4 Methods

4.1 Scientific Literature Review

A variety of scientific data sources were used to characterize baseline conditions in the area around the Kiggavik Project, including:

- Historical Studies — Historical studies in the area around the Kiggavik Project, largely investigations initiated by Urangesellschaft, were integrated in the characterization of baseline wildlife conditions for the Mine LSA, road LSAs, and RSA. Differences in study areas, methods, and some incomplete historical datasets prevented direct comparisons with the current baseline data. The availability of historical data is discussed prior to presentation of baseline data. A summary table of key information sources for wildlife resources is provided in Table 4.1-1 (including current baseline studies).
- Studies Related to the Meadowbank Project — Recent development and proximity of the AEM Meadowbank Project, located east of the Kiggavik Project and north of Baker Lake, makes it a useful source of regional data. Terrestrial wildlife baseline studies were completed at Meadowbank from 1999 to 2005 and long-term monitoring studies have been conducted from 2006 to 2013. Relevant information from those studies was used to provide additional regional context (AEM 2005a; AEM 2008 to 2014, internet site).
- Other Regional Studies — Although much of the relevant literature is from past studies for the Kiggavik Project, a number of key studies provided additional information. These regional studies include work conducted in the late 1970s on harvests and critical wildlife areas (IDS 1978), and a waterbird study conducted in the vicinity of Baker Lake (McLaren and Holdsworth 1978). Harvest data from the more recent Nunavut Wildlife Harvest Study were also used (NWMB 2005). Other Government of Nunavut (GN) regional data included regional ecological land classification (ELC) data (provided under a data-sharing agreement with AREVA), caribou collaring data, regional caribou movement for the Beverly-Ahiak herds collected by the Government of the Northwest Territories (GNWT) (provided to Gebauer & Associates under a data release agreement), and regional distribution maps for selected bird species from Canadian Wildlife Service (CWS). Studies completed in support of other mining projects were used as regional data sources, including Baker Lake hunter harvest data collected by AEM in 2007 and 2008 (AEM 2009, internet site), hunter harvest data collected jointly by AEM and AREVA from 2009 to 2013, and caribou movement data collected for Cameco Corporation (provided to AREVA under a data-sharing agreement). Any literature relevant to regional wildlife conditions is referenced in VEC-specific sections in this report (see Section 5).
- Territorial and Federal Sources — Information from territorial and federal government agencies was used to provide a regulatory context whenever necessary. In particular,

databases from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2014, internet site) and the Species at Risk Act (SARA 2014, internet site) were accessed regarding the status of federally-listed species in the RSA. Territorial status ranks for wildlife species are referenced to provide a more regional frame of reference on priority species (CESCC 2011, internet site).

Table 4.1-1 Summary of Available Data on Wildlife Populations for the Kiggavik Project Area

Year (reference)	Aerial Surveys	Collaring Studies	Ground Surveys[a]	IQ Studies, Interviews, Community Meetings	Hunter Harvest	Small Mammal Surveys	Raptor Nest Surveys	Bird Surveys	Incidental Wildlife Observations	Insect or Animal Tissue Chemistry
1977 (Maclaren & Holdsworth 1978)	-	-	-	-	-	-	-	LSA (BL)	LSA (BL)	-
1978 (IDS 1978)	-	-	-	RSA	RSA	-	-	-	-	-
1978 (Beak 1990)	-	-	LSA RSA	-	-	-	-	-	LSA RSA	-
1979 (Speller et al. 1979)	-	-	LSA RSA	-	-	LSA	-	LSA RSA	LSA RSA	-
1980 (URG 1981)	-	-	LSA RSA	-	-	LSA	LSA RSA	LSA RSA	LSA RSA	-
1989 (Beak 1990)	-	-	-	-	-	-	-	-	LSA	LSA
1991 (Beak 1991, Geomatics 1991)[b]	-	-	LSA	-	-	-	-	-	LSA	-
1996 to 2001 (NWMB 2005)	-	-	-	RSA	RSA	-	-	-	-	-
2007	LSA RSA	-	LSA	LSA, RSA	-	-	-	-	LSA RSA	-
2008	LSAs	-	LSAs	LSA, RSA	-	-	LSAs	LSAs	LSAs	LSA

Table 4.1-1 Summary of Available Data on Wildlife Populations for the Kiggavik Project Area

Year (reference)	Aerial Surveys	Collaring Studies	Ground Surveys[a]	IQ Studies, Interviews, Community Meetings	Hunter Harvest	Small Mammal Surveys	Raptor Nest Surveys	Bird Surveys	Incidental Wildlife Observations	Insect or Animal Tissue Chemistry
	RSA							RSA	RSA	RSA
2009	RSA	RSA	LSAs	LSA, RSA	RSA	LSA RSA	LSAs	LSAs RSA	LSAs RSA	LSA RSA
2010	-	RSA	LSAs	LSA, RSA	RSA	-	-	LSAs RSA	LSAs RSA	-
2011 to 2013	-	RSA	-	LSA, RSA	RSA	-	-	-	-	-

Only references directly relevant to the RSA are listed in this table. Other secondary literature sources were also consulted.

[a] Includes reconnaissance ground surveys and Height-of-Land surveys

[b] Additional baseline data may have been collected during this study; a complete list of all field surveys was not provided in available references

'-' = type of survey was not included; BL = Baker Lake dock facility; LSAs = any Project (mine, road) boundaries (some boundaries have changed over time)

4.2 Inuit Quajimajatuqangit

The term Inuit Qaujimajatuqangit is used to describe Inuit epistemology or the Indigenous knowledge of the Inuit (Tagalik 2012). Inuit Qaujimajatuqangit translates into English as “that which Inuit have always known to be true.” Inuit Qaujimajatuqangit, from its inception, was intended to include not only Inuit traditional knowledge, but also the contemporary values of Nunavut's communities (Arnakak 2002). The Government of Nunavut’s Department of Sustainable Development's IQ Working Group defined IQ as: the past, present and future knowledge, experience and values of Inuit society (Arnakak 2002).

Prior to the onset of baseline field studies, available Inuit Quajimajatuqangit (IQ) was collected to determine any areas of special concern in the LSAs and RSA. Sources included informal (undocumented) conversations with hunters, Hunter and Trappers Organizations (HTOs), community leaders, and local area residents. This information was useful for defining the final boundaries of the RSA to encompass known caribou use areas.

IQ and public engagement data were integrated throughout the TWBR. Sources included interviews and focus group discussions in Baker Lake and nearby communities, public meetings, open houses, and review panel sessions from 2008 onwards. Much of the IQ is integrated on maps alongside scientific data. IQ from published sources was also used (e.g., Freeman 1976; IDS 1978; Riewe 1992; McDonald et al. 1997; Mannik 1998; AEM 2005b).

IQ provided evidence on wildlife presence (e.g. caribou and other animals like to go where there is shelter, and they usually try to stay in areas where there are big lakes, IQ-BLE 2011).), behaviour (e.g. musk ox do not migrate, and travel slowly, only when the food source in an area is used up, IQ-CI03 2009), and habitat use (e.g. variation in caribou migration routes have occurred over the years, IQ-BL01 2009), and was used to characterize historical and existing baseline conditions. As outlined throughout this technical appendix, IQ and engagement information was often in agreement with available science. In some cases, IQ and engagement data provided supplemental information that addressed existing data gaps. In the limited cases of disagreement between technical and IQ data, a balanced presentation of the issues and a statement of conclusions are provided. In particular, information on caribou migration patterns, important caribou use areas (i.e., water crossings, calving, and post-calving areas), wildlife population conditions, and historical and current human use of caribou and other species was critical in characterizing terrestrial wildlife baseline conditions.

Information gathered through the AREVA/Agnico Eagle Mines Ltd. Hunter Harvest Study for caribou, muskox and wolverine influenced the scope of the baseline program. The 2007 to 2013 Hunter Harvest Study in Baker Lake may be considered engagement data and/or IQ data since the information gathered represents current knowledge regarding wildlife. This is consistent with the NIRB’s IQ definition glossary of the Kiggavik DEIS guidelines (NIRB 2011): “the traditional, current and evolving body of Inuit values, beliefs, experience, perceptions and knowledge regarding the environment, including land, water, wildlife and people, to the extent that people are part of the environment." The Hunter Harvest Study embodies the following IQ guiding principles: Avatimik Kamattiarniq (concept of environmental stewardship), Inuuqatigiitsiarniq (respecting others, relationships, and caring for people), Pilimmaksarniq (the concept of skills and knowledge acquisition) and Tunnganarniq (fostering good spirit by being open, welcoming, and inclusive).

Baseline data collection was aided by local Inuit field assistants (Table 4.2-1).

Table 4.2-1 List of Local Inuit Field Assistants Participating in Baseline Field Surveys (2007 to 2014)

Inuit Participant (Baker Lake)	2008	2009	2010	2011	2012	2013	2014	Task
Avaala, Kenny	-	√	-	√	-	-	-	Wildlife and vegetation surveys
Elytook, Thomas	-	√	-	-	-	-	-	Wildlife and vegetation surveys
Itkilik, Darren	-	√	-	-	-	-	-	Wildlife and vegetation surveys
Mannik, Hattie	√	-	-	-	-	-	-	Wildlife and vegetation surveys, Community work
Mannik, Tom	√	-	√	√	-	-	-	Wildlife and vegetation surveys
Martee, Daniel	-	√	-	-	-	-	-	Wildlife and vegetation surveys
Martee, Kevin	√	√	√	√	-	-	-	Wildlife and vegetation surveys
Putumiraqtuq, Joseph	-	√	√	-	-	-	-	Wildlife and vegetation surveys
Tiktaalaaq, Clarence	-	-	√	-	-	-	-	Wildlife and vegetation surveys
Utatnaq, Victor	√	√	√	√	√	√	√	Wildlife and vegetation surveys, Hunter harvest study

4.3 Field Studies

The overall strategy for the field program was to gather relevant information on VECs to best describe the presence of wildlife resources and how wildlife uses the area surrounding the Kiggavik Project. A more accurate picture of wildlife baseline conditions is developed if a variety of survey tools are used — tools that target different VECs, in different areas (e.g., LSA vs. RSA), and during different seasons (e.g., summer vs. winter). All of these tools create a 'pre-project' description of the area, to serve two purposes: (1) provide a basis for environmental assessment during the review process; and (2) provide a database of 'pre-project' conditions that can be used for future monitoring.

The types of field surveys selected for the baseline monitoring program were designed to capture the range of data that best meet the needs of this overall strategy. Particular study areas were surveyed more intensely than others because of preferred design alternatives and data gaps. Certain survey methods evolved to exercise caution with respect to the potential sensitivity of some species to disturbance from field work. Finally, baseline surveys were designed with the intent of providing data for a long-term monitoring strategy. Statistically valid replication (i.e., spatially, seasonally, and annually) was a key consideration in survey design. Many of the survey methods used specific observation points (i.e., survey stations, plots, transects), which are better suited for collecting future monitoring data than reconnaissance-type methods.

Local Inuit staff were present on most of the field survey teams because of their invaluable knowledge of the land, wildlife, and seasonal variability in distribution and abundance of animals, and their insight into historical and current land and wildlife use patterns of local Inuit (see participation in Table 4.2-1).

In summary, survey methods used from 2007 to 2010 included:

- **Ground surveys** — Height-of-land surveys were conducted at regular stations and intervals in the Mine LSA to identify species using the area (especially ungulates and predators). Other ground-based surveys were conducted in the Mine and road LSAs for the purposes of recording all wildlife observed in these areas (i.e., reconnaissance-scale surveys);
- **Aerial surveys** — Aerial surveys were flown over the RSA and LSA at various intervals in 2007 and 2008 (focusing on ungulates and predators);
- **Caribou satellite collaring studies** — Satellite collars were deployed on 21 caribou in 2009, 13 caribou in 2011, and 15 in 2013 for the purposes of monitoring caribou movement. This study was part of a larger scale, regional effort and involved coordination with AEM, Cameco, and the GN.
- **Raptor nests** — Raptor nests were identified by aerial and ground surveys in the Mine LSA and along the All-Season Road. Nests were monitored by ground-based visits.
- **Waterbird surveys** — Waterbird (including shorebird) surveys were conducted along shorelines within 200 m of Project facilities (including proposed road alignments) in various areas, during sensitive periods of nesting and molting, and around proposed infrastructure at the Thelon River and Baker Lake. Transects were also surveyed on multiple occasions during the 2009 field season in the Sissons Lease area of the Mine LSA, and a comparable control in the RSA to record waterbird use.

- **Breeding bird surveys** — Plots were monitored annually for two seasons in the Mine LSA and RSA to record and compare use by breeding birds during the nesting period. 'Program for Regional and International Shorebird Monitoring' (PRISM) methods were used. Breeding bird transects were also surveyed along the All-Season Road to record bird presence. All breeding birds observed on each field day were recorded and submitted to the Canadian Wildlife Service (CWS), as per the CWS bird checklist protocol.
- **Hunter harvest study** — In 2009, AREVA became a partner in a hunter harvest study initiated by AEM in 2007. Harvest details are recorded by participating households throughout the year, using harvest calendars and hunter interviews.
- **Camp log and wildlife monitors** — Camp wildlife monitors conducted regular field checks around the camp and active exploration areas. Monitors, other camp employees, and wildlife biologists recorded observed wildlife in the camp log, including observations made during routine flights. Most records are for observations in the Mine LSA; there are fewer records for the RSA.
- **Incidental observations** — Any non-targeted species observed during dedicated surveys (e.g., mammals observed during bird surveys) were recorded as incidental wildlife observations by wildlife biologists.
- **Tissue chemistry** — Tissues from insects, small mammals, and birds (captured accidentally) were sampled in the Mine LSA and RSA in 2008 and 2009, and analyzed for metal and radionuclide concentrations. Caribou and muskox tissues from animals already harvested by Baker Lake hunters were collected in 2009 and 2011, and analyzed for metal and radionuclide concentrations.

An overview of the field survey schedule is provided in Table 4.3-1. Sample field survey forms are provided in Attachment A.

Some surveys targeted particular VECs. For example, nesting and molting area surveys targeted waterbirds while satellite-collaring studies targeted caribou. A number of field surveys were designed to capture data on the presence of any VECs in a particular area (e.g., ground-based surveys conducted in road LSAs). During all field surveys, incidental observations of non-targeted species were always recorded. A summary of the VECs targeted in particular field surveys is provided in Table 4.3-2.

Table 4.3-1 Frequency and Timing of Baseline Studies (2007 to 2013)

Field Survey	Study Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Height-of-Land	Mine LSA	-	-	-	10	08-10	08-10	08-10	08/09	08	-	-	-
Ground-based	Mine LSA	-	-	-	-	-	08-09	08-09	07-09	07	-	-	-
	South AWAR[(a)]	-	-	-	-	-	-	08	09	-	-	-	-
	All-Season Road	-	-	-	10	10	08-09	08-09	08-09	-	-	-	-
	Winter Road	-	-	-	-	-	-	-	10	-	-	-	10
	Quarry sites	-	-	-	-	-	-	09	09	-	-	-	-
Aerial	Mine LSA	-	-	-	-	08	07	07-08	07	07-08	-	-	-
	RSA	-	-	-	-	08	-	08	07	08	08	09	-
	All-Season Road	-	-	-	-	-	-	08	-	-	-	-	-
	South AWAR[(a)]	-	-	-	-	-	-	08	-	-	-	-	-
Caribou Satellite Collaring	RSA	10-13	10-13	10-13	10-13	10-13	10-13	10-13	10-13	10-13	10-13	09-13	09-13
Raptor Nests	Mine LSA	-	-	-	-	-	08-09	08-09	07	-	-	-	-
	All-Season Road	-	-	-	-	-	08-09	08-09	09	-	-	-	-
	South AWAR[(a)]	-	-	-	-	-	-	08	-	-	-	-	-
Waterbird Nesting	Mine LSA	-	-	-	-	-	-	08-09	-	-	-	-	-
	All-Season Road	-	-	-	-	-	-	09	-	-	-	-	-
	South AWAR[(a)]	-	-	-	-	-	10	10	-	-	-	-	-

Table 4.3-1 Frequency and Timing of Baseline Studies (2007 to 2013)

Field Survey	Study Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Waterbird Molting Areas	Mine LSA	-	-	-	-	-	-	09	09	-	-	-	-
	All-Season Road	-	-	-	-	-	-	09	09	-	-	-	-
Waterbird Transects	Thelon Crossing	-	-	-	-	-	-	09	09	-	-	-	-
	Baker Lake Dock	-	-	-	-	-	10	09-10	09-10	-	-	-	-
	Sissons & Control	-	-	-	-	-	09	09	09	-	-	-	-
Breeding Bird PRISM Plots	Mine Site & Control	-	-	-	-	-	08-09	08-09	-	-	-	-	-
Breeding Bird Transects	All-Season Road	-	-	-	-	-	08-09	08-09	-	-	-	-	-
Bird Checklists	All Areas	-	-	-	10	08	08-10	08-10	08-10	08	-	-	-
Hunter Harvest Study	RSA	09-13	09-13	09-13	09-13	09-13	09-13	09-13	09-13	09-13	09-13	09-13	09-13
Camp Log & Wildlife Monitors	Mine LSA & RSA	-	-	-	-	09	07-10	07-10	07-10	07-09	-	-	-
Tissue Chemistry	Mine LSA & RSA	09	09	-	-	09, 11	-	08-09	08-09	-	-	-	-

[a] Alignment is no longer considered; 07 = 2007; 08 = 2008; 09 = 2009; 10 = 2010; 11 = 2011; 13 = 2013; '-' = No survey conducted

Table 4.3-2 Summary of Valued Ecosystem Components (VECs) Targeted in Baseline Field Surveys (2007 to 2013)

Field Survey	Valued Ecosystem Components					
	Waterbirds and Shorebirds	Upland Birds	Raptors	Caribou	Muskox	Large Predators
Height-of-Land	-	-	√	√	√	√
Ground-based	√	√	√	√	√	√
Aerial	(√)	(√)	√	√	√	√
Caribou Satellite Collaring	-	-	-	√	-	-
Raptor Nests	(√)	(√)	√	(√)	(√)	(√)
Waterbird Nesting	√	(√)	(√)	(√)	(√)	(√)
Waterbird Molting Areas	√	(√)	(√)	(√)	(√)	(√)
Waterbird Transects	√	(√)	(√)	(√)	(√)	(√)
Breeding Bird PRISM Plots	√	√	-	-	-	-
Breeding Bird Transects	√	√	-	-	-	-
Bird Checklists	√	√	√	-	-	-
Hunter Harvest Study	(√)	-	-	√	√	√
Camp Log / Monitors	√	√	√	√	√	√
Tissue Chemistry[a]	-	-	-	√	√	-

[a] Chemistry data for insects, small mammals, and birds provide information on prey species, not on VECs

(√) = These VECs were not targeted by this field survey, but observations were typically recorded

'-' = These VECs were not recorded as part of this survey

Since 2007, the baseline program has evolved based on lessons learned from previous seasons, stakeholder input, and changing information needs. In particular, aerial surveys, which were used during the first two years of baseline monitoring, were phased out of the field program. This change reflected a need for more site-specific, ground-based surveys, but was also the result of input received from stakeholders including the GN, GNWT, and Beverly-Qamanirjuaq Caribou Management Board (BQCMB) and their concerns regarding unnecessary disturbance to wildlife, particularly caribou, as a result of frequent aircraft overflights. Participation in the regional caribou collaring study also resulted from this change.

4.3.1 Height-of-Land Surveys

Height-of-land ground surveys were conducted in the Mine LSA during spring and summer seasons in 2008, 2009, and 2010, and during early winter and late winter in 2010, to identify wildlife species using the area and any wildlife aggregations (with a particular focus on ungulates) or predator presence that may have implications for camp or mine operation.

Twenty (20) HOL survey stations were established within the Mine LSA (see Figure 4.3-1). HOL surveys are stationary and consist of a 15-minute observation period where wildlife species and distance from survey point are documented. At least one experienced observer was part of every field team. Stations were accessed by foot in the spring and summer and by snowmobile in winter. Animals recorded at HOL stations were typically far away and undisturbed by approaching observers; therefore, no wait time was necessary between arriving at the station and starting observations. Small birds and mammals were usually not recorded during the HOL surveys since the focus of the survey was on ungulates, predatory mammals, larger birds, and raptors. The 20 survey locations took on average two days to complete[2] by two observers. The following information was collected at each HOL station for each wildlife observation (see sample form in Attachment A):

- date, time, and weather conditions;
- number of animals (i.e., group size);
- sex (male or female);
- age (calf, yearling, adult);
- habitat use (ELC unit);
- direction of travel (N, NE, E, SE, S, SW, W, NW);
- location and proximity to proposed mine facilities; and
- behaviour (resting, foraging, walking, running, etc.).

Wherever possible, the sex and age of ungulates were determined by a number of distinctive factors including size, coloring, and antler size and growth.

Attempts were made to conduct HOL surveys at all stations on a weekly basis in 2009, but logistics (e.g., weather, transport, seasonal density of animals) and the scope of work for each year of monitoring meant that survey frequency was not strictly weekly and that not all HOL stations were visited during each survey attempt. HOL survey days completed each year were:

[2] Twenty-four HOL stations were initially included, but four of these stations were not used after the 2008 season because this number of stations could not be surveyed over the two-day period.

- 2008: 17 survey days;
- 2009: 48 survey days. Survey frequency increased in 2009 due to a larger scope of work for that year of baseline monitoring and to avoid the use of aerial surveys; and
- 2010: 8 survey days. HOL surveys were completed opportunistically in 2010, reflecting a smaller scope of work for this year of monitoring.

4.3.2 Ground-based Surveys

Ground-based surveys were conducted in a number of areas within the RSA for the purposes of documenting all observed wildlife species in particular areas of interest. These reconnaissance surveys focused on the Mine LSA and road LSAs (Figure 4.3-2). Survey details were as follows:

- Wildlife reconnaissance surveys of the Mine LSA were completed during habitat classification surveys from August 24 to 31, 2007;
- Summer surveys were conducted along a southern all-season access road (known as the South AWAR, but since abandoned as an option) on July 27, 2008 and from August 23 to 27, 2009;
- Wildlife observations were completed in conjunction with ELC field survey plots on the All-Season Road from July 24 to 30, 2008, and between July 21 and August 6, 2009.
- Potential quarry sites along the All-Season Road were surveyed between July 21 and August 6, 2009 to document the presence of nearby terrestrial wildlife and critical habitat areas (e.g. cliff faces suitable for nesting raptors and eskers).
- A winter survey was conducted along the All-Season Road in April (4, 28 and 30) and May (7, 9, 18, and 20), 2010.
- A summer survey was completed along the Winter Road from August 6 to 8, 2010.
- A winter survey was conducted along the Winter Road on December 7 and 9, 2010.

Unlike the HOL surveys, no specific observations points were used for these surveys, except in the case of the quarry sites and ELC field survey plots, where specific locations were surveyed. In most cases, the entire length of road was surveyed. Ground-based surveys were considered ‘encounter’ surveys. Any wildlife seen by naked eye or binoculars at the site or along the road surveyed was recorded. Information recorded in field books would typically include: species name, total number of animals and/or animal sign (e.g., tracks, feces), location (UTM coordinates), and sex and age composition, where possible. Ground-based surveys were also conducted for particular wildlife groups (e.g., raptor nests, waterbirds, etc.), which are discussed in separate sections below.

4.3.3 Aerial Surveys

On August 26, 2007, a systematic aerial survey of a regional study area was flown to determine the number, distribution, and group composition of caribou and muskoxen in the area. Incidental wildlife observations were also recorded. The survey was conducted following 11 transect lines flown in a north-south direction, according to a pre-determined flight path using GPS coordinates. Eight weekly aerial surveys of two survey blocks within the Kiggavik and Sissons lease areas were conducted from July to September 2007 (Figure 4.3-3). Only one block was surveyed at a time, to limit disturbance, and information on caribou and muskox number, distribution, and group composition was collected, as well as incidental wildlife observations. Five of the eight surveys were flown systematically (north to south) while the other three surveys were non-systematic (circular). Finally, daily high-level surveys were flown in June/July 2007 to determine caribou presence around drilling operations.

In 2008, three aerial surveys of the Mine LSA were completed on May 25, July 28 and September 7. The aerial survey route included 18 transects spaced at 1.5 km intervals across the entire LSA and oriented in a north-south direction (Figure 4.3-4). With an effective survey viewing distance of 1,000 m (i.e., 500 m on each side of the aircraft), approximately 67% of the LSA was covered during the surveys. Total transect length flown during each complete survey was 296 km.

Five aerial surveys were conducted within the RSA between May and October 2008 (23 May, 22 July, 9 to 10 September, 2 to 3 October, and 30 October [partial]). The 14 transects (i.e., variable length and spaced every 10 km) were oriented perpendicular to the proposed road LSAs (Figure 4.3-5) to determine whether caribou or muskox were using all habitats (both near and far) at similar levels. Transect location corresponded with an earlier RSA (2008) that included areas south of Baker Lake. With an effective viewing or survey distance of 1,000 m (i.e., 500 m on each side of the aircraft), approximately 10% of the RSA was covered during the surveys. Total transect length flown during each complete survey was 1,030 km. An aerial reconnaissance survey of the RSA was also conducted on November 13, 2009 as part of the caribou collaring program (see Section 4.3.1.4). Transects were not flown systematically during this latter survey, but most of the western and central portion of the RSA was flown.

Aerial surveys of the All-Season Road, the haul road within the Mine LSA, and the previously considered South AWAR option were also flown in 2008. These flights were primarily for raptor nest surveys (see details in Section 4.3-5) but were also used as a high-level reconnaissance survey of these alignments.

Standard methods for aerial survey observation were used. Prior to each aerial survey, weather conditions were documented and the helicopter or aircraft windows and/or wing struts were calibrated to the proper transect strip width of 1,000 m (includes putting a piece of tape on the window for each observer). Everything below the tape on the window was considered to be within the transect strip (i.e., within 500 m of the aircraft). Flight altitude and ground speed averaged approximately 150 m above ground level (agl) and 130 to 160 km/hr, respectively. A minimum of three observers participated on each survey: the pilot, a navigator/observer, and an observer on the pilot's side of the aircraft. The pilot concentrated on maintaining altitude, ground speed, and staying on transect. The navigator/observer assisted the pilot in staying on track, plotting individual observations on a map, collecting waypoints for each observation, and reporting animals on his/her side of the aircraft. Local field assistants were also present, and these second (and sometimes third) observers communicated observations for the navigator to record.

The GPS locations of all wildlife sightings or observations of clearly identifiable wildlife sign (e.g., dens, nests, caribou craters) were recorded in field books. At a minimum, the number of individuals was recorded and, if possible, information on sex and age class. The sex and age of ungulates was determined by a number of distinctive factors including size, coloring, and antler size growth. Aerial observers were experienced in determining the sex and age of ungulates, but each employee received specific training on how to determine distinctive features related to sex and age under aerial survey conditions. All individuals or groups seen within the effective survey strip were recorded as 'In' while those beyond the transect boundary were recorded as 'Out'. In certain situations when animals (e.g., large caribou herd) were sighted outside the strip width, the navigator decided to deviate from transects to investigate further. Once these observations were completed, transects were resumed from the waypoint of the deviation. Observations of animals made while travelling between transects were recorded separately as incidental.

4.3.4 Caribou Satellite Collaring Studies

Caribou satellite-collar location maps were provided by the GN to AREVA on a regular basis starting in June 2009. In 2009 the maps were based on an original nine animals collared in 2008 by AEM and GN in the area around the Meadowbank Project. Caribou collar maps were initially used as a monitoring tool by locating caribou concentrations and preparing for possible caribou movements towards the Mine LSA and RSA. Collaring is being used more frequently as a monitoring method because of its ability to integrate spatial and temporal information on caribou population and movement, instead of the static 'snap shot' provided by more traditional aerial surveys. Given these advantages, AREVA committed to participating in a satellite-collaring program in partnership with AEM. A total of 21 collars were initially committed, based on available funding and as suggested by the GN. The level of effort was designed to gather project-specific data on caribou presence and movement, and to contribute to government-led regional studies that increase knowledge of herd dynamics over a larger geographic area.

The AREVA, AEM, and GN joint satellite-collaring program was initiated in November 2009. Aerial reconnaissance surveys were completed prior to deployment, and all 21 collars were deployed with no injury to any animals (Figure 4.3-6). The program was expanded and an additional collars were deployed in 2011 (13 collars) and 2013 (15 collars). Most caribou were collared west of Baker Lake in the RSA since aerial reconnaissance surveys, reports from road survey crews, and absence of incidental sightings within the Meadowbank area suggested that very few caribou were present in the Meadowbank RSA at the time of collaring. Animals were collared around Schultz Lake, between Aberdeen and Schulz lakes along the Thelon River, and in the vicinity of Judge Sissons Lake (Figure 4.3-6). Some animals were collared within the Meadowbank RSA as well (not shown on Figure 4.3-6). To complement the data collected from the collaring study, AREVA developed a data-sharing agreement with Cameco Corporation to access information Cameco has collected on caribou distribution in the northwestern and western portions of the RSA (based on ongoing field surveys).

4.3.5 Raptor Nest Surveys

Both aerial and ground-based survey methods were used during the baseline program to locate and monitor raptor nests. Ground-based raptor nest reconnaissance surveys were conducted in 2007 in the area around the Mine LSA (note that only inactive and potential nesting sites were identified). More extensive raptor nest surveys were conducted during the summer seasons in the following two years (2008 and 2009) (Figure 4.3-7). In late June 2008, an aerial survey was conducted along the All-Season Road and the haul road within the Mine LSA (i.e., between Kiggavik and Sissons leases). On July 27, 2008, an aerial survey of the South AWAR (no longer considered as an option) was also conducted. Three transects were surveyed along the full length of each of these alignments, with one transect situated on the alignment and two situated 500 m on either side of the proposed centerline. Total length of each transect on the All-Season Road was 104.7 km, and on the South AWAR (no longer considered as an option) was 85.3 km. Standard methods for aerial survey observation were used. Raptor nests observed by air were confirmed by ground surveys at a later date. Additional raptor nests were identified in the RSA and LSA during HOL and other ground-based surveys, including ground surveys conducted for waterbirds and upland birds.

All known raptor nest sites were visited during ground surveys on July 30 and August 1, 2009, to determine status. Nests were monitored with a spotting scope (to avoid unnecessary disturbance), and information on behaviour, number of eggs, number of chicks, and number of fledged young was determined. All observed raptor nests were labeled with a unique identifier and entered into the regional records maintained by the GN, as part of their efforts to maintain a complete database of raptor nest sites.

4.3.6 Waterbird Nesting and Molting Areas Surveys

Waterbird (e.g., waterfowl, shorebirds, jaegers, etc.) surveys were undertaken in 2008 and 2009 to determine presence/absence of waterbirds during the sensitive nesting and molting periods (Figure 4.3-8). Additional details for each survey are provided below.

4.3.6.1 Waterbird Nesting

Waterbird nesting surveys were generally conducted during the first two weeks of July in various areas. Surveys were conducted in the Mine LSA (July 1 to 4, 2008 and June 27 to July 3, 2009), along the All-Season Road (June 28 to July 11, 2009), and along the previously considered South AWAR option (June 29 to July 4, July 15, 2010).

Nesting surveys involved a thorough assessment of nesting waterbirds along shorelines (i.e., pond edges, shoreline of islands) within 200 m of proposed mine and road facilities. A team of two people was involved in the survey. Observers used maps (developed prior to fieldwork) and UTM coordinates for orientation. Two observers walked around the edges of islands, wetlands or shorelines, with one observer stationed 5 m from the water's edge and the second observer situated 15 m from the water's edge (i.e., 10 m between observers). UTM locations (taken with a handheld GPS unit) of all waterbirds and their nests were recorded in field books. Other wildlife species observed during the nesting surveys were also recorded.

4.3.6.2 Waterbird Molting Areas

In 2009, waterbird molting areas were surveyed in late July/early August in the Mine LSA and along the All-Season Road (July 26 to August 6, 2009). Wetlands, ponds and lakes within 200 m of the proposed mine and road facilities were surveyed to determine whether any of the larger waterbodies were utilized as molting areas for waterbirds (i.e., waterbird aggregations). Unlike the nest surveys, a thorough ground-based search of all shoreline areas was not conducted, instead, a spotting scope was used to identify and record waterbird presence on larger lakes and ponds. All observations were recorded in field books.

4.3.7 Waterbird Transects

4.3.7.1 Thelon River and Baker Lake

Surveys for waterbird presence were conducted along shorelines near the proposed river crossings at the Thelon River (Figure 4.3-9) and the proposed Baker Lake dock area (Figure 4.3-10). These surveys were completed as 'encounter' surveys, where any species observed with the naked eye or binoculars along the transect length, were recorded in field books. Location information was collected for all waterbirds.

Areas near the proposed Thelon River crossing were also included as part of the All-Season Road waterbird nest and molting area surveys (see above). In addition, specific shoreline surveys were completed within 2 km of the proposed crossing areas. Surveys were completed on July 15, August 11 (no waterbirds observed), and August 28 (no waterbirds observed), 2009.

Shoreline surveys were conducted within one kilometer of potential dock facilities east of the Hamlet of Baker Lake. The Baker Lake dock areas were surveyed on June 18, July 9, July 20, and August 24, 2010.

4.3.7.2 Sissons Lease and Sissons Control

Results of waterbird nest surveys in the Mine LSA in 2008 suggested that the Sissons Lease area may be important for breeding shorebirds, waterbirds, and possibly short-eared owl, a species designated as 'Special Concern' and listed on *SARA* Schedule 1 (*SARA* 2014, internet site). Stilt sandpipers (*Calidris himantopus*) were observed in 2008 at three different nest survey stations in the southwest corner of Sissons Lease, and a short-eared owl was observed in the northeast section. Overall bird occurrence and the availability of shoreline habitat and potential breeding areas in the area warranted a more detailed investigation.

To evaluate the importance of the area to waterbirds and short-eared owl, ground-based surveys were conducted from transects in the Sissons Lease Mine LSA and a control area in the RSA (Sissons Control) (Figure 4.3-11). Surveys were conducted on three separate occasions during the months of higher bird activity (June 29 to July 5, July 19 to 22, and Aug 1 to 4, 2009). Transects were spaced 500 m apart, followed shorelines of ponds and lakes where necessary, and extended 1 km beyond the boundary of proposed Project facilities. Survey crews recorded species and numbers of waterbirds (and some breeding birds) on each transect. Coordinates were not recorded for each encounter, rather data were gathered on total bird observations (visual or oral) along the entire transect line as an estimate of overall population density. The Sissons Control was selected based on similar habitat conditions to the Sissons Lease Mine LSA including ELC unit distribution, topography, elevation, and percent cover of lakes and ponds. Nine transects were completed in both the Sissons Lease Mine LSA (total transect length 33.8 km) and the Sissons Control (total transect length 33.2 km). Percent cover of wetlands in the Sissons Lease and Sissons Control was 15% and 10%, respectively.

4.3.8 Breeding Bird Surveys

Breeding bird surveys were conducted to determine presence/absence of upland breeding birds, including all passerines (i.e., migratory songbirds), ptarmigan, and some shorebirds.

4.3.8.1 Breeding Bird PRISM Plots

Program for Regional and International Shorebird Monitoring (PRISM) plots were surveyed in the Mine LSA and RSA in 2008 and 2009 during mid- to late-June (primary nesting period). Although originally developed to survey shorebird abundance, the PRISM method is suitable for landbirds because it attempts to determine an absolute number of breeding pairs within a defined area (Environment Canada 2011, internet site)[3]. Because of this standardized and intensive approach, results can be compared between areas and years, making it suitable for long-term monitoring purposes.

Twenty-five (25) plots in the Mine LSA and 20 plots in the RSA (Control) were monitored once each year (Figure 4.3-12). Plots were selected to provide a representative breakdown of ELC units that would be comparable between the Mine LSA and RSA (see Section 5.4.2.2). Two observers, spaced at 25 m intervals, walked slowly in a north to south direction across each PRISM plot (300 by 400 m) and recorded all birds and nests observed (~1.5 hours per plot). Surveys were conducted throughout the day (approximately 8am to 6pm). A handheld GPS was used for orientation purposes during the survey. Sightings were recorded on plot maps using predetermined codes for nests, probable nests, pairs, males, females, birds of unknown sex, and groups (see sample form in Attachment A). Direction of flight, interactions, and other behaviour were also recorded (see sample form in Attachment A). PRISM plots are used as a method of estimating absolute density of birds in an area, so field efforts avoided double-counting individuals and pairs by carefully tracking observations and locations on the PRISM plot map. Following each survey, the total number of birds of each species using each plot was determined and recorded on a separate datasheet. To avoid observation bias, different observers alternated between Mine LSA and RSA control plots. To avoid seasonal bias, survey days were alternated between Mine LSA and RSA control plots.

4.3.8.2 Breeding Bird Transects

Breeding bird transects were conducted along the All-Season Road LSA in mid- to late-June in 2008 and 2009. Ten (10) transects were established randomly and perpendicular to the All-Season Road (Figure 4.3-13). Each transect was 3 km long, with a 1.5 km portion of transect on either side of the road. Survey results were recorded in 100 m intervals (see sample form in Attachment A) to allow future statistical analysis of potential effects at different distances from the road alignment. Any birds

[3] "The Arctic PRISM protocol is well suited for use in general area shorebird and songbird monitoring around development sites. The PRISM protocol is being promoted for use in baseline and ongoing general monitoring programs, and CWS would like to see the PRISM protocol become an industry standard for environmental assessment and monitoring in the Canadian Arctic." (from Environment Canada 2011, internet site)

encountered (visually with the naked eye or binoculars, or by call), were recorded, as well as any nests, age/sex details, and behaviour.

All 10 transects were surveyed three times in both years. In 2008, transects were surveyed on June 20, 21, 22, 24, 25, 29, and July 3. In 2009, transects were surveyed on June 18, 19, 24, 25, 26, and July 1, 2 and 3. In 2009, a few transects were relocated because of a proposed new alignment for the All-Season Road (Figure 4.3-13).

4.3.9 Bird Checklists

Completion of bird checklists followed protocols established by the CWS. The checklists simply involve a day's end estimation of the total number of individuals and species observed on each field day. The information is reported for 10 by 10 km areas. From 2008 to 2010, a checklist record was completed for every day that wildlife surveys were conducted; 35 days in 2008, 67 days in 2009, and 14 days in 2010. On days when crews were in two widely separated locations, two checklists were completed. Completed forms were submitted to CWS personnel in Yellowknife, who are compiling bird records for Nunavut. For the purposes of this TWBR, bird checklists provide additional information on bird species presence.

4.3.10 Hunter Harvest Study

The Baker Laker Hunter Harvest Study (HHS) was initiated by AEM in 2007 as a condition of the NIRB certificate for the Meadowbank Gold Project, and serves to monitor hunting patterns, before, during, and following construction for that project. In 2009, AREVA became a partner in this regional study, and the study area was expanded westward to include the Kiggavik RSA. The HHS tracks the spatial distribution, seasonal patterns, and harvest rates of hunter kills. The study is similar to the Nunavut Wildlife Harvest Study (NWMB 2005) and the Inuvialuit Harvest Study conducted between 1988 and 1997 (The Joint Secretariat 2003); however, it is limited to one community (Baker Lake) and focuses on three VEC species (muskox, caribou, and wolverine) that are relevant to Inuit and northern culture. Complete HHS methods are provided in Attachment B.

The HHS is promoted within the community, and participation is encouraged through the use of raffles and prizes. Hunter harvest data are collected using a harvest calendar (see Attachment B), which is handed out at the beginning of the year. Participating households use the harvest calendar to record harvest details for each hunting date, including number and type of animals, sex and age, and harvest location based on a reference map. Hunter interviews are conducted typically four times each year to ensure completeness of harvest data, and maintain a personal and respectful relationship with the hunters. Interview notes were recorded in field books. Information collected during these interviews compliments data from the harvest calendars and provides additional wildlife data such as observations on caribou movements, aggregations, and hunting trends. A translator was used during the interview process, as needed. Meetings were also held with the HTO to ascertain the level of interest from hunters, to identify any additional areas for improvement, and to facilitate HTO involvement in the study.

The 2008 Baker Lake HTO member list included 683 local area hunters, trappers, and/or fishermen (collectively termed ‘hunter’). The 2008 member count constitutes the majority of Baker Lake residents at the time, but was likely a conservative (i.e., high) estimate of the number of individuals that actually hunt, trap or fish in the community as the list typically includes entire families. If only heads of household are counted, then there are approximately 389 primary hunters in Baker Lake based on the 2008 HTO member list. The total number of hunters on the HTO list has likely changed since this time given that the population in the Hamlet of Baker Lake increased 44% between 2006 and 2011 (Statistics Canada 2011, internet site).

For the current HHS, an estimated 10% of ‘regularly active’ Baker Lake hunters are participating in the study. Specifically, 49 active hunters were interviewed for the 2013 study year. The highest number of participants in a single study year was 62 hunters, in 2012. The estimated number of primary hunters in Baker Lake from the HHS study is comparable to the NWMB study (336 hunters; NWMB 2005) and estimates made more recently in the AREVA diet survey (conducted as part of socio-economic baseline studies, Tier 3 Technical Appendix 9A). Specifically, although the AREVA diet survey only involved 88 hunting households, the authors concluded that approximately 387 households are anticipated to hunt or fish in the community based on interview results of hunting activity and total households in Baker Lake.

4.3.11 Camp Log and Wildlife Monitors

Wildlife observations around the active exploration areas of the Project were recorded since 2007 by camp wildlife monitors, other camp employees, and wildlife biologists. Wildlife logs were placed in the camp kitchen and office, and AREVA employees and contractors were encouraged during site orientation to report any incidental wildlife sightings. Wildlife species seen during routine helicopter flights were also noted on the wildlife log book. Recorded information included date, time, species, number and sex of animals, location, behavior, comments, and observer (see sample form in Attachment A). Observations have been recorded for LSAs and the wider RSA.

As a component of the exploration wildlife monitoring program, AREVA committed to having on-site wildlife monitors stationed in the vicinity of Project activities (e.g., drill sites). Experienced Inuit wildlife monitors were on-site during all field seasons (2007 to 2010). A wildlife monitoring procedure and form record was implemented to ensure daily communication between the wildlife monitor and AREVA’s Environment and Radiation Protection (E&RP) Supervisor. In addition to the general responsibilities communicated with the wildlife monitors, the primary wildlife monitor in 2009 (Tom Mannik), identified five locations around the Kiggavik camp (corresponding to HOL stations 1 to 5) and visited them daily (see AREVA 2009, 2010a, 2010b, 2010c). Thorough notes on weather, wildlife species, behaviour, and direction of travel were recorded and provided to AREVA. Wildlife monitors also made daily visits to all drill sites. In some cases, records were from aerial observations, although most were ground-based.

4.3.12 Tissue Chemistry

Comments from engagement activities and IQ interviews indicated concern about potential contamination of animals and effects on people eating these animals. Community concerns were raised about contaminants of potential concern entering the local food chain (EN-RB NIRB April 2010) including, for example, *if uranium gets into animals, and people eat them, do we get sick* (EN-KUG NTI May 2007) and *if the caribou and people get in contact with the uranium, how long will the radiation affect the people and wildlife? How long will the healing process take* (EN-RB NIRB April 2010)? Collecting pre-operational data on tissue chemistry provides an important baseline for long-term monitoring strategy to address community concerns.

4.3.12.1 Insect, Small Mammal and Bird

Insects and small mammals were collected for tissue chemical analysis from 12 sampling locations within the RSA and Mine LSA. Ten 'near-field' locations were sampled in the Mine LSA (Figure 4.3-14A and B) in 2008, six of which were initially established as permanent sample plots in 2007. In 2009, two 'far-field' locations were sampled in areas outside of the potential influence of mine facilities, as indicated by air dispersion models. In addition to documenting baseline conditions on terrestrial and aquatic prey species within the Mine LSA and the RSA, ongoing monitoring of tissue chemistry in specimens collected at near-field and far-field sampling locations will help evaluate any observed changes as Project activities proceed. Plant tissue and soil samples were collected at the same locations.

In 2008, attempts were made to collect insects using Malaise traps at each of the above sampling locations. One trap was set at each of three sites for approximately two weeks, and traps were emptied every few days during this time. Malaise traps were largely unsuccessful and samples were collected at only these three sites (KIG3, KIG4 and KIG5). In 2009, insects were sampled using a Skeeter-Vac, which attracts insects to a carbon dioxide source (i.e., propane). Only one trap was available for sampling (set at KIG4), which was left in place for the entire sampling period because of slow specimen collection. Sampling was conducted in August 2009 but only the KIG4 sample was successfully collected (see Figure 4.3-14A). Species name, number of individuals, and other details were not recorded due to the nature of the sampling methods used.

In August 2009, small mammals were trapped at each of the sampling locations using snap-trapping techniques. At each sampling location, approximately 100 traps were set each night over a two to seven-day period. Traps were checked daily, and misfires and captures were recorded on data sheets (see sample form in Attachment A). Twenty-nine (29) samples were collected from eight of the near-field locations (KIG1, 2, 3, 4; SIS2, 3, 4, 5) and one of the far-field locations (REF1) (see

Figure 4.3-14B). Although small mammals were targeted for sampling, two small birds were also caught by the snap-traps and were consequently used for tissue analysis. Twenty-seven (27) small mammals (including nine composite samples of two same-species specimens each) and two small bird samples (including one composite sample of two same-species specimens) were analyzed.

4.3.12.2 Caribou and Muskox

Tissue from caribou and muskox was collected for analyses. Sample locations were based on hunter participation, and tissue samples were not specifically obtained from within the Kiggavik Project study areas. This strategy was selected to minimize any unnecessary and Project-related negative effects to caribou. Many samples were collected from animals taken from the area around Baker Lake, but some samples were collected further afield. Few samples were collected inside the RSA and none were collected from the LSA (Figure 4.3-15); however, since caribou movements are regional, these specimens likely represent the animals that typically travel in and out of the Kiggavik Project study areas.

In total, 76 caribou tissue samples (including bone, kidney, liver, and muscle) from 27 separate animals were collected from hunters in Baker Lake during two separate collection events in February and May 2009. Three muskox tissue samples (including bone, kidney and belly meat) from a single animal were collected in May 2011 from a hunter in Baker Lake. This animal was harvested around km 90 on the Meadowbank road. Samples were collected from whole carcasses or parts of separate animals that were either stored by hunters or recently killed by hunters. Details regarding the approximate location (UTM) and date of the kill, wet weight of each sample (measured using a kitchen scale, prior to laboratory submission), and age, sex, and health condition of the animal were recorded where possible as well as information regarding storage and handling methods (caribou only, Attachment C). Tissue samples were collected using clean knives and gloves to avoid contamination. Samples were frozen while in Baker Lake and shipped frozen to the laboratory.

4.4 Laboratory Analysis

4.4.1 Tissue Analysis

Tissue samples were sent to SRC Laboratories (Saskatoon, SK) and analyzed for total metals and radionuclide analyses. Details on analytical methods are provided in Attachment D. Particular parameters were analyzed as follows:

- Elemental analysis by ICP Atomic Emission Spectroscopy (ICP-AES) and Inductively Coupled Plasma Mass Spectrometry (ICP-MS);
- Radium-226, Thorium isotopes and Polonium-210 by Alpha Spectroscopy; and
- Lead-210 by Beta Counting of the Bismuth-210 Successor Product.

All insect species collected in the Malaise traps and with the Skeeter-Vac were included for analysis with intact insect bodies used (i.e., wings were not removed). None of the collected samples were composited for analysis, although the traps collected insects over a number of days at a time. Moisture was only measured in two out of four samples.

Small mammal samples were submitted for whole body analysis (including bones, guts, fur, feathers, etc.). Some samples were composited for analysis. For small mammals, nine out of 27 of the samples were composites of two organisms. For small birds, one of the two samples was composites of two organisms. Only same species were pooled together in a composite sample and only if collected at the same sampling station. Actual specimen compositing was done by the laboratory. The data for composited samples are included in the summary statistics as discrete data points.

Caribou tissue was also provided to the GN for DNA analysis, but samples have not yet been analyzed.

4.4.2 Data Analysis

4.4.3 Habitat Suitability Rankings

Habitat suitability rankings identify the importance of habitat use areas throughout the study area, as well as provide a description of anticipated seasonal trends in habitat use for VECs, as required by NIRB (2010). Habitat use is based primarily on the availability of food, which is considered the most limiting factor for wildlife in the study area. To rank habitat suitability, Ecological Land Classification (ELC) units were first developed to quantify the availability of various habitat types within the RSA and LSAs, followed by the ranking of these habitat types for different VECs.

Firstly, the ELC process delineated unique and distinguishable habitat types on the landscape using a combination of satellite imagery, map analysis, and field surveys. ELC units were developed in the VSBR (Technical Appendix 6B). A preliminary classification was first conducted using satellite image data and imaging software to detect and extract unique land cover features and to identify areas for site visits during field surveys. The preliminary classification yielded unique classes, which were then examined against the imagery and grouped into similar ELC types. The resulting potential ELC units were used as the basis to delineate field survey plots to ground-truth the information. In total, 374 ELC plots were surveyed in the RSA and LSA. During field surveys, detailed information relating to landform characteristics (e.g., slope, hummocks, tussocks, etc.), moisture regime, substrate (e.g., peat, moss, boulder, bedrock, etc.), and vegetation composition within a 20 by 20 m plot were collected and photographs were taken. With ground-based field data, a final list of ELC units was developed. Based on this process, the following ELC units were identified for the Kiggavik Project:

- Wet Graminoid;
- Graminoid Tundra;

- Graminoid/Shrub Tundra;
- Shrub Tundra;
- Shrub/Heath Tundra;
- Heath Tundra;
- Heath Upland;
- Heath Upland/Rock Complex;
- Lichen Tundra; and
- Other non-vegetated units including rock association, sand and gravel, water, disturbed land, and cloud/shadow.

For complete descriptions of each ELC unit, refer to the VSBR. A breakdown of ELC units found in the RSA and LSAs is provided in Table 4.5-1.

The accuracy of the final classification was assessed by comparing the ELC mapping to the 191 plots from the Kiggavik field survey program (2008 and 2009). The method for this assessment extracts all the values within 50 m of the survey plot and then compares them with the unit of the plot. This type of assessment overcomes the spatial inaccuracies of the GPS-derived locations for the survey plots and the spatial resolution of the Landsat imagery, and accounts for the scale differences. The overall accuracy of the classification was 82%. The units that have lower accuracies (<75%) are typically the transitional units. For example, the accuracy of the Shrub/Heath Tundra class is relatively low (73%) because this unit is the transition between Shrub Tundra and Heath Tundra.

Table 4.4-1 Percentages of Ecological Land Classification Units in Regional Study Area and Local Study Areas

ELC Units	Mine LSA		RSA		All-Season Road LSA		Winter Road LSA	
	hectare	%	hectare	%	hectare	%	hectare	%
Water	6,079	13.5%	251,161	25.6%	7,655	14.7%	20,827	37.1%
Disturbance	0	0%	556	0.1%	76	0.1%	0	0.0%
Cloud/Shadow	0	0%	2,029	0.2%	86	0.2%	203	0.4%
Sand	6	0%	1,852	0.2%	32	0.1%	248	0.4%
Gravel	83	0.2%	6,979	0.7%	146	0.3%	508	0.9%
Rock Association	40	0.1%	10,130	1.0%	479	0.9%	172	0.3%
Wet Graminoid	3,126	6.9%	71,126	7.2%	3,118	6.0%	5,490	9.8%
Graminoid Tundra	5,933	13.2%	123,189	12.5%	9,144	17.6%	8,269	14.7%
Graminoid/Shrub Tundra	4,626	10.3%	79,603	8.1%	3,087	5.9%	5,051	9.0%
Shrub Tundra	2,698	6.0%	41,639	4.2%	1,694	3.3%	1,776	3.2%
Shrub/Heath Tundra	3,716	8.3%	59,255	6.0%	3,066	5.9%	2,683	4.8%
Heath Tundra	16,216	36.0%	241,679	24.6%	18,146	34.9%	8,134	14.5%
Heath Upland	1,238	2.8%	31,304	3.2%	1,287	2.5%	952	1.7%
Heath Upland/Rock Complex	670	1.5%	46,536	4.7%	3,159	6.1%	1,097	2.0%
Lichen Tundra	578	1.3%	15,820	1.6%	857	1.6%	681	1.2%
Total	**45,009**	**100%**	**982,859**	**100%**	**52,031**	**100%**	**56,090**	**100%**

Secondly, ELC units were ranked according to their seasonal suitability for each VEC (i.e., High, Moderate, Low, and Nil) (see Table 4.5-2 for definitions). This approach, adapted from British Columbia standards (RIC 1999), is also used by the GN Department of Environment (DoE) to assess habitat value or suitability for a species over a large regional area without ground-truthing the entire area. The approach is scientifically defensible, efficient, and compatible with regional programs. Habitat suitability rankings for each VEC were developed based largely on relevant literature on VEC habitat use and requirements, field data, professional experience and judgment, and discussions with wildlife biologists with experience in the Arctic. For upland birds, bird use and preference by ELC unit was coarsely evaluated using PRISM plot data to inform habitat suitability ratings.

Table 4.4-2 Wildlife Habitat Suitability Rating Scheme

Forage Habitat Quality Relative to "Best in Territory" (%)[(a)]	4-class – Intermediate Knowledge of Habitat Use	
	Rating	Code
100–76%	Moderately High to High	H
26–75%	Moderate	M
1–25%	Low	L
0%	Nil	Nil

Source: RIC 1999

(a) 'Best in Territory' is the territorial benchmark habitat for a species against which all other habitats for that species are rated.

The habitat suitability rankings for the Kiggavik Project, for each ELC unit and for each VEC species or group, are presented in Tables 4.5-3A and 4.5-3B. Rankings are provided for the growing season for all VECs (defined as June 1 to September 30), and for the winter season (defined as October 1 to May 31) for any VECs that are present in the region year-round. As recommended in NIRB guidelines (NIRB 2010), to simplify analysis and discussion, indicator species are used in the assessment of habitat suitability for any VEC group.

Table 4.4-3A Habitat Suitability Rating for Key Valued Ecosystem Components and Indicator Species – Mammals, by Season, for the Local and Regional Study Areas

ELC Unit	Caribou		Muskox		Wolf Denning	% Area of Mine LSA	% Area of RSA
	Growing	Winter	Growing	Winter			
Water	Nil	L	Nil	L	Nil	13.5%	25.6%
Sand	M	L	L	L	H	0.0%	0.2%
Gravel	M	L	L	L	H	0.2%	0.7%
Rock Association	L	L	L	L	M	0.1%	1.0%
Wet Graminoid	H	M	M	M	Nil	6.9%	7.2%
Graminoid Tundra	H	M	M	M	Nil	13.2%	12.5%
Graminoid/ Shrub Tundra	H	M	M	M	Nil	10.3%	8.1%
Shrub Tundra	M	L	M	H	L	6.0%	4.2%
Shrub/Heath Tundra	H	M	M	H	L	8.3%	6.0%
Heath Tundra	M	H	M	M	L	36.0%	24.6%
Heath Upland	M	H	M	M	L	2.8%	3.2%
Heath Upland/Rock Complex	L	M	L	L	M	1.5%	4.7%
Lichen Tundra	M	H	L	L	L	1.3%	1.6%

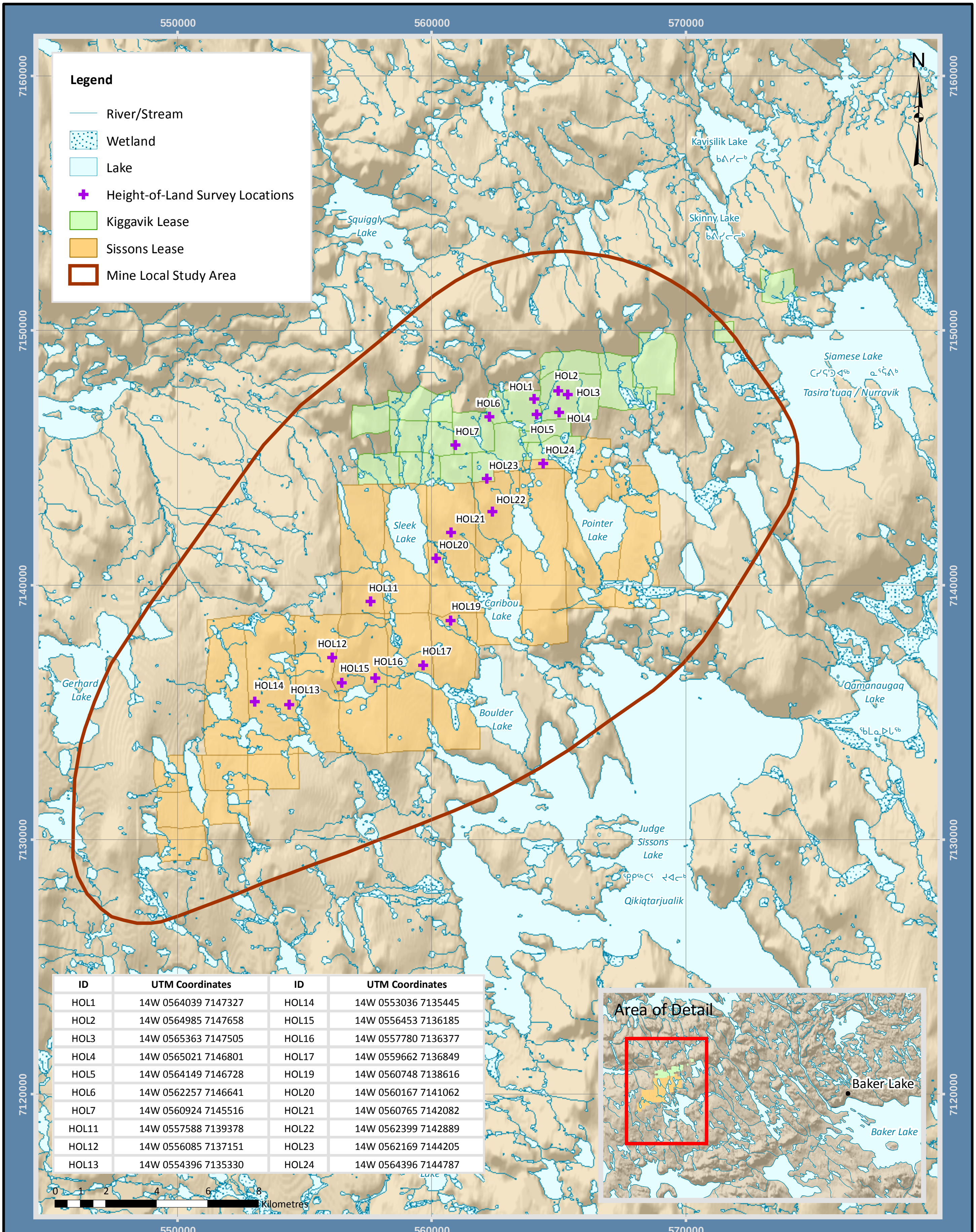
Growing season is approximately June 1 to September 30 (four months).
Winter season is defined as approximately October 1 to May 31 (eight months).
[a] Shrub Tundra used as surrogate for 2km raptor nest buffer ('H')
H = High; M = Moderate; L = Low

Table 4.5-3B Habitat Suitability Rating for Key Valued Ecosystem Components and Indicator Species – Birds

ELC Unit	Raptors (Peregrine Falcon)	Waterbirds (Long-tailed Duck)	Upland Shorebirds	Wetland Shorebirds	Upland Breeding Birds (Lapland Longspur)	Sensitive Species (Short-eared Owl)	% Area of Mine LSA	% Area of RSA
	Growing	Growing	Growing	Growing	Growing	Growing		
Water	M	H	Nil	L	L	Nil	13.5%	25.6%
Sand	M	M	H	L	M	L	0.0%	0.2%
Gravel	M	M	H	L	M	L	0.2%	0.7%
Rock Association	M	L	L	L	M	M	0.1%	1.0%
Wet Graminoid	M	H	M	H	H	M	6.9%	7.2%
Graminoid Tundra	M	H	M	H	H	H	13.2%	12.5%
Graminoid/ Shrub Tundra	M	M	M	M	H	H	10.3%	8.1%
Shrub Tundra	H[(a)]	L	L	L	H	H	6.0%	4.2%
Shrub/Heath Tundra	M	L	L	L	H	H	8.3%	6.0%
Heath Tundra	H	L	M	L	H	H	36.0%	24.6%
Heath Upland	H	L	M	L	H	M	2.8%	3.2%
Heath Upland/Rock Complex	M	L	L	L	M	M	1.5%	4.7%
Lichen Tundra	M	L	H	L	M	M	1.3%	1.6%

4.4.4 Chemistry Data

Basic statistics (i.e., mean, standard deviation, minimum and maximum) were used to summarize baseline chemistry data from the available baseline database. Statistical calculations used a value equivalent to half of the detection limit value for results below detection limit, which was considered to be a conservative estimate. Using these summary statistics, comparisons could be made between different areas, such as stations within the LSA and RSA, and different years (i.e., more recent data from 2007 to 2009 compared to historical data, where available).



ID	UTM Coordinates	ID	UTM Coordinates
HOL1	14W 0564039 7147327	HOL14	14W 0553036 7135445
HOL2	14W 0564985 7147658	HOL15	14W 0556453 7136185
HOL3	14W 0565363 7147505	HOL16	14W 0557780 7136377
HOL4	14W 0565021 7146801	HOL17	14W 0559662 7136849
HOL5	14W 0564149 7146728	HOL19	14W 0560748 7138616
HOL6	14W 0562257 7146641	HOL20	14W 0560167 7141062
HOL7	14W 0560924 7145516	HOL21	14W 0560765 7142082
HOL11	14W 0557588 7139378	HOL22	14W 0562399 7142889
HOL12	14W 0556085 7137151	HOL23	14W 0562169 7144205
HOL13	14W 0554396 7135330	HOL24	14W 0564396 7144787

Projection: NAD 1983 UTM Zone 14N
Creator: CASLYS CONSULTING LTD.
Date: 05/06/2014 Scale: 1:200,000
File: 4.3-1_HeightOfLand_Survey.mxd
Data Sources: Natural Resources Canada, GeoBase®, National Topographic Database, AREVA Resources Canada Inc., and Gebauer & Associates.

FIGURE 4.3-1
HEIGHT-OF-LAND SURVEY STATIONS WITHIN THE MINE LOCAL STUDY AREA

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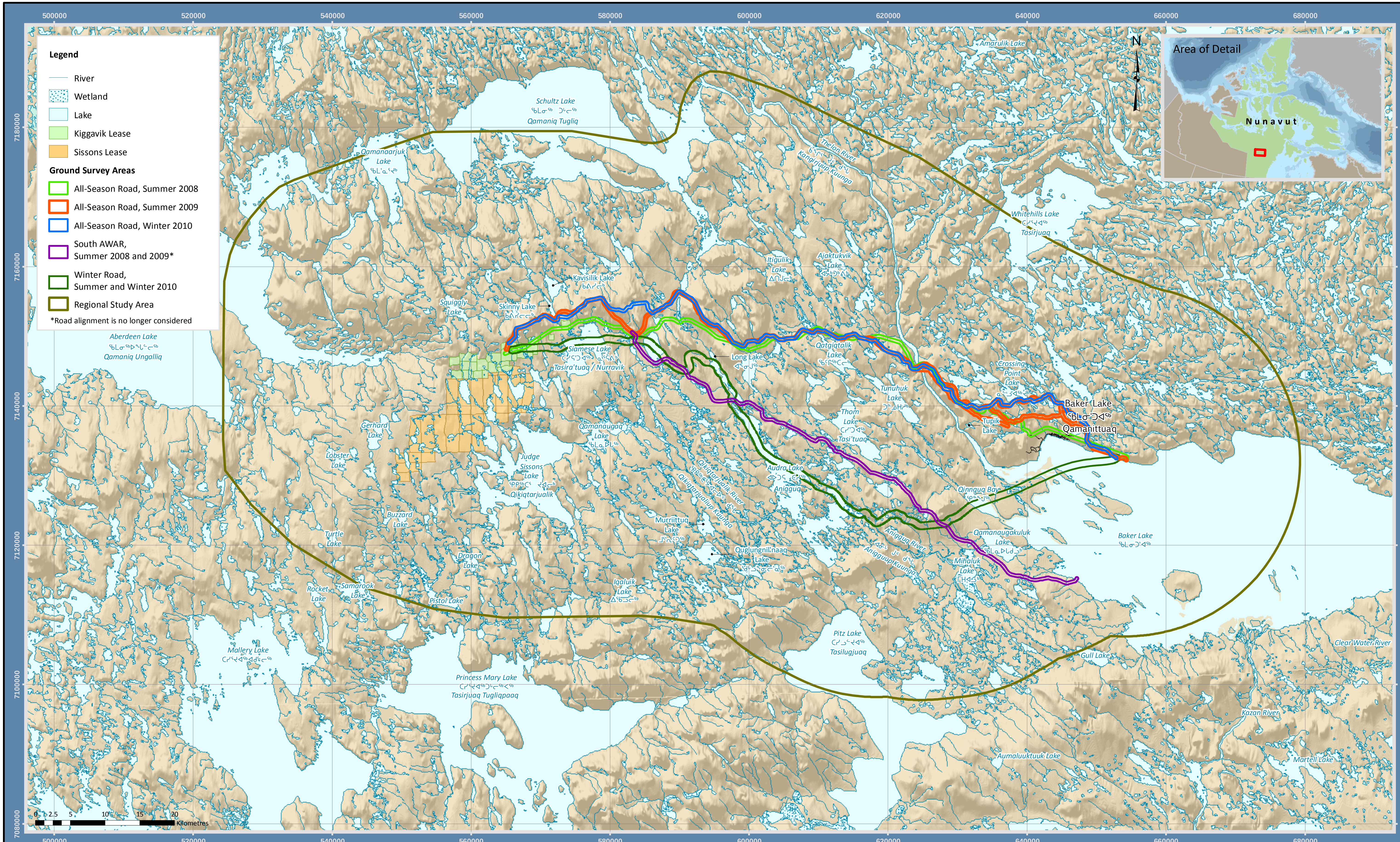

Projection: NAD 1983 UTM Zone 14N
Creator: CASLYS CONSULTING LTD.
Date: 04/28/2014 Scale: 1:500,000
File: 4.3-2_Ground_Survey_Areas_RSA.mxd
Data Sources: Natural Resources Canada, GeoBase®, National Topographic Database, AREVA Resources Canada Inc., and Gebauer & Associates.

FIGURE 4.3-2
GROUND-BASED SURVEY AREAS WITHIN THE REGIONAL STUDY AREA (RSA)

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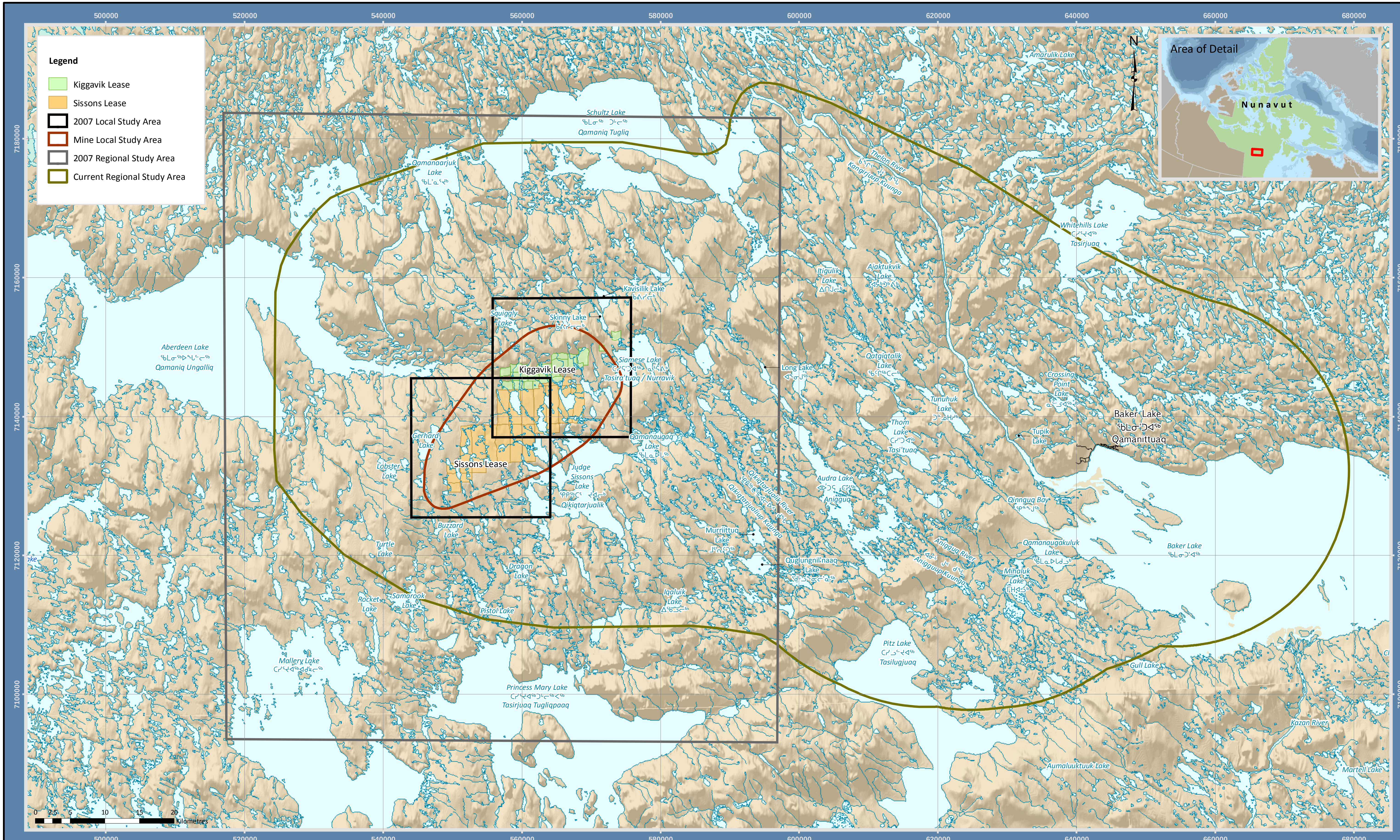

Projection: NAD 1983 UTM Zone 14N
Creator: CASLYS CONSULTING LTD.
Date: 04/28/2014 Scale: 1:500,000
File: 4.3-3_Kiggavik_Aerial_Survey_Blocks_2007.mxd
Data Sources: Natural Resources Canada, GeoBase®, National Topographic Database, AREVA Resources Canada Inc., and Gebauer & Associates.

FIGURE 4.3-3
LOCAL AND REGIONAL STUDY AREAS USED FOR AERIAL SURVEYS (2007)

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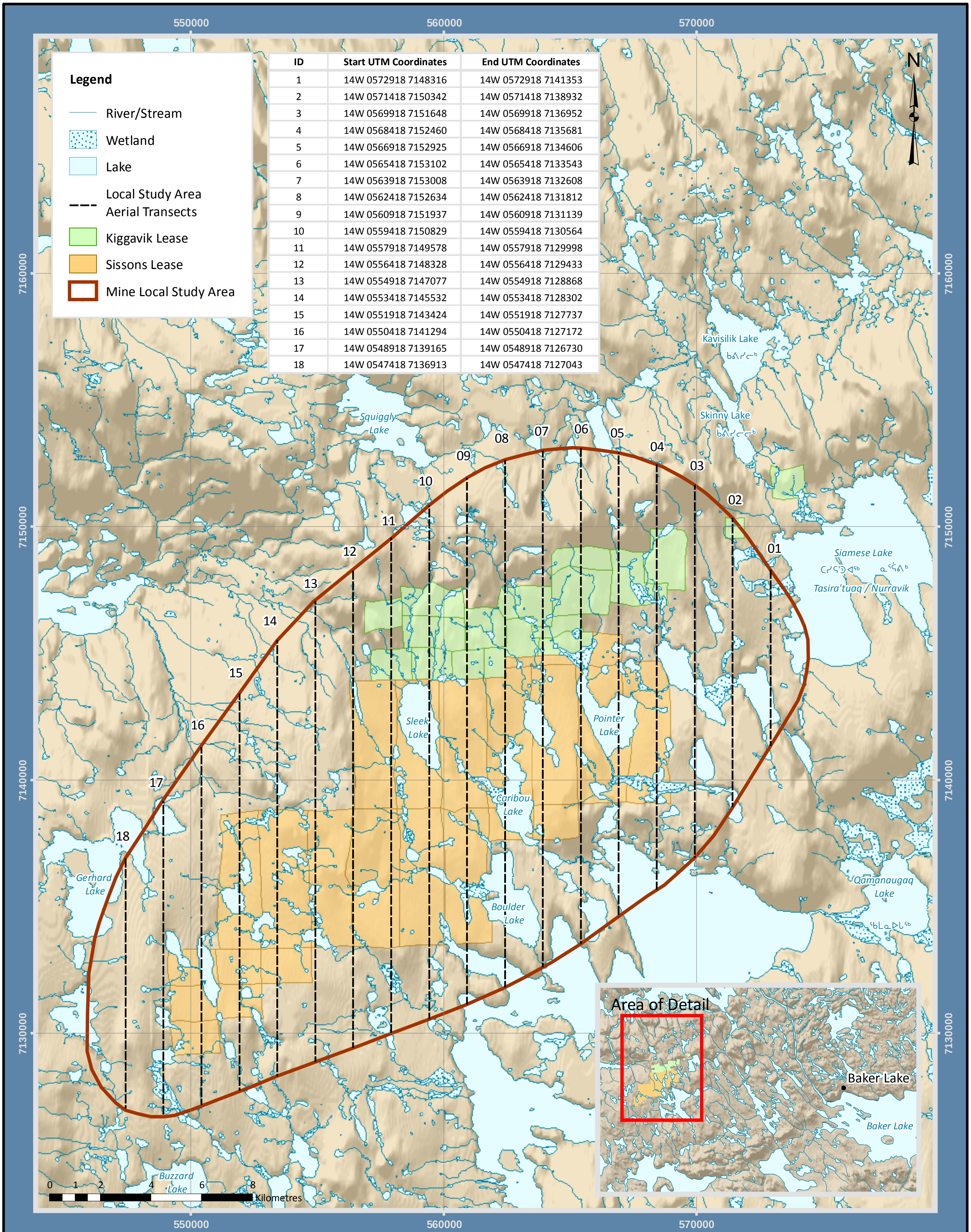

ID	Start UTM Coordinates	End UTM Coordinates
1	14W 0572918 7148316	14W 0572918 7141353
2	14W 0571418 7150342	14W 0571418 7138932
3	14W 0569918 7151648	14W 0569918 7136952
4	14W 0568418 7152460	14W 0568418 7135681
5	14W 0566918 7152925	14W 0566918 7134606
6	14W 0565418 7153102	14W 0565418 7133543
7	14W 0563918 7153008	14W 0563918 7132608
8	14W 0562418 7152634	14W 0562418 7131812
9	14W 0560918 7151937	14W 0560918 7131139
10	14W 0559418 7150829	14W 0559418 7130564
11	14W 0557918 7149578	14W 0557918 7129998
12	14W 0556418 7148328	14W 0556418 7129433
13	14W 0554918 7147077	14W 0554918 7128868
14	14W 0553418 7145532	14W 0553418 7128302
15	14W 0551918 7143424	14W 0551918 7127737
16	14W 0550418 7141294	14W 0550418 7127172
17	14W 0548918 7139165	14W 0548918 7126730
18	14W 0547418 7136913	14W 0547418 7127043

Projection: NAD 1983 UTM Zone 14N
Creator: CASLYS CONSULTING LTD.
Date: 05/06/2014 Scale: 1:200,000
File: 4.3-4_Mine_LSA_Aerial_Survey_Transects.mxd
Data Sources: Natural Resources Canada, GeoBase®, National Topographic Database, AREVA Resources Canada Inc., and Gebauer & Associates.

FIGURE 4.3-4
AERIAL SURVEY TRANSECTS WITHIN THE MINE LOCAL STUDY AREA (2008)

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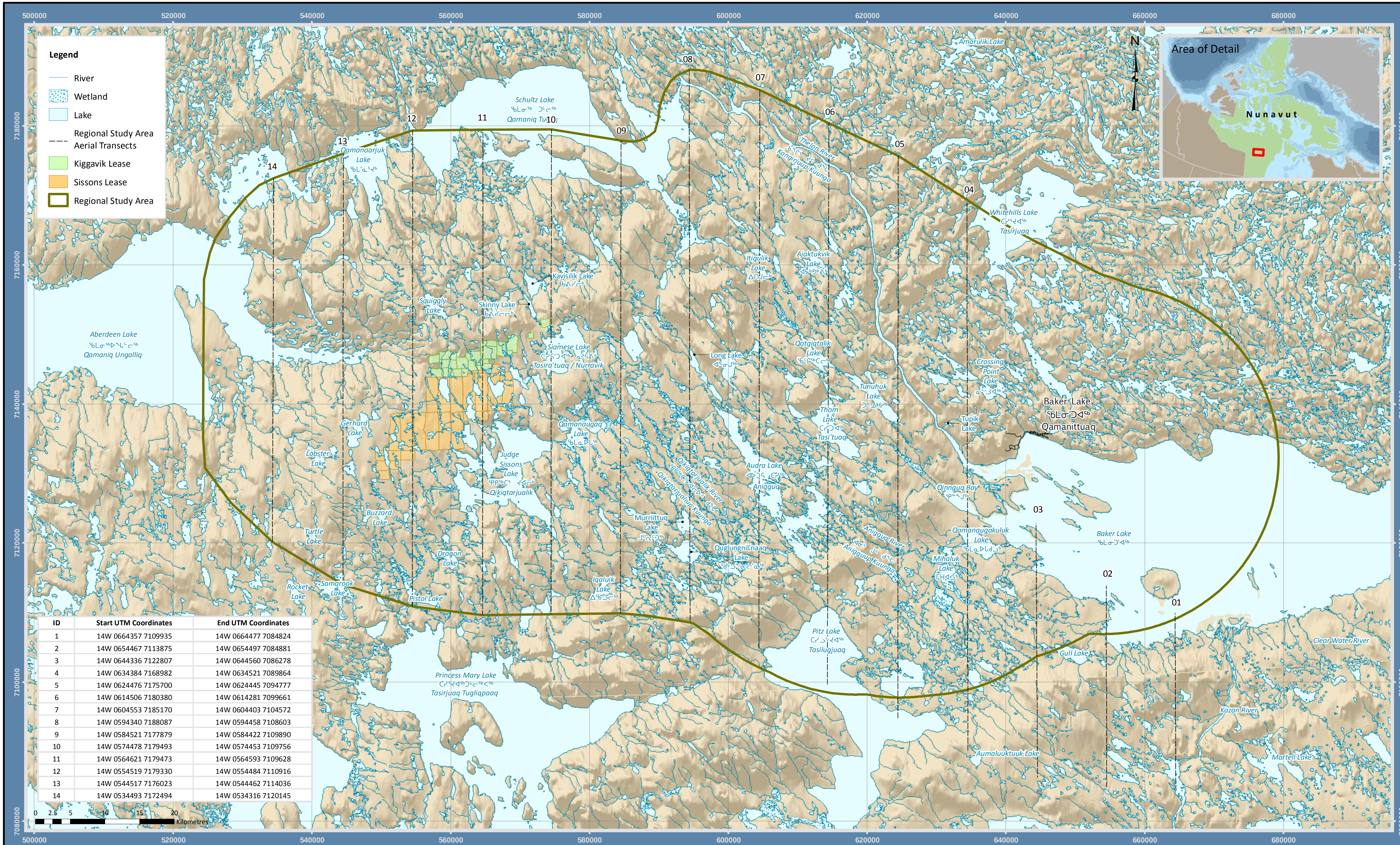

ID	Start UTM Coordinates	End UTM Coordinates
1	14W 0664357 7109935	14W 0664477 7084824
2	14W 0654467 7113875	14W 0654497 7084881
3	14W 0644336 7122807	14W 0644560 7086278
4	14W 0634384 7168982	14W 0634521 7089864
5	14W 0624476 7175700	14W 0624445 7094777
6	14W 0614506 7180380	14W 0614281 7099661
7	14W 0604553 7185170	14W 0604403 7104572
8	14W 0594340 7188087	14W 0594458 7108603
9	14W 0584521 7177879	14W 0584422 7109890
10	14W 0574478 7179493	14W 0574453 7109756
11	14W 0564621 7179473	14W 0564593 7109628
12	14W 0554519 7179330	14W 0554484 7110916
13	14W 0544517 7176023	14W 0544462 7114036
14	14W 0534493 7172494	14W 0534316 7120145

Projection: NAD 1983 UTM Zone 14N
Creator: CASLYS CONSULTING LTD.
Date: 04/28/2014 Scale: 1:500,000
File: 4.3-5_RSA_Aerial_Survey_Transects.mxd
Data Sources: Natural Resources Canada, GeoBase®, National Topographic Database, AREVA Resources Canada Inc., and Gebauer & Associates.

FIGURE 4.3-5

AERIAL SURVEY TRANSECTS WITHIN THE REGIONAL STUDY AREA (2008)

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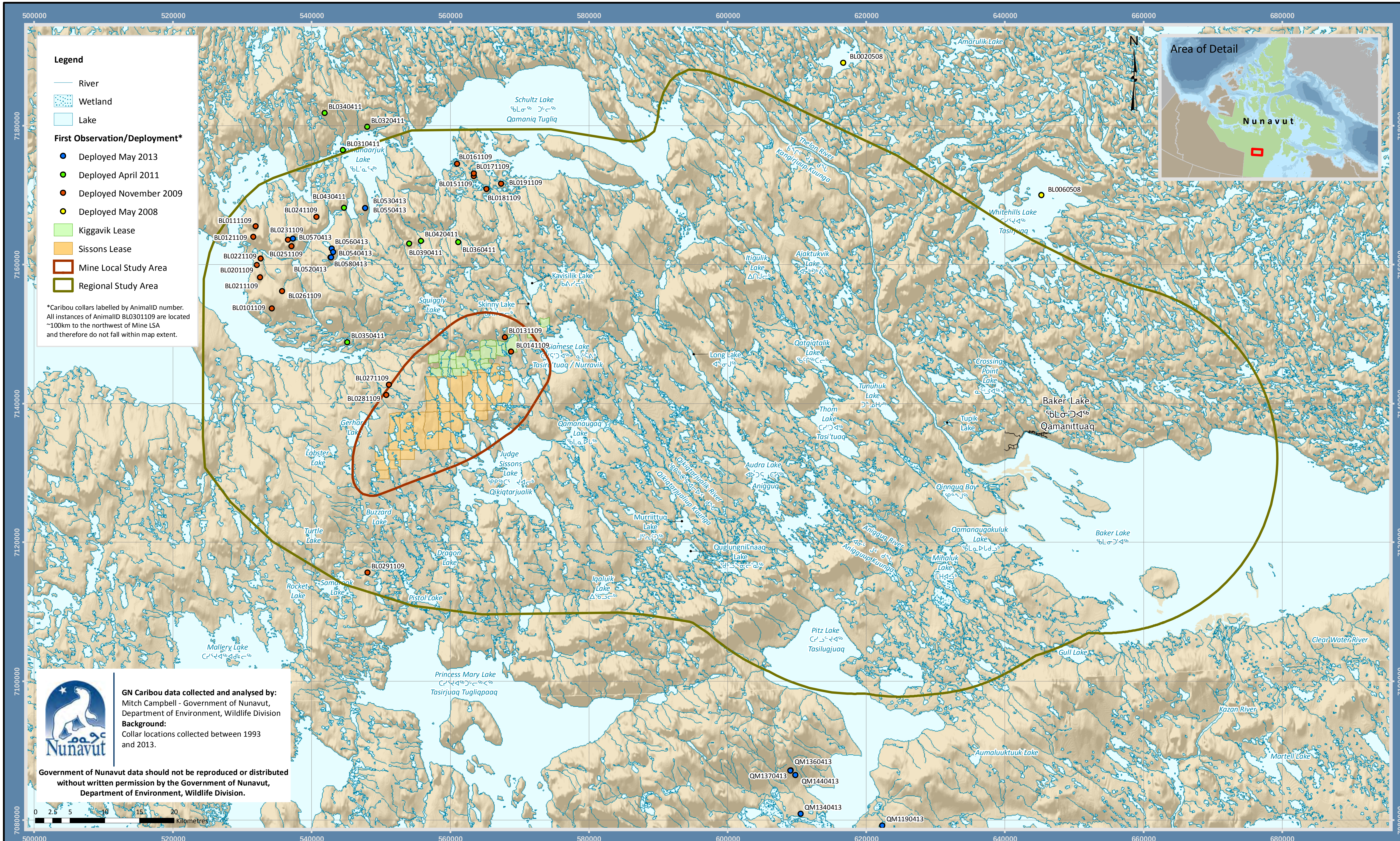

Projection: NAD 1983 UTM Zone 14N
Creator: CASLYS CONSULTING LTD.
Date: 05/01/2014 Scale: 1:500,000
File: 4.3-6_Caribou_Satellite_Collars_Deployed_BakerLk.mxd
Data Sources: Natural Resources Canada, GeoBase®, National Topographic Database, AREVA Resources Canada Inc., Gov't of Nunavut, and Gebauer & Associates.

FIGURE 4.3-6
CARIBOU SATELLITE COLLARS DEPLOYED IN THE BAKER LAKE AREA

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