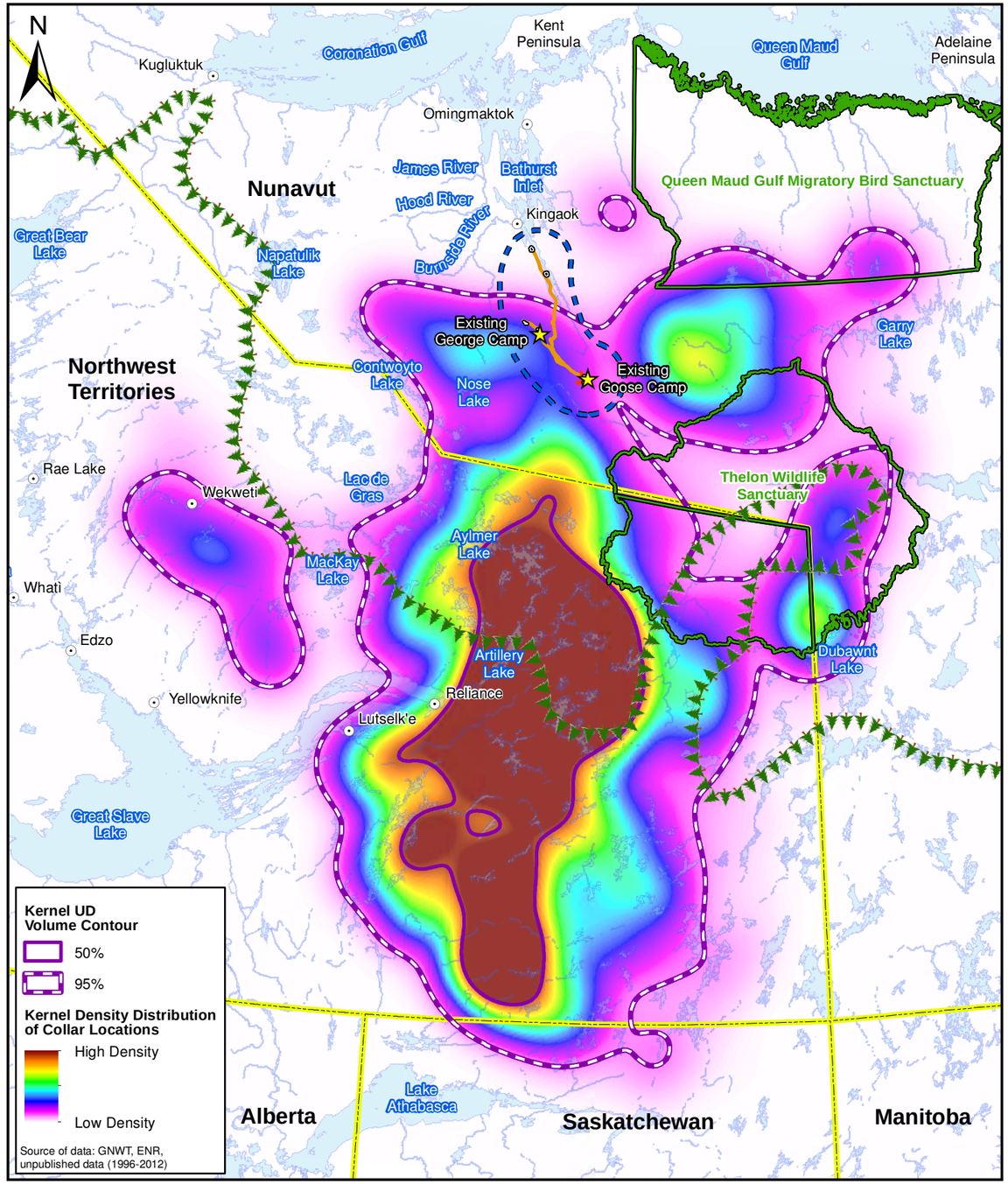


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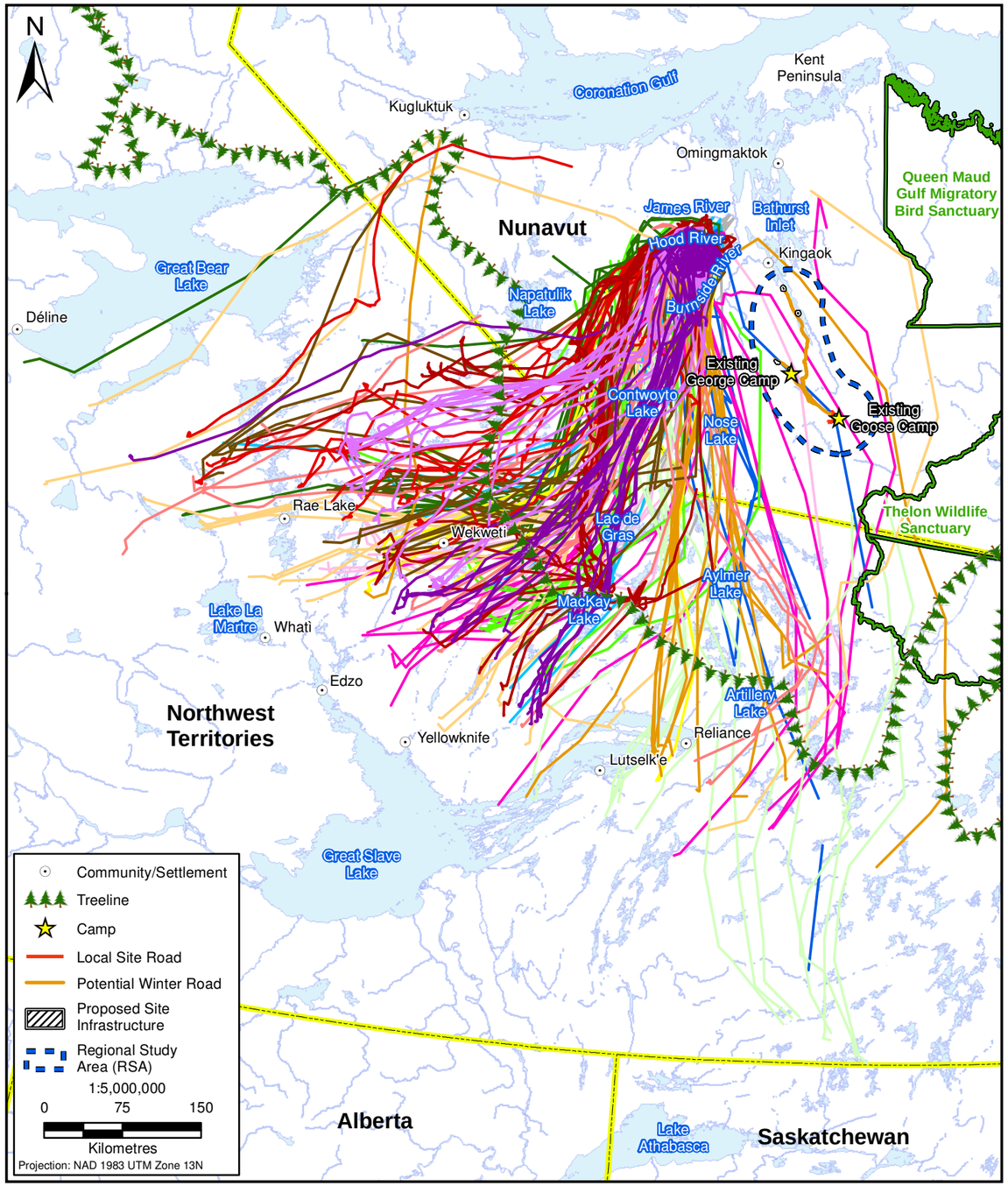
Figure 10.4-1

Distribution of Collared Bathurst and Beverly Caribou during Winter

a) Bathurst Spring Migration (April 15 to June 4) Travel Routes, 1996 to 2012



b) Ahiak Spring Migration (April 15 to June 4) Travel Routes, 2001 to 2012

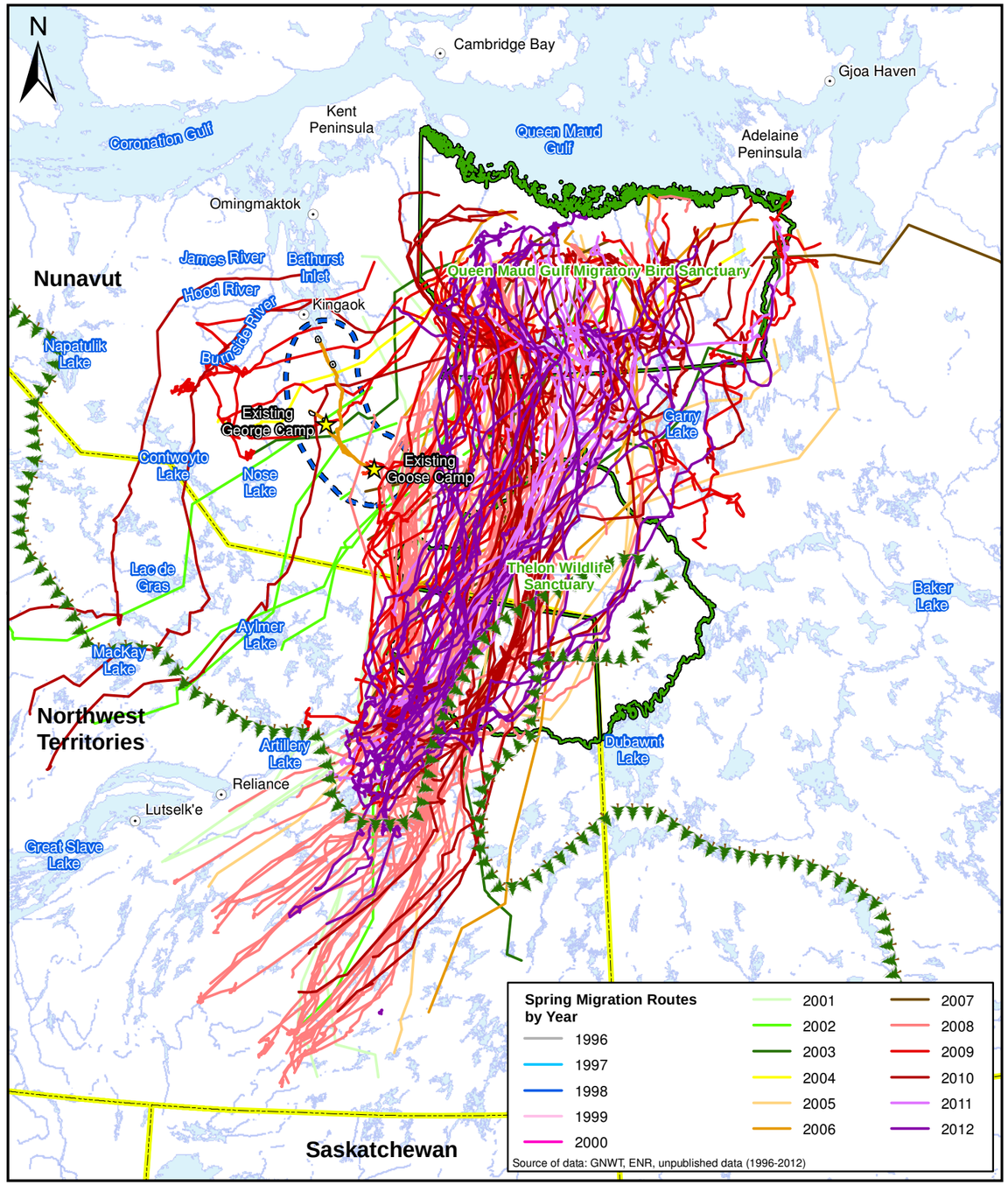


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Figure 10.4-2

Spring Migration Routes of Collared Bathurst and Beverly Caribou

10.4.1.4 Calving

Bathurst

Bathurst caribou calve to the north-west of the RSA by the Burnside, Hood, and James Rivers. This calving ground has remained relatively consistent over the period of 1996 to 2012 as evidenced by the small extent of 50 and 95% kernel UDs (Figure 10.4-3a).

The current extent of the Bathurst calving range spreads from the James River in the north to Contwoyto Lake in the south. The core use area for calving Bathurst caribou primarily occurs along the banks of the Hood River (Figure 10.4-3a).Two isolated 95% kernel UDs occurred outside of the main calving area to the south of Contwoyto Lake, most likely caused by females that did not calve during the year and thus did not reach the calving grounds or were still travelling during the peak of calving.

Beverly

The calving range for collared Beverly caribou spans a large geographic area from the east side of Bathurst Inlet west to the Adelaine Peninsula (Figure 10.4-3b). However, there were two smaller 95% kernel UDs surrounding the main range, one just below the Kent Peninsula and one just south of Garry Lake. The 95% kernel UD around Garry Lake overlaps the traditional calving grounds for Beverly caribou, which suggests that some caribou from the Beverly herd were included in this analysis. Within the main calving range, the core use area was generally located in the central area of the Queen Maud Migratory Bird Sanctuary along the coasts. A small portion of the calving range (95% kernel UD) overlapped the RSA, likely caused by a proportion of females that were still travelling to the calving grounds during the peak of calving.

10.4.1.5 Post-calving

Bathurst

Fixed kernel utilization distributions during the post-calving period show that the collared Bathurst caribou have used habitat at the southern edge of the RSA in years since 1996 (Figure 10.4-4a).

The post-calving range for Bathurst caribou spans from the current calving grounds to the southern shores of Contwoyto Lake. Collared caribou tend to use the same areas in a very similar fashion each year during the post-calving period. Most collared female caribou dispersed to the south-east from the calving grounds, passing by the George Camp, and then switch directions and travel west towards Nose and Contwoyto Lakes. This movement pattern influences the shape of the post-calving core use area, resulting in a backwards C configuration (Figure 10.4-4a). These data agree with local knowledge from the George and Goose camps, who report groups of caribou passing by the camps during the post-calving period. The number of caribou observed and reported were highly variable from year to year.

Beverly

Collared Beverly caribou are generally found far to the east of the RSA during post-calving (Figure 10.4-4b). The post-calving range for Beverly caribou was extensive and showed a high degree of overlap with calving grounds. Between the calving and post-calving periods, the overall range condensed from east to west, and spread southwards to Garry Lake (Figure 10.4-4b). One small, isolated 95% kernel UD occurred below the Kent Peninsula, similar to pattern observed during calving. There were two core use post-calving areas. The largest of these core use areas was located to the south of the calving grounds but still within the Queen Maud Gulf Migratory Bird Sanctuary, generally mirroring the change in configuration of the overall post-calving range. The smaller core use area was centered along the coasts just below the Adelaine Peninsula.

10.4.1.6 Summer

Bathurst

During summer, collared Bathurst caribou shift south-west from areas occupied during post calving and away from the RSA (Figure 10.4-5a). Bathurst and Beverly summer ranges overlap slightly around Contwoyto and Aylmer lakes, but for the most part these two herds are generally segregated at this time of year.

The summer range for Bathurst caribou was generally spread from Napatulik Lake south to MacKay Lake, and bordered the treeline in the west. Within the summer range, collared Bathurst caribou tended to be concentrated in areas around Contwoyto Lake, particularly along the south-west margin of this waterbody as evidenced by the large core use area spanning from Contwoyto Lake to Lac de Gras. Two smaller core use areas were identified, one on the north-west shores of Contwoyto Lake and one just to the east of Lac de Gras (Figure 10.4-5a).

Beverly

During summer, collared Beverly caribou spread to the south of their post-calving range and the western portion of their summer range overlaps the RSA (Figure 10.4-5b). The summer range of collared Beverly caribou was very expansive, covering almost as much area as the winter distribution. The summer range encompassed areas in the Queen Maud Bird Sanctuary used earlier during calving and post-calving periods, but extended much further to the south to areas within and surrounding the Thelon Wildlife Sanctuary (Figure 10.4-5b). There were two main areas of concentrated use for summering collared Beverly caribou. One core use area extended from the southern extension of Bathurst Inlet, through the RSA, to approximately Artillery Lake in the south (Figure 10.4-5b). Another smaller core use area was located to the east of Garry Lake.

10.4.1.7 Fall

Bathurst

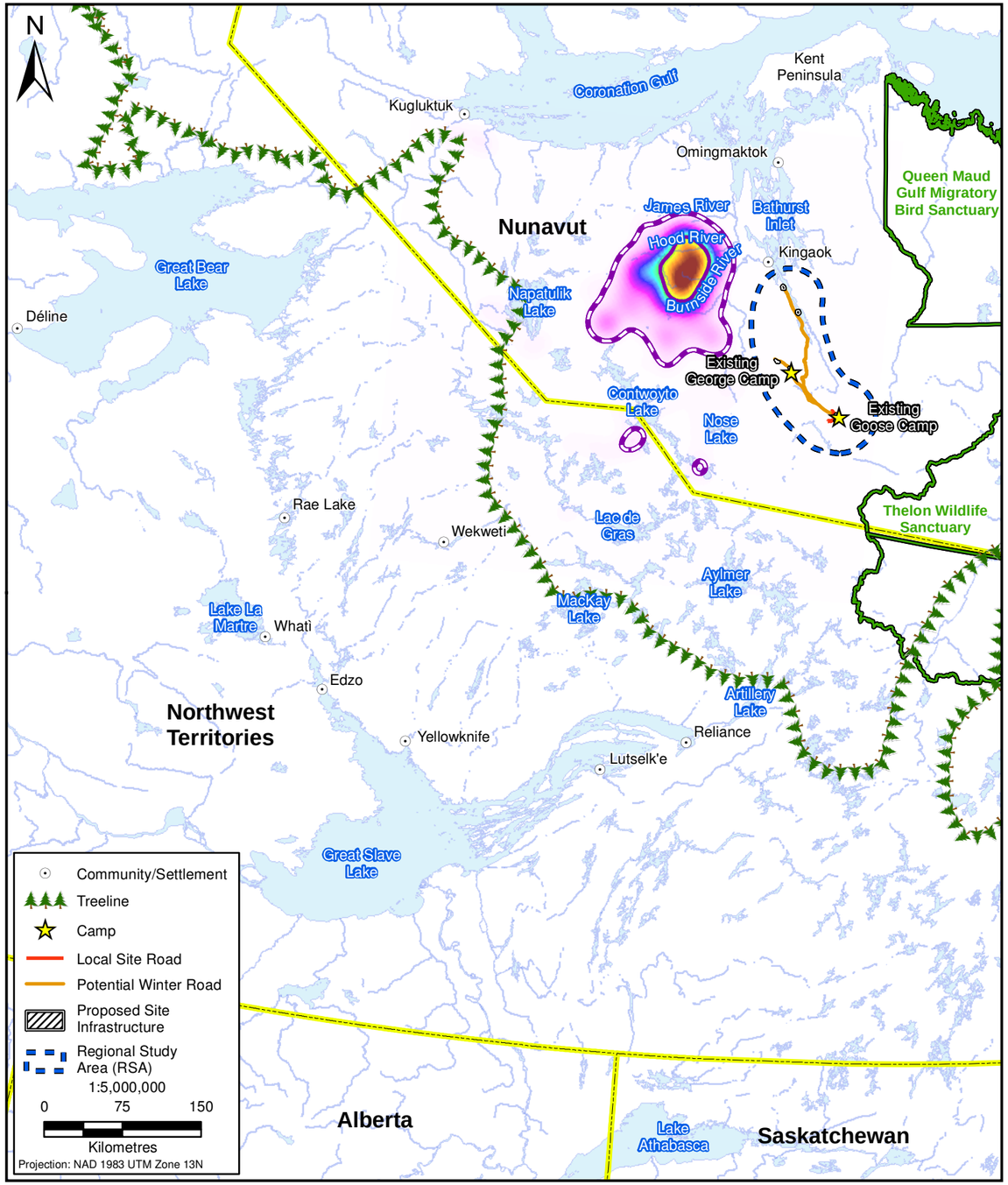
Kernel UDs during the fall (which includes the fall migration and the rut) show that collared Bathurst caribou are distributed in areas to the south-west of the RSA during this period (Figure 10.4-6a). The fall range for collared Bathurst caribou spread from areas used during the summer south to the shores of Great Slave Lake. The areas surrounding Lac le Gras and MacKay Lake receive a high amount of use during the fall, as exemplified by the spread of the core use area and kernel density of collar locations (Figure 10.4-6a).

Beverly

Similar to the summering period, collared Beverly caribou are very widely distributed latitudinally and longitudinally during the fall, and do spend some time within the southern RSA during this period (Figure 10.4-6b). There is a small amount of overlap in areas of active use between the herds; Bathurst and Beverly caribou both utilize habitat around Nose and Alymer lakes.

Collared Beverly caribou ranged across a large area from the Queen Maud Gulf south to the treeline in the fall, resulting in a geographically-extensive 95% kernel UD. The habitat within the western portion of the Thelon Wildlife Sanctuary received a large amount of use in the fall (primary core use area; Figure 10.4-6b). There was another small core use area located on the eastern edge of the Thelon Wildlife Sanctuary as well.

a) Bathurst Calving (June 5 to June 15) Distribution, 1996 to 2012



b) Ahiak Calving (June 4 to June 20) Distribution, 2001 to 2012

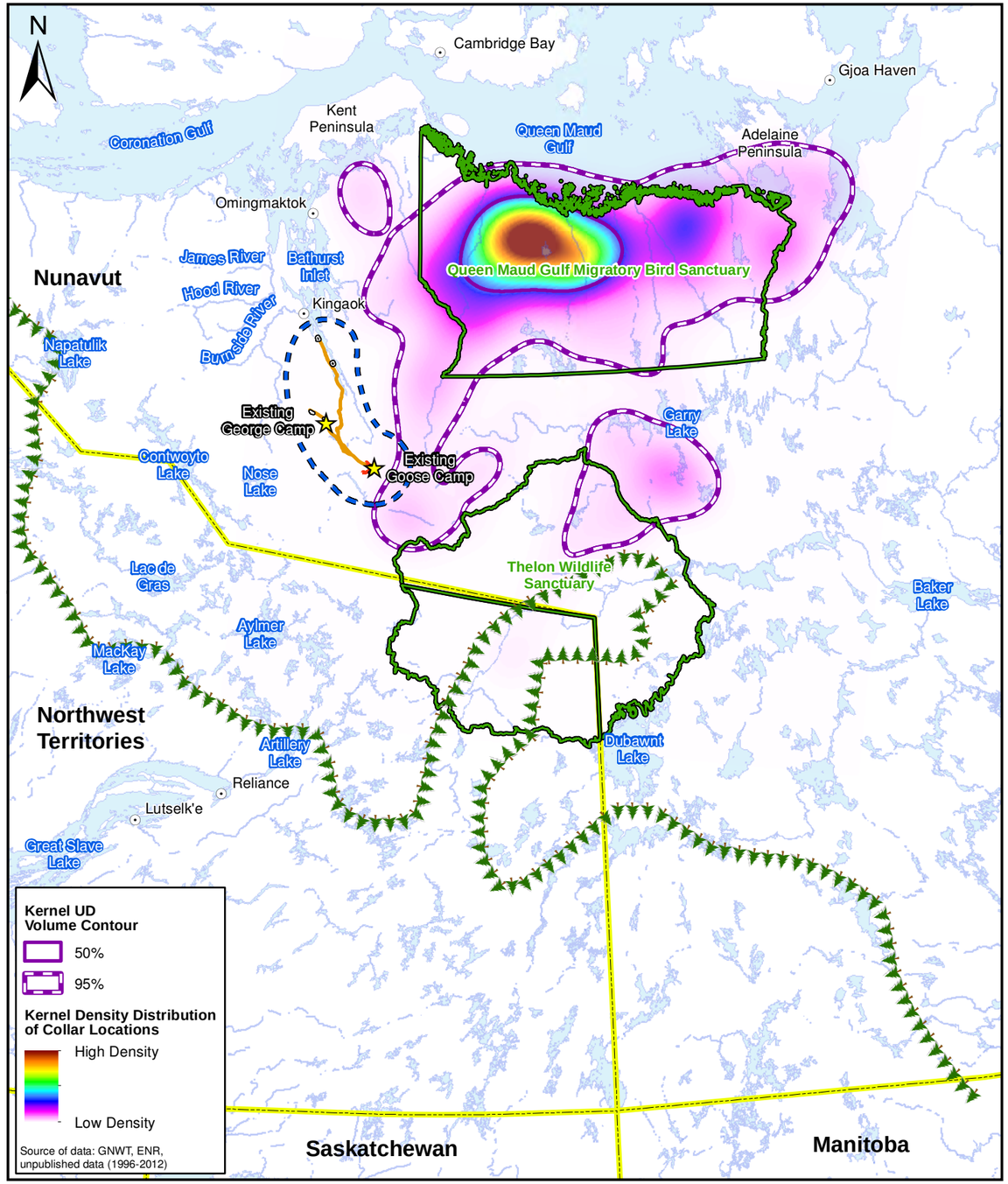


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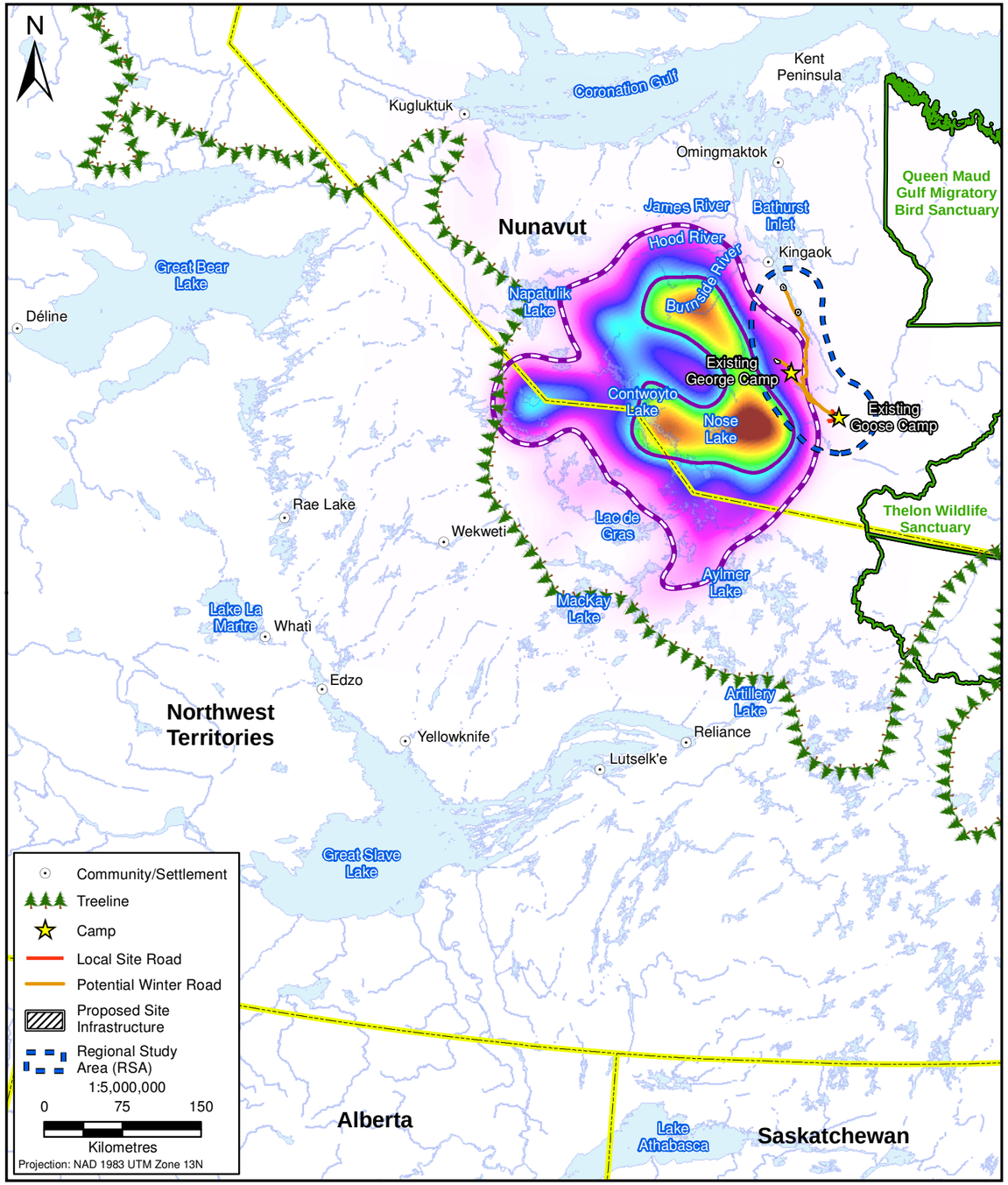
Figure 10.4-3

Distribution of Collared Bathurst and Beverly Caribou during Calving

a) Bathurst Post-calving (June 15 to July 20) Distribution, 1996 to 2012



b) Ahiak Post-calving (June 21 to July 15) Distribution, 2001 to 2012

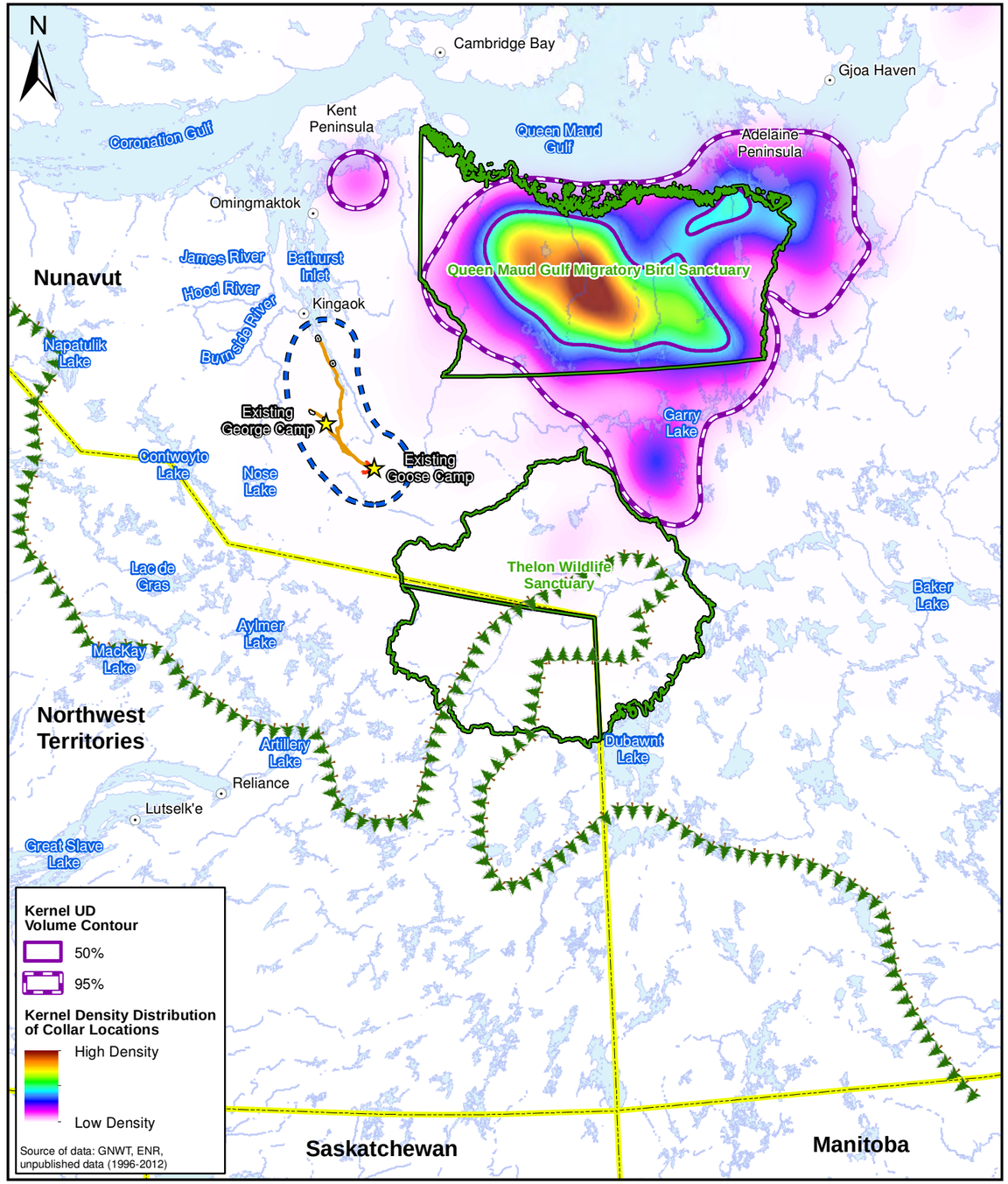


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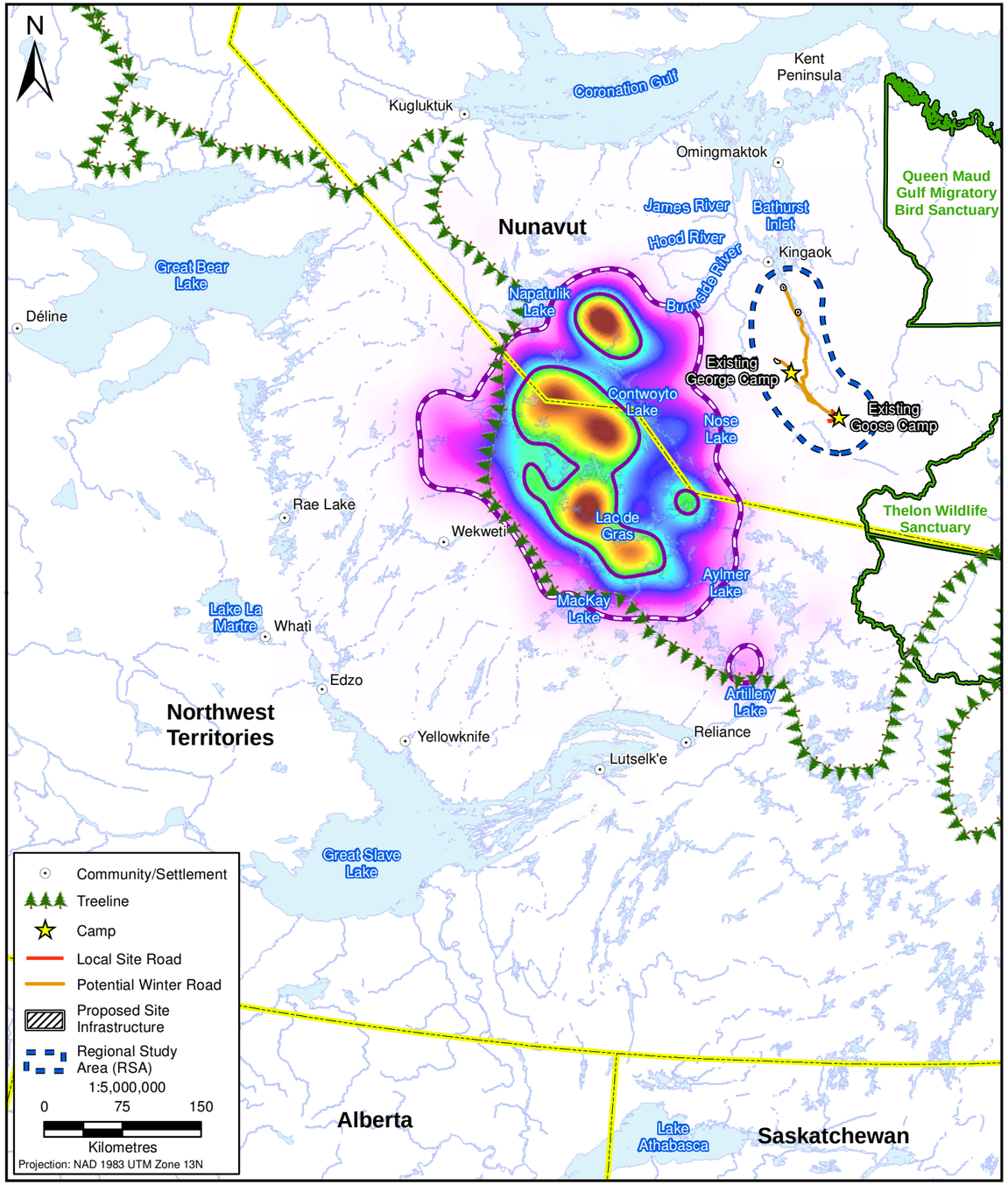
Figure 10.4-4

Distribution of Collared Bathurst and Beverly Caribou during Post-calving

a) Bathurst Summer (July 21 to Aug. 31) Distribution, 1996 to 2012



b) Ahiak Summer (July 22 to Aug. 31) Distribution, 2001 to 2012

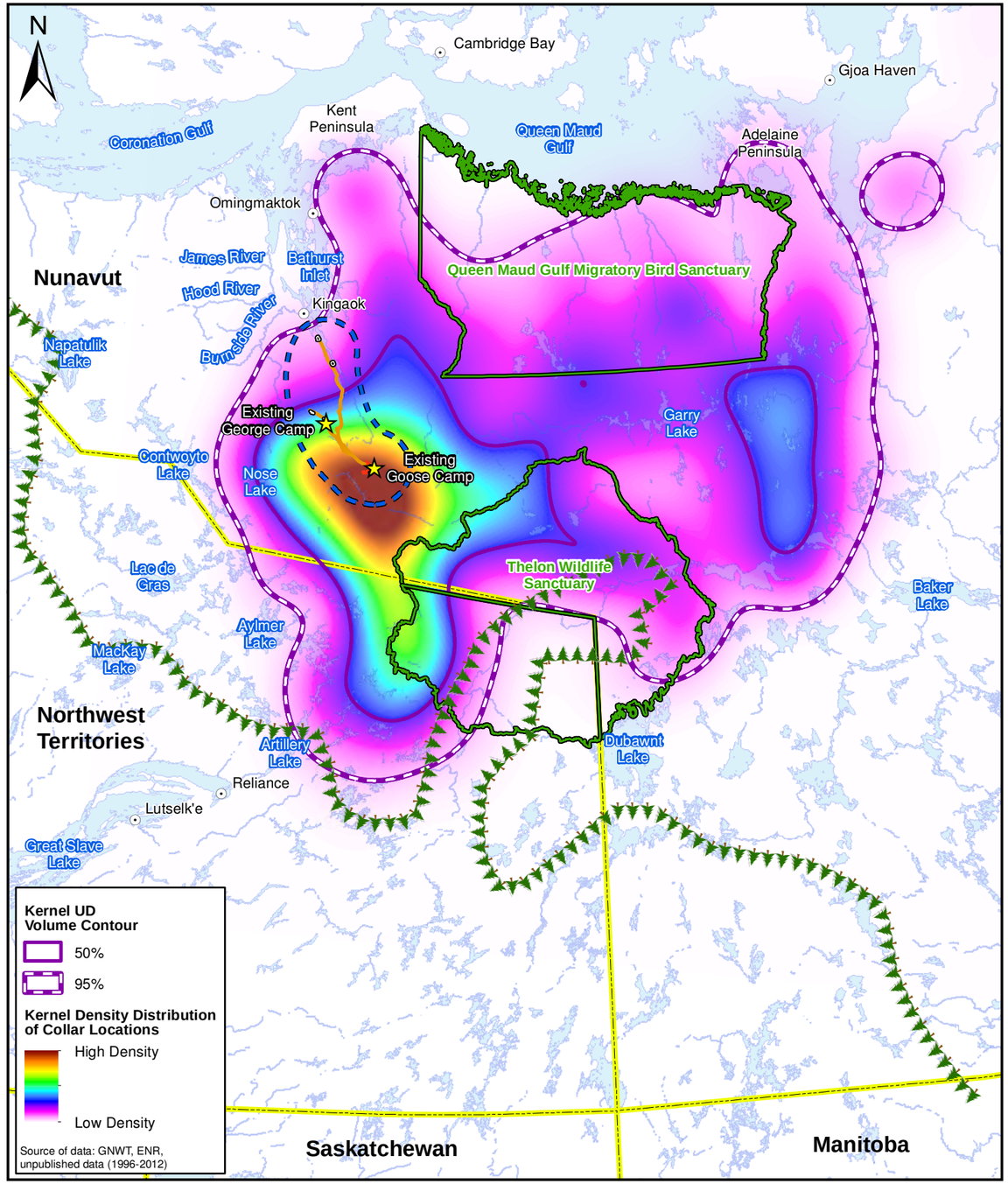


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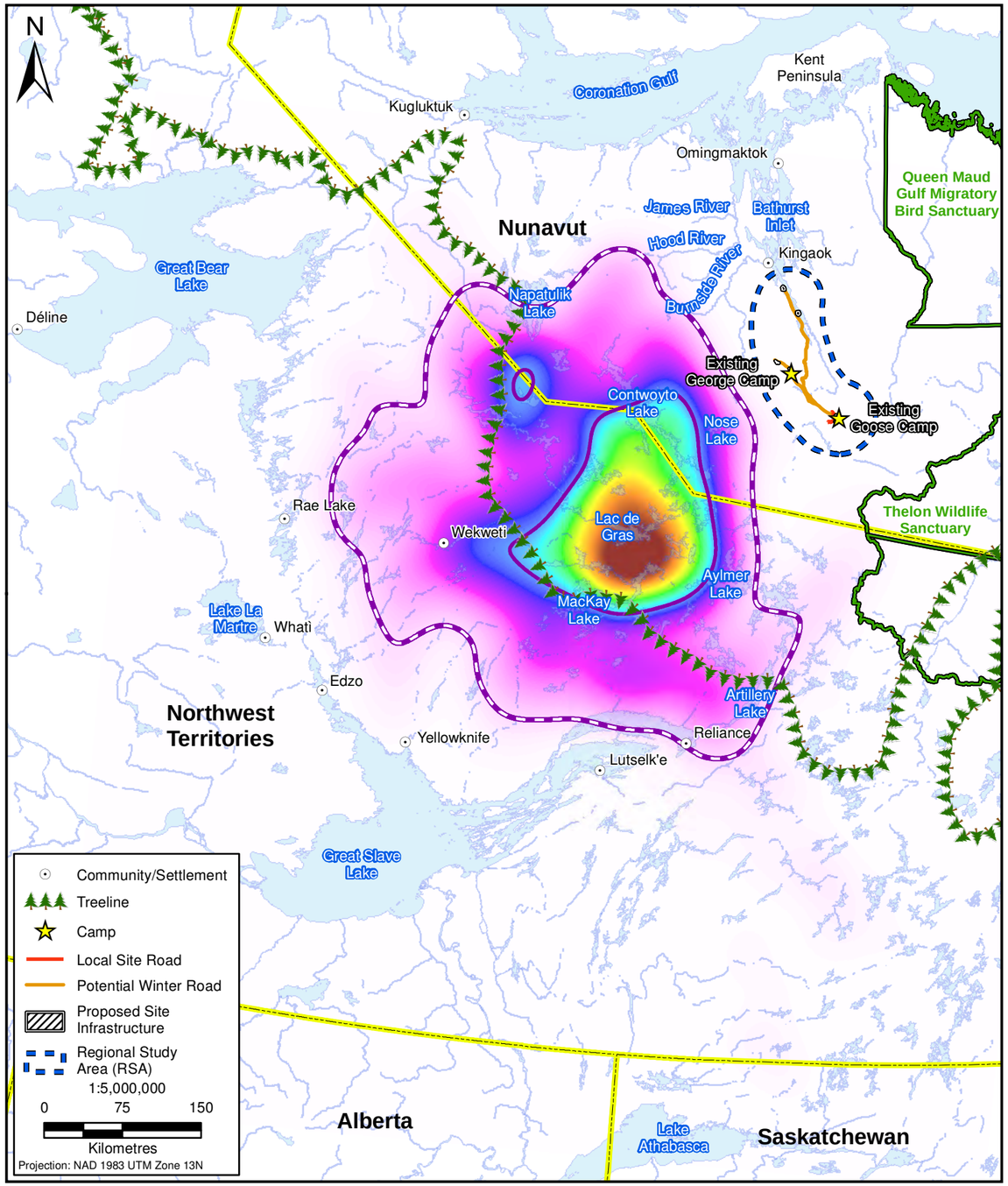
Figure 10.4-5

Distribution of Collared Bathurst and Beverly Caribou during Summer

a) Bathurst Fall (Sept. 1 to Oct. 31) Distribution, 1996 to 2012



b) Ahiak Fall (Sept. 1 to Oct. 31) Distribution, 2001 to 2012

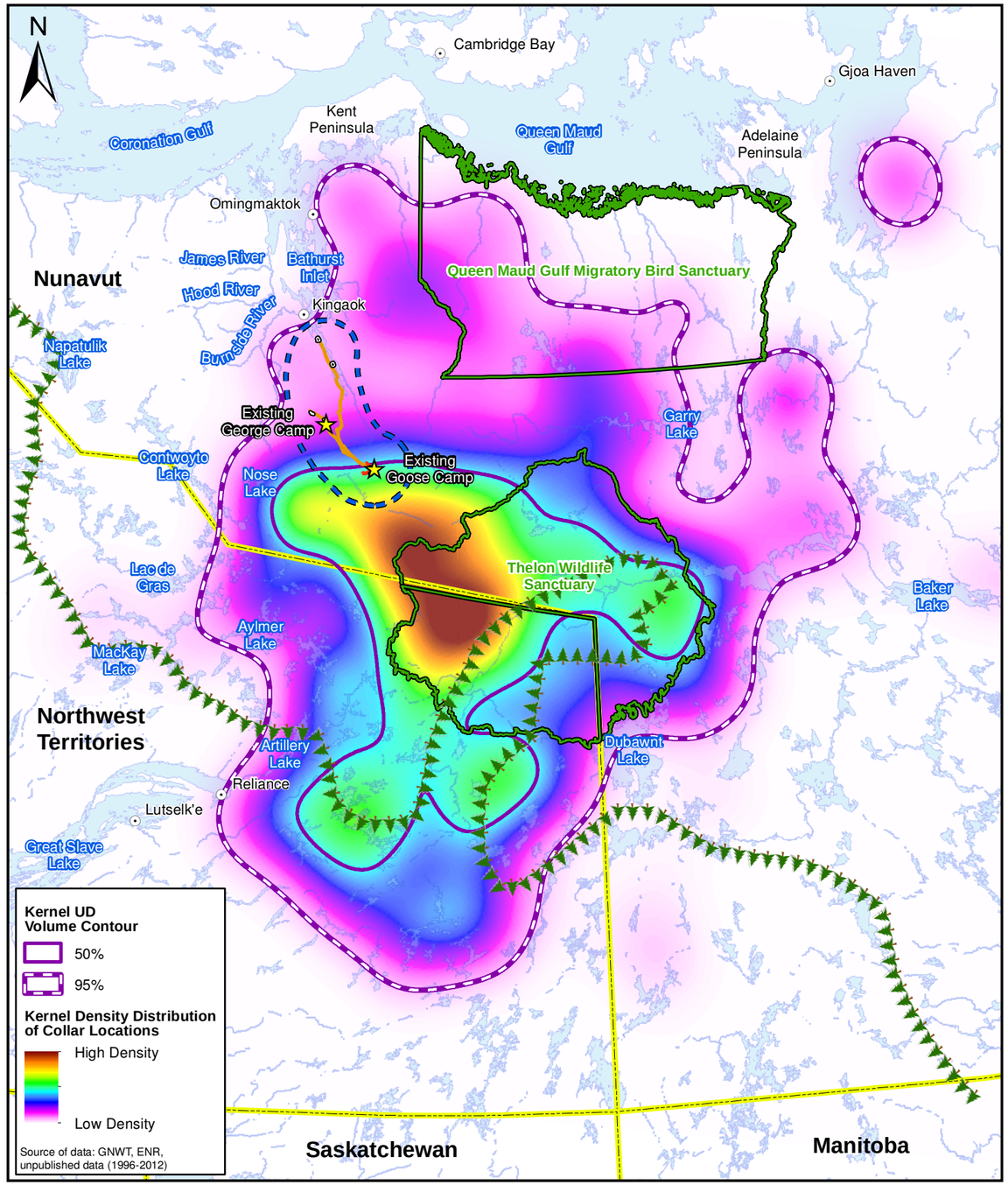


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Figure 10.4-6

Distribution of Collared Bathurst and Beverly Caribou during Fall

10.4.2 Remote Digital Cameras

10.4.2.1 Summary

A total of 2,573 caribou were observed by remote digital cameras within the Combined Camera Study Area during spring and summer of 2012 (Figure 10.4-7 and Figure 10.4-8; Appendix 10-3). A temporal and spatial trend of caribou movement through the Combined Camera Study Area was identified, with larger numbers of caribou outside of the RSA (west of the RSA) in June and July, and larger numbers of caribou in the RSA in the end of July and through August.

Eight large groups of caribou were observed by remote camera in the area outside of the RSA during the camera deployment period between May 23 and August 27, 2012. In the area outside of the RSA, west of the RSA, six large groups of caribou were observed and within the RSA, two large groups of caribou were observed. Moderate sized groups of caribou (50 – 100 individuals) were also observed west of the RSA during June and July but were not observed in the RSA.

Caribou were detected throughout the Combined Camera Study Area at higher rates within freshwater/riparian (2.644 $\pm$ 1.667 caribou/day) and tundra (0.792 $\pm$ 0.326 caribou/day) habitats, and lower rates within esker (0.014 $\pm$ 0.006 caribou/day) habitat. Proposed Project infrastructure sites had lower caribou detection rates (0.086 $\pm$ 0.034 caribou/day) relative to other camera sites (0.287 $\pm$ 0.173 caribou/day) within the RSA.

10.4.2.2 Survey Effort

Within the RSA, 30 remote cameras were deployed between May 23 and August 26, 2012 to detect caribou migratory timing and habitat use. These 30 cameras cumulatively surveyed for 2,622 days (Figure 10.4-9a). Ten of the 30 cameras deployed experienced periods of non-activity due to wildlife knocking down the camera tripod resulting in the camera surveying an incorrect aspect of the landscape. These non-active periods ranged from five to 33 days through the 96 day deployment period.

West of the RSA, 30 remote cameras were deployed between June 5 and August 30, 2012 to detect caribou migration and habitat use. These cameras cumulatively surveyed for 2,098 days (Figure 10.4-9b). Eleven of these 30 cameras deployed experienced periods of non-activity, again due to wildlife encounters. These non-active periods ranged from one to 56 days through the 86 day deployment period.

10.4.2.3 Temporal and Spatial Distribution Patterns of Caribou in the Study Area

Caribou were detected in large numbers west of the RSA earlier in the camera deployment period on June 26, June 28, and July 4, 2012, which corresponds to the post-calving period for Bathurst herd caribou (Table 10.3.1). As the season progressed into late-July and mid/late-August 2012, during the summer phase of the caribou life history cycle, large numbers of caribou were detected within the RSA on July 27, and August 20, 2012 (Figure 10.4-10 to Figure 10.4-12). Based on the analysis of collared caribou (Section 10.4.1), the larger number of caribou located west of the RSA in June and early July were likely post-calving Bathurst caribou, while the larger numbers of caribou recorded in the RSA in late July and early August were likely Beverly caribou on their summer range.

Within the RSA, the greatest numbers of caribou detected during the 2012 remote camera deployment period were within the south-east sector of the RSA (Figure 10.4-7). For example, both cameras BR28 and BR30 detected over 200 caribou within this region of the RSA. Other cameras within the RSA detected from 0 - 50 caribou, however, those cameras that detected closer to 50 caribou were all located near cameras BR28 and BR30 in the south-east sector of the RSA (Figure 10.4-7). Camera BR30 was located at a narrow, shallow point in the Back River where many caribou trails were observed to converge.

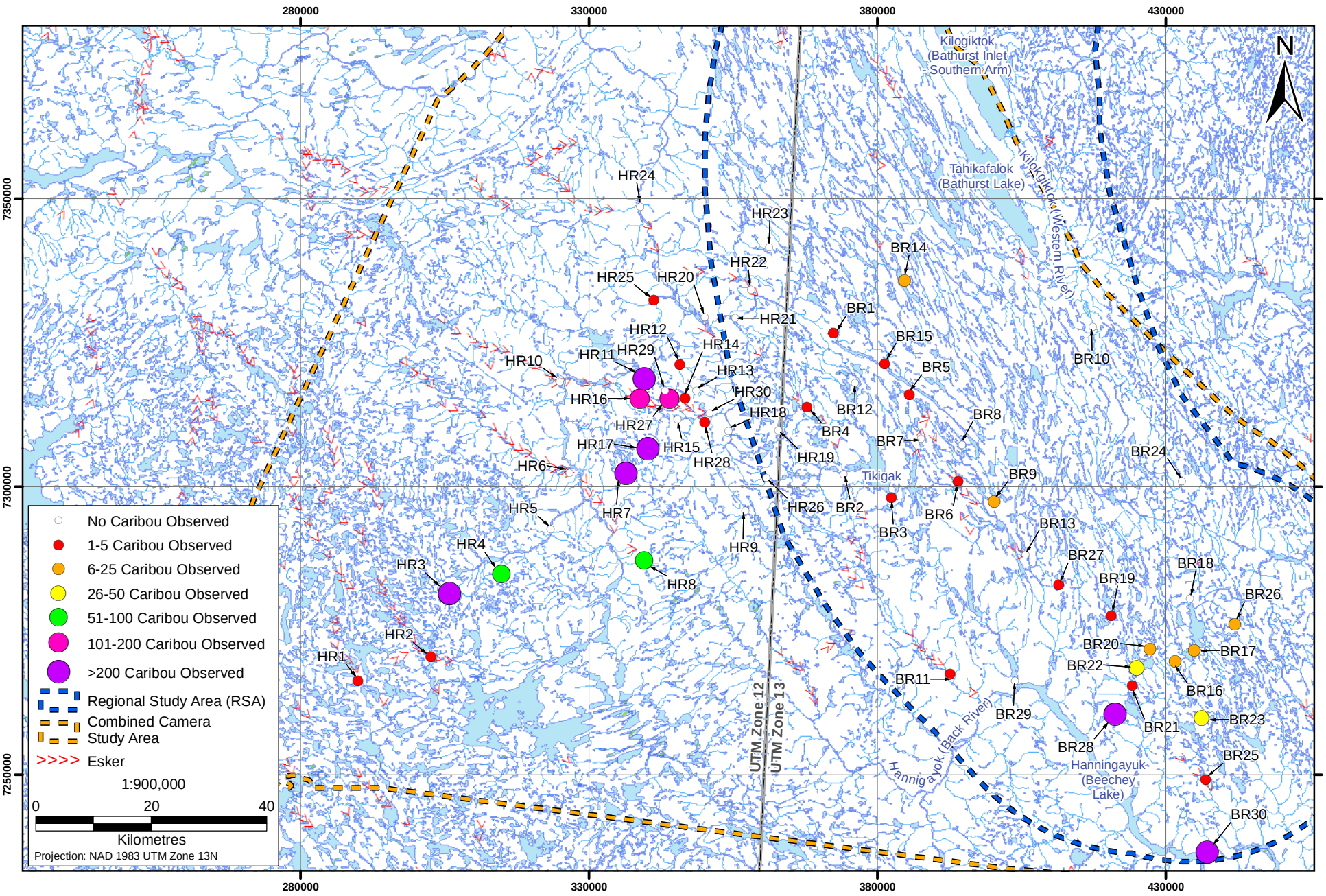

Figure 10.4-7

Sabina GOLD & SILVER CORP.

Number of Caribou Recorded by Remote Camera, 2012

Figure 10.4-7

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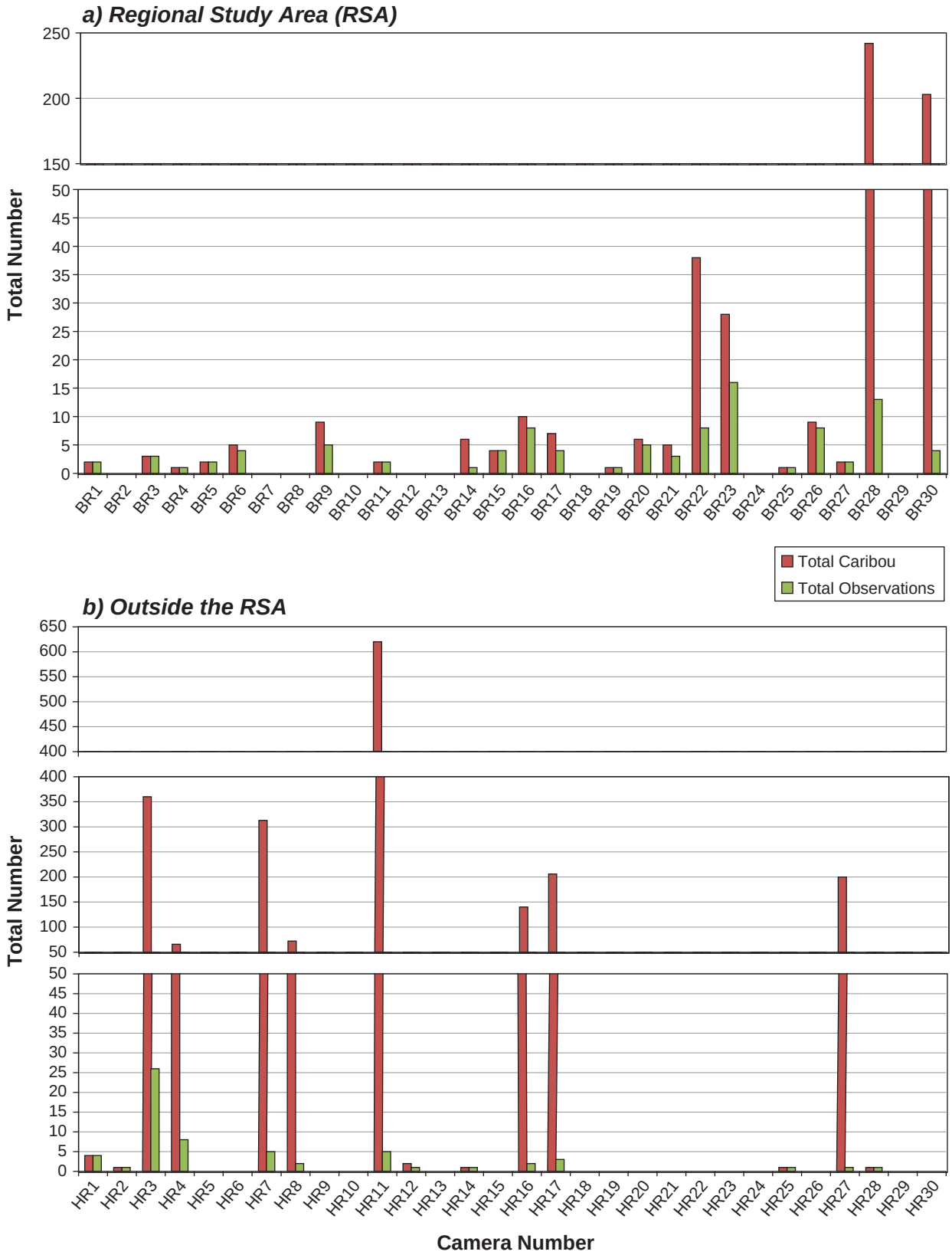

Sabina GOLD & SILVER CORP.

Number of Caribou and Observations Recorded at Each Remote Camera, 2012

Figure 10.4-8

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Figure 10.4-9

Sabina GOLD & SILVER CORP.

Remote Digital Camera Effort between May and August, 2012

Figure 10.4-9

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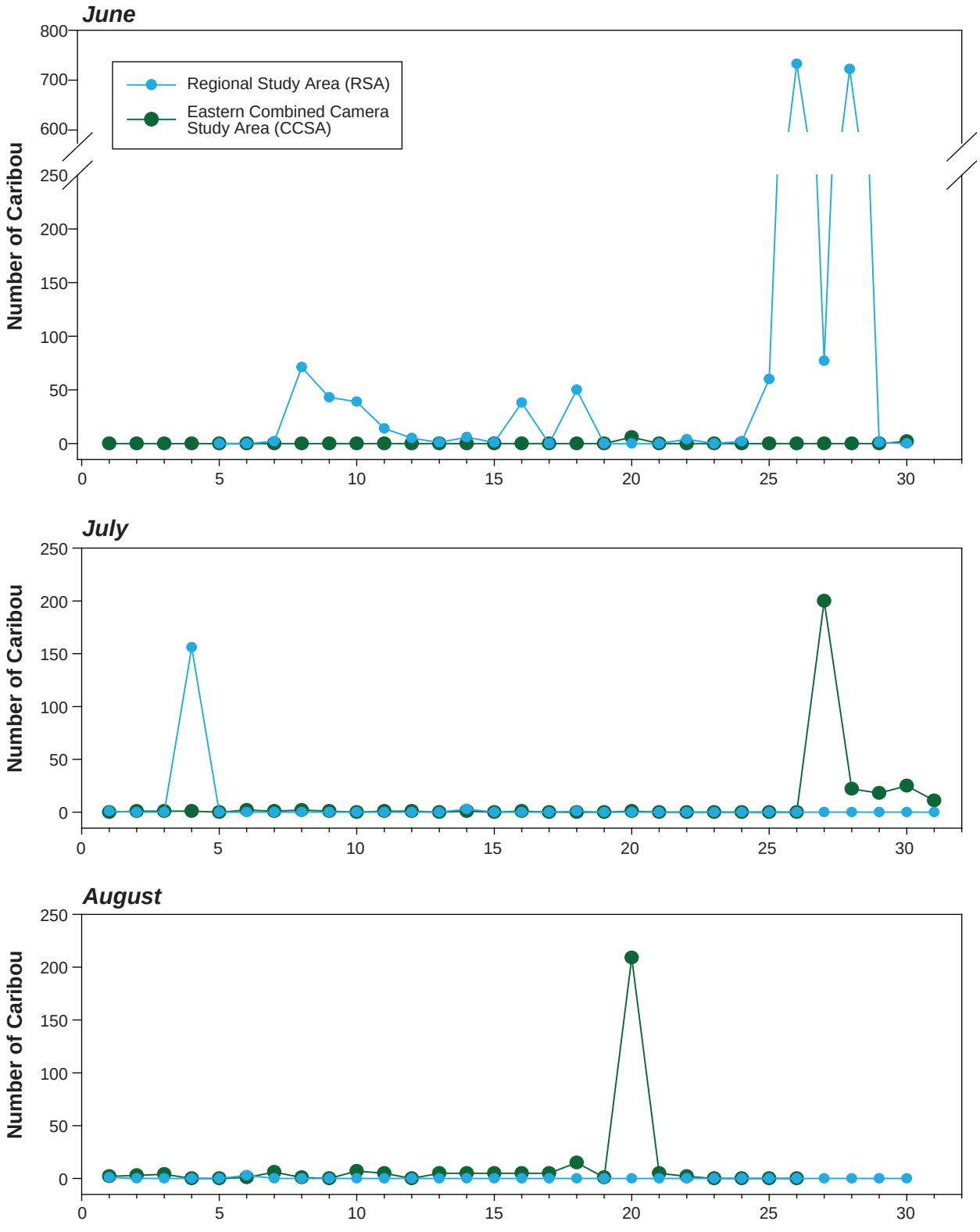

Figure 10.4-10

Temporal Trends in Number of Caribou, 2012

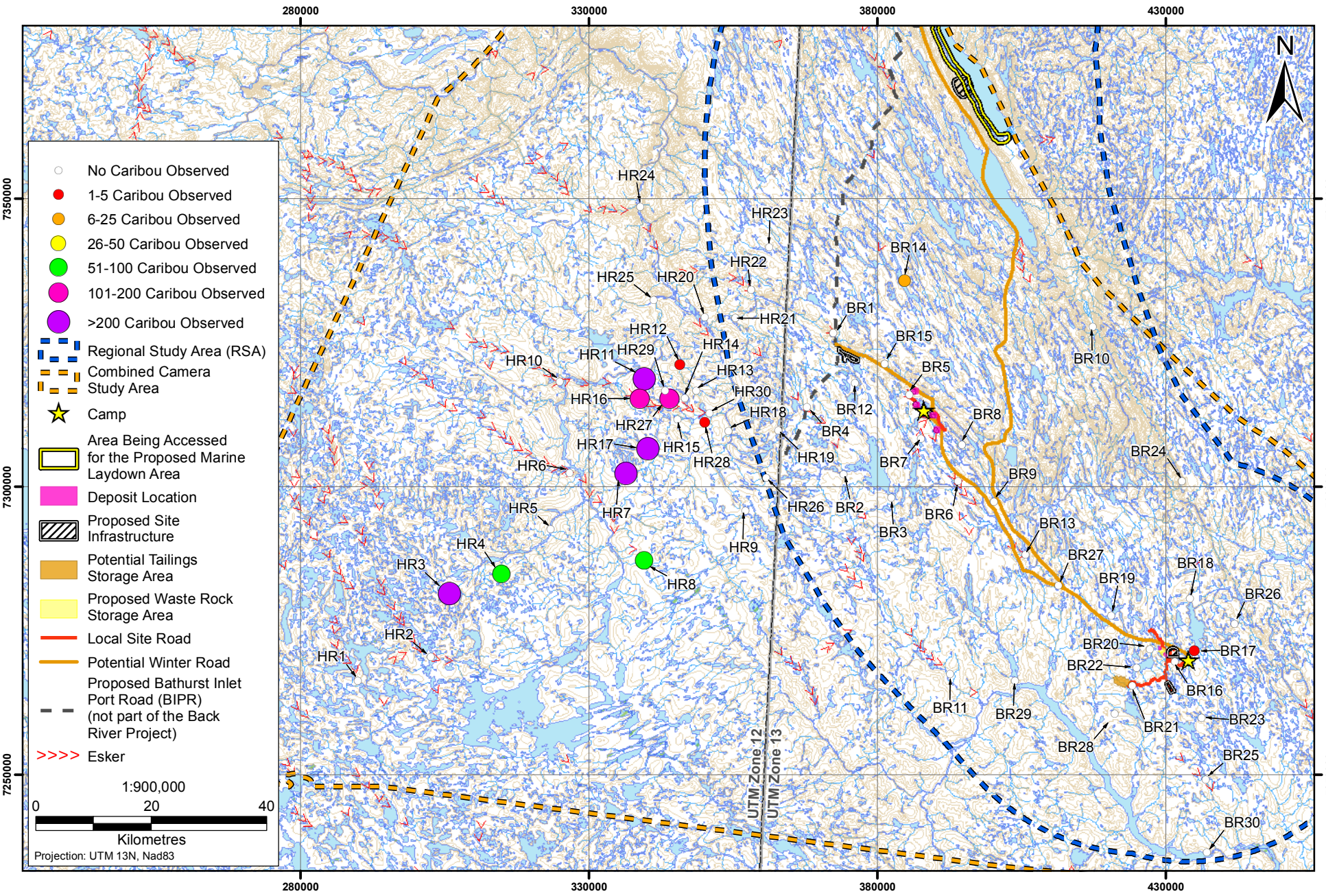

Figure 10.4-11

Sabina GOLD & SILVER CORP.

Number of Caribou Recorded by Remote Camera in June, 2012

Figure 10.4-11

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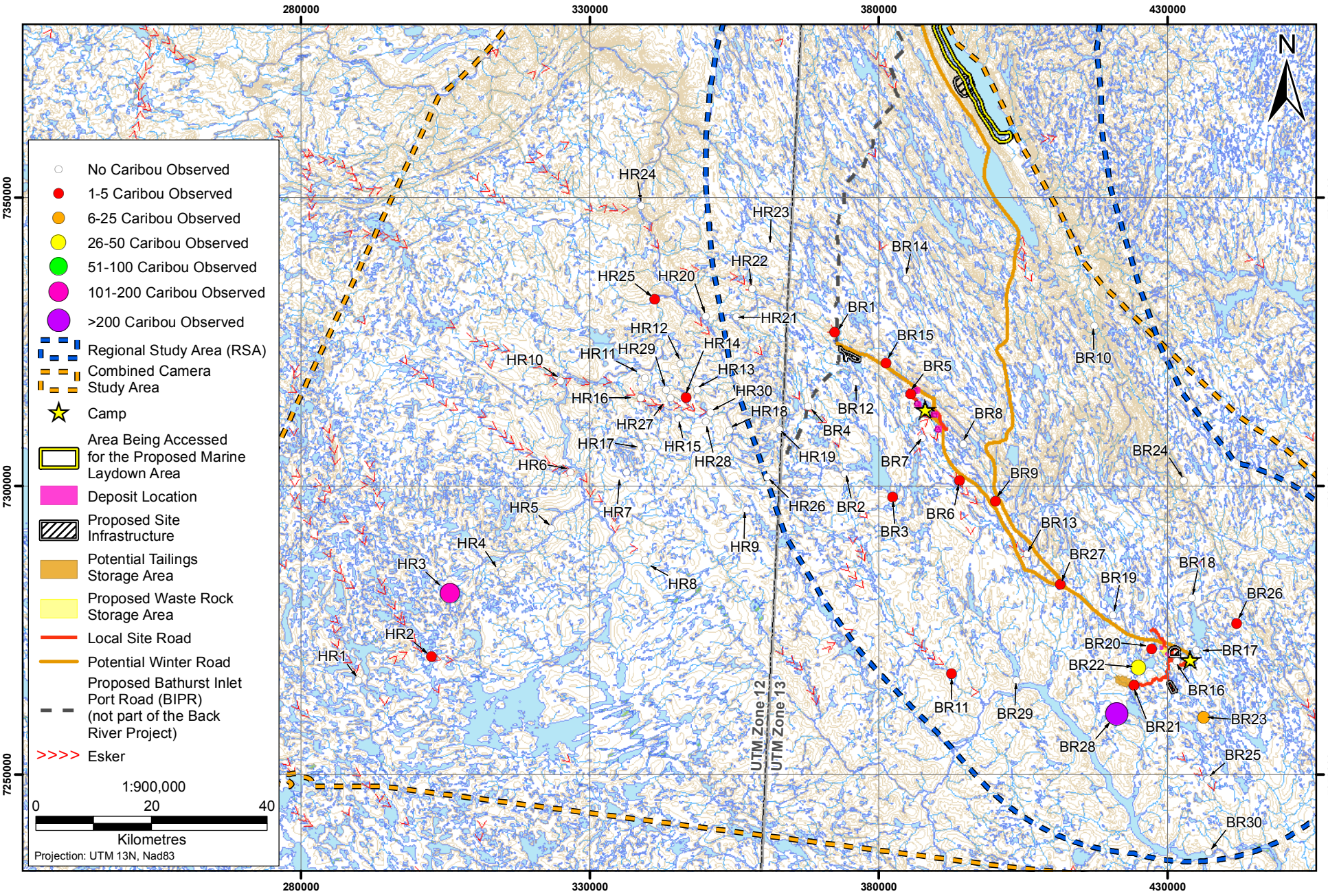

Figure 10.4-12

Sabina GOLD & SILVER CORP.

Number of Caribou Recorded by Remote Camera in July, 2012

Figure 10.4-12

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Large numbers of caribou were also detected in the area west of the RSA. Cameras HR3, HR7, HR17 and HR11, were all distributed along the western edge of the Combined Camera Study Area and detected greater than 200 caribou during June (Figure 10.4-7). Cameras HR16 and HR27, located near camera HR17 also detected between 101 to 200 caribou. Other cameras west of the RSA detected from 0 to 100 caribou (Figure 10.4-7).

10.4.2.4 Relative Size of Caribou Groups in the Combined Camera Study Area

Two cameras detected large groups of caribou (>100 individuals) within the RSA, which included camera BR28 (>200 caribou) on July 27, 2012 and camera BR30 (>200 caribou) on August 20, 2012 (Figure 10.4-12 and Figure 10.4-13; Appendix 10-4). The large total number of caribou detected in relation to the small number of independent camera observations confirmed that many caribou were observed in these groups (Figure 10.4-8). Other caribou observations within the RSA were characterized by much smaller numbers of individuals (less than 22) throughout the camera deployment period.

West of the RSA, five cameras detected large groups (>100 individuals) of caribou, which included HR3 (120 individuals on July 4, 2012), HR7 (250 individuals on June 28, 2012), HR11 (250 individuals on June 26, 2012 and 300 individuals on June 28, 2012), HR17 (200 individuals on June 26, 2012), and HR27 (200 individuals on June 26, 2012; Table 10.4-2). The large total number of caribou detected in relation to the small number of independent camera observations confirmed that caribou were observed in large groups at these locations (Figure 10.4-8; Appendix 10-4). Other caribou observations west of the RSA were characterized by moderate sized groups (51-100 individuals), which included HR7 (60 individuals on June 26, 2012), HR8 (70 individuals on June 27, 2012), HR11 (60 individuals on June 28, 2012), HR16 (60 individuals on June 25, 2012 and 80 individuals on June 28, 2012; Figure 10.4-8; Appendix 10-4).

Table 10.4-2. Total Number of Caribou and Size of Groups Detected by Remote Camera in the Combined Camera Study Area

Study Area	Total Number of Caribou	Number of Large Groups (>100 Caribou)	Number of Moderate Groups (50 – 100 Caribou)	Number of Small Groups (2 – 49 Caribou)	Number of Single Caribou
RSA	586	2	0	25	70
West of the RSA	1,987	6	5	31	18
Total	2.573	8	5	56	88

10.4.2.5 Trends in Habitat Use in the in the RSA and CCSA

Caribou detection rates varied across habitat types within the Combined Camera Study Area. Freshwater/riparian habitat had the highest overall caribou detection rate (2.644 caribou/day ± 1.667; Table 10-4-3). Tundra and bedrock had moderate detection rates relative to freshwater/riparian; wetland and esker habitat had the lowest detection rates of all habitats (Table 10.4-3). There was a large amount of variability in the detection rates at freshwater/riparian cameras as indicated by the standard error, which was primarily influenced by the lower sample size. Thus, these results should be interpreted with caution.

Table 10.4-3. Caribou Detection Rate by Habitat Type

Habitat Type	Camera Sample Size	Mean Detection Rate (caribou/day)	Standard Error (±)
Bedrock	7	0.516	0.363
Esker	15	0.014	0.006
Freshwater / Riparian	3	2.644	1.667
Tundra	31	0.792	0.326
Wetland	4	0.016	0.016

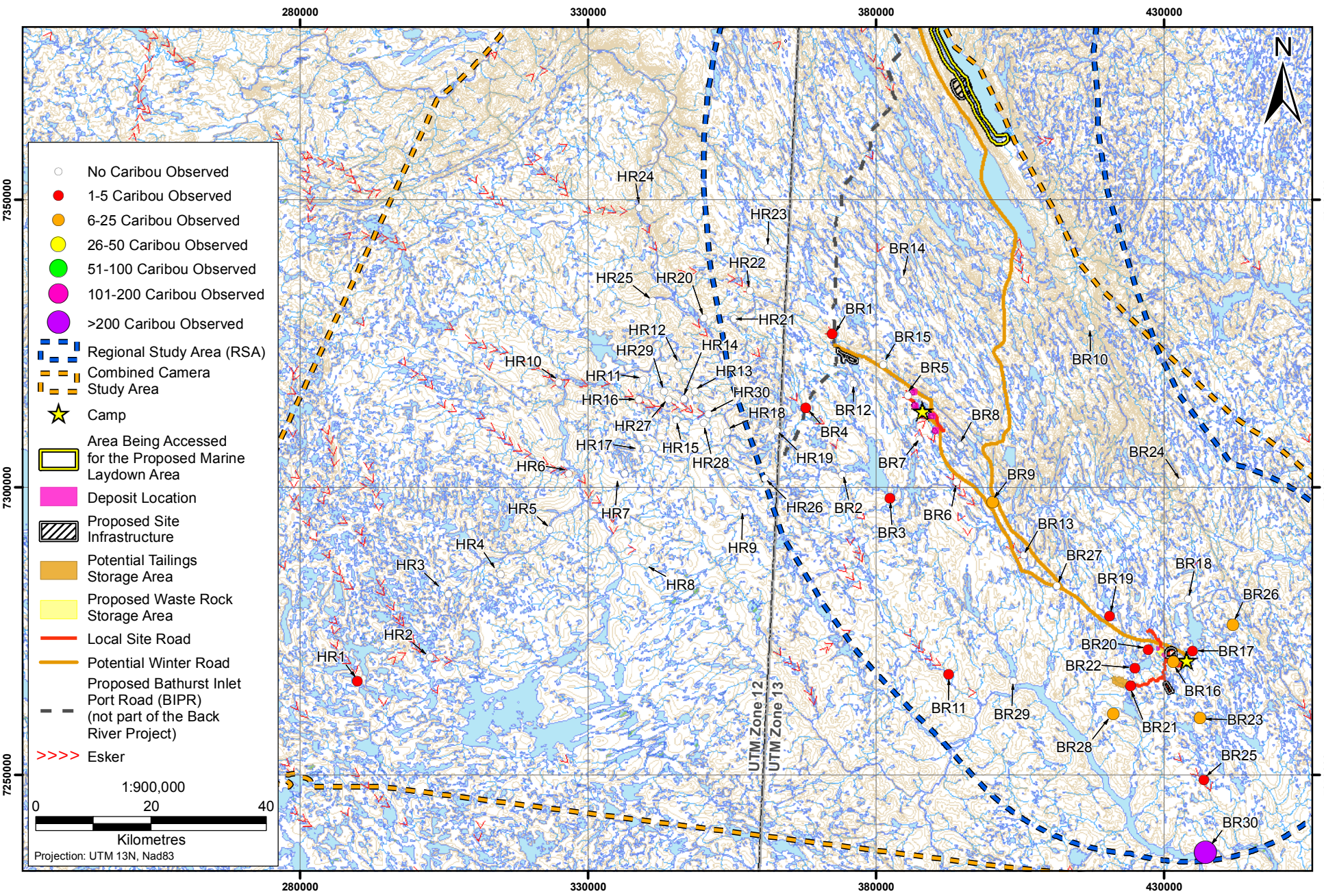

Figure 10.4-13

Sabina GOLD & SILVER CORP.

Number of Caribou Recorded by Remote Camera in August, 2012

Figure 10.4-13

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The higher caribou passage through these areas was expected; caribou seek out shallow areas along major watercourses to cross safely. Thus, the results indicate that many of these predicted river crossings were used in 2012 (e.g., remote camera BR30 which faced a crossing on the Back River (Plate 10.4-1).

Plate 10.4-1. A large herd of caribou observed crossing the Back River on August 20, 2012.

Fewer caribou were observed by cameras in areas where infrastructure is planned (0.086 ± 0.034), than away from these areas (0.287 caribou/day ± 0.173) (Table 10.4-4).

Table 10.4-4. Caribou Detection Rate by Infrastructure Site

	Camera Sample Size	Mean Detection Rate (caribou/day)	Standard Error (±)
Potential Infrastructure Site	11	0.086	0.034
Not a Potential Infrastructure Site	19	0.287	0.173

10.4.3 Incidental Observations of Caribou

In 2012, 1,288 caribou were observed incidentally between March and August within the RSA, with the majority of observations occurring in March (N = 588) and July (N = 593; Figure 10.4-14; Table 10.4-5; Appendix 5-2). The largest number of caribou observed in a group was 500 individuals observed on July 30, 2012 near Gander Lake.

PROJECT #0833-002-05 GIS # BAC-23-060 August 08 2013

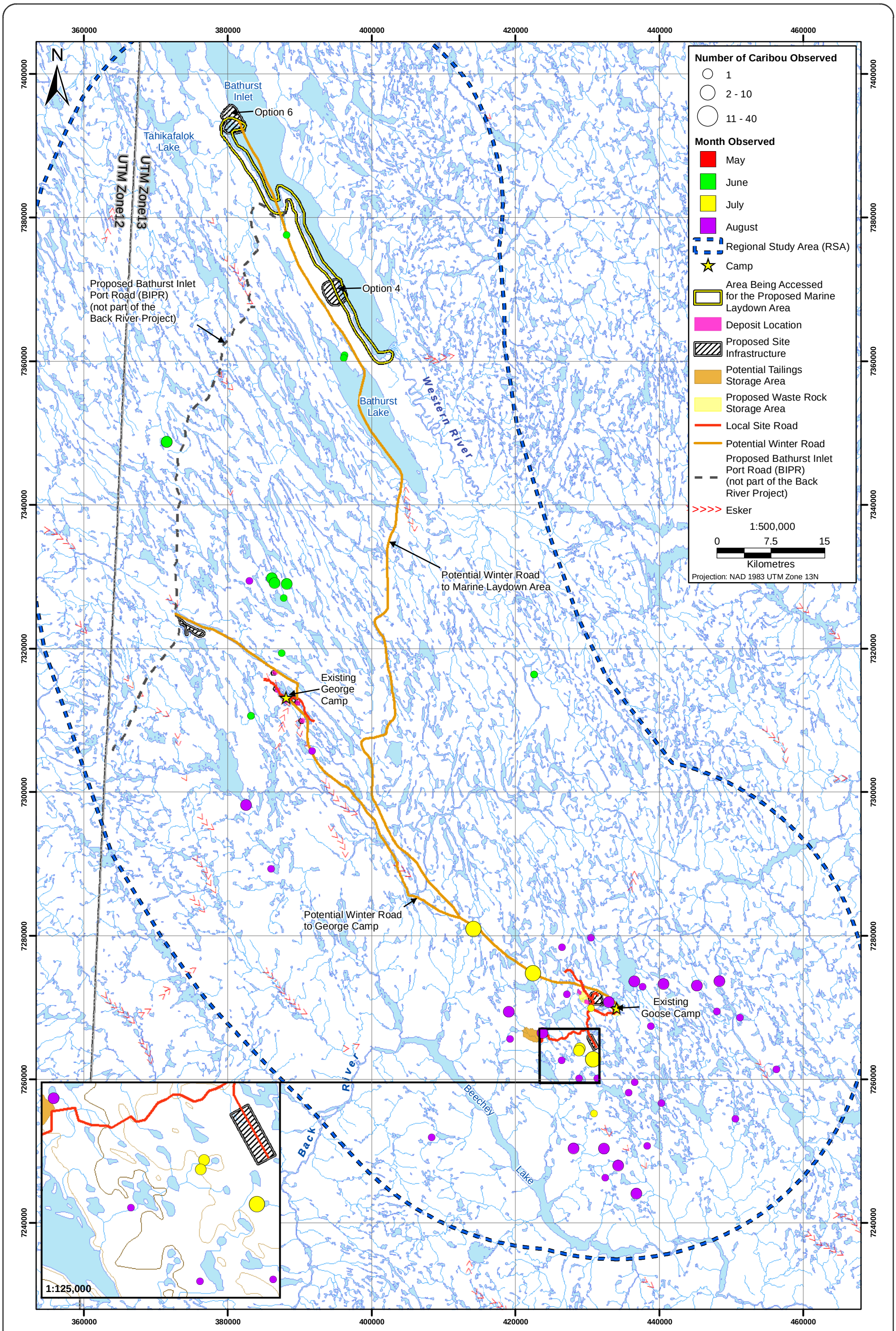

Figure 10.4-14

Sabina GOLD & SILVER CORP.

Incidental Observations of Caribou in the Regional Study Area, 2012

Figure 10.4-14

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Table 10.4-5. Caribou Observed Incidentally in the RSA, 2012

Month	Number of Caribou
March	588
April	4
May	2
June	35
July	593
August	66
Total	1,288

10.5 DISCUSSION

10.5.1 Summary

Fixed kernel utilization distributions (UDs) for collared Bathurst and Beverly caribou indicated that both the Bathurst and Beverly herds use habitat within the RSA on an annual basis. Collared Bathurst caribou were mostly present in the RSA during the post-calving period, where they migrate in a south-east direction past the George Property. Annual movement paths for collared caribou showed that Bathurst caribou generally migrated through the western RSA on their way to their calving grounds. Seasonal ranges for Beverly caribou overlap with the RSA in all seasons except during post-calving. Most notably, collared Beverly caribou were present within the RSA during the summer; a large summer core use area falls over the George and Goose properties. Collared Beverly caribou passed through the eastern edge of the RSA on their way to the calving grounds.

Caribou were generally detected in low numbers by remote digital camera within the RSA between May and August, 2012. A total of 2,573 caribou were detected in the Combined Camera Study Area during spring and summer of 2012. However, large groups were observed using both the RSA and the area west of the RSA over short periods of time. Eight large groups (> 100 individuals) of caribou were observed by remote camera in during the caribou post-calving and summer life history phases; six groups in the area west of the RSA, and two groups in the RSA. Moderate sized herds of caribou (50 – 100 individuals) were also observed west of the RSA but were not observed in the RSA. Caribou were associated most frequently with freshwater/riparian habitat followed by tundra habitat, with lowest detection rates of caribou in esker habitat. Detection of caribou by remote cameras at proposed infrastructure sites was lower relative to other sites within the RSA.

10.5.2 Distribution of Collared Caribou

10.5.2.1 Collared Caribou in the RSA

The collar data from 1996 to 2012 indicate that the Bathurst herd move through the RSA during the post-calving period in late June to mid/late July; the herd may also pass through on their way north to the calving grounds in the spring (May), but this use is very infrequent based on the collar data. The seasonal range and migration routes of Beverly caribou overlaps the RSA during spring migration, summer, fall, and winter, with the RSA occurring on the western edge of the Beverly herd range. Camera data corroborate the collar data on the timing of caribou occurring in the RSA.

These data represent the current condition during the last 10 to 15 years, but are heavily weighted towards the most recent (~2006) distribution of caribou. This section describes some of the background on the Bathurst and Beverly caribou, including the history of long term shifts in habitat use to put these data into a broader context.

Shifts in habitat use across longer periods of time are well documented in Arctic caribou herds. Most notable of the variation are in the locations of wintering areas and calving grounds (Sutherland and Gunn 1996; Thorpe et al. 2001; Gunn and D'Hont 2002; Adamczewski et al. 2009; D'Hont et al. 2009; Gunn, Russell, and Eamer 2011; Nagy, Campbell, and Kelly 2012). These trends may be influenced by several factors, such as forage availability and the presence of security habitat (for predator detection/avoidance). In addition, it appears that adjacent herds and the areas that they use throughout the year may influence how any one herd may use habitat (Nagy, Campbell, and Kelly 2012).

During the winter, most caribou within the Northwest Territories and Nunavut are found below or at the treeline. Beverly caribou are among the few Arctic herds where most animals winter in the tundra. Wintering areas are the most variable across all life history stages,, showing the least degree of overlap in use areas between years (D'Hont et al. 2009). This trend is influenced by the availability of forage, primarily arboreal lichens, and snow depth (D'Hont et al. 2009). Daily movement rates for caribou are lowest during the winter (Gunn et al. 2008), suggesting that caribou select areas with good food availability and generally exploit those areas for the duration of the winter. This trend is clearly supported by the distribution of the kernel UDs developed for Bathurst and Beverly caribou, as these kernel UDs had the greatest extent relative to other life history periods (Figure 10.4-1).

Shifts in calving grounds have been recorded in most Arctic caribou herds. These shifts may be a result from the overall habitat selection of females at this time. During calving, females appear to select habitat that is suboptimal in terms of forage quality (Griffith, Gunn, and Russel 2001). This habitat selection may be an artefact of predator aversion (e.g., good sightlines for detecting predators). Post-calving areas however are characterized by high amounts of green forage and females select these areas to meet the high energy demands of lactation (Griffith, Gunn, and Russel 2001). Caribou have the highest chance of disturbances resulting in population-level effects during calving and post-calving when calves are most susceptible to predation and disturbance (Murphy and Curatolo 1987; Nellemann and Cameron 1998; Russell, Kofinas, and Griffith 2002).

The calving ground of Bathurst caribou has gradually shifted from the western side of Bathurst Inlet (in the 1950s) to the eastern side (1960s to mid-1980s) and in recent years (the late 1990s) has shifted back to the western side (Sutherland and Gunn 1996; Thorpe et al. 2001; Gunn and D'Hont 2002). The calving range of collared Bathurst caribou from 1996 to 2012 were located between James River and Contwoyto Lake well to the north-west of the RSA, with the most concentrated use taking place between the Hood and Burnside Rivers (Figure 10.4-3a).

The Beverly herd has also shown a periodic shift in calving areas used over the years, although this shift has not been as dramatic as in the Bathurst herd. In the mid 1980's, Beverly caribou calved in a concentrated areas on the eastern edge of the Queen Maud Gulf, since then, the calving grounds have expanded along the entire edge of the Queen Maud Gulf from the Kent Peninsula in the west to the Adelaine Peninsula in the east (Gunn, Fournier, and Nishi 2000; Gunn and D'Hont 2002). However, this larger spread may be a result of immigration of Beverly caribou to this calving ground (Section 10.5.1.2). Collared Beverly caribou calved to the east of the RSA across the edge of the Queen Maud Gulf based on collar data from 2001 to 2012, the core of which occurred along the western portion of the gulf (Figure 10.4-3b).

These shifts in the locations of wintering and calving grounds generally only affects how caribou move between them (e.g., spring migration); these shifts do not seem to affect the location of summer and fall ranges. During the spring, pregnant females lead the northward migration to calving grounds. Past research and TK suggest that pregnant females exhibit a "determined" attitude during spring migration, moving rapidly and directly toward the calving grounds (Dogrib Treaty 11 Council 2001;

Gunn, Dragon, and Boulanger 2002; Gunn et al. 2008). Such homing tendencies for calving grounds have been shown in previous years with both Beverly and Bathurst caribou (Gunn et al. 2008).

Caribou appear to select a large variety of habitats during the summer and fall which are widely available across the tundra. Therefore, they do not exhibit a strong fidelity to any one area within summer and fall ranges, except for rutting areas that appear to be exclusively used among herds. During the summer, caribou herds are relatively dispersed, as illustrated by the large spread of the summer range and associated core use areas (Figure 10.4-5). For Beverly caribou, the area surrounding the RSA receives a high amount of use during the summer. The insect harassment period escalates during the summer and females have larger daily movement rates (Gunn et al. 2008) and may temporarily use windy areas such as eskers or shorelines to avoid biting insects (Thorpe et al. 2001). Males and immature caribou generally reunite with females and calves during the late summer; during this time, caribou tend to reduce overall movement and forage more to compensate for the increased energy demands of insect avoidance (Gunn et al. 2008).

Following the reunion of bulls and immature caribou with the cows and calves in the late summer, caribou herds migrate southwards during the fall. Within the fall range are rutting grounds that are used in October. For Bathurst caribou, the areas around Lac De Gras have been highlighted as an area that has been occupied by rutting caribou (GNWT ENR 2010). Beverly caribou migrate south and south-east towards the Thelon Game Sanctuary in the fall, located on the NWT/Nunavut border east of Great Slave Lake, where the rut occurs (Gunn, Fournier, and Nishi 2000). Analysis of collar data in the current report supports these trends, with high kernel density of collar locations (i.e., high amounts of use) overlapping Lac de Gras for Bathurst caribou in the fall and the eastern Thelon Wildlife Sanctuary for Beverly caribou (Figure 10.4-6).

10.5.3 Remote Digital Cameras

Sixty digital cameras (4,720 recording days) were deployed (May 23 and August 26, 2012) to determine temporal and spatial patterns of caribou movement through the study area. Camera detection rates of caribou were compared among habitat types to determine preferred habitat use by caribou in the combined caribou study area. In addition, camera detection rates were compared between sites where potential Project infrastructure may be built and control sites within the RSA to determine whether proposed Project infrastructure sites receive relatively high use by caribou. A total of 2,573 caribou were detected in the Combined Camera Study Area – six large groups were observed west of the RSA between June 25 and July 5, 2012, and 2 large groups were observed in the south-east sector of the RSA; one on July 27, 2012 and the other on August 20, 2012. These photos of large groups coincide with inferences from GPS collar locations of the timing and routes of migrating Bathurst and Beverly caribou. As indicated by the collar data, large groups photographed in the area west of the RSA in late June were of post-calving Bathurst caribou. Similarly, higher detections of large caribou groups in the south-east sector of the RSA in July reflects the spatial overlap of the south-east portion of the RSA with the summer range of the Beverly herd.

This study reveals several key benefits of using remote cameras to survey caribou, which complement the information gleaned from satellite data. Location data from GPS collars can be used to map the timing and location of caribou migration; however, only a small number of female caribou are collared each year. Thus, depending on the movements of collared females with respect to the whole herd, the movements of relatively large portions of the Bathurst and Beverly herds may not be reflected in the satellite data. Unlike satellite data, cameras can be used to record the size and timing of herd movements through the study area, which is particularly important for detecting movements close to proposed Project infrastructure sites.

Second, because collars are placed only on female caribou, the movements of immature and male caribou may not be reliably inferred from satellite data. Very low camera detections of caribou in the CCSA during calving corroborate the observations of researchers that bulls and immature caribou generally follow females to calving grounds (D. C. Heard, Williams, and Melton 1996). It is likely that males and immature caribou comprised a significant portion of the camera detections of individuals and small groups photographed during summer. While representing smaller numbers of caribou than those found in post-calving and summer aggregations of females and calves, these detections are important because they reveal similar temporal patterns to those indicated by the movements of satellite collared females.

Third, landscape features or potential Project infrastructure sites can be monitored by camera to determine their relative use, and thus importance to caribou. In this study, camera monitoring allowed the identification of a river crossing location. Water crossings have been identified as important aspects of caribou habitat in the 2012 Draft Nunavut Land Use Plan (NPC 2012). A water crossing site was identified at Camera 30 in the RSA at the southern end of Back River (also referred to as Beechey Lake), which was also indicated by a high density of caribou trails that paralleled the lake shoreline to the crossing location. In addition, caribou detection rates were 3.3 times higher at sites unrelated to the proposed Project.

During summer after the post-calving period, forage quality and insect harassment are believed to be the two main drivers of habitat selection by caribou. Caribou forage relatively intensely during summer, primarily in lowland sites such as sedge meadows where forage is more abundant and nutritious (Wilson et al. 2012). Females in particular must acquire adequate forage in summer to support lactation, and to maintain pregnancy throughout the winter (Couterier et al. 2009). Harassment by black and especially oestrid flies can cause significant disturbances to tundra caribou in July and August (Witter et al. 2012). Caribou attempt to avoid insects by moving for some part of the daytime to windier, cooler places, such as on top of eskers, at the edges of large rivers and lakes, and to higher elevation tundra where insects are less dense (Wilson et al. 2012; Witter et al. 2012). According to Inuit Traditional Knowledge, caribou often use eskers as travel corridors (Thorpe et al. 2001). In this study, camera detection rates of caribou were very low on eskers, despite the relatively high survey effort along eskers (15 of 60 cameras). In contrast, caribou elsewhere have been frequently detected by remote cameras moving along eskers found within their migration routes (Rescan 2012c). The lower use of esker habitats may suggest that caribou use other habitats for insect relief, such as lake edges ro windswept ridges. However, eskers have a sparse distribution across the tundra, and therefore, the lower detection rates may be caused by the infrequency of esker habitat within the summer range of Beverly caribou.

10.5.4 Incidental Observations of Caribou

Incidental observations of caribou within the RSA provide further support that caribou, which were likely those of the Beverly herd, were present within the RSA in highest numbers during March on their spring migration to calving grounds, and then again from late July and throughout summer.

11. Incidental Observations of Ungulates (Moose and Muskox)

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11. Incidental Observations of Ungulates (Moose and Muskox)

11.1 INTRODUCTION

Incidental observations of wildlife were recorded during the 2012 wildlife baseline studies. This section summarizes the incidental observations of moose (*Alces americanus*), and muskox (*Ovibos moschatus*) recorded within the RSA. Incidental observations of caribou are reported in Section 11. Baseline surveys were not directly conducted for moose and muskox but their incidental observations are valuable in understanding the baseline distribution and species present within the RSA.

Muskox are considered Secure in Nunavut (Wild Species 2005). Muskox are expected to occur within the RSA and are a dominant ungulate species of the Arctic. Their distribution encompasses the RSA and much of the adjacent northern expanse of Nunavut (Nunavut Development Corporation 2010). They have small home ranges of 27 to 70 km^2 in the winter and 223 km^2 on average in the summer (Reynolds 1998). They can thrive in cold conditions and feed on willow and tundra grasses commonly found throughout the region (GN DOE 2006). Muskox have been harvested as Inuit subsistence food for centuries and their fur, known as qiviut, is valuable for clothing and bedding (Nunavut Development Corporation 2010).

Moose do not have a conservation status within Nunavut or Canada and are considered Secure (Wild Species 2005). Moose are expected to occur within the RSA but are infrequent relative to other ungulate species. Moose distribution is at its peripheral edge across the RSA (GNWT ENR 2011). Suitable riparian shrub forage and cover habitat does exist within the RSA, however, the tundra landscape is dominated by other ecosystem types such as humocky low shrub, floodplain, and bedrock. Moose are typically found below treeline and prefer a mix of deciduous and conifer stands throughout the year (GNWT ENR 2011). Moose are a valued food source for resident and non-resident hunters.

11.2 OBJECTIVES

The objective of recording incidental observations of ungulates was to document the presence of ungulate species in the RSA.

11.3 METHODS

Incidental observations of moose and muskox were recorded during wildlife field surveys, by wildlife remote cameras, and by other field staff conducting baseline studies within the RSA. Date, location, species, number of individuals, gender, and habitat were documented whenever possible.

11.4 RESULTS

Muskox and/or moose were incidentally observed 12 times during baseline studies conducted in 2012, totalling 117 individuals (Table 11.4-1; Figure 11.4-1). Muskox sign was also observed in the winter at three wolverine hair sampling sites. Muskox were more frequently observed than moose. They were detected incidentally throughout the RSA 10 times, while moose were observed on two occasions near the Western River, which runs parallel to Bathurst Lake.

Muskox were observed 10 times between June and August 2012. Five observations were made of herds with greater than 10 individuals, and the other five observations consisted of detections of one or two individuals (Table 11.4-1). Figure 11.4-1 displays nine muskox detections (the August 16 and August 18 observations were considered a single herd due to their similar locations), herd sizes and detection dates (Table 11.4-1; Appendix 11.4-1). Likewise, the two muskox herds observed near the centre of the RSA and south-east of the existing George Camp could potentially be the same herd because they had similar numbers (N = 15 and 17), and could have moved the 7 km distance in the 11 weeks between observations (Figure 11.4-1).

Table 11.4-1. Moose and Muskox Incidental Observations

Date	Species Name	Number Observed	Habitat Type
06-April-12	Muskox	2	Rocky Heath Tundra
06-April-12	Muskox	Unknown = tracks and pellets	unknown
06-April-12	Muskox	Unknown = tracks	unknown
06-April-12	Muskox	Unknown = tracks and pellets	unknown
04-Jun-12	Muskox	1	Rocky Heath Tundra
10-Jun-12	Muskox	15	Rocky Heath Tundra
13-Jun-12	Muskox	2	Bathurst Inlet
19-Jun-12	Muskox	1	Rocky Heath Tundra
16-Aug-12	Muskox	20	Rocky Heath Tundra
18-Aug-12	Muskox	24	Rocky Heath Tundra
21-Aug-12	Muskox	1	Rocky Heath Tundra
25-Aug-12	Muskox	31	Sedge Meadow
26-Aug-12	Muskox	17	Sedge Meadow
19-Aug-12	Moose	2	Tall riparian shrub
27-Aug-12	Moose	1	Tall riparian shrub

Calves were observed in two of the herds (Plate 11.4-1; Appendix 11.4-1). Muskoxen were observed north-west of both exploration camps, near Beechey Lake and within the middle of the RSA close to the proposed marine winter road (Figure 11.4-1). Muskox were most commonly found in rocky heath tundra habitat (Plate 11.4-2; Table 11.4-1).

During late winter (April), two muskox were observed west of the Goose Property (Plate 11.4-3), and on the same day, recent muskox tracks were found at three different wolverine DNA sample sites relatively close to that observation. Gender is indistinguishable from the winter photo and no calves were observed.

Moose were observed incidentally two times near the Western River along the north-east corner of the RSA (Table 11.4-1; Figure 11.4-1). All three of the moose observed were bulls and both observations were captured in tall riparian shrub habitat (Plate 11.4-4; Appendix 11.4-1).

11.5 DISCUSSION

Muskox and moose were observed incidentally in 2012. Incidental observations confirmed that both of these ungulate species have suitable foraging habitat within the RSA (Table 11.4-1). The timing of incidental observations coincides with the wildlife baseline field surveys, which were most often conducted in the spring and the summer so the number of observations collected during those seasons is reflective of surveyor effort and not seasonal abundance.

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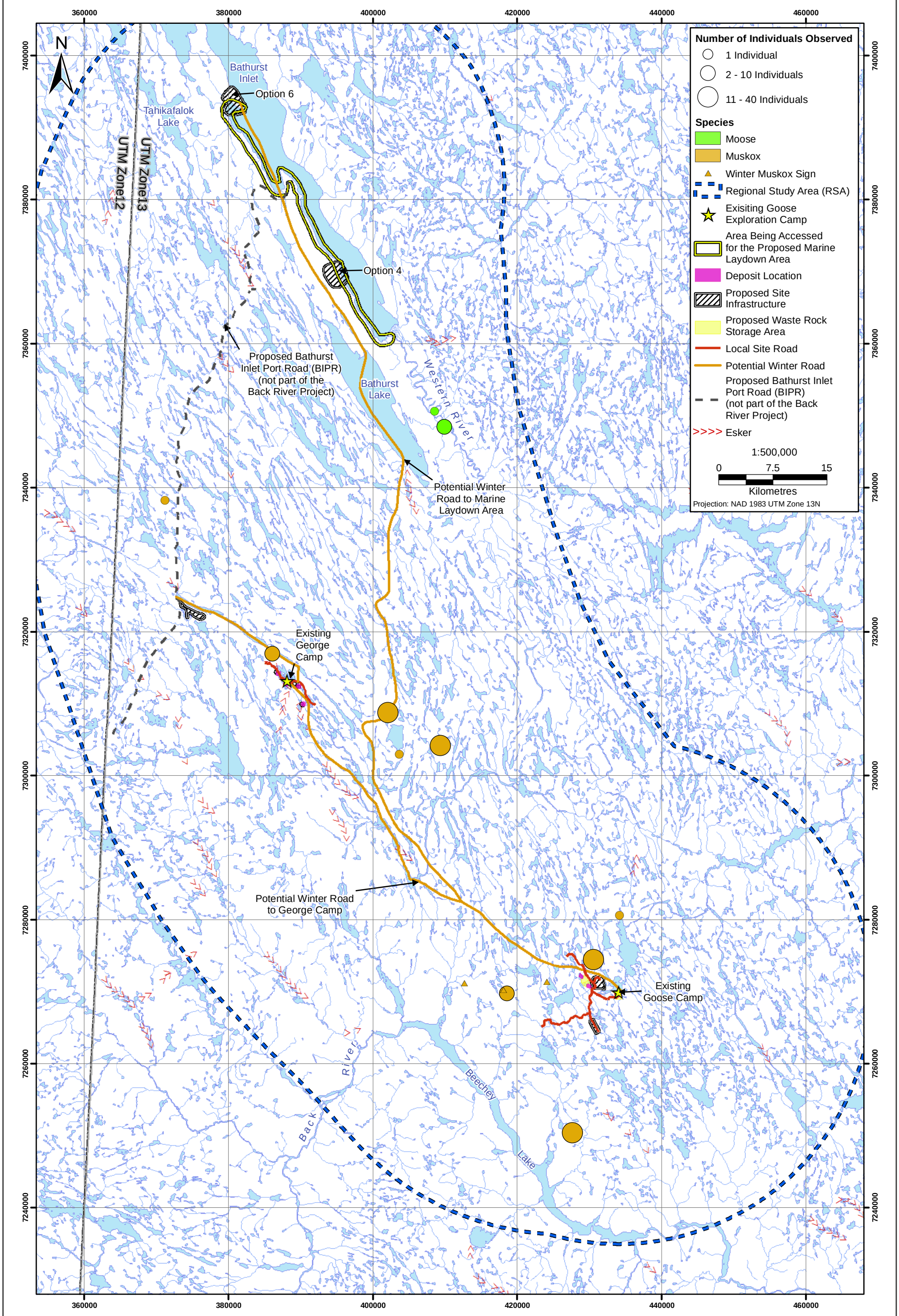

Figure 11.4-1

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Incidental Observations of Muskox and Moose, 2012

Figure 11.4-1

Rescan™ Engineers & Scientists

Plate 11.4-1. A muskox herd with two calves observed in a sedge meadow near Beechey Lake, August 25, 2012.

Plate 11.4-2. Muskox image captured by remote camera north-west of Goose Camp, August 21, 2012.

Plate 11.4-3. A late winter muskox picture taken April 6, 2012 west of Goose Camp.

Plate 11.4-4. A bull moose in tall riparian shrub habitat along the Western River, August 27, 2012.

Muskox were observed ten times, primarily within the middle of the RSA and most notably north-west of both properties. Muskox herds typically consist of 15 individuals (GN DOE 2006). Five of the herds observed during the 2012 baseline studies consisted of 15 or more individuals, (N = 15, 17, 20, 24, 31), but based on observation dates and spatial data, two herds were likely observed twice. The herd sizes and observation locations are consistent with observations collected during surveys conducted in the spring and summer of 2010 (Rescan 2011).

The April muskox observation confirms that muskox use the RSA during the winter and potentially during the calving season, which occurs from April to May (Reynolds 1998; NPC 2012). Herds in late

winter habitat may be sensitive to disturbance (Reynolds 1998). Research has indicated that cow calf displacement from winter range into areas of deeper snow may potentially increase mortality because of greater expenditure of energy to locate food and higher risks to predation (Reynolds 1998). Overall, site fidelity is higher in the winter for areas that provide suitable winter forage conditions (D. C. Heard, Williams, and Melton 1996; NPC 2012).

Three moose bulls were observed on two separate occasions in relatively the same area along the Western River. Moose are uncommon within the regional area but are not a species of conservation concern. The moose were in riparian shrubs, which is high quality moose forage and cover habitat.

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Definitions of the acronyms and abbreviations used in this reference list can be found in the Glossary and Abbreviations section.

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Personal Communication

Tate, G. 2013. Helicopter Pilot, Northern Air Support, George Camp. Personal Communication: April 28, 2013.

Appendix 4-1

Potentially Occurring Wildlife Species in the Back River Terrestrial and Marine Study Areas

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Appendix 4-1. Potentially Occuring Wildlife Species in the the Back River Terrestrial and Marine Study Areas

Common Name	Scientific Name	Group	Likelihood of Occurrence	Detected During Baseline Studies	Presence Relative to Study Area	Presence in Ecozones Associated with the Proposed Project			Conservation Status				
						Southern Arctic	Northern Arctic	Arctic Ocean	Terr. Rank	COSEWIC	SARA	Global Rank	IUCN Red List
Birds													
Yellow-billed Loon	*Gavia adamsii*	Waterbird	L	Y	Breeder	X	X		Secure	NAR		G4	Least Concern
Pacific Loon	*Gavia pacifica*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Red-throated Loon	*Gavia stellata*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Greater White-fronted Goose	*Anser albifrons*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Canada Goose	*Branta canadensis*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Cackling Goose	*Branta hutchinsii*	Waterbird	L	N	Seasonal Migrant	X	X		Secure			G5	Least Concern
Tundra Swan	*Cygnus columbianus*	Waterbird	L	N	Breeder	X	X		Secure			G5	Least Concern
Northern Pintail	*Anas acuta*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Common Eider	*Somateria mollissima*	Waterbird	L	Y	Seasonal Migrant	X	X		Sensitive			G5	Least Concern
King Eider	*Somateria spectabilis*	Waterbird	L	N	Seasonal Migrant	X	X		Sensitive			G5	Least Concern
Black (American) Scoter	*Melanitta americana*	Waterbird	L	Y	Seasonal Migrant	X			Undetermined			G5	Least Concern
White-winged Scoter	*Melanitta fusca*	Waterbird	L	Y	Breeder	X			Undetermined			G5	Least Concern
Surf Scoter	*Melanitta perspicillata*	Waterbird	L	Y	Breeder				Undetermined			G5	Least Concern
Long-tailed duck	*Clangula hyemalis*	Waterbird	L	Y	Breeder	X	X		Sensitive			G5	Least Concern
Red-breasted Merganser	*Mergus serrator*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Golden Eagle	*Aquila chrysaetos*	Raptor	L	Y	Breeder	X			Sensitive	NAR		G5	Least Concern
Rough-legged Hawk	*Buteo lagopus*	Raptor	L	Y	Breeder	X	X		Sensitive	NAR		G5	Least Concern
Northern Harrier	*Circus cyaneus*	Raptor	L	Y	Breeder	X			Undetermined	NAR		G5	Least Concern
Peregrine Falcon	*Falco peregrinus*	Raptor	L	Y	Breeder	X	X		Secure	TH/SC	1/3	G4	Least Concern
Gyrfalcon	*Falco rusticolus*	Raptor	L	Y	Resident	X	X		Sensitive	NAR		G5	Least Concern
Willow Ptarmigan	*Lagopus lagopus*	Upland Breeding Bird	L	Y	Resident	X	X		Secure			G5	Least Concern
Rock Ptarmigan	*Lagopus muta*	Upland Breeding Bird	L	Y	Resident	X	X		Secure			G5	Least Concern
Sandhill Crane	*Grus canadensis*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
American Golden-Plover	*Pluvialis dominica*	Shorebird	L	Y	Breeder	X	X		Sensitive			G5	Least Concern
Semipalmated Plover	*Charadrius semipalmatus*	Shorebird	L	Y	Breeder				Secure			G5	Least Concern
Least Sandpiper	*Calidris minutilla*	Shorebird	L	Y	Breeder	X			Sensitive			G5	Least Concern
Baird's Sandpiper	*Calidris bairdii*	Shorebird	L	N	Breeder	X	X		Secure			G5	Least Concern
Semipalmated Sandpiper	*Calidris pusilla*	Shorebird	L	Y	Breeder	X	X		Sensitive			G5	Least Concern
White-rumped Sandpiper	*Calidris fuscicollis*	Shorebird	L	N	Breeder/Seasonal Migrant	X	X		Secure			G5	Least Concern
Pectoral Sandpiper	*Calidris melanotos*	Shorebird	L	N	Breeder/Seasonal Migrant	X	X		Secure			G5	Least Concern
Red-necked Phalarope	*Phalaropus lobatus*	Shorebird	L	Y	Breeder	X	X		Sensitive			G4G5	Least Concern
Wilson's snipe	*Gallinago delicata*	Shorebird	L	N	Breeder	X			Undetermined			G5	Least Concern
Long-tailed Jaeger	*Stercorarius longicaudus*	Seabird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Parasitic Jaeger	*Stercorarius parasiticus*	Seabird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Herring Gull	*Larus argentatus*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Glaucous Gull	*Larus hyperboreus*	Waterbird	L	Y	Breeder	X	X		Sensitive			G5	Least Concern
Arctic Tern	*Sterna paradisaea*	Waterbird	L	Y	Breeder	X	X		Sensitive			G5	Least Concern
Short-eared Owl	*Asio flammeus*	Raptor	L	Y	Breeder	X			Sensitive	SC	3	G5	Least Concern
Snowy Owl	*Nyctea scandiaca*	Raptor	L	N	Seasonal Migrant	X	X		Secure	NAR		G5	Least Concern
Common Raven	*Corvus corax*	Raptor	L	Y	Resident	X	X		Secure			G5	Least Concern
Horned Lark	*Eremophila alpestris*	Upland Breeding Bird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Gray-cheeked Thrush	*Catharus minimus*	Upland Breeding Bird	L	N	Breeder	X			Undetermined			G5	Least Concern
American Pipit	*Anthus rubescens*	Upland Breeding Bird	L	Y	Breeder	X	X		Sensitive			G5	Least Concern
American Tree Sparrow	*Spizella arborea*	Upland Breeding Bird	L	Y	Breeder	X			Sensitive			G5	Least Concern
Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	L	Y	Breeder	X			Secure			G5	Least Concern
White-crowned Sparrow	*Zonotrichia leucophrys*	Upland Breeding Bird	L	Y	Breeder	X			Sensitive			G5	Least Concern
Harris's Sparrow	*Zonotrichia querula*	Upland Breeding Bird	L	N	Breeder	X			Sensitive			G5	Least Concern
Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Smith's Longspur	*Calcarius pictus*	Upland Breeding Bird	L	N	Breeder	X			Secure			G5	Least Concern
Snow Bunting	*Plectrophenax nivalis*	Upland Breeding Bird	L	N	Breeder	X	X		Sensitive			G5	Least Concern
Common Redpoll	*Carduelis flammea*	Upland Breeding Bird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Hoary Redpoll	*Carduelis hornemanni*	Upland Breeding Bird	L	Y	Breeder/Seasonal Migrant	X	X		Sensitive			G5	Least Concern
Common Loon	*Gavia immer*	Waterbird	P	N	Breeder	X	X		Secure	NAR		G5	Least Concern
Horned Grebe	*Podiceps auritus*	Waterbird	P	N	Breeder	X			Undetermined	SC		G5	Least Concern
Brant	*Branta bernicla*	Waterbird	P	Y	Seasonal Migrant	X	X		Secure			G5	Least Concern
Snow Goose	*Chen caerulescens*	Waterbird	P	N	Seasonal Migrant	X	X		Secure			G5	Least Concern
Ross's Goose	*Chen rosii*	Waterbird	P	N	Seasonal Migrant	X			Secure			G4	Least Concern
Mallard	*Anas platyrhynchos*	Waterbird	P	N	Breeder	X			Undetermined			G5	Least Concern

Appendix 4-1. Potentially Occuring Wildlife Species in the the Back River Terrestrial and Marine Study Areas

Common Name	Scientific Name	Group	Likelihood of Occurrence	Detected During Baseline Studies	Presence Relative to Study Area	Presence in Ecozones Associated with the Proposed Project			Conservation Status				
						Southern Arctic	Northern Arctic	Arctic Ocean	Terr. Rank	COSEWIC	SARA	Global Rank	IUCN Red List
Birds *(cont.)*													
Gadwall	*Anas strepera*	Waterbird	P	Y	Breeder				Accidental			G5	Least Concern
Green-winged Teal	*Anas crecca*	Waterbird	P	Y	Breeder	X			Undetermined			G5	Least Concern
Blue-winged Teal	*Anas discors*	Waterbird	P	N	Breeder				Accidental			G5	Least Concern
Greater Scaup	*Aythya marila*	Waterbird	P	Y	Breeder	X			Secure			G5	Least Concern
Common Goldeneye	*Bucephala clangula*	Waterbird	P	N	Breeder				Undetermined			G5	Least Concern
Bald Eagle	*Haliaeetus leucocephalus*	Raptor	P	Y	Breeder	X			Undetermined	NAR		G5	Least Concern
Black-bellied Plover	*Pluvialis squatarola*	Shorebird	P	N	Seasonal Migrant	X	X		Sensitive			G5	Least Concern
Lesser Yellowlegs	*Tringa flavipes*	Shorebird	P	N	Breeder	X			Undetermined			G5	Least Concern
Whimbrel	*Numenius phaeopus*	Shorebird	P	N	Seasonal Migrant	X			Sensitive			G5	Least Concern
Hudsonian Godwit	*Limosa haemastica*	Shorebird	P	N	Seasonal Migrant	X			Undetermined			G4	Least Concern
Ruddy Turnstone	*Arenaria interpres*	Shorebird	P	N	Seasonal Migrant	X	X		Sensitive			G5	Least Concern
Red Knot	*Calidris canutus*	Shorebird	P	N	Seasonal Migrant	X	X		At Risk	EN/SC		G4	Least Concern
Sanderling	*Calidris alba*	Shorebird	P	N	Seasonal Migrant	X	X		Sensitive			G5	Least Concern
Dunlin	*Calidris alpina*	Shorebird	P	Y	Seasonal Migrant	X	X		Sensitive			G5	Least Concern
Stilt Sandpiper	*Calidris himantopus*	Shorebird	P	Y	Seasonal Migrant	X			Secure			G5	Least Concern
Buff-breasted Sandpiper	*Tryngites subruficollis*	Shorebird	P	N	Seasonal Migrant	X			Sensitive			G4	Near threatened
Long-billed Dowitcher	*Limnodromus scolopaceus*	Shorebird	P	N	Seasonal Migrant	X			not ranked			G5	Least Concern
Red Phalarope	*Phalaropus fulicaria*	Shorebird	P	N	Seasonal Migrant	X	X		Sensitive			G5	Least Concern
Pomarine Jaeger	*Stercorarius pomarinus*	Seabird	P	N	Seasonal Migrant	X	X		Secure			G5	Least Concern
Mew Gull	*Larus canus*	Waterbird	P	N	Breeder	X			Undetermined			G5	Least Concern
Thayer's gull	*Larus thayeri*	Waterbird	P	N	Breeder		X		Sensitive			G5	Least Concern
Sabine's Gull	*Xema sabini*	Waterbird	P	N	Breeder	X	X		Secure			G5	Least Concern
Thick-billed Murre	*Uria lomvia*	Seabird	P	N	Breeder	X	X		Secure			G5	Least Concern
American Robin	*Turdus migratorius*	Upland Breeding Bird	P	N	Breeder	X			Secure			G5	Least Concern
Cliff Swallow	*Petrochelidon phyrrhonota*	Upland Breeding Bird	P	N	Breeder	X			Undetermined			G5	Least Concern
Yellow Warbler	*Setophaga petechia*	Upland Breeding Bird	P	N	Breeder	X			Undetermined			G5	Least Concern
Lincoln's Sparrow	*Melospiza lincolnii*	Upland Breeding Bird	P	N	Breeder				Undetermined			G5	Least Concern
Red-necked Grebe	*Podiceps grisegena*	Waterbird	U	N	Breeder	X			Accidental	NAR		G5	Least Concern
Northern Fulmar	*Fulmarus glacialis*	Seabird	U	N	Seasonal Migrant		X		Sensitive			G5	Least Concern
American Wigeon	*Anas americana*	Waterbird	U	N	Breeder				Undetermined			G5	Least Concern
Lesser Scaup	*Aythya affinis*	Waterbird	U	N	Breeder				Undetermined			G5	Least Concern
Bufflehead	*Bucephala albeola*	Waterbird	U	N	Breeder				Undetermined			G5	Least Concern
Eskimo Curlew	*Numenius borealis*	Shorebird	U	N	Seasonal Migrant	X			At Risk	EN	1	GH	Critically endangered
Purple Sandpiper	*Calidris maritima*	Shorebird	U	N	Seasonal Migrant		X		Secure			G5	Least Concern
Ross's Gull	*Rhodostethia rosea*	Waterbird	U	N	Breeder	X	X		At Risk	TH	1	G3G4	Least Concern
Iceland Gull	*Larus glaucoides*	Waterbird	U	N	Seasonal Migrant		X		Secure			G5	Least Concern
Ivory Gull	*Pagophila eburnea*	Waterbird	U	N	Seasonal Migrant		X		At Risk	EN	1	G5	Near threatened
Black-legged Kittiwake	*Rissa tridactyla*	Waterbird	U	N	Breeder		X		Secure			G5	Least Concern
Dovekie	*Alle alle*	Seabird	U	N	Breeder	X	X		Sensitive			G5	Least Concern
Black Guillemot	*Cepphus grylle*	Seabird	U	N	Breeder	X	X		Secure			G5	Least Concern
Great Horned Owl	*Bubo virginianus*	Raptor	U	N	Resident	X			Undetermined			G5	Least Concern
Northern Hawk Owl	*Surnia ulula*	Raptor	U	N	Resident	X			Undetermined	NAR		G5	Least Concern
Northern Shrike	*Lanius excubitor*	Upland Breeding Bird	U	N	Breeder	X			Undetermined			G5	Least Concern
Bohemian Waxwing	*Bombycilla garrulus*	Upland Breeding Bird	U	N	Breeder	X			Accidental			G5	Least Concern
Northern Wheatear	*Oenanthe oenanthe*	Upland Breeding Bird	U	N	Seasonal Migrant		X		Sensitive			G5	Least Concern
European Starling	*Sturnus vulgaris*	Upland Breeding Bird	U	N	Breeder	X			Exotic			G5	Least Concern
Orange-crowned Warbler	*Oreothlypis celata*	Upland Breeding Bird	U	N	Breeder				Accidental			G5	Least Concern
Blackpoll Warbler	*Setophaga striata*	Upland Breeding Bird	U	N	Breeder	X			Undetermined			G5	Least Concern
Wilson's Warbler	*Cardellina pusilla*	Upland Breeding Bird	U	N	Vagrant	X			Undetermined			G5	Least Concern
Rusty Blackbird	*Euphagus carolinus*	Upland Breeding Bird	U	N	Breeder	X			Undetermined	SC	1	G4	Least Concern
Mammals													
Grey Wolf	*Canis lupus*	Carnivore	L	Y	Resident	X	X		Secure	NAR		G4	Least Concern
Wolverine	*Gulo gulo*	Carnivore	L	N	Resident	X	X		Secure	SC		G4	Vulnerable
Grizzly Bear	*Ursus arctos*	Carnivore	L	Y	Resident	X	X		Sensitive	SC		G4	Least Concern
Arctic Fox	*Vulpes lagopus*	Carnivore	L	Y	Resident	X	X		Secure			G5	Least Concern
Red Fox	*Vulpes vulpes*	Carnivore	L	N	Resident	X	X		Secure			G5	Least Concern
Ermine	*Mustela erminea*	Furbearer	L	N	Resident	X	X		Secure			G5	Least Concern

Appendix 4-1. Potentially Occuring Wildlife Species in the the Back River Terrestrial and Marine Study Areas

Common Name	Scientific Name	Group	Likelihood of Occurrence	Detected During Baseline Studies	Presence Relative to Study Area	Presence in Ecozones Associated with the Proposed Project			Conservation Status				
						Southern Arctic	Northern Arctic	Arctic Ocean	Terr. Rank	COSEWIC	SARA	Global Rank	IUCN Red List
Mammals *(cont.)*													
Nearctic Collared Lemming	*Dicrostonyx groenlandicus (Dicrostonyx kilangmiutak)*	Small mammal	L	N	Resident	X	X		Secure			G5	Least Concern
Nearctic Brown Lemming	*Lemmus trimucronatus*	Small mammal	L	N	Resident	X	X		Secure			G5	Least Concern
Arctic Hare	*Lepus arcticus*	Small mammal	L	Y	Resident	X	X		Secure			G5	Least Concern
Root Vole (Tundra Vole)	*Microtus oeconomus*	Small mammal	L	N	Resident	X			Undetermined			G5	Least Concern
Meadow Vole	*Microtus pennsylvanicus*	Small mammal	L	N	Resident	X			Secure			G5	Least Concern
Taiga Vole (Chestnut-cheeked vole)	*Microtus xanthognathus*	Small mammal	L	N	Resident	X			not ranked			G5	Least Concern
Northern Red-backed Vole	*Myodes rutilus*	Small mammal	L	N	Resident	X	X		Secure			G5	Least Concern
Barren Ground Shrew	*Sorex ugyunak*	Small mammal	L	N	Resident	X			Undetermined			G5	Least Concern
Arctic Ground Squirrel	*Spermophilus parryii*	Small mammal	L	Y	Resident	X	X		Secure			G5	Least Concern
Muskox	*Ovibos moschatus*	Ungulate	L	Y	Resident	X	X		Secure			G4	Least Concern
Barrenground Caribou (except Dolphin-Union)	*Rangifer tarandus groenlandicus*	Ungulate	L	Y	Resident/Seasonal Migrant	X			Secure			G5TNR	Least Concern
Bearded Seal	*Erignathus barbatus*	Marine Mammal	L	Y	Resident			X	Undetermined	NAR		G4G5	Least Concern
Ringed Seal	*Pusa hispida*	Marine Mammal	L	Y	Resident			X	Secure	NAR		G5	Least Concern
Least Weasel	*Mustela nivalis*	Furbearer	P	N	Resident	X			Secure			G5	Least Concern
American Mink	*Neovison vison*	Furbearer	P	N	Resident	X			Undetermined			G5	Least Concern
Richardson's Collared Lemming	*Dicrostonyx richardsoni*	Small mammal	P	N	Resident	X	X		Secure			G4?	Least Concern
Arctic Shrew	*Sorex arcticus*	Small mammal	P	N	Resident	X			not ranked			G5	Least Concern
Moose	*Alces americanus*	Ungulate	P	N	Resident	X			Secure			G5	Least Concern
Barrenground Caribou (Dolphin Union population)	*Rangifer tarandus groenlandicus x pearyi (R. t. pearyi x groenlandicus)*	Ungulate	P	N	Seasonal Migrant	X	X		not ranked	SC		G5TNR	not ranked
Beluga	*Delphinapterus leucas*	Marine Mammal	P	N	Seasonal Migrant			X	Sensitive/Secure			G4	Vulnerable
Narwhal	*Monodon monoceros*	Marine Mammal	P	N	Seasonal Migrant				Sensitive	SC		G4	Data Deficient
Polar Bear	*Ursus maritimus*	Carnivore	U	N	Resident	X	X		Sensitive	SC	1	G3	Vulnerable
Beaver	*Castor canadensis*	Furbearer	U	N	Resident	X			Undetermined			G5	Least Concern
North American River Otter	*Lontra canadensis*	Furbearer	U	N	Resident	X			Sensitive			G5	Least Concern
Canadian Lynx	*Lynx canadensis*	Furbearer	U	N	Resident	X			Undetermined	NAR		G5	Least Concern
American Marten	*Martes americana*	Furbearer	U	N	Resident	X			Secure			G5	Least Concern
Snowshoe Hare	*Lepus americanus*	Small mammal	U	N	Resident	X			Sensitive			G5	Least Concern
Tundra Shrew	*Sorex tundrensis*	Small mammal	U	N	Resident	X			not ranked			G5	Least Concern
Peary Caribou	*Rangifer tarandus pearyi*	Ungulate	U	N	Seasonal Migrant		X		not ranked	EN	1	G5TNR	Endangered
Bowhead Whale	*Balaena mysticetus*	Marine Mammal	U	N	Seasonal Migrant			X	Sensitive	SC	1/2	G3TNR	Least Concern
Walrus	*Odobenus rosmarus*	Marine Mammal	U	N	Seasonal Migrant			X	Sensitive	SC		G4TNR	Least Concern
Harp Seal	*Phoca groenlandica*	Marine Mammal	U	N	Seasonal Migrant			X	Secure			G5	Least Concern
Little Brown Myotis	*Myotis lucifugus*	Bat	U	N	Breeder				Sensitive			G5	Least Concern
Long-legged Myotis	*Myotis volans*	Bat	U	N	Breeder				not ranked			G5	Least Concern
Western Long-eared Myotis	*Myotis evotis*	Bat	U	N	Breeder				not ranked			G5	Least Concern
Eastern Red Bat	*Lasiurus borealis*	Bat	U	N	Seasonal Migrant				Undetermined			G5	Least Concern
Hoary Bat	*Lasiurus cinereus*	Bat	U	N	Breeder				Undetermined			G5	Least Concern
Northern myotis	*Myotis septentrionalis*	Bat	U	N	Breeder				not ranked			G4	Least Concern

Appendix 5-1

Raptor Occupancy, Productivity, and Habitat Data, 2012

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Appendix 5-1. Raptor Occupancy, Productivity, and Habitat Data, 2012

Table 5-1a. Raptor Occupancy and Productivity Data, 2012 (See Table 5-1 b and c for status codes)

Nest Site	LAT_N83	LONG_N83	Date	Species	Status	Adults	Eggs	Young	Date	Species	Status	Adults	Dead Eggs	Dead Young	Live Young
67	65.9333279	-107.3750953	27-May	CORA	OB	2	YES		7/27/2012	CORA	EAF				
45	65.8337545	-106.4830412	26-May	CORA	OB	1	YES		7/28/2012	CORA	EAP				
39	65.8015268	-107.0028292	27-May	CORA	OB	1	YES		7/27/2012	CORA	F			1	
29	65.7607812	-106.0000052	26-May	CORA	OB	0	3	1	7/28/2012	CORA	EAP				
168	65.8495200	106.5412100	26-May	GOEA	OB	2	YES		7/28/2012	GOEA	B				2
30	65.7629887	-106.394374	26-May	GOEA	OB	1	2		7/28/2012	GOEA	F			1	
115	66.1655512	-107.3445206	26-May	GOEA	OB	2	YES		7/27/2012	GOEA	F				
35	65.7931026	-106.4709965	26-May	GOEA	OB	1	YES		7/28/2012	GOEA	F			1	
27	65.7598557	-106.5294042	26-May	GYRF	O1	1			7/28/2012	GYRF	F		4		
24	65.7304236	-106.9839473	27-May	GYRF	OB	2	3		7/27/2012	GYRF	EAF				
33	65.7743165	-106.0515317	26-May	GYRF	OB	1	3		7/28/2012	GYRF	F			2	
40	65.801619	-106.9448266	27-May	GYRF	OB	1	3		7/27/2012	GYRF	EAF				
107	66.1131583	-106.8715815	27-May	GYRF	OB	1		2	7/27/2012	GYRF	F			1	
25	65.7348869	-105.9970843	26-May	GYRF	OB	2	1		7/28/2012	GYRF	EAP	1			
43	65.8243666	-106.4720163	26-May	GYRF	OB	2	3		7/28/2012	GYRF	EAP				
89	66.0440622	-107.8548238	27-May	GYRF	OB	2	YES		7/27/2012	GYRF	P	2			3
90	66.0592567	-107.1746947	27-May	GYRF	O2	2			7/28/2012	GYRF	AF				
44	65.8293027	-107.1434007	27-May	PEFA	O1	1			7/27/2012	PEFA	B	1			3
12	65.6738605	-106.2814147	26-May	PEFA	O2	2			7/28/2012	PEFA	B	1			3
83	66.0211697	-107.7035009	27-May	PEFA	OB	2	YES		7/27/2012	PEFA	B	2			2
113	66.1568627	-107.4519945	26-May	PEFA	OB	1			7/27/2012	PEFA	B	1			3
127	66.2028942	-107.4949778	26-May		UIA				7/27/2012	PEFA	B	1			4
37	65.7968798	-107.1231274	27-May	PEFA	OB	2	2		7/27/2012	PEFA	AF				
166	65.7158500	106.9835400	26-May	PEFA	O1	1			7/27/2012	PEFA	AF				
6	65.5701596	-106.1463897	26-May	PEFA	O2	2			7/28/2012	PEFA	AF				
10	65.6182362	-106.2046865	26-May	PEFA	O2	2			7/28/2012	PEFA	AF				
17	65.6915600	-106.3171800	26-May	PEFA	O2	2			7/28/2012	PEFA	AF				
61	65.9117376	-108.0664786	27-May	PEFA	O2	2			7/27/2012	PEFA	AF				
70	65.9333601	-108.1992476	27-May	PEFA	O2	2			7/27/2012	PEFA	AF				
124	66.1873639	-107.4553968	26-May	PEFA	O2	2			7/27/2012	PEFA	AF				
7	65.5804107	-106.1647354	26-May	RLHA	OB	1	Y		7/28/2012	RLHA	AF				
18	65.7011503	-107.0144062	27-May	RLHA	OB	2	4		7/27/2012	RLHA	AF				
93	66.0597588	-107.1756082	26-May	RLHA	OB	1	3		7/27/2012	RLHA	AF				
105	66.1072631	-107.2485813	26-May	RLHA	OB	1	2		7/27/2012	RLHA	AF				
116	66.171748	-107.1171771	26-May	RLHA	OB	1	YES		7/27/2012	RLHA	F		1		
118	66.1781849	-107.4307505	26-May	RLHA	OB	2	YES		7/27/2012	RLHA	AF	1			
122	66.1833596	-107.4443982	26-May	RLHA	OB	1	YES		7/27/2012	RLHA	AF				
123	66.187056	-107.4545217	26-May	RLHA	OB	2	3		7/27/2012	RLHA	AF				
36	65.7955553	-106.9434408	27-May	RLHA	OB	1	3		7/27/2012	RLHA	P	1			1
100	66.0892208	-107.0040354	27-May	RLHA	OB	2	3		7/27/2012	RLHA	P	1			2
15	65.6896134	-106.3140351	26-May		UIA				7/28/2012		UIA				
27	65.7703013	-106.5168089	26-May		UIA				7/28/2012		UIA				
34	65.7760867	-106.409228	26-May		UIA				7/28/2012		UIA				
49	65.8511599	-107.172979	26-May		UIA				7/28/2012		UIA				

Appendix 5-1. Raptor Occupancy, Productivity, and Habitat Data, 2012

Table 5-1a. Raptor Occupancy and Productivity Data, 2012 (See Table 5-1 b and c for status codes)

Nest Site	LAT_N83	LONG_N83	Date	Species	Status	Adults	Eggs	Young	Date	Species	Status	Adults	Dead Eggs	Dead Young	Live Young
102	66.097849	-107.2142614	26-May		UIA				7/28/2012		UIA				
117	66.1720877	-107.1178603	26-May		UIA				7/27/2012		UIA				
126	66.1982473	-107.4790673	26-May		UIA				7/27/2012		UIA				
13	65.6754079	-106.2842508	26-May		UIA										
14	65.6847719	-106.306294	26-May		UIA										
53	65.8860916	-107.9874672	27-May		UIA										
72	65.940439	-106.7154468	27-May		UIA										
75	65.9513035	-108.0624611	27-May		UIA										
81	66.0130179	-107.7703986	26-May		UIA										
84	66.0269674	-107.1695459	26-May		UIA										
85	66.0300155	-107.7591454	26-May		UIA										
91	66.0593777	-106.8087298	27-May		UIA										
96	66.0763753	-107.2030706	26-May		UIA										
97	66.0827676	-107.2212043	26-May		UIA										
110	66.121128	-107.2673633	26-May		UIA										
112	66.1386683	-107.3152479	26-May		UIA										
114	66.1598639	-107.3316866	26-May		UIA										
121	66.1814201	-107.4309186	26-May		UIA										
125	66.1944131	-107.4745171	26-May		UIA										
128	66.2036086	-107.4959927	26-May		UIA										

Appendix 5-1. Raptor Occupancy, Productivity, and Habitat Data, 2012

Table 5-1b. Codes for Breeding Status during Occupancy Survey

Evidence of Breeding	Occupancy	Code	Definition	Required Observations
Increased Evidence of Breeding	Occupied Breeding	OB	A raptor nest at which a breeding pair is laying or incubating eggs, or, attending young.	1) an adult in incubation posture on a nest, OR, 2) egg(s) or live chick(s) in the nest and at least one attending adult.
	Occupied Pair	O2	A raptor nest site at which a raptor pair was observed, but no nest with eggs or young was observed. Either nest was not detected, or, female had not yet begun egg-laying. Important to check for recent nest construction for stick nesters as a recently-constructed but empty nest indicates egg-laying has not begun yet. The latter is more likely for peregrine falcons. Observations of young (and their age) during the productivity survey will determine whether the nest was not detected, or whether egg-laying had not yet begun.	1) Two raptors of the same species observed in relatively close proximity at or near a nest site, AND, 2) Nest with eggs or young was not observed, AND OPTIONALLY: 3) A newly-constructed nest or newly-refurbished nest.
	Occupied One Adult	O1	A raptor nest site at which only one adult was observed, no nest with eggs or young was observed, but other evidence of breeding was observed. Other evidence of breeding supports that the site is occupied by a pair, but that the other pair member was likely hunting (or was present but not detected).	1) One raptor adult, AND, 2) Nest with eggs or young was not observed, AND, 3) Fresh (reddish bits) prey remains (indicates courtship feeding), and for stick nesters, a recently-constructed stick nest (has green vegetation).
	Possible Attempt	PA	A raptor nest site at which no adults but recent signs of raptors attempting to breed were observed. Raptors do not initiate incubation until the penultimate eggs is laid. Therefore, observations of an egg without attending adults may mean the female is in the process of egg-laying. One or both adults may have been present, but were not detected, or both may have been absent from the site. Alternatively, these observations may represent a failed breeding attempt. There is no way to know without re-visiting the nest.	1) No adults, AND, and at least one of: 2) Egg(s) in nest, 3) Recently-constructed or recently-refurbished nest.
No Evidence of Breeding	Unoccupied One Adult	U1	A raptor nest site at which only one adult was observed, and no other evidence of breeding was observed. No other evidence of breeding suggests that the lone adult is a non-breeding 'floater', and thus this nest site should not be classified as 'occupied' (unless proven otherwise during productivity survey).	1) One raptor adult, AND, 2) Nest with eggs or young was not observed, AND, 3) No fresh (reddish bits) prey remains (indicates courtship feeding), or for stick nesters, no recently-constructed stick nests (no green vegetation).
	Unoccupied Inactive	UIA	A raptor nest site at which no adults and no recent evidence of breeding were observed.	1) No adults, AND, 2) No fresh signs (reddish prey remains, no green vegetation on nests). Additional observations: 3) Old nests – flat, sticks loose, brown vegetation Fallen down nests Snow covering the nest site

Appendix 5-1. Raptor Occupancy, Productivity, and Habitat Data, 2012

Table 5-1c. Codes for Breeding Status during Productivity Survey

Relative Certainty of Breeding Productivity	Productivity Status	Code	Definition	Required Observations
Confirmed	Breeding	B	The nest of a breeding pair of raptors that has produced at least one live chick of any age	
	Productive	P	The nest of a breeding pair of raptors that has produced at least one live chick (80% fledging age).	At least one live chick in nest, or at least one fledgling near nest.
	Failed	F	The nest of a breeding pair of raptors that failed to produce live chicks.	1) No attending adults, AND one of: 2) Egg(s) and/or dead chick(s) in nest that was productive during occupancy survey, OR, 3) Empty nest of any species except gyrfalcons and common ravens that was productive during the occupancy survey.
Assumed	Empty, Assumed Fledged	EAP	A empty gyrfalcon or common raven nest that was productive during the occupancy survey at which signs of fledging were observed during the productivity survey. Fledging must be possible based on time since observations made during the occupancy survey.	1) An empty nest that contained live eggs or chicks during the occupancy survey, AND: 2) Fledging is possible based on timing, AND, 3) Abundant accumulation of poop and prey remains around and in nest. For gyrfalcon and common raven only.
	Empty, Assumed Failed	EAF	A empty gyrfalcon or common raven nest that was productive during the occupancy survey at which fledging was not possible, or at which it was but there were no signs of fledging.	1) An empty nest that contained live eggs or chicks during the occupancy survey, AND, 2) Fledging is not possible based on timing, OR, 3) Fledging is possible based on timing, but low accumulation of poop and prey remains around and in nest. For gyrfalcon and common raven only.
	Assumed Failed	AF	A raptor nest site at which adult raptors and signs of breeding were observed during the occupancy survey but nests were not found ('occupied pair', 'occupied one adult'), at which no signs of successful breeding were observed during the productivity survey.	1) No attending adults, AND, 2) No live or dead eggs or chicks observed (any newly-constructed nests checked and found empty). For 'occupied pair', and 'occupied one adult' nest sites only.
	Possible Attempt, Assumed Failed	PAF	A raptor nest site at which no adults but signs of attempted breeding were observed during the occupancy survey ('possible attempt') for which no signs of successful breeding were observed during the productivity survey.	1) No attending adults, AND, 2) No live or dead eggs or chicks observed (any newly-constructed nests checked and found empty).
Confirmed Non-Breeding	Unoccupied, Non-Breeder	UNB	A raptor nest site at which one adult raptor was observed during the occupancy survey but no other signs of breeding ('unoccupied adult') at which no signs of breeding were observed during the productivity survey.	Confirmation of no signs of breeding.

Appendix 5-2

Incidental Observations of Wildlife, 2012

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Appendix 5-2. Incidental Observations of Wildlife, 2012

Survey/Source	Date	Easting	Northing	Common Name	Scientific Name	Species Code	No. Observed					Sign Only ?
							Male	Female	Young	Unknown	Total	
Carnivores												
Grizzly Bear DNA Survey	11-Jun-12	372439	7278713	Grizzly Bear	*Ursus arctos*	URAR		1	1		2	
Grizzly Bear DNA Survey	28-May-12	372632	7326110	Grizzly Bear	*Ursus arctos*	URAR		1	1		2	
Marine Mammal Survey	16-Jun-12	371931	7411192	Grizzly Bear	*Ursus arctos*	URAR		1	3		4	
Remote Camera Surveys	26-Aug-12	429200	7307924	Grizzly Bear	*Ursus arctos*	URAR		1	3		4	
Grizzly Bear DNA Survey	3-Aug-12	429576	7326796	Grizzly Bear	*Ursus arctos*	URAR		1	3		4	
		397558	7365662	Grizzly Bear	*Ursus arctos*	URAR			2		2	
		408753	7349518	Grizzly Bear	*Ursus arctos*	URAR		1	3		4	
Remote Camera Surveys	24-Aug-12	403889	7265903	Grizzly Bear	*Ursus arctos*	URAR				1	1	
Remote Camera Surveys	26-Aug-12	432924	7279556	Grey wolf	*Canis lupus*	CALU				1	1	
Remote Camera Surveys	26-Aug-12	423770	7317285	Grey wolf	*Canis lupus*	CALU				1	1	
Marine Bird Fall Survey	27-Aug-12	415387	7332851	Grizzly Bear	*Ursus arctos*	URAR				1	1	
Marine Bird Fall Survey	27-Aug-12	387737	7381839	Grey wolf	*Canis lupus*	CALU				1	1	
Marine Bird Fall Survey	27-Aug-12	380120	7393657	Grizzly Bear	*Ursus arctos*	URAR				1	1	
Marine Bird Fall Survey	27-Aug-12	381537	7388391	Grey wolf	*Canis lupus*	CALU				1	1	
Marine Bird Fall Survey	27-Aug-12	409576	7349419	Grey wolf	*Canis lupus*	CALU				1	1	
Grizzly Bear DNA Survey	9-Jun-12	396201	7334952	Grizzly Bear	*Ursus arctos*	URAR				1	1	
Breeding Bird Surveys	11-Jun-12	447227	7253057	Grey wolf	*Canis lupus*	CALU				1	1	
Breeding Bird Surveys	15-Jun-12	387487	7319401	Red Fox	*Vulpes vulpes*	VUVU				1	1	
Breeding Bird Surveys	16-Jun-12	387996	7313460	Red Fox	*Vulpes vulpes*	VUVU				1	1	
Marine Mammal Survey	13-Jun-12	383800	7385200	Wolverine	*Gulo gulo*	GUGU				1	1	
Raptor and Carnivore Den Survey	26-May-12	432904	7269554	Wolverine	*Gulo gulo*	GUGU				1	1	
Grizzly Bear DNA Survey	22-Jun-12	435337	7270005	Arctic Fox	*Vulpes lagopus*	VULA				1	1	
Grizzly Bear DNA Survey	22-Jun-12	435247	7268743	Grey wolf	*Canis lupus*	CALU				2	2	
Terrestrial Ecosystem Mapping Surveys	4-Aug-12	421968	7283299	Grey wolf	*Canis lupus*	CALU				1	1	
Terrestrial Ecosystem Mapping Surveys	7-Aug-12	417102	7270827	Grey wolf	*Canis lupus*	CALU				1	1	
Terrestrial Ecosystem Mapping Surveys	5-Aug-12	426413	7262712	Arctic Fox	*Vulpes lagopus*	VULA				1	1	
Terrestrial Ecosystem Mapping Surveys	5-Aug-12	428436	7258500	Grizzly bear	*Ursus arctos*	URAR				1	1	
Vegetation Surveys	17-Jul-12	431812	7269358	Arctic Fox	*Vulpes lagopus*	VULA				1	1	
Grizzly Bear DNA Survey	14-Aug-12	429653	7326734	Grey wolf	*Canis lupus*	CALU				1	1	
Grizzly Bear DNA Survey	16-Aug-12	397170	7290100	Grizzly Bear	*Ursus arctos*	URAR				1	1	
Grizzly Bear DNA Survey	27-Jul-12	392743	7310049	Grizzly Bear	*Ursus arctos*	URAR				1	1	
Grizzly Bear DNA Survey	28-Jul-12	432355	7300308	Grizzly Bear	*Ursus arctos*	URAR				1	1	
Grizzly Bear DNA Survey	28-May-12	418000	7324000	Wolverine	*Gulo gulo*	GUGU				1	1	
Grizzly Bear DNA Survey	26-May-12	464913	7267864	Wolverine	*Gulo gulo*	GUGU				1	1	
Grizzly Bear DNA Survey	29-May-12	403964	7298557	Grey wolf	*Canis lupus*	CALU				1	1	
Grizzly Bear DNA Survey	26-May-12	391564	7341032	Red fox	*Vulpes vulpes*	VUVU				1	1	
Grizzly Bear DNA Survey	26-May-12	453214	7290019	Grizzly Bear	*Ursus arctos*	URAR				1	1	
Marine Mammal Survey	13-Jun-12	399234	7363196	Grey wolf	*Canis lupus*	CALU				1	1	
Marine Mammal Survey	13-Jun-12	390786	7376192	Grizzly Bear	*Ursus arctos*	URAR				1	1	
Marine Mammal Survey	13-Jun-12	383886	7297083	Grey wolf	*Canis lupus*	CALU				1	1	
Marine Mammal Survey	13-Jun-12	401568	7360602	Grizzly Bear	*Ursus arctos*	URAR				1	1	
Marine Mammal Survey	13-Jun-12	398722	7363410	Grizzly Bear	*Ursus arctos*	URAR				1	1	

Appendix 5-2. Incidental Observations of Wildlife, 2012

Survey/Source	Date	Easting	Northing	Common Name	Scientific Name	Species Code	No. Observed					Sign Only ?
							Male	Female	Young	Unknown	Total	
Marine Mammal Survey	13-Jun-12	401378	7346781	Grizzly Bear	*Ursus arctos*	URAR				1	1	
Wolverine DNA Survey	1-Mar-12	431012	7269955	Wolverine	*Gulo gulo*	GUGU				1	1	Den
Breeding Bird Surveys	1-Jun-12	431145	7263746	Wolverine	*Gulo gulo*	GUGU					0	Den
Raptors												
Grizzly Bear DNA Survey	3-Aug-12	374067	7302443	Bald Eagle	*Haliaeetus leucocephalus*	BAEA				1	1	
Grizzly Bear DNA Survey	3-Aug-12	407070	7351733	Gyrfalcon	*Falco rusticolus*	GYRF				1	1	
Grizzly Bear DNA Survey	3-Aug-12	408332	7337816	Golden Eagle	*Aquila chrysaetos*	GOEA				1	1	
Grizzly Bear DNA Survey	4-Aug-12	454629	7277847	Golden Eagle	*Aquila chrysaetos*	GOEA				1	1	
Grizzly Bear DNA Survey	5-Aug-12	432547	7249457	Northern Harrier	*Circus cyaneus*	NOHA				1	1	
Grizzly Bear DNA Survey	5-Aug-12	432233	7300141	Gyrfalcon	*Falco rusticolus*	GYRF				1	1	Nest
Grizzly Bear DNA Survey	8-Jun-12	410293	7351302	Golden Eagle	*Aquila chrysaetos*	GOEA				1	1	
Breeding Bird Surveys	21-Jun-12	435337	7270005	Peregrine Falcon	*Falco peregrinus anatum*	PEFA				1	1	Nest
Breeding Bird Surveys	17-Jun-12	388950	7378082	Golden Eagle	*Aquila chrysaetos*	GOEA				1	1	
Breeding Bird Surveys	22-Jun-12	443677	7253810	Bald Eagle	*Haliaeetus leucocephalus*	BAEA				1	1	
Grizzly Bear DNA Survey	26-Jun-12	428329	7269129	Northern Harrier	*Circus cyaneus*	NOHA				1	1	
Waterbird Spring Staging Survey	29-May-12	391628	7314881	Peregrine Falcon	*Falco peregrinus anatum*	PEFA				1	1	
Waterbird Spring Staging Survey	29-May-12	437858	7250363	Rough-legged Hawk	*Buteo lagopus*	RLHA				1	1	
Waterbird Spring Staging Survey	29-May-12	422087	7264793	Short-eared Owl	*Asio flammeus*	SEOW				1	1	
Waterbird Spring Staging Survey	29-May-12	434200	7262770	Short-eared Owl	*Asio flammeus*	SEOW				1	1	
Grizzly Bear DNA Survey	1-Jul-12	384596	7335369	Bald Eagle	*Haliaeetus leucocephalus*	BAEA				1	1	
Remote Camera Surveys	24-Aug-12	400067	7264919	Bald Eagle	*Haliaeetus leucocephalus*	BAEA				1	1	
Remote Camera Surveys	26-Aug-12	384567	7319086	Bald Eagle	*Haliaeetus leucocephalus*	BAEA				1	1	
Remote Camera Surveys	25-Aug-12	394347	7314846	Golden Eagle	*Aquila chrysaetos*	GOEA				1	1	
Remote Camera Surveys	25-Aug-12	428962	7274810	Rough-legged Hawk	*Buteo lagopus*	RLHA				2	2	
Remote Camera Surveys	25-Aug-12	430659	7268590	Common Raven	*Corvus corax*	CORA				1	1	
Remote Camera Surveys	25-Aug-12	429380	7262863	Northern Harrier	*Circus cyaneus*	NOHA				2	2	
Remote Camera Surveys	27-Aug-12	419797	7305688	Gyrfalcon	*Falco rusticolus*	GYRF				1	1	
Remote Camera Surveys	27-Aug-12	415821	7334174	Bald Eagle	*Haliaeetus leucocephalus*	BAEA				1	1	
Remote Camera Surveys	27-Aug-12	404203	7359336	Golden Eagle	*Aquila chrysaetos*	GOEA		1			1	
Remote Camera Surveys	27-Aug-12	374766	7406912	Peregrine Falcon	*Falco peregrinus anatum*	PEFA					0	2 Nests
Breeding Bird Surveys	1-Jun-12	384087	7331801	Common Raven	*Corvus corax*	CORA				1	1	
Breeding Bird Surveys	2-Jun-12	384087	7331801	Golden Eagle	*Aquila chrysaetos*	GOEA				1	1	
Breeding Bird Surveys	3-Jun-12	386487	7329101	Rough-legged Hawk	*Buteo lagopus*	RLHA				1	1	
Breeding Bird Surveys	4-Jun-12	381900	7304100	Common Raven	*Corvus corax*	CORA				3	3	
Breeding Bird Surveys	5-Jun-12	386900	7380600	Common Raven	*Corvus corax*	CORA				1	1	
Breeding Bird Surveys	6-Jun-12	388800	7327700	Common Raven	*Corvus corax*	CORA				1	1	
Breeding Bird Surveys	7-Jun-12	426300	7267200	Bald Eagle	*Haliaeetus leucocephalus*	BAEA				1	1	
Breeding Bird Surveys	8-Jun-12	432900	7271900	Gyrfalcon	*Falco rusticolus*	GYRF				1	1	
Breeding Bird Surveys	9-Jun-12	427000	7256700	Peregrine Falcon	*Falco peregrinus anatum*	PEFA				1	1	
Breeding Bird Surveys	11-Jun-12	422200	7263800	Snowy Owl	*Nyctea scandiaca*	SNOW				1	1	
Breeding Bird Surveys	11-Jun-12	422200	7263800	Golden Eagle	*Aquila chrysaetos*	GOEA				1	1	
Breeding Bird Surveys	12-Jun-12	431100	7271400	Common Raven	*Corvus corax*	CORA				1	1	
Breeding Bird Surveys	13-Jun-12	429200	7249500	Common Raven	*Corvus corax*	CORA				1	1	

Appendix 5-2. Incidental Observations of Wildlife, 2012

Survey/Source	Date	Easting	Northing	Common Name	Scientific Name	Species Code	No. Observed					Sign Only ?
							Male	Female	Young	Unknown	Total	
Breeding Bird Surveys	14-Jun-12	427900	7247100	Rough-legged Hawk	*Buteo lagopus*	RLHA				1	1	
Breeding Bird Surveys	15-Jun-12	427900	7247100	Common Raven	*Corvus corax*	CORA				1	1	
Caribou												
Waterbird Fall Staging Sruvey	15-Aug-12	440556	7273318	Caribou	*Rangifer tarandis*	RATA				7	7	
Waterbird Fall Staging Sruvey	15-Aug-12	448343	7273684	Caribou	*Rangifer tarandis*	RATA				4	4	
Waterbird Fall Staging Sruvey	15-Aug-12	445221	7273051	Caribou	*Rangifer tarandis*	RATA				4	4	
Waterbird Fall Staging Sruvey	15-Aug-12	436527	7273671	Caribou	*Rangifer tarandis*	RATA				3	3	
Waterbird Fall Staging Sruvey	15-Aug-12	419199	7265661	Caribou	*Rangifer tarandis*	RATA				1	1	
Grizzly Bear DNA Survey	28-May-12	388500	731700	Caribou	*Rangifer tarandis*	RATA				2	2	
Grizzly Bear DNA Survey	20-Jul-12	430485	7269920	Caribou	*Rangifer tarandis*	RATA				1	1	
Raptor Productivity Survey	28-Jul-12	422401	7274860	Caribou	*Rangifer tarandis*	RATA				15	15	
Raptor Productivity Survey	29-Jul-12	414110	7281001	Caribou	*Rangifer tarandis*	RATA				30	30	
Raptor Productivity Survey	27-Jul-12	428969	7264358	Caribou	*Rangifer tarandis*	RATA				4	4	
Raptor Productivity Survey	27-Jul-12	428849	7264030	Caribou	*Rangifer tarandis*	RATA				6	6	
Raptor Productivity Survey	27-Jul-12	429898	4264175	Caribou	*Rangifer tarandis*	RATA				1	1	
Grizzly Bear DNA Survey	31-Jul-12	430896	7255183	Caribou	*Rangifer tarandis*	RATA				1	1	
Grizzly Bear DNA Survey	5-Aug-12	426413	7262712	Caribou	*Rangifer tarandis*	RATA				1	1	
Grizzly Bear DNA Survey	6-Aug-12	451184	7268669	Caribou	*Rangifer tarandis*	RATA				1	1	
Grizzly Bear DNA Survey	6-Aug-12	447949	7269504	Caribou	*Rangifer tarandis*	RATA				1	1	
Grizzly Bear DNA Survey	28-Jul-12	430786	7262826	Caribou	*Rangifer tarandis*	RATA				35	35	
Breeding Bird Surveys	9-Jun-12	396226	7360860	Caribou	*Rangifer tarandis*	RATA				1	1	
Breeding Bird Surveys	9-Jun-12	371525	7348742	Caribou	*Rangifer tarandis*	RATA				4	4	
Breeding Bird Surveys	13-Jun-12	387765	7327049	Caribou	*Rangifer tarandis*	RATA				1	1	
Breeding Bird Surveys	13-Jun-12	386130	7329788	Caribou	*Rangifer tarandis*	RATA			1	6	7	
Breeding Bird Surveys	10-Jun-12	422545	7316386	Caribou	*Rangifer tarandis*	RATA		1			1	
Breeding Bird Surveys	10-Jun-12	383177	7310619	Caribou	*Rangifer tarandis*	RATA				1	1	
Breeding Bird Surveys	15-Jun-12	387487	7319401	Caribou	*Rangifer tarandis*	RATA				1	1	
Breeding Bird Surveys	17-Jun-12	388192	7328998	Caribou	*Rangifer tarandis*	RATA				5	5	
Grizzly Bear DNA Survey	4-Aug-12	386006	7289385	Caribou	*Rangifer tarandis*	RATA				1	1	
Grizzly Bear DNA Survey	5-Aug-12	456269	7261432	Caribou	*Rangifer tarandis*	RATA				1	1	
Grizzly Bear DNA Survey	5-Aug-12	450526	7254487	Caribou	*Rangifer tarandis*	RATA				1	1	
Grizzly Bear DNA Survey	5-Aug-12	438271	7250725	Caribou	*Rangifer tarandis*	RATA				1	1	
Grizzly Bear DNA Survey	5-Aug-12	408355	7251883	Caribou	*Rangifer tarandis*	RATA				1	1	
Grizzly Bear DNA Survey	5-Aug-12	440273	7256689	Caribou	*Rangifer tarandis*	RATA				1	1	
Grizzly Bear DNA Survey	5-Aug-12	438790	7267438	Caribou	*Rangifer tarandis*	RATA				1	1	
Grizzly Bear DNA Survey	5-Aug-12	437664	7272927	Caribou	*Rangifer tarandis*	RATA				1	1	
Grizzly Bear DNA Survey	6-Aug-12	391697	7305740	Caribou	*Rangifer tarandis*	RATA				1	1	
Remote Camera Surveys	24-Aug-12	434271	7248023	Caribou	*Rangifer tarandis*	RATA				3	3	
Remote Camera Surveys	24-Aug-12	436838	7244098	Caribou	*Rangifer tarandis*	RATA				3	3	
Remote Camera Surveys	24-Aug-12	436558	7259618	Caribou	*Rangifer tarandis*	RATA				1	1	
Remote Camera Surveys	24-Aug-12	423729	7266514	Caribou	*Rangifer tarandis*	RATA		5	2		7	
Remote Camera Surveys	25-Aug-12	382514	7298226	Caribou	*Rangifer tarandis*	RATA				3	3	
Remote Camera Surveys	26-Aug-12	427115	7271892	Caribou	*Rangifer tarandis*	RATA	1				1	

Appendix 5-2. Incidental Observations of Wildlife, 2012

Survey/Source	Date	Easting	Northing	Common Name	Scientific Name	Species Code	No. Observed					Sign Only ?
							Male	Female	Young	Unknown	Total	
Remote Camera Surveys	26-Aug-12	430475	7279771	Caribou	*Rangifer tarandis*	RATA				1	1	
Remote Camera Surveys	26-Aug-12	426475	7278392	Caribou	*Rangifer tarandis*	RATA				1	1	
Remote Camera Surveys	25-Aug-12	382975	7329399	Caribou	*Rangifer tarandis*	RATA				1	1	
Remote Camera Surveys	25-Aug-12	419069	7269428	Caribou	*Rangifer tarandis*	RATA				3	3	
Remote Camera Surveys	25-Aug-12	428822	7260139	Caribou	*Rangifer tarandis*	RATA				1	1	
Remote Camera Surveys	25-Aug-12	431366	7260208	Caribou	*Rangifer tarandis*	RATA				1	1	
Remote Camera Surveys	25-Aug-12	435743	7258152	Caribou	*Rangifer tarandis*	RATA				1	1	
Remote Camera Surveys	25-Aug-12	432305	7250337	Caribou	*Rangifer tarandis*	RATA				2	2	
Remote Camera Surveys	25-Aug-12	428066	7250384	Caribou	*Rangifer tarandis*	RATA				2	2	
Remote Camera Surveys	25-Aug-12	432470	7246333	Caribou	*Rangifer tarandis*	RATA				1	1	
Remote Camera Surveys	25-Aug-12	432982	7270790	Caribou	*Rangifer tarandis*	RATA				3	3	
Breeding Bird Surveys	11-Jun-12	386487	7329101	Caribou	*Rangifer tarandis*	RATA		1	1	4	6	
Breeding Bird Surveys	13-Jun-12	388146	7377612	Caribou	*Rangifer tarandis*	RATA				1	1	
Breeding Bird Surveys	9-Jun-12	396122	7360451	Caribou	*Rangifer tarandis*	RATA				1	1	
Breeding Bird Surveys	9-Jun-12	371525	7348742	Caribou	*Rangifer tarandis*	RATA				4	4	
Breeding Bird Surveys	10-Jun-12	422545	7316385	Caribou	*Rangifer tarandis*	RATA				1	1	
Breeding Bird Surveys	10-Jun-12	383177	7310619	Caribou	*Rangifer tarandis*	RATA				1	1	
Waterbirds												
Marine Mammal Survey	13-Jun-12	626476	7422703	Unknown Loon	*Gavia spp.*	UNLO				2	2	
Marine Mammal Survey	13-Jun-12	382672	7387629	Canada Goose	*Branta canadensis*	CAGO				2	2	
Marine Mammal Survey	13-Jun-12	381707	7389708	Canada Goose	*Branta canadensis*	CAGO				8	8	
Marine Mammal Survey	13-Jun-12	377183	7399004	Pacific Loon	*Gavia pacifica*	PALO				5	5	
Marine Mammal Survey	13-Jun-12	374851	7403616	Canada Goose	*Branta canadensis*	CAGO				12	12	
Marine Mammal Survey	13-Jun-12	629584	7418954	Glaucous Gull	*Larus hyperboreus*	GLGU				55	55	
Marine Mammal Survey	13-Jun-12	630117	7418223	Glaucous Gull	*Larus hyperboreus*	GLGU				1	1	
Marine Mammal Survey	13-Jun-12	631197	7416770	Canada Goose	*Branta canadensis*	CAGO				1	1	
Marine Mammal Survey	13-Jun-12	631382	7416534	Red-breasted Merganser	*Mergus serrator*	RBME				1	1	
Marine Mammal Survey	13-Jun-12	377209	7399350	Tundra Swan	*Cygnus columbianus*	TUSW				2	2	
Marine Mammal Survey	13-Jun-12	384589	7385759	Red-breasted Merganser	*Mergus serrator*	RBME				6	6	
Marine Mammal Survey	13-Jun-12	387791	7382138	Unknown Jaeger	*Stercorarius spp.*	UNJA				2	2	
Marine Mammal Survey	13-Jun-12	630535	7421505	Glaucous Gull	*Larus hyperboreus*	GLGU				1	1	
Marine Mammal Survey	13-Jun-12	630708	7421302	Pacific Loon	*Gavia pacifica*	PALO				1	1	
Marine Mammal Survey	13-Jun-12	370533	7416453	Red-breasted Merganser	*Mergus serrator*	RBME				4	4	
Marine Mammal Survey	13-Jun-12	373081	7412210	Unknown Jaeger	*Stercorarius spp.*	UNJA				1	1	
Marine Mammal Survey	13-Jun-12	395593	7371162	Glaucous Gull	*Larus hyperboreus*	GLGU				6	6	
Marine Mammal Survey	13-Jun-12	402017	7359393	Canada Goose	*Branta canadensis*	CAGO				1	1	
Marine Mammal Survey	13-Jun-12	402247	7361987	Canada Goose	*Branta canadensis*	CAGO				17	17	
Marine Mammal Survey	13-Jun-12	401561	7363063	Unknown Scoter	*Melanitta spp.*	UNSC				1	1	
Marine Mammal Survey	13-Jun-12	400129	7365826	Unknown Scoter	*Melanitta spp.*	UNSC				1	1	
Marine Mammal Survey	13-Jun-12	394043	7376691	Snow Goose	*Chen caerulescens*	SNGO				2	2	
Marine Mammal Survey	13-Jun-12	393972	7376843	Unknown Scoter	*Melanitta spp.*	UNSC				1	1	
Marine Mammal Survey	13-Jun-12	378415	7405167	Unknown Eider	*Somateria spp.*	UNEI				1	1	
Marine Mammal Survey	13-Jun-12	371207	7418168	Common Eider	*Somateria mollissima*	COEI				2	2	

Appendix 5-2. Incidental Observations of Wildlife, 2012

Survey/Source	Date	Easting	Northing	Common Name	Scientific Name	Species Code	No. Observed					Sign Only ?
							Male	Female	Young	Unknown	Total	
Marine Mammal Survey	13-Jun-12	629582	7424950	Common Eider	*Somateria mollissima*	COEI				1	1	
Marine Mammal Survey	13-Jun-12	624015	7431137	Common Eider	*Somateria mollissima*	COEI				1	1	
Marine Mammal Survey	13-Jun-12	623955	7431179	Glaucous Gull	*Larus hyperboreus*	GLGU				1	1	
Marine Mammal Survey	13-Jun-12	615308	7437694	Canada Goose	*Branta canadensis*	CAGO				2	2	
Marine Mammal Survey	13-Jun-12	613666	7438690	Unknown Eider	*Somateria spp.*	UNEI				16	16	
Marine Mammal Survey	13-Jun-12	618427	7436720	Red-breasted Merganser	*Mergus serrator*	RBME				2	2	
Marine Mammal Survey	13-Jun-12	379040	7412883	Glaucous Gull	*Larus hyperboreus*	GLGU				1	1	
Marine Mammal Survey	13-Jun-12	630087	7432264	Glaucous Gull	*Larus hyperboreus*	GLGU				3	3	
Marine Mammal Survey	13-Jun-12	629621	7433353	Glaucous Gull	*Larus hyperboreus*	GLGU				4	4	
Marine Mammal Survey	13-Jun-12	626597	7436877	Glaucous Gull	*Larus hyperboreus*	GLGU				2	2	
Marine Mammal Survey	13-Jun-12	629693	7443176	Glaucous Gull	*Larus hyperboreus*	GLGU				3	3	
Marine Mammal Survey	13-Jun-12	375965	7435273	Unknown Eider	*Somateria spp.*	UNEI				4	4	
Marine Mammal Survey	13-Jun-12	376194	7434651	Unknown Eider	*Somateria spp.*	UNEI				2	2	
Marine Mammal Survey	13-Jun-12	377011	7441319	Pacific Loon	*Gavia pacifica*	PALO				1	1	
Marine Mammal Survey	13-Jun-12	374929	7444968	Glaucous Gull	*Larus hyperboreus*	GLGU				1	1	
Marine Mammal Survey	13-Jun-12	374728	7451722	Tundra Swan	*Cygnus columbianus*	TUSW				1	1	
Marine Mammal Survey	13-Jun-12	375309	7448069	Unknown Scoter	*Melanitta spp.*	UNSC				1	1	
Marine Mammal Survey	13-Jun-12	375541	7447453	Glaucous Gull	*Larus hyperboreus*	GLGU				2	2	
Marine Mammal Survey	13-Jun-12	376083	7446135	Glaucous Gull	*Larus hyperboreus*	GLGU				1	1	
Marine Mammal Survey	13-Jun-12	376286	7445811	Unknown Eider	*Somateria spp.*	UNEI				6	6	
Marine Mammal Survey	13-Jun-12	376387	7445661	Unknown Eider	*Somateria spp.*	UNEI				6	6	
Marine Mammal Survey	13-Jun-12	379054	7440560	Pacific Loon	*Gavia pacifica*	PALO				25	25	
Marine Mammal Survey	13-Jun-12	381208	7436832	Unknown Eider	*Somateria spp.*	UNEI				1	1	
Marine Mammal Survey	13-Jun-12	382788	7440972	Pacific Loon	*Gavia pacifica*	PALO				104	104	
Marine Mammal Survey	13-Jun-12	377738	7449293	Glaucous Gull	*Larus hyperboreus*	GLGU				2	2	
Marine Mammal Survey	13-Jun-12	376902	7451254	Unknown Eider	*Somateria spp.*	UNEI				45	45	
Marine Mammal Survey	13-Jun-12	376902	7451254	Glaucous Gull	*Larus hyperboreus*	GLGU				1	1	
Marine Mammal Survey	13-Jun-12	376782	7451548	Canada Goose	*Branta canadensis*	CAGO				3	3	
Marine Mammal Survey	13-Jun-12	626551	7468459	Glaucous Gull	*Larus hyperboreus*	GLGU				2	2	
Marine Mammal Survey	13-Jun-12	388487	7438364	Herring Gull	*Larus argentatus*	HEGU				5	5	
Marine Mammal Survey	16-Jun-12	401828	7361749	Tundra Swan	*Cygnus columbianus*	TUSW				1	1	
Marine Mammal Survey	16-Jun-12	401828	7361749	Herring Gull	*Larus argentatus*	HEGU				2	2	
Marine Mammal Survey	16-Jun-12	401599	7362166	Red-breasted Merganser	*Mergus serrator*	RBME				2	2	
Marine Mammal Survey	16-Jun-12	401059	7363384	Pacific Loon	*Gavia pacifica*	PALO				3	3	
Marine Mammal Survey	16-Jun-12	399857	7365934	Unknown Eider	*Somateria spp.*	UNEI				2	2	
Marine Mammal Survey	16-Jun-12	393541	7376970	Unknown Eider	*Somateria spp.*	UNEI				1	1	
Marine Mammal Survey	16-Jun-12	384107	7388644	Unknown Eider	*Somateria spp.*	UNEI				2	2	
Marine Mammal Survey	16-Jun-12	373108	7414790	Unknown Eider	*Somateria spp.*	UNEI				1	1	
Marine Mammal Survey	16-Jun-12	373108	7414790	Herring Gull	*Larus argentatus*	HEGU				1	1	
Marine Mammal Survey	16-Jun-12	372341	7416210	Unknown Eider	*Somateria spp.*	UNEI				1	1	
Marine Mammal Survey	16-Jun-12	371236	7418347	Red-breasted Merganser	*Mergus serrator*	RBME				1	1	
Marine Mammal Survey	16-Jun-12	370631	7419586	Red-breasted Merganser	*Mergus serrator*	RBME				7	7	
Marine Mammal Survey	16-Jun-12	394075	7432344	Unknown Eider	*Somateria spp.*	UNEI				44	44	

Appendix 5-2. Incidental Observations of Wildlife, 2012

Survey/Source	Date	Easting	Northing	Common Name	Scientific Name	Species Code	No. Observed					Sign Only ?
							Male	Female	Young	Unknown	Total	
Marine Mammal Survey	16-Jun-12	393780	7432856	Glaucous Gull	*Larus hyperboreus*	GLGU				45	45	
Marine Mammal Survey	16-Jun-12	372457	7475594	Glaucous Gull	*Larus hyperboreus*	GLGU				10	10	
Marine Mammal Survey	16-Jun-12	407070	7416310	Unknown Eider	*Somateria spp.*	UNEI				1	1	
Marine Mammal Survey	16-Jun-12	406938	7420227	Red-breasted Merganser	*Mergus serrator*	RBME				1	1	
Marine Mammal Survey	16-Jun-12	406470	7421436	Unknown Eider	*Somateria spp.*	UNEI				9	9	
Marine Mammal Survey	16-Jun-12	406137	7421867	Unknown Eider	*Somateria spp.*	UNEI				1	1	
Marine Mammal Survey	16-Jun-12	405512	7423022	Unknown Eider	*Somateria spp.*	UNEI				26	26	
Marine Mammal Survey	16-Jun-12	405337	7423339	Unknown Eider	*Somateria spp.*	UNEI				30	30	
Marine Mammal Survey	16-Jun-12	404550	7424784	Unknown Loon	*Gavia spp.*	UNLO				134	134	
Marine Mammal Survey	16-Jun-12	394995	7438940	Unknown Eider	*Somateria spp.*	UNEI				2	2	
Marine Mammal Survey	16-Jun-12	395202	7440720	Unknown Eider	*Somateria spp.*	UNEI				1	1	
Marine Mammal Survey	16-Jun-12	385478	7469435	Glaucous Gull	*Larus hyperboreus*	GLGU				43	43	
Marine Mammal Survey	16-Jun-12	386450	7466804	Unknown Eider	*Somateria spp.*	UNEI				1	1	
Marine Mammal Survey	16-Jun-12	386756	7465564	Glaucous Gull	*Larus hyperboreus*	GLGU				1	1	
Marine Mammal Survey	16-Jun-12	396078	7449607	Glaucous Gull	*Larus hyperboreus*	GLGU				10	10	
Marine Mammal Survey	16-Jun-12	395677	7450223	Unknown Eider	*Somateria spp.*	UNEI				15	15	
Marine Mammal Survey	16-Jun-12	394916	7451411	Unknown Eider	*Somateria spp.*	UNEI				1	1	
Marine Mammal Survey	16-Jun-12	388760	7464799	Glaucous Gull	*Larus hyperboreus*	GLGU				1	1	
Marine Mammal Survey	16-Jun-12	388666	7465111	Unknown Eider	*Somateria spp.*	UNEI				1	1	
Breeding bird	1-Jun-12	379350	7393100	Pacific Loon	*Gavia pacifica*	PALO				2	2	
Breeding bird	1-Jun-12	379350	7393100	Greater Scaup	*Aythya marila*	GRSC				2	2	
Breeding bird	1-Jun-12	379350	7393100	American Green-winged Teal	*Anas crecca*	AGWT				8	8	
Breeding bird	1-Jun-12	379350	7393100	Northern Shoveler	*Anas clypeata*	NOSH				5	5	
Breeding bird	1-Jun-12	379350	7393100	Canada Goose	*Branta canadensis*	CAGO				12	12	
Breeding bird	1-Jun-12	381250	7392700	Canada Goose	*Branta canadensis*	CAGO				55	55	
Breeding bird	1-Jun-12	383800	7385200	Yellow-billed Loon	*Gavia adamsii*	YBLO				1	1	
Breeding bird	1-Jun-12	383800	7385200	Red-throated Loon	*Gavia stellata*	RTLO				1	1	
Breeding bird	1-Jun-12	386900	7380600	American Green-winged Teal	*Anas crecca*	AGWT				1	1	
Breeding bird	1-Jun-12	386900	7380600	Red-throated Loon	*Gavia stellata*	RTLO				2	2	
Breeding bird	1-Jun-12	386900	7380600	Northern Pintail	*Anas acuta*	NOPI				6	6	
Breeding bird	1-Jun-12	401800	7359900	Northern Pintail	*Anas acuta*	NOPI				2	2	
Breeding bird	1-Jun-12	401800	7359900	Canada Goose	*Branta canadensis*	CAGO				1	1	
Breeding bird	1-Jun-12	401800	7359900	Greater White-fronted Goose	*Anser albifrons*	GWFG				1	1	
Breeding bird	1-Jun-12	401800	7359900	Northern Shoveler	*Anas clypeata*	NOSH				4	4	
Breeding bird	1-Jun-12	384087	7331801	Herring Gull	*Larus argentatus*	HEGU				1	1	
Breeding bird	1-Jun-12	388800	7327700	Greater White-fronted Goose	*Anser albifrons*	GWFG				6	6	
Breeding bird	1-Jun-12	383400	7321800	Canada Goose	*Branta canadensis*	CAGO				1	1	
Breeding bird	1-Jun-12	386487	7329101	Canada Goose	*Branta canadensis*	CAGO				17	17	
Breeding bird	1-Jun-12	386487	7329101	Herring Gull	*Larus argentatus*	HEGU				1	1	
Breeding bird	1-Jun-12	386487	7329101	Long-tailed Jaeger	*Stercorarius longicaudus*	LTJA				1	1	
Breeding bird	1-Jun-12	424500	7263700	Greater White-fronted Goose	*Anser albifrons*	GWFG				2	2	
Breeding bird	1-Jun-12	424500	7263700	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA				1	1	
Breeding bird	1-Jun-12	432900	7271900	Long-tailed Duck	*Clangula hyemalis*	LTDU				1	1	

Appendix 5-2. Incidental Observations of Wildlife, 2012

Survey/Source	Date	Easting	Northing	Common Name	Scientific Name	Species Code	No. Observed					Sign Only ?
							Male	Female	Young	Unknown	Total	
Breeding bird	1-Jun-12	432900	7271900	Herring Gull	*Larus argentatus*	HEGU				2	2	
Breeding bird	1-Jun-12	430950	7263750	Herring Gull	*Larus argentatus*	HEGU				1	1	
Breeding bird	1-Jun-12	430600	7267150	Yellow-billed Loon	*Gavia adamsii*	YBLO				1	1	
Breeding bird	1-Jun-12	430600	7267150	Long-tailed Duck	*Clangula hyemalis*	LTDU				1	1	
Breeding bird	1-Jun-12	435150	7272100	Herring Gull	*Larus argentatus*	HEGU				2	2	
Breeding bird	1-Jun-12	435150	7272100	Canada Goose	*Branta canadensis*	CAGO				16	16	
Breeding bird	1-Jun-12	422300	7266000	Greater White-fronted Goose	*Anser albifrons*	GWFG				2	2	
Breeding bird	1-Jun-12	422300	7266000	Long-tailed Jaeger	*Stercorarius longicaudus*	LTJA				1	1	
Breeding bird	1-Jun-12	421800	7275400	Long-tailed Duck	*Clangula hyemalis*	LTDU				3	3	
Breeding bird	1-Jun-12	424800	7265600	Greater White-fronted Goose	*Anser albifrons*	GWFG				4	4	
Breeding bird	1-Jun-12	424800	7265600	Canada Goose	*Branta canadensis*	CAGO				2	2	
Breeding bird	1-Jun-12	424800	7265600	Greater White-fronted Goose	*Anser albifrons*	GWFG				3	3	
Breeding bird	1-Jun-12	424800	7265600	Red-breasted Merganser	*Mergus serrator*	RBME				4	4	
Breeding bird	1-Jun-12	424800	7265600	Long-tailed Duck	*Clangula hyemalis*	LTDU				2	2	
Breeding bird	1-Jun-12	424800	7265600	Greater Scaup	*Aythya marila*	GRSC				1	1	
Breeding bird	1-Jun-12	424800	7265600	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA				1	1	
Breeding bird	1-Jun-12	422200	7263800	Northern Pintail	*Anas acuta*	NOPI				1	1	
Breeding bird	1-Jun-12	422200	7263800	American Green-winged Teal	*Anas crecca*	AGWT				1	1	
Breeding bird	1-Jun-12	431100	7271400	Long-tailed Duck	*Clangula hyemalis*	LTDU				2	2	
Breeding bird	1-Jun-12	431100	7271400	Canada Goose	*Branta canadensis*	CAGO				1	1	
Breeding bird	1-Jun-12	426300	7267200	Greater White-fronted Goose	*Anser albifrons*	GWFG				6	6	
Breeding bird	1-Jun-12	426300	7267200	Canada Goose	*Branta canadensis*	CAGO				6	6	
Breeding bird	1-Jun-12	380987	7305901	Canada Goose	*Branta canadensis*	CAGO				25	25	
Breeding bird	1-Jun-12	380987	7305901	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA				1	1	
Breeding bird	1-Jun-12	387487	7304001	Canada Goose	*Branta canadensis*	CAGO				104	104	
Breeding bird	1-Jun-12	387487	7304001	Northern Pintail	*Anas acuta*	NOPI				2	2	
Breeding bird	1-Jun-12	391800	7306300	Canada Goose	*Branta canadensis*	CAGO				45	45	
Breeding bird	1-Jun-12	391800	7306300	Long-tailed Duck	*Clangula hyemalis*	LTDU				1	1	
Breeding bird	1-Jun-12	384700	7315900	Canada Goose	*Branta canadensis*	CAGO				3	3	
Breeding bird	1-Jun-12	384700	7315900	Long-tailed Duck	*Clangula hyemalis*	LTDU				2	2	
Breeding bird	1-Jun-12	384700	7315900	Northern Pintail	*Anas acuta*	NOPI				5	5	
Breeding bird	1-Jun-12	390000	7308400	Greater White-fronted Goose	*Anser albifrons*	GWFG				1	1	
Breeding bird	1-Jun-12	390000	7308400	Northern Pintail	*Anas acuta*	NOPI				2	2	
Breeding bird	1-Jun-12	390000	7308400	Long-tailed Duck	*Clangula hyemalis*	LTDU				2	2	
Breeding bird	1-Jun-12	390000	7308400	American Green-winged Teal	*Anas crecca*	AGWT				3	3	
Breeding bird	1-Jun-12	390000	7308400	Greater Scaup	*Aythya marila*	GRSC				2	2	
Breeding bird	1-Jun-12	390000	7308400	Greater Scaup	*Aythya marila*	GRSC				1	1	
Breeding bird	1-Jun-12	380487	7314801	Tundra Swan	*Cygnus columbianus*	TUSW				2	2	
Breeding bird	1-Jun-12	380487	7314801	Long-tailed Duck	*Clangula hyemalis*	LTDU				1	1	
Breeding bird	1-Jun-12	393487	7314901	Canada Goose	*Branta canadensis*	CAGO				1	1	
Breeding bird	1-Jun-12	387487	7319401	Long-tailed Jaeger	*Stercorarius longicaudus*	LTJA				1	1	
Breeding bird	1-Jun-12	427000	7256700	Herring Gull	*Larus argentatus*	HEGU				1	1	
Breeding bird	1-Jun-12	427000	7256700	Canada Goose	*Branta canadensis*	CAGO				7	7	

Appendix 5-2. Incidental Observations of Wildlife, 2012

Survey/Source	Date	Easting	Northing	Common Name	Scientific Name	Species Code	No. Observed					Sign Only ?
							Male	Female	Young	Unknown	Total	
Breeding bird	1-Jun-12	427000	7256700	Northern Pintail	*Anas acuta*	NOPI				44	44	
Breeding bird	1-Jun-12	427000	7256700	Canada Goose	*Branta canadensis*	CAGO				45	45	
Breeding bird	1-Jun-12	427000	7256700	Long-tailed Duck	*Clangula hyemalis*	LTDU				10	10	
Breeding bird	1-Jun-12	427700	7252500	Long-tailed Jaeger	*Stercorarius longicaudus*	LTJA				1	1	
Breeding bird	1-Jun-12	387887	7321701	Yellow-billed Loon	*Gavia adamsii*	YBLO				1	1	
Breeding bird	1-Jun-12	383487	7324601	Canada Goose	*Branta canadensis*	CAGO				9	9	
Breeding bird	1-Jun-12	383487	7324601	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA				1	1	
Breeding bird	1-Jun-12	389287	7328801	Canada Goose	*Branta canadensis*	CAGO				26	26	
Breeding bird	1-Jun-12	396887	7330001	Canada Goose	*Branta canadensis*	CAGO				30	30	
Breeding bird	1-Jun-12	387687	7335301	Canada Goose	*Branta canadensis*	CAGO				134	134	
Breeding bird	1-Jun-12	387687	7335301	Tundra Swan	*Cygnus columbianus*	TUSW				2	2	
Breeding bird	1-Jun-12	396187	7334501	Unknown Loon	*Gavia spp.*	UNLO				1	1	
Breeding bird	1-Jun-12	389587	7312401	Canada Goose	*Branta canadensis*	CAGO				43	43	
Breeding bird	1-Jun-12	385887	7308201	Red-breasted Merganser	*Mergus serrator*	RBME				1	1	
Breeding bird	1-Jun-12	385887	7308201	Herring Gull	*Larus argentatus*	HEGU				1	1	
Breeding bird	1-Jun-12	385887	7308201	Canada Goose	*Branta canadensis*	CAGO				10	10	
Breeding bird	1-Jun-12	390787	7307701	Canada Goose	*Branta canadensis*	CAGO				15	15	
Breeding bird	1-Jun-12	390787	7307701	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA				1	1	
Breeding bird	1-Jun-12	392387	7316601	Canada Goose	*Branta canadensis*	CAGO				1	1	
Remote Camera Surveys	24-Aug-12	431603	7265237	Canada Goose	*Branta canadensis*	CAGO				60	60	
Remote Camera Surveys	24-Aug-12	433240	7253241	Canada Goose	*Branta canadensis*	CAGO				57	57	
Remote Camera Surveys	24-Aug-12	435235	7245823	Canada Goose	*Branta canadensis*	CAGO				140	140	
Remote Camera Surveys	24-Aug-12	436291	7247562	Canada Goose	*Branta canadensis*	CAGO				200	200	
Remote Camera Surveys	24-Aug-12	423729	7266514	Long-tailed Duck	*Clangula hyemalis*	LTDU				15	15	
Remote Camera Surveys	24-Aug-12	423729	7266514	Greater Scaup	*Aythya marila*	GRSC				1	1	
Remote Camera Surveys	24-Aug-12	387825	7313415	Greater White-fronted Goose	*Anser albifrons*	GWFG				16	16	
Remote Camera Surveys	24-Aug-12	390965	7311109	Yellow-billed Loon	*Gavia adamsii*	YBLO				2	2	
Waterbird Fall Staging Survey	15-Aug-12	381849	7332999	Unknown Diver	*Unknown Diver*	UNDI				1	1	
Waterbird Fall Staging Survey	15-Aug-12	382092	7299219	Red-breasted Merganser	*Mergus serrator*	RBME				18	18	
Waterbird Fall Staging Survey	15-Aug-12	382108	7300691	Red-breasted Merganser	*Mergus serrator*	RBME				3	3	
Waterbird Fall Staging Survey	15-Aug-12	396987	7314446	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA				1	1	
Waterbird Fall Staging Survey	15-Aug-12	379923	7307513	Canada Goose	*Branta canadensis*	CAGO				3	3	
Waterbird Fall Staging Survey	15-Aug-12	396684	7305487	Red-breasted Merganser	*Mergus serrator*	RBME				15	15	
Waterbird Fall Staging Survey	15-Aug-12	392836	7307800	Canada Goose	*Branta canadensis*	CAGO				12	12	
Waterbird Fall Staging Survey	15-Aug-12	409059	7290027	Canada Goose	*Branta canadensis*	CAGO				11	11	
Waterbird Fall Staging Survey	15-Aug-12	435752	7275352	Unknown Duck	*Unknown Duck*	UNDU				8	8	
Waterbird Fall Staging Survey	15-Aug-12	435580	7275076	Canada Goose	*Branta canadensis*	CAGO				14	14	
Waterbird Fall Staging Survey	15-Aug-12	426582	7257060	Greater Scaup	*Aythya marila*	GRSC				5	5	
Waterbird Fall Staging Survey	15-Aug-12	443125	7255072	Long-tailed Duck	*Clangula hyemalis*	LTDU				2	2	
Waterbird Fall Staging Survey	15-Aug-12	443123	7251231	Sandhill Crane	*Grus canadensis*	SACR				3	3	
Grizzly Bear DNA Survey	August 3 2012	383520	7349758	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA				4	4	
Grizzly Bear DNA Survey	August 3 2012	445413	7299819	Canada Goose	*Branta canadensis*	CAGO				50	50	
Grizzly Bear DNA Survey	August 4 2012	452407	7292991	Greater White-fronted Goose	*Anser albifrons*	GWFG				12	12	

Appendix 5-2. Incidental Observations of Wildlife, 2012

Survey/Source	Date	Easting	Northing	Common Name	Scientific Name	Species Code	No. Observed					Sign Only ?
							Male	Female	Young	Unknown	Total	
Grizzly Bear DNA Survey	August 4 2012	402027	7288607	Canada Goose	*Branta canadensis*	CAGO				75	75	
Grizzly Bear DNA Survey	August 4 2012	445719	7299587	Canada Goose	*Branta canadensis*	CAGO				45	45	
Grizzly Bear DNA Survey	August 4 2012	404063	7266228	Arctic Tern	*Sterna paradisaea*	ARTE				1	1	
Grizzly Bear DNA Survey	August 4 2012	414643	7267681	Canada Goose	*Branta canadensis*	CAGO				50	50	
Grizzly Bear DNA Survey	August 4 2012	445408	7266094	Canada Goose	*Branta canadensis*	CAGO				12	12	
Grizzly Bear DNA Survey	August 4 2012	451772	7266076	Canada Goose	*Branta canadensis*	CAGO				20	20	
Grizzly Bear DNA Survey	August 5 2012	437578	7273321	Arctic Tern	*Sterna paradisaea*	ARTE				7	7	
Grizzly Bear DNA Survey	August 5 2012	437578	7273321	Canada Goose	*Branta canadensis*	CAGO				23	23	
Vegetation Surveys	27-Jul-12	428876	7264743	Long-tailed Jaeger	*Stercorarius longicaudus*	LTJA				2	2	
Vegetation Surveys	21-Jul-12	428067	7266720	Sandhill Crane	*Grus canadensis*	SACR			2	2	4	
Terrestrial Ecosystem Mapping Surveys	15-Aug-12	396381	7277695	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA				1	1	
Waterbird Spring Staging Survey	28-May-12	400552	7333478	Canada Goose	*Branta canadensis*	CAGO				2	2	
Waterbird Spring Staging Survey	28-May-12	382331	7323045	Canada Goose	*Branta canadensis*	CAGO				1	1	
Waterbird Spring Staging Survey	28-May-12	382833	7323093	Unknown Goose	*Unknown Goose*	UNGO				5	5	
Waterbird Spring Staging Survey	28-May-12	380432	7315170	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA				1	1	
Waterbird Spring Staging Survey	28-May-12	386991	7302217	Greater White-fronted Goose	*Anser albifrons*	GWFG				2	2	
Waterbird Spring Staging Survey	28-May-12	429506	7273216	Sandhill Crane	*Grus canadensis*	SACR				3	3	
Waterbird Spring Staging Survey	28-May-12	435791	7276720	Herring Gull	*Larus argentatus*	HEGU				1	1	
Waterbird Spring Staging Survey	28-May-12	419142	7273670	Greater White-fronted Goose	*Anser albifrons*	GWFG				2	2	
Waterbird Spring Staging Survey	28-May-12	419023	7266204	Greater White-fronted Goose	*Anser albifrons*	GWFG				4	4	
Waterbird Spring Staging Survey	28-May-12	435693	7262867	Herring Gull	*Larus argentatus*	HEGU				1	1	
Waterbird Spring Staging Survey	28-May-12	426414	7260655	Canada Goose	*Branta canadensis*	CAGO				3	3	
Waterbird Spring Staging Survey	28-May-12	426586	7253532	Unknown Duck	*Unknown Duck*	UNDU				2	2	
Waterbird Spring Staging Survey	28-May-12	426586	7253532	Northern Pintail	*Anas acuta*	NOPI				1	1	
Waterbird Spring Staging Survey	28-May-12	426586	7253532	Canada Goose	*Branta canadensis*	CAGO				2	2	
Waterbird Spring Staging Survey	28-May-12	429060	7255103	Snow Goose	*Chen caerulescens*	SNGO				2	2	
Waterbird Spring Staging Survey	28-May-12	433823	7269595	Greater White-fronted Goose	*Anser albifrons*	GWFG				6	6	
Waterbird Spring Pair Survey	22-Jun-12	424950	7274840	Canada Goose	*Branta canadensis*	CAGO				1	1	
Waterbird Spring Pair Survey	22-Jun-12	421809	7272848	Canada Goose	*Branta canadensis*	CAGO				11	11	
Waterbird Spring Pair Survey	22-Jun-12	420055	7268714	Long-tailed Duck	*Clangula hyemalis*	LTDU				1	1	
Waterbird Spring Pair Survey	22-Jun-12	442098	7261280	Canada Goose	*Branta canadensis*	CAGO				6	6	
Waterbird Spring Pair Survey	22-Jun-12	442098	7261280	Red-breasted Merganser	*Mergus serrator*	RBME				3	3	
Waterbird Spring Pair Survey	22-Jun-12	443043	7259279	Sandhill Crane	*Grus canadensis*	SACR				1	1	
Waterbird Spring Pair Survey	22-Jun-12	442955	7258387	Herring Gull	*Larus argentatus*	HEGU				2	2	
Waterbird Spring Pair Survey	22-Jun-12	426857	7257492	Canada Goose	*Branta canadensis*	CAGO				50	50	
Waterbird Spring Pair Survey	22-Jun-12	426857	7257492	Greater White-Fronted Goose	*Anser albifrons*	GWFG				4	4	
Waterbird Spring Pair Survey	22-Jun-12	442958	7254297	Canada Goose	*Branta canadensis*	CAGO				25	25	
Waterbird Spring Pair Survey	22-Jun-12	443109	7248126	Red-breasted Merganser	*Mergus serrator*	RBME				1	1	
Waterbird Spring Pair Survey	22-Jun-12	380338	7315003	Long-tailed Duck	*Clangula hyemalis*	LTDU				1	1	
Waterbird Spring Pair Survey	22-Jun-12	384325	7313022	Long-tailed Duck	*Clangula hyemalis*	LTDU				3	3	
Waterbird Spring Pair Survey	22-Jun-12	398547	7333722	Greater Scaup	*Aythya marila*	GRSC				3	3	
Waterbird Spring Pair Survey	22-Jun-12	382442	7328127	Canada Goose	*Branta canadensis*	CAGO				5	5	
Waterbird Spring Pair Survey	22-Jun-12	382379	7324526	Herring Gull	*Larus argentatus*	HEGU				1	1	

Appendix 5-2. Incidental Observations of Wildlife, 2012

Survey/Source	Date	Easting	Northing	Common Name	Scientific Name	Species Code	No. Observed					Sign Only ?
							Male	Female	Young	Unknown	Total	
Waterbird Spring Pair Survey	22-Jun-12	396068	7323187	Long-tailed Duck	*Clangula hyemalis*	LTDU				1	1	
Waterbird Spring Pair Survey	22-Jun-12	398723	7322159	Greater Scaup	*Aythya marila*	GRSC				2	2	
Waterbird Summer Brood Survey	14-Jul-12	443241	7247449	Canada Goose	*Branta canadensis*	CAGO				50	50	
Waterbird Summer Brood Survey	14-Jul-12	443241	7247449	Canada Goose	*Branta canadensis*	CAGO				25	25	
Waterbird Summer Brood Survey	14-Jul-12	380094	7315388	Canada Goose	*Branta canadensis*	CAGO				11	11	
Waterbird Summer Brood Survey	14-Jul-12	394684	7308852	Unknown Duck	*Unknown Duck*	UNDU				13	13	
Waterbird Summer Brood Survey	14-Jul-12	396775	7306144	Canada Goose	*Branta canadensis*	CAGO				27	27	
Marine Bird Fall Survey	16-Aug-12	421208	7316145	Red-breasted Merganser	*Mergus serrator*	RBME				5	5	
Marine Bird Fall Survey	16-Aug-12	419409	7324958	Red-breasted Merganser	*Mergus serrator*	RBME				14	14	
Marine Bird Fall Survey	16-Aug-12	414660	7338957	Red-breasted Merganser	*Mergus serrator*	RBME				12	12	
Marine Bird Fall Survey	16-Aug-12	410988	7348245	Northern Pintail	*Anas acuta*	NOPI				14	14	
Marine Bird Fall Survey	16-Aug-12	408208	7350841	Northern Pintail	*Anas acuta*	NOPI				25	25	
Marine Bird Spring Survey	23-Jun-12	380968	7395499	Unknown Waterbird	*Unknown Waterbird*	UNWB				25	25	

Appendix 6-1

Locations and Habitat Types of PRISM Plots

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Appendix 6-1. Locations and Habitat Types of PRISM Plots

			Southwest Corner							
Survey Date	Plot ID	Zone	Easting	Northing	Region	Study Area	Habitat	% Contiguous Wetland	% Permanent Water	% Rock
17-Jun-12	BI1	13	379350	7393100	Bathurst Inlet	BI	Lowland	60	10	
17-Jun-12	BI2	13	381250	7392700	Bathurst Inlet	BI	Upland	2	0	
17-Jun-12	BI3	13	383800	7385200	Bathurst Inlet	BI	Lowland	40	5	
17-Jun-12	BI4	13	386900	7380600	Bathurst Inlet	BI	Upland	10	8	
20-Jun-12	BI5	13	401800	7359900	Bathurst Inlet	BI	Lowland	85	10	
09-Jun-12	LR2	13	384087	7331801	George	Reference	Lowland	30	10	
18-Jun-12	LR20	13	388800	7327700	George	Reference	Lowland	60	18	
18-Jun-12	LR21	13	383400	7321800	George	Reference	Lowland	85	1	
13-Jun-12	LR3	13	386487	7329101	George	Reference	Lowland	85	15	
18-Jun-12	LR6	13	393287	7327101	George	Reference	Lowland	35	10	
13-Jun-12	LR8	13	396287	7321301	George	Reference	Lowland	15	10	
24-Jun-12	LSA14*	13	424500	7263700	Goose	Focused	Lowland	70	8	
25-Jun-12	LSA19*	13	432900	7271900	Goose	Focused	Upland	8	4	35
22-Jun-12	LSA200	13	433100	7268750	Goose	Focused	Mixed	45	5	
22-Jun-12	LSA22*	13	430950	7263750	Goose	Focused	Lowland	15	0	
23-Jun-12	LSA26*	13	430600	7267150	Goose	Focused	Mixed	20	5	
25-Jun-12	LSA30*	13	435150	7272100	Goose	Focused	Lowland	15	15	
24-Jun-12	LSA300	13	422300	7266000	Goose	Focused	Lowland	65	10	
24-Jun-12	LSA301	13	421400	7267400	Goose	Focused	Upland	8	4	30
25-Jun-12	LSA302	13	429500	7272000	Goose	Focused	Upland	1	0	
25-Jun-12	LSA303	13	421800	7275400	Goose	Focused	Lowland	90	15	
24-Jun-12	LSA304	13	424800	7265600	Goose	Focused	Lowland	50	5	
26-Jun-12	LSA305	13	422200	7263800	Goose	Focused	Lowland	50	10	
26-Jun-12	LSA306	13	431100	7271400	Goose	Focused	Lowland	40	4	
26-Jun-12	LSA307	13	433250	7269900	Goose	Focused	Upland	17	2	
23-Jun-12	LSA7*	13	426300	7267200	Goose	Focused	Lowland	30	7	
10-Jun-12	LT11	13	380987	7305901	George	Focused	Upland	10	1	
10-Jun-12	LT12	13	387487	7304001	George	Focused	Upland	15	1	
16-Jun-12	LT21	13	381900	7304100	George	Focused	Lowland	90	10	
15-Jun-12	LT22	13	391800	7306300	George	Focused	Lowland	100	0	
16-Jun-12	LT24	13	384700	7315900	George	Focused	Lowland	40	5	20
16-Jun-12	LT25	13	390000	7308400	George	Focused	Lowland	80	1	
18-Jun-12	LT26	13	388300	7312000	George	Focused	Lowland	85	15	
10-Jun-12	LT6	13	380487	7314801	George	Focused	Lowland	25	5	
16-Jun-12	LT7	13	393487	7314901	George	Focused	Lowland	65	20	
15-Jun-12	LT9	13	387487	7319401	George	Focused	Lowland	25	5	
26-Jun-12	RA300	13	427000	7256700	Goose	Reference	Lowland	37	8	
27-Jun-12	RA301	13	429200	7249500	Goose	Reference	Lowland	30	1	
27-Jun-12	RA302	13	427900	7247100	Goose	Reference	Upland	4	1	60
27-Jun-12	RA303	13	427700	7252500	Goose	Reference	Upland	10	1	
12-Jun-12	UR1	13	392787	7334801	George	Reference	Upland	8	5	75
12-Jun-12	UR10	13	394387	7323601	George	Reference	Upland	0	0	
12-Jun-12	UR3	13	387887	7321701	George	Reference	Upland	0	0	
09-Jun-12	UR4	13	383487	7324601	George	Reference	Upland	10	0	
12-Jun-12	UR6	13	389287	7328801	George	Reference	Upland	10	1	
12-Jun-12	UR7	13	396887	7330001	George	Reference	Upland	0	5	70
12-Jun-12	UR8	13	387687	7335301	George	Reference	Upland	0	0	
09-Jun-12	UR9	13	396187	7334501	George	Reference	Upland	0	0	
15-Jun-12	UT1	13	389587	7312401	George	Focused	Upland	5	0	
10-Jun-12	UT10	13	382887	7309501	George	Focused	Upland	1	1	
15-Jun-12	UT12	13	385887	7308201	George	Focused	Upland	15	5	50
15-Jun-12	UT4	13	390787	7307701	George	Focused	Lowland	50	3	
15-Jun-12	UT5	13	385987	7316601	George	Focused	Upland	5	1	
13-Jun-12	UT9	13	392387	7316601	George	Focused	Upland	20	1	40

** Indicates a plot that was also surveyed in 2011.*

Appendix 6-2

Detections of Upland Breeding Birds and Nests in PRISM Plots

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Appendix 6-2. Detections of Upland Breeding Birds and Nests in PRISM Plots

Data ID	Plot ID	Species	Species Code	Number of Territories	Habitat Type	Male	Female	Unknown Sex	Eggs	Young	Comments
429	2012_BI1	American Tree Sparrow	ATSP	1	Sedge Meadow		1				no nest found
430	2012_BI1	American Tree Sparrow	ATSP	1	Tall Shrub		1				riparian shrub; probably flushed
431	2012_BI1	Hoary Redpoll	HORE	1	Sedge Meadow	1	1				
432	2012_BI1	Hoary Redpoll	HORE	1	Sedge Meadow	1	1				
419	2012_BI1	Lapland Longspur	LALO	1	Heath Lichen	1	1		5		15 m flush
418	2012_BI1	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1		5		20 cm flush, at base of birch shrub
420	2012_BI1	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
421	2012_BI1	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
422	2012_BI1	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
423	2012_BI1	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
424	2012_BI1	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
425	2012_BI1	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
426	2012_BI1	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
427	2012_BI1	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
405	2012_BI2	American Golden Plover	AMGP	1	Heath Lichen	1	1				visually detected
410	2012_BI2	Hoary Redpoll	HORE	1	Heath Lichen	1	1				female preening
409	2012_BI2	Hoary Redpoll	HORE	1	Heath Lichen		1				no male seen
406	2012_BI2	Horned Lark	HOLA	1	Heath Lichen	1	1				female skulking
407	2012_BI2	Horned Lark	HOLA	1	Heath Lichen	1	1				visually detected
412	2012_BI2	Redpoll	REDP	1	Short Shrub			1			very shrubby
402	2012_BI2	Savannah Sparrow	SAVS	1	Heath Hummock	1					visually detected
403	2012_BI2	Savannah Sparrow	SAVS	1	Heath Lichen	1					
404	2012_BI2	Semipalmated Plover	SEPL	1	Heath Lichen	1					visually detected
451	2012_BI3	American Tree Sparrow	ATSP	1	Tall Shrub	1					
455	2012_BI3	Common Redpoll	CORE	1	Rocky Heath			1			
446	2012_BI3	Hoary Redpoll	HORE	1	Heath Lichen	1	1				
445	2012_BI3	Hoary Redpoll	HORE	1	Tall Shrub	1	1				
447	2012_BI3	Lapland Longspur	LALO	1	Sedge Meadow	1	1				no nest found
452	2012_BI3	Semipalmated Plover	SEPL	1	Water			1			water/pool edge
454	2012_BI3	White-crowned Sparrow	WCSP	1	Short Shrub			1			
453	2012_BI3	White-crowned Sparrow	WCSP	1	Tall Shrub	1	1				territory in the large tall shrub area
456	2012_BI3	Willow Ptarmigan	WIPT	1	Tall Shrub	1					flushed a couple times as moving through the plot
457	2012_BI3	Yellow Warbler	YEWA	1	Tall Shrub	1					
458	2012_BI3	Yellow Warbler	YEWA	1	Tall Shrub	1	1				in beach/riparian shrub
476	2012_BI4	Lapland Longspur	LALO	1	Heath Lichen	1	1				
478	2012_BI4	Lapland Longspur	LALO	1	Sedge Meadow	1					visually detected
473	2012_BI4	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
475	2012_BI4	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
474	2012_BI4	Savannah Sparrow	SAVS	1	Tall Shrub	1	1				riparian shrub
546	2012_BI5	American Tree Sparrow	ATSP	1	Sedge Meadow			1			
548	2012_BI5	American Tree Sparrow	ATSP	1	Short Shrub	1					
543	2012_BI5	Hoary Redpoll	HORE	1	Tall Shrub		1				no nest found
544	2012_BI5	Horned Lark	HOLA	1	Beach			1			beach/short shrub
538	2012_BI5	Lapland Longspur	LALO	1	Sedge Meadow	1	1			4	
551	2012_BI5	Redpoll	REDP	1	Sedge Meadow			1			
540	2012_BI5	Savannah Sparrow	SAVS	1	Tall Shrub		1				

Appendix 6-2. Detections of Upland Breeding Birds and Nests in PRISM Plots

Data ID	Plot ID	Species	Species Code	Number of Territories	Habitat Type	Male	Female	Unknown Sex	Eggs	Young	Comments
533	2012_BI5	Savannah Sparrow	SAVS	1	Sedge Meadow		1				
535	2012_BI5	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
536	2012_BI5	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
537	2012_BI5	Savannah Sparrow	SAVS	1	Sedge Meadow			2			
541	2012_BI5	Semipalmated Sandpiper	SESA	1	Sedge Meadow	1	1				
542	2012_BI5	Semipalmated Sandpiper	SESA	1	Sedge Meadow			1			
545	2012_BI5	White-crowned Sparrow	WCSP	1	Tall Shrub		1				no nest found
549	2012_BI5	Wilson's Snipe	WISN	1	Sedge Meadow			1			
1	2012_LR2	Lapland Longspur	LALO	1	Heath Hummock	1	1				pair
5	2012_LR2	Savannah Sparrow	SAVS	1	Sedge Meadow			2			no activity
6	2012_LR2	Semipalmated Sandpiper	SESA	1	Sedge Meadow			1			
510	2012_LR20	American Golden Plover	AMGP	1	Sedge Meadow			1			
513	2012_LR20	Lapland Longspur	LALO	1	Heath Hummock	1					
512	2012_LR20	Lapland Longspur	LALO	1	Heath Hummock		1				visually detected
514	2012_LR20	Lapland Longspur	LALO	1	Sedge Meadow	1					visually detected
506	2012_LR20	Pectoral Sandpiper	PESA	1	Sedge Meadow			1			
507	2012_LR20	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
508	2012_LR20	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				visually detected
511	2012_LR20	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
509	2012_LR20	Semipalmated Sandpiper	SESA	1	Sedge Meadow			1			visually detected
501	2012_LR21	Horned Lark	HOLA	1	Rocky Heath			1			
495	2012_LR21	Lapland Longspur	LALO	1	Rocky Heath	1	1				
496	2012_LR21	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
497	2012_LR21	Lapland Longspur	LALO	1	Sedge Meadow	1					territorial singing
498	2012_LR21	Lapland Longspur	LALO	1	Sedge Meadow	1					
491	2012_LR21	Least Sandpiper	LESA	1	Sedge Meadow	1	1				female seemed to flush but no nest
492	2012_LR21	Least Sandpiper	LESA	1	Sedge Meadow	1	1				
493	2012_LR21	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
212	2012_LR3	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
214	2012_LR3	Lapland Longspur	LALO	1	Sedge Meadow	1	1				female, male calling
215	2012_LR3	Lapland Longspur	LALO	1	Sedge Meadow	1					aerial display
216	2012_LR3	Lapland Longspur	LALO	1	Sedge Meadow	1					
217	2012_LR3	Lapland Longspur	LALO	1	Sedge Meadow	1					
213	2012_LR3	Redpoll	REDP	1	Sedge Meadow			1			
211	2012_LR3	Savannah Sparrow	SAVS	1	Sedge Meadow	3					
523	2012_LR6	American Golden Plover	AMGP	1	Rocky Heath			1			making no noise
525	2012_LR6	Hoary Redpoll	HORE	1	Heath Lichen			1			
521	2012_LR6	Lapland Longspur	LALO	1	Heath Lichen	1	1				
524	2012_LR6	Lapland Longspur	LALO	1	Heath Lichen	1					
520	2012_LR6	Lapland Longspur	LALO	1	Rocky Heath		1		4		15 m flush
526	2012_LR6	Pectoral Sandpiper	PESA	1	Heath Lichen			1			
230	2012_LR8	Common Redpoll	CORE	1	Heath Hummock	1	1				calling, flew to west
228	2012_LR8	Lapland Longspur	LALO	1	Heath Hummock	1					no female
224	2012_LR8	Savannah Sparrow	SAVS	1	Heath Hummock	1	1				silent female, appeared to flush
225	2012_LR8	Savannah Sparrow	SAVS	1	Heath Hummock	1	1				female silent
226	2012_LR8	Savannah Sparrow	SAVS	1	Heath Hummock	1	1				

Appendix 6-2. Detections of Upland Breeding Birds and Nests in PRISM Plots

Data ID	Plot ID	Species	Species Code	Number of Territories	Habitat Type	Male	Female	Unknown Sex	Eggs	Young	Comments
655	2012_LSA14	American Golden Plover	AMGP	1	Heath Lichen	1	1				
653	2012_LSA14	Horned Lark	HOLA	1	Heath Lichen	1	1				
652	2012_LSA14	Lapland Longspur	LALO	1	Heath Lichen	1					
660	2012_LSA14	Lapland Longspur	LALO	1	Sedge Meadow	1					visually detected
661	2012_LSA14	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
654	2012_LSA14	Redpoll	REDP	1	Sedge Meadow	1	1				
656	2012_LSA14	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
657	2012_LSA14	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
658	2012_LSA14	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
659	2012_LSA14	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
762	2012_LSA19	Hoary Redpoll	HORE	1	Rocky Heath	1	1				
761	2012_LSA19	Horned Lark	HOLA	1	Rocky Heath	1	1				
763	2012_LSA19	Lapland Longspur	LALO	1	Rocky Heath	1	1				
766	2012_LSA19	Lapland Longspur	LALO	1	Rocky Heath	1					aerial display
764	2012_LSA19	Lapland Longspur	LALO	1	Sedge Meadow		1				
765	2012_LSA19	Savannah Sparrow	SAVS	1	Sedge Meadow			1			
578	2012_LSA200	Horned Lark	HOLA	1	Heath Lichen	1	1				
576	2012_LSA200	Lapland Longspur	LALO	1	Heath Hummock	1	1				
580	2012_LSA200	Lapland Longspur	LALO	1	Heath Lichen	1	1				
579	2012_LSA200	Redpoll	REDP	1	Heath Lichen	1	1				
577	2012_LSA200	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
569	2012_LSA22	Lapland Longspur	LALO	1	Heath Lichen		1				
568	2012_LSA22	Lapland Longspur	LALO	1	Heath Lichen		1				
567	2012_LSA22	Savannah Sparrow	SAVS	1	Rocky Heath	1					
565	2012_LSA22	Savannah Sparrow	SAVS	1	Short Shrub	1	1				
617	2012_LSA26	Horned Lark	HOLA	1	Heath Lichen	1	1				
612	2012_LSA26	Lapland Longspur	LALO	1	Heath Hummock	1	1				
620	2012_LSA26	Lapland Longspur	LALO	1	Heath Hummock	1					aerial display
614	2012_LSA26	Lapland Longspur	LALO	1	Sedge Meadow	1					aerial display
618	2012_LSA26	Lapland Longspur	LALO	1	Heath Hummock		1			5	
619	2012_LSA26	Lapland Longspur	LALO	1	Sedge Meadow	1					
613	2012_LSA26	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
616	2012_LSA26	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
615	2012_LSA26	Stilt Sandpiper	STSA	1	Sedge Meadow			1			
713	2012_LSA30	Lapland Longspur	LALO	1	Heath Hummock	1	1				
714	2012_LSA30	Lapland Longspur	LALO	1	Heath Hummock	1	1				
718	2012_LSA30	Lapland Longspur	LALO	1	Heath Hummock	1	1				
719	2012_LSA30	Lapland Longspur	LALO	1	Heath Hummock	1	1				no nest found
720	2012_LSA30	Lapland Longspur	LALO	1	Heath Hummock	1					territorial
722	2012_LSA30	Lapland Longspur	LALO	1	Heath Hummock	1					
717	2012_LSA30	Lapland Longspur	LALO	1	Heath Lichen	1	1				female skulking
721	2012_LSA30	Lapland Longspur	LALO	1	Heath Lichen	1					territorial
715	2012_LSA30	Lapland Longspur	LALO	1	Heath Hummock		1				lone female
716	2012_LSA30	Lapland Longspur	LALO	1	Heath Hummock		1				lone female
723	2012_LSA30	Red-necked Phalarope	RNPH	1	Sedge Meadow	1	1				flying around plot a lot
710	2012_LSA30	Savannah Sparrow	SAVS	1	Heath Hummock	1	1				

Appendix 6-2. Detections of Upland Breeding Birds and Nests in PRISM Plots

Data ID	Plot ID	Species	Species Code	Number of Territories	Habitat Type	Male	Female	Unknown Sex	Eggs	Young	Comments
709	2012_LSA30	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
712	2012_LSA30	Semipalmated Sandpiper	SESA	1	Sedge Meadow	1	1				female had brood patch, moved around entire plot
678	2012_LSA300	Lapland Longspur	LALO	1	Short Shrub		1			4	1 m flush
680	2012_LSA300	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
681	2012_LSA300	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
679	2012_LSA300	Lapland Longspur	LALO	1	Short Shrub	1					visually detected
682	2012_LSA300	Lapland Longspur	LALO	1	Short Shrub	1	1				
684	2012_LSA300	Least Sandpiper	LESA	1	Sedge Meadow			1			near small pool bordered by sedge meadow
685	2012_LSA300	Red-necked Phalarope	RNPH	1	Water	1					
688	2012_LSA300	Redpoll	REDP	1	Sedge Meadow			1			
670	2012_LSA300	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				assumed pair
671	2012_LSA300	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
672	2012_LSA300	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
673	2012_LSA300	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
676	2012_LSA300	Savannah Sparrow	SAVS	1	Sedge Meadow		1				right near muddy water area bordered by sedge meadow
669	2012_LSA300	Savannah Sparrow	SAVS	1	Short Shrub	1	1				
674	2012_LSA300	Savannah Sparrow	SAVS	1	Short Shrub	1	1				female preening, female flew to male at end of survey
675	2012_LSA300	Savannah Sparrow	SAVS	1	Short Shrub	1	1				
677	2012_LSA300	Savannah Sparrow	SAVS	1	Short Shrub	1					
686	2012_LSA300	Willow Ptarmigan	WIPT	1	Short Shrub			1			
687	2012_LSA300	Wilson's Snipe	WISN	1	Sedge Meadow			1			flushed
704	2012_LSA301	American Golden Plover	AMGP	1	Rocky Heath	1	1				
701	2012_LSA301	Hoary Redpoll	HORE	1	Rocky Heath			1			
700	2012_LSA301	Horned Lark	HOLA	1	Rocky Heath	1	1				
702	2012_LSA301	Lapland Longspur	LALO	1	Rocky Heath	1					
703	2012_LSA301	Lapland Longspur	LALO	1	Rocky Heath	1	1				visually detected
699	2012_LSA301	Least Sandpiper	LESA	1	Sedge Meadow			1			
754	2012_LSA302	American Tree Sparrow	ATSP	1	Short Shrub	1					
749	2012_LSA302	Common Redpoll	CORE	1	Rocky Heath	1	1				assumed pair
748	2012_LSA302	Hoary Redpoll	HORE	1	Rocky Heath	1	1				assumed pair
753	2012_LSA302	Horned Lark	HOLA	1	Heath Lichen	1					
750	2012_LSA302	Lapland Longspur	LALO	1	Heath Lichen	1	1				
751	2012_LSA302	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
738	2012_LSA303	American Tree Sparrow	ATSP	1	Heath Hummock	1					
737	2012_LSA303	Common Redpoll	CORE	1	Heath Lichen	1	1				
743	2012_LSA303	Hoary Redpoll	HORE	1	Rocky Heath			1			
733	2012_LSA303	Lapland Longspur	LALO	1	Heath Hummock	1					
734	2012_LSA303	Lapland Longspur	LALO	1	Heath Hummock	1	1				2 m flush
739	2012_LSA303	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
740	2012_LSA303	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
735	2012_LSA303	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
736	2012_LSA303	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
741	2012_LSA303	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
742	2012_LSA303	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
732	2012_LSA303	Savannah Sparrow	SAVS	1	Sedge Meadow		1		5		2 m flush
744	2012_LSA303	Semipalmated Sandpiper	SESA	1	Sedge Meadow			1			

Appendix 6-2. Detections of Upland Breeding Birds and Nests in PRISM Plots

Data ID	Plot ID	Species	Species Code	Number of Territories	Habitat Type	Male	Female	Unknown Sex	Eggs	Young	Comments
632	2012_LSA304	Lapland Longspur	LALO	1	Heath Hummock	1	1				
633	2012_LSA304	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
634	2012_LSA304	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
635	2012_LSA304	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
636	2012_LSA304	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
639	2012_LSA304	Least Sandpiper	LESA	1	Sedge Meadow	1	1				in wet spot, probable nest in plot
629	2012_LSA304	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				antagonistic behaviour between two pairs
630	2012_LSA304	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				antagonistic behaviour between two pairs
824	2012_LSA305	American Tree Sparrow	ATSP	1	Short Shrub	1	1				
825	2012_LSA305	American Tree Sparrow	ATSP	1	Short Shrub	1	1				
822	2012_LSA305	Hoary Redpoll	HORE	1	Rocky Heath	1	1				acting like a pair
823	2012_LSA305	Hoary Redpoll	HORE	1	Rocky Heath			1			additional individual with adjacent pair
821	2012_LSA305	Hoary Redpoll	HORE	1	Short Shrub	1	1			1	plus one fledgling following the parents around
810	2012_LSA305	Lapland Longspur	LALO	1	Heath Lichen	1	1				
813	2012_LSA305	Lapland Longspur	LALO	1	Rocky Heath	1					territorial
807	2012_LSA305	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
808	2012_LSA305	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
809	2012_LSA305	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
811	2012_LSA305	Lapland Longspur	LALO	1	Short Shrub	1					
812	2012_LSA305	Lapland Longspur	LALO	1	Sedge Meadow		1				
814	2012_LSA305	Lapland Longspur	LALO	1	Short Shrub		1				
816	2012_LSA305	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
815	2012_LSA305	Savannah Sparrow	SAVS	1	Short Shrub	1	1				
817	2012_LSA305	Savannah Sparrow	SAVS	1	Short Shrub	1	1				
819	2012_LSA305	Semipalmated Sandpiper	SESA	1	Sedge Meadow			1			
820	2012_LSA305	Stilt Sandpiper	STSA	1	Sedge Meadow	1	1				flushed/flew away
839	2012_LSA306	Hoary Redpoll	HORE	1	Heath Lichen	1	1				
838	2012_LSA306	Lapland Longspur	LALO	1	Heath Hummock	1	1			4	older nestlings, mobile, parents feeding frequently
844	2012_LSA306	Lapland Longspur	LALO	1	Heath Hummock	1	1				
845	2012_LSA306	Lapland Longspur	LALO	1	Heath Hummock	1	1				
840	2012_LSA306	Lapland Longspur	LALO	1	Heath Lichen	1					displaying
841	2012_LSA306	Lapland Longspur	LALO	1	Heath Lichen	1	1				
843	2012_LSA306	Savannah Sparrow	SAVS	1	Heath Hummock	1					
842	2012_LSA306	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
857	2012_LSA307	Horned Lark	HOLA	1	Heath Lichen	1	1				foraging and moving around
855	2012_LSA307	Lapland Longspur	LALO	1	Heath Hummock	1	1				
856	2012_LSA307	Lapland Longspur	LALO	1	Heath Hummock	1	1				no nest found
849	2012_LSA307	Lapland Longspur	LALO	1	Heath Lichen	1	1				
850	2012_LSA307	Lapland Longspur	LALO	1	Heath Lichen	1	1				
851	2012_LSA307	Lapland Longspur	LALO	1	Heath Lichen	1	1				
852	2012_LSA307	Lapland Longspur	LALO	1	Heath Lichen	1	1				
853	2012_LSA307	Lapland Longspur	LALO	1	Heath Lichen	1	1				
858	2012_LSA307	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
859	2012_LSA307	Semipalmated Sandpiper	SESA	1	Sedge Meadow	1	1				
596	2012_LSA7	American Golden Plover	AMGP	1	Rocky Heath	1	1				
594	2012_LSA7	American Tree Sparrow	ATSP	1	Short Shrub	1	1				mixed short shrub/rocks

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Data ID	Plot ID	Species	Species Code	Number of Territories	Habitat Type	Male	Female	Unknown Sex	Eggs	Young	Comments
595	2012_LSA7	American Tree Sparrow	ATSP	1	Short Shrub	1					
599	2012_LSA7	Common Redpoll	CORE	1	Short Shrub	1	1				mixed short shrub/rocks
602	2012_LSA7	Hoary Redpoll	HORE	1	Heath Lichen	1					
600	2012_LSA7	Hoary Redpoll	HORE	1	Sedge Meadow			1			
583	2012_LSA7	Lapland Longspur	LALO	1	Heath Hummock	1					
584	2012_LSA7	Lapland Longspur	LALO	1	Rocky Heath	1					
586	2012_LSA7	Lapland Longspur	LALO	1	Rocky Heath	1	1				
585	2012_LSA7	Lapland Longspur	LALO	1	Short Shrub	1	1				
587	2012_LSA7	Lapland Longspur	LALO	1	Heath Lichen		1				no male around
597	2012_LSA7	Least Sandpiper	LESA	1	Sedge Meadow			1			
601	2012_LSA7	Redpoll	REDP	1	Short Shrub			1			
598	2012_LSA7	Redpoll	REDP	1	Short Shrub	1	1				mixed short shrub/rocks
593	2012_LSA7	Savannah Sparrow	SAVS	1	Heath Hummock	1					
589	2012_LSA7	Savannah Sparrow	SAVS	1	Sedge Meadow	1					visually detected
590	2012_LSA7	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
592	2012_LSA7	Savannah Sparrow	SAVS	1	Short Shrub		1				mixed short shrub/rocks and wet
591	2012_LSA7	Savannah Sparrow	SAVS	1	Short Shrub	1	1				mixed short shrub/rocks
588	2012_LSA7	Savannah Sparrow	SAVS	1	Sedge Meadow		1				probable nest (not seen)
95	2012_LT11	Lapland Longspur	LALO	1	Heath Lichen	1	1				visually detected
96	2012_LT11	Lapland Longspur	LALO	1	Heath Lichen	1	1				visually detected
97	2012_LT11	Lapland Longspur	LALO	1	Heath Lichen	1	1				visually detected
98	2012_LT11	Lapland Longspur	LALO	1	Heath Lichen	1	1		5		flush distance = 5 m
100	2012_LT11	Lapland Longspur	LALO	1	Heath Lichen	1					singing and calling
102	2012_LT11	Redpoll	REDP	1	Heath Lichen			1			sitting
101	2012_LT11	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				visually detected
69	2012_LT12	Lapland Longspur	LALO	1	Heath Lichen	1	1				visually detected
70	2012_LT12	Lapland Longspur	LALO	1	Heath Lichen	1	1				visually detected
71	2012_LT12	Lapland Longspur	LALO	1	Heath Lichen	1					aerial territory display
72	2012_LT12	Lapland Longspur	LALO	1	Heath Lichen	1					aerial territory display
76	2012_LT12	Lapland Longspur	LALO	1	Heath Lichen	1					didn't do aerial singing
78	2012_LT12	Lapland Longspur	LALO	1	Sedge Meadow	1					visually detected
73	2012_LT12	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
74	2012_LT12	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
75	2012_LT12	Semipalmated Sandpiper	SESA	1	Sedge Meadow	1	1				
363	2012_LT21	Hoary Redpoll	HORE	1	Heath Lichen			1			probably flushed
359	2012_LT21	Lapland Longspur	LALO	1	Heath Hummock		1		5		5 m flush, with low shrub, nest in willow shrub, south aspect
364	2012_LT21	Lapland Longspur	LALO	1	Heath Hummock	1	1				with low shrub
361	2012_LT21	Lapland Longspur	LALO	1	Heath Lichen	1	1				with low shrub
365	2012_LT21	Lapland Longspur	LALO	1	Sedge Meadow	1					
362	2012_LT21	Savannah Sparrow	SAVS	1	Heath Lichen	1	1				with low shrub
354	2012_LT21	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
355	2012_LT21	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
356	2012_LT21	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
357	2012_LT21	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
358	2012_LT21	Savannah Sparrow	SAVS	1	Heath Hummock		1		4		with low shrub
352	2012_LT21	Savannah Sparrow	SAVS	1	Sedge Meadow		1				probably nest defense

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Data ID	Plot ID	Species	Species Code	Number of Territories	Habitat Type	Male	Female	Unknown Sex	Eggs	Young	Comments
360	2012_LT21	Semipalmated Sandpiper	SESA	1	Heath Hummock			2			one visual, one calling; probably flushed the incubator
353	2012_LT21	Willow Ptarmigan	WIPT	1	Sedge Meadow		1				in small willow
278	2012_LT22	Hoary Redpoll	HORE	1	Heath Lichen	1	1				
282	2012_LT22	Lapland Longspur	LALO	1	Heath Hummock	1					aerial display
283	2012_LT22	Lapland Longspur	LALO	1	Sedge Meadow	1					aerial display
284	2012_LT22	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
285	2012_LT22	Lapland Longspur	LALO	1	Sedge Meadow	1					
275	2012_LT22	Red-necked Phalarope	RNPH	1	Sedge Meadow	1					looked to have flushed from wetland area with suitable hummocks for nests
276	2012_LT22	Redpoll	REDP	1	Tussock Grass			1			
280	2012_LT22	Savannah Sparrow	SAVS	1	Heath Hummock	1					
281	2012_LT22	Savannah Sparrow	SAVS	1	Heath Lichen	1	1				
279	2012_LT22	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
277	2012_LT22	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
273	2012_LT22	Semipalmated Sandpiper	SESA	1	Sedge Meadow	1	1				sticking to one area, probably nest nearby
274	2012_LT22	Willow Ptarmigan	WIPT	1	Heath Hummock		1				flushed in willow, didn't find nest
336	2012_LT24	American Golden Plover	AMGP	1	Rocky Heath			1			alarm calling and broken wing display
334	2012_LT24	Hoary Redpoll	HORE	1	Rocky Heath	1	1				loafing on rocks
335	2012_LT24	Horned Lark	HOLA	1	Rocky Heath	1	1				visually detected
338	2012_LT24	Lapland Longspur	LALO	1	Rocky Heath	1	1				
339	2012_LT24	Lapland Longspur	LALO	1	Rocky Heath	1	1				visually detected
340	2012_LT24	Lapland Longspur	LALO	1	Rocky Heath	1	1				visually detected
342	2012_LT24	Lapland Longspur	LALO	1	Rocky Heath	1					visually detected
341	2012_LT24	Lapland Longspur	LALO	1	Sedge Meadow		1				assumed territory; no male nearby
331	2012_LT24	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
332	2012_LT24	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
337	2012_LT24	Semipalmated Sandpiper	SESA	1	Sedge Meadow	1	1				calling
377	2012_LT25	Lapland Longspur	LALO	1	Sedge Meadow	1	1				female preening brood patch
378	2012_LT25	Lapland Longspur	LALO	1	Sedge Meadow	1	1				male actively flying around
379	2012_LT25	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
376	2012_LT25	Red-necked Phalarope	RNPH	1	Sedge Meadow	1	1				very wet area, flew into pond at the south end of plot and copulated
371	2012_LT25	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
372	2012_LT25	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
373	2012_LT25	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
374	2012_LT25	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
375	2012_LT25	Semipalmated Sandpiper	SESA	1	Sedge Meadow			1			no call, silent
530	2012_LT26	Horned Lark	HOLA	1	Rocky Heath	1					
529	2012_LT26	Lapland Longspur	LALO	1	Sedge Meadow	1					
528	2012_LT26	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
531	2012_LT26	Semipalmated Sandpiper	SESA	1	Sedge Meadow			1			
53	2012_LT6	American Golden Plover	AMGP	1	Heath Lichen			1			visually detected
60	2012_LT6	Common Redpoll	CORE	1	Short Shrub			1			
54	2012_LT6	Horned Lark	HOLA	1	Rocky Heath	1	1				visually detected
56	2012_LT6	Horned Lark	HOLA	1	Rocky Heath			1			visually detected
46	2012_LT6	Lapland Longspur	LALO	1	Heath Lichen	1	1		5		flush distance = ~ 2 m
47	2012_LT6	Lapland Longspur	LALO	1	Heath Lichen	1	1				visually detected
58	2012_LT6	Lapland Longspur	LALO	1	Heath Lichen	1					visually detected

Appendix 6-2. Detections of Upland Breeding Birds and Nests in PRISM Plots

Data ID	Plot ID	Species	Species Code	Number of Territories	Habitat Type	Male	Female	Unknown Sex	Eggs	Young	Comments
50	2012_LT6	Lapland Longspur	LALO	1	Rocky Heath	1	1				visually detected
48	2012_LT6	Lapland Longspur	LALO	1	Sedge Meadow	1	1				visually detected
49	2012_LT6	Lapland Longspur	LALO	1	Sedge Meadow	1	1				visually detected
57	2012_LT6	Lapland Longspur	LALO	1	Sedge Meadow	1					visually detected
59	2012_LT6	Lapland Longspur	LALO	1	Sedge Meadow	1					
51	2012_LT6	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				visually detected
52	2012_LT6	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				visually detected
55	2012_LT6	Savannah Sparrow	SAVS	1	Short Shrub	1					visually detected
390	2012_LT7	Hoary Redpoll	HORE	1	Sedge Meadow	1	1				probable nest defence
396	2012_LT7	Lapland Longspur	LALO	1	Heath Hummock	1	1				
397	2012_LT7	Lapland Longspur	LALO	1	Heath Hummock	1					
398	2012_LT7	Lapland Longspur	LALO	1	Heath Hummock	1					
395	2012_LT7	Lapland Longspur	LALO	1	Heath Lichen	1	1				
391	2012_LT7	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
392	2012_LT7	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
393	2012_LT7	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
394	2012_LT7	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
389	2012_LT7	Savannah Sparrow	SAVS	1	Heath Hummock	1	1				calling/nest defence
387	2012_LT7	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				calling/nest defence
388	2012_LT7	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				
305	2012_LT9	Lapland Longspur	LALO	1	Sedge Meadow	1	1		4		male calling at beginning of survey, nest found at end of survey
308	2012_LT9	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
310	2012_LT9	Lapland Longspur	LALO	1	Sedge Meadow	1	1				female hesitant to leave area
311	2012_LT9	Lapland Longspur	LALO	1	Sedge Meadow	1					
307	2012_LT9	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				visually detected
315	2012_LT9	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
791	2012_RA300	American Tree Sparrow	ATSP	1	Short Shrub	1	1				visually detected
790	2012_RA300	Common Redpoll	CORE	1	Short Shrub			1			
789	2012_RA300	Hoary Redpoll	HORE	1	Short Shrub	1	1				
792	2012_RA300	Hoary Redpoll	HORE	1	Short Shrub			1			
775	2012_RA300	Lapland Longspur	LALO	1	Heath Hummock	1					
776	2012_RA300	Lapland Longspur	LALO	1	Sedge Meadow	1					
779	2012_RA300	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
774	2012_RA300	Lapland Longspur	LALO	1	Short Shrub	1					
777	2012_RA300	Lapland Longspur	LALO	1	Short Shrub	1					
778	2012_RA300	Lapland Longspur	LALO	1	Short Shrub		1				
793	2012_RA300	Pectoral Sandpiper	PESA	1	Sedge Meadow			1			very wet sedge meadow
794	2012_RA300	Red-necked Phalarope	RNPH	1	Water	1					in small pool in sedge meadow
786	2012_RA300	Savannah Sparrow	SAVS	1	Short Shrub		1				
780	2012_RA300	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				male did not sing
781	2012_RA300	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				male did not sing; lots of alarm calling by pairs
787	2012_RA300	Savannah Sparrow	SAVS	1	Short Shrub			1			moved in with pair
782	2012_RA300	Savannah Sparrow	SAVS	1	Short Shrub	1	1				
783	2012_RA300	Savannah Sparrow	SAVS	1	Short Shrub	1	1				
784	2012_RA300	Savannah Sparrow	SAVS	1	Short Shrub	1	1				broken wing diplay
785	2012_RA300	Savannah Sparrow	SAVS	1	Short Shrub	1	1				

Appendix 6-2. Detections of Upland Breeding Birds and Nests in PRISM Plots

Data ID	Plot ID	Species	Species Code	Number of Territories	Habitat Type	Male	Female	Unknown Sex	Eggs	Young	Comments
788	2012_RA300	Savannah Sparrow	SAVS	1	Short Shrub		1				no nest found
873	2012_RA301	American Tree Sparrow	ATSP	1	Short Shrub	1	1				
874	2012_RA301	American Tree Sparrow	ATSP	1	Short Shrub	1					
875	2012_RA301	Hoary Redpoll	HORE	1	Sedge Meadow	1	1				
876	2012_RA301	Hoary Redpoll	HORE	1	Short Shrub	1	1				
877	2012_RA301	Hoary Redpoll	HORE	1	Short Shrub	1					
865	2012_RA301	Lapland Longspur	LALO	1	Sedge Meadow			1			one juvenile fledgling
862	2012_RA301	Lapland Longspur	LALO	1	Short Shrub	1	1				
864	2012_RA301	Lapland Longspur	LALO	1	Short Shrub	1					
869	2012_RA301	Savannah Sparrow	SAVS	1	Short Shrub	1	1				
870	2012_RA301	Savannah Sparrow	SAVS	1	Short Shrub	1	1				
871	2012_RA301	Savannah Sparrow	SAVS	1	Short Shrub	1	1				
868	2012_RA301	Savannah Sparrow	SAVS	1	Short Shrub		1				
866	2012_RA301	Savannah Sparrow	SAVS	1	Short Shrub		1				
867	2012_RA301	Savannah Sparrow	SAVS	1	Short Shrub		1				
872	2012_RA301	Savannah Sparrow	SAVS	1	Sedge Meadow		1				
893	2012_RA302	American Pipit	AMPI	1	Rocky Heath	1	1				
890	2012_RA302	Common Redpoll	CORE	1	Rocky Heath	1	1				
891	2012_RA302	Harris' Sparrow	HASP	1	Rocky Heath	1	1				
892	2012_RA302	Harris' Sparrow	HASP	1	Rocky Heath	1					
887	2012_RA302	Horned Lark	HOLA	1	Rocky Heath	1	1				
888	2012_RA302	Horned Lark	HOLA	1	Rocky Heath	1	1				
889	2012_RA302	Redpoll	REDP	1	Rocky Heath	1	1			1	probably with fledgling
896	2012_RA302	Rock Ptarmigan	ROPT	1	Rocky Heath	1					visually detected
894	2012_RA302	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
895	2012_RA302	White-crowned Sparrow	WCSP	1	Sedge Meadow	1					
901	2012_RA303	American Golden Plover	AMGP	1	Heath Lichen	1	1		4		nest found at end of survey; pair moving around most of plot
907	2012_RA303	American Tree Sparrow	ATSP	1	Short Shrub	1					visually detected
908	2012_RA303	Horned Lark	HOLA	1	Heath Lichen	1	1				
909	2012_RA303	Horned Lark	HOLA	1	Rocky Heath	1	1				
902	2012_RA303	Lapland Longspur	LALO	1	Heath Lichen	1	1				
904	2012_RA303	Lapland Longspur	LALO	1	Heath Lichen	1					visually detected
903	2012_RA303	Lapland Longspur	LALO	1	Rocky Heath	1	1				calling back to one another
905	2012_RA303	Lapland Longspur	LALO	1	Rocky Heath	1					territorial
911	2012_RA303	Redpoll	REDP	1	Rocky Heath	1	1				assumed pair
910	2012_RA303	Rock Ptarmigan	ROPT	1	Heath Hummock	1	1				
183	2012_UR1	Hoary Redpoll	HORE	1	Rocky Heath			1			landed in plot
182	2012_UR1	Horned Lark	HOLA	1	Rocky Heath			1			visually detected
180	2012_UR1	Lapland Longspur	LALO	1	Rocky Heath	1	1				female "nesty'
181	2012_UR1	Lapland Longspur	LALO	1	Rocky Heath	1					aerial display
184	2012_UR1	Lapland Longspur	LALO	1	Rocky Heath	1					
185	2012_UR1	Redpoll	REDP	1	Rocky Heath			1			calling from ground
150	2012_UR10	Horned Lark	HOLA	1	Heath Hummock	1					
146	2012_UR10	Lapland Longspur	LALO	1	Heath Hummock	1	1				
147	2012_UR10	Lapland Longspur	LALO	1	Heath Hummock	1	1				
148	2012_UR10	Lapland Longspur	LALO	1	Heath Hummock	1	1				

Appendix 6-2. Detections of Upland Breeding Birds and Nests in PRISM Plots

Data ID	Plot ID	Species	Species Code	Number of Territories	Habitat Type	Male	Female	Unknown Sex	Eggs	Young	Comments
151	2012_UR10	Lapland Longspur	LALO	1	Heath Hummock	1					
145	2012_UR10	Savannah Sparrow	SAVS	1	Heath Hummock	1	1		4		female flushed, maybe 1 m
149	2012_UR10	Semipalmated Sandpiper	SESA	1	Heath Hummock	1	1				in drier area on top of ridge, probably territory to west in wetter area
172	2012_UR3	Lapland Longspur	LALO	1	Heath Lichen	1	1				female flushed but didn't find nest
173	2012_UR3	Lapland Longspur	LALO	1	Heath Lichen	1					aerial display
175	2012_UR3	Lapland Longspur	LALO	1	Heath Lichen	1					visually detected
39	2012_UR4	American Golden Plover	AMGP	1	Heath Hummock	1	1				visual, assumed pair
37	2012_UR4	Lapland Longspur	LALO	1	Heath Hummock	1	1				visual
34	2012_UR4	Lapland Longspur	LALO	1	Short Shrub	1					visual
36	2012_UR4	Lapland Longspur	LALO	1	Short Shrub	1	1				visual
118	2012_UR6	American Golden Plover	AMGP	1	Rocky Heath	1	1				
111	2012_UR6	Horned Lark	HOLA	1	Rocky Heath	1	1				visually detected
112	2012_UR6	Lapland Longspur	LALO	1	Heath Hummock	1	1		4		discovered w/o flush; pair in area
123	2012_UR6	Lapland Longspur	LALO	1	Heath Hummock	1					
113	2012_UR6	Lapland Longspur	LALO	1	Rocky Heath	1	1		5		Female flushed
119	2012_UR6	Lapland Longspur	LALO	1	Rocky Heath	1					aerial display
120	2012_UR6	Lapland Longspur	LALO	1	Rocky Heath	1					aerial display
121	2012_UR6	Lapland Longspur	LALO	1	Rocky Heath	1					aerial display
114	2012_UR6	Savannah Sparrow	SAVS	1	Heath Hummock	1					
115	2012_UR6	Savannah Sparrow	SAVS	1	Heath Hummock	1					
116	2012_UR6	Savannah Sparrow	SAVS	1	Heath Hummock	1					
117	2012_UR6	Savannah Sparrow	SAVS	1	Sedge Meadow	1					visually detected
135	2012_UR7	American Pipit	AMPI	1	Rocky Heath	1	1				visually detected
136	2012_UR7	American Pipit	AMPI	1	Rocky Heath	1					visually detected
137	2012_UR7	American Pipit	AMPI	1	Rocky Heath	1					visually detected
138	2012_UR7	Harris' Sparrow	HASP	1	Heath Lichen	1					no visual, at edge of plot
133	2012_UR7	Horned Lark	HOLA	1	Rocky Heath	1	1				visually detected
134	2012_UR7	Horned Lark	HOLA	1	Rocky Heath	1	1				visually detected
157	2012_UR8	Horned Lark	HOLA	1	Heath Lichen	1	1				female seemed 'nesty', constantly foraging
154	2012_UR8	Lapland Longspur	LALO	1	Heath Hummock	1	1				
155	2012_UR8	Lapland Longspur	LALO	1	Heath Hummock	1	1				
156	2012_UR8	Lapland Longspur	LALO	1	Heath Hummock	1	1				
158	2012_UR8	Lapland Longspur	LALO	1	Heath Lichen	1	1				
159	2012_UR8	Lapland Longspur	LALO	1	Heath Lichen	1	1		4		female not incubating, probably still laying
161	2012_UR8	Redpoll	REDP	1	Heath Lichen			1			landed in plot, possibly territory in plot
25	2012_UR9	American Golden Plover	AMGP	1	Heath Hummock			1			
14	2012_UR9	Horned Lark	HOLA	1	Heath Hummock	1	1		4		did not see pair at nest (no flush cue), later spotted in vicinity of nest
22	2012_UR9	Horned Lark	HOLA	1	Heath Hummock	1					
23	2012_UR9	Horned Lark	HOLA	1	Heath Hummock			1			
13	2012_UR9	Lapland Longspur	LALO	1	Heath Hummock	1	1		5		female flushed 15 m
15	2012_UR9	Lapland Longspur	LALO	1	Heath Hummock	1	1				
16	2012_UR9	Lapland Longspur	LALO	1	Heath Hummock	1	1				
17	2012_UR9	Lapland Longspur	LALO	1	Heath Hummock	1					
21	2012_UR9	Lapland Longspur	LALO	1	Heath Hummock	1	1				male flew up to female
20	2012_UR9	Savannah Sparrow	SAVS	1	Heath Hummock	1	1				
27	2012_UR9	Savannah Sparrow	SAVS	1	Heath Hummock		1				no male in vicinity

Appendix 6-2. Detections of Upland Breeding Birds and Nests in PRISM Plots

Data ID	Plot ID	Species	Species Code	Number of Territories	Habitat Type	Male	Female	Unknown Sex	Eggs	Young	Comments
26	2012_UR9	Semipalmated Sandpiper	SESA	1	Heath Hummock			1			
292	2012_UT1	Lapland Longspur	LALO	1	Heath Hummock	1	1				visually detected
294	2012_UT1	Lapland Longspur	LALO	1	Heath Hummock	1					
293	2012_UT1	Lapland Longspur	LALO	1	Sedge Meadow	1	1				
299	2012_UT1	Lapland Longspur	LALO	1	Sedge Meadow	1					visually detected
296	2012_UT1	Redpoll	REDP	1	Esker	1	1				flushed from boulder, 2 m
295	2012_UT1	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
297	2012_UT1	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
298	2012_UT1	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
89	2012_UT10	Horned Lark	HOLA	1	Rocky Heath	1					visually detected
88	2012_UT10	Lapland Longspur	LALO	1	Rocky Heath	1					visually detected
90	2012_UT10	Lapland Longspur	LALO	1	Rocky Heath	1					visually detected
258	2012_UT12	Hoary Redpoll	HORE	1	Rocky Heath	1	1				
266	2012_UT12	Horned Lark	HOLA	1	Heath Lichen	1	1				
265	2012_UT12	Horned Lark	HOLA	1	Rocky Heath	1	1				visually detected
263	2012_UT12	Lapland Longspur	LALO	1	Heath Lichen	1					aerial display
262	2012_UT12	Lapland Longspur	LALO	1	Rocky Heath	1					
264	2012_UT12	Lapland Longspur	LALO	1	Rocky Heath	1					aerial display
259	2012_UT12	Redpoll	REDP	1	Heath Lichen	1	1				
260	2012_UT12	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
261	2012_UT12	Savannah Sparrow	SAVS	1	Sedge Meadow	1					
247	2012_UT4	American Golden Plover	AMGP	1	Rocky Heath	1	1				male flight call
251	2012_UT4	Horned Lark	HOLA	1	Rocky Heath	1					
244	2012_UT4	Lapland Longspur	LALO	1	Heath Lichen		1				flushed up but no nest
245	2012_UT4	Lapland Longspur	LALO	1	Heath Lichen		1				no male nearby
241	2012_UT4	Lapland Longspur	LALO	1	Rocky Heath	1	1				visually detected
242	2012_UT4	Lapland Longspur	LALO	1	Rocky Heath	1	1				visually detected
243	2012_UT4	Lapland Longspur	LALO	1	Rocky Heath	1	1				visually detected
249	2012_UT4	Lapland Longspur	LALO	1	Rocky Heath	1					visually detected
248	2012_UT4	Lapland Longspur	LALO	1	Heath Hummock		1				visually detected
240	2012_UT4	Red-necked Phalarope	RNPH	1	Heath Lichen		1				twirling around in small pool of water, feeding
246	2012_UT4	Rock Ptarmigan	ROPT	1	Rocky Heath	1					visually detected
236	2012_UT4	Savannah Sparrow	SAVS	1	Heath Hummock	1	1				visually detected
237	2012_UT4	Savannah Sparrow	SAVS	1	Heath Hummock	1	1				visually detected
234	2012_UT4	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				visually detected
235	2012_UT4	Savannah Sparrow	SAVS	1	Sedge Meadow	1	1				visually detected
238	2012_UT4	Savannah Sparrow	SAVS	1	Sedge Meadow	1					no female
250	2012_UT4	Semipalmated Sandpiper	SESA	1	Sedge Meadow	1					
239	2012_UT4	Wilson's Snipe	WISN	1	Rocky Heath	1	1				male calling stridently
320	2012_UT5	Harris' Sparrow	HASP	1	Rocky Heath	1					visually detected
322	2012_UT5	Horned Lark	HOLA	1	Rocky Heath	1					
324	2012_UT5	Horned Lark	HOLA	1	Rocky Heath			1			visually detected
325	2012_UT5	Horned Lark	HOLA	1	Rocky Heath	1	1				visually detected
327	2012_UT5	Horned Lark	HOLA	1	Rocky Heath	1	1				visually detected
321	2012_UT5	Lapland Longspur	LALO	1	Rocky Heath	1	1				visually detected
319	2012_UT5	Least Sandpiper	LESA	1	Sedge Meadow		1		4		flushed at 3 m overhang on nest, edge of sedge meadow

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Data ID	Plot ID	Species	Species Code	Number of Territories	Habitat Type	Male	Female	Unknown Sex	Eggs	Young	Comments
326	2012_UT5	Redpoll	REDP	1	Rocky Heath	1					visually detected
195	2012_UT9	Horned Lark	HOLA	1	Rocky Heath	1					
190	2012_UT9	Lapland Longspur	LALO	1	Rocky Heath	1	1				aerial display
191	2012_UT9	Lapland Longspur	LALO	1	Rocky Heath	1					aerial display
192	2012_UT9	Lapland Longspur	LALO	1	Rocky Heath	1					aerial display
193	2012_UT9	Lapland Longspur	LALO	1	Rocky Heath	1					aerial display
194	2012_UT9	Lapland Longspur	LALO	1	Rocky Heath	1					aerial display
199	2012_UT9	Lapland Longspur	LALO	1	Rocky Heath	1					
196	2012_UT9	Lapland Longspur	LALO	1	Sedge Meadow	1					
200	2012_UT9	Lapland Longspur	LALO	1	Sedge Meadow	1					
201	2012_UT9	Redpoll	REDP	1	Heath Lichen		1		5		female flushed at 1m at base of small willow
198	2012_UT9	Rock Ptarmigan	ROPT	1	Rocky Heath	1					
197	2012_UT9	Semipalmated Sandpiper	SESA	1	Sedge Meadow	1	1				no nest seen, but acting territorial
411	2012_BI2	Hoary Redpoll	HORE	2	Short Shrub			3			very shrubby
408	2012_BI2	Lapland Longspur	LALO	2	Heath Lichen	2					
401	2012_BI2	Savannah Sparrow	SAVS	2	Beach	2					visually detected
450	2012_BI3	American Tree Sparrow	ATSP	2	Short Shrub	2					
449	2012_BI3	Savannah Sparrow	SAVS	2	Heath Lichen	2					with some short shrub
448	2012_BI3	Savannah Sparrow	SAVS	2	Sedge Meadow	2					visually detected
472	2012_BI4	American Tree Sparrow	ATSP	2	Tall Shrub	2					
477	2012_BI4	Lapland Longspur	LALO	2	Heath Lichen	2					calling and singing
547	2012_BI5	American Tree Sparrow	ATSP	2	Tall Shrub	2					
539	2012_BI5	Lapland Longspur	LALO	2	Sedge Meadow	2					
553	2012_BI5	Redpoll	REDP	2	Tall Shrub			3			
2	2012_LR2	Lapland Longspur	LALO	2	Heath Hummock	2	1				one pair and adjacent male
494	2012_LR21	Savannah Sparrow	SAVS	2	Sedge Meadow	2					visually detected
522	2012_LR6	Lapland Longspur	LALO	2	Rocky Heath	2					visually detected
229	2012_LR8	Lapland Longspur	LALO	2	Heath Hummock	2					no females
227	2012_LR8	Semipalmated Sandpiper	SESA	2	Sedge Meadow			3			flew into wet rocky area (drainage); perched and preened then flew off down rocky drainage to south
570	2012_LSA22	Lapland Longspur	LALO	2	Heath Hummock	2					
566	2012_LSA22	Savannah Sparrow	SAVS	2	Heath Hummock	2					
711	2012_LSA30	Savannah Sparrow	SAVS	2	Heath Hummock	2					
683	2012_LSA300	American Tree Sparrow	ATSP	2	Short Shrub	2					
638	2012_LSA304	Lapland Longspur	LALO	2	Heath Hummock	2					no noise
637	2012_LSA304	Lapland Longspur	LALO	2	Sedge Meadow	2					
631	2012_LSA304	Red-necked Phalarope	RNPH	2	Water	2	1				male chasing each other, one pair in mix
628	2012_LSA304	Savannah Sparrow	SAVS	2	Sedge Meadow	2					visually detected
805	2012_LSA305	Lapland Longspur	LALO	2	Heath Lichen	2					
806	2012_LSA305	Lapland Longspur	LALO	2	Sedge Meadow	2					
854	2012_LSA307	Lapland Longspur	LALO	2	Heath Lichen	2					
103	2012_LT11	Redpoll	REDP	2	Heath Lichen			3			probably using plot
77	2012_LT12	Lapland Longspur	LALO	2	Heath Lichen	2					visually detected
67	2012_LT6	Lapland Longspur	LALO	2	Short Shrub	2					flew into plot at edge
306	2012_LT9	Savannah Sparrow	SAVS	2	Sedge Meadow	2					one male spotted
863	2012_RA301	Lapland Longspur	LALO	2	Short Shrub	2					territorial
878	2012_RA301	Redpoll	REDP	2	Short Shrub			3			

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Data ID	Plot ID	Species	Species Code	Number of Territories	Habitat Type	Male	Female	Unknown Sex	Eggs	Young	Comments
906	2012_RA303	Lapland Longspur	LALO	2	Rocky Heath	2					
38	2012_UR4	Lapland Longspur	LALO	2	Heath Hummock	2					visual
160	2012_UR8	Lapland Longspur	LALO	2	Heath Lichen	2					
24	2012_UR9	Horned Lark	HOLA	2	Heath Hummock	2					agression, flying at one another
323	2012_UT5	Lapland Longspur	LALO	2	Rocky Heath	2					singing 5 m apart
428	2012_BI1	American Tree Sparrow	ATSP	3	Sedge Meadow	3					
3	2012_LR2	Lapland Longspur	LALO	3	Sedge Meadow	3	1				one pair with two adjacent male territories
752	2012_LSA302	Lapland Longspur	LALO	3	Heath Lichen	3					
818	2012_LSA305	Savannah Sparrow	SAVS	3	Sedge Meadow	3					on male in a little bit of wetter, muddy area
99	2012_LT11	Lapland Longspur	LALO	3	Heath Lichen	3					visually detected
333	2012_LT24	Savannah Sparrow	SAVS	3	Sedge Meadow	3					no females seen
174	2012_UR3	Lapland Longspur	LALO	3	Heath Lichen	3					
32	2012_UR4	Lapland Longspur	LALO	3	Rocky Heath	3					visual
33	2012_UR4	Lapland Longspur	LALO	3	Short Shrub	3					visual
19	2012_UR9	Lapland Longspur	LALO	3	Heath Hummock	3					flying around in souteastern corner of plot
552	2012_BI5	Common Redpoll	CORE	unknown	Tall Shrub			7			likely multiple pairs of birds in group
4	2012_LR2	Lapland Longspur	LALO	unknown	Heath Hummock	7					all either singing or calling
499	2012_LR21	Lapland Longspur	LALO	unknown	Heath Hummock	5					
500	2012_LR21	Lapland Longspur	LALO	unknown	Rocky Heath	5					
343	2012_LT24	Lapland Longspur	LALO	unknown	Rocky Heath	7					
309	2012_LT9	Lapland Longspur	LALO	unknown	Sedge Meadow	4					most males calling
122	2012_UR6	Lapland Longspur	LALO	unknown	Rocky Heath	5					
18	2012_UR9	Lapland Longspur	LALO	unknown	Heath Hummock	6					

Appendix 6-3

Detections of Upland Breeding Birds Outside of PRISM Plot Boundaries

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Appendix 6-3. Detections of Upland Breeding Birds Outside of PRISM Plot Boundaries

ID	Plot ID	Species	Species Code	Male	Female	Unknown Sex
502	2012_LR21	American Golden Plover	AMGP			1
727	2012_LSA30	American Golden Plover	AMGP			1
694	2012_LSA300	American Golden Plover	AMGP			1
828	2012_LSA305	American Golden Plover	AMGP			1
104	2012_LT11	American Golden Plover	AMGP			1
85	2012_LT12	American Golden Plover	AMGP			1
882	2012_RA301	American Golden Plover	AMGP			2
186	2012_UR1	American Golden Plover	AMGP			1
165	2012_UR8	American Golden Plover	AMGP			1
204	2012_UT9	American Golden Plover	AMGP			1
143	2012_UR7	American Pipit	AMPI	1		
433	2012_BI1	American Tree Sparrow	ATSP	1		
414	2012_BI2	American Tree Sparrow	ATSP	1		
466	2012_BI3	American Tree Sparrow	ATSP	2		
482	2012_BI4	American Tree Sparrow	ATSP	1		
559	2012_BI5	American Tree Sparrow	ATSP	1		
666	2012_LSA14	American Tree Sparrow	ATSP	1		
772	2012_LSA19	American Tree Sparrow	ATSP	1		
728	2012_LSA30	American Tree Sparrow	ATSP	1		
757	2012_LSA302	American Tree Sparrow	ATSP	1		
645	2012_LSA304	American Tree Sparrow	ATSP	1		
608	2012_LSA7	American Tree Sparrow	ATSP	1		
886	2012_RA301	American Tree Sparrow	ATSP	1		
769	2012_LSA19	Harris' Sparrow	HASP	1		
897	2012_RA302	Harris' Sparrow	HASP	1		
141	2012_UR7	Harris' Sparrow	HASP	1		
304	2012_UT1	Harris' Sparrow	HASP	1		
272	2012_UT12	Harris' Sparrow	HASP	1		
692	2012_LSA300	Horned Lark	HOLA	1		
693	2012_LSA300	Horned Lark	HOLA	1	1	
747	2012_LSA303	Horned Lark	HOLA	1		
837	2012_LSA305	Horned Lark	HOLA			1
105	2012_LT11	Horned Lark	HOLA			1
366	2012_LT21	Horned Lark	HOLA			2
348	2012_LT24	Horned Lark	HOLA	1		
65	2012_LT6	Horned Lark	HOLA	1		
915	2012_RA303	Horned Lark	HOLA	1		
188	2012_UR1	Horned Lark	HOLA	1		
128	2012_UR6	Horned Lark	HOLA	1		
130	2012_UR6	Horned Lark	HOLA			1
131	2012_UR6	Horned Lark	HOLA			1
167	2012_UR8	Horned Lark	HOLA	1	1	
28	2012_UR9	Horned Lark	HOLA	1		
303	2012_UT1	Horned Lark	HOLA	1		

Appendix 6-3. Detections of Upland Breeding Birds Outside of PRISM Plot Boundaries

ID	Plot ID	Species	Species Code	Male	Female	Unknown Sex
92	2012_UT10	Horned Lark	HOLA	1		
330	2012_UT5	Horned Lark	HOLA	1		
205	2012_UT9	Horned Lark	HOLA	2		
558	2012_BI5	Lapland Longspur	LALO	1		
7	2012_LR2	Lapland Longspur	LALO	2		
8	2012_LR2	Lapland Longspur	LALO	1		
232	2012_LR8	Lapland Longspur	LALO	2		
665	2012_LSA14	Lapland Longspur	LALO	2		
771	2012_LSA19	Lapland Longspur	LALO	1		
574	2012_LSA22	Lapland Longspur	LALO	1		
623	2012_LSA26	Lapland Longspur	LALO	4		
730	2012_LSA30	Lapland Longspur	LALO	1		
697	2012_LSA300	Lapland Longspur	LALO	1	1	
698	2012_LSA300	Lapland Longspur	LALO	1		
708	2012_LSA301	Lapland Longspur	LALO	2		
758	2012_LSA302	Lapland Longspur	LALO	1		
760	2012_LSA302	Lapland Longspur	LALO	1		
746	2012_LSA303	Lapland Longspur	LALO	2		
647	2012_LSA304	Lapland Longspur	LALO	2		
648	2012_LSA304	Lapland Longspur	LALO	1		
829	2012_LSA305	Lapland Longspur	LALO	1		
836	2012_LSA305	Lapland Longspur	LALO	1		
861	2012_LSA307	Lapland Longspur	LALO	1		
609	2012_LSA7	Lapland Longspur	LALO	2		
82	2012_LT12	Lapland Longspur	LALO	1		
83	2012_LT12	Lapland Longspur	LALO	1		
368	2012_LT21	Lapland Longspur	LALO	1		
290	2012_LT22	Lapland Longspur	LALO	1		
291	2012_LT22	Lapland Longspur	LALO	1		
349	2012_LT24	Lapland Longspur	LALO	1		
386	2012_LT25	Lapland Longspur	LALO	1		
64	2012_LT6	Lapland Longspur	LALO	1		
313	2012_LT9	Lapland Longspur	LALO	2		
314	2012_LT9	Lapland Longspur	LALO	1		
917	2012_RA303	Lapland Longspur	LALO	1		
189	2012_UR1	Lapland Longspur	LALO	2		
152	2012_UR10	Lapland Longspur	LALO	1		
153	2012_UR10	Lapland Longspur	LALO	1		
179	2012_UR3	Lapland Longspur	LALO	3		
43	2012_UR4	Lapland Longspur	LALO	2		
129	2012_UR6	Lapland Longspur	LALO	1		
168	2012_UR8	Lapland Longspur	LALO	3		
170	2012_UR8	Lapland Longspur	LALO	1	1	
30	2012_UR9	Lapland Longspur	LALO	1		

Appendix 6-3. Detections of Upland Breeding Birds Outside of PRISM Plot Boundaries

ID	Plot ID	Species	Species Code	Male	Female	Unknown Sex
93	2012_UT10	Lapland Longspur	LALO	2		
256	2012_UT4	Lapland Longspur	LALO	2		
206	2012_UT9	Lapland Longspur	LALO	1		
207	2012_UT9	Lapland Longspur	LALO	1		
208	2012_UT9	Lapland Longspur	LALO	1	1	
696	2012_LSA300	Least Sandpiper	LESA			1
610	2012_LSA7	Least Sandpiper	LESA			1
916	2012_RA303	Least Sandpiper	LESA			1
469	2012_BI3	Redpoll	REDP		1	
166	2012_UR8	Redpoll	REDP			1
434	2012_BI1	Redpoll	REDP	1	1	
460	2012_BI3	Redpoll	REDP			3
470	2012_BI3	Redpoll	REDP			2
480	2012_BI4	Redpoll	REDP			2
554	2012_BI5	Redpoll	REDP			6
9	2012_LR2	Redpoll	REDP			1
504	2012_LR21	Redpoll	REDP			1
527	2012_LR6	Redpoll	REDP			3
231	2012_LR8	Redpoll	REDP			1
662	2012_LSA14	Redpoll	REDP			2
571	2012_LSA22	Redpoll	REDP			1
622	2012_LSA26	Redpoll	REDP			1
724	2012_LSA30	Redpoll	REDP			3
691	2012_LSA300	Redpoll	REDP			2
705	2012_LSA301	Redpoll	REDP			2
755	2012_LSA302	Redpoll	REDP			2
644	2012_LSA304	Redpoll	REDP			2
826	2012_LSA305	Redpoll	REDP			2
860	2012_LSA307	Redpoll	REDP			2
603	2012_LSA7	Redpoll	REDP			3
81	2012_LT12	Redpoll	REDP			1
367	2012_LT21	Redpoll	REDP			1
286	2012_LT22	Redpoll	REDP			3
345	2012_LT24	Redpoll	REDP			3
62	2012_LT6	Redpoll	REDP			3
797	2012_RA300	Redpoll	REDP			5
880	2012_RA301	Redpoll	REDP			3
913	2012_RA303	Redpoll	REDP			1
187	2012_UR1	Redpoll	REDP			2
176	2012_UR3	Redpoll	REDP			2
41	2012_UR4	Redpoll	REDP			1
42	2012_UR4	Redpoll	REDP			1
126	2012_UR6	Redpoll	REDP			2
139	2012_UR7	Redpoll	REDP			1

Appendix 6-3. Detections of Upland Breeding Birds Outside of PRISM Plot Boundaries

ID	Plot ID	Species	Species Code	Male	Female	Unknown Sex
164	2012_UR8	Redpoll	REDP			3
301	2012_UT1	Redpoll	REDP			1
91	2012_UT10	Redpoll	REDP			3
267	2012_UT12	Redpoll	REDP			2
252	2012_UT4	Redpoll	REDP			2
328	2012_UT5	Redpoll	REDP			3
202	2012_UT9	Redpoll	REDP			3
416	2012_BI2	Red-necked Phalarope	RNPH	1	1	
621	2012_LSA26	Red-necked Phalarope	RNPH			1
127	2012_UR6	Rock Ptarmigan	ROPT			1
464	2012_BI3	Savannah Sparrow	SAVS	1		
465	2012_BI3	Savannah Sparrow	SAVS			1
479	2012_BI4	Savannah Sparrow	SAVS		1	
484	2012_BI4	Savannah Sparrow	SAVS	2		
557	2012_BI5	Savannah Sparrow	SAVS	3		
517	2012_LR20	Savannah Sparrow	SAVS	1		
220	2012_LR3	Savannah Sparrow	SAVS	1		
233	2012_LR8	Savannah Sparrow	SAVS	1		
667	2012_LSA14	Savannah Sparrow	SAVS	1		
770	2012_LSA19	Savannah Sparrow	SAVS	1		
581	2012_LSA200	Savannah Sparrow	SAVS	1		
573	2012_LSA22	Savannah Sparrow	SAVS	1		
729	2012_LSA30	Savannah Sparrow	SAVS	2		
695	2012_LSA300	Savannah Sparrow	SAVS	1		
707	2012_LSA301	Savannah Sparrow	SAVS	1		
759	2012_LSA302	Savannah Sparrow	SAVS	1		
646	2012_LSA304	Savannah Sparrow	SAVS	3		
835	2012_LSA305	Savannah Sparrow	SAVS	2		
607	2012_LSA7	Savannah Sparrow	SAVS	3		
84	2012_LT12	Savannah Sparrow	SAVS	1		
289	2012_LT22	Savannah Sparrow	SAVS	1		
350	2012_LT24	Savannah Sparrow	SAVS	1		
63	2012_LT6	Savannah Sparrow	SAVS			2
802	2012_RA300	Savannah Sparrow	SAVS		1	
803	2012_RA300	Savannah Sparrow	SAVS	1	1	
804	2012_RA300	Savannah Sparrow	SAVS	1		
885	2012_RA301	Savannah Sparrow	SAVS	1		
914	2012_RA303	Savannah Sparrow	SAVS	1	1	
178	2012_UR3	Savannah Sparrow	SAVS	1		
44	2012_UR4	Savannah Sparrow	SAVS	1		
142	2012_UR7	Savannah Sparrow	SAVS	1		
169	2012_UR8	Savannah Sparrow	SAVS	1		
302	2012_UT1	Savannah Sparrow	SAVS	1		
271	2012_UT12	Savannah Sparrow	SAVS	1		

Appendix 6-3. Detections of Upland Breeding Birds Outside of PRISM Plot Boundaries

ID	Plot ID	Species	Species Code	Male	Female	Unknown Sex
254	2012_UT4	Savannah Sparrow	SAVS	2		
255	2012_UT4	Savannah Sparrow	SAVS			1
329	2012_UT5	Savannah Sparrow	SAVS	1		
209	2012_UT9	Savannah Sparrow	SAVS	2		
439	2012_BI1	Semipalmated Plover	SEPL			1
485	2012_BI4	Semipalmated Plover	SEPL			1
435	2012_BI1	Semipalmated Sandpiper	SESA			5
468	2012_BI3	Semipalmated Sandpiper	SESA			1
486	2012_BI4	Semipalmated Sandpiper	SESA			1
210	2012_LR3	Semipalmated Sandpiper	SESA	1	1	
827	2012_LSA305	Semipalmated Sandpiper	SESA			1
108	2012_LT11	Semipalmated Sandpiper	SESA			2
312	2012_LT9	Semipalmated Sandpiper	SESA			1
706	2012_LSA301	Stilt Sandpiper	STSA			1
467	2012_BI3	White-crowned Sparrow	WCSP	1		
481	2012_BI4	Wilson's Snipe	WISN	1		
556	2012_BI5	Wilson's Snipe	WISN	1		
881	2012_RA301	Wilson's Snipe	WISN	1		
222	2012_LR3	Long-tailed Jaeger	LTJA			1
690	2012_LSA300	Long-tailed Jaeger	LTJA			1
316	2012_LT9	Long-tailed Jaeger	LTJA			1
912	2012_RA303	Long-tailed Jaeger	LTJA			1
664	2012_LSA14	Parasitic Jaeger	PAJA			1
651	2012_LSA304	Parasitic Jaeger	PAJA			1
107	2012_LT11	Parasitic Jaeger	PAJA			1
45	2012_UR4	Parasitic Jaeger	PAJA			1
257	2012_UT4	Parasitic Jaeger	PAJA			1

Appendix 7-1

Waterbird Aerial Survey Details, 2012

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Appendix 7-1. Waterbird Aerial Survey Details, 2012

Survey Type	Date	Region	Survey Area	Start	End	Time off Transect (min)	Total Survey Time (min)	Temp. (°C)	Weather	Cloud Cover (%)	Wind (km/hr)	Lighting
Spring Staging	29-May-12	Goose	Focused	2:48:00 PM	3:57:00 PM	7	62	10	Sunny	0	10 NW	Variable
Spring Staging	29-May-12	Goose	Reference	4:27:00 PM	5:35:00 PM	7	61	10	Sunny	0	10 NW	Bright
Spring Staging	29-May-12	George	Focused	12:36:00 PM	1:46:00 PM	8	62	10	Sunny	0	10 NW	Variable
Spring Staging	29-May-12	George	Reference	10:08:00 AM	11:17:00 AM	7	62	10	Sunny	0	10 NW	Variable
Spring Pair	22-Jun-12	Goose	Focused	10:29:00 AM	11:42:00 AM	8	65	8	Cloudy	95	10 NW	Flat
Spring Pair	22-Jun-12	Goose	Reference	12:52:00 PM	1:65:00 PM	8	65	11	Partly Cloudy	60	20 NW	Bright
Spring Pair	23-Jun-12	George	Focused	1:03:00 PM	2:15:00 PM	10	62	18	Cloudy	100	15-20 NW	Flat
Spring Pair	23-Jun-12	George	Reference	10:52:00 AM	12:01:00 PM	7	62	18	Sunny	5	10-15 NW	Bright
Summer Brood	14-Jul-12	Goose	Focused	11:14:00 AM	12:23:00 PM	8	61	14	Sunny	5	5 NE	Bright
Summer Brood	14-Jul-12	Goose	Reference	8:20:00 AM	9:42:00 AM	7	75	11	Sunny	5	8 NE	Bright
Summer Brood	15-Jul-12	George	Focused	10:13:00 AM	11:25:00 AM	8	64	16	Sunny	5	5 SW	Bright
Summer Brood	14-Jul-12	George	Reference	3:38:00 PM	4:50:00 PM	7	65	18	Sunny	5	10 NW	Bright
Summer Brood	15-Jul-12	Bathurst Inlet	Focused	1:05:00 PM	1:25:00 PM	0	25	19	Sunny	2	5 NW	Bright
Fall Staging	25-Aug-12	Goose	Focused	2:02:00 PM	3:21:00 PM	11	68	10	Partly Sunny		5 SSE	Flat/Patchy
Fall Staging	25-Aug-12	Goose	Reference	4:09:00 PM	5:27:00 PM	10	68	13	Cloudy		5 SSE	Flat
Fall Staging	25-Aug-12	George	Focused	11:02:00 AM	12:26:00 PM	9	75	8	Partly Sunny		5 SSE	Flat/Patchy
Fall Staging	25-Aug-12	George	Reference	9:00:00 AM	10:12:00 AM	9	63	8	Cloudy		5 SSE	Patchy
Fall Staging	27-Aug-12	Bathurst Inlet	Focused	3:04:00 PM	4:32:00 PM	0	92	10	Cloudy	100	10 SW	Flat

Appendix 7-2

Waterbird Observation Data, Aerial Surveys, 2012

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Appendix 7-2. Waterbird Observation Data, Aerial Surveys, 2012

Date	Survey	Region	Survey Strata	Transect	Distance	WPT	Zone	Easting	Northing	Species	Scientific Name	Species Code	No. Drakes	No. Hens	No. Unknown	No. Pairs	Breeding	No. Young	Young Class	Total	Habitat	Habitat Size	Behaviour	Comments
29-May-12	Spring Staging	George	Reference	1						n/a										0				no observations
29-May-12	Spring Staging	George	Reference	2	< 400 m	002	13 W	392583	7333451	Greater White-fronted Goose	*Anser albifrons*	GWFG				1				2	HT		F/O	
29-May-12	Spring Staging	George	Reference	3	< 400 m	003	13 W	383874	7331550	Canada Goose	*Branta canadensis*	CAGO				2				4	LK	Medium	F/O	
29-May-12	Spring Staging	George	Reference	3	< 400 m	004	13 W	388166	7331319	Glaucous Gull	*Larus hyperboreus*	GLGU			5					5	LK	Large	F/O	
29-May-12	Spring Staging	George	Reference	4						n/a										0				no observations
29-May-12	Spring Staging	George	Reference	5	< 400 m	005	13 W	386384	7327268	Glaucous Gull	*Larus hyperboreus*	GLGU			1					1	LK	Large	F/O	
29-May-12	Spring Staging	George	Reference	6						n/a										0				no observations
29-May-12	Spring Staging	George	Reference	7	< 400 m					n/a										0				no observations
29-May-12	Spring Staging	George	Reference	8	< 400 m					n/a										0				no observations
29-May-12	Spring Staging	George	Focused	9	< 400 m	008	13 W	392312	7318927	Herring Gull	*Larus argentatus*	HEGU			1					1	LK	Large	F/O	
29-May-12	Spring Staging	George	Focused	9	< 400 m	009	13 W	394057	7318879	Canada Goose	*Branta canadensis*	CAGO			3					3	SL	Medium		
29-May-12	Spring Staging	George	Focused	10	< 400 m	010	13 W	385114	7316998	Snow Goose	*Chen caerulescens*	SNGO				1				2	LK	Large		
29-May-12	Spring Staging	George	Focused	10	< 400 m	010	13 W	385114	7316998	Canada Goose	*Branta canadensis*	CAGO			30					30	LK	Large		
29-May-12	Spring Staging	George	Focused	11	< 400 m	012	13 W	385392	7314786	Herring Gull	*Larus argentatus*	HEGU			1					1	LK	Large		sitting on ice
29-May-12	Spring Staging	George	Focused	12	< 400 m	014	13 W	384699	7313022	Herring Gull	*Larus argentatus*	HEGU			1					1	LK	Medium		
29-May-12	Spring Staging	George	Focused	13						n/a										0				no observations
29-May-12	Spring Staging	George	Focused	14	< 400 m	015	13 W	391221	7308970	Herring Gull	*Larus argentatus*	HEGU			1					1	LK	Large		
29-May-12	Spring Staging	George	Focused	15	< 400 m	016	13 W	387025	7306864	Tundra Swan	*Cygnus columbianus*	TUSW			2					2	WT	Small		
29-May-12	Spring Staging	George	Focused	15	< 400 m	017	13 W	388693	7306849	Greater White-fronted Goose	*Anser albifrons*	GWFG			2					2	HT		F/O	
29-May-12	Spring Staging	George	Focused	15	< 400 m	018	13 W	389681	7306840	Greater White-fronted Goose	*Anser albifrons*	GWFG			2					2	HT			sitting
29-May-12	Spring Staging	George	Focused	16	< 400 m	019	13 W	391886	7304946	Canada Goose	*Branta canadensis*	CAGO			8					8			F/O	
29-May-12	Spring Staging	George	Focused	16	< 400 m	020	13 W	388676	7304992	Greater White-fronted Goose	*Anser albifrons*	GWFG			7					7			F/O	
29-May-12	Spring Staging	George	Focused	16	< 400 m	020	13 W	388676	7304992	Herring Gull	*Larus argentatus*	HEGU			2					2			F/O	
29-May-12	Spring Staging	Goose	Focused	1	< 400 m	023	13 W	428839	7276737	Greater White-fronted Goose	*Anser albifrons*	GWFG			3					3	HT		F/O	
29-May-12	Spring Staging	Goose	Focused	1	< 400 m	024	13 W	429749	7276751	Greater White-fronted Goose	*Anser albifrons*	GWFG			3					3	HT		F/O	flushed
29-May-12	Spring Staging	Goose	Focused	1	< 400 m	025	13 W	431674	7276745	Greater White-fronted Goose	*Anser albifrons*	GWFG			9					9	LK	Large	F/O	
29-May-12	Spring Staging	Goose	Focused	2	< 400 m	027	13 W	431313	7274874	Greater White-fronted Goose	*Anser albifrons*	GWFG			6					6	LK	Medium	F/O	flushed
29-May-12	Spring Staging	Goose	Focused	2	< 400 m	028	13 W	423097	7274858	Canada Goose	*Branta canadensis*	CAGO			3					3	LK	Large	F/O	
29-May-12	Spring Staging	Goose	Focused	2	< 400 m	029	13 W	421977	7274955	Greater White-fronted Goose	*Anser albifrons*	GWFG			6					6	HT		F/O	
29-May-12	Spring Staging	Goose	Focused	3	< 400 m	031	13 W	426092	7272736	Canada Goose	*Branta canadensis*	CAGO			4					4	HT		F/O	
29-May-12	Spring Staging	Goose	Focused	4	< 400 m	032	13 W	422312	7270913	Canada Goose	*Branta canadensis*	CAGO				1				2	LK	Large		< 500m
29-May-12	Spring Staging	Goose	Focused	5	< 400 m	033	13 W	422817	7268835	Canada Goose	*Branta canadensis*	CAGO			2					2	HT		F/O	
29-May-12	Spring Staging	Goose	Focused	5	< 400 m	034	13 W	427953	7268832	Greater White-fronted Goose	*Anser albifrons*	GWFG			1					1	LK	Medium	F/O	
29-May-12	Spring Staging	Goose	Focused	5	< 400 m	034	13 W	427953	7268832	Northern pintail	*Anas acuta*	NOPI			1					1	LK	Medium	F/O	
29-May-12	Spring Staging	Goose	Focused	5	< 400 m	035	13 W	432396	7268881	Canada Goose	*Branta canadensis*	CAGO			4					4	HT			flushed
29-May-12	Spring Staging	Goose	Focused	6	< 400 m	036	13 W	433883	7266796	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA			1					1	HT		F/O	
29-May-12	Spring Staging	Goose	Focused	6	< 400 m	037	13 W	432970	7266784	Greater White-fronted Goose	*Anser albifrons*	GWFG				1				2	HT		F/O	
29-May-12	Spring Staging	Goose	Focused	6	< 400 m	038	13 W	432638	7266796	Canada Goose	*Branta canadensis*	CAGO			4					4	LK	Large	F/O	landed on lake
29-May-12	Spring Staging	Goose	Focused	6	< 400 m	039	13 W	428077	7266911	Greater White-fronted Goose	*Anser albifrons*	GWFG			4					4	HT			flushed
29-May-12	Spring Staging	Goose	Focused	6	< 400 m	040	13 W	427241	7266902	Canada Goose	*Branta canadensis*	CAGO				1				2	HT			flushed
29-May-12	Spring Staging	Goose	Focused	6	< 400 m	041	13 W	421406	7266920	Greater White-fronted Goose	*Anser albifrons*	GWFG			27					27	LK	Small		flushed
29-May-12	Spring Staging	Goose	Focused	7	< 400 m	044	13 W	423472	7264746	Greater White-fronted Goose	*Anser albifrons*	GWFG			26					26	HT		F/O	
29-May-12	Spring Staging	Goose	Focused	7	< 400 m	045	13 W	424499	7264738	Gadwall	*Anas strepera*	GADW				1				2	LK	Large		
29-May-12	Spring Staging	Goose	Focused	7	< 400 m	046	13 W	429649	7264762	Unknown Duck	*Unknown Duck*	UNDU			1					1	LK	Medium		unknown duck
29-May-12	Spring Staging	Goose	Focused	8	< 400 m	048	13 W	434200	7262770	Canada Goose	*Branta canadensis*	CAGO				1				2	HT		F/O	
29-May-12	Spring Staging	Goose	Focused	8	< 400 m	049	13 W	429312	7262945	Greater White-fronted Goose	*Anser albifrons*	GWFG			9					9	HT			flushed
29-May-12	Spring Staging	Goose	Focused	8	< 400 m	050	13 W	423554	7262973	Canada Goose	*Branta canadensis*	CAGO				1				2	HT			flushed
29-May-12	Spring Staging	Goose	Reference	9	< 400 m	052	13 W	428901	7260324	Snow Goose	*Chen caerulescens*	SNGO			100					100	LK	Large	F/O	
29-May-12	Spring Staging	Goose	Reference	10	< 400 m	053	13 W	429231	7258376	Snow Goose	*Chen caerulescens*	SNGO			63					63	HT		F/O	
29-May-12	Spring Staging	Goose	Reference	10	< 400 m	053	13 W	429231	7258376	Canada Goose	*Branta canadensis*	CAGO				1				2	HT		F/O	
29-May-12	Spring Staging	Goose	Reference	10	< 400 m	054	13 W	426770	7257232	Canada Goose	*Branta canadensis*	CAGO			54					54	HT		F/O	
29-May-12	Spring Staging	Goose	Reference	11	< 400 m	056	13 W	431173	7256207	Snow Goose	*Chen caerulescens*	SNGO			4					4	SL		F/O	
29-May-12	Spring Staging	Goose	Reference	12	< 400 m	057	13 W	438566	7254322	Herring Gull	*Larus argentatus*	HEGU			2					2	LK	Medium	F/O	
29-May-12	Spring Staging	Goose	Reference	12	< 400 m	058	13 W	431469	7254362	Greater White-fronted Goose	*Anser albifrons*	GWFG			6					6	HT		F/O	
29-May-12	Spring Staging	Goose	Reference	12	< 400 m	058	13 W	431469	7254362	Canada Goose	*Branta canadensis*	CAGO			4					4	HT		F/O	

Appendix 7-2. Waterbird Observation Data, Aerial Surveys, 2012

Date	Survey	Region	Survey Strata	Transect	Distance	WPT	Zone	Easting	Northing	Species	Scientific Name	Species Code	No. Drakes	No. Hens	No. Unknown	No. Pairs	Breeding	No. Young	Young Class	Total	Habitat	Habitat Size	Behaviour	Comments
29-May-12	Spring Staging	Goose	Reference	12	< 400 m	059	13 W	430888	7254371	Greater White-fronted Goose	*Anser albifrons*	GWFG			3					3	LK	Small	F/O	
29-May-12	Spring Staging	Goose	Reference	13	< 400 m	061	13 W	428164	7252234	Canada Goose	*Branta canadensis*	CAGO				1				2	LK	Large		
29-May-12	Spring Staging	Goose	Reference	13	< 400 m	062	13 W	437646	7252135	Northern pintail	*Anas acuta*	NOPI				2				4	LK	Small		
29-May-12	Spring Staging	Goose	Reference	13	< 400 m	062	13 W	437646	7252135	Canada Goose	*Branta canadensis*	CAGO				1				2	LK	Small		
29-May-12	Spring Staging	Goose	Reference	13	< 400 m	063	13 W	438048	7252117	Sandhill Crane	*Grus canadensis*	SACR			1					1	LK	Large		flushed
29-May-12	Spring Staging	Goose	Reference	13	< 400 m	064	13 W	439632	7252075	Herring Gull	*Larus argentatus*	HEGU			2					2	LK	Large		on island in lake
29-May-12	Spring Staging	Goose	Reference	14	< 400 m	065	13 W	441863	7250251	Canada Goose	*Branta canadensis*	CAGO				1				2	LK	Large		flushed
29-May-12	Spring Staging	Goose	Reference	14	< 400 m	066	13 W	440899	7250310	Greater White-fronted Goose	*Anser albifrons*	GWFG			3					3	SL			flushed
29-May-12	Spring Staging	Goose	Reference	14	< 400 m	067	13 W	440144	7250323	Greater White-fronted Goose	*Anser albifrons*	GWFG				1				2	SL			flushed
29-May-12	Spring Staging	Goose	Reference	14	< 400 m	069	13 W	436094	7250414	Canada Goose	*Branta canadensis*	CAGO			6					6	LK	Large		
29-May-12	Spring Staging	Goose	Reference	14	< 400 m	069	13 W	436094	7250414	Red-breasted Merganser	*Mergus serrator*	RBME				1				2	LK	Large	F/O	
29-May-12	Spring Staging	Goose	Reference	14	< 400 m	070	13 W	432668	7250413	Greater White-fronted Goose	*Anser albifrons*	GWFG			4					4	WT			flushed
29-May-12	Spring Staging	Goose	Reference	14	< 400 m	071	13 W	429763	7250399	Greater White-fronted Goose	*Anser albifrons*	GWFG				1				2	RI	Large		
29-May-12	Spring Staging	Goose	Reference	15	< 400 m	072	13 W	431328	7248112	Snow Goose	*Chen caerulescens*	SNGO			10					10	RI	Large		
29-May-12	Spring Staging	Goose	Reference	15	< 400 m	072	13 W	431328	7248112	Canada Goose	*Branta canadensis*	CAGO			20					20	RI	Large		
29-May-12	Spring Staging	Goose	Reference	15	< 400 m	072	13 W	431328	7248112	Greater White-fronted Goose	*Anser albifrons*	GWFG			4					4	RI	Large		
29-May-12	Spring Staging	Goose	Reference	15	< 400 m	073	13 W	432055	7248142	Snow Goose	*Chen caerulescens*	SNGO			5					5	RI	Large	F/O	
29-May-12	Spring Staging	Goose	Reference	15	< 400 m	074	13 W	436598	7248100	Greater White-fronted Goose	*Anser albifrons*	GWFG				1				2	HT		F/O	
29-May-12	Spring Staging	Goose	Reference	15	< 400 m	075	13 W	437240	7248095	Glaucous Gull	*Larus hyperboreus*	GLGU			3					3	LK	Medium		
29-May-12	Spring Staging	Goose	Reference	15	< 400 m	076	13 W	438249	7248074	Snow Goose	*Chen caerulescens*	SNGO				1				2	HT		F/O	
29-May-12	Spring Staging	Goose	Reference	15	< 400 m	076	13 W	438249	7248074	Greater White-fronted Goose	*Anser albifrons*	GWFG				1				2	HT		F/O	
29-May-12	Spring Staging	Goose	Reference	15	< 400 m	077	13 W	442159	7248105	Greater White-fronted Goose	*Anser albifrons*	GWFG				1				2	LK	Large		
29-May-12	Spring Staging	Goose	Reference	16	< 400 m	078	13 W	437861	7246397	Snow Goose	*Chen caerulescens*	SNGO			15					15	RI		F/O	
29-May-12	Spring Staging	Goose	Reference	16	< 400 m	078	13 W	437861	7246397	Greater White-fronted Goose	*Anser albifrons*	GWFG			40					40	RI			
29-May-12	Spring Staging	Goose	Reference	16	< 400 m	079	13 W	428750	7246362	Greater White-fronted Goose	*Anser albifrons*	GWFG			4					4	RI			
29-May-12	Spring Staging	George RSA	Reference	Off	off	001	13 W	400552	7333478	Canada Goose	*Branta canadensis*	CAGO				1				2	LK	Medium		
29-May-12	Spring Staging	George RSA	Reference	Off	off	006	13 W	382331	7323045	Canada Goose	*Branta canadensis*	CAGO			1					1	LK	Medium		
29-May-12	Spring Staging	George RSA	Reference	Off	off	007	13 W	382833	7323093	Unknown Goose		GOOSE			5					5	LK	Medium		
29-May-12	Spring Staging	George	Focused	Off	off	011	13 W	380432	7315170	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA			1					1	HT		F/O	
29-May-12	Spring Staging	George	Focused	Off	off	021	13 W	386991	7302217	Greater White-fronted Goose	*Anser albifrons*	GWFG			2					2			F/O	
29-May-12	Spring Staging	George	Focused	Off	off	022	13 W	429506	7273216	Sandhill Crane	*Grus canadensis*	SACR			3					3	WT			
29-May-12	Spring Staging	Goose	Focused	Off	off	026	13 W	435791	7276720	Herring Gull	*Larus argentatus*	HEGU			1					1	LK	Large		sitting
29-May-12	Spring Staging	Goose	Focused	Off	off	030	13 W	419142	7273670	Greater White-fronted Goose	*Anser albifrons*	GWFG			2					2	HT		F/O	
29-May-12	Spring Staging	Goose	Focused	Off	off	042	13 W	419023	7266204	Greater White-fronted Goose	*Anser albifrons*	GWFG			4					4	SL			flushed
29-May-12	Spring Staging	Goose	Focused	Off	off	047	13 W	435693	7262867	Herring Gull	*Larus argentatus*	HEGU			1					1	HT		F/O	
29-May-12	Spring Staging	Goose RSA	Reference	Off	off	051	13 W	426414	7260655	Canada Goose	*Branta canadensis*	CAGO			3					3				
29-May-12	Spring Staging	Goose RSA	Reference	Off	off	060	13 W	426586	7253532	Unknown Duck	*Unknown Duck*	UNDU			2					2	LK	Medium	F/O	
29-May-12	Spring Staging	Goose RSA	Reference	Off	off	060	13 W	426586	7253532	Northern pintail	*Anas acuta*	NOPI			1					1	LK	Medium	F/O	
29-May-12	Spring Staging	Goose RSA	Reference	Off	off	060	13 W	426586	7253532	Canada Goose	*Branta canadensis*	CAGO				1				2	LK	Medium	F/O	
29-May-12	Spring Staging	Goose RSA	Reference	Off	off	080	13 W	429060	7255103	Snow Goose	*Chen caerulescens*	SNGO				1				2				
29-May-12	Spring Staging	Goose RSA	Reference	Off	off	081	13 W	433823	7269595	Greater White-fronted Goose	*Anser albifrons*	GWFG			6					6	LK			
22-Jun-12	Spring Pair	Goose	Focused	1	< 200 m	24	13 W	423937	7276857	Canada Goose	*Branta canadensis*	CAGO			22					22	PO			flock
22-Jun-12	Spring Pair	Goose	Focused	1	< 200 m	25	13 W	428382	7276918	Northern pintail	*Anas acuta*	NOPI		1						1	PO			
22-Jun-12	Spring Pair	Goose	Focused	1	< 200 m	25	13 W	428382	7276918	Greater Scaup	*Aythya marila*	GRSC	2							2	PO			
22-Jun-12	Spring Pair	Goose	Focused	1	< 200 m	26	13 W	429379	7276932	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	1	< 200 m	27	13 W	431050	7276945	Long-tailed Duck	*Clangula hyemalis*	LTDU	1	1						2	LA	Medium	PA	
22-Jun-12	Spring Pair	Goose	Focused	1	< 200 m	28	13 W	435576	7276861	Herring Gull	*Larus argentatus*	HEGU			1					1	LA	Large	FO	
22-Jun-12	Spring Pair	Goose	Focused	2	< 200 m	29	13 W	433739	7274768	Herring Gull	*Larus argentatus*	HEGU			1					1	HT	Small	FO	
22-Jun-12	Spring Pair	Goose	Focused	2	< 200 m	29	13 W	433739	7274768	Northern pintail	*Anas acuta*	NOPI	1							1	LA	Small		
22-Jun-12	Spring Pair	Goose	Focused	2	< 200 m	30	13 W	427517	7274781	Herring Gull	*Larus argentatus*	HEGU			2					2	HT	Large	FO	
22-Jun-12	Spring Pair	Goose	Focused	2	< 200 m	30	13 W	427517	7274781	Arctic Tern	*Sterna paradisaea*	ARTE			1					1	LA	Large	FO	
22-Jun-12	Spring Pair	Goose	Focused	2	< 200 m	31	13 W	426458	7274806	Canada Goose	*Branta canadensis*	CAGO			18					18	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	2	off	32	13 W	424950	7274840	Canada Goose	*Branta canadensis*	CAGO									LA			
22-Jun-12	Spring Pair	Goose	Focused	2	< 200 m	33	13 W	422613	7274871	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Medium		
22-Jun-12	Spring Pair	Goose	Focused	2	< 200 m	34	13 W	422086	7274900	Canada Goose	*Branta canadensis*	CAGO			6					6	LA	Large		

Appendix 7-2. Waterbird Observation Data, Aerial Surveys, 2012

Date	Survey	Region	Survey Strata	Transect	Distance	WPT	Zone	Easting	Northing	Species	Scientific Name	Species Code	No. Drakes	No. Hens	No. Unknown	No. Pairs	Breeding	No. Young	Young Class	Total	Habitat	Habitat Size	Behaviour	Comments
22-Jun-12	Spring Pair	Goose	Focused	2	< 200 m	35	13 W	421331	7274887	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Medium		
22-Jun-12	Spring Pair	Goose	Focused	3	off	36	13 W	421809	7272848	Canada Goose	*Branta canadensis*	CAGO			11					11	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	3	< 200 m	36	13 W	421809	7272848	Canada Goose	*Branta canadensis*	CAGO			18					18	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	3	< 200 m	37	13 W	423386	7272940	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Medium		
22-Jun-12	Spring Pair	Goose	Focused	3	< 200 m	38	13 W	427685	7273070	Yellow-billed Loon	*Gavia adamsii*	YBLO			1					1	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	3	< 200 m	39	13 W	429643	7273126	Long-tailed Duck	*Clangula hyemalis*	LTDU		1						1	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	3	< 200 m	40	13 W	432688	7273063	Long-tailed Duck	*Clangula hyemalis*	LTDU	1	1						2	LA	Large	PA	
22-Jun-12	Spring Pair	Goose	Focused	4	< 200 m	41	13 W	435443	7270816	Canada Goose	*Branta canadensis*	CAGO			10					10	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	4	< 200 m	43	13 W	420791	7270813	Long-tailed Duck	*Clangula hyemalis*	LTDU	1	1						2	LA	Large	PA	
22-Jun-12	Spring Pair	Goose	Focused	5	off	44	13 W	420055	7268714	Long-tailed Duck	*Clangula hyemalis*	LTDU		1						1	LA			
22-Jun-12	Spring Pair	Goose	Focused	5	< 200 m	45	13 W	423441	7268833	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	5	< 200 m	46	13 W	428207	7269015	Long-tailed Duck	*Clangula hyemalis*	LTDU	1	1						2	LA	Large	PA	
22-Jun-12	Spring Pair	Goose	Focused	6	< 200 m	47	13 W	434426	7266740	Herring Gull	*Larus argentatus*	HEGU			1					1	LA	Large	FO	
22-Jun-12	Spring Pair	Goose	Focused	6	< 200 m	48	13 W	431279	7266732	Canada Goose	*Branta canadensis*	CAGO			20					20	LA	Large		flock
22-Jun-12	Spring Pair	Goose	Focused	6	< 200 m	48	13 W	431279	7266732	Canada Goose	*Branta canadensis*	CAGO			6					6	LA	Large		flock
22-Jun-12	Spring Pair	Goose	Focused	6	< 200 m	49	13 W	423431	7266888	Canada Goose	*Branta canadensis*	CAGO			16					16	LA	Large		flock
22-Jun-12	Spring Pair	Goose	Focused	6	< 200 m	49	13 W	423431	7266888	Northern pintail	*Anas acuta*	NOPI	4							4	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	7	< 200 m	50	13 W	419528	7264698	Canada Goose	*Branta canadensis*	CAGO			2					2	LA	Medium		
22-Jun-12	Spring Pair	Goose	Focused	7	< 200 m	51	13 W	423436	7264645	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	7	< 200 m	52	13 W	424177	7264654	Canada Goose	*Branta canadensis*	CAGO			8					8	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	7	< 200 m	52	13 W	424177	7264654	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	7	< 200 m	53	13 W	426332	7264718	Long-tailed Duck	*Clangula hyemalis*	LTDU	1	1						2	LA	Large	PA	
22-Jun-12	Spring Pair	Goose	Focused	7	< 200 m	54	13 W	427707	7264712	Long-tailed Duck	*Clangula hyemalis*	LTDU			1					1	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	7	< 200 m	55	13 W	431797	7264837	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	7	< 200 m	55	13 W	431797	7264837	Canada Goose	*Branta canadensis*	CAGO			4					4	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	7	< 200 m	56	13 W	434379	7264916	Herring Gull	*Larus argentatus*	HEGU			2					2	LA	Large	FO	
22-Jun-12	Spring Pair	Goose	Focused	8	< 200 m	57	13 W	430011	7262802	Long-tailed Duck	*Clangula hyemalis*	LTDU	1	1						2	LA	Medium	PA	
22-Jun-12	Spring Pair	Goose	Focused	8	< 200 m	58	13 W	427871	7262773	Canada Goose	*Branta canadensis*	CAGO			7					7	LA	Large	FO	
22-Jun-12	Spring Pair	Goose	Focused	8	< 200 m	58	13 W	427871	7262773	Canada Goose	*Branta canadensis*	CAGO			12					12	LA	Large	FO	
22-Jun-12	Spring Pair	Goose	Focused	8	< 200 m	59	13 W	427221	7262778	Canada Goose	*Branta canadensis*	CAGO			42					42	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	8	< 200 m	60	13 W	423764	7262724	Canada Goose	*Branta canadensis*	CAGO			50					50	LA	Large		
22-Jun-12	Spring Pair	Goose	Focused	8	< 200 m	60	13 W	423764	7262724	Canada Goose	*Branta canadensis*	CAGO			12					12	LA	Large		
22-Jun-12	Spring Pair	Goose	Reference	8	off	61	13 W	442098	7261280	Canada Goose	*Branta canadensis*	CAGO			6					6	LA		FO	
22-Jun-12	Spring Pair	Goose	Reference	8	off	61	13 W	442098	7261280	Red-breasted Merganser	*Mergus serrator*	RBME	3							3	LA			
22-Jun-12	Spring Pair	Goose	Reference	9	< 200 m	62	13 W	434572	7260382	Canada Goose	*Branta canadensis*	CAGO			5					5	LA	Large		flock
22-Jun-12	Spring Pair	Goose	Reference	9	< 200 m	62	13 W	434572	7260382	Red-breasted Merganser	*Mergus serrator*	RBME	2							2	LA	Large	FO	
22-Jun-12	Spring Pair	Goose	Reference	9	< 200 m	63	13 W	435779	7260428	Canada Goose	*Branta canadensis*	CAGO			17					17	LA	Large		flock
22-Jun-12	Spring Pair	Goose	Reference	9	< 200 m	64	13 W	436338	7260430	Canada Goose	*Branta canadensis*	CAGO			12					12	LA	Large		flock
22-Jun-12	Spring Pair	Goose	Reference	9	< 200 m	65	13 W	436767	7260453	Canada Goose	*Branta canadensis*	CAGO			3					3	LA	Large		flock
22-Jun-12	Spring Pair	Goose	Reference	9	< 200 m	66	13 W	439456	7260454	Canada Goose	*Branta canadensis*	CAGO			35					35	LA	Large		flock
22-Jun-12	Spring Pair	Goose	Reference	9	< 200 m	67	13 W	440844	7260437	Arctic Tern	*Sterna paradisaea*	ARTE			2					2	LA	Large	FO	
22-Jun-12	Spring Pair	Goose	Reference	9	< 200 m	68	13 W	442930	7260240	Arctic Tern	*Sterna paradisaea*	ARTE			1					1	LA	Large	FO	
22-Jun-12	Spring Pair	Goose	Reference	9	off	69	13 W	443043	7259279	Sandhill Crane	*Grus canadensis*	SACR			1					1	LA			
22-Jun-12	Spring Pair	Goose	Reference	9	off	70	13 W	442955	7258387	Herring Gull	*Larus argentatus*	HEGU			2					2	LA			
22-Jun-12	Spring Pair	Goose	Reference	10	< 200 m	71	13 W	435758	7258319	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA			1					1			FO	
22-Jun-12	Spring Pair	Goose	Reference	10	< 200 m	72	13 W	428090	7258269	Long-tailed Duck	*Clangula hyemalis*	LTDU	1	1						2	LA	Large	PA	
22-Jun-12	Spring Pair	Goose	Reference	10	off	73	13 W	426857	7257492	Canada Goose	*Branta canadensis*	CAGO			50					50				
22-Jun-12	Spring Pair	Goose	Reference	10	off	73	13 W	426857	7257492	Greater White-fronted Goose	*Anser albifrons*	GWFG			4					4				
22-Jun-12	Spring Pair	Goose	Reference	11	< 200 m	74	13 W	427724	7256245	Long-tailed Duck	*Clangula hyemalis*	LTDU	1	1						2	LA	Large	PA	
22-Jun-12	Spring Pair	Goose	Reference	11	< 200 m	74	13 W	427724	7256245	Canada Goose	*Branta canadensis*	CAGO			3					3	LA	Large		
22-Jun-12	Spring Pair	Goose	Reference	11	< 200 m	75	13 W	430042	7256341	Canada Goose	*Branta canadensis*	CAGO			10					10	LA	Large		flock
22-Jun-12	Spring Pair	Goose	Reference	11	< 200 m	76	13 W	431522	7256359	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	PO			
22-Jun-12	Spring Pair	Goose	Reference	11	< 200 m	77	13 W	433016	7256335	Canada Goose	*Branta canadensis*	CAGO			11					11	LA	Large		flock
22-Jun-12	Spring Pair	Goose	Reference	11	< 200 m	78	13 W	435741	7256445	Canada Goose	*Branta canadensis*	CAGO			55					55	LA	Large		flock
22-Jun-12	Spring Pair	Goose	Reference	11	< 200 m	79	13 W	436178	7256429	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Large		

Appendix 7-2. Waterbird Observation Data, Aerial Surveys, 2012

Date	Survey	Region	Survey Strata	Transect	Distance	WPT	Zone	Easting	Northing	Species	Scientific Name	Species Code	No. Drakes	No. Hens	No. Unknown	No. Pairs	Breeding	No. Young	Young Class	Total	Habitat	Habitat Size	Behaviour	Comments
22-Jun-12	Spring Pair	Goose	Reference	11	< 200 m	80	13 W	437793	7256444	Herring Gull	*Larus argentatus*	HEGU			1					1	LA	Large	FO	
22-Jun-12	Spring Pair	Goose	Reference	11	< 200 m	80	13 W	437793	7256444	Red-breasted Merganser	*Mergus serrator*	RBME	1							1	LA	Large	FO	
22-Jun-12	Spring Pair	Goose	Reference	11	< 200 m	81	13 W	439685	7256466	Herring Gull	*Larus argentatus*	HEGU			2					2	LA	Large	FO	
22-Jun-12	Spring Pair	Goose	Reference	11	< 200 m	82	13 W	440771	7256416	Red-breasted Merganser	*Mergus serrator*	RBME	1	1						2	LA	Large	PA	
22-Jun-12	Spring Pair	Goose	Reference	11	off	83	13 W	442958	7254297	Canada Goose	*Branta canadensis*	CAGO			25					25	LA			
22-Jun-12	Spring Pair	Goose	Reference	12	< 200 m	84	13 W	440945	7254098	Canada Goose	*Branta canadensis*	CAGO			11					11	LA	Large		flock
22-Jun-12	Spring Pair	Goose	Reference	12	< 200 m	85	13 W	439562	7254149	Canada Goose	*Branta canadensis*	CAGO			25					25	LA	Large		flock
22-Jun-12	Spring Pair	Goose	Reference	12	< 200 m	86	13 W	437493	7254181	Canada Goose	*Branta canadensis*	CAGO			13					13	LA	Large		flock
22-Jun-12	Spring Pair	Goose	Reference	12	< 200 m	87	13 W	430283	7254383	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Large		
22-Jun-12	Spring Pair	Goose	Reference	12	< 200 m	87	13 W	430283	7254383	Canada Goose	*Branta canadensis*	CAGO			12					12	LA	Large		
22-Jun-12	Spring Pair	Goose	Reference	12	< 200 m	88	13 W	428542	7254348	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Large		
22-Jun-12	Spring Pair	Goose	Reference	13	< 200 m	89	13 W	436645	7252190	Greater Scaup	*Aythya marila*	GRSC	4	4						8	LA	Large	PA	
22-Jun-12	Spring Pair	Goose	Reference	13	< 200 m	89	13 W	436645	7252190	Red-breasted Merganser	*Mergus serrator*	RBME	3							3	LA	Large		
22-Jun-12	Spring Pair	Goose	Reference	13	< 200 m	90	13 W	441958	7252270	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Medium		
22-Jun-12	Spring Pair	Goose	Reference	14	< 200 m	91	13 W	439179	7250318	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Small		
22-Jun-12	Spring Pair	Goose	Reference	14	< 200 m	93	13 W	432485	7250156	Canada Goose	*Branta canadensis*	CAGO			50					50	LA	Large		
22-Jun-12	Spring Pair	Goose	Reference	14	< 200 m	93	13 W	432485	7250156	Long-tailed Duck	*Clangula hyemalis*	LTDU	3							3	LA	Large		
22-Jun-12	Spring Pair	Goose	Reference	15	< 200 m	94	13 W	430509	7248146	Canada Goose	*Branta canadensis*	CAGO			15					15	LA	Large		
22-Jun-12	Spring Pair	Goose	Reference	15	< 200 m	94	13 W	430509	7248146	Northern pintail	*Anas acuta*	NOPI	2							2	LA	Large	FO	
22-Jun-12	Spring Pair	Goose	Reference	15	< 200 m	95	13 W	437349	7248366	Greater White-fronted Goose	*Anser albifrons*	GWFG			1					1	WET		FO	
22-Jun-12	Spring Pair	Goose	Reference	15	< 200 m	96	13 W	439952	7248394	Canada Goose	*Branta canadensis*	CAGO			30					30	LA	Large		
22-Jun-12	Spring Pair	Goose	Reference	15	< 200 m	97	13 W	440569	7248405	Canada Goose	*Branta canadensis*	CAGO			15					15	LA	Large		
22-Jun-12	Spring Pair	Goose	Reference	15	< 200 m	97	13 W	440569	7248405	Greater Scaup	*Aythya marila*	GRSC	1	2						3	LA	Large	PA	
22-Jun-12	Spring Pair	Goose	Reference	15	off	98	13 W	443109	7248126	Red-breasted Merganser	*Mergus serrator*	RBME			1					1	LA			
22-Jun-12	Spring Pair	Goose	Reference	16	< 200 m	99	13 W	442649	7246199	Long-tailed Duck	*Clangula hyemalis*	LTDU	2							2	LA	Large		
22-Jun-12	Spring Pair	Goose	Reference	16	< 200 m	100	13 W	432418	7246155	Canada Goose	*Branta canadensis*	CAGO			11					11	LA	Medium		flock
22-Jun-12	Spring Pair	Goose	Reference	16	< 200 m	100	13 W	432418	7246155	Canada Goose	*Branta canadensis*	CAGO			8					8	LA	Medium		flock
22-Jun-12	Spring Pair	Goose	Reference	16	< 200 m	101	13 W	428704	7246162	Canada Goose	*Branta canadensis*	CAGO			6					6	RI			flock
22-Jun-12	Spring Pair	Goose	Reference	16	< 200 m	101	13 W	428704	7246162	Canada Goose	*Branta canadensis*	CAGO			5					5	RI			flock
23-Jun-12	Spring Pair	George	Focused	9	< 200 m	116	13 W	380463	7318906	Canada Goose	*Branta canadensis*	CAGO			1					1	LA	Large		
23-Jun-12	Spring Pair	George	Focused	9	< 200 m	116	13 W	380463	7318906	Long-tailed Duck	*Clangula hyemalis*	LTDU	2							2	LA	Large		
23-Jun-12	Spring Pair	George	Focused	9	< 200 m	117	13 W	392743	7319083	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Medium		
23-Jun-12	Spring Pair	George	Focused	10	< 200 m	118	13 W	396209	7316747	Long-tailed Duck	*Clangula hyemalis*	LTDU	1	1						2	LA	Large	PA	
23-Jun-12	Spring Pair	George	Focused	10	< 200 m	119	13 W	394860	7316775	Canada Goose	*Branta canadensis*	CAGO			25					25	LA	Large		on ice at edge of lake
23-Jun-12	Spring Pair	George	Focused	10	< 200 m	121	13 W	388185	7316913	Canada Goose	*Branta canadensis*	CAGO			1					1	LA	Large		
23-Jun-12	Spring Pair	George	Focused	10	off	122	13 W	380338	7315003	Long-tailed Duck	*Clangula hyemalis*	LTDU			1					1	LA			
23-Jun-12	Spring Pair	George	Focused	11	< 200 m	123	13 W	389152	7315031	Long-tailed Duck	*Clangula hyemalis*	LTDU	1	1						2	LA	Large	PA	
23-Jun-12	Spring Pair	George	Focused	11	< 200 m	124	13 W	389645	7315057	Unknown Duck	*Unknown Duck*	UNDU			1					1	LA	Large		RBME?
23-Jun-12	Spring Pair	George	Focused	12	off	126	13 W	384325	7313022	Long-tailed Duck	*Clangula hyemalis*	LTDU			3					3	LA			>400m
23-Jun-12	Spring Pair	George	Focused	12	< 200 m	127	13 W	380648	7312988	Long-tailed Duck	*Clangula hyemalis*	LTDU		1						1	LA	Large	FO	flushed?
23-Jun-12	Spring Pair	George	Focused	13	< 200 m	128	13 W	380733	7310842	Herring Gull	*Larus argentatus*	HEGU			1					1	LA	Medium	FO	
23-Jun-12	Spring Pair	George	Focused	13	< 200 m	129	13 W	383257	7310783	Herring Gull	*Larus argentatus*	HEGU			1					1	LA	Large	FO	
23-Jun-12	Spring Pair	George	Focused	13	< 200 m	130	13 W	390364	7310715	Herring Gull	*Larus argentatus*	HEGU			1					1	LA	Large	FO	
23-Jun-12	Spring Pair	George	Focused	14	< 200 m	131	13 W	393397	7308874	Unknown Duck	*Unknown Duck*	UNDU			2					2	LA	Large	PA	
23-Jun-12	Spring Pair	George	Focused	14	< 200 m	132	13 W	384404	7308974	Yellow-billed Loon	*Gavia adamsii*	YBLO			1					1	LA	Large		
23-Jun-12	Spring Pair	George	Focused	14	< 200 m	133	13 W	381954	7309072	Long-tailed Duck	*Clangula hyemalis*	LTDU	1	1						2	LA	Large	PA	
23-Jun-12	Spring Pair	George	Focused	15	< 200 m	134	13 W	381216	7306798	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Large		
23-Jun-12	Spring Pair	George	Focused	15	< 200 m	135	13 W	385907	7306717	Canada Goose	*Branta canadensis*	CAGO			14					14	LA	Large		
23-Jun-12	Spring Pair	George	Focused	15	< 200 m	136	13 W	387451	7306720	Canada Goose	*Branta canadensis*	CAGO			11					11	LA	Large		
23-Jun-12	Spring Pair	George	Focused	15	< 200 m	137	13 W	387936	7306702	Long-tailed Duck	*Clangula hyemalis*	LTDU		1						1	LA	Large		
23-Jun-12	Spring Pair	George	Focused	15	< 200 m	138	13 W	388058	7306720	Canada Goose	*Branta canadensis*	CAGO			40					40	LA	Large		
23-Jun-12	Spring Pair	George	Focused	15	< 200 m	139	13 W	392148	7306925	Canada Goose	*Branta canadensis*	CAGO			22					22	LA	Large		
23-Jun-12	Spring Pair	George	Focused	16	< 200 m	140	13 W	391996	7304833	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA			1					1	HT	Large	FO	
23-Jun-12	Spring Pair	George	Focused	16	< 200 m	140	13 W	391996	7304833	Long-tailed Duck	*Clangula hyemalis*	LTDU	1		1					2	LA	Large		
23-Jun-12	Spring Pair	George	Focused	16	< 200 m	141	13 W	386154	7304816	Long-tailed Duck	*Clangula hyemalis*	LTDU	1		1					2	LA	Large		

Appendix 7-2. Waterbird Observation Data, Aerial Surveys, 2012

Date	Survey	Region	Survey Strata	Transect	Distance	WPT	Zone	Easting	Northing	Species	Scientific Name	Species Code	No. Drakes	No. Hens	No. Unknown	No. Pairs	Breeding	No. Young	Young Class	Total	Habitat	Habitat Size	Behaviour	Comments
23-Jun-12	Spring Pair	George	Reference	1	< 200 m	104	13 W	382553	7335356	Arctic Tern	*Sterna paradisaea*	ARTE			2					2	HT			
23-Jun-12	Spring Pair	George	Reference	1	< 200 m	105	13 W	383926	7335498	Canada Goose	*Branta canadensis*	CAGO			12					12	LA	Large		
23-Jun-12	Spring Pair	George	Reference	1	off	106	13 W	398547	7333722	Greater Scaup	*Aythya marila*	GRSC	3							3	LA			
23-Jun-12	Spring Pair	George	Reference	4	off	107	13 W	382442	7328127	Canada Goose	*Branta canadensis*	CAGO			5					5	LA			
23-Jun-12	Spring Pair	George	Reference	5	< 200 m	108	13 W	392937	7327141	Canada Goose	*Branta canadensis*	CAGO			8					8	LA	Large		
23-Jun-12	Spring Pair	George	Reference	5	< 200 m	108	13 W	392937	7327141	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA	Large		
23-Jun-12	Spring Pair	George	Reference	6	< 200 m	109	13 W	386783	7325222	Greater Scaup	*Aythya marila*	GRSC	1							1	LA	Medium		
23-Jun-12	Spring Pair	George	Reference	6	off	110	13 W	382379	7324526	Herring Gull	*Larus argentatus*	HEGU			1					1	HT		FO	
23-Jun-12	Spring Pair	George	Reference	7	< 200 m	111	13 W	390139	7323215	Red-breasted Merganser	*Mergus serrator*	RBME	2							2	LA	Large		
23-Jun-12	Spring Pair	George	Reference	7	< 200 m	111	13 W	390139	7323215	Greater White-fronted Goose	*Anser albifrons*	GWFG			2					2	LA	Large		
23-Jun-12	Spring Pair	George	Reference	7	off	112	13 W	396068	7323187	Long-tailed Duck	*Clangula hyemalis*	LTDU	1							1	LA			on ice
23-Jun-12	Spring Pair	George	Reference	7	off	113	13 W	398723	7322159	Greater Scaup	*Aythya marila*	GRSC	1	1						2	LA			
14-Jul-12	Summer Brood	Goose	Reference	1	< 200 m	2	13 W	441252	7259901	Unknown Diver	*Unknown Diver*	UNDI			1					1	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	1	< 200 m	3	13 W	440590	7259897	Canada Goose	*Branta canadensis*	CAGO			18					18	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	1	< 200 m	4	13 W	437976	7259953	Canada Goose	*Branta canadensis*	CAGO			10					10	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	1	< 200 m	5	13 W	435304	7260088	Canada Goose	*Branta canadensis*	CAGO			40					40	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	1	< 200 m	5	13 W	435304	7260088	Snow Goose	*Chen caerulescens*	SNGO			1					1	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	1	< 200 m	6	13 W	434341	7260123	Canada Goose	*Branta canadensis*	CAGO			8					8	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	1	< 200 m	7	13 W	432457	7260218	Canada Goose	*Branta canadensis*	CAGO			7					7	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	1	< 200 m	8	13 W	430699	7260355	Canada Goose	*Branta canadensis*	CAGO			6					6	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	1	< 200 m	9	13 W	429530	7260358	Canada Goose	*Branta canadensis*	CAGO			8					8	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	1	< 200 m	9	13 W	429530	7260358	Canada Goose	*Branta canadensis*	CAGO			28					28	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	1	< 200 m	9	13 W	429530	7260358	Unknown Diver	*Unknown Diver*	UNDI			2					2	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	1	< 200 m	10	13 W	427528	7260336	Canada Goose	*Branta canadensis*	CAGO			10					10	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	2	< 200 m	17	13 W	441954	7257934	Unknown Waterbird	*Unknwon Waterbird*	UNWB			4					4	LA	Large		Re-doing transect 2 because veered off (GPS navigation failure)
14-Jul-12	Summer Brood	Goose	Reference	2	< 200 m	18	13 W	437830	7258131	Canada Goose	*Branta canadensis*	CAGO			31					31	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	2	< 200 m	19	13 W	437270	7258126	Canada Goose	*Branta canadensis*	CAGO			48					48	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	2	< 200 m	20	13 W	434807	7258205	Canada Goose	*Branta canadensis*	CAGO			2					2	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	2	< 200 m	20	13 W	434807	7258205	Canada Goose	*Branta canadensis*	CAGO			70					70	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	2	< 200 m	20	13 W	434807	7258205	Canada Goose	*Branta canadensis*	CAGO			20					20	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	2	< 200 m	21	13 W	431406	7258355	Unknown Waterbird	*Unknwon Waterbird*	UNWB			5					5	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	2	< 200 m	21	13 W	431406	7258355	Canada Goose	*Branta canadensis*	CAGO			12					12	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	2	< 200 m	22	13 W	428427	7258382	Canada Goose	*Branta canadensis*	CAGO			33					33	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	2	< 200 m	23	13 W	427374	7258314	Unknown Diver	*Unknown Diver*	UNDI			6					6	LA	Large		Scaup?
14-Jul-12	Summer Brood	Goose	Reference	3	< 200 m	24	13 W	427875	7256290	Unknown Waterbird	*Unknwon Waterbird*	UNWB	1				Yes	4	IIc	5	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	3	< 200 m	25	13 W	430063	7256176	Canada Goose	*Branta canadensis*	CAGO			16					16	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	3	< 200 m	25	13 W	430063	7256176	Arctic Tern	*Sterna paradisaea*	ARTE			2					2	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	3	< 200 m	25	13 W	430063	7256176	Greater Scaup	*Aythya marila*	GRSC			8					8	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	3	< 200 m	26	13 W	432833	7256019	Canada Goose	*Branta canadensis*	CAGO			2		Yes	6	III	8	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	3	< 200 m	27	13 W	433651	7255984	Unknown Gull	*Uknown Gull*	UNGU			1					1	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	3	< 200 m	28	13 W	434786	7256000	Canada Goose	*Branta canadensis*	CAGO			4					4	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	3	< 200 m	28	13 W	434786	7256000	Canada Goose	*Branta canadensis*	CAGO			19					19	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	3	< 200 m	28	13 W	434786	7256000	Canada Goose	*Branta canadensis*	CAGO			2					2	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	3	< 200 m	29	13 W	435957	7255968	Canada Goose	*Branta canadensis*	CAGO			16					16	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	3	< 200 m	29	13 W	435957	7255968	Canada Goose	*Branta canadensis*	CAGO			17					17	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	3	< 200 m	30	13 W	439227	7256080	Canada Goose	*Branta canadensis*	CAGO			5					5	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	3	< 200 m	31	13 W	440832	7256131	Canada Goose	*Branta canadensis*	CAGO			9					9	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	3	< 200 m	31	13 W	440832	7256131	Unknown Duck	*Unknown Duck*	UNDU			6					6	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	3	< 200 m	32	13 W	442925	7256182	Canada Goose	*Branta canadensis*	CAGO			7					7	LA	Small		
14-Jul-12	Summer Brood	Goose	Reference	4	< 200 m	34	13 W	442108	7254381	Sandhill Crane	*Grus canadensis*	SACR			2					2	WET	#N/A		
14-Jul-12	Summer Brood	Goose	Reference	4	< 200 m	35	13 W	438715	7254425	Canada Goose	*Branta canadensis*	CAGO			1		Yes	4	III	5	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	4	< 200 m	35	13 W	438715	7254425	Canada Goose	*Branta canadensis*	CAGO			17					17	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	4	< 200 m	36	13 W	436345	7254528	Unknown Waterbird	*Unknwon Waterbird*	UNWB			1					1	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	4	< 200 m	37	13 W	430583	7254505	Unknown Diver	*Unknown Diver*	UNDI			11					11	LA	Large		

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Date	Survey	Region	Survey Strata	Transect	Distance	WPT	Zone	Easting	Northing	Species	Scientific Name	Species Code	No. Drakes	No. Hens	No. Unknown	No. Pairs	Breeding	No. Young	Young Class	Total	Habitat	Habitat Size	Behaviour	Comments
14-Jul-12	Summer Brood	Goose	Reference	4	< 200 m	37	13 W	430583	7254505	Pacific Loon	*Gavia pacifica*	PALO			1			1		2	LA	Large		first year PALO
14-Jul-12	Summer Brood	Goose	Reference	4	< 200 m	38	13 W	429511	7254610	Canada Goose	*Branta canadensis*	CAGO			28					28	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	5	< 200 m	39	13 W	427531	7252392	Long-tailed jaeger	*Stercorarius longicaudus*	LTJA			1					1	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	5	< 200 m	40	13 W	428715	7252301	Black scoter	*Melanitta nigra*	BLSC			1					1	LA	Medium		
14-Jul-12	Summer Brood	Goose	Reference	5	< 200 m	41	13 W	432716	7252109	Arctic Tern	*Sterna paradisaea*	ARTE			1					1	HT	#N/A		
14-Jul-12	Summer Brood	Goose	Reference	5	< 200 m	42	13 W	436825	7252009	Red-breasted Merganser	*Mergus serrator*	RBME		1						1	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	5	< 200 m	43	13 W	439110	7252019	Red-throated Loon	*Gavia stellata*	RTLO			1					1	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	5	< 200 m	44	13 W	439654	7252038	Canada Goose	*Branta canadensis*	CAGO			25					25	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	5	< 200 m	44	13 W	439654	7252038	Canada Goose	*Branta canadensis*	CAGO			8					8	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	5	< 200 m	44	13 W	439654	7252038	Unknown Waterbird	*Unknwon Waterbird*	UNWB			1					1	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	6	< 200 m	45	13 W	440369	7250660	Canada Goose	*Branta canadensis*	CAGO			65		Yes	4	III	69	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	6	< 200 m	46	13 W	436820	7250799	Red-throated Loon	*Gavia stellata*	RTLO			1					1	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	7	< 200 m	47	13 W	429969	7248201	Canada Goose	*Branta canadensis*	CAGO			2		Yes	3	III	5	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	7	< 200 m	47	13 W	429969	7248201	Canada Goose	*Branta canadensis*	CAGO			2					2	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	7	< 200 m	47	13 W	429969	7248201	Canada Goose	*Branta canadensis*	CAGO			1		Yes	4	III	5	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	7	< 200 m	47	13 W	429969	7248201	Canada Goose	*Branta canadensis*	CAGO			57					57	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	7	< 200 m	48	13 W	440626	7247898	Canada Goose	*Branta canadensis*	CAGO			43					43	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	7	< 200 m	49	13 W	442484	7248172	Canada Goose	*Branta canadensis*	CAGO			23					23	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	7	off	50	13 W	443241	7247449	Canada Goose	*Branta canadensis*	CAGO			50					50	LA	#N/A		
14-Jul-12	Summer Brood	Goose	Reference	7	off	50	13 W	443241	7247449	Canada Goose	*Branta canadensis*	CAGO			25					25	LA	#N/A		
14-Jul-12	Summer Brood	Goose	Reference	8	< 200 m	51	13 W	442631	7246390	Unknown Diver	*Unknown Diver*	UNDI			2					2	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	8	< 200 m	52	13 W	435928	7246593	Canada Goose	*Branta canadensis*	CAGO			65					65	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	8	< 200 m	53	13 W	433536	7246673	Canada Goose	*Branta canadensis*	CAGO			7					7	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	8	< 200 m	54	13 W	433279	7246700	Canada Goose	*Branta canadensis*	CAGO			10					10	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	8	< 200 m	54	13 W	433279	7246700	Canada Goose	*Branta canadensis*	CAGO			7					7	LA	Large		
14-Jul-12	Summer Brood	Goose	Reference	8	< 200 m	55	13 W	430836	7246634	Canada Goose	*Branta canadensis*	CAGO			18					18	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	1	< 200 m	57	13 W	420691	7276697	Unknown Diver	*Unknown Diver*	UNDI			3					3	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	1	< 200 m	58	13 W	428145	7276475	Canada Goose	*Branta canadensis*	CAGO			22					22	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	1	< 200 m	59	13 W	430381	7276494	Red-throated Loon	*Gavia stellata*	RTLO			1					1	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	1	< 200 m	60	13 W	435463	7276773	Canada Goose	*Branta canadensis*	CAGO			19					19	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	2	< 200 m	61	13 W	429321	7275093	Canada Goose	*Branta canadensis*	CAGO			13					13	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	2	< 200 m	62	13 W	421293	7275030	Unknown Diver	*Unknown Diver*	UNDI			1					1	LA	Medium		
14-Jul-12	Summer Brood	Goose	Focused	3	< 200 m	63	13 W	420063	7272949	Canada Goose	*Branta canadensis*	CAGO			8					8	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	3	< 200 m	63	13 W	420063	7272949	Canada Goose	*Branta canadensis*	CAGO			1		Yes	3	IIc	4	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	3	< 200 m	63	13 W	420063	7272949	Canada Goose	*Branta canadensis*	CAGO			23					23	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	3	< 200 m	64	13 W	421894	7272672	Unknown Gull	*Uknown Gull*	UNGU			1					1	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	3	< 200 m	65	13 W	422417	7272694	Canada Goose	*Branta canadensis*	CAGO			1					1	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	3	< 200 m	65	13 W	422417	7272694	Canada Goose	*Branta canadensis*	CAGO			32					32	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	3	< 200 m	66	13 W	435779	7272839	Black scoter	*Melanitta nigra*	BLSC	7	2						9	LA	Large		2 brown could be juveniles not hens?
14-Jul-12	Summer Brood	Goose	Focused	4	< 200 m	67	13 W	434286	7270933	Long-tailed Duck	*Clangula hyemalis*	LTDU	1	1						2	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	5	< 200 m	68	13 W	424803	7268322	Canada Goose	*Branta canadensis*	CAGO			18					18	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	5	< 200 m	69	13 W	425331	7268255	Herring Gull	*Larus argentatus*	HEGU			1					1	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	5	< 200 m	69	13 W	425331	7268255	Canada Goose	*Branta canadensis*	CAGO			25					25	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	6	< 200 m	70	13 W	419620	7266881	Canada Goose	*Branta canadensis*	CAGO			19					19	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	7	< 200 m	71	13 W	424211	7264768	Unknown Diver	*Unknown Diver*	UNDI			4					4	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	7	< 200 m	72	13 W	425707	7264690	Canada Goose	*Branta canadensis*	CAGO			12					12	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	7	< 200 m	72	13 W	425707	7264690	Canada Goose	*Branta canadensis*	CAGO			22					22	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	7	< 200 m	73	13 W	433785	7264665	Canada Goose	*Branta canadensis*	CAGO			29					29	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	7	< 200 m	73	13 W	433785	7264665	Canada Goose	*Branta canadensis*	CAGO			4					4	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	8	< 200 m	74	13 W	435278	7262922	Canada Goose	*Branta canadensis*	CAGO			11					11	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	8	< 200 m	74	13 W	435278	7262922	Canada Goose	*Branta canadensis*	CAGO			2					2	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	8	< 200 m	74	13 W	435278	7262922	Canada Goose	*Branta canadensis*	CAGO			5					5	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	8	< 200 m	74	13 W	435278	7262922	Canada Goose	*Branta canadensis*	CAGO			12					12	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	8	< 200 m	75	13 W	434723	7263009	Canada Goose	*Branta canadensis*	CAGO			4					4	HT	Large		
14-Jul-12	Summer Brood	Goose	Focused	8	< 200 m	75	13 W	434723	7263009	Herring Gull	*Larus argentatus*	HEGU			1					1	LA	Large		

Appendix 7-2. Waterbird Observation Data, Aerial Surveys, 2012

Date	Survey	Region	Survey Strata	Transect	Distance	WPT	Zone	Easting	Northing	Species	Scientific Name	Species Code	No. Drakes	No. Hens	No. Unknown	No. Pairs	Breeding	No. Young	Young Class	Total	Habitat	Habitat Size	Behaviour	Comments
14-Jul-12	Summer Brood	Goose	Focused	8	< 200 m	76	13 W	427877	7263073	Canada Goose	*Branta canadensis*	CAGO			58					58	LA	Large		
14-Jul-12	Summer Brood	Goose	Focused	8	< 200 m	77	13 W	424354	7263170	Unknown Waterbird	*Unknwon Waterbird*	UNWB			30					30	LA	Large		
14-Jul-12	Summer Brood	George	Reference	1	< 200 m	78	13 W	382579	7335441	Canada Goose	*Branta canadensis*	CAGO			60					60	LA	Large		
14-Jul-12	Summer Brood	George	Reference	2	< 200 m	80	13 W	386873	7333366	Canada Goose	*Branta canadensis*	CAGO			70					70	LA	Large		
14-Jul-12	Summer Brood	George	Reference	2	< 200 m	81	13 W	382596	7333389	Unknown Waterbird	*Unknwon Waterbird*	UNWB			7					7	LA	Large		
14-Jul-12	Summer Brood	George	Reference	4	< 200 m	82	13 W	383942	7329351	Canada Goose	*Branta canadensis*	CAGO			3					3	LA	Large		
14-Jul-12	Summer Brood	George	Reference	5	< 200 m	83	13 W	385891	7327461	Unknown Diver	*Unknown Diver*	UNDI			1					1	LA	Large		YBLO?
14-Jul-12	Summer Brood	George	Reference	5	< 200 m	84	13 W	386498	7327486	Canada Goose	*Branta canadensis*	CAGO			23					23	LA	Large		
14-Jul-12	Summer Brood	George	Reference	6	< 200 m	85	13 W	387956	7325318	Herring Gull	*Larus argentatus*	HEGU			1					1	LA	Large		
14-Jul-12	Summer Brood	George	Reference	8	< 200 m	86	13 W	395192	7321291	Canada Goose	*Branta canadensis*	CAGO			16					16	LA	Large		
15-Jul-12	Summer Brood	George	Focused	1	< 200 m	88	13 W	380395	7318852	Unknown Diver	*Unknown Diver*	UNDI			7					7	LA	Large		immediately under heli
15-Jul-12	Summer Brood	George	Focused	1	< 200 m	89	13 W	386452	7318956	Unknown Duck	*Unknown Duck*	UNDU			1					1	LA	Large		
15-Jul-12	Summer Brood	George	Focused	1	< 200 m	90	13 W	388240	7318974	Canada Goose	*Branta canadensis*	CAGO			7					7	LA	Large		
15-Jul-12	Summer Brood	George	Focused	1	< 200 m	91	13 W	392216	7318927	Unknown Waterbird	*Unknwon Waterbird*	UNWB			9					9	LA	Large		
15-Jul-12	Summer Brood	George	Focused	1	< 200 m	91	13 W	392216	7318927	Unknown Waterbird	*Unknwon Waterbird*	UNWB			3					3	LA	Large		
15-Jul-12	Summer Brood	George	Focused	2	< 200 m	92	13 W	395540	7316978	Canada Goose	*Branta canadensis*	CAGO			30					30	LA	Large		estimate
15-Jul-12	Summer Brood	George	Focused	2	< 200 m	93	13 W	394197	7316990	Greater White-fronted Goose	*Anser albifrons*	GWFG			5					5	LA	Large		
15-Jul-12	Summer Brood	George	Focused	2	< 200 m	93	13 W	394197	7316990	Unknown Duck	*Unknown Duck*	UNDU			12					12	LA	Large		
15-Jul-12	Summer Brood	George	Focused	2	< 200 m	94	13 W	385984	7316905	Red-breasted Merganser	*Mergus serrator*	RBME	1							1	LA	Small		
15-Jul-12	Summer Brood	George	Focused	2	off	95	13 W	380094	7315388	Canada Goose	*Branta canadensis*	CAGO			11					11	LA	#N/A		
15-Jul-12	Summer Brood	George	Focused	3	< 200 m	96	13 W	382044	7314774	Black scoter	*Melanitta nigra*	BLSC			4					4	LA	Large		
15-Jul-12	Summer Brood	George	Focused	3	< 200 m	97	13 W	388657	7314857	Pacific Loon	*Gavia pacifica*	PALO			2					2	LA	Large		
15-Jul-12	Summer Brood	George	Focused	4	< 200 m	98	13 W	387511	7313017	Yellow-billed Loon	*Gavia adamsii*	YBLO			3					3	LA	Large		
15-Jul-12	Summer Brood	George	Focused	5	< 200 m	99	13 W	383369	7310950	Red-throated Loon	*Gavia stellata*	RTLO			2					2	LA	Large		
15-Jul-12	Summer Brood	George	Focused	5	< 200 m	100	13 W	385996	7310983	Canada Goose	*Branta canadensis*	CAGO			67					67	LA	Large		
15-Jul-12	Summer Brood	George	Focused	6	off	102	13 W	394684	7308852	Unknown Duck	*Unknown Duck*	UNDU			13					13	LA	#N/A		
15-Jul-12	Summer Brood	George	Focused	6	< 200 m	103	13 W	394125	7308851	Unknown Duck	*Unknown Duck*	UNDU			4					4	LA	Large		
15-Jul-12	Summer Brood	George	Focused	6	< 200 m	104	13 W	393929	7308844	Unknown Duck	*Unknown Duck*	UNDU			1					1	LA	Large		
15-Jul-12	Summer Brood	George	Focused	6	< 200 m	105	13 W	391830	7308847	Canada Goose	*Branta canadensis*	CAGO			35					35	LA	Large		
15-Jul-12	Summer Brood	George	Focused	7	< 200 m	106	13 W	381454	7306808	Long-tailed Duck	*Clangula hyemalis*	LTDU			3					3	LA	Large		
15-Jul-12	Summer Brood	George	Focused	7	< 200 m	106	13 W	381454	7306808	Long-tailed Duck	*Clangula hyemalis*	LTDU			3					3	LA	Large		
15-Jul-12	Summer Brood	George	Focused	7	< 200 m	107	13 W	386537	7306876	Yellow-billed Loon	*Gavia adamsii*	YBLO			1					1	LA	Large		
15-Jul-12	Summer Brood	George	Focused	7	< 200 m	108	13 W	387458	7306894	Canada Goose	*Branta canadensis*	CAGO			8					8	LA	Small		
15-Jul-12	Summer Brood	George	Focused	7	< 200 m	109	13 W	388685	7306936	Canada Goose	*Branta canadensis*	CAGO			75					75	LA	Large		
15-Jul-12	Summer Brood	George	Focused	7	< 200 m	110	13 W	390307	7306961	Pacific Loon	*Gavia pacifica*	PALO			1					1	LA	Large		
15-Jul-12	Summer Brood	George	Focused	7	< 200 m	111	13 W	392507	7306971	Canada Goose	*Branta canadensis*	CAGO			16					16	LA	Large		
15-Jul-12	Summer Brood	George	Focused	7	off	112	13 W	396775	7306144	Canada Goose	*Branta canadensis*	CAGO			27					27	LA	#N/A		
15-Jul-12	Summer Brood	George	Focused	8	< 200 m	113	13 W	393749	7304850	Canada Goose	*Branta canadensis*	CAGO			36					36	LA	Large		
15-Jul-12	Summer Brood	George	Focused	8	< 200 m	114	13 W	392826	7304873	Unknown Duck	*Unknown Duck*	UNDU			10					10	LA	Large		
15-Jul-12	Summer Brood	George	Focused	8	< 200 m	115	13 W	391755	7304889	Unknown Diver	*Unknown Diver*	UNDI			5					5	LA	Large		
15-Jul-12	Summer Brood	George	Focused	8	< 200 m	116	13 W	386951	7304934	Unknown Gull	*Uknown Gull*	UNGU			2					2	LA	Large		
15-Jul-12	Summer Brood	George	Focused	8	< 200 m	117	13 W	386008	7304928	Red-throated Loon	*Gavia stellata*	RTLO			2					2	LA	Large		
15-Jul-12	Summer brood	Bathurst Inlet	Focused	MLSA	< 200 m		13 W	397313	7366767	Unknown Gull	*Uknown Gull*	UNGU			10					10	MA			
15-Jul-12	Summer brood	Bathurst Inlet	Focused	MLSA	< 200 m		13 W	395420	7371394	Unknown Diver	*Unknown Diver*	UNDI			1					1	MA			
15-Jul-12	Summer brood	Bathurst Inlet	Focused	MLSA	< 200 m		13 W	379689	7392975	Unknown Waterbird	*Unknwon Waterbird*	UNWB			1					1	MA			
15-Jul-12	Summer brood	Bathurst Inlet	Focused	MLSA	< 200 m		13 W	382049	7392838	Unknown Gull	*Uknown Gull*	UNGU			1					1	MA			
15-Jul-12	Summer brood	Bathurst Inlet	Focused	MLSA	< 200 m		13 W	382163	7393355	Red-breasted Merganser	*Mergus serrator*	RBME			1					1	MA			
15-Jul-12	Summer brood	Bathurst Inlet	Focused	MLSA	off		13 W	380968	7395499	Unknown Waterbird	*Unknwon Waterbird*	UNWB								25	MA			large group at distance
15-Jul-12	Summer brood	Bathurst Inlet	Focused	MLSA	< 200 m		13 W	380623	7395734	Unknown Gull	*Uknown Gull*	UNGU			5					5	MA			
15-Jul-12	Summer brood	Bathurst Inlet	Focused	MLSA	< 200 m		13 W	379793	7397047	Yellow-billed Loon	*Gavia adamsii*	YBLO			1					1	MA			
25-Aug-12	Fall Staging	George	Reference	1	< 400 m	42	13 W	7334696	382447	Yellow-billed Loon	*Gavia adamsii*	YBLO								1	LA	Large	Diving	
25-Aug-12	Fall Staging	George	Reference	1	< 400 m	43	13 W	7335489	383968	Herring Gull	*Larus argentatus*	HEGU								1	LA	Large		
25-Aug-12	Fall Staging	George	Reference	1	< 400 m	44	13 W	7335754	385993	Canada Goose	*Branta canadensis*	CAGO								40	LA	Large	Flying	
25-Aug-12	Fall Staging	George	Reference	1	< 400 m	46	13 W	7335936	390580	Canada Goose	*Branta canadensis*	CAGO								55	LA	Large		
25-Aug-12	Fall Staging	George	Focused	1	< 400 m	68	13 W	7319233	384243	Yellow-billed Loon	*Gavia adamsii*	YBLO								1	LA	Large		

Appendix 7-2. Waterbird Observation Data, Aerial Surveys, 2012

Date	Survey	Region	Survey Strata	Transect	Distance	WPT	Zone	Easting	Northing	Species	Scientific Name	Species Code	No. Drakes	No. Hens	No. Unknown	No. Pairs	Breeding	No. Young	Young Class	Total	Habitat	Habitat Size	Behaviour	Comments
25-Aug-12	Fall Staging	George	Focused	1	< 400 m	69	13 W	7319187	390102	Canada Goose	*Branta canadensis*	CAGO								62	LA	Large		
25-Aug-12	Fall Staging	George	Focused	1	< 400 m	70	13 W	7319076	392685	Unknown Diver	*Unknown Diver*	UNDI								3	LA	Medium		
25-Aug-12	Fall Staging	Goose	Focused	1	< 400 m	102	13 W	7276771	419798	Herring Gull	*Larus argentatus*	HEGU								1	LA	Large	Flying	
25-Aug-12	Fall Staging	Goose	Focused	1	< 400 m	103	13 W	7276694	426723	Canada Goose	*Branta canadensis*	CAGO								40	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	1	< 400 m	104	13 W	7276673	428732	Canada Goose	*Branta canadensis*	CAGO								60	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	1	< 400 m	105	13 W	7276693	432793	Canada Goose	*Branta canadensis*	CAGO								22	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	1	< 400 m	105	13 W	7276693	432793	Canada Goose	*Branta canadensis*	CAGO								26	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	1	< 400 m	106	13 W	7276718	433458	Canada Goose	*Branta canadensis*	CAGO								8	LA	Large	Flying	
25-Aug-12	Fall Staging	Goose	Focused	1	< 400 m	107	13 W	7276750	434511	Pacific Loon	*Gavia pacifica*	PALO								2	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	1	< 400 m	139	13 W	7260164	427460	Tundra Swan	*Cygnus columbianus*	TUSW								2	LA	Large		1 Pair
25-Aug-12	Fall Staging	Goose	Reference	1	< 400 m	141	13 W	7260143	429249	Canada Goose	*Branta canadensis*	CAGO								32	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	1	< 400 m	143	13 W	7260222	434598	Unknown Diver	*Unknown Diver*	UNDI								1	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	1	< 400 m	144	13 W	7260249	435406	Greater Scaup	*Aythya marila*	GRSC								2	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	1	< 400 m	144	13 W	7260249	435406	Canada Goose	*Branta canadensis*	CAGO								14	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	1	< 400 m	145	13 W	7260239	438254	Canada Goose	*Branta canadensis*	CAGO								4	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	1	< 400 m	146	13 W	7260243	439671	Canada Goose	*Branta canadensis*	CAGO								8	LA	Large	flying	
25-Aug-12	Fall Staging	Goose	Reference	1	< 400 m	147	13 W	7260220	440784	Pacific Loon	*Gavia pacifica*	PALO								2	LA	Large		
25-Aug-12	Fall Staging	George	Reference	2	< 400 m	47	13 W	7333383	390996	Greater Scaup	*Aythya marila*	GRSC								1	LA	Large		
25-Aug-12	Fall Staging	George	Reference	2	< 400 m	48	13 W	7333410	386558	Canada Goose	*Branta canadensis*	CAGO								80	LA	Large		1 flock
25-Aug-12	Fall Staging	George	Reference	2	< 400 m	48	13 W	7333410	386558	Canada Goose	*Branta canadensis*	CAGO								15	LA	Large		1 flock
25-Aug-12	Fall Staging	George	Reference	2	< 400 m	48	13 W	7333410	386558	Canada Goose	*Branta canadensis*	CAGO								20	LA	Large		1 flock
25-Aug-12	Fall Staging	George	Reference	2	< 400 m	48	13 W	7333410	386558	Canada Goose	*Branta canadensis*	CAGO								7	LA	Large		1 flock
25-Aug-12	Fall Staging	George	Focused	2	< 400 m	71	13 W	7316800	393653	Long-tailed Duck	*Clangula hyemalis*	LTDU								1	LA	Large		
25-Aug-12	Fall Staging	George	Focused	2	< 400 m	72	13 W	7316852	384720	Canada Goose	*Branta canadensis*	CAGO								30	RI			
25-Aug-12	Fall Staging	George	Focused	2	< 400 m	73	13 W	7316969	382100	Canada Goose	*Branta canadensis*	CAGO								3	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	2	< 400 m	110	13 W	7274786	430437	Canada Goose	*Branta canadensis*	CAGO								100	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	2	< 400 m	111	13 W	7274809	429749	Long-tailed Duck	*Clangula hyemalis*	LTDU								1	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	2	< 400 m	114	13 W	7274884	422950	Canada Goose	*Branta canadensis*	CAGO								100	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	2	< 400 m	148	13 W	7258131	440359	Sandhill Crane	*Grus canadensis*	SACR								2	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	2	< 400 m	151	13 W	7258161	435279	Canada Goose	*Branta canadensis*	CAGO								15	HT	Large	Roosting	
25-Aug-12	Fall Staging	Goose	Reference	2	< 400 m	151	13 W	7258161	435279	Canada Goose	*Branta canadensis*	CAGO								24	HT	Large	Roosting	
25-Aug-12	Fall Staging	Goose	Reference	2	< 400 m	151	13 W	7258161	435279	Canada Goose	*Branta canadensis*	CAGO								27	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	2	< 400 m	152	13 W	7258167	434262	Yellow-billed Loon	*Gavia adamsii*	YBLO								1	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	2	< 400 m	153	13 W	7258166	434118	Herring Gull	*Larus argentatus*	HEGU								2	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	2	< 400 m	154	13 W	7258261	427942	Long-tailed Duck	*Clangula hyemalis*	LTDU								1	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	2	< 400 m	155	13 W	7258287	427627	Long-tailed Duck	*Clangula hyemalis*	LTDU								6	LA	Large		
25-Aug-12	Fall Staging	George	Reference	3	< 400 m	50	13 W	7331526	388335	Greater Scaup	*Aythya marila*	GRSC								4	LA	Large		
25-Aug-12	Fall Staging	George	Focused	3	< 400 m	74	13 W	7314913	382917	Unknown Diver	*Unknown Diver*	UNDI								1	LA	Large		
25-Aug-12	Fall Staging	George	Focused	3	< 400 m	75	13 W	7314832	389605	Canada Goose	*Branta canadensis*	CAGO								28	LA	Large		
25-Aug-12	Fall Staging	George	Focused	3	< 400 m	77	13 W	7314876	396439	Red-breasted Merganser	*Mergus serrator*	RBME								2	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	3	< 400 m	115	13 W	7272739	419767	Herring Gull	*Larus argentatus*	HEGU								1	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	3	< 400 m	116	13 W	7272801	421027	Unknown Diver	*Unknown Diver*	UNDI								1	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	3	< 400 m	117	13 W	7272784	421976	Canada Goose	*Branta canadensis*	CAGO								4	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	3	< 400 m	118	13 W	7272724	428718	Pacific Loon	*Gavia pacifica*	PALO								1	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	3	< 400 m	120	13 W	7272747	432331	Canada Goose	*Branta canadensis*	CAGO								20	SL			
25-Aug-12	Fall Staging	Goose	Focused	3	< 400 m	121	13 W	7272737	434886	Canada Goose	*Branta canadensis*	CAGO								26	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	3	< 400 m	121	13 W	7272737	434886	Canada Goose	*Branta canadensis*	CAGO								38	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	3	< 400 m	122	13 W	7272686	435527	Canada Goose	*Branta canadensis*	CAGO								34	SL			
25-Aug-12	Fall Staging	Goose	Reference	3	< 400 m	158	13 W	7256124	430460	Red-breasted Merganser	*Mergus serrator*	RBME								20	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	3	< 400 m	159	13 W	7256088	433005	Pacific Loon	*Gavia pacifica*	PALO								2	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	3	< 400 m	160	13 W	7256051	440229	Greater Scaup	*Aythya marila*	GRSC	4	9						13	LA	Large		ground-truthed
25-Aug-12	Fall Staging	Goose	Reference	3	< 400 m	160	13 W	7256051	440229	Long-tailed Duck	*Clangula hyemalis*	LTDU								7	LA	Large		INCIDENTAL Counted on ground-truthed, missed on first pass
25-Aug-12	Fall Staging	George	Reference	4	< 400 m	51	13 W	7329277	392269	Canada Goose	*Branta canadensis*	CAGO								8	LA	Large		
25-Aug-12	Fall Staging	George	Reference	4	< 400 m	51	13 W	7329277	392269	Canada Goose	*Branta canadensis*	CAGO								16	LA	Large		

Appendix 7-2. Waterbird Observation Data, Aerial Surveys, 2012

Date	Survey	Region	Survey Strata	Transect	Distance	WPT	Zone	Easting	Northing	Species	Scientific Name	Species Code	No. Drakes	No. Hens	No. Unknown	No. Pairs	Breeding	No. Young	Young Class	Total	Habitat	Habitat Size	Behaviour	Comments
25-Aug-12	Fall Staging	George	Reference	4	< 400 m	52	13 W	7329298	391946	Canada Goose	*Branta canadensis*	CAGO								25	LA	Large		
25-Aug-12	Fall Staging	George	Reference	4	< 400 m	53	13 W	7329354	387187	Canada Goose	*Branta canadensis*	CAGO								40	LA	Small		
25-Aug-12	Fall Staging	George	Focused	4	< 400 m	79	13 W	7313064	387794	Canada Goose	*Branta canadensis*	CAGO								11	LA	Large		
25-Aug-12	Fall Staging	George	Focused	4	< 400 m	80	13 W	7313052	386251	Long-tailed Duck	*Clangula hyemalis*	LTDU								2	LA	Small		
25-Aug-12	Fall Staging	George	Focused	4	< 400 m	81	13 W	7313074	384729	Long-tailed Duck	*Clangula hyemalis*	LTDU								1	LA	Medium		
25-Aug-12	Fall Staging	Goose	Focused	4	< 400 m	123	13 W	7270852	425125	Herring Gull	*Larus argentatus*	HEGU								2	LA	Large	on rocks	
25-Aug-12	Fall Staging	Goose	Focused	4	< 400 m	124	13 W	7270950	421434	Canada Goose	*Branta canadensis*	CAGO								14	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	4	< 400 m	164	13 W	7254301	430219	Long-tailed Duck	*Clangula hyemalis*	LTDU								18	LA	Large		
25-Aug-12	Fall Staging	George	Reference	5	< 400 m	55	13 W	7327486	386294	Canada Goose	*Branta canadensis*	CAGO								38	LA	Large		
25-Aug-12	Fall Staging	George	Reference	5	< 400 m	56	13 W	7327422	392400	Canada Goose	*Branta canadensis*	CAGO								8	LA	Large	Flying	
25-Aug-12	Fall Staging	George	Focused	5	< 400 m	82	13 W	7310768	381079	Unknown Diver	*Unknown Diver*	UNDI								1	LA	Large		
25-Aug-12	Fall Staging	George	Focused	5	< 400 m	83	13 W	7310802	385359	Unknown Diver	*Unknown Diver*	UNDI								1	LA	Large		
25-Aug-12	Fall Staging	George	Focused	5	< 400 m	84	13 W	7310781	390005	Red-breasted Merganser	*Mergus serrator*	RBME								1	LA	Large		
25-Aug-12	Fall Staging	George	Focused	5	< 400 m	85	13 W	7310791	391560	Canada Goose	*Branta canadensis*	CAGO			1			5		6	LA	Large		BROOD
25-Aug-12	Fall Staging	George	Focused	5	< 400 m	86	13 W	7310884	395901	Canada Goose	*Branta canadensis*	CAGO			1			3		4	LA	Large		BROOD
25-Aug-12	Fall Staging	Goose	Focused	5	< 400 m	126	13 W	7268613	425534	Long-tailed Duck	*Clangula hyemalis*	LTDU								4	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	5	< 400 m	127	13 W	7268594	427413	Red-throated Loon	*Gavia stellata*	RTLO								1	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	5	< 400 m	165	13 W	7251980	433420	Canada Goose	*Branta canadensis*	CAGO								6	LA	Medium		
25-Aug-12	Fall Staging	George	Reference	6	< 400 m	57	13 W	7325308	398214	Canada Goose	*Branta canadensis*	CAGO								35			Flying	
25-Aug-12	Fall Staging	George	Reference	6	< 400 m	58	13 W	7325337	390778	Long-tailed Duck	*Clangula hyemalis*	LTDU								2	LA	Large		
25-Aug-12	Fall Staging	George	Reference	6	< 400 m	59	13 W	7325395	383084	Herring Gull	*Larus argentatus*	HEGU						2		5	LA	Large	Flying	
25-Aug-12	Fall Staging	George	Focused	6	< 400 m	87	13 W	7308870	391380	Herring Gull	*Larus argentatus*	HEGU								2	LA	Large		
25-Aug-12	Fall Staging	George	Focused	6	< 400 m	88	13 W	7308936	381936	Long-tailed Duck	*Clangula hyemalis*	LTDU								4	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	6	< 400 m	129	13 W	7266661	433148	Long-tailed Duck	*Clangula hyemalis*	LTDU								3	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	6	< 400 m	130	13 W	7266777	424177	Canada Goose	*Branta canadensis*	CAGO								44	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	6	< 400 m	167	13 W	7250231	439985	Yellow-billed Loon	*Gavia adamsii*	YBLO								2	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	6	< 400 m	168	13 W	7250288	435822	Long-tailed Duck	*Clangula hyemalis*	LTDU								3	LA	Large		
25-Aug-12	Fall Staging	George	Reference	7	< 400 m	60	13 W	7323238	394609	Canada Goose	*Branta canadensis*	CAGO								25			Flying	
25-Aug-12	Fall Staging	George	Reference	7	< 400 m	61	13 W	7323295	398236	Canada Goose	*Branta canadensis*	CAGO								8	LA	Large		
25-Aug-12	Fall Staging	George	Focused	7	< 400 m	91	13 W	7306922	381352	Unknown Diver	*Unknown Diver*	UNDI								1	LA	Large		
25-Aug-12	Fall Staging	George	Focused	7	< 400 m	92	13 W	7306951	387354	Canada Goose	*Branta canadensis*	CAGO								6	LA	Small		
25-Aug-12	Fall Staging	George	Focused	7	< 400 m	93	13 W	7306935	388262	Greater Scaup	*Aythya marila*	GRSC								6	LA	Large		
25-Aug-12	Fall Staging	George	Focused	7	< 400 m	94	13 W	7306887	394366	Pacific Loon	*Gavia pacifica*	PALO								1	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	7	< 400 m	131	13 W	7264602	424546	Long-tailed Duck	*Clangula hyemalis*	LTDU								2	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	7	< 400 m	132	13 W	7264573	426025	Long-tailed Duck	*Clangula hyemalis*	LTDU								15	LA	Large		ground-truthed
25-Aug-12	Fall Staging	Goose	Focused	7	< 400 m	133	13 W	7264680	434034	Herring Gull	*Larus argentatus*	HEGU								2	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	7	< 400 m	134	13 W	7264711	434572	Canada Goose	*Branta canadensis*	CAGO								160	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	7	< 400 m	173	13 W	7248152	429942	Greater Scaup	*Aythya marila*	GRSC								8	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	7	< 400 m	173	13 W	7248152	429942	Greater Scaup	*Aythya marila*	GRSC								10	LA	Large		
25-Aug-12	Fall Staging	Goose	Reference	7	< 400 m	176	13 W	7248058	439624	Northern pintail	*Anas acuta*	NOPI								20	LA	Large		ground-truthed
25-Aug-12	Fall Staging	Goose	Reference	7	< 400 m	177	13 W	7248143	430176	Unknown Diver	*Unknown Diver*	UNDI								1	LA	Large		
25-Aug-12	Fall Staging	George	Reference	8	< 400 m	62	13 W	7321140	398198	Long-tailed Duck	*Clangula hyemalis*	LTDU								3	LA	Large		
25-Aug-12	Fall Staging	George	Reference	8	< 400 m	63	13 W	7321194	395073	Canada Goose	*Branta canadensis*	CAGO								40	LA	Large		
25-Aug-12	Fall Staging	George	Reference	8	< 400 m	63	13 W	7321194	395073	Canada Goose	*Branta canadensis*	CAGO								30	LA	Large	Flying	
25-Aug-12	Fall Staging	George	Reference	8	< 400 m	64	13 W	7321201	391753	Canada Goose	*Branta canadensis*	CAGO								25	LA	Large		
25-Aug-12	Fall Staging	George	Focused	8	< 400 m	96	13 W	7304899	393893	Canada Goose	*Branta canadensis*	CAGO								60	LA	Large		
25-Aug-12	Fall Staging	George	Focused	8	< 400 m	96	13 W	7304899	393893	Canada Goose	*Branta canadensis*	CAGO								25	LA	Large		
25-Aug-12	Fall Staging	George	Focused	8	< 400 m	97	13 W	7304915	387580	Herring Gull	*Larus argentatus*	HEGU								1			Flying	
25-Aug-12	Fall Staging	George	Focused	8	< 400 m	98	13 W	7304932	386054	Greater Scaup	*Aythya marila*	GRSC								1	LA	Large		
25-Aug-12	Fall Staging	George	Focused	8	< 400 m	99	13 W	7305029	380905	Canada Goose	*Branta canadensis*	CAGO								12	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	8	< 400 m	135	13 W	7262817	433828	Canada Goose	*Branta canadensis*	CAGO								14	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	8	< 400 m	135	13 W	7262817	433828	Canada Goose	*Branta canadensis*	CAGO								9	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	8	< 400 m	135	13 W	7262817	433828	Canada Goose	*Branta canadensis*	CAGO								4	LA	Large		
25-Aug-12	Fall Staging	Goose	Focused	8	< 400 m	136	13 W	7262825	431284	Herring Gull	*Larus argentatus*	HEGU								1	HT		Flying	
25-Aug-12	Fall Staging	Goose	Focused	8	< 400 m	138	13 W	7262777	426722	Red-breasted Merganser	*Mergus serrator*	RBME								5	LA	Large		

Appendix 7-2. Waterbird Observation Data, Aerial Surveys, 2012

Date	Survey	Region	Survey Strata	Transect	Distance	WPT	Zone	Easting	Northing	Species	Scientific Name	Species Code	No. Drakes	No. Hens	No. Unknown	No. Pairs	Breeding	No. Young	Young Class	Total	Habitat	Habitat Size	Behaviour	Comments
25-Aug-12	Fall Staging	Goose	Reference	8	< 400 m	178	13 W	7246284	435621	Canada Goose	*Branta canadensis*	CAGO								200	HT		Flying	
25-Aug-12	Fall Staging	George	Reference	Off	off	49	13 W	7332999	381849	Unknown Diver	*Unknown Diver*	UNDI								1	LA			INCIDENTAL
25-Aug-12	Fall Staging	George	Reference	Off	off	66	13 W	7299219	382092	Red-breasted Merganser	*Mergus serrator*	RBME								18				INCIDENTAL
25-Aug-12	Fall Staging	George	Reference	Off	off	67	13 W	7300691	382108	Red-breasted Merganser	*Mergus serrator*	RBME								3				INCIDENTAL
25-Aug-12	Fall Staging	George	Focused	Off	off	78	13 W	7314446	396987	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA								1			Flying	INCIDENTAL
25-Aug-12	Fall Staging	George	Focused	Off	off	89	13 W	7307513	379923	Canada Goose	*Branta canadensis*	CAGO								3	LA			INCIDENTAL
25-Aug-12	Fall Staging	George	Focused	Off	off	95	13 W	7305487	396684	Red-breasted Merganser	*Mergus serrator*	RBME								15	LA			INCIDENTAL
25-Aug-12	Fall Staging	George	Focused	Off	off	100	13 W	7307800	392836	Canada Goose	*Branta canadensis*	CAGO								12	LA			INCIDENTAL
25-Aug-12	Fall Staging	George	Focused	Off	off	101	13 W	7290027	409059	Canada Goose	*Branta canadensis*	CAGO								11	LA			INCIDENTAL
25-Aug-12	Fall Staging	Goose	Focused	Off	off	108	13 W	7275352	435752	Unknown Duck	*Unknown Duck*	UNDU								8	LA			INCIDENTAL
25-Aug-12	Fall Staging	Goose	Focused	Off	off	109	13 W	7275076	435580	Canada Goose	*Branta canadensis*	CAGO								14	LA			INCIDENTAL
25-Aug-12	Fall Staging	Goose	Reference	Off	off	156	13 W	7257060	426582	Greater Scaup	*Aythya marila*	GRSC								5	LA			INCIDENTAL
25-Aug-12	Fall Staging	Goose	Reference	Off	off	162	13 W	7255072	443125	Long-tailed Duck	*Clangula hyemalis*	LTDU								2	LA			
25-Aug-12	Fall Staging	Goose	Reference	Off	off	166	13 W	7251231	443123	Sandhill Crane	*Grus canadensis*	SACR			1			2		3	WT			INCIDENTAL
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	Off	off	186	13 W	421208	7316145	Red-breasted Merganser	*Mergus serrator*	RBME								5	RI			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	Off	off	187	13 W	419409	7324958	Red-breasted Merganser	*Mergus serrator*	RBME								14	RI			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	Off	off	195	13 W	414660	7338957	Red-breasted Merganser	*Mergus serrator*	RBME								12	RI			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	Off	off	196	13 W	410988	7348245	Northern Pintail	*Anas acuta*	NOPI								14	ES			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	Off	off	197	13 W	408208	7350841	Northern Pintail	*Anas acuta*	NOPI								25	ES			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	199	13 W	400320	7361120	Red-throated Loon	*Gavia stellata*	RTLO								3	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	201	13 W	399885	7361942	Red-breasted Merganser	*Mergus serrator*	RBME								2	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	203	13 W	395628	7371515	Herring Gull	*Larus argentatus*	HEGU								3	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	204	13 W	394746	7371892	Red-breasted Merganser	*Mergus serrator*	RBME								15	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	205	13 W	390443	7380490	Herring Gull	*Larus argentatus*	HEGU								4	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	208	13 W	387037	7381392	Canada Goose	*Branta canadensis*	CAGO								25	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	209	13 W	385159	7383864	Red-throated Loon	*Gavia stellata*	RTLO								2	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	211	13 W	384526	7385546	Canada Goose	*Branta canadensis*	CAGO								15	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	211	13 W	384526	7385546	Red-throated Loon	*Gavia stellata*	RTLO								1	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	211	13 W	384526	7385546	Red-breasted Merganser	*Mergus serrator*	RBME								12	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	211	13 W	384526	7385546	Glaucous Gull	*Larus hyperboreus*	GLGU								12	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	212	13 W	383070	7387774	Greater Scaup	*Aythya marila*	GRSC								14	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	213	13 W	381967	7389447	Red-breasted Merganser	*Mergus serrator*	RBME								16	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	213	13 W	381967	7389447	Glaucous Gull	*Larus hyperboreus*	GLGU								2	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	217	13 W	379415	7392691	Red-throated Loon	*Gavia stellata*	RTLO								3	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	218	13 W	379975	7393497	Canada Goose	*Branta canadensis*	CAGO								200	HT			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	221	13 W	380922	7392905	Greater Scaup	*Aythya marila*	GRSC								90	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	222	13 W	381796	7392423	Red-breasted Merganser	*Mergus serrator*	RBME								7	MA			
27-Aug-12	Fall Staging	Bathurst Inlet	Focused	On	< 400 m	222	13 W	381796	7392423	Greater Scaup	*Aythya marila*	GRSC								3	MA			

Appendix 8-1

Total Transect Lengths and Ice Condition in the MLSA and MRSA during Marine Mammal Surveys, 2012

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Appendix 8-1. Total Transect Lengths and Ice Condition in the MLSA and MRSA during Marine Mammal Surveys, 2012

Survey Area	Transect ID	Total Transect Length	Land	Open Water	Broken Ice	Melted Ice	Cracked Ice	Solid Ice
Marine Focused	1-2	21.95	8.02	4.75	1.08	8.1	-	-
	3-4	21.3	8.41	1.71	1.44	9.74	-	-
	5-6	47.44	0.46	6.98	5.96	27.33	0.17	6.53
	7-8	47.25	9.78	13.37	2.24	7.62	2.41	11.84
Total Marine Focused		**137.94**	**26.67**	**26.8**	**10.73**	**52.79**	**2.58**	**18.37**
Marine Regional	1-2	25.97	13.9	5.33	0.58	6.17	-	-
	3-4	27.48	9.4	11.71	4.7	1.67	-	-
	5-6	27.48	-	12.67	5.43	9.39	-	-
	7-8	29.78	4.99	6.23	2.48	11.68	3.84	0.56
	8-9	30.95	8.68	-	-	4.18	-	17.81
	10-11	32.45	5.01	-	-	2.03	-	25.13
	11-12	27.27	7.95	1.94	5.74	6.86	-	4.78
	13-14	42.33	7.98	-	-	5.85	-	28.5
	15-16	37.37	5.91	-	1.21	10.17	-	20.08
	17-18	32.34	8.51	4.18	2.93	2.82	-	13.9
	19-20	19.58	10.06	2.58	-	6.94	-	-
	21-22	14.59	7.26	5.72	-	1.61	-	-
	23-24	25.7	5.74	4.4	-	15.56	-	-
	25-26	50.69	27.65	-	-	20.25	0.79	2
	27-28	56.24	12.43	-	-	-	15.05	28.76
	29-30	50.75	1.62	-	-	-	14.43	34.69
	31-32	72.81	16.18	2.5	-	-	14.84	39.29
	33-34	66.87	25.82	5.58	-	11	5.84	18.63
	35-36	41.24	18.72	1.29	6.04	6.26	-	8.93
	37-38	39.45	20.48	3.8	-	4.17	-	11
	38-39	3	-	-	-	-	-	3
	39-40	25	5.83	-	-	-	-	19.17
	41-42	25	0.14	-	-	-	5.18	19.68
	43-44	25	-	-	-	-	6.33	18.67
	45-46	14.88	8.36	-	-	-	1.58	4.94
	46-47	19.61	1.28	-	-	-	-	18.34
Total Marine Regional		**863.83**	**233.9**	**67.93**	**29.12**	**126.61**	**67.89**	**337.84**
Total		**1001.77**	**260.57**	**94.73**	**39.84**	**179.39**	**70.47**	**356.21**

Appendix 9-1

Carnivore Den Surveys Conducted in 2007 Used to Guide Surveys in 2012

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Appendix 9-1. Carnivore Den Surveys Conducted in 2007* Used to Guide Surveys in 2012

Survey Data					Species Observation Data				Den and Habitat Data				
Den Site ID	Date	Easting	Northing	Occupancy Status	Species	No. Animals	Scat	Bones	Habitat	Slope Position	Slope (%)	Aspect	Comments
DU08	1-Aug-07	405437	7288209	Active	Wolf	3 Pups			Esker	Mid-slope	10%	NE	Multiple entrances; known to pilots; check in July
DU09	16-Jun-07	388665	7311851	Active	Red fox	1 Adult, 2 Pups			Esker	Lower-slope	10%	S	Approx. 5 entrances.
DU10	16-Jun-07	385887	7316032	Active	Wolf	1 Adult, off grey	Yes	Yes	Esker	Lower-slope	5%	N	Approx. 6 entrances; fresh scat, fresh tracks, bones.
DU11	16-Jun-07	385244	7316266	Potentially Active	Wolf				Esker	Lower-slope	5%	W	Not far from wpt. 326.
DU12	16-Jun-07	374606	7299782	Inactive	Wolf		Yes	Yes	Esker	Top		W	Abundant bones, old wolf scat, 3 or 4 main entrances, covering approx. 20m x 15m, currently used by ground squirrels.
DU13	16-Jun-07	377353	7287740	Inactive	Wolf/Fox				Esker	Lower-slope	5%	W	2 entrances; historical wolf or fox den; currently used by ground squirrels.
DU16	17-Jun-07	450987	7268275	Inactive	Wolf				Glaciofluvial or Lacustrine				Potential densite. Active last year according to pilot Bruce. Did not find, may be under snowbank.

**Surveys Conducted in 2007 by Gartner Lee Ltd. (Gartner Lee Ltd. 2008)*

Appendix 9-2

Carnivore Den Occupancy and Productivity Data, 2012

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Appendix 9-2. Carnivore Den Occupancy and Productivity Data, 2012

a) Carnivore Den Occupancy Data, 2012

Survey Data								Species Data		Habitat Data					
Den ID	WPT ID	Occupancy Assessment Date	Survey Year	Zone	Easting	Northing	Occupancy Status	Species	No. Animals	Habitat Type	Slope Position	Slope %	Aspect	Soil Texture	Comments
1	DU08	27-May-12	2012	13 W	405436	7288210	Inactive	Unknown Species		Esker	Middle	10	NE	Sandy	none found; multiple entrances observed in 2007
2	DU09	27-May-12	2012	13 W	388664	7311852	Unknown	Fox		Esker	Lower	10	SE	Sandy	Photos 24-32; some scat around holes
3	DU10	27-May-12	2012	13 W	385886	7316033	Unknown	Unknown Species		Esker	Lower	5	N	Sandy	potential wolf scat (old)
4	DU11	27-May-12	2012	13 W	385244	7316267	Unknown	Unknown Species		Esker	Lower	5	W	Sandy	appears inactive, bones nearby
4	DU12	27-May-12	2012	13 W	374605	7299783	Inactive	Unknown Species		Esker	Top	-	W	Sandy	lots of old activity, bones everywhere; Photos 55-64
6	DU13	27-May-12	2012	13 W	377352	7287741	Inactive	Unknown Species		Esker	Lower	5	W	Sandy	~150m from WPT alternate den location
11	DU14	27-May-12	2012	13 W	380331	7282017	Active	Wolf	2	Esker	Lower	5	NE	Sandy	pregnant pair? Photos 65-76
7	DU16	26-May-12	2012	13 W	450986	7268276	Unknown	Unknown Species		Glacio-fluvial	Top	-		Sandy	sik sik dens - potentially fox; lots of wolf tracks too
8	FOXX2	27-May-12	2012	13 W	384548	7295604	Inactive	Fox		Glacio-fluvial	Upper	-	S	Rock/sand	
12	FOXX1	27-May-12	2012	13 W	373188	7325677	Active	Fox		Esker	Upper	-	SE	Sandy	wolf scat around den
13	WOLF1	26-May-12	2012	13 W	455688	7286193	Unknown	Wolf	2	Esker	Lower - Middle	-	S	Sandy loam	potential den

b) Carnivore Den Productivity Data, 2012

Survey Data								Species Observation Data				Den and Habitat Data						
Den ID	WPT ID	Productivity Assessment Date	Zone	Easting	Northing	Occupancy Status	Productivity Status	Species	No. Adults	No. Young	Evidence of Use	No. Holes	Diameter of Holes (cm)	Slope Position	Aspect	Soil Texture	Habitat Type	Comments
11	DU14	27-Jul-12	13 W	380331	7282017	Active	Unknown	Wolf	0	0	scat, caribou bones, digs, hait	5	15 - 20	Top	NW	Sandy	Esker	Photos 412-416 - Two adults with pups were seen regularly at this den by NAS helicopter pilots
12	FOXX1	27-Jul-12	13 W	373188	7325677	Active	Unknown	Arctic Fox	0	0	scat, fur, digs, bones (hare)	5	10 - 15	Middle	S	Sandy	Esker	Photos 402-405
10	FOX2	27-Jul-12	13 W	388091	7311053	Active	Productive	Red Fox	0	0	some bones	6	10 - 15	Top	N/A - facing up	Sandy	Esker	2 pups seen 3 weeks earlier, 2 adults seen regularly in camp
13	WOLF1	27-Jul-12	13 W	455688	7286193	Active	Unknown	Wolf	0	0	lots of big scat, bones, excavations	5	30, 20 -30	Top	S	Sandy	Esker	One main hole that goes into den for several digs with no length
9	10	27-Jul-12	13 W	417120	7337712	Active	Unknown	Grizzly Bear	0	0	fox skull, wolf scat, nothing inside hole	1	100	Top	S	Sandy	Glacio-fluvial	One huge hole that collapsed

Appendix 10-1

Summary of Collar Locations and Number of Collared Caribou from the Bathurst and Beverly Herds used for Kernel Density Analysis

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Appendix 10-1. Summary of Collar Locations and Number of Collared Caribou from the Bathurst and Beverly Herds used for Kernel Density Analysis

	No. of Locations per Year[1]																	
Caribou Collar ID No.	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total Per Collar
Bathurst Herd																		
100	53	65	31	61	59	50												319
101	51	61	14															126
102	42																	42
103	52	67																119
104	53	56																109
105	51	41	66	67	61													286
106	53	64																117
107	38																	38
108	12																	12
109	53	67																120
110			70															70
111				31	52	61	62	17										223
112			1															1
113			2	63														65
114			2															2
115			2															2
116			1															1
117				57	62	62	61											242
118			1	62	62													125
119				60	57	63	62	24										266
121				62	61													123
122				45	53	53												151
124				61	57	43												161
125				57	30													87
126				21	29													50
127				56	58	57												171
128				63		37												100
130						61	59	54	27	6								207
133						19												19
137						44	60	62										166
140							45											45
141							84	100	80									264
142							84	100										184
144							71											71
145							68											68
147							45											45
150								77	71									148
153								70										70
154								85	80									165
156								85	80									165

Appendix 10-1. Summary of Collar Locations and Number of Collared Caribou from the Bathurst and Beverly Herds used for Kernel Density Analysis

Caribou Collar ID No.	No. of Locations per Year[1]																	Total Per Collar
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	
Bathurst Herd (cont'd)																		
157								85	80									165
158								67										67
162										99	100	58						257
163										100	100	68	54					322
166										100	100	54						254
167										100								100
168										100	100	58						258
171										100	100	70	55					325
178										81	99	69	85					334
180										82	99	57						238
182										83	99	12	85					279
184										82	99	69	85					335
185										83								83
186										82								82
188										82	99	68	33					282
189										82								82
191										82	99	69	85					335
192										75	84	16						175
193										78	95	77	80					330
194										77	95	65						237
195												75	105					180
196												75	106					181
197												75	118	114	48			355
198												75	106	12	101			294
199												63						63
200												75	21					96
202												61						61
308												77	228					305
361													184	232				416
168			1															1
180			1															1
195			1															1
196			1															1
197			1									1						2
198			1															1
199			1															1
200			1															1
202			1															1
308			1									17						18
361												1						1

Appendix 10-1. Summary of Collar Locations and Number of Collared Caribou from the Bathurst and Beverly Herds used for Kernel Density Analysis

Caribou Collar ID No.	No. of Locations per Year[1]																	Total Per Collar
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	
Bathurst Herd (cont'd)																		
BBG204												1						1
BG204													39	297	193			529
BG205													38	256	193			487
BG207													38	149				187
BG208													39	269	194			502
BG209												1	38	248				287
BG212												1	39	302	189			531
BG213												2	39	308	194			543
BG215												2	39	188				229
BG216												4	39	224				267
BG218													38	304	135			477
BG219														120				120
BG222															73			73
BG225											6	1			211	408	544	1,170
BG226															108			108
BG227		1													213	263		477
BG228												1			200	309		510
BG231		24	20								23	11			200	420	584	1,282
BG232			17								19	84			209	426	521	1,276
BG234															207	327		534
BG235											1	292				231	292	816
BG236			6								4	207				333	248	798
BG237																205		205
BG238																185		185
BG239																196		196
BG240											4	24				332	280	640
BG242																195		195
BG244																237		237
BG245																164		164
BG246																237		237
BG247											4	22				340	605	971
BGCA12401												23					591	614
BGCA12402												15					562	577
BGCA12403																	531	531
BGCA12404												5					537	542
BGCA12405												24					558	582
BGCA12406												13					543	556
BGCA12407												13			2		538	553
BGCA12408												12			12		480	504
BGCA12409												10					498	508

Appendix 10-1. Summary of Collar Locations and Number of Collared Caribou from the Bathurst and Beverly Herds used for Kernel Density Analysis

Caribou Collar ID No.	No. of Locations per Year[1]																	Total Per Collar
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	
Bathurst Herd (cont'd)																		
BGCA12411												8			3		344	355
BGCA12412												15					596	611
BGCA12413												11					438	449
BGCA12457												7					293	300
Total Locations per Year	**458**	**446**	**243**	**766**	**641**	**550**	**701**	**826**	**418**	**1,574**	**1,429**	**2,214**	**1,816**	**3,023**	**2,685**	**4,808**	**9,583**	
Total Collars (Total Functioning) per Year[1]	**10**	**9 (8)**	**23 (6)**	**14**	**12**	**11**	**11**	**12**	**6**	**19 (18)**	**21 (16)**	**51 (38)**	**25**	**14**	**19 (17)**	**17**	**20**	
Beverly Herd																		
131						51	22											73
132						56	42											98
134						26												26
135						56	73	75	109	102	6							421
136						56	73	9										138
139							94	94										188
143							95	109	82									286
146							60											60
148							92											92
172										93	109	91	105					398
173										93	109	67						269
174										127	172	148	163					610
176										93	11							104
177										93	109	91	104					397
179										93	109	91	105					398
180												24	105					129
181										93	27							120
194												24	108					132
301											94	534						628
302											84	709	514	597	647	341		2,892
303											89	699	468					1,256
304											86	718	515	470				1,789
305											89	696	509	580	421			2,295
309											85	724	528	576	492			2,405
311											89	712	530	322				1,653
313											92	742	457					1,291
314											101	727	453					1,281
315											97	536						633
317											91	529	57	575	439			1,691
319											92	733	477					1,302
320											89	720	532	561	519			2,421
321												169						169

Appendix 10-1. Summary of Collar Locations and Number of Collared Caribou from the Bathurst and Beverly Herds used for Kernel Density Analysis

Caribou Collar ID No.	No. of Locations per Year[1]																	Total Per Collar
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	
Beverly Herd (cont'd)																		
322												358	488					846
323												361	478					839
325												352	390					742
326												173						173
329												332	514	579	621	383		2,429
330												323	467					790
331												365	522	415	424	438	139	2,303
333												342	520	567	657	558	203	2,847
334												345	455					800
335												352	471					823
338													338	592	628	556	241	2,355
339													370	582	499			1,451
340													361	603	487			1,451
342													340	584	630	486		2,040
343													352	564	352			1,268
344													310					310
345													348	583	391			1,322
346													356	476				832
347													299					299
348													273					273
349													360	573	408			1,341
350													352	582	660	314		1,908
351													421	592	638	570	123	2,344
352													415	568	411			1,394
353													171					171
354													291					291
355													417	566	491			1,474
356													432	335				767
357													573	97	644	542	412	2,268
358													420	600	631	322		1,973
359													421	576	374			1,371
360													417	565	662	339		1,983
363													166					166
364													239					239
365													162					162
366													418	389				807
BG220														894	1143	264	220	2,521
BG221														907	1159	314	14	2,394
BG224															298			298
BGCA12414																	563	563

Appendix 10-1. Summary of Collar Locations and Number of Collared Caribou from the Bathurst and Beverly Herds used for Kernel Density Analysis

	No. of Locations per Year[1]																
Caribou Collar ID No.	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total Per Collar**
Beverly Herd (cont'd)																		
BGCA12416																	551	551
BGCA12417																	575	575
BGCA12418																	198	198
BGCA12419																	550	550
BGCA12541																	551	551
BGCA12542																	596	596
BGCA12543																	573	573
BGCA12544																	162	162
BGCA12545																	569	569
BGCA12547																	564	564
BGCA12548																	560	560
BGCA12549																	562	562
BGCA12551																	565	565
BGCA12552																	574	574
BGCA12553																	568	568
BGCA12554																	478	478
BGCA12555																	577	577
BGCA12556																	570	570
BGCA12557																	524	524
BGCA12558																	173	173
BGCA12560																	567	567
Total Locations per Year						**245**	**551**	**287**	**191**	**787**	**1,830**	**12,787**	**19,057**	**16,470**	**14,726**	**5,427**	**12,522**	
Total Collars (Total Functioning) per Year[1]						**5**	**8**	**4 (3)**	**2**	**8**	**21 (20)**	**31**	**52**	**30**	**26**	**13**	**29**	

[1] Caribou with less than 10 collar locations were assumed to have stopped fucntioning shortly after deplomen; these data points were not used in analyses due to the low sample size. Thus, the number of functioning collars (i.e., those that collected more than 10 loctions) are less than those deployed.

Appendix 10-2

Remote Digital Camera Locations and Habitat Attributes

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Appendix 10-2. Remote Digital Camera Locations and Habitat Attributes

Camera Number	Zone	Easting	Northing	RSA or West of RSA	Compass Bearing	Date/Time deployed	Date/Time collected	Potential Infrastructure Site	Habitat Class	Habitat Analysis	Habitat Code and Comments	Caribou Detection Rate (caribou/day)
BR1	13	372339	7326747	RSA	267	2012-05-24 18:00:00	2012-08-26 16:00:00	No	Tundra	Tundra	TH (dry, dwarf shrub)	0.022
BR2	13	374094	7302270	RSA	356	2012-05-25 14:30:00	2012-08-26 15:51:14	No	Esker	Esker	ES (sparse unvegetated, cobble)	0.000
BR3	13	382439	7298201	RSA	137	2012-05-25 15:00:00	2012-08-25 10:29:48	No	Tundra	Tundra	TL (mesic, dwarf to low shrub)	0.033
BR4	13	367751	7313892	RSA	245	2012-05-24 18:30:00	2012-08-26 15:34:05	No	Esker	Esker	ES (sparse unvegetated, cobble)	0.011
BR5	13	385511	7315992	RSA	300	2012-05-25 13:30:00	2012-08-26 14:58:04	Yes	Esker	Esker	ES (sparse unvegetated, cobble)	0.027
BR6	13	393907	7300999	RSA	300	2012-05-25 16:00:00	2012-08-26 14:10:42	No	Esker	Esker	EH (dwarf shrub/herb)	0.068
BR7	13	387597	7308385	RSA	190	2012-05-25 15:30:00	2012-08-26 14:30:00	No	Esker and Tundra	Esker	EH and TH (tundra, dwarf shrub)	0.000
BR8	13	394585	7307407	RSA	307	2012-05-24 16:29:54	2012-08-26 14:18:27	No	Bedrock	Bedrock	BL and BR (rocky, dry and sparse vegetation)	0.000
BR9	13	400143	7297497	RSA	90	2012-06-11 15:23:27	2012-08-26 12:30:26	Yes	Tundra	Tundra	TH and TB (dwarf shrub, small % blockfield)	0.119
BR10	13	417330	7327873	RSA	340	2012-05-24 15:59:07	2012-08-24 12:00:00	No	Freshwater	Freshwater	RI (river)	0.000
BR11	13	392564	7267456	RSA	298	2012-05-25 16:30:00	2012-08-24 16:14:29	No	Esker	Esker	ES (sparse unvegetated, cobble)	0.031
BR12	13	376091	7318071	RSA	150	2012-05-25 13:56:31	2012-08-26 15:25:41	No	Tundra	Tundra	TH (dry, dwarf shrub)	0.000
BR13	13	405680	7288177	RSA	290	2012-05-25 10:26:31	2012-08-26 12:16:47	Yes	Esker	Esker	ES (sparse unvegetated, cobble)	0.000
BR14	13	384683	7335946	RSA	290	2012-05-24 16:49:57	2012-08-26 14:33:10	No	Wetland	Wetland	WC and WB (round-fruited sedge, small % bog complex)	0.064
BR15	13	381277	7321450	RSA	310	2012-05-25 13:35:42	2012-08-26 15:15:04	Yes	Esker	Esker	ES (sparse unvegetated, cobble)	0.064
BR16	13	431573	7269702	RSA	308	2012-05-23 17:22:36	2012-08-26 09:24:07	Yes	Tundra	Tundra	TL and TB (mesic, dwarf shrub, small % blockfield)	0.106
BR17	13	434895	7271625	RSA	320	2012-05-23 17:30:00	2012-08-26 10:33:32	Yes	Tundra and Bedrock	Tundra	TH and BL (dwarf shrub, dry rocky lichen)	0.074
BR18	13	434151	7280644	RSA	346	2012-05-25 09:19:51	2012-08-26 11:31:46	No	Esker	Esker	EH (dwarf shrub, herb)	0.000
BR19	13	420493	7277591	RSA	80	2012-05-25 10:00:00	2012-08-26 11:49:05	Yes	Tundra	Tundra	TH (dry, dwarf shrub)	0.011
BR20	13	427241	7271826	RSA	240	2012-05-23 18:00:00	2012-08-26 08:48:24	Yes	Bedrock	Bedrock	BL (dry, rocky lichen)	0.063
BR21	13	424176	7265510	RSA	195	2012-05-23 18:04:58	2012-08-24 16:58:30	Yes	Tundra	Tundra	TH (dry, dwarf shrub)	0.054
BR22	13	424969	7268652	RSA	336	2012-05-23 18:00:00	2012-08-24 18:13:19	Yes	Tundra	Tundra	TL (mesic, dwarf to low shrub)	0.409
BR23	13	436244	7259900	RSA	40	2012-05-24 15:00:00	2012-08-24 15:22:24	No	Tundra	Tundra	TL (mesic, dwarf to low shrub)	0.304
BR24	13	432791	7301044	RSA	5	2012-05-24 15:26:18	2012-08-26 17:02:50	No	Esker and Freshwater	Esker	ES, EH (sparse, unvegetated gravel, dwarf shrub and herb), and RI (river)	0.000
BR25	13	436875	7249174	RSA	343	2012-05-24 14:24:07	2012-08-24 15:03:33	No	Esker	Esker	EH or EW (dwarf, low to tall shrub)	0.012
BR26	13	441825	7276151	RSA	237	2012-05-24 15:00:10	2012-08-26 09:02:27	No	Tundra	Tundra	TH (dry, dwarf shrub)	0.096
BR27	13	411364	7282979	RSA	190	2012-05-25 09:54:05	2012-08-26 11:59:39	Yes	Tundra and Bedrock	Tundra	TH and BL (dwarf shrub, dry rocky lichen)	0.021
BR28	13	421107	7260616	RSA	344	2012-05-23 18:21:17	2012-08-24 15:42:53	No	Tundra	Tundra	TL and TB (mesic, dwarf shrub, small % blockfield)	2.605
BR29	13	403829	7266323	RSA	256	2012-05-25 16:30:00	2012-08-24 16:32:49	No	Tundra, Bedrock, and Freshwater	Tundra	TL, BL (mesic, dwarf to low shrub, and dry rocky lichen), and RI (river)	0.000
BR30	13	437153	7236588	RSA	326	2012-05-24 14:02:25	2012-08-24 14:37:15	No	Riparian and Freshwater	Freshwater	RL (short to tall wet shrub), and RI (river)	2.206
HR1	12	556139	7261563	West of RSA	205	2012/06/06 12:30:00	2012/08/27 09:57:01	Yes	Bedrock	Bedrock	BL (dry, rocky lichen)	0.072
HR2	12	577350	7287632	West of RSA	260	2012/06/06 13:30:00	2012/08/27 10:10:44	No	Bedrock	Bedrock	BL (dry, rocky lichen)	0.012
HR3	12	570542	7299351	West of RSA	125	2012/06/06 14:32:36	2012/08/27 10:27:17	No	Tundra	Tundra	TL (mesic, dwarf to low shrub)	4.430
HR4	12	584927	7308817	West of RSA	27	2012/06/15 14:30:00	2012/08/27 10:41:16	No	Tundra and Bedrock	Bedrock	TL and BL (mesic, dwarf to low shrub, and dry rocky lichen)	0.906
HR5	12	586937	7302713	West of RSA	310	2012/06/15 15:00:00	2012/08/27 10:52:19	No	Tundra	Tundra	TH (dry, dwarf shrub)	0.000
HR6	12	594733	7322169	West of RSA	140	2012/06/15 15:00:00	2012/08/27 11:03:59	No	Wetland	Wetland	WC and WA (round-fruited sedge, small % fen/marsh)	0.000
HR7	12	601828	7302831	West of RSA	315	2012/06/13 20:00:00	2012/08/27 11:25:53	No	Tundra	Tundra	TH and TL (dry, dwarf shrub, mesic, dwf to low shrub)	4.846
HR8	12	609753	7285491	West of RSA	337	2012/06/15 14:30:00	2012/08/27 13:40:42	Yes	Tundra	Tundra	TB (blockfield)	1.766
HR9	12	630002	7300746	West of RSA	42	2012/06/15 14:00:00	2012/08/30 16:45:08	Yes	Wetland	Wetland	WF (undifferentiated fen)	0.000
HR10	12	585999	7321984	West of RSA	175	2012/06/15 15:30:00	2012/08/25 12:00:00	No	Esker	Esker	ES (sparse unvegetated, cobble)	0.000
HR11	12	602183	7344582	West of RSA	322	2012/06/08 15:30:00	2012/08/26 14:20:02	No	Tundra	Tundra	TS (wet, low to tall shrub)	7.853
HR12	12	607314	7334050	West of RSA	128	2012/06/05 17:30:00	2012/08/26 08:39:27	No	Tundra	Tundra	TH and TB (dry, dwarf shrub, blockfield)	0.025
HR13	12	611892	7319879	West of RSA	214	2012/06/15 17:00:00	2012/08/26 08:51:32	No	Tundra	Tundra	TS (wet, low to tall shrub)	0.000
HR14	12	615960	7326023	West of RSA	42	2012/06/05 17:30:00	2012/08/25 17:14:38	No	Tundra	Tundra	TH (dry, dwarf shrub)	0.012
HR15	12	610310	7320282	West of RSA	352	2012/06/08 17:25:24	2012/08/26 15:52:01	No	Bedrock	Bedrock	BL (dry, rocky lichen)	0.000
HR16	12	605602	7315827	West of RSA	165	2012/06/05 17:37:11	2012/08/26 15:37:46	No	Tundra	Tundra	TL (mesic, dwarf to low shrub)	1.727
HR17	12	601793	7319097	West of RSA	350	2012/06/06 12:00:00	2012/08/27 14:03:31	No	Freshwater	Freshwater	RI (river)	5.725
HR18	12	616161	7324823	West of RSA	114	2012/06/13 19:00:00	2012/08/27 11:41:11	No	Freshwater, Riparian and Tundra	Tundra	RI (river), RW (short to tall wet shrub), and TL (mesic, dwarf to low shrub)	0.000
HR19	12	629216	7334160	West of RSA	335	2012/06/13 19:12:13	2012/08/30 17:11:20	No	Tundra	Tundra	TH and TB (dry, dwarf shrub, blockfield)	0.000
HR20	12	613504	7329147	West of RSA	330	2012/06/13 21:00:00	2012/08/26 09:36:23	Yes	Esker	Esker	ES and EH (sparse, unvegetated gravel, dwarf shrub and herb)	0.000
HR21	12	618713	7330724	West of RSA	33	2012/06/15 17:24:58	2012/08/26 09:50:51	No	Tundra	Tundra	TL (mesic, dwarf to low shrub)	0.000
HR22	12	624450	7357133	West of RSA	310	2012/06/15 18:00:00	2012/08/26 16:56:10	No	Esker	Esker	EH (dwarf shrub, herb)	0.000
HR23	12	622624	7366910	West of RSA	225	2012/06/15 18:00:00	2012/08/26 14:00:03	No	Wetland	Wetland	WC (round-fruited sedge)	0.000
HR24	12	596895	7374265	West of RSA	318	2012/06/15 18:06:01	2012/08/26 12:47:57	No	Tundra	Tundra	TS (wet, low to tall shrub)	0.000
HR25	12	604372	7340882	West of RSA	16	2012/06/13 20:30:00	2012/08/26 12:12:30	No	Tundra	Tundra	TH (dry, dwarf shrub)	0.014
HR26	12	625337	7310551	West of RSA	62	2012/06/15 14:00:00	2012/08/30 16:57:33	Yes	Bedrock and Tundra	Tundra	BL and TB (dry, rocky lichen, blockfield)	0.000
HR27	12	607496	7320577	West of RSA	324	2012/06/08 15:52:07	2012/08/25 17:43:11	No	Bedrock	Bedrock	BL (dry, rocky lichen)	2.562
HR28	12	617411	7317126	West of RSA	32	2012/06/08 18:03:29	2012/08/26 11:45:35	Yes	Tundra	Tundra	TL (mesic, dwarf to low shrub)	0.013
HR29	12	605027	7343168	West of RSA	94	2012/06/08 16:00:18	2012/08/26 09:10:13	No	Tundra	Tundra	TH (dry, dwarf shrub)	0.000
HR30	12	618866	7315574	West of RSA	265	2012/06/08 17:55:25	2012/08/26 11:34:30	Yes	Esker	Esker	ES and EH (sparse, unvegetated gravel, dwarf shrub and herb)	0.000

Appendix 10-3

Images of Wildlife Captured by Remote Digital Cameras, May to August 2012

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Appendix 10-3. Images of Wildlife Captured by Remote digital Cameras, May to August 2012

		Camera Photo(s) Details								Wildlife Recorded on Photo(s)				
Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
RSA Cameras														
BR1	4-Jun-12	1	11:00:00		T	515		1		Unknown	Unknown			Grizzly tripod is knocked down; Camera lens is blurry or has film on it
BR1	6-Jun-12	1	02:30:00		T	594	595	2		Mammal	Grizzly Bear	2	Walking	Camera knocked over in 595 - 764 (by bears in 594?) - bears appear just in 594
BR1	12-Jun-12	1	19:00:00		T	915		1		Unknown	Unknown			Grizzly tripod is knocked down
BR1	13-Jun-12	1	22:30:00		T	970		1		Mammal	Grizzly Bear	1	Sniffing	Sniffing grizzly tripod
BR1	16-Jun-12	1	11:30:00		T	1092		1		Mammal	Arctic Ground Squirrel	1	Running	
BR1	17-Jun-12	1	06:30:00		T	1130		1		Mammal	Arctic Ground Squirrel	1	Running	
BR1	19-Jun-12	1	01:00:00		T	1215		1		Unknown	Unknown			Camera has been bumped so angle of view has changed - photos are all still blurry, camera angle view fixed at 9:00am
BR1	19-Jun-12	2	13:30:00		T	1239		1		Unknown	Unknown			Grizzly tripod knocked down
BR1	21-Jun-12	1	19:00:00		T	1346		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR1	27-Jun-12	1	08:00:00		T	1612		1		Mammal	Arctic Ground Squirrel	1	Sniffing	
BR1	28-Jun-12	1	19:00:00		T	1682		1		Mammal	Arctic Ground Squirrel	1	Sniffing	Investigating the grizzly tripod
BR1	29-Jun-12	1	15:30:00		T	80		1		Mammal	Arctic Ground Squirrel	1	Foraging	
BR1	30-Jun-12	1	07:10:03		M	112	141	30	3	Unknown	Unknown	1	Unknown	
BR1	2-Jul-12	1	06:14:09	06:14:18	M	50	59	10	1	Mammal	Arctic Ground Squirrel	1	Running	
BR1	6-Jul-12	1	01:37:16	01:42:10	M	243	302	60	6	Mammal	Grizzly Bear	1	Rubbing, Sniffing	Rolling on ground
BR1	11-Jul-12	1	02:00:00		T	553		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR1	11-Jul-12	2	15:30:00		T	580		1		Mammal	Arctic Ground Squirrel	1	Sniffing	
BR1	11-Jul-12	3	17:30:00		T	584		1		Mammal	Arctic Ground Squirrel	1	Sniffing	
BR1	12-Jul-12	1	03:08:48	03:08:55	M	604	613	10	1	Mammal	Caribou	1	Walking	
BR1	12-Jul-12	2	15:30:00		T	638		1		Mammal	Arctic Ground Squirrel	1	Sniffing	
BR1	14-Jul-12	1	17:30:00		T	738		1		Mammal	Arctic Ground Squirrel	1	Sniffing	
BR1	16-Jul-12	1	03:41:19	03:41:27	M	807	816	10	1	Mammal	Wolf	1	Walking, Sniffing	
BR1	17-Jul-12	1	06:30:00	07:00:00	T	870	871	2		Avian	Shorebird	1	Standing	Size of LESA, SESA, BASA
BR1	17-Jul-12	2	08:00:00		T	873		1		Mammal	Arctic Ground Squirrel	1	Running	
BR1	18-Jul-12	1	07:30:00		T	920		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR1	18-Jul-12	2	16:00:00		T	937		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR1	19-Jul-12	1	07:00:00		T	967		1		Avian	Songbird	1	Standing	
BR1	19-Jul-12	2	08:00:00		T	969		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR1	19-Jul-12	3	11:30:00		T	976		1		Mammal	Arctic Ground Squirrel	1	Sniffing	
BR1	20-Jul-12	1	10:30:00	10:32:19	T/M	1022	1032	11	1	Mammal	Arctic Ground Squirrel	1	Standing	
BR1	20-Jul-12	2	12:30:00		T	1036		1		Mammal	Arctic Ground Squirrel	1	Sniffing	
BR1	20-Jul-12	3	13:00:00		T	1037		1		Mammal	Arctic Ground Squirrel	1	Sniffing	
BR1	20-Jul-12	4	19:00:00		T	1049		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR1	21-Jul-12	1	09:56:29	09:56:37	M	1079	1088	10	1	Mammal	Arctic Ground Squirrel	1	Foraging	
BR1	21-Jul-12	2	14:00:00		T	1097		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR1	22-Jul-12	1	04:56:06	04:56:14	M	1127	1136	10	1	Avian	Songbird	1	Flying	
BR1	22-Jul-12	2	10:18:12	10:18:19	M	1148	1157	10	1	Mammal	Arctic Ground Squirrel	1	Running, Foraging	
BR1	23-Jul-12	1	15:00:00		T	1215		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR1	24-Jul-12	1	07:38:14	07:38:22	M	1249	1258	10	1	Mammal	Arctic Ground Squirrel	1	Foraging	
BR1	25-Jul-12	1	04:06:26	04:21:36	M	1321	1770	450	45	Mammal	Grizzly Bear	1	Walking, Sniffing	
BR1	28-Jul-12	1	12:30:23		M	1932	1941	10	1	Mammal	Arctic Ground Squirrel	1	Foraging	
BR1	29-Jul-12	1	11:00:00		T	1986		1		Avian	Songbird	1	Standing	
BR1	30-Jul-12	1	07:49:36		M	2028	2037	10	1	Mammal	Wolf	1	Walking	
BR1	31-Jul-12	1	08:30:00		T	2087		1		Avian	Savanah Sparrow	2	Standing	
BR1	31-Jul-12	2	12:38:40	12:39:49	M	2096	2105	10	1	Mammal	Arctic Ground Squirrel	1	Running, Standing	
BR1	31-Jul-12	3	13:30:00		T	2107		1		Avian	Songbird	2	Standing	
BR1	1-Aug-12	1	07:19:16	07:19:23	M	2143	2152	10	1	Mammal	Arctic Ground Squirrel	1	Running, Standing	
BR1	1-Aug-12	2	13:19:55	13:20:02	M	2165	2174	10	1	Mammal	Caribou	1	Running	Looks like back end of a caribou
BR1	1-Aug-12	3	14:00:00		T	2176		1		Mammal	Arctic Ground Squirrel	1	Sitting	
BR1	2-Aug-12	1	09:31:41	09:31:48	M	2216	2225	10	1	Mammal	Arctic Ground Squirrel	1	Running	
BR1	2-Aug-12	2	10:30:00		T	2227		1		Avian	Songbird	1	Perched	

Appendix 10-3. Images of Wildlife Captured by Remote digital Cameras, May to August 2012

		Camera Photo(s) Details							Wildlife Recorded on Photo(s)				
Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
BR1	2-Aug-12	3	15:00:00		T	2236		1		Avian	Shorebird	1	Standing	
BR1	2-Aug-12	4	20:49:15	20:59:43	M	2258	2467	210	21	Mammal	Grizzly Bear	1	Standing, Sniffing, Rolling	
BR1	3-Aug-12	1	06:00:05	06:07:30	M	2487	2676	190	19	Mammal	Grizzly Bear	1	Sniffing at camera	
BR1	3-Aug-12	2	09:33:18	09:33:24	M	2684	2693	10	1	Mammal	Arctic Ground Squirrel	1	Running	
BR1	4-Aug-12	1	06:30:59	06:38:05	M	2816	2955	140	14	Mammal	Grizzly Bear	1	Sniffing	
BR1	4-Aug-12	2	13:30:00		T	2969		1		Mammal	Arctic Ground Squirrel	1	Foraging	
BR1	5-Aug-12	1	21:16:49	21:18:34	M	3033	3102	70	7	Mammal	Grizzly Bear	1	Sniffing	
BR1	7-Aug-12	1	02:31:05	02:34:56	M	3192	3291	100	10	Mammal	Wolf	1	Walking, Sniffing	
BR1	7-Aug-12	2	03:12:14	03:13:15	M	3303	3362	60	6	Mammal	Wolf	1	Sniffing, Rubbing	
BR1	7-Aug-12	3	06:30:00		T	3369		1		Mammal	Grizzly Bear	1	Walking, Sniffing	
BR1	7-Aug-12	4	10:30:00		T	3377		1		Mammal	Arctic Ground Squirrel	1	Foraging	
BR1	7-Aug-12	5	11:55:20	11:55:42	M	3380	3399	20	2	Mammal	Wolf	1	Walking	
BR1	8-Aug-12	1	17:32:12	17:32:20	M	3460	3469	10	1	Mammal	Arctic Ground Squirrel	1	Foraging	
BR1	8-Aug-12	2	19:30:00		T	3473		1		Mammal	Arctic Ground Squirrel	1	Foraging	
BR1	8-Aug-12	3	20:39:40	20:42:29	M	3476	3535	60	6	Mammal	Grizzly Bear	1	Rolling	
BR1	9-Aug-12	1	01:13:54	01:20:14	M	3545	3704	160	16	Mammal	Wolf	1	Walking, Sniffing	
BR1	11-Aug-12	1	15:33:22	15:34:02	M	3830	3849	20	2	Mammal	Wolverine	1	Walking, Sniffing	
BR1	12-Aug-12	1	17:04:21	17:07:18	M	3901	4060	160	16	Mammal	Grizzly Bear	1	Sniffing, Rolling	
BR1	14-Aug-12	1	03:36:13	03:36:20	M	4130	4139	10	1	Mammal	Wolf	1	Walking	Hard to tell if it's the same wolf from previous occasions
BR1	15-Aug-12	1	15:41:23	15:41:30	M	4231	4239	10	1	Mammal	Wolf	1	Walking, Sniffing	Might be same wolf?
BR1	19-Aug-12	1	09:25:12	09:25:20	M	4420	4429	10	1	Mammal	Wolverine	1	Walking, Sniffing	
BR1	20-Aug-12	1	10:00:00	11:30:00	T	4479	4482	4	0	Avian	Willow Ptarmigan	2	Standing	Definitely a male in the photos wilh a female sulking around - but hard to see her
BR1	21-Aug-12	1	14:30:00		T	4536		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR1	23-Aug-12	1	19:40:15	19:41:18	M	4643	4672	30	3	Mammal	Grizzly Bear	1	Sniffing, Walking, Rolling	Not sure if this is a bear we have seen previously
BR2	30-Jun-12	1	08:00:00		T	44		1		Avian	Songbird	1	Perched	
BR2	6-Jul-12	1	08:35:28	08:36:28	M	256	295	40	4	Mammal	Wolf	1	Walking, Sniffing	
BR2	11-Jul-12	1	02:42:18	02:43:16	M	534	563	30	3	Mammal	Wolf	1	Sniffing	
BR2	12-Jul-12	1	06:00:00		T	629		1		Avian	Raptor	1	Perched	Rough-legged hawk or Short-eared owl
BR2	14-Jul-12	1	07:30:00		T	728		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR2	16-Jul-12	1	07:30:00		T	824		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR2	23-Jul-12	1	22:37:51	22:52:51	M	1191	1500	310	31	Mammal	Grizzly Bear	1	Rubbing, Sniffing	
BR2	24-Jul-12	1	08:06:03		M/T	1520	1686	167	16	Unknown	Unknown		Camera down	Camera tripod was knocked over - taking pictures of ground
BR2	25-Jul-12	1	23:11:53	23:22:37	M	1778	1907	130	13	Mammal	Grizzly Bear	1	Walking, Sniffing	Cannot see bear until second trigger set of photos; bear moved camera angle view to the right quite a bit
BR2	25-Jul-12	1	23:32:01	23:39:05	M	1909	1998	90	9	Mammal	Wolf	1	Walking, Sniffing	Wolf pulling on bungee cord on grizzly tripod
BR2	26-Jul-12	1	01:25:51	01:30:00	M	2012	2111	100	10	Mammal	Wolf	1	Walking, Sniffing, Rolling	
BR2	26-Jul-12	2	01:30:00		T	2112		1		Mammal	Wolf	1	Walking	
BR2	26-Jul-12	3	07:30:00		T	2124		1		Mammal	Wolf	1	Walking, Sniffing	
BR2	28-Jul-12	1	03:21:53	03:22:01	M	2212	2221	10	1	Mammal	Wolf	1	Sniffing	Female wolf due to pee stance?
BR2	28-Jul-12	2	05:42:52	05:54:33	M	2227	2286	60	6	Mammal	Grizzly Bear	1	Walking, Sniffing	Bear knocked camera down at photo 2282 and subsequent photos up to 2693 are of the ground
BR2	1-Aug-12	1	16:47:55	16:48:01	M	2551	2560	10	1	Mammal	Grizzly Bear	1	Sniffing	A nose comes into fuzzy view in photo 2552
BR2	6-Aug-12	1	06:16:53	06:17:00	M	2950	2959	10	1	Mammal	Wolf	1	Walking	Hard to tell if wolf has been seen before
BR2	15-Aug-12	1	12:37:48	12:37:56	M	3513	3522	10	1	Mammal	Arctic Ground Squirrel	1	Walking	
BR2	17-Aug-12	1	05:57:29	05:59:01	M/T	3637	3666	30	3	Mammal	Wolf	2	Walking, Sniffing	
BR2	17-Aug-12	2	06:00:00		T	3667		1		Mammal	Wolf	1	Walking	
BR2	18-Aug-12	1	07:32:43	07:32:50	M	3729	3738	10	1	Avian	Songbird	1	Flying	Bird doesn't appear until third shot in trigger series
BR2	18-Aug-12	2	07:33:23	07:33:29	M	3739	3748	10	1	Mammal	Wolf	1	Walking, Sniffing	Might be a wolf observed previously
BR2	18-Aug-12	3	23:08:47	23:27:07	M	3780	3809	30	3	Mammal	Wolf	2	Walking, Sniffing	Second wolf doesn't appear until second trigger series - looks like same pair from before
BR2	21-Aug-12	1	21:12:43	21:13:30	M	3950	3999	50	5	Mammal	Grizzly Bear	1	Moving camera around	Bear knocked camera over - can just make out foot with claws in 2nd and 3rd photo
BR2	25-Aug-12	1	14:34:04	14:34:12	M	4179	4188	10	1	Mammal	Arctic Ground Squirrel	1	Walking	Camera still on ground - can just make out tail

Appendix 10-3. Images of Wildlife Captured by Remote digital Cameras, May to August 2012

		Camera Photo(s) Details								Wildlife Recorded on Photo(s)				
Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
BR2	10-Jun-12	1	08:30:00		T	757								Grizzly tripod baited - camera was put back inside case upside down - righted again on 20 June
BR2	26-Jun-12	1	20:00:00		T	1548		1		Mammal	Grizzly Bear	1	Sniffing	Grizzly bear knocked down grizzly tripod
BR3	23-Jun-12	1	17:00:00		T	1397		1		Mammal	Unknown	1	On ground	Dark blob in this photo only. Maybe a bear or musk ox? Maybe a rogue mosquito?
BR3	2-Jul-12	1	04:59:52	05:00:01	M	1825	1835	10	1	Mammal	Caribou	1	Traveling	Photo 1825 included in Good Photos.
BR3	2-Jul-12	1	05:00:00		T	1834		1		Mammal	Caribou	1	Traveling	
BR3	4-Jul-12	1	22:06:38	22:06:46	M	1966	1975	10	1	Mammal	Caribou	1	Traveling	Only 4 of 10 photos with caribou. Photo 1968 included in Good Photos.
BR3	5-Jul-12	1	10:00:00		T	1999		1		Mammal	Unknown	2	On ground	Two light colored, small spots, directly in middle photo and just to the right.
BR3	28-Jul-12	1	19:44:24	19:48:30	M	3153	3262	110	11	Mammal	Grizzly Bear	1	Checking camera	I assume this is one individual. Bear not in all photos. Photo 3257 included in Good photos.
BR3	21-Aug-12	1	19:20:07	19:20:14	M	4414	4423	10	1	Mammal	Caribou	1	Traveling	Only 1 (first) photo of animal. Photo 4414 included in Good Photos.
BR4	25-Jul-12	1	09:41:50	09:41:57	M	1240	1249	10	1	Mammal	Grizzly Bear	1	At bear post	Bear not in all photos.
BR4	26-Jul-12	1	05:33:01	05:36:10	M	1290	1329	40	4	Mammal	Grizzly Bear	1	At bear post	Bear knocked down post. Assume this is not the bear from 7/25/12. Bear not in all photos.
BR4	26-Jul-12		19:00:00		T	1356				Mammal	Wolf	1	Sniffing bear post	Note that the motion trigger was not set off. Photo 1356 included in Good Photos.
BR4	2-Aug-12	1	10:35:43	10:35:51	M	1676	1685	10	1	Mammal	Caribou	1	At camera post	
BR4	12-Jun-12		01:00:00		T	878				Mammal	Wolverine	1	At bear post	Looks like a wolverine, note that the motion trigger was not set off. Photo 878 included on Good Photos.
BR5	7-Jul-12	1	07:02:38	07:02:46	M	321	330	10	1	Mammal	Caribou	1	Traveling	Caribou not in all photos.
BR5	14-Jul-12	1	19:03:23	19:03:31	M	701	710	10	1	Mammal	Caribou	1	Traveling	Caribou not in all photos.
BR5	16-Jul-12	1	23:16:51	23:16:59	M	815	824	10	1	Mammal	Wolf	1	Traveling	
BR5	29-Jul-12	1	07:12:22	07:13:47	M	1427	1486	60	6	Mammal	Grizzly Bear	1	Checking out camera	Bear not in all photos.
BR5	2-Aug-12	1	02:00:17	02:08:38	M	1679	1708	30	3	Mammal	Hare	1	Hanging around	Hare not in all photos.
BR5	8-Aug-12	1	06:07:47	06:08:54	M	2005	2024	20	2	Mammal	Grizzly Bear	1	Checking out camera	Likely a bear, but not 100% certain. Camera is knocked upwards at photo 2016.
BR5	8-Aug-12					2016	1996							Camera knocked upwards, stayed upwards until takedown on 8/26/12.
BR6	6-Jul-12	1	22:58:36		M	274		1	1	Mammal	Caribou	1	Walking	
BR6	8-Jul-12	1	05:10:03	05:10:05	M	355	358	4	1	Mammal	Caribou	1	Walking	
BR6	11-Jul-12	1	00:36:09	00:36:10	M	511	512	2	1	Mammal	Caribou	1	Walking	
BR6	14-Jul-12	1	06:04:10	06:04:20	M	682	693	12	2	Mammal	Wolf	1	Walking	Sniffing at bear post, turns and walks towards camera
BR6	17-Jul-12	1	01:42:55	01:49:47	M	847	926	80	8	Mammal	Grizzly Bear	1	Walking	Knocks down bear tripod, interested in camera, lots of super closeups
BR6	24-Jul-12	1	07:27:02	07:28:12	M	1284	1308	25	3	Mammal	Wolf	2	Walking	
BR6	1-Aug-12	1	09:25:33	09:54:44	M	1823	2043	221	22	Mammal	Grizzly Bear	1	Walking	Scratching at post for about 10 triggers, plays with camera and knocks everything down
BR6	1-Aug-12	2	20:38:39	20:38:48	M	2066	2074	9	1	Mammal	Arctic Ground Squirrel	1	Walking	
BR6	3-Aug-12	1	05:55:34		M	2202		1	1	Mammal	Arctic Ground Squirrel	1	Walking	Walking away, might be same one seen August 1, 2012
BR6	4-Aug-12	1	00:54:09	00:54:17	M	2379	2388	10	2	Mammal	Grizzly Bear	1	Scratching post	Knocks down camera again
BR6	7-Aug-12	1	23:15:59	23:16:34	M	2648	2674	36	3	Mammal	Grizzly Bear	1	Sniffing at post	Knocks down camera again
BR6	16-Aug-12	1	21:01:30	21:01:44	M	3117	3136	20	2	Mammal	Wolf	1	Walking	
BR6	18-Aug-12	1	16:18:29	16:18:35	M	3223	3232	10	1	Mammal	Wolf	1	Curious	Young wolf
BR6	20-Aug-12	1	13:07:42	13:11:57	M	3323	3362	40	4	Mammal	Grizzly Bear	1	Curious	Walks to camera, and knocks it down
BR6	30-Jul-02	1	13:57:05	13:57:07	M	1726	1727	2	1	Mammal	Wolf	1	Walking	Sniffing at bear post
BR6	28-May-12	1	07:00:00		T	127		1		Mammal	Caribou	2	Standing	Maybe two caribou, one animal in front of snowpack and the other lower left
BR6	1-Aug-12		09:54:44											camera has been down for 3 days, from August 1, 9:54:44 until August 3, 14:51:15
BR6	4-Aug-12		00:54:17											camera has been down for 3 days, from August 4, 0:54:09 until August 6, 10:16:13 - bear post was not fixed

Appendix 10-3. Images of Wildlife Captured by Remote digital Cameras, May to August 2012

		Camera Photo(s) Details							Wildlife Recorded on Photo(s)				
Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
BR6	7-Aug-12		23:16:34											camera has been down for 8 days, from August 7, 23:16:34 until August 14 , 14:37:07
BR6	20-Aug-12		13:11:57											camera has been down for 7 days, from August 20 13:11:57 until August 26 , 14:10:33
BR6	3-Aug-12		14:51:17											
BR6	6-Aug-12		10:16:13											
BR6	14-Aug-12		14:37:07											
BR6	26-Aug-12		14:10:33											
BR7														No observations in photo set.
BR8	28-May-12		08:00:00		T	186		1		Small Mammal	Arctic Ground Squirrel	1	Standing on rock	Spp unknown.
BR8	28-May-12		08:30:00		T	187		1		Small Mammal	Arctic Ground Squirrel	1	Standing on rock	Spp unknown, maybe same individual as in previous photo.
BR8	22-Jun-12		01:30:00		T	1383		1		Avian	Willow Ptarmigan	1	Curled up on rock	Spp unknown.
BR8	15-Jul-12	1	10:33:12	10:33:19	M	2566	2575	10	1	Avian	Mallard	1	Flying	I know we aren't suppose to note waterfowl, but should make sure this isn't something else?
BR8	24-Jul-12		19:30:00		T	3035		1		Mammal	Grizzly Bear	1	Standing behind rock	Spp unknown.
BR8	31-Jul-12	1	06:52:52	06:53:44	M	3346	3375	30	3	Mammal	Grizzly Bear	1	At camera	No great photos.
BR9	20-Jul-12	1	13:00:00		T	438		1		Mammal	Caribou	1	Grazing	
BR9	29-Jul-12	1	07:00:00		T	2361		1		Unknown	Arctic Ground Squirrel	1	Sitting	
BR9	10-Aug-12	1	14:32:26	14:32:34	M	2953	2962	10	1	Mammal	Caribou	1	Walking, Grazing	
BR9	10-Aug-12	2	21:47:29	21:47:37	M	2977	2986	10	1	Mammal	Caribou	1	Walking	
BR9	11-Aug-12	1	15:30:00		T	3022		1		Mammal	Caribou	2	Grazing	
BR9	20-Aug-12	1	19:00:00		T	3461		1		Avian	Canada Goose	34	Walking	
BR9	20-Aug-12	2	21:00:00		T	3465		1		Mammal	Caribou	4	Walking	
BR10	3-Jun-12	1	16:58:36	17:08:47	M/T	532	662	131	13	Mammal	Grizzly Bear	1	Attracted to camera and tripod	Bear investigated camera and then knocked bait tripod over, bit into triangle
BR10	5-Jun-12	1	08:30:00		T	741		1		Mammal	Arctic Ground Squirrel	1	Running	
BR10	5-Jun-12	2	14:00:00		T	752		1		Mammal	Arctic Ground Squirrel	1	Running	
BR10	5-Jun-12	3	19:58:23	19:58:28	M	784	793	10	1	Avian	Songbird?	2	Flying	784 and 787
BR10	6-Jun-12	1	08:30:00		T	839		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	6-Jun-12	2	09:00:00		T	840		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	6-Jun-12	3	13:00:00		T	848		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	7-Jun-12	1	08:00:00		T	886		1		Mammal	Arctic Ground Squirrel	2	Walking	
BR10	7-Jun-12	2	09:30:00		T	889		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	7-Jun-12	3	13:30:00		T	897		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	8-Jun-12	1	06:30:00		T	931		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	8-Jun-12	2	07:30:00		T	933		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	8-Jun-12	3	09:30:00		T	937		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	8-Jun-12	4	16:30:00		T	951		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	9-Jun-12	1	09:00:00		T	984		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	9-Jun-12	2	14:30:00		T	995		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	9-Jun-12	3	15:30:00		T	997		2		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	10-Jun-12	1	08:00:00		T	1490		1		Mammal	Arctic Ground Squirrel	1	Running	
BR10	10-Jun-12	2	10:30:00		T	1495		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	10-Jun-12	3	12:30:00		T	1499		3		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	11-Jun-12	1	11:00:00		T	1544		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	11-Jun-12	2	15:30:00		T	1553		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	11-Jun-12	3	17:00:00		T	1556		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	13-Jun-12	2	16:00:00		T	1650		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	16-Jun-12	1	19:00:00		T	1800		1		Mammal	Moose	1	Walking	
BR10	20-Jun-12	2	18:57:00		M/T	2041	2061	21	2	Mammal	Grizzly Bear	1	Attracted to camera and tripod	Photo 2051 - Looks like same bear as June 3. Bear investigated camera and knocked bait tripod over
BR10	23-Jun-12	1	06:15:30		M	2180	2199	20	2	Mammal	Grizzly Bear	1	Attracted to camera and tripod	
BR10	23-Jun-12	2	10:30:00		T	2208		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	24-Jun-12	1	07:00:00		T	2249		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	24-Jun-12	2	14:30:00		T	2264		1		Mammal	Arctic Ground Squirrel	1	Walking	

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Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
BR10	24-Jun-12	3	16:00:00	16:30:00	T	2267	2268	2		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	24-Jun-12	4	19:39:58	19:41:22	M	2275	2324	50	5	Mammal	Grizzly Bear	1	Attracted to camera and tripod	2286 bird tail?
BR10	25-Jun-12	1	15:39:02		T	2452		1		Mammal	Arctic Ground Squirrel?	1	Running	
BR10	25-Jun-12	2	16:30:00		T	2456		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	26-Jun-12	1	18:00:00		T	2507		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	28-Jun-12	1	07:30:00	08:30:00	T	2592	2594	3		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	28-Jun-12	2	11:00:00		T	2599		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	28-Jun-12	3	19:00:00		T	2615		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	29-Jun-12	1	12:30:00		T	2670		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	2-Jul-12	1	09:56:29	10:00:19	M/T	3586	3766	181	18	Mammal	Grizzly Bear	2	Attracted to camera and tripod	Mother Bear and Two Year Cub, Knocked bait tripod over
BR10	3-Jul-12	1	08:30:00		T	3811		1		Mammal	Arctic Ground Squirrel	1	Running	
BR10	5-Jul-12	1	19:51:54	20:00:13	M/T	3940	4080	141	14	Mammal	Grizzly Bear	4	Attracted to camera and tripod	Blond Mother Bear and Three Year Old Cubs
BR10	6-Jul-12	1	19:30:00		T	4127		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	14-Jul-12	1	20:00:00		T	4549		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	17-Jul-12	1	07:41:09	07:45:29	M	4669	4748	80	8	Mammal	Grizzly Bear	1	Attracted to camera and tripod	Knocked over bait tripod without triggering camera.
BR10	19-Jul-12	1	05:30:00		T	4840				Avian	Redpoll?	1	Standing	
BR10	19-Jul-12	2	15:30:00		T	4860				Mammal	Arctic Ground Squirrel	1	Running	
BR10	20-Jul-12	1	18:30:00		T	4914		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	22-Jul-12	1	12:00:00		T	4997		1		Mammal	Arctic Ground Squirrel	1	Running	
BR10	23-Jul-12	1	13:30:00		T	5048		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	24-Jul-12	1	08:00:00	08:30:00	T	5085	5086	2		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	24-Jul-12	2	11:00:00		T	5091		1		Avian	Songbird?	2	Flying	
BR10	25-Jul-12	1	20:00:00		T	5267		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	27-Jul-12	1	14:00:00		T	5351		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	27-Jul-12	2	18:38:29	18:46:03	M	5361	5460	100	10	Mammal	Grizzly Bear	1	Attracted to camera and tripod	Knocked over bait tripod
BR10	27-Jul-12	3	19:00:00		T	5461		1		Mammal	Grizzly Bear	1	Attracted to camera and tripod	
BR10	27-Jul-12	4	20:40:46	20:45:34	M	5465	5514	50	5	Mammal	Grizzly Bear	1	Attracted to camera and tripod	Different bear than 5361-5460, knocked over camera tripod
BR10	7-Aug-12	1	16:43:54	16:46:35	M	6455	6554	100	10	Mammal	Grizzly Bear	1	Attracted to camera and tripod	Knocked bait tripod over
BR10	10-Aug-12	1	17:30:00		T	6700		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	10-Aug-12	2	18:30:00		T	6702		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	11-Aug-12	1	10:00:00		T	6733		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	11-Aug-12	2	14:30:00		T	6742		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR10	11-Aug-12	3	17:30:00		T	6748		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR10	27-Jul-12	5	20:45:36	07:00:00	M/T	5515	6171	656	2					Triggered photos are from camera settling after falling down
BR10	4-Aug-12	1	07:00:56	07:01:03	M	6172	6181	10	1	Small Mammal	Arctic Ground Squirrel	1		Camera is down, so difficult to tell
BR10	4-Aug-12	2	07:30:00	13:30:00	M	6182	6194	12						
BR10	4-Aug-12		14:30:00											
BR11	5-May-12	1	13:48:05		M	566	585	20	2	Mammal	Wolf	1	Walking	
BR11	6-May-12	1	02:30:00		T	621		1		Avian	American Golden Plover	1	Standing	
BR11	27-May-12	1	09:30:00		T	83		1		Mammal	Arctic Ground Squirrel	1	Standing	
BR11	1-Jun-12	1	06:30:00		T	327		1		Avian	Ptarmigan	1	Standing	
BR11	4-Jun-12	1	06:07:54	06:08:08	M	483	502	20	2	Mammal	Wolf	1	Walking, Sniffing	
BR11	4-Jun-12	2	15:00:00		T	520		1		Mammal	Arctic Ground Squirrel	1	Walking	
BR11	19-Jun-12	1	09:30:00	10:00:00	T	1289	1290	2		Avian	Bald Eagle	1	Sitting, Standings	
BR11	20-Jun-12	1	17:30:00		T	1413		1		Avian	Raptor	1	Flying	
BR11	27-Jun-12	1	05:13:20		M	1755	1814	60	6	Mammal	Grizzly Bear	1	Sniffing, Rolling, Walking	
BR11	3-Jul-12	1	05:00:32	05:00:41	M	2293	2302	10	1	Mammal	Wolf	1	Walking	
BR11	6-Jul-12	1	18:04:56	18:05:05	M	2473	2482	10	1	Mammal	Caribou	1	Walking	
BR11	13-Jul-12	1	18:04:29	18:04:38	M	2863	2872	10	1	Mammal	Grizzly Bear	1	Walking, Sniffing	Bear pushed camera down
BR11	13-Jul-12	2	18:07:22		M	2873								
BR11	22-Jul-12	1	19:44:25	19:46:22	M	3348	3427	80	8	Mammal	Grizzly Bear	1	Sniffing	Can only see some hair and claws in the right corner of the camera
BR11	26-Jul-12	1	09:30:00		T	3599								

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		Camera Photo(s) Details								Wildlife Recorded on Photo(s)				
Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
BR11	28-Jul-12	1	06:28:38	06:38:08	M	3901	3951	50	5	Mammal	Grizzly Bear	1	Sniffing	Bear knocked camera down
BR11	28-Jul-12	2	07:24:57	07:25:07	M	3963	3972	10	1	Mammal	Grizzly Bear	1	Sniffing	Assume might be same bear from 30mins ago.
BR11	3-Aug-12	1	07:22:26	07:22:32	M	4431	4440	10	1	Mammal	Caribou	1	Walking	
BR11	3-Aug-12	2	16:39:55	16:40:01	M	4460	4469	10	1	Avian	Raven	1	Flying	
BR11	8-Aug-12	1	01:53:51	01:53:59	M	4760	4769	10	1	Mammal	Wolf	1	Walking	
BR11	13-Aug-12	1	08:31:54	08:32:01	M	5024	5033	10	1	Mammal	Wolf	1	Walking, Sniffing	
BR11	18-Aug-12	1	09:03:21	09:04:09	M	5292	5491	200	20	Mammal	Grizzly Bear	2	Sniffing	Can see a small foot in 5330; camera knocked down in 5333
BR12	3-Jun-12	1	22:51:23	22:53:05	M	501	560	60	6	Mammal	Grizzly Bear	1	At camera post.	No good photos.
BR12	25-Jul-12		17:00:00		T	3145		1		Mammal	Grizzly Bear	1	Walking towards camera.	
BR12	25-Jul-12	1	17:01:05	17:02:08	M	3146	3185	40	4	Mammal	Grizzly Bear	1	At camera post.	Same bear as in previous T photo observation.
BR13	30-May-12				M	254	258							Camera was moved to new location in front of bear tripod.
BR13	8-Jun-12		20:30:00		T	707		1		Mammal	Grizzly Bear	2	At bear post.	
BR13	8-Jun-12	1	20:30:05	20:35:10	M	708	787	80	8	Mammal	Grizzly Bear	2	At bear and camera posts.	Same 2 bears as in previous observation. Some good photos.
BR13	8-Jun-12	2	22:03:36	22:05:04	M	791	830	40	4	Mammal	Grizzly Bear	1	At bear and camera posts.	Maybe same bear observed just 1.5 hrs earlier? Some good photos.
BR13	28-Jul-12	1	12:16:57	12:21:17	M	3611	3670	60	6	Mammal	Grizzly Bear	1	At bear and camera posts.	
BR13	7-Aug-12	1	22:01:26	22:07:21	M	4221	4260	40	4	Mammal	Grizzly Bear	1	At bear and camera posts.	
BR13	8-Aug-12	1	06:03:17	06:05:21	M	4277	4296	20	2	Mammal	Grizzly Bear	1	At bear and camera posts.	This observation was 8 hours after last sighting, I assume this is a different bear? Some good photos.
BR13	17-Aug-12	1	19:22:58	19:24:06	M	4770	4809	40	4	Mammal	Grizzly Bear	1	At camera post.	
BR13	19-Aug-12	1	16:46:59	16:52:07	M	4901	4940	40	4	Mammal	Grizzly Bear	1	At camera post.	
BR14	20-Jun-12		05:00:00		T	1353		1		Mammal	Caribou	6	Foraging	Individuals are small and a little blurry, so good to review.
BR15	4-Jun-12	1	14:54:33	14:54:44	M	493	502	10	1	Mammal	Grizzly Bear	1	At camera post	After this observation the camera may have been down until 6/30/2012 when checked; no photos between 6/4 and 6/30.
BR15	3-Jul-12		12:30:00		T	764		1		Mammal	Caribou	1	Resting in front of camera	Animal didn't set off Motion Trigger. Bedded down in front of camerna. Good Photo.
BR15	3-Jul-12		13:00:00		T	765		1		Mammal	Caribou	1	Resting in front of camera	Animal didn't set off Motion Trigger. Bedded down in front of camerna.
BR15	3-Jul-12		13:30:00		T	766		1		Mammal	Caribou	1	Resting in front of camera	Animal didn't set off Motion Trigger. Bedded down in front of camerna.
BR15	3-Jul-12		14:00:00		T	767		1		Mammal	Caribou	1	Resting in front of camera	Animal didn't set off Motion Trigger. Bedded down in front of camerna.
BR15	3-Jul-12		14:30:00		T	768		1		Mammal	Caribou	1	Resting in front of camera	Animal didn't set off Motion Trigger. Bedded down in front of camerna.
BR15	3-Jul-12		18:30:00		T	776		1		Mammal	Caribou	1	Resting in front of camera	Animal didn't set off Motion Trigger. Bedded down in front of camerna.
BR15	3-Jul-12		19:00:00		T	777		1		Mammal	Caribou	1	Resting in front of camera	Animal didn't set off Motion Trigger. Bedded down in front of camerna.
BR15	3-Jul-12		19:30:00		T	778		1		Mammal	Caribou	1	Resting in front of camera	Animal didn't set off Motion Trigger. Bedded down in front of camerna.
BR15	3-Jul-12		20:00:00		T	779		1		Mammal	Caribou	1	Resting in front of camera	Animal didn't set off Motion Trigger. Bedded down in front of camerna.
BR15	4-Jul-12		11:30:00		T	810		1		Mammal	Caribou	1	Resting in front of camera	Animal didn't set off Motion Trigger. Bedded down in front of camerna. Assume different animal as observation is on the next day.
BR15	4-Jul-12		12:00:00		T	811		1		Mammal	Caribou	1	Resting in front of camera	Animal didn't set off Motion Trigger. Bedded down in front of camerna.
BR15	4-Jul-12		12:30:00		T	812		1		Mammal	Caribou	1	Resting in front of camera	Animal didn't set off Motion Trigger. Bedded down in front of camerna.
BR15	4-Jul-12		19:55:37	19:55:45	M	827	836	10	1	Mammal	Caribou	1	Walking towards camera	Not sure if this should be considered a separate animal from early day's observation?

Appendix 10-3. Images of Wildlife Captured by Remote digital Cameras, May to August 2012

		Camera Photo(s) Details							Wildlife Recorded on Photo(s)				
Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
BR15	4-Jul-12		20:19:57	20:20:04	M	838	847	10	1	Mammal	Caribou	1	In front of camera	
BR15	8-Jul-12		18:42:52	18:43:00	M	1037	1046	10	1	Mammal	Caribou	1	In front of camera	
BR15	9-Jul-12		14:01:49	14:01:55	M	1086	1095	10	1	Mammal	Caribou	1	In front of camera	1086 Good Photo.
BR15	16-Jul-12		06:09:08	06:09:15	M	1416	1425	10	1	Mammal	Caribou	1	In front of camera	1419 Good photo.
BR15	22-Jul-12		22:21:56	22:22:04	M	1746	1755	10	1	Mammal	Wolf	1	In front of camera	
BR15	4-Aug-12		21:54:01	21:54:54	M	2379	2398	20	2	Mammal	Grizzly Bear	1	In front of camera	Not exactly sure what this is, looks like it could be a grizzly bear. Camera tipped upwards at end of encounter.
BR15	9-Aug-12		17:52:51	17:53:16	M	2631	2650	20	2					Camera now set properly again. Maybe a camera check?
BR15	16-Aug-12		13:07:32	13:07:39	M	2978	2987	10	1	Avian	Peregrine Falcon	1	Flew in front of camera	Check spp.
BR16	17-Jun-12	1	08:59:05	08:59:12	M	1244	1253	10	1	Mammal	Arctic Fox	1	Traveling	Photo 1244 in Good Photos.
BR16	18-Jun-12		20:30:00		T	1325		1		Small Mammal	Arctic Ground Squirrel	1	Sitting	Not exactly sure what this is.
BR16	27-Jun-12		16:00:00		T	1768		1		Small Mammal	Arctic Ground Squirrel	1	Sitting	Not exactly sure what this is.
BR16	29-Jun-12		17:00:00		T	1866		1		Small Mammal	Arctic Ground Squirrel	1	Sitting	Possibly same animal in previous observation, still not exactly sure what spp.
BR16	29-Jun-12		19:00:00		T	1870		1		Mammal	Arctic Ground Squirrel	1	Sitting	Possibly same animal in previous observation, slightly different location, still not exactly sure what spp.
BR16	10-Aug-12	1	04:22:46	04:23:57	M	4127	4196	70	7	Mammal	Caribou	3	Traveling/Foraging	
BR16	10-Aug-12	2	18:25:37	18:25:45	M	4225	4234	10	1	Mammal	Caribou	1	Traveling/Foraging	Photo 4227 in Good Photos.
BR16	15-Aug-12	1	20:36:56	20:38:44	M	4480	4519	40	4	Mammal	Caribou	1	Traveling/Foraging	
BR16	16-Aug-12	1	13:23:14	13:23:31	M	4553	4572	20	2	Mammal	Caribou	1	Traveling/Foraging	Photo 4566 in Good Photos.
BR16	19-Aug-12	1	20:00:08	20:00:15	M	4731	4740	10	1	Mammal	Caribou	1	Traveling/Foraging	
BR16	20-Aug-12	1	05:02:06	05:02:24	M	4759	4778	20	2	Mammal	Caribou	1	Traveling/Foraging	
BR16	21-Aug-12	1	12:37:51	12:40:02	M	4842	4861	20	2	Mammal	Caribou	1	Traveling/Foraging	Photo 4843 in Good Photos.
BR16	21-Aug-12	2	16:55:59	16:57:41	M	4870	4939	70	7	Mammal	Caribou	1	Traveling/Foraging	Photo 4893 in Good Photos.
BR16	21-Aug-12		17:00:00		T	4940		1		Mammal	Caribou	1	Traveling/Foraging	Same animal as in previous observation.
BR16	21-Aug-12		19:30:00		T	4945		1		Mammal	Caribou	1	Foraging	Looks like a caribou, wasn't in previous or following photos.
BR17	30-May-12	1	06:00:00		T	314		1		Avian	Snowy Owl	1	Perched	Looks like owl, back to camera and in the distance, could be wolf
BR17	1-Jun-12	1	13:46:46	13:48:52	M	426	476	51	6	Mammal	Wolf	2	Walking	Two wet wolves
BR17	1-Jun-12	2	14:20:57	14:21:04	M	477	486	10	1	Mammal	Wolf	1	Walking	Seems to be pursuing other wolves seen 30 minutes earlier
BR17	30-Jun-12	1	19:00:00		T	2520		1		Mammal	Caribou	2	Walking	Two caribou are located on ridge, very difficult see ID with 100% confidence
BR17	19-Jul-12	1	00:45:12	00:45:17	M	3436	3441	5	1	Mammal	Wolf	1	Walking	
BR17	29-Jul-12	1	02:49:43	02:49:59	M	3990	4000	11	2	Mammal	Arctic Fox	1	Curious	Attracted to barrel, placed July 25, 13:00:44
BR17	2-Aug-12	1	04:30:00		T	4205		1		Mammal	Arctic Fox	1	Curious	Camera frosted, did not trigger
BR17	6-Aug-12	1	23:55:30	23:55:31	M	4436	4437	2	1	Mammal	Arctic Fox	1	Leaving a deposit	Probably same fox
BR17	13-Aug-12	1	04:30:00		T	4743		1		Mammal	Caribou	2		Might be a question about one or two, looks like two
BR17	15-Aug-12	1	09:04:08	09:04:23	M	4849	4864	16	2	Mammal	Caribou	1	foraging	Lots of butt shots
BR17	16-Aug-12	1	08:00:00		T	4914		1		Mammal	Unknown	1		Muskox? Caribou?
BR17	20-Aug-12	1	14:30:00		T	5119		1		Mammal	Caribou	2	foraging	
BR18	25-Jun-12	1	12:40:29	12:40:51	M	1812	1831	20	2	Mammal	Grizzly Bear	1	At camera post near bait post	
BR18	1-Aug-12	1	06:21:47	06:27:55	M	3921	4140	22	220	Mammal	Grizzly Bear	4	At bait post	Knock down of camera at photo 4031. Photos 3922, 3931-3950, 3962, 3977, 3998 Good Photos.
BR18	6-Aug-12		01:00:00		T	4514		1		Mammal	Hare	1	At bait post	
BR18	15-Aug-12	1	07:36:!3	07:37:28	M	4960	4979	20	2	Mammal	Wolf	1	At bait post	Photo 4979 Good Photo.
BR18	15-Aug-12	2	10:57:09	10:57:19	M	4986	4995	10	1					Bait post put on ground by someone.
BR18	22-Aug-12	1	14:07:31	14:17:44	M	5338	5417	80	8	Mammal	Musk Ox	1	Near bait post	Photos 5393 and 5400 Good Photos.
BR19	26-May-12	1	17:00:00		T	63		1		Avian	American Golden Plover	1	Standing	
BR19	3-Jun-12	1	13:30:00		T	517		1		Avian	American Golden Plover	1	Standing	
BR19	5-Jun-12	1	05:00:00		T	596		1		Mammal	Arctic Fox	1	Sniffing	
BR19	5-Jun-12	2	05:00:12	05:00:22	M	597	606	10	1	Mammal	Arctic Fox	1	Walking, Sniffing	
BR19	5-Jun-12	3	08:12:10	08:12:16	M	613	622	10	1	Mammal	Arctic Fox	1	Walking, Sniffing	

Appendix 10-3. Images of Wildlife Captured by Remote digital Cameras, May to August 2012

		Camera Photo(s) Details							Wildlife Recorded on Photo(s)				
Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
BR19	6-Jun-12	1	04:00:00		T	662		1		Mammal	Arctic Fox	1	Walking	
BR19	6-Jun-12	2	04:00:01	04:00:07	M	663	672	10	1	Mammal	Arctic Fox	1	Walking	
BR19	8-Jun-12	1	00:30:33	00:30:51	M	762	781	20	2	Mammal	Arctic Fox	1	Running	
BR19	8-Jun-12	2	03:26:56	03:27:02	M	787	796	10	1	Mammal	Arctic Fox	1	Running	
BR19	8-Jun-12	3	22:27:12	22:27:19	M	835	844	10	1	Mammal	Arctic Fox	1	Running	
BR19	15-Jun-12	1	23:52:44	23:53:17	M	1282	1301	20	2	Mammal	Wolverine	1	Sniffing	
BR19	16-Jun-12	1	05:07:07	05:07:13	M	1313	1322	10	1	Mammal	Arctic Fox	1	Running	
BR19	7-Jul-12	1	04:11:02	04:11:33	M	2499	2508	10	1	Mammal	Arctic Fox	1	Running	
BR19	7-Jul-12	2	05:09:15	05:09:34	M	2511	2530	20	2	Mammal	Arctic Fox	1	Running	
BR19	10-Jul-12	1	01:18:04	01:18:11	M	2667	2676	10	1	Mammal	Arctic Fox	1	Peeing, Running	
BR19	13-Jul-12	1	02:12:52	02:13:00	M	2823	2832	10	1	Mammal	Arctic Fox	1	Sniffing, Running	
BR19	28-Jul-12	1	02:07:53	02:07:59	M	3668	3677	10	1	Mammal	Arctic Fox	2	Sniffing, Running	
BR19	29-Jul-12	1	13:00:00		T	3747		1		Avian	Raptor	1	Perched	
BR19	8-Aug-12	1	02:10:50	01:10:58	M	4223	4232	10	1	Mammal	Wolf	1	Walking, Sniffing	
BR19	9-Aug-12	1	00:06:31	00:08:24	M	4279	4328	50	5	Mammal	Wolf	3	Walking	
BR19	13-Aug-12	1	20:00:00		T	4560		1		Avian	Canada Goose	5	Grazing	
BR19	15-Aug-12	1	22:00:00		T	4684		1		Mammal	Caribou	1	Standing	
BR19	16-Aug-12	1	02:26:48	02:27:29	M	4693	4712	20	2	Mammal	Arctic Fox	1	Sniffing	
BR19	22-Aug-12	1	22:14:25	22:14:48	M	5041	5060	20	2	Mammal	Arctic Fox	1	Running	
BR19	25-Aug-12	1	21:13:13	21:13:49	M	5203	5222	20	2	Mammal	Arctic Fox	1	Walking, Sniffing	
BR19	26-Aug-12	1	00:48:20	00:48:27	M	5230	5239	10	1	Mammal	Arctic Fox	1	Walking, Sniffing	
BR20	29-Jul-12	1	18:13:04	18:13:12	M	3768	3777	10	1	Mammal	Caribou	1	Walking	
BR20	30-Jul-12	1	21:40:26	21:44:26	M	3833	3902	70	7	Mammal	Caribou	2	Walking	
BR20	7-Aug-12	1	11:44:50	11:44:57	M	4287	4296	10	1	Mammal	Caribou	1	Walking	
BR20	7-Aug-12	1	14:56:12	14:57:09	M	4303	4342	40	4	Mammal	Grizzly Bear	1	Sniffing	
BR20	11-Aug-12	1	05:34:36	05:34:00	M	4517	4526	10	1	Mammal	Caribou	1	Walking	
BR20	11-Aug-12	2	20:56:07	20:56:24	M	4557	4576	20	2	Mammal	Caribou	1	Walking	
BR21	31-May-12	1	03:41:47	03:41:54	M	386	395	10	1	Avian	Unknown raptor	1	Flying in front of camera	Hard to tell what species, but looks to be a raptor.
BR21	8-Jun-12		08:30:00		T	789		1		Helicopter	Helicopter	1	At edge of lake	
BR21	17-Jun-12	1	17:46:43	17:46:51	M	1250	1259	10	1	Mammal	Wolf	1	Walking in front of camera	Photo 1250 in Good Photos.
BR21	29-Jun-12	1	02:40:11	02:40:19	M	1836	1845	10	1	Mammal	Fox	1	Walking in front of camera	I think this is fox or small wolf?
BR21	26-Jul-12	1	19:53:23	19:54:28	M	3286	3335	50	5	Mammal	Grizzly	1	At camera post	Photos 3286-3288 Good Photos.
BR21	29-Jul-12		15:30:00		T	3471		1		Mammal	Caribou	1	Walking in front of camera	Didn't trigger a Motion set.
BR21	30-Jul-12	1	02:00:23	02:00:31	M	3493	3502	10	1	Mammal	Fox	1	Walking in front of camera	
BR21	14-Aug-12	1	14:44:27	14:44:49	M	4258	4277	20	2	Mammal	Wolf	1	Walking in front of camera	Photos 4258, 4259, 4261 in Good photos.
BR21	14-Aug-12		21:00:00		T	4290		1		Mammal	Caribou	3	Foraging	Didn't trigger a Motion set.
BR21	16-Aug-12	1	21:06:39	21:06:46	M	4387	4396	10	1	Mammal	Caribou	1	Traveling	Photo 4391 in Good photos.
BR21	24-Aug-12	1	05:30:56	05:31:04	M	4760	4769	10	1	Mammal	Wolf	1	Traveling	Just caught back end on photo 4760, looks like a wolf.
BR22	6-Jun-12	1	01:25:24	01:25:29	M	640	649	10	1	Mammal	Arctic Fox	1	Running	
BR22	21-Jul-12	1	22:52:25	22:52:32	M	2963	2972	10	1	Mammal	Wolf	1	Walking	
BR22	24-Jul-12	1	05:00:00		T	3091		1		Avian	Canada Goose	10	Grazing	
BR22	26-Jul-12	1	16:13:49	16:14:46	M	3210	3259	50	5	Mammal	Grizzly Bear	1	Sniffing	
BR22	28-Jul-12	1	19:30:00		T	3362		1		Mammal	Caribou	20	Grazing	
BR22	29-Jul-12	1	07:00:00		T	3385		1		Mammal	Caribou	2	Grazing	
BR22	29-Jul-12	2	09:30:00		T	3390		1		Mammal	Caribou	1	Grazing	
BR22	31-Jul-12	1	05:33:03	05:33:11	M	3479	3488	10	1	Mammal	Caribou	2	Walking	
BR22	31-Jul-12	2	07:39:28	07:39:42	M	3493	3512	20	2	Mammal	Caribou	8	Walking	
BR22	1-Aug-12	1	06:00:00		T	3567		1		Avian	Canada Goose	8	Grazing	
BR22	2-Aug-12	1	07:30:00		T	3618		1		Mammal	Caribou	2	Walking	
BR22	3-Aug-12	1	00:24:37	00:24:52	M	3652	3671	20	2	Mammal	Caribou	1	Walking	
BR22	3-Aug-12	2	22:22:31	22:22:37	M	3716	3725	10	1	Mammal	Wolf	1	Walking	
BR22	5-Aug-12	1	15:30:00		T	3808		1		Mammal	Wolf	1	Sitting	
BR22	12-Aug-12	1	08:30:00		T	4130		1		Mammal	Caribou	1	Sitting, Standing?	
BR22	12-Aug-12	2	09:00:00		T	4131		1		Mammal	Caribou	1	Grazing	same animal as previous entry
BR22	15-Aug-12	1	17:49:36	17:50:01	M	4293	4322	30	3	Mammal	Caribou	2	Walking	
BR22	20-Aug-12	1	17:00:00		T	4561		1		Avian	Canada Goose	25	Grazing	

Appendix 10-3. Images of Wildlife Captured by Remote digital Cameras, May to August 2012

		Camera Photo(s) Details							Wildlife Recorded on Photo(s)				
Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
BR23	23-Jul-12		20:30:00		T	3072		1		Avian	Greater White Fronted Geese	1	Foraging	
BR23	23-Jul-12		21:00:00		T	3073		1		Avian	Greater White Fronted Geese	6	Foraging	
BR23	29-Jul-12	1	12:42:46	12:43:42	M	3375	3394	20	2	Mammal	Caribou	1	Foraging	Photo 3383 in Good Photos.
BR23	29-Jul-12	2	23:18:10	23:18:26	M	3426	3445	20	2	Mammal	Caribou	10	Foraging/Traveling	Dark photo, not totally clear on number of animals, but close to 10 individuals.
BR23	3-Aug-12	1	05:11:34	05:11:41	M	3660	3669	10	1	Mammal	Caribou	1	Traveling	
BR23	3-Aug-12	2	17:53:17	17:53:25	M	3695	3704	10	1	Mammal	Caribou	1	Traveling	Photo 3695 n Good Photos.
BR23	6-Aug-12	1	21:40:40	21:40:45	M	3857	3866	10	1	Mammal	Caribou	1	Traveling	
BR23	7-Aug-12		09:00:00		T	3889		1		Mammal	Caribou	1	Traveling	
BR23	7-Aug-12		10:30:00		T	3892		1		Mammal	Caribou	1	Traveling	Animal on far shore of pond, not entirely sure it's a caribou.
BR23	13-Aug-12	1	09:22:03	09:22:29	M	4178	4197	20	2	Mammal	Caribou	3	Foraging/Traveling	Photo 4178 in Good Photos.
BR23	13-Aug-12		14:30:00		T	4208		1		Mammal	Caribou	2	Foraging	
BR23	14-Aug-12	1	18:58:40	18:58:55	M	4265	4284	20	2	Mammal	Caribou	1	Foraging/Traveling	Photo 4272 in Good Photos.
BR23	16-Aug-12	1	13:11:28	13:12:21	M	4370	4389	20	2	Mammal	Caribou	1	Foraging/Traveling	
BR23	16-Aug-12		16:00:00		T	4395		1		Mammal	Caribou	1	Foraging	
BR23	17-Aug-12		15:30:00		T	4442		1		Mammal	Caribou	1	Foraging	
BR23	17-Aug-12		16:00:00		T	4443		1		Mammal	Caribou	1	Foraging	Same animal as in previous T photo from same day?
BR23	17-Aug-12		16:30:00		T	4444		1		Mammal	Caribou	1	Foraging	Same animal as in previous T photo from same day?
BR23	17-Aug-12		17:00:00		T	4445		1		Mammal	Caribou	1	Foraging	Same animal as in previous T photo from same day?
BR23	18-Aug-12		12:04:05	12:04:11	M	4524	4533	10	1	Mammal	Caribou	1	Traveling	
BR23	18-Aug-12		19:00:00		T	4547		1		Mammal	Caribou	1	Resting	
BR23	18-Aug-12		19:30:00		T	4548		1		Mammal	Caribou	1	Resting	Same animal as in previous T photo.
BR23	19-Aug-12		04:30:00		T	4566		1		Mammal	Caribou	2	Foraging	Looks like caribou, but animals are dark and far away.
BR23	20-Aug-12		18:18:25	18:18:31	M	4642	4651	10	1	Mammal	Caribou	1	Foraging/Traveling	
BR23	21-Aug-12		13:30:00		T	4690		1		Mammal	Caribou	2	Resting	Looks like caribou, but animals are a little far away.
BR23														Birds using pond throughout the summer.
BR24	1-Jun-12		10:00:00		T	493								Grizzly bear pod set up in front of camera.
BR24	18-Jul-12		16:39:16	16:44:13	M	3149	3178	30	2	Mammal	Grizzly Bear	1	At bear and camera posts	Photo 3162 Good Photo. Photo 3169 bear knocks down bear post.
BR24	24-Jul-12		16:00:00			3545								Bear post upright.
BR24	24-Jul-12	1	19:16:07	19:24:06	M	3552	3611	60	6	Mammal	Grizzly Bear	1	At bear and camera posts	Photos 3583-3591 in Good Photos. Photo 3592 bear knocks down bear post.
BR24	29-Jul-12	1	06:05:04	06:08:21	M	3896	4055	160	16	Mammal	Grizzly Bear	1	At bear and camera posts	Photos 3936-3945 in Good Photos. Photos 4016-4046 in Good Photos. Bear post still knocked down and camera knocked sideways.
BR24	29-Jul-12	2	07:45:19	08:19:38	M	4059	4299	240	24	Mammal	Grizzly Bear	2	At bear and camera posts	Photo 4225 camera knocked on ground.
BR24	3-Aug-12		14:00:00		T	4675								Camera and bear post upright.
BR24	7-Aug-12	1	04:40:34	04:41:18	M	4909	4928	20	2	Mammal	Grizzly Bear	1	At bear and camera posts	Photo 4909 bear post knocked down.
BR24	9-Aug-12	1	11:43:31	11:51:00	M	5039	5318	280	28	Mammal	Grizzly Bear	3	At bear and camera posts	Photo 5139 camera knocked down.
BR24	9-Aug-12	2	20:15:04		M	5346	5435	90	9	Mammal	Grizzly Bear	Unknown	At knocked over camera	Only saw bear paw, camera still knocked down.
BR24	14-Aug-12		16:30:00		T	5704								Camera upright, at different angle/persepctive.
BR24	16-Aug-12	1	12:37:19	12:45:21	M	5793	5892	100	10	Mammal	Grizzly Bear	1	At camera post	
BR24	17-Aug-12	1	09:00:36	09:29:56	M	5957	6026	70	7	Mammal	Grizzly Bear	Unknown	At camera post	In series you can see 3 heads, or what looks like in Photo 6025. Not sure how many individuals.
BR24	17-Aug-12	2	09:30:03	09:32:35	M	6028	6087	60	6	Mammal	Grizzly Bear	Unknown	At camera post	Likely same individuals from pervious M set. Photo 6039 camera knocked over.
BR24	17-Aug-12		17:17:46			6103								Camera upright.
BR24	21-Aug-12	1	18:33:00	18:34:47	M	6308	6377	70	7	Mammal	Grizzly Bear	1	At camera post	Photo 6338 camera knocked down.
BR24	25-Aug-12	1	11:22:22	11:28:19	M	6575	6714	140	14	Mammal	Grizzly Bear	1	At camera post	Only saw bear paw, camera still knocked down.
BR24	25-Aug-12	2	11:31:03	11:32:17	M	6716	6765	50	5	Mammal	Grizzly Bear	Unknown	At camera post	No good observations-assumed only 1 animal, camera still knocked down.
BR24	26-Aug-12		17:02:50			6828								End photos
BR25	6-Jun-12	1	03:39:20	03:40:31	M	820	839	40	2	Mammal	Grizzly Bear	1	Scratching Post	Removes bear post, repaired June 11 at 11:00:00
BR25	8-Jun-12	1	07:00:00		T	1068		1		Mammal	Grizzly Bear	1	Walking	
BR25	17-Jun-12	1	07:04:40	07:09:13	M	1534	1583	50	5	Mammal	Grizzly Bear	1	Scratching Post	Removes bear post, repaired June 21 at 13:33:22

Appendix 10-3. Images of Wildlife Captured by Remote digital Cameras, May to August 2012

		Camera Photo(s) Details								Wildlife Recorded on Photo(s)				
Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
BR25	21-Jul-12	1	03:05:55		M	3543		1	1	Mammal	Grizzly Bear	1		Camera shifts and the next timed photo (3553)the bear scratching post is gone, likely GB, post is fixed July 25, 10:37:32
BR25	27-Jul-12	1	10:17:09	10:17:28	M	3895	3914	20	2	Mammal	Grizzly Bear	1		Camera seems wonky, did not pick up bear removing post again, triggers when bear hits camera, frost/film on camera
BR25	1-Aug-12	1	23:39:17	23:39:53	M	4182	4201	20	2	Mammal	Grizzly Bear	1	Pushing camera	Again, something moves in front of camera, likely GB - bear post repaired August 5 at 14:54:40
BR25	6-Aug-12	1	00:24:39	00:24:49	M	4472	4485	20	2	Mammal	Grizzly Bear		Knocks down camera	Knocks camera to ground and removes post. Likely GB. Camera fixed August 15, 16:51:46
BR25	9-Aug-12	1	06:07:23	06:14:13	M	4718	4779	62	7	Mammal	Grizzly Bear	1	Playing with down bear posts	Bear walks in front of camera, playing with posts
BR25	9-Aug-12	2	10:36:45	10:36:53	M	4797	4806	10	1	Mammal	Grizzly Bear	1		Could be same bear as earlier in the morning
BR25	10-Aug-12	1	11:30:00		T	4886		1		Mammal	Grizzly Bear	1	Walking	Bear walking away, camera still down
BR25	12-Aug-12	1	09:20:51	09:21:46	M	5008	5024	17	2	Mammal	Wolf	1	Sniffing	
BR25	21-Aug-12	1	15:49:11	15:49:19	M	5813	5819	6	1	Mammal	Grizzly Bear			Don't get a look at the bear, but pretty sure it is. Also camera took only 6 pictures when triggered, not the usual 10
BR25	22-Aug-12	1	18:29:43	18:30:08	M	5872	5902	30	3	Mammal	Caribou	1	Curious	
BR25	6-Aug-12		00:24:49											
BR25	15-Aug-12		16:51:46											
BR25	24-Aug-12	1	15:03:42											
BR26	30-Jul-12	1	10:10:43	10:10:49	M	3256	3265	10	1	Mammal	Caribou	1	Traveling	
BR26	7-Aug-12	1	20:30:59	20:31:07	M	3671	3680	10	1	Mammal	Caribou	1	Traveling	Very dark photo, but this looks like a caribou.
BR26	11-Aug-12	1	14:05:30	14:05:56	M	3860	3879	20	2	Mammal	Caribou	1	Foraging/Traveling	
BR26	11-Aug-12	2	14:09:42	14:09:48	M	3880	3889	10	1	Mammal	Caribou	1	Traveling	I think this is the same individual from previous observation.
BR26	11-Aug-12	3	14:15:14	14:15:20	M	3890	3899	10	1	Mammal	Caribou	1	Foraging/Traveling	
BR26	11-Aug-12	4	14:17:56	14:18:02	M	3900	3909	10	1	Mammal	Caribou	1	Foraging/Traveling	I think this is the same individual from previous observation.
BR26	13-Aug-12	1	19:19:41	19:19:48	M	4016	4025	10	1	Mammal	Caribou	1	Foraging/Traveling	
BR26	14-Aug-12	1	13:30:00		T	4062		1		Mammal	Caribou	1		I think this is a caribou but animal is a little far away.
BR26	20-Aug-12	1	18:24:52	18:25:00	M	4360	4369	10	1	Mammal	Caribou	1	Foraging/Traveling	
BR26	21-Aug-12	1	12:44:03	12:44:23	M	4407	4426	20	2	Mammal	Caribou	2	Foraging/Traveling	
BR26	22-Aug-12	1	11:22:20	11:22:42	M	4472	4491	20	2	Mammal	Caribou	1	Foraging/Traveling	
BR27	4-Jun-12	1	13:58:24	13:58:49	M	499	518	20	2	Mammal	Grizzly Bear	1	At camera post	
BR27	13-Jun-12	1	12:30:00		T	958		1		Mammal	Unknown	2		Not exactly sure what this is, but it wasn't in previous or following photo.
BR27	21-Jul-12	1	08:30:00		T	2944		1		Mammal	Red Fox	1	Resting/hiding?	Not exactly sure what this is, but it wasn't in previous or following photo.
BR27	29-Jul-12	1	17:51:19	17:51:26	M	3347	3356	10	1	Mammal	Caribou	1	Traveling	
BR27	29-Jul-12	2	19:25:05	19:25:37	M	3360	3389	30	3	Mammal	Caribou	1	Traveling	
BR28	22-Jul-12	1	04:16:56	04:17:20	M	3013	3042	30	3	Mammal	Arctic Fox	1	Curious	
BR28	27-Jul-12	1	20:40:24	20:41:51	M	3316	3355	40	4	Mammal	Caribou	6	Walking	
BR28	27-Jul-12	2	20:48:41	20:48:48	M	3356	3365	10	1	Mammal	Caribou	200	Walking	First series beginning of herd, could clump series 1-5?
BR28	27-Jul-12	3	21:00:00		T	3366		1		Mammal	Caribou	200	Walking	50-100 individuals (maybe more), slow moving herd, motion did not trigger camera, too far
BR28	27-Jul-12	4	21:30:00		T	3367		1		Mammal	Caribou	200	Walking	slow moving herd
BR28	27-Jul-12	5	22:00:00		T	3368		1		Mammal	Caribou	200	Walking	passed through by 22:30:00
BR28	27-Jul-12	6	23:00:00		T	3370		1		Mammal	Grizzly Bear	1	Walking away from camera	zoom in, looks like bear following herd?
BR28	28-Jul-12	1	21:57:45	21:57:54	M	3416	3425	10	1	Mammal	Caribou	2	Walking	
BR28	30-Jul-12	1	03:02:29	03:03:07	M	3485	3524	40	4	Mammal	Caribou	22	Walking	At least 22 individuals, maybe more but hard to count due to light and small ridge
BR28	31-Jul-12	1	22:31:19	22:31:26	M	3612	3621	10	1	Mammal	Caribou	1	Walking	six pictures captured within the trigger
BR28	1-Aug-12	1	23:45:38	23:45:45	M	3672	3681	10	1	Mammal	Caribou	1	Walking	six pictures captured within the trigger
BR28	16-Aug-12	1	04:20:27	04:22:23	M	4383	4482	100	10	Mammal	Caribou	1	curious	Young animal toying with the camera

Appendix 10-3. Images of Wildlife Captured by Remote digital Cameras, May to August 2012

		Camera Photo(s) Details							Wildlife Recorded on Photo(s)				
Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
BR28	17-Aug-12	1	17:50:08	19:00:00	M/T	4558	4650	93	9	Mammal	Caribou	1	Walking, eating , resting and posing	Bull hanging around for long time, camera did not pick up caribou leaving
BR28	17-Aug-12	1	20:00:00		T	4652		1		Mammal	Caribou	3	walking and feeding	
BR28	18-Aug-12	1	15:45:56	15:46:04	M	4692	4701	10	1	Mammal	Caribou	1	walking	pair separated by few seconds (see following entry)
BR28	18-Aug-12	2	15:46:23	15:46:29	M	4702	4711	10	1	Mammal	Caribou	1	walking	Following previous entered bull
BR28	18-Aug-12	1	17:57:13	17:57:40	M	4716	4745	30	3	Mammal	Caribou	3	Walking	Small group
BR28	18-Aug-12	1	18:51:42	18:51:58	M	4748	4767	20	2	Mammal	Caribou	1	walking	
BR28	18-Aug-12	1	20:29:39	20:30:00	M/T	4771	4781	11	2	Mammal	Caribou	5	walking	another small group
BR29	28-May-12	1	00:11:12	00:11:19	M	113	122	10	1	Mammal	Fox	1	Traveling	
BR29	2-Jun-12		09:30:00			434								Bear post set up and camera angle/perspective moved.
BR29	16-Jun-12	1	05:05:53	05:16:50	M	1118	1237	120	12	Mammal	Wolf	1	At bear post	
BR29	16-Jun-12		05:30:00		T	1238		1		Mammal	Wolf	1	Sleeping	
BR29	16-Jun-12		06:00:00		T	1239		1		Mammal	Wolf	1	Sleeping	
BR29	16-Jun-12	2	06:06:49	06:07:17	M	1240	1269	30	3	Mammal	Wolf	1	At bear post	
BR29	18-Jun-12	1	09:11:10	09:20:29	M	1372	1651	280	28	Mammal	Grizzly Bear	2	At bear post	Bear post knocked down.
BR29	20-Jun-12					1835								Bear post set up.
BR29	30-Jul-12	1	17:55:20	18:00:24	M	3997	4167	171	17	Mammal	Grizzly Bear	1	At bear and camera post	Bear post knocked down.
BR29	2-Aug-12	1	00:26:18	00:27:46	M	4276	4295	20	2	Mammal	Wolf	1	At bear post	
BR29	4-Aug-12	1	01:59:12	01:59:35	M	4395	4424	30	3	Mammal	Wolverine	1	At bear post	
BR29	4-Aug-12	2	02:00:20	02:00:36	M	4426	4445	20	2	Mammal	Wolverine	1	At bear post	
BR29	4-Aug-12	3	20:36:35	20:36:41	M	4483	4492	10	1	Mammal	Wolf	1	At bear post	
BR29	5-Aug-12		12:30:00			4567								Bear post set up.
BR29	14-Aug-12	1	05:19:05	05:19:14	M	4985	4994	10	1	Mammal	Wolf	1	Traveling	
BR29	15-Aug-12		15:00:00			5076								Bear post removed.
BR29	21-Aug-12	1	03:48:00	03:49:08	M	5572	5591	20	2	Mammal	Wolf	1	Rolling at old bear post	
BR29	22-Aug-12	1	08:59:01	09:00:25	M	5650	5670	21	2	Mammal	Wolf	1	Rolling at old bear post	Likely same individual from previous day.
BR30	24-May-12	1	14:30:00	23:30:00	T	21	39	19	0	Avian	Geese	50	Standing, Swimming	All timed photos
BR30	25-May-12	1	00:00:00	11:30:00	T	40	63	24	0	Avian	Geese	50	Standing, Swimming	All timed photos
BR30	25-May-12	2	14:00:00		T	68		1	0	Avian	Geese	7	Standing	
BR30	25-May-12	3	14:30:00		T	69		1	0	Avian	Geese	2	Standing	
BR30	25-May-12	4	23:30:00		T	87		1	0	Avian	Geese	21	Standing	
BR30	26-May-12	1	00:00:00	05:30:00	T	88	99	12	0	Avian	Geese	30	Standing, Swimming	
BR30	26-May-12	2	10:30:00		T	109		1	0	Avian	Geese	7	Standing	
BR30	26-May-12	3	12:30:00		T	113		1	0	Avian	Geese	6	Standing	
BR30	26-May-12	4	15:00:00	15:30:00	T	118	119	2	0	Avian	Geese	15	Standing	
BR30	12-Jun-12	1	11:04:45	11:05:23	M	2097	2116	20	2	Avian	Canada Goose	4	Walking, Grazing	
BR30	12-Jun-12	2	23:27:40	23:27:53	M	2161	2180	20	2	Mammal	Wolf	1	Sniffing	Assume it's a wolf due to height of camera; howver, could potentially be a fox
BR30	6-Jul-12	1	20:17:49	20:19:32	M	3737	3826	90	9	Mammal	Grizzly Bear	1	Sniffing	
BR30	21-Jul-12	1	05:53:02	05:54:12	M	6078	6107	30	3	Mammal	Grizzly Bear	1	Sniffing	
BR30	27-Jul-12	1	21:44:57	21:48:17	M	6428	6517	90	9	Mammal	Grizzly Bear	1	Sniffing	
BR30	8-Aug-12	1	05:59:23	05:59:31	M	7102	7111	10	1	Mammal	Caribou	1	Walking, Sniffing	
BR30	10-Aug-12	1	02:51:17	02:51:26	M	7202	7211	10	1	Mammal	Caribou	1	Walking, Sniffing	Can only see part of an ear
BR30	18-Aug-12	1	08:00:38	08:00:45	M	7607	7616	10	1	Mammal	Caribou	1	Walking, Sniffing	Can only see part of an ear
BR30	20-Aug-12	1	20:25:00	20:26:19	M	7737	7766	30	3	Mammal	Caribou	200	Walking, Swimming across	
BR30	20-Aug-12	2	20:30:00		T	7767		1		Mammal	Caribou	15	Walking, Swimming across	
BR30	20-Aug-12	3	21:30:00		T	7769		1		Mammal	Caribou	25	Walking, Swimming across	
West of RSA Cameras														
HR1	20-Jul-12		18:00:00		T	207		1		Bird or small mammal	Unknown	1	Resting	Not sure what spp this is? Included previous and following photos for ref.
HR1	22-Jul-12	1	07:38:22	07:42:14	M	283	302	20	2	Mammal	Grizzly bear	1	At camera post	
HR1	31-Jul-12	1	17:28:21	17:28:32	M	754	763	10	1	Mammal	Grizzly bear?	1	Walking away from camera	Looks like a grizzly, but shedding!
HR1	1-Aug-12		16:30:00		T	810		1		Mammal	Caribou	1	Walking	
HR1	6-Aug-12		09:30:00		T	1036		1		Mammal	Caribou?	1	At pond	Looks like a caribou?
HR1	6-Aug-12		14:00:00		T	1045		1		Mammal	Caribou?	1	Bedded down?	Looks like a caribou bedded down? Included previous and following photo for ref.

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		Camera Photo(s) Details							Wildlife Recorded on Photo(s)				
Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
HR1	6-Aug-12		17:00:00		T	1051		1		Mammal	Caribou?	1	Foraging	Looks like a small caribou? Counted previously?
HR1	18-Aug-12		14:00:00		T	1631		1		Shorebird	Dunlin?	1	Loafing	This could be a dunlin? Included previous and following photo for ref.
HR1	20-Aug-12	1	22:06:34	22:06:44	M	1744	1753	10	1	Mammal	Grizzly bear	1	Walking towards camera	
HR2	11-Jun-12	1	22:52:48	22:52:57	M			10	1	Mammal	Wolf	1	walking, investigating camera	
HR2	14-Jun-12	1	00:22:17	00:22:26	M			10	1	Mammal	Wolf	1	investigating camera, walking	
HR2	4-Jul-12	1	21:44:58	21:45:08	M			10	1		Caribou	1	investigating camera	
HR2	5-Jul-12	1	01:26:28	01:26:37	M			10	1	Mammal	Wolf	1	walking behind the rocks	only seen in photo 10
HR2	20-Jul-12	1	22:32:56	22:33:05	M	310	319	10	1	Mammal	Wolf	2	Walking near camera	
HR2	23-Jul-12		22:30:00		T	463		1		Bird	Unknown	1	Loafing on rock	Maybe a gull? Inlcuded previous and following photo for ref.
HR2	28-Jul-12		07:00:00		T	672		1		Bird?	Unknown	1	Loafing on rock	Spp unknown. Included previous and following photo for ref.
HR2	3-Aug-12		05:00:00		T	956		1		Bird?	Unknown	1	Loafing on rock	Spp unknown. Included previous and following photo for ref.
HR2	7-Aug-12		12:30:00		T	1163		1		Bird?	Unknown	1	Loafing on rock	Spp unknown. Included previous and following photo for ref.
HR2	11-Aug-12		09:07:07	09:07:16	M	1349	1358	10	1	Mammal	Grizzly bear	1	At camera post	
HR2	21-Aug-12		10:00:00		T	1840		1		Bird?	Unknown	2	On ground	Spp unknown. Included previous and following photo for ref.
HR2	23-Aug-12		19:30:00		T	1955		1		Bird	Canada Geese?	4	On pond	
HR2	23-Aug-12		20:00:00		T	1956		1		Bird	Canada Geese?	7	On pond	Some may have been counted previously?
HR2	23-Aug-12		20:30:00		T	1957		1		Bird	Canada Geese?	7	On pond	
HR2	23-Aug-12		21:00:00		T	1958		1		Bird	Canada Geese?	4	On pond	
HR3	7-Jun-12	1	15:27:57		M			10	1	Mammal	Caribou	2	grazing, eating, walking away	
HR3	8-Jun-12		06:30:00		T			1		Mammal	Caribou	20	grazing, eating, walking away	hard to say if these are all part of the same herd over course of day
HR3	8-Jun-12		07:30:00		T			1		Mammal	Caribou	25	grazing	
HR3	8-Jun-12		14:30:00		T			1		Mammal	Caribou	20	grazing, walking	
HR3	8-Jun-12		18:30:00		T			1		Mammal	Caribou	6	grazing, walking	
HR3	9-Jun-12		15:30:00		T			1		Mammal	Caribou	4	grazing, walking	
HR3	9-Jun-12		16:00:00		T			1		Mammal	Caribou	4	grazing, walking	
HR3	9-Jun-12		18:00:00		T			1		Mammal	Caribou	8	grazing, walking	
HR3	9-Jun-12		20:00:00		T			1		Mammal	Caribou	7	grazing	1 visible with herd in b/g
HR3	9-Jun-12	1	20:01:07	20:01:16	M			10	1	Mammal	Caribou	7	walking	1 visible with herd in b/g
HR3	9-Jun-12		21:30:00		T			1		Mammal	Caribou	8	grazing	check if this whole group is part of same herd…
HR3	9-Jun-12		22:00:00		T			1		Mammal	Caribou	16	grazing	
HR3	10-Jun-12		01:00:00		T			1		Mammal	Caribou	25	grazing	
HR3	10-Jun-12		16:00:00		T			1		Mammal	Caribou	4	grazing	
HR3	10-Jun-12		16:30:00		T			1		Mammal	Caribou	4	grazing	
HR3	10-Jun-12		18:30:00		T			1		Mammal	Caribou	8	grazing	
HR3	11-Jun-12		00:30:00		T			1		Mammal	Caribou	12	grazing	
HR3	11-Jun-12		02:30:00		T			1		Mammal	Caribou	1	grazing	
HR3	11-Jun-12		15:30:00		T			1		Mammal	Caribou	1	grazing	
HR3	12-Jun-12		23:00:00		T			1		Mammal	Caribou	5	grazing	
HR3	13-Jun-12	1	22:55:56	22:56:09	M			10	1	Mammal	Caribou	1	investigating camera	
HR3	13-Jun-12		23:00:00		T			1		Mammal	Caribou	1	grazing	
HR3	13-Jun-12	2	23:04:13	23:04:22	M			10	1	Mammal	Caribou	1	investigating camera	
HR3	14-Jun-12		03:30:00		T			1		Mammal	Caribou	1	grazing	
HR3	14-Jun-12		19:30:00		T			1		Mammal	Caribou	5	grazing	
HR3	16-Jun-12	1	00:19:20	00:19:29	M			10	1	Mammal	Caribou	8	standing, walking, grazing	
HR3	16-Jun-12		03:30:00		T			1		Mammal	Caribou	12	grazing	approx 12-15 caribou
HR3	16-Jun-12	2	08:53:08	08:53:17	M			10	1	Mammal	Caribou	3	grazing, investigating camera	
HR3	16-Jun-12	3	21:13:43	21:13:54	M			10	1	Mammal	Bear	1	investigating camera	only seen in photo 10
HR3	26-Jun-12		11:00:00		T			1			Unknown	7		don't look like caribou, darker…muskox?
HR3	26-Jun-12		11:30:00		T			1			Unknown	5		

Appendix 10-3. Images of Wildlife Captured by Remote digital Cameras, May to August 2012

		Camera Photo(s) Details							Wildlife Recorded on Photo(s)				
Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
HR3	4-Jul-12		05:30:00		T			1		Mammal	Caribou	35	grazing	number very approximate
HR3	4-Jul-12	1	05:44:42	05:44:52	M			10	1	Mammal	Caribou	12	grazing, sitting	mostly they seem to be relaxing
HR3	4-Jul-12	2	06:51:52	06:52:01	M			10	1	Mammal	Caribou	6	grazing, sitting, walking	same group
HR3	4-Jul-12		07:00:00		T			1		Mammal	Caribou	120	grazing, sitting	tons of them…could be many more than 120
HR3	14-Jul-12		09:30:00		T			1			Unknown	3	unknown behavior	
HR4	15-Jun-12		23:00:00		T			1		Mammal	Caribou	1	grazing	
HR4	15-Jun-12		23:14:42	23:14:51	M			10	1	Mammal	Caribou	1	grazing, standing, walking	
HR4	16-Jun-12		22:25:52	22:26:03	M			10	1	Mammal	Caribou	12	grazing, walking, investigating camera	approx 12 visible, probably part of larger herd
HR4	16-Jun-12		22:30:00		T			1		Mammal	Caribou	15	grazing	
HR4	18-Jun-12		11:30:00		T			1		Mammal	Caribou	30	grazing	probably more…
HR4	18-Jun-12		13:00:00		T			1		Mammal	Caribou	1	grazing	
HR4	18-Jun-12		13:30:00		T			1		Mammal	Caribou	4	grazing	
HR4	18-Jun-12	1	14:23:42	14:23:51	M			10	1	Mammal	Caribou	2	grazing, looking at camera	
HR4	18-Jun-12	2	14:52:49	14:52:58	M			10	1	Mammal	Caribou	12	grazing, standing, walking, looking at camera	right horizon
HR4	18-Jun-12		15:30:00		T			1		Mammal	Caribou	1	grazing	
HR4	18-Jun-12		17:00:00		T			1		Avian	Bird	1	standing	
HR4	21-Jun-12		08:30:00		T			1			Unknown	2		looks larger and whiter than caribou…
HR5	24-Jul-12		12:30:00		T	495		1		Mammal?	Unknown?	1		Not sure what this is (white wolf or caribou?), but wasn't in previous or following photo, which are included for ref.
HR5	15-Aug-12		07:00:00		T	1550		1		Bird	Sparrow sp.	1	Loafing on rock	Previous and following photo included for ref.
HR6	6-Aug-12	1	09:12:!4	09:12:17	M	1105	1114	10	1	Mammal	Grizzly bear	1	At camera post	
HR7	26-Jun-12		10:30:00		T			1			Caribou	1		on horizon - too far to gather any info
HR7	26-Jun-12		16:00:00		T			1			Caribou	30		on horizon - too far to gather any info
HR7	26-Jun-12		16:30:00		T			1			Caribou	60		on horizon - too far to gather any info
HR7	26-Jun-12		17:00:00		T			1			Caribou	60		on horizon - too far to gather any info
HR7	26-Jun-12		17:30:00		T			1			Caribou	30		on horizon - too far to gather any info
HR7	26-Jun-12		17:00:00		T			1			Caribou	60		on horizon - too far to gather any info
HR7	26-Jun-12		17:30:00		T			1			Caribou	30		on horizon - too far to gather any info
HR7	26-Jun-12		18:00:00		T			1			Caribou	10		on horizon - too far to gather any info
HR7	26-Jun-12		18:30:00		T			1			Caribou	2		on horizon - too far to gather any info
HR7	27-Jun-12		08:00:00		T			1			Caribou	1		
HR7	28-Jun-12		06:17:24	06:17:34	M			10	1	Mammal	Caribou	250	grazing	probably more….
HR7	28-Jun-12		13:00:00		T			1		Mammal	Caribou	1		
HR7	2-Jul-12		10:27:27	10:27:37	M			10	1		Unknown	1	investigating camera	looks like a bear…
HR7	21-Jul-12	1	09:16:12	09:16:25	M	376	385	10	1	Mammal	Grizzly bear	1	At camera post	
HR7	31-Jul-12		17:00:00		T	881		1		Mammal	Musk Ox	15	Resting on tundra	Not totally sure these are musk ox? Please check numbers of individuals. Included previous photo for ref. Previously counted?
HR7	31-Jul-12		17:30:00		T	882		1		Mammal	Musk Ox	10	Resting on tundra	Musk ox? Number of individuals? Previously counted?
HR7	31-Jul-12		18:00:00		T	883		1		Mammal	Musk Ox	10	Resting on tundra	Musk ox? Number of individuals? Previously counted?
HR7	31-Jul-12		18:30:00		T	884		1		Mammal	Musk Ox	11	Resting on tundra	Musk ox? Number of individuals? Previously counted?
HR7	31-Jul-12		19:00:00		T	885		1		Mammal	Musk Ox	8	Resting on tundra	Musk ox? Number of individuals? Previously counted?
HR7	31-Jul-12		19:30:00		T	886		1		Mammal	Musk Ox	9	Resting on tundra	Musk ox? Number of individuals? Previously counted?
HR7	18-Aug-12		08:30:00		T	1728		1		Bird	Unknown raptor	1	Flying	
HR7	18-Aug-12		11:30:00		T	1734		1		Bird	Terns?	2	Flying	Looks like slender wings of terns, but the body looks brown? Not sure of ID?
HR8	24-Jun-12		14:00:00		T			1			Caribou	2		
HR8	27-Jun-12		23:00:00		T			1		Mammal	Caribou	70	grazing	probably more….
HR8	2-Jul-12		00:12:25	00:12:35	M			10	1		Unknown	1	investigating camera	though it looks like a bear
HR8	3-Jul-12		12:24:37	12:24:49	M			10	1	Mammal	Bear	1	investigating camera	possibly the same bear, 36 hrs later
HR8	26-Jul-12	1	08:49:02	08:52:49	M	584	603	20	2	Mammal	Grizzly bear?	1	At camera post	No positive ID on animal, but camera gets tipped over, like a bear encounter.
HR8	29-Jul-12	1	03:40:08	03:40:17	M	758	767	10	1	Mammal	Unknown	1	At camera post	Camera still tipped over, but smaller white paws how up. Fox or hare?
HR8	3-Aug-12	1	01:52:35	01:52:35	M	1044	1053	10		Mammal	Arctic hare	1	At camera post	Camera still tipped over
HR8	3-Aug-12	2	12:35:49	12:36:00	M	1076	1085	10	1	Bird	Sparrow sp.	1	At camera post	Camera still tipped over
HR8	8-Aug-12	1	07:24:29	07:24:38	M	1325	1334	10	1	Bird	Sparrow sp.	1	At camera post	Camera still tipped over

Appendix 10-3. Images of Wildlife Captured by Remote digital Cameras, May to August 2012

		Camera Photo(s) Details								Wildlife Recorded on Photo(s)				
Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
HR8	16-Aug-12	1	01:43:07	01:43:17	M	1718	1727	10	1	Mammal	Arctic hare	1	At camera post	Camera still tipped over
HR8	17-Aug-12	1	04:25:26	04:25:35	M	1781	1790	10	1	Mammal	Arctic hare	1	At camera post	Camera still tipped over
HR8	21-Aug-12	1	04:04:39	04:16:31	M	2003	2022	20	2	Mammal	Arctic hare	1	At camera post	Camera still tipped over
HR8	21-Aug-12	2	12:04:47	12:04:56	M	2049	2058	10	1	Bird	Sparrow sp.	1	At camera post	Camera still tipped over
HR8	23-Aug-12	1	03:24:31	03:24:40	M	2147	2156	10	1	Mammal	Arctic hare	1	At camera post	Camera still tipped over
HR9	28-Jul-12		17:30:00		T	702		1		Bird	Gull	1	On shore of pond	
HR9	29-Jul-12		15:30:00		T	746		1		Bird	Gull	1	On shore of pond	
HR9	31-Jul-12		14:00:00		T	839		1		Bird	Gull	1	On shore of pond	
HR9	1-Aug-12		20:30:00		T	900		1		Bird	White-fronted geese?	12	Flying low across tundra	Not entire sure of species ID, and numbers of individuals.
HR9	19-Aug-12		21:00:00		T	1765		1		Bird	Gull	1	On shore of pond	
HR9	19-Aug-12		21:30:00		T	1766		1		Bird	Gull	1	On shore of pond	
HR10	16-Jun-12		12:11:54	12:12:03	M			10	1	Mammal	Wolf	1	walking, investigating camera	
HR11	22-Jun-12		14:30:00		T			1		Mammal	Caribou	4	grazing	
HR11	26-Jun-12		09:30:00		T			1		Mammal	Caribou	250	grazing	probably more…
HR11	26-Jun-12	1 to 8	09:33:54	10:08:47	M			80	8	Mammal	Caribou	250	grazing	
HR11	26-Jun-12		10:00:00		T			1		Mammal	Caribou	200	grazing	
HR11	26-Jun-12		10:30:00		T			1		Mammal	Caribou	80	grazing	
HR11	26-Jun-12		11:00:00		T			1		Mammal	Caribou	40	grazing	
HR11	26-Jun-12	9	11:00:33	11:00:43	M			10	1	Mammal	Caribou	40	grazing	
HR11	26-Jun-12		11:30:00		T			1		Mammal	Caribou	20	grazing	
HR11	26-Jun-12	10	11:47:05	11:47:14	M			10	1	Mammal	Caribou	20	grazing	
HR11	28-Jun-12		01:43:04	01:46:55	M			20	2	Mammal	Caribou	60	grazing	with cute babies
HR11	28-Jun-12		03:30:00		T			1			Caribou	6		
HR11	28-Jun-12		11:30:00		T			1		Mammal	Caribou	250		hundreds
HR11	28-Jun-12		12:00:00		T			1		Mammal	Caribou	250		hundreds
HR11	28-Jun-12		12:30:00		T			1		Mammal	Caribou	300		hundreds
HR11	28-Jun-12		13:00:00		T			1		Mammal	Caribou	250		hundreds
HR11	28-Jun-12		13:30:00		T			1		Mammal	Caribou	80		
HR11	28-Jun-12		14:00:00		T			1		Mammal	Caribou	50		
HR11	28-Jun-12		15:30:00		T			1		Mammal	Caribou	30		
HR11	1-Aug-12		02:30:00		T	862		1		Bird	Ptarmigan	7	Loafing	
HR11	1-Aug-12		18:00:00		T	893		1		Bird	Shorebird sp.	1	Loafing	Previous and following photos included for ref
HR12	10-Jun-12		01:00:00		T			1		Mammal	Caribou	2	grazing	
HR12	10-Jun-12		01:30:00		T			1		Mammal	Caribou	2	sitting	looks like same 2 are now resting
HR12	10-Jun-12		02:00:00		T			1		Mammal	Caribou	2	sitting	looks like same 2 are now resting
HR12	10-Jun-12		02:30:00		T			1		Mammal	Caribou	2	sitting	looks like same 2 are now resting
HR12	10-Jun-12		03:00:00		T			1		Mammal	Caribou	2	sitting	looks like same 2 are now resting
HR13														No wildlife observations
HR14	18-Jul-12		22:00:00		T	260		1		Mammal	Caribou	1	Foraging	
HR15														No wildlife observations
HR16	7-Jun-12		14:30:00		T			1		Mammal	Muskox	1	grazing	
HR16	7-Jun-12		15:00:00		T			1		Mammal	Muskox	1	grazing	
HR16	25-Jun-12		12:30:00		T			1		Mammal	Caribou	30	grazing	
HR16	25-Jun-12		13:00:00		T			1		Mammal	Caribou	40		
HR16	25-Jun-12		13:30:00		T			1		Mammal	Caribou	40	grazing, resting	
HR16	25-Jun-12		14:00:00		T			1		Mammal	Caribou	20	grazing, resting	
HR16	25-Jun-12		14:30:00		T			1		Mammal	Caribou	20	grazing, resting	
HR16	25-Jun-12		15:00:00		T			1		Mammal	Caribou	50	grazing, resting	
HR16	25-Jun-12		15:07:28	16:26:01	M			70	7	Mammal	Caribou	60	grazing, resting	herd grows in number over time
HR16	25-Jun-12		15:30:00		T			1		Mammal	Caribou	60	grazing, resting	
HR16	25-Jun-12		16:00:00		T			1		Mammal	Caribou	60	grazing, resting	
HR16	25-Jun-12		16:30:00		T			1		Mammal	Caribou	60	grazing, resting	
HR16	28-Jun-12		18:30:00		T			1		Mammal	Caribou	16	grazing, walking	
HR16	28-Jun-12		19:00:00		T			1		Mammal	Caribou	80	grazing, walking	
HR16	3-Jul-12		02:34:35	02:34:45	M			10	1	Mammal	Wolf	1	investigating camera	with a cute bird on the rock behind

Appendix 10-3. Images of Wildlife Captured by Remote digital Cameras, May to August 2012

		Camera Photo(s) Details							Wildlife Recorded on Photo(s)				
Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
HR17	26-Jun-12		04:00:00		T			1		Mammal	Caribou	150		too far to gather any info
HR17	26-Jun-12		04:30:00		T			1		Mammal	Caribou	200		too far to gather any info
HR17	26-Jun-12		05:00:00		T			1		Mammal	Caribou	150		too far to gather any info
HR17	26-Jun-12		05:30:00		T			1		Mammal	Caribou	125		too far to gather any info
HR17	26-Jun-12		06:00:00		T			1		Mammal	Caribou	75		too far to gather any info
HR17	26-Jun-12		06:30:00		T			1		Mammal	Caribou	75		too far to gather any info
HR17	26-Jun-12		07:00:00		T			1		Mammal	Caribou	6		too far to gather any info
HR17	27-Jun-12		10:00:00		T			1		Mammal	Caribou	4	grazing, walking	
HR17	27-Jun-12		10:30:00		T			1		Mammal	Caribou	5	grazing, walking	
HR17	29-Jun-12		14:00:00		T			1		Mammal	Caribou	1	walking in stream	
HR17	30-Jun-12		04:07:33	04:07:47	M			10	1		Unknown	1	investigating camera	probably a bear?
HR17	19-Jul-12		21:30:00		T	275		1		Bird	Canada Geese	2	Foraging	
HR17	27-Jul-12	1	01:57:41	01:57:54	M	620	629	10	1	Mammal	Grizzly bear	1	At camera post	
HR18	23-Aug-12		15:00:00		T	1973		1		Mammal?	Unknown	1	Loafing	Not sure what species, maybe grizzly bear
HR18	23-Aug-12		15:30:00		T	1974		1		Mammal?	Unknown	1	Loafing	Not sure what species, maybe grizzly bear
HR18	23-Aug-12		16:00:00		T	1975		1		Mammal?	Unknown	1	Loafing	Not sure what species, maybe grizzly bear
HR18	23-Aug-12		16:30:00		T	1976		1		Mammal?	Unknown	1	Loafing	Not sure what species, maybe grizzly bear
HR19														No wildlife observations!
HR19	22-Aug-12		11:00:00		T	1917		1		Raptor	Unknown	1	Flying	Not sure of species, maybe rough legged hawk?
HR19	23-Aug-12		11:00:00		T	1965		1		Bird	Sparrow sp.	1	Loafing	
HR20	30-Jul-12	1	02:46:23	02:46:33	M	661	670	10	1	Mammal	Grizzly bear	1	At camera post	
HR20	31-Jul-12	1	03:16:21	03:16:32	M	720	729	10	1	Mammal	Grizzly bear	1	At camera post	
HR21	24-Jun-12		17:32:43	17:32:55	M			10	1		Unknown	1	investigating camera	bear?
HR21	15-Aug-12		07:00:00		T	1438				Waterfowl	Canada Geese	7	At pond edge	
HR21	15-Aug-12		07:30:00		T	1439				Waterfowl	Canada Geese	8	At pond edge	
HR21	15-Aug-12		13:00:00		T	1450				Waterfowl	Canada Geese	10	At pond edge	
HR21	15-Aug-12		13:30:00		T	1451				Waterfowl	Canada Geese	2	At pond edge	
HR21	15-Aug-12		14:00:00		T	1452				Waterfowl	Canada Geese	6	At pond edge	
HR21	15-Aug-12		14:30:00		T	1453				Waterfowl	Canada Geese	23	In pond	
HR21	15-Aug-12		15:30:00		T	1455				Waterfowl	Canada Geese	19	In pond	
HR21	15-Aug-12		21:30:00		T	1467				Waterfowl	Canada Geese	21	In pond	
HR21	23-Aug-12		10:30:00		T	1829				Waterfowl	Unknown	7	In pond	
HR21	24-Aug-12	1	22:41:33	22:41:47	M	1902	1911	10	1	Mammal	Unknown	1	At camera post	No good ID on spp, likely grizzly?
HR22	6-Jul-12		06:03:16	06:03:16	M			1	1	Avian	Bird	2	flying	most insane looking thing, possibly alien
HR22	31-Jul-21		17:00:00		T	738		1		Shorebird	Unknown?	1	Loafing	Not sure of ID, maybe turnstone?
HR22	16-Aug-12	1	07:09:32	07:09:42	M	1487	1496	10	1	Mammal	Grizzly bear	1	At camera post	Beautiful grizzly
HR23														No wildlife observations
HR24	1-Jul-12		03:21:02	03:21:15	M			10	1	Mammal	Muskox	1	investigating camera	
HR24	8-Jul-12		09:24:04	09:32:14	M			30	3	Mammal	Bear	1	walking, investigating camera	
HR24	8-Jul-12		09:30:00		T			1		Mammal	Bear	1		same bear
HR24	31-Jul-12	1	07:04:19	07:04:33	M	761	770	10	1	Mammal	Grizzly bear	1	At camera post	
HR24	14-Aug-12		06:30:00		T	1441		1		Bird	Sparrow sp.	1	Loafing in grass	
HR24	15-Aug-12	1	17:59:07	17:59:25	M	1512	1521	10	1	Mammal	Grizzly bear	1	At camera post	
HR25	1-Jul-12		05:07:06	05:07:15	M			10	1	Mammal	Caribou	1	walking	
HR25	28-Jul-12		11:00:00		T	625		1		Mammal?	Unknown	1		Not sure what this is, but wasn't in previous or following photo, which are included for ref.
HR25	30-Jul-12		04:30:00		T	708		1		Waterfowl	Canada Geese	6		
HR25	30-Jul-12		05:00:00		T	709		1		Waterfowl	Canada Geese	10		
HR25	30-Jul-12		05:30:00		T	710		1		Waterfowl	Canada Geese	8		
HR25	30-Jul-12		06:00:00		T	711		1		Waterfowl	Canada Geese	6		
HR25	30-Jul-12		06:30:00		T	712		1		Waterfowl	Canada Geese	10		
HR25	30-Jul-12		07:00:00		T	713		1		Waterfowl	Canada Geese	6		
HR26	8-Jul-12		18:30:00		T			1			Unknown			probably not an animal, but then what is it?
HR27	26-Jun-12		04:00:00		T			1		Mammal	Caribou	10		herd grows in number over time
HR27	26-Jun-12		04:30:00		T			1		Mammal	Caribou	40		
HR27	26-Jun-12		05:00:00		T			1		Mammal	Caribou	60		

Appendix 10-3. Images of Wildlife Captured by Remote digital Cameras, May to August 2012

		Camera Photo(s) Details							Wildlife Recorded on Photo(s)				
Camera No.	Date	Series	Start Time	End Time	Photo Type	Start Photo	End Photo	No. Photos	No.Triggers	Animal Group	Species	No. Animals	Behaviour	Comment(s)
HR27	26-Jun-12		05:30:00		T			1		Mammal	Caribou	70		
HR27	26-Jun-12		06:00:00		T			1		Mammal	Caribou	200		
HR27	26-Jun-12		06:30:00		T			1		Mammal	Caribou	200		
HR27	26-Jun-12		07:00:00		T			1		Mammal	Caribou	200		
HR27	26-Jun-12		07:30:00		T			1		Mammal	Caribou	140		
HR27	26-Jun-12		08:00:00		T			1		Mammal	Caribou	80		
HR27	27-Jun-12		16:00:00		T			1			Unknown	1		strange looking animal (rooster?)
HR28	27-Jun-12		03:59:36	03:59:45	M			10	1	Mammal	Caribou	1	walking	
HR28	27-Jun-12		10:30:00		T			1			Unknown			small group of dark colored animals (not sure if walking or flying)
HR29														No wildlife observations
HR30	18-Jul-12		22:30:00		T	321		1		Mammal	Wolf	1		
HR30	16-Aug-12	1	04:49:34	04:49:44	M	1688	1697	10	1	Mammal	Grizzly bear	1		
HR30	22-Aug-12		11:00:00		T	1998		1		Bird	Unknown raptor	1		No sure what spp?

Appendix 10-4

Summary of Caribou Herds by Camera Number in the Combined Camera Study Area

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Appendix 10-4. Summary of Caribou Groups by Camera Number in the Combined Camera Study Area

Camera Number	Total Caribou	Total Observations	Caribou Detection Rate (caribou/day)	# Large Groups (>100 individuals)	# Moderate Groups (50-100 individuals)	# Small Groups (2-49 individuals)	# Single Caribou
BR1	2	2	0.022	0	0	0	2
BR2	0	0	0.000	0	0	0	0
BR3	3	3	0.033	0	0	0	3
BR4	1	1	0.011	0	0	0	1
BR5	2	2	0.027	0	0	0	2
BR6	5	4	0.068	0	0	1	3
BR7	0	0	0.000	0	0	0	0
BR8	0	0	0.000	0	0	0	0
BR9	9	5	0.119	0	0	2	3
BR10	0	0	0.000	0	0	0	0
BR11	2	2	0.031	0	0	0	2
BR12	0	0	0.000	0	0	0	0
BR13	0	0	0.000	0	0	0	0
BR14	6	1	0.064	0	0	1	0
BR15	4	4	0.064	0	0	0	4
BR16	10	8	0.106	0	0	1	7
BR17	7	4	0.074	0	0	3	1
BR18	0	0	0.000	0	0	0	0
BR19	1	1	0.011	0	0	0	1
BR20	6	5	0.063	0	0	1	4
BR21	5	3	0.054	0	0	1	2
BR22	38	8	0.409	0	0	6	2
BR23	28	16	0.304	0	0	3	13
BR24	0	0	0.000	0	0	0	0
BR25	1	1	0.012	0	0	0	1
BR26	9	8	0.096	0	0	1	7
BR27	2	2	0.021	0	0	0	2
BR28	242	13	2.605	1	0	5	7
BR29	0	0	0.000	0	0	0	0
BR30	203	4	2.206	1	0	0	3
HR1	4	4	0.072	0	0	0	4
HR2	1	1	0.012	0	0	0	1
HR3	360	26	4.430	1	0	22	3
HR4	66	8	0.906	0	0	5	3
HR5	0	0	0.000	0	0	0	0
HR6	0	0	0.000	0	0	0	0
HR7	313	5	4.846	1	1	0	3
HR8	72	2	1.766	0	1	1	0
HR9	0	0	0.000	0	0	0	0
HR10	0	0	0.000	0	0	0	0
HR11	620	5	7.853	2	1	2	0
HR12	2	1	0.025	0	0	1	0
HR13	0	0	0.000	0	0	0	0
HR14	1	1	0.012	0	0	0	1
HR15	0	0	0.000	0	0	0	0
HR16	140	2	1.727	0	2	0	0
HR17	206	3	5.725	1	0	1	1
HR18	0	0	0.000	0	0	0	0
HR19	0	0	0.000	0	0	0	0
HR20	0	0	0.000	0	0	0	0
HR21	0	0	0.000	0	0	0	0
HR22	0	0	0.000	0	0	0	0
HR23	0	0	0.000	0	0	0	0
HR24	0	0	0.000	0	0	0	0
HR25	1	1	0.014	0	0	0	1
HR26	0	0	0.000	0	0	0	0
HR27	200	1	2.562	1	0	0	0
HR28	1	1	0.013	0	0	0	1
HR29	0	0	0.000	0	0	0	0
HR30	0	0	0.000	0	0	0	0

Appendix 11-1

Muskox and Moose Incidental Observations, 2012

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Appendix 11-1. Muskox and Moose Incidental Observations, 2012

Date Observed	Baseline Study	Species	Scientific Name	Number Observed	Habitat Type	Easting	Northing	Comments
19-Aug-12	Archeology	Moose	*Alces americanus*	2	Tall riparian shrub	404543	7333323	Bulls
27-Aug-12	Fall waterbird staging surveys	Moose	*Alces americanus*	1	Tall riparian shrub	408542	7350622	Young Bull
06-Apr-12	Wolverine DNA	Muskox	*Ovibos moschatus*	0	Unknown	418058	7270272	muskox tracks
06-Apr-12	Wolverine DNA	Muskox	*Ovibos moschatus*	0	Unknown	412643	7271192	muskox tracks and pellets
06-Apr-12	Wolverine DNA	Muskox	*Ovibos moschatus*	0	Unknown	424091	7271372	muskox tracks and pellets
06-Apr-12	Wolverine DNA	Muskox	*Ovibos moschatus*	2	Rocky Heath Tundra	418566	7269726	picture taken en route to a wolverine DNA sampling site
04-Jun-12	Grizzly Bear DNA	Muskox	*Ovibos moschatus*	1	Rocky Heath Tundra	403637	7302970	Adult
10-Jun-12	Grizzly Bear DNA	Muskox	*Ovibos moschatus*	15	Rocky Heath Tundra	409374	7304142	12 Adults, 3 Calves
13-Jun-12	Marine mammal surveys	Muskox	*Ovibos moschatus*	2	Bathurst Inlet	386074	7316911	
19-Jun-12	Grizzly Bear DNA	Muskox	*Ovibos moschatus*	1	Rocky Heath Tundra	371166	7338273	Adult
16-Aug-12	Grizzly Bear DNA	Muskox	*Ovibos moschatus*	20	Rocky Heath Tundra	430580	7274434	same herd as observed by Archeology (see line below)
18-Aug-12	Archeology	Muskox	*Ovibos moschatus*	24	Rocky Heath Tundra	430580	7274434	herd seen in area over a period of several days
21-Aug-12	Remote cameras	Muskox	*Ovibos moschatus*	1	Rocky Heath Tundra	434151	7280644	1 Adult
25-Aug-12	Fall waterbird staging surveys	Muskox	*Ovibos moschatus*	31	Sedge Meadow	427640	7250398	28 adults, (1 Bull, 2 Calves)
26-Aug-12	Fall waterbird staging surveys	Muskox	*Ovibos moschatus*	17	Sedge Meadow	402088	7308696	1 male and one herd of 16

Appendix V5-5D

Back River Project: Wildlife Baseline Report 2011

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BACK RIVER PROJECT
Wildlife Baseline Report 2011

Sabina
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March 2012

BACK RIVER PROJECT
WILDLIFE BASELINE REPORT 2011

March 2012
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Prepared by:

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Vancouver, British Columbia

Executive Summary

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Executive Summary

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut. Several exploration targets exist in the Goose Lake property area, including the Llama, Umwelt, Echo, and Goose deposits. For 2011, wildlife baseline studies were conducted in the areas that could be influenced by the future development of these deposits.

The objectives of wildlife baseline studies were to characterize the mammal and avian communities within various study areas around the Goose Lake area and Bathurst Inlet area, depending on the wildlife species being characterized. A number of desk-based and field inventory studies were undertaken to collect baseline data. These studies included a literature review of existing relevant information on wildlife and wildlife habitats within the region and a desk-based evaluation of the occurrence of wildlife species in the region, particularly those of conservation concern. Field surveys in 2011 focused on upland breeding birds, waterbirds, raptors, marine birds, carnivores and their denning habitat, and incidental observations of marine and terrestrial mammals.

A total of 45 bird species, two marine mammals, and seven terrestrial mammals were confirmed to occur within the Project study areas. Of these species, 18 birds (American pipit, American golden-plover, American tree sparrow, white-crowned sparrow, dunlin, hoary redpoll, least sandpiper, red-necked phalarope, semipalmated sandpiper, short-eared owl, long-tailed duck, Arctic tern, golden eagle, gyrfalcon, rough-legged hawk, peregrine falcon, common eider, and glaucous gull) and one mammal (grizzly bear) are identified as species of conservation concern at the territorial or federal level.

Upland breeding bird surveys were conducted in late June and early July, 2011, to characterize distribution and abundance of upland breeding birds in the local study area (LSA) and a reference area (RA). A total of 17 species were observed during these surveys or observed incidentally during other baseline environmental studies. Breeding evidence was confirmed for eight species, including a short-eared owl nest (short-eared owl is a federally listed species of conservation concern). High diversity of upland breeding birds was recorded in both the LSA and the RA, suggesting a relatively even distribution of species within the two study areas.

Aerial surveys for waterbirds were conducted in 2011 to document habitat use, abundance, and richness in the LSA and RA during the early breeding (July) and late breeding/early staging periods (August). Overall, 14 species (10 waterbirds and four seabirds) were observed, with the majority of observations being Canada geese. Species abundance was highest during August, as staging groups were likely beginning to congregate. Of the 14 species observed, two are of conservation concern: long-tailed duck and Arctic tern. Both species were observed during the July surveys, suggesting that they may breed in the LSA and RA.

Surveys were conducted in 2011 to determine the occupancy and productivity status of raptor nests in the raptor and carnivore study area (RCSA). Eleven nests, occupied by gyrfalcon, rough-legged hawk, golden eagle, and unknown species, were observed during occupancy surveys in June. None of the nests were confirmed to be productive during productivity surveys in July; however, two nests (one gyrfalcon and one rough-legged hawk) contained a large amount of whitewash (excrement) which suggests that the chicks may have hatched, and one nest contained deceased gyrfalcon chicks. In addition to the three cliff-nesting raptors observed to be nesting in the RCSA, peregrine falcon, bald eagle, northern

harrier, short-eared owl, and common raven adults were also observed. Therefore, eight species are present in the RCSA, suggesting a relatively broad range of raptor species occurring in the study area.

Marine bird surveys were conducted in July and August, 2011 in the marine regional study area (MRSA). Overall, 15 marine bird species were observed throughout Bathurst Inlet. A higher abundance of birds were observed during the breeding survey (N = 1,812) compared to the early fall staging survey (N = 957). No breeding evidence was observed. Two species of conservation concern at the territorial level were observed (common eider and glaucous gull), both of which are listed as Sensitive.

Incidental observations of marine mammals were recorded during marine bird aerial surveys in July and August, 2011 in the MRSA. During aerial surveys, three ringed seals, one bearded seal, and one unknown seal were observed. No seals were observed hauled out on the beaches, rock outcrops, or islands in Bathurst Inlet. All five seals that were observed were swimming in the inlet when spotted. No whales or walrus were observed during the aerial surveys.

The carnivore den occupancy survey was conducted in June, 2011, and the productivity survey was conducted in July, 2011, in the RCSA. No carnivore dens were observed during the aerial surveys. However, incidental observations of two female grizzly bears with cubs, young wolves, and a fox kit suggest that carnivore dens may be present. Suitable denning habitat exists within the RCSA, which is located within the range of denning grizzly bears, grey wolves, and Arctic foxes.

Incidental observations of mammals, including signs of wildlife (e.g. tracks, scat, and dens), were recorded during wildlife field inventories in 2011. A total of seven terrestrial mammal species (Arctic fox, Arctic ground squirrel, Arctic hare, caribou, grey wolf, grizzly bear, and muskox) and 2,531 individuals were observed incidentally during field baseline surveys in 2011. The most commonly observed species were caribou. Caribou were recorded on 25 separate occasions totalling 2,506 individuals. A large number of caribou were observed moving south just to the east of the Goose Lake camp on July 26 and 27; roughly 2,000 individuals were recorded on July 27. The Back River Project is located within the Ahiak, Bathurst, and Dolphin and Union caribou herd's annual home range. Ahiak and Bathurst caribou are most commonly present around the Goose Lake area in the summer (mid-July to the end of August), based on the distribution of collared female caribou. Therefore, annual use of habitat by caribou can be expected during the summer. Dolphin and Union caribou may be present around the Goose Lake area in the winter.

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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

ANOVA	Analysis of Variance – a statistical test of whether the means of two or more groups are equal
ANCOVA	Analysis of Covariance – a statistical test similar to ANOVA but with the addition of a continuous variable
BIPR	Bathurst Inlet Port and Road
CESCC	Canadian Endangered Species Conservation Council
COSEWIC	Committee on the Status of Endangered Wildlife in Canada - A federal committee of experts that assesses and designates the level of threat to wildlife and vegetation species in Canada
DFO	Department of Fisheries and Oceans, Canada
Ecosystem (terrestrial)	A volume of earth-space that is composed of non-living parts (climate, geologic materials, groundwater, and soils) and living or biotic parts, which are all constantly in a state of motion, transformation, and development. No size or scale is inferred.
GN DOE	Government of Nunavut Department of Environment
GPS	Global Positioning System
Habitat	Land and water surface used by wildlife. This may include biotic and abiotic aspects such as vegetation, exposed bedrock, water and topography.
Hectare (ha)	10,000 m^2 or 0.01 km^2 or 2.47 acres
IUCN	International Union for Conservation of Nature
LSA	Local Study Area
MANOVA	Multivariate Analysis of Variance – statistical test similar to ANOVA but with two or more dependent variables
MSA	Marine Study Area
NLCA	Nunavut Land Claims Agreement
NPC	Nunavut Planning Commission
NWMB	Nunavut Wildlife Management Board
NWT	Northwest Territories
PRISM	Program for Regional and International Shorebird Monitoring
RA	Reference Area
RCSA	Raptor and Carnivore Study Area

SARA	*Species at Risk Act* (2002b) - A Canadian federal statute which is designed to meet one of Canada's commitments under the International Convention on Biological Diversity. The goal of the Act is to protect endangered or threatened organisms and their habitats. It also manages species which are not yet threatened, but whose existence or habitat is in jeopardy.
Shannon's Diversity and Equitability	Shannon's Diversity Index is a mathematical measure of species diversity in a community. Diversity indices provide more information about community composition than species richness as they also take the relative abundance of different species into account, along with the number of species (Magurran 1988; Rosenzweig 1995). Shannon's Equitability reports how proportionate the numbers of individuals are within a community as a measure of the evenness.
95% Confidence Interval	The range of values in which there is 95% confidence that the true value of the mean falls
UTM	Universal Transverse Mercator
Waterbird	Umbrella term used to encompass all birds that exclusively use water habitat for foraging, breeding, or staging during the year
Wetland	Sites dominated by hydrophytic vegetation where soils are water-saturated for a sufficient length of time such that excess water and resulting low soil oxygen levels are principal determinants of vegetation and soil development (MacKenzie and Moran 2004)
Wilks' Δ	Probability distribution used in multivariate hypothesis testing and is interpreted as the proportion of variance in the outcomes that is not explained by an effect

1. Introduction

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1. Introduction

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut. The Project consists of several properties, one of which is the Goose Lake property (Figure 1-1). An exploration camp is located beside Goose Lake (Goose Lake Camp), and Sabina conducted a drilling program out of this camp during 2011.

Several exploration targets exist in the Goose Lake property area, including the Llama, Umwelt, Echo, and Goose deposits. For 2011, select baseline studies were conducted in the areas that could be influenced by the future development of these deposits. Rescan Environmental Services (Rescan) was contracted by Sabina, to conduct the following baseline studies in 2011:

- Dustfall and Air Quality;
- Surface Hydrology;
- ML/ARD
- Lake and Pond Bathymetry;
- Freshwater Quality, Sediment Quality, and Aquatic Biology;
- Freshwater Fish and Fish Habitat;
- Wildlife;
- Archaeology; and
- Airstrip Fish Habitat and Vegetation.

In addition, Sabina continued to operate a meteorological station on site as well as collect data on permafrost temperatures.

This report presents the results from the 2011 Wildlife Baseline Program. A number of desk-based and field inventory studies were undertaken to collect baseline data on wildlife within the Project area. These studies included a literature review for existing relevant information on wildlife and wildlife habitats within the area and a desk-based evaluation of the potential presence of species at risk (according to the federal *Species at Risk Act*). Field studies focused on upland breeding birds, waterbirds, raptors, marine birds, marine mammals, and carnivores in the area around the Goose Lake property and in Bathurst Inlet.

LEGEND:
- Gold Deposit
- Base Metal Deposit
- Diamond Deposit
- Operating Mine
- Proposed BIPR Port

Figure 1-1

Back River Project Location

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2. Background Information

2. Background Information

2.1 APPLICABLE LEGISLATION

Wildlife and wildlife habitat are protected by both federal and territorial legislation, including the Nunavut *Wildlife Act* (2003), Nunavut *Land Claims Agreement Act* (1993a), Canadian *Wildlife Act* (1994a), the Canada *Migratory Birds Convention Act* (1994c), and the Canada *Species at Risk Act* (SARA; 2002a; Table 2.1-1).

Table 2.1-1. Relevant Acts or Regulations for Wildlife and Wildlife Habitat

Act or Regulation	Implications for Management
Nunavut *Wildlife Act* (2003)	• Identifies and defines wildlife management strategies for Nunavut, including strategies for conservation, protection and recovery of species at risk, managing nuisance wildlife, and possession of wildlife. The Act provides interpretation of approved and restricted hunting and related activities, including the possession of wildlife and enforcement that will follow should any of the Act's issued sections and corresponding regulations be contravened. • Pertaining NU *Wildlife Act* Regulations are as follows: Birds of Prey Regulations, Wildlife General Regulations, and Wildlife Licenses and Permits Regulations.
Nunavut *Land Claims Agreement Act* (1993a)	• Legislation that enforces the Nunavut Land Claims Agreement (NLCA; 1993b). The Nunavut Wildlife Management Board (NWMB) is established under the NLCA with the responsibility to manage wildlife and wildlife habitat in conjunction with the Government of Nunavut Department of Environment (GN DOE). • Within Section 5.2.34 of the NLCA, additional responsibilities for the NWMB are outlined, including the approval of conservation areas, wildlife management zones, wildlife management strategies, species at risk recovery plans, and designation of species of conservation concern and disseminate wildlife management information to appropriate government bodies.
Canada *Wildlife Act* (1994a)	• Identifies and defines wildlife management strategies for Canada, including strategies for managing nuisance wildlife and possession of wildlife. It provides interpretation of approved and restricted hunting and related activities including the possession of wildlife and enforcement that will follow should any of the Acts issued sections and corresponding regulations be contravened.
Canada *Migratory Birds Convention Act* (1994c)	• Prohibits the taking or killing of migratory birds, their nests, and eggs, and the deposition of harmful substances in areas frequented by migratory birds. • Species protected include waterfowl, cranes, rails and coots, shorebirds including gulls and terns, pigeons and doves, insectivorous songbirds (excluding blackbirds), seabirds, loons, grebes, herons, egrets, and bitterns.
Canada *Species at Risk Act* (2002a)	• Protects wildlife on federal lands as well as the critical habitat of those species listed on the "List of Wildlife Species at Risk," and protects all SARA-listed migratory birds. • Section 137 amends the *Canadian Environmental Assessment Act* (1992) to clarify, for greater certainty, that environmental assessments must always consider effects to listed wildlife species, their critical habitat, or the residences of individuals of that species. • Section 79(2) states "the person must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plans."

2.2 PAST ENVIRONMENTAL STUDIES IN THE PROJECT AREA

Over the past decade, several environmental studies have been conducted within and surrounding the Back River Project area. Wildlife studies, including surveys for ungulates, carnivore dens, small mammals, raptors, and waterbirds, were conducted along the proposed road alignment between Contwoyto Lake and Bathurst Inlet and within Bathurst Inlet for the Bathurst Inlet Port and Road (BIPR) Project in 2001 and 2002 (Rescan 2007a). Additional surveys for ungulates and upland breeding birds were conducted in 2007 for the BIPR project (Rescan 2007b, 2007c). Three years of wildlife studies were conducted in the Hackett River area approximately 100 km to west of the Back River property, including surveys for ungulates, carnivores dens, small mammals, raptors, waterbirds, and upland breeding birds in 2007 and 2008 and ungulate surveys in 2010 (Rescan 2008a, 2008b, 2011). Wildlife baseline studies were conducted in 2007 directly within and surrounding the Back River Project area by Gartner Lee Limited, and included surveys for ungulates, carnivores dens, raptors, and upland breeding birds (Gartner Lee Ltd. 2008). Where feasible, the results of these studies are integrated into the current report.

3. Study Areas

3. Study Areas

There are four wildlife study areas that were developed to direct wildlife baseline studies for the Back River Project in 2011. Three of these, the Local Study Area (LSA), Reference Area (RA), and Raptor and Carnivore Study Area (RCSA) encompass the terrestrial area surrounding the Goose Lake property area (Figure 3-1). The LSA measures 16 km by 16 km (256 km^2) and is roughly centered over the Goose Lake Camp. The RA also measures 16 km by 16 km and was placed within a different watershed adjacent to the LSA to facilitate the future comparison of potential effects on wildlife between the LSA and RA. Upland breeding bird and waterbird surveys were conducted in the LSA and RA. The RCSA, extending 35 km from the Goose Lake Camp, was delineated to reflect a larger area anticipated to provide habitat for raptors and carnivores, which have large home ranges. Raptor and carnivore den surveys were conducted within the RCSA.

The fourth study area is the Bathurst Inlet Marine Regional Study Area (MRSA), which encompasses the marine area where a potential barge or port site could be located and the associated shipping route within Bathurst Inlet (Figure 3-2). The study area extends from the bottom of the inlet to approximately 175 km north to Umingmaktok and is approximately 70 km in width to include all marine areas within the lower portion of Bathurst Inlet. Marine bird surveys were conducted within the MRSA.

The wildlife study areas are all located within the Southern Arctic Ecozone. Ecozones are broad scale landscape units with similar abiotic and biotic factors including climate, geography, and vegetation (Strong and Zoltai 1989; Environment Canada 2000). The Southern Arctic Ecozone extends across much of the southern portion of continental Nunavut, and is bordered by the Northern Arctic Ecozone to the north. The southern border of the Southern Arctic Ecozone is defined by a lack of full-size trees. Stunted forms of tree species, such as dwarf birch (*Betula nana*), green alder (*Alnus viridis* spp. *crispa*), and many species of willow (*Salix* sp.) grow throughout the ecozone, with stunted white (*Picea glauca*) and black spruce (*P. mariana*) present more towards the south. Much of the area is dominated by sedge fens, cottongrass tussock tundra, and heath. Sparsely vegetated areas, such as the wind-swept crests of eskers, are also common (NRC 2007).

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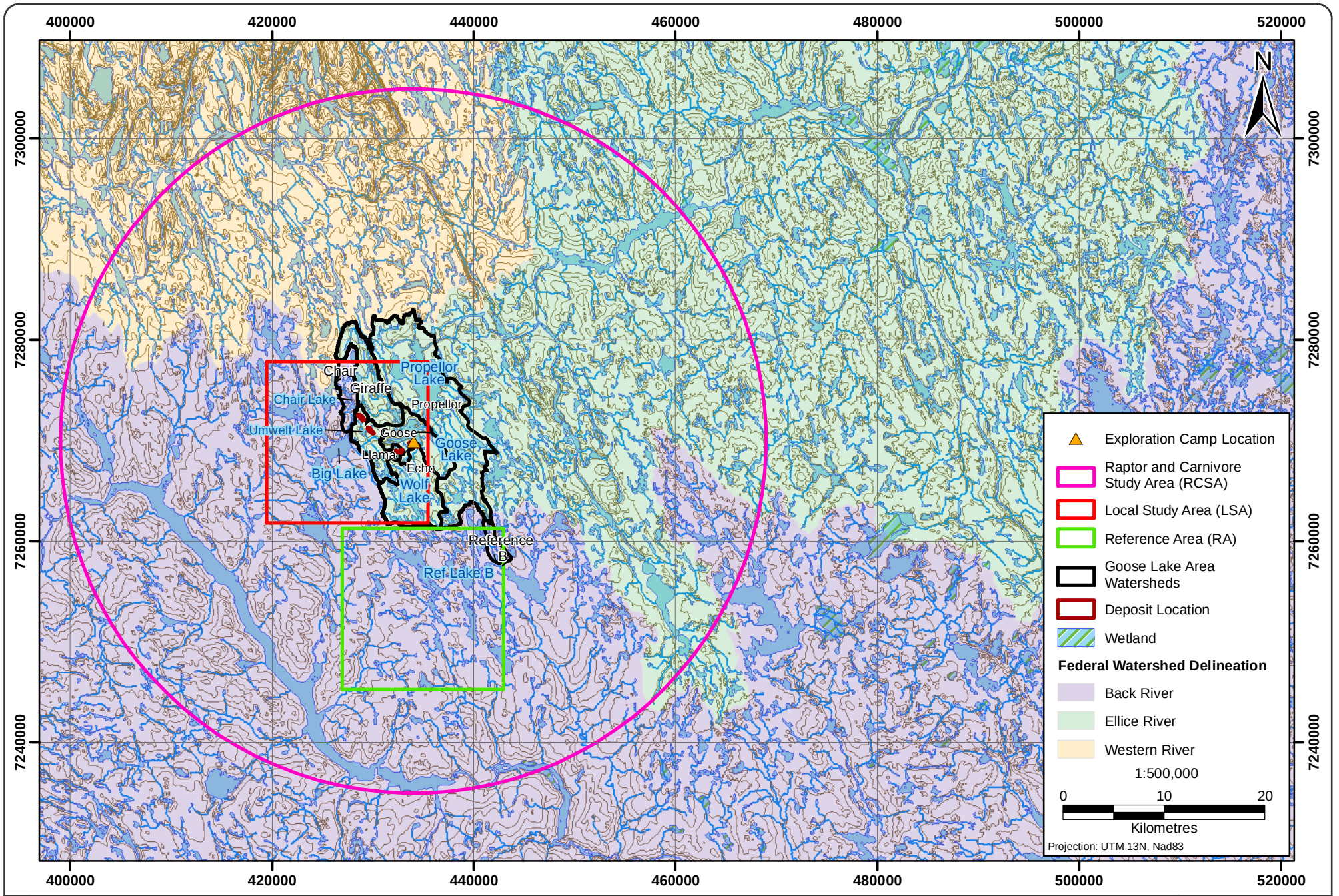

Figure 3-1

Sabina Gold & Silver Corp.

Back River Terrestrial Wildlife Study Areas, 2011

Figure 3-1

Rescan™ Engineers & Scientists

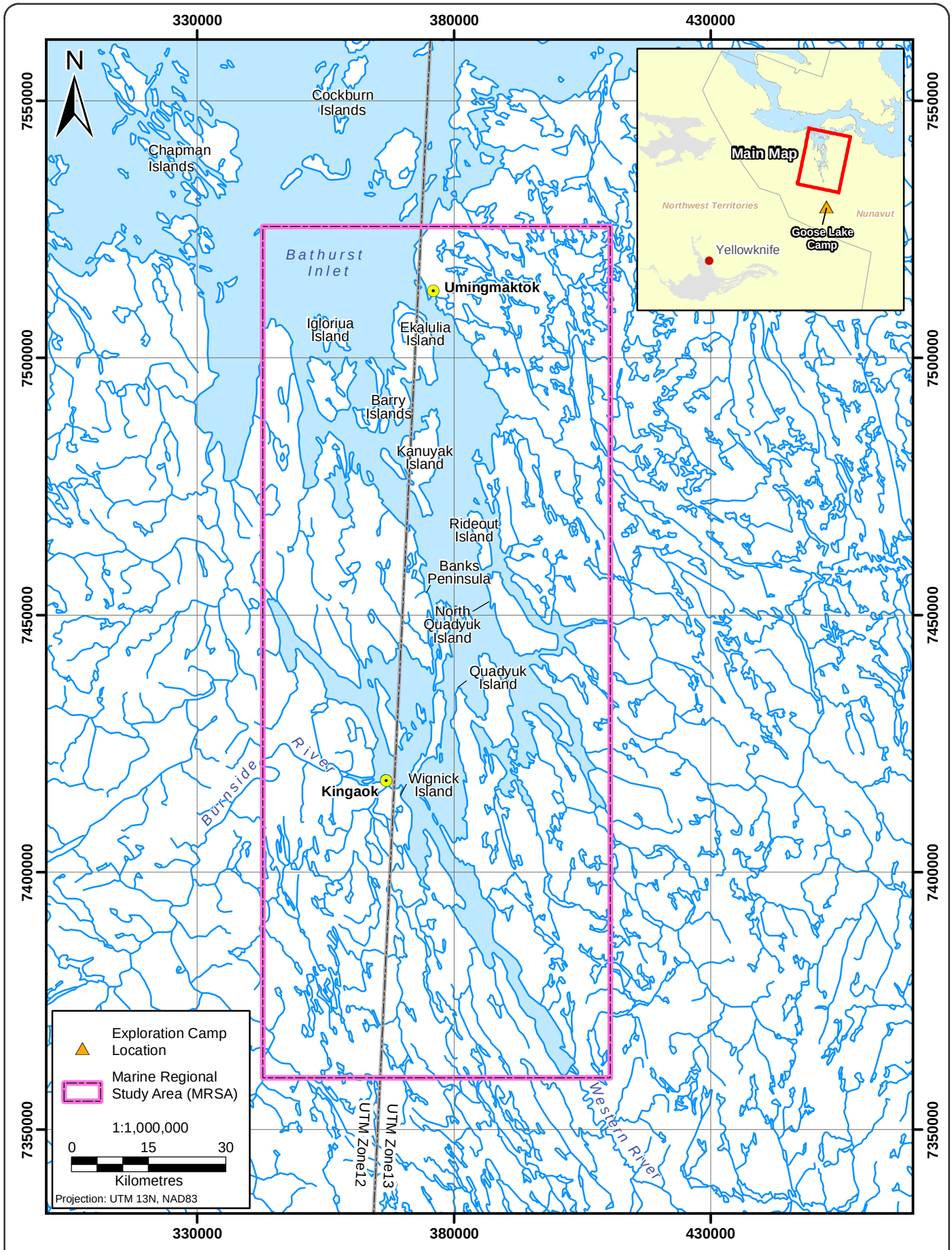

Figure 3-2

Back River Regional Marine Wildlife Study Area, 2011

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4. Species of Conservation Concern

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4. Species of Conservation Concern

A desk-based literature and database search was conducted to develop a list of wildlife species of conservation concern that potentially occur within the RCSA and MSA. The likelihood of occurrence was based on distribution and habitat requirements according to multiple sources (Sibley 2000; National Geographic Society 2002; Alderfer 2006; F. A. Reid 2006; Richards and White 2008; NatureServe 2011a). The likelihood of occurrence was placed into three categories of each potentially occurring species: likely, possible, and unlikely (Table 4-1).

Table 4-1. Criteria for Assessing the Likelihood of Occurrence in the Wildlife Study Areas

Category	Definition and Criteria for Assessment[1]
Likely (L)	Species that are likely to occur. Species in the category have overlapping seasonal ranges with the RCSA and/or MSA, are known to occur in the Southern Arctic Ecozone, and seasonal habitat requirements are met within the RCSA and/or MSA.
Possible (P)	Species that possibly occur. Species in this category may or may not have overlapping seasonal ranges with the RCSA and/or MSA, seasonal habitat requirements may or may not be met within the either study area, but have been detected in Southern Arctic Ecozone or within two ecozones to the north of the in Southern Arctic Ecozone (Northern Arctic, Arctic Ocean). Many migratory bird species can be placed in this category as species are expected to pass over or near the RCSA and/or MSA during spring and fall migrations, and as such, their presence would be possible but infrequent. In addition, species where the northern edge of their range overlaps within the Southern Arctic Ecozone are placed in this category as their presence would also be possible but infrequent.
Unlikely (U)	Species that are unlikely to occur. Species in this category have seasonal ranges that occur near the RCSA and/or MSA (within 150 km) and may or may not have been detected in either the Southern Arctic, Northern Arctic, or Arctic Ocean ecozones. However, seasonal habitat requirements are not met within the RCSA and/or MSA. Species with low population sizes are also placed in this category.

[1] *Likelihood that species occur in the region was based upon range maps and ecological information according to various sources (Sibley 2000; National Geographic Society 2002; Alderfer 2006; F. A. Reid 2006; Richards and White 2008; NatureServe 2011a).*

The conservation status of potentially occurring wildlife species was assessed according to territorial (Canadian Endangered Species Conservation Council; CESCC), federal (Committee on the Status of Endangered Wildlife in Canada [COSEWIC]; *Species at Risk Act*), and international (NatureServe; International Union for Conservation of Nature [IUCN]) assessment bodies (Tables 4-2 to 4-4). Nunavut currently does not have a species ranking program administered by the NWMB, and thus the CESCC designations for Nunavut were used to assess the status of wildlife in the territory (CESCC 2010). Species of conservation concern include species or populations that are 1) territorially ranked as At Risk, May Be At Risk, or Sensitive, 2) classified as Endangered, Threatened, or Special Concern, as designated by COSEWIC, 3) on Schedule 1 of *SARA*, 4) globally ranked as Imperilled or Vulnerable by NatureServe, or 5) listed as Critically Endangered, Endangered, Vulnerable, or Near Threatened by IUCN.

A total of 108 birds and 44 mammals potentially occur within the RCSA and/or MSA (Appendix 4-1). Of these species, 49 (37 birds and 12 mammals) are identified as species of conservation concern (Table 4-5). Overall, 35 species of conservation concern were considered likely occurring or possibly occurring within the study areas.

Table 4-2. CESCC Conservation Statuses and Definitions (for Nunavut)

Rank	General Status	Definition
0.2	Extinct	Species that are extirpated worldwide (i.e., they no longer exist anywhere).
0.1	Extirpated	Species that are no longer present in a given geographic area, but occur in other areas.
1	At Risk	Species for which a formal assessment (i.e., COSEWIC, Nunavut assessment body) has been completed and that were determined to be at risk of extirpation or extinction.
2	May Be At Risk	Species that may be at risk of extirpation or extinction and are therefore candidates for a detailed risk assessment by COSEWIC or the Nunavut assessment body.
3	Sensitive	Species that are not believed to be at risk of immediate extirpation or extinction but may require special attention or protection to prevent them from becoming at risk.
4	Secure	Species that are not believed to belong in the categories Extinct, Extirpated, At Risk, May Be At Risk, Sensitive, Accidental or Exotic.
5	Undetermined	Species for which insufficient data, information, or knowledge is available with which to reliably evaluate their general status.
6	Not accessed	Species that are known or believed to be present regularly in the geographic area in Canada to which the rank applies, but have not yet been assessed by the general status program.
7	Exotic	Species that have been moved beyond their natural range as a result of human activity.
8	Accidental/Vagrant	Species occurring infrequently and unpredictably, outside their usual range.

Source: CESCC (2011).

Table 4-3. Federal Conservation Statuses and Definitions

COSEWIC		
Status		**Definition**
E:	Endangered	A species facing imminent extirpation or extinction
T:	Threatened	A species that is likely to become endangered if limiting factors are not reversed
SC:	Special Concern	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events
NAR:	Not at Risk	A species that has been evaluated and found not to be at risk
DD:	Data Deficient	A species for which there is insufficient scientific information to support status designation
SARA		
Schedule		**Definition**
1:		Protected under SARA as of proclamation in June 2003. These species were assessed by COSEWIC using the revised assessment criteria. The list classifies the species as either being extirpated, endangered, threatened, or a special concern.
2 and 3:		Assessed prior to October 1999 and require re-assessment using the revised criteria, after which the Governor in Council may, on the recommendation of the Minister, add the species to the Federal List of Wildlife Species at Risk.

Source: COSEWIC (2010); Government of Canada (2010a).

Table 4-4. International Conservation Statuses and Definitions

NatureServe (global rank)		
Rank		**Definition**
G#G#:	Range Rank	A numeric range rank (e.g., G2G3) is used to indicate the range of uncertainty about the status of the species or community
G2:	Imperilled	At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors
G3:	Vulnerable	At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors
G4:	Apparently Secure	Uncommon but not rare; some cause for long-term concern due to declines or other factors
G5:	Secure	Common; widespread, and abundant
T:	Infraspecific Taxon (trinomial)	The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank; e.g., the global rank of a critically imperilled subspecies of an otherwise widespread and common species would be G5T1
IUCN		
Category		**Definition**
EX:	Extinct	Species where there is no reasonable doubt that the last individual has died
EW:	Extinct in the Wild	Species only known to survive in cultivation, in captivity, or as a naturalized population (or populations) well outside the past range
CR:	Critically Endangered	Species considered to be facing an extremely high risk of extinction in the wild, with high population declines over the last 10 years and extremely small ranges and population size
EN:	Endangered	Species considered to be facing an extremely high risk of extinction in the wild, with moderate to high population declines over the last 10 years and small ranges and population size
VU:	Vulnerable	Species considered to be facing an extremely high risk of extinction in the wild, with moderate population declines over the last 10 years and small to moderate ranges and population size
NT:	Near Threatened	Species that has been evaluated and does not currently qualify for Critically Endangered, Endangered, or Vulnerable categories, but is close to qualifying for or is likely to qualify for a threatened category (CR, EN, or VU) in the near future
LC:	Least Concern	Species that has been evaluated and does not qualify for any of the above categories and is widespread and abundant
DD:	Data Deficient	Species for which there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status
NE:	Not Evaluated	Species that has not yet been evaluated against the IUCN criteria

Source: IUCN (2001); NatureServe (2011b).

Table 4-5. Potentially Occurring Wildlife Species of Conservation Concern

Common Name	Scientific Name	Conservation Status[1]					Likelihood of Occurrence[2]	Detected during Baseline Studies
		NU Status	COSEWIC	SARA	Global Rank	IUCN Red List		
Birds								
American golden-plover	*Pluvialis dominica*	Sensitive			G5	Least Concern	L	Y
American pipit	*Anthus rubescens*	Sensitive			G5	Least Concern	L	Y
American tree sparrow	*Spizella arborea*	Sensitive			G5	Least Concern	L	Y
Arctic tern	*Sterna paradisaea*	Sensitive			G5	Least Concern	L	Y
Black-bellied plover	*Pluvialis squatarola*	Sensitive			G5	Least Concern	P	N
Buff-breasted sandpiper	*Tryngites subruficollis*	Sensitive			G4	Near threatened	P	N
Common eider*	*Somateria mollissima*	Sensitive			G5	Least Concern	L	Y
Dovekie*	*Alle alle*	Sensitive			G5	Least Concern	U	N
Dunlin	*Calidris alpina*	Sensitive			G5	Least Concern	P	Y
Eskimo curlew	*Numenius borealis*	At Risk	EN	1	GH	Critically endangered	U	N
Glaucous gull*	*Larus hyperboreus*	Sensitive			G5	Least Concern	L	Y
Golden eagle	*Aquila chrysaetos*	Sensitive	NAR		G5	Least Concern	L	Y
Gyrfalcon	*Falco rusticolus*	Sensitive	NAR		G5	Least Concern	L	Y
Harris's sparrow	*Zonotrichia querula*	Sensitive			G5	Least Concern	L	N
Hoary redpoll	*Carduelis hornemanni*	Sensitive			G5	Least Concern	L	Y
Horned grebe	*Podiceps auritus*	Undetermined	SC		G5	Least Concern	P	N
Ivory gull*	*Pagophila eburnea*	At Risk	EN	1	G5	Near threatened	U	N
King eider*	*Somateria spectabilis*	Sensitive			G5	Least Concern	L	N
Least sandpiper	*Calidris minutilla*	Sensitive			G5	Least Concern	L	Y
Long-tailed duck	*Clangula hyemalis*	Sensitive			G5	Least Concern	L	Y
Northern fulmar*	*Fulmarus glacialis*	Sensitive			G5	Least Concern	U	N
Northern wheatear	*Oenanthe oenanthe*	Sensitive			G5	Least Concern	U	N
Peregrine falcon	*Falco peregrinus*	Secure	TH/SC	1/3	G4	Least Concern	L	Y
Red knot	*Calidris canutus*	At Risk	EN/SC		G4	Least Concern	P	N
Red-necked phalarope	*Phalaropus lobatus*	Sensitive			G4G5	Least Concern	L	Y
Red phalarope	*Phalaropus fulicaria*	Sensitive			G5	Least Concern	P	N

(continued)

Table 4-5. Potentially Occurring Wildlife Species of Conservation Concern (completed)

Common Name	Scientific Name	Conservation Status[1]					Likelihood of Occurrence[2]	Detected during Baseline Studies
		NU Status	COSEWIC	SARA	Global Rank	IUCN Red List		
Ross's gull*	*Rhodostethia rosea*	At Risk	TH	1	G3G4	Least Concern	U	N
Rough-legged hawk	*Buteo lagopus*	Sensitive	NAR		G5	Least Concern	L	Y
Ruddy turnstone	*Arenaria interpres*	Sensitive			G5	Least Concern	P	N
Rusty blackbird	*Euphagus carolinus*	Undetermined	SC	1	G4	Least Concern	U	N
Sanderling	*Calidris alba*	Sensitive			G5	Least Concern	P	N
Semipalmated sandpiper	*Calidris pusilla*	Sensitive			G5	Least Concern	L	Y
Short-eared owl	*Asio flammeus*	Sensitive	SC	3	G5	Least Concern	L	Y
Snow bunting	*Plectrophenax nivalis*	Sensitive			G5	Least Concern	L	N
Thayer's gull*	*Larus thayeri*	Sensitive			G5	Least Concern	P	N
Whimbrel	*Numenius phaeopus*	Sensitive			G5	Least Concern	P	N
White-crowned sparrow	*Zonotrichia leucophrys*	Sensitive			G5	Least Concern	L	Y
Mammals								
Beluga*	*Delphinapterus leucas*	Sensitive/Secure			G4	Vulnerable	P	N
Bowhead whale*	*Balaena mysticetus*	Sensitive	SC	1/2	G3TNR	Least Concern	U	N
Dolphin Union caribou*	*Rangifer tarandus groenlandicus*	not ranked	SC		G5TNR	not ranked	P	N
Grizzly bear	*Ursus arctos*	Sensitive	SC		G4	Least Concern	L	Y
Little brown myotis	*Myotis lucifugus*	Sensitive			G5	Least Concern	U	N
Narwhal*	*Monodon monoceros*	Sensitive	SC		G4	Data Deficient	P	N
North American River Otter	*Lontra canadensis*	Sensitive			G5	Least Concern	U	N
Peary caribou*	*Rangifer tarandus pearyi*	not ranked	EN	1	G5TNR	Endangered	U	N
Polar bear*	*Ursus maritimus*	Sensitive	SC	1	G3	Vulnerable	U	N
Snowshoe hare	*Lepus americanus*	Sensitive			G5	Least Concern	U	N
Walrus*	*Odobenus rosmarus*	Sensitive	SC		G4TNR	Least Concern	U	N
Wolverine	*Gulo gulo*	Secure	SC		G4	Vulnerable	L	N

[1] *See Tables 4-2 to 4-4 for Conservation Status definitions.*
[2] *See Table 4-1 for Likelihood of Occurrence definition.*
* *Species that only have the potential to occur within marine areas in Bathurst Inlet and the Arctic ocean.*

5. Upland Breeding Birds

5. Upland Breeding Birds

5.1 INTRODUCTION

The tundra of Nunavut supports many upland breeding birds (i.e., ground-nesting species such as ptarmigan, shorebirds, and passerines). Many animals rely on birds as a food source; therefore, monitoring and understanding bird populations are important aspects of monitoring ecosystem health. For the purposes of this report, upland breeding birds include ptarmigan, shorebirds, and songbirds (passerines, except common raven, which is included in the raptor section). In addition, short-eared owls (*Asio flammeus*) are included here as they are ground-nesting species and their nests are most likely to be found during upland breeding bird surveys.

There are a total of 24 species that may breed within the LSA and RA (i.e., those that are likely to occur; Appendix 4-1). Generally, the breeding season for upland breeding birds in Nunavut begins in June and ends in July. Upland breeding bird nests are normally well hidden in tussocks or camouflaged on the tundra. They can be difficult to locate but territoriality (e.g., singing males or distraction displays) allows for the identification of probable nest locations.

5.2 OBJECTIVES

Baseline studies were designed to investigate the upland breeding bird community within the LSA and the RA. Specifically, the study objectives were to:

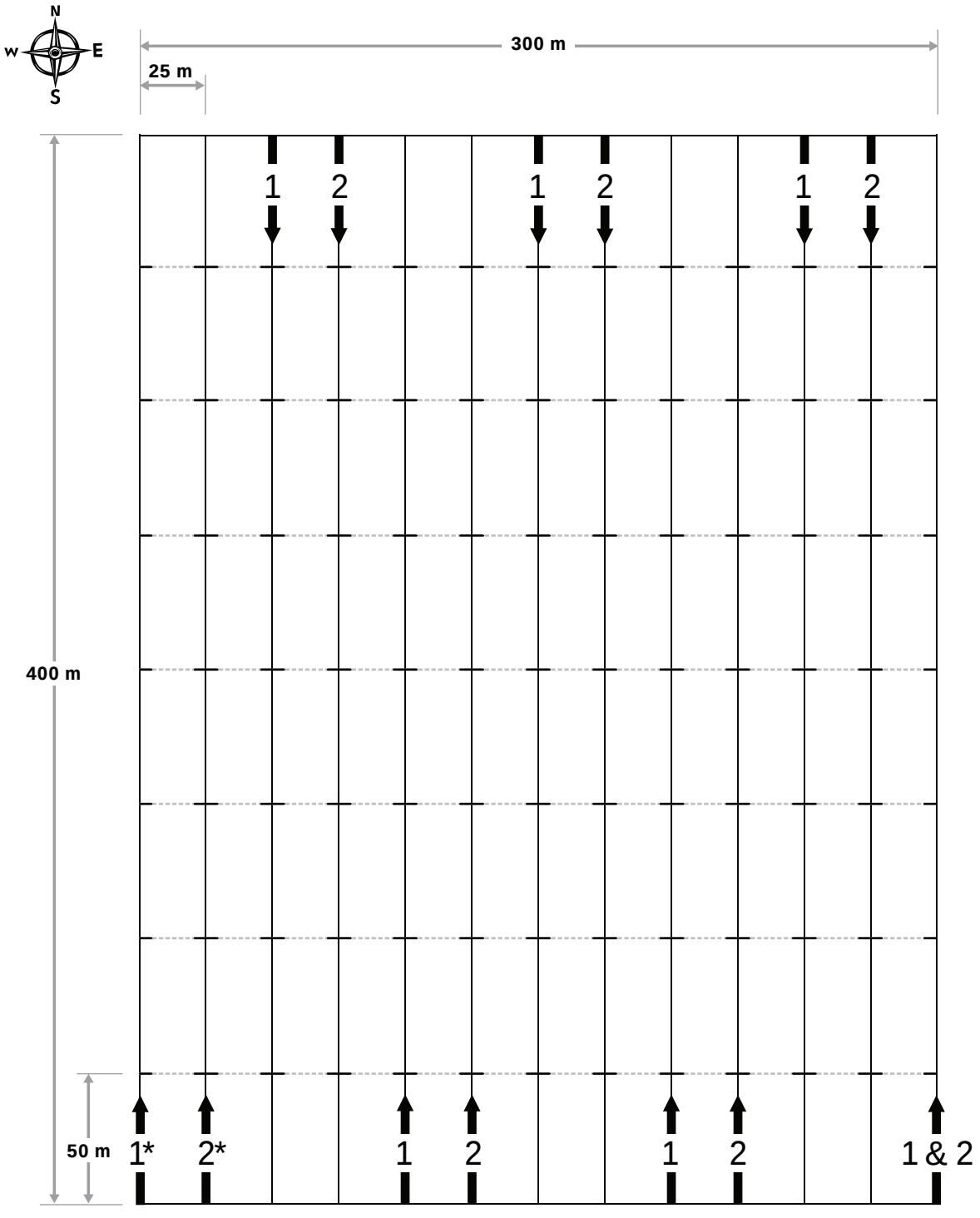
- characterize the relative abundance and distribution of upland breeding birds in the study areas;
- establish baseline information on the density of upland breeding birds within dominant habitat types; and
- identify species of conservation concern in the area.

5.3 METHODS

5.3.1 PRISM Surveys

Surveys for upland breeding birds were conducted using standard inventory methods for upland breeding birds in tundra or grassland habitats (Ralph et al. 1993; Environment Canada 2004). The Program for Regional and International Shorebird Monitoring (PRISM) methodology was used to survey upland breeding birds ("shorebird rapid surveys"; Skagen et al. 2003). One hundred PRISM survey locations were delineated at random using GIS maps of the area before arriving at Back River. Prior to beginning the surveys, 30 of the 100 locations were selected to ensure a diversity of habitat types were included within survey boundaries; locations that appeared to have >20% of the survey area in water were omitted.

Surveyed areas (referred to as PRISM plots) were 400 x 300 m (12 ha) in size and were surveyed simultaneously by two observers with binoculars. Beginning in the southwest corner of each plot, observers slowly walked back and forth along six paired 400 m transects spaced 25 m apart; the last transect line was walked by both observers (Figure 5.3-1). All upland breeding birds observed on the ground or flushed within 12.5 m on either side of each transect line were noted. A detailed map of the plot was drawn showing the location of each bird observed; all birds observed flying into the plot and landing, and flying over the plot were also included on the map. One observer characterized and mapped the major habitat types and prominent habitat features within each plot.



** observers*

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Schematic of PRISM Plot and Survey Methodology

Figure 5.3-1

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For all upland breeding birds observed, the observers recorded the species and sex (wherever possible) with particular emphasis on recording male/female pairs. Nest searches were conducted when an individual conducted a distraction display (i.e., a behaviour performed by birds to draw attention of predators away from their nest and young). When a nest was found, the species and nest contents (number of eggs and/or chicks) and the location (UTMs) were recorded using a handheld Garmin GPS Map60CS. If obvious nesting behaviour was noted but no nest was found, the location was recorded as a probable nest.

Surveys were conducted in the early morning, when possible. Weather (wind speed and direction, temperature, and cloud cover) was recorded at every plot; surveys were not conducted during periods of heavy rain and/or strong wind (>30 km/h).

5.3.2 Data Analysis

To summarize species observations and habitat associations, upland breeding birds were categorized into bird groups (ptarmigan, shorebirds, songbirds, and owls) because of shared life and habitat requirements. Density was calculated as the total number of birds per km^2 and is presented as the mean of all plots within each study area (LSA and RA) ± 95% Confidence Interval (CI).

To assess differences in upland breeding bird habitat preference, an analysis of variance (ANOVA) was performed in SAS 9.2 (PROC GLM; SAS Institute) with the null hypothesis that no differences in habitat preference occurred. As hoary and common redpolls are difficult to differentiate, these species were grouped together as redpolls. Dunlin, stilt sandpiper, unknown sandpiper, American pipit, and short-eared owl were omitted from the analysis because of small sample sizes (less than three sightings).

To compare diversity of upland breeding bird communities among the LSA, RA, and the study area as a whole, Shannon's diversity (H) was calculated using the equation:

$$H = -\sum_{i=1}^{s} p_i \ln p_i \qquad \text{Or} \qquad H' = -\sum_{i=1}^{s} \frac{n_i}{N} \ln \frac{n_i}{N}$$

where S is the total number of species in a community (species richness) and p_i is the relative abundance of each species, calculated as the proportion of individuals of a given species (n_i) to the total number of individuals in the community (N).

To provide information on community equity, Shannon's equitability (E_H) was calculated using the following equation:

$$E_H = \frac{H'}{H_{\max}} = \frac{H'}{\ln S}$$

Equitability assumes a value between 0 and 1, with 1 being complete evenness (i.e., roughly equivalent numbers of birds belonging to each species recorded). H and E_H were calculated for each PRISM plot and data was summarized as the mean of S, H, and E_H for the LSA and RA with 95% CI.

To assess differences in diversity and equitability of upland breeding birds between the LSA and RA, a multivariate analysis of variance (MANOVA) was performed in SAS 9.2 (PROC GLM; SAS Institute) with the null hypothesis that no differences in species richness, diversity, and equitability were observed.

5.4 RESULTS

Thirty PRISM plots were surveyed from June 24 to July 3, 2011; 15 plots were within the LSA and 15 within the RA (Figure 5.4-1). Each plot took an average of 1.5 hours to survey (Appendix 5.4-1).

In total, 16 upland breeding bird species and 514 individual birds were recorded, including one short-eared owl (Table 5.4-1; Appendix 5.4-2). Overall, Lapland longspurs and savannah sparrows were the most abundant species observed, comprising 54% and 17% of observations, respectively. Redpolls and horned larks were the next most abundant species (9% and 6%, respectively). Only 6% (N = 33) of all upland breeding birds observed were shorebirds.

Of the 16 species observed, nine are listed as Sensitive in Nunavut by the CESCC (CESCC 2010): American pipit, American golden-plover, American tree sparrow, dunlin, hoary redpoll, least sandpiper, red-necked phalarope, semipalmated sandpiper, and short-eared owl (Figure 5.4-2). The short-eared owl is also federally listed on Schedule 3 as Special Concern under the *SARA* (Government of Canada 2010b).

Table 5.4-1. Summary of Upland Breeding Bird Species Observed, 2011

Group	Species	Scientific Name	No. Observed		Total Observed
			LSA	RA	
Ptarmigan	Rock ptarmigan	*Lagopus mutus*	7	4	11
	Willow ptarmigan	*Lagopus lagopus*	18	3	21
	Total Ptarmigan		**25**	**7**	**32**
Shorebird	American golden plover	*Pluvialis dominica*	3	10	13
	Dunlin	*Calidris alpine*	0	1	1
	Least sandpiper	*Calidris minutilla*	5	1	6
	Red-necked phalarope	*Phalaropus lobatus*	0	3	3
	Semipalmated sandpiper	*Calidris pusilla*	3	4	7
	Stilt sandpiper	*Calidris himantopus*	0	2	2
	Unknown sandpiper		1	0	1
	Total Shorebird		**12**	**21**	**33**
Songbird	American pipit	*Anthus rubescens*	1	0	1
	American tree sparrow	*Spizella arborea*	4	0	4
	Common redpoll	*Carduelis flammea*	10	7	17
	Hoary redpoll	*Carduelis hornemanni*	0	1	1
	Horned lark	*Eremophila alpestris*	17	15	32
	Lapland longspur	*Calcarius lapponicus*	153	127	280
	Redpoll spp.*	*Carduelis* spp.	19	7	26
	Savannah sparrow	*Passerculus sandwichensis*	42	45	87
	Total Songbird		**246**	**202**	**448**
Owl	Short-eared owl	*Asio flammeus*	1	0	1
	Total Owl		**1**	**0**	**1**
Total			**284**	**230**	**514**

** Hoary and common redpolls are difficult to differentiate between based on sound. Where the species could not be positively identified, the observers categorized these birds as redpoll spp. Both species were visually confirmed to be present.*

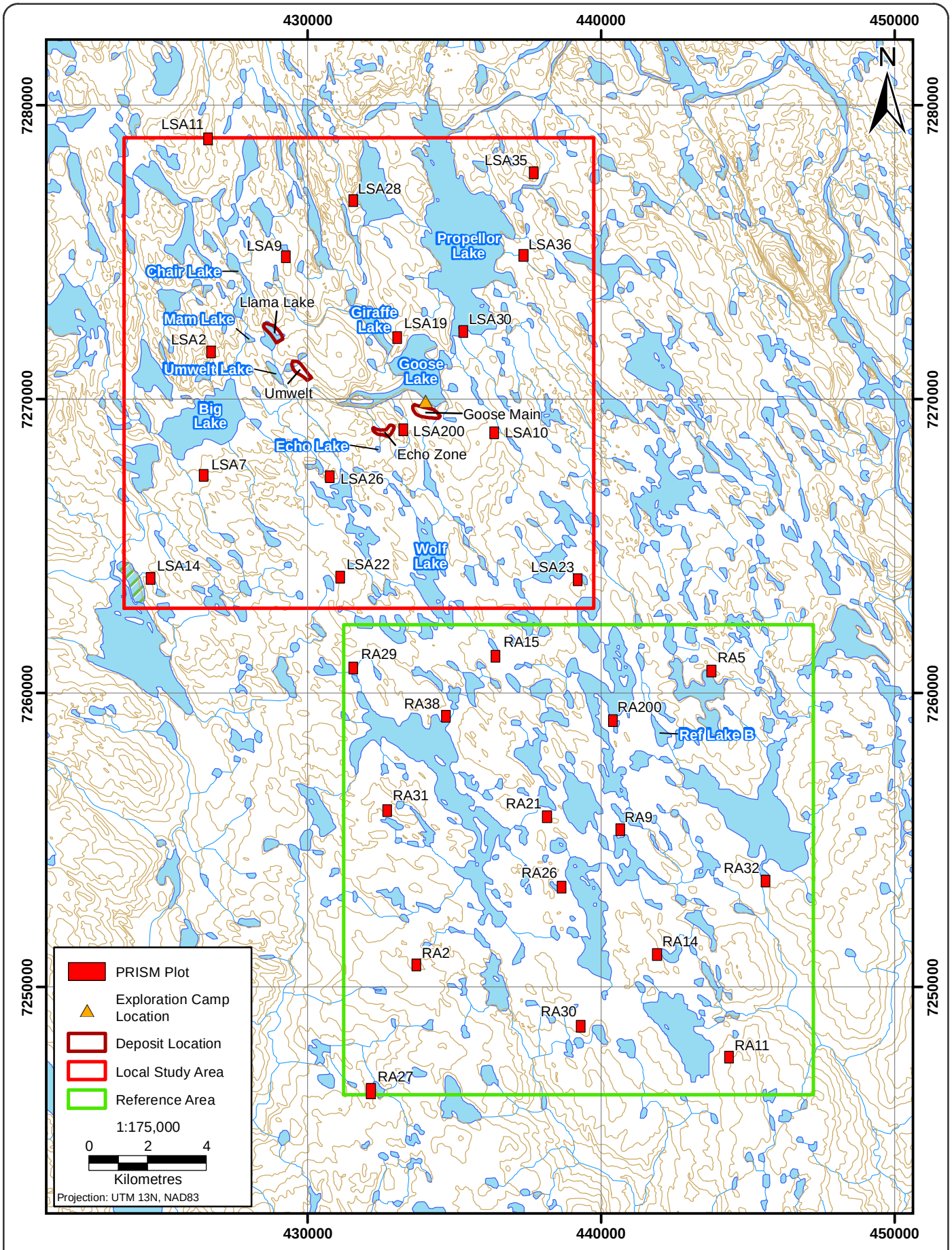

Figure 5.4-1

Location of PRISM Plots in the LSA and RA

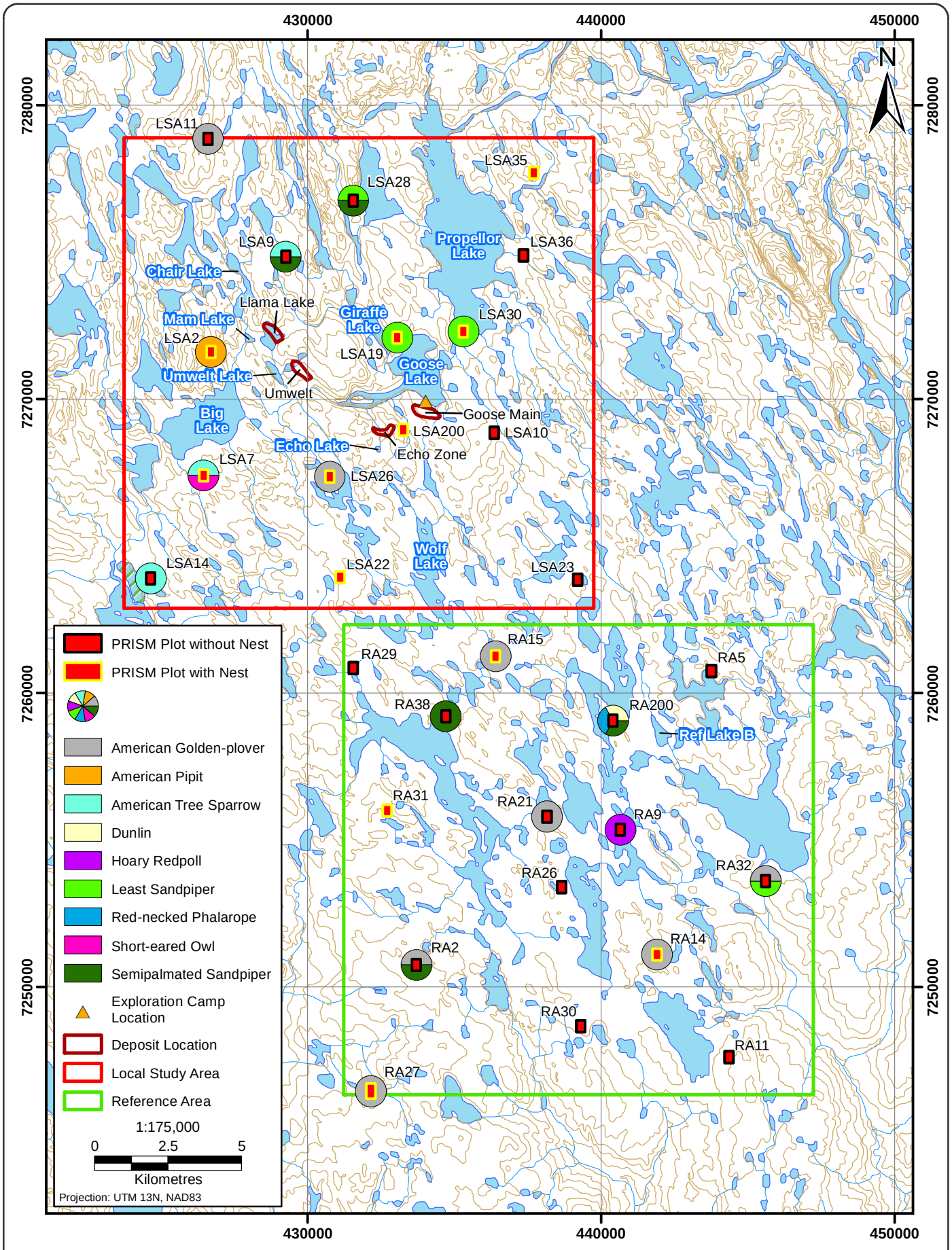

Figure 5.4-2

Distribution of PRISM Plots Containing Species of Conservation Concern and Nests, 2011

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Upland breeding bird species richness, diversity, and equitability did not differ significantly between the LSA and RA (Wilks' Δ = 0.93, $F_{3,26}$ = 0.70, p = 0.56) and on average were relatively high in both the LSA (S = 4.20 ± 0.61, H = 1.08 ± 0.18, and E_H = 0.76 ± 0.15) and RA (S = 4.00 ± 1.41, H = 1.04 ± 0.18, and E_H = 0.78 ± 0.06, Figure 5.4-3; Table 5.4-2). The total density of upland breeding birds observed in the Back River LSA was 153.89 birds/km^2 ± 31.95 and in the RA was 127.22 birds/km^2 ± 20.99.

Table 5.4-2. Species Richness (S), Shannon's Diversity (H), and Equitability (E_H) Indices for Upland Breeding Birds, 2011

PRISM Plot	S	H	E_H	PRISM Plot	S	H	E_H
LSA				***RA***			
2	5	1.50	0.94	2	6	1.66	0.92
7	3	0.97	0.89	5	4	0.73	0.53
9	5	1.26	0.78	9	4	1.21	0.87
10	2	0.47	0.67	11	3	0.97	0.89
11	6	1.43	0.80	14	5	1.33	0.83
14	5	1.45	0.90	15	2	0.53	0.76
19	3	0.68	0.62	21	6	1.63	0.91
22	5	1.04	0.64	26	3	0.79	0.72
23	4	1.24	0.90	27	6	1.22	0.68
26	5	1.41	0.88	29	3	0.85	0.78
28	5	0.97	0.60	30	3	0.79	0.72
30	4	1.08	0.78	31	3	0.68	0.62
35	2	0.27	0.39	32	3	1.04	0.95
36	4	1.25	0.90	38	3	0.76	0.69
200	5	1.20	0.74	200	6	1.46	0.82

5.4.1 Upland Breeding Bird Community Composition by Habitat Type

Observers recorded nine main habitat types within PRISM plots: boulder/bedrock, heath hummock, lichen/heath, rocky heath, short shrub, tussock grass, water, wet grass/sedge, and wetland. Of these nine habitat types, 37% of species observations occurred on lichen/heath, 26% were on heath hummock, 12% were on rocky heath, 11% were on short shrubs, and the final 14% were distributed between the remaining habitat categories (Table 5.4-3). The majority of species observed were found in heath (lichen, hummock, and rocky) at least 50% of the time (Figure 5.4-4). Statistical analysis of habitat preference among species revealed significant differences in the total number of species observed among habitat types ($F_{48,54}$= 72.08, p < 0.0001; Figure 5.4-4), supporting the observed trend that species use heath habitats more often than other habitat types.

These calculations provide a basis for comparing the differences in species composition between habitat types. However, these calculations should be interpreted with caution as PRISM plots were a mosaic of different habitat types, resulting in an uneven amount of sampling effort between habitat types. The observations of species per habitat type may be influenced by the high amount of sampling effort in heath habitats and the relatively lower sampling effort within remaining habitat types.

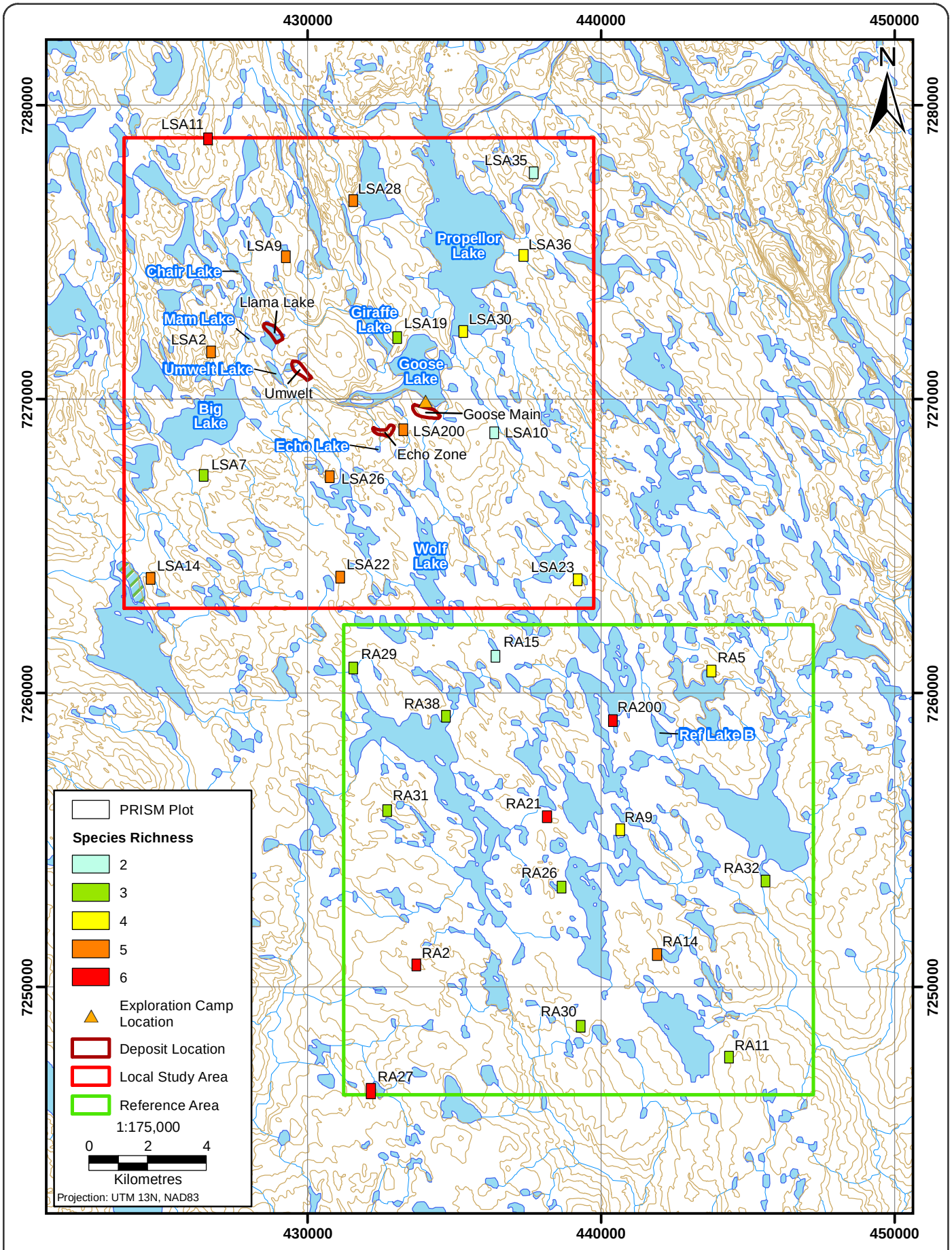

Figure 5.4-3

Species Richness recorded in PRISM Plots, 2011

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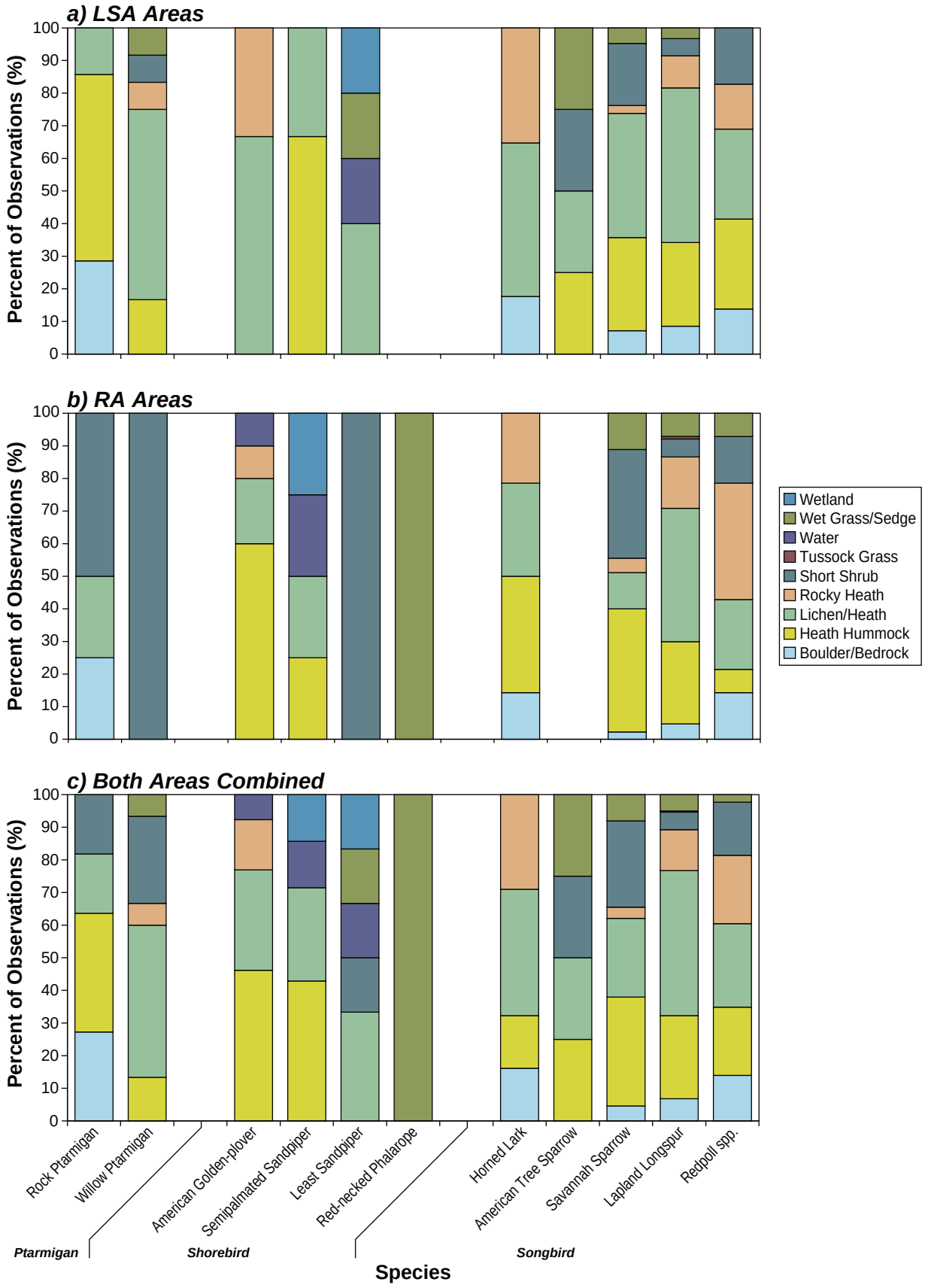

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Summary of Upland Breeding Bird Habitat Use in the LSA, RA, and Both Areas Combined, 2011

Figure 5.4-4

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Table 5.4-3. Upland Breeding Bird Habitat Use, 2011

Habitat	Ptarmigan		Shorebird		Songbird		Owl		All Species	
	No.	%	No.	%	No.	%	No.	%	No.	%
Boulder/Bedrock	3	11.5	0	0	34	7.6	0	0	**37**	**7.4**
Heath Hummock	6	23.1	9	28.1	115	25.8	0	0	**130**	**25.8**
Lichen/Heath	9	34.6	10	31.3	170	38.2	0	0	**188**	**37.4**
Rocky Heath	1	3.8	2	6.3	56	12.6	1	100	**60**	**11.9**
Short Shrub	6	23.1	2	6.3	46	10.3	0	0	**54**	**10.7**
Tussock Grass	0	0	0	0	1	0.2	0	0	**1**	**0.2**
Water	0	0	2	6.3	0	0	0	0	**2**	**0.4**
Wet Grass/Sedge	1	3.8	1	3.1	23	5.2	0	0	**25**	**5.0**
Wetland	0	0	6	18.8	0	0	0	0	**6**	**1.2**
Total	**26**		**32**		**445**		**1**		**503**	

5.4.2 Evidence of Breeding

Within the 30 PRISM plots surveyed, 12 nests were found, nine of which were in the LSA and three in the RA (Figure 5.4-2). Nests belonged to six different species: American golden plover, common redpoll, Lapland longspur, rock ptarmigan, savannah sparrow, and short-eared owl (Plate 5.4-1). Similar to the abundance data, most of the nests found were Lapland longspur (58%; Table 5.4-4). Furthermore, most nests were found in heath habitat (lichen, hummock, and rocky) except the common redpoll nest, which was observed in short shrubs (Appendix 5.4-2). Other indications of breeding behaviour were observed during the PRISM plot surveys, including 47 pairs (24 of which were Lapland longspur), five probable nests (indicated by territorial behaviour of an adult), and one willow ptarmigan female with six chicks (Table 5.4-4).

Table 5.4-4. Upland Breeding Bird Breeding Behaviour Observations, 2011

Species	Behaviour			Nest Contents	
	Pairs	Probable Nests	Nests	No. Eggs	No. Chicks
American golden plover	5	2	1	5	
Common redpoll	1	1	1	5	
Hoary redpoll	6	0	0		
Lapland longspur	24	1	7	3, 3, 5	4, 3, 5, 3[c]
Rock ptarmigan	0	0	2[a]	11	
Savannah sparrow	8	0	1	5	
Short-eared owl	0	0	1	5	
Willow ptarmigan	1	0	0[b]		6
Unknown redpoll	2	1	0		

[a] *One nest was old that had potentially been depredated.*
[b] *No physical nest site was found as the chicks were mobile and had moved away from nest.*
[c] *One nest contained three hatchlings and one egg.*

Common redpoll

Savannah sparrow

Lapland longspur

Rock ptarmigan

Short-eared owl

American golden-plover

Plate 5.4-1. Nests sites recorded during PRISM surveys in 2011.

5.4.3 Incidental Observations of Upland Breeding Birds

Incidental observations of upland breeding birds were recorded outside of PRISM plots and during other baseline environmental work conducted for the Project in 2011. Similar to the PRISM plot observations, the most common species observed were Lapland longspurs, savannah sparrows, horned larks, and redpolls (Table 5.4-5, see Appendix 11.4-1). One species was observed incidentally that was not recorded inside a PRISM plot; a single white-crowned sparrow was heard outside of PRISM LSA 19 just north of the Goose Lake camp. White-crowned sparrow is listed as Sensitive in Nunavut by the CESCC (CESCC 2010).

Table 5.4-5. Incidental Upland Breeding Bird Observations, 2011

Species	Scientific Name	No. Observed		Total Observed
		LSA	RA	
American golden plover	*Pluvialis dominica*	5	3	8
American tree sparrow	*Spizella arborea*	2	4	6
Common redpoll	*Carduelis flammea*	9	0	9
Horned lark	*Eremophila alpestris*	8	1	9
Lapland longspur	*Calcarius lapponicus*	24	18	42
Least sandpiper	*Calidris minutilla*	2	0	2
Red-necked phalarope	*Phalaropus lobatus*	1	0	1
Redpoll spp.	*Carduelis* spp.	12	15	27
Rock ptarmigan	*Lagopus mutus*	2	0	2
Savannah sparrow	*Passerculus sandwichensis*	16	13	29
Semipalmated sandpiper	*Calidris pusilla*	0	3	3
Stilt sandpiper	*Calidris himantopus*	0	2	2
White crowned sparrow	*Zonotrichia leucophrys*	1	0	1
Willow ptarmigan	*Lagopus lagopus*	25	0	25
Unknown sandpiper		12	1	13
Total		**119**	**60**	**179**

5.5 DISCUSSION

Upland breeding bird surveys were conducted in 2011 to document species richness, abundance, habitat use, and breeding behaviour. Overall, 17 upland breeding bird species were observed during surveys or incidentally, the most abundant of which were Lapland longspur followed by savannah sparrow, redpoll spp., and horned lark. Species diversity and equitability were high in both the LSA and RA, suggesting a relatively even distribution of species within the two study areas.

The terrestrial habitat in the LSA and RA is relatively homogenous and dominated by heath tundra (lichen, hummock, and rocky heath). Accordingly, most of the observations of upland breeding birds were within these habitats. Many species may be present in these dominant habitat types but require habitats such as shrubs for breeding. For example, redpolls normally construct their nests in or under the branches of shrubs (Knox and Lowther 2000b, 2000a). Thus, understanding the specific nesting habitat requirements of species is as important as knowing where they frequently display or forage.

Breeding evidence (e.g., nests, territorial behaviour, and pairs) was confirmed for eight species (Table 5.4-4) and 12 nests were observed belonging to six different species: American golden plover, common redpoll, Lapland longspur, rock ptarmigan, savannah sparrow, and short-eared owl. The majority of nests (N = 9) were observed within the LSA.

Of the 17 species observed in 2011, 10 are listed as Sensitive in Nunavut. In addition, one species, short-eared owl, is of conservation concern at the federal level, listed on Schedule 3 as a population of Special Concern under the *SARA* (Government of Canada 2010b). One short-eared owl was flushed from a nest in PRISM LSA 7, south of Big Lake. Short-eared owls breed at low densities in the Arctic (except along the coastlines) and often select tundra with pockets of willow for nesting habitat (Government of Canada 2010b). Short-eared owls may also use the same nest location in consecutive years, building a new nest on top of an old one (Wiggins, Holt, and Leasure 2006).

6. Waterbirds

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6. Waterbirds

6.1 INTRODUCTION

The lakes and wetlands of Nunavut support a large number of waterbirds, some of which are summer residents and others transient migrants. The term waterfowl has been used interchangeably with waterbirds; however, waterfowl refers only to species of dabbling and diving ducks, geese, and swans in the family Anatidae. For the purposes of this report, the term "waterbird" is used as an umbrella term to encompass birds that exclusively use water habitat for foraging, breeding, or staging during the year, and includes all waterfowl, loons, grebes, jaegers, gulls, and terns.

The presence of waterbirds is an indication of the availability of functional habitat. Lakes used by different species of waterbirds during different breeding phases can represent multiple facets of site productivity providing insight into the inherent and comparative importance of each lake habitat (e.g., Nummi and Poysa 1993). In addition to hosting food species, lake attributes such as size, shape, and emergent vegetation structure and composition are important for waterbird nesting territories, transient staging, and safety from predators (Hoyer and Canfield 1994; Sovada, Anthony, and Batt 2001).

6.2 OBJECTIVES

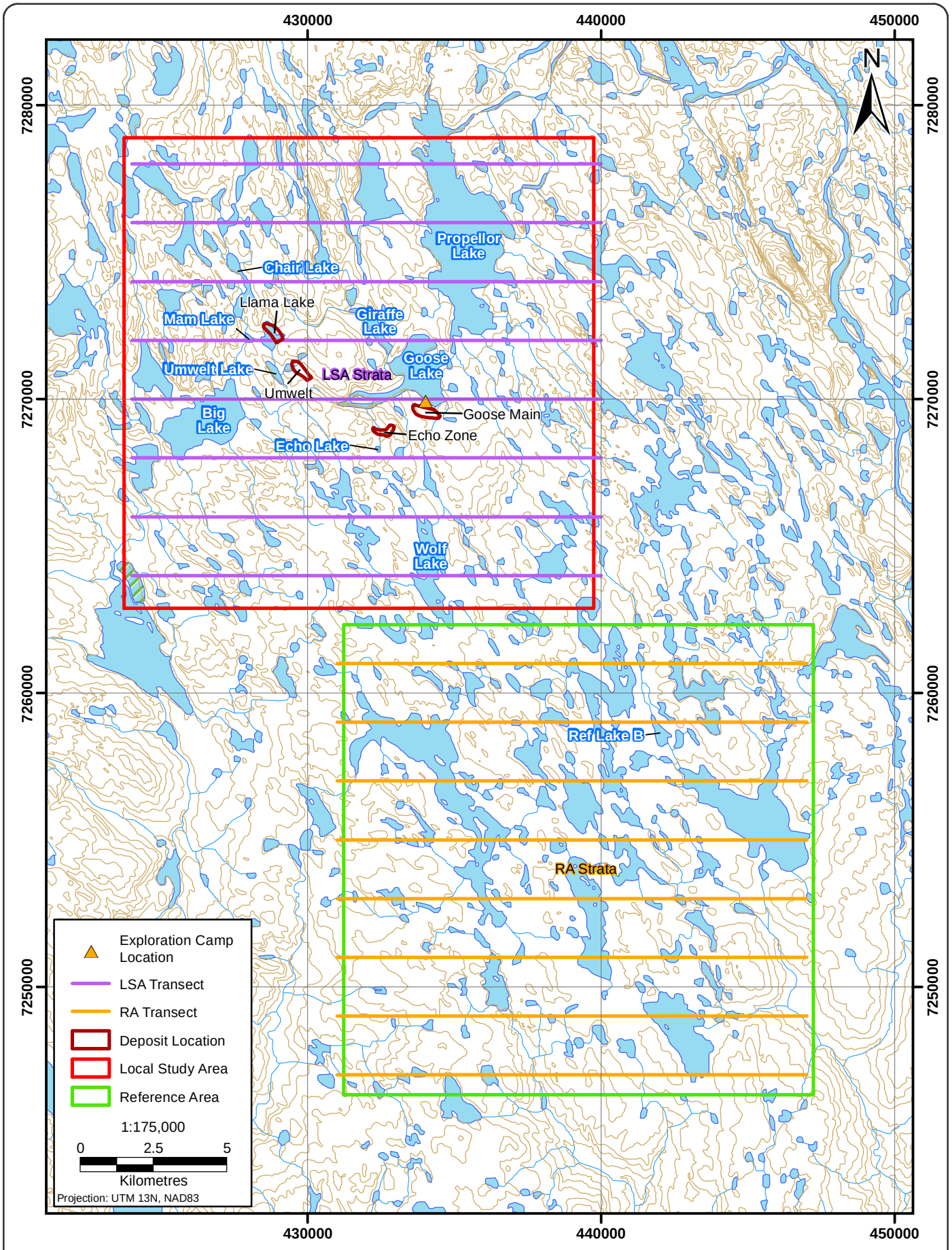
Baseline studies were designed to investigate the waterbird community within the LSA and RA. Specifically, the study objectives were to:

- provide information on waterbird abundance, richness, and habitat use in the LSA and RA;
- identify important habitats (e.g., breeding or staging sites); and
- identify species of conservation concern in the area.

6.3 METHODS

Two aerial surveys for waterbirds were conducted in 2011: one in July (early breeding survey) and the other in August (late breeding/early staging survey) to document waterbird breeding evidence, brood species and distribution, and to identify potential early staging waterbodies. Both surveys were conducted along transect lines in the LSA and RA. Each aerial survey block included eight 16 km long transects for a total transect survey distance of 128 km per block (Figure 6.3-1).

Aerial survey transects were flown by helicopter at speeds of 40 to 100 km/hour and at an altitude of approximately 30 to 50 m above the water. Two observers were present in the helicopter in addition to the pilot during the surveys. Observers searched lake surfaces and wetlands for waterbirds and/or waterbird broods. Whenever waterbirds were observed they were identified to the species level, when possible. Additionally, habitat information and coordinates of the observations were recorded using a handheld Garmin GPS Map60CS. Habitat was categorized into six types of habitat: river, wetland, creek, lake, tundra, and other. All observations of waterbird broods were recorded along with the number of young observed and the brood class (Table 6.3-1).



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Waterbird Aerial Survey Strata and Transects Lines in the LSA and RA

Figure 6.3-1

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Table 6.3-1. Brood Class Descriptions for Waterbirds

Brood Class	Description
IA	Young are covered in bright down, neck and tail not prominent; 1-7 days old
IB	Young are covered in fading down, neck and tail not prominent; 8-13 days old
IC	Young are downed-covered, but colour faded, body elongated; 14 -18 days old
IIA	First feathers appear, replacing down on sides and tail; 19-27 days old
IIB	Over half of body covered with feathers; 28-42 days old
IIC	Small amount of down remains, among feathers of back; 28 -42 days old
III	Fully feathered but incapable of flight; 43-55 days of age, flying at 56-60 days old

Source: Bellrose (1980).

6.3.1 Data Analysis

To assess differences in lake size preference, an analysis of covariance (ANCOVA) was performed in SAS 9.2 (Proc GLM, SAS Institute, Cary, NC) with the null hypothesis that waterbirds use all lake habitat with equal probability. For the purpose of analyses, species were categorized into corresponding groups (loons, geese, dabbling ducks, diving ducks, and cranes) because of shared life and habitat requirements. For the habitat analysis, observations of loons and diving ducks were grouped together as 'divers' and geese and dabbling ducks were grouped together as 'herbivores' because of low sample sizes in some of the species groups. Species diversity and equitability were calculated using Shannon's diversity (*H*) and equitability (E_H; see Section 5.3.2 for methodology).

6.4 RESULTS

Aerial surveys for waterbirds were conducted during the early breeding period on July 4 and 6, 2011, and during the late breeding/early staging period on August 6, 2011 (Appendix 6.4-1). During these two surveys, 10 waterbird species and four additional seabird species (parasitic jaeger, long-tailed jaeger, herring gull, and Arctic tern) and 1,885 individual birds were observed and identified to the species level (Table 6.4-1; Appendix 6.4-2). Unknown diving duck species (N = 17) and unknown gull species (N = 9) were also observed but not identified to the species level. The most commonly observed species was Canada goose (N = 1,732), particularly during the August survey (N = 1,107), followed by Arctic tern (N = 33), herring gull (N = 24), and long-tailed duck (N = 20). All long-tailed ducks were observed during the early breeding survey in July.

Table 6.4-1. Waterbird Species Observed during Aerial Surveys in July and August, 2011

Group	Species	Scientific Name	No. Observed		Total Observed
			July	August	
Loon	Pacific loon	*Gavia pacifica*	0	6	6
	Red-throated loon	*Gavia stellata*	1	0	1
	Total Loon		**1**	**6**	**7**
Goose	Canada goose	*Branta canadensis*	625	1,107	1,732
	Greater white-fronted goose	*Anser albifrons*	12	5	17
	Total Goose		**637**	**1,112**	**1,749**
Dabbling Duck	Gadwall	*Anas strepera*	3	0	3
	Northern pintail	*Anas acuta*	4	10	14
	Total Dabbling Duck		**7**	**10**	**17**

(continued)

Table 6.4-1. Waterbird Species Observed during Aerial Surveys in July and August, 2011 (completed)

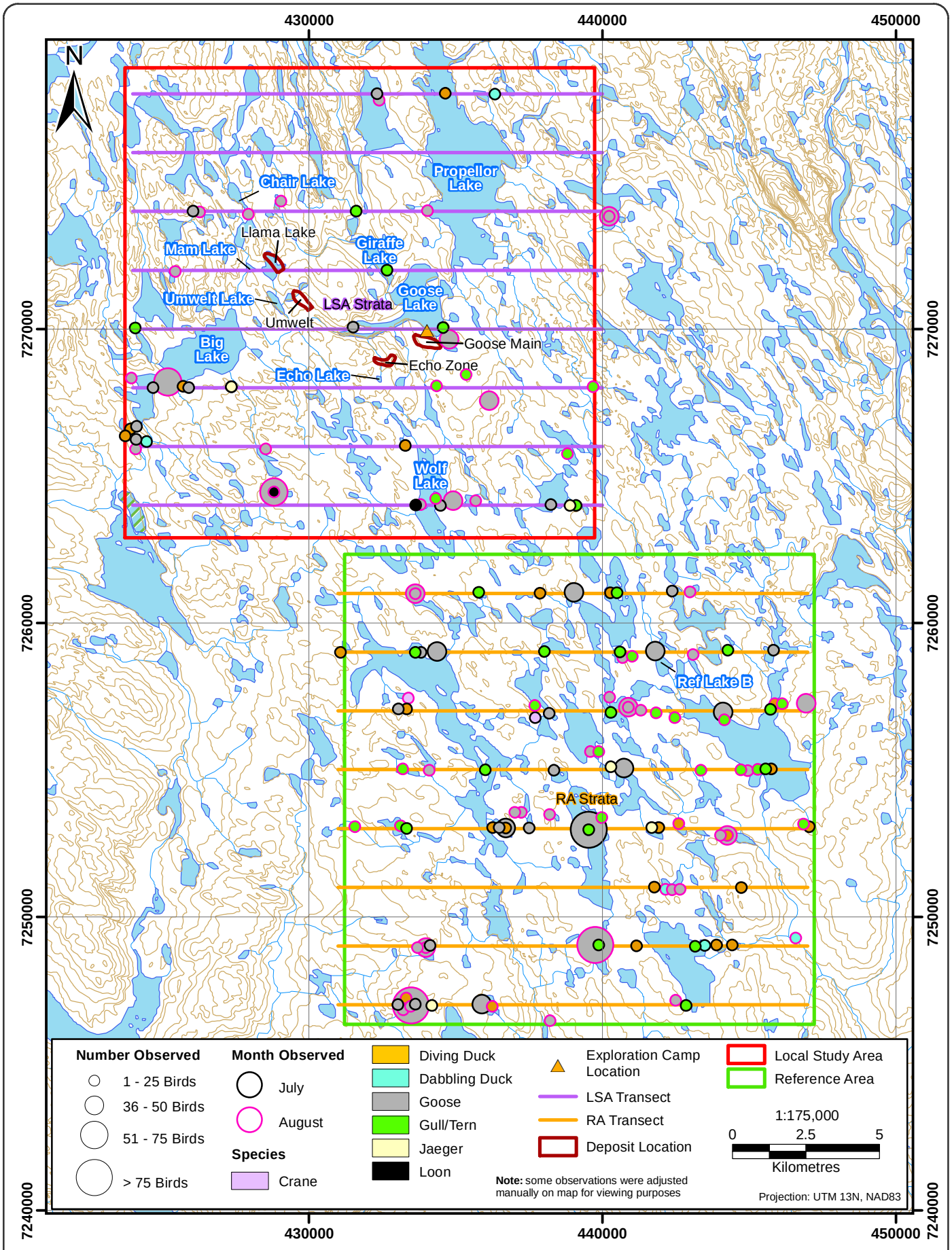
Group	Species	Scientific Name	No. Observed		Total Observed
			July	August	
Diving Duck	Greater scaup	*Aythya fuligula*	10	0	10
	Long-tailed duck	*Clangula hyemalis*	20	0	20
	Red-breasted merganser	*Mergus serrator*	11	3	14
	Unknown diving duck		0	17	17
	Total Diving Duck		**41**	**20**	**61**
Crane	Sandhill crane	*Grus canadensis*	2	3	5
	Total Crane		**2**	**3**	**5**
Jaeger	Long-tailed jaeger	*Stercorarius longicaudus*	1	0	1
	Parasitic jaeger	*Stercorarius parasiticus*	5	0	5
	Total Jaeger		**6**	**0**	**6**
Gulls/Terns	Arctic tern	*Sterna paradisaea*	19	14	33
	Herring gull	*Larus argentatus*	16	8	24
	Unknown gull		0	9	9
	Total Gull/Tern		**35**	**31**	**66**
Total			**729**	**1,182**	**1,911**

Overall, a higher abundance of birds was observed during the August late breeding/early staging survey (RA: N = 752; LSA: N = 448) compared to the July early breeding survey (RA: N = 613; LSA: N = 116; Figure 6.4-1). The majority of waterbirds observed during the early breeding survey in July were in the RA (Figure 6.4-1). Waterbirds were distributed relatively evenly throughout the RA and were more concentrated in the southwest and southeast of the LSA (Figure 6.4-1).

Of the six habitat types noted during surveys, 96% of species observations occurred on lakes, 2% were in wetlands, and 2% were relatively evenly distributed between the remaining four habitat categories (Table 6.4-2). The majority of waterbird species were observed in lake habitat (almost 100% of the time; Figure 6.4-2). Statistical analysis of lake-size preference among divers and herbivores revealed no significant differences between species observations and lake size ($F_{3,79} = 0.20$, $p = 0.89$; Figure 6.4-3).

Table 6.4-2. Waterbird Habitat Use, 2011

	Loon		Goose		Dabbling Duck		Diving Duck		Crane		Jaeger		Gull/ Tern		All Species	
Habitat	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Lake	7	100	1,660	97.1	10	58.8	61	100	3	60	2	33.3	58	87.9	**1,813**	**96.3**
Heath Tundra	0	0	2	0.1	2	11.8	0	0	2	40	4	66.7	5	7.6	**15**	**0.8**
Creek	0	0	12	0.7	0	0	0	0	0	0	0	0	0	0	**12**	**0.6**
Wetland	0	0	35	2.1	0	0	0	0	0	0	0	0	0	0	**35**	**1.9**
River	0	0	0	0	5	29.4	0	0	0	0	0	0	0	0	**5**	**0.3**
Other	0	0	0	0	0	0	0	0	0	0	0	0	3	4.5	**3**	**0.2**
Total	**7**		**1709**		**17**		**61**		**5**		**6**		**66**		**1,883**	



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Distribution of Waterbird Groups during Aerial Surveys, 2011

Figure 6.4-1

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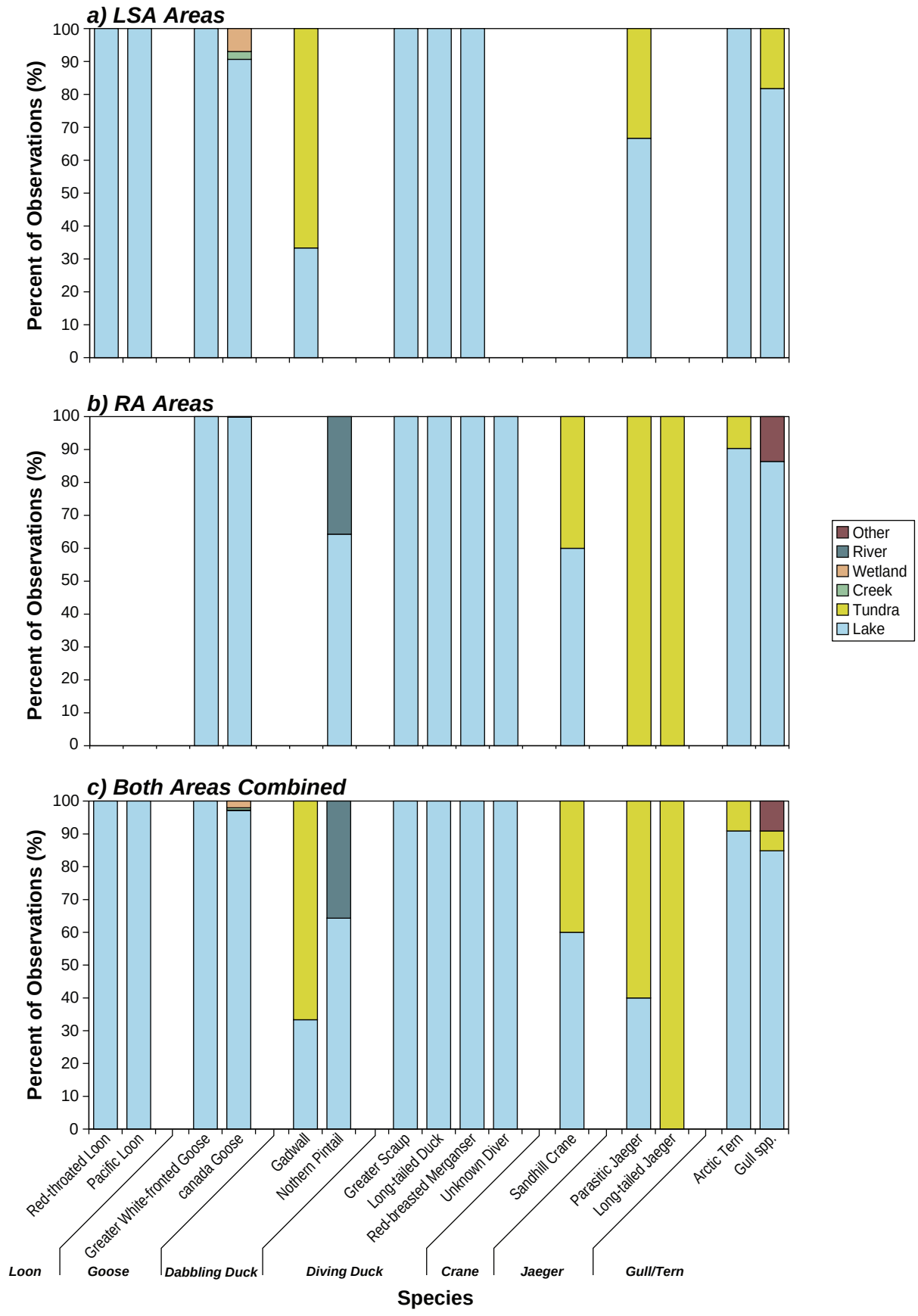

Figure 6.4-2

Summary of Waterbird Habitat Use in the LSA, RA, and Both Areas Combined, 2011

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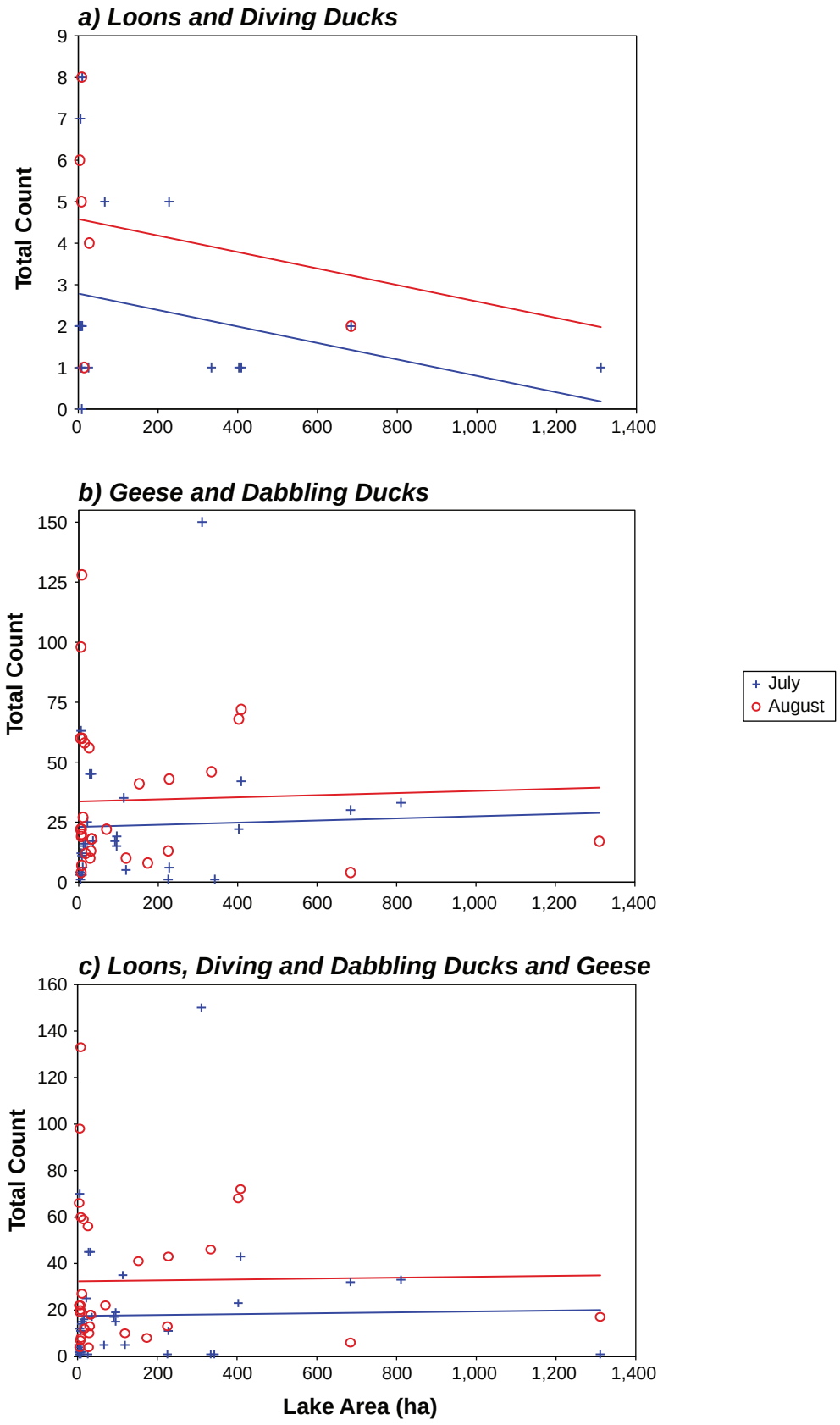

Note: Data shown with ANCOVA regression lines.

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Waterbird Groups Observed in Different Sized Lakes, 2011

Figure 6.4-3

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Species diversity was relatively low in the Back River study areas, and was only marginally higher in the LSA (***H*** = 0.52) as compared to the RA (***H*** = 0.47). This is because of the high number of Canada geese and low numbers of other species observed, as indicated by the low equitability (LSA = 0.22, RA = 0.20).

6.4.1 Breeding Evidence

No breeding evidence was observed during the July early breeding survey. During the August late breeding survey, five broods were observed (Table 6.4-3). Two were Canada goose broods and were observed in the LSA, and the remaining broods (one sandhill crane and two northern pintail) were observed in the RA (Table 6.4-3). Brood class observations were made only in late stages (brood classes II and III) representing broods greater than 28 days old.

Table 6.4-3. Brood Class Observations, 2011

Group	Species	Brood Size	Brood Class	Location	Habitat
Crane	Sandhill crane	1	IIc	RA	Lake
Dabbling duck	Northern pintail	4	III	RA	Lake
		4	IIIc	RA	River
Goose	Canada goose	1	III	LSA	Wetland
		4	Unknown	LSA	Lake

6.4.2 Species of Conservation Concern

Two species are of conservation concern and listed as sensitive in Nunavut; Arctic tern and Long-tailed duck. These two species were observed in both the LSA and the RA. Long-tailed ducks (N = 20) were only observed during the early breeding survey in July, and Arctic terns (N = 33) were observed during both surveys.

6.4.3 Incidental Observations of Waterbirds

During other field surveys in 2011, 11 species of waterbirds including 245 individuals were observed incidentally (Table 6.4-4; see Appendix 11.4-1). The most commonly observed species was Canada goose (N = 87) followed by greater white-fronted goose (N = 51), herring gull (N = 23), and long-tailed duck (N = 19). The majority of incidental observations were within the LSA (N = 160), likely reflecting the greater sampling effort in the LSA relative to the RA. All species observed incidentally were also detected during the waterbird aerial surveys.

6.5 DISCUSSION

Aerial surveys for waterbirds were conducted in 2011 to document habitat use, abundance, and richness in the study areas during the early breeding and late breeding/early staging periods. Overall, 14 species (10 waterbirds and four seabirds) were observed, with the majority of observations being Canada geese, resulting in low species diversity and equitability. Of the 14 species observed, two are of conservation concern: long-tailed duck and Arctic tern. Both species were observed during the July surveys, suggesting that they may breed in the LSA and RA.

Waterbird abundance was highest in the RA and during August. The increased abundance and frequency of observations of large groups (mainly Canada geese) in August suggests staging groups were likely beginning to congregate. Overall, the distribution of waterbird groups in August suggests that small and medium sized lakes were preferred during early staging.

Table 6.4-4. Incidental Observations of Waterbirds, 2011

Species	Scientific Name	No. Observed		Total Observed
		LSA	RA	
Arctic tern	*Sterna paradisaea*	5	5	10
Canada goose	*Branta canadensis*	52	35	87
Greater white-fronted goose	*Anser albifrons*	49	2	51
Herring gull	*Larus argentatus*	9	15	24
Long-tailed duck	*Clangula hyemalis*	6	13	19
Long-tailed jaeger	*Stercorarius longicaudus*	3	5	8
Northern pintail	*Anas acuta*	6	1	7
Pacific loon	*Gavia pacifica*	17	0	17
Parasitic jaeger	*Stercorarius parasiticus*	4	5	9
Red-breasted merganser	*Mergus serrator*	9	0	9
Red-throated loon	*Gavia stellata*	0	3	3
Unknown jaeger		0	1	1
Total		**160**	**85**	**245**

No broods were observed in July during the early breeding survey; however, the observations of late stage brood classes in August suggests that broods would have been present during the July surveys but would have been very young and sensitive to disturbance (i.e., retreating to hiding spots before being spotted by observers).

It is generally acknowledged that a correlation exists between latitude and species diversity, where Arctic species diversity is low (Chernov 2002). Results from the 2011 baseline surveys are consistent with this assumption, demonstrating that the low diversity observed within the Back River study area is typical for the region. Species diversity was about the same in both the LSA and RA, further supporting this assumption.

7. Raptors

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7. Raptors

7.1 INTRODUCTION

Raptor breeding activity is monitored because raptors and their nests are legally protected under the Nunavut *Wildlife Act* (2003). Raptors (i.e., eagles, hawks, and falcons) are considered good indicators of habitat quality because of their sensitivity to human disturbance and environmental contamination (e.g., Elliott et al. 1997; Martinez-Abrain et al. 2010). Cliff nesting raptors in the Project area include peregrine falcon (*Falco peregrinus tundrius*), gyrfalcon (*Falco rusticolus*), rough-legged hawk (*Buteo lagopus*), golden eagle (*Aquila chrysaetos*), and bald eagle (*Haliaeetus leucocephalus*). Common ravens (*Corvus corvax*) are included as functional raptors in Nunavut because they compete for the same resources as the cliff-nesting raptors in the Project area.

7.2 OBJECTIVES

Surveys were conducted in 2011 to assess the presence and distribution of cliff nesting raptor species within the RCSA. Specifically, the objectives were to:

- conduct occupancy surveys to determine the location and status of nests in raptor territories;
- conduct productivity surveys to determine the productivity of occupied nests;
- characterize raptor species abundance and distribution in the RCSA;
- identify species of conservation concern; and
- record incidental observations of all raptors species observed in the RCSA, including species that are not cliff nesters.

7.3 METHODS

7.3.1 Aerial Surveys

Raptor surveys were conducted at cliff nesting habitat within the RCSA (Figure 3-1) in accordance with current raptor inventory protocol (RIC 2001). Survey flights were flown at a minimum of 50 m above the nest and flying speed was between 30 to 80 km per hour to prevent disturbing the nesting raptors and still maintain an effective height for distinguishing raptor species brood data. Nest sites were surveyed twice in 2011: the spring occupancy survey was conducted in June to determine occupancy of raptor nests, and the summer productivity survey was conducted in July to determine the number of chicks produced at each nest site.

The results of previously conducted raptor surveys in the Back River RSCA were used to guide aerial surveys in 2011. A large portion of the RCSA was surveyed for raptor nests in 2007 (Gartner Lee Ltd. 2008). All raptor nests identified in 2007, including those that were not occupied by raptors at the time, were resurveyed during the spring occupancy survey.

Habitat information was collected to characterize cliff nesting habitat within the RCSA and identify any additional potentially suitable nesting sites. Common ravens (*Corvus corax*) were included in the raptor data sets because they are considered functional raptors, due to their interactions with raptors in nesting territories and because they construct stick nests that are adopted by some raptor species (Poole 2011).

Observations of raptors or raptor nests were noted and geo-referenced (wherever possible) when they were observed incidentally during other wildlife field inventories.

7.3.1.1 Raptor Occupancy Surveys

A raptor occupancy survey was conducted to identify the location of occupied raptor nest sites within the LSA and RCSA. Aerial surveys were conducted by helicopter in June 2011. Surveys were flown horizontally along cliff faces to evaluate nest status and species presence. If the cliff was greater than 30 m high, two flight passes were taken (one at the top level and one at the lower level) to ensure that no potential nests were missed. A handheld Garmin GPS Map60CS (with advertised accuracy 3 to 15 m) was used to record survey routes and nest locations.

Data recorded included raptor species, number of birds, chicks, or eggs, locations of nests, and habitat information. When adults were observed sitting on the nest in incubation posture, the presence of eggs or young was inferred at the nest site. Minimum time was spent at active nests to reduce the potential for disturbance to the birds.

7.3.1.2 Raptor Productivity Surveys

In July 2011, aerial productivity surveys were conducted by helicopter at occupied nest sites. Each site was surveyed for species presence and for brood information (e.g., number of young and age of young). Minimum time was spent observing at the active nests to reduce the potential for disturbance to the chicks.

Production was reported as the total number of young fledged or raised to an advanced stage of development from all productive territories. Productivity was reported as the number of young produced per occupied territory per year (Poole 2011).

7.4 RESULTS

Raptor occupancy surveys were conducted on June 2 and June 5, 2011, and productivity surveys were conducted from July 25 to 27, 2011. A total of five raptor species and 30 individuals were observed on surveys (Table 7.4-1). The most abundant species observed were gyrfalcons, with a relative abundance comprising 40% of the total observations. Peregrine falcons were the next most abundant species observed comprising 27% of the total observations. Juvenile raptors were not observed during the surveys.

Table 7.4-1. Raptors Observed during 2011 Aerial Surveys

Species	No. Observed		Total Observed
	Occupancy	Productivity	
Common raven	2		**2**
Golden eagle	1		**1**
Gyrfalcon	9	3	**12**
Peregrine falcon	1	4	**5**
Rough-legged hawk	5		**5**
Unknown falcon sp.	4	1	**5**
Total	**22**	**8**	**30**

Four of the five species observed during aerial surveys are species of conservation concern. Golden eagle, gyrfalcon, and rough-legged hawk are listed as Sensitive in Nunavut by the CESCC (2010). Peregrine falcon *tundrius* subspecies, while listed as Secure in Nunavut by the CESCC (2010), is federally listed on Schedule 3 as a population of Special Concern under SARA (Government of Canada 2011).

7.4.1 Occupancy Surveys

A total of 13 nest sites were surveyed in June, 2011, and 11 of these nests were occupied by raptors (Figure 7.4-1). Four of the thirteen nest sites were new sites for 2011 (i.e., were not previously identified in 2007; Gartner Lee Ltd. 2008; Appendix 7.4-1).

Gyrfalcon and rough-legged hawk had the highest number of occupied nests (N = 4; Plate 7.4-1), followed by an unknown falcon species (N = 2), and golden eagle (N = 1). Eggs were observed at three nest sites (O17, O18, O28; Figure 7.4-1). The remaining nests that were considered to be occupied because of the posture of the adult in the nest (i.e., bird did not flush from nest site as helicopter approached suggesting that the bird was incubating eggs; Appendix 7.4-1). Overall, raptor nests were found primarily in cliff habitat along a ridge that runs north-northwest through the RCSA (Figure 7.4-1).

Plate 7.4-1. Gyrfalcon at nest site O3 located at the western portion of Goose Lake in the LSA.

7.4.2 Productivity Surveys

All 11 nest sites identified in June were revisited in July. No nest sites were conclusively determined to be productive, as no live chicks were observed at any nest (Figure 7.4-2; Appendix 7.4-2).

Of the three nests where eggs were observed in June, there were no indications around the nest site suggesting that the adults were successful in raising and fledging chicks. However, there was a pair of gyrfalcon around nest site O28 and a pair of peregrine falcon observed around O17 (Appendix 7.4-2). Of the remaining eight nests, two (O3 in the LSA and O13 in the RCSA) contained a large amount of whitewash (excrement) which suggests that the chicks may have hatched. One nest in the northwest RCSA (O24) contained a pair of deceased gyrfalcon chicks. No adult birds or any fledglings were present around any of these nest sites.

A total of eight new nest sites were identified during the productivity survey (P3, P4, P6, P9 to P13; Figure 7.4-2). Five nests were in the northeastern portion of the RCSA. Several of these nest sites appeared to be occupied earlier in the year based on amount of whitewash and/or down in nest (Plate 7.4-2), but no birds were observed during the July surveys.

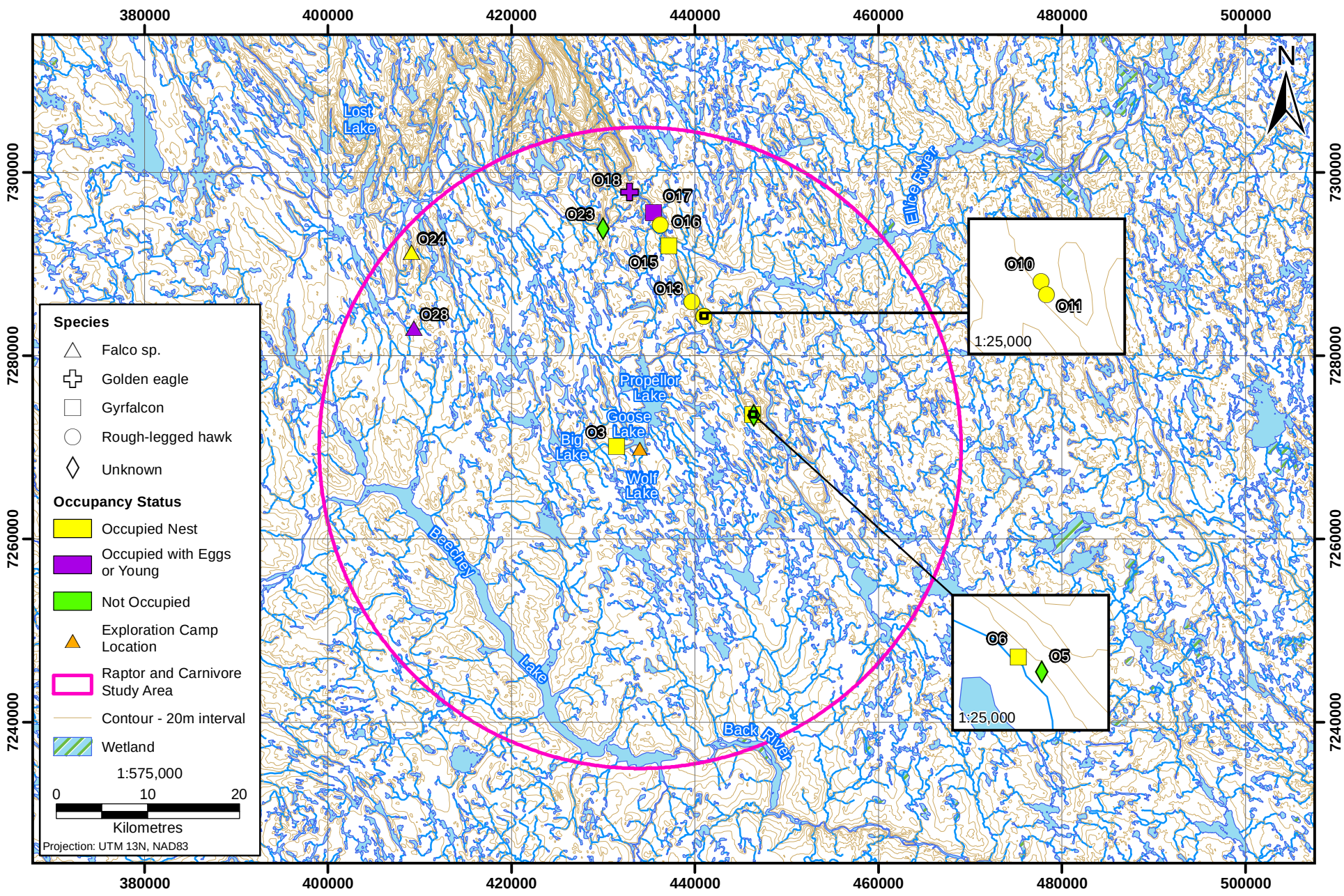

Figure 7.4-1

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Status of Raptor Nests during Occupancy Surveys, June 2011

Figure 7.4-1

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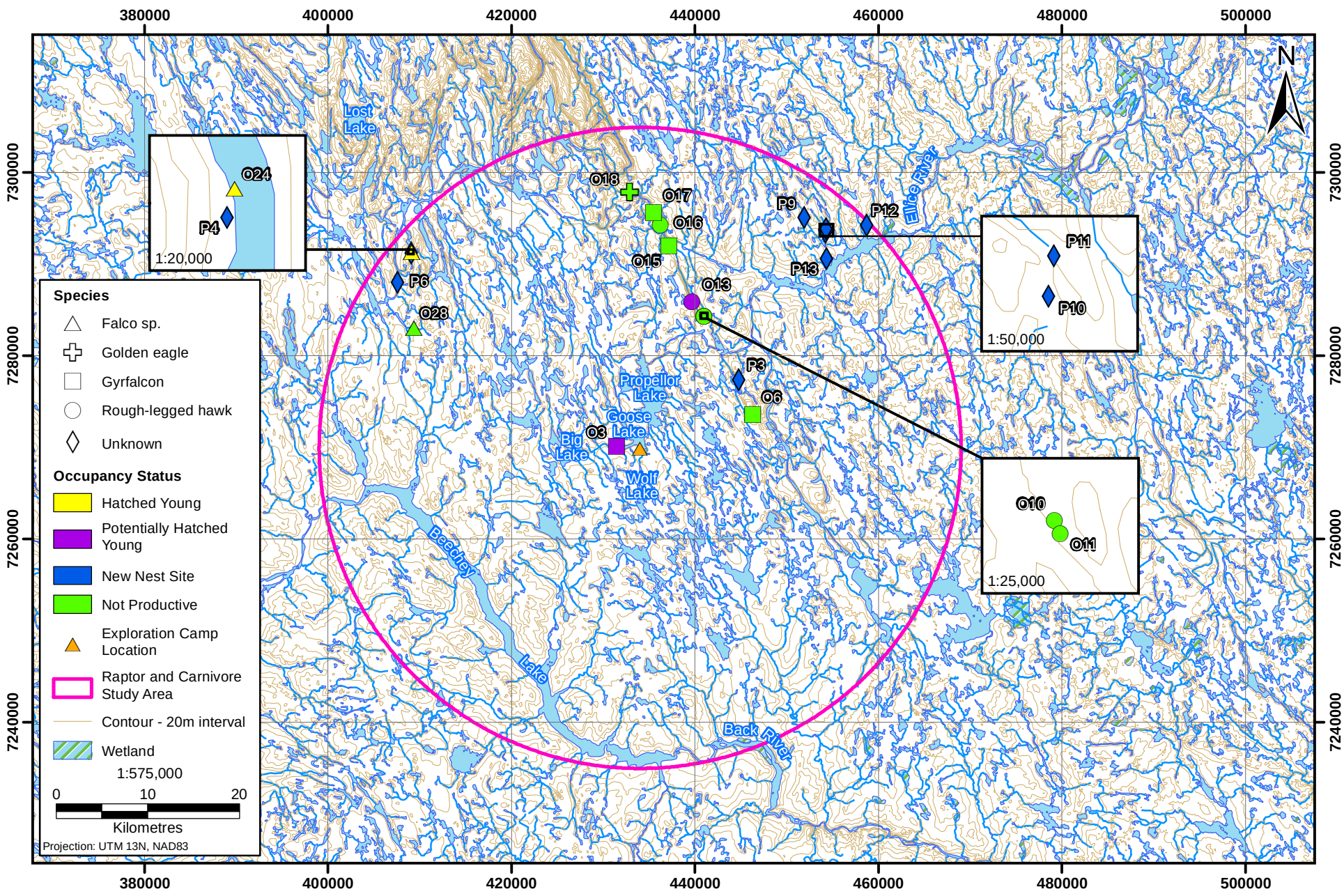

Figure 7.4-2

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Status of Raptor Nests during Productivity Surveys, July 2011

Figure 7.4-2

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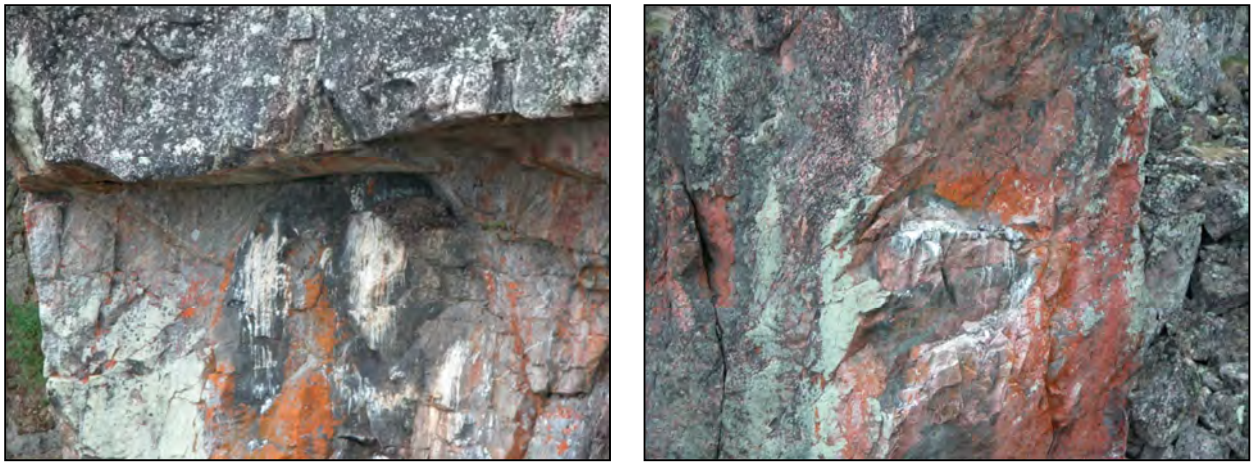

Plate 7.4-2. Example of new nesting sites identified during the productivity survey that contain evidence of use in 2011.

7.4.3 Incidental Observations of Raptors

During other field studies in 2011, six raptor species (16 individuals) were observed incidentally (Table 7.4-2; see Appendix 11.4-1). Two of these species, bald eagle and northern harrier, were not focal species during raptor surveys. In addition, a short-eared owl nest was observed during upland breeding bird surveys in June (Section 5.4).

Table 7.4-2. Incidental Observations of Raptors Recorded during Field Surveys in 2011

Species	Scientific Name	No. Observed
Bald eagle	*Haliaeetus leucocephalus*	3
Common raven	*Corvus corax*	6
Golden eagle	*Aquila chrysaetos*	3
Gyrfalcon	*Falco rusticolus*	1
Northern harrier	*Circus cyaneus*	2
Peregrine falcon	*Falco peregrinus*	1
Total		**16**

7.5 DISCUSSION

Surveys were conducted in 2011 to determine the occupancy and productivity status of raptor nests in the RCSA. Eleven nests, occupied by gyrfalcon, rough-legged hawk, golden eagle, and unknown species, were observed during occupancy surveys in June. None of the nests were confirmed to be productive during productivity surveys in July; however, two nests (one gyrfalcon and one rough-legged hawk) contained a large amount of whitewash (excrement) which suggests that the chicks may have hatched, and one nest contained deceased gyrfalcon chicks.

The timing of the aerial surveys coincided with the point at which eggs (June) and chicks (July) should be visible in active nests and when chicks have the greatest probability of survival, but would still be young enough to be present at the nest. Raptor information collected during these surveys do not indicate nest success as the sample of nests found is too small to calculate hatching and fledging success, but does confirm that golden eagles, rough-legged hawks, and gyrfalcons are breeding in the study area.

In addition to the three cliff-nesting raptors observed to be nesting in the RCSA, peregrine falcon, bald eagle, northern harrier, short-eared owl, and common raven adults were also observed. Therefore, eight species are present in the RCSA, suggesting a relatively broad range of raptor species occurring in the study area.

All nests were observed north of the Goose Lake camp, particularly in cliff habitat along a ridge that runs north-northwest through the RCSA. Raptor nests were likely not observed south of Goose Lake camp because of the absence of suitable nesting habitat.

8. Marine Birds

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8. Marine Birds

8.1 INTRODUCTION

Marine birds include seabirds, seaducks, shorebirds, and some waterbird species that are reliant on marine environments during various life history stages, such as foraging or staging (Gill et al. 1996). The Queen Maud Gulf Migratory Bird Sanctuary is approximately 200 km east of Bathurst Inlet. The sanctuary is an important bird area with about 60 goose colonies and more than 12 species of waterbirds breeding within the sanctuary. It is possible that in addition to locally breeding waterbirds some of the breeding species from the sanctuary could use Bathurst Inlet as a staging area prior to fall migration.

Marine birds and their habitat are protected under several forms of federal legislation. Migratory marine bird species receive protection under the federal *Migratory Bird Convention Act (1994b)*, which includes regulations that prohibit the killing, capturing, injuring, taking or disturbing of migratory birds, or the damaging, destroying, removing or disturbing of nests (Canadian Wildlife Service 1991). The federal *Species at Risk Act* (SARA; 2002b) protects threatened marine bird species and their habitats.

8.2 OBJECTIVES

Marine bird surveys were conducted to document the presence and distribution of marine bird species within Bathurst Inlet. The specific goals of collecting marine bird baseline data were to:

- establish baseline information for marine bird presence and relative abundance during breeding (July) and early fall staging (August);
- establish baseline information on locations that are particularly important for promoting high species richness or diversity; and
- determine whether any species of conservation concern occur in the area.

8.3 METHODS

8.3.1 Aerial Surveys

Marine bird surveys were conducted in July and August, 2011. Aerial surveys were conducted along two types of transect: shoreline transects (Figure 8.3-1) and marine transects (Figure 8.3-2). Flight altitude during all aerial surveys was 152 m (500 ft) and flight speed was 100 knots. In addition to the pilot, one observer and one recorder were present in the aircraft (helicopter or floatplane) during the surveys. Observers searched an area of approximately 500 m on either side of the aircraft for marine birds. Whenever a marine bird was observed, the species, number of individuals, and behaviour were recorded, as well as the location of the sighting using a handheld Garmin GPS Map60CS.

8.3.2 Ground Surveys

Marine bird ground surveys were conducted during the breeding survey in July, 2011, to locate marine bird nests. Surveys were conducted within 100 m of the shoreline of Bathurst Inlet. Two observers spaced 25 m apart walked along the shoreline searching for nests of marine birds. Surveys were conducted for 30 minutes; because shoreline topography was not consistent among transects, transect length varied between 1 and 1.8 km. When nests were detected, the observers recorded their location with a handheld Garmin GPS Map60CS, and recorded species, nest contents, and observations of birds flying along shorelines and on the water.

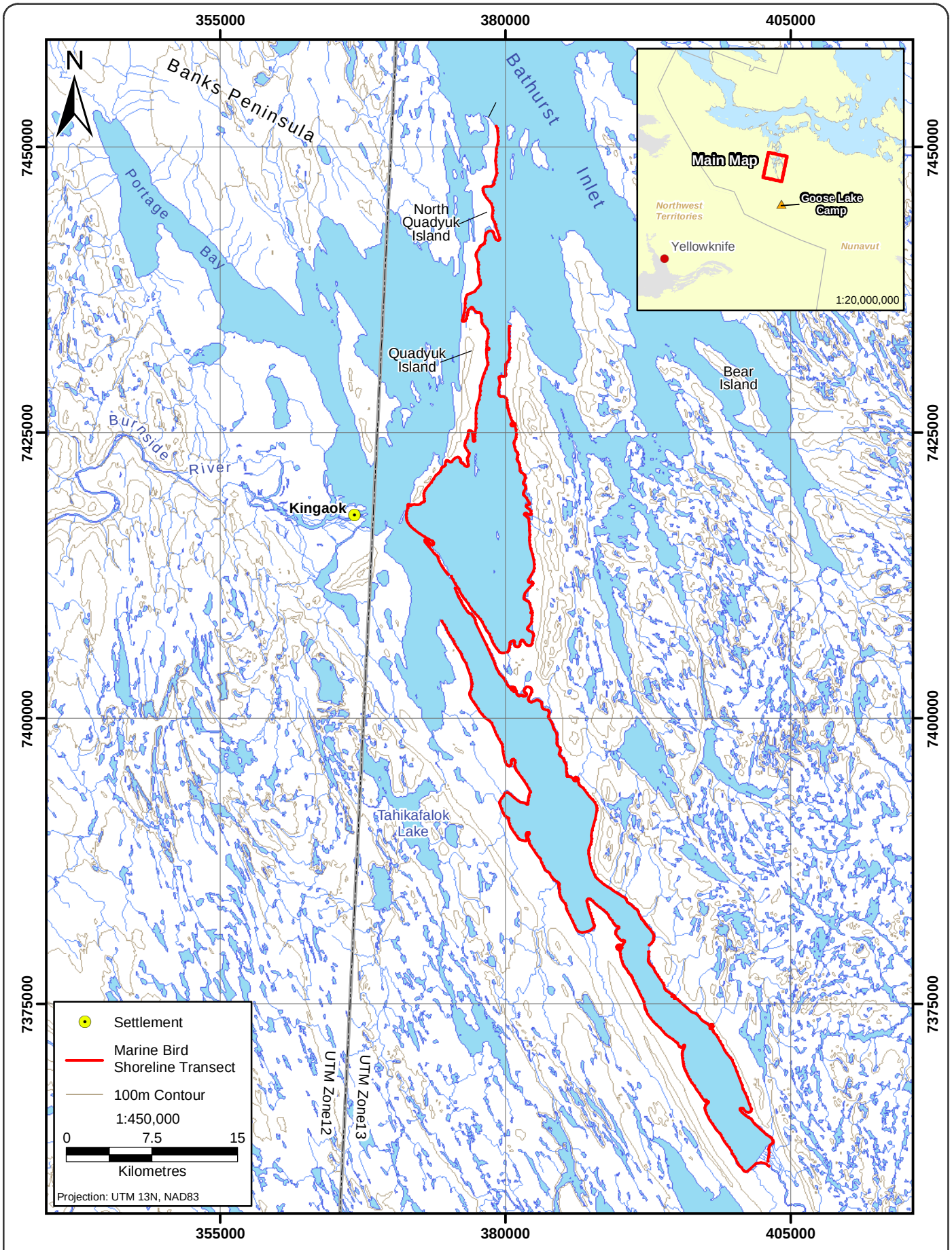

Figure 8.3-1

Marine Bird Shoreline Transects Surveyed in Bathurst Inlet, July and August 2011

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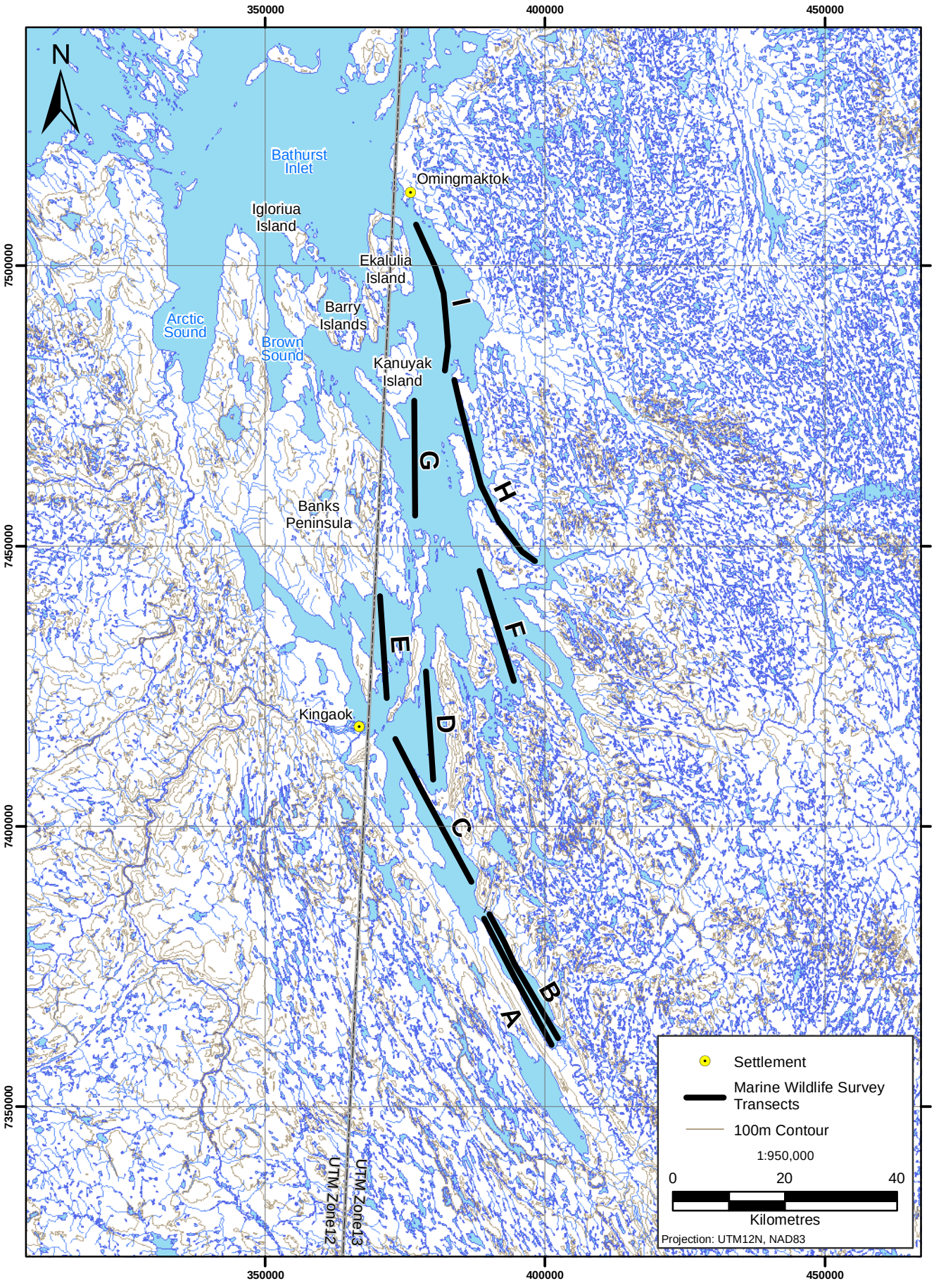

Figure 8.3-2

Marine Bird Marine Transects Surveyed in Bathurst Inlet, August 2011

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8.4 RESULTS

8.4.1 Breeding Surveys

Marine bird breeding surveys (aerial shoreline transects and ground surveys) were conducted on July 6, 2011 (Appendices 8.4-1 and 8.4-2). A total of 15 species and 1,808 individuals were observed and identified to the species level (Table 8.4-1). An additional four unidentified marine bird species (three unknown ducks and one unknown loon) were also observed. The most commonly observed species were red-breasted merganser (N = 660), Canada goose (N = 615), greater scaup (N = 257), and herring gull (N = 107).

Table 8.4-1. Marine Bird Species Observed during Breeding and Early Fall Staging Surveys in Bathurst Inlet, July and August, 2011

			No. Observed			
			Breeding Surveys		Fall Staging Survey	
Group	Species	Scientific Name	Aerial	Ground		Total
Loon	Pacific loon	*Gavia pacifica*	3	0	0	**3**
	Red-throated loon	*Gavia stellata*	17	0	0	**17**
	Yellow-billed loon	*Gavia adamsii*	4	0	0	**4**
	Unknown loon	*Gavia* spp.	1	0	1	**2**
	Total Loon		**25**	**0**	**1**	**26**
Goose	Brant	*Branta bernicla*	0	0	5	**5**
	Canada goose	*Branta canadensis*	612	3	187	**802**
	Total Goose		**612**	**3**	**192**	**807**
Dabbling Duck	Gadwall	*Anas strepera*	1	0	0	**1**
	Green-winged teal	Anas crecca	9	1	0	**10**
	Total Dabbling Duck		**10**	**1**	**0**	**11**
Diving Duck	Black scoter	*Melanitta nigra*	21	0	0	**21**
	Common eider	*Somateria mollissima*	20	0	0	**20**
	Greater scaup	*Aythya fuligula*	257	0	0	**257**
	Red-breasted merganser	*Mergus serrator*	653	7	45	**705**
	Surf scoter	*Melanitta prespicillata*	27	0	0	**27**
	White-winged scoter	*Melanitta fusca*	43	0	0	**43**
	Unknown eider		0	0	30	**30**
	Unknown scoter		0	0	238	**238**
	Unknown diving duck		0	0	17	**17**
	Total Diving Duck		**1,021**	**7**	**330**	**1,358**
Sandpiper	Semipalmated plover	*Charadrius semipalmatus*	0	1	0	**1**
	Unknown sandpiper		0	0	100	**100**
	Total Sandpiper		**0**	**1**	**100**	**101**
Gulls/Terns	Glaucous gull	*Larus hyperboreus*	22	0	0	**22**
	Herring gull	*Larus argentatus*	107	0	0	**107**
	Unknown gull		0	0	169	**169**
	Total Gulls/Terns		**129**	**0**	**169**	**298**
Unknown	Unknown duck		3	0	80	**83**
	Unknown marine bird		0	0	85	**85**
	Total Unknown		**3**	**0**	**165**	**168**
Total			**1,800**	**12**	**957**	**2,769**

The majority (99%) of birds were detected during the aerial surveys along the shoreline transects (Appendix 8.4-3); only 12 individual birds (three Canada geese, one green-winged teal, seven red-breasted mergansers, and one semipalmated plover) were observed during ground surveys (Appendix 8.4-4). No nests or broods were observed during ground or aerial surveys.

Large congregations (>75 individual birds) of geese were observed toward the southern tip of Bathurst Inlet and large groups of diving ducks were observed further north and along Quadyuk Island (Figure 8.4-1).

8.4.2 Early Fall Staging Survey

Early fall staging aerial surveys for marine birds were conducted on August 5 and 6, 2011 (Appendix 8.4-1). Three species and 237 individual birds were observed and identified to the species level (Appendix 8.4-3). An additional 720 unidentified marine birds that could not be identified to the species level were also observed, including unknown ducks, gulls, loons, eiders, scoters, and sandpipers (Table 8.4-1). The most commonly observed species were unknown scoters (N = 238), Canada geese (N = 187), unknown gulls (N = 169), and unknown sandpipers (N = 100).

Large congregations (>75 individual birds) of geese, diving ducks, and sandpipers were observed along the coast of the southern end of the Inlet during shoreline transect surveys (Figure 8.4-2). Smaller groups of gulls and terns were observed throughout the inlet, particularly to the north near Quadyuk Island (Figure 8.4-2). During marine transect surveys, larger groups of diving ducks were observed at the southern tip of Bathurst Inlet, and groups of gulls and terns were observed throughout the study area (Figure 8.4-3).

8.4.3 Species of Conservation Concern

Two species of conservation concern at the territorial level in Nunavut were observed: common eider (Sensitive) and glaucous gull (Sensitive). Both species were only observed in July during the breeding surveys, but no breeding evidence was observed. No marine bird species that are federally listed were observed in the MSA.

8.4.4 Incidental Observations of Marine Birds

Tundra swans are the only species that was incidentally observed during travel between the MSA and the Goose Lake exploration camp during aerial marine bird surveys. Ten tundra swans were observed within the MSA on a freshwater lake just to the south of Kingaok on July 5 (Bathurst Inlet Lodge; see Appendix 11.4-1). This species was not observed on any marine, terrestrial, or waterbird survey.

8.5 DISCUSSION

Overall, 2,769 individual marine birds (15 species) were observed throughout Bathurst Inlet. A higher abundance of birds were observed during the breeding survey (N = 1,812) compared to the early fall staging survey (N = 957). No breeding evidence was observed. Two species of conservation concern at the territorial level were observed (common eider and glaucous gull), both of which are listed as Sensitive.

During the breeding surveys, large groups of geese and diving ducks were observed along the shoreline throughout the MSA. During early staging surveys, only a few large groups of birds were observed: geese were observed just south of Kingaok, diving ducks and shorebirds southeast of Tahikafalok Lake, and diving ducks at the southern tip of Bathurst Inlet. During staging surveys, multiple small groups of gulls and terns were also observed throughout the MSA. Therefore, it appears as though more large groups of birds were observed throughout the study area during the breeding survey compared to the staging survey.

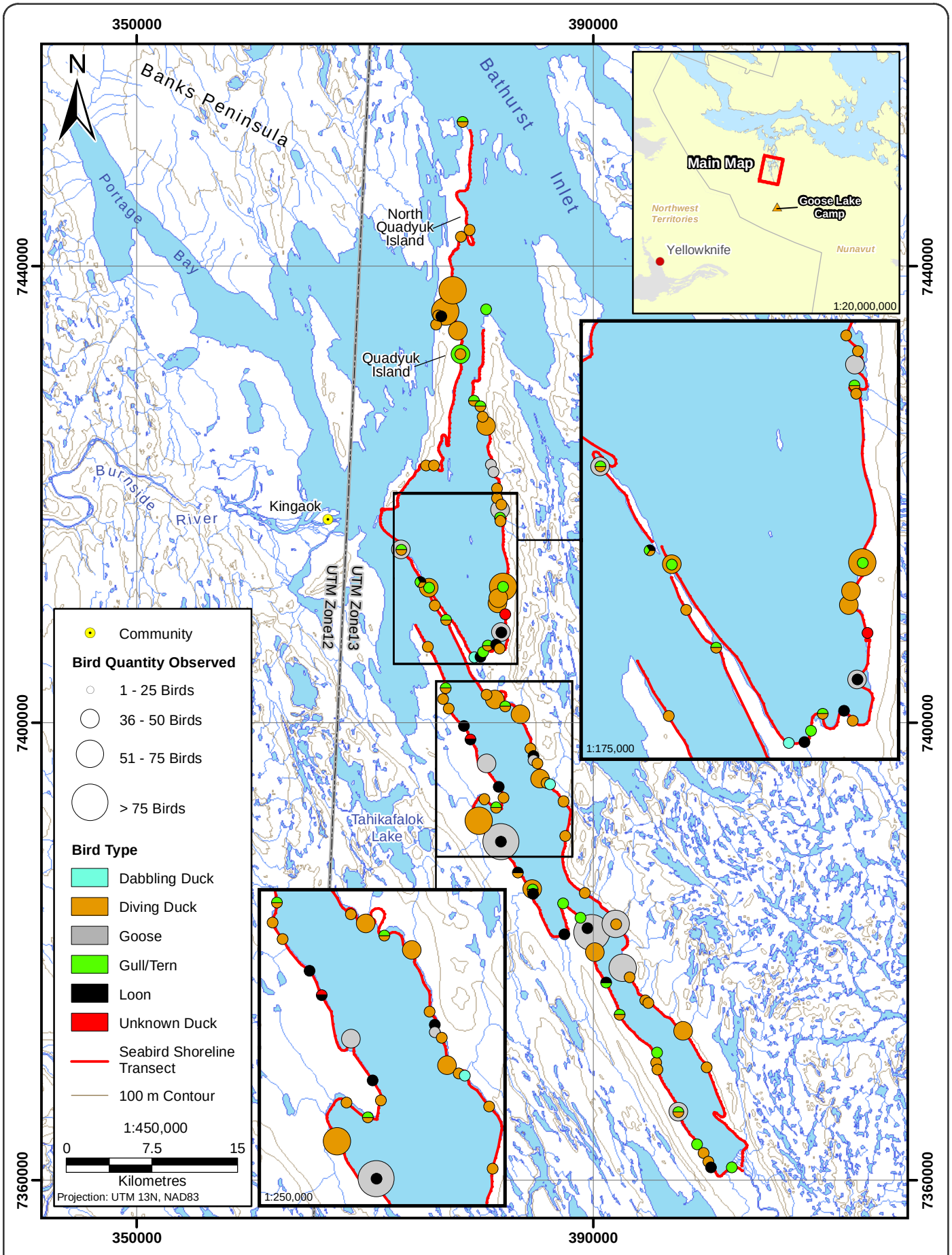

Figure 8.4-1

Marine Birds Observed during Breeding Aerial Surveys along the Shoreline, July, 2011

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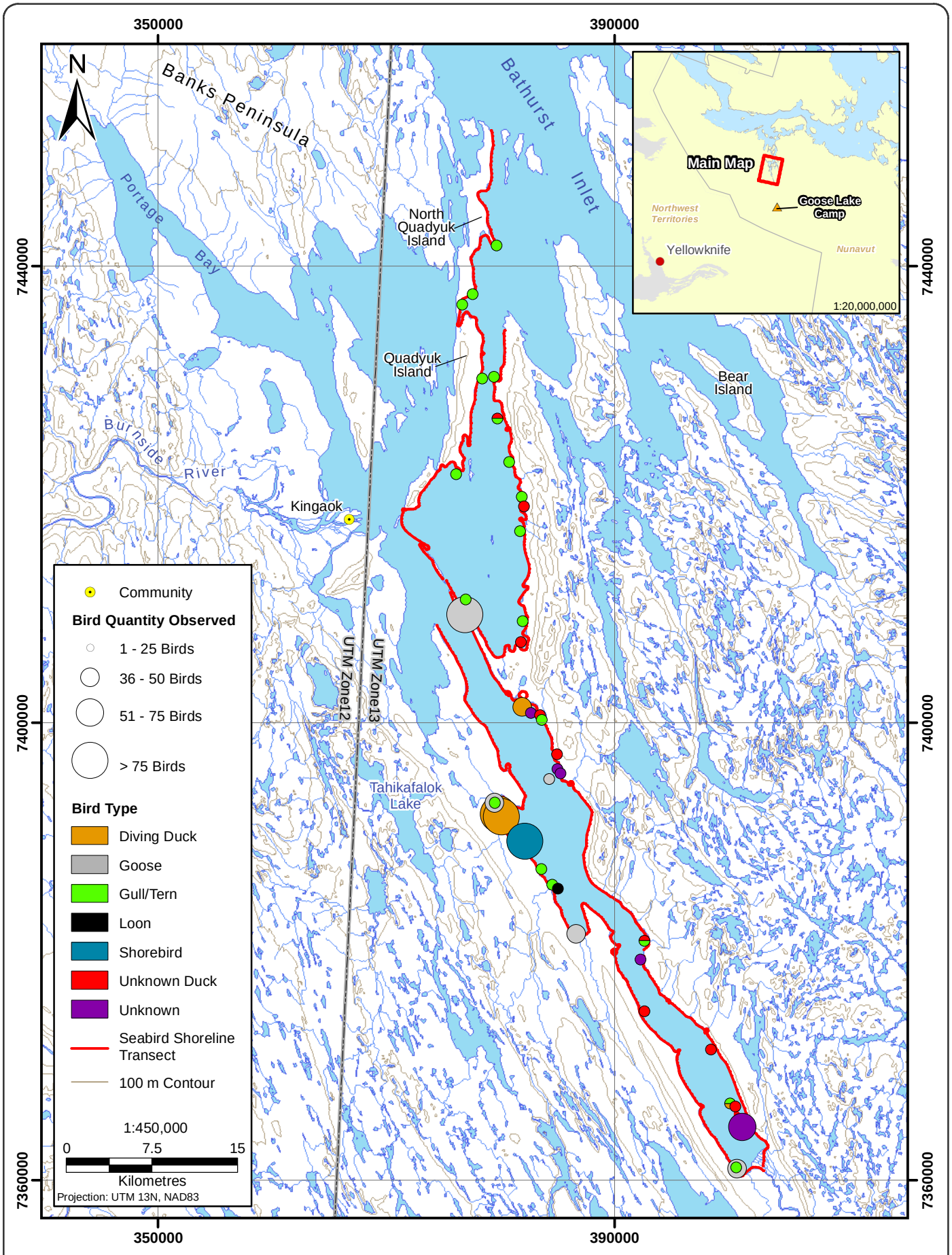

Figure 8.4-2

Marine Birds Observed during Early Fall Staging Surveys along the Shoreline, August, 2011

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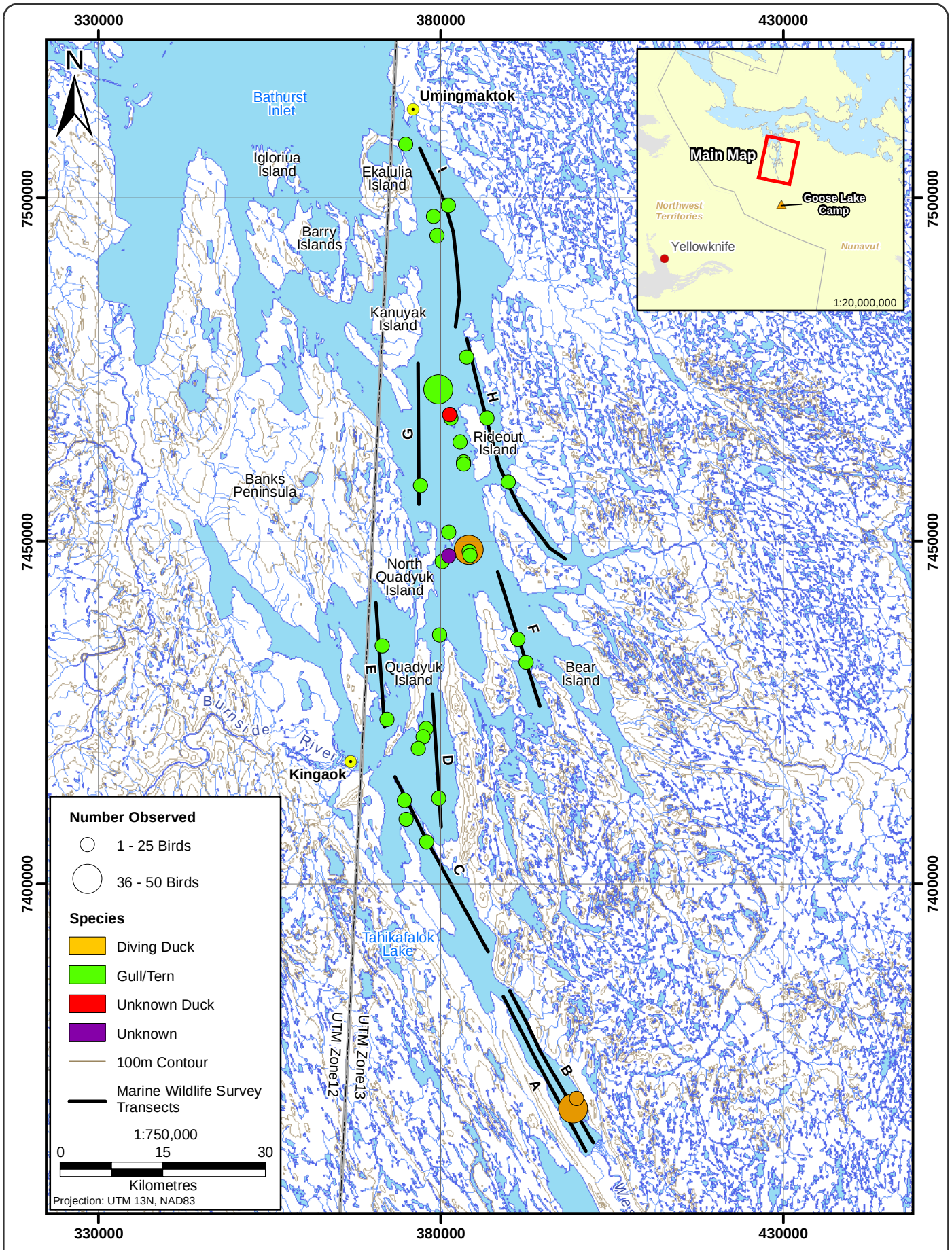

Figure 8.4-3

Marine Birds Observed during Early Fall Staging Surveys along Marine Transects, August, 2011

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Large groups of some species observed in August were likely staging/moulting groups. Large groups of diving ducks (particularly scoters) observed in July were likely groups of males that remained on the ocean throughout the breeding season to access prey species that are readily available and easier to access than on lakes. In August, post-breeding individual scoters preparing themselves for fall migration were likely joining these male groups, increasing group sizes.

Although many breeding marine birds retreat to lakes to rear their broods, three waterfowl species may nest in close proximity to the coast of Bathurst Inlet: Brant geese, common eiders, and red-breasted mergansers (Reed et al. 1998; Titman 1999; Goudie, Robertson, and Reed 2000). Breeding habitat for these species does occur within the surveyed areas but the lack of observed sightings of broods may suggest that these species are not using this area for breeding, or may reflect the difficulty of observing broods on the ocean. Other species are reliant on the marine environment and are likely using Bathurst Inlet as a main foraging location during the breeding season. These species include the red-throated loon, yellow-billed loon, Brant goose, greater scaup, common eiders, scoters (black, white-winged, and surf), and red-breasted mergansers (North 1994; Bordage and Savard 1995; Brown and Fredrickson 1997; Reed et al. 1998; Savard, Bordage, and Reed 1998; Titman 1999; Barr, Eberl, and Mcintyre 2000; Goudie, Robertson, and Reed 2000; Kessel, Rocque, and Barclay 2002). The high abundance of some of these species observed during aerial surveys may suggest that the inlet is used for foraging.

Prior to migrating, many species of waterfowl congregate at staging areas where they build fat and protein stores critical for their survival during migration (e.g., Ankney and MacInnes 1978). Most marine bird species observed in Bathurst Inlet during the two surveys in the summer of 2011 were completed before large staging congregations would be present. However, the great increase in the number of scoters and geese during the early staging survey in August suggests Bathurst Inlet may provide staging habitat for these species.

9. Marine Mammals

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9. Marine Mammals

9.1 INTRODUCTION

There are two marine mammals that may be resident in Bathurst Inlet: the ringed seal (*Phoca hispida*) and the bearded seal (*Erignathus barbatus*). Additionally, bowhead whales (*Balaena mysticetus*), belugas (*Delphinopterus lecuas*), narwhals (*Monodon monocerus*), and walrus (*Odobensus resmarus*) may be seen in Bathurst Inlet.

Marine mammals fall under the jurisdiction of the Department of Fisheries and Oceans Canada (DFO), and are protected under the federal *Fisheries Act* (1985). Although cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals and sea lions) are mammals, their inclusion in this Act reflects the fact that they were once managed and harvested as "fish" stocks. Section 32 and 35(1) of the federal *Fisheries Act* protect marine mammals and their habitat from alteration, disruption, or destruction. Section 7 of the Marine Mammal Regulations protects marine mammals from being disturbed.

9.2 OBJECTIVES

Observations of marine mammals were collected opportunistically during marine bird surveys in Bathurst Inlet to document the number and species of marine mammals using the inlet during the summer.

9.3 METHODS

Marine mammal incidental observations were recorded during marine bird aerial surveys in July and August, 2011 (see Section 8.3.1 for marine bird aerial survey methodology; Figures 8.3-1 and 8.3-2). Whenever a marine mammal was observed incidentally, the location was recorded with a handheld Garmin GPS Map60CS, and species and behavioural observations were also noted.

9.4 RESULTS

Incidental observations of marine mammals were recorded during marine bird aerial surveys on July 6, August 5, and August 6, 2011. During 6 hours and 31 minutes of aerial surveys covering a total of 870.9 km, three ringed seals, one bearded seal, and one unknown seal were observed (Table 9.4-1; Appendix 9.4-1). No seals were observed hauled out on the beaches, rock outcrops, or islands in Bathurst Inlet. All five seals that were observed were swimming in the inlet when spotted. No whales or walrus were observed during the aerial surveys.

Table 9.4-1. Marine Mammal Species Observed Incidentally during Marine Bird Aerial Surveys in July and August, 2011

Species	Number Observed		Total
	July	August	
Bearded Seal (*Erignathus barbatus*)	0	1	1
Ringed Seal (*Pusa hispida*)	2	1	3
Unknown Seal	0	1	1

9.5 DISCUSSION

Five seals were incidentally observed during summer surveys in Bathurst Inlet in 2011. There remains very little published about the ecology of Bathurst Inlet; for example, oceanic fish species, their numbers, and distribution in the inlet remains widely un-quantified. Both ringed and bearded seals prey upon fish and their presence/absence may affect the number of seals using the inlet. The low number of marine mammals observed in Bathurst Inlet may be due to the relative low density observed in many mammal species or may suggest the inlet is not used during the summer by the majority of marine mammal species.

10. Carnivore Dens

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10. Carnivore Dens

10.1 INTRODUCTION

Baseline surveys for carnivore dens were conducted to identify carnivore species using the RCSA and the distribution of existing active dens. The predominant mammalian carnivores on the tundra and within the study area are grizzly bears (*Ursus arctos)*, grey wolves (*Canis lupus*), and Arctic foxes (*Alopex lagopus*).

10.1.1 Carnivore Species and Denning Ecology

10.1.1.1 Grizzly Bears

Grizzly bears are listed as special concern by COSEWIC and as sensitive by Nunavut Wild Species. The barren-ground grizzly bear population in Canada's central Arctic is near the northern- and eastern-most extent of their North American range. They are characterized by relatively low density in an area of low productivity and high seasonality (Ferguson and McLoughlin 2000; P. D. McLoughlin, Ferguson, and Messier 2000). The population of barren-ground grizzly bears in the Slave Geological Province was estimated at 800 (±200 SE) individuals in 2003, where annual adult survival is >97%, and annual home ranges are the largest in North America (female: 2,100 km^2; male 7,200 km^2) (P. D. McLoughlin, F. Messier, et al. 2003; P. D. McLoughlin, M. K. Taylor, et al. 2003).

Eskers are important habitat for grizzly bears, as they are used for denning, travelling, and hunting. Females, especially those with cubs, may select "non-typical" denning locations and avoid eskers to reduce risk of predation by male bears (Banci and Moore 1997). Dens have been found on heath tundra, heath tundra with more than 30% boulder content, spruce forest, tall shrub riparian areas, and birch seep areas. Although grizzly bear den sites are widely distributed throughout the Slave Geological Province (P.D. McLoughlin et al. 2003), the locations of dens tend to be clustered (Banci and Moore 1997) and bears tend to den in the same denning areas year after year (LeFranc et al. 1987).

10.1.1.2 Grey Wolves

Wolves are the predominant predators of barren-ground caribou and rely primarily on adequate ungulate densities to maintain habitat occupancy (Walton et al. 2001; Paquette and Ludwig 2003). Alternative prey, such as birds and small mammals, can sustain wolves during periods of low ungulate availability.

During the spring, wolves follow the caribou herds north of the treeline and choose den sites south of the calving grounds. This strategy likely optimizes the availability of food resources for rearing pups (Heard and Williams 1992). Wolf pups usually leave the natal den in early August, but do not leave the summer range until October. As predators of migratory caribou, wolves within the Back River area have larger home ranges and exhibit fewer territorial behaviours than wolves in other parts of North America (Walton et al. 2001). Wolves require specific habitat features that allow them to dig denning structures. In the tundra environment within the Slave Geological Province, eskers and other glacial deposits provide the best habitat for den sites (Mueller 1995; Rescan 1995; Golder 1998; Walton et al. 2001; Cluff, Walton, and Paquet 2002; P.D. McLoughlin et al. 2004). Dens may also occur in other areas that are easy to excavate such as mounds of glacial-fluvial sediment or along lake banks. Dens are focal points of wolf activity during the summer, and there is evidence that individual wolves exhibit fidelity to den sites (Cluff, Walton, and Paquet 2002), returning and using the same areas in successive years (Walton et al. 2001).

10.1.1.3 Arctic Foxes

Arctic foxes occur throughout the Arctic (Feldhamer, Thompson, and Chapman 2003). Annual density fluctuations are often related to prey availability, particularly lemmings (D. G. Reid, Krebs, and Kenney 1997; Angerbjörn, Tannerfeldt, and Erlinge 1999; Feldhamer, Thompson, and Chapman 2003), where there is often a lag effect with the peak fox abundance following peak rodent abundance by one to two years.

Foxes use earthen dens primarily for reproduction and cover during bad weather events (Eberhardt, Garrott, and Hanson 1983). Dens can be found in open tundra, talus slopes, rock outcrops, and under boulder piles. Dens are generally in mounds, close to streams, in locations with low snow cover, and where ground temperature and depth of loose soil are high (Smits, Smith, and Slough 1988; Szor, Berteaux, and Gauthier 2008). Similar to grizzly bears, fox dens are also usually located on steep slopes with a southerly aspect, and in sandy soils (Smits, Smith, and Slough 1988; Szor, Berteaux, and Gauthier 2008). Foxes may dig many dens, but those used for reproduction tend to be in areas with sufficient food resources and far from other dens (Szor, Berteaux, and Gauthier 2008). Foxes show strong den fidelity, which is exhibited by breeding adults even when rodent availability is low, demonstrating permanency of dens sites and the importance of determining their locations within proximity to proposed Project activities (Strand et al. 2000; Feldhamer, Thompson, and Chapman 2003).

10.2 OBJECTIVES

The objectives of the carnivore den surveys in 2011 were to determine the location, number, and status of grizzly bear, wolf, and fox dens within the RCSA.

10.3 METHODS

10.3.1 Aerial Surveys

Aerial surveys were conducted using a helicopter to identify carnivore dens within the RCSA (Figure 3-1). An occupancy survey was conducted in June, 2011, to determine the species occupying a den and occupancy status. Potential den sites were surveyed, during which time the surveyors determined whether den sites were active, inactive, or unknown. Status was determined based on observations of species at the den sites or suitable den characteristics, such as multiple or single den entrances of appropriate size and fresh tracks or scat. When dens were found to be active and species were positively identified, the helicopter immediately left the area to minimize disturbance to the animals.

In July 2011, productivity surveys were conducted at dens identified as active or unknown during the 2011 occupancy surveys. These dens were revisited to confirm their status and determine if they had been productive through the summer. Surveys were conducted using a helicopter, during which time the surveyors determined whether den sites were active and determined whether young were present (i.e., productive). When dens were determined to be inactive, a ground survey was conducted to confirm the status by looking for signs of recent activity such as tracks, scat, or food debris. When dens were found to be active and/or species were positively identified at the den site, the helicopter immediately left the area to minimize disturbance to the animals.

10.4 RESULTS

The carnivore den occupancy survey was conducted on June 2 and June 5, 2011, and the productivity survey was conducted from July 25 to 27, 2011. No carnivore dens were observed during the aerial surveys. A wolf pair was observed during occupancy surveys and one Arctic fox kit was observed during productivity surveys (Table 10.4-1); however, no dens were observed.

Table 10.4-1. Carnivores Observed during Occupancy and Productivity Surveys, 2011

Date	Easting	Northing	Species	Scientific Name	No. Observed
June 5, 2011	405615	7288237	Grey Wolf	*Canis lupus*	2
July 26, 2011	440645	7284632	Arctic Fox	*Alopex lagopus*	1

10.5 DISCUSSION

No carnivore dens were observed during occupancy or productivity surveys in 2011. No reproductive behaviour was noted in the Back River study area. However, incidental observations of two female grizzly bears with cubs (Section 11.4), young wolves, and a fox kit suggest that carnivore dens may be present. Suitable denning habitat exists within the RCSA, which is located within the range of denning grizzly bears, grey wolves, and Arctic foxes.

11. Incidental Observation of Mammals

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11. Incidental Observations of Mammals

11.1 INTRODUCTION

Systematic baseline surveys were conducted in 2011 for upland breeding birds, waterbirds, raptors, marine birds, marine mammals, and carnivore dens. During these surveys, all incidental sightings of mammal species within the four wildlife study areas (the LSA, RA, RSCA, and MSA) were recorded.

11.2 OBJECTIVES

The objective of recording incidental observations of mammals was to document the presence of mammal species in the LSA, RA, RSCA, and MSA.

11.3 METHODS

Incidental observations of mammals, including signs of wildlife (e.g. tracks, scat, and dens), were recorded during wildlife field inventories in 2011. Date, species, number of individuals, sex, age, behaviour, location, and habitat were documented whenever possible. Incidental observations of mammals were also documented by field staff in other disciplines.

11.4 RESULTS

A total of seven mammal species and 2,531 individuals were observed incidentally during field baseline surveys in 2011 (Figure 11.4-1; Table 11.4-1; Plate 11.4-1; Appendix 11.4-1). The most commonly observed species were caribou. Caribou were recorded on 25 separate occasions totalling 2,506 individuals (Table 11-4-1; Appendix 11.4-1). A large number of caribou were observed moving south just to the east of the Goose Lake camp on July 26 and 27; roughly 2,000 individuals were recorded on July 27.

Table 11-4-1. Incidental Observations of Mammals Recorded in 2011

Species	Scientific Name	No. Observed				Total Observed
		June	July	August	September	
Arctic fox	*Alopex lagopus*	1				**1**
Arctic ground squirrel	*Spermophilus parryii*		0*			**0***
Arctic hare	*Lepus arcticus*	1				**1**
Caribou	*Rangifer tarandus groenlandicus*	26	2,430	50		**2,506**
Grey wolf	*Canis lupus*	1	4		5	**10**
Grizzly bear	*Ursus arctos*		4	3	3	**10**
Muskox	*Ovibos moschatus*	3				**3**
Total		**31**	**2,439**	**53**	**8**	**2,531**

** A ground squirrel colony was observed during raptor productivity surveys, no individuals were observed at the colony.*

A higher number of mammals were observed incidentally in July and August, likely due to the higher survey effort during the summer (Figure 11.4-1; Table 11-4-1). In addition, the majority of incidental observations were recorded in the LSA and RA, also likely due to the higher number of field staff recording observations in these areas.

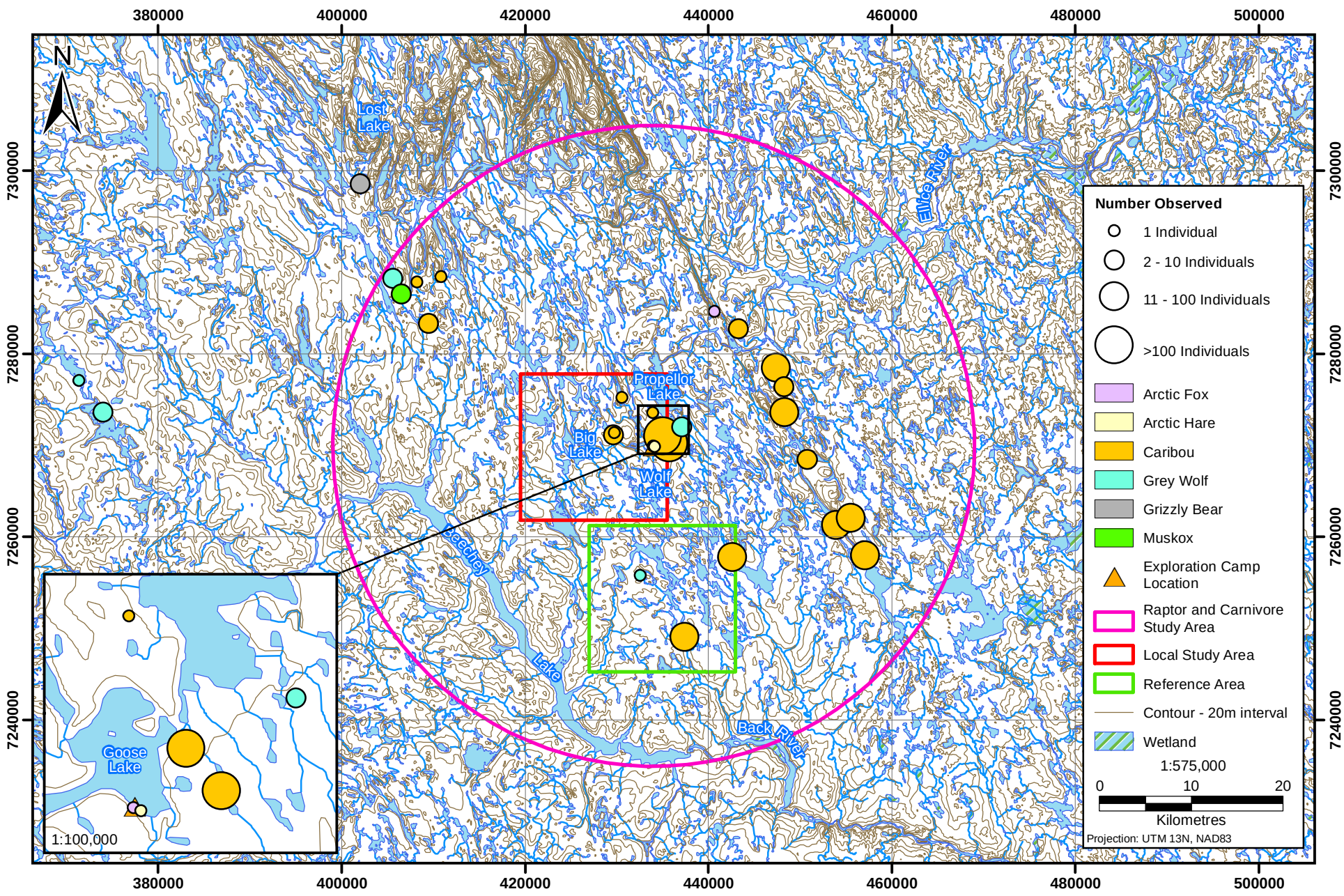

Figure 11.4-1a

Sabina

Incidental Observations of Mammals Recorded during Baseline Studies, 2011 - Goose Lake Property Area

Figure 11.4-1a

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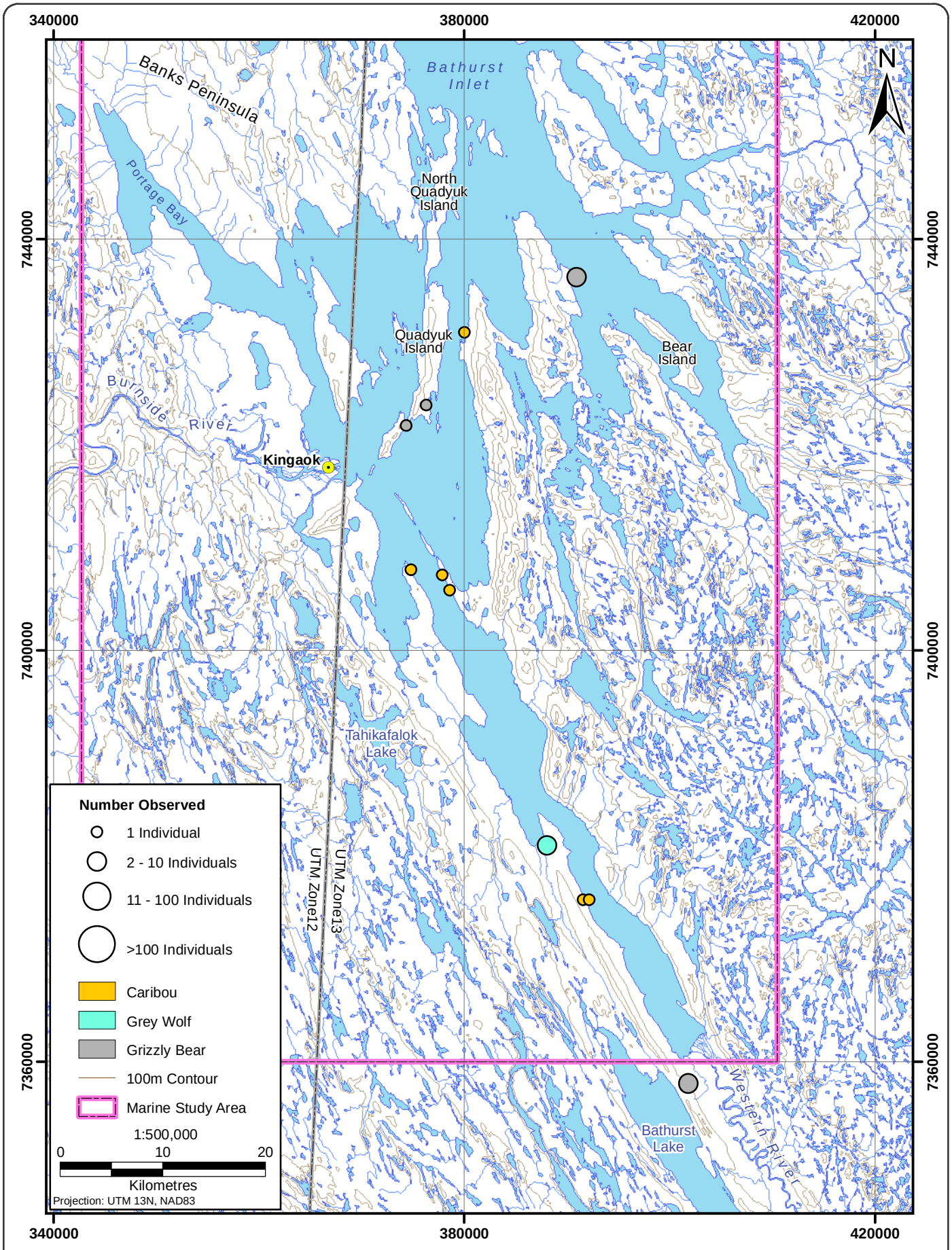

Figure 11.4-1b

Incidental Observations of Mammals Recorded during Baseline Studies, 2011 - Bathurst Inlet

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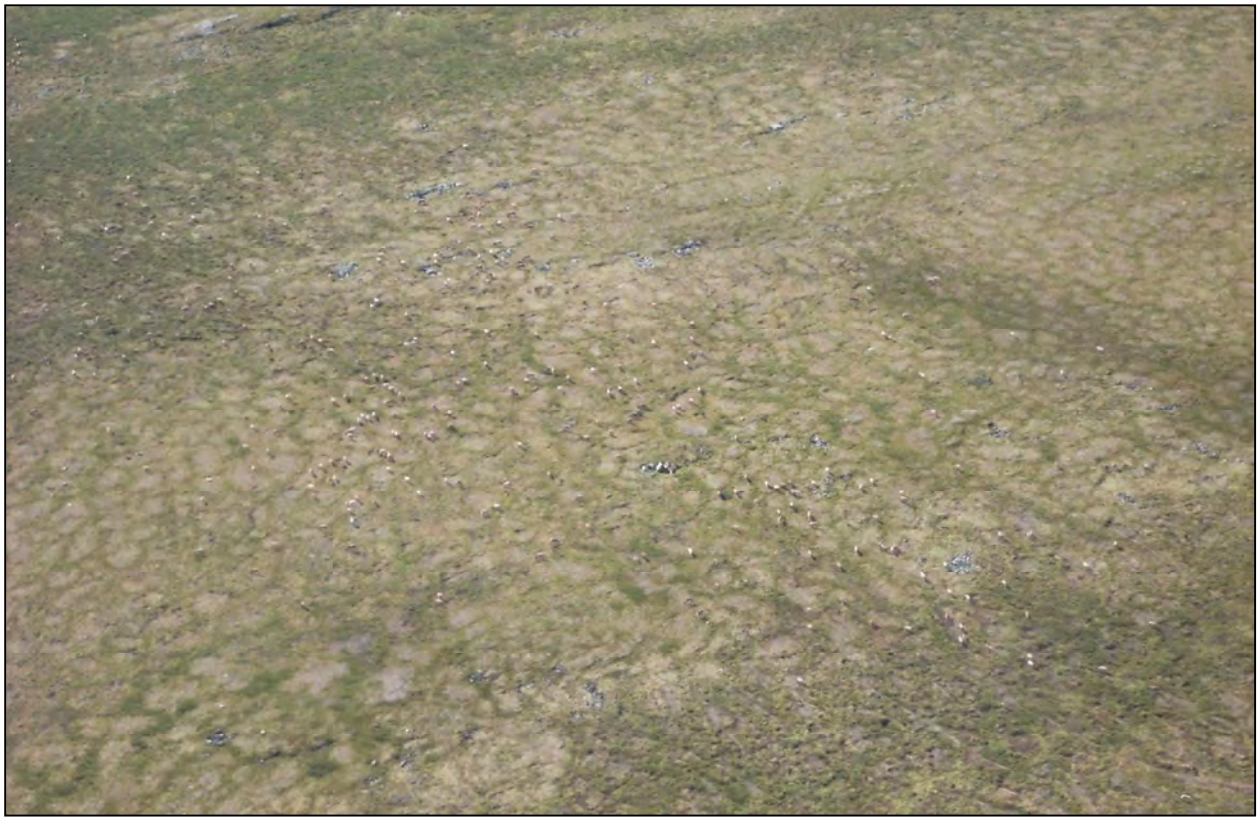
a) Arctic hare observed at Goose Lake Camp, June 4, 2011

b) Part of large group of caribou observed migrating south past the Goose Lake Camp, July 27, 2011



c) Part of large group of caribou observed migrating south just east of the Goose Lake Camp, July 27, 2011

Plate 11.4-1. Example of incidental mammal observations collected in 2011.

There were several observations of mammals with young, including two observations of a female grizzly bear with two yearlings, one observation of four yearling wolves, and multiple observations of caribou calves with the large caribou herd that passed by the Goose Lake Camp in late July (Appendix 11.4-1).

11.5 DISCUSSION

Seven mammal species were observed incidentally in 2011; caribou were the most frequently observed mammals. The Back River Project is located within the Ahiak and Bathurst caribou herd's annual home range (GNWT ENR 2011; Rescan 2011). Ahiak and Bathurst caribou are most commonly present around the Project area in the summer (mid-July to the end of August), based on the distribution of collared female caribou (Rescan 2011). Therefore, annual use of habitat within the LSA by caribou can be expected during the summer.

Incidental observations confirmed that carnivore dens likely occur within or near the RCSA. While no dens were observed during aerial surveys in June and July, young wolves and grizzly bears were observed in the RCSA in September (Appendix 11.4-1). Therefore, suitable denning habitat occurs within or near the Project area.

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Appendix 4-1

Potentially Occurring Wildlife Species in the Back River Terrestrial and Marine Study Areas

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Appendix 4-1. Potentially Occurring Wildlife Species in the Back River Terrestrial and Marine Study Areas

Common Name	Scientific Name	Group	Likelihood of Occurrence	Detected During Baseline Studies	Presence Relative to Study Area	Presence in Ecozones Associated with the Proposed Project			Conservation Status				
						Southern Arctic	Northern Arctic	Arctic Ocean	Terr. Rank	COSEWIC	SARA	Global Rank	IUCN Red List
Birds													
Yellow-billed Loon	*Gavia adamsii*	Waterbird	L	Y	Breeder	X	X		Secure	NAR		G4	Least Concern
Pacific Loon	*Gavia pacifica*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Red-throated Loon	*Gavia stellata*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Greater White-fronted Goose	*Anser albifrons*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Canada Goose	*Branta canadensis*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Cackling Goose	*Branta hutchinsii*	Waterbird	L	N	Seasonal Migrant	X	X		Secure			G5	Least Concern
Tundra Swan	*Cygnus columbianus*	Waterbird	L	N	Breeder	X	X		Secure			G5	Least Concern
Northern Pintail	*Anas acuta*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Common Eider	*Somateria mollissima*	Waterbird	L	Y	Seasonal Migrant	X	X		Sensitive			G5	Least Concern
King Eider	*Somateria spectabilis*	Waterbird	L	N	Seasonal Migrant	X	X		Sensitive			G5	Least Concern
Black (American) Scoter	*Melanitta americana*	Waterbird	L	Y	Seasonal Migrant	X			Undetermined			G5	Least Concern
White-winged Scoter	*Melanitta fusca*	Waterbird	L	Y	Breeder	X			Undetermined			G5	Least Concern
Surf Scoter	*Melanitta perspicillata*	Waterbird	L	Y	Breeder				Undetermined			G5	Least Concern
Long-tailed duck	*Clangula hyemalis*	Waterbird	L	Y	Breeder	X	X		Sensitive			G5	Least Concern
Red-breasted Merganser	*Mergus serrator*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Golden Eagle	*Aquila chrysaetos*	Raptor	L	Y	Breeder	X			Sensitive	NAR		G5	Least Concern
Rough-legged Hawk	*Buteo lagopus*	Raptor	L	Y	Breeder	X	X		Sensitive	NAR		G5	Least Concern
Northern Harrier	*Circus cyaneus*	Raptor	L	Y	Breeder	X			Undetermined	NAR		G5	Least Concern
Peregrine Falcon	*Falco peregrinus*	Raptor	L	Y	Breeder	X	X		Secure	TH/SC	1/3	G4	Least Concern
Gyrfalcon	*Falco rusticolus*	Raptor	L	Y	Resident	X	X		Sensitive	NAR		G5	Least Concern
Willow Ptarmigan	*Lagopus lagopus*	Upland Breeding Bird	L	Y	Resident	X	X		Secure			G5	Least Concern
Rock Ptarmigan	*Lagopus muta*	Upland Breeding Bird	L	Y	Resident	X	X		Secure			G5	Least Concern
Sandhill Crane	*Grus canadensis*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
American Golden-Plover	*Pluvialis dominica*	Shorebird	L	Y	Breeder	X	X		Sensitive			G5	Least Concern
Semipalmated Plover	*Charadrius semipalmatus*	Shorebird	L	Y	Breeder				Secure			G5	Least Concern
Least Sandpiper	*Calidris minutilla*	Shorebird	L	Y	Breeder	X			Sensitive			G5	Least Concern
Baird's Sandpiper	*Calidris bairdii*	Shorebird	L	N	Breeder	X	X		Secure			G5	Least Concern
Semipalmated Sandpiper	*Calidris pusilla*	Shorebird	L	Y	Breeder	X	X		Sensitive			G5	Least Concern
White-rumped Sandpiper	*Calidris fuscicollis*	Shorebird	L	N	Breeder/Seasonal Migrant	X	X		Secure			G5	Least Concern
Pectoral Sandpiper	*Calidris melanotos*	Shorebird	L	N	Breeder/Seasonal Migrant	X	X		Secure			G5	Least Concern
Red-necked Phalarope	*Phalaropus lobatus*	Shorebird	L	Y	Breeder	X	X		Sensitive			G4G5	Least Concern
Wilson's snipe	*Gallinago delicata*	Shorebird	L	N	Breeder	X			Undetermined			G5	Least Concern
Long-tailed Jaeger	*Stercorarius longicaudus*	Seabird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Parasitic Jaeger	*Stercorarius parasiticus*	Seabird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Herring Gull	*Larus argentatus*	Waterbird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Glaucous Gull	*Larus hyperboreus*	Waterbird	L	Y	Breeder	X	X		Sensitive			G5	Least Concern
Arctic Tern	*Sterna paradisaea*	Waterbird	L	Y	Breeder	X	X		Sensitive			G5	Least Concern
Short-eared Owl	*Asio flammeus*	Raptor	L	Y	Breeder	X			Sensitive	SC	3	G5	Least Concern
Snowy Owl	*Nyctea scandiaca*	Raptor	L	N	Seasonal Migrant	X	X		Secure	NAR		G5	Least Concern
Common Raven	*Corvus corax*	Raptor	L	Y	Resident	X	X		Secure			G5	Least Concern
Horned Lark	*Eremophila alpestris*	Upland Breeding Bird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Gray-cheeked Thrush	*Catharus minimus*	Upland Breeding Bird	L	N	Breeder	X			Undetermined			G5	Least Concern
American Pipit	*Anthus rubescens*	Upland Breeding Bird	L	Y	Breeder	X	X		Sensitive			G5	Least Concern
American Tree Sparrow	*Spizella arborea*	Upland Breeding Bird	L	Y	Breeder	X			Sensitive			G5	Least Concern
Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	L	Y	Breeder	X			Secure			G5	Least Concern
White-crowned Sparrow	*Zonotrichia leucophrys*	Upland Breeding Bird	L	Y	Breeder	X			Sensitive			G5	Least Concern
Harris's Sparrow	*Zonotrichia querula*	Upland Breeding Bird	L	N	Breeder	X			Sensitive			G5	Least Concern
Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Smith's Longspur	*Calcarius pictus*	Upland Breeding Bird	L	N	Breeder	X			Secure			G5	Least Concern
Snow Bunting	*Plectrophenax nivalis*	Upland Breeding Bird	L	N	Breeder	X	X		Sensitive			G5	Least Concern
Common Redpoll	*Carduelis flammea*	Upland Breeding Bird	L	Y	Breeder	X	X		Secure			G5	Least Concern
Hoary Redpoll	*Carduelis hornemanni*	Upland Breeding Bird	L	Y	Breeder/Seasonal Migrant	X	X		Sensitive			G5	Least Concern
Common Loon	*Gavia immer*	Waterbird	P	N	Breeder	X	X		Secure	NAR		G5	Least Concern
Horned Grebe	*Podiceps auritus*	Waterbird	P	N	Breeder	X			Undetermined	SC		G5	Least Concern
Brant	*Branta bernicla*	Waterbird	P	Y	Seasonal Migrant	X	X		Secure			G5	Least Concern
Snow Goose	*Chen caerulescens*	Waterbird	P	N	Seasonal Migrant	X	X		Secure			G5	Least Concern
Ross's Goose	*Chen rosii*	Waterbird	P	N	Seasonal Migrant	X			Secure			G4	Least Concern
Mallard	*Anas platyrhynchos*	Waterbird	P	N	Breeder	X			Undetermined			G5	Least Concern

Appendix 4-1. Potentially Occurring Wildlife Species in the Back River Terrestrial and Marine Study Areas

Common Name	Scientific Name	Group	Likelihood of Occurrence	Detected During Baseline Studies	Presence Relative to Study Area	Presence in Ecozones Associated with the Proposed Project			Conservation Status				
						Southern Arctic	Northern Arctic	Arctic Ocean	Terr. Rank	COSEWIC	SARA	Global Rank	IUCN Red List
Birds *(cont.)*													
Gadwall	*Anas strepera*	Waterbird	P	Y	Breeder				Accidental			G5	Least Concern
Green-winged Teal	*Anas crecca*	Waterbird	P	Y	Breeder	X			Undetermined			G5	Least Concern
Blue-winged Teal	*Anas discors*	Waterbird	P	N	Breeder				Accidental			G5	Least Concern
Greater Scaup	*Aythya marila*	Waterbird	P	Y	Breeder	X			Secure			G5	Least Concern
Common Goldeneye	*Bucephala clangula*	Waterbird	P	N	Breeder				Undetermined			G5	Least Concern
Bald Eagle	*Haliaeetus leucocephalus*	Raptor	P	Y	Breeder	X			Undetermined	NAR		G5	Least Concern
Black-bellied Plover	*Pluvialis squatarola*	Shorebird	P	N	Seasonal Migrant	X	X		Sensitive			G5	Least Concern
Lesser Yellowlegs	*Tringa flavipes*	Shorebird	P	N	Breeder	X			Undetermined			G5	Least Concern
Whimbrel	*Numenius phaeopus*	Shorebird	P	N	Seasonal Migrant	X			Sensitive			G5	Least Concern
Hudsonian Godwit	*Limosa haemastica*	Shorebird	P	N	Seasonal Migrant	X			Undetermined			G4	Least Concern
Ruddy Turnstone	*Arenaria interpres*	Shorebird	P	N	Seasonal Migrant	X	X		Sensitive			G5	Least Concern
Red Knot	*Calidris canutus*	Shorebird	P	N	Seasonal Migrant	X	X		At Risk	EN/SC		G4	Least Concern
Sanderling	*Calidris alba*	Shorebird	P	N	Seasonal Migrant	X	X		Sensitive			G5	Least Concern
Dunlin	*Calidris alpina*	Shorebird	P	Y	Seasonal Migrant	X	X		Sensitive			G5	Least Concern
Stilt Sandpiper	*Calidris himantopus*	Shorebird	P	Y	Seasonal Migrant	X			Secure			G5	Least Concern
Buff-breasted Sandpiper	*Tryngites subruficollis*	Shorebird	P	N	Seasonal Migrant	X			Sensitive			G4	Near threatened
Long-billed Dowitcher	*Limnodromus scolopaceus*	Shorebird	P	N	Seasonal Migrant	X			not ranked			G5	Least Concern
Red Phalarope	*Phalaropus fulicaria*	Shorebird	P	N	Seasonal Migrant	X	X		Sensitive			G5	Least Concern
Pomarine Jaeger	*Stercorarius pomarinus*	Seabird	P	N	Seasonal Migrant	X	X		Secure			G5	Least Concern
Mew Gull	*Larus canus*	Waterbird	P	N	Breeder	X			Undetermined			G5	Least Concern
Thayer's gull	*Larus thayeri*	Waterbird	P	N	Breeder		X		Sensitive			G5	Least Concern
Sabine's Gull	*Xema sabini*	Waterbird	P	N	Breeder	X	X		Secure			G5	Least Concern
Thick-billed Murre	*Uria lomvia*	Seabird	P	N	Breeder	X	X		Secure			G5	Least Concern
American Robin	*Turdus migratorius*	Upland Breeding Bird	P	N	Breeder	X			Secure			G5	Least Concern
Cliff Swallow	*Petrochelidon phyrrhonota*	Upland Breeding Bird	P	N	Breeder	X			Undetermined			G5	Least Concern
Yellow Warbler	*Setophaga petechia*	Upland Breeding Bird	P	N	Breeder	X			Undetermined			G5	Least Concern
Lincoln's Sparrow	*Melospiza lincolnii*	Upland Breeding Bird	P	N	Breeder				Undetermined			G5	Least Concern
Red-necked Grebe	*Podiceps grisegena*	Waterbird	U	N	Breeder	X			Accidental	NAR		G5	Least Concern
Northern Fulmar	*Fulmarus glacialis*	Seabird	U	N	Seasonal Migrant		X		Sensitive			G5	Least Concern
American Wigeon	*Anas americana*	Waterbird	U	N	Breeder				Undetermined			G5	Least Concern
Lesser Scaup	*Aythya affinis*	Waterbird	U	N	Breeder				Undetermined			G5	Least Concern
Bufflehead	*Bucephala albeola*	Waterbird	U	N	Breeder				Undetermined			G5	Least Concern
Eskimo Curlew	*Numenius borealis*	Shorebird	U	N	Seasonal Migrant	X			At Risk	EN	1	GH	Critically endangered
Purple Sandpiper	*Calidris maritima*	Shorebird	U	N	Seasonal Migrant		X		Secure			G5	Least Concern
Ross's Gull	*Rhodostethia rosea*	Waterbird	U	N	Breeder	X	X		At Risk	TH	1	G3G4	Least Concern
Iceland Gull	*Larus glaucoides*	Waterbird	U	N	Seasonal Migrant		X		Secure			G5	Least Concern
Ivory Gull	*Pagophila eburnea*	Waterbird	U	N	Seasonal Migrant		X		At Risk	EN	1	G5	Near threatened
Black-legged Kittiwake	*Rissa tridactyla*	Waterbird	U	N	Breeder		X		Secure			G5	Least Concern
Dovekie	*Alle alle*	Seabird	U	N	Breeder	X	X		Sensitive			G5	Least Concern
Black Guillemot	*Cepphus grylle*	Seabird	U	N	Breeder	X	X		Secure			G5	Least Concern
Great Horned Owl	*Bubo virginianus*	Raptor	U	N	Resident	X			Undetermined			G5	Least Concern
Northern Hawk Owl	*Surnia ulula*	Raptor	U	N	Resident	X			Undetermined	NAR		G5	Least Concern
Northern Shrike	*Lanius excubitor*	Upland Breeding Bird	U	N	Breeder	X			Undetermined			G5	Least Concern
Bohemian Waxwing	*Bombycilla garrulus*	Upland Breeding Bird	U	N	Breeder	X			Accidental			G5	Least Concern
Northern Wheatear	*Oenanthe oenanthe*	Upland Breeding Bird	U	N	Seasonal Migrant		X		Sensitive			G5	Least Concern
European Starling	*Sturnus vulgaris*	Upland Breeding Bird	U	N	Breeder	X			Exotic			G5	Least Concern
Orange-crowned Warbler	*Oreothlypis celata*	Upland Breeding Bird	U	N	Breeder				Accidental			G5	Least Concern
Blackpoll Warbler	*Setophaga striata*	Upland Breeding Bird	U	N	Breeder	X			Undetermined			G5	Least Concern
Wilson's Warbler	*Cardellina pusilla*	Upland Breeding Bird	U	N	Vagrant	X			Undetermined			G5	Least Concern
Rusty Blackbird	*Euphagus carolinus*	Upland Breeding Bird	U	N	Breeder	X			Undetermined	SC	1	G4	Least Concern
Mammals													
Grey Wolf	*Canis lupus*	Carnivore	L	Y	Resident	X	X		Secure	NAR		G4	Least Concern
Wolverine	*Gulo gulo*	Carnivore	L	N	Resident	X	X		Secure	SC		G4	Vulnerable
Grizzly Bear	*Ursus arctos*	Carnivore	L	Y	Resident	X	X		Sensitive	SC		G4	Least Concern
Arctic Fox	*Vulpes lagopus*	Carnivore	L	Y	Resident	X	X		Secure			G5	Least Concern
Red Fox	*Vulpes vulpes*	Carnivore	L	N	Resident	X	X		Secure			G5	Least Concern
Ermine	*Mustela erminea*	Furbearer	L	N	Resident	X	X		Secure			G5	Least Concern

Appendix 4-1. Potentially Occurring Wildlife Species in the Back River Terrestrial and Marine Study Areas

Common Name	Scientific Name	Group	Likelihood of Occurrence	Detected During Baseline Studies	Presence Relative to Study Area	Presence in Ecozones Associated with the Proposed Project			Conservation Status				
						Southern Arctic	Northern Arctic	Arctic Ocean	Terr. Rank	COSEWIC	SARA	Global Rank	IUCN Red List
Mammals *(cont.)*													
Nearctic Collared Lemming	*Dicrostonyx groenlandicus (Dicrostonyx kilangmiutak)*	Small mammal	L	N	Resident	X	X		Secure			G5	Least Concern
Nearctic Brown Lemming	*Lemmus trimucronatus*	Small mammal	L	N	Resident	X	X		Secure			G5	Least Concern
Arctic Hare	*Lepus arcticus*	Small mammal	L	Y	Resident	X	X		Secure			G5	Least Concern
Root Vole (Tundra Vole)	*Microtus oeconomus*	Small mammal	L	N	Resident	X			Undetermined			G5	Least Concern
Meadow Vole	*Microtus pennsylvanicus*	Small mammal	L	N	Resident	X			Secure			G5	Least Concern
Taiga Vole (Chestnut-cheeked vole)	*Microtus xanthognathus*	Small mammal	L	N	Resident	X			not ranked			G5	Least Concern
Northern Red-backed Vole	*Myodes rutilus*	Small mammal	L	N	Resident	X	X		Secure			G5	Least Concern
Barren Ground Shrew	*Sorex ugyunak*	Small mammal	L	N	Resident	X			Undetermined			G5	Least Concern
Arctic Ground Squirrel	*Spermophilus parryii*	Small mammal	L	Y	Resident	X	X		Secure			G5	Least Concern
Muskox	*Ovibos moschatus*	Ungulate	L	Y	Resident	X	X		Secure			G4	Least Concern
Barrenground Caribou (except Dolphin-Union)	*Rangifer tarandus groenlandicus*	Ungulate	L	Y	Resident/Seasonal Migrant	X			Secure			G5TNR	Least Concern
Bearded Seal	*Erignathus barbatus*	Marine Mammal	L	Y	Resident			X	Undetermined	NAR		G4G5	Least Concern
Ringed Seal	*Pusa hispida*	Marine Mammal	L	Y	Resident			X	Secure	NAR		G5	Least Concern
Least Weasel	*Mustela nivalis*	Furbearer	P	N	Resident	X			Secure			G5	Least Concern
American Mink	*Neovison vison*	Furbearer	P	N	Resident	X			Undetermined			G5	Least Concern
Richardson's Collared Lemming	*Dicrostonyx richardsoni*	Small mammal	P	N	Resident	X	X		Secure			G4?	Least Concern
Arctic Shrew	*Sorex arcticus*	Small mammal	P	N	Resident	X			not ranked			G5	Least Concern
Moose	*Alces americanus*	Ungulate	P	N	Resident	X			Secure			G5	Least Concern
Barrenground Caribou (Dolphin Union population)	*Rangifer tarandus groenlandicus x pearyi (R. t. pearyi x groenlandicus)*	Ungulate	P	N	Seasonal Migrant	X	X		not ranked	SC		G5TNR	not ranked
Beluga	*Delphinapterus leucas*	Marine Mammal	P	N	Seasonal Migrant			X	Sensitive/Secure			G4	Vulnerable
Narwhal	*Monodon monoceros*	Marine Mammal	P	N	Seasonal Migrant				Sensitive	SC		G4	Data Deficient
Polar Bear	*Ursus maritimus*	Carnivore	U	N	Resident	X	X		Sensitive	SC	1	G3	Vulnerable
Beaver	*Castor canadensis*	Furbearer	U	N	Resident	X			Undetermined			G5	Least Concern
North American River Otter	*Lontra canadensis*	Furbearer	U	N	Resident	X			Sensitive			G5	Least Concern
Canadian Lynx	*Lynx canadensis*	Furbearer	U	N	Resident	X			Undetermined	NAR		G5	Least Concern
American Marten	*Martes americana*	Furbearer	U	N	Resident	X			Secure			G5	Least Concern
Snowshoe Hare	*Lepus americanus*	Small mammal	U	N	Resident	X			Sensitive			G5	Least Concern
Tundra Shrew	*Sorex tundrensis*	Small mammal	U	N	Resident	X			not ranked			G5	Least Concern
Peary Caribou	*Rangifer tarandus pearyi*	Ungulate	U	N	Seasonal Migrant		X		not ranked	EN	1	G5TNR	Endangered
Bowhead Whale	*Balaena mysticetus*	Marine Mammal	U	N	Seasonal Migrant			X	Sensitive	SC	1/2	G3TNR	Least Concern
Walrus	*Odobenus rosmarus*	Marine Mammal	U	N	Seasonal Migrant			X	Sensitive	SC		G4TNR	Least Concern
Harp Seal	*Phoca groenlandica*	Marine Mammal	U	N	Seasonal Migrant			X	Secure			G5	Least Concern
Little Brown Myotis	*Myotis lucifugus*	Bat	U	N	Breeder				Sensitive			G5	Least Concern
Long-legged Myotis	*Myotis volans*	Bat	U	N	Breeder				not ranked			G5	Least Concern
Western Long-eared Myotis	*Myotis evotis*	Bat	U	N	Breeder				not ranked			G5	Least Concern
Eastern Red Bat	*Lasiurus borealis*	Bat	U	N	Seasonal Migrant				Undetermined			G5	Least Concern
Hoary Bat	*Lasiurus cinereus*	Bat	U	N	Breeder				Undetermined			G5	Least Concern
Northern myotis	*Myotis septentrionalis*	Bat	U	N	Breeder				not ranked			G4	Least Concern

Appendix 5.4-1

PRISM Plot Locations and Survey Details, 2011

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Appendix 5.4-1. PRISM Plot Locations and Survey Details, 2011

Survey Date	Plot Name	Plot (Unique)	Start Time	End Time	Elapsed Time (hr)	Elapsed Time (min)	Southwest Corner		Northwest Corner	
							Easting	Northing	Easting	Northing
24-Jun-11	LSA11	2011_LSA11	8:46	10:57	2:11	131	426450	7278650	426450	7279050
24-Jun-11	LSA28	2011_LSA28	11:40				431400	7276550	431400	7276950
24-Jun-11	LSA35	2011_LSA35	14:00	15:36	1:36	96	437550	7277500	437550	7277900
25-Jun-11	LSA10	2011_LSA10	12:28	13:48	1:20	80	436200	7268650	436200	7269050
25-Jun-11	LSA2	2011_LSA2	14:30	16:03	1:33	93	426550	7271400	426550	7271800
25-Jun-11	LSA30	2011_LSA30	9:48	11:34	1:46	106	435150	7272100	435150	7272500
25-Jun-11	LSA36	2011_LSA36	7:22	9:04	1:42	102	437200	7274700	437200	7275100
27-Jun-11	RA11	2011_RA11	14:11	15:34	1:23	83	444200	7247400	444200	7247800
27-Jun-11	RA2	2011_RA2	10:02	11:50	1:48	108	433550	7250550	433550	7250950
27-Jun-11	RA27	2011_RA27	7:20	9:14	1:54	114	432000	7246200	432000	7246600
27-Jun-11	RA30	2011_RA30	12:23	13:56	1:33	93	439150	7248450	439150	7248850
28-Jun-11	RA21	2011_RA21	14:46	16:15	1:29	89	438000	7255600	438000	7256000
28-Jun-11	RA26	2011_RA26	13:11	14:30	1:19	79	438500	7253200	438500	7253600
28-Jun-11	RA32	2011_RA32	7:24	9:02	1:38	98	445450	7253400	445450	7253800
28-Jun-11	RA9	2011_RA9	7:40	9:23	1:43	103	440500	7255150	440500	7255550
29-Jun-11	LSA14	2011_LSA14	13:38	15:06	1:28	88	424500	7263700	424500	7264100
29-Jun-11	LSA22	2011_LSA22	11:46	13:20	1:34	94	430950	7263750	430950	7264150
29-Jun-11	RA29	2011_RA29	9:30	11:12	1:42	102	431400	7260650	431400	7261050
29-Jun-11	RA31	2011_RA31	7:35	9:08	1:33	93	432550	7255800	432550	7256200
30-Jun-11	RA15	2011_RA15	14:30	15:47	1:17	77	436250	7261050	436250	7261450
30-Jun-11	RA200	2011_RA200	10:04	11:45	1:41	101	440250	7258850	440250	7259250
30-Jun-11	RA5	2011_RA5	12:13	13:36	1:23	83	443600	7260550	443600	7260950
1-Jul-11	LSA23	2011_LSA23	7:08	8:39	1:31	91	439050	7263650	439050	7264050
1-Jul-11	LSA26	2011_LSA26	9:11	10:40	1:29	89	430600	7267150	430600	7267550
2-Jul-11	LSA19	2011_LSA19	7:14	8:59	1:45	105	432900	7271900	432900	7272300
2-Jul-11	LSA7	2011_LSA7	13:20	15:05	1:42	102	426300	7267200	426300	7267600
2-Jul-11	LSA9	2011_LSA9	11:19	12:52	1:33	93	429100	7274650	429100	7275050
3-Jul-11	LSA200	2011_LSA200	12:00	13:41	1:41	101	433100	7268750	433100	7269150
3-Jul-11	RA14	2011_RA14	7:38	9:23	1:45	105	441750	7250900	441750	7251300
3-Jul-11	RA38	2011_RA38	9:45	11:26	1:41	101	434550	7259000	434550	7259400

Appendix 5.4-1. PRISM Plot Locations and Survey Details, 2011

	Southeast Corner		Northeast Corner		Weather Conditions		
Survey Date	Easting	Northing	Easting	Northing	Temperature (°c)	Cloud Cover (%)	Wind (km/hr)
24-Jun-11	426750	7278650	426750	7279050	12	5	
24-Jun-11	431700	7276550	431700	7276950	12	5	10
24-Jun-11	437850	7277500	437850	7277900	15	5	25
25-Jun-11	436500	7268650	436500	7269050	10	80	5
25-Jun-11	426850	7271400	426850	7271800	5	100	15
25-Jun-11	435450	7272100	435450	7272500	5	100	10
25-Jun-11	437500	7274700	437500	7275100	3	100	10
27-Jun-11	444500	7247400	444500	7247800			
27-Jun-11	433850	7250550	433850	7250950	6	100	15
27-Jun-11	432300	7246200	432300	7246600	4	100	15
27-Jun-11	439450	7248450	439450	7248850	4	70	20
28-Jun-11	438300	7255600	438300	7256000	8	100	5
28-Jun-11	438800	7253200	438800	7253600	8	100	15
28-Jun-11	445750	7253400	445750	7253800	5	100	10
28-Jun-11	440800	7255150	440800	7255550	10	100	10
29-Jun-11	424800	7263700	424800	7264100	10	0	15
29-Jun-11	431250	7263750	431250	7264150	8	80	20
29-Jun-11	431700	7260650	431700	7261050	10	5	10
29-Jun-11	432850	7255800	432850	7256200	6	30	10
30-Jun-11	436550	7261050	436550	7261450	8	100	15
30-Jun-11	440550	7258850	440550	7259250	8	100	10
30-Jun-11	443900	7260550	443900	7260950	5		15
1-Jul-11	439350	7263650	439350	7264050	9	100	30
1-Jul-11	430900	7267150	430900	7267550	6	100	40
2-Jul-11	433200	7271900	433200	7272300	2		10
2-Jul-11	426600	7267200	426600	7267600	5	100	5
2-Jul-11	429400	7274650	429400	7275050	5	100	10
3-Jul-11	433400	7268750	433400	7269150	11	5	15
3-Jul-11	442050	7250900	442050	7251300	8	50	10
3-Jul-11	434850	7259000	434850	7259400	10	20	5

Appendix 5.4-2

PRISM Survey Data, 2011

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Appendix 5.4-2. PRISM Survey Data, 2011

Survey Date	Entry ID	Plot Name	Plot (Unique)	Species	Scientific Name	Code	No Observed				Total Observed	Habitat of Obs.	Behaviour	Comment(s)
							Male	Female	Young	Unknown				
24-Jun-11	78	LSA11	2011_LSA11	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		wet hummocks
24-Jun-11	79	LSA11	2011_LSA11	Lapland Longspur	*Calcarius lapponicus*	LALO	2				2	Boulder/Bedrock		
24-Jun-11	80	LSA11	2011_LSA11	Common Redpoll	*Carduelis flammea*	CORE				1	1	Boulder/Bedrock		
24-Jun-11	81	LSA11	2011_LSA11	Rock Ptarmigan	*Lagopus muta*	ROPT	1				1	Boulder/Bedrock		
24-Jun-11	82	LSA11	2011_LSA11	Horned Lark	*Eremophila alpestris*	HOLA				2	2	Boulder/Bedrock		Flew out of plot
24-Jun-11	83	LSA11	2011_LSA11	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Boulder/Bedrock		
24-Jun-11	84	LSA11	2011_LSA11	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Boulder/Bedrock		
24-Jun-11	85	LSA11	2011_LSA11	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
24-Jun-11	86	LSA11	2011_LSA11	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Boulder/Bedrock		
24-Jun-11	87	LSA11	2011_LSA11	Horned Lark	*Eremophila alpestris*	HOLA	1				1	Boulder/Bedrock		
24-Jun-11	88	LSA11	2011_LSA11	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Boulder/Bedrock		
24-Jun-11	89	LSA11	2011_LSA11	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Boulder/Bedrock		
24-Jun-11	90	LSA11	2011_LSA11	Common Redpoll	*Carduelis flammea*	CORE				1	1	Lichen/Heath		
24-Jun-11	91	LSA11	2011_LSA11	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Boulder/Bedrock		
24-Jun-11	92	LSA11	2011_LSA11	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Boulder/Bedrock		
24-Jun-11	93	LSA11	2011_LSA11	Rock Ptarmigan	*Lagopus muta*	ROPT	1				1	Boulder/Bedrock		
24-Jun-11	94	LSA11	2011_LSA11	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
24-Jun-11	95	LSA11	2011_LSA11	Common Redpoll	*Carduelis flammea*	CORE	1	1			2	Lichen/Heath	Pair	
24-Jun-11	96	LSA11	2011_LSA11	American Golden-plover	*Pluvialis dominica*	AGPL	1	1			2	Lichen/Heath	Pair	
24-Jun-11	97	LSA11	2011_LSA11	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Boulder/Bedrock		
24-Jun-11	98	LSA11	2011_LSA11	Horned Lark	*Eremophila alpestris*	HOLA				1	1	Lichen/Heath		
24-Jun-11	99	LSA11	2011_LSA11	Common Redpoll	*Carduelis flammea*	CORE				1	1	Boulder/Bedrock		
24-Jun-11	100	LSA11	2011_LSA11	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Lichen/Heath	Pair	
24-Jun-11	197	LSA28	2011_LSA28	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
24-Jun-11	198	LSA28	2011_LSA28	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
24-Jun-11	199	LSA28	2011_LSA28	Least Sandpiper	*Calidris minutilla*	LESA				1	1	Lichen/Heath		
24-Jun-11	200	LSA28	2011_LSA28	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Lichen/Heath	Pair	
24-Jun-11	201	LSA28	2011_LSA28	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
24-Jun-11	202	LSA28	2011_LSA28	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Lichen/Heath	Pair	
24-Jun-11	203	LSA28	2011_LSA28	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
24-Jun-11	204	LSA28	2011_LSA28	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
24-Jun-11	205	LSA28	2011_LSA28	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Lichen/Heath	Pair	
24-Jun-11	206	LSA28	2011_LSA28	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Lichen/Heath	Pair	
24-Jun-11	207	LSA28	2011_LSA28	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
24-Jun-11	208	LSA28	2011_LSA28	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
24-Jun-11	209	LSA28	2011_LSA28	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Lichen/Heath		
24-Jun-11	210	LSA28	2011_LSA28	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
24-Jun-11	211	LSA28	2011_LSA28	Least Sandpiper	*Calidris minutilla*	LESA				1	1	Lichen/Heath		
24-Jun-11	212	LSA28	2011_LSA28	Horned Lark	*Eremophila alpestris*	HOLA	1	1			2	Lichen/Heath	Pair	
24-Jun-11	213	LSA28	2011_LSA28	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
24-Jun-11	214	LSA28	2011_LSA28	Semipalmated Sandpiper	*Calidris pusilla*	SESA				1	1	Lichen/Heath		
24-Jun-11	215	LSA28	2011_LSA28	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Lichen/Heath		
24-Jun-11	216	LSA28	2011_LSA28	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
24-Jun-11	254	LSA35	2011_LSA35	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
24-Jun-11	255	LSA35	2011_LSA35	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
24-Jun-11	256	LSA35	2011_LSA35	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Lichen/Heath	Pair	
24-Jun-11	257	LSA35	2011_LSA35	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
24-Jun-11	258	LSA35	2011_LSA35	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
24-Jun-11	259	LSA35	2011_LSA35	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Short Shrub		
24-Jun-11	260	LSA35	2011_LSA35	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
24-Jun-11	261	LSA35	2011_LSA35	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Heath Hummock	Nest Found	Nest with 5 eggs

Appendix 5.4-2. PRISM Survey Data, 2011

Survey Date	Entry ID	Plot Name	Plot (Unique)	Species	Scientific Name	Code	No Observed				Total Observed	Habitat of Obs.	Behaviour	Comment(s)
							Male	Female	Young	Unknown				
24-Jun-11	262	LSA35	2011_LSA35	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Boulder/Bedrock		
24-Jun-11	263	LSA35	2011_LSA35	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
24-Jun-11	264	LSA35	2011_LSA35	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
24-Jun-11	265	LSA35	2011_LSA35	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1			
25-Jun-11	1	LSA2	2011_LSA2	Rock Ptarmigan	*Lagopus muta*	ROPT	1				1	Lichen/Heath		
25-Jun-11	2	LSA2	2011_LSA2	Rock Ptarmigan	*Lagopus muta*	ROPT					0	Lichen/Heath	Nest Found	nest with 11 eggs
25-Jun-11	3	LSA2	2011_LSA2	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
25-Jun-11	4	LSA2	2011_LSA2	American Pipit	*Anthus rubescens*	AMPI				1	1	Lichen/Heath		
25-Jun-11	5	LSA2	2011_LSA2	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1	1			2	Lichen/Heath	Pair	
25-Jun-11	6	LSA2	2011_LSA2	Horned Lark	*Eremophila alpestris*	HOLA	1				1	Lichen/Heath		flew from 75m NE
25-Jun-11	7	LSA2	2011_LSA2	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Lichen/Heath		
25-Jun-11	8	LSA2	2011_LSA2	Horned Lark	*Eremophila alpestris*	HOLA				1	1	Rocky Heath		
25-Jun-11	9	LSA2	2011_LSA2	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Lichen/Heath	Nest Found	Nest with 3 eggs
25-Jun-11	67	LSA10	2011_LSA10	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Lichen/Heath	Pair	
25-Jun-11	68	LSA10	2011_LSA10	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Short Shrub		
25-Jun-11	69	LSA10	2011_LSA10	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Boulder/Bedrock		
25-Jun-11	70	LSA10	2011_LSA10	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
25-Jun-11	71	LSA10	2011_LSA10	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
25-Jun-11	72	LSA10	2011_LSA10	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Short Shrub	Pair	Flew out of plot
25-Jun-11	73	LSA10	2011_LSA10	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
25-Jun-11	74	LSA10	2011_LSA10	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Lichen/Heath		
25-Jun-11	75	LSA10	2011_LSA10	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Short Shrub		
25-Jun-11	221	LSA30	2011_LSA30	Least Sandpiper	*Calidris minutilla*	LESA				1	1	Wetland		
25-Jun-11	222	LSA30	2011_LSA30	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		
25-Jun-11	223	LSA30	2011_LSA30	Willow Ptarmigan	*Lagopus lagopus*	WIPT	2				2	Heath Hummock		Flew into plot from south
25-Jun-11	224	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
25-Jun-11	225	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
25-Jun-11	226	LSA30	2011_LSA30	Least Sandpiper	*Calidris minutilla*	LESA				1	1	Water		
25-Jun-11	227	LSA30	2011_LSA30	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Heath Hummock		
25-Jun-11	228	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
25-Jun-11	230	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
25-Jun-11	231	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Heath Hummock		
25-Jun-11	232	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Heath Hummock	Pair	
25-Jun-11	233	LSA30	2011_LSA30	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Short Shrub		
25-Jun-11	234	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Short Shrub		
25-Jun-11	235	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Short Shrub		
25-Jun-11	236	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Wet Grass/Sedge		
25-Jun-11	237	LSA30	2011_LSA30	Willow Ptarmigan	*Lagopus lagopus*	WIPT				1	1	Wet Grass/Sedge		
25-Jun-11	238	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Heath Hummock		
25-Jun-11	239	LSA30	2011_LSA30	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		
25-Jun-11	240	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
25-Jun-11	241	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO				1	1	Lichen/Heath	Nest Found	Nest with 3 eggs
25-Jun-11	242	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Wet Grass/Sedge		
25-Jun-11	243	LSA30	2011_LSA30	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Wet Grass/Sedge		
25-Jun-11	244	LSA30	2011_LSA30	Willow Ptarmigan	*Lagopus lagopus*	WIPT				1	1	Short Shrub		
25-Jun-11	245	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Short Shrub		
25-Jun-11	246	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Rocky Heath		
25-Jun-11	247	LSA30	2011_LSA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
25-Jun-11	274	LSA36	2011_LSA36	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
25-Jun-11	275	LSA36	2011_LSA36	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Lichen/Heath		
25-Jun-11	276	LSA36	2011_LSA36	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Short Shrub		

Appendix 5.4-2. PRISM Survey Data, 2011

Survey Date	Entry ID	Plot Name	Plot (Unique)	Species	Scientific Name	Code	No Observed				Total Observed	Habitat of Obs.	Behaviour	Comment(s)
							Male	Female	Young	Unknown				
25-Jun-11	277	LSA36	2011_LSA36	Unknown Redpoll		REDP				1	1	Short Shrub		
25-Jun-11	278	LSA36	2011_LSA36	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Short Shrub		
25-Jun-11	279	LSA36	2011_LSA36	Unknown Redpoll		REDP				1	1	Lichen/Heath	Flying	
25-Jun-11	280	LSA36	2011_LSA36	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Lichen/Heath	Flying	
25-Jun-11	281	LSA36	2011_LSA36	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Lichen/Heath	Pair	
25-Jun-11	282	LSA36	2011_LSA36	Unknown Sandpiper						1	1	Lichen/Heath		
25-Jun-11	283	LSA36	2011_LSA36	Unknown Redpoll		REDP				2	2	Lichen/Heath		
25-Jun-11	284	LSA36	2011_LSA36	Lapland Longspur	*Calcarius lapponicus*	LALO	2				2	Lichen/Heath		
25-Jun-11	285	LSA36	2011_LSA36	Lapland Longspur	*Calcarius lapponicus*	LALO				1	1	Lichen/Heath		
27-Jun-11	318	RA2	2011_RA2	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Lichen/Heath		
27-Jun-11	319	RA2	2011_RA2	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Short Shrub		
27-Jun-11	320	RA2	2011_RA2	Unknown Redpoll		REDP				1	1	Lichen/Heath		Flew from 75m east
27-Jun-11	321	RA2	2011_RA2	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		Wet tussocks/hummocks
27-Jun-11	322	RA2	2011_RA2	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		Wet tussocks/hummocks
27-Jun-11	323	RA2	2011_RA2	American Golden-plover	*Pluvialis dominica*	AGPL	1	1			2	Heath Hummock	Pair	Wet tussocks/hummocks
27-Jun-11	324	RA2	2011_RA2	Horned Lark	*Eremophila alpestris*	HOLA	1	1			2	Heath Hummock	Pair	Wet tussocks/hummocks
27-Jun-11	325	RA2	2011_RA2	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		Wet tussocks/hummocks
27-Jun-11	326	RA2	2011_RA2	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
27-Jun-11	327	RA2	2011_RA2	Semipalmated Sandpiper	*Calidris pusilla*	SESA				1	1	Wetland		In a drainage with muddy orange water
27-Jun-11	328	RA2	2011_RA2	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		Wet tussocsks/hummocks
27-Jun-11	330	RA2	2011_RA2	Horned Lark	*Eremophila alpestris*	HOLA	1				1	Boulder/Bedrock		Flew into plot
27-Jun-11	331	RA2	2011_RA2	Horned Lark	*Eremophila alpestris*	HOLA				1	1	Boulder/Bedrock		
27-Jun-11	389	RA11	2011_RA11	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1	1			2	Short Shrub	Pair	
27-Jun-11	390	RA11	2011_RA11	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Short Shrub		
27-Jun-11	391	RA11	2011_RA11	Willow Ptarmigan	*Lagopus lagopus*	WIPT	1	1			2	Short Shrub	Pair	
27-Jun-11	392	RA11	2011_RA11	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Short Shrub		
27-Jun-11	393	RA11	2011_RA11	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Short Shrub		
27-Jun-11	394	RA11	2011_RA11	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Short Shrub		
27-Jun-11	395	RA11	2011_RA11	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1	1			2	Short Shrub	Pair	
27-Jun-11	396	RA11	2011_RA11	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Rocky Heath		
27-Jun-11	397	RA11	2011_RA11	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1	1			2	Heath Hummock	Pair	Drier and less shrubby
27-Jun-11	398	RA11	2011_RA11	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
27-Jun-11	399	RA11	2011_RA11	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		Drier and less shrubby
27-Jun-11	400	RA11	2011_RA11	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		Drier and less shrubby, with a few rocks
27-Jun-11	469	RA27	2011_RA27	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
27-Jun-11	470	RA27	2011_RA27	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
27-Jun-11	471	RA27	2011_RA27	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
27-Jun-11	472	RA27	2011_RA27	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
27-Jun-11	473	RA27	2011_RA27	Horned Lark	*Eremophila alpestris*	HOLA	1				1	Lichen/Heath		
27-Jun-11	474	RA27	2011_RA27	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
27-Jun-11	475	RA27	2011_RA27	Horned Lark	*Eremophila alpestris*	HOLA				1	1	Heath Hummock		
27-Jun-11	476	RA27	2011_RA27	American Golden-plover	*Pluvialis dominica*	AGPL	1	1			2	Heath Hummock	Probable Nest	
27-Jun-11	477	RA27	2011_RA27	Lapland Longspur	*Calcarius lapponicus*	LALO	4				4	Heath Hummock		
27-Jun-11	478	RA27	2011_RA27	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
27-Jun-11	479	RA27	2011_RA27	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1	1			2	Lichen/Heath	Nest Found	Nest with 5 eggs (432251 724377), nest GPSed as Lalon4
27-Jun-11	480	RA27	2011_RA27	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
27-Jun-11	481	RA27	2011_RA27	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Wet Grass/Sedge		
27-Jun-11	482	RA27	2011_RA27	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Wet Grass/Sedge		
27-Jun-11	483	RA27	2011_RA27	Rock Ptarmigan	*Lagopus muta*	ROPT				1	1	Lichen/Heath		
27-Jun-11	484	RA27	2011_RA27	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
27-Jun-11	485	RA27	2011_RA27	Stilt Sandpiper	*Calidris himantopus*	STSA				1	1	Short Shrub		

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Survey Date	Entry ID	Plot Name	Plot (Unique)	Species	Scientific Name	Code	No Observed				Total Observed	Habitat of Obs.	Behaviour	Comment(s)
							Male	Female	Young	Unknown				
27-Jun-11	509	RA30	2011_RA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
27-Jun-11	510	RA30	2011_RA30	Lapland Longspur	*Calcarius lapponicus*	LALO				1	1	Lichen/Heath		
27-Jun-11	511	RA30	2011_RA30	Unknown Redpoll		REDP				1	1	Boulder/Bedrock		
27-Jun-11	512	RA30	2011_RA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Boulder/Bedrock		
27-Jun-11	513	RA30	2011_RA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
27-Jun-11	514	RA30	2011_RA30	Unknown Redpoll		REDP				1	1	Lichen/Heath		
27-Jun-11	515	RA30	2011_RA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Boulder/Bedrock		
27-Jun-11	516	RA30	2011_RA30	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		
27-Jun-11	517	RA30	2011_RA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Short Shrub	Pair	
27-Jun-11	518	RA30	2011_RA30	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Wet Grass/Sedge		
27-Jun-11	519	RA30	2011_RA30	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
27-Jun-11	520	RA30	2011_RA30	Common Redpoll	*Carduelis flammea*	CORE				1	1	Wet Grass/Sedge		
28-Jun-11	361	RA9	2011_RA9	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Rocky Heath		
28-Jun-11	362	RA9	2011_RA9	Unknown Redpoll		REDP				1	1	Short Shrub		
28-Jun-11	363	RA9	2011_RA9	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Boulder/Bedrock		
28-Jun-11	364	RA9	2011_RA9	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Boulder/Bedrock		
28-Jun-11	365	RA9	2011_RA9	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Boulder/Bedrock		
28-Jun-11	366	RA9	2011_RA9	Rock Ptarmigan	*Lagopus muta*	ROPT				1	1	Boulder/Bedrock		
28-Jun-11	367	RA9	2011_RA9	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
28-Jun-11	368	RA9	2011_RA9	Common Redpoll	*Carduelis flammea*	CORE				1	1	Short Shrub		
28-Jun-11	370	RA9	2011_RA9	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Rocky Heath		
28-Jun-11	371	RA9	2011_RA9	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Rocky Heath		
28-Jun-11	372	RA9	2011_RA9	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
28-Jun-11	373	RA9	2011_RA9	Common Redpoll	*Carduelis flammea*	CORE				1	1	Rocky Heath		Flew to the west
28-Jun-11	374	RA9	2011_RA9	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
28-Jun-11	375	RA9	2011_RA9	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Heath Hummock		Wet HH
28-Jun-11	376	RA9	2011_RA9	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		Wet HH
28-Jun-11	377	RA9	2011_RA9	Hoary Redpoll	*Carduelis hornemanni*	HORE				1	1	Heath Hummock		Wet HH
28-Jun-11	378	RA9	2011_RA9	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		Wet HH
28-Jun-11	379	RA9	2011_RA9	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Heath Hummock		Wet HH
28-Jun-11	433	RA21	2011_RA21	Rock Ptarmigan	*Lagopus muta*	ROPT	1				1	Short Shrub		
28-Jun-11	434	RA21	2011_RA21	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Short Shrub		
28-Jun-11	435	RA21	2011_RA21	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Short Shrub		
28-Jun-11	436	RA21	2011_RA21	Willow Ptarmigan	*Lagopus lagopus*	WIPT				1	1	Short Shrub		
28-Jun-11	437	RA21	2011_RA21	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Short Shrub		
28-Jun-11	438	RA21	2011_RA21	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Short Shrub		
28-Jun-11	439	RA21	2011_RA21	Rock Ptarmigan	*Lagopus muta*	ROPT		1			1	Short Shrub		
28-Jun-11	440	RA21	2011_RA21	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1	1			2	Short Shrub	Pair	
28-Jun-11	441	RA21	2011_RA21	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
28-Jun-11	442	RA21	2011_RA21	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
28-Jun-11	443	RA21	2011_RA21	American Golden-plover	*Pluvialis dominica*	AGPL	1	1			2	Lichen/Heath	Probable Nest	
28-Jun-11	444	RA21	2011_RA21	Unknown Redpoll		REDP				1	1	Boulder/Bedrock		
28-Jun-11	452	RA26	2011_RA26	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		Wet HH
28-Jun-11	453	RA26	2011_RA26	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Heath Hummock		Wet HH
28-Jun-11	454	RA26	2011_RA26	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		Wet HH
28-Jun-11	455	RA26	2011_RA26	Lapland Longspur	*Calcarius lapponicus*	LALO	3				3	Lichen/Heath		
28-Jun-11	456	RA26	2011_RA26	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		
28-Jun-11	457	RA26	2011_RA26	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
28-Jun-11	458	RA26	2011_RA26	Common Redpoll	*Carduelis flammea*	CORE				1	1	Rocky Heath		
28-Jun-11	459	RA26	2011_RA26	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
28-Jun-11	460	RA26	2011_RA26	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		

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							Male	Female	Young	Unknown				
28-Jun-11	461	RA26	2011_RA26	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		
28-Jun-11	462	RA26	2011_RA26	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
28-Jun-11	551	RA32	2011_RA32	American Golden-plover	*Pluvialis dominica*	AGPL				1	1	Water		
28-Jun-11	552	RA32	2011_RA32	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Short Shrub		Wet shurbby HT
28-Jun-11	554	RA32	2011_RA32	Least Sandpiper	*Calidris minutilla*	LESA				1	1	Short Shrub		Wet shrubby HT, on lakeshore
28-Jun-11	555	RA32	2011_RA32	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Short Shrub		Wet shrubby HT
29-Jun-11	112	LSA14	2011_LSA14	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
29-Jun-11	113	LSA14	2011_LSA14	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1			1	2	Short Shrub		
29-Jun-11	114	LSA14	2011_LSA14	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		
29-Jun-11	115	LSA14	2011_LSA14	Rock Ptarmigan	*Lagopus muta*	ROPT	2	2			4	Heath Hummock		
29-Jun-11	116	LSA14	2011_LSA14	Horned Lark	*Eremophila alpestris*	HOLA	1				1	Lichen/Heath		
29-Jun-11	117	LSA14	2011_LSA14	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
29-Jun-11	118	LSA14	2011_LSA14	American Tree Sparrow	*Spizella arborea*	ATSP				1	1	Wet Grass/Sedge		
29-Jun-11	119	LSA14	2011_LSA14	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Wet Grass/Sedge		
29-Jun-11	120	LSA14	2011_LSA14	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
29-Jun-11	121	LSA14	2011_LSA14	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Wet Grass/Sedge		
29-Jun-11	143	LSA22	2011_LSA22	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
29-Jun-11	144	LSA22	2011_LSA22	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Rocky Heath		
29-Jun-11	145	LSA22	2011_LSA22	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Boulder/Bedrock	Pair	
29-Jun-11	146	LSA22	2011_LSA22	Common Redpoll	*Carduelis flammea*	CORE				2	2	Boulder/Bedrock		
29-Jun-11	147	LSA22	2011_LSA22	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Boulder/Bedrock		
29-Jun-11	148	LSA22	2011_LSA22	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
29-Jun-11	149	LSA22	2011_LSA22	Common Redpoll	*Carduelis flammea*	CORE				1	1	Short Shrub		
29-Jun-11	150	LSA22	2011_LSA22	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
29-Jun-11	151	LSA22	2011_LSA22	Unknown Redpoll		REDP	1	1			2	Short Shrub	Probable Nest	
29-Jun-11	152	LSA22	2011_LSA22	Unknown Redpoll		REDP				1	1	Rocky Heath		
29-Jun-11	153	LSA22	2011_LSA22	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
29-Jun-11	154	LSA22	2011_LSA22	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Rocky Heath		
29-Jun-11	155	LSA22	2011_LSA22	Lapland Longspur	*Calcarius lapponicus*	LALO				1	1	Rocky Heath	Probable Nest	
29-Jun-11	156	LSA22	2011_LSA22	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
29-Jun-11	157	LSA22	2011_LSA22	Lapland Longspur	*Calcarius lapponicus*	LALO	2	1			3	Lichen/Heath		
29-Jun-11	158	LSA22	2011_LSA22	Unknown Redpoll		REDP					0	Rocky Heath		old nest
29-Jun-11	159	LSA22	2011_LSA22	Horned Lark	*Eremophila alpestris*	HOLA	1				1	Lichen/Heath		
29-Jun-11	160	LSA22	2011_LSA22	Lapland Longspur	*Calcarius lapponicus*	LALO			3	1	4	Heath Hummock	Nest Found	Nest with 3 chicks
29-Jun-11	161	LSA22	2011_LSA22	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
29-Jun-11	162	LSA22	2011_LSA22	Willow Ptarmigan	*Lagopus lagopus*	WIPT	1				1	Rocky Heath		wet hummocks
29-Jun-11	491	RA29	2011_RA29	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
29-Jun-11	492	RA29	2011_RA29	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
29-Jun-11	493	RA29	2011_RA29	Lapland Longspur	*Calcarius lapponicus*	LALO	2				2	Lichen/Heath		
29-Jun-11	494	RA29	2011_RA29	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		On edge of lake
29-Jun-11	495	RA29	2011_RA29	Stilt Sandpiper	*Calidris himantopus*	STSA				1	1	Lichen/Heath		On edge of lake
29-Jun-11	496	RA29	2011_RA29	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
29-Jun-11	497	RA29	2011_RA29	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Lichen/Heath		On small HT island in lake
29-Jun-11	498	RA29	2011_RA29	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Short Shrub		
29-Jun-11	499	RA29	2011_RA29	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Wet Grass/Sedge		
29-Jun-11	500	RA29	2011_RA29	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Short Shrub		
29-Jun-11	501	RA29	2011_RA29	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Short Shrub		
29-Jun-11	502	RA29	2011_RA29	Lapland Longspur	*Calcarius lapponicus*	LALO	2				2	Wet Grass/Sedge		
29-Jun-11	503	RA29	2011_RA29	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Wet Grass/Sedge		On edge of lake
29-Jun-11	528	RA31	2011_RA31	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
29-Jun-11	529	RA31	2011_RA31	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		

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							Male	Female	Young	Unknown				
29-Jun-11	530	RA31	2011_RA31	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Lichen/Heath	Pair	
29-Jun-11	531	RA31	2011_RA31	Lapland Longspur	*Calcarius lapponicus*	LALO	2				2	Lichen/Heath		
29-Jun-11	532	RA31	2011_RA31	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
29-Jun-11	533	RA31	2011_RA31	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
29-Jun-11	534	RA31	2011_RA31	Horned Lark	*Eremophila alpestris*	HOLA				1	1	Lichen/Heath		
29-Jun-11	535	RA31	2011_RA31	Lapland Longspur	*Calcarius lapponicus*	LALO			3		3	Lichen/Heath	Nest Found	Nest with 2-3 chicks and 1 egg
29-Jun-11	536	RA31	2011_RA31	Horned Lark	*Eremophila alpestris*	HOLA	1	1			2	Lichen/Heath	Pair	
29-Jun-11	537	RA31	2011_RA31	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Lichen/Heath	Pair	
29-Jun-11	538	RA31	2011_RA31	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
29-Jun-11	539	RA31	2011_RA31	Unknown Redpoll		REDP					0	Lichen/Heath		old redpoll nest
29-Jun-11	540	RA31	2011_RA31	Lapland Longspur	*Calcarius lapponicus*	LALO	2				2	Lichen/Heath		
29-Jun-11	541	RA31	2011_RA31	Common Redpoll	*Carduelis flammea*	CORE				1	1	Rocky Heath		
30-Jun-11	337	RA5	2011_RA5	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Tussock Grass		
30-Jun-11	339	RA5	2011_RA5	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
30-Jun-11	340	RA5	2011_RA5	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
30-Jun-11	341	RA5	2011_RA5	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
30-Jun-11	342	RA5	2011_RA5	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Rocky Heath	Pair	
30-Jun-11	343	RA5	2011_RA5	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Heath Hummock	Pair	
30-Jun-11	344	RA5	2011_RA5	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		
30-Jun-11	345	RA5	2011_RA5	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Heath Hummock		
30-Jun-11	346	RA5	2011_RA5	Horned Lark	*Eremophila alpestris*	HOLA	1	1			2	Heath Hummock	Pair	
30-Jun-11	347	RA5	2011_RA5	Lapland Longspur	*Calcarius lapponicus*	LALO	2				2	Rocky Heath		
30-Jun-11	348	RA5	2011_RA5	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
30-Jun-11	349	RA5	2011_RA5	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		Fairly flat sparse HT
30-Jun-11	350	RA5	2011_RA5	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Heath Hummock		
30-Jun-11	351	RA5	2011_RA5	Lapland Longspur	*Calcarius lapponicus*	LALO	2				2	Rocky Heath		
30-Jun-11	352	RA5	2011_RA5	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
30-Jun-11	353	RA5	2011_RA5	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		Low sparse HT
30-Jun-11	354	RA5	2011_RA5	Lapland Longspur	*Calcarius lapponicus*	LALO	2				2	Rocky Heath		
30-Jun-11	356	RA5	2011_RA5	Common Redpoll	*Carduelis flammea*	CORE				1	1		Flying	
30-Jun-11	422	RA15	2011_RA15	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
30-Jun-11	423	RA15	2011_RA15	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
30-Jun-11	424	RA15	2011_RA15	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Boulder/Bedrock		
30-Jun-11	425	RA15	2011_RA15	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Heath Hummock		
30-Jun-11	426	RA15	2011_RA15	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
30-Jun-11	427	RA15	2011_RA15	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
30-Jun-11	428	RA15	2011_RA15	American Golden-plover	*Pluvialis dominica*	AGPL	1	1			2	Heath Hummock	Pair	
30-Jun-11	429	RA15	2011_RA15	Lapland Longspur	*Calcarius lapponicus*	LALO		1	5		6	Heath Hummock	Nest Found	Nest with 5 chicks
30-Jun-11	579	RA200	2011_RA200	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
30-Jun-11	580	RA200	2011_RA200	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
30-Jun-11	581	RA200	2011_RA200	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
30-Jun-11	582	RA200	2011_RA200	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		Wet HT
30-Jun-11	583	RA200	2011_RA200	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
30-Jun-11	584	RA200	2011_RA200	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Wet Grass/Sedge		
30-Jun-11	585	RA200	2011_RA200	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Lichen/Heath		Wet HT
30-Jun-11	586	RA200	2011_RA200	Red-necked Phalarope	*Phalaropus lobatus*	RNPH		1			1	Wetland		
30-Jun-11	587	RA200	2011_RA200	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1	1			2	Wet Grass/Sedge	Pair	
30-Jun-11	588	RA200	2011_RA200	Common Redpoll	*Carduelis flammea*	CORE				1	1	Lichen/Heath		
30-Jun-11	589	RA200	2011_RA200	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
30-Jun-11	590	RA200	2011_RA200	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		Wet HH
30-Jun-11	591	RA200	2011_RA200	Semipalmated Sandpiper	*Calidris pusilla*	SESA				1	1	Heath Hummock		Wet HH

Appendix 5.4-2. PRISM Survey Data, 2011

Survey Date	Entry ID	Plot Name	Plot (Unique)	Species	Scientific Name	Code	No Observed				Total Observed	Habitat of Obs.	Behaviour	Comment(s)
							Male	Female	Young	Unknown				
30-Jun-11	592	RA200	2011_RA200	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Heath Hummock		Wet HH
30-Jun-11	593	RA200	2011_RA200	Red-necked Phalarope	*Phalaropus lobatus*	RNPH		1			1	Wetland		
30-Jun-11	594	RA200	2011_RA200	Semipalmated Sandpiper	*Calidris pusilla*	SESA				1	1	Lichen/Heath		
30-Jun-11	595	RA200	2011_RA200	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
30-Jun-11	596	RA200	2011_RA200	Red-necked Phalarope	*Phalaropus lobatus*	RNPH	1				1	Wetland		
30-Jun-11	597	RA200	2011_RA200	Dunlin	*Calidris alpina*	DUNL				1	1	Wetland		
30-Jun-11	598	RA200	2011_RA200	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
1-Jul-11	168	LSA23	2011_LSA23	Lapland Longspur	*Calcarius lapponicus*	LALO				1	1	Heath Hummock		
1-Jul-11	169	LSA23	2011_LSA23	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
1-Jul-11	170	LSA23	2011_LSA23	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
1-Jul-11	171	LSA23	2011_LSA23	Unknown Redpoll		REDP				1	1	Heath Hummock		
1-Jul-11	172	LSA23	2011_LSA23	Unknown Redpoll		REDP				1	1	Rocky Heath		
1-Jul-11	173	LSA23	2011_LSA23	Lapland Longspur	*Calcarius lapponicus*	LALO				1	1	Short Shrub		
1-Jul-11	174	LSA23	2011_LSA23	Unknown Redpoll		REDP				1	1	Short Shrub		
1-Jul-11	175	LSA23	2011_LSA23	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Short Shrub		
1-Jul-11	176	LSA23	2011_LSA23	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Lichen/Heath		
1-Jul-11	177	LSA23	2011_LSA23	Horned Lark	*Eremophila alpestris*	HOLA				1	1	Rocky Heath		
1-Jul-11	178	LSA23	2011_LSA23	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
1-Jul-11	181	LSA26	2011_LSA26	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Rocky Heath		
1-Jul-11	182	LSA26	2011_LSA26	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Rocky Heath		
1-Jul-11	183	LSA26	2011_LSA26	Horned Lark	*Eremophila alpestris*	HOLA				1	1	Rocky Heath		
1-Jul-11	184	LSA26	2011_LSA26	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
1-Jul-11	185	LSA26	2011_LSA26	Common Redpoll	*Carduelis flammea*	CORE				1	1	Rocky Heath		
1-Jul-11	186	LSA26	2011_LSA26	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
1-Jul-11	187	LSA26	2011_LSA26	Horned Lark	*Eremophila alpestris*	HOLA				1	1	Rocky Heath		
1-Jul-11	188	LSA26	2011_LSA26	Horned Lark	*Eremophila alpestris*	HOLA	1				1	Lichen/Heath		
1-Jul-11	189	LSA26	2011_LSA26	American Golden-plover	*Pluvialis dominica*	AGPL				1	1	Rocky Heath	Nest Found	Nest with 4 eggs (430719 7267501)
1-Jul-11	190	LSA26	2011_LSA26	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
1-Jul-11	191	LSA26	2011_LSA26	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
1-Jul-11	192	LSA26	2011_LSA26	Unknown Redpoll		REDP				1	1	Rocky Heath		
1-Jul-11	193	LSA26	2011_LSA26	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
1-Jul-11	194	LSA26	2011_LSA26	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
1-Jul-11	195	LSA26	2011_LSA26	Horned Lark	*Eremophila alpestris*	HOLA	1	1			2	Rocky Heath	Pair	
2-Jul-11	14	LSA7	2011_LSA7	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
2-Jul-11	15	LSA7	2011_LSA7	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Lichen/Heath		
2-Jul-11	16	LSA7	2011_LSA7	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
2-Jul-11	17	LSA7	2011_LSA7	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Lichen/Heath		Flew west
2-Jul-11	18	LSA7	2011_LSA7	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
2-Jul-11	19	LSA7	2011_LSA7	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Lichen/Heath		
2-Jul-11	20	LSA7	2011_LSA7	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1	1			2	Lichen/Heath	Pair	
2-Jul-11	21	LSA7	2011_LSA7	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Wet Grass/Sedge		
2-Jul-11	22	LSA7	2011_LSA7	American Tree Sparrow	*Spizella arborea*	ATSP				1	1	Lichen/Heath		
2-Jul-11	23	LSA7	2011_LSA7	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Short Shrub		
2-Jul-11	24	LSA7	2011_LSA7	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
2-Jul-11	25	LSA7	2011_LSA7	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Lichen/Heath		
2-Jul-11	26	LSA7	2011_LSA7	Short-eared Owl	*Asio flammeus*	SEOW				1	1	Short Shrub	Nest Found	Nest with 5 eggs
2-Jul-11	27	LSA7	2011_LSA7	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Lichen/Heath		
2-Jul-11	28	LSA7	2011_LSA7	American Tree Sparrow	*Spizella arborea*	ATSP	1				1	Short Shrub		
2-Jul-11	29	LSA7	2011_LSA7	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Wet Grass/Sedge		
2-Jul-11	35	LSA7	2011_LSA7	Common Redpoll	*Carduelis flammea*	REDP					0		Nest Found	Redpoll nest with 5 eggs, coordinates 426457 7267605
2-Jul-11	37	LSA9	2011_LSA9	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		

Appendix 5.4-2. PRISM Survey Data, 2011

Survey Date	Entry ID	Plot Name	Plot (Unique)	Species	Scientific Name	Code	No Observed				Total Observed	Habitat of Obs.	Behaviour	Comment(s)
							Male	Female	Young	Unknown				
2-Jul-11	38	LSA9	2011_LSA9	Unknown Redpoll		REDP	1	1			2	Heath Hummock	Pair	
2-Jul-11	39	LSA9	2011_LSA9	Unknown Redpoll		REDP				1	1	Heath Hummock		
2-Jul-11	40	LSA9	2011_LSA9	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
2-Jul-11	41	LSA9	2011_LSA9	Lapland Longspur	*Calcarius lapponicus*	LALO	2				2	Heath Hummock		
2-Jul-11	42	LSA9	2011_LSA9	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		
2-Jul-11	43	LSA9	2011_LSA9	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
2-Jul-11	44	LSA9	2011_LSA9	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
2-Jul-11	45	LSA9	2011_LSA9	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Heath Hummock		
2-Jul-11	46	LSA9	2011_LSA9	American Tree Sparrow	*Spizella arborea*	ATSP				1	1	Heath Hummock		
2-Jul-11	47	LSA9	2011_LSA9	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		Flew south
2-Jul-11	48	LSA9	2011_LSA9	Unknown Redpoll		REDP	2				2	Heath Hummock		
2-Jul-11	49	LSA9	2011_LSA9	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Heath Hummock		
2-Jul-11	50	LSA9	2011_LSA9	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Heath Hummock	Pair	
2-Jul-11	51	LSA9	2011_LSA9	Semipalmated Sandpiper	*Calidris pusilla*	SESA				2	2	Heath Hummock		Flew into plot from north
2-Jul-11	52	LSA9	2011_LSA9	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
2-Jul-11	53	LSA9	2011_LSA9	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
2-Jul-11	54	LSA9	2011_LSA9	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		
2-Jul-11	55	LSA9	2011_LSA9	Unknown Redpoll		REDP				1	1	Heath Hummock		
2-Jul-11	56	LSA9	2011_LSA9	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Heath Hummock	Pair	
2-Jul-11	57	LSA9	2011_LSA9	Savannah Sparrow	*Passerculus sandwichensis*	SAVS		1			1	Heath Hummock		
2-Jul-11	58	LSA9	2011_LSA9	Common Redpoll	*Carduelis flammea*	CORE				1	1	Heath Hummock	Probable Nest	
2-Jul-11	59	LSA9	2011_LSA9	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
2-Jul-11	127	LSA19	2011_LSA19	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
2-Jul-11	128	LSA19	2011_LSA19	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
2-Jul-11	129	LSA19	2011_LSA19	Least Sandpiper	*Calidris minutilla*	LESA				1	1	Wet Grass/Sedge		
2-Jul-11	130	LSA19	2011_LSA19	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
2-Jul-11	131	LSA19	2011_LSA19	Unknown Redpoll		REDP		1			1	Lichen/Heath		
2-Jul-11	132	LSA19	2011_LSA19	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Boulder/Bedrock		
2-Jul-11	133	LSA19	2011_LSA19	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
2-Jul-11	134	LSA19	2011_LSA19	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		
2-Jul-11	135	LSA19	2011_LSA19	Lapland Longspur	*Calcarius lapponicus*	LALO		1	4		5	Lichen/Heath	Nest Found	Nest with four chicks
3-Jul-11	292	LSA200	2011_LSA200	Horned Lark	*Eremophila alpestris*	HOLA				1	1	Lichen/Heath		
3-Jul-11	293	LSA200	2011_LSA200	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Lichen/Heath	Pair	
3-Jul-11	294	LSA200	2011_LSA200	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Lichen/Heath	Pair	
3-Jul-11	295	LSA200	2011_LSA200	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
3-Jul-11	296	LSA200	2011_LSA200	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		
3-Jul-11	297	LSA200	2011_LSA200	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
3-Jul-11	298	LSA200	2011_LSA200	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
3-Jul-11	299	LSA200	2011_LSA200	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Heath Hummock		
3-Jul-11	300	LSA200	2011_LSA200	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		
3-Jul-11	301	LSA200	2011_LSA200	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Lichen/Heath	Pair	
3-Jul-11	302	LSA200	2011_LSA200	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		
3-Jul-11	303	LSA200	2011_LSA200	Unknown Redpoll		REDP				1	1	Lichen/Heath		Flew out of plot
3-Jul-11	304	LSA200	2011_LSA200	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
3-Jul-11	305	LSA200	2011_LSA200	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		Wet between hummocks
3-Jul-11	306	LSA200	2011_LSA200	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Heath Hummock		
3-Jul-11	307	LSA200	2011_LSA200	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Heath Hummock		
3-Jul-11	308	LSA200	2011_LSA200	Willow Ptarmigan	*Lagopus lagopus*	WIPT		1	6		7	Lichen/Heath	Nest Found	With six chicks
3-Jul-11	309	LSA200	2011_LSA200	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Lichen/Heath	Pair	
3-Jul-11	403	RA14	2011_RA14	Unknown Redpoll		REDP				1	1	Rocky Heath	Probable Nest	
3-Jul-11	404	RA14	2011_RA14	Horned Lark	*Eremophila alpestris*	HOLA	1	1	1		3	Rocky Heath	Pair	Family group with fledger

Appendix 5.4-2. PRISM Survey Data, 2011

Survey Date	Entry ID	Plot Name	Plot (Unique)	Species	Scientific Name	Code	No Observed				Total Observed	Habitat of Obs.	Behaviour	Comment(s)
							Male	Female	Young	Unknown				
3-Jul-11	405	RA14	2011_RA14	American Golden-plover	*Pluvialis dominica*	AGPL				1	1	Rocky Heath		
3-Jul-11	406	RA14	2011_RA14	Unknown Redpoll		REDP				1	1	Rocky Heath		
3-Jul-11	407	RA14	2011_RA14	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Rocky Heath		
3-Jul-11	408	RA14	2011_RA14	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Lichen/Heath		
3-Jul-11	409	RA14	2011_RA14	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
3-Jul-11	410	RA14	2011_RA14	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		
3-Jul-11	411	RA14	2011_RA14	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Wet Grass/Sedge		
3-Jul-11	412	RA14	2011_RA14	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Boulder/Bedrock		
3-Jul-11	413	RA14	2011_RA14	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Lichen/Heath		Wet HT/hummocks
3-Jul-11	414	RA14	2011_RA14	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Rocky Heath		
3-Jul-11	557	RA38	2011_RA38	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Heath Hummock		
3-Jul-11	558	RA38	2011_RA38	Savannah Sparrow	*Passerculus sandwichensis*	SAVS				1	1	Heath Hummock		
3-Jul-11	559	RA38	2011_RA38	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Heath Hummock		
3-Jul-11	560	RA38	2011_RA38	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Heath Hummock		
3-Jul-11	561	RA38	2011_RA38	Lapland Longspur	*Calcarius lapponicus*	LALO	1	1			2	Heath Hummock	Pair	
3-Jul-11	563	RA38	2011_RA38	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
3-Jul-11	564	RA38	2011_RA38	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
3-Jul-11	565	RA38	2011_RA38	Lapland Longspur	*Calcarius lapponicus*	LALO		1			1	Wet Grass/Sedge		
3-Jul-11	566	RA38	2011_RA38	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		
3-Jul-11	567	RA38	2011_RA38	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Wet Grass/Sedge		
3-Jul-11	568	RA38	2011_RA38	Savannah Sparrow	*Passerculus sandwichensis*	SAVS	1				1	Wet Grass/Sedge		
3-Jul-11	569	RA38	2011_RA38	Semipalmated Sandpiper	*Calidris pusilla*	SESA				1	1	Water		On lakeshore
3-Jul-11	570	RA38	2011_RA38	Lapland Longspur	*Calcarius lapponicus*	LALO	1				1	Heath Hummock		

Appendix 6.4-1

Waterbird Aerial Survey Details, 2011

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Appendix 6.4-1. Waterbird Aerial Survey Details, 2011

Survey Type	Date	Survey Strata	Start Time	End Time	Time off Transect (min)	Total Survey Time (min)	Temp. (˚C)	Cloud Cover (%)	Wind (km/hr)	Lighting
Spring Staging	04-Jul-11	LSA	12:27	13:49	14	82	16	<5	30	Bright
Spring Staging	06-Jul-11	RA	17:38	18:50	8	72	14		20	Bright
Fall Staging	06-Aug-11	LSA	11:16	12:50	13	94	15	10	5	Bright
Fall Staging	06-Aug-11	RA	13:41	15:10	7	89	15	10	5	Bright

Appendix 6.4-2

Waterbird Observation Data, Aerial Surveys 2011

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Appendix 6.4-2. Waterbird Observation Data, Aerial Surveys 2011

UID	Date	Survey Type	Survey Strata	Transect	Easting	Northing	Group No.	Species	Scientific Name	Code	Distance from Transect	No. Drakes	No. Hens	No. Unknown	Brood No.	Brood Class	Total Birds	Behaviour	Habitat Type	Comments
1	4-Jul-11	Spring Staging	LSA	1	432335	7277990	1	Canada Goose	*Branta canadensis*	CAGO	B			1			1		Lake	
2	4-Jul-11	Spring Staging	LSA	1	434651	7278001	1	Red-breasted Merganser	*Mergus serrator*	RBME	B	1					1		Lake	
3	4-Jul-11	Spring Staging	LSA	1	436343	7277975	1	Gadwall	*Anas strepera*	GADW	B	1	1				2	Pair	Heath Tundra	on the tundra, likely flushed off nest
4	4-Jul-11	Spring Staging	LSA	2	423479	7275842	1	Canada Goose	*Branta canadensis*	CAGO	C			10			10		Lake	off transect
5	4-Jul-11	Spring Staging	LSA	3	426059	7273989	1	Canada Goose	*Branta canadensis*	CAGO	B			12			12		Lake	
6	4-Jul-11	Spring Staging	LSA	3	431616	7273995	1	Herring Gull	*Larus argentatus*	HEGU	B			1			1	Flying	Lake	
7	4-Jul-11	Spring Staging	LSA	4	432665	7271993	1	Herring Gull	*Larus argentatus*	HEGU	B			1			1	Flying	Lake	
8	4-Jul-11	Spring Staging	LSA	5	424098	7270028	1	Herring Gull	*Larus argentatus*	HEGU	B			2			2	Flying	Lake	
9	4-Jul-11	Spring Staging	LSA	5	431521	7270045	1	Canada Goose	*Branta canadensis*	CAGO	B			1			1		Lake	
10	4-Jul-11	Spring Staging	LSA	5	434578	7270033	1	Herring Gull	*Larus argentatus*	HEGU	B			2			2	Flying	Lake	
11	4-Jul-11	Spring Staging	LSA	-	440239	7269724	1	Red-breasted Merganser	*Mergus serrator*	RBME	C	5					5		Lake	off transect
12	4-Jul-11	Spring Staging	LSA	-	440239	7269724	2	Arctic Tern	*Sterna paradisaea*	ARTE	C			2			2	Flying	Lake	off transect
13	4-Jul-11	Spring Staging	LSA	6	427373	7268016	1	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA	B	1	1				2	Pair	Lake	
14	4-Jul-11	Spring Staging	LSA	6	425721	7268031	1	Canada Goose	*Branta canadensis*	CAGO	B			22			22		Lake	
15	4-Jul-11	Spring Staging	LSA	6	425721	7268031	2	Red-breasted Merganser	*Mergus serrator*	RBME	B	1					1		Lake	
16	4-Jul-11	Spring Staging	LSA	6	424706	7267996	1	Canada Goose	*Branta canadensis*	CAGO	B			5			5		Lake	
17	4-Jul-11	Spring Staging	LSA	6	423934	7266588	1	Greater White-fronted Goose	*Anser albifrons*	GWFG	B			6			6		Lake	
18	4-Jul-11	Spring Staging	LSA	6	423934	7266588	2	Greater Scaup	*Aythya fuligula*	GRSC	B	1	1				2	Pair	Lake	
19	4-Jul-11	Spring Staging	LSA	6	423934	7266588	3	Long-tailed Duck	*Clangula hyemalis*	LTDU	B	3	3				6		Lake	
20	4-Jul-11	Spring Staging	LSA	7	424125	7266222	1	Canada Goose	*Branta canadensis*	CAGO	B			18			18		Lake	
21	4-Jul-11	Spring Staging	LSA	7	424471	7266159	1	Gadwall	*Anas strepera*	GADW	B			1			1		Lake	
22	4-Jul-11	Spring Staging	LSA	7	433287	7266018	1	Greater Scaup	*Aythya fuligula*	GRSC	B	1	1				2	Pair	Lake	
23	4-Jul-11	Spring Staging	LSA	8	439112	7263978	1	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA	B			1			1	Flying	Heath Tundra	
24	4-Jul-11	Spring Staging	LSA	8	439112	7263978	1	Arctic Tern	*Sterna paradisaea*	ARTE	B			1			1	Flying	Lake	
25	4-Jul-11	Spring Staging	LSA	8	438257	7264009	1	Canada Goose	*Branta canadensis*	CAGO	B			15			15		Lake	
26	4-Jul-11	Spring Staging	LSA	8	434490	7263981	1	Canada Goose	*Branta canadensis*	CAGO	B			6			6		Lake	
27	4-Jul-11	Spring Staging	LSA	8	433686	7263987	1	Red-throated Loon	*Gavia Stellata*	RTLO	B			1			1		Lake	
28	4-Jul-11	Spring Staging	LSA	8	433686	7263987	2	Red-breasted Merganser	*Mergus serrator*	RBME	B	3	1				4		Lake	
29	6-Jul-11	Spring Staging	RA	9	433036	7246991	1	Canada Goose	*Branta canadensis*	CAGO	B			11			11		Lake	
30	6-Jul-11	Spring Staging	RA	9	433641	7247007	1	Canada Goose	*Branta canadensis*	CAGO	B			15			15		Lake	
31	6-Jul-11	Spring Staging	RA	9	434205	7246971	1	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA	B			1			1	Flying	Heath Tundra	
32	6-Jul-11	Spring Staging	RA	9	435901	7247013	1	Canada Goose	*Branta canadensis*	CAGO	B			45			45		Lake	
33	6-Jul-11	Spring Staging	RA	9	442867	7246962	1	Herring Gull	*Larus argentatus*	HEGU	B			2			2	Flying	Lake	
34	6-Jul-11	Spring Staging	RA	10	444440	7249026	1	Greater Scaup	*Aythya fuligula*	GRSC	B		1				1		Lake	
35	6-Jul-11	Spring Staging	RA	10	443905	7249027	1	Red-breasted Merganser	*Mergus serrator*	RBME	B		2				2		Lake	
36	6-Jul-11	Spring Staging	RA	10	443497	7249013	1	Northern Pintail	*Anas acuta*	NOPI	B	2	2				4		Lake	
37	6-Jul-11	Spring Staging	RA	10	443170	7248982	1	Herring Gull	*Larus argentatus*	HEGU	B			2			2	Flying	Lake	
38	6-Jul-11	Spring Staging	RA	10	441175	7249004	1	Long-tailed Duck	*Clangula hyemalis*	LTDU	B		1				1		Lake	
39	6-Jul-11	Spring Staging	RA	10	439890	7249024	1	Arctic Tern	*Sterna paradisaea*	ARTE	B			1			1	Flying	Lake	
40	6-Jul-11	Spring Staging	RA	10	434135	7249018	1	Greater White-fronted Goose	*Anser albifrons*	GWFG	B			3			3		Lake	
41	6-Jul-11	Spring Staging	RA	11	441784	7250998	1	Long-tailed Duck	*Clangula hyemalis*	LTDU	B	1					1		Lake	
42	6-Jul-11	Spring Staging	RA	11	444749	7250980	1	Long-tailed Duck	*Clangula hyemalis*	LTDU	B	1					1		Lake	
43	6-Jul-11	Spring Staging	RA	12	447057	7253051	1	Long-tailed Duck	*Clangula hyemalis*	LTDU	B	1					1		Lake	
44	6-Jul-11	Spring Staging	RA	12	441930	7253030	1	Greater Scaup	*Aythya fuligula*	GRSC	B	1	1				2	Pair	Lake	
45	6-Jul-11	Spring Staging	RA	12	441930	7253030	2	Parasitic Jaeger	*Stercorarius parasiticus*	PAJA	B			1			1	Flying	Heath Tundra	
46	6-Jul-11	Spring Staging	RA	12	439548	7252947	1	Arctic Tern	*Sterna paradisaea*	ARTE	B			1			1	Flying	Heath Tundra	
47	6-Jul-11	Spring Staging	RA	12	439548	7252947	2	Canada Goose	*Branta canadensis*	CAGO	B			150			150		Lake	
48	6-Jul-11	Spring Staging	RA	12	437521	7253009	1	Canada Goose	*Branta canadensis*	CAGO	B			1			1		Lake	
49	6-Jul-11	Spring Staging	RA	12	436713	7253013	1	Greater Scaup	*Aythya fuligula*	GRSC	B	2	1				3		Lake	
50	6-Jul-11	Spring Staging	RA	12	436713	7253013	2	Canada Goose	*Branta canadensis*	CAGO	B			13			13		Lake	
51	6-Jul-11	Spring Staging	RA	12	436713	7253013	3	Canada Goose	*Branta canadensis*	CAGO	C			50			50		Lake	off to south
52	6-Jul-11	Spring Staging	RA	12	436713	7253013	4	Long-tailed Duck	*Clangula hyemalis*	LTDU	B	2	2				4	Pair	Lake	
53	6-Jul-11	Spring Staging	RA	12	433212	7253001	1	Arctic Tern	*Sterna paradisaea*	ARTE	B			2			2	Flying	Lake	
54	6-Jul-11	Spring Staging	RA	-	430476	7254512	1	Canada Goose	*Branta canadensis*	CAGO	C			15			15		Lake	off transect
55	6-Jul-11	Spring Staging	RA	13	436026	7254982	1	Arctic Tern	*Sterna paradisaea*	ARTE	B			5			5	Flying	Lake	

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56	6-Jul-11	Spring Staging	RA	13	438367	7254973	1	Canada Goose	*Branta canadensis*	CAGO	B			25			25		Lake	
57	6-Jul-11	Spring Staging	RA	13	440305	7255092	1	Long-tailed Jaeger	*Stercorarius longicaudus*	LTJA	B			1			1	Flying	Heath Tundra	
58	6-Jul-11	Spring Staging	RA	13	440750	7255041	1	Canada Goose	*Branta canadensis*	CAGO	B			35			35		Lake	
59	6-Jul-11	Spring Staging	RA	13	445371	7254991	1	Herring Gull	*Larus argentatus*	HEGU	B			1			1	Flying	Lake	
60	6-Jul-11	Spring Staging	RA	13	445371	7254991	2	Red-breasted Merganser	*Mergus serrator*	RBME	B		2				2		Lake	
61	6-Jul-11	Spring Staging	RA	14	445735	7257040	1	Herring Gull	*Larus argentatus*	HEGU	B			1			1	Flying	Lake	
62	6-Jul-11	Spring Staging	RA	14	444119	7256960	1	Canada Goose	*Branta canadensis*	CAGO	B			30			30		Lake	
63	6-Jul-11	Spring Staging	RA	14	440296	7256940	1	Herring Gull	*Larus argentatus*	HEGU	B			1			1	Flying	Lake	
64	6-Jul-11	Spring Staging	RA	14	438192	7256913	1	Canada Goose	*Branta canadensis*	CAGO	B			17			17		Lake	
65	6-Jul-11	Spring Staging	RA	14	437727	7256758	1	Sandhill Crane	*Grus canadensis*	SACR	B			2			2		Heath Tundra	
66	6-Jul-11	Spring Staging	RA	14	433332	7257057	1	Greater White-fronted Goose	*Anser albifrons*	GWFG	B			3			3		Lake	
67	6-Jul-11	Spring Staging	RA	14	433332	7257057	2	Long-tailed Duck	*Clangula hyemalis*	LTDU	B	1	1				2	Pair	Lake	
68	6-Jul-11	Spring Staging	RA	15	431086	7258986	1	Long-tailed Duck	*Clangula hyemalis*	LTDU	B	1	1				2	Pair	Lake	
69	6-Jul-11	Spring Staging	RA	15	433824	7258986	1	Canada Goose	*Branta canadensis*	CAGO	B			6			6		Lake	
70	6-Jul-11	Spring Staging	RA	15	433824	7258986	2	Arctic Tern	*Sterna paradisaea*	ARTE	B			7			7	Flying	Lake	
71	6-Jul-11	Spring Staging	RA	15	434369	7259011	1	Canada Goose	*Branta canadensis*	CAGO	B			27			27		Lake	
72	6-Jul-11	Spring Staging	RA	15	438039	7259017	1	Herring Gull	*Larus argentatus*	HEGU	B			1			1	Flying	Lake	
73	6-Jul-11	Spring Staging	RA	15	440611	7258994	1	Arctic Tern	*Sterna paradisaea*	ARTE	B			1			1	Flying	Lake	
74	6-Jul-11	Spring Staging	RA	15	441815	7259031	1	Canada Goose	*Branta canadensis*	CAGO	B			45			45		Lake	
75	6-Jul-11	Spring Staging	RA	15	444295	7259057	1	Arctic Tern	*Sterna paradisaea*	ARTE	B			1			1	Flying	Lake	
76	6-Jul-11	Spring Staging	RA	15	445848	7259056	1	Canada Goose	*Branta canadensis*	CAGO	B			16			16		Lake	
77	6-Jul-11	Spring Staging	RA	16	442387	7261076	1	Canada Goose	*Branta canadensis*	CAGO	B			17			17		Lake	
78	6-Jul-11	Spring Staging	RA	16	440288	7261019	1	Herring Gull	*Larus argentatus*	HEGU	B			1			1	Flying	Lake	
79	6-Jul-11	Spring Staging	RA	16	440288	7261019	2	Red-breasted Merganser	*Mergus serrator*	RBME	B		1				1		Lake	
80	6-Jul-11	Spring Staging	RA	16	439036	7261024	1	Canada Goose	*Branta canadensis*	CAGO	B			42			42		Lake	
81	6-Jul-11	Spring Staging	RA	16	437894	7261000	1	Long-tailed Duck	*Clangula hyemalis*	LTDU	B	1	1				2	Pair	Lake	
82	6-Jul-11	Spring Staging	RA	16	435804	7261025	1	Herring Gull	*Larus argentatus*	HEGU	B			1			1	Flying	Lake	
83	6-Aug-11	Fall Staging	LSA	1	432411	7277777	1	Canada Goose	*Branta canadensis*	CAGO				13			13		Lake	
84	6-Aug-11	Fall Staging	LSA	3	426286	7273959	1	Canada Goose	*Branta canadensis*	CAGO				4			4	Flying	Lake	flying over lake
85	6-Aug-11	Fall Staging	LSA	3	427946	7273894	1	Canada Goose	*Branta canadensis*	CAGO				18	4		22		Lake	4 likely immature
86	6-Aug-11	Fall Staging	LSA	3	429060	7274333	1	Canada Goose	*Branta canadensis*	CAGO				20			20		Lake	
87	6-Aug-11	Fall Staging	LSA	3	434054	7274009	1	Canada Goose	*Branta canadensis*	CAGO				17			17		Lake	
88	6-Aug-11	Fall Staging	LSA	3	440242	7273812	1	Canada Goose	*Branta canadensis*	CAGO				6			6		Lake	
89	6-Aug-11	Fall Staging	LSA	3	440242	7273812	2	Canada Goose	*Branta canadensis*	CAGO				35			35		Lake	
90	6-Aug-11	Fall Staging	LSA	4	436883	7272006	1			Shorebirds				12			12	Flying	Lake	flying over small lake
91	6-Aug-11	Fall Staging	LSA	4	425461	7271949	1	Canada Goose	*Branta canadensis*	CAGO				19			19		Lake	
92	6-Aug-11	Fall Staging	LSA	5	434794	7269640	1	Canada Goose	*Branta canadensis*	CAGO				34	1	3	35		Wetland	standing in shallow water
93	6-Aug-11	Fall Staging	LSA	6	439693	7268023	1			Gull				2			2	Flying	Heath Tundra	flying over tundra
94	6-Aug-11	Fall Staging	LSA	6	436146	7267542	1	Canada Goose	*Branta canadensis*	CAGO				38			38		Lake	
95	6-Aug-11	Fall Staging	LSA	6	435363	7268440	1			Gull				1			1		Lake	
96	6-Aug-11	Fall Staging	LSA	6	434357	7268050	1			Gull				1			1		Lake	
97	6-Aug-11	Fall Staging	LSA	6	425203	7268181	1	Canada Goose	*Branta canadensis*	CAGO				68			68		Lake	
98	6-Aug-11	Fall Staging	LSA	6	423953	7268320	1	Canada Goose	*Branta canadensis*	CAGO				10			10		Lake	
99	6-Aug-11	Fall Staging	LSA	-	423904	7267911	1	Canada Goose	*Branta canadensis*	CAGO				20			20			
100	6-Aug-11	Fall Staging	LSA	-	423924	7266796	1	Pacific Loon	*Gavia pacifica*	PALO				16			16		Lake	
101	6-Aug-11	Fall Staging	LSA	7	424100	7265909	1	Canada Goose	*Branta canadensis*	CAGO				12			12		Creek	
102	6-Aug-11	Fall Staging	LSA	7	428539	7265900	1	Canada Goose	*Branta canadensis*	CAGO				10			10		Lake	
103	6-Aug-11	Fall Staging	LSA	7	438819	7265736	1	Arctic Tern	*Sterna paradisaea*	ARTE				1			1	Flying	Lake	
104	6-Aug-11	Fall Staging	LSA	8	435695	7264142	1	Canada Goose	*Branta canadensis*	CAGO				12			12		Lake	
105	6-Aug-11	Fall Staging	LSA	8	434923	7264147	1	Canada Goose	*Branta canadensis*	CAGO				41			41		Lake	
106	6-Aug-11	Fall Staging	LSA	8	434326	7264208	1			Gull				1			1	Flying	Lake	
107	6-Aug-11	Fall Staging	LSA	8	433809	7264015	1	Canada Goose	*Branta canadensis*	CAGO				2			2		Lake	
108	6-Aug-11	Fall Staging	LSA	8	428818	7264435	1	Canada Goose	*Branta canadensis*	CAGO				60			60		Lake	some on grass/shore other on water
109	6-Aug-11	Fall Staging	LSA	8	428818	7264435	1	Pacific Loon	*Gavia pacifica*	PALO				6			6		Lake	
110	6-Aug-11	Fall Staging	LSA	-	423358	7264296	1	Long-tailed Jaeger	*Stercorarius longicaudus*	LTJA				2			2	Flying	Heath Tundra	

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111	6-Aug-11	Fall Staging	RSA	1	443000	7261038	1	Canada Goose	*Branta canadensis*	CAGO				2			2	Flying	Heath Tundra	flying over tundra
112	6-Aug-11	Fall Staging	RSA	1	433640	7260981	1	Canada Goose	*Branta canadensis*	CAGO				16			16		Lake	
113	6-Aug-11	Fall Staging	RSA	1	433640	7260981	2	Canada Goose	*Branta canadensis*	CAGO				40			40			on land/shore
114	6-Aug-11	Fall Staging	RSA	2	440714	7258863	1	Arctic Tern	*Sterna paradisaea*	ARTE				3			3	Flying	Lake	flying over lake
115	6-Aug-11	Fall Staging	RSA	2	440714	7258863	2	Canada Goose	*Branta canadensis*	CAGO				7			7		Lake	
116	6-Aug-11	Fall Staging	RSA	2	443107	7258908	1	Canada Goose	*Branta canadensis*	CAGO				18			18		Lake	8 on lake, 10 on land/shore
117	6-Aug-11	Fall Staging	RSA	3	446958	7257244	1	Canada Goose	*Branta canadensis*	CAGO				34			34		Lake	
118	6-Aug-11	Fall Staging	RSA	3	445885	7257243	1	Herring Gull	*Larus argentatus*	HEGU				2			2		Lake	
119	6-Aug-11	Fall Staging	RSA	3	445885	7257243	2	Red-breasted Merganser	*Mergus serrator*	RBME				2			2		Lake	
120	6-Aug-11	Fall Staging	RSA	3	444167	7256687	1	Herring Gull	*Larus argentatus*	HEGU				1			1	Flying	Lake	flying over lake
121	6-Aug-11	Fall Staging	RSA	3	442483	7256760	1			Gull				1			1	Flying	Other	
122	6-Aug-11	Fall Staging	RSA	3	441835	7256919	1			Gull				2			2	Flying	Other	
123	6-Aug-11	Fall Staging	RSA	3	441325	7257010	1	Canada Goose	*Branta canadensis*	CAGO				18			18		Lake	
124	6-Aug-11	Fall Staging	RSA	3	440894	7257116	1	Canada Goose	*Branta canadensis*	CAGO				16			16		Lake	
125	6-Aug-11	Fall Staging	RSA	3	440894	7257116	2	Canada Goose	*Branta canadensis*	CAGO				40			40		Lake	
126	6-Aug-11	Fall Staging	RSA	3	440264	7257466	1	Canada Goose	*Branta canadensis*	CAGO				16			16		Lake	
127	6-Aug-11	Fall Staging	RSA	3	437706	7257184	1	Arctic Tern	*Sterna paradisaea*	ARTE				2			2	Flying	Lake	flying over lake
128	6-Aug-11	Fall Staging	RSA	3	433392	7257435	1	Sandhill Crane	*Grus canadensis*	SACR				2	1	2c	3		Lake	running on tundra next to lake
129	6-Aug-11	Fall Staging	RSA	-	430862	7256154	1	Canada Goose	*Branta canadensis*	CAGO				3			3		Lake	standing on tundra next to lake
130	6-Aug-11	Fall Staging	RSA	4	433209	7255010	1	Arctic Tern	*Sterna paradisaea*	ARTE				1			1	Flying	Heath Tundra	flying over tundra
131	6-Aug-11	Fall Staging	RSA	4	434103	7254972	1	Canada Goose	*Branta canadensis*	CAGO				13			13		Lake	most are on land walking beside lake
132	6-Aug-11	Fall Staging	RSA	4	439609	7255613	2	Canada Goose	*Branta canadensis*	CAGO				8			8	Flying	Lake	
133	6-Aug-11	Fall Staging	RSA	4	439609	7255613	1			Gull				1			1	Flying	Lake	
134	6-Aug-11	Fall Staging	RSA	4	443362	7254968	1	Arctic Tern	*Sterna paradisaea*	ARTE				1			1	Flying	Heath Tundra	flying over tundra
135	6-Aug-11	Fall Staging	RSA	4	445344	7254989	2	Arctic Tern	*Sterna paradisaea*	ARTE				5			5		Lake	on small island in lake
136	6-Aug-11	Fall Staging	RSA	4	445344	7254989	3	Canada Goose	*Branta canadensis*	CAGO				4			4		Lake	
137	6-Aug-11	Fall Staging	RSA	4	445344	7254989	1	Herring Gull	*Larus argentatus*	HEGU				1			1		Lake	on small island in lake
138	6-Aug-11	Fall Staging	RSA	5	446994	7253153	1	Herring Gull	*Larus argentatus*	HEGU				2			2	Flying	Lake	flying over lake
139	6-Aug-11	Fall Staging	RSA	5	444276	7252765	1	Canada Goose	*Branta canadensis*	CAGO				40			40		Lake	
140	6-Aug-11	Fall Staging	RSA	5	444276	7252765	3	Canada Goose	*Branta canadensis*	CAGO				18			18		Lake	
141	6-Aug-11	Fall Staging	RSA	5	444276	7252765	2	Red-breasted Merganser	*Mergus serrator*	RBME				1			1		Lake	
142	6-Aug-11	Fall Staging	RSA	5	442619	7253168	1			unk. Duck				8			8		Lake	dove into water, probably Long-tailed Ducks
143	6-Aug-11	Fall Staging	RSA	5	439990	7253366	1	Arctic Tern	*Sterna paradisaea*	ARTE				1			1	Flying	Lake	flying over lake
144	6-Aug-11	Fall Staging	RSA	5	438212	7253472	1	Canada Goose	*Branta canadensis*	CAGO				22			22		Lake	
145	6-Aug-11	Fall Staging	RSA	5	437242	7253548	2	Canada Goose	*Branta canadensis*	CAGO				22			22		Lake	
146	6-Aug-11	Fall Staging	RSA	5	437242	7253548	1	Greater White-fronted Goose	*Anser albifrons*	GWFG				5			5		Lake	
147	6-Aug-11	Fall Staging	RSA	5	433129	7253094	1	Herring Gull	*Larus argentatus*	HEGU				1			1	Flying	Lake	flying over lake
148	6-Aug-11	Fall Staging	RSA	5	431573	7253051	1	Herring Gull	*Larus argentatus*	HEGU				1			1	Flying	Lake	flying over lake
149	6-Aug-11	Fall Staging	RSA	6	442161	7250919	1	Canada Goose	*Branta canadensis*	CAGO				15			15		Lake	
150	6-Aug-11	Fall Staging	RSA	6	442161	7250919	2	Canada Goose	*Branta canadensis*	CAGO				16			16		Lake	
151	6-Aug-11	Fall Staging	RSA	6	442161	7250919	3	Northern Pintail	*Anas acuta*	NOPI		1			4	3	5		Lake	diving
152	6-Aug-11	Fall Staging	RSA	7	446602	7249259	1	Northern Pintail	*Anas acuta*	NOPI		1			4	3c	5		River	in small stream and ran into grass on tundra
153	6-Aug-11	Fall Staging	RSA	7	439764	7249025	1	Canada Goose	*Branta canadensis*	CAGO				98			98		Lake	
154	6-Aug-11	Fall Staging	RSA	7	433984	7248938	1	Canada Goose	*Branta canadensis*	CAGO				6			6		Lake	
155	6-Aug-11	Fall Staging	RSA	7	433984	7248938	2	Canada Goose	*Branta canadensis*	CAGO				10			10		Lake	
156	6-Aug-11	Fall Staging	RSA	7	433984	7248938	3	Canada Goose	*Branta canadensis*	CAGO				44			44	Flying	Lake	flying over and landing on lake
157	6-Aug-11	Fall Staging	RSA	8	433482	7246967	1	Canada Goose	*Branta canadensis*	CAGO				12			12		Lake	
158	6-Aug-11	Fall Staging	RSA	8	433482	7246967	2	Canada Goose	*Branta canadensis*	CAGO				6			6		Lake	
159	6-Aug-11	Fall Staging	RSA	8	433482	7246967	3	Canada Goose	*Branta canadensis*	CAGO				110			110		Lake	
160	6-Aug-11	Fall Staging	RSA	8	433482	7246967	4			unk. Duck				5			5		Lake	diving
161	6-Aug-11	Fall Staging	RSA	8	436249	7246937	1			unk. Duck				4			4		Lake	diving
162	6-Aug-11	Fall Staging	RSA	8	438231	7246454	1	Canada Goose	*Branta canadensis*	CAGO				22			22		Lake	
163	6-Aug-11	Fall Staging	RSA	8	442515	7247153	1	Canada Goose	*Branta canadensis*	CAGO				10			10	Flying	Lake	flying over lake

Appendix 7.4-1

Raptor Occupancy Data, 2011

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Appendix 7.4-1. Raptor Occupancy Data, 2011.

Survey Date	Nest ID (2007)	Species (2007)	WPT	Nest ID (2011)	Species (2011)	Easting	Northing	Nest Status	Occupied Territory	Substrate*	Overhang (%)	Nest Ht (m)	Cliff Ht (m)	Aspect	# Adults	# Eggs	# Young	Est. age (days)	Habitat	Comment(s)
02-Jun-11	DU045	Peregrine falcon	3	O3	Gyrfalcon	431486	7270160	OcN	Occupied Territory	RL	0			SSW	2				Island at Goose (Lake) Neck	lots of white wash on cliff, dark coloured adult sitting on nest, light coloured adult flew in. probably eggs in nest given dark adults posture in nest
02-Jun-11	DU046	Peregrine falcon	4		Gyrfalcon	431850	7278043	PT	Potential Territory						1					adult flying along cliff, no nest seen
02-Jun-11	DU103	Golden eagle	5	O5	Unoccupied	446382	7273572	NO	Not Occupied	GL					2				height of land above stream	adults flying along cliff, old stick nest seen
02-Jun-11	DU103	Golden eagle	6	O6	Gyrfalcon	446272	7273640	OcN	Occupied Territory	RL	0	90	100	S						probable nest of 2 gyrfalcons seen at wpt 5
02-Jun-11	DU102	Peregrine falcon			Unoccupied	447097	7272483	NO	Not Occupied											no nest seen near this waypoint
05-Jun-11	DU101	Unoccupied			Unoccupied	447759	7273494	NO	Not Occupied											cliff was mostly snow covered still
05-Jun-11	DU096	Peregrine falcon	9		Peregrine falcon	441133	7284111	PT	Potential Territory						1				rock ledge	adult flying along cliff, no nest seen
05-Jun-11	DU097	Unoccupied	10	O10	Rough-legged hawk	440957	7284406	OcN	Occupied Territory	HS		22.5	24	W	1				rock ledge	
05-Jun-11	DU098	Rough-legged hawk			Unoccupied	439983	7285400	NO	Not Occupied											no nest seen
05-Jun-11			11	O11	Rough-legged hawk	440983	7284344	OcN	Occupied Territory	HS	40	15		E	1				rock ledge	
05-Jun-11	DU099	Peregrine falcon	12		Falco sp.	439746	7285937	PT	Potential Territory						1					adult flying along cliff
05-Jun-11	DU100	Unoccupied			Unoccupied	438079	7289960	NO	Not Occupied											no nest seen
05-Jun-11			13	O13	Rough-legged hawk	439640	7285945	OcN	Occupied Territory	HS	100	21	42	SSE	2				rock	
05-Jun-11			14		Common raven	437832	7291421	PT	Potential Territory						1					adult flying along cliff
05-Jun-11	DU104	Peregrine falcon	15	O15	Gyrfalcon	437120	7292088	OcN	Occupied Territory	HS	100	12	27	NE	2				rock cliff	Adult probably sitting on eggs given no flush, other individual seen flying, Abandoned eagle nest above falcon nest, two nearby ledges with white wash
05-Jun-11	DU105	Peregrine falcon			Unoccupied	436630	7293002	NO	Not Occupied											no nest seen
05-Jun-11	DU106	Golden Eagle	16	O16	Rough-legged hawk	436176	7294399	OcN	Occupied Territory	HS	80	30	36	W	1				rock cliff	
05-Jun-11			17	O17	Gyrfalcon	435484	7295676	OE	Occupied Territory	HS	30	36	48	SSE	2	2			rock ledge	
05-Jun-11	DU107	Unoccupied	18	O18	Golden eagle	432883	7297938	OE	Occupied Territory	HS	100	60	72	SW	1	1			rock ledge	ID not positive (bird flying), not a large nest
05-Jun-11			19		Golden eagle	431352	7299342	NO	Not Occupied											potentially same individual as Nest ID O18, flying around
05-Jun-11			21		Unoccupied	432334	7301863	NO	Not Occupied											
05-Jun-11			22		Common raven	432960	7302618	PT	Potential Territory						1					adult flying along cliff
05-Jun-11			23	O23	Unoccupied	429939	7293996	NO	Not Occupied	HS										abandoned nest, orange moss nearby
05-Jun-11	DU049	Gyrfalcon	24	O24	Falco sp.	409047	7291410	OcN	Occupied Territory	HS	100	21	27	E	1					Adult probably sitting on eggs given that it did not flush, inactive nest 1.2 meters under active nest
05-Jun-11	DU047	Peregrine falcon	27		Falco sp.	409284	7283180	PT	Potential Territory						2					adults flying around, probably belong to Nest ID O28
05-Jun-11	DU047	Peregrine falcon	28	O28	Falco sp.	409316	7283099	OE	Occupied Territory	vegetation	0	1.5	6	SW		4			rock ledge	rock ledge above river

** RL = rocky ledge, GL = gravelly ledge, HS = hawk stick*

Appendix 7.4-2

Raptor Nest Productivity 2011

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Appendix 7.4-2. Raptor Nest Productivity 2011.

Survey Date	WPT	Nest ID	Easting	Northing	Species	*Occupancy Status	Productive?	Substrate*	Overhang (%)	Nest Ht (m)	Cliff Ht (m)	Aspect	No. Adults	No. Eggs	No. Young	Est. age (days)	Habitat	Comment(s)
25-Jul-11	JS1		445072	7275545	Gyrfalcon	n/a							1					adult flying around
25-Jul-11	LB9		441133	7284111	Peregrine Falcon	PT							1					hanging around
25-Jul-11	LB11	O11	440983	7284344	Rough-legged Hawk	OcN												no chicks, feather in nest
25-Jul-11	LB5		446382	7273572	Gyrfalcon	PT												no activity
25-Jul-11	LB6	O6	446272	7273640	Gyrfalcon	OcN												no activity
25-Jul-11	LB10	O10	440957	7284406	Rough-legged hawk	OcN												could not find nest, revist later (July 26)
25-Jul-11	LB3	P3	444685	7277501	Unknown	new nest		HS	0	50	60							white wash by nest
25-Jul-11	LB12		493746	7285937	Falco sp.	PT												
25-Jul-11	LB12		493746	7285937	Peregrine Falcon	n/a							1					peregrine falcon near by wpt LB12
25-Jul-11	LB13	O13	439640	7285945	Rough-legged hawk	OcN												could not find nest, revist later (July 26)
25-Jul-11	LB14		437832	7291421	Common raven	PT												probably not an occupied territory, no nest in area
25-Jul-11	LB15	O15	437120	7292088	Gyrfalcon	OcN												no recent evidence of use
25-Jul-11	LB16	O16	436176	7294399	Rough-legged hawk	OcN												no activity
25-Jul-11	LB17	O17	435484	7295676	Gyrfalcon	OE	?											could not find nest, revist later (July 26)
25-Jul-11	LB18	O18	432883	7297938	Golden eagle	OE	No											5 old nests on cliff, not active
25-Jul-11	JS4	P4	409018	7291299	Unknown	new nest		HS				E						stick nest, no feathers or white wash
25-Jul-11	LB24	O24	409047	7291410	Falco sp.	OcN	No											2 dead gyrfalcon chicks in nest
25-Jul-11	LB27		409284	7283180	Falco sp.	PT												no adult in area
25-Jul-11	LB28	O28	409316	7283099	Falco sp.	OE												could not find nest, revist later (July 26)
25-Jul-11	LB4	O4	431850	7278043	Gyrfalcon	PT												probably not an occupied territory, no nest in area
25-Jul-11	LB3	O3	431486	7270160	Gyrfalcon	OcN												caribou antler in nest, whitewash no eggs
26-Jul-11	LB28	O28	409316	7283099	Gyrfalcon	OE	?						2					revisit: gyrfalcon hanging around, three potential nest scrapes found but no evidence of recent activity
26-Jul-11	LB17	O17	435484	7295676	Gyrfalcon	OE	?	RL										revisit: no nest, two peregrine falcons (see below for lcoation)
26-Jul-11	JS5	-	404534	7288617	Peregrine Falcon	n/a							2					
26-Jul-11	JS6	P6	407517	7288082	Unknown	new nest		RL	20	7	12	S					rocky cliff by river	old nest site
26-Jul-11	LB10	O10	440957	7284406	Rough-legged hawk	OcN												revisit: no nest found in area
26-Jul-11	LB13	O13	439640	7285945	Rough-legged hawk	OcN												revisit: whitewash (potential fledgling)
26-Jul-11	JS9	P9	451855	7295158	Unknown	new nest		HS	100	16	25	W						down and lots of whitewash
26-Jul-11	JS10	P10	454190	7293611	Unknown	new nest		HS	0	7	12	E						stick, no down, lots of whitewash
26-Jul-11	JS11	P11	454238	7293992	Unknown	new nest		HS	10	15	19	E						no down or whitewash
26-Jul-11	JS12	P12	458696	7294311	Unknown	new nest		HS	0	7	14	W						
26-Jul-11	JS13	P13	454278	7290723	Unknown	new nest		HS/GL	20	7	16	E						lots of whitewash, no down
27-Jul-11	JS17		448231	7276382	Peregrine Falcon	n/a							1					adult flying around

OcN = Occupied Nest, OE = Occupied nest with Eggs, PT = Potential Territory

Appendix 8.4-1

Marine Bird Aerial Survey Details, 2011

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Appendix 8.4-1. Marine Bird Aerial Survey Details, 2011

Survey Type	Date	Survey Strata	Start Time	End Time	Time off Transect (min)	Total Survey Time (min)	Temp. (˚C)	Cloud Cover (%)	Wind (km/hr)	Lighting
Breeding	06-Jul-11	Shoreline	9:57	16:18	230	381	15		20	Flat
Fall Staging	05-Aug-11	Shoreline	14:27	15:51	13	84		100	0-5	Flat
Fall Staging	06-Aug-11	Shoreline	8:21	8:56	0	35		0	0-5	Bright
Fall Staging	05-Aug-11	Marine	8:52	11:01	6	129		100	0-5	Flat
Fall Staging	05-Aug-11	Marine	13:29	15:19	71	110		100	0-5	Flat

Appendix 8.4-2

Marine Bird Ground Survey Details, 2011

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Appendix 8.4-2. Marine Bird Ground Survey Details, 2011

			Transect Start Details			Transect End Details			Shoreline	Slope		
Date	Transect	Zone	Time	Easting	Northing	Time	Easting	Northing	Description	Description	Habitat Description	Comment(s)
05-Jul-11	T1	13	11:10	387538	7383996	11:40	388615	7383019	gravel	moderate	lichen/heath association	
05-Jul-11	T2	13	12:01	391627	7376044	12:31	392186	7374617	rock	moderate	lichen/heath with some small birch/willow clumps	
05-Jul-11	T3	13	13:04	396371	7367920	13:34	397047	7366904	rock	steep	lots of tall birch/willow and some open heath	
05-Jul-11	T4	13	13:47	400433	7360862	14:32	401380	7360370	sand/mud	flat	grassy and heath with some clumps of willow/birch and wet ponds	survey stopped from 14:07 to 14:22
05-Jul-11	T5	13	14:46	400814	7367652	15:16	400421	7368782	gravel/rock	steep	willow/birch association, very tall	
05-Jul-11	T6	13	16:05	379705	7393406	16:45	381032	7392991	mud/rock	flat	first 700 m is wetland (small pools and muddy) and remaining transect is lichen/heath association	
05-Jul-11	T7	13	17:30	376686	7425159	18:00	377229	7424320	rock	flat	mixed wet grassy lichen and some muddy areas, slope increased at the end.	
06-Jul-11	T8	13	12:44	378148	7445688	13:14	378808	7444579	shale	steep	predominately shale cliffs, very little vegetation	
06-Jul-11	T9	13	13:35	380190	7434700	14:05	380349	7433454	rock	flat-moderate	exposed bedrock at beginning of transect, the rest is a mix of heath and short shrubs	
06-Jul-11	T10	13	14:55	374873	7412746	15:25	374078	7414158	rock	flat	lichen/heath association with some short shrubs along shore	

Appendix 8.4-3

Marine Bird Observation Data, Aerial Surveys 2011

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Appendix 8.4-3. Marine Bird Observation Data, Aerial Surveys 2011

UID	Date	Survey Type	Survey Strata	Transect	Easting	Northing	Group No.	Species	Scientific Name	Code	No. Drakes	No. Hens	No. Unknown	Total Birds	Behaviour	Comments
1	6-Jul-11	Breeding	Shoreline	5	402124	7361110	1	Glaucous Gull	*Larus hyperboreus*	GLGU			2	2		
2	6-Jul-11	Breeding	Shoreline	5	402124	7361110	2	Herring Gull	*Larus argentatus*	HEGU			12	12		
3	6-Jul-11	Breeding	Shoreline	5	400311	7361108	1	Pacific Loon	*Gavia pacifica*	PALO			1	1		
4	6-Jul-11	Breeding	Shoreline	5	400095	7361594	1	Greater Scaup	*Aythya fuligula*	GRSC	1	1		2		
5	6-Jul-11	Breeding	Shoreline	5	399657	7362349	1	Red-breasted Merganser	*Mergus serrator*	RBME	2			2		
6	6-Jul-11	Breeding	Shoreline	5	399110	7363117	1	Herring Gull	*Larus argentatus*	HEGU			4	4		
7	6-Jul-11	Breeding	Shoreline	5	397472	7365958	1	Red-breasted Merganser	*Mergus serrator*	RBME	2			2		
8	6-Jul-11	Breeding	Shoreline	5	397472	7365958	2	Greater Scaup	*Aythya fuligula*	GRSC	8	2		10		
9	6-Jul-11	Breeding	Shoreline	5	397472	7365958	3	Canada Goose	*Branta candensis*	CAGO			30	30		
10	6-Jul-11	Breeding	Shoreline	5	397472	7365958	4	Herring Gull	*Larus argentatus*	HEGU			1	1		
11	6-Jul-11	Breeding	Shoreline	5	395614	7369649	1	Greater Scaup	*Aythya fuligula*	GRSC	10			10		
12	6-Jul-11	Breeding	Shoreline	5	395505	7370254	1	Black Scoter	*Melanitta nigra*	BLSC	11			11		
13	6-Jul-11	Breeding	Shoreline	5	395597	7371128	1	Herring Gull	*Larus argentatus*	HEGU			4	4		
14	6-Jul-11	Breeding	Shoreline	5	395597	7371128	2	Glaucous Gull	*Larus hyperboreus*	GLGU			2	2		
15	6-Jul-11	Breeding	Shoreline	5	392299	7374455	1	Herring Gull	*Larus argentatus*	HEGU			11	11		
16	6-Jul-11	Breeding	Shoreline	5	392299	7374455	2	Black Scoter	*Melanitta nigra*	BLSC	4			4		
17	6-Jul-11	Breeding	Shoreline	5	391137	7377251	1	Herring Gull	*Larus argentatus*	HEGU			3	3		
18	6-Jul-11	Breeding	Shoreline	5	391137	7377251	2	Red-throated Loon	*Gavia stellata*	RTLO			2	2		
19	6-Jul-11	Breeding	Shoreline	5	390167	7379909	1	Greater Scaup	*Aythya fuligula*	GRSC	20	10		30		
20	6-Jul-11	Breeding	Shoreline	5	390167	7379909	2	Surf Scoter	*Melanitta prespicillata*	SUSC	1			1		
21	6-Jul-11	Breeding	Shoreline	5	390167	7379909	3	Red-breasted Merganser	*Mergus serrator*	RBME	2			2		
22	6-Jul-11	Breeding	Shoreline	5	389877	7381624	1	Canada Goose	*Branta candensis*	CAGO			100	100		
23	6-Jul-11	Breeding	Shoreline	5	389501	7382014	1	Red-throated Loon	*Gavia stellata*	RTLO			3	3		
24	6-Jul-11	Breeding	Shoreline	5	388886	7382946	1	Herring Gull	*Larus argentatus*	HEGU			1	1		
25	6-Jul-11	Breeding	Shoreline	5	387343	7384216	1	Herring Gull	*Larus argentatus*	HEGU			3	3		
26	6-Jul-11	Breeding	Shoreline	5	387343	7384216	2	Glaucous Gull	*Larus hyperboreus*	GLGU			2	2		
27	6-Jul-11	Breeding	Shoreline	5	387486	7381484	1	Red-throated Loon	*Gavia stellata*	RTLO			2	2		
28	6-Jul-11	Breeding	Shoreline	5	384722	7385047	1	Red-throated Loon	*Gavia stellata*	RTLO			1	1		
29	6-Jul-11	Breeding	Shoreline	5	384670	7385435	1	Red-breasted Merganser	*Mergus serrator*	RBME	30			30		
30	6-Jul-11	Breeding	Shoreline	5	384670	7385435	2	Herring Gull	*Larus argentatus*	HEGU			2	2		
31	6-Jul-11	Breeding	Shoreline	5	384670	7385435	3	Glaucous Gull	*Larus hyperboreus*	GLGU	1			1		
32	6-Jul-11	Breeding	Shoreline	5	384670	7385435	4	Black Scoter	*Melanitta nigra*	BLSC	1			1		
33	6-Jul-11	Breeding	Shoreline	5	383382	7386905	1	Red-throated Loon	*Gavia stellata*	RTLO	1			1		
34	6-Jul-11	Breeding	Shoreline	5	383382	7386905	2	Red-breasted Merganser	*Mergus serrator*	RBME	5			5		
35	6-Jul-11	Breeding	Shoreline	5	381907	7389596	1	Canada Goose	*Branta candensis*	CAGO			150	150		
36	6-Jul-11	Breeding	Shoreline	5	381907	7389596	2	Red-throated Loon	*Gavia stellata*	RTLO			1	1		
37	6-Jul-11	Breeding	Shoreline	5	379997	7391422	1	Greater Scaup	*Aythya fuligula*	GRSC	40	20		60		
38	6-Jul-11	Breeding	Shoreline	5	380442	7393317	1	Greater Scaup	*Aythya fuligula*	GRSC	7	2		9		
39	6-Jul-11	Breeding	Shoreline	5	381477	7392590	1	Glaucous Gull	*Larus hyperboreus*	GLGU			1	1		
40	6-Jul-11	Breeding	Shoreline	5	381477	7392590	2	Greater Scaup	*Aythya fuligula*	GRSC			11	11		
41	6-Jul-11	Breeding	Shoreline	5	381477	7392590	3	Black Scoter	*Melanitta nigra*	BLSC	5			5		
42	6-Jul-11	Breeding	Shoreline	5	381477	7392590	4	Red-breasted Merganser	*Mergus serrator*	RBME	3			3		
43	6-Jul-11	Breeding	Shoreline	5	382127	7393416	1	Red-breasted Merganser	*Mergus serrator*	RBME	1	1		2		
44	6-Jul-11	Breeding	Shoreline	5	381717	7394380	1	Yellow-billed Loon	*Gavia adamsii*	YBLO			1	1		
45	6-Jul-11	Breeding	Shoreline	5	380673	7396406	1	Canada Goose	*Branta candensis*	CAGO			45	45		
46	6-Jul-11	Breeding	Shoreline	5	379244	7398531	1	Red-throated Loon	*Gavia stellata*	RTLO			2	2		
47	6-Jul-11	Breeding	Shoreline	5	379244	7398531	2	Pacific Loon	*Gavia pacifica*	PALO			2	2		
48	6-Jul-11	Breeding	Shoreline	5	379244	7398531	3			Unknown Duck			2	2		
49	6-Jul-11	Breeding	Shoreline	5	378646	7399719	1	Red-throated Loon	*Gavia stellata*	RTLO			1	1		
50	6-Jul-11	Breeding	Shoreline	5	377341	7401251	1	Red-breasted Merganser	*Mergus serrator*	RBME	1	1		2		
51	6-Jul-11	Breeding	Shoreline	5	376852	7402072	1	Greater Scaup	*Aythya fuligula*	GRSC			4	4		
52	6-Jul-11	Breeding	Shoreline	5	377062	7403032	1	Red-breasted Merganser	*Mergus serrator*	RBME	8			8		
53	6-Jul-11	Breeding	Shoreline	5	377062	7403032	2	Glaucous Gull	*Larus hyperboreus*	GLGU			1	1		
54	6-Jul-11	Breeding	Shoreline	5	375491	7406667	1	Common Eider	*Somateria mollissima*	COEI	1	1		2		
55	6-Jul-11	Breeding	Shoreline	5	375491	7406667	2	Common Eider	*Somateria mollissima*	COEI	1	2		3		
56	6-Jul-11	Breeding	Shoreline	2	375601	7411832	1	Red-breasted Merganser	*Mergus serrator*	RBME	35			35		
57	6-Jul-11	Breeding	Shoreline	2	375601	7411832	2	Herring Gull	*Larus argentatus*	HEGU			5	5		

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58	6-Jul-11	Breeding	Shoreline	2	375601	7411832	3	Glaucous Gull	*Larus hyperboreus*	GLGU			3	3		
59	6-Jul-11	Breeding	Shoreline	2	376094	7410282	1	Common Eider	*Somateria mollissima*	COEI		1		1		
60	6-Jul-11	Breeding	Shoreline	2	377114	7409006	1	Red-breasted Merganser	*Mergus serrator*	RBME	8	2		10		
61	6-Jul-11	Breeding	Shoreline	2	377114	7409006	2	Glaucous Gull	*Larus hyperboreus*	GLGU			1	1		
62	6-Jul-11	Breeding	Shoreline	2	380663	7402459	1	White-winged Scoter	*Melanitta fusca*	WWSC			10	10		
63	6-Jul-11	Breeding	Shoreline	2	380663	7402459	2	Greater Scaup	*Aythya fuligula*	GRSC	9	2		11		
64	6-Jul-11	Breeding	Shoreline	2	381384	7402021	1	Greater Scaup	*Aythya fuligula*	GRSC	35			35		
65	6-Jul-11	Breeding	Shoreline	2	382298	7401428	1	Red-breasted Merganser	*Mergus serrator*	RBME	10	10		20		
66	6-Jul-11	Breeding	Shoreline	2	382298	7401428	2	Glaucous Gull	*Larus hyperboreus*	GLGU			1	1		
67	6-Jul-11	Breeding	Shoreline	2	383644	7400725	1	Red-breasted Merganser	*Mergus serrator*	RBME	20	17		37		
68	6-Jul-11	Breeding	Shoreline	2	384496	7397720	1	Red-breasted Merganser	*Mergus serrator*	RBME	11			11		
69	6-Jul-11	Breeding	Shoreline	2	384754	7397079	1			Unknown Loon			1	1		
70	6-Jul-11	Breeding	Shoreline	2	384755	7396718	1	Canada Goose	*Branta candensis*	CAGO			21	21		
71	6-Jul-11	Breeding	Shoreline	2	385086	7396445	1	Red-breasted Merganser	*Mergus serrator*	RBME	4			4		
72	6-Jul-11	Breeding	Shoreline	2	385361	7395100	1	Red-breasted Merganser	*Mergus serrator*	RBME			50	50		
73	6-Jul-11	Breeding	Shoreline	2	385908	7394712	1	Red-breasted Merganser	*Mergus serrator*	RBME	3			3		
74	6-Jul-11	Breeding	Shoreline	2	386221	7394600	1	Green-winged Teal	*Anas crecca*	GWTE	9			9		
75	6-Jul-11	Breeding	Shoreline	2	387388	7393125	1	Red-breasted Merganser	*Mergus serrator*	RBME	12			12		
76	6-Jul-11	Breeding	Shoreline	2	387562	7390103	1	Red-breasted Merganser	*Mergus serrator*	RBME	1			1		
77	6-Jul-11	Breeding	Shoreline	2	389252	7385100	1	Red-breasted Merganser	*Mergus serrator*	RBME	1	1		2		
78	6-Jul-11	Breeding	Shoreline	2	391993	7382382	1	Red-breasted Merganser	*Mergus serrator*	RBME	4			4		
79	6-Jul-11	Breeding	Shoreline	2	391993	7382382	2	Canada Goose	*Branta candensis*	CAGO			70	70		
80	6-Jul-11	Breeding	Shoreline	1	374847	7412319	1	Common Eider	*Somateria mollissima*	COEI	2	2		4		
81	6-Jul-11	Breeding	Shoreline	1	374847	7412319	2	Red-throated Loon	*Gavia stellata*	RTLO			2	2		
82	6-Jul-11	Breeding	Shoreline	1	374847	7412319	3	Herring Gull	*Larus argentatus*	HEGU			10	10		
83	6-Jul-11	Breeding	Shoreline	1	373164	7415167	1	Herring Gull	*Larus argentatus*	HEGU			16	16		
84	6-Jul-11	Breeding	Shoreline	1	373164	7415167	2	Common Eider	*Somateria mollissima*	COEI	3			3		
85	6-Jul-11	Breeding	Shoreline	1	373164	7415167	3	Red-breasted Merganser	*Mergus serrator*	RBME	1			1		
86	6-Jul-11	Breeding	Shoreline	1	373164	7415167	4	Canada Goose	*Branta candensis*	CAGO			35	35		
87	6-Jul-11	Breeding	Shoreline	1	375334	7422521	1	Red-breasted Merganser	*Mergus serrator*	RBME	4	1		5		
88	6-Jul-11	Breeding	Shoreline	1	376039	7422514	1	Common Eider	*Somateria mollissima*	COEI		7		7		
89	6-Jul-11	Breeding	Shoreline	1	378370	7432249	1	White-winged Scoter	*Melanitta fusca*	WWSC	20			20		
90	6-Jul-11	Breeding	Shoreline	1	378370	7432249	2	Herring Gull	*Larus argentatus*	HEGU			32	32		
91	6-Jul-11	Breeding	Shoreline	1	378160	7434298	1	Red-breasted Merganser	*Mergus serrator*	RBME	30	10		40		
92	6-Jul-11	Breeding	Shoreline	1	377056	7435974	1	Red-breasted Merganser	*Mergus serrator*	RBME			70	70		
93	6-Jul-11	Breeding	Shoreline	1	376673	7435583	1	Red-throated Loon	*Gavia stellata*	RTLO	1	1		2		
94	6-Jul-11	Breeding	Shoreline	1	376209	7434866	1	Red-breasted Merganser	*Mergus serrator*	RBME	6	7		13		
95	6-Jul-11	Breeding	Shoreline	1	376401	7435656	1	Red-breasted Merganser	*Mergus serrator*	RBME	17			17		
96	6-Jul-11	Breeding	Shoreline	1	377701	7437855	1	Red-breasted Merganser	*Mergus serrator*	RBME			70	70		
97	6-Jul-11	Breeding	Shoreline	1	378409	7442562	1	Surf Scoter	*Melanitta prespicillata*	SUSC	10		15	25		
98	6-Jul-11	Breeding	Shoreline	1	379141	7443143	1	Red-breasted Merganser	*Mergus serrator*	RBME		2		2		
99	6-Jul-11	Breeding	Shoreline	1	378530	7452584	1	Red-breasted Merganser	*Mergus serrator*	RBME	1	1		2		
100	06-Jul-11	Breeding	Shoreline	1	378530	7452584	2	Glaucous Gull	*Larus hyperboreus*	GLGU			1	1		
101	06-Jul-11	Breeding	Shoreline	3	380593	7436170	2	Herring Gull	*Larus argentatus*	HEGU			2	2		
102	06-Jul-11	Breeding	Shoreline	3	379521	7428179	1	Glaucous Gull	*Larus hyperboreus*	GLGU			2	2		
103	06-Jul-11	Breeding	Shoreline	3	379521	7428179	2	Red-breasted Merganser	*Mergus serrator*	RBME	7	1		8		
104	06-Jul-11	Breeding	Shoreline	3	380129	7427691	1	Red-breasted Merganser	*Mergus serrator*	RBME	2	1		3		
105	06-Jul-11	Breeding	Shoreline	3	380129	7427691	2	Glaucous Gull	*Larus hyperboreus*	GLGU			1	1		
106	06-Jul-11	Breeding	Shoreline	3	380303	7426755	1	Red-breasted Merganser	*Mergus serrator*	RBME	2			2		
107	06-Jul-11	Breeding	Shoreline	3	380613	7425964	1	Red-breasted Merganser	*Mergus serrator*	RBME	30	10		40		
108	06-Jul-11	Breeding	Shoreline	3	381015	7422584	1	Canada Goose	*Branta candensis*	CAGO			10	10		
109	06-Jul-11	Breeding	Shoreline	3	381253	7421950	1	Canada Goose	*Branta candensis*	CAGO			12	12		
110	06-Jul-11	Breeding	Shoreline	3	381569	7420488	1	White-winged Scoter	*Melanitta fusca*	WWSC	7			7		
111	06-Jul-11	Breeding	Shoreline	3	381551	7419632	1	Red-breasted Merganser	*Mergus serrator*	RBME	12			12		
112	06-Jul-11	Breeding	Shoreline	3	381948	7419089	1	Surf Scoter	*Melanitta prespicillata*	SUSC	1			1		
113	06-Jul-11	Breeding	Shoreline	3	381948	7419089	2	Red-breasted Merganser	*Mergus serrator*	RBME	1			1		
114	06-Jul-11	Breeding	Shoreline	3	381855	7418632	1	Canada Goose	*Branta candensis*	CAGO			45	45		

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115	06-Jul-11	Breeding	Shoreline	3	381834	7417924	1	Glaucous Gull	*Larus hyperboreus*	GLGU			1	1		
116	06-Jul-11	Breeding	Shoreline	3	381834	7417924	2	Red-breasted Merganser	*Mergus serrator*	RBME	2			2		
117	06-Jul-11	Breeding	Shoreline	3	381834	7417924	3	Greater Scaup	*Aythya fuligula*	GRSC		4		4		
118	06-Jul-11	Breeding	Shoreline	3	381881	7417646	1	Greater Scaup	*Aythya fuligula*	GRSC		1		1		
119	06-Jul-11	Breeding	Shoreline	3	382104	7411894	1	Greater Scaup	*Aythya fuligula*	GRSC	3			3		
120	06-Jul-11	Breeding	Shoreline	3	382104	7411894	2	Red-breasted Merganser	*Mergus serrator*	RBME			50	50		
121	06-Jul-11	Breeding	Shoreline	3	382104	7411894	3	Herring Gull	*Larus argentatus*	HEGU			1	1		
122	06-Jul-11	Breeding	Shoreline	3	381709	7410917	1	Red-breasted Merganser	*Mergus serrator*	RBME			32	32		
123	06-Jul-11	Breeding	Shoreline	3	381635	7410439	1	Red-breasted Merganser	*Mergus serrator*	RBME	30	5		35		
124	06-Jul-11	Breeding	Shoreline	3	382271	7409500	1			Unknown Duck			1	1		
125	06-Jul-11	Breeding	Shoreline	3	381928	7407911	1	Canada Goose	*Branta candensis*	CAGO			34	34		
126	06-Jul-11	Breeding	Shoreline	3	381928	7407911	2	Yellow-billed Loon	*Gavia adamsii*	YBLO			1	1		
127	06-Jul-11	Breeding	Shoreline	3	381771	7406509	1	Greater Scaup	*Aythya fuligula*	GRSC	2	1		3		
128	06-Jul-11	Breeding	Shoreline	3	381474	7406842	1	Yellow-billed Loon	*Gavia adamsii*	YBLO			1	1		
129	06-Jul-11	Breeding	Shoreline	3	380748	7406748	1	White-winged Scoter	*Melanitta fusca*	WWSC	6			6		
130	06-Jul-11	Breeding	Shoreline	3	380748	7406748	2	Glaucous Gull	*Larus hyperboreus*	GLGU			2	2		
131	06-Jul-11	Breeding	Shoreline	3	380343	7406173	1	Glaucous Gull	*Larus hyperboreus*	GLGU			1	1		
132	06-Jul-11	Breeding	Shoreline	3	380122	7405785	1	Yellow-billed Loon	*Gavia adamsii*	YBLO			1	1		
133	06-Jul-11	Breeding	Shoreline	3	379587	7405747	1	Gadwall	*Anas strepera*	GADW			1	1		
134	06-Jul-11	Breeding	Shoreline	4	392611	7378529	1	Canada Goose	*Branta candensis*	CAGO			60	60		
135	06-Jul-11	Breeding	Shoreline	4	393172	7377729	1	Red-breasted Merganser	*Mergus serrator*	RBME	2			2		
136	06-Jul-11	Breeding	Shoreline	4	394576	7375696	1	Greater Scaup	*Aythya fuligula*	GRSC	8	4		12		
137	06-Jul-11	Breeding	Shoreline	4	394810	7375480	1	Greater Scaup	*Aythya fuligula*	GRSC	1	1		2		
138	06-Jul-11	Breeding	Shoreline	4	397901	7373029	1	Greater Scaup	*Aythya fuligula*	GRSC	40	10		50		
139	06-Jul-11	Breeding	Shoreline	4	399942	7369839	1	Red-breasted Merganser	*Mergus serrator*	RBME	1			1		
140	5-Aug-11	Fall Staging	Marine	F	392506	7432276	1			Gull			8	8	on water	
141	5-Aug-11	Fall Staging	Marine	F	391283	7435640	1			Gull			1	1	flying	
142	5-Aug-11	Fall Staging	Marine	H	389894	7458566	1			Gull			1	1	flying	
143	5-Aug-11	Fall Staging	Marine	H	386760	7467850	1			Gull			7	7		
144	5-Aug-11	Fall Staging	Marine	H	383804	7476745	1			Gull			6	6		
145	5-Aug-11	Fall Staging	Marine	I	381085	7498882	1			Gull			10	10	on small island	rain began at 9:20
146	5-Aug-11	Fall Staging	Marine	Shipping route	374874	7507819	1			Gull			2	2	flying	
147	5-Aug-11	Fall Staging	Marine	Shipping route	378924	7497241	1			Gull			1	1	flying	
148	5-Aug-11	Fall Staging	Marine	Shipping route	379478	7494459	1			Gull			2	2	flying	
149	5-Aug-11	Fall Staging	Marine	Shipping route	379678	7472081	1			Gull			40	40	standing on island and flying above it	at least 40 individuals, could be more
150	5-Aug-11	Fall Staging	Marine	Shipping route	381358	7468383	1			Gull			1	1	flying	
151	5-Aug-11	Fall Staging	Marine	Shipping route	381476	7467888	1			Gull			2	2	flying	
152	5-Aug-11	Fall Staging	Marine	Shipping route	381296	7468371	1			unk. Duck			9	9	on water	Brown birds, likely female eiders
153	5-Aug-11	Fall Staging	Marine	Shipping route	381296	7468371	2			unk. Duck			2	2	on water	Brown birds, likely female eiders
154	5-Aug-11	Fall Staging	Marine	Shipping route	382829	7464382	1			Gull			1	1	flying	
155	5-Aug-11	Fall Staging	Marine	Shipping route	383313	7461448	1			Gull			1	1	flying	
156	5-Aug-11	Fall Staging	Marine	Shipping route	383336	7461143	1			Gull			2	2	on island	
157	5-Aug-11	Fall Staging	Marine	Shipping route	384113	7448669	1	Red-breasted Merganser	*Mergus serrator*	RBME			45-50	45-50	on water	out of rain at 10:15
158	5-Aug-11	Fall Staging	Marine	Shipping route	384186	7448410	1			Gull			2	2		
159	5-Aug-11	Fall Staging	Marine	Shipping route	384296	7447873	1			Gull			20	20	on island and swimming near island	gulls on island, water, and in flight
160	5-Aug-11	Fall Staging	Marine	Shipping route	381191	7447780	1			unk. Bird			3	3	swimming	unknown relatively large black bird (Brant?)
161	5-Aug-11	Fall Staging	Marine	Shipping route	380240	7446956	1			Gull			5	5	on island	
162	5-Aug-11	Fall Staging	Marine	Shipping route	381186	7451261	1			Gull			1	1	flying	
163	5-Aug-11	Fall Staging	Marine	Shipping route	379858	7436245	1			Gull			1	1	swimming/on water	
164	5-Aug-11	Fall Staging	Marine	Shipping route	377845	7422614	1			Gull			1	1	flying	
165	5-Aug-11	Fall Staging	Marine	Shipping route	377404	7421395	1			Gull			1	1	on island	
166	5-Aug-11	Fall Staging	Marine	Shipping route	376701	7419697	1			Gull			6	6	on water	
167	5-Aug-11	Fall Staging	Marine	Shipping route	374938	7409371	1			Gull			1	1	flying	
168	5-Aug-11	Fall Staging	Marine	B	399841	7368694	1			Scoters			8	8	on water	
169	5-Aug-11	Fall Staging	Marine	B	399333	7367215	1			Scoters			35	35	on water	
170	5-Aug-11	Fall Staging	Marine	C	377954	7406077	1			Gull			1	1	flying	
171	5-Aug-11	Fall Staging	Marine	C	374672	7412088	1			Gull			1	1	flying	

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172	5-Aug-11	Fall Staging	Marine	E	372168	7423919	1			Gull			2	2	flying	
173	5-Aug-11	Fall Staging	Marine	E	371467	7434688	1			Gull			1	1		
174	5-Aug-11	Fall Staging	Marine	G	377027	7458026	1			Gull			1	1		
175	5-Aug-11	Fall Staging	Shoreline	1	379642	7441789	1			Gull			3	3		
176	5-Aug-11	Fall Staging	Shoreline	1	377558	7437538	1			Gull			1	1		
177	5-Aug-11	Fall Staging	Shoreline	1	376657	7436606	1			Gull			1	1		
178	5-Aug-11	Fall Staging	Shoreline	1	378395	7430130	1			Gull			1	1		
179	5-Aug-11	Fall Staging	Shoreline	1	376099	7421751	1			Gull			1	1		
180	5-Aug-11	Fall Staging	Shoreline	3	376906	7409446	1	Canada Goose	*Branta candensis*	CAGO			79	79	swimming and on land	16 swimming and 60 on shore/land
181	5-Aug-11	Fall Staging	Shoreline	3	376940	7410809	1			Gull			2	2		
182	5-Aug-11	Fall Staging	Shoreline	3	381791	7407082	1			unk. Duck			10	10	swimming	dark coloured duck
183	5-Aug-11	Fall Staging	Shoreline	3	381951	7408892	1			Gull			1	1		
184	5-Aug-11	Fall Staging	Shoreline	3	381716	7416769	1			Gull			1	1		
185	5-Aug-11	Fall Staging	Shoreline	3	382063	7418936	1			unk. Duck			17	17	swimming	brown back and a white belly (immature eiders or male long-tailed ducks?)
186	5-Aug-11	Fall Staging	Shoreline	3	381878	7419763	1			Gull			1	1	flying	
187	5-Aug-11	Fall Staging	Shoreline	3	380751	7422813	1			Gull			1	1	flying	
188	5-Aug-11	Fall Staging	Shoreline	3	379735	7426627	1			Gull			12	12	on land and flying	
189	5-Aug-11	Fall Staging	Shoreline	3	379735	7426627	2			unk. Duck			10	10	swimming and diving	diving ducks
190	5-Aug-11	Fall Staging	Shoreline	3	379436	7430272	1			Gull			1	1	flying	
191	5-Aug-11	Fall Staging	Marine	D	379720	7412438	1			Gull			6	6		
192	5-Aug-11	Fall Staging	Shoreline	5	379508	7392992	1			Gull			1	1	flying	
193	5-Aug-11	Fall Staging	Shoreline	5	379508	7392992	2	Canada Goose	*Branta candensis*	CAGO			30	30	swimming	
194	5-Aug-11	Fall Staging	Shoreline	5	380111	7391779	1			Scoter			100	100	swimming	
195	5-Aug-11	Fall Staging	Shoreline	5	379847	7392013	1			Scoter			80	80	swimming	
196	5-Aug-11	Fall Staging	Shoreline	5	382143	7389615	1			Shorebirds			100	100	flying	
197	5-Aug-11	Fall Staging	Shoreline	5	383593	7387223	1			Gull			1	1	flying	
198	5-Aug-11	Fall Staging	Shoreline	5	384548	7385820	1			Gull			1	1		
199	5-Aug-11	Fall Staging	Shoreline	5	385020	7385482	1			unk. Loon			1	1	swimming	
200	5-Aug-11	Fall Staging	Shoreline	5	386662	7381497	1	Canada Goose	*Branta candensis*	CAGO			50	50	swimming	2 groups relatively close together
201	5-Aug-11	Fall Staging	Shoreline	5	392630	7374738	1			unk. Duck			5	5		brown medium sized birds (eiders?)
202	5-Aug-11	Fall Staging	Shoreline	5	400665	7361088	1			Gull			1	1		
203	5-Aug-11	Fall Staging	Shoreline	5	400756	7360969	1	Canada Goose	*Branta candensis*	CAGO			28	28	swimming	
204	6-Aug-11	Fall Staging	Shoreline	4	401225	7364610	1			unk. Bird			60	60	on water	
205	6-Aug-11	Fall Staging	Shoreline	4	400580	7366422	1			unk. Duck			6	6	on water	
206	6-Aug-11	Fall Staging	Shoreline	4	400117	7366701	1			Gull			1	1	flying	
207	6-Aug-11	Fall Staging	Shoreline	4	400117	7366701	2			Scoters			15	15	on water	
208	6-Aug-11	Fall Staging	Shoreline	4	398469	7371379	1			unk. Duck			5	5	on water	
209	6-Aug-11	Fall Staging	Shoreline	4	392281	7379275	1			unk. Bird			5	5	on water	White bellies and dark backs (Pintails?)
210	6-Aug-11	Fall Staging	Shoreline	4	392604	7380922	1			Gull			2	2	on water	
211	6-Aug-11	Fall Staging	Shoreline	4	392604	7380922	2			unk. Duck			6	6	on water	
212	6-Aug-11	Fall Staging	Shoreline	2	385001	7395921	1			unk. Bird			9	9		
213	6-Aug-11	Fall Staging	Shoreline	2	384948	7397241	1			unk. Duck			7	7		diving ducks
214	6-Aug-11	Fall Staging	Shoreline	2	385264	7395564	1			unk. Bird			7	7		
215	6-Aug-11	Fall Staging	Shoreline	2	384258	7395061	1	Brant	*Branta bernicla*	Brant			5	5		
216	6-Aug-11	Fall Staging	Shoreline	2	383622	7400257	1			Gull			1	1	flying	
217	6-Aug-11	Fall Staging	Shoreline	2	383487	7400655	1			unk. Duck			20	20		
218	6-Aug-11	Fall Staging	Shoreline	2	382676	7400869	1			unk. Bird			4	4	on water	Tiny, black, and very small (black scoters?)
219	6-Aug-11	Fall Staging	Shoreline	2	381932	7401366	1			Eiders (Common?)			30	30	on water	likely females with immatures (some had a white breast, others brown)

Appendix 8.4-4

Marine Bird Observation Data, Ground Surveys 2011

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Appendix 8.4-4. Marine Bird Observation Data, Ground Surveys 2011

Date	Transect	Species	Scientific Name	Code	No. Detected		Comment(s)
					On Shore	On Water	
05-Jul-11	T1	None					
05-Jul-11	T2	None					
05-Jul-11	T3	None					
05-Jul-11	T4	Canada Goose	*Branta canadensis*	CAGO		1	floating low in water, potentially deceased
05-Jul-11	T5	Canada Goose	*Branta canadensis*	CAGO		2	near shore
05-Jul-11	T6	American green-winged Teal	*Anas carolinensis*	AGWT	1		one male flushed from small pool on shore
05-Jul-11	T6	Red-breasted Merganser	*Mergus serrator*	RBME		7	six males and one female diving roughly 200 m from shore
05-Jul-11	T7	None					
06-Jul-11	T8	Semipalmated Plover	*Charadrius semipalmatus*	SEPL	1		peeping
06-Jul-11	T9	None					
06-Jul-11	T10	None					

Appendix 9.4-1

Marine Mammal Incidental Observations, 2011

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Appendix 9.4-1. Marine Mammal Incidental Observations, 2011

UID	Date	Time	WPT#	Easting	Northing	Species	Total #	Transect	Survey Strata
190	5-Jul-11	12:22	96	376551	7436873	Ringed Seal	1	001	Shoreline
196	5-Jul-11	14:22	101	380593	7436170	Ringed Seal	1	003	Shoreline
11	4-Aug-11	10:00	86	379435	7483648	Unknown Seal	1	Shipping route	Marine
55	4-Aug-11	15:04	127	378419	7426629	Ringed Seal	1	003	Shoreline
59	4-Aug-11	15:24	131	377075	7402271	Bearded Seal	1	005	Shoreline

Appendix 11.4-1

Incidental Observations of Wildlife, 2011

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Appendix 11.4-1. Incidental Observations of Wildlife, 2011

Date	Month	Survey	PRISM Plot No. (PRISM Survey Only)	Location	Easting	Northing	Species	Scientiific Name	Group	No. Observed					Total Observed	Comment(s)
										Male	Female	Young	Eggs	Unknown Age/Sex		
2-Jun-11	6	Raptor Occupancy		Goose Lake	434126	7269597	Canada Goose	*Branta canadensis*	Waterbird	2	2				4	2 pairs
2-Jun-11	6	Raptor Occupancy		Goose Lake	434126	7269597	Greater White-fronted Goose	*Anser albifrons*	Waterbird					48	48	At least 8 pair, flushed when Twin Otter arrived
2-Jun-11	6	Raptor Occupancy		Goose Lake			Least Sandpiper	*Calidris minutilla*	Upland Breeding Bird	1	1				2	Pair observed in flooded area SE of camp
2-Jun-11	6	Raptor Occupancy		Goose Lake	434126	7269597	Northern Pintail	*Anas acuta*	Waterbird	4	1				5	1 pair and 3 males, flushed when Twin Otter arrived
3-Jun-11	6	Raptor Occupancy		Goose Lake Camp	434000	7269930	Horned Lark	*Eremophila alpestris*	Upland Breeding Bird					2	2	
3-Jun-11	6	Raptor Occupancy		Goose Lake Camp	434000	7269930	Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird					4	4	
4-Jun-11	6	Raptor Occupancy		Goose Lake Camp	434000	7269930	Arctic Fox	*Alopex lagopus*	Carnivore					1	1	
5-Jun-11	6	Raptor Occupancy		Goose Lake Camp	434142	7269871	Arctic Hare	*Lepus arcticus*	Small Mammal					1	1	
5-Jun-11	6	Raptor Occupancy		RCSA	432600	7301585	Unknown jaeger		Waterbird					1	1	
5-Jun-11	6	Raptor Occupancy		RCSA	409477	7283292	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					5	5	
5-Jun-11	6	Raptor Occupancy		RCSA	443289	7282706	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					2	2	
5-Jun-11	6	Raptor Occupancy		RCSA	447362	7278465	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					19	19	
5-Jun-11	6	Raptor Occupancy		RCSA	406501	7286538	Muskox	*Ovibos moschatus*	Ungulate					3	3	
5-Jun-11	6	Raptor Occupancy		Goose Lake Camp	434000	7269930	Rock Ptarmagin	*Lagopus mutus*	Upland Breeding Bird					2	2	
24-Jun-11	6	PRISM survey	LSA11	LSA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird	6	1			2	9	2 flying, 6 males, and 1 female
24-Jun-11	6	PRISM survey	LSA11	LSA			Common Redpoll	*Carduelis flammea*	Upland Breeding Bird					2	2	Flying
24-Jun-11	6	PRISM survey	LSA11	LSA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Outside plot
24-Jun-11	6	PRISM survey	LSA11	LSA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	3					3	3 males
24-Jun-11	6	PRISM survey	LSA28	LSA			Horned Lark	*Eremophila alpestris*	Upland Breeding Bird	1	1				2	Pair
24-Jun-11	6	PRISM survey	LSA28	LSA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Outside plot
24-Jun-11	6	PRISM survey	LSA28	LSA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird	1					1	1 male
24-Jun-11	6	PRISM survey	LSA28	LSA			Long-tailed Duck	*Clangula hyemalis*	Waterbird					1	1	Outside plot
24-Jun-11	6	PRISM survey	LSA35	LSA			Common Redpoll	*Carduelis flammea*	Upland Breeding Bird					1	1	Flying
24-Jun-11	6	PRISM survey	LSA35	LSA			Golden Eagle	*Aquila chrysaetos*	Raptor					1	1	Flying
24-Jun-11	6	PRISM survey	LSA35	LSA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Flying
24-Jun-11	6	PRISM survey	LSA35	LSA			Horned Lark	*Eremophila alpestris*	Upland Breeding Bird	1					1	1 male
24-Jun-11	6	PRISM survey	LSA35	LSA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird	1					1	1 male
24-Jun-11	6	PRISM survey	LSA35	LSA			Pacific Loon	*Gavia pacifica*	Waterbird					1	1	Outside plot
24-Jun-11	6	PRISM survey	LSA35	LSA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	2					2	2 males
25-Jun-11	6	PRISM survey	LSA10	LSA			American Golden Plover	*Pluvialis dominica*	Upland Breeding Bird					1	1	Outside plot
25-Jun-11	6	PRISM survey	LSA10	LSA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					1	1	Flying
25-Jun-11	6	PRISM survey	LSA2	LSA			Common Redpoll	*Carduelis flammea*	Upland Breeding Bird					4	4	Flying
25-Jun-11	6	PRISM survey	LSA2	LSA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Outside plot
25-Jun-11	6	PRISM survey	LSA2	LSA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird	1					1	1 male
25-Jun-11	6	PRISM survey	LSA2	LSA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	1					1	1 male
25-Jun-11	6	PRISM survey	LSA30	LSA			Canada Goose	*Branta canadensis*	Waterbird					18	18	On lake
25-Jun-11	6	PRISM survey	LSA30	LSA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Flying
25-Jun-11	6	PRISM survey	LSA30	LSA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird	2	1				3	Pair and 1 male
25-Jun-11	6	PRISM survey	LSA30	LSA			Long-tailed Duck	*Clangula hyemalis*	Waterbird		1				1	1 female
25-Jun-11	6	PRISM survey	LSA30	LSA			Red-breasted Merganser	*Mergus serrator*	Waterbird	4					4	4 males
25-Jun-11	6	PRISM survey	LSA30	LSA			Arctic Tern	*Sterna paradisaea*	Waterbird	1	1				2	pair foraging
25-Jun-11	6	PRISM survey	LSA36	LSA			American Golden Plover	*Pluvialis dominica*	Upland Breeding Bird					1	1	Outside plot
25-Jun-11	6	PRISM survey	LSA36	LSA			Common Redpoll	*Carduelis flammea*	Upland Breeding Bird					1	1	Outside plot
25-Jun-11	6	PRISM survey	LSA36	LSA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Outside plot
25-Jun-11	6	PRISM survey	LSA36	LSA			Horned Lark	*Eremophila alpestris*	Upland Breeding Bird	1					1	1 male
25-Jun-11	6	PRISM survey	LSA36	LSA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	1					1	1 male
25-Jun-11	6	PRISM survey	LSA36	LSA			Arctic Tern	*Sterna paradisaea*	Waterbird					1	1	Outside plot
27-Jun-11	6	PRISM survey	RA11	RA			American Tree Sparrow	*Spizella arborea*	Upland Breeding Bird	1					1	1 male
27-Jun-11	6	PRISM survey	RA11	RA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					1	1	Flying
27-Jun-11	6	PRISM survey	RA2	RA			Canada Goose	*Branta canadensis*	Waterbird					1	4	Outside plot
27-Jun-11	6	PRISM survey	RA2	RA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird	1					1	1 male
27-Jun-11	6	PRISM survey	RA2	RA			Long-tailed Duck	*Clangula hyemalis*	Waterbird	1					1	1 male
27-Jun-11	6	PRISM survey	RA2	RA			Northern Pintail	*Anas acuta*	Waterbird	1					1	1 male
27-Jun-11	6	PRISM survey	RA2	RA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	2					2	2 males
27-Jun-11	6	PRISM survey	RA2	RA			Stilt Sandpiper	*Calidris himantopus*	Upland Breeding Bird					1	1	Outside plot
27-Jun-11	6	PRISM survey	RA2	RA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					1	1	Flying
27-Jun-11	6	PRISM survey	RA27	RA			Canada Goose	*Branta canadensis*	Waterbird					1	1	On lake
27-Jun-11	6	PRISM survey	RA27	RA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Flying
27-Jun-11	6	PRISM survey	RA27	RA			Horned Lark	*Eremophila alpestris*	Upland Breeding Bird					1	1	Outside plot
27-Jun-11	6	PRISM survey	RA27	RA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					1	1	Flying
27-Jun-11	6	PRISM survey	RA27	RA			Canada Goose	*Branta canadensis*	Waterbird					1	3	Outside plot
27-Jun-11	6	PRISM survey	RA30	RA			American Tree Sparrow	*Spizella arborea*	Upland Breeding Bird					1	1	Outside plot
27-Jun-11	6	PRISM survey	RA30	RA			Long-tailed Duck	*Clangula hyemalis*	Waterbird	3	3				6	3 pairs
27-Jun-11	6	PRISM survey	RA30	RA			Parasitic Jaeger	*Stercorarius parasiticus*	Waterbird					1	1	Flying
27-Jun-11	6	PRISM survey	RA30	RA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	1					1	1 male
27-Jun-11	6	PRISM survey	RA30	RA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					2	2	Flying
27-Jun-11	6	PRISM survey	RA30	RA			Greater White-fronted Goose	*Anser albifrons*	Waterbird					2	2	Flying
27-Jun-11	6	PRISM survey	RA27	RA			Long-tailed Duck	*Clangula hyemalis*	Waterbird	1					1	1 male flying

Appendix 11.4-1. Incidental Observations of Wildlife, 2011

Date	Month	Survey	PRISM Plot No. (PRISM Survey Only)	Location	Easting	Northing	Species	Scientiific Name	Group	No. Observed					Total Observed	Comment(s)
										Male	Female	Young	Eggs	Unknown Age/Sex		
28-Jun-11	6	PRISM survey	RA21	RA			American Tree Sparrow	*Spizella arborea*	Upland Breeding Bird					1	1	Outside plot
28-Jun-11	6	PRISM survey	RA21	RA			Canada Goose	*Branta canadensis*	Waterbird					3	3	Outside plot
28-Jun-11	6	PRISM survey	RA21	RA			Herring Gull	*Larus argentatus*	Waterbird					2	2	Flying
28-Jun-11	6	PRISM survey	RA21	RA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird					2	2	Pair
28-Jun-11	6	PRISM survey	RA21	RA			Long-tailed Jaeger	*Stercorarius longicaudus*	Waterbird					1	1	Outside plot
28-Jun-11	6	PRISM survey	RA21	RA			Stilt Sandpiper	*Calidris himantopus*	Upland Breeding Bird					1	1	Outside plot
28-Jun-11	6	PRISM survey	RA21	RA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					1	1	Flying
28-Jun-11	6	PRISM survey	RA26	RA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Flying
28-Jun-11	6	PRISM survey	RA26	RA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird	1				2	3	1 male, 2 unknown
28-Jun-11	6	PRISM survey	RA26	RA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	2					2	2 males
28-Jun-11	6	PRISM survey	RA32	RA			Parasitic Jaeger	*Stercorarius parasiticus*	Waterbird	1	1		2		2	Pair and nest with 2 eggs inside PRISM RA 32
28-Jun-11	6	PRISM survey	RA32	RA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Flying
29-Jun-11	6	PRISM survey	LSA14	LSA			Long-tailed Duck	*Clangula hyemalis*	Waterbird					1	1	Outside plot
29-Jun-11	6	PRISM survey	LSA14	LSA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	1					1	1 male
29-Jun-11	6	PRISM survey	LSA14	LSA			Greater Scaup	*Aythya fuligula*	Waterbird					1	1	Outside plot
29-Jun-11	6	PRISM survey	LSA14	LSA			Greater White-fronted Goose	*Anser albifrons*	waterbird					1	1	Outside plot
29-Jun-11	6	PRISM survey	LSA22	LSA			American Golden Plover	*Pluvialis dominica*	Upland Breeding Bird					1	1	Outside plot
29-Jun-11	6	PRISM survey	LSA22	LSA			Common Redpoll	*Carduelis flammea*	Upland Breeding Bird					1	1	Flying
29-Jun-11	6	PRISM survey	LSA22	LSA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird					2	2	Outside plot
29-Jun-11	6	PRISM survey	LSA22	LSA			Parasitic Jaeger	*Stercorarius parasiticus*	Waterbird					1	1	Flying
29-Jun-11	6	PRISM survey	LSA22	LSA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	1					1	1 male
29-Jun-11	6	PRISM survey	RA29	RA			Canada Goose	*Branta canadensis*	Waterbird					4	4	Flying
29-Jun-11	6	PRISM survey	RA29	RA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Flying
29-Jun-11	6	PRISM survey	RA29	RA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird	1					1	1 male
29-Jun-11	6	PRISM survey	RA29	RA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	1					1	1 male
29-Jun-11	6	PRISM survey	RA29	RA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					1	1	Flying
29-Jun-11	6	PRISM survey	RA31	RA			American Tree Sparrow	*Spizella arborea*	Upland Breeding Bird	1					1	1 male
29-Jun-11	6	PRISM survey	RA31	RA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Outside plot
29-Jun-11	6	PRISM survey	RA31	RA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird	2				1	3	2 males, 1 unknown
29-Jun-11	6	PRISM survey	RA31	RA			Long-tailed Duck	*Clangula hyemalis*	Waterbird	2					2	2 males
29-Jun-11	6	PRISM survey	RA31	RA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					1	1	Flying
29-Jun-11	6	PRISM survey	RA31	RA	432550	7255800	Grey Wolf	*Canis lupus*	Carnivore					1	1	Outside plot
29-Jun-11	6	PRISM survey	RA31	RA			Arctic Tern	*Sterna paradisaea*	Waterbird					1	1	Outside plot
29-Jun-11	6	PRISM survey	RA31	RA			Unknown Sandpiper	*n/a*	Upland Breeding Bird					1	1	Outside plot
29-Jun-11	6	PRISM survey	LSA14	LSA			American Golden Plover	*Pluvialis dominica*	Upland Breeding Bird	1	1				2	Pair flying
30-Jun-11	6	PRISM survey	RA15	RA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Flying
30-Jun-11	6	PRISM survey	RA15	RA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	1					1	1 male
30-Jun-11	6	PRISM survey	RA15	RA			Greater Scaup	*Aythya fuligula*	Waterbird	1	1				2	pair flying
30-Jun-11	6	PRISM survey	RA200	RA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Outside plot
30-Jun-11	6	PRISM survey	RA200	RA			Long-tailed Duck	*Clangula hyemalis*	Waterbird					2	2	Outside plot
30-Jun-11	6	PRISM survey	RA200	RA			Semipalmated Sandpiper	*Calidris pusilla*	Upland Breeding Bird					3	3	Outside plot
30-Jun-11	6	PRISM survey	RA200	RA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					3	3	Flying
30-Jun-11	6	PRISM survey	RA200	RA			Red-throated Loon	*Gavia stellata*	Waterbird	1	1				2	Pair
30-Jun-11	6	PRISM survey	RA200	RA			Arctic Tern	*Sterna paradisaea*	Waterbird					4	4	Flying
30-Jun-11	6	PRISM survey	RA5	RA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird	1				1	2	1 male, 1 unknown
30-Jun-11	6	PRISM survey	RA5	RA			Long-tailed Duck	*Clangula hyemalis*	Waterbird	1					1	1 male
30-Jun-11	6	PRISM survey	RA5	RA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	2					2	2 male
30-Jun-11	6	PRISM survey	RA9	RA			Herring Gull	*Larus argentatus*	Waterbird					2	2	Outside plot
30-Jun-11	6	PRISM survey	RA9	RA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird	2	1				3	2 males, 1 female
30-Jun-11	6	PRISM survey	RA9	RA			Red-throated Loon	*Gavia stellata*	Waterbird					1	1	Outside plot
30-Jun-11	6	PRISM survey	RA9	RA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	1				1	2	1 male, 1 unknown
30-Jun-11	6	PRISM survey	RA9	RA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					2	2	Outside plot
30-Jun-11	6	PRISM survey	RA9	RA			Long-tailed Jaeger	*Stercorarius longicaudus*	Waterbird					1	1	flying
30-Jun-11	6	PRISM survey	RA5	RA			Common Raven	*Corvus corax*	Raptor					1	1	Outside plot
1-Jul-11	7	PRISM survey	LSA23	LSA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	2					2	2 males
1-Jul-11	7	PRISM survey	LSA26	LSA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Outside plot
1-Jul-11	7	PRISM survey		Goose Lake Camp	434000	7269930	Willow Ptarmagin	*Lagopus lagopus*	Upland Breeding Bird					5	5	Many adults in camp
2-Jul-11	7	PRISM survey	LSA19	LSA			American Tree Sparrow	*Spizella arborea*	Upland Breeding Bird	1					1	1 male
2-Jul-11	7	PRISM survey	LSA19	LSA			Horned Lark	*Eremophila alpestris*	Upland Breeding Bird					1	1	Outside plot
2-Jul-11	7	PRISM survey	LSA19	LSA			Long-tailed Jaeger	*Stercorarius longicaudus*	Waterbird					1	1	Outside plot
2-Jul-11	7	PRISM survey	LSA19	LSA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird					1	1	Outside plot
2-Jul-11	7	PRISM survey	LSA19	LSA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					4	4	Flying
2-Jul-11	7	PRISM survey	LSA19	LSA			White crowned Sparrow	*Zonotrichia leucophrys*	Upland Breeding Bird	1					1	1 singing male heard
2-Jul-11	7	PRISM survey	LSA7	LSA			American Tree Sparrow	*Spizella arborea*	Upland Breeding Bird					1	1	Outside plot
2-Jul-11	7	PRISM survey	LSA7	LSA			Northern Pintail	*Anas acuta*	Waterbird		1				1	1 female flying
2-Jul-11	7	PRISM survey	LSA7	LSA			Parasitic Jaeger	*Stercorarius parasiticus*	Waterbird	1	1				2	Pair
2-Jul-11	7	PRISM survey	LSA7	LSA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	1				1	2	1 male, 1 unknown
2-Jul-11	7	PRISM survey	LSA7	LSA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					1	1	Outside plot

Appendix 11.4-1. Incidental Observations of Wildlife, 2011

Date	Month	Survey	PRISM Plot No. (PRISM Survey Only)	Location	Easting	Northing	Species	Scientiific Name	Group	No. Observed					Total Observed	Comment(s)
										Male	Female	Young	Eggs	Unknown Age/Sex		
2-Jul-11	7	PRISM survey	LSA7	LSA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					1	4	Outside plot
2-Jul-11	7	PRISM survey	LSA9	LSA			Long-tailed Duck	*Clangula hyemalis*	Waterbird	1					1	1 male
2-Jul-11	7	PRISM survey	LSA9	LSA			Long-tailed Duck	*Clangula hyemalis*	Waterbird	1	1				2	Pair
2-Jul-11	7	PRISM survey	LSA9	LSA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird	1					1	1 male
2-Jul-11	7	PRISM survey	LSA9	LSA			Red-necked Phalarope	*Phalaropus lobatus*	Upland Breeding Bird	1					1	1 male
2-Jul-11	7	PRISM survey	LSA9	LSA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	2					2	2 males
2-Jul-11	7	PRISM survey	LSA9	LSA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					1	1	Outside plot
2-Jul-11	7	PRISM survey	LSA19	LSA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird					1	1	Outside plot
3-Jul-11	7	PRISM survey	LSA200	LSA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Flying
3-Jul-11	7	PRISM survey	LSA200	LSA			Horned Lark	*Eremophila alpestris*	Upland Breeding Bird					1	1	Outside plot
3-Jul-11	7	PRISM survey	LSA200	LSA			Northern Harrier	*Circus cyaneus*	Raptor		1				1	Female
3-Jul-11	7	PRISM survey	LSA200	LSA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					1	1	Outside plot
3-Jul-11	7	PRISM survey	LSA200	LSA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Outside plot
3-Jul-11	7	PRISM survey	LSA200	LSA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird		1				1	1 female
3-Jul-11	7	PRISM survey	RA14	RA			American Golden Plover	*Pluvialis dominica*	Upland Breeding Bird					2	2	Outside plot
3-Jul-11	7	PRISM survey	RA14	RA			Herring Gull	*Larus argentatus*	Waterbird					1	1	Outside plot
3-Jul-11	7	PRISM survey	RA14	RA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird					1	1	Outside plot
3-Jul-11	7	PRISM survey	RA14	RA			Long-tailed Jaeger	*Stercorarius longicaudus*	Waterbird					1	1	Outside plot
3-Jul-11	7	PRISM survey	RA14	RA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	1					1	1 male
3-Jul-11	7	PRISM survey	RA14	RA			Unknown Redpoll	*Carduelis spp.*	Upland Breeding Bird					2	2	Flying
3-Jul-11	7	PRISM survey	RA38	RA			American Golden Plover	*Pluvialis dominica*	Upland Breeding Bird					1	1	Outside plot
3-Jul-11	7	PRISM survey	RA38	RA			Canada Goose	*Branta canadensis*	Waterbird					2	2	Outside plot
3-Jul-11	7	PRISM survey	RA38	RA			Herring Gull	*Larus argentatus*	Waterbird					2	2	Flying
3-Jul-11	7	PRISM survey	RA38	RA			Lapland Longspur	*Calcarius lapponicus*	Upland Breeding Bird	2					2	2 males
3-Jul-11	7	PRISM survey	RA38	RA			Long-tailed Jaeger	*Stercorarius longicaudus*	Waterbird					2	2	Outside plot
3-Jul-11	7	PRISM survey	RA38	RA			Parasitic Jaeger	*Stercorarius parasiticus*	Waterbird					2	2	Flying
3-Jul-11	7	PRISM survey	RA38	RA			Savannah Sparrow	*Passerculus sandwichensis*	Upland Breeding Bird	1					1	1 male
3-Jul-11	7	PRISM survey	RA38	RA			Herring Gull	*Larus argentatus*	Waterbird					1	1	at lake in RA 38
4-Jul-11	7	Waterbird 1		LSA	440239	7269725	Arctic Tern	*Sterna paradisaea*	Waterbird					2	2	Flying
4-Jul-11	7	Waterbird 1		LSA	423478	7275843	Canada Goose	*Branta canadensis*	Waterbird					10	10	Off the end of Waterbird Transect LSA 2 West
4-Jul-11	7	Waterbird 1		LSA	437079	7272004	Grey Wolf	*Canis lupus*	Carnivore					2	2	Pair?
4-Jul-11	7	Waterbird 1		LSA	430030	7274001	Northern Harrier	*Circus cyaneus*	Raptor					1	1	
4-Jul-11	7	Waterbird 1		LSA	440239	7269725	Red-breasted Merganser	*Mergus serrator*	Waterbird	5					5	Males, off the end of Waterbird Transect LSA 5 East
5-Jul-11	7	Waterbird 1		LSA	430593	7275235	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					1	1	
5-Jul-11	7	Waterbird 1		Bathurst Inlet	391566	7375757	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					1	1	
5-Jul-11	7	Waterbird 1		Bathurst Inlet	391566	7375757	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					1	1	
05-Jul-11	7	Waterbird 1		Bathurst Inlet	630068	7407973	Tundra Swan	*Cygnus columbianus*	Waterbird					10	10	
05-Jul-11	7	Waterbird 1		Bathurst Inlet	374352	7421829	Grizzly Bear	*Ursus arctos*	Carnivore					1	1	
05-Jul-11	7	Waterbird 1		Bathurst Inlet	376307	7423848	Grizzly Bear	*Ursus arctos*	Carnivore					1	1	
6-Jul-11	7	Waterbird 1		Bathurst Inlet	374808	7407849	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					1	1	
6-Jul-11	7	Waterbird 1		Bathurst Inlet	377867	7407310	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					1	1	
6-Jul-11	7	Waterbird 1		Bathurst Inlet	378594	7405858	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					1	1	
6-Jul-11	7	Waterbird 1		Bathurst Inlet	380019	7430890	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					1	1	
6-Jul-11	7	Waterbird 1		RA	430475	7254512	Canada Goose	*Branta canadensis*	Waterbird					15	15	Off the end of Waterbird Transect RA 4 West
6-Jul-11	7	Waterbird 1		Bathurst Inlet	379861	7403452	Golden Eagle	*Aquila chrysaetos*	Raptor					1	1	
6-Jul-11	7	Waterbird 1		Bathurst Inlet	382127	7393416	Golden Eagle	*Aquila chrysaetos*	Raptor					1	1	
6-Jul-11	7	Waterbird 1		RA	435433	7258976	Peregrine Falcon	*Falco peregrinus*	Raptor					1	1	Flying
06-Jul-11	7	Waterbird 1		Bathurst Inlet	401821	7357860	Grizzly Bear	*Ursus arctos*	Carnivore					2	2	
06-Jul-11	7	Waterbird 1		Bathurst Inlet	388066	7381036	Grey Wolf	*Canis lupus*	Carnivore					2	2	pair observed around Bathurst fuel cache
26-Jul-11	7	Raptor Productivity		RCSA	436126	7287537	Arctic Ground Squirrel	*Spermophilus parryii*	Small Mammal						n/a	probable sik-sik colony but some larger holes
26-Jul-11	7	Raptor Productivity		RCSA	408207	7287820	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					1	1	
26-Jul-11	7	Raptor Productivity		RCSA	410841	7288441	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					1	1	
27-Jul-11	7	Raptor Productivity		RCSA	437378	7249084	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					50	50	Mostly male
27-Jul-11	7	Raptor Productivity		RCSA	448231	7276382	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					2	2	
27-Jul-11	7	Raptor Productivity		RCSA	448273	7273622	Caribou	*Rangifer tarandus groenlandicus*	Ungulate			12		20	32	20 Adults and 12 calves
27-Jul-11	7	Raptor Productivity		RCSA	450755	7268437	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					3	3	
27-Jul-11	7	Raptor Productivity		RCSA	453899	7261282	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					50	50	
27-Jul-11	7	Raptor Productivity		RCSA	455511	7262067	Caribou	*Rangifer tarandus groenlandicus*	Ungulate			15		20	35	20 adults and 15 calves; mixed group
27-Jul-11	7	Raptor Productivity		RCSA	457076	7257994	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					40	40	Adults, no calves observed
27-Jul-11	7	Raptor Productivity		LSA	453512	7258080	Parasitic Jaeger	*Stercorarius parasiticus*	Waterbird					1	1	Observed flying during Raptor survey
27-Jul-11	7	Raptor Productivity		Goose Lake Camp	435667	7270251	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					2000	2000	large groups passing by camp all day
29-Jul-11	7	camp1		RCSA	433910	7273560	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					1	1	Solitary male standing atop a ridge
29-Jul-11	7	camp1		RCSA	435000	7271050	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					200	200	Herd of ~200 individuals grazing
30-Jul-11	7	camp1		RCSA	429620	7271140	Caribou	*Rangifer tarandus groenlandicus*	Ungulate	3	4				7	3 males, 4 females grazing
30-Jul-11	7	camp1		RCSA	429720	7271360	Caribou	*Rangifer tarandus groenlandicus*	Ungulate	1					1	Single male
5-Aug-11	8	Waterbird 2		Bathurst Inlet	400756	7360969	Bald Eagle	*Haliaeetus leucocephalus*	Raptor					1	1	Flying
5-Aug-11	8	Waterbird 2		Bathurst Inlet	380181	7435073	Common Raven	*Corvus corax*	Raptor					1	1	Flying
5-Aug-11	8	Waterbird 2		Bathurst Inlet	390939	7436288	Grizzly Bear	*Ursus arctos*	Carnivore		1	2			3	Adult female and two cubs

Appendix 11.4-1. Incidental Observations of Wildlife, 2011

Date	Month	Survey	PRISM Plot No. (PRISM Survey Only)	Location	Easting	Northing	Species	Scientiific Name	Group	No. Observed					Total Observed	Comment(s)
										Male	Female	Young	Eggs	Unknown Age/Sex		
6-Aug-11	8	Waterbird 2		LSA	437417	7276357	Bald Eagle	*Haliaeetus leucocephalus*	Raptor					1	1	Flying over tundra
6-Aug-11	8	Waterbird 2		LSA	437637	7273894	Bald Eagle	*Haliaeetus leucocephalus*	Raptor					1	1	Flying
6-Aug-11	8	Waterbird 2		LSA	423904	7267911	Canada Goose	*Branta canadensis*	Waterbird					20	20	Off the end of Waterbird Transect LSA 6 West
6-Aug-11	8	Waterbird 2		RA	430862	7256154	Canada Goose	*Branta canadensis*	Waterbird					3	3	On tundra off Waterbird Transect RA 3 West
6-Aug-11	8	Waterbird 2		LSA	437417	7276357	Common Raven	*Corvus corax*	Raptor					4	4	Flying over tundra
6-Aug-11	8	Waterbird 2		LSA	431574	7269923	Gyrfalcon	*Falco rusticolus*	Raptor					1	1	Flying, visible nest on cliff face
6-Aug-11	8	Waterbird 2		LSA	423358	7264296	Long-tailed Jaeger	*Stercorarius longicaudus*	Waterbird					2	2	Flying off the end of Waterbird Transect LSA 8 West
6-Aug-11	8	Waterbird 2		LSA	423924	7266796	Pacific Loon	*Gavia pacifica*	Waterbird					16	16	Off the end of Waterbird Transect LSA 7 West
6-Aug-11	8	Waterbird 2		LSA	436883	7272006	Unknown Sandpiper		Upland Breeding Bird					12	12	Observed flying over small lake during Waterbird aerial surveys
6-Aug-11	8	Waterbird 2		Goose Lake Camp	434000	7269930	Willow Ptarmagin	*Lagopus lagopus*	Upland Breeding Bird					20	20	Many adults and chicks in camp
15-Aug-11	8	Hyrdology		RA	442573	7257794	Caribou	*Rangifer tarandus groenlandicus*	Ungulate					50	50	huge group that passed by hyrdo station
9-Sep-11	9	camp2		RCSA	373983	7273626	Grey Wolf	*Canis lupus*	Carnivore			4			4	Young -about a year old, no adult observed
10-Sep-11	9	camp2		RCSA	371365	7277100	Grey Wolf	*Canis lupus*	Carnivore					1	1	Walking on tundra
10-Sep-11	9	camp2		RCSA	402037	7298533	Grizzly Bear	*Ursus arctos*	Carnivore		1	2			3	Adult female and two one year olds

Appendix V5-5E

Back River and Hackett River Projects: 2010 Caribou and Muskox Baseline Report

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BACK RIVER AND HACKETT RIVER PROJECTS
2010 Caribou and Muskox Baseline Report

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May 2011

BACK RIVER AND HACKETT RIVER PROJECTS

2010 CARIBOU AND MUSKOX BASELINE REPORT

May 2011
Project #0833-002-05

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Prepared for:

Sabina Gold & Silver Corp.

Prepared by:

Rescan™ Environmental Services Ltd.
Vancouver, British Columbia

Executive Summary

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Executive Summary

Sabina Gold and Silver Corporation (Sabina) owns the surface and subsurface leases for the potential Back River and Hackett River Projects. Back River is an exploration gold project and Hackett River is an exploration base metal project, both of which are located in the West Kitikmeot region of Nunavut. Rescan Environmental Services (Rescan) was contracted by Sabina to conduct wildlife baseline studies in 2010. The Back River and Hackett River wildlife baseline program in 2010 focused specifically on ungulates.

The 2010 wildlife baseline program was carried out in May through July, and was designed to assess the baseline distribution of two ungulate species, caribou and muskox, in areas surrounding the properties. Surveys were conducted in the Back and Hackett River regional study area (RSA), an area consisting of a 35 km buffer around the Hackett, George, and Goose camps/sites, and access corridors between Hackett Camp and Bathurst Inlet, George Camp and Bathurst Inlet, and Hackett Camp and George Camp.

Three aerial surveys were conducted in the RSA for the collection of baseline information on caribou and muskox. These surveys corresponded with the spring migration for the Bathurst herd (May), calving, (June), and post calving (July) life history periods for caribou. A total of 65 caribou were observed during aerial surveys. The highest caribou numbers (28 individuals) were recorded in June, corresponding to the time when animals were congregating on their calving grounds. Caribou groups, ranging in size from 1 to 19 individuals, were most often recorded in the northern portion of the RSA on all three surveys. A total of 87 muskox were observed in the RSA; 82 adults and 5 calves/juveniles. The majority of muskox were observed in large groups of greater than 15 individuals.

Existing data from satellite collaring programs for the Bathurst and Ahiak caribou herds was used to supplement the characterization of the distribution of caribou relative to the RSA. Fixed kernel utilization distributions (UDs) were developed from collar locations to identify areas of concentrated use (50% kernel UD) and areas actively used by caribou (95% kernel UD). Fixed kernel UDs were analyzed by year and by life history period. For the spring migration period, individual paths were generated for each collared caribou to visually portray the migration route. Both caribou herds use habitat in the RSA on an annual basis. For the most part, collared Bathurst caribou use habitat within the RSA during the post-calving period while collared Ahiak caribou use habitat within the RSA during winter, summer, and fall, as evidenced by overlapping 50% and 95% kernel UDs during these periods. Annual movement paths for collared caribou show that Bathurst caribou and for the most part, Ahiak caribou, do not migrate through the RSA on their way to their calving grounds.

Incidental observations of other wildlife species were also recorded during aerial surveys for ungulates. A total of 16 species were recorded that could be identified to the species level, including four mammals and 12 birds. An additional six species were recorded that could not be identified to species.

Three species observed during baseline studies in 2010 are of conservation concern: grizzly bear, wolverine, and white-crowned sparrow. Grizzly bear and wolverine are listed as special concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Territorially, the wolverine is listed as secure whereas the grizzly bear is sensitive. White-crowned sparrow is also listed as sensitive in Nunavut. The remaining species are considered secure.

Acknowledgements

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Acknowledgements

This report was prepared for Sabina Gold and Silver Corporation by Rescan Environmental Services Ltd. Fieldwork was conducted by Greg Sharam (M.Sc., Ph.D.), Leslie Bol (M.Sc., R.P.Bio.), and Brian Milakovic (M.Sc., Ph.D.). Fieldwork was conducted out of the Goose Lake Camp. Field-related support was provided by Dan Russell of Sabina, Air Tindi, and Arctic Sunwest Charters. This report was written by Julia Shewan (B.Sc.) with writing and editing support from Katie Kuker (M.Sc.) and Greg Sharam. The project was managed by Deborah Muggli (M.Sc., Ph.D., R.P.Bio).

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BACK RIVER AND HACKETT RIVER PROJECTS

2010 CARIBOU AND MUSKOX BASELINE REPORT

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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

COSEWIC	Committee on the Status of Endangered Wildlife in Canada - A federal committee of experts that assesses and designates the level of threat to wildlife and vegetation species in Canada.
Fixed Kernel Utilization Distribution (UD)	A technique that can be used to generate an estimate of an area within which a group of animals have a certain probability of being located over a period of time. For example, a 50% fixed kernel UD spatially defines the minimum amount of area within which a group of animals have a 50% chance of being contained within that certain amount of area. The area encompassed by a 50% kernel UD represents areas where the location points for multiple animals are more densely packed together over the specified time period, suggesting areas of concentrated use or "core use" areas. Larger probability values (i.e., 95% kernel UDs) usually span over larger areas, as they encompass an area where all animals have a 95% chance of being contained within that area. Therefore, 95% kernel UD contains more location points that are located farther away from concentration centres, suggesting areas of "active use".
GN DOE	Government of the Nunavut Department of Environment
GNWT ENR	Government of the Northwest Territories Department of Environment and Natural Resources
GPS	global positioning system
Life History Period	Periods of an animal's life that can be separated on the basis of certain characteristics, such as by animal behaviour, habitat use, or reproductive stage. For caribou, there are six general life history periods that can be separated by to habitat use and animal behaviour; winter, spring migration, calving, post-calving, summer, and fall migration (including the rutting period).
NPC	Nunavut Planning Commission
RSA	Regional Study Area
SARA	*Species at Risk Act* - A Canadian federal statute which is designed to meet one of Canada's commitments under the International Convention on Biological Diversity. The goal of the Act is to protect endangered or threatened organisms and their habitats. It also manages species which are not yet threatened, but whose existence or habitat is in jeopardy.

1. Introduction

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1. Introduction

Sabina Gold and Silver Corporation (Sabina) owns the surface and subsurface leases for the potential Back River and Hackett River Projects. Back River is an exploration gold project and Hackett River is an exploration base metal project, both of which are located in the West Kitikmeot region of Nunavut (Figure 1-1). Rescan Environmental Services (Rescan) was contracted by Sabina to conduct baseline ungulate studies within a regional area that encompassed both the Back and Hackett River properties in 2010. This report presents the results from the aerial surveys for ungulates (caribou and muskox).

The Back River and Hackett River wildlife baseline program in 2010 focused specifically on ungulates. Caribou studies included the use of two data sources. First, fixed-wing aerial surveys were conducted during three life history periods within the Back River and Hackett River project areas. Secondly, data from satellite-collared female caribou was acquired from the government of the Northwest Territories to assess the distribution of caribou herds in relation to the Back River and Hackett River project areas. The distribution of muskox was also assessed during aerial surveys.

The objectives of the ungulate studies in 2010 were to identify the abundance and distribution of caribou within the Back and Hackett River areas during key life history periods for caribou. The specific objectives were to:

- conduct aerial surveys to record the caribou population in the Back and Hackett River areas during the spring migration (May), calving (June), and post calving (July) life history periods;
- observe the muskox population in the Back and Hackett River Project areas during the same surveys;
- record incidental observations of wildlife during aerial surveys; and
- utilize existing data from collared caribou to supplement the characterization of the distribution of caribou in relation to the Back and Hackett River Project areas.

General Back River and Hackett River Project Location Map

Figure 1-1

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2. Ungulate Populations near the Back River and Hackett River Projects

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2. Ungulate Populations near the Back River and Hackett River Projects

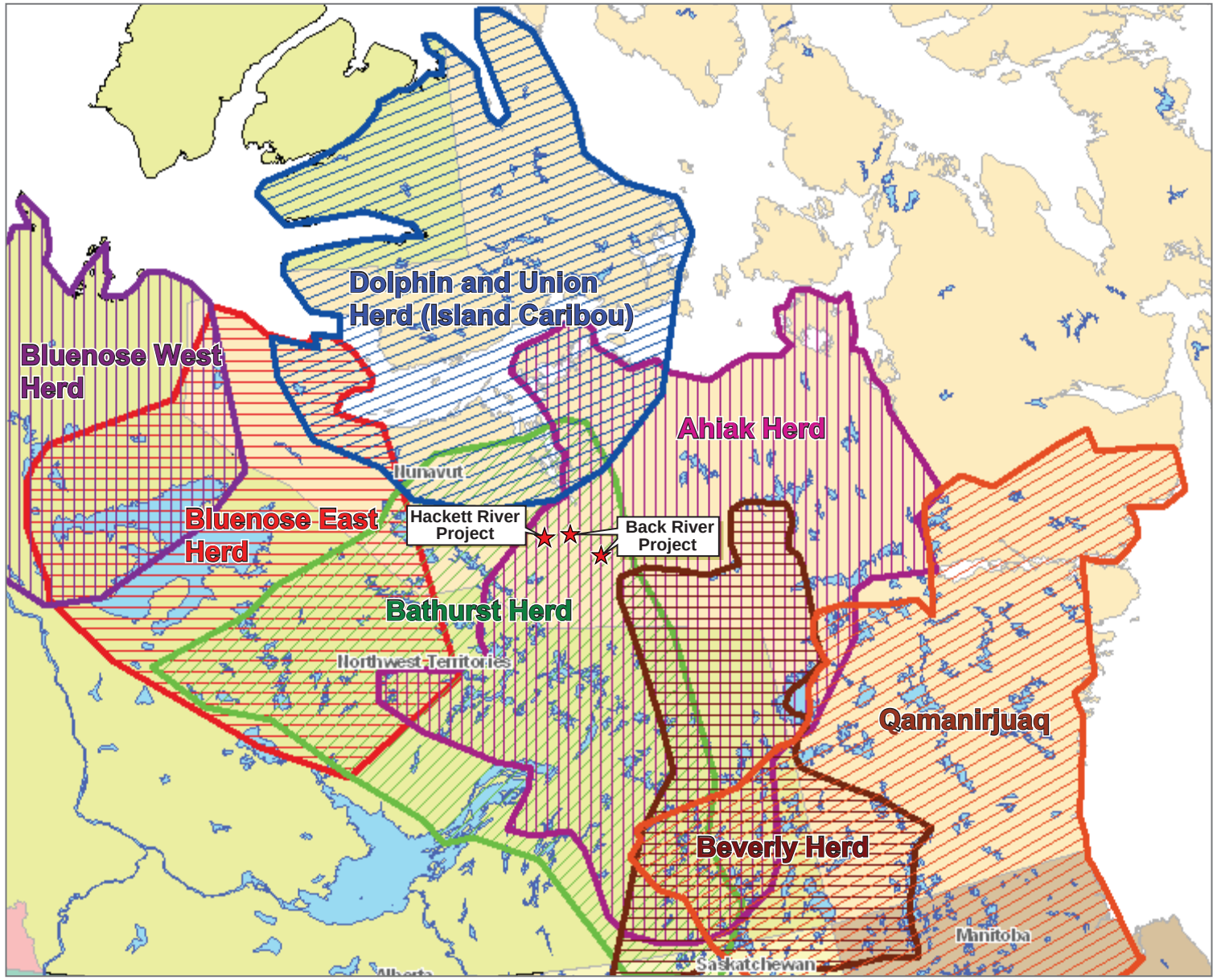
Caribou (*Rangifer tarandus*) and muskox (*Ovibos moschatus*) have been identified as keystone species in the Arctic. Caribou and muskox provide food and income for Inuit, support carnivore populations as main prey items, and have the ability to alter vegetation communities over vast areas. Grizzly bear, wolves and wolverine, which have also been identified as culturally and biologically important species in the Kitikmeot region of Nunavut, rely on caribou and muskox for large portions of their diet (Thorpe et al. 2001). Three caribou herds have been recorded in the vicinity of the Back River and Hackett River projects: the Bathurst, Ahiak, and Dolphin and Union herds (Figure 2-1). Muskox in the vicinity of the Back River and Hackett River projects are from the MX/14 (central mainland) population, which lies within the MX14 and MX19 wildlife management zones (Dumond 2006).

The Bathurst caribou population has declined from 472,000 ± 72,900 animals in 1986 (Heard and Williams 1991) to 186,005 ± 40,146 animals in 2003 (Gunn et al. 2005). These estimates are based on calving ground surveys of breeding females and they suggest an average annual decline of 5% per year since 1986 (Boulanger et al. 2004; Gunn et al. 2005). Survey results from 2006 suggest that the decline continued at 5% per annum with a herd size estimated at 128,000 ± 27,300 (Nishi et al. 2007; GNWT ENR 2010). Recent estimates suggest that the decline is even more rapid; a 2009 calving ground survey placed the herd size at 31,900 ± 11,000 (GNWT ENR 2009). Annual monitoring of calf survival indicates that mean winter calf survival and calf-cow ratios for the Bathurst herd have declined by almost 50% from 2001 to 2004 compared with the 1985 to 1996 period (Gunn, Boulanger, and Williams 2005).

The Ahiak herd is a relatively understudied population of caribou, first described as a separate herd in 1986. At that time, a systematic calving area survey along the Queen Maud Gulf estimated the herd size at 40,000 to 60,000 animals (Gunn, Fournier, and Nishi 2000). A decade later the herd increased in size to roughly 200,000 animals. The current population trend of the Ahiak herd is unknown; however, aerial surveys flown during the calving season in recent years (2006 to 2009) suggest that the herd is declining (CARMA 2010).

In the early 1900s, the Dolphin and Union caribou herd was estimated at 100,000 animals (COSEWIC 2004). Overhunting is reported to have caused a population crash between 1900 and 1920 to the point where caribou were not observed migrating between Victoria Island and the mainland (Gunn 2005). In the late 1980s and early 1990s, the Dolphin and Union herd had recovered to the point where they resumed their historic migrations between Victoria Island and the mainland (Gunn et al. 1997; Poole et al. 2010). Approximately 7,200 Dolphin and Union caribou were counted prior to migration in spring 1993 (Gunn et al. 1997). In 1997, the Dolphin and Union herd was estimated at 28,000 ± 3,350 animals (Nishi and Gunn 2004), which is approximately one third of its historic size.

Dolphin and Union caribou have recently been recognized as a genetically distinct population from the Peary caribou and barren-ground caribou (COSEWIC 2004). The Dolphin and Union herd is designated as a sub-population of Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) due to high harvests without recent population estimates (COSEWIC 2004). Potential threats to this herd's long term viability are climate warming and shipping activity across the herd's migration route (COSEWIC 2004). Climate warming may shorten the amount of time caribou have to cross between the mainland and Victoria Island during the spring and fall migrations, since this movement is dependent on ice formation. Shipping and icebreaking make Dolphin and Union caribou "vulnerable to die-offs similar to those that have affected Peary caribou" (COSEWIC 2004). The herd is pending addition to Schedule 1 of the *Species at Risk Act* (SARA).



Source: Department of Environment, Government of Nunavut, 2007

FIGURE 2-1

Annual Ranges of Caribou Herds in Nunavut

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Rescan™

Caribou abundance is thought to fluctuate with a periodicity of between 40 and 70 years (Gunn 2003). While the decline in caribou numbers may be a consequence of natural population cycles, current low numbers make the populations vulnerable to human harvest, disturbance, disease, and weather events. Caribou vary in their response to disturbances based on the time of year and age of calves. Caribou are most sensitive to population-level impacts during calving and post-calving when calves are most susceptible to predation and disturbance (Russell, Kofinas, and Griffith 2002). Calving and post-calving areas are designated as important habitat for caribou in Nunavut; two caribou herds' calving grounds, the Beverly and Qamanirjuaq herds, are protected areas in Nunavut (NPC 2008).

Muskox are the only other large ungulate aside from caribou that occupy the barren-grounds. However, unlike caribou, muskox do not migrate long distances. Muskox in Nunavut and the NWT were estimated at 140,000 animals in 1997 (Fournier and Gunn 1998). Nineteen thousand of these animals were from mainland populations, while the remainder were from populations inhabiting the Canadian Arctic Islands. The number of muskox between the northeast section of Contwoyto Lake and the southwest tip of Bathurst Inlet, which encompasses the Back River and Hackett River Project areas, was estimated at 3,400 ± 460 animals during a 1986 systematic strip transect survey (Gunn 1990). Muskox are recovering from near extinction in the early 1900s due to overhunting. Although the population has been increasing over the last thirty years, recent declines have occurred on the mainland (Dumond 2006).

3. Methods

3. Methods

3.1 STUDY AREA

The focal study area for the ungulate aerial surveys was the Hackett and Back River Regional Study Area (RSA) (Figure 3.1-1), which included a 35 km buffer around the Hackett, George, and Goose camps/sites, and access corridors between Hackett Camp and Bathurst Inlet, George Camp and Bathurst Inlet, and Hackett Camp and George Camp. The dominant habitat type within the study area was heath tundra; however, other major habitat types are present in lower abundance, including boulder field, sedge wetland, shrub (riparian shrub and birch seep), esker, and rocky outcrops.

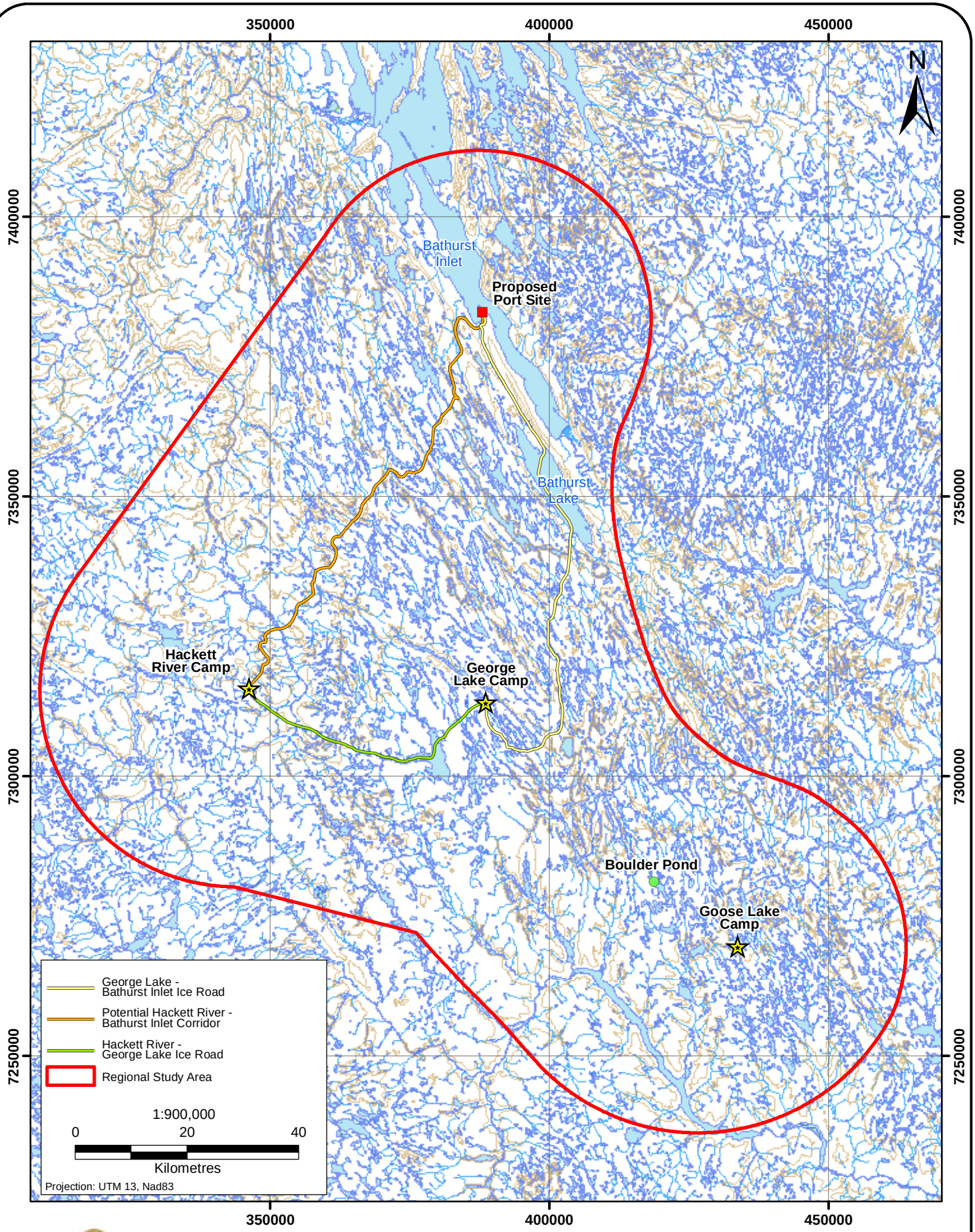
3.2 AERIAL SURVEYS

Three aerial surveys were flown during the spring and summer of 2010. Surveys were scheduled to correspond with spring migration, calving, and the post calving period for caribou. Surveys were conducted along pre-determined transect lines within the RSA (Figure 3.2-1); transect lines were parallel at a distance of 8 km apart. Transect lines for aerial surveys were based on those developed for baseline studies for the Hackett River Project in 2007 (refer to Figure 5.3-1 in Rescan 2008a). Several transect lines were lengthened to the extent of the RSA and four additional transect lines (Transects 16 through 20) were added within the Goose Lake area (Figure 3.2-1).

Aerial surveys were conducted using standard census techniques for large mammals. The aircraft followed transect lines using an onboard Garmin global positioning system (GPS) at an elevation of 122 m and speed of approximately 150 km/hr. The width of the survey transect was 500 m on either side of the airplane. Each observer calibrated this distance before the survey by having the airplane fly over two markers at an elevation of approximately 122 m. The markers were spaced 500 m apart and the observers noted the angle of the outside marker against calibration markers that were placed on the aircraft wing struts.

During survey flights, observers noted the sex, if possible, and number of caribou observed and the approximate distance that the animals were from the aircraft in 100 m increments (termed distance bins). When large groups of ungulates were observed, the airplane circled the group in order to achieve a more accurate count. Each observer counted the caribou independently and counts of each observer were averaged. Caribou were classified as bulls, cows or young; nursery groups were also identified. Muskox were classified as either adults or calves. The location and habitat, if possible, for each observation were also recorded. All caribou and muskox observed off-transect (greater than 500 m from the aircraft or during ferry flights) were also recorded.

Survey conditions were noted for each survey flight, including the snow cover, air temperature, wind speed, visibility and survey time. Incidental observations were also recorded for a variety of wildlife that could be identified from aircraft. Species, numbers of adults and/or offspring, GPS location, and habitats in which they were observed were documented whenever possible.



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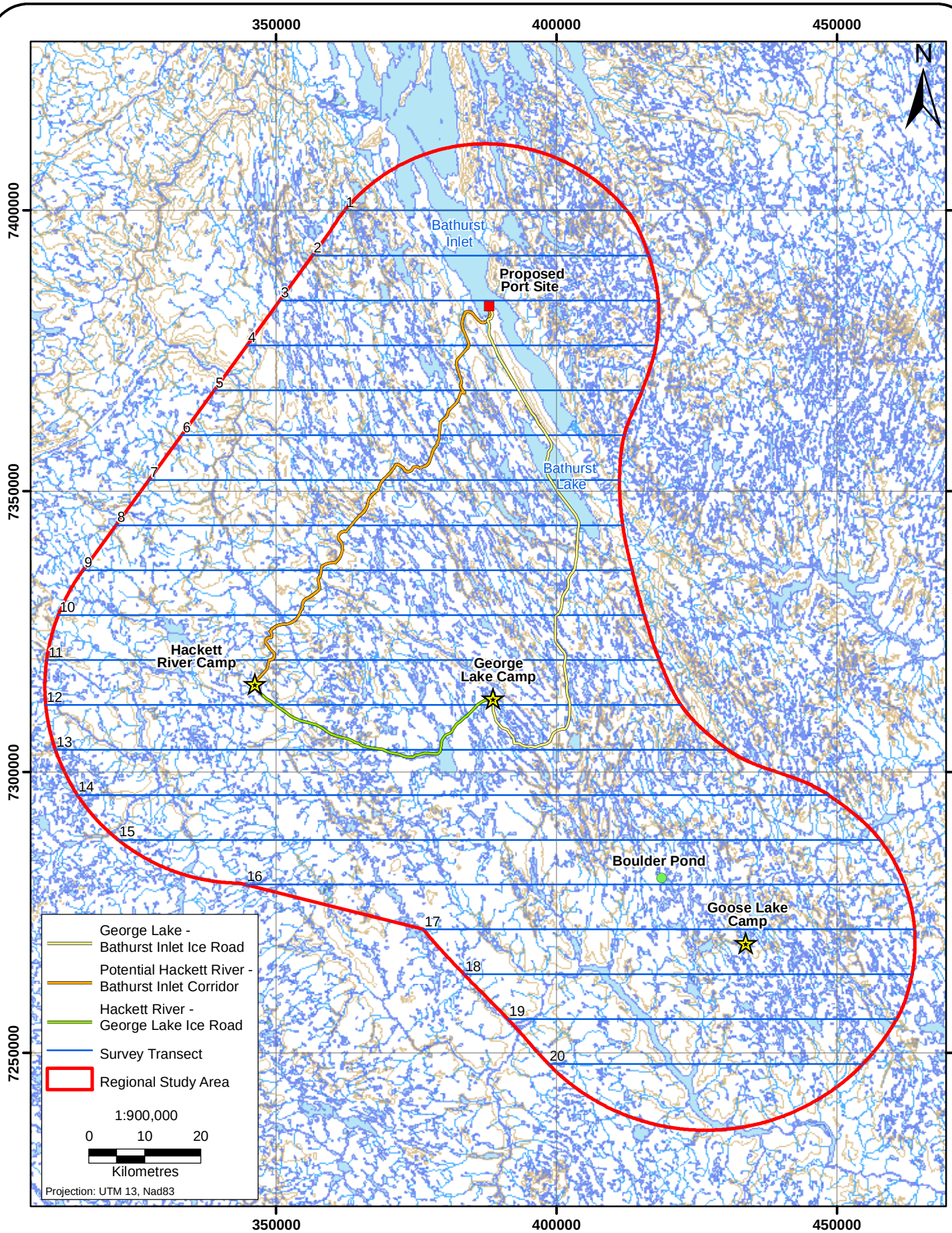
Regional Study Area for Caribou Surveys, 2010

FIGURE 3.1-1

Rescan™



Transect Lines within the Back and Hackett River RSA, 2010

FIGURE 3.2-1

3.3 TERRITORIAL GOVERNMENT CARIBOU COLLAR DATA

Collaring programs for caribou have been established in the Northwest Territories and Nunavut. Each year satellite collars are fitted on a group of female caribou during the winter. The data generated from these programs allow researchers to investigate seasonal trends in habitat use as well as track real time movement patterns of caribou herds. A collaring program for the Bathurst herd has been in place since approximately 1996. Collaring programs for the Ahiak and Dolphin and Union herds began in 2001.

Unpublished existing satellite collar data from the Bathurst and Ahiak herds was obtained from Bruno Croft (GNWT ENR) for analysis of the distribution of these herds relative to the Back and Hackett River RSA. As the Dolphin and Union herd has a minimal chance to interact with habitat in the RSA, no analysis of satellite collar data was required for this herd. Data from 2007 to the present was the focus of analysis.

3.4 DATA ANALYSIS

3.4.1 Survey Effort

The percentage of the transect lines that were flown during each survey was calculated by using the flightlines recorded during each survey. Maps of aerial survey flightlines are presented in Appendix 1.

3.4.2 Survey Observations

The total number of animals observed during aerial surveys was calculated, in addition to group size and composition. Group size included a total count of animals seen at each sighting. Group composition included three categories; single (solitary animal), nursery group (calves present), and non-nursery groups (no calves present).

3.4.3 Distribution of Collared Caribou

Fixed kernel utilization distributions (UDs) were used to contextualize the spatial distribution of collared caribou relative to the RSA. This method can be used to determine the core use areas for a single animal or a group of animals (termed 50% kernel UD) as well as the areas of active use (termed 95% kernel UD). The 50% kernel UD represents an area with a 50% probability that an animal (or group of animals) is inside that area; the same is true for 95% kernel UD. Fixed kernel UDs were generated using Home Range Tools for ArcGIS 9.

Data was analyzed by general life history stage, as presented in Table 3.4-1. These stages vary between herds and are defined by movement rates for migrations vs. winter and summer ranges (Johnson et al. 2005). The peak of calving (the day when 50% of the caribou have calved) and the weaning of calves are loosely used to define the calving period and post-calving periods, respectively. Calves are typically weaned three to five weeks after they are born (Russell, Kofinas, and Griffith 2002). It is acknowledged that these life history stages vary seasonally within one herd as well, particularly dates defining calving and post-calving; thus, a wider spread in dates is used here than in more recent studies (e.g., Flanders et al. 2009). Data were also separated by year from 2007 to 2010 to identify annual trends in habitat utilization. However, as the winter period spans the end of one year (Nov 1 to Dec 31) to the beginning of the next (Jan 1 to Apr 14), data was aggregated and defined by the beginning of the year. That is to say, the defined winter period of any year always included wintering points from the previous year. For example, winter 2008 includes collar location data from November 1, 2007 to April 14, 2008.

Table 3.4-1. Life Cycle Stage Dates for Bathurst and Ahiak Caribou

Life History Stage	Bathurst	Ahiak
Winter	November 1 to April 14	November 1 to April 14
Spring Migration	April 15 to June 4	April 15 to June 4
Calving	June 5 to June 15	June 5 to June 20
Post-Calving	June 16 to July 20	June 21 to July 15
Summer	July 21 to August 31	July 16 to August 31
Fall (Migration and Rut)	September 1 to October 31	September 1 to October 31

Kernel distributions were not appropriate for the spring migration, as this event is very linear in nature and is undertaken at a rapid pace relative to other life history stages (including the fall migration). Therefore, individual caribou movements were investigated during the spring migration periods to display the areas used instead of generating fixed kernel utilization distributions. Movement paths were generated using Hawths Tools for ArcGIS 9.3.

It should be noted that kernel UDs are based only on data from collared females, and thus, does not represent the entire distribution of Bathurst and Ahiak caribou during the various life history stages. Pregnant females migrate to calving grounds in the spring more quickly than yearlings and males which take advantage of succulent spring and summer vegetation as it emerges across the tundra (GNWT ENR 2010). Females and their newly born young typically reunite with the rest of the herd during the late summer, when they travel to rutting areas and then return to wintering grounds. However, as females are the only herd members that travel from wintering grounds to calving grounds and back again, using collar data from females provides a reasonable estimation of areas used by the whole herd (winter, summer, fall, and the rut) while highlighting areas of particular importance to calving females (calving and post-calving).

4. Results

4. Results

4.1 SURVEY EFFORT

The first survey was conducted on May 7 and 8, 2010. Low fog and cloud was encountered in the northern portion of the RSA and surveys along several transect lines were curtailed for safety reasons; the average survey coverage of transect lines across the whole RSA was 89 ± 3.3% (average ± standard error) (Appendix 2). The weather conditions during the second (June 7 and 8) and third (July 13 to 15) survey were more favourable, resulting in an average survey coverage of 96 ± 2.2% and 99 ± 0.8%, respectively.

4.2 AERIAL SURVEY OBSERVATIONS

During the three surveys, a total of 65 caribou and 87 muskox were observed (Appendix 3). The most animals observed during any one survey period occurred during the June survey, when 97 animals (28 caribou and 69 muskox) were recorded. The majority of caribou and muskox were observed on transect (i.e., within 500 m of the aircraft).

During the first survey (spring migration period for caribou), a total of two groups of caribou totalling 24 individuals were observed (Figure 4.2-1; Table 4.2-1). Most of the caribou (19 individuals) were observed in one group along Transect 7; all of these individuals were females. One muskox adult was observed during the first survey (Figure 4.2-1).

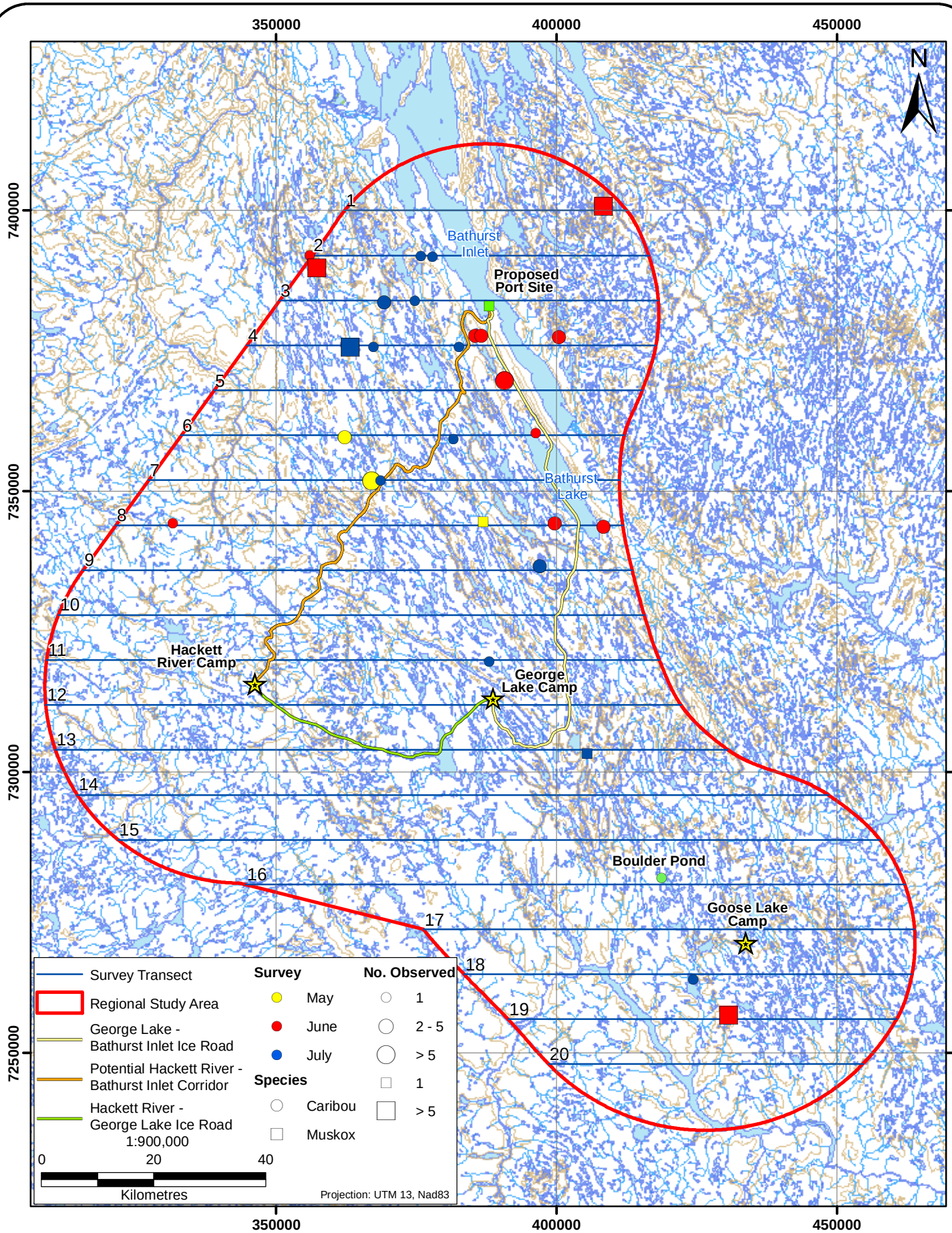
Table 4.2-1. Caribou and Muskox Observed during Aerial Surveys, 2010

	Caribou					Muskox		
Survey	Bulls	Cows	Calves/ Juveniles	Unknown	Total	Adults	Calves/ Juveniles	Total
1 (May 7 - 8)	-	19	-	5	24	1	-	1
2 (June 7 - 8)	-	14	-	13 (1)	27 (1)	30 (34)	5	35 (34)
3 (July 13 - 15)	3	-	-	9 (1)	12 (1)	17	-	17
Grand Total	3	33	-	29	65	82	5	87

** parentheses denote animals observed off transect (more than 500 m from the aircraft or during ferry flights)*
- Denotes no observation of caribou or muskox

During the second survey (calving period for caribou), a total of 10 groups of caribou totalling 28 individuals were observed (Figure 4.2-1; Table 4.2-1). Four of the groups were composed of females; sex could not be positivity ascertained in the remaining six groups (termed unclassified adults; Appendix 3). One solitary caribou adult was observed off transect along Transect 6. Sixty-nine muskox were observed within three groups during the second survey. All individuals were seen in large groups (≥15 individuals), one of which was a nursery group observed along Transect 19 just south of Goose Lake Camp (Figure 4.2-1). The largest group of muskox (34 individuals) was observed just off Transect 2 west of Bathurst Inlet (Figure 4.2-1; Plate 4.2-1).

During the third survey (post-calving period for caribou), thirteen caribou were observed mainly as separate, dispersed individuals; only two groups consisted of more than one animal (Figure 4.2-1; Table 4.2-1). One solitary caribou adult was observed off transect along Transect 18. No females were positively identified during the third survey; all individuals recorded where either bulls or unclassified adults (Appendix 3). Two groups of muskox were observed during the third survey; one group of 16 adults and one lone adult (Figure 4.2-1).



Caribou and Muskox Observations during Aerial Surveys, 2010

FIGURE 4.2-1

Plate 4.2-1. Group of 34 Muskox observed near Bathurst Inlet, June 8, 2010.

4.3 DISTRIBUTION OF COLLARED CARIBOU

4.3.1 Summary

Fixed kernel utilization distributions (UDs) for collared Bathurst and Ahiak caribou showed that both herds use habitat in the RSA on an annual basis. Notably, collared Bathurst caribou consistently used the RSA during the post-calving period; caribou moved in a southeasterly direction past the Hackett River Camp during this period. Collared Ahiak caribou were mostly present in the RSA during the winter, summer, and fall periods. Annual movement paths for collared caribou showed that Bathurst caribou and for the most part, Ahiak caribou, do not migrate through the RSA on their way to their calving grounds.

The number of collared caribou included in each fixed kernel UD dataset varied between years, based on data provided by the GNWT. Sample sizes for each kernel UD by year and herd is presented in Table 4.3-1.

Table 4.3-1. Sample Sizes for Fixed Kernel UDs

	No. of Collared Caribou used for generating kernel UDs by Year			
Herd	**2007**	**2008**	**2009**	**2010**
Bathurst	21	15	13	16
Ahiak	24	51	29	26

4.3.2 Winter

Collared Bathurst caribou have not wintered near the RSA in any year (Figure 4.3-1a). Collared Ahiak caribou, on the other hand, have wintered within and in areas surrounding the RSA in more than one year (Figure 4.3-1b). The areas actively used by collared Bathurst and Ahiak caribou (95% kernel UD) overlapped north of Great Slave Lake during the winter.

Collared Bathurst caribou winter far to the south of the RSA. From 2007 to the present, areas of active use were widely spread along roughly the same latitude from Great Bear Lake to Great Slave Lake (Figure 4.3-1a). Core use areas (50% kernel UD) across years generally overlapped with one another. However, during the winter of 2010 (spanning from November 2009 to April 2010), a group of females wintered further north than previously documented, as shown by a 50% kernel UD just to the south of Napatulik Lake (Figure 4.1-1a).

Collared Ahiak caribou exhibit a much more variable winter distribution than collared Bathurst caribou. Areas of active use span a large area from Bathurst Inlet south to Lake Athabasca (Figure 4.3-1b). Core use areas tended to be distributed to the west and south of Great Slave Lake, many of which overlapped between years. More recently, smaller groups of collared caribou have wintered around Bathurst Inlet. One core use area in 2009 overlapped with the southern RSA (Figure 4.3-1b).

4.3.3 Spring Migration

Based on movement paths of collared Bathurst caribou, it appears that most individuals from this herd tend to pass on the west side of Contwoyto Lake on their way to the calving grounds (Figure 4.3-2a). No collared Bathurst caribou have been shown to migrate through the RSA from 2007 to the present on their way to the traditional calving grounds. Most collared females made a very straight and direct migration from the wintering grounds to the calving grounds (Figure 4.3-2a).

The spring migration route for collared Ahiak caribou passes to the east of Bathurst Inlet in a generally northerly direction from wintering grounds (Figure 4.3-2b). A handful of individuals have passed through the RSA during spring migration in each year; however, most collared females passed several tens of kilometres to the east of the RSA. Similar to collared Bathurst caribou, collared Ahiak females moved in a very direct manor towards the calving ground. Interestingly, a few females appeared to have wintered and migrated along with the Bathurst herd in 2007 and 2010 and in doing so, passed through the RSA in the last stages of their migration to calving grounds east of Bathurst Inlet.

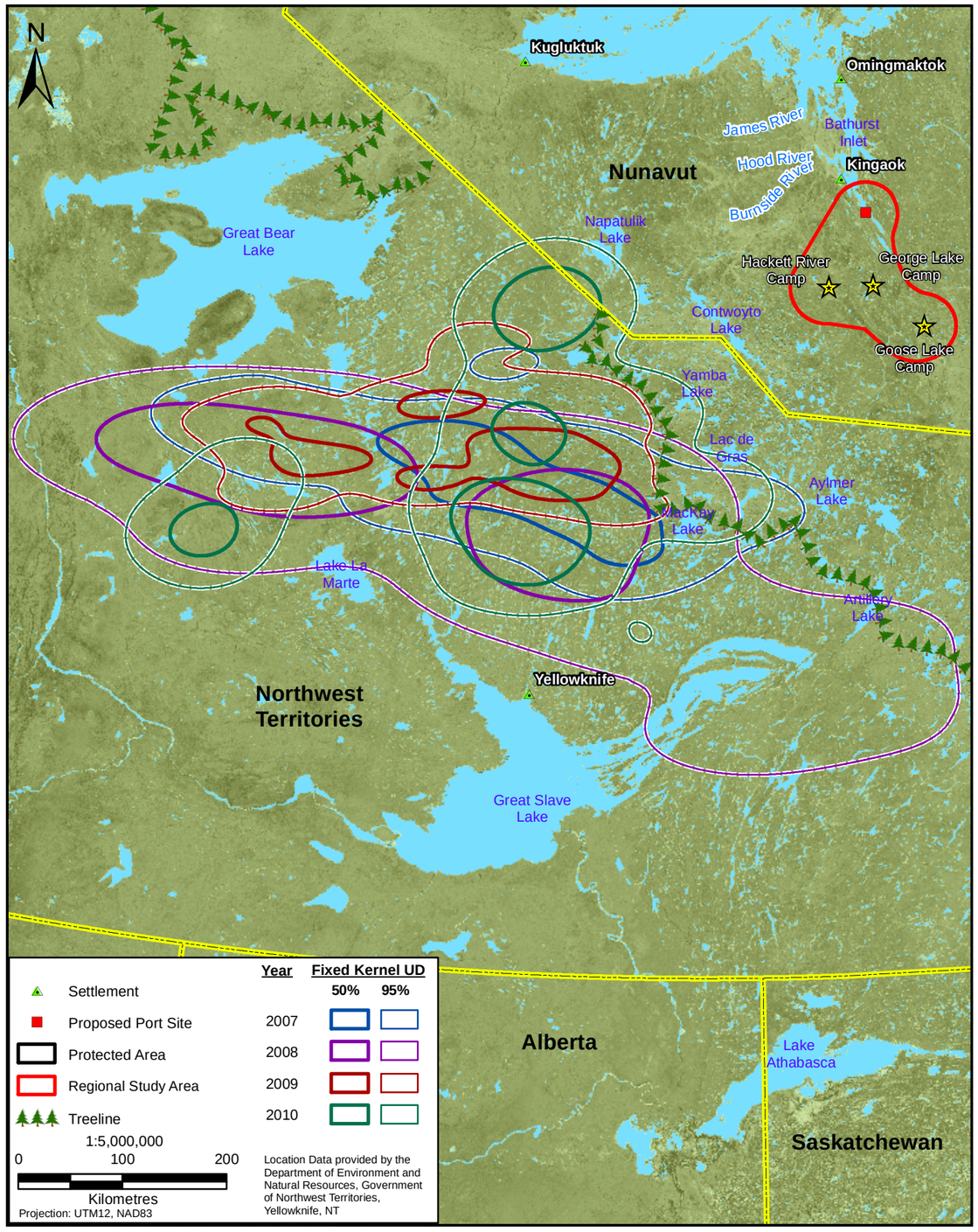
4.3.4 Calving

Fixed kernel utilization distributions for the two herds during the calving period show that the principle calving grounds are located outside of the RSA (Figures 4.3-3a and 4.3-3b). However, a 95% kernel UD overlapped with the southern RSA for both herds in single years, for Bathurst in 2010 and for Ahiak in 2008. There is no overlap in areas actively use by Bathurst and Ahiak caribou during the calving period.

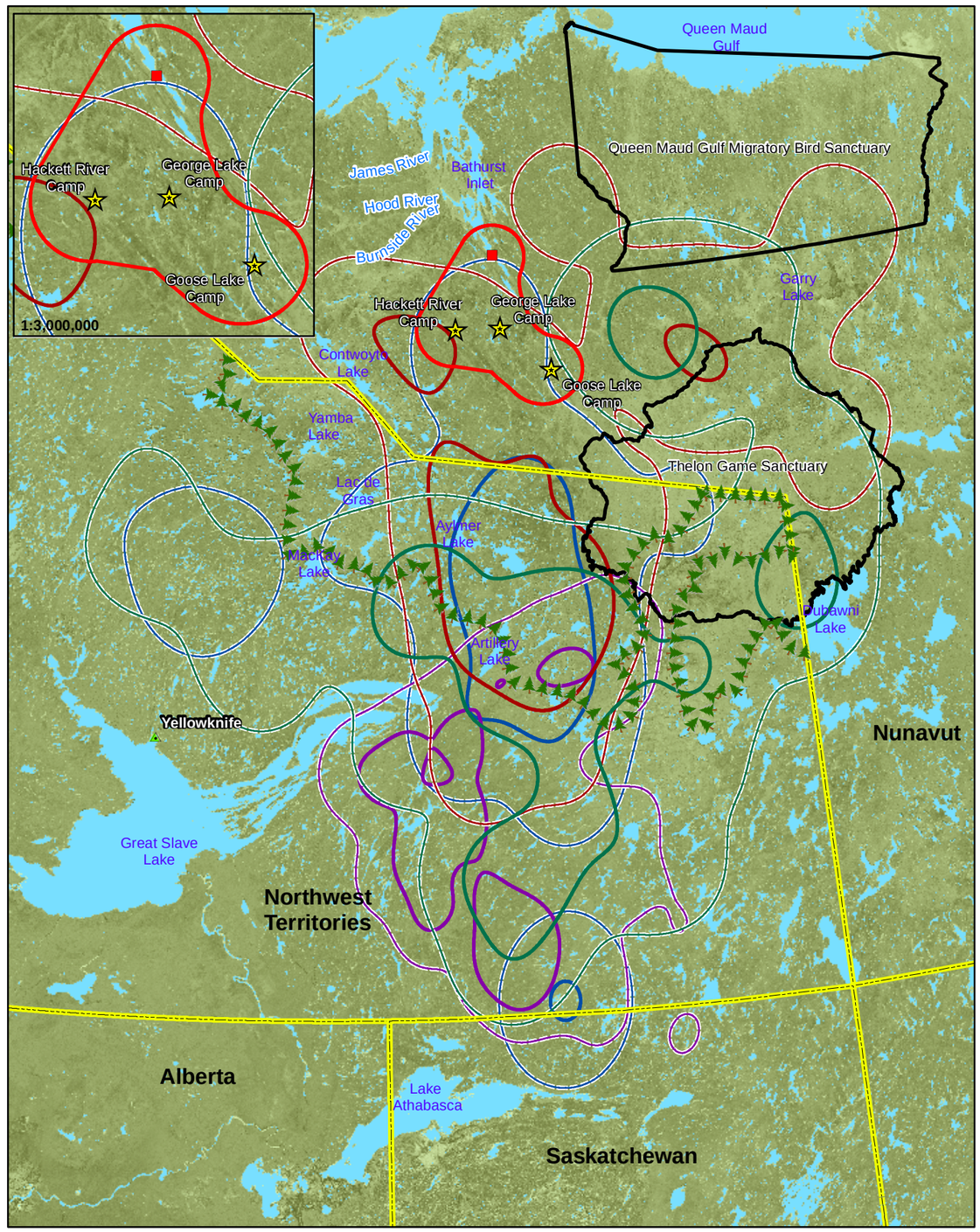
Areas of active use and core use areas for calving collared Bathurst caribou show a high degree of overlap across years, located primarily between the Burnside and Hood rivers to the northwest of the RSA (Figure 4.3-3a). Several smaller areas (isolated 95% kernel UD) outside of the main calving area appear to be used infrequently, such as areas near Contwoyto and Napatulik lakes in 2009 and in the southwestern RSA in 2010. It is possible that these are locations of collared females that did not calve during that year.

The calving distribution of collared Ahiak caribou overlapped a great deal from 2007 to 2010. For the most part, collared Ahiak caribou calved along the Queen Maud Gulf (Figure 4.3-3b). In 2008, collared caribou actively used a much larger area in comparison to other years, and a separate core use area was identified south of Garry Lake. The southern extension of the fixed 95% kernel UD in 2008 as well as the southern core use area (and isolated southerly UDs in 2009 and 2010) suggests that some locations for collared caribou included those females calving within the Beverly calving grounds. Despite the large areas of active use for calving Ahiak caribou, no UDs overlapped the RSA (Figure 4.3-3b).

a) Bathurst



b) Ahiak



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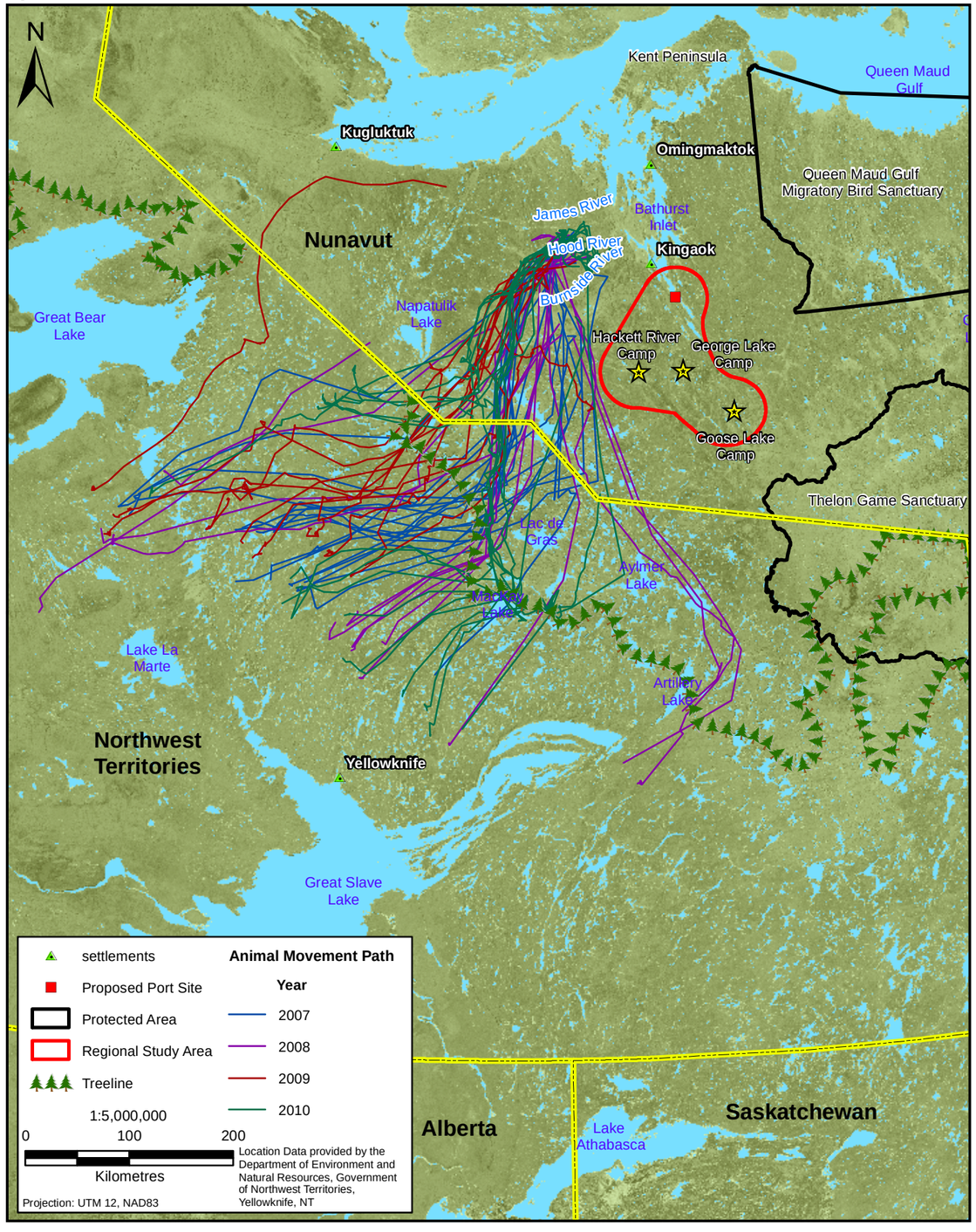
Distribution of Collared Bathurst and Ahiak Caribou during Winter, 2007 to 2010

FIGURE 4.3-1

Rescan™

a) Bathurst



b) Ahiak

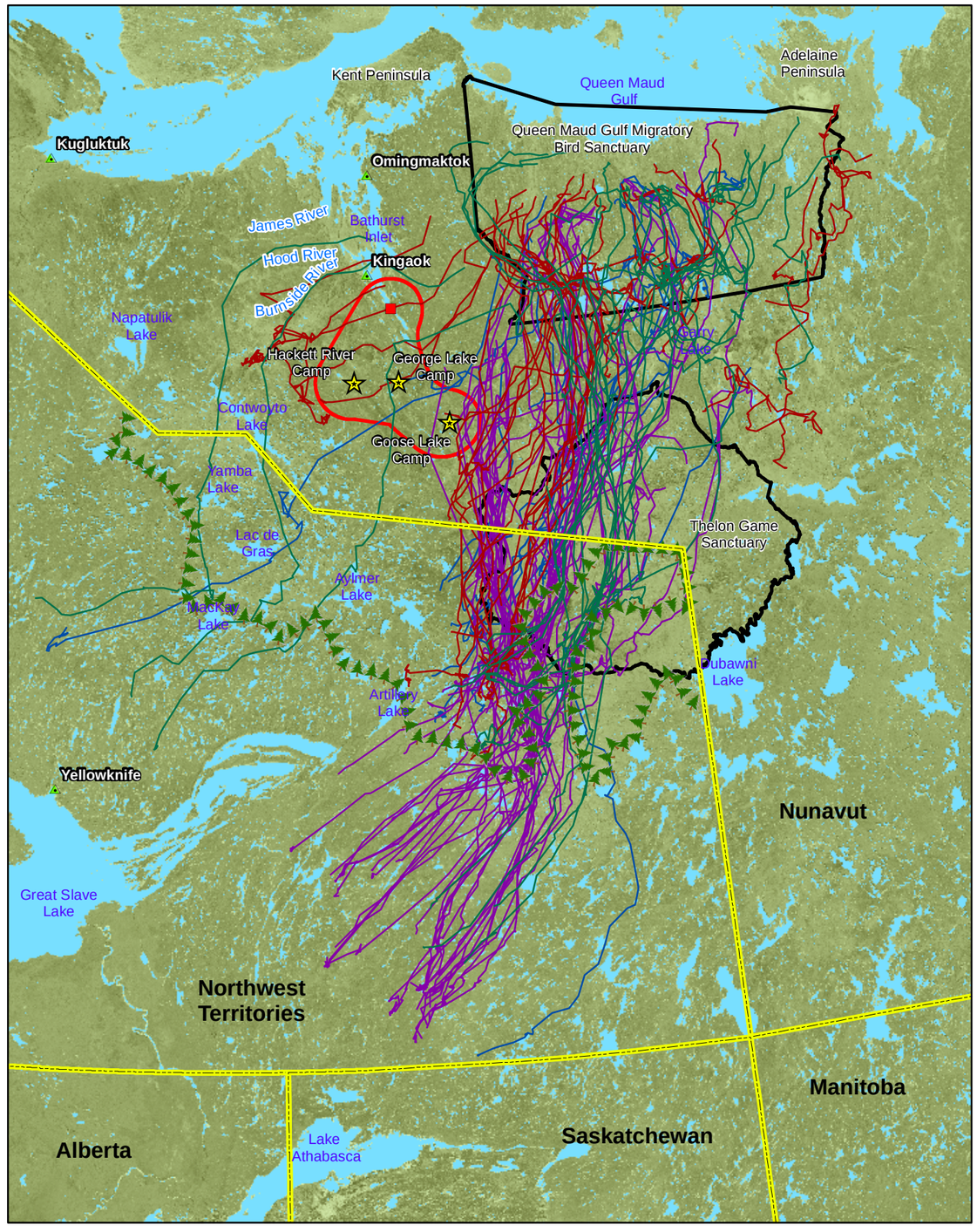
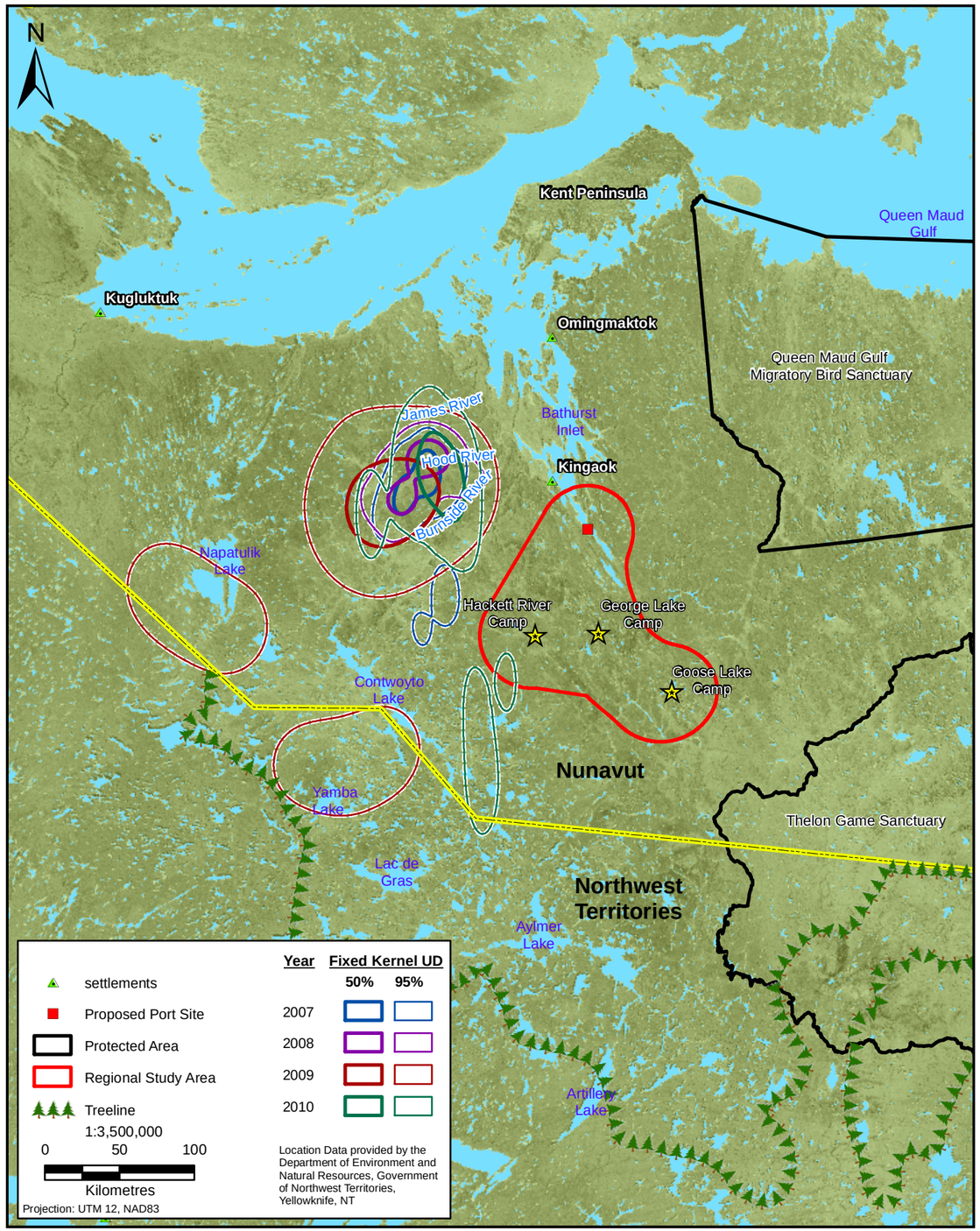


FIGURE 4.3-2

Spring Migration Routes of Collared Bathurst and Ahiak Caribou, 2007 to 2010

a) Bathurst



b) Ahiak

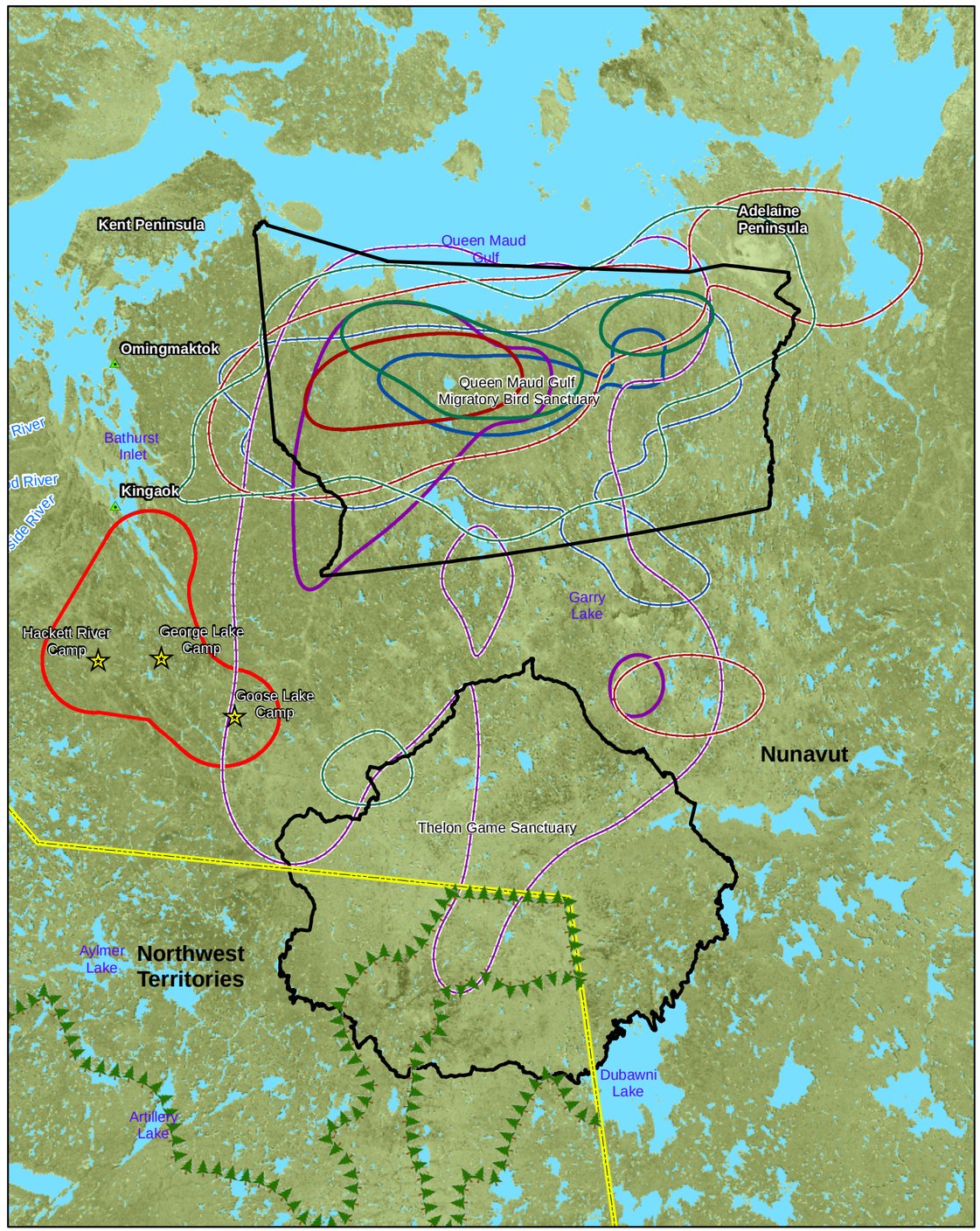


FIGURE 4.3-3

Distribution of Collared Bathurst and Ahiak Caribou during Calving, 2007 to 2010

4.3.5 Post-calving

Fixed kernel utilization distributions during the post-calving period show that the collared Bathurst caribou consistently use habitat in the south part of the RSA every year (Figure 4.3-4a) while collared Ahiak caribou are generally found far to the east during this period (Figure 4.3-4b).

Collared Bathurst caribou tend to use the same areas in a very similar fashion each year during the post-calving period. Collared female caribou dispersed from the calving grounds southeast through the RSA and then slightly back to the west again, as shown by the backwards C configuration of core use areas (Figure 4.3-4a). These core use areas surrounded the Hackett River Camp location (Figure 4.3-4a). Areas of active use across years during this period spanned from the calving grounds east to Bathurst Inlet and south past Contwoyto Lake. In any one year, nearly half of the RSA was being actively used by collared Bathurst caribou during post-calving (Figure 4.3-4a). Interestingly, one collared female dispersed to an area just south of Kugluktuk during the post-calving period in 2009, generating an isolated 95% fixed UD to the west of the main use areas. These data agree with local knowledge from the Hackett River and Goose Lake camps, who report groups of caribou passing through the RSA during the post-calving period. However, the number of caribou observed and reported were highly variable from year to year.

Core use areas for collared Ahiak caribou during post-calving were extensive and showed a high degree of overlap between years; these areas were generally to the south of the calving grounds within the Queen Maud Gulf Migratory Bird Sanctuary (Figure 4.3-4b). In some years, there were separate core use areas identified. In 2010, there was one to the east of the calving grounds near the Adelaine Peninsula. In 2007 and 2008, there were two overlapping just south of Garry Lake, possibly from collared females that calved within the traditional calving grounds for the Beverly herd. Areas of active use also overlapped on a larger scale surrounding core use areas from 2007 to the present, none of which overlapped with the RSA (Figure 3.3-4b).

4.3.6 Summer

During summer, collared Bathurst and Ahiak caribou shift southwest from areas occupied during post calving and as such, collared Bathurst caribou move away from the RSA (Figure 4.3-5a) while collared Ahiak caribou move to areas closer to the RSA (Figure 4.3-5b). Collared Bathurst and Ahiak caribou show some intermixing during the summer in areas around Contwoyto and Aylmer lakes.

Collared Bathurst caribou tended to be concentrated in areas around Contwoyto Lake during the summer, particularly along the southwest margin of this waterbody. In most years (2007 to 2009), there were two or more separate core use areas identified (Figure 4.3-5a), indicating that several smaller areas were receiving a concentrated amount of use. No areas of active use overlapped with the RSA, these areas generally were tightly constrained to the shape of the core use areas. However, the distribution of the area of active use in 2009 was highly influenced by a collared female who travelled just south of Kugluktuk during the post-calving period. She travelled back south during the summer, rejoining the main herd at the end of summer (Figure 4.3-5a).

The main areas of concentrated use for summering collared Ahiak caribou, as evidenced by overlapping 50% kernel UDs across years, extended along a band from the southern extension of Bathurst Inlet to approximately Artillery Lake (Figure 4.3-5b). Some of the core use areas overlapped with the southern RSA in 2008, 2009, and 2010 and were distributed around the Goose Lake Camp location (Figure 4.3-5b). Areas of active use were expansive, covering more area than 95% kernel UDs delineated for any of the previous life history periods. Across years, active use areas spanned a longitudinal area from Contwoyto Lake to Baker Lake and a latitudinal area from Queen Maud Gulf south past Artillery Lake (Figure 4.3-5b).

4.3.7 Fall

Fixed kernel utilization distributions during the fall (which includes the fall migration and the rut) show that collared Bathurst caribou are distributed in areas to the southwest of the RSA during this period (Figure 4.3-6a). Similar to the summering period, collared Ahiak caribou are very widely distributed latitudinally and longitudinally during the fall (Figure 4.3-6b). There is a small amount of overlap in areas of active use between the herds; Bathurst and Ahiak caribou both utilize habitat around Contwoyto and Mackay lakes.

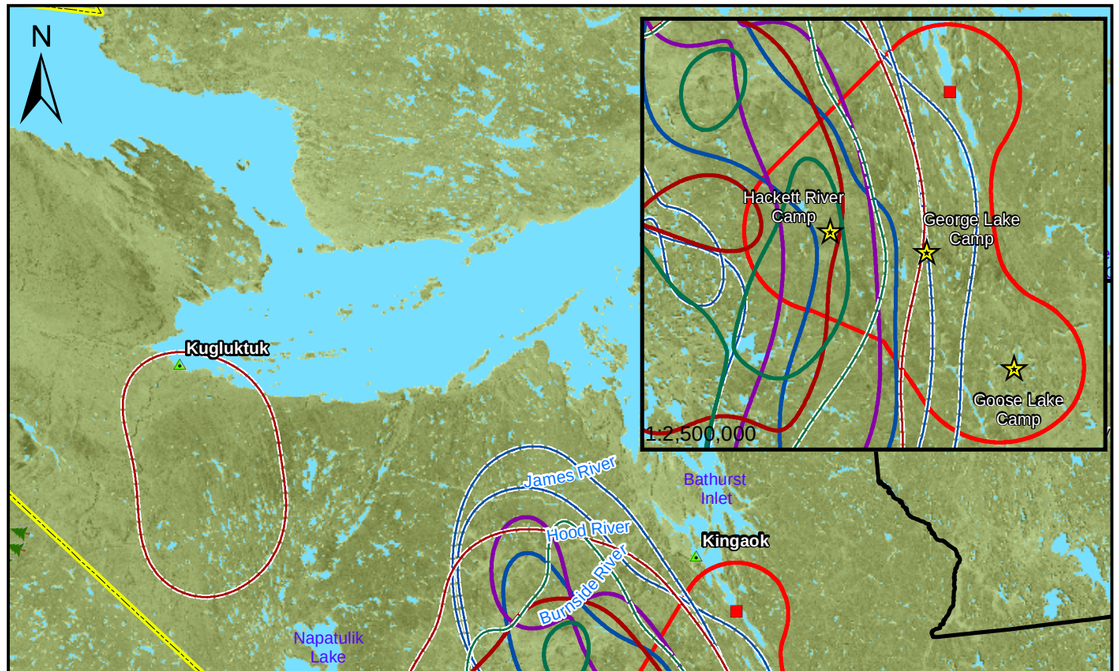
Collared Bathurst caribou exhibited a varied distribution during the fall, as exemplified in the spread of core use areas (Figure 4.3-6a). However, there was consistent overlap between annual core use areas around Lac de Gras except in 2010. However, 2010 did not include as many data points as in previous years; GNWT collar data was provided up to September 28, 2010. No active use areas overlapped with the RSA from 2007 to the 2010; however, active use areas spanned from the western edge of the RSA to nearly Great Bear Lake south to the eastern arm of Great Slave Lake (Figure 4.3-6a).

Core use areas for collared Ahiak caribou during the fall overlapped with areas used during summer; however, core use areas were generally wider east-west than those in the summer (Figure 4.3-6b). In 2007, these core use areas were located near the treeline east of Great Slave Lake; in all other years, the majority of core use areas were located further north within the Thelon Game Sanctuary. Ahiak caribou actively used habitat from the Queen Maud Gulf south to the treeline. Fixed 95% kernel UDs overlapped with the RSA in each year since 2007 (Figure 4.3-6b).

4.4 INCIDENTAL WILDLIFE OBSERVATIONS

A total of 16 species were recorded incidentally during aerial surveys in the RSA or at the Goose Lake Camp by surveyors (Table 4.4-1, Appendix 4). An additional six species were recorded that could not be identified to the species level. Two grizzly bears (potentially a mother and yearling) were observed near Bathurst Lake on Transect 9 and one adult was observed on Transect 5 in June (Appendix 4). A solitary grizzly bear was also observed along Transect 18 southeast of Goose Lake Camp in July. Two wolves were noted in June; one adult was observed east of Bathurst Inlet just off Transect 1 and another was observed along Transect 16. A wolverine was observed near Goose Lake Camp in May; wolverine tracks were also documented along Transect 16 in June (Table 4.4-1; Appendix 4). A number of seal breathing holes were recorded over Bathurst Inlet (Transects 1 - 5) during the June survey; these holes could belong to the ringed seal (*Pusa hispida*) or the bearded seal (*Erignathus barbatus*), two species known to occur in the area. Several bird species were also observed. Common ravens were widely distributed across the RSA in May and June; several species of waterfowl (Canada geese, tundra swans, and duck spp.) were commonly observed in June and July (Table 4.4-1; Appendix 4). A number of wildlife observations were recorded around or the near the Goose Lake Camp (Appendix 4; Plate 4.4-1).

a) Bathurst



b) Ahiak

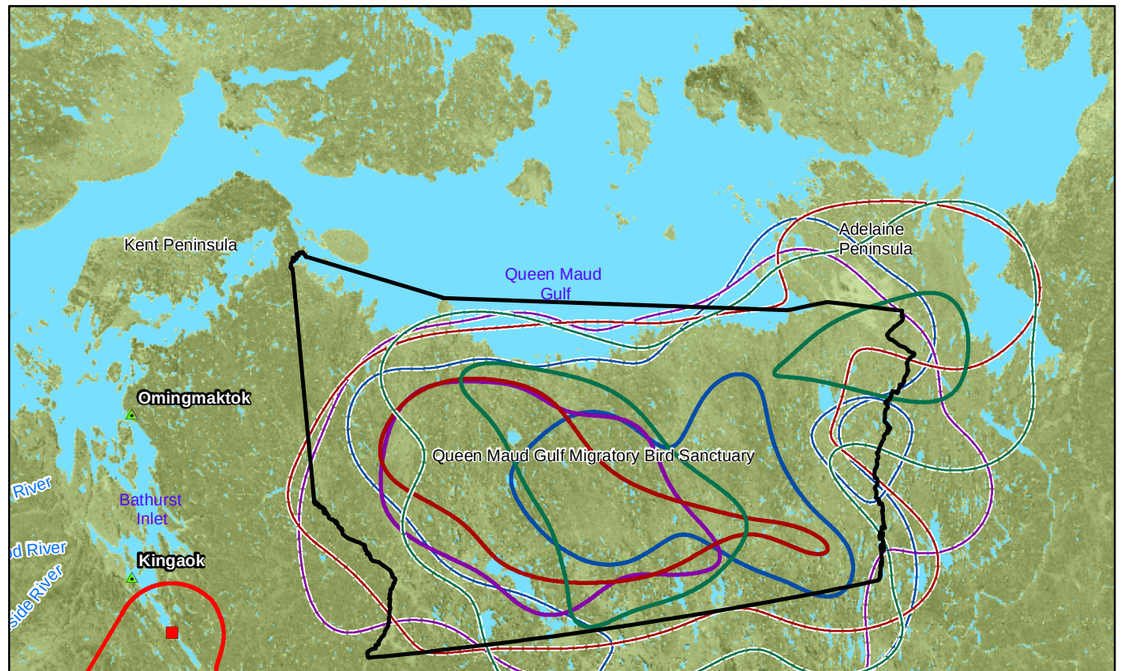
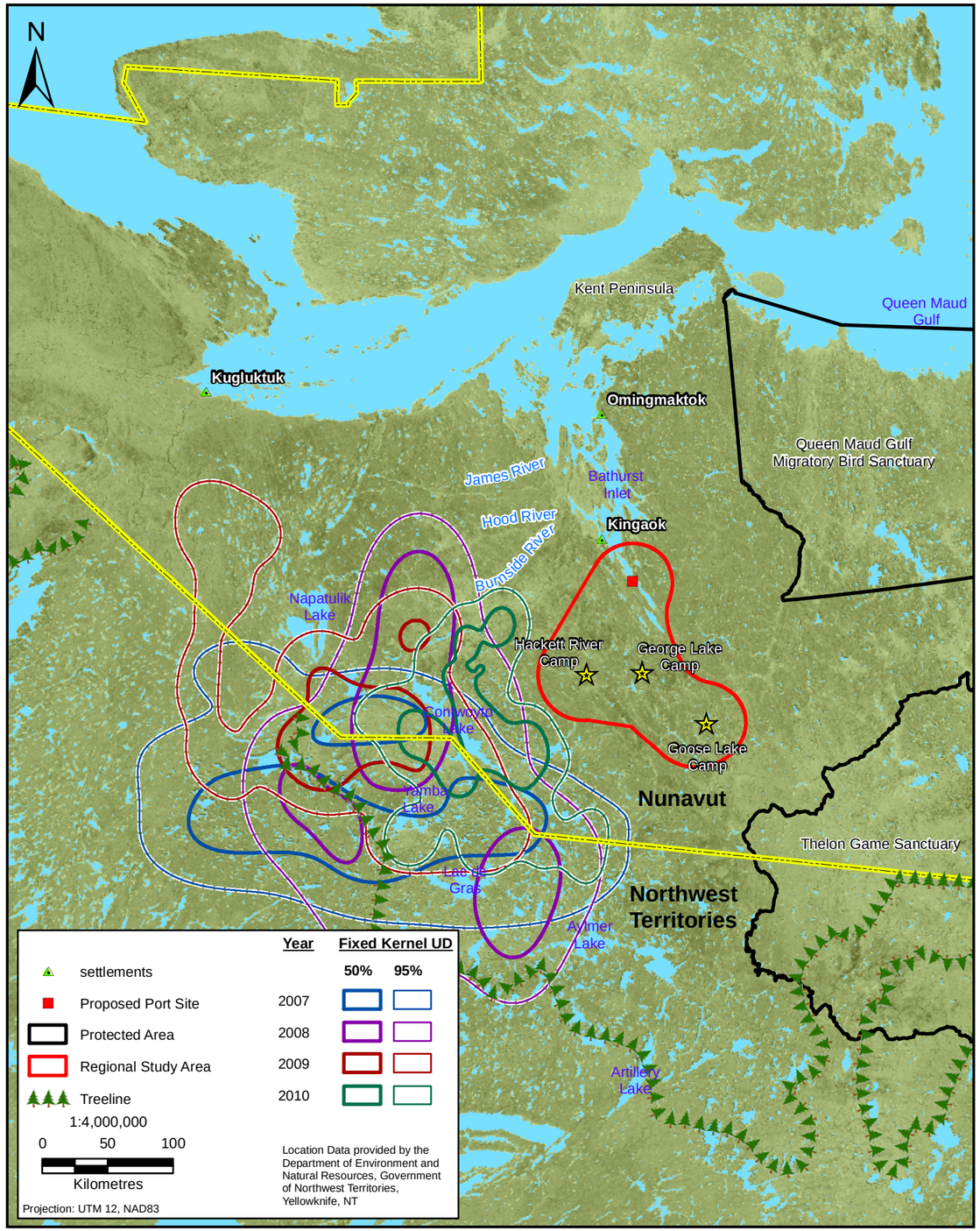


FIGURE 4.3-4

Distribution of Collared Bathurst and Ahiak Caribou during Post-Calving, 2007 to 2010

a) Bathurst



b) Ahiak

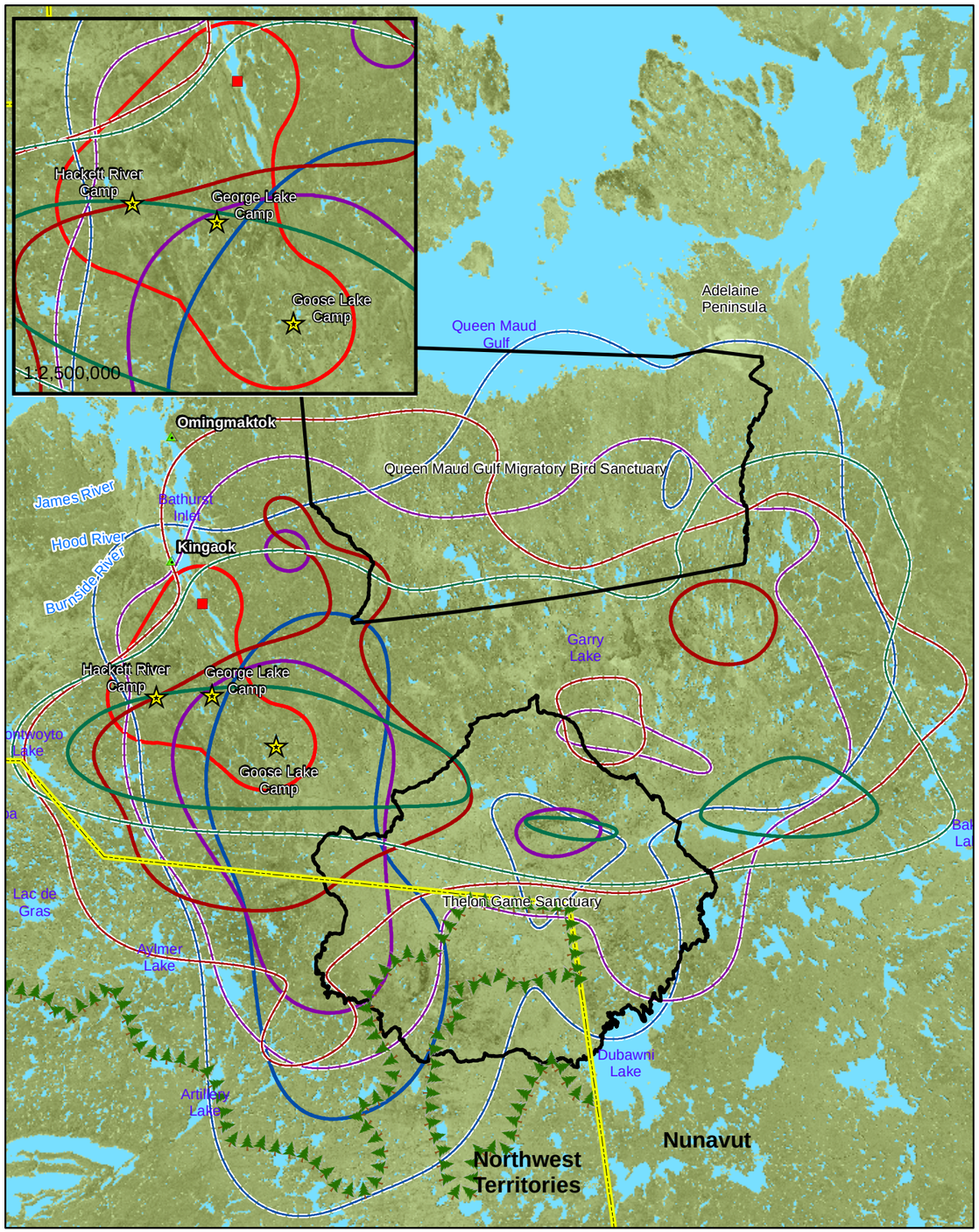
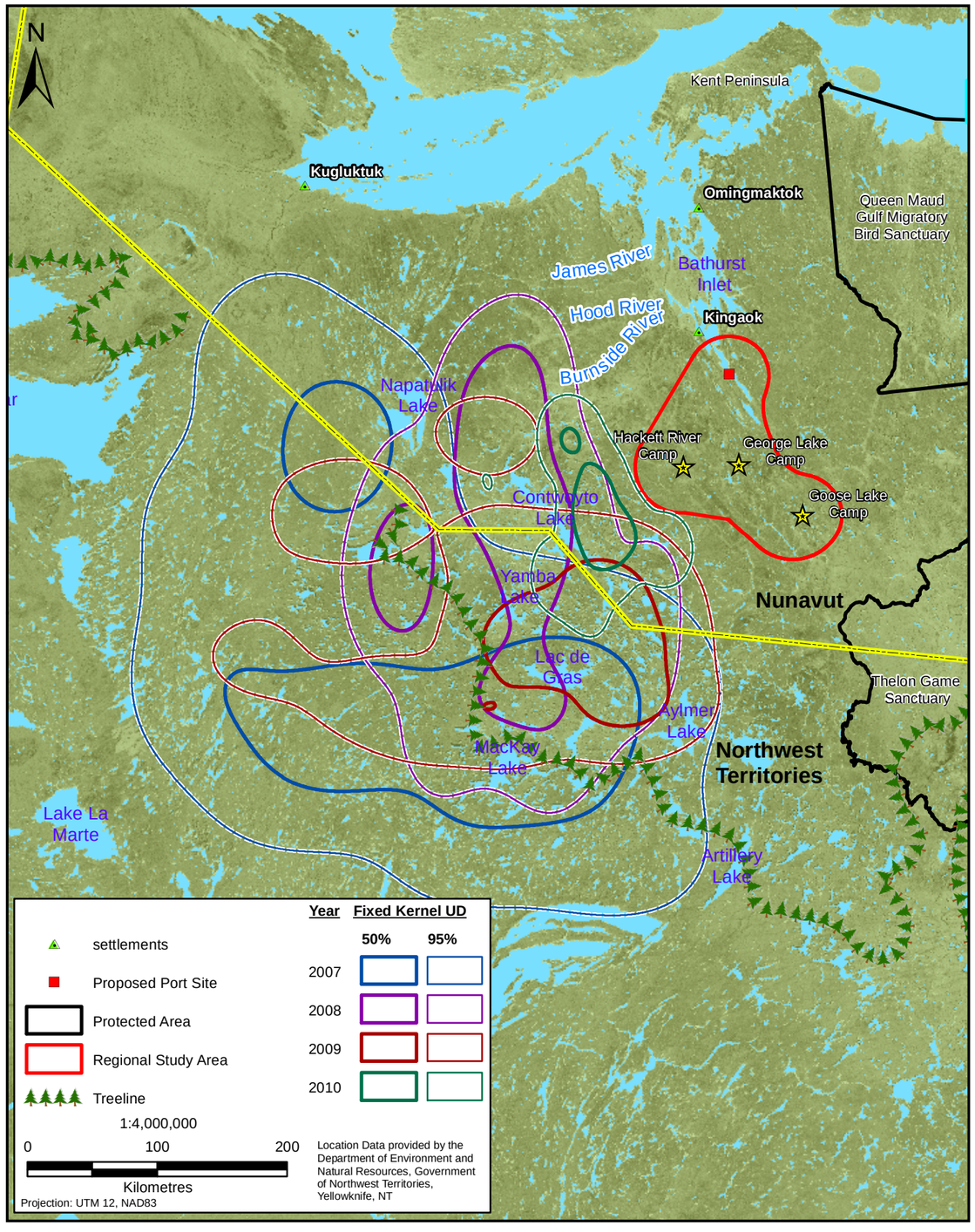


FIGURE 4.3-5

Distribution of Collared Bathurst and Ahiak Caribou during Summer, 2007 to 2010

a) Bathurst



b) Ahiak

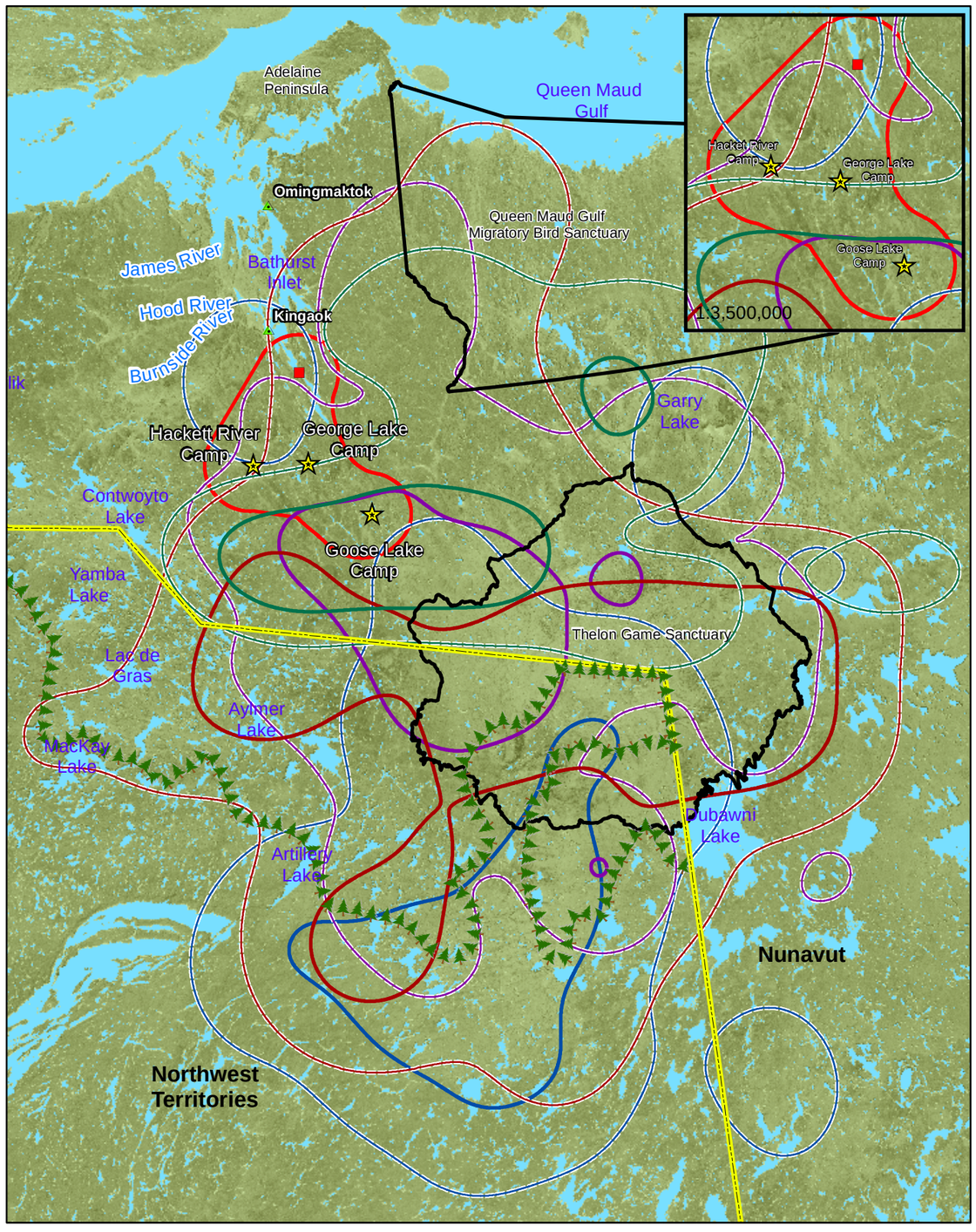


FIGURE 4.3-6

Distribution of Collared Bathurst and Ahiak Caribou during the Fall, 2007 to 2010

Table 4.4-1. Incidental Wildlife Observations, 2010

Common Name	Scientific Name	No. Observed During Aerial Surveys			Grand Total
		Survey 1 (May 4 - 5)	Survey 2 (June 7 - 8)	Survey 3 (July 13 - 15)	
Arctic hare	*Lepus arcticus*	1	-	1	**2**
Bald eagle	*Haliaeetus leucocephalus*	-	-	1	**1**
Canada goose	*Branta canadensis*	-	53	8	**61**
Common raven	*Corvus corax*	5	2	-	**7**
Greater white-fronted goose	*Anser albifrons*	-	1	-	**1**
Grey wolf	*Canis lupus*	-	2	-	**2**
Grizzly bear	*Ursus arctos*	-	3	1	**4**
Horned lark	*Eremophila alpestris*	-	1	1	**2**
Lapland longspur	*Calcarius lapponicus*	-	1	-	**1**
Long-tailed duck	*Clangula hyemalis*	-	2	1	**3**
Rock ptarmigan	*Lagopus muta*	18	-	-	**18**
Seal spp.[1]	n/a	-	-	-	**-**
Snow goose	*Chen caerulescens*	-	6	-	**6**
Tundra swan	*Cygnus columbianus*	-	1	9	**10**
Unknown duck	n/a	-	2	236	**238**
Unknown gull	n/a	-	-	1	**1**
Unknown ptarmigan	*Lagopus* spp.	-	1	-	**1**
Unknown redpoll	*Carduelis* spp.	-	2	2	**4**
Unknown shorebird	n/a	-	-	1	**1**
White-crowned sparrow	*Zonotrichia leucophrys*	-	1	-	**1**
Willow ptarmigan	*Lagopus lagopus*	-	-	12	**12**
Wolverine[2]	*Gulo gulo*	1	-	-	**1**
Grand Total		**25**	**78**	**273**	**376**

[1] *approximately 26 breathing holes were observed over Bathurst Inlet during the second survey.*
[2] *wolverine tracks were also observed during the second survey.*

4.5 SPECIES OF CONSERVATION CONCERN

The conservation status of wildlife observed during the 2010 baseline program were assessed using territorial, federal, and international ranking systems. A total of three species; grizzly bear, wolverine, and white-crowned sparrow; are of conservation concern. Grizzly bear and wolverine are listed as special concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (COSEWIC 2002, 2003). Territorially, the wolverine is listed as secure whereas the grizzly bear is sensitive (Wild Species 2005). White-crowned sparrow is also listed as sensitive in Nunavut (Wild Species 2005). The remaining species are considered secure.

Regionally, barren-ground caribou are considered to be a sensitive species, although they are not protected by territorial or federal legislation. Declining numbers in many caribou herds in the Northwest Territories and Nunavut have prompted the development of management plans with definable strategies to conserve caribou populations (e.g., GNWT ENR 2006).

a) Willow ptarmigan pair with chicks, July 15, 2010

b) Arctic hare, July 13, 2010

c) Rock ptarmigans, May 5, 2010

Plate 4.4-1. Wildlife Observations from Goose Lake Camp, 2010

5. Discussion

5. Discussion

5.1 CARIBOU

Caribou were detected at very low numbers within the RSA during all three surveys conducted in 2010 (N = 65). Most of the caribou were observed during the second survey (N = 28), corresponding to the calving period, but no young caribou were detected during surveys. In comparison to previous aerial survey data, the total number of caribou observed in 2010 was greater than that observed in 2008 but less than the total number recorded in 2007 (Rescan 2008a, 2008b).

Based on traditional knowledge and historical research, Bathurst and Ahiak caribou have been documented within the Hackett and Back River areas, in various amounts, during nearly all life history periods (Thorpe et al. 2001; Gunn and D'Hont 2002; Russell, Kofinas, and Griffith 2002; Gunn et al. 2008). The distribution of caribou and frequency of use of areas near the Hackett and Back River Projects, however, has varied in the past and in recent years. In the north, caribou are assigned to herds based on their occupation of a traditional calving ground as well as traditional rutting areas. Cows return to the same general area to calve every year. However, the calving grounds are known to shift over longer timeframes (Sutherland and Gunn 1996; GNWT ENR 2010), which then influences how female caribou move to their calving grounds and also the areas used after they have calved. Therefore, shifts in calving grounds over the years have influenced how and when Bathurst and Ahiak caribou interact use the RSA. The following section presents a summary of past research and traditional knowledge (where available) on the seasonal distribution and movements patterns of Bathurst and Ahiak caribou and compares this information to the results of the current report.

During the winter, most caribou within the Northwest Territories and Nunavut are found below or at the treeline. Across life history stages, wintering areas are the most variable, showing the least degree of overlap in use areas between years (D'Hont et al. 2009). This trend is influenced by the availability of forage, primarily arboreal lichens, and snow depth (D'Hont et al. 2009). Historically, Bathurst caribou have wintered in areas spanning from Great Bear Lake southeast along the treeline to northern Saskatchewan (Thorpe et al. 2001; D'Hont et al. 2009). Ahiak caribou are unique among Arctic herds in that some animals winter in the tundra, particularly in areas around Bathurst Inlet (Gunn, Fournier, and Nishi 2000). This herd has also wintered in areas surrounding Great Slave Lake down to northern Saskatchewan (Gunn, Fournier, and Nishi 2000; Gunn, D'Hont, and Williams 2005). Dolphin and Union caribou also winter on the tundra, principally in the area surrounding Bathurst Inlet. There is also overlap between the wintering grounds of Bathurst and Ahiak caribou and adjacent herds including the Bluenose East and Beverly herds (Gunn, D'Hont, and Williams 2005; GNWT ENR 2010).

The current wintering areas for Bathurst and Ahiak caribou, as shown by 50% and 95% kernel utilization distributions (UDs) from 2007 to 2010, are similar to areas historically occupied by these two herds. Collared Bathurst caribou were primarily located in areas below the treeline spread from Great Bear to Great Slave Lake (Figure 2.5-2a). Additionally, collared Ahiak caribou actively used habitat on the tundra and below the treeline from 2007 to the present and consistently used several small areas (50% kernel UDs) to the east and west of Bathurst Inlet throughout the winter (Figure 2.5-2b). One 50% kernel UD overlapped with the RSA in 2009 and two 95% kernel UDs overlapped the RSA in 2007 and 2009 (Figure 2.5-2b).

During the spring, pregnant females lead the northward migration to calving grounds. Migration routes to calving grounds are not entirely predictable as there is variability in the areas used in winter; however, they do show some overlap closer to traditional calving grounds. Contwoyto Lake and the Lupin Mine site

have historically been on the spring migration path for Bathurst caribou (Urquhart 1981; Mueller and Gunn 1996; Thorpe et al. 2001). More recent collar data supports this observation; in most years since 1996 Bathurst caribou have moved from wintering grounds past Contwoyto Lake (Gunn, Dragon, and Boulanger 2002; Gunn et al. 2008). Historical information on migration routes of Ahiak caribou is lacking. Based on recent collar data (~1996), Ahiak caribou that winter east of Great Slave Lake follow a predominately north-south oriented migration route towards calving areas (Gunn, Fournier, and Nishi 2000). Individuals that winter on the tundra possibly migrate further east to calving areas than those that winter below the treeline (Nagy pers. comm. in Adamczewski et al. 2009).

Annual migration paths based on collar data from 2007 to the present agree with previously identified migration routes for Bathurst and Ahiak herds. Collared Bathurst caribou tended to converge upon areas surrounding Contwoyto Lake in each year since 2007 (Figure 2.5-3a). Collared Ahiak caribou wintering below the treeline east of Great Slave Lake proceed in a northerly direction towards the Queen Maud Gulf. Collared caribou from the Ahiak herd have passed through the RSA during the spring migration in 2007, 2009, and 2010. Some of these caribou migrated along the route used by Bathurst caribou and switched direction to the Ahiak calving grounds just prior to the calving period. Such homing tendencies for calving grounds have been shown in previous years with both Ahiak and Bathurst caribou (Gunn et al. 2008). Others appear to be tundra wintering Ahiak caribou that use habitat around Bathurst Inlet, and thus pass eastwards through the RSA on their way to the calving grounds. Aerial surveys conducted during the spring migration in 2010 recorded two groups of caribou in the northern RSA. These caribou were likely members of the Ahiak herd, possibly those that winter on the tundra.

The calving ground of Bathurst caribou has gradually shifted from the western side of Bathurst Inlet (in the 1950s) to the eastern side (1960s to mid-1980s) and in recent years (the late 1990s) has shifted back to the western side (Sutherland and Gunn 1996; Thorpe et al. 2001; Gunn and D'Hont 2002). In recent years, cows have calved northeast of Contwoyto Lake, between the Hood and Burnside Rivers (Sutherland and Gunn 1996; Gunn and D'Hont 2002; Gunn, Dragon, and Boulanger 2002). The Ahiak herd has also shown a periodic shift in calving areas used over the years, although this shift has not been as dramatic as in the Bathurst herd. In the mid 1980's, Ahiak caribou calved in a concentrated areas on the eastern edge of the Queen Maud Gulf, since then, the calving grounds have expanded along the entire edge of the Queen Maud Gulf from the Kent Peninsula in the west to the Adelaine Peninsula in the east (Gunn, Fournier, and Nishi 2000; Gunn and D'Hont 2002).

The current calving areas, based on the distribution of core use and active use areas from 2007 to the present, overlap with the areas identified above. Collared Bathurst caribou in each year were concentrated in areas along the Hood River and the majority actively used areas from James River to Burnside River (Figure 2.5-4a). Collared Ahiak caribou calved across the edge of the Queen Maud Gulf; the extension of core use areas in 2009 was further south than in any other year. No significant overlap between areas of active use in either Bathurst or Ahiak caribou was observed based on recent collar data. Aerial surveys in 2010 recorded several groups of caribou in the RSA during the calving period, the majority of which were situated around Bathurst Inlet (Figure 2.5-1). These caribou were likely Bathurst caribou that had not reached the calving grounds at the time of the survey.

During the post-calving and summer periods, Bathurst cows and calves generally move to areas surrounding and south of Contwoyto Lake (Gunn and D'Hont 2002; Gunn, Dragon, and Boulanger 2002). However, there is evidence that the route travelled during post-calving has changed in the last few decades. In 1996, calving females dispersed west to Napatulik Lake before shifting south and west towards Contwoyto Lake (Gunn, Dragon, and Boulanger 2002). In 2000, a shift was detected, where females proceeded southeast from the calving grounds, moving on the eastern side of Contwoyto Lake towards summer areas. More recently (~2005), collared cows generally make a clockwise movement southeast and then northwest towards summering areas between Contwoyto and Mackay lakes (Gunn et

al. 2008). Ahiak cows disperse south and southwest during post-calving and the summer, using habitat in the southern portion of the Queen Maud Gulf Migratory Bird Sanctuary. Unlike Bathurst cows, Ahiak cows do not depart immediately from the calving area post-parturition; therefore there is some overlap in areas used for calving and post-calving (Gunn, Fournier, and Nishi 2000; Gunn and D'Hont 2002).

The distributions of caribou based on 2007 to 2010 kernel UDs suggest that collared Bathurst and Ahiak caribou generally occupy the same post-calving and summer ranges as they have in previous years. Collared Bathurst caribou follow a distinct route during the post calving period, passing southeast through the RSA just to the east of the Hackett River Camp before turning northwest towards Contwoyto Lake (Figure 2.5-5a). The areas between Napatulik, Contwoyto, and Mackay lakes received a highest amount of use during the summer (Figure 2.5-6a). Collared Ahiak caribou generally dispersed southwards during post-calving, nearly reaching Garry Lake before then shifting southwest during the summer (Figures 2.5-5b and 2.5-6b). This summer southwest shift has brought caribou in the vicinity of the RSA and the Goose Lake Camp each year since 2007 (Figure 2.5-6b). During the post-calving aerial survey in 2010, solitary or grouped caribou were observed around Bathurst Inlet (Figure 2.5-1). There is high likelihood that these are Bathurst caribou, as these caribou have consistently passed through the RSA since the early 2000's.

Following the reunion of bulls and immature caribou with the cows and calves in the late summer, caribou herds migrate southwards during the fall. Within the fall range are rutting grounds that are used in October. For Bathurst caribou, the areas around Lac De Gras have been highlighted as an area that has been occupied by rutting caribou (GNWT ENR 2010). However, satellite collar data form 1996 to 2005 suggests a wide band of area along the same latitude as Lac de Gras has been used during the fall and the rut (Gunn et al. 2008). During the fall, Ahiak caribou migrate south and southeast towards the Thelon Game Sanctuary, located on the NWT/Nunavut border east of Great Slave Lake, where the rut occurs (Gunn, Fournier, and Nishi 2000).

The current fall range, based on the distribution of core use and active use areas from 2007 to the present, are similar to areas historically occupied by these two herds. Several core use areas for collared Bathurst caribou surrounded Aylmer Lake, Lac de Gras, and Mackay Lake from 2007 to 2009 (Figure 2.5-7a). In some years, the fall 50% and 95% kernel UDs extended west below the treeline into the boreal forest (2007) as well as extending northward past Contwoyto Lake (2008) and northwestward to Napatulik Lake (2007). Despite the large area occupied during this period, no UDs were found within the RSA. Similarly broad areas were used by collared Ahiak caribou in the fall, and there was overlap with summer distributions (Figures 2.5-6b and 2.5-7b). However, many core use areas (except for 2007) encompassed habitat within the Thelon Game Sanctuary. Collared caribou also actively used habitat on the periphery of the main core use areas, including habitat within the RSA in all four years (Figure 2.5-7b).

5.2 MUSKOX

A total of 87 muskox were recorded during aerial surveys in 2010, most of which were observed in large groups in June and July. One of these groups was a nursery group, located in the southern portion of the RSA near Goose Lake Camp (Figure 2.5-1). In comparison to previous aerial survey data, the total number of caribou observed in 2010 was greater than that observed in 2008 but less than the total number recorded in 2007 (Rescan 2008a, 2008b).

Muskox occupy relatively small home ranges. In the winter, muskox home range size varies from 27 to 70 km^2 and in the summer the average home range size is 223 km^2(Reynolds 1998). It is possible that groups observed on more than one survey may represent resident herds that use habitat within the RSA on an annual basis. Muskox were observed in the same area during 2007, 2008 and 2010; an area of

flat-topped hills with abundant wind-swept plateaus and steps approximately 10 km west of the proposed port site on Bathurst Inlet. This may represent a core area for a herd, or an area of particularly good habitat, which is occupied more often - leading to multiple observations in this area.

The number of muskox recorded on 2010 aerial surveys is similar to population estimates generated for the area in 2005. In August 2005, a thorough survey of the area between Coppermine River and Bathurst Inlet was conducted (Dumond 2007). During this survey, 52 muskox (50 adults and 2 calves) were recorded along aerial transects within the RSA; several other muskox were recorded off transect as well.

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Appendix 1

Summary Maps of Survey Flightlines and Observations

Rescan™
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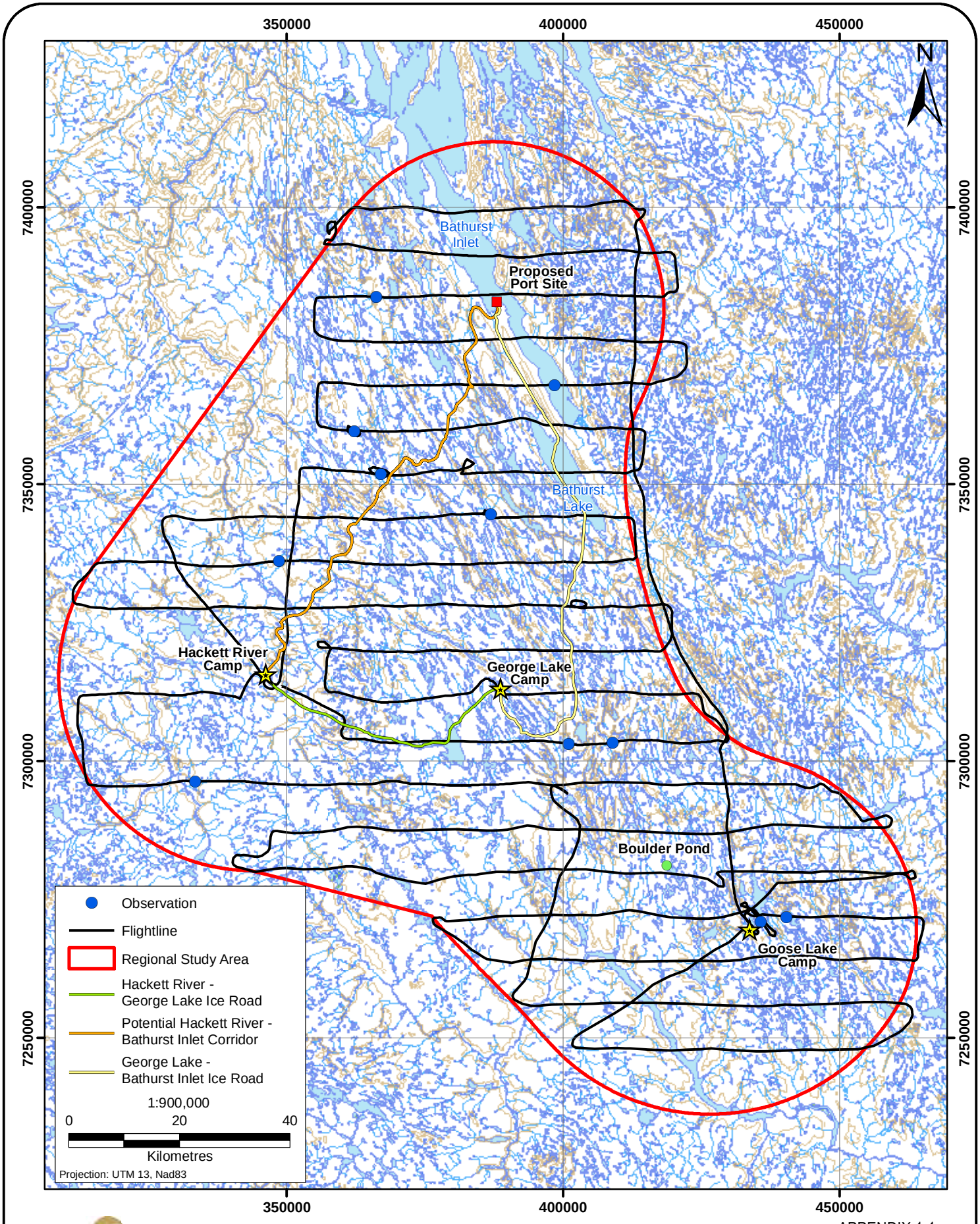
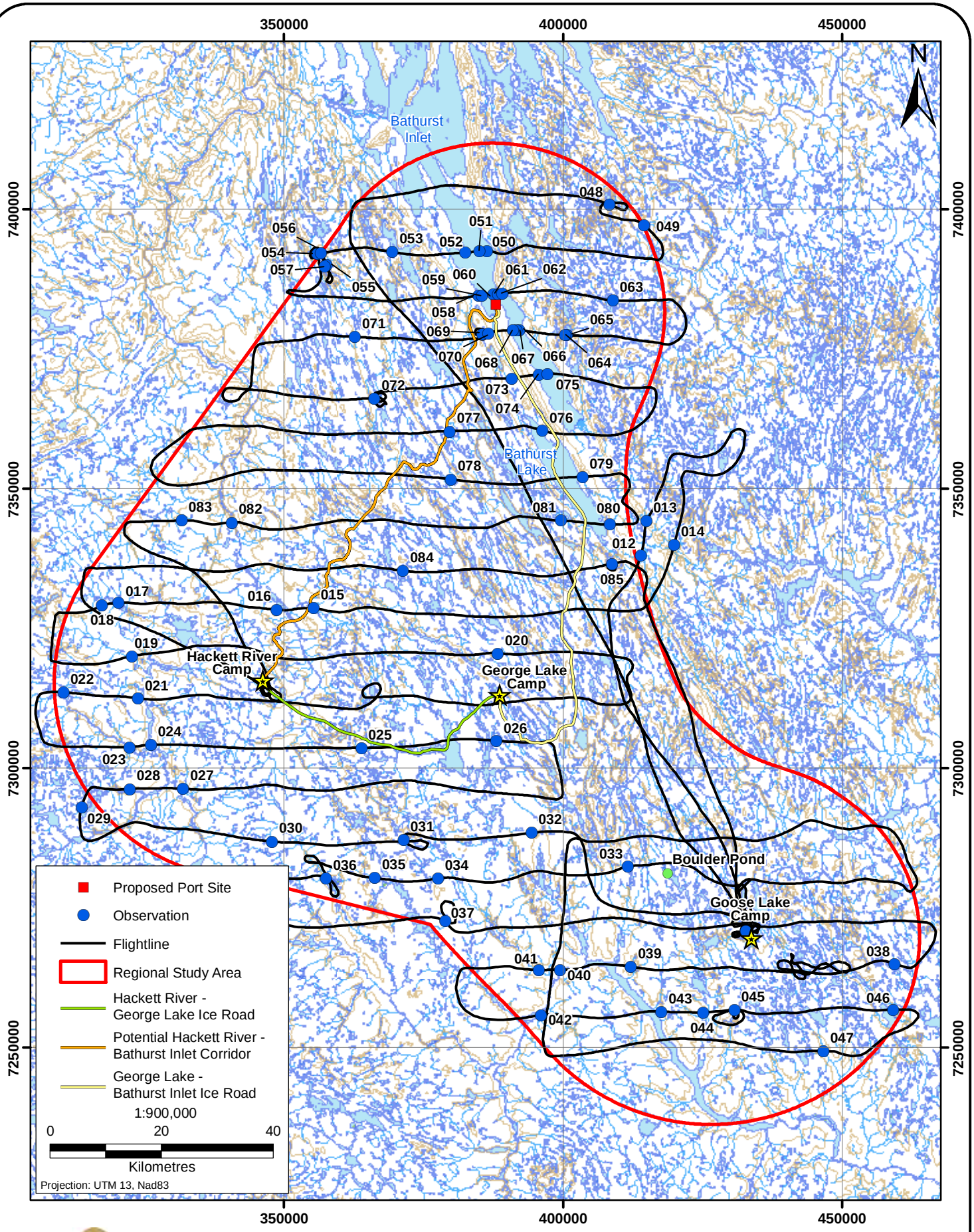


Survey Flightlines and Summary of Survey Observations, May 2010

APPENDIX 1-1



Sabina GOLD & SILVER CORP.

Survey Flightlines and Summary of Survey Observations, June 2010

APPENDIX 1-2

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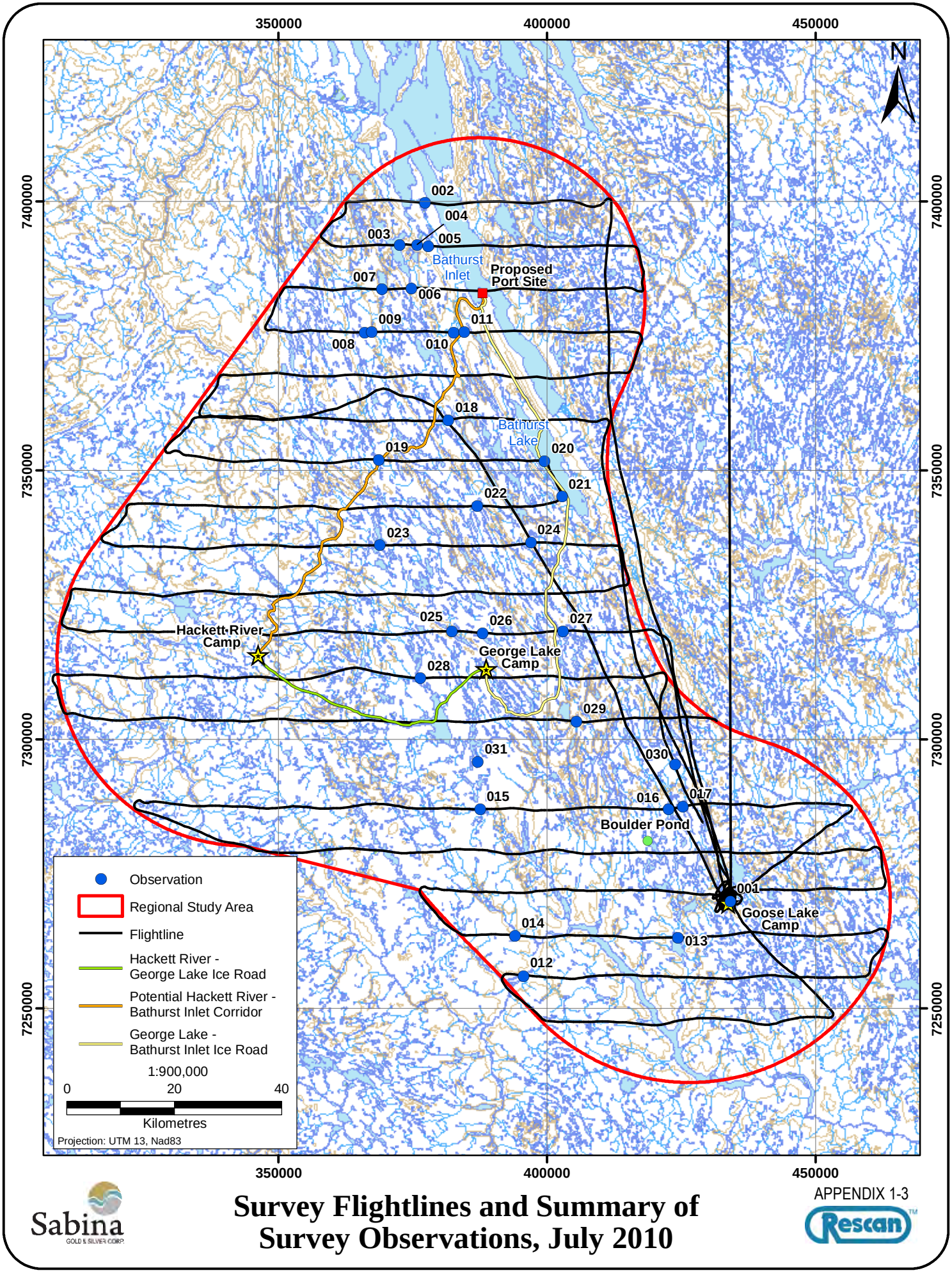

Sabina GOLD & SILVER CORP.

Survey Flightlines and Summary of Survey Observations, July 2010

APPENDIX 1-3

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Appendix 2

Aerial Survey Details, 2010

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Appendix 2. Aerial Survey Details, 2010

		May Survey			June Survey			July Survey		
Transect Line	Total Length (km)	Date Surveyed	Estimated length missed due to weather (km)	% Completed	Date Surveyed	Estimated length missed due to weather (km)	% Completed	Date Surveyed	Estimated length missed due to weather (km)	% Completed
1	50.2	05-May-10	0	100	08-Jun-10	0	100	13-Jul-10	0	100
2	59.9	05-May-10	0	100	08-Jun-10	0	100	13-Jul-10	0	100
3	67.5	05-May-10	5	92.6	08-Jun-10	0	100	13-Jul-10	0	100
4	72.9	05-May-10	11	84.9	08-Jun-10	0	100	13-Jul-10	0	100
5	76.3	05-May-10	17	77.7	08-Jun-10	0	100	13-Jul-10	0	100
6	78.9	05-May-10	23	70.8	08-Jun-10	0	100	14-Jul-10	0	100
7	83.9	05-May-10	25	70.2	08-Jun-10	0	100	14-Jul-10	11	86.9
8	90.3	05-May-10	6	93.4	08-Jun-10	0	100	14-Jul-10	9	90.0
9	97.8	05-May-10	0	100	08-Jun-10	0	100	14-Jul-10	0	100
10	104	05-May-10	0	100	07-Jun-10	0	100	14-Jul-10	0	100
11	109	05-May-10	48	56.0	07-Jun-10	6	94.5	14-Jul-10	0	100
12	113	05-May-10	15	86.7	07-Jun-10	10	91.2	15-Jul-10	0	100
13	120	05-May-10	50	58.3	07-Jun-10	32	73.3	15-Jul-10	0	100
14	134	05-May-10	0	100	07-Jun-10	49	63.4	15-Jul-10	0	100
15	136	04-May-10	25	81.6	07-Jun-10	0	100	14-Jul-10	0	100
16	117	04-May-10	0	100	07-Jun-10	0	100	14-Jul-10	0	100
17	87.5	04-May-10	0	100	07-Jun-10	0	100	14-Jul-10	0	100
18	79.8	04-May-10	0	100	07-Jun-10	0	100	14-Jul-10	0	100
19	69.2	04-May-10	0	100	07-Jun-10	0	100	14-Jul-10	0	100
20	56	04-May-10	0	100	07-Jun-10	0	100	14-Jul-10	0	100
Total	**1803.2**		**225**			**97**			**20**	
Average				**89**			**96**			**99**
± Standard Error				**3.3**			**2.2**			**0.8**

Appendix 3

Caribou and Muskox Survey Raw Data, 2010

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Appendix 3. Caribou and Muskox Survey Raw Data, 2010

Date	Survey	Transect	Waypoint	Easting	Northing	Distance from Aircraft	Species	No. Observed						Total	Comment(s)
								Adult (Undermined sex)	Bull	Cows	Yearling	Calf	Unknown		
5-May-10	1	6	005	7359702	362191	400	Caribou	5	0	0	0	0	0	5	
5-May-10	1	7	006	7351912	366997	500	Caribou	0	0	19	0	0	0	19	
5-May-10	1	8	007	7344599	386867	500	Muskox	1	0	0	0	0	0	1	
7-Jun-10	2	17	037	7272695	378824		Caribou	0	0	0	0	0	1	1	probable caribou, not confirmed
7-Jun-10	2	18	039	7264497	412165		Caribou	0	0	0	0	0	1	1	probable caribou, not confirmed
7-Jun-10	2	19	045	7256764	430744	400	Muskox	15	0	0	2	3	0	20	
8-Jun-10	2	1	048	7400851	408375	300	Muskox	15	0	0	0	0	0	15	
8-Jun-10	2	N/A	054	7392081	355922	300	Caribou	0	0	1	0	0	0	1	
8-Jun-10	2	N/A	055	7389995	357609	<500	Caribou	0	0	1	0	0	0	1	
8-Jun-10	2	N/A	057	7389772	357212	>500	Muskox	34	0	0	0	0	0	34	off transect
8-Jun-10	2	3	063	7383746	408948		Caribou	1	0	0	0	0	0	1	probable caribou, not confirmed
8-Jun-10	2	4	065	7377553	400434	300	Caribou	0	0	3	0	0	0	3	
8-Jun-10	2	4	069	7377683	385472	400	Caribou	3	0	0	0	0	0	3	
8-Jun-10	2	4	070	7377765	386539	400	Caribou	5	0	0	0	0	0	5	
8-Jun-10	2	6	076	7360441	396320	>500	Caribou	1	0	0	0	0	0	1	
8-Jun-10	2	8	080	7343656	408404	400	Caribou	2	0	0	0	0	0	2	
8-Jun-10	2	8	081	7344342	399688	500	Caribou	2	0	0	0	0	0	2	
8-Jun-10	2	8	083	7344394	331579	200	Caribou	1	0	0	0	0	0	1	
8-Jun-10	2	5	073	7369823	390725	300	Caribou	0	0	9	0	0	0	9	
13-Jul-10	3	2	004	7391940	375729	<500	Caribou	1	0	0	0	0	0	1	
13-Jul-10	3	2	005	7391765	377841	<500	Caribou	0	1	0	0	0	0	1	
13-Jul-10	3	3	006	7383966	374714	<500	Caribou	1	0	0	0	0	0	1	
13-Jul-10	3	3	007	7383691	369206	500	Caribou	0	0	0	0	0	2	2	
13-Jul-10	3	4	008	7375673	363196	<500	Muskox	0	0	0	0	0	16	16	
13-Jul-10	3	4	009	7375740	367308	500	Caribou	0	0	0	0	0	1	1	
13-Jul-10	3	4	010	7375719	382565	<500	Caribou	0	1	0	0	0	0	1	
14-Jul-10	3	6	018	7359396	381581	<500	Caribou	1	0	0	0	0	0	1	
14-Jul-10	3	18	013	7263190	424426	>500	Caribou	0	0	0	0	0	1	1	
14-Jul-10	3	7	019	7352006	368610	<500	Caribou	0	1	0	0	0	0	1	
14-Jul-10	3	9	024	7336695	397021	300	Caribou	2	0	0	0	0	0	2	
14-Jul-10	3	11	026	7319833	387979	<500	Caribou	1	0	0	0	0	0	1	
15-Jul-10	3	13	029	7303391	405501	<500	Muskox	0	0	0	0	0	1	1	

Appendix 4

Incidental Wildlife Observations, 2010

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Appendix 4. Incidental Wildlife Observations, 2010

								No. Observed						
Date	Survey	Transect	Waypoint	Easting	Northing	Common Name	Scientific Name	Adult (Undermined sex)	Male	Female	Young	Unknown	Total	Comment(s)
4-May-10	1	17	002	440358	7271979	Wolverine	*Gulo gulo*					1	1	
5-May-10	1	3	003	366178	7383901	Common raven	*Corvus corax*					1	1	
5-May-10	1	5	004	398459	7367975	Common raven	*Corvus corax*					1	1	
5-May-10	1	9	008	348552	7336158	Common raven	*Corvus corax*					1	1	
5-May-10	1	14	011	333345	7296385	Common raven	*Corvus corax*					2	2	
5-May-10	1	n/a		432788	7270994	Rock ptarmigan	*Lagopus muta*		16	2			18	near Goose Camp airstrip
5-May-10	1	n/a		432788	7270994	Arctic hare	*Lepus arcticus*					1	1	near Goose Camp airstrip
7-Jun-10	2	10	017	320265	7329598	Canada goose	*Branta canadensis*	2					2	
7-Jun-10	2	14	028	322261	7296300	Canada goose	*Branta canadensis*	2					2	
7-Jun-10	2	14	029	313667	7292998	Common raven	*Corvus corax*	1					1	
7-Jun-10	2	15	030	347763	7286909	Canada goose	*Branta canadensis*	2					2	
7-Jun-10	2	16	033	411604	7282507	Snow goose	*Chen caerulescens*	4					4	
7-Jun-10	2	16	035	366208	7280378	Wolverine	*Gulo gulo*							Tracks
7-Jun-10	2		036	357444	7280336	Grey wolf	*Canis lupus*	1					1	probable, not confirmed
7-Jun-10	2	18	038	459406	7264996	Unknown duck		2					2	black ducks
7-Jun-10	2	18	039	412165	7264497	Canada goose	*Branta canadensis*	10					10	
7-Jun-10	2	18	040	399523	7263945	Canada goose	*Branta canadensis*	2					2	in river
7-Jun-10	2	18	041	395703	7263924	Long-tailed duck	*Clangula hyemalis*	2					2	
7-Jun-10	2	19	044	425148	7256311	Snow goose	*Chen caerulescens*	2					2	
7-Jun-10	2	19	045	430744	7256764	Canada goose	*Branta canadensis*	7					7	
7-Jun-10	2	19	045	430744	7256764	Canada goose	*Branta canadensis*	2					2	
7-Jun-10	2	n/a		434123	7270020	Horned lark	*Eremophila alpestris*					1	1	Observed at Goose Camp
7-Jun-10	2	n/a		434123	7270020	Unknown redpoll	*Carduelis* spp.					2	2	Observed at Goose Camp
7-Jun-10	2	n/a		434123	7270020	Lapland longspur	*Calcarius lapponicus*					1	1	Observed at Goose Camp
7-Jun-10	2	n/a		434123	7270020	Unknown ptarmigan	*Lagopus spp.*					1	1	Observed at Goose Camp
7-Jun-10	2	n/a		434123	7270020	White-crowned sparrow	*Zonotrichia leucophrys*					1	1	Observed at Goose Camp
7-Jun-10	2	n/a		434123	7270020	Greater white-fronted goose	*Anser albifrons*					1	1	Observed at Goose Camp
8-Jun-10	2	1	049	414535	7397241	Grey wolf	*Canis lupus*	1					1	
8-Jun-10	2	2	050	386286	7392574	Seal spp.								Hole
8-Jun-10	2	2	051	384965	7392529	Seal spp.								Hole
8-Jun-10	2	2	052	382406	7392295	Seal spp.								2 seal holes
8-Jun-10	2	2	053	369348	7392465	Canada goose	*Branta canadensis*	15					15	on the tundra
8-Jun-10	2	3	058	384810	7384586	Tundra swan	*Cygnus columbianus*	1					1	
8-Jun-10	2	3	059	385371	7384630	Seal spp.								Hole
8-Jun-10	2	3	060	387473	7384783	Seal spp.								Hole
8-Jun-10	2	3	061	388291	7384879	Seal spp.								3 breathing holes
8-Jun-10	2	3	062	389053	7384990	Seal spp.								Hole
8-Jun-10	2	4	066	392127	7378369	Seal spp.								Hole
8-Jun-10	2	4	067	391608	7378376	Canada goose	*Branta canadensis*	11					11	
8-Jun-10	2	4	068	390951	7378354	Seal spp.								Hole
8-Jun-10	2	5	072	366133	7366249	Grizzly bear	*Ursus arctos*	1					1	
8-Jun-10	2	5	074	395721	7370489	Seal spp.								Hole
8-Jun-10	2	5	075	397210	7370662	Seal spp.								Hole
8-Jun-10	2	n/a				Seal spp.								12 holes over Bathurst Inlet
8-Jun-10	2	7	078	379837	7351713	Common raven	*Corvus corax*	1					1	
8-Jun-10	2	9	085	408774	7336590	Grizzly bear	*Ursus arctos*	2					2	Large brown grizzly with smaller blond one

Appendix 4. Incidental Wildlife Observations, 2010

								No. Observed						
Date	Survey	Transect	Waypoint	Easting	Northing	Common Name	Scientific Name	Adult (Undermined sex)	Male	Female	Young	Unknown	Total	Comment(s)
13-Jul-10	3	1	002	377197	7399759	Tundra swan	*Cygnus columbianus*	2					2	in a lake
13-Jul-10	3	2	003	372504	7392018	Tundra swan	*Cygnus columbianus*	3					3	near lakeshore
13-Jul-10	3	3	007	369206	7383691	Tundra swan	*Cygnus columbianus*	2					2	in a lake
13-Jul-10	3	4	011	384547	7375782	Tundra swan	*Cygnus columbianus*	2					2	in a lake
14-Jul-10	3	19	012	395600	7256137	Unknown duck						1	1	on the tundra
14-Jul-10	3	18	014	393977	7263568	Grizzly bear	*Ursus arctos*	1					1	on the tundra
14-Jul-10	3	15	015	387459	7287062	Unknown duck						25	25	in a lake
14-Jul-10	3	15	016	422629	7287083	Unknown duck						40	40	in a lake
14-Jul-10	3	15	017	425288	7287546	Unknown duck						26	26	3 groups
14-Jul-10	3	8	022	386992	7343476	Bald eagle	*Haliaeetus leucocephalus*					1	1	flying
14-Jul-10	3	9	023	368853	7336122	Unknown duck						10	10	in a lake
14-Jul-10	3	11	025	382263	7320147	Unknown duck						8	8	in a lake
14-Jul-10	3	11	027	402985	7320200	Unknown duck						27	27	in a lake
14-Jul-10	3	12	028	376395	7311430	Unknown duck						60	60	in a lake
14-Jul-10	3	14	030	423882	7295383	Unknown duck						24	24	in a lake
14-Jul-10	3	14	031	387054	7295852	Unknown duck						15	15	in a lake
15-Jul-10	3	n/a	001	434123	7270020	Willow ptarmigan	*Lagopus lagopus*		1	1	10		12	Observed at Goose Camp
15-Jul-10	3	n/a	001	434123	7270020	Canada goose	*Branta canadensis*	8					8	Observed at Goose Camp
15-Jul-10	3	n/a	001	434123	7270020	Long-tailed duck	*Clangula hyemalis*			1			1	Observed at Goose Camp
15-Jul-10	3	n/a	001	434123	7270020	Unknown shorebird						1	1	Observed at Goose Camp
15-Jul-10	3	n/a	001	434123	7270020	Unknown gull						1	1	Observed at Goose Camp
15-Jul-10	3	n/a	001	434123	7270020	Horned lark	*Eremophila alpestris*					1	1	Observed at Goose Camp
15-Jul-10	3	n/a	001	434123	7270020	Unknown redpoll	*Carduelis* spp.					2	2	Observed at Goose Camp