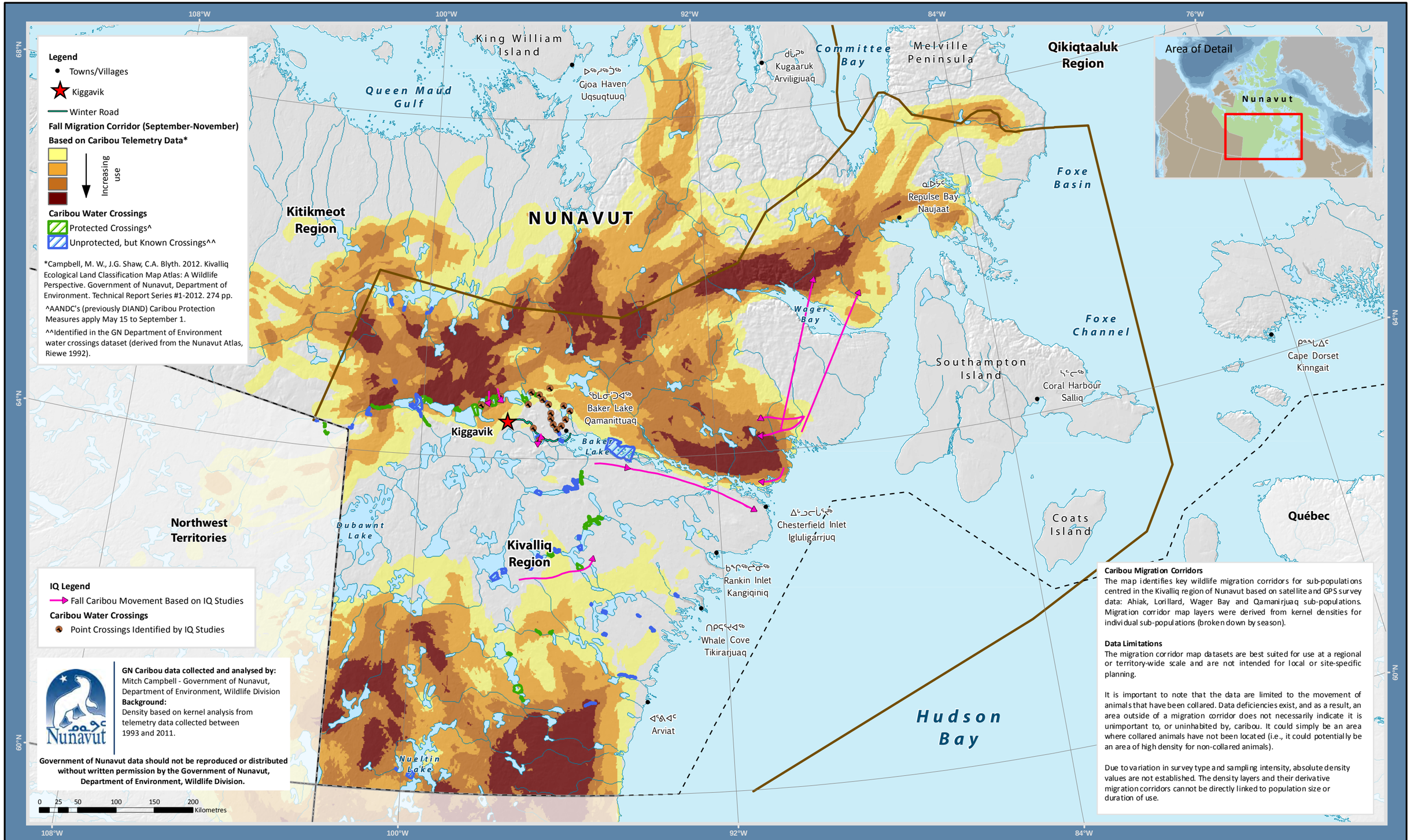
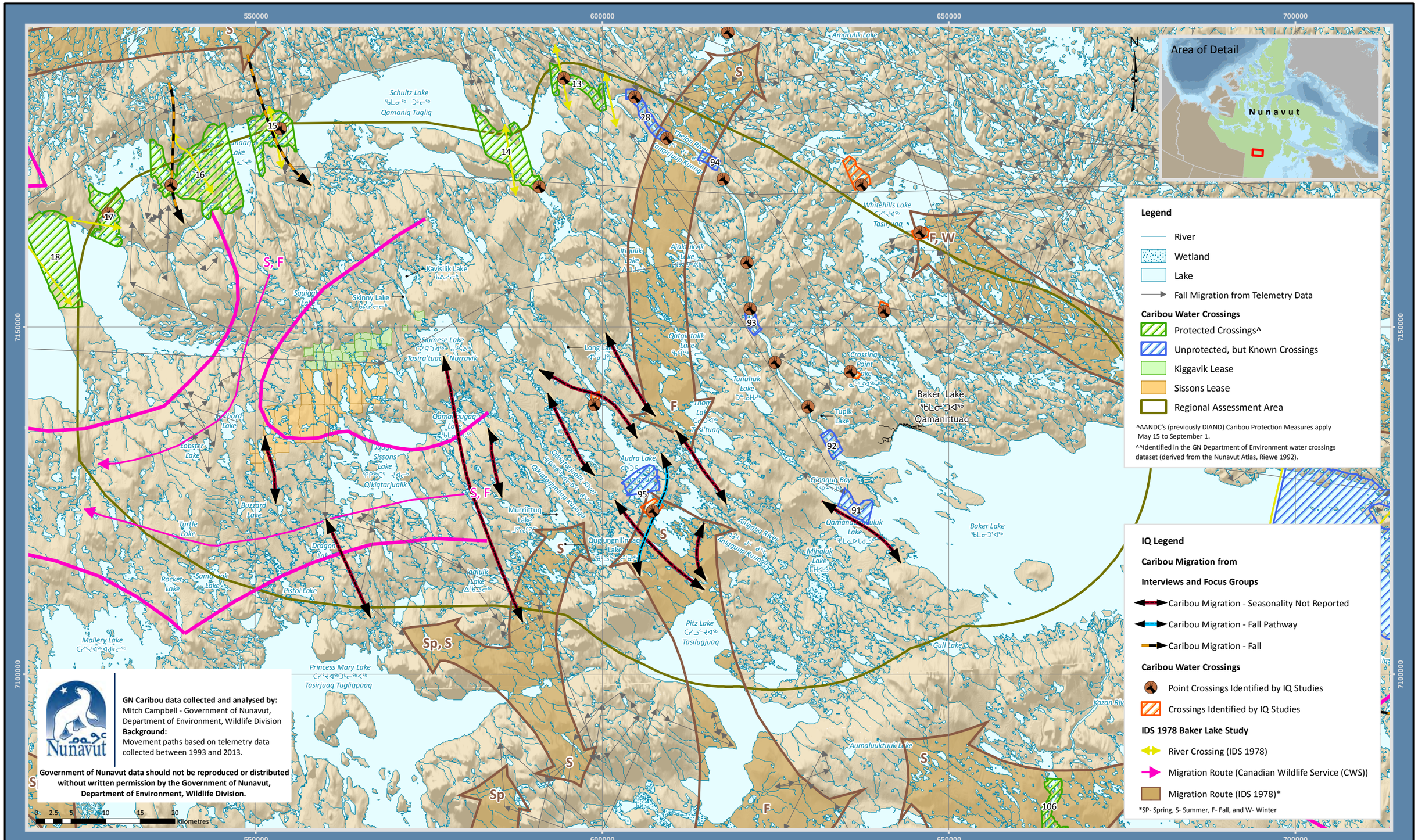


Projection: Canada Lambert Conformal Conic
Creator: CASLYS CONSULTING LTD.
Date: 05/01/2014 Scale: 1:4,500,000
File: 5.7-12C_Caribou_IQ_Fall_Migration_Corridors.mxd
Data Sources: Natural Resources Canada, GeoBase®, National Topographic Database, AREVA Resources Canada Inc., Government of Nunavut, Gebauer & Associates, Golder Associates Ltd.

FIGURE 5.7-12C
FALL MIGRATION CORRIDORS (BASED ON GOVERNMENT OF NUNAVUT TELEMETRY DATA) WITH FALL CARIBOU MIGRATION FROM IQ STUDIES

KIGGAVIK PROJECT - EIS

Gebauer & Associates Environmental Consultants
CASLYS CONSULTING
AREVA
AREVA Resources Canada Inc - P.O. Box 9204 - 817 - 45th Street West - Saskatoon, SK - S7K 3X5



Projection: NAD 1983 UTM Zone 14N
Creator: CASLYS CONSULTING LTD.
Date: 05/01/2014 Scale: 1:500,000
File: 5.7-12D_Caribou_IQ_Fall_Migration_RSA.mxd
Data Sources: Natural Resources Canada, GeoBase®, National Topographic Database, AREVA Resources Canada Inc., INAC, Baker Lake Hunter Focus Group, Arviat Elders Focus Group, CWS, Gov't of Nunavut, Gov't of GNWT, Gebauer & Associates, Golder Associates Ltd.

FIGURE 5.7-12D
FALL CARIBOU MOVEMENT NEAR THE RSA FROM CARIBOU COLLAR DATA AND MIGRATION PATTERNS FROM IQ STUDIES

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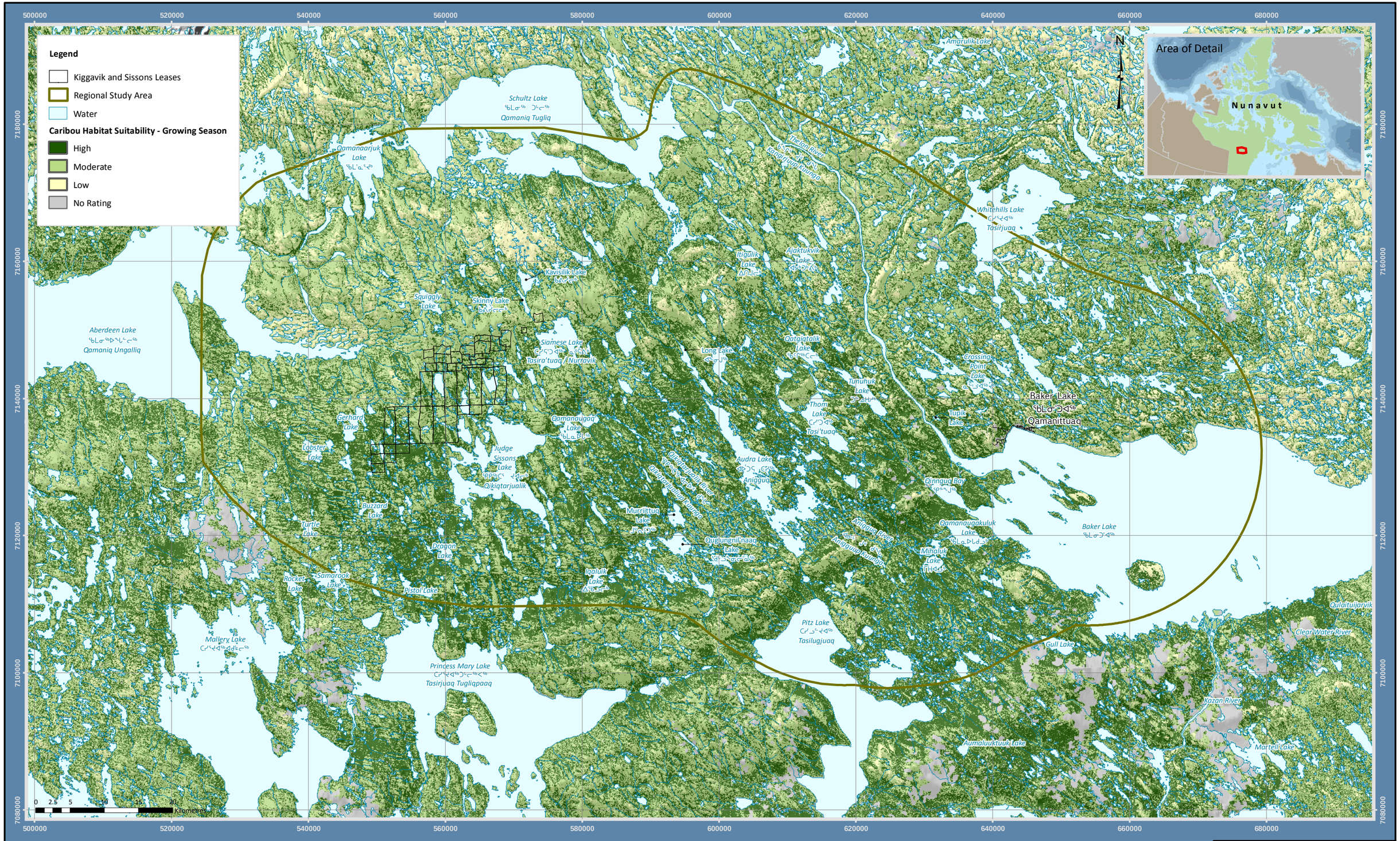

Projection: NAD 1983 UTM Zone 14N
Creator: CASLYS CONSULTING LTD.
Date: 04/22/2014 Scale: 1:500,000
File: 5.7-13_Caribou_Habitat_Suitability_Growing.mxd
Data Sources: Natural Resources Canada, GeoBase®, National Topographic Database, AREVA Resources Canada Inc., and Gebauer & Associates.

FIGURE 5.7-13
CARIBOU HABITAT SUITABILTY - GROWING SEASON

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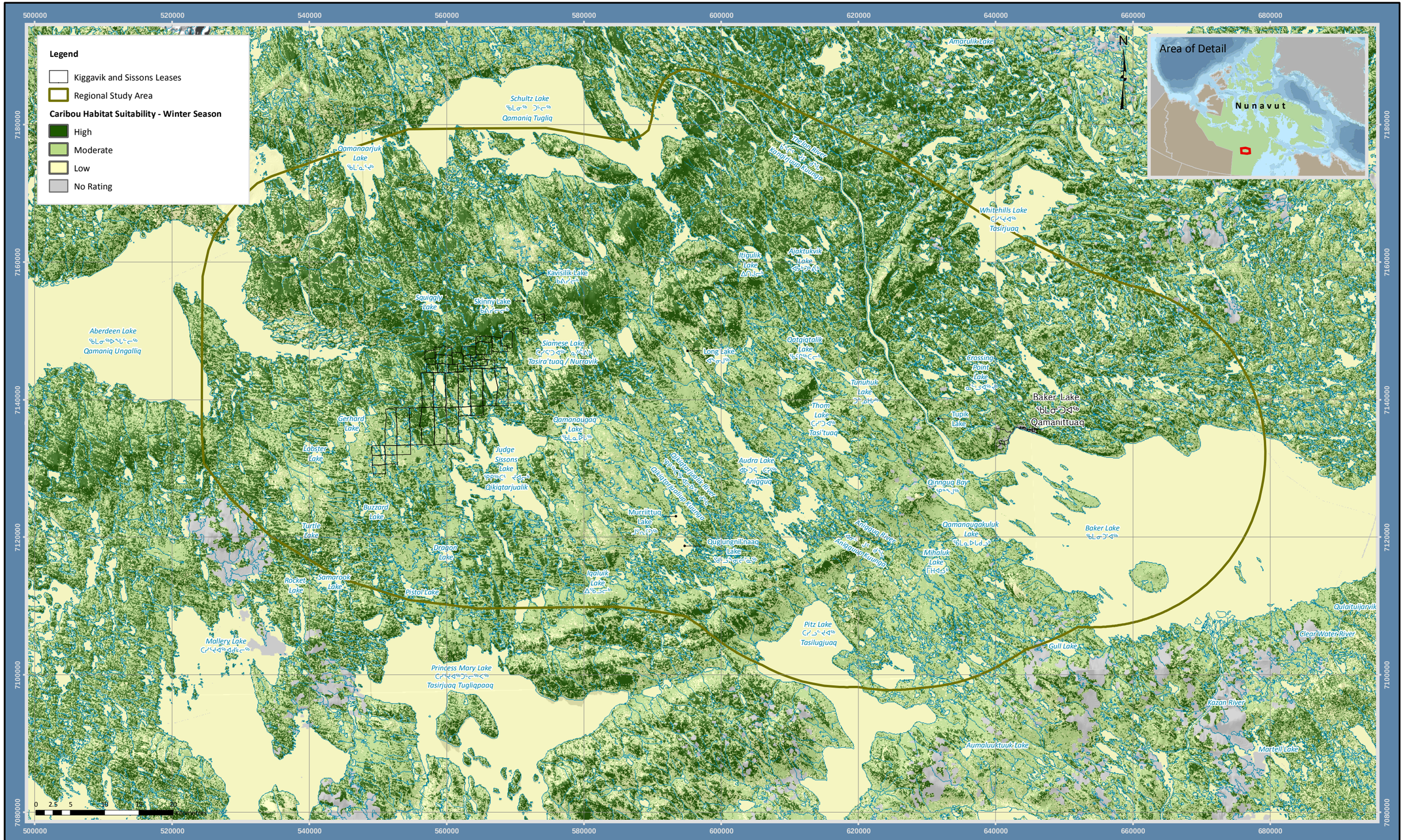

Projection: NAD 1983 UTM Zone 14N
Creator: CASLYS CONSULTING LTD.
Date: 04/22/2014 Scale: 1:500,000
File: 5.7-14_Caribou_Habitat_Suitability_Winter.mxd
Data Sources: Natural Resources Canada, GeoBase®, National Topographic Database, AREVA Resources Canada Inc., and Gebauer & Associates.

FIGURE 5.7-14
CARIBOU HABITAT SUITABILTY - WINTER SEASON

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5.7.2 Muskox

5.7.2.1 Status and Traditional Use

Muskox is listed as 'Secure' in Nunavut (CESCC 2011, internet site) and is not listed federally under the *SARA* or by COSEWIC (COSEWIC 2014, internet site; *SARA* 2014, internet site). In the mid-1900s, with concerns about declining populations, the territorial government banned all muskox harvest. Only in recent years has hunting again been permitted on a license basis. To this day, Elders and hunters in Baker Lake talk about these restrictions and how the restrictions affected their current hunting patterns for muskox. One Elder said that *for many years, they were not aware that they could eat muskox and others said they didn't harvest them because they are protected* (IQ-BL10 2008; IQ-BL02 2008).

Recently, muskoxen have begun to re-establish populations in many parts of Nunavut (Campbell and Setterington 2001). Hunters in the Kivalliq Region have reported increased observations in muskox closer to their communities (Ford et al. 2012). Baker Lake residents suggest that muskox populations have increased since the 1960s, and that the animals may have moved into the area from the Thelon Wildlife Sanctuary. Other IQ studies have reported an increased number of muskox near the Baker Lake area (AEM 2005b). Since the mid-2000s, muskoxen have been observed to move eastward from Pitz Lake, along the south side of Baker Lake, and are now found in the Barbour Bay area of Chesterfield Inlet. Muskoxen do not migrate, and travel slowly, only when the food source in an area is used up (IQ-CI03 2009; IQ-CI06 2009).

Muskoxen are harvested in the region, but less frequently. From IQ, it was noted that Inuit generally do not harvest muskox because the skin is not as good as caribou skin, the hair is of no use and they do not eat it (IQ-CI03 2009). Elders did not identify muskox as an important food source (IQ-BL10 2008; IQ-BL02 2008). The 2009 to 2010 diet survey concurs with this, with only 10% of households reported eating muskox meat, and it had a very low preference in local diets. The diet survey did indicate higher harvest totals for muskox compared to other data sources with an estimated 35 muskoxen reported harvested in 2009 to 2010. Comparatively, total annual muskox harvest ranged from 1 to 10 animals between 1997 and 2001 (see Table 5.1-7B; NWMB 2005). More recent (2007 to 2013) harvest data for muskox from the Baker Lake HHS have been low (two to four animals per year). Low reported harvest rates are to be expected given IQ and engagement data on the effect of muskox protection (IQ-BL10 2008; IQ-BL02 2008).

Muskox hunting areas are noted to the southwest of the RSA (west of Mallery Lake) from IQ and engagement data (Figure 5.7-15). *Muskox used to be hunted west of Baker Lake, but are now hunted just inland from Chesterfield Inlet, and mostly by sport hunters* (IQ-CI01 2009). Lands situated west and north of Gibson Lake have been noted as an important muskox hunting area for residents of Baker Lake in previous studies (Riewe 1992).

5.7.2.2 Population Data

Surveys in the central Kivalliq region undertaken by the GN DoE in 1999 and 2000 estimated a density of 0.043 muskox/km² (Campbell and Setterington 2001). This density was considered to be low relative to areas surveyed to the southwest in the Kitikmeot region (0.105 to 0.110 muskox per km²; Campbell and Setterington 2001). Following hunter reports of increased muskox observations, a follow-up muskox survey was completed in 2010 in the central Kivalliq Region, in the area south of the Thelon and including the RSA (Ford et al. 2012). Early analysis of these data found muskoxen extending over a much larger range than surveys conducted a decade prior. Population estimates were double the estimates from 1999 (n = 2,143 in 1999; n = 4,736 animals in 2010). Although the areas surveyed were different and density calculations were not compared, both the 1999 and the 2010 survey were designed to evaluate muskox population figures for the entire region. Study authors noted that densities in the 2010 data were lower and that the population was more spread out (Ford et al. 2012).

Muskoxen were regularly observed during most wildlife survey programs including aerial surveys, HOL and other ground-based surveys, and camp wildlife logs. A summary of muskoxen recorded during aerial surveys of the LSA and RSA from 2007 to 2009 is provided in Tables 5.7-6 (LSA) and 5.7-7 (RSA). Results from 2007 and 2008 are illustrated in Figure 5.1-1F for the LSA and Figure 5.1-1G for the RSA, and 2009 observations for the RSA are provided in Figure 5.1-2. Incidental ground observations of muskoxen throughout the RSA were recorded in 2007 (Figure 5.1-3). Muskoxen have also been observed on all of the surveyed road alignments (Figures 5.1-4 to 5.1-7), including along the All-Season Road during the winter season. Information on muskox occurrence from historical and baseline field programs is included in Table 5.7-8. Seasonal muskox observations from HOL surveys and winter surveys are provided in Tables 5.1-1 and 5.1-3. A summary of all muskox observations and IQ and engagement data on muskox areas is provided in Figure 5.7-15.

In 2007, muskoxen were seen on every aerial survey of the LSA, which were flown in August and September. In 2008, surveys of the LSA were flown in May, July, and early September, but muskoxen were only seen on one day (July 28, 2008) and both muskox groups observed at that time were in the Sissons Lease portion of the Mine LSA (see Figure 5.1-1F). Muskoxen have been observed by hunters in the area, a*round Judge Sisson Lake I saw about 30 muskox* (EN-BL CLC Nov 2008). By contrast, muskoxen were almost always observed during aerial surveys of the RSA, which spanned from May to November from 2007 to 2009. Although muskoxen were found throughout the RSA, a high number of sightings were in the southeastern portion of the study area just west of the Kazan River. Higher numbers in southeastern portions of the area concur with IQ related to *muskox numbers increasing and spreading eastward and along the south shore of Baker Laker* (IQ-CI03 2009; IQ-CI06 2009; AEM 2005b).

The largest cow-calf group reported numbered 80 individuals. Group composition was not determined to minimize disturbance to animals, but it is likely that at least a third of this group (and

others) were calves based on observed size. Most bulls observed were single or in small groups, as would be expected (Gunn and Sutherland 1997b).

Table 5.7-6 Muskox Recorded During Aerial Surveys of the Local Study Area (2007 and 2008)

Muskox	2007 Mine LSA					2008 Mine LSA		
	10 Aug	19 Aug	28 Aug	5 Sep	21 Sep	25 May	28 Jul	7 Sep
Cumulative Number	19	1	29	4	0	0	3	0
# of Groups	4	1	2	3	0	0	2	0
Largest Group	14	1	28	3	0	0	2	0
# of Bulls	ND	ND	ND	ND	ND	ND	1	ND
# of Cows	ND	ND	ND	ND	ND	ND	1	ND
# of Calves	ND	ND	ND	ND	ND	ND	1	ND
Comments	1 nursing group	ND	1 nursing group	ND	ND	ND	cow/calf group	ND
Data are also presented in Figure 5.1-1F and summarized in Figure 5.7-15. ND = No data								

Table 5.7-7 Muskox Recorded During Aerial Surveys of the Regional Study Area (2007 to 2009)

Muskox	2007 RSA	2008 RSA					2009 RSA[(a)]
	26 Aug	23 May	22 Jul	9/10 Sep	2/3 Oct	30 Oct	13/14 Nov
Cumulative Number	130	127	52	130	40	ND	71
# of Groups	16	7	11	10	5	ND	5
Largest Group	44	80	13	50	21	ND	28
# of Bulls	ND	ND	3+	4+	3+	ND	3+
# of Cows	ND	ND	ND	ND	ND	ND	ND
# of Calves	ND	10+	2+	11+	2+	ND	12+
Comments	31% nursing	group of 80 with at least 10 calves	lone bulls and cow/ calf groups	groups of 27 and 56 are cow/calf groups	larger groups are likely cow/calf	ND	2 mid-sized cow/calf groups
Data are also presented in Figure 5.1-1G and 5.1-2, and summarized in Figure 5.7-15.							

(a) 2009 aerial survey conducted as part of caribou collaring work

ND = No data

Table 5.7-8 Summary of Current and Historical Data on Muskox Sightings in the Kiggavik Regional Study Area

Year	Observation Method	Total Number Observed	Number of Sightings	Number of Animals Per Sighting	% of Sightings with Calves	% of Calves (where observed)	Density Estimate
2010	Winter Road	1	1	1	0	0	ND
	South AWAR Nest Survey	4	1	4	0	0	ND
	Baker Lake Docks	2	2	1	0	0	ND
	All-Season Road Winter Survey	13	1	13	100%	23% (yearlings)	ND
	HOL (Mine LSA)	28	3	5 to 16	66	28% (yearlings)	ND
	Camp Log/Monitor	662	70	1 to 76	ND	ND	ND
2009	RSA Aerial	71	5	1 to 28	60%	24%	ND
	South AWAR Ground	7	4	1 to 4	ND	ND	ND
	HOL (Mine LSA)	160	35	1 to 28	ND	ND	ND
	Sissons Transects (RSA)	1	1	1	0	0	0
	Sissons Transects (LSA)	2	2	1	0	0	0
	Camp Log/Monitor	147	22	1 to 30	~13%	~45%	ND
2008	RSA Aerial	349	33	1 to 80	~50%	>5%	ND
	Mine LSA Aerial	3	2	1 to 2	50%	33%	ND
	South AWAR Aerial	54	6	1 to 30	ND	ND	ND
	South AWAR Ground	15	3	2 to 11	ND	ND	ND
	HOL (Mine LSA)	142	15	1 to 18	ND	ND	ND
2007	RSA Aerial	130	16	1 to 44	31%	ND	ND
	Mine LSA Aerial	54	10	1 to 28	20%	ND	ND
	Incidental	241	23	1 to 50	31%	ND	ND

Table 5.7-8 Summary of Current and Historical Data on Muskox Sightings in the Kiggavik Regional Study Area

Year	Observation Method	Total Number Observed	Number of Sightings	Number of Animals Per Sighting	% of Sightings with Calves	% of Calves (where observed)	Density Estimate
	Camp Log/Monitors[(a)]	ND	19	1 to 20	58%	ND	ND
1992[(b)]	Unknown	ND	25	ND	ND	20%	ND
1986[(c)]	Unknown	ND	ND	ND	ND	ND	0.06/km^2
1979[(d)]	Ground Survey	1	1	1	0%	ND	ND

(a) AREVA 2008

(b) 'Operation Raleigh Arctic Expedition' (BEAK 1992)

(c) Case and Graf 1986

(d) Speller et al. 1979

ND = No data, or data too limited to calculate

Given the data summarized in Table 5.7-8, there is some evidence that muskox numbers have increased since the 1970s, which is also supported by IQ and engagement data. In all years and all baseline survey types, the largest group sighted was 80 animals. One record from camp wildlife monitors of a herd estimated to be 1,500 individuals in the Mine LSA, observed from the air (AREVA 2010c), was likely caribou. Overall ratio of calves to cows appears to be in the 30 to 50% range. The higher numbers recorded by camp monitors in 2010 may include some double-counting of herds. Regardless of this potential over-estimate, muskox observations around camp did appear to increase in 2010.

5.7.2.3 Habitat Suitability

During aerial surveys flown over the RSA and LSA in 2007, the majority (90%) of muskox groups were feeding or standing in heath tundra (44%) and tussock hummock (31%) habitats. Data on muskox habitat use was not collected during the 2008 and 2009 aerial surveys, largely because of concern about approaching and disturbing muskoxen.

The suitability of habitats for muskoxen within the RSA was determined by rating each of the ELC habitat units as High, Moderate, or Low during the growing and winter seasons (see Tables 4.5-2 and 4.5-3A). A summary of the ELC units, ratings and justification is provided Table 5.7-9. Ratings were based on a literature review of ecological requirements of muskoxen. Generally, muskoxen feed on grasses, sedges and willows in the winter (Gunn and Sutherland 1997b; Nellemann and Reynolds 1997; Schaeffer et al. 1996). ELC units with a large component of grasses, sedges and

willows include Wet Graminoid, Graminoid Tundra, Graminoid/Shrub Tundra, Shrub Tundra, and Shrub/Heath Tundra. Heath Tundra and Heath Upland are often exposed and windblown. Muskoxen are known to move to these types of areas in the winter where forage is more accessible (Nellemann and Reynolds 1997). The general impression of aerial observers was that muskoxen prefer open areas of heath tundra and tend to avoid rock-dominated habitats.

Muskoxen feed on willow in the summer (Gunn and Sutherland 1997b; Nellemann and Reynolds 1997). ELC units with a large willow component are Graminoid/Shrub Tundra, Shrub Tundra, and Shrub/Heath Tundra. Earlier in the summer, muskoxen are known to feed on sedges (Gunn 1984b) that are found within the Graminoid/Shrub Tundra, Shrub Tundra, and Shrub/Heath Tundra ELC units. In the Queen Maud Gulf area, located north of the RSA, muskoxen use wetlands (i.e., Wet Graminoid, Graminoid Tundra, and Graminoid/ Shrub Tundra ELC units) and tussock/hummock areas (i.e., Heath Tundra and Heath Upland) habitats in the summer (Gunn and Sutherland 1997b).

The total areas of High, Moderate and Low suitability muskox habitat within the RSA and LSAs during the growing and winter seasons are presented in Table 5.7-10. No High suitability habitat for muskox is found in any study area during the growing season. IQ supports this observation as the only muskox hunting area was identified to the west and outside of the RSA (Figure 5.7-15). In general, more Moderate-rated habitats are found in the Mine LSA (83.4%) than in the surrounding RSA (65.9%). High suitability winter season habitat is still limited but greatest in the Mine LSA. The Winter Road LSA has the least High and Moderate suitability habitat for the winter season. Distribution of High, Moderate, and Low suitability habitats for the growing and winter seasons is provided in Figures 5.7-16 and 5.7-17, respectively. Generally, Moderate-rated muskox habitats for both growing and winter seasons are found throughout the RSA.

Table 5.7-9 Summary of Current and Historical Data on Muskox Sightings in the Kiggavik Regional Study Area

ELC Unit	Growing	Winter	Reasoning
Water	Nil	L	Water is not important muskox habitat in either season.
Sand	L	L	Sand is not important muskox habitat in either season as there is little available food.
Gravel	L	L	Gravel is not important muskox habitat in either season as there is little available food.
Rock Association	L	L	Rock Association provides little usable habitat for muskoxen as there is little available food.
Wet Graminoid	M	M	Wet Graminoid habitat was categorized as moderate in the growing and winter season because of the availability of preferred foods including grasses, sedges and willows/shrubs.
Graminoid Tundra	M	M	Graminoid Tundra habitat was categorized as moderate in the growing and winter season because of the availability of preferred foods including grasses, sedges and willows/shrubs.
Graminoid/ Shrub Tundra	M	M	Graminoid/Shrub Tundra habitat was categorized as moderate in the growing and winter season because of the availability of preferred foods including grasses, sedges and willows/shrubs.
Shrub Tundra	M	H	Shrubs (willows) form a large part of muskox diet in the growing and winter seasons, but particularly in winter when deep snow limits access to grasses and sedges in low-lying areas.
Shrub/Heath Tundra	M	H	Shrubs (willows) form a large part of muskox diet in the growing and winter seasons, but particularly in winter when deep snow limits access to grasses and sedges in low-lying areas.
Heath Tundra	M	M	Heath Tundra habitat has shrubs used by muskoxen in the growing and winter seasons. Due to the shallower snow depths in these areas, shrubs are more accessible, although they occur at lower densities than in wetter habitats.
Heath Upland	M	M	Heath Upland habitat has shrubs used by muskoxen in the growing and winter seasons. Due to the shallower snow depths in these areas, shrubs are more accessible, although they occur at lower densities than in wetter habitats.
Heath Upland/ Rock Complex	L	L	Due to the high densities of rock, shrub availability is lower than in the heath upland habitat unit.
Lichen Tundra	L	L	Lichen is not an important food source for muskoxen in any season.
Growing season is approximately June 1 to September 30 (four months). Winter season is defined as approximately October 1 to May 31 (eight months). H = High; M = Moderate; L = Low			

Table 5.7-10 Comparative Percentages of Muskox Habitat Suitability in Local and Regional Study Areas for Growing and Winter Season

Habitat Suitability – Growing Season	Mine LSA		All-Season Road LSA		Winter Road LSA		RSA	
	ha	%	ha	%	ha	%	ha	%
High	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Moderate	37,553	83.4%	39,542	76.0%	32,355	57.7%	647,795	65.9%
Low	7,456	16.6%	12,327	23.7%	23,533	42.0%	332,480	33.8%
No Rating	0	0.0%	162	0.3%	203	0.4%	2,585	0.3%
Totals	**45,009**	**100.0%**	**52,031**	**100.0%**	**56,090**	**100.0%**	**982,859**	**100.0%**
Habitat Suitability – Winter Season	**Mine LSA**		**All-Season Road LSA**		**Winter Road LSA**		**RSA**	
	ha	**%**	**ha**	**%**	**ha**	**%**	**ha**	**%**
High	6,414	14.3%	4,761	9.1%	4,460	8.0%	100,894	10.3%
Moderate	31,139	69.2%	34,781	66.8%	27,895	49.7%	546,901	55.6%
Low	7,456	16.6%	12,327	23.7%	23,533	42.0%	332,480	33.8%
No Rating	0	0.0%	162	0.3%	203	0.4%	2,585	0.3%
Totals	**45,009**	**100.0%**	**52,031**	**100.0%**	**56,090**	**100.0%**	**982,859**	**100.0%**

Growing season is approximately June 1 to September 30 (four months).
Winter season is defined as approximately October 1 to May 31 (eight months).
ha = hectare