Caribou Study

Proposed Bay d'Espoir to Western Avalon Transmission Line (TL 267)

FINAL REPORT

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EXECUTIVE SUMMARY

The purpose of this study is to provide an overview of the occurrence, population status, distribution, seasonal movements and habitat associations of woodland caribou (*Rangifer tarandus caribou*) individuals or populations that are known or are likely to occur in vicinity of the proposed Bay d'Espoir to Western Avalon Transmission Line (TL 267 or the Project). This involved the identification, review, analysis and summary of existing and available information and datasets, including published and unpublished reports, journal articles, theses, government documents and datasets and other sources. Consultation with the Newfoundland and Labrador Department of Environment and Conservation (NLDEC) was also undertaken to obtain recent caribou monitoring data and associated habitat use mapping for caribou in south-central and eastern Newfoundland.

The proposed transmission line crosses through the southern portion of Middle Ridge Caribou Management Area (# 64), which is largely occupied by animals associated with the Middle Ridge Wildlife and Bay du Nord Wilderness Reserves. The largest single caribou aggregation on the Island is the Middle Ridge Caribou Herd, which peaked in abundance during the mid-1990s at approximately 20,000 individuals. All caribou populations in Newfoundland have experienced significant fluctuations over the past 40 years, a pattern that has been highly synchronous across the entire Island. Recent estimates suggest that abundance has now declined by 65 percent over the last two decades. In 2008, the Government of Newfoundland and Labrador announced a five-year Caribou Strategy that would include an ecosystem-based analysis of local caribou population dynamics. As part of these initiatives, the NLDEC recently delineated caribou occurrence in Newfoundland using caribou telemetry data and kernel analyses to determine relative utilization and distributions for each season.

The proposed Project would potentially interact with seasonal core use and occupancy areas for caribou throughout the year, although the nature and degree of such overlap varies considerably by location, time and type. The Project directly intersects with small portions of primary and secondary core areas for caribou during the over wintering, summer post calving and/or fall rutting periods. Although it does not directly intersect with any identified core areas for the spring calving period, it does occur within several kilometers of a number of identified primary areas.

The information provided through this study is intended to support the Project's Environmental Assessment registration and review, and will be used in its on-going planning and design and eventual permitting and implementation.

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1.0 INTRODUCTION

Newfoundland Labrador Hydro (Hydro) owns and operates an extensive electrical generation and transmission system on the Island of Newfoundland, which includes a 613 megawatt (MW) hydroelectric generation station at Bay d'Espoir in the south-central portion of the Island, as well as several transmission lines that extend between it and other electrical infrastructure and load centres across the Island. This includes two existing transmission lines that run from that facility to Sunnyside which were constructed in the late 1960s, as well as a transmission system between Sunnyside and Chapel Arm.

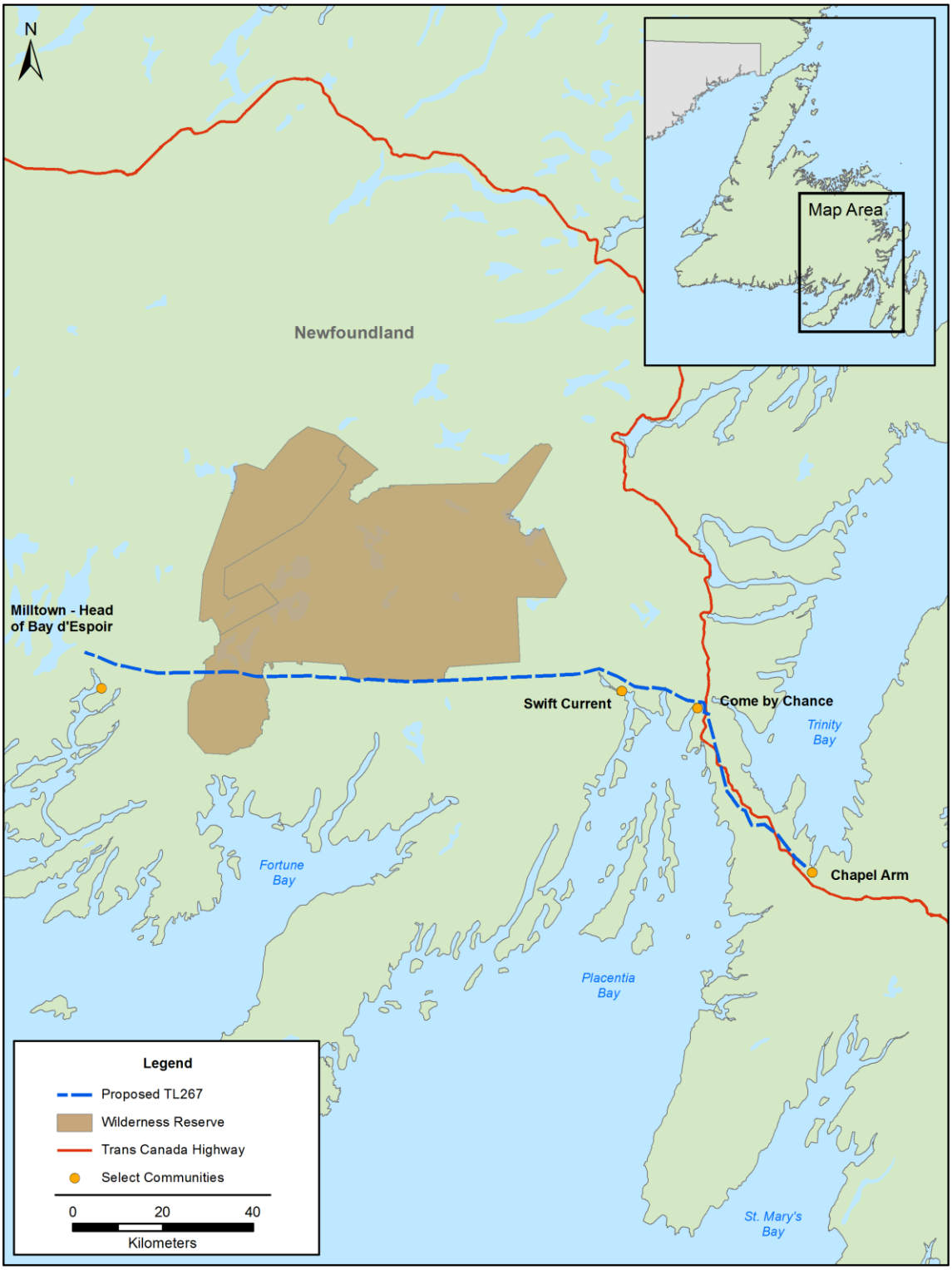
The proposed development project that is the subject of this study includes the construction and operation of a new 230 kilovolt (kV) transmission line that will be approximately 188 km long and connect the existing Bay d'Espoir and Western Avalon Terminal Stations (hereinafter also referred to as the "Project" or "TL 267"). The proposed TL 267 will parallel existing transmission line infrastructure (TL 202 and TL 206) from Bay d'Espoir to Come by Chance and further parallels TL 203 from Come by Chance to the Western Avalon substation in Chapel Arm (Figure 1). Along with the proposed development of TL 267, upgrades to existing infrastructure at the Bay d'Espoir and Western Avalon terminal stations will also be completed as part of this Project. The existing transmission lines (TL 202, 203 and 206) were cleared and constructed within the boundaries of the easement granted to Hydro by Government at the time of their development, as will the proposed TL 267.

Given that this new transmission line and associated infrastructure will entirely follow along existing transmission lines and other infrastructure in the region, the Project is expected to have few if any environmental issues associated with it. Hydro is, however, committed to ensuring that Project construction and operations are conducted in an environmentally acceptable manner, in full compliance with associated environmental regulations and permits, as well as the company's own environmental policies, plans and standards.

Hydro has therefore planned and completed an environmental study program in relation to the proposed Project, in order to obtain and compile information on key aspects of the existing biophysical and socioeconomic environments within and near the Project area. The information provided through this study program is intended to support the Project's Environmental Assessment (EA) registration and review, and will be used in on-going Project planning and design, as well as in the eventual permitting and construction / mitigation planning for the Project.

This *Caribou Study* comprises one component of that environmental study program. The objective of this study is to provide a description of the occurrence, population status, distribution, seasonal movements and habitat associations of woodland caribou (*Rangifer tarandus caribou*) that are known or are likely to occur in the vicinity of the proposed development, and which may therefore interact with the Project during its construction and/or operations phases.

Figure 1 - The Proposed Bay d'Espoir to Western Avalon Transmission Line (TL 267)



2.0 APPROACH AND METHODS

The following sections describe the general approach and methodology that were used in the planning and completion of this Study, including the established study areas, data sources, and the overall methods used to compile and present the resulting environmental information.

2.1 Study Area and Regional Context

As noted previously, the proposed Project will include construction and operation of a new electrical transmission system along existing transmission lines and roadways in south-central and eastern Newfoundland, for a total distance of approximately 188 km.

Given the location and geographic extent of the Project, and the landscape level at which caribou populations exist and function, a regional scale was used in assessing and describing the known presence, abundance, spatial and temporal distribution of caribou in relation to the Project.

In completing the analysis, the study has focused upon identifying, reviewing and presenting information at a number of geographic scales, including where relevant:

> *Project Area* or *Transmission Line Right of Way*: A specific routing has been selected for the transmission line, which will involve a cleared right of way approximately 40 m wide.
>
> *Study Area*: A larger (1 km wide) Study Area was established that forms the key focus of the study, which extends 500 m on either side of the centre line of the identified right of way for the proposed TL 267 as described above. This surrounding area is considered in order to provide relevant, regional context for the analysis, as well as address the potential for Project-related activities to occur outside the 40 m wide transmission line routing itself.
>
> *Regional Study Area*: The study and its associated analysis also considers the larger region of south-central and eastern Newfoundland that surrounds the Project and Study Areas described above, and generally encompasses the overall geographic extent and movements of any caribou (individuals or populations) that may interact with the Project.

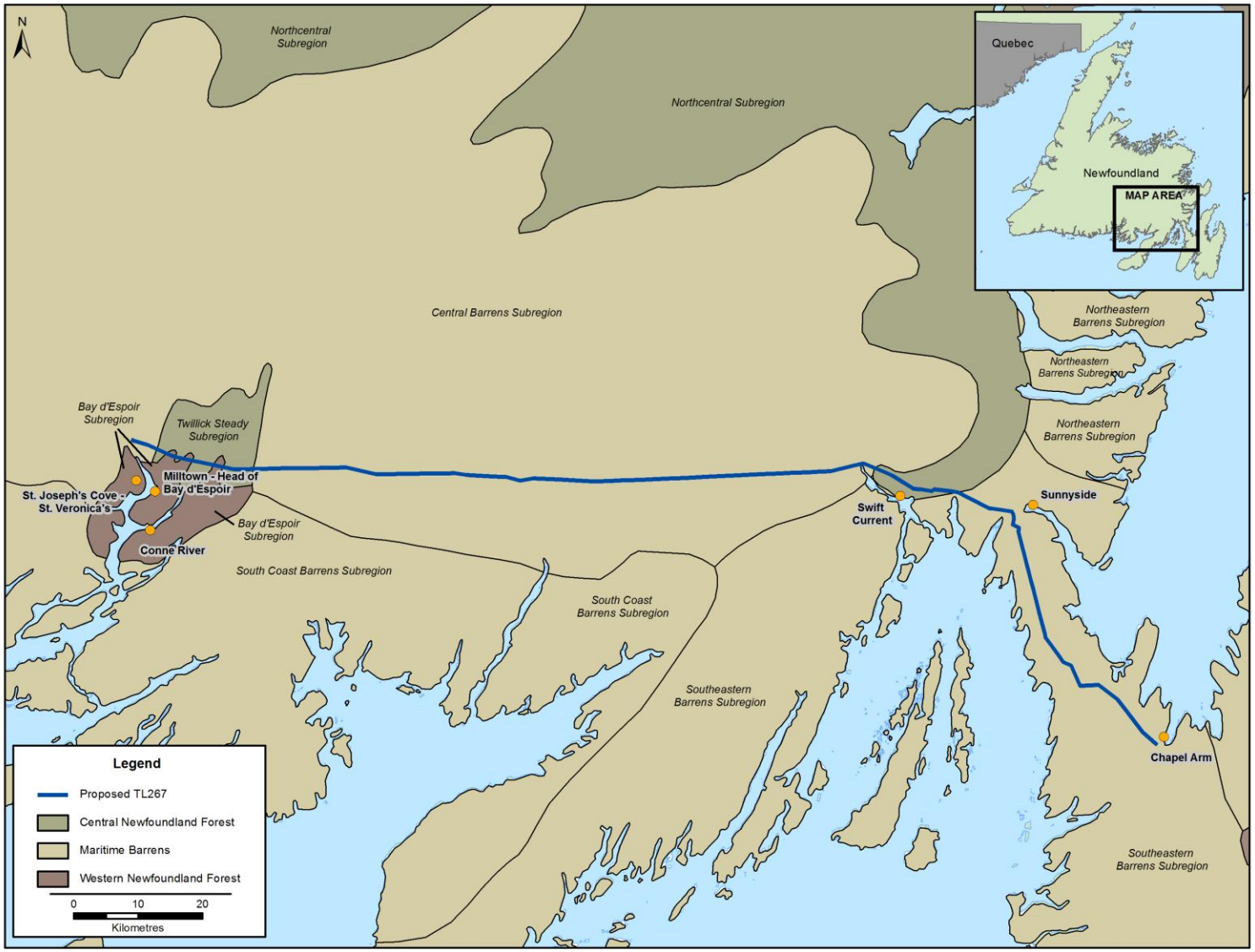
The proposed transmission line extends through south-central and eastern portions of the Island of Newfoundland, and in doing so, will cross through a portion of the *Boreal Shield Ecozone* of Canada (Natural Resources Canada 2007). The Boreal Shield Ecozone consists of a base of ancient bedrock covered by gravel, sand and other glacial deposits. Regional topography is comprised of broadly rolling uplands that form poorly drained depressions covered by lakes, ponds and wetlands. The climate of the Ecozone is generally continental in nature, with long cold winters, short warm summers and abundant precipitation. Cool temperatures and a short growing season along with acidic soils influence the resultant vegetation community composition, distribution and abundance. The landscape configuration consists primarily of forested cover dominated by coniferous species intermixed with hardwoods. Bogs, marshes and other wetlands comprise the remaining landscape matrix of vegetation communities.

At the provincial scale, the proposed transmission line will also pass through three of the Ecoregions that have been identified on the Island of Newfoundland (Damman 1983), including (primarily) the large Maritime Barrens Ecoregion, along with small portions of the Central Newfoundland Forest at the western and eastern end, and the Western Newfoundland Forest Ecoregion at its western end (Figure 2).

The Maritime Barrens Ecoregion extends from the east to the west coast through the south central portion of the Island. This ecoregion has the coldest summers on the Island of Newfoundland with frequent fog and strong winds. Winters are relatively mild with intermittent snow cover particularly near the coastline. Annual precipitation exceeds 1,250 mm. The landscape pattern consists of usually stunted, almost pure stands of Balsam Fir, broken by extensive open heathland. Good forest growth is localized on long slopes of a few protected valleys. The development of the extensive heath landscape was precipitated by indiscriminate burning by European settlers. Railways in the nineteenth century also had a significant impact on fire frequency in the eastern part of the region. The heaths are dominated by *Kalmia angustifolia* on protected slopes where snow accumulates and by cushions of *Empetrum nigrum* or *Empetrum easmesii* on windswept ridges and headlands. Forest fires have been historically common in much of this area, altering the successional trajectory from balsam fir to black spruce (*Picea mariana*) and sometimes birch (*Betula sp.*) to aspen (*Populus sp*.) (Meades 1990), and the region has also seen widespread insect outbreaks. Human activity and associated disturbances have been relatively low in the region (Fifield et al. 2013).

The Study Area also crosses through a portion of the existing boundaries of the Bay du Nord Wilderness Reserve (2,895 km^2), which encompasses a vast landscape of ponds, rivers, barrens, bogs and fens, forests, and thickets. The main conservation objective for establishing the Reserve was to protect habitat (primarily winter) for the Middle Ridge woodland caribou herd, and the Reserve also protects a representative portion of the Maritime Barrens subregion of the above described Maritime Barrens Ecoregion.

Figure 2 – Ecoregions in Newfoundland Crossed by the Proposed Project



2.2 Information Sources and Mapping

Information on woodland caribou in the Study Area was obtained through the identification, review, analysis and summary of existing and available information and datasets, including published and unpublished reports, journal articles, theses, government documents and datasets and other sources. Consultation with the Newfoundland and Labrador Department of Environment and Conservation (NLDEC) was also undertaken to obtain recent caribou monitoring data and associated habitat use mapping for caribou in south-central and eastern Newfoundland.

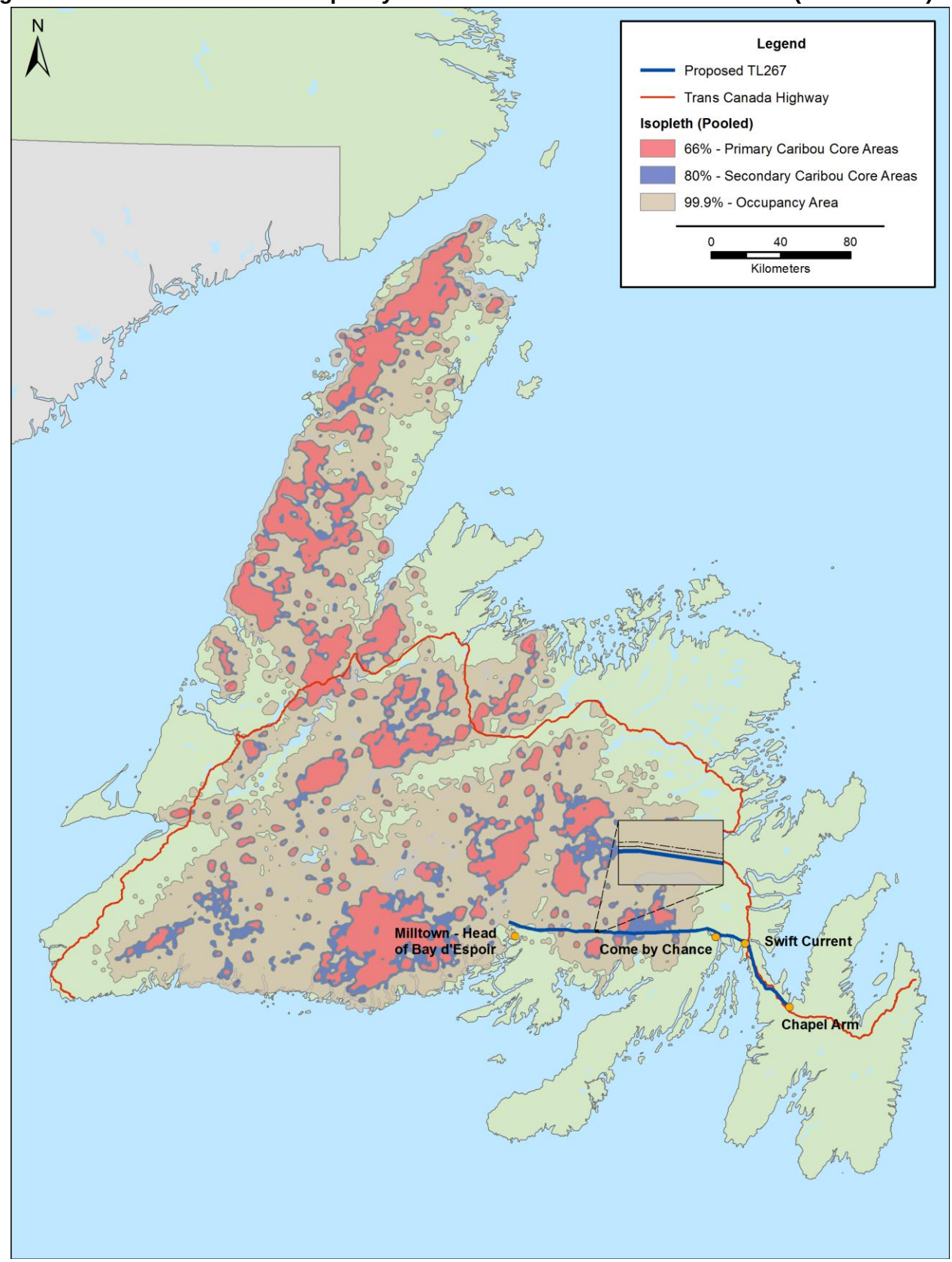
In an effort to better understand and describe the dynamics of woodland caribou in Newfoundland, the Government of Newfoundland and Labrador initiated the Caribou Data Synthesis program in 1996 to systematically evaluate all available data and inform management decisions. Findings from this first synthesis prompted additional funding in 2008 for a new five-year intensive research based Caribou Strategy to address the population decline, obtain a better understanding of caribou ecology and ultimately to inform long-term management strategies. These research programs have resulted in a wealth of new and detailed information on these caribou, including populations which may interact with the proposed transmission line, which will ultimately facilitate more informed long term management and conservation of the population. This information as it relates to the Study Area has been reviewed and summarized for this report.

In Newfoundland, the NLDEC has delineated caribou distribution and habitat use in Newfoundland using caribou telemetry data and kernel analyses to ascertain relative utilization distributions for each season. Kernel density estimation is a well-accepted probabilistic statistical approach (Worton 1989) that has been extensively used to visualize the intensity of animal space use from a sample of locations provided by tracking collars. The probability kernels are combined into a probability surface called the utilization distribution. This surface is then contoured, connecting areas of equal probability of occurrence based on the utilization distribution surface created from the kernels. The kernels are inclusive, meaning that overall occupancy areas also include the secondary core areas, which include the primary core areas. Kernel sizes and shapes have been determined so as to encompass caribou annual and seasonal home range sizes, as well as daily, seasonal, and yearly movements and the distribution of protected areas within the range of individual populations (NLDEC 2011).

The NLDEC used data from 1979 to 2014 to create the above described seasonal kernels (Figure 3 shows the "pooled" mapping data for all seasons across the entire Island). Seasons were defined as winter (December 1 – April 30), spring (May 1 to June 30, associated with calving), summer (July 1 to September 30, the post-calving period) and fall (October 1 to November 31, associated with the rutting / mating period). All available, updated and processed seasonal distribution data for caribou were requested by the Study Team and obtained from the NLDEC, including 99 percent occupancy areas, 80 percent secondary and 66 or 50 percent primary core areas for each season. Occupancy kernels (99 percent kernels) indicate zones where caribou can occur for a given season and/or for the year. Primary core areas (66 percent or 50 percent kernels, depending on season) represent the most frequently used areas and therefore the most important zones within a seasonal range. Secondary kernels represent areas that are also used by caribou but to a lesser extent than for the identified primary core use areas.

Additional information on the overall biology, distribution and status of woodland caribou in the province was obtained through a review of select primary literature for Newfoundland caribou that included: Bergerud (1971, 1972, 1975), Mahoney et al. (1990 , 2001), Mahoney and Schaefer (2002), and Mahoney and Virgil (2003), Snow and Mahoney (1995), Randell et al. (2012) and Morrison et al. (2012). Other reports were also reviewed, including Morgan and Doucet (2007) which identifies previously defined core calving / post-calving and over-wintering areas for caribou in the province (see Appendix F). The Recovery Strategy for Three Woodland Caribou Herds (*Rangifer tarandus caribou*; Boreal population) in Labrador, Canada (Schmelzer et al. 2004), the Federal Recovery Strategy for Boreal Population of Canada (Environment Canada 2012) and recent information from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2011) were also reviewed for applicable background information pertaining to caribou ecology, population structure and responses to natural and anthropogenic factors and disturbances.

Figure 3 –Caribou Core and Occupancy Areas on the Island of Newfoundland (All Seasons)



3.0 CARIBOU ECOLOGY AND MANAGEMENT

Woodland caribou (*Rangifer tarandus caribou*) are native to both Newfoundland and Labrador and are part of the Boreal Population of caribou, which is sub-divided into two ecotypes, the migratory forest-tundra ecotype and the more sedentary forest-dwelling ecotype (Environment Canada 2012). Ecotypes are distinguished primarily by different predator avoidance behavioural strategies during calving and post-calving seasons (Bergerud 1996; Bergerud et al. 2008). Boreal caribou occur on the landscape in small groups or individually in the boreal forest across Canada. At calving, female boreal caribou will try to space-away from each other to avoid predation.

Newfoundland caribou appear to be a mix of ecotypes. While their movement dynamics and predator influence is more similar to boreal caribou, their pre-calving migrations, communal calving areas and fluctuations in abundance are similar to those of migratory caribou.

Over the past several decades, many caribou populations have undergone significant declines in their numbers (Schaefer 2003; Vors and Boyce 2009; Festa-Bianchet et al. 2011), with climate and human disturbances usually being cited as the most likely factors causing these decreases (Vors and Boyce 2009; Tyler 2010; Joly et al. 2011). Caribou herds in Newfoundland have likewise undergone considerable changes and fluctuations in abundance in recent years, with numbers declining precipitously in the late 1990s (Mahoney et al. 2012). Unlike Labrador's woodland caribou herds, those on the Island of Newfoundland are not currently listed as threatened under the *NL Endangered Species Act* or the federal *Species at Risk Act*.

The following sections provide an overview of caribou populations and their associated dynamics, structures, behaviors and habitat use, followed by a general discussion of the current management of this species.

3.1 Population Dynamics and Influences

As noted above, many populations of caribou across North America, including those in Newfoundland, are currently in a state of decline or experiencing a lowered probability of persistence (Environment Canada 2012). This phenomenon could reflect large scale changes in either the extrinsic or intrinsic factors influencing caribou abundance (Bastille-Rousseau et al. 2013).

All caribou populations in Newfoundland have experienced considerable increases and declines in their numbers over the last 40 years, a pattern that has been highly synchronous across the entire Island (NLDEC 2009). In the early 1900s, caribou were abundant, but then declined rapidly between 1915 and 1930 (NLDEC 2009). These populations remained relatively low in abundance until the 1970s, then increased to approximately 90,000 caribou by the late 1990s (NLDEC 2009). By the mid to late 1990s, population declines were again being detected in most populations, but the scale of these declines was unknown. Recent estimates suggest that caribou populations have now declined to an estimated 32,000 animals (NLDEC 2009) an approximate 65 percent decline over the past two decades (Soulliere et al. 2010).

In 2008, the Government of Newfoundland and Labrador announced a comprehensive five-year Caribou Strategy that would expand on the findings of earlier efforts to form an ecosystem-based analysis of local caribou population dynamics. The strategy was research-intensive and focused on caribou and predator ecology, non-predation factors, and human dimensions (NLDEC 2009). By 2012, all populations had been re-surveyed providing an updated assessment of caribou abundance and distribution throughout the Island (NLDEC 2013).

A number of potential explanations have been put forward with regard to these observed fluctuations in caribou populations and their abundance. The main hypotheses include long term winter severity trend effects (Gunn 2003) and density dependent degradation of range suitability (Crête and Huot 1993; Mahoney and Schaefer 2002). Recent analysis has demonstrated that all Newfoundland caribou populations have fluctuated dramatically over the last 40 years, and that these fluctuations were synchronized in a manner consistent with an extrinsic driving factor (Ranta et al. 1995, 1997) such as weather (Bastille-Rousseau et al. 2013). Caribou population trajectories have been time-delayed relative to winter severity, but not relative to calving-ground productivity, suggesting that trends in winter severity may synchronize broad-scale changes in caribou abundance (Bastille-Rousseau et al. 2013).

Predation is also a key consideration and may serve to also influence population dynamics. Black bear (*Ursus americanus*) and coyote (*Canis latrans*) are the primary predators of caribou on the Island of Newfoundland (Blake 2006, Fifield et al. 2013, Fifield and Lewis 2013). Preliminary research suggests that black bears account for approximately 30 percent of deaths of radio-collared caribou calves and an additional 15 percent were predated by coyotes (NLDEC 2009). Ongoing research is examining the extent to which predation mortality may be contributing to these population declines (Fifield et al. 2013, Fifield and Lewis 2013).

3.2 Population Structure

Newfoundland caribou have been reported to be most closely related to caribou in Ontario and Québec (Eger et al. 2009) as well as Labrador (Wilkerson 2010), but are somewhat distinct from their nearest neighbours on the mainland of Labrador and Québec due to the movement barrier caused by the Strait of Belle Isle. Recent analysis did not detect shared haplotypes among the caribou of the Island and those of the mainland (Cronin et al. 2005; Eger et al. 2009), suggesting that the Island's caribou comprise a separate population. Movement between herds by GPS collared females on the Island has not been frequently observed (Mahoney and Virgil 2003). However, Wilkerson (2010) reported little evidence of genetic structure among populations in Newfoundland as revealed by mtDNA, suggesting little differentiation between populations and indicating that some level of gene flow across populations is occurring. To date, no microsatellite surveys of Newfoundland caribou have been carried out (COSEWIC 2011).

Caribou are distributed across much of the Island of Newfoundland in varying densities. Although certain areas receive relatively higher use than others, the overall home ranges of all herds cover much of the Island's Northern Peninsula, central and southwestern Newfoundland, as well as the Avalon Peninsula. There can be considerable seasonal overlap between herds or aggregations (Mahoney and Virgil 2003) resulting in confusion regarding the delineation of population structure.

Female caribou display fidelity for specific calving areas, which forms the basis for the traditional division of the Island's caribou into separate populations.

Currently, the Newfoundland caribou population is partitioned into 19 herds or aggregations across the Island (NLDEC 2013), although in some instances adjacent herds may seasonally interact during the calving, over-wintering or fall rut periods (Courtois et al. 2003). In other instances, physical geographic barriers are assumed to impair connectivity. The concept of a metapopulation of caribou in Newfoundland has also been discussed, but this has not yet been evaluated scientifically (Stantec 2011).

3.3 Behavioural Ecotypes and Site Fidelity

Caribou populations have broad landscape-level habitat requirements (Arsenault and Manseau 2011), and the concept of space use resides at the heart of caribou ecology (Bergman et al. 2000, Schaefer and Mahoney 2013). Behavioural ecotypes are defined through space use strategies of adult females, the underlying mechanism driving population structure (Brown and Theberge 1985, Schaefer et al. 2000, Nagy et al. 2011).

As described previously, woodland caribou are native to both Newfoundland and Labrador and are part of the Boreal Population of caribou, which is sub-divided into the migratory forest-tundra ecotype and the more sedentary forest-dwelling ecotype (Environment Canada 2012). Ecotypes are distinguished primarily by different predator avoidance behavioural strategies during calving and post-calving seasons (Bergerud 1996, Bergerud et al. 2008). Calving strategy, rather than migration distance, is therefore a key feature that differentiates caribou ecotypes, because the length of travel to and from calving areas can be highly variable between populations and even between years (COSEWIC 2011). The migratory forest-tundra ecotype is associated with tundra habitats in Northern Labrador and can undergo extensive migrations between winter and calving grounds, typically calving in large aggregates. The sedentary ecotype is forest-dwelling and typically disperses seasonally during the spring, typically calving in isolation (Bergerud et al. 2008).

Although caribou in Newfoundland are considered to be the forest-dwelling ecotype, some herds or aggregations have traditionally exhibited behaviour that is typically associated with barren ground or forest-tundra ecotypes (NLDEC 2011). Newfoundland caribou have been described as using both aggregated and dispersed calving strategies. The Corner Brook herd, for example, has been described as representing the dispersed calving ecotype (Mahoney and Virgil 2003), while other herds typically calve in aggregations but only undergo short migrations (Bergerud 1971; Mahoney and Schaefer 2002). Significantly, most caribou in Newfoundland have shifted from aggregated calving to dispersed calving while undergoing a population decline since 2000 (COSEWIC 2011).

Fidelity is the tendency of animals to remain in, or return to, a particular spatial location at different times of the year or across multiple years (Switzer 1993), and is believed to increase an individual's knowledge of the local environment by increasing their ability to find resources while reducing predation risk (Schaefer et al. 2000). Patterns of seasonal range fidelity are an important attribute of woodland caribou habitat use patterns, with implications for evaluating the effects of anthropogenic disturbance (such as infrastructure development and other human activities). Disturbance within home range or local core use areas can cause caribou to abandon or shift their distributions (Dyer et al.

2001, Oberg 2001, Neufeld 2006, Antoniuk 2007, Tracz 2010). Caribou avoidance of linear features was documented by Dyer et al. (2001) in Northern Alberta, for example, where maximum avoidance distances of 250 m were reported for roads and seismic lines. Oberg (2001) found that roads were avoided by caribou to a distance of 500 m. Neufeld (2006) found that caribou weakly selected areas away from pipelines in all seasons and from roads during rendezvous and nomadic seasons for wolves, as well as observing an avoidance of cut block areas at the 1 km scale. Tracz (2010) found that petroleum development resulted in home range abandonment by female woodland caribou.

Boreal forests landscapes across Canada are inherently dynamic within parameters determined by natural biophysical processes and anthropogenic disturbance (Racey and Arsenault 2007). The landscape disturbance model presented in the federal Boreal Caribou Recovery Strategy demonstrates that caribou can tolerate some level of disturbance (30-40 percent) within their home range, but that the probability of persistence declines with increasing levels of disturbance (Environment Canada 2012). Whether they avoid, abandon or persist in an area depends on the size and extent of cumulative disturbances within their range (Sorensen et al. 2007), their viability as a population, and whether the landscape provides sufficient amounts of accessible alternative suitable habitat to sustain the population (Environment Canada 2012).

In particular, caribou and other ungulate species are known to be particularly sensitive to disturbance during the calving season from May to June (Bradshaw et al. 1998, Bowyer et al. 1999, Vistnes and Nelleman 2008, Lykkja et al. 2009). Adult female caribou have also been found to be highly sensitive to human and habitat disturbance from forestry, mining and other impacts (Schaefer and Mahoney 2007, Weir et al. 2007, Vors et al. 2007, Boulanger et al. 2012), particularly during calving and calf-rearing (Chubbs and Keith 1992, Harrington and Veitch 1992; Nellemann and Cameron 1998, Armitage and Stopp 2003, Courtois et al. 2007, 2008). In the Red Wine and Mealy Mountains populations of Labrador, adult females were highly philopatric to calving and post-calving sites (Brown and Theberge 1985, Schaefer et al. 2000, Popp et al. 2008). In Québec and Ontario, site fidelity varied among seasons, being higher during calving and summer and lower in the winter (Faille et al. 2010, Hazell and Taylor 2011, Hazell et al. 2015). Faille et al. (2010) found that anthropogenic disturbances had a strong negative effect on home-range fidelity during annual, summer and winter periods, whereas natural disturbance (such as forest fires) was the dominant factor during calving (Faille et al. 2010).

3.4 Habitat Selection and Use

Newfoundland caribou use a mixture of boreal and taiga forests, shrub lands, peatlands and barrens (Environment Canada 2012). They feed predominantly on lichens in suitable lichen-rich habitats, although they prefer fungi, the green leaves of deciduous shrubs and forbs, and new spring growth of sedges when available (Bergerud 1972). Fecal pellet analysis indicated the relative proportion of terrestrial lichens, shrubs, herbs and mosses ingested varied depending on whether the population was in a period of rapid growth, slow growth or decline (Soulliere et al. 2012). Habitat selection occurs at multiple spatial scales, with selection processes influenced by factors including habitat configuration, caribou disturbance thresholds, predator-prey dynamics, and amount and connectivity of high quality habitat patches within the landscape matrix (Arsenault and Manseau 2011).

3.4.1 Winter Habitat

In the winter period, caribou typically forage on reindeer lichens (*Cladina sp*.) and arboreal lichens growing on trees as well as evergreen shrubs (Bergerud 1972). Caribou habitat and forage selection is also influenced by snow cover, depth and crust. Deep snow alters energetic requirements for moving and foraging as well as predation risk. Shallow snow offers reduced predation risk by allowing increased mobility and thus ice-covered areas such as wetlands, lakes, rivers can provide visibility and mobility advantages (Bergerud et al. 2008; Fortin et al. 2008). Caribou are therefore often observed using rivers and lakes for movement between areas within winter ranges. Access to arboreal lichens is particularly important when snow is deepest as they may be the only accessible food (Fortin et al. 2008). Mature, undisturbed boreal forests are typically considered high quality habitat for caribou including a dependable source of such lichens (Schaefer and Pruitt 1991; Schaefer 1996; Mahoney and Virgil 2003; O'Brien et al. 2006; Fortin et al. 2008). Terrestrial lichens are also selected (Courtois et al. 2004; Fortin et al. 2008) and it has been observed that caribou will dig craters up to 142 cm deep to access ground vegetation (Brown and Theberge 1990).

Recently harvested or burned stands and/or disturbed sites have typically been found to be used less than other habitats during winter (Mahoney and Virgil 2003, Fortin et al. 2008). Areas that support alternative prey are often avoided by caribou as they may increase the risk of predation (Seip 1992; Fortin et al. 2008). In Newfoundland, black bear and coyote are the main predator species, and moose are the alternative ungulate prey species (Mahoney and Virgil 2003). Black bears preferentially forage in regenerating stands and will opportunistically prey on ungulate calves (Mahoney and Virgil 2003).

3.4.2 Calving / Post Calving Habitat

Mahoney and Virgil (2003) found that adult caribou in Western Newfoundland selected rock and heath barrens, and virgin and mature forest stands significantly more than other habitat types during the calving / post-calving period. Open water has also been found to be important as it can be used for escape from predators (Bergerud 1985; Bergerud et al. 1990, 2008). As with woodland caribou in many regions across Canada, female caribou seek calving sites with low predation risk (Bergerud and Page 1987; Bergerud et al. 2008). Females avoid more open disturbed areas that support alternative prey such as moose, and recently harvested stands and disturbed sites have been found to be used significantly less than other habitats during this period (Mahoney and Virgil 2003).

3.5 Caribou Management and Conservation

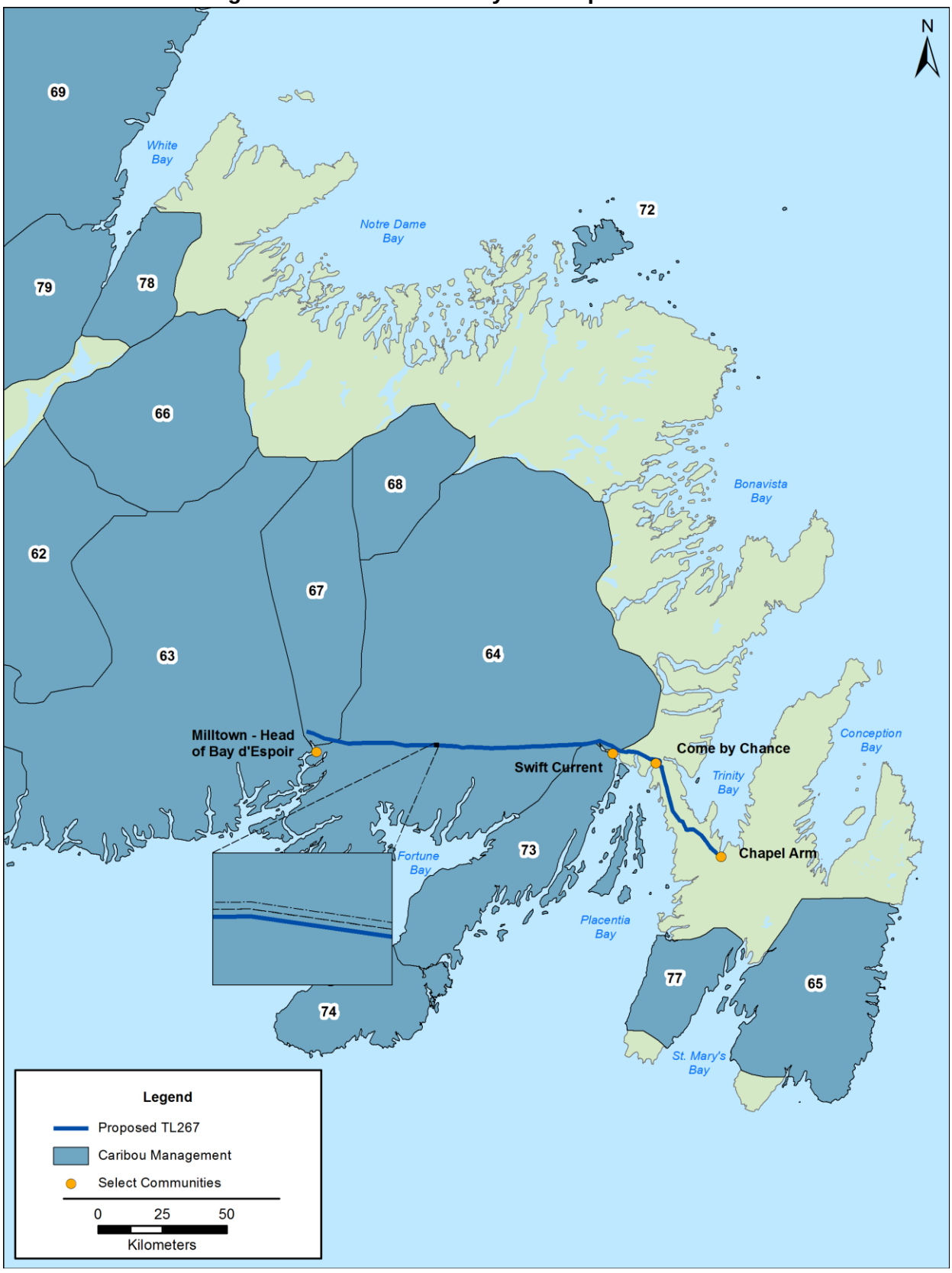
Unlike Labrador's three woodland caribou herds, those occurring on the Island are not listed (and therefore, legally protected) as "Threatened" under the Newfoundland and Labrador *Endangered Species Act* (2004) or the Canadian *Species at Risk Act* (2002). Caribou have typically occurred in higher densities on the Island than those observed in Labrador, although there have been significant declines in the Newfoundland populations, as described above, which have triggered increased monitoring and management efforts since 2008 (NLDEC 2011). When COSEWIC conducted its woodland caribou status assessment in 2002, the Newfoundland population of woodland caribou was estimated at 85,000, leading to the current designation of "Not at Risk" (COSEWIC 2002). Since the last COSEWIC assessment, the Newfoundland population has declined by an estimated 67 percent (Soulliere et al. 2012), with decadal trends in winter severity (Gunn 2003) and time lag density

dependence (Bastille-Rousseau et al. 2013) caused by degradation in range (Crete and Huot 1993; Bergerud 1996; Mahoney and Schaefer 2002) being the main explanations that have been put forward. Newfoundland caribou have been identified as their own "designatable unit" (DU5) for the purpose of future national assessments of conservation status (COSEWIC 2011).

Provincial caribou management is largely dependent upon maintaining accurate and up to date population demographic estimates, most specifically population surveys and herd classifications undertaken in the fall (NLDEC 2013). There are currently 19 identified Caribou Management Areas on the Island of Newfoundland, of which 14 will be open for hunting in the 2015 season. Hunting seasons for most areas extend from early / mid September to early December (or with an earlier closing date for several zones), with an overall 2015 quota of 735 animals. The proposed transmission line intersects with the southern portion of Middle Ridge Management Area (# 64) and to a much lesser extent the southern extent of the Pot Hill (# 67) Management Area (Figure 4).

Despite the recent shift in the understanding of caribou population distribution in Newfoundland, caribou are still managed by herds as determined by calving areas (NLDEC 2008).

Figure 4 – Caribou Management Areas Crossed by the Proposed Transmission Line



3.6 Future Population Trends

In 2008, the Government of Newfoundland and Labrador initiated a five-year Caribou Strategy to address the recent declines in caribou abundance and to assist in the development of an associated management plan. An important component of the Strategy has involved the development of population projection models to forecast future population abundance, and several analyses have been undertaken to assess the population dynamics for the Island as well as individual herds (Morrison et al. 2012; Randell et al. 2012). Both the Population Viability Analysis (PVA, Randell et al. 2012) and Leslie-matrix models (Morrison et al. 2012) project continued reduced rates of decline for Newfoundland caribou as long as the current demographic trends continue. Under this scenario, individual herd projections to the year 2030 indicate declines ranging from 1.2 percent to 4.8 percent annually (Randell et al. 2012).

Overall, rates of decline projected by PVA (under current conditions) are largely consistent with those estimated from recent population censuses (Randell et al. 2012). However the PVA-projected annual rate of decline for the Middle Ridge Herd under current conditions was inconsistent with recent population census results which suggested that the population may have stabilized by 2010 (NLDEC 2013). Recent composition surveys on the Middle Ridge Herd have indicated an improvement in calf recruitment in this population. However, current recruitment rates remain significantly lower than those observed in the 1980s when the population was expanding and are likely insufficient to sustain the population at current levels (Randell et al. 2012).

It is possible that overall rates of calf survival for the Middle Ridge Herd used in the PVA (and estimated from radio-collared animals) may be biased by the extremely low rate of survival of calves from the southern calving ground (Randell et al. 2012). Increases in sample size in both the northern and southern calving areas and associated analyses will examine the extent to which a bias occurs as well as improve the precision of calf survival estimates for this herd.

The analysis revealed that hunting closures alone will not be sufficient to stabilize populations, and further increases in rates of calf survival are required to halt or reverse the current decline. The PVA revealed that minimum calf survival rates between 40 and 45 percent are needed to attain population stability (Randell et al. 2012). The minimum average calf survival rates required to attain population stability for the Middle Ridge herd are between 35 – 40 percent (Randell et al. 2012). These projected rates are comparable to those observed during a period of population growth for Newfoundland caribou (Mahoney 2000), and may therefore be obtainable; historically (1980-89) calf survival for the Middle Ridge herd has been 49 percent. High rates of calf mortality, resulting principally from predation by multiple predators (bears, coyotes, lynx and eagles) in the first two months of life are responsible for low recruitment (Trindale et al. 2011), but why calves appear to have recently become more susceptible to predation is currently unknown (Randell et al. 2012).

4.0 CARIBOU PRESENCE AND DISTRIBUTIONS IN THE STUDY AREA

The largest single caribou aggregation on the Island is the Middle Ridge Caribou Herd which peaked in abundance during the mid-1990s at approximately 20,000 individuals. Surveys in 2003 and then 2006 estimated that the population had declined from approximately 15,000 animals to 8,748 ± 393 animals. By 2010, survey results estimated the herd at 8,814 ± 907 animals, indicating that the population may have stabilized somewhat. The most recent survey was undertaken in March 2013 and generated a population estimate of 10,445 ± 433 animals (NLDEC 2013). When compared to the 2008 and 2010 survey estimates, the results from the 2013 survey indicate a considerable increase in numbers suggesting that the population may be growing in size again (NLDEC 2013).

As described previously, the NLDEC recently delineated caribou occurrence in Newfoundland using caribou telemetry data (1979 to 2014) and kernel analyses to determine relative utilization distributions for each season, including the winter (December 1 – April 30), spring (May 1 to June 30, calving), summer (July 1 to September 30, post-calving) and fall (October 1 to November 31, rutting / mating) periods.

Caribou distribution and habitat use on the Island has therefore been most recently described through the use of occupancy areas, which include information on the intensity of use (NLDEC 2011). Rather than designating calving and wintering areas as core areas as had been done in the past (e.g., Morgan and Doucet 2007, see Appendix F) the current approach considers all areas of use over all seasons (NLDEC 2011). Primary core areas (66 percent or 50 percent kernels, depending on season) represent the most frequently used areas and therefore the most important zones within a seasonal range. Secondary (80 percent) kernels represent areas that are also used by caribou but to a lesser extent than for the identified primary core use areas. Occupancy (99 percent) kernels indicate zones where caribou can occur for a given season and/or for the year. The total extent of pooled caribou occupancy areas in Newfoundland is 93,371 km^2, which includes 20,023 km^2 of secondary core areas and 12,479 km^2 of primary core areas (see earlier Figure 3).

The proposed Project would potentially interact with seasonal core use and occupancy areas for caribou throughout the year, although the nature and degree of such overlap varies considerably by location, time and type (Figures 5 to 9). Overall, the proposed transmission line right of way intersects with 96.5 km of areas occupied by caribou at some time during the year, including 1.8 km and 24.2 km of primary or secondary core areas, respectively. These areas are interspersed from the Bay du Nord Wilderness Reserve extending east to Swift Current. No occupancy or core areas were identified for caribou east of Swift Current.

During the winter, the distribution of caribou tends to be clustered into three core areas largely outside of the Study Area, two to the south (outside of the Bay du Nord Wilderness Reserve) and one north of the transmission line, within the Reserve. By the spring this distribution has become more dispersed across the landscape, reflecting the movement to calving areas. The proposed transmission line right of way intersects 75.4 km of areas occupied by caribou in the winter, including 0.4 km and 15.6 km of primary and secondary core over wintering zones.

The Middle Ridge Herd has two main calving areas, including a northern calving ground that overlaps the Central Newfoundland Forest Ecoregion and the Maritime Barrens Ecoregion, and a southern

calving ground which is entirely encompassed within the Maritime Barrens Ecoregion (Fifield et al. 2013). In addition to these two main calving areas, some calves are born to the east of the northern calving ground in the Meta Pond area (Fifield et al. 2013). The proposed transmission line route does not intersect any spring primary core calving areas (66 percent kernels), but does intersect 31.9 km of areas occupied by caribou (99 percent kernels) in that season.

After calving, females largely remain in the same areas due to more restricted movement from young calves but generally increase the size of range used for the remainder of the summer, and post calving distributions are typically comparable to those observed in the spring. The proposed transmission line intersects 76.6 km of areas occupied by caribou in the summer, including 2.5 km of primary core caribou areas and 6.8 km of secondary core areas. During the fall, animals tend to aggregate for the rutting period, which in this region appears to be mainly associated with the Bay du Nord Wilderness Reserve and associated barren lands. The proposed transmission line intersects 71.1 km of areas occupied by caribou in the fall including 26.1 km of secondary and 19.4 km of primary core caribou areas, respectively.

The Project would therefore interact with core use areas for caribou in the Middle Ridge Herd that are used at various times of the year. In particular it would directly intersect small portions of primary and secondary core areas for caribou during the over wintering period, summer post calving period and fall rut period (Table 1). Although it does not directly intersect any core areas for the spring calving period, it does occur within several kilometers of such primary use areas.

Table 1 – Summary of Seasonal Core Use Areas Crossed by the Proposed Transmission Line

Seasonal Ranges	Pooled (km)	Winter (km)	Spring (km)	Summer (km)	Fall (km)
Occupancy Area (99.9% kernel)	96.5	75.4	31.9	76.6	71.1
Secondary Core Use Area (80% kernel)	24.2	15.6	0.0	6.8	26.1
Primary Core Use Area (66% kernel)	1.8	0.4	0.0	2.5	19.4
Primary Core Use Area (50% kernel)*	-	0.0	-	-	-
*Analysis of primary core wintering ranges includes a 50% and 66% kernel, the remaining seasons are based on 66% kernels only.					

More detailed mapping for the identified core areas that are crossed by the proposed Project is provided in the Map Atlases included in Appendices A to E.

Figure 5 – Caribou Core Areas Crossed by the Proposed Transmission Line – Pooled

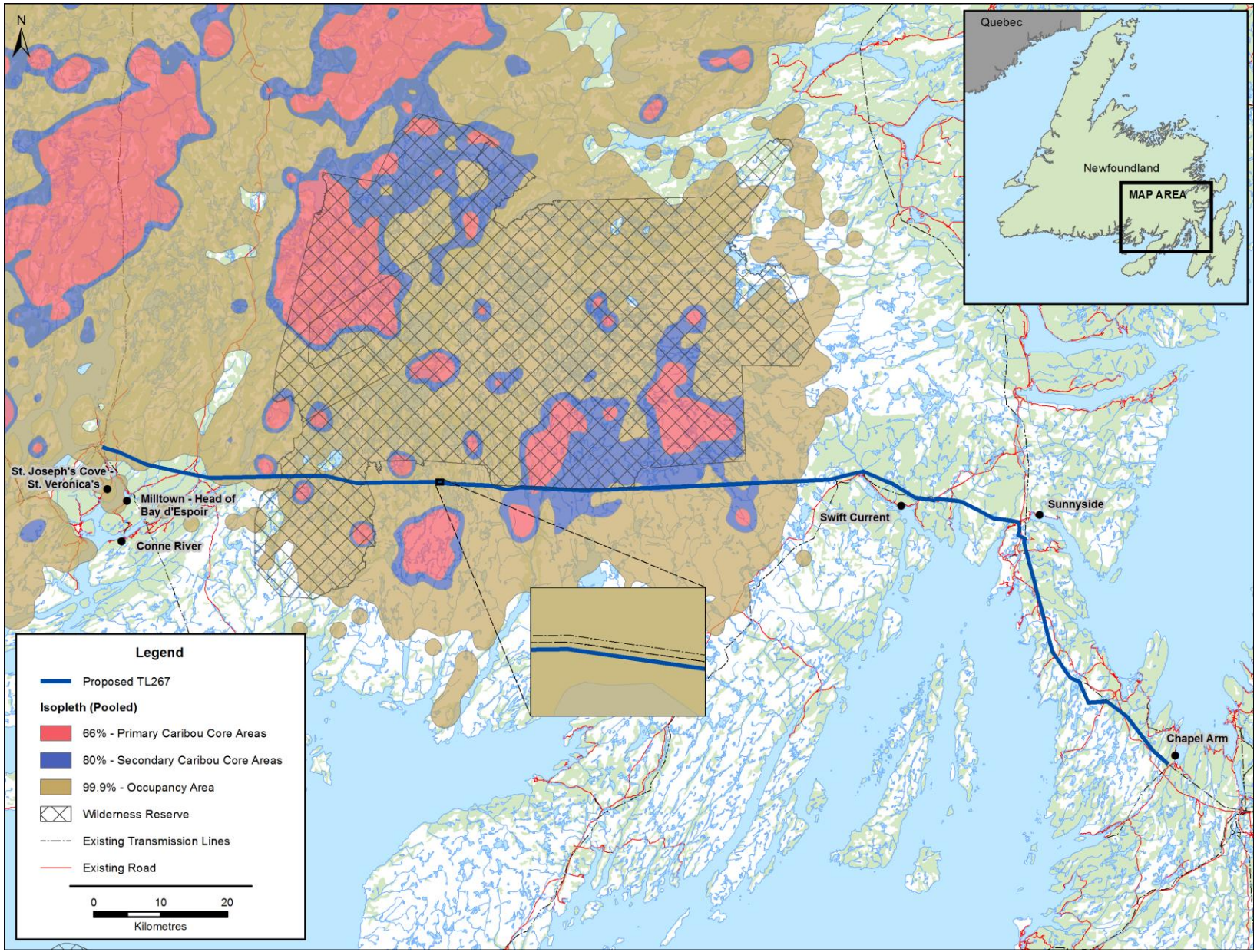


Figure 6 – Caribou Core Areas Crossed by the Proposed Transmission Line – Winter

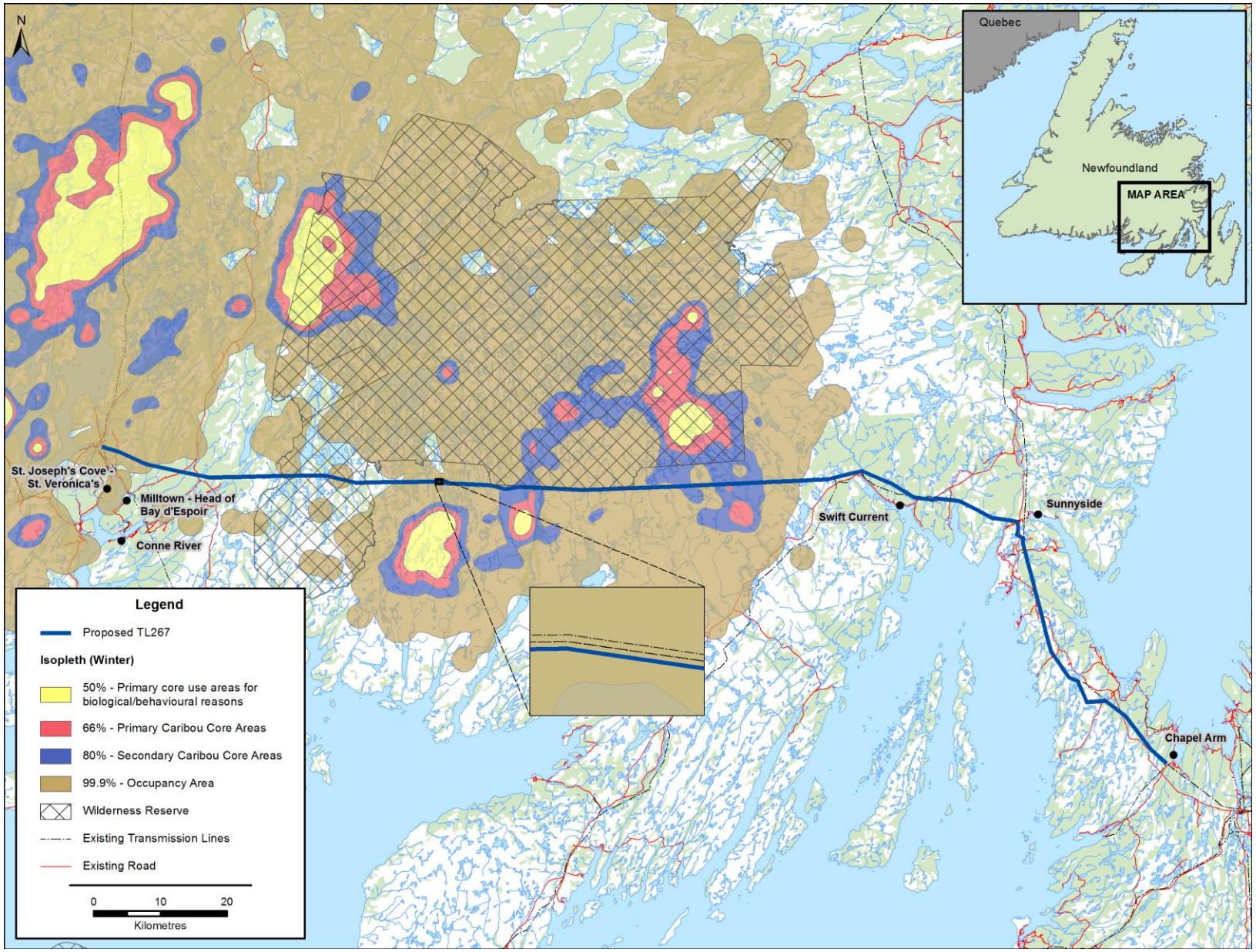


Figure 7 –Caribou Core Areas Crossed by the Proposed Transmission Line – Spring

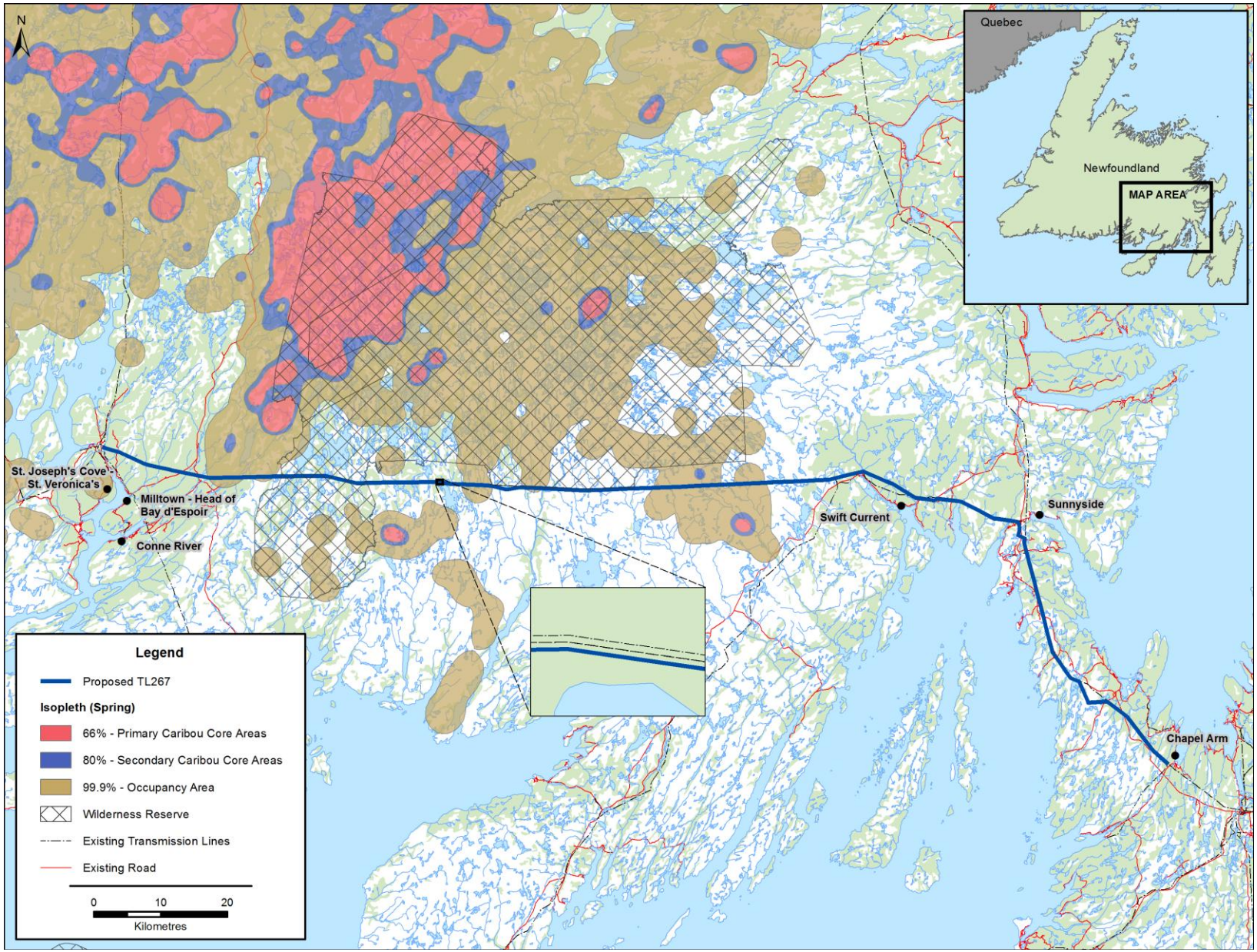


Figure 8 –Caribou Core Areas Crossed by the Proposed Transmission Line – Summer

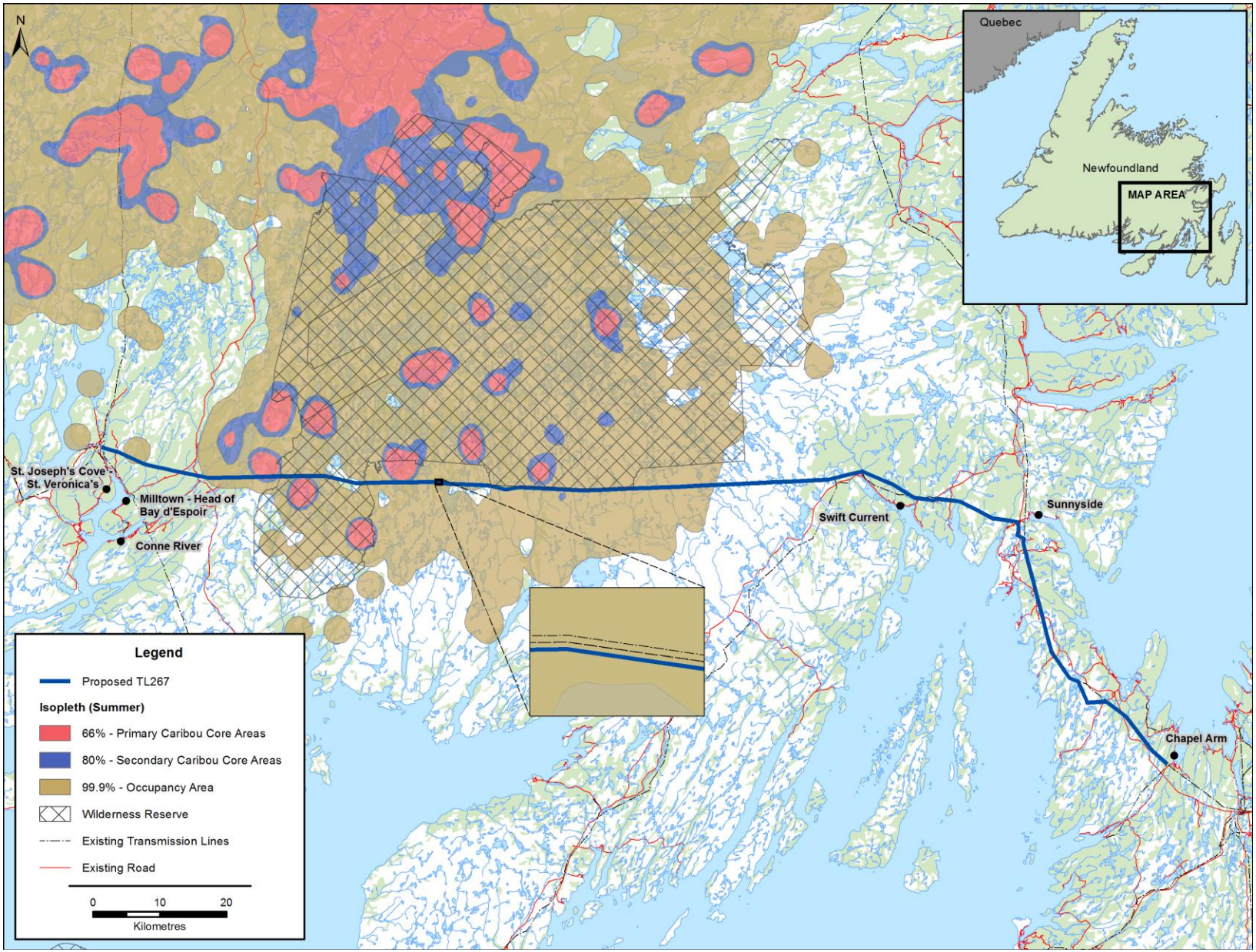
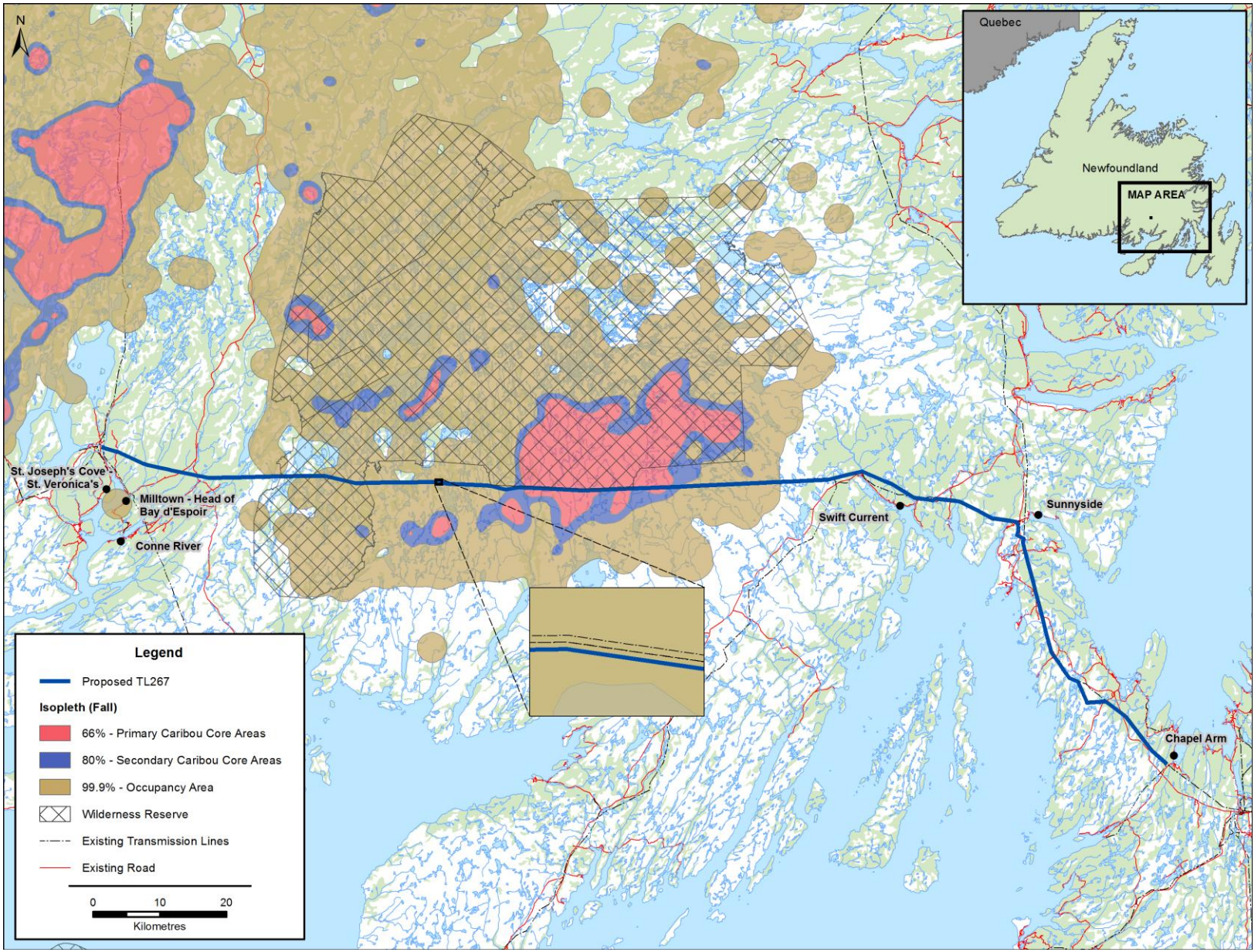


Figure 9 –Caribou Core Areas Crossed by the Proposed Transmission Line – Fall



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Appendix A

Map Index

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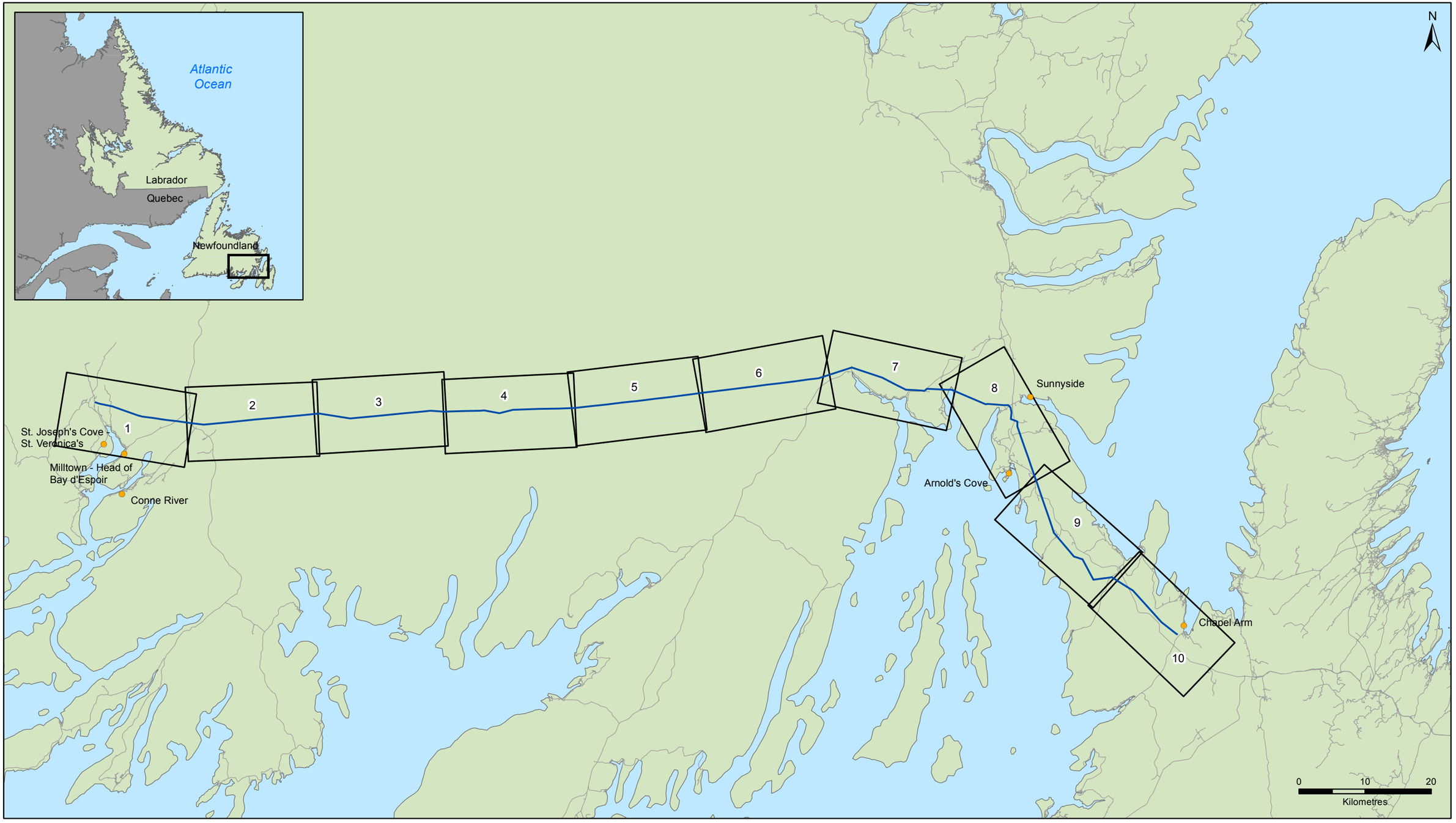

newfoundland labrador hydro a nalcor energy company	MAP INDEX PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU STUDY	amec foster wheeler

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Appendix B

Map Atlas: Caribou Core Areas – Winter

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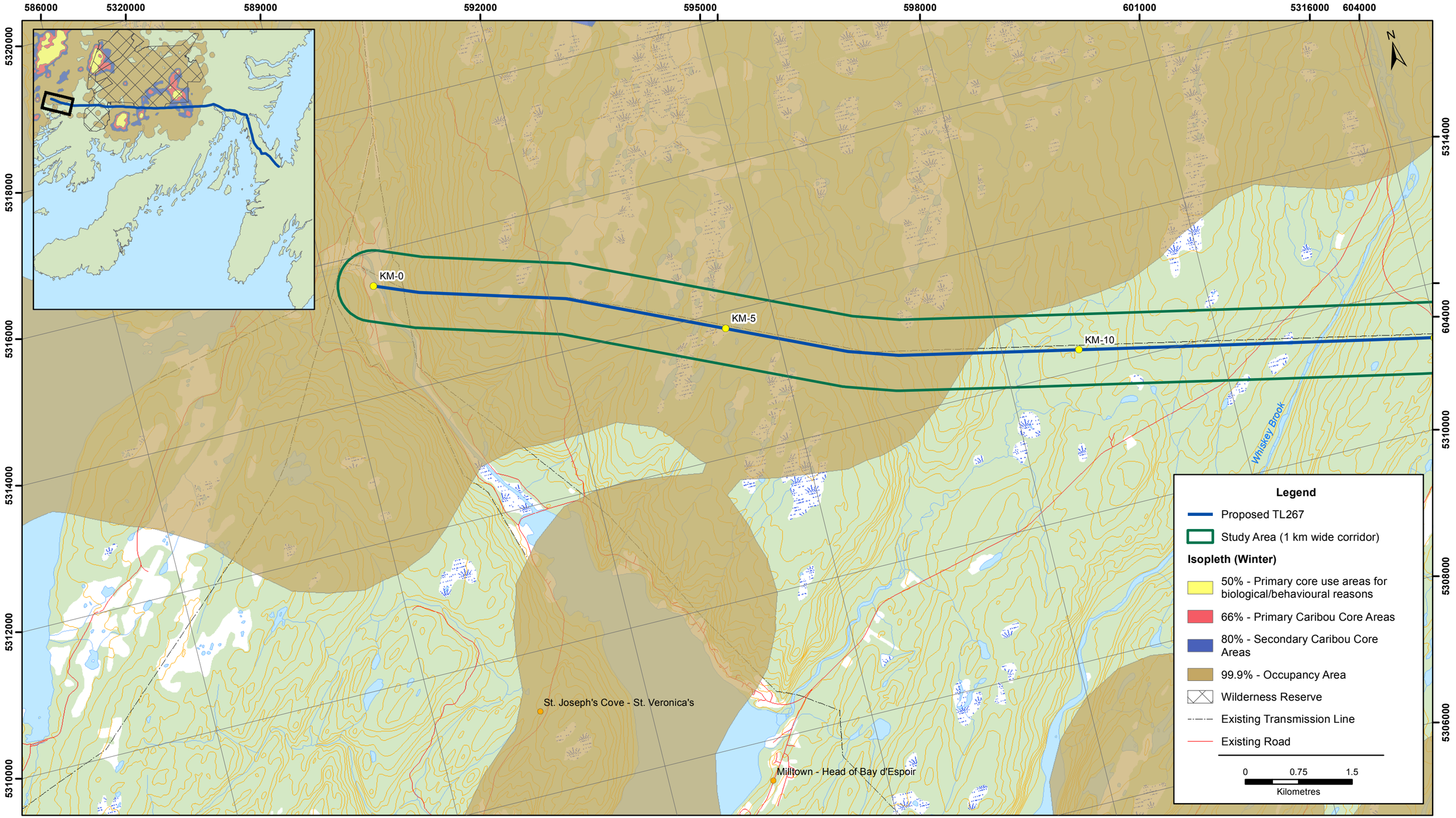

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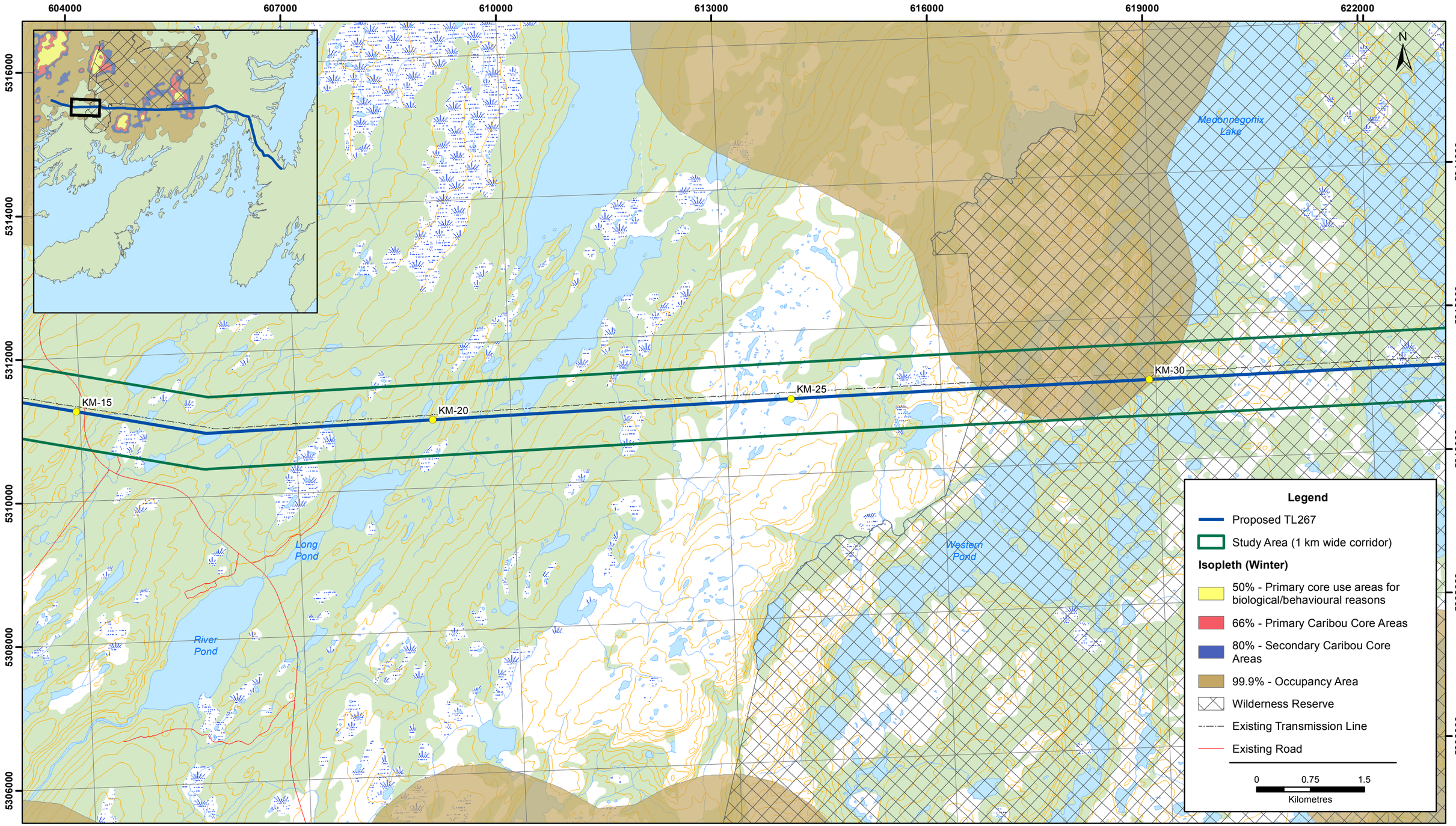

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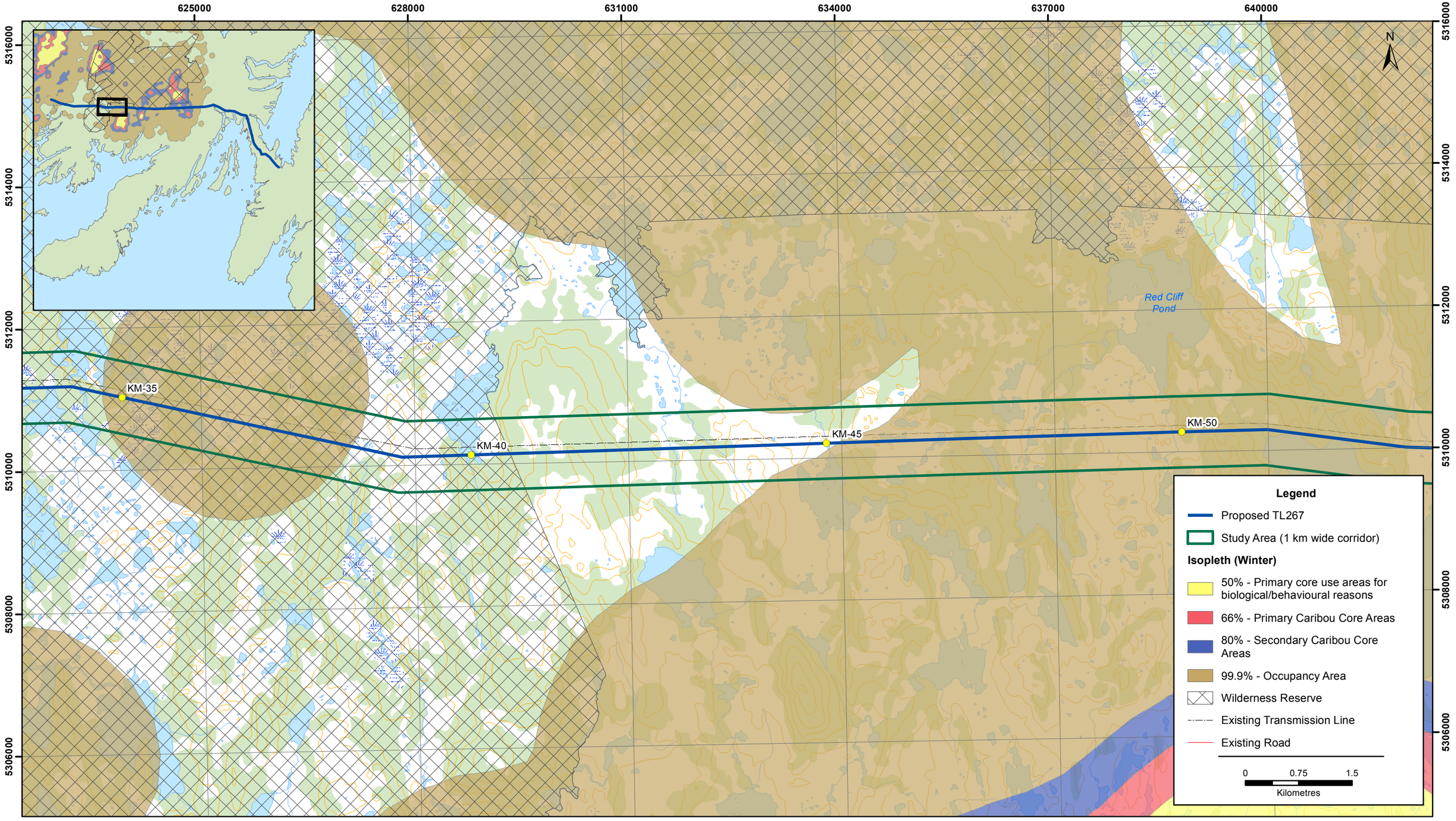

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU WINTER ISOPLETH

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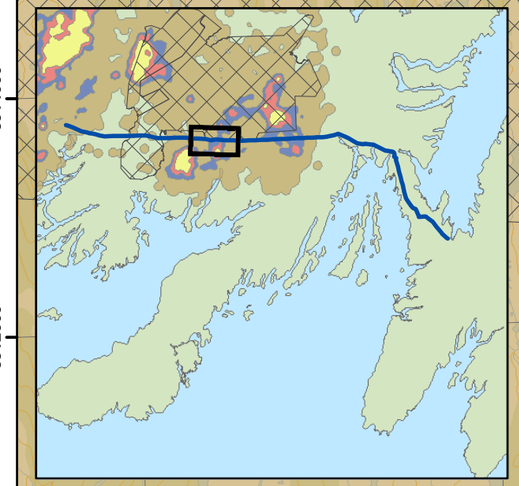

N

KM-55 KM-60 KM-65 KM-70

Pin Hill Brook

Beaver Brook

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

Isopleth (Winter)

- 50% - Primary core use areas for biological/behavioural reasons
- 66% - Primary Caribou Core Areas
- 80% - Secondary Caribou Core Areas
- 99.9% - Occupancy Area
- Wilderness Reserve
- Existing Transmission Line
- Existing Road

0 0.75 1.5

Kilometres

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU WINTER ISOPLETH

newfoundland labrador hydro a nalcor energy company

amec foster wheeler

661000 664000 667000 670000 673000 676000 679000

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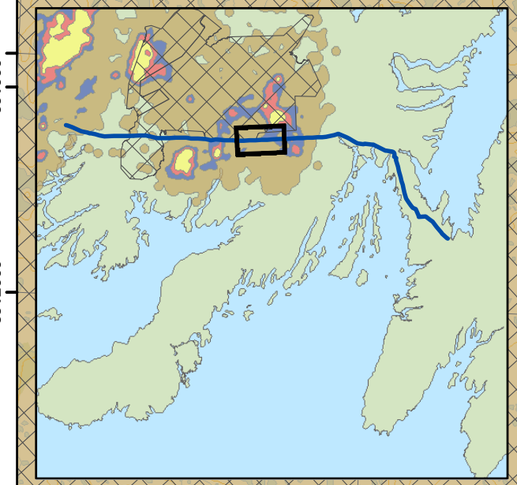

N

Pin Hill Pond

KM-75 KM-80 KM-85 KM-90

Dunns Mountain Pond

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

Isopleth (Winter)

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0 0.75 1.5

Kilometres

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU WINTER ISOPLETH

newfoundland labrador hydro a nalcor energy company

amec foster wheeler

682000 685000 688000 5316000 691000 694000 697000

5314000 5312000 5310000 5308000 5306000 5304000

5316000 5312000 5310000 5308000 5306000

N

KM-95 KM-100 KM-105 KM-110

Long Pond

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

Isopleth (Winter)

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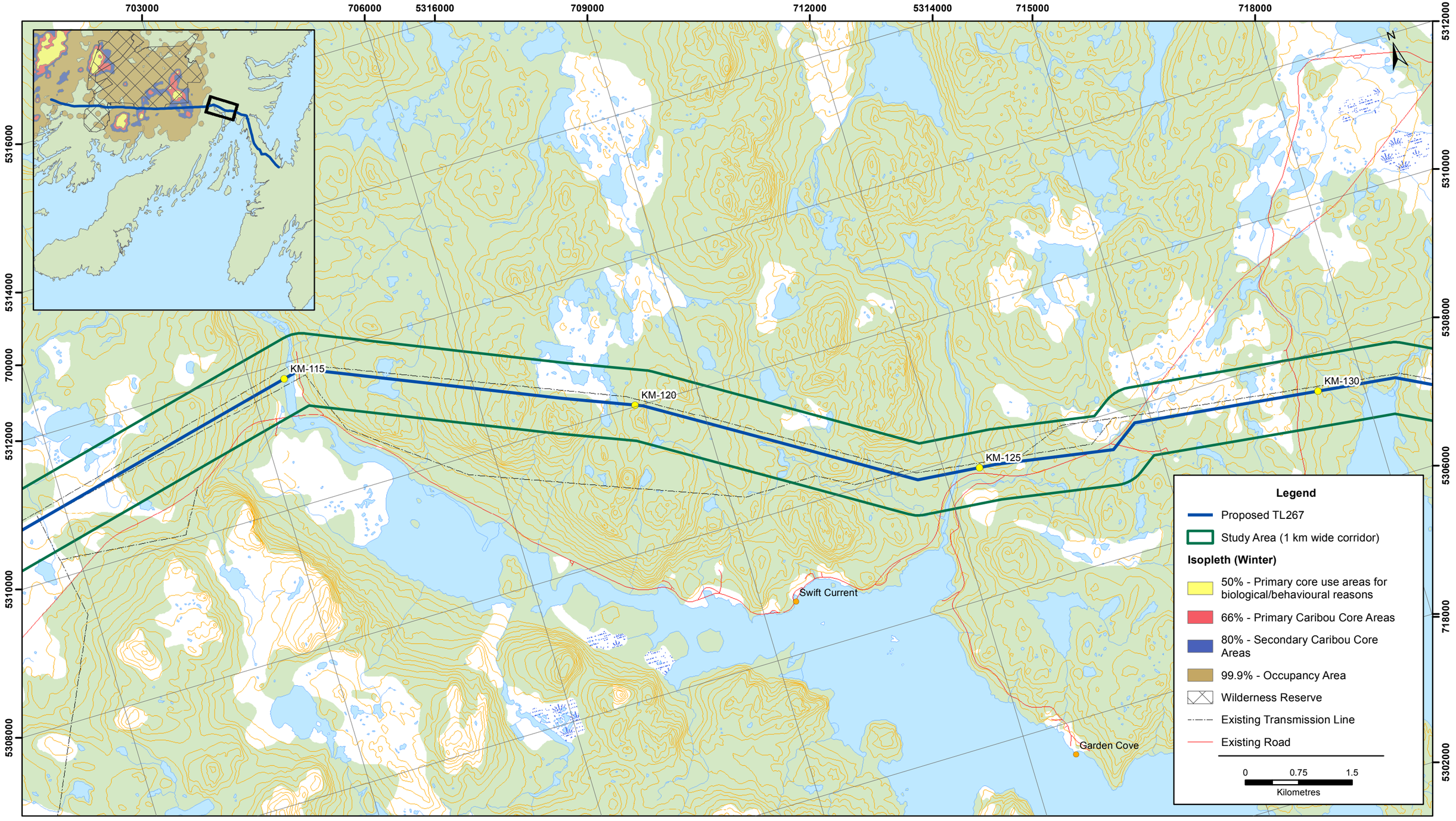
0 0.75 1.5
Kilometres

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU WINTER ISOPLETH

newfoundland labrador hydro a nalcor energy company

amec foster wheeler



PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU WINTER ISOPLETH

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724000 721000 5310000 718000 733000 730000 5292000 727000

Sunnyside

Island Pond

KM-140

KM-145

KM-150

KM-135

KM-130

Placentia Bay

N

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

Isopleth (Winter)

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- Existing Road

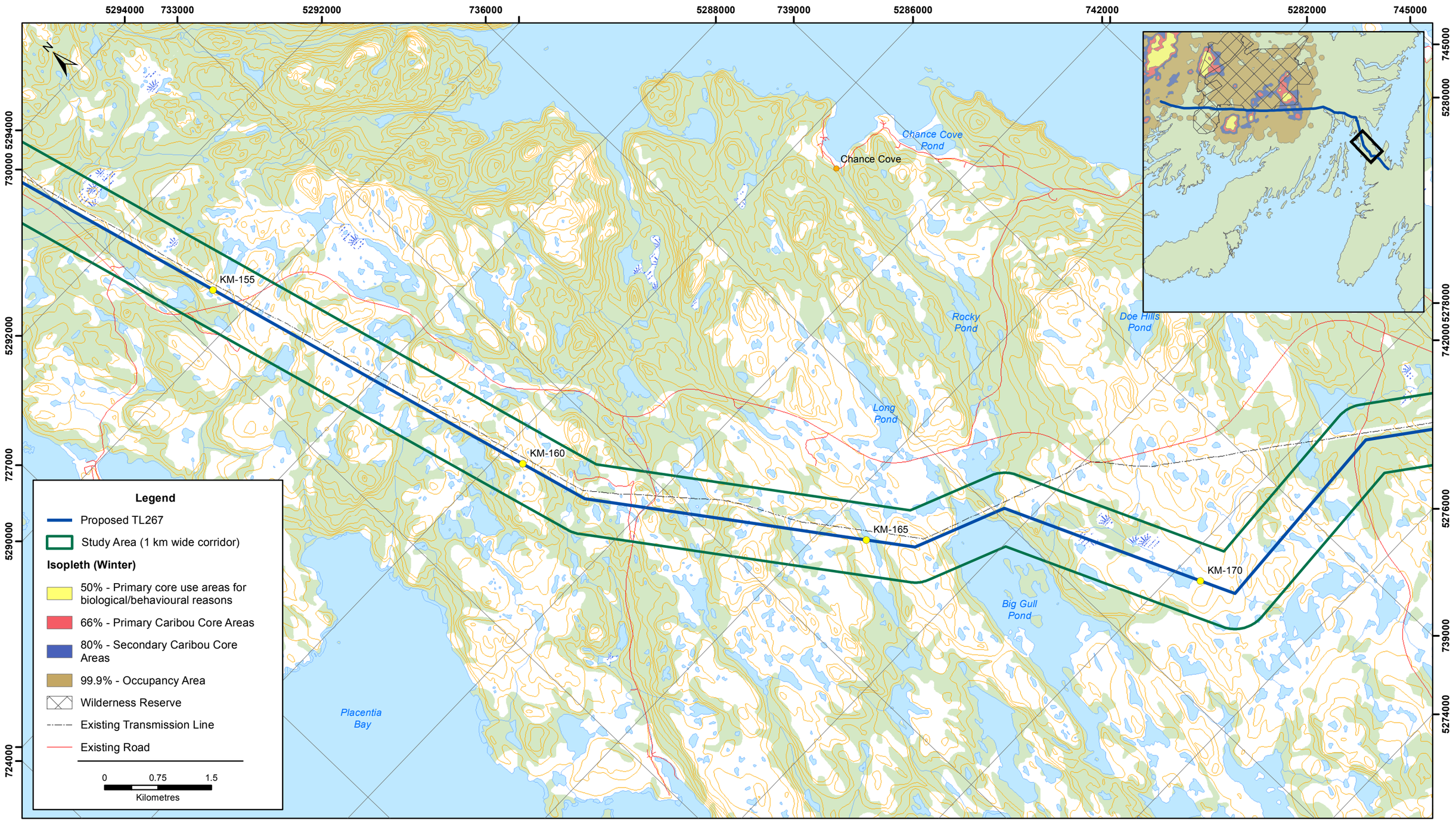
0 0.75 1.5

Kilometres

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU WINTER ISOPLETH

newfoundland labrador hydro a nalcor energy company

amec foster wheeler



PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU WINTER ISOPLETH

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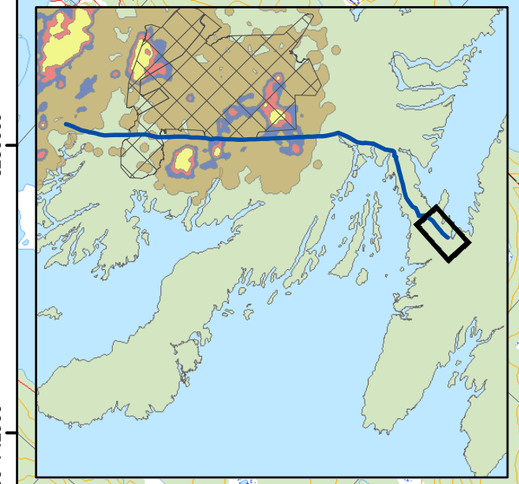
5280000 742000 5278000 739000 5274000

5266000 757000 5264000 754000 5262000 751000



Norman's Cove - Long Cove

Chapel Arm

KM-175

KM-180

KM-185

Beaver Pond

Beaver Pond

Blue Gull Pond

N

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

Isopleth (Winter)

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- Existing Road

0 0.75 1.5

Kilometres

newfoundland labrador hydro a nalcor energy company

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU WINTER ISOPLETH

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Appendix C

Map Atlas: Caribou Core Areas – Spring

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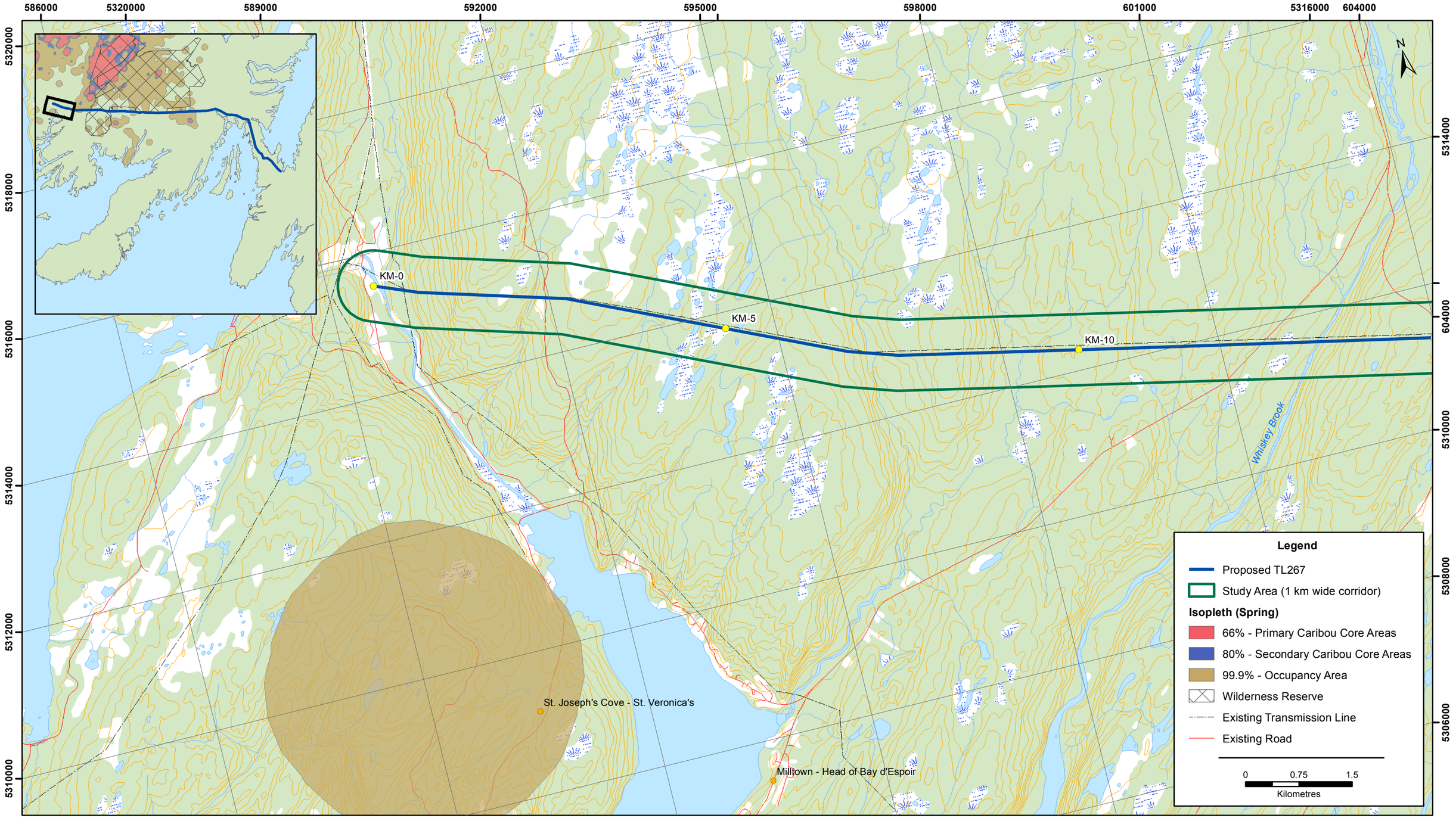

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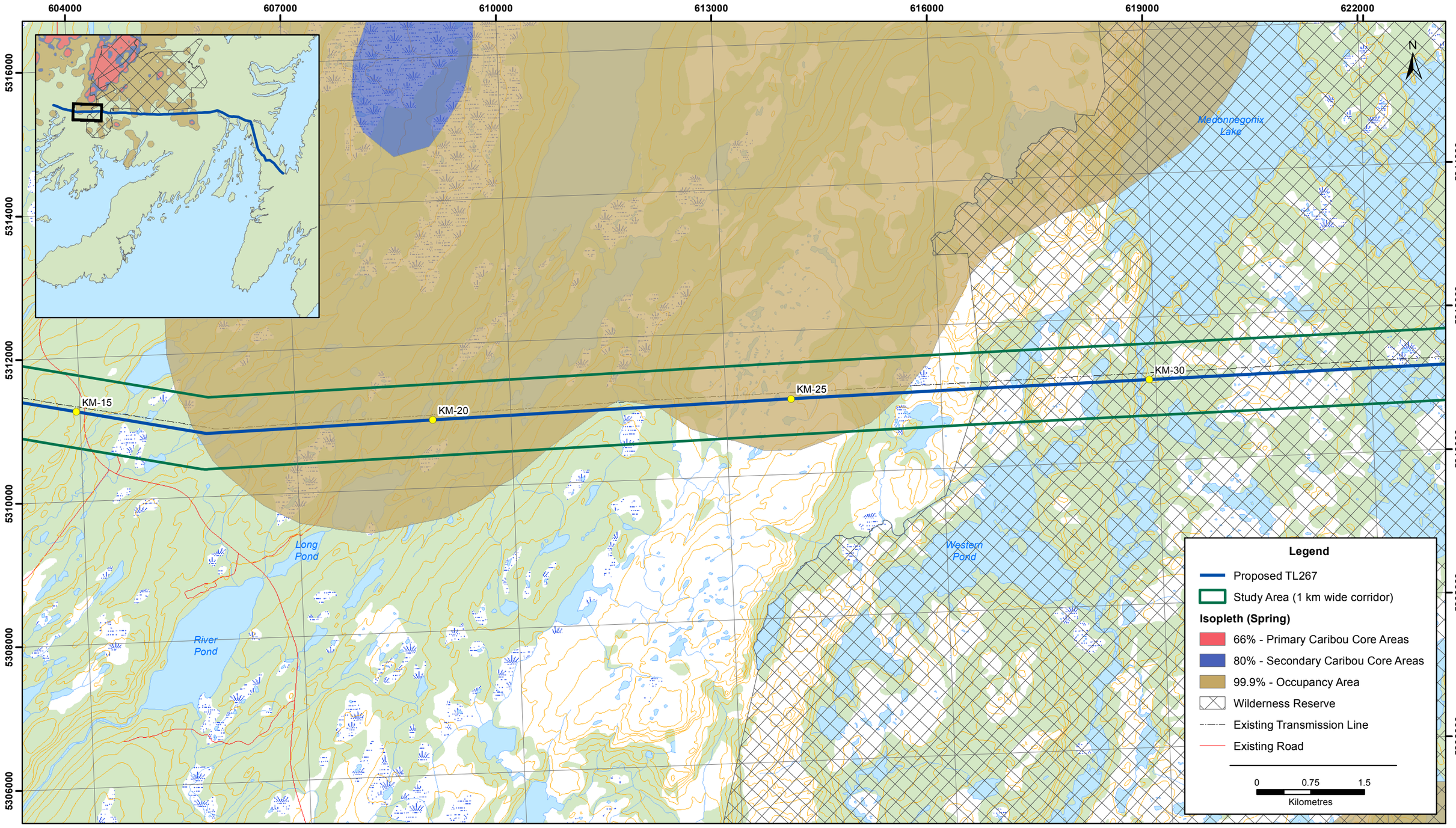

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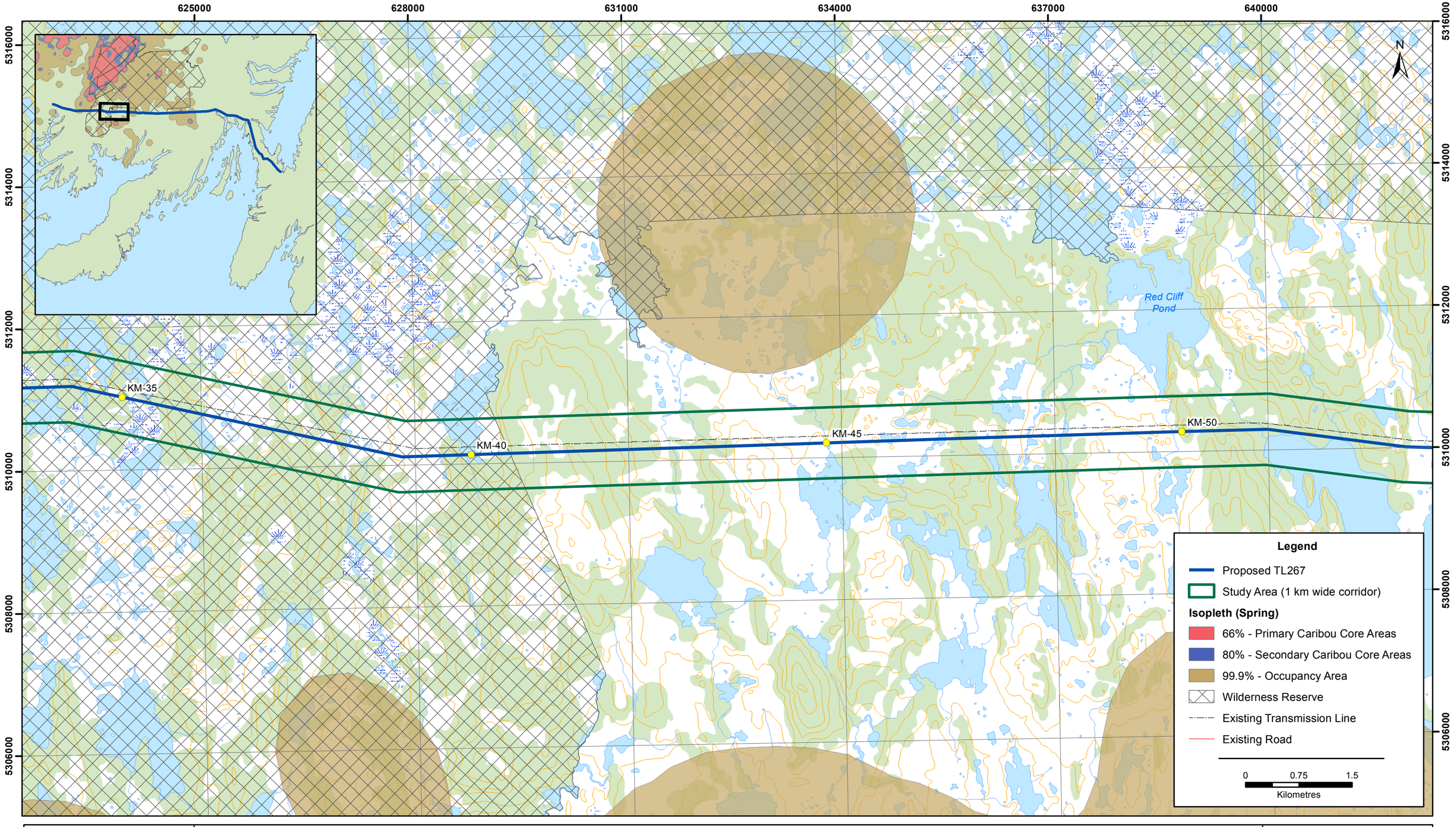

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU SPRING ISOPLETH

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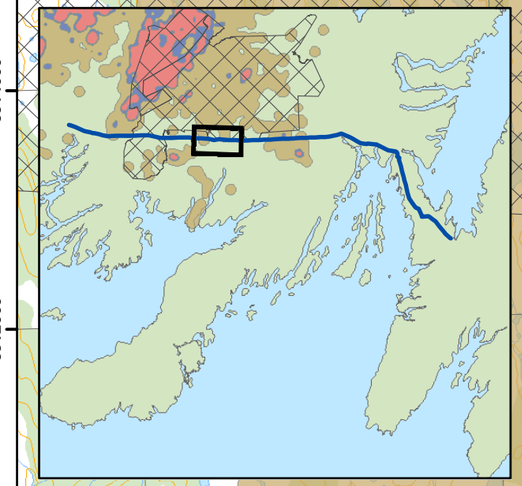

N

KM-55

KM-60

KM-65

KM-70

Pin Hill Brook

Beaver Brook

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

Isopleth (Spring)

- 66% - Primary Caribou Core Areas
- 80% - Secondary Caribou Core Areas
- 99.9% - Occupancy Area
- Wilderness Reserve
- Existing Transmission Line
- Existing Road

0 0.75 1.5

Kilometres

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU SPRING ISOPLETH

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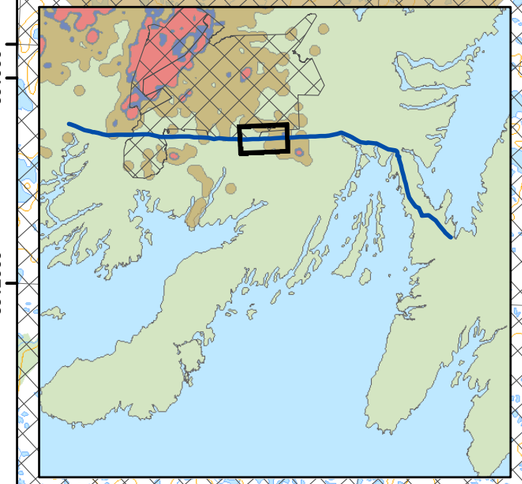
5314000 5312000 5310000 5308000 5306000 5304000



N

Pin Hill Pond

KM-75 KM-80 KM-85 KM-90

Dunns Mountain Pond

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

Isopleth (Spring)

- 66% - Primary Caribou Core Areas
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- Existing Transmission Line
- Existing Road

0 0.75 1.5
Kilometres

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU SPRING ISOPLETH

682000 685000 688000 5316000 691000 694000 697000

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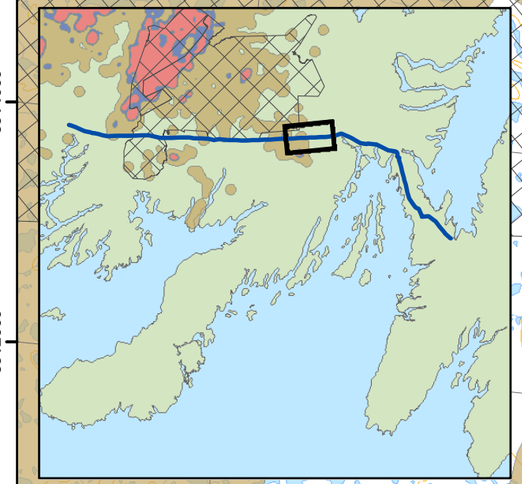

KM-95 KM-100 KM-105 KM-110

Long Pond

N

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

Isopleth (Spring)

- 66% - Primary Caribou Core Areas
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- Wilderness Reserve
- Existing Transmission Line
- Existing Road

0 0.75 1.5
Kilometres

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU SPRING ISOPLETH

nalcor energy

amec foster wheeler

703000 706000 5316000 709000 712000 5314000 715000 718000

5312000 5310000 5308000 5306000 5302000

5316000 5314000 700000 5312000 5310000 5308000 718000

N

KM-115 KM-120 KM-125 KM-130

Swift Current

Garden Cove

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

Isopleth (Spring)

- 66% - Primary Caribou Core Areas
- 80% - Secondary Caribou Core Areas
- 99.9% - Occupancy Area
- Wilderness Reserve
- Existing Transmission Line
- Existing Road

0 0.75 1.5

Kilometres

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU SPRING ISOPLETH

727000 5312000 5310000 5308000 730000 5306000 5304000 5302000 733000 5298000 5296000

724000 721000 5310000 718000 733000 730000 727000 5292000

Sunnyside

KM-140

KM-145

KM-150

KM-135

KM-130

Island Pond

Jacks Pond

Placentia Bay

N

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

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0 0.75 1.5
Kilometres

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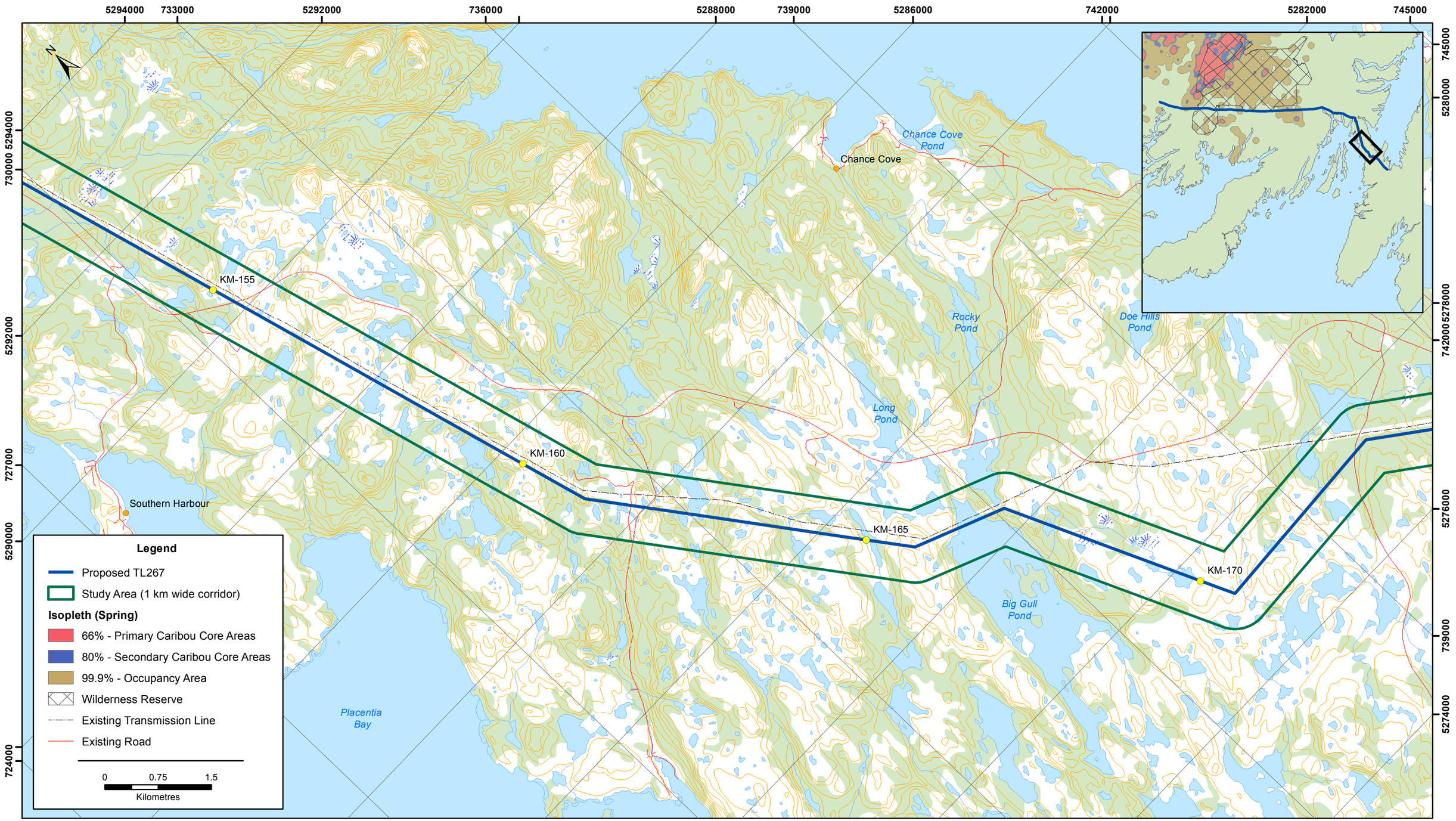

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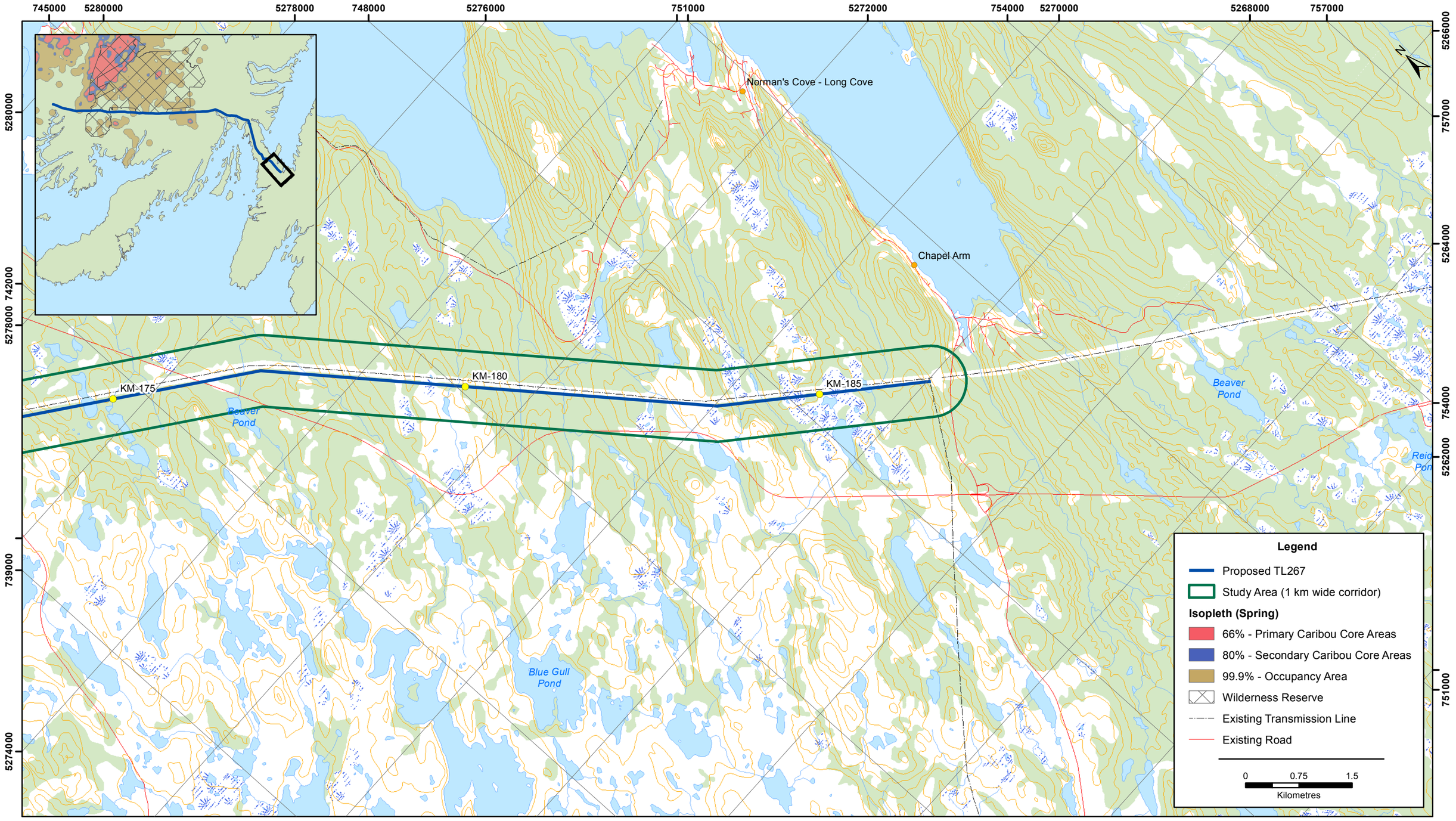

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU SPRING ISOPLETH

Appendix D

Map Atlas: Caribou Core Areas – Summer

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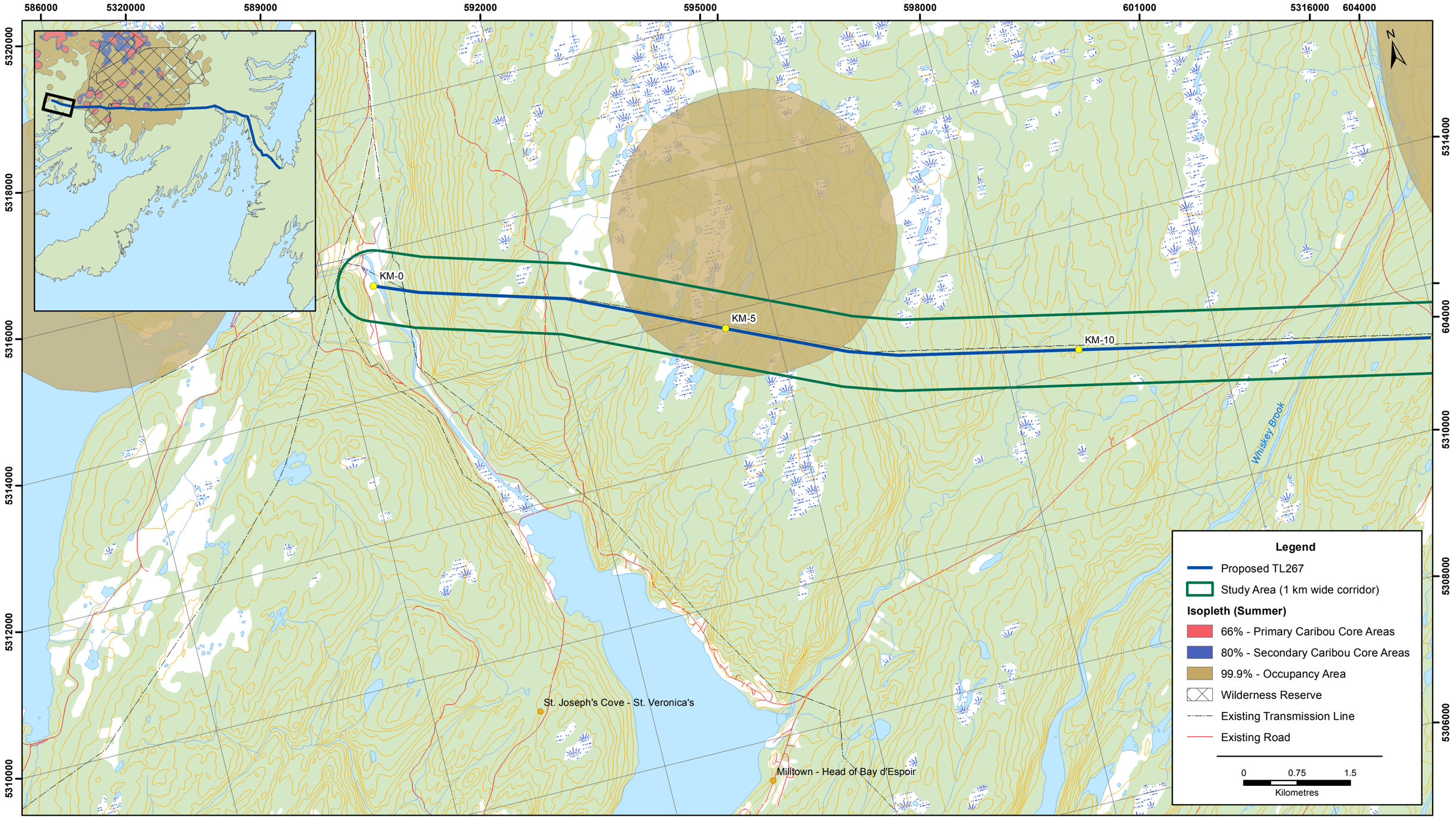
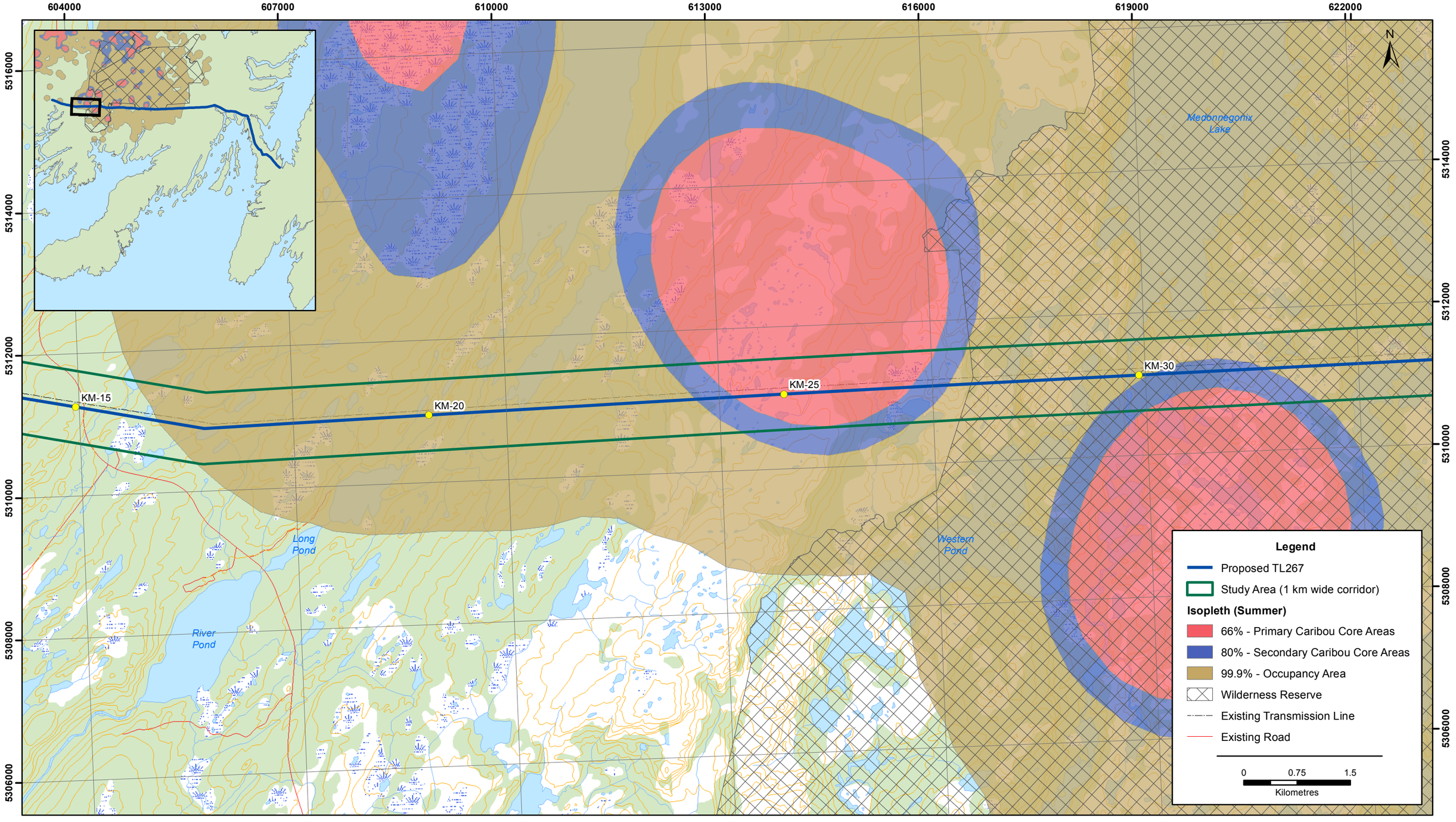


PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU SUMMER ISOPLETH

newfoundland labrador hydro
a nalcor energy company

amec foster wheeler



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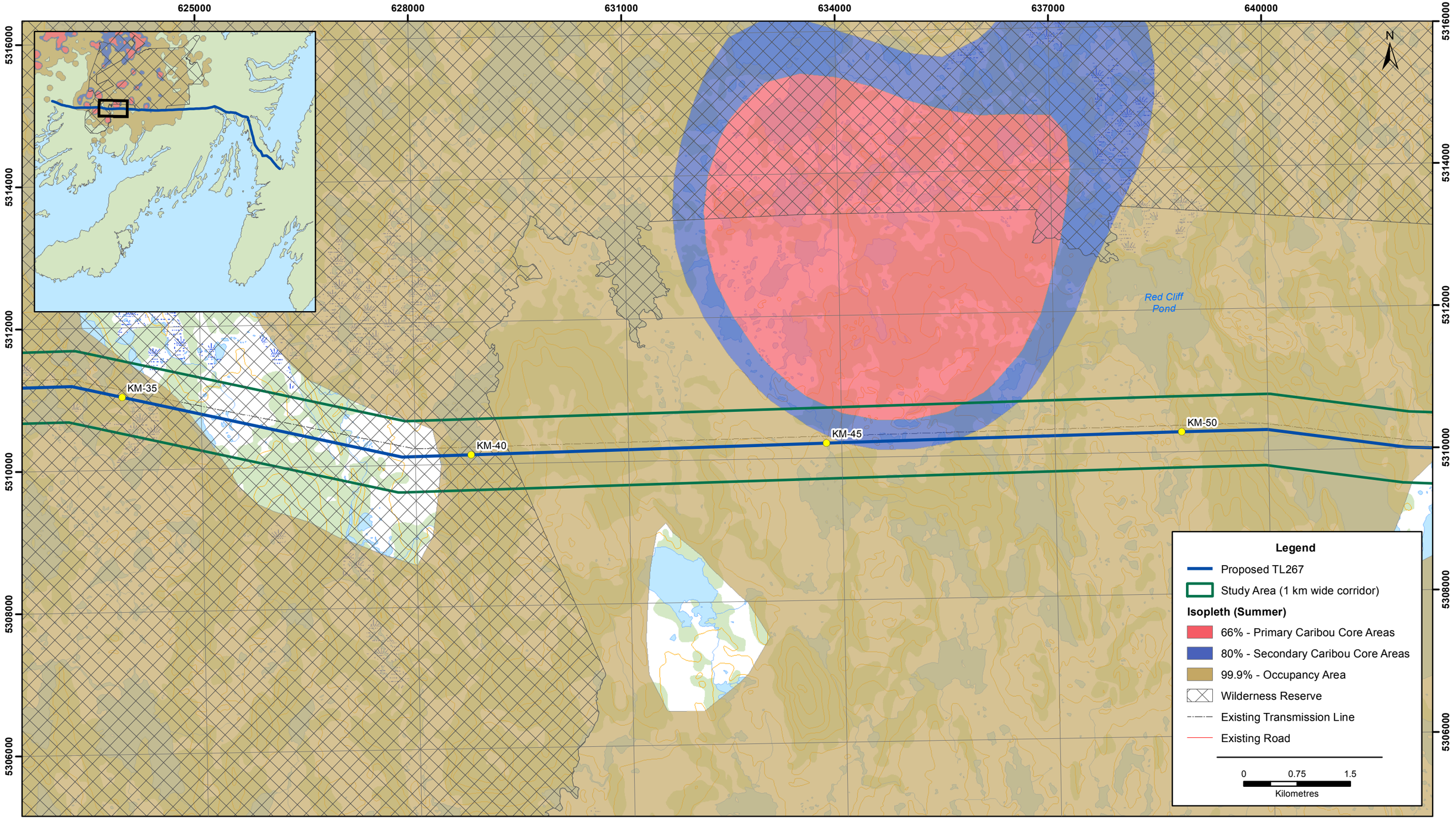

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU SUMMER ISOPLETH

643000 646000 649000 652000 655000 658000 661000

5314000 5312000 5310000 5308000 5306000 5304000

N

KM-55 KM-60 KM-65 KM-70

Pin Hill Brook

Beaver Brook

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

Isopleth (Summer)

- 66% - Primary Caribou Core Areas
- 80% - Secondary Caribou Core Areas
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- Wilderness Reserve
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- Existing Road

0 0.75 1.5

Kilometres

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU SUMMER ISOPLETH

newfoundland labrador hydro a nalcor energy company

amec foster wheeler

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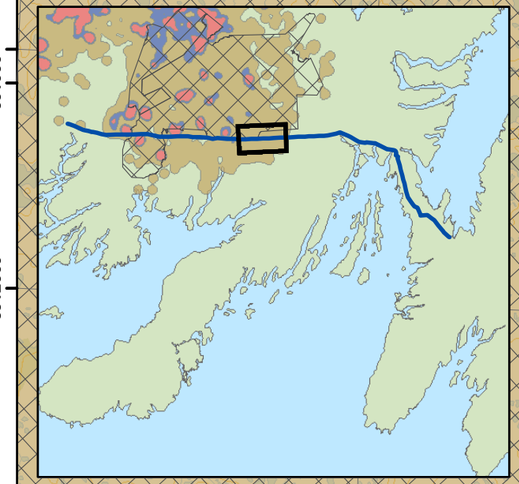

N

Pin Hill Pond

KM-75 KM-80 KM-85 KM-90

Dunns Mountain Pond

Legend

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Kilometres

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newfoundland labrador hydro a nalcor energy company

amec foster wheeler

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5314000 5312000 5310000 5308000 5306000 5304000

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N

KM-95 KM-100 KM-105 KM-110

Long Pond

Legend

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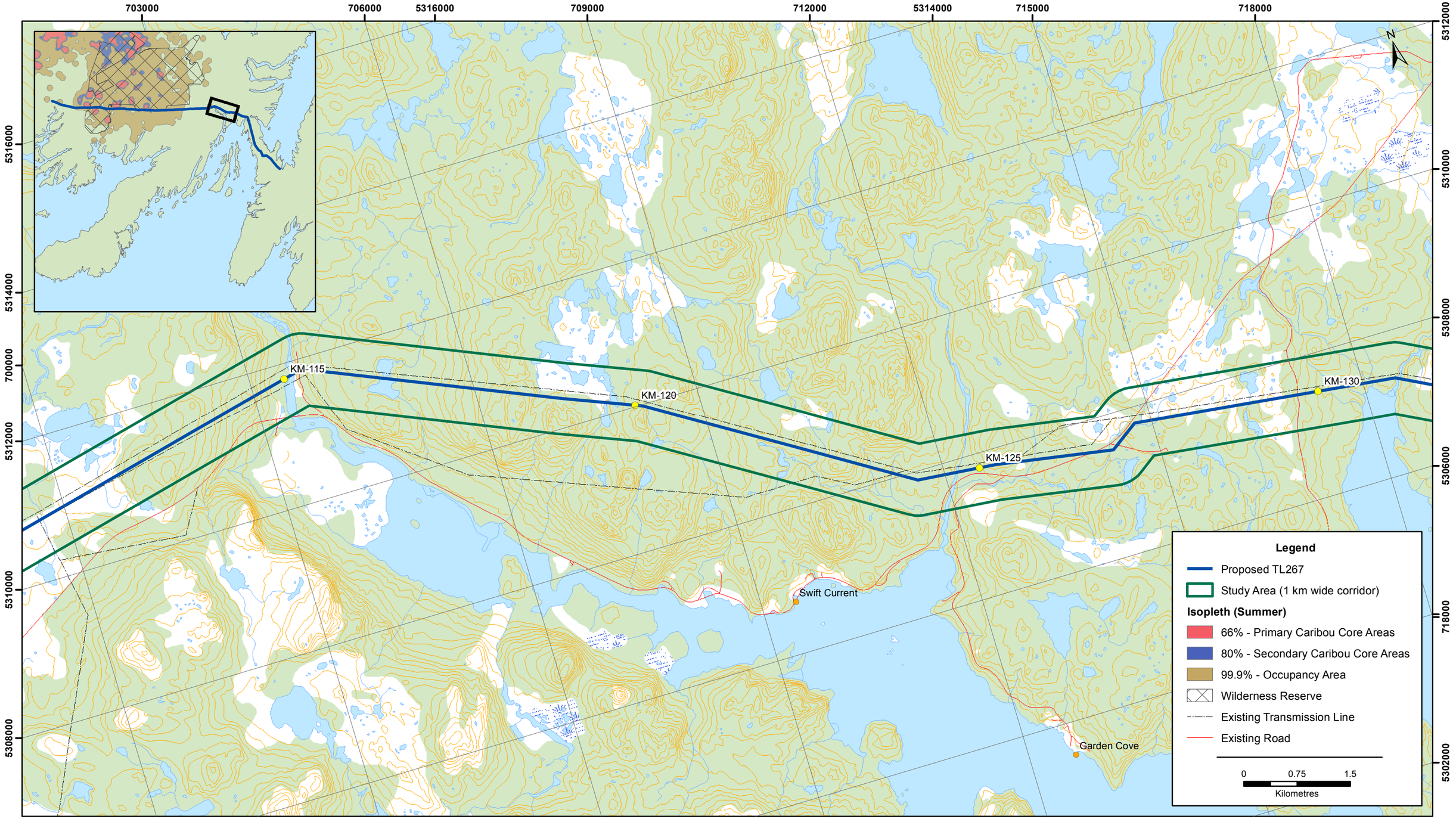
0 0.75 1.5
Kilometres

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU SUMMER ISOPLETH

newfoundland labrador hydro a nalcor energy company

amec foster wheeler



PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU SUMMER ISOPLETH

727000 5312000 5310000 5308000 730000 5306000 5304000 5302000 733000 5298000 5296000

724000 721000 5310000 718000 733000 730000 727000 5292000

Sunnyside

KM-140

KM-145

KM-150

KM-135

KM-130

Island Pond

Jacks Pond

Placentia Bay

N

Legend

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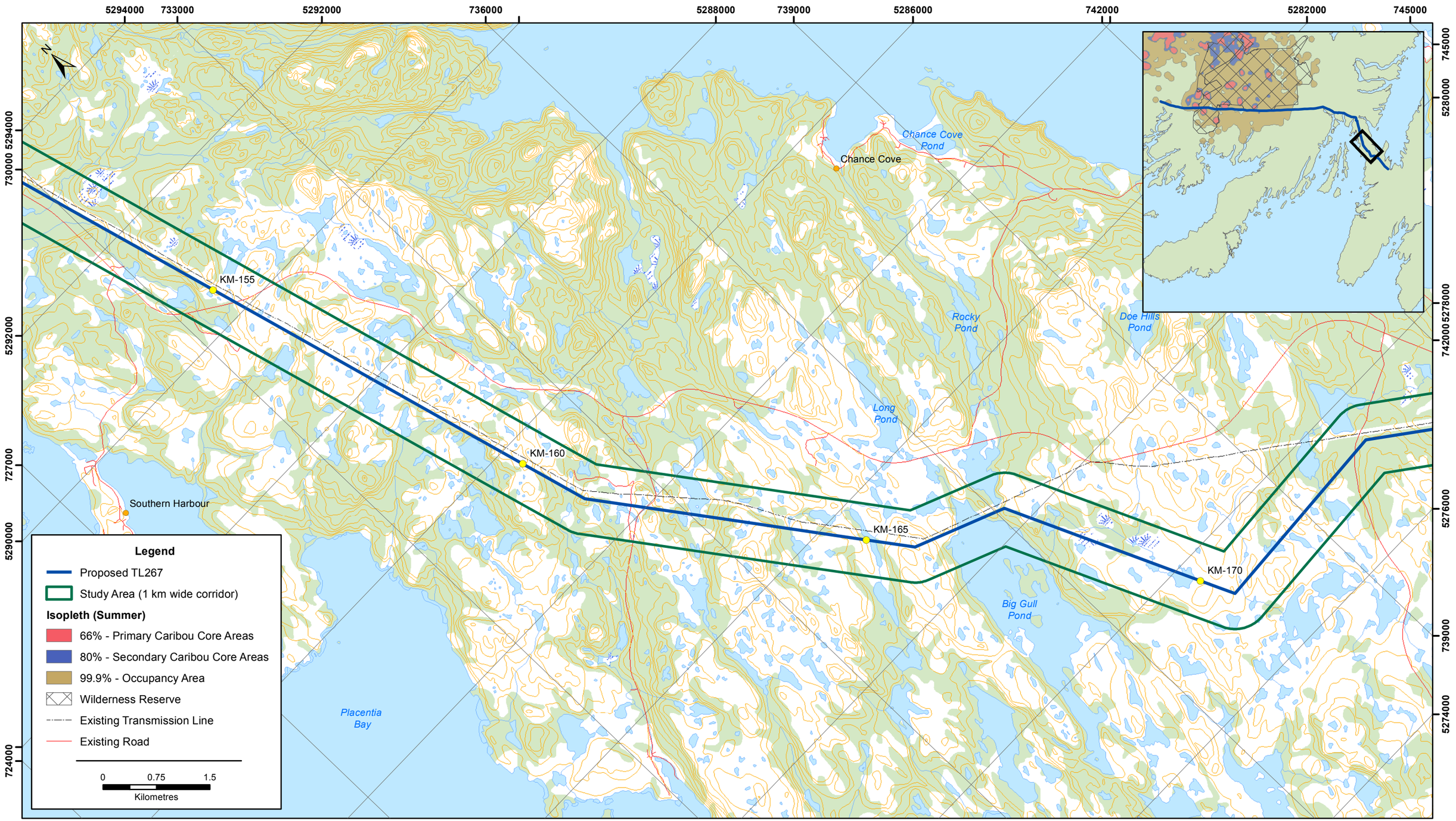
Kilometres

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU SUMMER ISOPLETH

newfoundland labrador hydro a nalcor energy company

amec foster wheeler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5290000
724000
745000
5280000
742000
5278000
5276000
739000
5274000
N
Chance Cove
Chance Cove Pond
KM-155
KM-160
KM-165
KM-170
Rocky Pond
Doe Hills Pond
Long Pond
Big Gull Pond
Southern Harbour
Placentia Bay
Legend
Proposed TL267
Study Area (1 km wide corridor)
Isopleth (Summer)
66% - Primary Caribou Core Areas
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Wilderness Reserve
Existing Transmission Line
Existing Road
0
0.75
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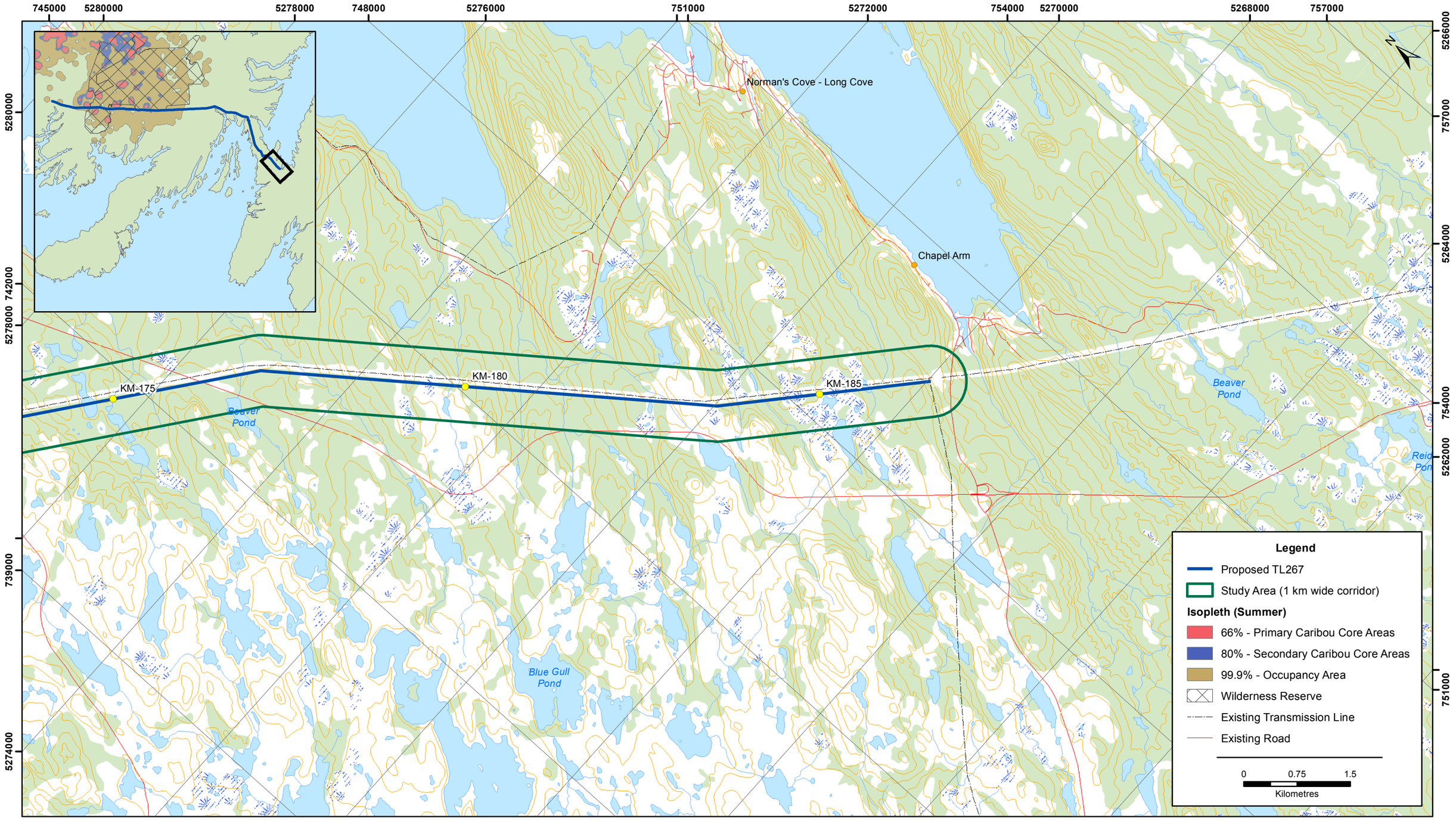
Kilometres



PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU SUMMER ISOPLETH

Appendix E

Map Atlas: Caribou Core Areas – Fall

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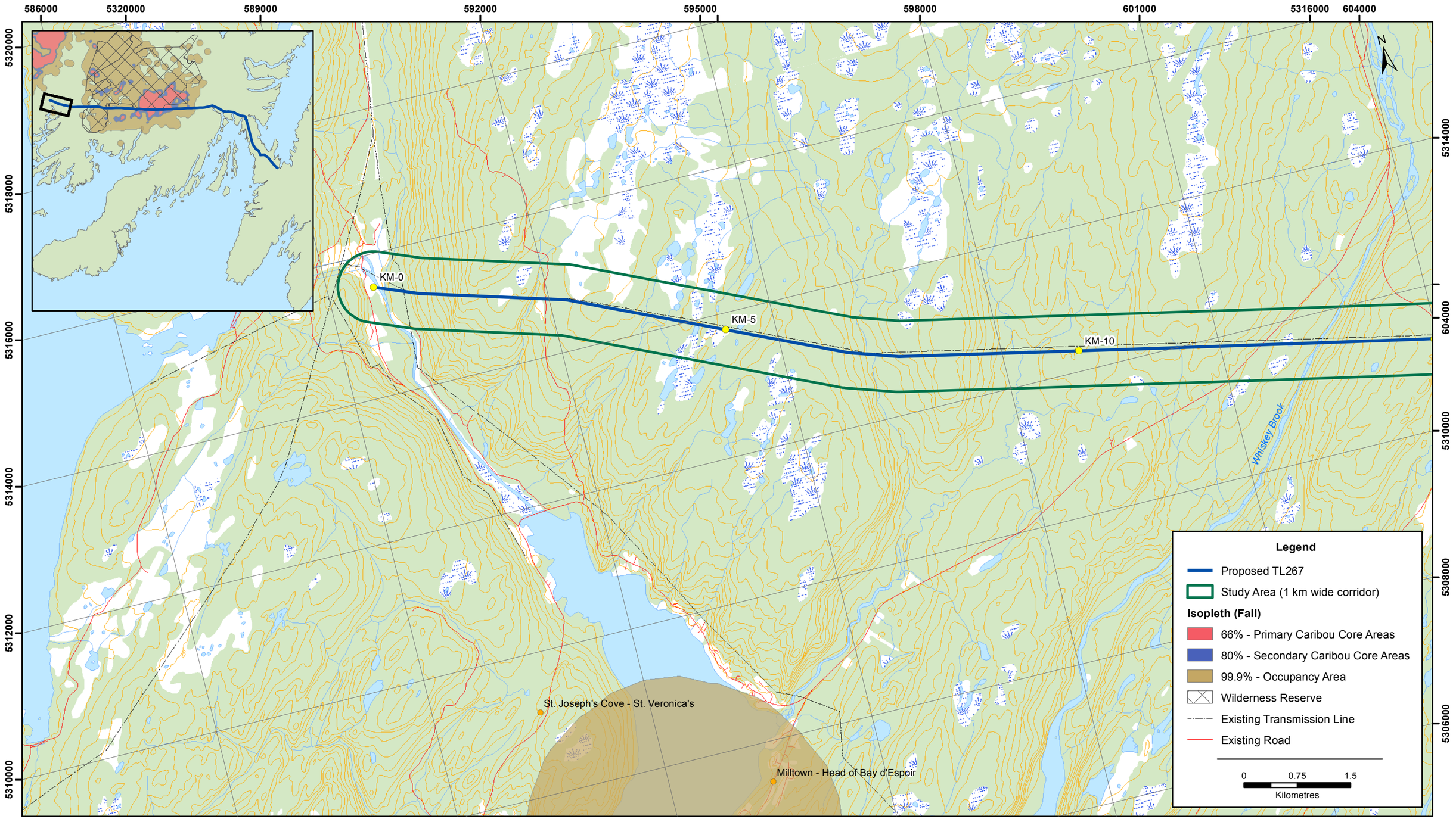
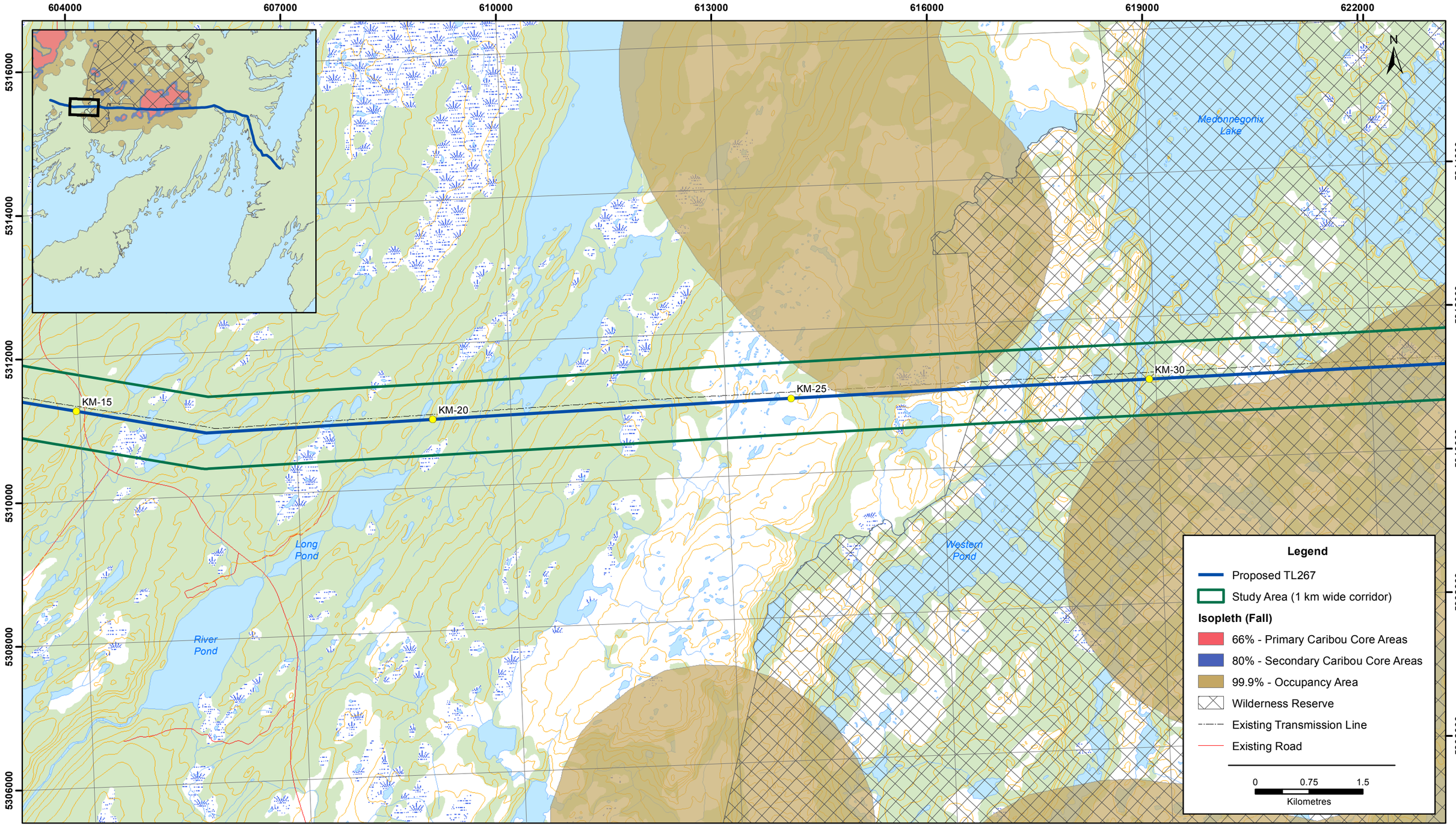


PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU FALL ISOPLETH

newfoundland labrador hydro
a nalcor energy company

amec foster wheeler



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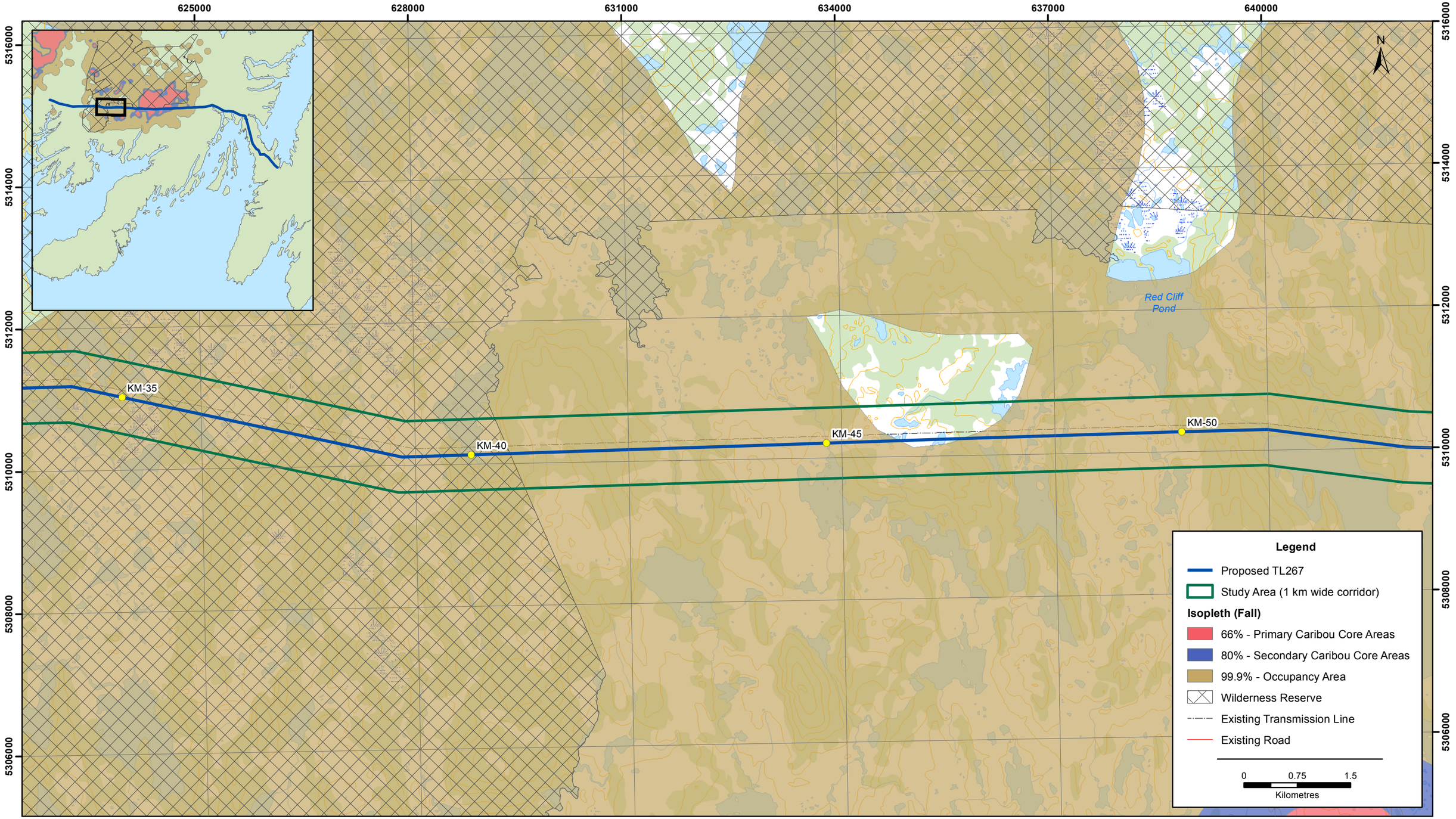


PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU FALL ISOPLETH

643000 646000 649000 652000 655000 658000 661000

5314000 5312000 5310000 5308000 5306000 5304000

N

KM-55 KM-60 KM-65 KM-70

Pin Hill Brook

Beaver Brook

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

Isopleth (Fall)

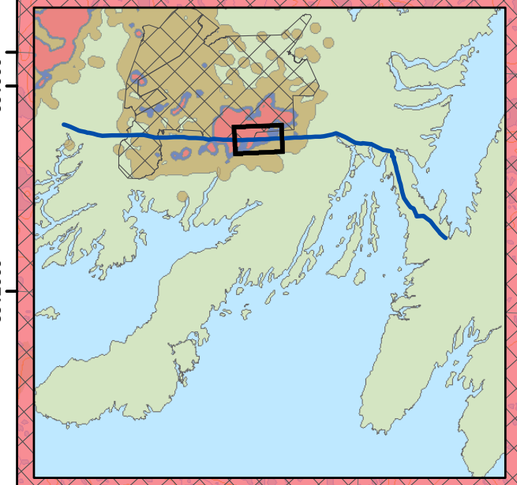
- 66% - Primary Caribou Core Areas
- 80% - Secondary Caribou Core Areas
- 99.9% - Occupancy Area
- Wilderness Reserve
- Existing Transmission Line
- Existing Road

0 0.75 1.5
Kilometres

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU FALL ISOPLETH

661000 664000 667000 670000 673000 676000 679000

5314000 5312000 5310000 5308000 5306000 5304000



N

Pin Hill Pond

KM-75 KM-80 KM-85 KM-90

Dunns Mountain Pond

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

Isopleth (Fall)

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- 99.9% - Occupancy Area
- Wilderness Reserve
- Existing Transmission Line
- Existing Road

0 0.75 1.5

Kilometres

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU FALL ISOPLETH

newfoundland labrador hydro a nalcor energy company

amec foster wheeler

682000 685000 688000 5316000 691000 694000 697000

5314000 5312000 5310000 5308000 5306000 5304000

5316000 5312000 5308000 5306000

N

KM-95 KM-100 KM-105 KM-110

Long Pond

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

Isopleth (Fall)

- 66% - Primary Caribou Core Areas
- 80% - Secondary Caribou Core Areas
- 99.9% - Occupancy Area
- Wilderness Reserve
- Existing Transmission Line
- Existing Road

0 0.75 1.5
Kilometres

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU FALL ISOPLETH

newfoundland labrador hydro a nalcor energy company

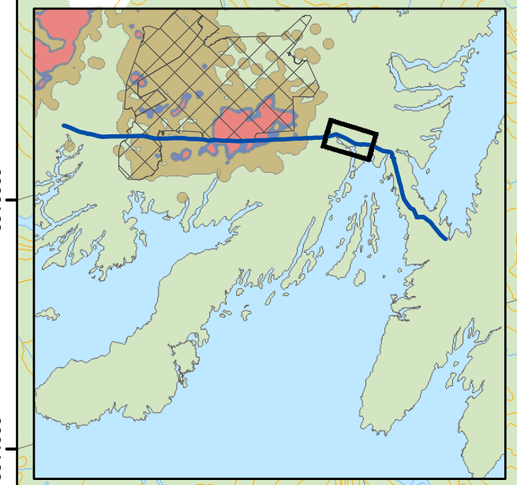
amec foster wheeler

703000 706000 5316000 709000 712000 5314000 715000 718000

5312000

5316000 5314000 700000 5312000 5310000 5308000

5310000 5308000 5306000 718000 5302000



KM-115

KM-120

KM-125

KM-130

Swift Current

Garden Cove

N

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

Isopleth (Fall)

- 66% - Primary Caribou Core Areas
- 80% - Secondary Caribou Core Areas
- 99.9% - Occupancy Area
- Wilderness Reserve
- Existing Transmission Line
- Existing Road

0 0.75 1.5

Kilometres

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU FALL ISOPLETH

newfoundland labrador hydro a nalcor energy company

amec foster wheeler

727000 5312000 5310000 5308000 730000 5306000 5304000 5302000 733000 5298000 5296000

724000 721000 5310000 718000 733000 730000 727000 5292000

Sunnyside

Island Pond

KM-140

KM-145

KM-150

KM-135

KM-130

Jacks Pond

Placentia Bay

Legend

- Proposed TL267
- Study Area (1 km wide corridor)

Isopleth (Fall)

- 66% - Primary Caribou Core Areas
- 80% - Secondary Caribou Core Areas
- 99.9% - Occupancy Area
- Wilderness Reserve
- Existing Transmission Line
- Existing Road

0 0.75 1.5

Kilometres

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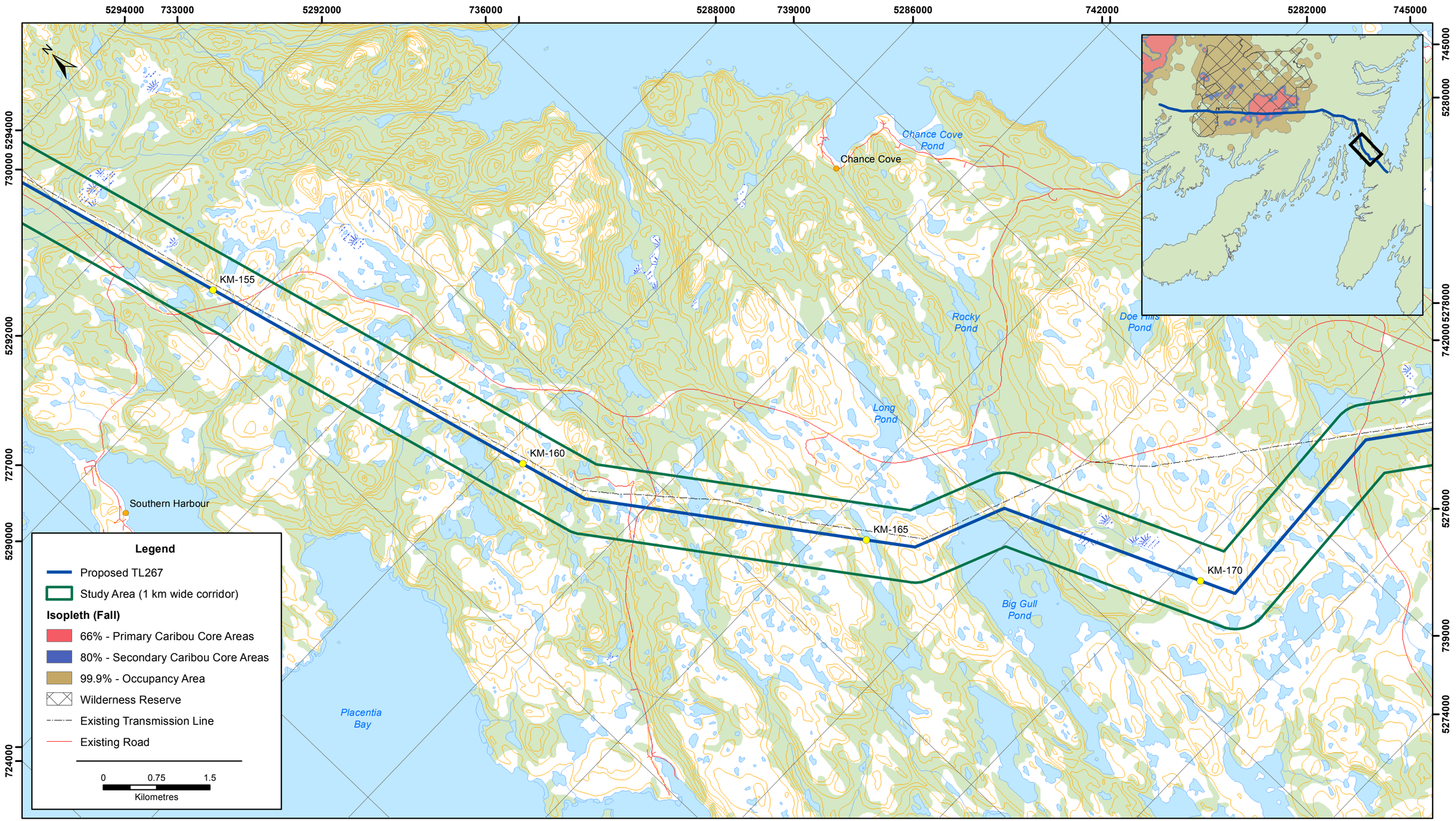

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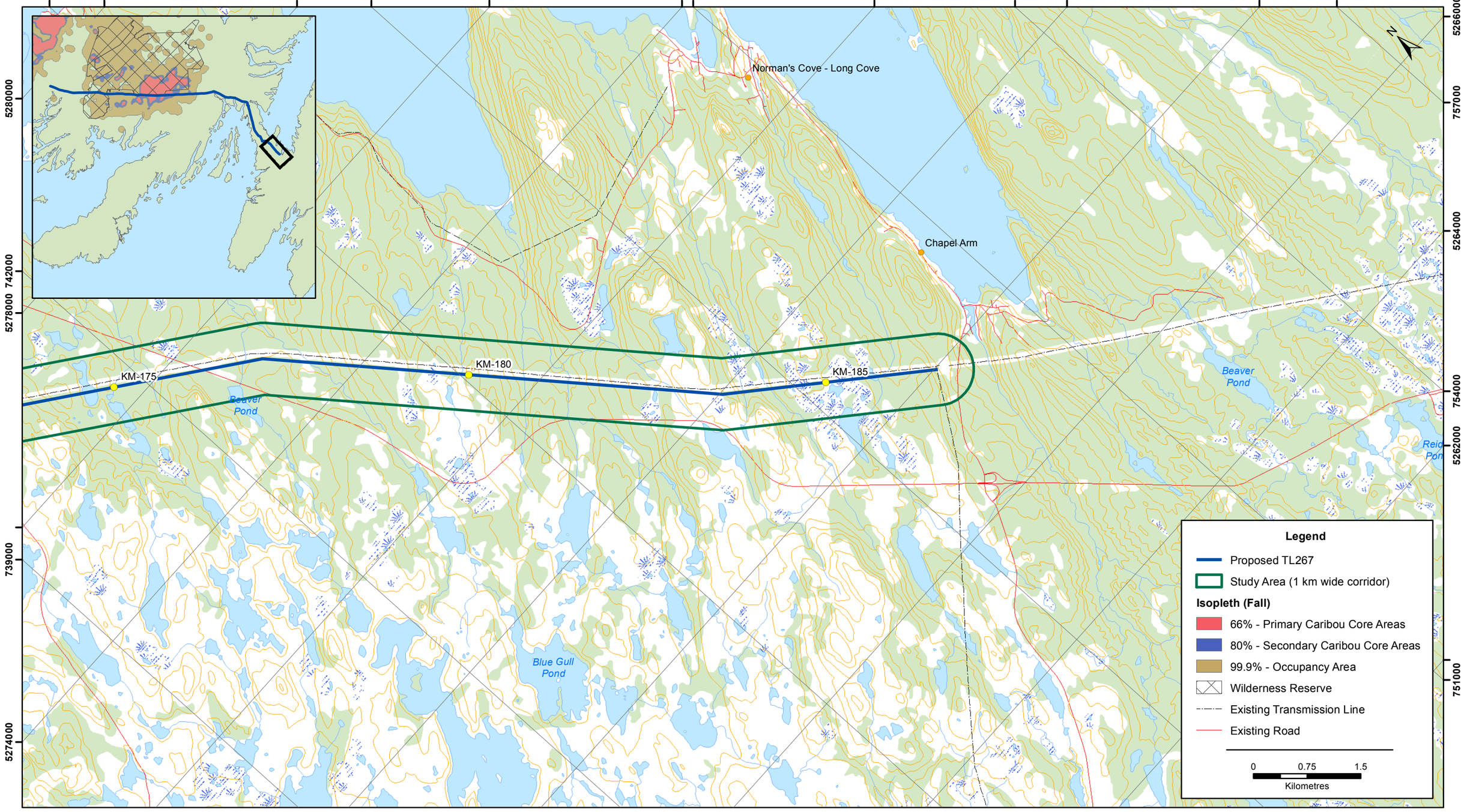

PROPOSED BAY D'ESPOIR TO WESTERN AVALON TRANSMISSION LINE (TL 267) – CARIBOU FALL ISOPLETH

Appendix F

Formerly Recognized Caribou Core Areas in Newfoundland

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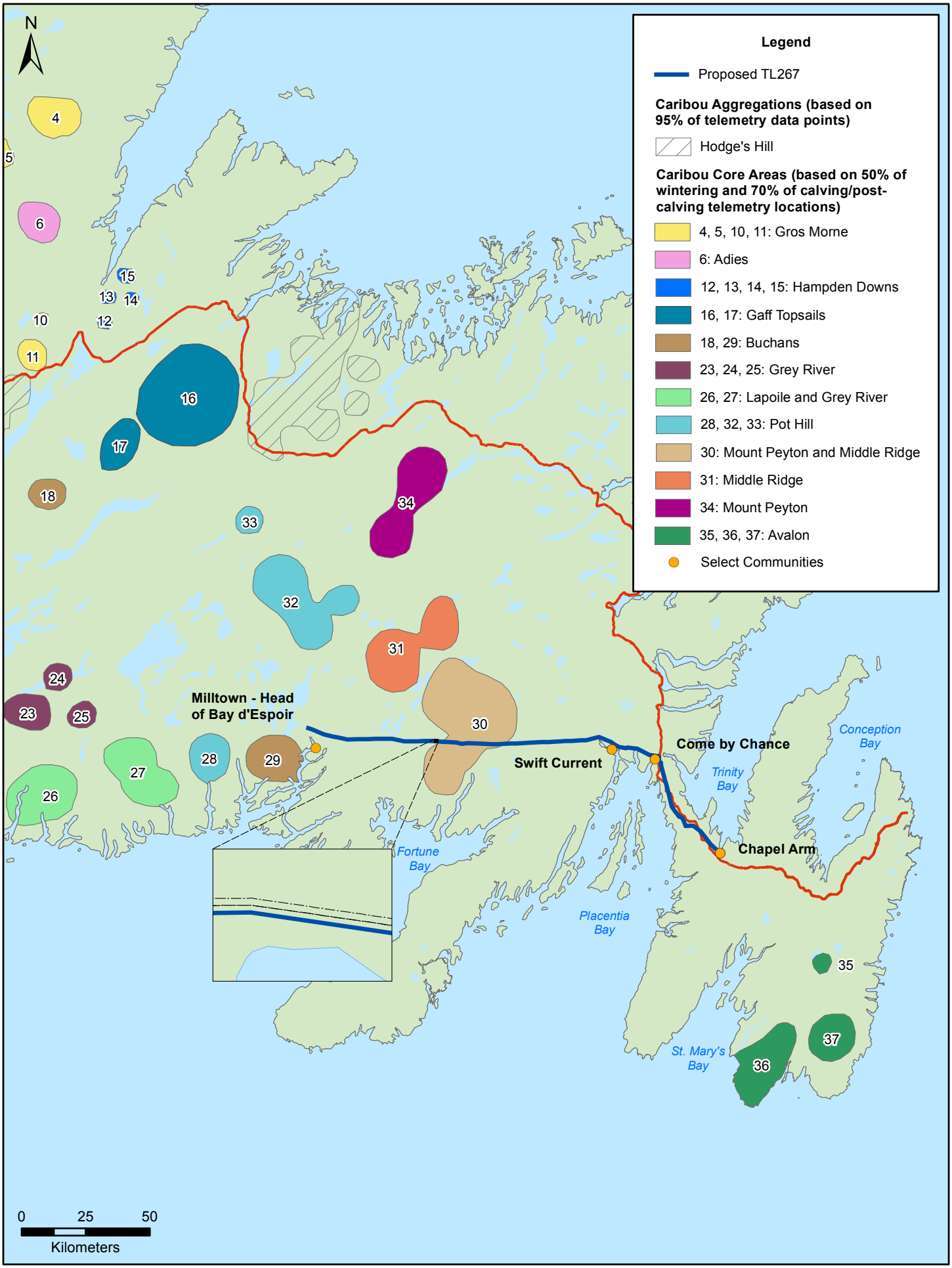
N
Legend
Proposed TL267
Caribou Aggregations (based on 95% of telemetry data points)
Hodge's Hill
Caribou Core Areas (based on 50% of wintering and 70% of calving/post-calving telemetry locations)
4, 5, 10, 11: Gros Morne
6: Adies
12, 13, 14, 15: Hampden Downs
16, 17: Gaff Topsails
18, 29: Buchans
23, 24, 25: Grey River
26, 27: Lapoile and Grey River
28, 32, 33: Pot Hill
30: Mount Peyton and Middle Ridge
31: Middle Ridge
34: Mount Peyton
35, 36, 37: Avalon
Select Communities
Milltown - Head of Bay d'Espoir
Swift Current
Come by Chance
Chapel Arm
Fortune Bay
Placentia Bay
Trinity Bay
Conception Bay
St. Mary's Bay
0
25
50
Kilometers