Labrador – Island Transmission Link

Wetlands Inventory and Classification

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WTO TBR0060 Work Order 664156
Contract #LC-EV-002

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July 26, 2010

EXECUTIVE SUMMARY

Nalcor Energy is proposing to develop the *Labrador – Island Transmission Link* (the Project), a High Voltage Direct Current (HVdc) transmission system extending from Gull Island in Central Labrador to Soldiers Pond on the Island of Newfoundland's Avalon Peninsula. Project planning and design are (as of the time at which this study was completed) at a stage of having identified a proposed 2 km wide corridor for the on-land portions of the proposed HVdc transmission line.

As part of the environmental assessment (EA) for the Project, Nalcor Energy has carried out a regional Ecological Land Classification (ELC), which included the identification, classification and analysis of all wetlands that are located within the proposed transmission corridor, and thus may interact with the proposed Project.

As a part of the ELC field program, wetlands within the transmission corridor were field surveyed (20 in Labrador and 68 in Newfoundland). Vegetation, site photographs and site condition data were collected during those surveys and used to classify the wetland as per the Canadian Wetland Classification System. High-resolution satellite images and aerial photographs of the proposed transmission corridor were incorporated, along with the location of all surveyed wetlands, into a computer-based geographic information system (GIS) and used to delineate wetland boundaries of all wetlands greater than 2 ha. The visual signature specific to each wetland class was derived from the surveyed wetland locations and professional experience and then used to interpret classes and forms for the approximately 1,700 wetlands within the proposed transmission corridor.

Three primary wetland classes - bogs, fens and marshes - were identified within the corridor. A fourth class was derived to encompass complexes of fen and bog that were not practical to separate at the 1:50,000 mapping scale used for the exercise. In total, wetlands cover approximately 8 percent of the proposed transmission corridor in Labrador and approximately 10 percent in Newfoundland. The highest percent cover of wetland is found in central Newfoundland, where wetlands cover approximately 12 percent of the corridor. Bogs are the most common wetland class, covering 3 percent of the corridor area in Labrador and 4 percent in Newfoundland. Fens cover 2 percent in both Labrador and Newfoundland. Marshes cover less than 0.1 percent of the Newfoundland corridor area and are not present in the Labrador portion of the corridor. Bog/fen complexes covered 3 percent in Labrador and 4 percent in Newfoundland.

An atlas of all wetlands delineated to class and form at a scale of 1:50,000 along the entire length of the proposed transmission corridor is included as an appendix to this report.

Although fens and bogs are similar in their role within and interaction with the ecosystem, there are some differences between them and marshes in terms of broad functional categories. Of the three wetland classes within the proposed transmission corridor, bogs have the lowest biological productivity and marshes have the highest. Bogs are an important habitat for many wildlife species; however, the increased biological productivity in fens and in particular, marshes, results in higher overall habitat values. Bogs, fens and marshes all play an important role in attenuating surface water flow, especially some of the larger wetland forms (string bogs, ribbed fens and large marshes). Given the location of the proposed transmission corridor, most wetlands within it are not in populated or developed areas. The relative isolation of the majority of wetlands from developed

areas means they do not receive or filter water affected by farming, industrial processing or other human activities.

The type and level of information provided on wetlands through this study is considered appropriate and adequate for the Project's EA and ongoing planning and design, including the eventual selection of a specific route for the proposed transmission line. In addition to the detailed inventory and classification of wetlands within the proposed 2 km wide transmission corridor provided through this study and report, the larger ELC (Stantec 2010) also identifies and delineates all wetlands within a larger (15 km wide) regional study area that encompasses the proposed corridor and various alternative transmission corridor segments.

Table of Contents

List of Figures

List of Tables

List of Appendices

1.0 INTRODUCTION

Nalcor Energy is proposing to develop the *Labrador – Island Transmission Link* (the Project), a High Voltage Direct Current (HVdc) transmission system extending from Gull Island in central Labrador to Soldiers Pond on the Island of Newfoundland's Avalon Peninsula. The Environmental Assessment (EA) of the Project is ongoing, with an Environmental Impact Statement (EIS) currently being prepared by Nalcor Energy.

In preparation for and in support of the Project's EA, this *Wetlands Inventory and Classification Study* was completed in order to present information on wetlands in the area of, and which may interact with, the proposed Project as environmental baseline information for use in the EIS.

Specifically, this report presents the results of a wetland inventory and classification exercise within the proposed 2 km wide transmission corridor of the HVdc transmission line. The report:

- provides a background of wetlands and their development in Newfoundland and Labrador;
- identifies and classifies all of the wetlands within the proposed transmission corridor as per the Canadian Wetland Classification System; and
- presents a functional analysis overview of each wetland class.

1.1 Project Overview

The Project involves the construction and operation of transmission infrastructure within and between Labrador and the Island of Newfoundland.

The proposed transmission system, as currently planned, will include the following key components:

- an ac-dc converter station at Gull Island in central Labrador, on the north side of the Churchill River adjacent to the switchyard for the Lower Churchill Hydroelectric Generation Project;
- an HVdc transmission line extending from Gull Island across southeastern Labrador to the Strait of Belle Isle. This overhead transmission line will be approximately 407 km in length with a cleared right-of-way averaging 60 m wide, and consist of single galvanized steel lattice towers;
- cable crossings of the Strait of Belle Isle with associated infrastructure, including cables placed under the seafloor across the Strait through various means to provide the required cable protection;
- an HVdc transmission line (similar to that described above) extending from the Strait of Belle Isle across the Island of Newfoundland to the Avalon Peninsula, for a distance of approximately 688 km;
- a dc-ac converter station at Soldiers Pond on the Island of Newfoundland's Avalon Peninsula; and
- electrodes in Labrador and on the Island, with overhead lines connecting them to their respective converter stations.

Project planning and design are currently at a stage of having identified a 2 km wide corridor for the on-land portion of the proposed transmission line, and 500 m wide corridors for the proposed Strait of Belle Isle cable crossings, as well as various alternative corridor segments in particular areas.

It is these proposed transmission corridors and components that were the subject of Nalcor Energy's environmental baseline study program. Project planning is in progress, and it is anticipated that the Project description will continue to evolve as engineering and design work continue. The EA of the Project will also identify and evaluate alternative means of carrying out the Project that are technically and economically feasible.

In conjunction and concurrent with the EA process, Nalcor Energy will be continuing with its technical and environmental analyses of the corridors, in order to identify and select a specific routing for the Project. The eventual transmission routes and locations will be selected with consideration of technical, environmental and socioeconomic factors.

1.2 Study Purpose

The purpose of this *Wetlands Inventory and Classification Study* is to identify, inventory and classify the wetlands within the currently identified transmission corridor and to provide a functional analysis of each wetland class. This regional environmental baseline information will be used in the EA of the Project, as well as ongoing Project planning and design work, including the eventual (post- EA) transmission line routing.

Planning and design work for the proposed Project to date, including the selection of a general Project study area and an eventual corridor for the transmission line, has included consideration of a range of environmental and technical factors. This has included an attempt to avoid difficult terrain and environmentally sensitive areas, such as wetlands, wherever possible. However, given the relative ubiquity of wetlands throughout Newfoundland and Labrador and the linear nature and overall geographic extent of the proposed transmission line, it is inevitable that the Project will interact to some degree with wetlands in the province.

The eventual transmission line routing (as described above) will play a key role in addressing potential interactions with and effects on wetlands. This will involve identifying (and attempting to avoid, where possible) these wetlands, for both practical and environmental reasons. In addition, and through its standard construction and operating procedures, Nalcor Energy currently has in place effective processes and proven measures to minimize the effects of its activities on vegetation and wetlands. These issues and mitigation measures will be further identified and proposed through the EA process.

1.3 Study Area and Approach

The wetland inventory was developed at a scale of 1:50,000 for an area of land 2 km wide and approximately 1,100 km long, from Gull Island in Labrador to Soldiers Pond on the Avalon Peninsula in Newfoundland as defined in Appendix A (Index). Alternative transmission corridor segments, as identified in Appendix A, are not considered directly in this detailed inventory. In addition to the detailed inventory and classification of wetlands within the proposed 2 km wide transmission corridor provided through this study and report, the larger Ecological Land Classification (ELC) (Stantec 2010) also identifies and delineates all wetlands within a larger (15 km wide) regional study area which encompasses the proposed transmission corridor and various alternative transmission corridor segments.

In this study, wetlands are described within an Ecoregions Framework (Figure 1.1) following Meades (1990) for Labrador (Table 1.1), and Damman (1983) for the Island of Newfoundland (Table 1.2). Descriptions within this report follow a north-south direction from Gull Island in Labrador to the Strait of Belle Isle and from the Strait of Belle Isle to Soldiers Pond in Newfoundland. Each Ecoregion is delineated according to differences in regional climate where the relationship between species and habitat is basically similar. Thus, each Ecoregion has a distinctive, recurring pattern of vegetation and soil development controlled by regional climate and physiographic factors (Damman 1983). The same class of wetlands may occur in different Ecoregions, but each Ecoregion will have a distinctive assemblage of the different wetland classes as a result of regional influences such as climate (especially rainfall, temperature, and cloudiness) and regional-scale topography, geology and physiography.

The wetlands described in this report are classified according to the Canadian Wetlands Classification System (Warner and Rubec 1997). Each of the classes of wetlands (e.g., bogs, fens, marshes and swamps) can be divided primarily on the basis of ecological and floristic features, and further subdivided into a variety of wetland forms on the basis of surface morphology of the wetland (e.g., slope, raised, flat), position in the landscape (e.g., valley, delta, basin), surface features (e.g., ridges, nets, ribbed, mounds) and proximity to water bodies and tidal effects.

As a result of the geographic extent of the Project and the regional scale of this study, as well as the kinds of wetlands that occur at this scale, the focus of this study is at the level of the wetland form, almost completely within the bog and fen wetland classes.

To enhance the understanding of the wetlands that occur within the proposed transmission corridor, and the many processes that form them, a discussion is presented regarding some of the more important factors that affect formation and development of wetlands.

Wetlands are important and valued because of their biological, biogeochemical and hydrologic functions, including their role in the natural purification and storage of freshwater, in runoff and flood control, and as habitats for waterfowl, fish and other wildlife. Their protection is also the subject of various federal, provincial and municipal agreements, legislation and policies. Therefore, a general discussion of functional assessments of wetlands is also presented.

1.4 Wetland Formation and Development

Wetlands are defined as lands having the water table at, near, or above the land surface, or are saturated for a long enough period to promote wetland aquatic processes, as indicated by wet soils, hydrophilic vegetation and various kinds of biological activity that are adapted to wetland environments (Tarnocai 1980). While many environmental, ecological, biological, biogeochemical and hydrological factors are involved in the formation, development and/or maintenance of wetlands, it is the strong relationship between microbial activity and soil environmental conditions that ultimately determines the accumulation of organic matter in these ecosystems.

Figure 1.1 Ecoregions of Newfoundland and Labrador

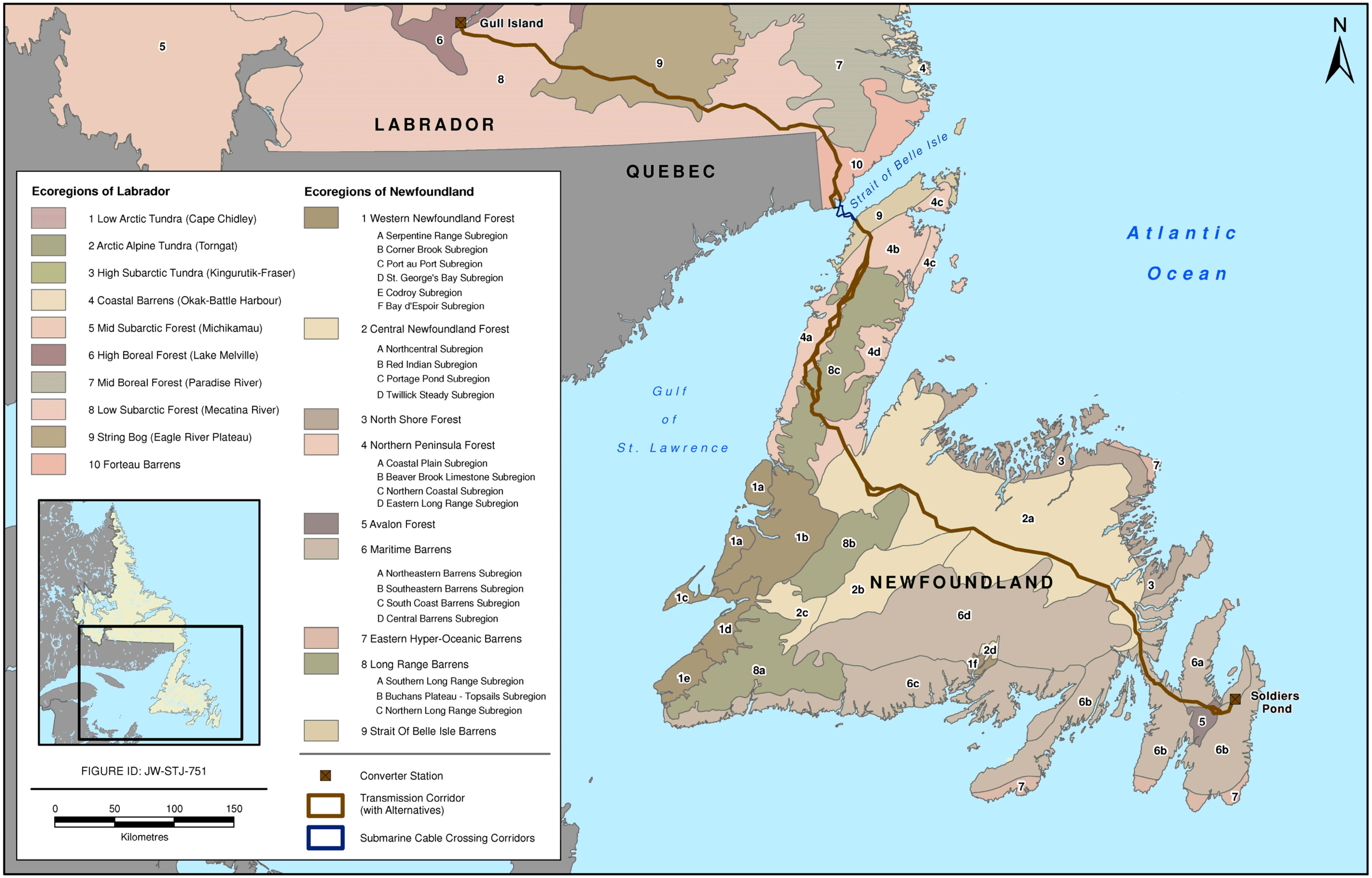


Table 1.1 Description of Labrador Ecoregions Crossed by the Transmission Corridor

Ecoregions
High Boreal Forest (Lake Melville) Ecoregion This Ecoregion encompasses the Churchill River Valley and the coastal plain surrounding Lake Melville. It has the most favourable climate in Labrador, with cool summers and cold winters. Forests are closed crown and highly productive. Growing season is 120 to 140 days, precipitation (adjusted) ranges from <1,000 to 1,100 mm, and mean daily temperatures are 13°C (>+14°C) in July and -14°C to -18°C in February. Plateau bogs occur along the southern coastal plain of Lake Melville and ribbed fens occur in poorly drained upland depressions and slopes.
String Bog (Eagle River Plateau) Ecoregion The Eagle River Plateau comprises this Ecoregion. Wet string bogs and, to a lesser extent, ribbed fens, with open pools, dominate the whole area. The plateau is composed of large areas of these peatlands interrupted only by a few conspicuous eskers and shallow rivers. Productive forests, similar to those of the Low Subarctic Forest (Mecatina River), occur only on bedrock-controlled slopes approaching the Mealy Mountains. The climate is subarctic, with both cool summers and cool winters. Growing season is 120 to 140 days, precipitation (adjusted) is 1,000 to 1,200 mm, mean snowfall is 5 m and mean daily temperatures are 13°C in July and -13°C to -16°C in February.
Low Subarctic Forest (Mecatina River) This Ecoregion occurs primarily in southern Labrador, but with an outlier located north of Lake Melville and another north of the Red Wine Mountains. The climate is continental to subarctic, with warm to cool summers and cold winters. Growing season is 120 to 140 days, precipitation (adjusted) ranges from 800 to 1,300 mm, and average daily temperatures are 13°C in July and -13°C to -21°C in February. Black spruce is the dominant tree species, while spruce woodland occurs on drier sites. Extensive string bogs, ribbed fens and string bog ribbed fen complexes cover large areas of this region.
Forteau Barrens Ecoregion This Ecoregion is located at the southeastern most area of Labrador, adjacent to the Strait of Belle Isle. The area is covered with low scrub spruce, barrens and slope bogs. The climate is boreal, with cool and rainy summers and cold winters. Growing season is 100 to 120 days, precipitation (adjusted) ranges from 1,200 to 1,400 mm and mean daily temperatures are 12°C in July and -9°C to -12.5°C in February. Tree growth is limited by a combination of wind, wet soils and cool temperatures. Black spruce will attain heights of 10 to 12 m only along sheltered rivers where soils are better drained.
Source: Meades (1990)

Table 1.2 Description of Newfoundland Ecoregions and Subregions Crossed by the Transmission Corridor

Ecoregions and Subregions
Strait of Belle Isle Barrens Ecoregion This Ecoregion occupies the bleak, northernmost part of the Great Northern Peninsula, where elevations are mostly less than 60 m. The climate is cold and the vegetation approaches that of tundra more than any other region. Growing season is <110 days, precipitation (observed) ranges from 760 to 900 mm, precipitation (adjusted) is approximately 1,500 mm and mean daily temperatures are 12°C to 14°C in July and -9°C in February. Snow fall averages <2.5 to 3.0 m. Peatlands are small, shallow and minerotrophic.
Northern Peninsula Forest Ecoregion This region comprises the forested parts of the Great Northern Peninsula, including the largely bog-covered marine deposits along the northwest coast. Forest fires are very infrequent and as a result, balsam fir is the predominant forest tree, especially in the deep valleys of the Long Range Mountains. The region differs from that of most other Ecoregions by its short vegetative season (110 to 152 days) and, for the most part, lower precipitation (1,300 to more than 1,500 mm). Mean daily temperatures are 13°C to 15°C in July and -8°C to -13°C in February. Coastal Plain Subregion: Most of the coastal plain is covered by large ombrotrophic plateau bogs that have formed in poorly-drained valleys and depressions that run parallel to the mountains and coastline. Beaver Brook Limestone Subregion: Area of very productive forest, presence of limestone bedrock and tills and sheltered valleys. Minerotrophic/calcareous fens are common. Eastern Long Range Subregion: Forested lower slopes (up to 450 m elevation) along the eastern side of the Long Range Mountains.

Ecoregions and Subregions
Long Range Barrens Ecoregion Discontinuous region of highlands (Southern Long Range, Buchans Plateau-Topsails, Northern Long Range) from the southwest coast to the northern part of the Long Range Mountains. Elevations range from 200 to >650 m. Growing season is shorter than that in other regions, precipitation (adjusted) ranges from <1,200 to >2,000 mm, and mean daily temperatures are 13°C to 15°C in July and -5°C to -8°C in February. Snow can exceed 5 m. Most of the Ecoregion is characterized by rock barrens, with dwarf shrub heaths, shallow ribbed fens and areas of low, wind stunted trees. Northern Long Range Subregion: This subregion has the best-developed snowbank vegetation in the Long Range Mountains. Includes the Highlands of St. John's, the coldest part of the Island.
Central Newfoundland Forest Ecoregion Heavily forested area, with a gently rolling to hilly topography underlain by acidic bedrock. Black spruce is the dominant tree in the landscape, due to the more important role of forest fires. Region has the most continental climate in Newfoundland, with highest summer temperature, and climatic gradients from south to north and from east to west. Growing season is 140 to 160 days, precipitation (adjusted) ranges from 1,200 to 1,600 mm and average daily temperatures are 15°C to 16°C in July and -4°C to -8°C in February. Changes in vegetation are controlled by these climatic differences. Red Indian Subregion: This area has the coolest summer temperatures, highest precipitation and shortest growing season within the Ecoregion. Although dense forests are prevalent, bogs are also common. North-Central Subregion: Area has highest summer maximum temperatures in Newfoundland, lower rainfall than in other subregions and has prolonged dry spells. Forest fire frequency is high and black spruce stands are common.
Avalon Forest Ecoregion Sheltered, forested areas of central Avalon Peninsula. The entire area is less than 500 km^2 area, under 250 m elevation, underlain by ribbed moraine and dotted with innumerable small lakes and bogs, as well as larger domed bogs. Climate is similar to that of the surrounding Maritimes Barrens Ecoregion. However, because of its sheltered position, fog is frequently funnelled into the area from the south, and the area appears to have higher fog frequencies in summer than the surrounding barrens. Growing season is >160 days, precipitation ranges from 1,400 to 1,500 mm, and mean daily temperatures are 14°C to 16°C in July and -4°C to -7°C in February. The dominant tree cover is balsam fir. Convex domed bogs, often with an abundance of *Rhacomitrium lanuginusom* on the hummocks, and slope bogs are characteristic of this Ecoregion.
Maritime Barrens Ecoregion Includes most of the eastern peninsulas, the barren in central Newfoundland, and a coastal strip on the south coast, extending west to Port aux Basques. Summers are cool, winters are relatively mild, growing season is 150 to 160 days, precipitation (adjusted) ranges from 1,250 to 1,600 mm, and mean daily temperatures are 13°C to 16°C in July and -3°C to -8°C in February. Fog frequency is also high, and decreases inland and northward. Sheep laurel is the most dominant dwarf shrub species, while Canada rhodora and blueberry are also abundant. Arctic-alpine species occur on the most exposed and coldest, wind-swept sites. Small slope bogs and basin bogs dot the landscape. Central Barrens Subregion: Deeper snow packs and more abundant dome bogs distinguish this subregion from the others in the Maritime Barrens Ecoregion. Northeastern Barrens Subregion: This subregion has warmer temperatures and more extensive forest than other subregions. Southeastern Barrens Subregion: Includes the typically maritime sheep laurel barrens, with only small pockets of forest. This subregion covers most of the Avalon and Burin Peninsulas.
Source: Damman (1983)

Bogs and fens (collectively called peatlands) are characterized by varying amounts of accumulated organic material, called peat. The formation of peat generally involves a combination of biotic, chemical and physical processes, in combination with a variety of environmental factors (e.g., temperature, precipitation, evaporation) over a long period of time. While physical processes and environmental factors influence all peatland development, it is the biotic processes of vegetative productivity, and the rate at which vegetative remains decompose, that determine the formation and development of all peatlands. Thus, peatlands will only develop when decomposition rates are unable to keep up with the rate at which vegetative remains are deposited on the surface.

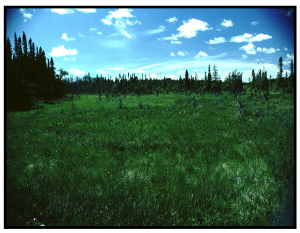
In nutrient-rich peatlands, where vegetative growth, soil microbial activity and organic matter decomposition are all high, rates of peat accumulation are very low. However, in ombrotrophic peatland ecosystems, where surface vegetative growth is extremely slow, the cool, acidic, nutrient-poor environment retards microbial activity and organic matter decomposition. Thus, accumulation of peat deposits to depths of 10 m or more are not uncommon. Likewise, the formation of convex surfaces on domed peatlands is attributed to differential rates of vegetation growth and decomposition between the edge and centre of the wetland. Around the edge of domed peatlands, where soil conditions are often influenced by more nutrient-enriched seepage waters from the surrounding upland soils, rates of vegetative productivity and decomposition are both high and peat accumulation is minimal.

The development and extent of wetlands in Newfoundland and Labrador are controlled by a variety of environmental factors. Cool temperatures, high amounts of precipitation and subsequent reduced rates of evaporation, as well as soil and topographic conditions that reduce and/or impair runoff, all create conditions ideal for the formation and development of wetlands. For example, small “topographically-confined” peatland deposits have developed on slopes and in poorly-draining basins throughout Newfoundland and Labrador. In areas of southeastern Newfoundland, high rainfall, frequent fog and decreased rates of evaporation and runoff have led to the formation of peatlands that blanket both hills and valleys. And, in many areas of Labrador, where rates of precipitation are lower, the combination of cooler temperatures, poor drainage and a shorter growing season have led to the development of extensive areas of shallow peatlands over the landscape.

While wet climatic conditions constitute the overall driving force behind the formation of most peatlands, many of the smaller wetland deposits are strongly influenced by the underlying soils and glacial tills. For example, in eastern Newfoundland, where most of the bedrock and surficial geology are acid, nutrient-poor bogs are common. However, in western Newfoundland, where much of the underlying substrate consists of limestone and/or limestone tills, high concentrations of calcium and reduced soil acidity have led to the development of more nutrient-rich peatlands.

Table 1.3 presents the characteristics of wetland classes for the province.

Table 1.3 Characteristics and Examples of Wetland Classes: Bog, Fen, Marsh, and Swamp

Wetland Class	Characteristics
BOG 	Peat-covered wetlands in which the vegetation show the effects of a high water table and a general lack of nutrients. It forms primarily from the accumulation of Sphagnum mosses in poorly-draining sites in which ground waters are ion-poor, acidic and low in oxygen saturation. However, the surface of the bog is level with, or often raised above, the surrounding terrain and the influence of nutrient-enriched seepage water. Thus, it is "ombrotrophic", receiving its nutrients mainly from precipitation (Wells and Pollett 1983).
FEN 	Peatlands that have developed predominantly from the accumulation of grasses and sedges. Its growth and development are controlled by seepage waters from surrounding or adjacent upland mineral soils. Fens are characterized by a high water table, but with a very slow internal drainage by seepage down very low gradient slopes. The oxygen saturation is relatively low but higher than in bogs. Nutrient conditions vary from weakly minerotrophic to eutrophic in areas of base-rich substrates such as limestone. In these areas, the ground water is usually ion-rich and weakly acidic to alkaline (Wells and Pollett 1983).
MARSH 	A mineral or sometimes peat-filled wetland periodically inundated by standing, or slowly moving, nutrient-rich waters. Surface water levels may fluctuate seasonally, with declining levels exposing draw-down zones of matted vegetation, or mud flats. The substratum usually consists principally of mineral material, although some marshes are associated with peat deposits (Tarnocai 1980; Wells and Pollett 1983).
SWAMP 	A mineral wetland with standing or gently flowing waters that occur in pools and channels, and is usually at or near the surface. Substrate is generally minimal, occurring as well-decomposed forest peat underlain at times by fen peat. The vegetation is characterized by a dense tree cover of coniferous or deciduous species, tall shrubs and some mosses (Tarnocai 1980).

1.5 Wetlands in Newfoundland and Labrador: An Overview

Wetlands are generally widespread across much of Newfoundland and Labrador, covering between 15 to 20 percent of the landscape of the province (Wells and Hirvonen 1988), the third highest percentage amongst Canadian provinces. With the exception of some large marshes that occur along major rivers, or in river deltas, the wetlands in Newfoundland and Labrador consist mainly of peatlands (bogs and fens). Alder swamps and riparian marshes also occur along smaller streams and rivers.

Over the past 20 to 30 years, these wetlands have been classified based on ecological, morphological and floristic criteria (Wells 1981, 1996; Wells and Pollett 1983; Wells and Hirvonen 1988). In addition, studies have also documented the potential of wetlands for peat moss (Northlands Ltd. 1978, 1979, 1980, 1981, 1982) and fuel peat (Wells and Vardy 1980).

1.6 Wetland Vegetation

Bogs and fens are, as a rule, easily separated based on the ecological boundary between ombrotrophic (bogs) and minerotrophic (fens). Two good examples of this ecological separation are ombrotrophic domed bogs and eutrophic (strongly minerotrophic) slope fens. While nutrient parameters can easily differentiate both classes of peatlands, the surface vegetation, or plant communities, also reflect the nutrient and/or ecological conditions that exist in any peatland ecosystem. Such a phytosociological classification has been documented for peatlands throughout Atlantic Canada (Wells 1996). Relationships are shown between species assemblages, nutrient parameters, regional environmental conditions and the distribution of each vegetation community in the Atlantic Region. A synopsis of this documentation and representative pictures of each plant community are presented in Figures 1.2 and 1.3.

Ombrotrophic domed bogs are characterized by an abundance of Sphagnum mosses (e.g., *Sphagnum fuscum*, *Sphagnum rubellum, Sphagnum flavicomans*) and dwarf shrubs (e.g., *Kalmia angustifolia, Kalmia polifolia*, *Andromeda glaucophylla*, *Chamaedaphne calyculata*, *Empetrum nigrum*), and often an abundance of lichens (*Cladina rangiferina*, C*ladina mitis, Cladina arbuscula, Cladina alpestris*).

The wet flats of bogs are characterized by *Sphagnum magellanicum*, *Sphagnum flavicomans*, and *Sphagnum rubellum*. In Newfoundland and much of southern Labrador, the wetter, and smaller, depressions and hollows are dominated by *Sphagnum tenellum*. In northern Newfoundland and Labrador, lichens (e.g., *Cetraria nivalis, Ochrelochia frigida, Sphaerophorus globusus, Alectoria nigricans, Cladonia boryi* and *Cladonia uncialis*) and the moss, *Rhacomitrium lanuginosum*, are common, often giving the peatland a whitish appearance. The adjacent wet flats are often large, black in appearance, and dominated by *Cladopodiella fluitans* and *Odontoschisma sphagnii*.

Minerotrophic peatlands range from strongly minerotrophic (or eutrophic) fens, which are dominated by sedges and grasses, to weakly-minerotrophic fens where Sphagnum mosses dominate the ground flora. Eutrophic fens are lawn-like in appearance and are characterized by an abundance of sedges and grasses (e.g., *Carex oligosperma, Carex exilis, Carex michauxiana, Carex lasiocarpa, Scirpus cespitosus*) and relatively few Sphagnum mosses (*Sphagnum warnstorfii*, *Sphagnum subsecundum*). Shrubs consist of *Dasiphora fruticosa, Lonicera villosa, Rosa nitida* and some *Chamadaphne calyculata*. Mosses such as *Campylium stellatum, Sellaginella sealginoides* and *Drepanocladus revolvens* comprise the major bryophyte flora. The moderately-minerotrophic fens, found mainly in Newfoundland, are dominated by Sphagnum mosses such as *Sphagnum papillosum, Sphagnum magellanicum, and Sphagnum rubellum*. On the more weakly-minerotrophic fens in Labrador, *Sphagnum angustifolium* and *Chamaedaphne calyculata* are often abundant.

Figure 1.2 Vegetation Communities Commonly Found on Ombrotrophic Bogs in Atlantic Canada

Dry Bog Communities – Common to all dry bog communities

Rubus chamaemorus, *Kalmia angustifolia*, *Empetrum nigrum*, *Polytrichum strictum*, *Vaccinium angustifolium*, *Cetraria islandica*, *Cladina mitis*, *Cladina alpestris*, *Cladina arbuscula*, *Cladina rangiferina*

Bog Hummocks (below)

Sphagnum fuscum, *Sphagnum rubellum*, *Microlepidozia setaceae*, *Mylia anomala*, *Larix laricina*

Northern Bog Hummocks & Ridges (below)

Cetraria nivalis, *Vaccinium uliginosum*, *Ochrolechia frigida*, *Vaccinium vitis-idaea*, *Sphaerophorus globosus*, *Carex rariflora*, *Rhacomitrium lanuginosum*, *Cladonia uncialis*, *Alectoria nigricans*, *Cornicularia aculeate*, *Ptilidium ciliare*, *Cladonia boryi*

Note whitish surface colour on some hummocks caused by abundance of *Cladina* lichens and *Rhacomitrium* moss

Wet Bog Communities – Common to all hollows and flats:

Sphagnum tenellum, *Sphagnum pulchrum*, *Sphagnum rubellum*, *Odontoschisma sphagni*, *Rhynchospora alba*, *Cladopodiella fluitans*, *Mylia anomala*, *Cetraria islandica*

Wet Bog "Sphagnum" Flats (below)

Sphagnum magellanicum, *Kalmia angustifolia*, *Sphagnnum flavicomans*, *Dicranum scoparium*, *Sphagnum papillosum*, *Carex oligosperma*, *Cladina arbuscula*, *Cladina rangiferina*

Northern Wet Flats & Hollows (blackish flats adjacent to Northern Bog Hummocks)

Ochrolechia frigida, *Carex rariflora*, *Vaccinium uliginosum*, *Ptilidium ciliare*, *Cornicularia aculeata*, *Sphagnum compactum*, *Empetrum nigrum*, *Kalmia angustifolia*

Wet Bog Hollows (above)

Sphagnum magellanicum, *Sphagnum cuspidatum*, *Carex oligosperma*, *Utricularia cornuta*, *Eriophorum spissum*, *Cephalozia conivens*

Figure 1.3 Vegetation Communities Commonly Found on Minerotrophic Fens in Atlantic Canada

Fen Lawn Communities

Carex exilis
Oclemena nemoralis
Smilacina trifolia
Carex oligosperma
Lonicera villosa
Larix laricina
Sanguisorba canadensis
Solidago uliginosa
Myrica gale
Betula michauxii

Ribbed Fens

Sphagnum compactum
Cladopodiella fluitans
Coptis groenlandicum
Calliergon stramineum
Sphagnum warnstorfii
Sphagnum magellanicum
Vaccinium uliginosum
Carex limosa
Rubus acaulis
Sphagnum pulchrum
Betula glandulosa
Sphagnum rubellum

Eutrophic Fens (Newfoundland and Labrador)

Campylium stellatum
Selaginella selaginoides
Sphagnum warnstorfii
Aualcomnium palustre
Carex limosa
Potentilla fruticosa
Betula pumila
Picea mariana

Fen Hummock / String Communities

Sphagnum rubellum
Picea mariana
Betula michauxii
Mylia anomala
Sphagnum magellanicum
Smilicina trifolia
Cetraria islandica
Carex oligosperma
Carex pauciflora
Larix laricina

Fen Hummocks and Ridges (right)

Sphagnum fuscum
Sphagnum rubellum
Kalmia angustifolia
Empetrum nigrum
Ledum groenlandicum
Vaccinium angustifolium
Rubus chamaemorus
Cetraria islandica
Cladina mitis
Cladina alpestris
Cladina arbuscula

Weakly Minerotrophic Ribbed Fens (flat areas between ridges)

Sphagnum angustifolium
Cladopodiella fluitans
Carex limosa
Sphagnum compactum
Vaccinium uliginosum
Ptilidium ciliare

1.7 Wetland Values and Functions

Wetlands are an integral component of the boreal ecosystems that stretch across northern Canada and throughout the circumboreal regions of the world. In Newfoundland and Labrador, they are abundant throughout the landscape. Wetlands/peatlands have traditionally been recognized for values that range from accessing areas for hunting in the fall, to hauling wood in the wintertime, to berry harvesting in the summertime. However, in recent years, as populations and urban pressures on land use increase, and wetlands throughout the world have been disturbed, destroyed or threatened, understanding the importance of wetlands to nature and society has shifted more towards a "function-oriented" approach. The following sections document the relationships between wetlands, their values, and some of the more important wetland functions that provide benefits for society and the many organisms that live on, in and around these ecosystems.

1.7.1 Wetland Values

Wetland values are benefits that the wetlands provide to the environment, or to people. They can be ecological, social and economic values that may or may not be easily measured (Novitzi et al. 1997). For example, some of the more common economic values associated with wetlands are their value for provision of peat moss and peat for fuel, or for biological production of agricultural crops such as cranberries. Some of the recreational and/or social values provided by wetlands include such things as photographic opportunities (e.g., orchids, sundews, yellow bladderworts, pitcher plants). Ecologically, wetlands also provide habitats for many organisms, and serve as linkages with surrounding forested or barren ecosystems.

1.7.2 Wetland Functions

Wetland functions are the natural physical, biological and chemical processes that occur in the development and maintenance of any wetland ecosystem. Smith et al. (1995, p. 21) describes wetland functions as "the normal or characteristic activities that take place in wetland ecosystems or simply the things that wetlands do. Wetlands perform a wide variety of functions in a hierarchy from simple to complex as a result of their physical, chemical, and biological attributes." Likewise, Novitzi et al. (1997, p. 2) defines wetland functions as "…a process or series of processes that take place within a wetland. These include the storage of water, transformation of nutrients, growth of living matter and diversity of wetland plants, and they have value for the wetland itself, for surrounding ecosystems, and for people." Similarly, Kusler (2004, p. 2) explains that "…the term, function, refers to natural processes contributing to the 'capacity' of a wetland and related ecosystems to provide certain goods and services." Capacity is further defined as "the ability of a wetland and related water and floodplain/riparian resource to produce various goods and services of use to society. Capacity is primarily dependent upon hydrologic, biological, and chemical processes but also depends on other characteristics such as soils, topography, and size" (Kusler 2004).

2.0 APPROACH AND METHODS

This *Wetlands Inventory and Classification Study* was conducted as part of a broader ELC for the Project. The purpose of the associated wetland field survey was to provide site information on vegetation composition and general site conditions necessary to accurately classify representative wetlands along the length of the proposed transmission corridor.

The vegetation/habitat survey site (plot) data and the grouping of that data into wetland classes were used to establish reference sites. The reference sites were used in collaboration with the high-resolution areal images to determine the visual signature of each wetland class and to delineate their boundaries within the proposed transmission corridor.

2.1 Field Surveys

Field surveys were conducted as part of the overall ELC field program (Stantec 2010) during July and August 2008. Field teams were comprised of a vegetation ecologist, wildlife ecologist and field technologist. Helicopters were used to access all surveyed wetlands in Labrador. Sites were accessed in Newfoundland by helicopter and vehicle. Plots specific to the wetland inventory were established in representative wetlands along the length of the proposed transmission corridor, and were established within areas of homogeneous vegetation cover.

Plot data included observations on the tree, shrub and ground layers within areas of homogeneous vegetation cover. The tree layer was defined as tree and shrub species more than 2 m high, the shrub layer as less than or equal to 2 m high. The ground layer was defined as the zone occupied by all the herb species and prostrate woody species. Plots were approximately 400 m^2 in size.

Percent ground cover was estimated for each observed plant species within each layer. Plant species names were in accordance with Newfoundland and Labrador Annotated Checklist (Meades 1990). Vegetation inventory data were recorded on handheld Trimble Nomad^{tm} electronic data loggers. The location of the plot was recorded by the data logger in Universal Transverse Mercator (UTM) 1983 North American Datum (NAD 83) coordinates. General site conditions, including a preliminary wetland classification, were also recorded. Representative photographs were taken at each site and plant vouchers of species of uncertain identity were collected for identification.

As part of the ELC program, habitat ratings were generated for specific wildlife species for each plot and compiled into amalgamated values per vegetation community (habitat type) or wetland class. Wildlife habitat ratings are discussed in greater detail in the wildlife studies undertaken for the Project's EA.

Vegetation field data were downloaded from the data loggers into ArcGIS 9.0 and MS Excel spreadsheets for processing and analysis. UTM coordinates for all the plant species observed within each plot were amalgamated into a single coordinate to allow for ease of data use. All field data were digitized and tabulated for analysis and summary presentation. The data for each plot were used to classify the surveyed wetlands as per the Canadian Wetland Classification System.

Wetlands were opportunistically surveyed during the larger ELC. Any wetland located within a 1 km radius (2 km buffer) of the proposed transmission corridor was sampled using the above criteria. During the field program, 88 wetland plots from within the 1,700 (approximately 5 percent) wetlands delineated and classified in the mapping phase of the study were surveyed. Figures 2.1 to 2.6 present site photographs of representative wetlands surveyed during the field program. Figure 2.7 presents the general distribution of wetland vegetation/habitat plot locations.

Figure 2.1 String Bog in the Low Subarctic Forest (Mecatina River) Ecoregion (Labrador)

Figure 2.2 Bog in the String Bog (Eagle River Plateau) Ecoregion (Labrador)

Figure 2.3 Fen in the Low Subarctic Forest (Mecatina River) Ecoregion (Labrador)

Figure 2.4 Fen in the Central Newfoundland Forest Ecoregion (Newfoundland)

Figure 2.5 Basin Marsh in the Northern Peninsula Forest Ecoregion (Newfoundland)

Figure 2.6 Bog in the Central Newfoundland Forest Ecoregion (Newfoundland)

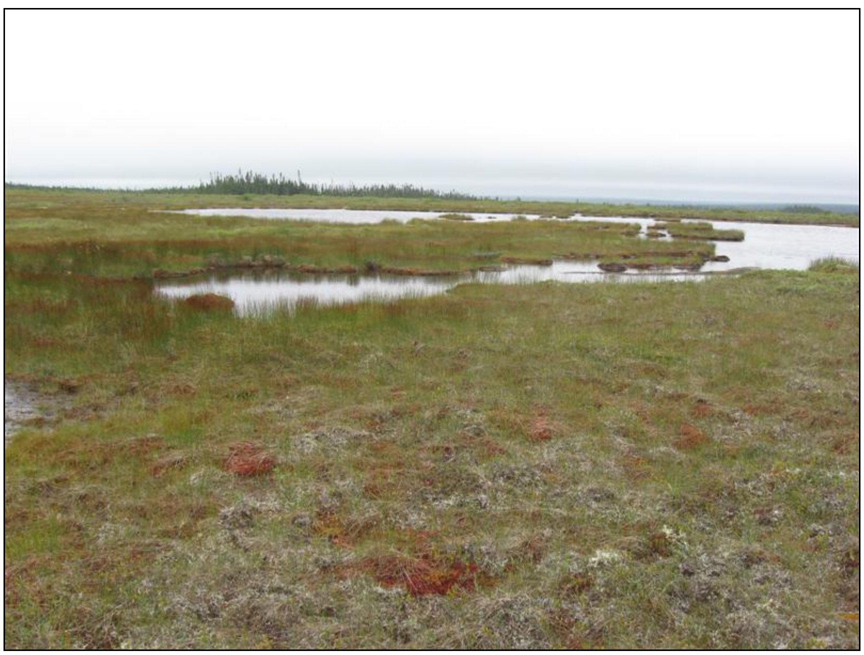
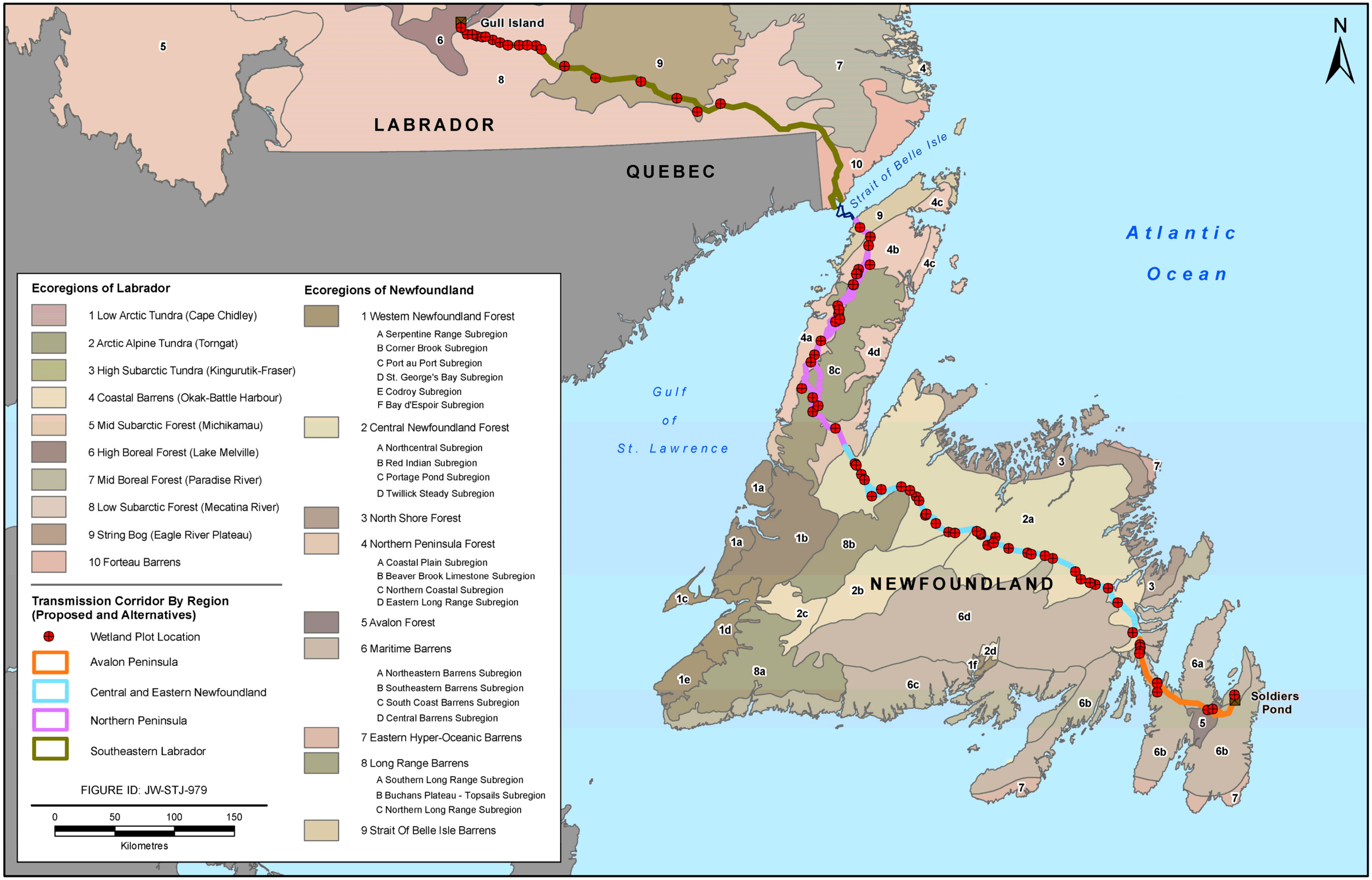


Figure 2.7 Wetland Plot Locations for Labrador and Newfoundland



2.2 Wetland Mapping

Geographically-referenced high-resolution aerial photographs and satellite images were used in conjunction with information gathered during the field surveys to classify wetlands and delineate their boundaries. Aerial photographs were used for approximately 30 percent of the transmission corridor (primarily central Newfoundland) and satellite images for approximately 70 percent.

2.2.1 Imagery

Orthocorrected digital aerial photography at a scale of 1:30,000 for central Newfoundland was provided by the Newfoundland and Labrador Department of Environment and Conservation - Lands Branch, Survey and Mapping Division. The high-resolution digital aerial photography has a spatial resolution of 60 cm. The years of the photography ranged from 1999 to 2006.

For areas of the proposed transmission corridor not covered by the available digital aerial photography, high-resolution SPOT 5 satellite imagery with a spatial resolution of 2.5 and 5 m was acquired. The 2.5 m panchromatic (greyscale) imagery was coloured using both SPOT 5 10 m multispectral imagery and Landsat 7 imagery. The most recent imagery having less than 10 percent cloud cover, acquired during snow-free conditions between the months of June and October, was used for this program. The years of the imagery ranged from 2005 to 2008.

With the incorporation of the high-resolution aerial photographs and satellite images into a GIS platform, the wetland specialist was able to magnify the surface features (vegetation colour signature, texture and distribution) of an area of interest better than the 1:50,000 mapping scale. This allowed for a more accurate examination and interpretation than otherwise practical using the coarser-resolution Landsat images.

2.2.2 Wetland Delineation and Classification

To optimize resources, wetlands were mapped and classified along the proposed 2 km wide transmission corridor in this study. Wetlands were mapped for a 15 km wide regional ELC study area as part of the larger Project ELC (Stantec 2010). The objective of this approach was to provide as much detail as possible for those wetlands that may potentially interact with the proposed Project, while providing an overall identification of wetland locations along the entire length of the corridor and adjacent area.

All discernable wetlands at a scale of 1:50,000 were manually delineated within the proposed transmission corridor using a combination of Landsat and SPOT satellite imagery, aerial photography and wetlands identified on the National Topographic System (NTS).

The field-surveyed and classified wetlands were used as control sites by the wetland expert to determine the typical visual signature of the various wetland classes found in each Ecoregion. The visual signatures of the control wetland classes on the high-resolution spatial images were then used to interpret the delineated wetlands within the GIS system.

It was evident as the mapping and fieldwork proceeded that almost all wetlands encountered fell into the two peatland classes, bogs and fens, with only a few instances of marshes. Using criteria outlined in the Canadian Wetland Classification System (Warner and Rubec 1997) and Wells (1996), these wetland classes were further divided into five bog forms, three fen forms and two marsh forms as listed in Table 2.1

Table 2.1 Summary of Wetland Classes used for the Detailed Wetland Mapping

Wetland Class	Wetland Form
Organic (Peatlands)	
Bog	Domed Bog
	Slope Bog
	Plateau Bog
	Basin Bog
	String Bog
Fen	Slope Fen
	Ladder Fen
	Ribbed Fen
Mineral	
Marsh	Riparian Stream Marsh
	Basin Marsh

Some wetland polygons included two or more wetland forms. Although these wetlands occur adjacent to one another, they maintain the hydrological, ecological and floristic features that normally characterize each ecosystem, as if it were a separate entity on the landscape. For the purpose of this mapping exercise, these areas are classified as wetland complexes, and are named according to the wetland forms that comprise each complex, (e.g., Domed Bog Ladder Fen and Ribbed Fen Slope Bog).

The wetlands outside of the proposed transmission corridor but within the larger 15 km wide ELC study area were delineated as part of the ELC study and were not differentiated into specific wetland classes. The ELC study (Stantec 2010) describes and maps those wetlands in further detail.

2.3 Study Team

The Study Team included the component manager, a study lead, field biologists and assistants and data management and reporting personnel. Team members have in-depth knowledge and experience in their fields of expertise and a broad general knowledge of the work conducted by other experts in related fields. Brief biographical statements highlighting roles and responsibilities and relevant education and employment experience, of key personnel are provided in Appendix B.

3.0 RESULTS

A total of 88 wetland plots were established and sampled within the proposed transmission corridor. Approximately 1,700 discrete wetlands were delineated and classified in the mapping phase of the study.

3.1 Vegetative Cover and Abundance for Wetland Classes Surveyed

Plant species presence and abundance (expressed as a percentage of ground area covered by the species) were used to classify the surveyed wetlands as per the Canadian Wetland Classification System. Of the 20 wetlands surveyed in Labrador, 14 were classed as bog and six as fen. Of the 68 surveyed wetlands in Newfoundland, 37 were classed as bog, 30 were classed as fen and one as marsh.

Tables 3.1 to 3.5 present summaries of the vegetation cover for each surveyed wetland class for the Labrador and Newfoundland portions of the proposed transmission corridor. Percent occurrence and average cover values derived from the field observations are included in the summary vegetation tables for each of the classes surveyed.

Percent occurrence is the percentage of times that a species was observed in all survey sites for that wetland class. For example, a value of 10 indicates that a species was observed in 10 percent of the survey sites for that wetland class.

Average cover is the observed estimation of percent of ground covered by a plant species (when viewed directly above the survey site) averaged for the total number of survey sites for that wetland class. For example, larch was observed in the shrub layer in 11 (or 79 percent) of the 14 bogs surveyed in Labrador. Larch covered between .01 to 5 percent of the 11 surveyed bogs in which it was observed. When averaged over all 14 bog sites surveyed (three sites did not have larch), the area covered by larch shrubs is calculated at 1.5 percent.

Values of ≤0.1 percent indicate that a plant species will on average cover no more than a 63 cm by 63 cm area (0.4 m^2) of a 400 m^2 survey plot.

Table 3.1 Bog Vegetation Summary for Labrador Sites

Scientific Name	Common Name	Percent Occurrence	Average Cover (%)
Tree Cover			
Larix laricina	larch	7	≤0.1
Shrub Cover			
Alnus incana subsp. rugosa	speckled alder, tag alder	7	≤0.1
Andromeda glaucophylla	bog rosemary	86	2.1
Betula michauxii	Newfoundland dwarf birch	36	0.2
Betula sp.	birch	7	≤0.1
Chamaedaphne calyculata	leatherleaf	100	15.8
Kalmia polifolia	bog laurel	71	0.6
Larix laricina	larch	79	1.5
Picea mariana	black spruce	64	2.4

Scientific Name	Common Name	Percent Occurrence	Average Cover (%)
Rhododendron groenlandicum	Labrador tea	50	0.6
Salix sp.	willow	7	≤0.1
Vaccinium angustifolium	low-bush blueberry	7	≤0.1
Vaccinium uliginosum	alpine bilberry, bog bilberry	64	1.3
Ground Cover			
Aster radula	rough aster	7	≤0.1
Carex aquatilis var. aquatilis	water sedge	7	≤0.1
Carex limosa	mud sedge	57	4.2
Carex oligosperma	few-seed sedge	93	25.1
Carex pauciflora	few-flowered sedge	43	≤0.1
Carex rariflora	loose-flowered alpine sedge	7	4.3
Carex rostrata	beaked sedge	21	2.1
Cetraria sp.	fruticose lichen	29	0.2
Cladina mitis	yellow-green lichen	7	≤0.1
Cladina rangiferina	reindeer lichen	7	≤0.1
Cladina sp.	reindeer lichen	29	0.2
Cladina stellaris	reindeer lichen	7	≤0.1
Cladonia sp.	Cladonia lichen	14	≤0.1
Coptis trifolia	goldthread, three-leaf goldthread	7	≤0.1
Drosera anglica	English sundew	7	≤0.1
Drosera rotundifolia	round-leaf sundew	50	≤0.1
Equisetum fluviatile	water horsetail	7	≤0.1
Eriophorum chamissonis	Chamisso's cottongrass	14	0.2
Eriophorum tenellum	rough cottongrass	14	≤0.1
Eriophorum viridicarinatum	thin-leaf cottongrass	7	≤0.1
Eriophroum spissum	hare's tail	7	≤0.1
Gaultheria hispidula	creeping snowberry	7	≤0.1
Juncus sp.	rush	7	≤0.1
Liverwort	liverwort	36	1.6
Maianthemum trifolium	three-leaf false Solomon's-seal	14	≤0.1
Menyanthes trifoliata	bogbean, buckbean	57	2.7
Moss	moss	14	2.2
Nuphar variegata	yellow pondlily, bullhead, spatterdock	7	≤0.1
Pleurozium schreberi	red-stemmed moss	7	≤0.1
Polytrichum sp.	hairmoss	7	≤0.1
Ptilidium sp.	ptilidium moss	14	≤0.1
Rhododendron groenlandicum	Labrador tea	7	≤0.1
Rubus chamaemorus	bakeapple, cloudberry	50	0.8
Sarracenia purpurea subsp. purpurea	pitcher plant	14	≤0.1
Scheuchzeria palustris	pod grass	29	≤0.1
Sphagnum magellanicum	sphagnum moss	14	≤0.1
Sphagnum rubrum	sphagnum moss	7	≤0.1
Sphagnum sp.	sphagnum moss	100	68.1
Trichophorum cespitosum	deergrass	86	4.8
Vaccinium oxycoccos	small cranberry, marshberry	86	1.0
Viola sp.	violet	7	≤0.1
Number of Survey Sites: 14			

Table 3.2 Fen Vegetation Survey Summary for Labrador Sites

Scientific Name	Common Name	Percent Occurrence	Average Cover (%)
Shrub Cover			
Andromeda glaucophylla	bog rosemary	67	2.8
Betula glandulosa	glandular birch	50	7.6
Betula michauxii	Newfoundland dwarf birch	33	0.2
Chamaedaphne calyculata	leatherleaf	67	3.4
Dasiphora fruticosa	shrubby cinquefoil	17	0.7
Kalmia polifolia	bog laurel	83	0.2
Larix laricina	larch	83	1.0
Picea mariana	black spruce	83	2.7
Rhododendron groenlandicum	Labrador tea	50	0.2
Salix candida	hoary willow, sage-leaf willow	17	15.0
Salix pedicellaris	bog willow	50	1.6
Salix sp.	willow	17	3.3
Vaccinium angustifolium	low-bush blueberry	17	≤0.1
Vaccinium cespitosum	dwarf blueberry	17	≤0.1
Vaccinium uliginosum	alpine bilberry, bog bilberry	67	1.3
Ground Cover			
Agropyron tachycaulum	slender wheatgrass	17	0.3
Agrostis scabra var. geminata	twin bent	33	5.8
Aster radula	rough aster	33	≤0.1
Bromus ciliatus	fringed brome	17	11.7
Calamagrostis canadensis var. canadensis	bluejoint, Canada reedgrass	33	2.8
Carex aquatilis var. aquatilis	water sedge	33	13.4
Carex brunnescens subsp. brunnescens	brownish sedge	17	≤0.1
Carex echinata subsp. echinata	little prickly sedge	17	≤0.1
Carex limosa	mud sedge	50	4.3
Carex oligosperma	few-seed sedge	83	32.2
Carex pauciflora	few-flowered sedge	50	≤0.1
Carex rostrata	beaked sedge	17	6.7
Carex trisperma	three-fruited sedge	17	≤0.1
Cetraria sp.	fruticose lichen	17	≤0.1
Chamerion angustifolium subsp. circumvagum	fireweed	17	0.8
Cladina rangiferina	reindeer lichen	17	≤0.1
Cladina sp.	reindeer lichen	33	≤0.1
Cladonia sp.	Cladonia lichen	33	0.2
Comarum palustre	marsh cinquefoil	17	3.3
Coptis trifolia	goldthread, three-leaf goldthread	50	0.2
Daucus carota	wild carrot, Queen Anne's lace	17	≤0.1
Deschampsia cespitosa subsp. cespitosa	tufted hairgrass	17	3.3
Deschampsia flexuosa	wavy hairgrass	17	≤0.1
Dicranum sp.	broom moss	17	≤0.1
Drosera rotundifolia	round-leaf sundew	33	≤0.1
Empetrum nigrum subsp. nigrum	black crowberry	17	≤0.1

Scientific Name	Common Name	Percent Occurrence	Average Cover (%)
Galium trifidum subsp. trifidum	three-petalled bedstraw	17	≤0.1
Gaultheria hispidula	creeping snowberry	17	≤0.1
Liverwort	liverwort	33	0.2
Maianthemum canadense subsp. canadense	wild lily-of-the-valley	17	≤0.1
Maianthemum trifolium	three-leaf false Solomon's-seal	67	0.2
Menyanthes trifoliata	bogbean, buckbean	33	0.6
Myrica gale	sweet gale	17	0.8
Nuphar variegata	yellow pond lily, bullhead, spatterdock	17	≤0.1
Petasites frigidus var. palmatus	arctic sweet coltsfoot	17	≤0.1
Pleurozium schreberi	red-stemmed moss	33	≤0.1
Polytrichum sp.	hairmoss	67	2.4
Ptilidium sp.	ptilidium moss	17	≤0.1
Rubus arcticus subsp. acaulis	plumboy	33	1.5
Rubus chamaemorus	bakeapple, cloudberry	33	0.7
Sarracenia purpurea subsp. purpurea	pitcher plant	17	≤0.1
Scheuchzeria palustris	pod grass	17	≤0.1
Sphagnum fuscum	rusty sphagnum	17	0.2
Sphagnum girgensohnii	Girgensohn's sphagnum	17	0.8
Sphagnum sp.	sphagnum moss	83	54.2
Symphyotrichum novi-belgii var. novi-belgii	New York aster	17	≤0.1
Trichophorum alpinum	alpine cottongrass	17	≤0.1
Trichophorum cespitosum	deergrass	50	0.4
Vaccinium oxycoccos	small cranberry, marshberry	67	0.2
Viola palustris	alpine marsh violet	17	≤0.1
Viola selkirkii	Selkirks's violet, great spurred violet	17	0.5
Number of Survey Sites: 6			

Table 3.3 Bog Vegetation Survey Summary for Newfoundland Sites

Scientific Name	Common Name	Percent Occurrence	Average Cover (%)
Tree Cover			
Picea mariana	black spruce	3	0.41
Shrub Cover			
Abies balsamea	balsam fir	5	≤0.1
Alnus incana subsp. rugosa	speckled alder, tag alder	3	≤0.1
Amelanchier bartramiana	Bartram's chuckleypear	5	≤0.1
Andromeda glaucophylla	bog rosemary	68	1.3
Betula cordifolia	heartleaf birch, mountain white birch	3	≤0.1
Betula glandulosa	glandular birch	3	≤0.1
Betula michauxii	Newfoundland dwarf birch	11	≤0.1
Betula pumila var. pumila	dwarf birch, bog birch	3	≤0.1
Chamaedaphne calyculata	leatherleaf	84	5.3
Gaylussaccia dumosa var. bigeloviana	dwarf huckleberry	14	0.2

Scientific Name	Common Name	Percent Occurrence	Average Cover (%)
Juniperis communis	common juniper	3	≤0.1
Kalmia angustifolia	sheep laurel	78	8.3
Kalmia polifolia	bog laurel	84	0.9
Larix laricina	larch	68	2.6
Myrica gale	sweet gale	24	1.0
Myrica pensylvanica	northern bayberry	3	≤0.1
Nemopanthus mucronatus	mountain holly, catberry	14	≤0.1
Photinia floribunda	purple chokeberry	11	≤0.1
Picea mariana	black spruce	51	4.2
Rhododendron canadense	rhodora	11	0.3
Rhododendron groenlandicum	Labrador tea	89	1.8
Vaccinium angustifolium	low-bush blueberry	11	0.2
Vaccinium boreale	northern blueberry	19	≤0.1
Vaccinium cespitosum	dwarf blueberry	3	≤0.1
Vaccinium macrocarpon	large cranberry	5	0.2
Vaccinium uliginosum	alpine bilberry, bog bilberry	27	0.9
Viburnum nudum var. cassinoides	northern wild raisin	3	≤0.1
Ground Cover			
Aster nemoralis	bog aster	3	≤0.1
Aster radula	rough aster	5	≤0.1
Calamagrostis canadensis var. canadensis	bluejoint, Canada reedgrass	3	≤0.1
Calamagrostis pickeringii	Pickering's reedgrass	11	0.6
Carex aquatilis var. aquatilis	water sedge	3	≤0.1
Carex bigelowii subsp. bigelowii	Bigelow's sedge	3	≤0.1
Carex exilis	coastal sedge	11	0.4
Carex nigra	smooth black sedge	3	≤0.1
Carex oligosperma	few-seed sedge	32	5.6
Carex pauciflora	few-flowered sedge	11	0.6
Carex rariflora	loose-flowered alpine sedge	5	≤0.1
Carex stylosa	variegated sedge	3	≤0.1
Carex trisperma	three-fruited sedge	8	0.4
Cetraria delisei	cetraria lichen	3	≤0.1
Cetraria ericetorum	Iceland lichen	3	≤0.1
Cetraria sepincola	cetraria lichen	5	≤0.1
Cladina mitis	green reindeer lichen	5	0.4
Cladina rangiferina	gray reindeer lichen	16	1.0
Cladina sp.	reindeer lichen	70	10.9
Cladina stellata	reindeer lichen	3	≤0.1
Cladonia sp.	Cladonia lichen	22	0.8
Coptis trifolia	goldthread, three-leaf goldthread	16	≤0.1
Cornus canadensis	crackerberry, bunchberry	16	≤0.1
Deschampsia flexuosa	wavy hairgrass	3	0.4
Dicranum sp.	dicranum moss	11	0.6
Drosera intermedia	spatulateleaf sundew	8	≤0.1
Drosera longifolia	English sundew	5	≤0.1
Drosera rotundifolia	round-leaf sundew	78	0.2
Eleocharis palustris	creeping spikerush, Small's spikerush	14	4.1
Empetrum nigrum subsp. nigrum	black crowberry	70	5.7

Scientific Name	Common Name	Percent Occurrence	Average Cover (%)
Equisetum fluviatile	water horsetail	3	≤0.1
Eriophorum angustifolium subsp. angustifolium	tall cottongrass	5	≤0.1
Eriophorum chamissonis	Chamisso's cottongrass	5	≤0.1
Eriophorum sp.	cottongrass	5	≤0.1
Eriophorum vaginatum subsp. spissum	hare's cottongrass	19	≤0.1
Eriophorum virginicum	tawny cottongrass	22	≤0.1
Gaultheria hispidula	creeping snowberry	3	≤0.1
Geocaulon lividum	northern comandra	5	≤0.1
Juncus trifidus	highland rush	3	≤0.1
Linnaea borealis subsp. longiflora	twinflower	3	≤0.1
Lycopodium annotinum	bristly clubmoss	5	≤0.1
Maianthemum canadense subsp. canadense	wild lily-of-the-valley	16	0.2
Maianthemum trifolium	three-leaf false Solomon's-seal	11	≤0.1
Menyanthes trifoliata	bogbean, buckbean	3	≤0.1
Nuphar variegata	yellow pond lily, bullhead, spatterdock	5	≤0.1
Oclemena nemoralis	bog aster	8	0.2
Pleurozium schreberi	feathermoss	22	0.3
Polytrichum sp.	polytrichum moss	3	≤0.1
Prenanthes trifoliolata	tall rattlesnakeroot, gall-of-the-earth	3	≤0.1
Ptilidium sp.	ptilidium moss	5	0.5
Racomitrium sp.	wooly-hair moss	16	1.2
Rhynchospora alba	white beakrush	35	2.1
Rhynchospora capillacea	capillary beakrush	3	≤0.1
Rubus chamaemorus	bakeapple, cloudberry	70	2.5
Sanguisorba canadensis subsp. canadensis	bottlebrush	5	≤0.1
Sarracenia purpurea subsp. purpurea	pitcher plant	70	0.2
Scheuchzeria palustris	pod grass	11	≤0.1
Solidago canadensis subsp. canadensis var. canaden	Canada goldenrod	3	≤0.1
Solidago macrophylla	large-leaf goldenrod	3	≤0.1
Solidago multiradiata	northern goldenrod	8	≤0.1
Solidago uliginosa	bog goldenrod	11	≤0.1
Sphagnum sp.	sphagnum moss	95	64.2
Trichophorum alpinum	apline cottongrass	3	≤0.1
Trichophorum cespitosum	deergrass	81	30.8
Trientalis borealis subsp. borealis	starflower	5	≤0.1
Utricularia cornuta	horned bladderwort	24	≤0.1
Utricularia macrorhiza	common bladderwort	3	≤0.1
Vaccinium oxycoccos	small cranberry, marshberry	73	≤0.1
Vaccinium vitis-idaea subsp. minus	partridgeberry	5	≤0.1
Number of Survey Sites: 37			

Table 3.4 Fen Vegetation Survey Summary for Newfoundland Sites

Scientific Name	Common Name	Percent Occurrence	Average Cover (%)
Tree Cover			
Picea mariana	black spruce	3.33	0.7
Shrub Cover			
Abies balsamea	balsam fir	3	0.3
Alnus incana subsp. rugosa	speckled alder, tag alder	23	0.2
Alnus viridis subsp. crispa	mountain alder, green alder	7	≤0.1
Andromeda glaucophylla	bog rosemary	57	0.2
Betula glandulosa	glandular birch	3	≤0.1
Betula michauxii	Newfoundland dwarf birch	43	1.1
Betula minor	dwarf white birch	3	≤0.1
Betula pumila var. pumila	dwarf birch, bog birch	10	≤0.1
Chamaedaphne calyculata	leatherleaf	63	1.4
Dasiphora fruticosa subsp. floribunda	shrubby cinquefoil	23	0.8
Juniperis communis	common juniper	40	0.4
Juniperus horizontalis	creeping juniper	7	≤0.1
Kalmia angustifolia	sheep laurel	20	0.5
Kalmia polifolia	bog laurel	20	≤0.1
Larix laricina	larch	77	1.8
Lonicera villosa	mountain fly honeysuckle	13	0.2
Myrica gale	sweet gale	90	5.1
Photinia floribunda	purple chokeberry	17	≤0.1
Photinia melanocarpa	black chokeberry	3	≤0.1
Picea mariana	black spruce	27	1.1
Rhododendron canadense	rhodora	7	≤0.1
Rhododendron groenlandicum	Labrador tea	37	1.8
Rosa nitida	shining rose, northeastern rose	20	≤0.1
Salix sp.	willow	3	≤0.1
Spiraea alba var. latifolia	broadleaf meadowsweet	7	≤0.1
Vaccinium boreale	northern blueberry	3	≤0.1
Vaccinium cespitosum	dwarf blueberry	3	≤0.1
Vaccinium macrocarpon	large cranberry	3	≤0.1
Vaccinium ovalifolium	oval-leaf bilberry	3	≤0.1
Viburnum nudum var. cassinoides	northern wild raisin	3	≤0.1
Ground Cover			
Agrostis scabra var. scabra	rough bent, rough hairgrass	13	≤0.1
Aster nemoralis	bog aster	3	≤0.1
Aster radula	rough aster	60	0.5
Calamagrostis canadensis var. canadensis	bluejoint, Canada reedgrass	13	6.4
Calamagrostis pickeringii	Pickering's reedgrass	37	3.4
Calamagrostis stricta subsp. inexpansa var. inexpa	narrow reedgrass	3	≤0.1
Calla palustris	wild calla	3	0.3
Caltha palustris	marsh marigold, cowslip	3	≤0.1
Carex aquatilis var. aquatilis	water sedge	7	2.4

Scientific Name	Common Name	Percent Occurrence	Average Cover (%)
Carex brunnescens subsp. brunnescens	brownish sedge	10	≤0.1
Carex buxbaumii	Buxbaum's sedge	3	≤0.1
Carex echinata subsp. echinata	little prickly sedge	17	0.3
Carex exilis	coastal sedge	50	8.7
Carex flava	yellow sedge	7	1.7
Carex folliculata	northern long sedge	7	≤0.1
Carex intumescens	bladder sedge	3	≤0.1
Carex lasiocarpa subsp. americana	slender sedge, wooly-fruit sedge	13	3.9
Carex limosa	mud sedge	3	≤0.1
Carex magellanica subsp. Irrigua	bog sedge	3	≤0.1
Carex michauxiana	Michaux's sedge	23	2.1
Carex oligosperma	few-seed sedge	70	5.0
Carex pauciflora	few-flowered sedge	10	0.2
Carex rostrata	beaked sedge	13	2.6
Carex sp.	sedge	13	3.4
Carex stylosa	variegated sedge	3	≤0.1
Carex tenuiflora	sparse-flowered sedge	3	≤0.1
Carex trisperma	three-fruited sedge	3	≤0.1
Carex viridula subsp. brachyrrhyncha var. elatior	little green sedge	7	2.7
Cirsium muticum	swamp thistle	3	≤0.1
Cirsium vulgare	bull thistle	3	≤0.1
Cladina mitis	green reindeer lichen	7	≤0.1
Cladina rangiferina	gray reindeer lichen	3	≤0.1
Cladina sp.	reindeer lichen	13	0.7
Cladonia sp.	Cladonia lichen	3	≤0.1
Clintonia borealis	corn lily	3	≤0.1
Comarum palustre	marsh cinquefoil	10	0.2
Conioselinum chinense	hemlock parsley	3	≤0.1
Coptis trifolia	goldthread, three-leaf goldthread	7	≤0.1
Cornus canadensis	crackerberry, bunchberry	7	1.2
Deschampsia flexuosa	wavy hairgrass	3	0.2
Dichanthelium acuminatum var. fasciculatum	woolly panicgrass	3	≤0.1
Dicranum sp.	dicranum moss	7	≤0.1
Drosera intermedia	spatulate-leaf sundew	20	≤0.1
Drosera longifolia	English sundew	23	≤0.1
Drosera rotundifolia	round-leaf sundew	67	≤0.1
Dryopteris campyloptera	mountain woodfern	3	≤0.1
Dulichium arundinaceum	threeway sedge	3	≤0.1
Eleocharis palustris	creeping spikerush, Small's spikerush	13	3.4
Empetrum nigrum subsp. nigrum	black crowberry	17	0.2
Epilobium palustre	marsh willowherb	3	≤0.1
Equisetum arvense	field horsetail	3	≤0.1
Equisetum fluviatile	water horsetail	7	≤0.1
Equisetum hyemale subsp. affine	tall scouring rush	3	≤0.1
Equisetum sylvaticum	woodland horsetail	7	≤0.1

Scientific Name	Common Name	Percent Occurrence	Average Cover (%)
Eriocaulon aquaticum	white buttons	17	≤0.1
Eriophorum angustifolium subsp. angustifolium	tall cottonegrass	20	≤0.1
Eriophorum chamissonis	Chamisso's cottongrass	3	≤0.1
Eriophorum virginicum	tawny cottongrass	37	≤0.1
Eriophorum viridicarinatum	thinleaf cottongrass	3	≤0.1
Eupatorium maculatum	spotted Joe-Pye weed	7	≤0.1
Euphrasia nemorosa	common eyebright	3	≤0.1
Galium saxatile	heath bedstraw	3	≤0.1
Galium trifidum subsp. trifidum	three-petalled bedstraw	3	≤0.1
Gaultheria hispidula	creeping snowberry	3	≤0.1
Glyceria sp.	mannagrass	3	0.7
Iris versicolor	blue flag	17	0.5
Juncus brevicaudatus	narrow-panicled rush	13	≤0.1
Juncus canadensis	Canada rush	13	≤0.1
Juncus sp.	rush	7	≤0.1
Juncus stygius var. americanus	moor rush	3	≤0.1
Lasiocarpa sp.	(blank)	3	0.3
Lonicera villosa	mountain fly honeysuckle	3	≤0.1
Lycopodium annotinum	bristly club moss	7	≤0.1
Lycopus uniflorus	northern bugleweed	7	≤0.1
Maianthemum canadense subsp. canadense	wild lily-of-the-valley	3	≤0.1
Maianthemum trifolium	three-leaf false Solomon's-seal	23	0.2
Malaxis unifolia	green addersmouth	3	≤0.1
Mentha arvensis	wild mint	7	≤0.1
Menyanthes trifoliata	bogbean, buckbean	20	0.2
Moss	moss	7	2.3
Nuphar variegata	yellow pond lily, bullhead, spatterdock	10	≤0.1
Oclemena nemoralis	bog aster	30	0.2
Orchid	orchid	3	≤0.1
Packera paupercula	alpine ragwort	7	≤0.1
Platanthera clavellata	green woodland orchid	10	≤0.1
Platanthera dilatata var. dilatata	scentbottle	20	≤0.1
Platanthera grandiflora	large purple fringed orchid	7	≤0.1
Pleurozium schreberi	feathermoss	10	≤0.1
Pogonia ophioglossoides	rose pogonia	13	≤0.1
Potamogeton confervoides	alga pondweed	3	≤0.1
Potamogeton oakesianus	Oakes' pondweed	3	≤0.1
Potamogeton robbinsii	Robbins' pondweed	3	≤0.1
Rhinanthus minor subsp. minor	common yellow rattle	7	≤0.1
Rhynchospora alba	white beakrush	67	9.5
Rhynchospora fusca	brown beakrush	13	0.9
Rubus arcticus subsp. acaulis	plumboy	10	≤0.1
Rubus chamaemorus	bakeapple, cloudberry	7	≤0.1
Sanguisorba canadensis subsp. Canadensis	bottlebrush	57	1.0

Scientific Name	Common Name	Percent Occurrence	Average Cover (%)
Sarracenia purpurea subsp. purpurea	pitcher plant	3	≤0.1
Schizaea pusilla	curly-grass fern	3	≤0.1
Schoenoplectus subterminalis	water club-brush	7	0.2
Scirpus hattorianus	mosquito bulrush	3	0.2
Scirpus pedicellatus	stalked bullrush	3	0.2
Scutellaria sp	skullcap	3	≤0.1
Selaginella selaginoides	northern spikemoss	10	≤0.1
Solidago macrophylla	large-leaf goldenrod	3	≤0.1
Solidago multiradiata	northern goldenrod	7	≤0.1
Solidago rugosa var. rugosa	rough-stemmed goldenrod	3	≤0.1
Solidago uliginosa	bog goldenrod	43	0.2
Sparganium emersum	unbranched burreed	3	0.2
Sphagnum papillosum	sphagnum moss	3	0.3
Sphagnum pylaesii	sphagnum moss	3	0.5
Sphagnum sp.	sphagnum moss	90	38.8
Spiranthes romanzoffiana	hooded ladies-tresses	7	1.3
Symphyotrichum novi-belgii var. novi-belgii	New York aster	3	≤0.1
Symphyotrichum puniceum	purple-stem aster	3	≤0.1
Thalictrum alpinum	alpine meadowrue	17	0.3
Thalictrum pubescens var. pubescens	tall meadowrue, king-of-the-meadow	33	0.4
Thalictrum sp.	meadowrue	3	≤0.1
Thelypteris palustris var. pubescens	marsh fern	3	≤0.1
Tofieldia glutinosa	sticky tofieldia	3	≤0.1
Triadenum fraseri	Fraser's marsh St. Johns wort	10	≤0.1
Trichophorum alpinum	alpine cottongrass	13	0.2
Trichophorum cespitosum	deergrass	67	21.8
Trientalis borealis subsp. borealis	starflower	7	≤0.1
Triglochin palustris	marsh arrow grass	13	≤0.1
Triglochin sp.	arrow grass	3	≤0.1
Utricularia cornuta	horned bladderwort	33	≤0.1
Utricularia intermedia	flat-leaf bladderwort	13	≤0.1
Utricularia minor	small bladderwort	7	≤0.1
Vaccinium oxycoccos	small cranberry, marshberry	40	≤0.1
Viola blanda	sweet white violet	7	0.3
Viola cucullata	marsh blue violet	3	≤0.1
Viola sp.	violet	3	≤0.1
Number of Survey Sites: 30			

Table 3.5 Marsh Vegetation Survey Summary for Newfoundland Sites

Scientific Name	Common Name	Percent Occurrence	Average Cover (%)
Ground Cover			
Argentina anserina	silverweed	100	≤0.1
Carex flava	yellow sedge	100	20
Carex utriculata	bottle sedge	100	20
Juncus brevicaudatus	narrow-panicled rush	100	0.5
Juncus effusus	soft rush	100	10
Potamogeton spirillus	northern snailseed pondweed	100	0.1
Ranunculus flammula var. reptans	creeping spearwort	100	0.5
Number of Survey Sites: 1			

3.2 Description of Wetland Forms and Complexes along the Transmission Corridor

Eight peatland forms, various peatland complexes and several marsh sites (e.g., basin and riparian stream) were classified for the areas within the proposed transmission corridor. The locations and extent of these wetlands are presented in Appendix A. Note the Wetland form classification codes are included at the beginning of the atlas.

To ensure a better understanding of each of the major wetland forms and complexes, a synopsis of each form and complex for this report is presented in Table 3.6 to 3.8. Note, these forms and complexes are not necessarily restricted to the proposed transmission corridor. The reader is referred to Wells (1981, 1996), Wells and Hirvonen (1988), Wells and Pollett (1983) and Wells and Zoltai (1985) for a more comprehensive documentation of each of the wetlands within Newfoundland and Labrador.

Table 3.6 Bog Forms Identified along the Proposed Transmission Corridor

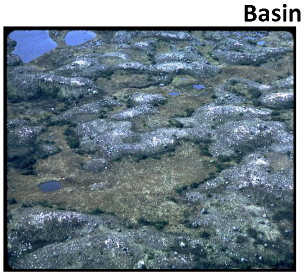
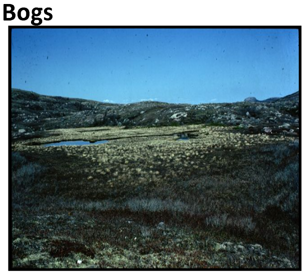
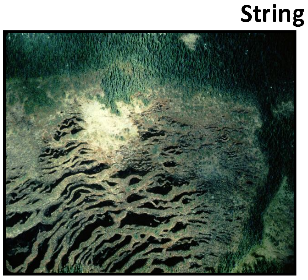
PEATLAND FORM	FEATURES
Domed Bogs  	Throughout Newfoundland and southern Labrador, but concentrated mainly in forested regions of central Newfoundland, central Avalon Peninsula, western Newfoundland and the Cartwright-Charlottetown area of Labrador. Surfaces are convex or domed and raised above the surrounding terrain, often with pools that are arranged in discontinuous, parallel rings around an epicentre, or highest/deepest point. Depth: 3.0 to 10.0 m.
Slope Bogs  	Throughout most of Newfoundland and Labrador, mainly as small peatland deposits that are topographically confined to poorly-draining slopes. Surface relatively uniform, sloping and with few pools. Water table at, or close to, the surface throughout the year. Depth: 1.0 to 2.0 m.
Basin Bogs  	Occur as small, organic deposits in poorly-draining basins throughout Newfoundland and Labrador, but most common in eastern and southern Newfoundland. Surfaces are flat with few pools and the water table is at, or close to the surface throughout the year. Depth: 1.0 to 2.0 m.
Plateau Bogs  	Occur mainly in northwestern Newfoundland, and the Carter Basin (Lake Melville) in Labrador. Surface raised above the surrounding terrain, but flat to undulating with steeply sloping margins. Pools without any distinctive pattern, ranging in size from small in the south to large, extensive flats in the north. Depth: 1.5 to 2.5 m.
String Bogs  	Very common throughout Labrador. Surface gently sloping, with pools oriented at right angles to direction of slope. Depth: 1.0 to 1.5 m.

Table 3.7 Fen Forms and Peatland Complexes Identified along the Proposed Transmission Corridor

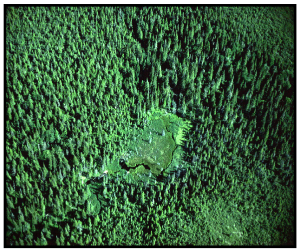
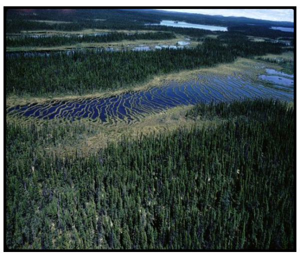
PEATLAND FORM	FEATURES
Slope Fens  	Occur throughout Newfoundland and Labrador, usually on small slopes in the forested regions of the province. Surface is relatively uniform, sloping and with few pools. Small streams are common. Depth: 0.5 to 1.5 m.
Atlantic Ribbed Fens  	Very common throughout Labrador, and higher elevations of Newfoundland (e.g., Witless Bay Line, Gaff Topsails, Long Range Mountains). Surface gently sloping, usually with numerous linear pools oriented at right angles to direction of slope. Depth: 0.25 to 1.0 m.
Ladder Fens  	Small, narrow fens that occur on gently sloping terrain, mainly along the edges, or borders, of raised and plateau bogs. Linear-shaped pools are often abundant, occurring at right-angles to direction of slope, having a ladder-like appearance when viewed from the air. Depth: 0.5 to 1.5 m.
Wetland Complexes  	Wetland complexes consist of two, or more, wetland types (usually peatlands) that exist adjacent to, and contiguous with, each other. Although these wetlands occur adjacent to one another, they maintain the hydrological, ecological and floristic features that normally characterize each ecosystem as if it were a separate entity on the landscape.

Table 3.8 Marsh Forms Identified along the Proposed Transmission Corridor

MARSH FORM	FEATURES
Riparian Stream Marsh 	Occur throughout Newfoundland and Labrador, although not common. They sometimes occupy riparian zones of streams and rivers and are usually located on recent alluvial sediments deposited in sheltered areas not influenced by strong water currents.
Basin Marsh 	Scattered throughout Newfoundland and Labrador, but not common. Situated in well-defined basins and depressions in inland regions outside the influence of sea waters and sea spray. They receive waters from groundwater discharge, surface runoff, and sometimes from stream and river inflow.

3.3 Wetland Area and Distribution

Approximately 9 percent (20,608 ha) of the entire proposed transmission corridor area (220,971 ha) is comprised of wetland (Figure 3.1). When considered from a regional perspective, wetlands cover approximately 8 percent (6,801 ha) of the total proposed corridor area (83,321 ha) for Labrador (Figure 3.2) and approximately 10 percent (13,807 ha) of the total area (137,650 ha) for Newfoundland. The Northern Peninsula (Figure 3.3) portion of the proposed transmission corridor is approximately 9 percent wetland, Central and Eastern Newfoundland (Figure 3.4) 12 percent and the Avalon Peninsula (Figure 3.5) 9 percent. Table 3.9 presents a summary of the total proposed transmission corridor and wetland area by geographic region.

Table 3.9 Wetland Area Summary for Proposed Transmission Corridor

Geographic Region	Proposed Transmission Corridor Area (ha)	Wetland Area (ha)	Percent Wetland
Southeastern Labrador	83,321	6,801	8
Northern Peninsula	47,488	4,166	9
Central and Eastern Newfoundland	64,156	7,393	12
Avalon Peninsula	26,006	2,248	9
Entire Transmission Corridor	**220,971**	**20,608**	**9**

Figure 3.1 Overview of Geographic Regions along the Proposed Transmission Corridor

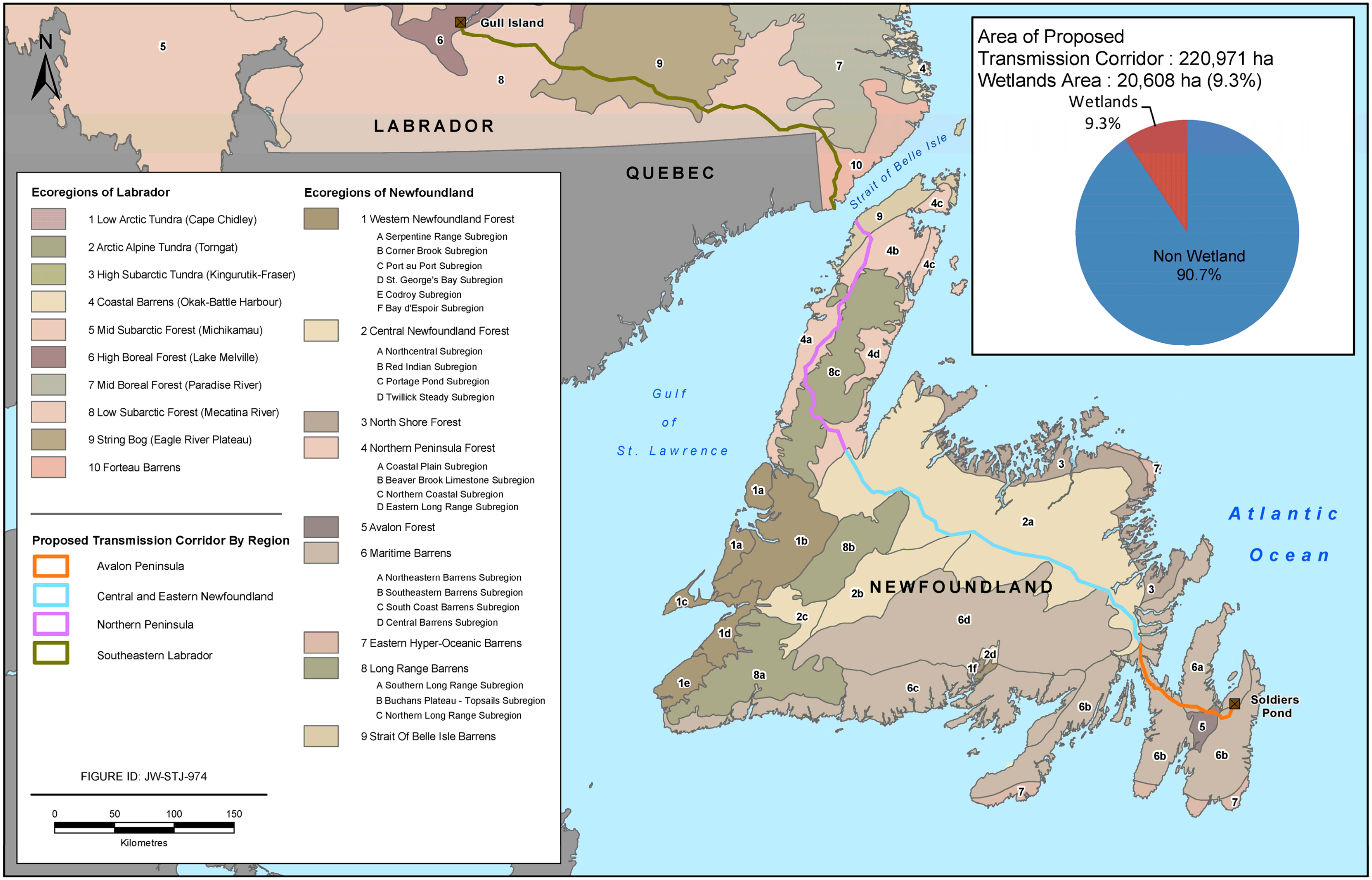


Figure 3.2 Wetland Distribution for Southeastern Labrador Region of the Proposed Transmission Corridor

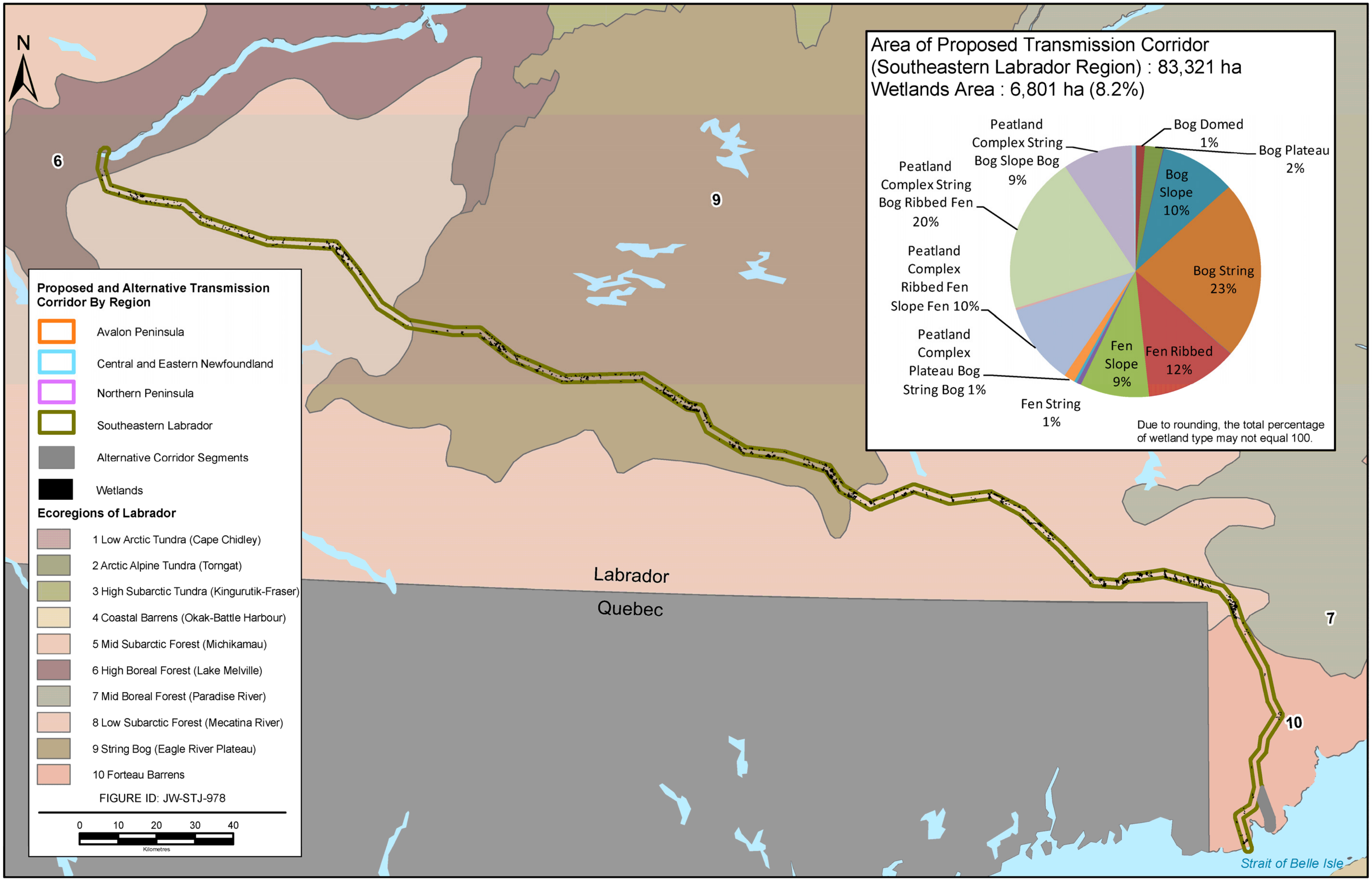


Figure 3.3 Wetland Distribution for the Northern Peninsula Region of the Proposed Transmission Corridor

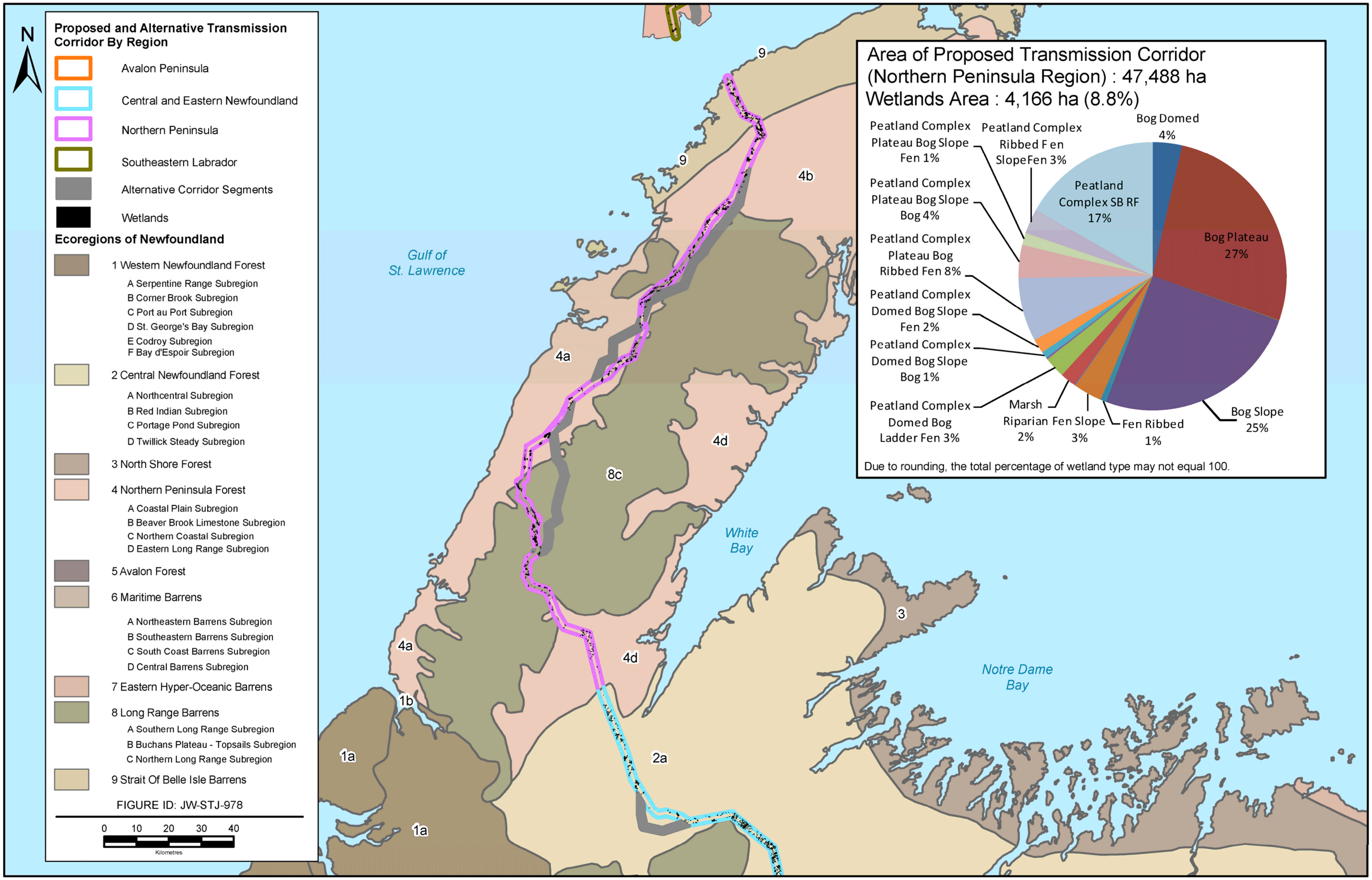


Figure 3.4 Wetland Distribution for the Central and Eastern Newfoundland Region of the Proposed Transmission Corridor

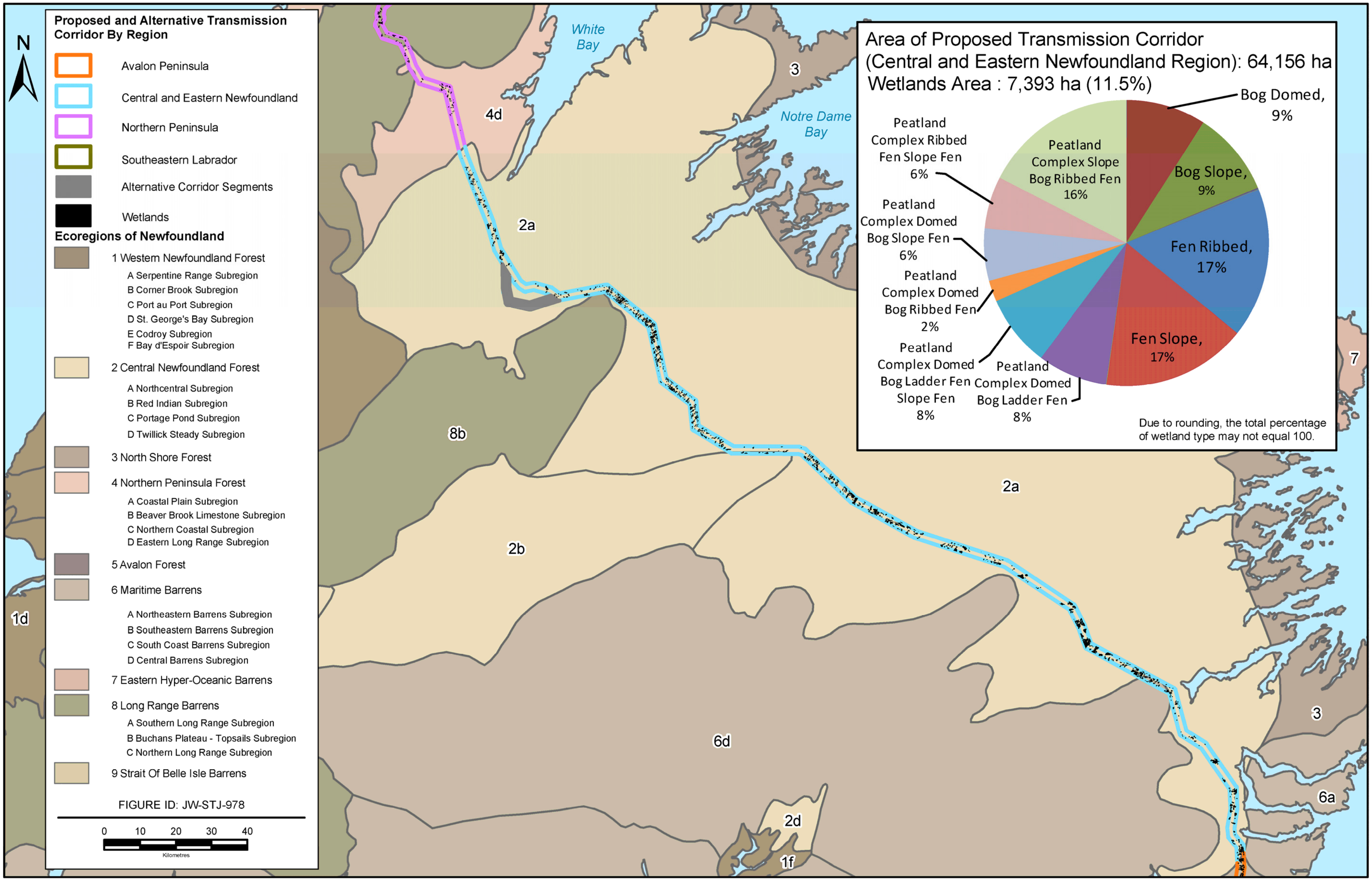
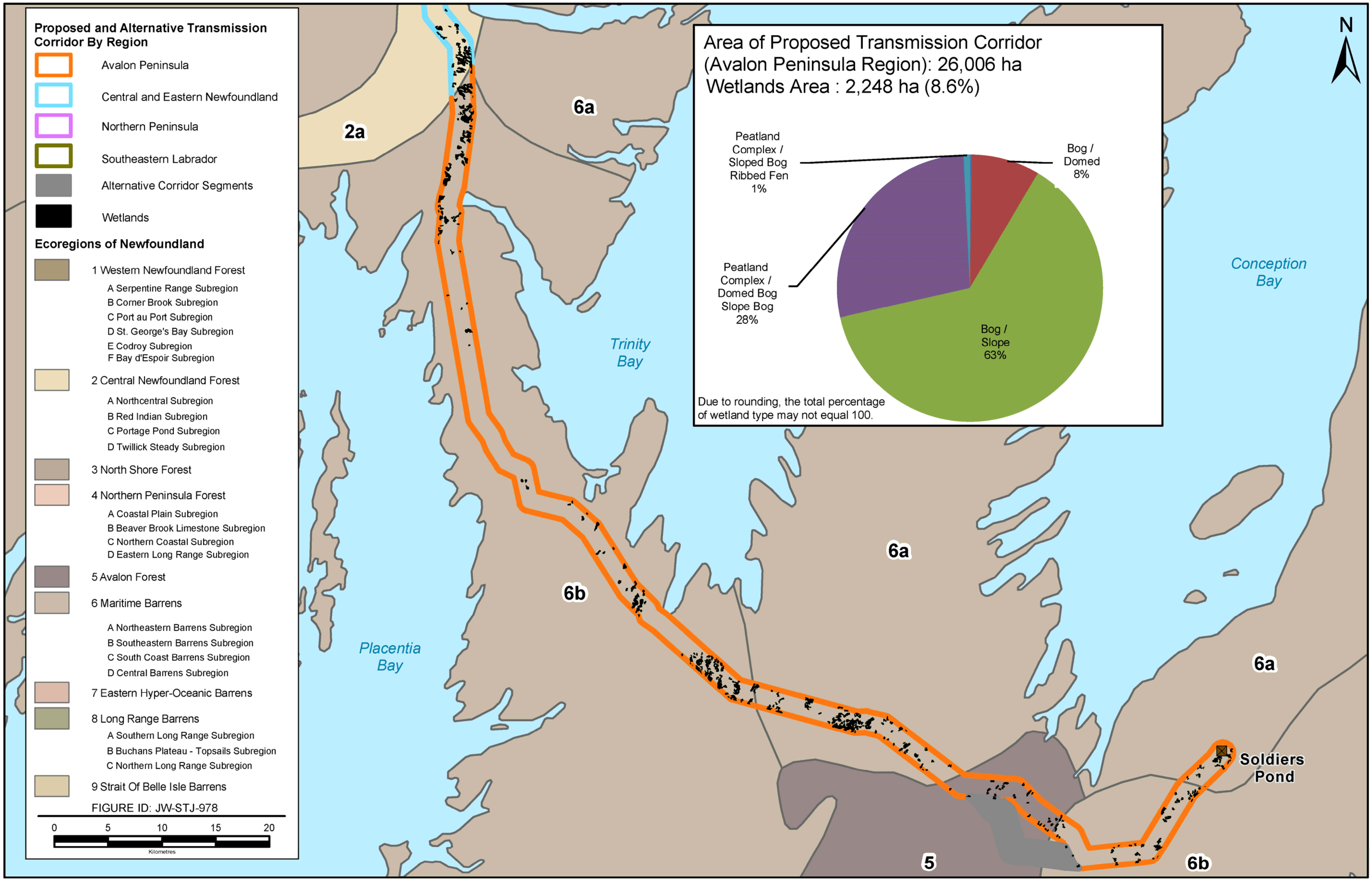


Figure 3.5 Wetland Distribution for the Avalon Peninsula Region of the Proposed Transmission Corridor



The total and relative area of the various wetland classes and forms for the proposed transmission corridor are summarized by Ecoregion in Tables 3.10 and 3.11. The High Boreal Forest, Low Subarctic Forest, String Bog and Forteau Barrens Ecoregions correspond to the Southeastern Labrador geographic region in Table 3.9 and Figure 3.2. The Strait of Belle Isle Barrens, Northern Peninsula Forest, and Long Range Barrens Ecoregions correspond primarily to the Northern Peninsula geographic region in Table 3.9 and Figure 3.3. The Central Newfoundland Forest Ecoregion corresponds to the Central and Eastern Newfoundland geographic region in Table 3.9 and Figure 3.4. The Maritime Barrens and Avalon Forest Ecoregions correspond primarily to the Avalon Peninsula geographic region in Table 3.9 and Figure 3.5. The Long Range Barrens and Maritime Barrens Ecoregions also occur to a reduced extent within the Central and Eastern Newfoundland geographic region.

Table 3.10 Area of Wetland by Form for the Proposed Transmission Corridor – Labrador Ecoregions

Ecoregion	Wetland Class	Wetland Form	Area (ha)*	Percent of Corridor
High Boreal Forest (Lake Melville) *(1,372 ha)***	Fen	Ribbed	12	≤0.5
	Total		*12*	*≤0.5*
High Boreal Forest (Lake Melville) Wetland Total			**12**	**0.9**
Low Subarctic Forest (Mecatina River) *(42,158 ha)*	Bog	Blanket	8	≤0.5
		Domed	22	≤0.5
		Plateau	161	≤0.5
		Slope	281	0.7
		String	580	1.4
		Total	*1,052*	*2.5*
	Fen	Domed	2	≤0.5
		Ribbed	462	1.1
		Slope	374	0.9
		String	14	≤0.5
		Total	*852*	*2.0*
	Peatland Complex	Plateau Bog String Bog	97	≤0.5
		String Bog Slope Bog	465	1.1
		String Bog Ribbed Fen	712	1.7
		Ribbed Fen Slope Fen	595	1.4
		Slope Bog Ribbed Fen	20	≤0.1***
		String Bog Slope Fen	5	≤0.1
		Total	*1,894*	*4.5*
Low Subarctic Forest (Mecatina River) Wetland Total			**3,798**	**9.0**
String Bog (Eagle River Plateau) *(26,123 ha)*	Bog	Domed	52	≤0.5
		Ribbed	6	≤0.1
		Slope	214	0.8
		String	969	3.7
		Total	*1,241*	*4.7*
	Fen	Ribbed	338	1.3
		Slope	220	0.8
		String	25	≤0.1
		Total	*583*	*2.2*

Ecoregion	Wetland Class	Wetland Form	Area (ha)*	Percent of Corridor
String Bog (Eagle River Plateau) *(26,123 ha)* (cont.)	Peatland Complex	String Bog Slope Bog	113	≤0.5
		String Bog Ribbed Fen	669	2.6
		Ribbed Fen Slope Fen	112	≤0.5
		Domed Bog Slope Bog	25	≤0.1
		String Bog Slope Fen	25	≤0.1
		Total	*944*	*3.6*
		String Bog (Eagle River Plateau) Wetland Total	**2,768**	**10.6**
Forteau Barrens *(13,668 ha)*	Bog	Slope	165	1.2
		String	12	≤0.1
		Total	*177*	*1.3*
	Fen	Slope	14	≤0.1
		Total	*14*	*≤0.1*
	Peatland Complex	String Bog Slope Bog	33	≤0.5
		Total	*33*	*≤0.5*
		Forteau Barrens Wetland Total	**224**	**1.6**
Grand Total			***6,801***	***8.2***

**Area of Wetland Form within section of the corridor per Ecoregion*
*** Land area of proposed transmission corridor within Ecoregion*
****Wetland forms where percent of corridor is ≤0.5 are not included in Figures 3.2 to 3.5*

Table 3.11 Area of Wetland by Form for the Proposed Transmission Corridor - Newfoundland Ecoregions

Ecoregion	Wetland Class	Wetland Form	Area (ha)*	Percent of Corridor
Strait of Belle Isle Barrens *(3,622 ha)*	Bog	Domed	9	≤0.5
		Plateau	583	16.1
		Slope	11	≤0.5
		Total	*603*	*16.6*
		Strait Of Belle Isle Wetland Total	**603**	**16.6**
Northern Peninsula Forest *(28,573 ha)*	Bog	Domed	138	≤0.5
		Plateau	454	1.6
		Ribbed	2	≤0.1
		Slope	643	2.2
		Total	*1,237*	*4.3*
	Fen	Ribbed	25	≤0.1
		Slope	108	≤0.5
		Total	*133*	*≤0.5*
	Marsh	Basin	4	≤0.1
		Riparian	38	≤0.5
		Total	*42*	*≤0.5*
	Peatland Complex	Domed Bog Slope Bog	27	≤0.1
		Domed Bog Slope Fen	65	≤0.5
		Slope Bog Ribbed Fen	167	0.6
		Plateau Bog Ribbed Fen	317	1.1
		Plateau Bog Slope Bog	166	0.6
		Plateau Bog Slope Fen	61	≤0.5
		Domed Bog Ladder Fen Slope Fen	9	≤0.1
		Domed Bog Ladder Fen	58	≤0.5
		Total	*870*	*3.0*
		Northern Peninsula Forest Wetland Total	**2,282**	**8.0**

Ecoregion	Wetland Class	Wetland Form	Area (ha)*	Percent of Corridor
Long Range Barrens *(15,293 ha)*	Bog	Domed	2	≤0.1
		Plateau	79	≤0.5
		Slope	398	2.6
		Total	*479*	*3.1*
	Fen	Ribbed	5	≤0.1
		Slope	36	≤0.5
		Total	*41*	*≤0.5*
	Marsh	Riparian	42	≤0.5
		Total	*42*	*≤0.5*
	Peatland Complex	Domed Bog Slope Bog	7	≤0.1
Long Range Barrens *(15,293 ha)* (Cont.)		Domed Bog Slope Fen	7	≤0.1
		Slope Bog Ribbed Fen	531	3.5
		Ribbed Fen Slope Fen	126	0.8
		Domed Bog Ladder Fen	48	≤0.5
		Total	*719*	*4.7*
		Long Range Barrens Wetland Total	**1,281**	**8.4**
Central Newfoundland Forest *(64,156 ha)*	Bog	Basin	4	≤0.1
		Domed	675	1.1
		Slope	680	1.1
		Total	*1,359*	*2.1*
	Fen	Domed	4	≤0.1
		Ladder	3	≤0.1
		Ribbed	1,283	2.0
		Slope	1,236	1.9
		Total	*2,526*	*3.9*
	Marsh	Riparian	3	≤0.1
		Total	*3*	*≤0.1*
	Peatland Complex	Domed Bog Slope Fen	449	0.7
		Slope Bog Ribbed Fen	1,210	1.9
		Ribbed Fen Slope Fen	449	0.7
		Domed Bog Ribbed Fen	181	≤0.5
		Domed Bog Ladder Fen Slope Fen	615	1.0
		Domed Bog Ladder Fen	601	0.9
		Total	*3,505*	*5.5*
		Central Newfoundland Forest Wetland Total	**7,393**	**11.5**
Maritime Barrens *(23,766 ha)*	Bog	Basin	5	≤0.1
		Domed	114	≤0.5
		Slope	1,301	5.5
		Total	*1,420*	*6.0*
	Fen	Slope	9	≤0.1
		Total	*9*	*≤0.1*
	Peatland Complex	Domed Bog Slope Bog	571	2.4
		Slope Bog Ribbed Fen	129	≤0.5
		Total	*700*	*2.9*
		Maritime Barrens Wetland Total	**2,129**	**9.0**
Avalon Forest *(2240 ha)*	Bog	Domed	67	3.0
		Slope	52	2.3
		Total	*119*	*5.3*
		Avalon Forest Wetland Total	**119**	**5.3**
Grand Total			***13,807***	***10.0***

**Area of Wetland Form within section of the corridor per Ecoregion*
*** Land area of proposed transmission corridor within Ecoregion*

4.0 DISCUSSION

The results of the field surveys and wetland inventory within the proposed transmission corridor are generally consistent with the scientific literature in terms of wetland class, form and vegetation composition for Newfoundland and Labrador. However, the proportion of wetland area is less than the overall and generally accepted 15 to 20 percent of the provincial landscape, due primarily to attempts to avoid wetland areas, where possible, during transmission corridor selection. With wetlands covering 8 percent of the proposed transmission corridor in Labrador and 10 percent in Newfoundland, they are still a prevalent component of the landscape.

Bogs and peatland complexes are the most common wetlands in the Labrador region of the corridor, with each covering approximately 3 percent of the total transmission corridor area, with fens covering approximately 2 percent. In the Newfoundland region, bogs and peatland complexes are again the most common, with both covering approximately 4 percent of the total transmission corridor area. Fens cover approximately 2 percent and marshes less than 0.1 percent of the total for the Newfoundland region of the transmission corridor area.

Given their role as wildlife habitat, their potential for water storage and flood regulation, the vast stores of carbon that reside in wetlands and the potential for release of carbon dioxide into the atmosphere following disturbances, various agencies, organizations and governments have recently placed much emphasis on the need to preserve and maintain wetlands. The Federal Policy on Wetland Conservation (Government of Canada 1991) states its main objective is "to promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future." This policy aims to ensure that wetlands are used in a manner "...that enhances prospects for their sustained and productive use by future generations". The Federal Policy on Wetland Conservation, as well as similar wetland policies in many provinces, also aims to ensure "maintenance of the functions and values derived from wetlands throughout Canada" and "no net loss of wetland functions on all federal lands and waters in Canada". These policies have become necessary, given the net loss of wetlands that has occurred in many of the more populated and/or developed regions of Canada.

Wetland functional analyses have been developed as a tool for use in EAs to address the issues of avoidance, minimization and compensatory mitigation of wetland function. It is generally site-specific and driven by collected data. However, the process of assessing the role and importance of wetland functions to society and nature is often problematic and controversial. Kusler (2004, p. 1) states that "no topic in wetland management has during the last two decades spawned more controversy, reports or papers than assessment of wetland functions and values"; and, furthermore,

> "….the assessment of functions and values involves a variety of conceptual questions (i.e., definition of "function" and "value"), assumptions and data gathering and analyses challenges which are not easily resolved and there is no general agreement among scientists on how to resolve them. In addition, detailed accurate site-specific assessment of functions/values is complicated and requires the gathering of a great deal of time series information (e.g., hydrology, species) that is rarely available and cannot be easily generated. There are significant gaps in scientific knowledge

> pertaining to the assessment of specific functions such as habitat requirements for a particular plant and animal species. Perhaps, the most problematic issue regarding function assessments is selecting the correct approach or method for a particular wetland."

Kusler (2004) further points out that Bartoldus (1999) described 40 rapid assessment methods for assessing wetland functions and values. There are now probably 90 or more approaches. More recently, Hanson et al. (2008) reported that, during the last 20 years, approximately 100 different methods have been developed to assess wetland functions, and that no single method is best for all regions and situations in Canada or the United States.

Despite the methodological problems inherently associated with wetland functional analyses, most researchers and authors generally agree on the major categories of wetland functions, and the validity of this general methodology for assessing potential environmental effects. Novitzi et al. (1997) describe habitat, hydrology and water quality as three important functions, although they also point out that these distinctions are somewhat arbitrary and simplistic. Similarly, Smith et al. (1995) list hydrological processes, biogeochemical processes and habitat as the three most important functions of wetland. Overall, hydrology, habitat, biological productivity and biogeochemical processes are probably the most relevant functional categories, although peat carbon processes and their relationship with climate change and/or global warming have also become very relevant in recent years. Depending on the wetland ecosystem in question, other wetland functions can be assessed. For example, for coastal wetlands, Brouwer et al. (1999) describe flood control, water supply and water quality as important wetland functions. For wetland types such as mangrove, woodland, freshwater marsh, salt or brackish marsh and un-vegetated sediments, Brander et al. (2004) have identified flood control, water supply, water quality, habitat and nursery, recreational hunting, recreational fishing, amenity, materials, fuel wood and biodiversity as relevant in wetland assessments.

Based on these considerations, five key wetland functional categories (biological productivity, carbon cycling, hydrology, water quality and habitat) are considered as the most important ecological services provided by wetlands that occur along the proposed transmission line corridor in Newfoundland and Labrador. These functional categories provide a structure for assessing the value of wetlands and for identifying potential environmental interactions with the proposed Project. Given the geographic extent of the proposed transmission corridor from Labrador to eastern Newfoundland, it is not possible or practical to analyze the functions of all the individual wetlands within it. Thus, an overview of wetland functions within these major functional categories (biological productivity, carbon cycling, hydrology, water quality and habitat) is discussed in Sections 4.1 to 4.5, respectively, for the wetland classes that occur along the proposed transmission corridor in Newfoundland and Labrador.

4.1 Biological Productivity

Biological productivity in wetlands/peatlands represents the amount and rate of production of vegetation or biomass that occurs in that ecosystem over a given period of time. However, accumulation of such wetlands will only occur when net primary productivity exceeds losses of organic matter due to decomposition, disturbances (e.g., fires) and dissolved organic carbon export. In both bogs and fens, microbial activity and, hence, decomposition, are adversely affected by cold soil temperatures, low nutrient availability and a water table at or near the surface of the wetland for most of the year. While productivity in bogs is low, the cold, acidic, nutrient-poor soil conditions also adversely affect microbial activity. As a result, rates of decomposition are low, rates of organic matter accumulation are high, and deep bogs (2 to 10 m) are common on the landscape. However, in fens (especially rich fens), where nutrients are more available and pH is higher, microbial activity and rates of decomposition are also higher. As a result, accumulation in fens is very slow, and shallow fens less than 1 m in depth are common.

The relatively higher levels of nutrients brought into marsh wetlands from the surrounding landscape and the fluctuating water table lead to relatively higher levels of biological productivity than that of fens and bogs.

4.2 Carbon Cycling

Carbon cycling in wetlands is very closely linked to biological productivity. In wetlands, carbon is stored as peat. The rate of peat production is directly linked to the rate of carbon sequestration. Bogs, with their higher rates of peat accumulation, remove and store more atmospheric carbon.

Although fens also accumulate and store peat, the rate of accumulation, as discussed in Section 4.1, is generally lower than that for bogs. As such, fens play a lesser role in atmospheric carbon sequestration.

The rate of plant decomposition in marsh wetlands is typically equal to or greater than the rate of plant biological productivity, resulting in minimal to no peat accumulation. Although carbon is stored in marshes in the form of living plant biomass, the amount of carbon stored over several seasons is likely to remain the same. As such, marsh wetlands in the proposed transmission corridor are not likely to store or release atmospheric carbon.

4.3 Hydrology

Bogs are typically situated to receive water primarily from direct precipitation and, as such, likely play a minor role in attenuating water flows from the surrounding area. However, in extreme weather events, extensive areas of bog may play the same hydrologic role as extensive areas of fens.

Extensive fen areas (e.g., ribbed fens) receive water from the surrounding landscape and will therefore play a role in attenuating water flows. The size of the fen is proportional to its effect on the surface hydrology.

Marshes are typically directly associated with streams and riparian areas and as such, can play an active role in water flow regimes by ameliorating peak flows and dry periods.

4.4 Water Quality

Bogs within the proposed transmission corridor are contained within topographical/hydrological systems away from urban influences, and are not affected by flooding or sources of pollution from outside sources. Thus, the potential for bogs to capture excess nutrients from suspended sediments and be subject to eutrophication from manures, fertilizers, septic tanks and sewage is low.

Fens are functionally very similar to bogs with respect to water quality both in terms of adjacency to sources of pollution and the ability to absorb any potential nutrients or suspended sediments.

Marshes, depending on position in the proposed transmission corridor, may play an active role in absorbing excess nutrients and suspended sediments. However, the relatively small area occupied by marsh wetlands within the proposed transmission corridor means that they are not likely to substantially influence the quality of water over the length of the corridor.

4.5 Habitat

Bogs have a relatively low rate of biological productivity when compared to the other wetland classes in the proposed transmission corridor. Lower biological productivity generally means there is less consumable biomass (food). However, wildlife may also use wetlands for shelter, travel routes and as staging areas. Various wetland forms will provide particular habitat requirements for a number of species and therefore affect habitat values. For example, string bogs and the associated open water pools will provide more suitable habitat to waterfowl than domed bogs.

Fens have relatively higher biological productivity when compared to bogs but less than that of marshes. The potential for fens to provide habitat for species found along the corridor is highly variable dependent on location, form and wildlife in the area. However, in general, fens may provide habitat to more species than that of the bog wetlands.

Marshes are more productive biologically than both bogs and fens. The increase in available nutrients, combined with the surrounding riparian habitat, is likely to provide habitat for a wider variety of wildlife species than that of fens and bogs.

The reader is referred to the *Labrador – Island Transmission Link Ecological Land Classification Study* (Stantec 2010) and associated wildlife studies for the EA for more detail on wildlife habitat values assigned to the wetlands found within and adjacent to the proposed transmission corridor.

5.0 SUMMARY AND CONCLUSION

A total of 88 wetlands were field surveyed in all Ecoregions along the proposed transmission corridor as part of a broader ELC study. Information derived from the field surveys was used in conjunction with recently acquired high-resolution spatial images, literature and professional experience to delineate and classify the wetlands within the proposed transmission corridor within each Ecoregion.

Three primary wetland classes, bogs, fens and marshes, were identified within the corridor. A fourth class was derived to encompass complexes of fen and bog that were not practical to separate at the 1:50,000 mapping scale used for this exercise. In total, wetlands cover approximately 8 percent of the proposed transmission corridor in Labrador and approximately 10 percent in Newfoundland. The highest percent cover of wetland is found in Central and Eastern Newfoundland, where wetlands cover approximately 12 percent of the corridor. An atlas of wetlands delineated to class and form at a scale of 1:50,000 along the entire length of the proposed transmission corridor is included as an appendix to this report (Appendix A).

Of the three wetland classes found within the proposed transmission corridor, bogs have the lowest biological productivity and marshes have the highest. While bogs are an important habitat for many wildlife species, the increased biological productivity in fens and, in particular, marshes results in higher overall habitat values. Due to their location within the landscape, fens and marshes play more of a role in attenuating surface water flows than bogs. Given the geographic extent of the proposed transmission corridor, most wetlands within it are not in populated or developed areas. The relative isolation of the majority of wetlands from developed areas means that they do not receive or filter water affected by anthropogenic activities such as farming, industrial processing and domestic discharges.

The key objective of the study was to provide the type and level of information on the wetland environment necessary for the eventual EA and other regulatory requirements for the proposed Project. In particular, this report provides a documentation of wetlands and relationships with which the Project could potentially interact on a regional scale. Wetlands have been described and mapped at a scale appropriate to the regional application of the study and provides information for use in the EA, as well as a foundation to assist with eventual route selection.

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