PEI-NB Cable Interconnection Upgrade Project - Volume 3, New Brunswick

Project No. 121811475

Prepared for:
Maritime Electric Company, Limited

Prepared by:
Stantec Consulting Ltd.
165 Maple Hills Avenue
Charlottetown PE C1C 1N9

September 30, 2015

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Abbreviations

ACCDC	Atlantic Canada Conservation Data Council
ACNOS	Atlantic Canada Nocturnal Owl Surveys
AIA	Archaeological Impact Assessment
BBS	Breeding Bird Survey
CBC	Christmas Bird Count
CEAA	*Canadian Environmental Assessment Act*
CO_2e	Carbon Dioxide Equivalent
DU	Ducks Unlimited
ECMC	Ecological Communities of Management Concern
EIA	Environmental Impact Assessment
EIW	Ecologically Important Wetland
EMF	Electromagnetic Fields
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GHG	Greenhouse Gas
H-Frame	Horizontal Frame
iBoF	Inner Bay of Fundy
ICT	Information and Communications Technology
kV	Kilovolt
LAA	Local Assessment Area
LiDAR	Light Detection and Ranging
MBBA	Maritime Breeding Bird Atlas
MECL	Maritime Electric Company, Limited
mG	Milligauss
MW	Megawatt
NB	New Brunswick
NB *CEA*	New Brunswick *Clean Environment Act*

NB Power	New Brunswick Power
NBATVF	New Brunswick All-terrain Vehicle Federation
NBDELG	New Brunswick Department of Environment and Local Government
NBFSC	New Brunswick Federation of Snowmobile Clubs
NBTFHF	New Brunswick Trappers and Fur Harvesters Federation
NS	Nova Scotia
PDA	Project Development Area
PEI	Prince Edward Island
PEIDCLE	Prince Edward Island Department of Communities, Land and Environment
PSW	Provincially Significant Wetland
RAA	Regional Assessment Area
RFA	Recreational Fishing Area
RoW	Right-of-way
SAR	Species at Risk
SOCC	Species of Conservation Concern
VC	Valued Component

1.0 INTRODUCTION

Prince Edward Island Energy Corporation (PEIEC), with Maritime Electric Company, Limited (MECL) serving as construction agent, proposes to upgrade the electrical power interconnection between Prince Edward Island (PEI) and New Brunswick.

The PEI-NB Cable Interconnection Upgrade Project (the "Project") includes construction and operation of a high voltage alternating current transmission system. The main Project components are:

- two 180 megawatt, 138 kilovolt submarine cables
- two landfall sites (where the submarine cable trenches are brought ashore)
- two termination sites (for converting submarine cables to overhead transmission lines or substation);
- three-phase, 138 kilovolt transmission lines within New Brunswick
- expansion of the existing MECL substation in Borden-Carleton, PEI and upgrading of the New Brunswick Power Corporation (NB Power) substation in Memramcook, NB

The Project will span three geographic regions as shown in Volume 1, Figure 1.1 including:

- PEI – a landfall site will be constructed adjacent to the expanded MECL substation in Borden-Carleton, and a termination site will be located within the substation
- The Northumberland Strait – two high voltage alternating current submarine cables will span approximately 16.5 km from Cape Tormentine to Borden-Carleton
- New Brunswick – a landfall site and termination site will be constructed in Cape Tormentine as well as approximately 57 km of overhead transmission lines within new and existing easements to the existing NB Power substation in Memramcook

To reflect the three geographic regions, the environmental impact statement (EIS) for the Project is divided into four volumes:

- Volume 1 includes a detailed description of the overall Project, regulatory framework, consultation activities, and an overview of EIA methodology.
- Volume 2 includes an assessment of potential environmental effects associated with land-based Project components and activities located in PEI.
- Volume 3 (this volume) includes an assessment of potential environmental effects associated with land-based Project components and activities located in New Brunswick.
- Volume 4 includes an assessment of potential environmental effects associated with marine based Project components and activities located in the Northumberland Strait.

The following sub-sections provide an overview of Project components and activities located within New Brunswick. A detailed description of all components and activities related to the Project is provided in Volume 1, Chapter 2.

1.1 DESCRIPTION OF PROJECT COMPONENTS IN NEW BRUNSWICK

Within New Brunswick, the Project includes construction of a landfall site and termination site, overhead transmission lines, and upgrading of an existing substation.

1.1.1 Landfall Site

The submarine cable will make landfall at Cape Tormentine, NB, located approximately 3 km east of the Confederation Bridge on land that is currently owned by the Cape Tormentine Community Development Corporation.

The landfall site is anticipated to be approximately 10 m wide, include one trench for both cables, and potentially a concrete structure to facilitate landfall. The trench will be approximately 1 to 2 m deep and 200 m in length, and will connect the submarine cable to the termination site. The trench may intersect a paved section of Route 955, a highway maintained by the New Brunswick Department of Transportation.

1.1.2 Termination Site

A cable termination site is required to facilitate the transition from submarine cable to overhead transmission. The termination site in New Brunswick will be located at Cape Tormentine, approximately 200 m from the shoreline. The site will be similar in appearance to a substation and will include a riser pole, ground grid, overhead switches, and perimeter fence. A climate-controlled metering building will be constructed on site to house weather sensitive equipment. This building covers a footprint of approximately 18 m^2 (3.5 m x 5 m) and will be located inside the perimeter fence.

1.1.3 Overhead Transmission Lines

Approximately 57 km of land-based transmission line will be built within New Brunswick, originating in Memramcook and terminating in Cape Tormentine. These transmission lines will be three-phase 138 kV lines and will tie into NB Power’s existing substation in Memramcook and the termination site in Cape Tormentine.

Approximately 17 km of the total 57 km of overhead transmission line corridor between Melrose and Cape Tormentine will be new-build construction within a combination of new and existing easements on which there is no existing transmission line. This 17 km section of transmission line will be twinned (i.e., two lines running parallel) and will require clearing of a 60 m wide corridor.

The remaining 40 km of overhead transmission line in New Brunswick will be new-build construction adjacent to existing twinned transmission lines between Memramcook and Melrose, requiring widening of existing cleared corridors by 30 m.

1.1.4 Substation Upgrade

Upgrades required at the Memramcook, NB existing substation include addition of one new 138 kV line termination point, and requires a single circuit breaker, disconnect switches, instrument transformers, protection and control, and telecommunications equipment.

1.1.5 Project Footprint

The total Project footprint, or Project Development Area (PDA) within New Brunswick is approximately 225.6 ha.

1.2 PROJECT PHASES AND SCHEDULE

The Project includes three phases: construction, operation, and decommissioning and abandonment.

Construction in NB is scheduled to begin in March 2016 with clearing of the RoW for transmission line between Melrose and Cape Tormentine. Key Project timelines are provided in Volume 1, Section 2.5. The operation phase will begin with energizing of the submarine cable, scheduled for December 2016. Project completion is expected in June 2017 with the commissioning of the transmission line between Melrose and Memramcook. The operation phase duration is based on the predicted useful service life of the Project, which is estimated to be 40 years.

Land-based infrastructure will be decommissioned at the end of its useful service life, in accordance with the applicable standards and regulations at that time. Most site infrastructure will be decommissioned, removed and sold or disposed of.

2.0 ENVIRONMENTAL SETTING AND POTENTIAL INTERACTIONS

New Brunswick is the largest of Canada's three Maritime Provinces, and lies adjacent to the Gaspé Peninsula of Quebec and the American state of Maine. New Brunswick has an estimated population of 751,171 and was one of the first provinces to join together to form the Dominion of Canada in 1867 (Historica Canada 2015; Statistics Canada 2012).

The Province covers roughly 73,440 square kilometres, ranging from about 242 kilometres east to west and 322 kilometres north to south. The northern part of the province is dominated by mountains that are part of the Appalachian Mountain Range. Approximately 5% of New Brunswick's land is used for farming, with the majority of suitable agricultural land located along major rivers. 83% of the Province is forested. The remaining land is used for residential, commercial/industrial, and institutional. The geology of New Brunswick consists mainly of rock layers that were formed in the Palaeozoic, Ordovician, and Carboniferous periods. These rocks include granites; red, green, and grey sandstones; and combinations of limestone, gypsum, salt, and shale (Historica Canada 2015).

New Brunswick's climate is typical of a coastal area and of an inland province. January is generally the coldest month and July is the warmest, with the interior experiencing warmer summers and colder winters. Summers typically average daytime highs between 20 and 22°C around the Bay of Fundy. These temperatures increase towards 25°C in the interior of the province. In winter, the interior often experiences average temperatures between -20°C to -30°C, while the southern coast temperatures average -7.5°C. Spring and early summer are fairly dry in the province, but New Brunswick receives a large amount of rainfall during the summer months, with the interior receiving roughly 1,200 millimetres of rainfall per year (Historica Canada 2015; World Atlas 2015).

Wildlife in New Brunswick is similar to that of the terrestrial environments in the other Maritime Provinces. The forests provide suitable habitat for herds of both moose and white tailed deer, and smaller animals such as porcupines, raccoons, chipmunks and squirrels, lynx, bobcats, coyotes, foxes, and a variety of others. Along the coast of the Northumberland Strait and the Bay of Fundy, there are a number of different bird species that can be seen such as plovers, sandpipers, cormorants, terns, eagles, osprey, herrons, ducks, and gulls (Canadian Geographic 2015; AMEC 2007; JWEL 2001).

The Project location within New Brunswick includes a cable landfall site along the northeastern shore of New Brunswick in Cape Tormentine. This land is currently owned by the Cape Tormentine Community Development Corporation. The Cape Jourimain National Wildlife Area, is approximately 1.5 km west of the cable landfall site in New Brunswick. It was designated in 1980 due to the variety of waterfowl and shorebirds that inhabit the area.

2.1 POTENTIAL INTERACTIONS

Potential valued components (VCs) were reviewed to determine if there was potential for interaction with Project components located in New Brunswick (Table 2.1). This volume considers only Project interactions in New Brunswick. Potential interactions in PEI are considered separately in Volume 2 (PEI) and marine-based components of the environment are considered in Volume 4 (Northumberland Strait).

Table 2.1 Interactions between Potential Valued Components and Project Components Located in New Brunswick

Valued Component	Interaction with Project Components Located in New Brunswick?
Atmospheric Environment	No
Groundwater Resources	No
Freshwater Environment	Yes
Terrestrial Environment	Yes
Marine Environment	N/A
Land Use	Yes
Commercial, Recreational and Aboriginal Fisheries	N/A
Socioeconomic Environment	Yes
Heritage Resources	Yes
Other Marine Users	N/A
Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons	Yes
Note: N/A - Not applicable to New Brunswick volume.	

Freshwater Environment, Terrestrial Environment, Land Use, Socioeconomic Environment, Heritage resources, and Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons are carried through this environmental assessment as VCs (Chapter 3).

The following sub-sections provide rationale for not including Atmospheric Environment and Groundwater Resources.

2.1.1 Groundwater Resources

2.1.1.1 Existing Conditions

Groundwater is the source of drinking water for the residents and businesses along the transmission line corridor in New Brunswick. Residents along the majority of the transmission line corridor obtain their groundwater from individual water wells drilled on their properties, with the exception of residents in Port Elgin where municipal wells are used as the water supply. There are plans to provide a municipal water supply to residents in the east end of Memramcook which would also be provided by municipal wells.

Wellfield Protected Areas have been delineated for the municipal supply wells in Port Elgin, and will be delineated for the future municipal water supply in the east end of Memramcook. Three protection zones are typically defined that restrict land-use activities that are potentially hazardous to groundwater quality.

These zones are established based on groundwater travel time to a well, and they are designed to be protective against three types of groundwater contaminants: bacterial, petroleum products and chlorinated solvents. Zones include:

- Zone A lies closest to the wellhead and therefore poses the highest risk of pollution. The Designation Order states that septic tanks, sewer lines, petroleum products, chlorinated solvents, pesticides and similar chemicals or activities must be controlled or in some cases restricted within this zone. Its outer boundary surrounds the area where the potential for living organisms such as bacteria or viruses exists which could reach a supply well prior to their expected natural die-off. Potential bacterial contaminant sources such as manure or new septic tanks are more restricted in this zone.
- Zone B lies more distant from the wellhead and surrounds Zone A. The risk of bacterial contamination from land use is greatly reduced in Zone B, but significant pollution risks still persist from petroleum products, chlorinated solvents or other persistent chemicals or activities.
- Zone C surrounds Zones A and B and is located furthest from the wellhead. Controls on some chemicals or activities are much less stringent in Zone C, but are still required for the more persistent contaminants such as chlorinated solvents, some petroleum products and groundwater extraction.

2.1.1.2 Potential Interactions with Project Components

The transmission corridor passes through Zone C of the northern Port Elgin Wellfield Protected Area. The construction and operation of an overhead power transmission line is not listed as a restricted activity within the wellfield.

Trenching will be required for the installation of the cables to the proposed termination site at the landfall site. This may also require some dewatering within the trenches during the construction of the Project. However, as the depth to groundwater (estimated to be 3.0 to 4.5 m below ground between the substation and the coastline) is greater than the expected depth of the excavation for the cable (approximately 2 m), these activities are not expected to interact with the existing uses of groundwater resources.

Operation of the transmission line will require vegetation management. A combination of mechanical and chemical means may be used as appropriate. The use of chemical vegetation management will be conducted in accordance with government regulations, and thus are not anticipated to interact with Groundwater Resources along the transmission corridor.

2.1.1.3 Summary

Based on the lack of interactions noted above, there are no substantive interactions between the Project and Groundwater Resources anticipated. Groundwater Resources is therefore not considered as a VC in New Brunswick for the purpose of environmental assessment.

2.1.2 Atmospheric Environment

The Atmospheric Environment can be characterized by three components; air quality, climate, and sound quality. The Atmospheric Environment is typically described as:

- Air quality, characterized by the measure of the constituents of ambient air, and includes the presence and the quantity of air contaminants in the atmosphere.
- Climate, which is characterized by the composite or generally prevailing meteorological conditions of a region, including temperature, air pressure, humidity, precipitation, sunshine, cloudiness, and winds, throughout the seasons, averaged over a number of years (typically a 30 year period of record). In relation to climate change, climate is understood to be influenced by releases of greenhouse gases (GHGs) from human activities as well as natural sources, Project-based releases of GHGs are typically used as an indicator of potential environmental effects on Climate. The assessment of potential environmental effects of Climate on the Project is addressed in Chapter 4 (Effects of the Environment on the Project Chapter).
- Sound quality, which is characterized by the type, character, frequency, intensity, and duration of noise (unwanted sound) in the outdoor environment. The audible frequencies for humans are in the range of 20 - 20,000 Hertz (Hz). Vibration, identified as oscillations in matter that may lead to unwanted sound or stress in materials, is also typically considered as part of sound quality.

In this EIA, combustion gases, particulate matter and electric and magnetic fields (EMF) are considered in relation to air quality and GHGs released during combustion processes are considered in relation to climate change as those are the primary air contaminants associated with this type of project. Noise is evaluated based on sound pressure levels and consideration of vibration levels. Project phases include construction, operation, and decommissioning and abandonment and the area of assessment is within 1 km of the Project Development Area (PDA) for air quality and noise. For this Project, the PDA is limited to the anticipated area of physical disturbance associated with the construction or operation of the Project. The PDA includes the Memramcook substation expansion, the 30 m wide overhead transmission line corridor twinning from Memramcook to Melrose, the new 60 m wide corridor from Melrose to Cape Tormentine, and the Cape Tormentine landfall site above the high water mark. The area of assessment for climate change is global.

The *New* Brunswick *Clean Air Act* applies to the Project for air quality objectives. There are no applicable sound quality or greenhouse gas regulations governing the Project.

2.1.2.1 Existing Conditions

Air Quality

The existing air quality in the vicinity of the Project is mainly influenced by traffic and nearby farming activities. Contributors to air pollution include combustion emissions from vehicle traffic (mainly related to the Confederation Bridge) and combustion and fugitive emissions, agricultural contaminant emissions, and the generation of airborne dust during agricultural activities such as plowing.

In general, air quality of the area of the Project meets the provincial air quality objectives, established under the *Clean Air Act,* most of the time. During most times of the year, wind patterns in the area tend to disperse most pollutants released in the region. Generally, climate conditions provide good dispersion of air contaminants and frequent rainfall scavenges air contaminants from the atmosphere. The ambient air quality also benefits from the infusion of relatively clean oceanic air masses from the North Atlantic. Occasionally, air masses from central Canada or the eastern seaboard to the south may transport contaminants such as ozone into the area, causing a reduction in air quality. At other times, the weather is dominated by high-pressure air masses that produce low wind speed and poor dispersion of local emissions, which can lead to elevated concentrations of air contaminants and reduced air quality.

There were no exceedance events of the provincial air quality objectives (measuring carbon monoxide, hydrogen sulphide, nitrogen dioxide, sulphur dioxide, and total suspended particulate) in 2012 or 2013 near Moncton, NB (NBDELG 2015).

The Canadian Ambient Air Quality Standards (CAAQS) record long-term trends for particulate matter and ground level ozone across Canada. In Moncton, the 2015 CAAQS target was met, from data collected in 2011 to 2013 (NBDELG 2015).

Greenhouse Gas (GHG) Emissions

The quantities of greenhouse gases (GHGs) released to the atmosphere have been reported in Canada's national inventory report for 2013 as 15.7 million tonnes CO_2e for the province of NB, and 726 million tonnes for Canada (Environment Canada 2015). On this basis, NB represents a small fraction of Canada's GHG releases annually (2.2%).

Global emissions of GHGs were estimated to be 44 billion tonnes of carbon dioxide equivalent (CO_2e) in 2011 (latest available data), excluding land use change and forestry (World Resources Institute 2014). Therefore, on this basis Canada's contribution to global GHG emissions is approximately 1.6%.

Environment Canada's Facility Greenhouse Gas Emissions Reporting Program (GHGRP) provides information on greenhouse gas (GHG) emissions from Canadian facilities over the reporting threshold. Any facility with annual GHG emissions of 50,000 tonnes of CO_2e or higher is required to report to the program.

Information and data are taken from the Environment Canada website found at:
http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=F81C9414-1&offset=2&toc=show.

There are 12 facilities in NB which exceed the Environment Canada reporting threshold, producing 7,475,000 tonnes CO_2e in 2013. This accounts for approximately 3% of the total reported provincially and approximately 1% of the national reported total for 2013.

Climate

The closest weather station to the PDA with available historical data is in Sackville, NB, located approximately 15 km south of the PDA (where the proposed transmission line travels near Cookville). Limited historical climate data for wind speed and wind direction are available for the Sackville station; therefore, wind data from the Moncton weather station, located approximately 30 km from the Memramcook substation, are also reviewed to provide some indication of the magnitude of winds experienced in the region.

Annual climate normals for the nearest weather station (Sackville) indicate that January is typically the coldest month, with a mean daily temperature of -7.5 degrees Celsius (°C). August is typically the hottest month, having a mean daily temperature of 17.6°C. The mean annual precipitation is 1,146.5 millimeters (mm). October is typically the rainiest month with an average rainfall amount of 105.4 mm, while January is the snowiest month with an average recorded snowfall of 62.6 centimeters (cm). The prevailing winds in Moncton are generally from the west during November to March, with winds predominantly blowing from the north during April, and from the southwest during May to October (Government of Canada 2015). The average annual wind speed is approximately 16.8 km/hr. The maximum wind speeds occur in January with average speeds of 19.2 km/hr and minimum wind speeds occur in August with an average speed of 13.2 km/hr (Government of Canada 2015).

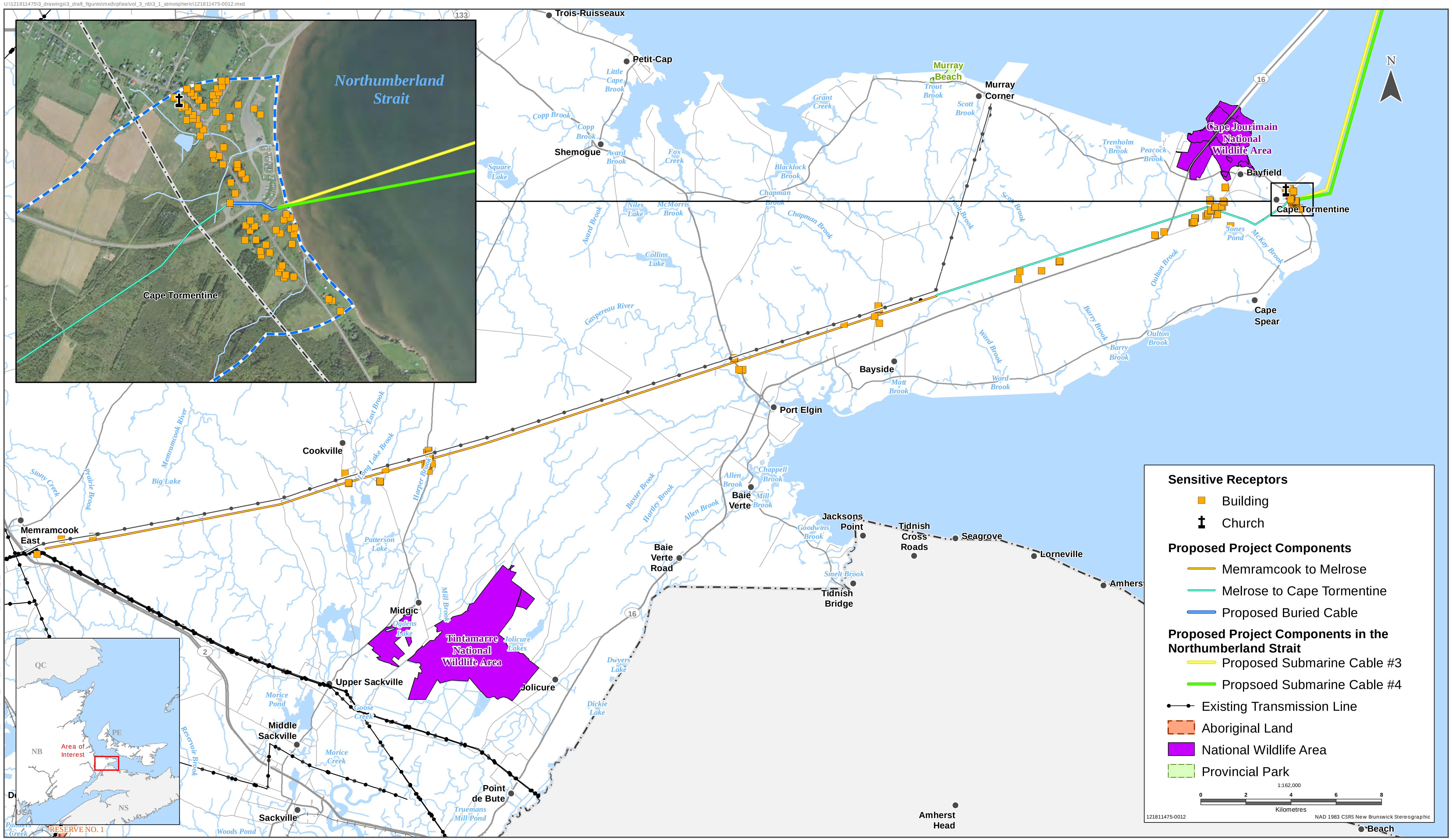
Sound Quality

The area near the substation in Memramcook is in a rural area with residential dwellings (Figure 2.1). Sound quality in this vicinity of the substation is expected to be mainly influenced by vehicle traffic due to the presence of an existing highway, as well as from operating farm machinery, and existing NB Power infrastructure (substation, transmission lines). The PDA, along the transmission right-of-way is in a rural area along forested land. Sound quality in the vicinity of the transmission line is expected to be mainly influenced by wildlife activity and nearby roadways in some locations. The area near the landing site in Cape Tormentine is also in a rural area with a number of residential dwellings and a local church (Figure 2.1). Sound quality in this area of the Project is expected to be mainly influenced by vehicle traffic due to the presence of the Confederation Bridge and an existing highway, as well as from operating farm machinery and noise from the ocean near the shoreline. No other noise sensitive areas were identified proximate to the PDA.

Overall, existing sound pressure levels are expected to be typical of rural ambient levels. Based on past research conducted in Alberta, the average rural ambient sound level in Alberta was about 35 dBA at night and 45 dBA during day (AER 2007). Measurements conducted in other areas of NB generally agree with these values and based on the limited interaction expected from the Project on sound quality, no background monitoring was conducted for the Project.

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_1_atmospheric\121811475-0012.mxd

Document Path: U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_1_atmospheric\121811475-0012.mxd



Sources: Base Data - Natural Earth. Thematic Data - ERBC, Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011).Project Data from Stantec or provided by NB Power / MECL. Buildings digitized from survey of aerial imagery.

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Stantec

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Potential Acoustic Receptors in New Brunswick

Figure 2.1

2.1.2.2 Potential Interactions with Project Components

Project-related releases of air contaminants to the atmosphere will include small amounts of combustion gases from the operation of on-site construction equipment and large trucks used to deliver equipment to the site. There may also be some dust generated as a result of excavation activities and equipment traveling on unpaved surfaces.

Releases of greenhouse gases (GHGs) will occur in small quantities from fuel combustion in heavy equipment and trucks used for project activities. No substantive emissions of air contaminants or GHGs will occur during Project operation. Emissions during eventual decommissioning and abandonment are expected to be similar or less than those that would occur during construction.

Combustion gases from the Project are not likely to cause any notable or substantive changes in air quality with the use of well-maintained equipment.

Dust is typically the primary concern in relation to air quality during construction; however standard mitigation can control dust to below regulatory objectives. Mitigation includes timely re-vegetation of exposed soil to limit dust generation as well as the use of dust suppressants (typically water sprays) on unpaved areas during dry periods.

Topsoil and overburden stockpiled during construction will be seeded and re-vegetated periodically. The generation of airborne dust from these sources is therefore considered to be nominal. Topsoil and overburden are transferred by trucks to stockpiles. While material handling may generate dust, it is assumed that the material is wet and that minimal dust is generated. The emissions will remain largely confined to the Project area and the immediately adjacent areas and will be of short duration.

The construction phase is short in duration and will be transient (i.e., carried out to install one part of the line, then moving on to another area) along the transmission corridor (and the contractor will be required to follow a preventative maintenance schedule for equipment. As a result, Project-related releases of air contaminants to the atmosphere are not likely to cause the ambient air quality standards to be exceeded. On this basis, no further assessment of Project interactions with air quality is required.

The quantities of greenhouse gases released to the atmosphere during Project construction are expected to be very small in comparison to provincial and national totals. These can be partially mitigated through the use of well-maintained equipment and implementation of an idling awareness program to reduce unnecessary idling. During operation, no substantive GHGs would be released from the Project.

During construction, sound emissions and vibration will result from the operation of heavy equipment (for excavating and vegetation clearing) and from transportation vehicles on Project access roads. Noise will, however, remain largely confined to the PDA and the immediately adjacent areas, and will be transient and short in duration. If noise complaints from local residents are received, the information will be evaluated and additional mitigation may be required. Construction will be limited to daytime hours, if possible, to reduce disturbance and annoyance to the nearest residences.

During operation, sound quality is not expected to be influenced by the upgrades to the existing substation in Memramcook, NB (addition of one new 138 kV line termination point, requiring a single circuit breaker, disconnect switches, instrument transformers, protection and control and telecommunications equipment) or operation of the transmission lines. The Project substation is expected to produce noise that is similar in nature (frequency and level) to noise from the existing substation, as the upgrades are not expected to affect noise levels. Detailed engineering specifications for equipment are not yet available to predict the change in noise; however based on the upgrades to the substation, noise is not expected to be a concern.

Noise levels will be reviewed in relation to the final design prior to installation, in consideration of the nearest residence (approximately 150 m away). The remainder of the Project is not expected to contribute to or generate noise at the nearest residences.

During operation, the effects of EMFs are not expected to be a concern. Several studies have been done to assess the potential effects of electric and magnetic fields (or EMF) at extremely low frequencies (ELF in the range of 30-300 Hertz, where power frequency is 50-60 Hertz) on human health.

Related specifically to electrical transmission lines, a federal-provincial territorial committee in

Canada has reviewed the evidence and prepared a response statement in 2008 and updated it in 2009, on public concerns regarding EMF. The main conclusions are that, "In the context of power frequency EMFs, health risks to the public from such exposures have not been established" and secondly, "there is insufficient evidence showing exposure to EMFs from power lines can cause adverse health effects" (Health Canada 2009).

It is also noted that a warning to the public to avoid living near or spending time in proximity to power lines is not required (Health Canada 2009). Therefore, based on the above, no substantive interactions between the Project and the effects of EMFs are anticipated.

Based on the reasons explained above and the planned implementation of known and proven mitigation, no substantive interactions between the Project and the Atmospheric Environment are anticipated. Atmospheric Environment is therefore not considered as a VC in NB for the purpose of environmental assessment.

2.1.2.3 Summary

Based on the lack of interactions noted above, there are no substantive interactions between the Project and Atmospheric Environment anticipated. Atmospheric Environment is therefore not considered as a VC in New Brunswick for the purpose of environmental assessment.

3.0 ENVIRONMENTAL EFFECTS ASSESSMENT

3.1 ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS ON THE FRESHWATER ENVIRONMENT

The Project has the potential to interact with waterbodies along the overhead transmission line corridor. Construction, operation, and decommissioning and abandonment activities have the potential to change the freshwater environment through alteration of freshwater habitats, increased risk of fish mortality or changes in water quality. The Freshwater Environment was selected as a VC for environmental assessment due to the importance of freshwater habitat as an ecosystem component and the associated regulatory protection afforded it as well as its social importance.

The Freshwater Environment VC considers project environmental effects on freshwater fish species and water quality within areas that may be affected by the project. Fish includes all species of fish and shellfish that are fished commercially, recreationally or by Aboriginal groups and reside within the PDA or use the associated habitat during any lifestage. Water quality is assessed in relation to guidelines for the protection of aquatic life and freshwater habitats.

The applicable regulations and policies, potential environmental effects, and temporal and spatial boundaries used in the assessment are identified and defined further in Section 3.2.1.1.

The Freshwater Environment VC is intrinsically linked to Section 3.3: Terrestrial Environment through riparian vegetation and wetlands and Section 3.1: Marine Environment (Volume 4 – Marine Assessment) through anadromous or catadromous species.

3.1.1 Scope of Assessment

The assessment of the Freshwater Environment takes into account the importance of freshwater habitat as an ecosystem component and the associated regulatory protection and social importance. This section describes the regulatory and policy setting, the social topics included in the assessment from consultation and engagement with stakeholders and First Nations, and the boundaries of the assessment. The potential environmental effects and their pathways are identified along with the measureable parameters and the significance criteria for the evaluation of environmental effects on Freshwater Environment.

3.1.1.1 Regulatory and Policy Setting

Effects on Freshwater Environment associated with the Project are subject to federal and provincial regulatory requirements. The key regulatory requirements are each described in brief.

Key acts and regulations are supported by additional federal, provincial and non-governmental policies and guidelines which are not described, these supporting policies include:

- The Fisheries Protection Policy Statement (DFO 2013)

- Watercourse Alterations Technical Guidelines (GNB 2012)
- Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (CCME 1990)

Fisheries Act

The *Jobs, Growth and Prosperity* Act came into force on November 25, 2013 and resulted in changes to several sections of the *Fisheries Act*, most notably Section 35 which defines serious harm to fish and their habitat. Changes were also made to Sections 6, 20, 21 of the *Fisheries Act*, which pertain to the regulatory review process and fish passage or obstructions. An updated Fisheries Protection Policy Statement was released, replacing the previous Fish Habitat Policy. The amendments in Section 35 of the *Fisheries Act* adopt "serious harm to fish" replacing "harmful alteration, disruption or destruction (HADD), of fish habitat".

The updated Fisheries Protection Policy Statement interprets "serious harm" to commercial, recreational or Aboriginal (CRA) fish and fish that support a fishery as:

- the death of fish
- a permanent alteration to fish habitat of a spatial scale, duration or intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes
- the destruction of fish habitat of a spatial scale, duration, or intensity that fish can no longer rely upon such habitats for use as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes

The definitions of fish and fish habitat established under the *Fisheries Act* are:

- "Fish" includes (a) parts of fish, (b) shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals and (c) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals.
- "Fish habitat" means spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly to carry out their life processes.

CRA fishery species are primarily protected under federal legislation and regulations, and are socially and economically important. They are defined by the *Fisheries Act* as follows:

- Commercial fisheries are recognized as fish species harvested under license for the purpose of sale.
- Recreational fisheries are recognized as fish species targeted by anglers for personal use or sport, as well as coarse and forage fish which support this fishery.
- Aboriginal fisheries are recognized as fish species caught by Aboriginal groups for subsistence, social or ceremonial purposes. In the absence of supporting information regarding Aboriginal fisheries, Aboriginal fisheries are considered to include all fish species, including those fished recreationally and commercially, and those that support those fisheries.

With the recent amendments, the requirement under the Act to gain authorization will apply only where a project results in "serious harm" to a CRA fishery, any species which are not part of or contribute to a fishery are not protected under the *Fisheries Act*. An alteration of fish habitat must be deemed to be permanent to be of regulatory consequence under the Act. This assessment of "serious harm" to fish and fish habitat within the Local and Regional Assessment Areas is described in Section 3.1.1.4.

Table 3.1 outlines the relevant requirements for the Project under the federal *Fisheries Act* and regulations.

Table 3.1 Relevant Directives under the *Fisheries Act*

Regulations	Nature of Directive	Relevance to Project	Federal Authority
Section 20(1)	Regulate designs that provide the free passage of fish without harm and maintain a flow of water sufficient to allow the free passage of fish.	Watercourse crossing designs and provision of fish passage.	DFO
Section 35(1)	Provide protection of fish and fish habitat.	Watercourse crossing designs	DFO
Section 35(2)	Permit authorizations for the alteration of fish habitat.	Permit *Fisheries Act* authorizations for habitat alterations, if required.	DFO
Section 36	Implement mitigation as per guidelines to prevent introduction of deleterious substances into fish bearing waters.	All heavy equipment work within watercourse buffers (30 m) and need to prevent erosion and sedimentation of watercourses, or fuel spills from reaching watercourses.	DFO/Environment Canada

Species at Risk Acts

Seven species, and 10 populations, are currently included in the Federal *Species at Risk Act* (*SARA*) registry and the New Brunswick *Species at Risk Act* (NB *SARA*) list, with ranges in New Brunswick. These species, along with the Federal *SARA* and NB *SARA* status' are listed in Table 3.2.

Species listed provincially as extirpated, endangered, threatened or of special concern are formally protected under NB *SARA*. Federally, species listed under Schedule 1 as extirpated, endangered or threatened are formally protected under the Federal *SARA*. Species at risk are formally protected through prohibitions on killing, harassing or capturing a listed species, unless otherwise approved through a ministerial order (i.e., license or permit). Habitat critical to the survival of any listed species at risk is protected by prohibitions on destruction or alteration. A Recovery Strategy outlines what needs to be done to arrest or reverse the decline of a species this is generally prepared by Environment Canada on behalf of the minister.

Table 3.2 Federal and Provincial Freshwater Fish Species Listed as at Risk in New Brunswick

Common Name	Scientific Name	Federal Status[1]	Provincial Status[2]
American Eel	*Anguilla rostrata*	-	Threatened
Atlantic Salmon (Inner Bay of Fundy Population)	*Salmo salar*	Schedule 1- Endangered	Endangered
Atlantic Salmon (Gaspe-Southern Gulf of St. Lawrence population)	*Salmo salar*	-	Special Concern
Brook Floater	*Alasmidonta varicosa*	Special Concern	Special Concern
Rainbow Smelt (Lake Utopia small-bodied population)	*Osmerus mordax*	Threatened	Threatened
Rainbow Smelt (Lake Utopia large-bodied population)	*Osmerus mordax*	-	Threatened
Striped Bass (Bay of Fundy Population)	*Morone saxatilis*	-	Endangered
Striped Bass (Southern Gulf of St. Lawrence Population)	*Morone saxatilis*	-	Special Concern
Yellow Lampmussel	*Lampsilis cariosa*	Special Concern	Special Concern

Notes:
[1] Government of Canada. June 2015. Species at Risk Public Registry according to *Species at Risk Act* – Schedule 1
[2] Department of Environment, New Brunswick 2015 – *Species at Risk Act*, 2013.
- Not listed under the respective Act

The potential of a SAR species to use the freshwater habitat within the PDA will result in an assessment of the potential effects of the Project on the species. This assessment will review any critical habitat identified in the species' Recovery Strategy and provide mitigation measures to comply with the federal and provincial *Species at Risk Acts*.

New Brunswick *Clean Water Act—Watercourse and Wetland Alteration Regulations*

The purpose of the *Watercourse and Wetland Alteration Regulation* (WAWA Regulation) is to protect the water quality and aquatic habitat of the streams, rivers, lakes and wetlands of New Brunswick from unmitigated works in or near watercourses and wetlands. The regulation requires the issuance of a permit by the New Brunswick Department of Environment and Local Government (NBDELG).

A Watercourse and Wetland Alteration Permit is required before:

- the physical modification of the bed or banks of a watercourse
- the modification of flow of water, or
- any disturbance of the ground or removal of vegetation within 30 m of a watercourse

New Brunswick *Clean Environment Act—Water Quality Regulation*

The *Water Quality Regulation* is the main regulatory instrument in New Brunswick for regulating the release of effluents to the waters of the Province, which include surface water within the jurisdiction of the Province. Section 3(1) of the regulation requires that any source of substances that may directly or indirectly cause water pollution or release of substances to the waters of the Province must apply for and obtain a Certificate of Approval under that regulation.

The Regulation defines "water pollution" as "(a) any alteration of the physical, chemical, biological or aesthetic properties of the waters of the Province, including change of the temperature, colour, taste or odour of the waters, or (b) the addition of any liquid, solid, radioactive, gaseous or other substance to the waters of the Province or the removal of such substance from the waters of the Province, which renders or is likely to render the waters of the Province harmful to the public health, safety or welfare or harmful or less useful for domestic, municipal, industrial, agricultural, recreational, or other lawful uses or harmful or less useful to animals, birds or aquatic life."

3.1.1.2 The Influence of Consultation and Engagement on the Assessment

The consultation program in support of this EIS focused primarily on the areas most likely to be affected by the Project. Issues or concerns regarding the Freshwater Environment identified during consultation and engagement (Table 3.3) informed baseline data collection and are addressed through the effects assessment.

Table 3.3 Issues Raised by Aboriginal Groups and Stakeholders

Question /Issue	Community / Organization	Summary of Comments	Response
The Project has the potential to result in 'serious harm' to fish.	Fisheries and Oceans Canada (DFO) – Ecosystem Management	DFO requested detail on the description of any in-water works or watercourse fording and mitigation measures utilized to avoid impacts to fish and fish habitat.	No in-water works are anticipated to occur in New Brunswick. The mitigation and effects assessment on watercourse crossings are described in Section 3.2.4.

3.1.1.3 Potential Environmental Effects, Pathways and Measureable Parameters

Throughout the life of the Project (construction, operation, and decommissioning and abandonment), there will be interactions with the Freshwater Environment. These interactions are grouped and assessed as a change in the freshwater environment. Unmitigated construction, operation, and decommissioning and abandonment of the Project have the potential to induce a change in the freshwater environment. The loss of fish habitat quality or quantity, a decrease in water quality or an increase in mortality risk to fish species can result from an interaction between the Project and the Freshwater Environment. The potential environmental effect pathways are listed in Table 3.4 along with the associated measurable parameters, which will serve to inform the characterization of the potential residual environmental effects related to a change in the Freshwater Environment.

Table 3.4 Potential Environmental Effects, Effect Pathways and Measurable Parameters for the Freshwater Environment

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in the Freshwater Populations	• Destruction or alteration of habitat arising from disturbance of the watercourse during clearing, grubbing, pole installation or access road crossings during construction and operation. • Direct mortality of fish resulting from installation of infrastructure within watercourses during construction or operation. • Direct mortality or injury to freshwater fish resulting from acute changes in nutrient, sediment or contaminant concentrations (water quality) from sedimentation or accidental releases during construction, operation or decommissioning and abandonment.	• Areal extent of altered or lost fish habitat (m^2). • Baseline water quality (pH, dissolved oxygen, temperature, turbidity and total suspended solids (TSS)). • Mortality of fish (number of fish killed).

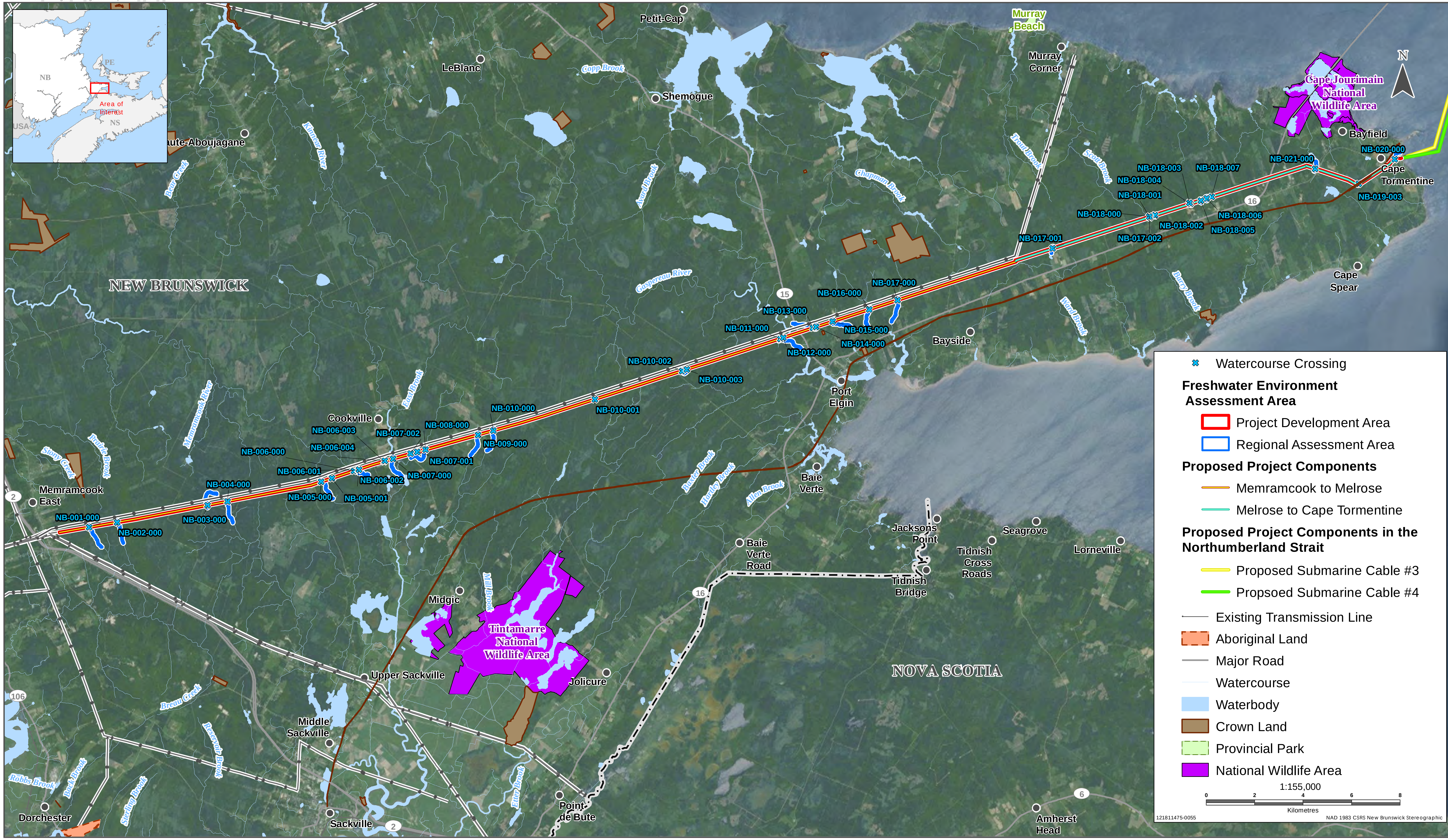
3.1.1.4 Boundaries

The spatial boundaries for the environmental effects assessment of fish and fish habitat are defined below, and take into account the scale and spatial extent of potential environmental affects, existing scientific and traditional knowledge, current land and resource use, and biological and ecological considerations.

3.1.1.4.1 Spatial Boundaries

The spatial boundaries for the Freshwater Environment VC have been divided into three assessment areas as presented in Figure 3.1 and the freshwater mapbook, Appendix A. The Project Development Area (PDA), the Local Assessment Area (LAA) and the Regional Assessment Area (RAA) are defined below.

- Project Development Area (PDA): The PDA includes the immediate area of physical disturbance associated with the construction and operation of the Project. The PDA includes: the existing substation in Memramcook where upgrades to the existing substation will occur within the substation footprint; a 40 km long, 30 m wide transmission line RoW from Memramcook to Melrose and a 17 km long, 60 m wide transmission line RoW from Melrose to Cape Tormentine; a cable termination site; and a 10 m easement around cable lines. The PDA is illustrated in Figure 3.1 as it applies to the Freshwater Environment.



Sources: Base Data - Natural Resources (2011).Project Data from Stantec or provided by NB Power / MECL. Imagery - ArcGIS Map Service World Imagery, Natural Resources (2011).

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Stantec

Freshwater Environment Project Development Area and Regional Assessment Area

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Figure 3.1

- Local Assessment Area (LAA): The LAA includes a portion of the watercourse measuring 100 m upstream and 200 m downstream of the corridor centerline. The LAA was selected to encompass all areas with the potential to have indirect loss of fish habitat. The LAA is where environmental effects are reasonably expected to occur and are measureable to a high degree of confidence. For example, the LAA includes sufficient upstream and downstream freshwater habitat at all crossings to evaluate anticipated measureable environmental effects from construction, operation, and decommissioning and abandonment. The LAA is illustrated in the freshwater mapbook in Appendix A.
- Regional Assessment Area (RAA): The RAA includes the area that establishes the context for determining significance of project-specific effects. It is also the area within which potential cumulative effects—the residual effects from the Project in combination with those of past, present and reasonably foreseeable projects—are assessed (Figure 3.1). The RAA encompasses the PDA and the LAA.

3.1.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of the Project on Freshwater Environment include construction, operation, and decommissioning and abandonment. Construction is expected to occur over a period of 16 months. Construction of the landfall site and transmission line from Melrose to Cape Tormentine is expected to be completed over 9 to 10 months, between March and December 2016. Construction of transmission line between Melrose and Memramcook is expected to begin in September 2016 with completion expected to take place in June 2017. Operation will begin following construction and is anticipated to continue for the life of the Project (approximately 40 years). Decommissioning and abandonment would take place following the useful service life of the Project and which would be carried out in accordance with regulations in place at that time.

3.1.1.5 Residual Environmental Effects Description Criteria

Table 3.5 provides the criteria that are used to characterize residual environmental effects on the Freshwater Environment.

Table 3.5 Characterization of Residual Environmental Effects on the Freshwater Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect.	**Positive**—an environmental effect that moves measurable parameters in a direction beneficial to the Freshwater Environment relative to baseline. **Adverse**—an environmental effect that moves measurable parameters in a direction detrimental to the Freshwater Environment relative to baseline. **Neutral**—no net change in measureable parameters for the Freshwater Environment relative to baseline.

Table 3.5 Characterization of Residual Environmental Effects on the Freshwater Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	The amount of change in the freshwater environment relative to existing conditions.	**Negligible**—no measurable change in the Freshwater Environment. **Low**—a measurable change anticipated in low-sensitivity habitats and no measurable mortality risk to non-listed species. **Moderate**—measurable change in fish habitat or anticipated mortality risk to non-listed species. **High**—measurable change in the Freshwater Environment from a change in sensitive habitat or habitat designated as important to listed species or anticipated mortality to listed species.
Geographic Extent	The geographic area in which an environmental effect occurs.	**PDA**—residual environmental effects are restricted to the PDA. **LAA**—residual environmental effects extend into the LAA. **RAA**—residual environmental effects interact with those of other projects in the RAA.
Frequency	Identifies when the residual environmental effect occurs and how often during the Project or in a specific phase.	**Single event**—occurs only once during the life of the project. **Multiple irregular event**—occurs more than once at no set schedule. **Multiple regular events**—occurs more than once at regular intervals. **Continuous**—occurs continuously.
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the effect can no longer be measured or otherwise perceived.	**Short-term**—residual environmental effect restricted to the construction or operation phase of the Project. Includes effects to the Freshwater Environment of less than 1 year. **Medium-term**—residual environmental effect restricted to the construction or operation phase of the Project. Includes effects to the Freshwater Environment of between 1 and 5 years. **Long-term**—residual environmental effect extends beyond the life of the project (i.e., beyond decommissioning and abandonment).
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases.	**Reversible**—the environmental effect will cease during or after the Project is complete, the results of the effect will allow the Freshwater Environment to recover to baseline. **Irreversible**—the environmental effect will persist after the life of the Project, even after mitigation measures are enacted. The Freshwater Environment will not recover to baseline.

Table 3.5 Characterization of Residual Environmental Effects on the Freshwater Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Ecological and Socioeconomic Context	Existing condition and trends in the area where environmental effects occur.	**Undisturbed**—the area is relatively undisturbed or not adversely affected by human activity. **Disturbed**—area has been substantially previously disturbed by human development or human development is still present.

3.1.1.6 Significance Definition

A significant adverse residual environmental effect on the Freshwater Environment is one that:

- causes increased mortality of CRA or species at risk fish
- causes a permanent alteration to or the destruction of fish habitat of a spatial scale, duration or intensity that limits or diminishes the ability of fish to use such habitats and results in a decrease in the sustainability of the populations or the local fisheries
- decreases water quality to a level which induces mortality or diminishes the ability of fish to use such habitats and results in a decrease in the sustainability of the populations or the local fisheries

Applicable legislation and regulations used to characterize the significance determinations for the alteration or destruction of fish habitat or changes in water quality include the *Canadian Environmental Protection Act*, New Brunswick's WAWA Regulations, The Fisheries Protection Policy Statement (DFO 2013), New Brunswick Watercourse Alterations Technical Guidelines(GNB 2012), Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (CCME FAL – CCME 1990).

3.1.2 Existing Conditions of the Freshwater Environment

In this section the existing conditions of the Freshwater Environment are described for the LAA, the understanding of the PDA conditions enables a more accurate assessment of potential project environmental effects on the Freshwater Environment. This section also describes the methods used to obtain data on the existing conditions and an overview of freshwater habitat, fish presence and water quality.

3.1.2.1 Methods

A review of relevant fish, and fish habitat data from various sources (NBDNR, UNB, ACCDC, COSEWIC, etc.) was undertaken which included previous environmental assessments and publically available reports from various freshwater groups, researchers and government. Although the review of previous studies and existing information provided some information on the Freshwater Environment in the Project location, and specifically at the regional and local spatial scales, it was determined additional information and data were required to support the assessment for the currently proposed Project. Specifically, freshwater fish habitat data, and water quality were required in the Freshwater

Environment along the transmission line corridor. Field studies were undertaken in the spring of 2015 to supplement the existing data.

Data and information collected during field studies described below were used to characterize the existing conditions for the Freshwater Environment.

Field Methods

During the spring of 2015 a fish and fish habitat survey was conducted within the new-build transmission line right-of-way in NB. This survey was conducted to characterize the Freshwater Environment. The potential interaction between the construction of the transmission line corridor and watercourses would be limited to work within the riparian zone and watercourse crossings for equipment; therefore, the standard Stantec approach was modified to focus on this zone. At each watercourse, fish and fish habitat assessments were conducted 200 m downstream and 100 m upstream of the transmission line centerline. Data collected included substrate type, degree of embeddedness, stream width and depth, flow velocity, and riparian zone characteristics. During the field habitat assessments in-situ water quality data were collected at the centerline of each watercourse crossing using a Hanna multi-parameter water quality meter. Water quality data collected included pH, conductivity, salinity, temperature, dissolved oxygen and turbidity. Water velocity data were collected in streams with detectable water velocity (i.e., where water was flowing at rate at which it could be measured).

There was no electrofishing conducted along the proposed corridor. During planning and development of the survey it was assumed that all watercourses which provided fish habitat either contain or support CRA fisheries. Incidental observations on fish presence were noted where fish were observed.

3.1.2.2 Overview

The Project components in New Brunswick cover an area of approximately 225.6 ha and cross 31 watercourses and four ephemeral channels (Figure 3.1). The PDA is situated along a drainage divide. Watercourses in the southwestern portion of the corridor drain into the Bay of Fundy, either through Cumberland Basin or Shepody Bay. The watercourses along the northeastern portion of the corridor drain into the Northumberland Strait. For the overview of the Freshwater Environment, fish species composition is described in terms of environmental assessment boundaries while fish habitat and water quality is described on a watercourse by watercourse basis.

3.1.2.2.1 Fish Presence

As noted above, fish community sampling within the PDA was not conducted as part of the Freshwater Environment baseline studies. Information on fish species presence was obtained from a literature review of the area and existing knowledge. Fish inhabiting the PDA are expected to include species of cyprinids (minnows), salmonids, perches, herring, shad, eel, and sucker (Curry et al. n.d.). Table 3.6 lists the species anticipated to occur within the PDA, LAA and RAA. Freshwater mussels are expected to be present within the larger watercourses such as Tantramar River, Musquash Brook, Gasperau River and Timber River. Table 3.7 lists the watercourses to be crossed by the project and whether fish are expected to be present.

3.1.2.2.2 Species at Risk

Seven species, and 10 populations are currently included in the Federal *SARA* registry and the NB *SARA* list with home ranges in New Brunswick (Table 3.2). Of these species Atlantic salmon (inner Bay of Fundy (iBoF) population), and American eel are the two species which may be encountered in the RAA. The remaining species and populations listed in Table 3.2 are limited to home ranges outside the Project's RAA and therefore are not included as part of the description of the existing environment. Due to the sensitive nature of the Inner Bay of Fundy (iBoF) Atlantic salmon stocks, watercourses which drain into the iBoF have been identified in the table.

Table 3.6 Freshwater Fish Species Presence

Common Name	Scientific Name	Potential Presence in:		
		PDA	LAA	RAA
Alewife (Gaspereau)	*Alosa pseudoharengus*	✓	✓	✓
American Eel	*Anguilla rostrata*	✓	✓	✓
American Shad	*Alosa sapidissima*	-	✓	✓
Atlantic Salmon	*Salmo salar*	✓	✓	✓
Atlantic Tomcod	*Microgadus tomcod*	-	-	✓
Banded Killifish	*Fundulus diaphanus*	✓	✓	✓
Blacknose Dace	*Rhinichthys atratulus*	✓	✓	✓
Blacknose Shiner	*Notropis heterolepis*	✓	✓	✓
Brook Trout	*Salvelinus fontinalis*	✓	✓	✓
Brown Bullhead	*Ameiurus nebulosus*	✓	✓	✓
Common Shiner	*Notropis cornutus*	✓	✓	✓
Fourspine Stickleback	*Apeltes quadracus*	-	-	✓
Golden Shiner	*Notemigonus crysoleucas*	✓	✓	✓
Lake Chub	*Couesius plumbeus*	✓	✓	✓
Mummichog	*Fundulus heteroclitus*	-	-	✓
Ninespine Stickleback	*Pungitius pungitius*	✓	✓	✓
Northern Redbelly Dace	*Chrosomus eos*	✓	✓	✓
Rainbow Smelt	*Osmerus mordax*	-	-	✓
Slimy Sculpin	*Cottus cognatus*	✓	✓	✓
Threespine Stickleback	*Gasterosteus aculeatus*	✓	✓	✓
White Perch	*Morone americana*	✓	✓	✓
White Sucker	*Catostomus commersoni*	✓	✓	✓
Yellow Perch	*Perca flavescens*	✓	✓	✓
Note: Data adapted from Curry et al. n.d., and Scott and Crossman 1998.				

Table 3.7 Fish Habitat Presence within the LAA

Project Site ID	Watercourse Name	Stream Order	Channel Width (m)	Wetted Width (m)	Fish Bearing Potential	iBoF Waters
NB-001-00	Tributary to Breau Creek	1	1.70	0.50	✓	✓
NB-002-00	Tributary to Breau Creek	Ephemeral	Interstitial Flow			
NB-003-00	Tributary to Joe Brook	1	1.23	5.00	✓	✓
NB-004-00	Tributary to Joe Brook	2	1.02	0.92	✓	✓
NB-005-00	Tributary to Musquash Brook	1	1.20	0.95	✓	✓
NB-005-01	Tributary to Musquash Brook	1	3.30	1.00	✓	✓
NB-006-00	Musquash Brook	2	4.07	3.59	✓	✓
NB-006-01	Tributary to Musquash Brook	1	1.30	1.00	✓	✓
NB-006-03	Tributary to Tantramar River	1	1.30	0.80	✓	✓
NB-007-00	Tantramar River	4	18	128	✓	✓
NB-007-01	Tributary to Tantramar River	1	0.89	0.45	✓	✓
NB-007-02	Tributary to Tantramar River	1	0.78	0.54	✓	✓
NB-008-00	Tributary to Tantramar River	1	3.10	2.80	✓	✓
NB-009-00	Harper Brook	1	0.94	0.80	✓	✓
NB-010-01	Tributary to Robinson Brook	1	0.88	0.69	✓	✓
NB-010-02	Tributary to Crystal Brook	1	0.82	0.78	✓	-
NB-010-03	Tributary to Crystal Brook	1	2.35	2.08	✓	-
NB-011-00	Tributary to Gasperau River	1	0.85	0.70	✓	-
NB-012-00	Gasperau River	2	18.0	15.0	✓	-
NB-013-00	Tributary to Gasperau River	1	5.00	4.00	✓	-
NB-014-00	Tributary to Gasperau River	1	0.95	0.95	✓	-
NB-015-00	Timber River	2	1.04	0.90	✓	-
NB-016-00	Tributary to Timber River	2	2.40	2.36	✓	-
NB-017-00	Tributary to Timber River	2	4.10	2.80	✓	-
NB-017-01	Tributary to Matt Brook	1	1.30	0.55	✓	-
NB-017-02	Tributary to Scott Brook	Ephemeral	Interstitial Flow		-	-
NB-018-00	Scott Brook	1	0.50	0.40	✓	-
NB-018-01	Tributary to Scott Brook	1	0.48	0.42	✓	-
NB-018-04	Tributary to Trenholm Brook	1	0.55	0.50	✓	-
NB-018-05	Tributary to Trenholm Brook	1	4.00	0.51	✓	-
NB-018-06	Tributary to Trenholm Brook	1	0.49	0.42	✓	-
NB-018-07	Tributary to Trenholm Brook	Ephemeral	Interstitial Flow		-	
NB-019-03	Tributary to the Northumberland Strait	Ephemeral	Interstitial Flow		-	-

Table 3.7 Fish Habitat Presence within the LAA

Project Site ID	Watercourse Name	Stream Order	Channel Width (m)	Wetted Width (m)	Fish Bearing Potential	iBoF Waters
NB-020-00	Tributary to the Northumberland Strait	1	0.82	0.57	✓	-
NB-021-00	Tributary to the Northumberland Strait	1	10.0	10.0	✓	-

3.1.2.2.3 Stream Habitat

Overall, for the watercourses assessed, stream gradients are low and the habitats are primarily depositional. Run type habitats are prevalent with few higher gradient riffles or rapids. As a result of active or inactive beaver dams, wide, deep, flat water sections are present in several watercourses. These impoundments often result in wide and deep sections of habitat often with fine sediment and undetectable water velocity. These beaver dams result in habitat that is uncharacteristic of undammed watercourses.

The majority (n=24) of the watercourses along the proposed transmission line corridor are 1st order, narrow (mean channel width = 1.86 m), shallow (mean channel depth = 0.21 m) and perennial. These watercourses are generally associated with wetlands and have small drainage areas and water flow velocities (mean water velocity = 0.15 m/s) were low at the time of the field study. There were seven 2nd order or higher order watercourses assessed during the field habitat assessment. These watercourses are wider (mean channel width = 6.95 m) and deeper (mean channel depth = 0.75 m) with a greater range of water velocities (<0.05 to 0.74 m/s). In addition to the watercourses previously mentioned, there are four ephemeral channels crossed by the Project.

The majority of the 1st order water crossings (20 of 24 watercourse crossings) have substrate predominantly composed of fines and organic material. These watercourse crossings are generally located within or adjacent to wetlands along the overhead transmission line corridor. The 2nd order and higher streams are fewer in number (n=7) and have a greater proportion of gravel and cobble substrate.

Riparian vegetation varied within the Project assessment area both along the proposed corridor and between watercourses. At the proposed centerline of the overhead transmission line, the riparian vegetation is composed primarily of grasses (58% of sites), shrubs (29% of sites) and immature forest (10% of sites). These values are based on data from the 31 watercourses crossed by the Project and exclude the data collected from the ephemeral channels. The dominant riparian vegetation is representative of the wetland habitat that envelopes the watercourses along the corridor. Descriptions of the wetland habitats are included in Section 3.3 (Terrestrial Environment).

Table 3.8 Freshwater Habitat Summary at Centerline of Proposed Watercourse Crossings

Project Site ID	Watercourse Name	Stream Order	Channel Width	Wetted Width	Channel Depth	Habitat Type	Substrate								
							O	F	G	LG	C	B	LB	Br	Embed.
NB-001-00	Tributary to Breau Creek	1	1.70	0.50	0.07	Shallow Run	100	-	-	-	-	-	-	-	N
NB-002-00	Tributary to Breau Creek	Ephemeral	Interstitial Flow				Not Applicable								
NB-003-00	Tributary to Joe Brook	1	1.23	5.00	0.46	Flat	100	-	-	-	-	-	-	-	N/A
NB-004-00	Tributary to Joe Brook	2	1.02	0.92	0.33	Shallow Run	95	5	-	-	-	-	-	-	N/A
NB-005-00	Tributary to Musquash Brook	1	1.20	0.95	0.32	Shallow Run	5	95	5	-	-	-	-	-	L
NB-005-01	Tributary to Musquash Brook	1	3.30	1.00	0.11	Riffle	10	20	45	15	10	-	-	-	M
NB-006-00	Musquash Brook	2	4.07	3.59	0.18	Shallow Run	-	-	10	30	50	10	-	-	L
NB-006-01	Tributary to Musquash Brook	1	1.30	1.00	0.20	Shallow Run	-	95	-	-	5	-	-	-	H
NB-006-03	Tributary to Tantramar River	1	1.30	0.80	0.03	Shallow Run	10	90	-	-	-	-	-	-	N/A
NB-007-00	Tantramar River	4	18	128	2.00	Flat	90	10	-	-	-	-	-	-	N/A
NB-007-01	Tributary to Tantramar River	1	0.89	0.45	0.04	Shallow Run	-	90	10	-	-	-	-	-	M
NB-007-02	Tributary to Tantramar River	1	0.78	0.54	0.09	Shallow Run	-	90	10	-	-	-	-	-	M
NB-008-00	Tributary to Tantramar River	1	3.10	2.80	0.28	Moderate Run	-	40	30	20	10	-	-	-	L
NB-009-00	Harper Brook	1	0.94	0.80	0.15	Shallow Run	-	70	30	-	-	-	-	-	H
NB-010-01	Tributary to Robinson Brook	1	0.88	0.69	0.37	Shallow Run	10	90	-	-	-	-	-	-	N/A
NB-010-02	Tributary to Crystal Brook	1	0.82	0.78	0.09	Shallow Run	-	80	5	15	-	-	-	-	M
NB-010-03	Tributary to Crystal Brook	1	2.35	2.08	0.33	Impoundment	100	-	-	-	-	-	-	-	N/A
NB-011-00	Tributary to Gasperau River	1	0.85	0.70	0.09	Riffle	-	95	5	-	-	-	-	-	H
NB-012-00	Gasperau River	2	18.0	15.0	2.00	Deep Run	-	20	-	5	70	5	-	-	M
NB-013-00	Tributary to Gasperau River	1	5.00	4.00	0.75	Flat	100	-	-	-	-	-	-	-	N/A
NB-014-00	Tributary to Gasperau River	1	0.95	0.95	0.13	Shallow Run	-	20	20	60	-	-	-	-	M

Table 3.8 Freshwater Habitat Summary at Centerline of Proposed Watercourse Crossings

Project Site ID	Watercourse Name	Stream Order	Channel Width	Wetted Width	Channel Depth	Habitat Type	Substrate								
							O	F	G	LG	C	B	LB	Br	Embed.
NB-015-00	Timber River	2	1.04	0.90	0.23	Shallow Run	-	100	-	-	-	-	-	-	N/A
NB-016-00	Tributary to Timber River	2	2.40	2.36	0.37	Moderate Run	20	80	-	-	-	-	-	-	N/A
NB-017-00	Tributary to Timber River	2	4.10	2.80	0.14	Riffle	-	10	30	30	30	-	-	-	M
NB-017-01	Tributary to Matt Brook	1	1.30	0.55	0.07	Shallow Run	20	80	-	-	-	-	-	-	N/A
NB-017-02	Tributary to Scott Brook	Ephemeral	Interstitial Flow				Not Applicable								
NB-018-00	Scott Brook	1	0.50	0.40	0.12	Shallow Run	-	-	40	60	-	-	-	-	L
NB-018-01	Tributary to Scott Brook	1	0.48	0.42	0.10	Shallow Run	20	80	-	-	-	-	-	-	N/A
NB-018-04	Tributary to Trenholm Brook	1	0.55	0.50	0.10	Shallow Run	5	45	50	-	-	-	-	-	L
NB-018-05	Tributary to Trenholm Brook	1	4.00	0.51	0.04	Shallow Run	20	80	-	-	-	-	-	-	L
NB-018-06	Tributary to Trenholm Brook	1	0.49	0.42	0.08	Shallow Run	50	50	-	-	-	-	-	-	N/A
NB-018-07	Tributary to Trenholm Brook	Ephemeral	Interstitial Flow				Not Applicable								
NB-019-03	Tributary to the Northumberland Strait	Ephemeral	Interstitial Flow				Not Applicable								
NB-020-00	Tributary to the Northumberland Strait	1	0.82	0.57	0.13	Shallow Run	15	85	-	-	-	-	-	-	N/A
NB-021-00	Tributary to the Northumberland Strait	1	10.0	10.0	0.80	Flat	100	-	-	-	-	-	-	-	N/A

KEY
O – Organic, F – Fines, G – Gravel, LG – Large Gravel, C – Cobble, B – Boulder, LB – Large Boulder, Br – Boulder.

A summary of the habitat characteristics associated with each stream crossing is provided in Table 3.8. The data included in Table 3.8 was collected at the centerline of the proposed overhead transmission lines; the complete summary of data for each watercourse is included in Appendix A. Within the PDA, there are six named brooks or rivers which will be crossed by the overhead transmission lines, the remaining watercourse crossings are unnamed tributaries; therefore, all watercourse crossings were given project ID numbers for the purpose of the assessment.

3.1.2.2.4 Water Quality

During the field habitat assessments in-situ water quality data were collected at each watercourse with flowing water using a Hanna multi-parameter water quality meter. Results obtained from these measurements are presented in Table 3. 9 and are representative of conditions at the time of measurement. Water velocity data were collected in streams with detectable water velocity.

Overall, the average water quality values measured in the 1st order (n=24) watercourses indicated a temperate (12.4°C), moderately well oxygenated (8.4 mg/L) environment with low conductivity (65 µS/cm[A]) and turbidity (2.8 NTU). The pH values ranged from 5.50 to 8.15 with a mean of 7.34. Water velocity measurements ranged from <0.05 to 0.38 m/s.

The 2nd order and larger watercourses (n=7) had a higher mean temperature (13.9°C) and dissolved oxygen concentration (9.4 mg/L). The mean conductivity and turbidity values were lower at 33 µS/cm[A] and 2.7 NTU, respectively. The pH values in the larger watercourses ranged from 6.05 to 8.12 with a mean of 6.90. Water velocity measurements ranged from <0.05 m/s to 0.74 m/s.

Water quality in the Freshwater Environment is often compared to the Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CWQG FAL) published by the Canadian Council for the Ministers of the Environment (CCME). Values for dissolved oxygen pH and turbidity are listed under the CWQG FAL.

The CWQG FAL value for dissolved oxygen is based on fish life stage (early life stage or all other life stages) and temperature preference (cold water species or warm water species). For this assessment the cold water early life stage guideline was used, which is also the most stringent. This guideline indicates that the lowest acceptable dissolved oxygen concentration in a Freshwater Environment is 9.5 mg/L.

The CWQG FAL value for pH is listed as an optimal range for fish habitat 6.5 to 9.0 pH units, this range was used to assess water quality at watercourse crossings.

The generally accepted turbidity criteria are based on an increase from the existing conditions. The CWQG FAL recommend an increase of less than 8 NTU at any one time when baseline values are less than 80 NTU and an average increase of less than 2 NTU in a 30 day period. The provincial governments of Alberta and British Columbia have adopted this guideline as their provincial criteria.

Table 3.9 Water Quality Summary from Centerline of Proposed Watercourse Crossings

Project Site ID	Watercourse Name	Stream Order	Water Temp. (°C)	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	pH (pH units)	Turbidity (NTU)
NB-001-00	Tributary to Breau Creek	1	10.1	33	9.81	8.73	3.4
NB-002-00	Tributary to Breau Creek	Ephemeral	Not Applicable				
NB-003-00	Tributary to Joe Brook	1	17.1	26	6.84	8.14	1.6
NB-004-00	Tributary to Joe Brook	2	16.5	22	7.54	8.12	0.6
NB-005-00	Tributary to Musquash Brook	1	11.8	5	8.91	6.81	2.3
NB-005-01	Tributary to Musquash Brook	1	9.8	26	8.90	5.50	0.9
NB-006-00	Musquash Brook	2	11.4	30	8.76	6.40	0.7
NB-006-01	Tributary to Musquash Brook	1	12.1	26	10.20	7.30	1.5
NB-006-03	Tributary to Tantramar River	1	11.9	28	7.30	7.45	1.6
NB-007-00	Tantramar River	4	9.9	30	9.83	6.78	0.9
NB-007-01	Tributary to Tantramar River	1	7.8	35	8.42	7.05	1.4
NB-007-02	Tributary to Tantramar River	1	8.6	29	9.61	7.15	1.2
NB-008-00	Tributary to Tantramar River	1	12.1	35	7.86	7.05	1.9
NB-009-00	Harper Brook	1	11.9	34	8.61	7.35	2.0
NB-010-01	Tributary to Robinson Brook	1	11.8	33	6.86	7.65	1.8

Table 3.9 Water Quality Summary from Centerline of Proposed Watercourse Crossings

Project Site ID	Watercourse Name	Stream Order	Water Temp. (°C)	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	pH (pH units)	Turbidity (NTU)
NB-010-02	Tributary to Crystal Brook	1	12.2	45	7.74	7.05	2.8
NB-010-03	Tributary to Crystal Brook	1	13.1	45	7.66	8.15	2.8
NB-011-00	Tributary to Gasperau River	1	13.1	13	8.67	7.43	0.9
NB-012-00	Gasperau River	2	11.9	47	9.33	7.09	4.8
NB-013-00	Tributary to Gasperau River	1	11.1	56	6.83	7.85	1.2
NB-014-00	Tributary to Gasperau River	1	14.1	27	7.82	7.79	1.9
NB-015-00	Timber River	2	12.6	35	8.94	6.78	0.9
NB-016-00	Tributary to Timber River	2	17.4	13	6.86	6.05	5.7
NB-017-00	Tributary to Timber River	2	17.8	58	14.36	7.21	5.0
NB-017-01	Tributary to Matt Brook	1	13.8	181	11.03	6.59	0.1
NB-017-02	Tributary to Scott Brook	Ephemeral	Not Applicable				
NB-018-00	Scott Brook	1	11.5	101	10.18	6.76	3.8
NB-018-01	Tributary to Scott Brook	1	14.5	57	8.17	7.43	3.1
NB-018-04	Tributary to Trenholm Brook	1	15.7	63	9.98	7.87	2.9
NB-018-05	Tributary to Trenholm Brook	1	15.1	23	8.48	7.83	2.2
NB-018-06	Tributary to Trenholm Brook	1	14.6	31	8.47	7.65	2.3

Table 3.9 Water Quality Summary from Centerline of Proposed Watercourse Crossings

Project Site ID	Watercourse Name	Stream Order	Water Temp. (°C)	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	pH (pH units)	Turbidity (NTU)
NB-018-07	Tributary to Trenholm Brook	Ephemeral	Not Applicable				
NB-019-03	Trib to the Northumberland Strait	Ephemeral	Not Applicable				
NB-020-00	Trib to the Northumberland Strait	1	11.9	350	7.55	6.85	6.3
NB-021-00	Trib to the Northumberland Strait	1	12.6	265	6.89	6.88	17

Using the CWQG FAL criteria the water quality at the watercourse crossings was within guideline values for pH in 28 of 31 watercourses with a mean pH of 7.18. The dissolved oxygen was within guideline values for 8 of 31 watercourses with a mean dissolved oxygen concentration of 8.66 mg/L. Generally, areas with slow moving water or impounded areas such as wetland channels, beaver impoundments or debris dams were associated with low dissolved oxygen, the majority of the high energy environments 2nd order and above streams contained a higher dissolved oxygen content. The water quality values (Table 3.9) in concert with the stream habitat characteristics (Table 3.8) indicate a high potential for fish presence in the 35 watercourses crossed by the Project.

3.1.3 Project Interactions with the Freshwater Environment

The Project will interact with the Freshwater Environment through construction, operation and decommissioning and abandonment. These interactions between the Project and the Freshwater Environment may result in a change in freshwater populations. Table 3.10 identifies the project physical activities that might interact with freshwater populations to result in the environmental effects. These interactions are indicated by check marks, and are discussed in detail in Section 3.1.4 in the context of effects pathways, standard and project-specific mitigation, and residual environmental effects. A justification is also provided for non-interactions (no check marks).

Table 3.10 Potential Project-Environment Interactions and Effects on the Freshwater Environment

Project Components and Physical Activities	Potential Environmental Effect
	Change in Freshwater Populations
Construction	
Site Preparation for Land Based Transmission Lines	✓
Physical Construction of Land Based Transmission Lines	✓
Landfall Construction	-
Upgrading of Electrical Substation	-
Inspection and Energizing of the Transmission Lines	-
Clean-up and Re-vegetation of the Transmission Corridor	✓
Emissions and Wastes	✓
Transportation	-
Employment and Expenditure	-
Operation	
Energy Transmission	-
Vegetation Management	✓
Infrastructure Inspection, Maintenance and Repair	✓
Access Road Maintenance	✓

Table 3.10 Potential Project-Environment Interactions and Effects on the Freshwater Environment

Project Components and Physical Activities	Potential Environmental Effect
	Change in Freshwater Populations
Emissions and Wastes	✓
Transportation	-
Employment and Expenditure	-
Decommissioning and Abandonment	
Decommissioning	✓
Reclamation	✓
Emissions and Wastes	✓
Employment and Expenditure	-

Notes:
✓ = Potential interactions that might cause an effect.
– = Interactions between the project and the Freshwater Environment are not expected.

3.1.4 Assessment of Residual Environmental Effects on the Freshwater Environment

This section describes the interactions between the Project and the Freshwater Environment (those potential interactions identified in Section 3.1.3). Interactions between the Project and the Freshwater Environment that could result in a change in freshwater populations were assessed for each Project phase using the identified analytical assessment techniques. Accidents, Malfunctions, and Unplanned Events are discussed separately in Section 5.

Project activities that have the potential to interact with the Freshwater Environment will utilize avoidance or mitigation measures to manage environmental effects during construction, operation, and decommissioning and abandonment. The use of standard mitigation measures and an EPP will assist in managing environmental effects. Using the mitigation measures, temporal avoidance and Best Management Practices (BMPs) described in the EPP the Proponent will reduce residual environmental effects on the Freshwater Environment.

During construction, it is anticipated that no interaction will occur between the freshwater environment from landfall construction, transportation, upgrading of the electrical substation or inspection and energization. During operation, interaction between the Freshwater Environment and energy transmission, or transportation is not anticipated.

Project employment and expenditures, which are a component of most or all components and physical activities, are the main drivers of many socioeconomic effects. Activities relating to employment and expenditures are addressed in the Socioeconomic Environment VC (Section 3.5). Employment and expenditure, therefore, will not be addressed with respect to the Freshwater Environment.

3.1.4.1 Analytical Assessment Techniques

The assessment of change in freshwater populations includes potential project environmental effects such as:

- direct or indirect loss or alteration of habitat during construction and operation resulting from disturbance of the watercourse during clearing, grubbing, pole installation or access road crossings
- direct mortality of fish resulting from installation of water crossing structures and transmission line poles below the waterline during construction or operation
- direct mortality or injury to freshwater fish resulting from acute changes in nutrient, sediment or contaminant concentrations (water quality) from sedimentation or accidental releases during construction, operation, or decommissioning and abandonment

Environmental effects discussed in this section focus on interactions with species which are part of a CRA fishery, or Species at Risk. These two groups of species are protected by provisions of the *Fisheries Act, Candian Environmental Protection Act,* and federal or provincial *SARA*. The environmental effects are assessed on the basis of the project description, collected field data and quantified using peer reviewed literature and existing knowledge.

3.1.4.2 Assessment of a Change in Freshwater Populations

A change in freshwater populations may result from interactions between the Freshwater Environment and the Project during construction, operation, and decommissioning and abandonment. The assessment of change in freshwater populations defines the Project environmental effect pathways for each phase of the Project, the mitigation measures to be put in place to reduce environmental effects on freshwater populations and the resulting residual environmental effects, whether the effects are positive or negative.

3.1.4.2.1 Project Pathways for Freshwater Populations

The Project is expected to interact with the Freshwater Environment throughout the life of the Project. The pathways for a change in freshwater populations are discussed in terms of the project phases starting with construction.

Construction

During construction it is anticipated that site preparation, physical construction of the transmission lines, and clean-up and re-vegetation of the transmission corridor will directly interact with the Freshwater Environment. Surface run-off may also indirectly interact with the Freshwater Environment.

Site preparation, especially clearing has the potential to decrease the abundance of riparian vegetation along watercourses, which may reduce bank stability, increase erosion, suspended sediment concentrations and nutrient concentrations in the watercourse (DFO 2010). The loss of stream shading may result in increased stream temperatures during summer months (Teti 1998). Reducing riparian vegetation may reduce the diversity and abundance of the aquatic food supply through the reduction of invertebrates and their food sources (DFO 2010).

The use of equipment within 30 m of the watercourse for site preparation, physical construction of the transmission lines and clean-up and re-vegetation of the transmission line corridor may result in increased suspended sediment concentrations and physical alteration of watercourse habitats. Soil may be mobilized by equipment working within 30 m of the watercourses which may enter the watercourses and alter ecological conditions such as water quality and stream habitat. Sediment entering watercourses may reduce visibility affecting predator or prey awareness or, if concentrations of sediment are high enough, damage gill structures (DFO 2010). Direct conduits to the watercourse may be created from equipment rutting; these ruts may create a pathway for sediment or contaminants to enter the watercourse. The crossing of watercourses by clearing equipment and crews offer the potential for the physical alteration of watercourse bed and banks. The alteration of bed and banks may change fish habitat quality and the suitability for life processes.

During re-vegetation, the use of hydraulically applied seed mixes (hydro-seeding) within 30 m of a watercourse may change water quality by increasing nutrient concentrations. An increase in nutrient concentration may lead to eutrophication of watercourses which is generally evident by increased growth of aquatic plants and algae.

Emissions and wastes for the construction stage apply to soil erosion from Project activities and contamination from the loss of hydrocarbons (lube, fuel, oil) or vehicle fluids. The operation of equipment within 30 m of a watercourse increases the risk of contaminants entering the watercourse. The ecological effects from hydrocarbons or vehicle fluids can range from alteration of the watercourse habitats to mortality of freshwater fish.

Operation

During operation transmission line corridor maintenance activities such as vegetation management and access road grading may directly change freshwater populations. The management of vegetation within the transmission line corridor,(i.e., cutting and removal) will be completed with machinery with hand clearing adjacent to watercourses. Decreasing riparian vegetation along watercourses may reduce bank stability and increase erosion, suspended sediment concentrations and nutrient loading on the watercourse (DFO 2010). The loss of stream shading may result in increased stream temperatures during summer months (Teti 1998). Reducing riparian vegetation may reduce the diversity and abundance of aquatic food supply through the reduction of invertebrates and their food sources (DFO 2010).

The maintenance of access roads (i.e., grading and leveling) has the potential to mobilize soil or roadbed material which may enter the watercourses and increase suspended sediments. The increase in suspended sediments may alter ecological conditions such as water quality and stream habitat. Sediment entering the watercourse may reduce visibility effecting predator or prey awareness or, if concentrations of sediment are high enough, damage gill structures (DFO 2010).

Decommissioning and Abandonment

Changes to freshwater populations during decommissioning and abandonment may occur from similar pathways as were identified during the construction phase. Decommissioning and reclamation of the transmission corridor will occur at the end of the useful life of the Project. At the time of decommissioning most of the site infrastructure will be de-energized and removed. Removable assets will be taken from site and sold or disposed of. Access roads, power supplies, and other utilities, will be decommissioned unless required for care and maintenance of the site during closure and post closure. On-site power supplies and utility poles no longer needed will be decommissioned and removed from the site to approved off-site facilities.

The removal of utility poles within 30 m of a watercourse may result in increased sediment concentrations and physical alteration of watercourse habitats. On-site equipment may mobilize soil that may then enter the watercourses and increase suspended sediment. Increased suspended sediment may alter ecological conditions such as water quality and spawning habitat. Sediment entering the watercourse may reduce visibility effecting predator or prey awareness or, if concentrations of sediment are high enough, damage gill structures (DFO 2010). Direct conduits to the watercourse may be created from equipment rutting; these ruts may create a pathway for sediments or contaminants to enter the watercourse. The crossing of watercourses by clearing equipment and crews offer the potential for the physical alteration of watercourse bed and banks. The alteration of bed and banks may change fish habitat quality and the suitability for life processes.

During reclamation of the transmission line corridor, the use of hydraulically applied seed mixes (hydro-seeding) within 30 m of a watercourse may change water quality by increasing nutrient concentrations. An increase in nutrient concentration may lead to eutrophication of watercourses which is generally evident by increased growth of aquatic plants and algae.

The Project pathways described above identify potential interactions and changes to freshwater populations from development of the Project. Mitigation measures established based on the identified Project pathways are described in the following section. The mitigation measures will be incorporated into the Project stages (construction, operation and decommissioning and abandonment). Any residual environmental effects on the Freshwater Environment resulting after the implementation of the identified mitigation measures are described in Section 3.1.4.3.

3.1.4.2.2 Mitigation for Freshwater Populations

The following section outlines regulations (i.e., NB *Watercourse and Wetland Alteration Regulations)* ,codified measures (DFO Measures to Avoid Harm), proven mitigation and industry best management practices. The following measures will be implemented to reduce the environmental effects of the interactions between the Project and the Freshwater Environment during all stages of the Project:

- Plan temporary access roads to avoid watercourses, where possible.
- Span all watercourses and there will be no in-stream work.
- The EPP includes general construction BMPs, a spill management plan and an erosion and sediment control plan. All employees and contractors working on the Project will be trained on the EPP prior to starting work.
- During planning and siting of the transmission line structures NB Power will avoid, where possible, the placement of a transmission line structure within 30 m of a watercourse.

- Clearing of vegetation within the transmission line corridor will occur by hand within 30 m of a watercourse. Where practical, a riparian buffer with a width of 10 m will remain on each bank.
- Temporary watercourse crossings will be installed where required to allow equipment to cross over each watercourse, the temporary crossings will be designed in accordance with the Watercourse and Wetland Alteration Program and completely span the watercourse. No watercourses will be forded by equipment.
- If rutting is observed leading up to a watercourse crossing, brush matting or log corduroy will be installed at the approaches.
- If required, transmission line structure construction within 30 m of a watercourse will be constructed in accordance with the Watercourse and Wetland Alteration Regulations, including any recommendations made under approval from NBDELG.
- No washing, fueling or maintenance of vehicles or equipment will occur within 30 m of a watercourse without secondary containment.
- No storage of fuel will occur within 30 m of a watercourse or wetland.
- Machinery will arrive on-site in a clean condition and be maintained free of fluid leaks, invasive species and noxious weeds.
- Vegetation clearing during operation will not occur within 30 m of a watercourse unless the vegetation height violates the clearance requirements for reliability standards to be met by NB Power.

3.1.4.2.3 Residual Project Environmental Effects for Freshwater Populations

Residual Project environmental effects on the Freshwater Environment from construction, and operation are anticipated to occur during initial site clearing and vegetation management. These activities will result in a change in water quality via an increase in stream temperature and a change in the diversity and abundance of aquatic food supply. These environmental effects are the result of clearing the riparian vegetation during construction and periodically during operation as needed for maintenance.

Freshwater aquatic species such as fish are cold-blooded and have preferred temperature ranges, if temperatures exceed these ranges additional stress is put on that species (DFO 2010). For fish species water temperature is the primary factor that regulates their metabolism, increased water temperature will decrease energy reserves and create stress on fish (PNW 2005). Additionally, water warming decreases the saturation of dissolved oxygen and increases algae growth (Ducharne 2008) both of which may increase stress on aquatic species.

In 1st and 2nd order streams shade provided by riparian vegetation and groundwater inputs are the most important stream characteristics to influence water temperature outside of air temperature (EPA 2001). The increase in summertime (June to Sept) stream temperature from the loss of riparian vegetation was quantified in several studies and ranged from +1 to +6 °C. The stream temperatures rose between [1 to 3°C in Oregon (Cole 2013), 4 to 5°C in coastal BC (Burton and Likens 1973), 3.6 °C in Idaho (Gravelle and Link 2007), up to 6 °C in interior BC (Rex et al. 2012) and 1.4-4.4 °C in Maine (Wilkerson et al. 2006)]. The data generated by Wilkerson et al. (2006) is closest in proximity and best compares to meteorological conditions expected in the PDA. This data suggests an increase in stream temperatures of 1.4 to 4.4°C can be expected during stages of the Project where riparian vegetation is removed. The management of vegetation along the transmission line corridor will periodically remove riparian vegetation in a section of 30 to 60 m of stream habitat. A 30 m wide area of vegetation will be removed for the construction of the transmission line corridor from Memramcook to Melrose and a 60 m wide corridor will be created from Melrose to Cape Tormentine. The area of vegetation removal along the corridor is narrower than the 250 to 400 m wide sections of clearcut studied by Wilkerson et al. (2006). Based on the more northern conditions and the smaller amount of riparian vegetation lost it can be expected that the increase in stream temperature will be on the lower end of the temperature range published. Additionally, Blann et al. (2002) found the narrower the stream reach the lower the height of the vegetation required to achieve shade. Blann et al. (2002) noted little difference in stream water temperatures in Minnesota streams where grasses completely cover the channel. This is relative to the Project as the field data indicated grass was the dominant riparian vegetation type for 16 of the 29 1st order watercourses, the thermal regimes for these watercourses are expected to be less effected and will return to baseline conditions sooner after clearing.

NB Power will include a 10 m riparian buffer zone around watercourses within transmission line corridors, vegetation management at these locations will be less periodic and consist of managing the height of vegetation, not complete clearing. The width of the buffer which is left after clearing appears to mitigate temperature increases. In coastal British Columbia, Gomi et al. (2006) reported increases of 0.1 to 0.8 °C with 10 m buffers and no significant temperature increases at 30 m width, whereas Wilkerson et al. (2006) reported maximum increases of 1.0 to 1.4 °C with 11 m buffers and negligible increases with 23 m or partially cut buffers in Maine.

The return of stream temperatures downstream of a clearcut, to preharvest or baseline conditions, was studied by Zwieniecki and Newton (1999). A reduction of stream temperature was identified to occur within 150-300 m of the watercourse entering habitat with riparian vegetation (Zwieniecki and Newton 1999). Cole and Newton (2008) also assessed water temperature decreases within riparian zones downstream of clearcut tree harvesting. The study determined water temperatures decreased within 300 m of entering habitat with mature riparian vegetation (Cole and Newton 2008). The Cole and Newton (2008) study indicated that the shade produced by mature riparian vegetation decreased water temperatures within 300 m of the clearcut in all streams, though did not decrease water temperatures completely to preharvest or baseline conditions for three out of four streams.

In relation to the Project, these studies indicate during periods of vegetation management an increase in stream temperatures of 1.4 to 4.4°C can be expected within the PDA, these temperatures will decrease within 300 m of the transmission line corridor, though may not decrease completely to baseline levels. Vegetation management (tree and brush clearing) will occur once during construction and more frequently during the operation of the transmission line corridor. During periods of vegetation management an increase in stream temperatures can be expected within the PDA. These increased water temperatures will begin to decrease within 300 m of the transmission line corridor, though may not decrease completely to baseline levels within 300 m.

A change in the diversity and abundance of aquatic food supply may occur from the temporary loss of riparian vegetation. The loss of riparian vegetation can result in decreased leaf litter input and result in changes in the invertebrate assemblage (Jaywardana 2010). Hynes (1970) indicated that invertebrates are the most widespread and important food for fish inhabiting moving waters. Richardson's (1993) literature review found that salmonid productivity was limited by the presence of benthic invertebrates.

The resulting effect on fish from reducing riparian vegetation is dependent on the scale of disturbance (Horwitz et al. 2008). Jones et al. (1999) found little change in fish assemblages where riparian zones were absent for < 3 km, but did find a change in fish assemblages for non-forested stream reaches greater than 3 km. Johnson and Covich (1997) indicated that the amount of detritus in the stream best related to riparian cover 500 to 1,000 m upstream of their study sites. Fitzpatick et al. (2001) indicated that the total area of riparian cover in a watershed was more important than local riparian width for fish assemblages.

In relation to the Project, the temporary loss of riparian vegetation may result in a change in the aquatic food supply for freshwater fish. The temporary nature and limited spatial scale of the removal of riparian vegetation is not anticipated to reduce the productivity of the watercourses crossed by the Project nor modify the fish assemblages within.

3.1.4.3 Summary of Residual Project Environmental Effects on Freshwater Populations

The residual Project environmental effects for the Freshwater Environment described above are summarized in Table 3.11

Table 3.11 Summary of Project Residual Environmental Effects on Freshwater Populations

Residual Environmental Effect	Residual Environmental Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socioeconomic Context
Change in Freshwater Populations	C	A	L	PDA	ST	S	R	D/U
	O	A	L	PDA	ST	R	R	D
	D	P	L	PDA	LT	S	R	D

KEY

See Table 3.5 for detailed definitions.

Project Phase:
C: Construction
O: Operation
D: Decommissioning and Abandonment

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term
P: Permanent
NA: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socioeconomic Context:
D: Disturbed
U: Undisturbed
R: Resilient
NR: Not resilient

3.1.5 Determination of Significance

3.1.5.1 Significance of Residual Project Effects

The residual Project environmental effects as a result of construction and operation of the Project on freshwater populations are adverse, low in magnitude and spatially limited to the PDA. These residual Project environmental effects will occur once during construction of the overhead transmission corridor and more frequently during operation, the duration of these effects is based on regeneration of the riparian vegetation and is considered short term. Once the Project is complete and decommissioned or abandoned, the freshwater habitats will return to baseline conditions. The residual Project environmental effects as a result of decommissioning and abandonment are characterized as positive, low in magnitude and spatially limited to the PDA. The effects are considered positive as riparian regeneration of the vegetation to baseline conditions will occur after decommissioning is complete. With the mitigation outlined and the environmental protection measures described, the residual environmental effects on the VC are predicted to be not significant.

3.1.6 Prediction Confidence

The prediction confidence is high for the determination of significance on environmental effects to freshwater populations. With the current state of knowledge on the potential effects to fish and fish habitat, the limited spatial scale of effects in a relatively small PDA, and the implementation of proven mitigation measures which reflect accepted best management practices, effects to freshwater populations are expected to be minimal.

3.1.7 Follow-up and Monitoring

There are no suggested follow-up or monitoring activities for the Freshwater Environment.

3.2 ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS ON THE TERRESTRIAL ENVIRONMENT

The Terrestrial Environment, including vegetation, wildlife, and wetlands, is an important environmental component that is valued by the people of New Brunswick for environmental, recreational, aesthetic and socioeconomic importance. The Terrestrial Environment has therefore been selected as a valued component (VC) based on potential interactions between the Project and vegetation and wildlife, including Species at Risk (SAR) and species of conservation concern (SOCC), and wetlands, including wetland area and wetland function. This VC also addresses Ecological Communities of Management Concern (ECMC), which are communities that fulfill special management objectives on Crown land in New Brunswick or have been identified as supporting unique ecological features, either through field work, or by local conservation organizations (e.g., Environmentally Significant Areas (ESA)). The Terrestrial Environment VC is closely linked to the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, and is also linked to Land Use, and the Freshwater Environment VCs.

3.2.1 Scope of Assessment

This section defines and describes the scope of the assessment of potential environmental effects on Terrestrial Environment.

3.2.1.1 Regulatory and Policy Setting

3.2.1.1.1 Vegetation and Wildlife Species

With respect to vegetation and wildlife, this VC focuses on Species at Risk (SAR) and species of conservation concern (SOCC). SAR species include those listed as endangered, threatened or special concern by the federal *Species at Risk Act* (*SARA*), the New Brunswick *Species at Risk Act* (NB *SARA*), or by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). COSEWIC assesses and designates the status of species and recommends this designation for legal protection under *SARA*. On lands under provincial jurisdiction, federal *SARA* goals are typically reflected through provincial legislation, policy, and guidelines.

While some species included as SAR in this assessment currently have regulatory protection under Schedule 1 of the federal *SARA* or the *Prohibitions Regulation* of NB *SARA*, the definition above also includes those species on the NB *SARA List of Species at Risk Regulation* and those listed by COSEWIC that are candidates for further review and may become protected within the timeframe of this Project.

SARA serves several purposes: to prevent the extirpation or extinction of wildlife species; to provide recovery strategies for species that are extirpated, endangered or threatened due to human activity; and to manage species of special concern so they do not become threatened or endangered. Under *SARA*, it is forbidden to kill, injure, harass, destroy the residence of, destroy the critical habitat of, capture or take an individual designated as extirpated, endangered, or threatened on federally regulated lands or designated critical habitat elsewhere.

SOCC are not listed under federal or provincial legislation but are considered rare in New Brunswick, or the long-term sustainability of their populations has been evaluated as tenuous. SOCC are defined here as species ranked S1 (critically imperiled), S2 (imperiled), or S3 (vulnerable) in New Brunswick by the Atlantic Canada Conservation Data Centre (ACCDC) (ACCDC 2015a). Unlike SAR, SOCC are not afforded any direct protection by either federal or provincial legislation. SOCC are included in this VC as a precautionary measure, reflecting observations and trends in their provincial population status, and are often important indicators of ecosystem health and regional biodiversity. Rare species are often an indicator of the presence of unusual and/or sensitive habitat; their protection as umbrella species can confer protection on their associated unusual habitats and co-existing species.

The *Migratory Birds Convention Act* (*MBCA*) protects and conserves migratory bird populations, individuals, and their nests within all lands in Canada. All birds are covered under the *MBCA* in Canada, with the exception of some bird families (e.g., cormorants, pelicans, grouse, quail, pheasants, ptarmigan, hawks, owls, eagles, falcons, kingfishers, crows, and jays). The *MBCA* is the enabling statute for the *Migratory Birds Regulations*. Section 6 of the *Migratory Birds Regulations* states that without the authorization of a permit, the disturbance, destruction, or taking of a nest, egg, nest shelter, eider duck shelter, or duck box of a migratory bird, or possession of a migratory bird, carcass, skin, nest, or egg of a migratory bird are prohibited. As there are no authorizations to allow construction-related effects on migratory birds and their nests, best management practices and guidelines (e.g., Migratory Birds Convention Act: A Best Management Practice for Pipelines (Canadian Energy Pipeline Association and Stantec 2013), Incidental Take Avoidance Guidelines (EC 2015)) are available to facilitate compliance with the *MBCA*.

3.2.1.1.2 Wetlands

Wetlands are defined in federal and provincial policies as land permanently or temporarily submerged or saturated by water near the soil surface, for long enough that the area maintains aquatic processes. These aquatic processes are characterized by plants that are adapted to saturated soil conditions, wet or poorly drained soils, and other biotic conditions found in wet environments (Government of Canada 1991; NBDNRE and NBDELG 2002).

A federal mandate for wetland conservation is provided by The Federal Policy on Wetland Conservation (Government of Canada 1991). Policy goals are intended to apply on federal lands and waters or to federal programs where wetland loss has reached critical levels. They also apply to federally designated wetlands, such as Ramsar sites, of which there are none affected by the Project.

Wetlands in New Brunswick are managed by the New Brunswick Department of Environment and Local Government (NBDELG), and their management is guided by the New Brunswick Wetlands Conservation Policy (NBDNRE and NBDELG 2002). This policy aims to protect wetlands through securement, stewardship, education and awareness, and to maintain wetland function within New Brunswick. Legislation that supports the policy includes the New Brunswick *Clean Water Act* and associated *Watercourse and Wetland Alteration* (*WAWA) Regulation*, and the New Brunswick *Clean Environment Act* and associated *Environmental Impact Assessment Regulation* (EIA Regulation).

NBDELG maintains the official map of known wetlands in the province; it is available to the public on the GeoNB website (SNB 2011). As of November 2011, NBDELG considers the GeoNB map to represent the extent of "regulated" wetlands within the province. Any wetlands labelled as "Provincially Significant Wetlands" (PSW) in this database are subject to a greater level of protection, as outlined in the New Brunswick Wetland Conservation Policy (NBDNRE and NBDELG 2002).

The *WAWA Regulation* applies to all wetlands of 1 hectare (ha) or greater in size, or any wetland contiguous to a watercourse. Pending changes to the wetland policy implementation, this assessment has been conducted according to current requirements (i.e., wetlands that are greater than 1 ha in size or are contiguous with a watercourse are regulated as per the *New Brunswick Clean Water Act*).

Due to the relative complexity and subjectivity of measuring wetland function, area of wetland loss is used in New Brunswick and other Canadian jurisdictions as a surrogate for loss of wetland function. This assessment will identify noteworthy wetland functions where they occur, but the change will be reported in terms of area affected. It is assumed that wetland compensation may be required for any permanent loss of wetland area, which would facilitate no net loss of wetland function as stipulated under the provincial policy.

3.2.1.2 The Influence of Consultation and Engagement on the Assessment

As outlined in Volume 1, Section 3.2 (Consultation and Engagement), scoping documents were sent to provincial regulators in PEI and New Brunswick, in addition to Public Works and Government Services Canada (PWGSC). Responses were received from provincial regulators and Environment Canada. For the Terrestrial Environment in New Brunswick, concerns were raised and mitigation measures were suggested regarding migratory birds, particularly in terms of site lighting and collisions with transmission lines.

3.2.1.3 Potential Environmental Effects, Pathways and Measurable Parameters

Based on knowledge of the terrestrial conditions within the Project Development Area (PDA) and surroundings, and the Project and its associated activities, the following potential environmental effects were selected for the assessment of the Terrestrial Environment: change in vegetation and wildlife; and change in wetland area and function.

Table 3.12 summarizes the potential effects, effect pathways, and measureable parameters for the Terrestrial Environment VC.

Table 3.12 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Terrestrial Environment

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change In Vegetation and Wildlife	• Vegetation clearing and ground disturbance along the transmission line, for pole placement, at landing sites, and for line maintenance may have an effect on vegetation and wildlife SAR/SOCC, if they are present, and will change vegetation communities (including ECMC) and habitat for wildlife (e.g., through fragmentation). • Sensory disturbance related to construction activities can lead to avoidance by wildlife species.	• Loss of vascular plant or wildlife SAR or SOCC (number of individuals or populations). • Loss of vegetation communities (ha). • Loss or alteration of wildlife habitat (ha). • Fragmentation of interior forest (ha). • Habitat avoidance. • Loss or alteration of ECMC (ha).
	• Collisions with transmission lines are a cause of mortality for many avian species. • The Project may interact with wildlife movement between NB and NS (Chignecto Isthmus) and near Cape Tormentine.	• Mortality of wildlife.
Change In Wetland Area or Function	• Vegetation clearing within the RoW and excavation for pole placement, and vegetation maintenance during operation may change wetland area and function.	• Loss of wetland area (ha). • Change in wetland function.

3.2.1.4 Boundaries

3.2.1.4.1 Spatial Boundaries

The spatial boundaries for the environmental effects assessment of the Terrestrial Environment are defined below, and illustrated in Figure 3.2 and in the Terrestrial mapbook in Appendix B.

- Project Development Area (PDA): The PDA comprises the immediate area of physical disturbance associated with the construction and operation of the Project. The PDA includes the existing substation in Memramcook where upgrades to the existing substation will occur within the substation footprint; a 40 km long, 30 m wide transmission line RoW from Memramcook to Melrose and a 17 km long, 60 m wide transmission line RoW from Melrose to Cape Tormentine; a cable termination site; and a 10 m easement around cable lines. The total area of the PDA is approximately 225.6 ha. See Figure 3.2 and the Terrestrial mapbook in Appendix B, highlighting the PDA for the Terrestrial Environment.
- Local Assessment Area (LAA): The LAA is the maximum area within which Project-related environmental effects can be predicted or measured with a reasonable degree of accuracy and confidence, and encompassing the likely zone of influence. For the Terrestrial Environment specifically, this area includes the PDA plus an additional 500 m perimeter around the PDA. The LAA is primarily defined by wildlife and wildlife habitat where noise may penetrate wildlife habitats. Edge effects are often thought to extend up to 300 m in forested landscapes for some avian species, although are typically reported to be most pronounced at lower distances to the edge (Batáry and Báldi 2004;); thus, this LAA is considered conservative. The area of potential direct or indirect effects on vegetation and wetlands is expected to be much smaller than that for wildlife and wildlife habitat. The LAA is illustrated in the terrestrial mapbook in Appendix B.
- Regional Assessment Area (RAA): The RAA is the area within which Project-related environmental effects may overlap or accumulate with the environmental effects of other projects or activities that have been or will be carried out (i.e., cumulative effects). The RAA also accommodates a wider geographic area for ecological context. For the Terrestrial Environment, the RAA is defined as the two ecodistricts that surround the Project, the Kouchibouguac and Petitcodiac Ecodistricts. These ecodistricts are both within the Eastern Lowlands Ecoregion and together total 7,370.1 km^2 (Figure 3.3.).

3.2.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of the Project on the Terrestrial Environment include construction, operation, and decommissioning and abandonment. Construction in the Terrestrial Environment is expected to occur over a period of 16 months. Construction of the landfall site and transmission line from Melrose to Cape Tormentine is expected to be completed over 9 to 10 months, between March and December 2016. Construction of transmission line between Melrose and Memramcook is expected to begin in September 2016 with completion expected to take place in June 2017. Operation will begin following construction and is anticipated to continue for the life of the Project (approximately 40 years). Decommissioning and abandonment would take place following the useful service life of the Project and which would be carried out in accordance with regulations in place at that time.

Sources: GeoNB, NB Power, SNB, NBDNR Imagery: ESRI World

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

Terrestrial Environment Assessment Area Boundaries (PDA and RAA Only)

Figure 3.2

3.2.1.5 Residual Environmental Effects Description Criteria

Criteria used to characterize and describe residual environmental effects for the assessment of Terrestrial Environment are provided in Table 3.13.

Table 3.13 Characterization of Residual Environmental Effects on the Terrestrial Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive**—an effect that moves measurable parameters in a direction beneficial to the Terrestrial Environment relative to baseline conditions. **Adverse**—an effect that moves measurable parameters in a direction detrimental to the Terrestrial Environment relative to baseline conditions. **Neutral**—no net change in measureable parameters for the Terrestrial Environment relative to baseline conditions.
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible**—no measurable change from baseline conditions. **Low**—a measurable change from baseline conditions, but below regulatory thresholds and does not affect the ongoing viability of terrestrial populations. **Moderate**—measurable change from baseline conditions that is above regulatory thresholds, but does not affect the ongoing viability of terrestrial populations. **High**—measurable change from baseline conditions that is above regulatory thresholds, and adversely affects the ongoing viability of terrestrial populations.
Geographic Extent	The geographic area in which an environmental, effect occurs	**PDA**—residual effects are restricted to the PDA. **LAA**—residual effects extend into the LAA. **RAA**—residual effects extend beyond the LAA, into the RAA.
Frequency	Identifies when the residual effect occurs and how often during the Project or in a specific phase	**Single event**—occurs once. **Multiple irregular event**—occurs at no set schedule. **Multiple regular event**—occurs at regular intervals. **Continuous**— occurs continuously.
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the effect can no longer be measured or otherwise perceived	**Short-term**—residual effect restricted to the duration of proposed construction. **Medium-term**—residual effect extends through two or more growing/breeding seasons. **Long-term**—residual effect extends beyond the life of the Project.
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible**—the effect is likely to be reversed after activity completion and reclamation. **Irreversible**—the effect is unlikely to be reversed.

Table 3.13 Characterization of Residual Environmental Effects on the Terrestrial Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Ecological and Socioeconomic Context	Existing condition and trends in the area where environmental effects occur	**Undisturbed**—area is relatively undisturbed or not adversely affected by human activity. **Disturbed**—area has been substantially previously disturbed by human development or human development is still present.

3.2.1.6 Significance Definition

3.2.1.6.1 Change in Vegetation and Wildlife

For a change in vegetation and wildlife, a significant adverse residual environmental effect on the Terrestrial Environment is defined as one or more of the following:

- one which alters the terrestrial habitat in such a way as to cause decline in the distribution or abundance of a viable population of SAR/SOCC
- one which results in direct mortality of individuals or communities of SAR/SOCC such that long-term survival within the RAA is substantially reduced as a result
- one which results in a non-permitted contravention of any of the prohibitions stated in Sections 32-36 of *SARA*, or in contravention of any of the prohibitions stated in Section 28 of NB *SARA*
- in the case of any SAR/SOCC, any non-compliance with the management plans (developed as a result of Section 65 of *SARA* or Section 20 of the NB *SARA*) currently in place
- one which results in direct mortality of individuals such that long-term survival of wildlife populations within the RAA is substantially reduced as a result
- one which results in a reduction in wildlife dispersal or migration such that long-term survival of wildlife populations within the RAA is substantially reduced as a result
- one which affects vegetation communities and wildlife habitat in such a way as to cause a decline in abundance or change in distribution of common and secure populations such that the populations will not be sustainable within the RAA
- one which affects ECMC such that they experience a change in function, and can no longer support any special populations they contain

3.2.1.6.2 Change in Wetland Area or Function

For a change in wetland area or function, a significant adverse residual environmental effect on the Terrestrial Environment is defined as:

- one which results in an unauthorized permanent net loss of wetland area, or loss of wetland function in a PSW, after consideration of planned mitigation or provincially required compensation for unavoidable wetland losses
- one which results in the loss of important function (i.e., one that would result in a significant effect on another VC that relies upon wetlands) at the RAA level, provided by a wetland that cannot be avoided or mitigated

3.2.2 Existing Conditions for the Terrestrial Environment

3.2.2.1 Methods

3.2.2.1.1 Information Sources

Vegetation and Wildlife

Records for vegetation, wildlife, and ECMCs occurring within the LAA and surrounding area were obtained from various sources, including the ACCDC, the North American Breeding Bird Survey (BBS), the Maritimes Breeding Bird Atlas (MBBA), and the Atlantic Canada Nocturnal Owl Surveys (ACNOS).

Atlantic Canada Conservation Data Centre

The ACCDC is a registered charity that was established in 1997, and has the following mission statement, "*To assemble and provide objective and understandable data and expertise about species and ecological communities of conservation concern, including those at risk, and to undertake field biological inventories in support of decision-making, research, and education in Atlantic Canada*." (ACCDC 2015b). ACCDC data, including SAR, SOCC, and managed areas, were obtained within 5 km of the Project (ACCDC 2014b).

North American Breeding Bird Survey

The BBS began in 1966 and is now one of the longest-running breeding bird surveys in North America. The BBS database is extensive and can be used to determine long-term population trends of breeding bird species in Canada. A search of the BBS database was conducted to obtain records of bird species observed near the PDA (EC 2014).

Maritimes Breeding Bird Atlas

The second MBBA 2006-2010 was a five-year project to update the distribution and abundance of all bird species breeding in the three Maritimes provinces. The first MBBA was conducted from 1986-1990. The MBBA database provides information including species presence, breeding evidence, and relative abundance in a given 10 km by 10 km area (known as an "atlas square"). Data were obtained for the atlas squares 20LR89, 20LR99, 20MR09, 20MS00, 20MS10, 20MS20, and 20MS30, which encompass the Project.

Atlantic Canada Nocturnal Owl Surveys

The ACNOS was initiated in 2001 to help monitor trends in the abundance of relatively common owls. The survey seeks to monitor the region's owl populations and gather information about the distribution of owls in Atlantic Canada.

The ACNOS database from Bird Studies Canada, accessed via the NatureCounts website (BSC 2015), provides basic information about the presence of owl species detected from specific points on survey routes (called "survey stops") in a given year. Data are available from 2001 to 2007. Data were obtained from Route 69 (Migic) and Route 70 (Bourgeois Mills), which are crossed by the Project.

Wetlands

The LAA contains wetlands and PSWs mapped by NBDELG on the GeoNB website (GeoNB-mapped wetlands, SNB 2011). Wetlands within New Brunswick are also mapped by the Department of Natural Resources (NBDNR) and the New Brunswick Hydrographic Network (NBHN). These spatial data were used to quantify wetlands within the LAA (i.e., where wetlands were not field-delineated).

3.2.2.1.2 Field Surveys

Vegetation and Wetlands

Field surveys for vegetation and wetlands were conducted between August 18 and September 10, 2014. Surveys were conducted within the PDA with the exception of the landing site, which was not available at the time of the surveys and portions of the Upper Tantramar Marsh that are not accessible by foot. These areas were surveyed in August, 2015, and the results of these surveys will be described in a supplemental report.

Wetlands were delineated and classified according to the Canadian Wetland Classification System (CWCS, NWWG 1997). This system classifies wetlands to three levels: class, form/subform, and type. There are five wetland classes: bog, fen, swamp, marsh, or shallow water. Form and subform indicate the physical morphology and hydrological characteristics of the wetland. Wetland type distinguishes wetland communities based on one of eight groups of dominant vegetation. Information on wetland function was also recorded for each wetland, and geographic coordinates and field notes were recorded for wetland boundaries. Any wetlands demonstrating exceptional examples of important wetland functions that could be affected by a change in vegetation cover, such as the support of SAR, numerous SOCC, or sensitive ecological communities, were noted. Hydrological functions can be inferred by the CWCS forms of each wetland.

Wildlife

In June and July of 2015, baseline wildlife surveys were conducted within the LAA and surrounding area to characterize wildlife use of the area. The results of these surveys were not available at the time of writing, and will be described in a supplemental report. Incidental wildlife observations from 2014 vegetation and wetland surveys are reported.

Nomenclature for all taxa follows that used by the ACCDC (ACCDC 2014a).

3.2.2.2 Overview

The LAA lies within the Eastern Lowlands Ecoregion, crossing two of its ecodistricts: the Kouchibouguac Ecodistrict, and the Petitcodiac Ecodistrict. The ecoregion has the highest percentage of wetlands of all the New Brunswick ecoregions as a product of its uniquely low relief and poor drainage. This ecoregion also has the largest area of peatlands, which occur both inland and along the coast. The forests in the ecoregion primarily appear boreal in character; although the two ecodistricts where the LAA is situated have a somewhat more temperate, mixedwood character.

The Kouchibouguac Ecodistrict encompasses the eastern coastline of the province from Cape Tormentine to Miramichi Bay. This flat, low ecodistrict experiences only a 30 m difference in elevation from its highest to its lowest point. Widespread, early-successional hardwood forests are present as a result of 300 years of settlement in this ecodistrict, and contain trembling aspen (*Populus tremuloides*), red maple (*Acer rubrum*), and white birch (*Betula papyrifera*). Later successional forests are primarily coniferous and mixedwood stands consisting of spruce, hemlock, red maple, sugar maple (*Acer saccharum*), and beech (*Fagus grandifolia*). Black spruce (*Picea mariana*) stands grow on the edges of widespread peatlands.

The Petitcodiac Ecodistrict is a low-lying, gently rolling area which encompasses the Petitcodiac River basin. The Petitcodiac River is the dominant feature of the landscape in this ecodistrict. Boreal-type coniferous forests are common in the ecodistrict, with red spruce being the most abundant species. White spruce (*Picea glauca*), black spruce, balsam fir (*Abies balsamea*), red maple, white birch, and trembling aspen are also common. Hemlock (*Tsuga canadensis*), white pine (*Pinus strobus*), and tamarack (*Larix laricina*) may also be present in smaller numbers. Tolerant hardwood stands of beech, sugar maple, and yellow birch (*Betula alleghaniensis*) are only found on ridgetops and upper slopes.

The PDA stretches from Memramcook to Cape Tormentine through predominantly forested habitat of a variety of age classes. It crosses through scattered patches of development and agriculture which tend to be concentrated around major watercourses such as the Tantramar River, Harper Brook, and the Gaspereau River. Agricultural areas are also common along the eastern end of Route 16 and near Cape Tormentine. The PDA follows along the southern edge of an existing transmission line corridor for approximately 71% of its length with the final 29% crossing through forest and developed landscape in the east.

The eastern end of the LAA is close to a number of large marsh complexes that serve as important migratory stopover locations and breeding areas for waterfowl. While there are a large number of forested wetlands within the PDA, exceeding 30% of the landscape, there are few larger open wetland types intersected by the PDA. Along the Tantramar River, the Upper Tantramar Marsh which is an Ecologically Significant Area (ESA) and part of a National Wildlife Area (NWA) is crossed at its northern extent by the PDA. The majority of wetlands in the LAA are dominated by mixed deciduous and coniferous tree species such as black spruce, balsam fir, red maple, and white ash (*Fraxinus americana*).

3.2.2.2.1 Vegetation

Land classification in the PDA and LAA is dominated by forests, representing 70.5 and 70.9%, respectively (Table 3.14). The majority of this forested land is in a young-immature age class. Softwood stands are more common than hardwood or mixedwood stands.

Wetlands are more common within the PDA than the LAA, comprising 22.7% of the PDA vs. 15.7% of the LAA. This is likely because field delineation of wetlands, which is more accurate than air photo interpretation, only occurred within the PDA and immediately adjacent areas.

Table 3.14 Land Classification within the PDA and LAA

Land classification	PDA		LAA	
	hectares	%	hectares	%
Agricultural	9.0	4.0	312.2	5.1
Anthropogenic	3.6	1.6	95.3	1.6
Beach	0.01	0.004	1.1	0.02
Forest	159.1	70.5	4,469.5	73.7
Clearcut	1.5	0.7	19.8	0.3
Regen-sapling Hardwood	21.6	9.6	527.3	8.7
Regen-sapling Mixedwood	15.8	7.0	387.6	6.4
Regen-sapling Softwood	3.1	1.4	168.9	2.8
Young-immature Hardwood	23.4	10.4	538.2	8.9
Young-immature Mixedwood	17.8	7.9	516.7	8.5
Young-immature Softwood	63.3	28.0	1,721.2	28.3
Mature-overmature Hardwood	1.8	0.8	131.1	2.2
Mature-overmature Mixedwood	4.2	1.8	199.0	3.3
Mature-overmature Softwood	6.6	2.9	248.2	4.1
Forestry Other	-	-	3.6	0.06
No Data/Private Land	0.02	0.01	7.9	0.1
Industrial	1.1	0.5	42.7	0.7
Tidal Flat	-	-	0.1	0.002
Transmission Line	1.7	0.7	198.5	3.3
Waterbody	0.1	0.07	5.5	0.1
Wetland	50.9	22.7	955.7	15.7
Bog	0.3	0.1	2.6	0.04
Fen	0.2	0.1	19.7	0.3
Marsh	0.6	0.3	51.5	0.9
Shallow Water	1.1	0.5	12.8	0.2
Shrub Swamp	17.3	7.7	298.5	4.9
Treed Bog	1.2	0.6	2.5	0.04
Treed Swamp	30.2	13.4	568.1	9.3
Total	**225.6**	**100.0**	**6,080.6**	**100.0**

The ACCDC data for the Project (ACCDC 2014b) indicated the potential for six vascular plant SOCC within or near the LAA: northern blueberry (*Vaccinium boreale*; S1), Greene's rush (*Juncus greenei*; S1), red-disked yellow pond-lily (*Nuphar lutea spp. rubrodisca*; S2), slender cottongrass (*Eriophorum gracile*; S2), dwarf ginseng (*Panax trifolius*; S3) and seaside brookweed (*Salmolus valerandi spp. parviflorus*; S3) (Appendix B, Sheet 10 and 37).

During the 2014 field surveys, 396 vascular plant species were observed within the PDA and surrounding surveyed area (Appendix A), including 17 SOCC (Table 3.15; Appendix B, Sheets 4-9, 11-13, 15-16, 18, 21, 24, 27, 30, 31, 34, 35, 39, and 40).

Table 3.15 Vascular Plant Species of Conservation Concern Observed within the Project Development Area and Surrounding Surveyed Area

Common Name	Scientific Name	ACCDC S-Rank[1]	Occurrences within the PDA
Blood Milkwort	*Polygala sanguinea*	S2	0
Dotted Smartweed	*Polygonum punctatum*	S3	3
Dwarf Clearweed	*Pilea pumila*	S3	0
Halberd-leaved Tearthumb	*Polygonum arifolium*	S3	11
Hop Sedge	*Carex lupulina*	S3	0
Kalm's Hawkweed	*Hieracium kalmii*	S1	1
Large Purple Fringed Orchid	*Platanthera grandiflora*	S3	3
Red-Disked Yellow Pond-lily	*Nuphar lutea ssp. rubrodisca*	S2	1
Showy Lady's-slipper	*Cypripedium reginae*	S3	1 large population
Slender Cottongrass	*Eriophorum gracile*	S2	1
Small Yellow Pond-lily	*Nuphar lutea ssp. pumila*	S3	1
Swamp Rose	*Rosa palustris*	S3	0
Thyme-leaved Speedwell	*Veronica serpyllifolia ssp. humifusa*	S3	1
White Fringed Orchid	*Platanthera blephariglottis*	S3	7
White Fringed Orchid	*Platanthera blephariglottis var. blephariglottis*	S3	1
Wiegand's Sedge	*Carex wiegandii*	S3	3
Yellow Ladies'-tresses	*Spiranthes ochroleuca*	S1	3

Notes:
[1] S1 = critically imperiled, S2 = imperiled, S3 = vulnerable(ACCDC 2015a)

Although not the focus of these surveys, one bryophyte SOCC was observed within the Upper Tantramar Marsh. Floating crystalwort (*Riccia fluitans*) is a liverwort that is ranked S2S4 by the ACCDC (Appendix B, Sheet 11). Purple-fringed liverwort (*Ricciocarpos natans*), a liverwort with no S-rank, was also observed within the Upper Tantramar Marsh.

There is potential for southern twayblade (*Listera australis*) in the Memramcook to Melrose portion of the PDA. This plant is listed as endangered under the NB *SARA*. These sites will be visited in early June, 2016 (during the flowering period for this species), prior to construction.

Ecological Communities of Management Concern

The LAA contains several ECMC [i.e., communities that fulfill special management objectives on Crown land in New Brunswick or have been identified as supporting unique ecological features, either through field work, or by local conservation organizations (e.g., Environmentally Significant Areas (ESA))]. The Upper Tantramar Marsh ESA and Upper Tantramar Eastern Habitat Joint Venture site both refer to extensive wetland complex habitat on the upper reaches of the Tantramar River (Appendix B Sheet 11). South of the LAA, this wetland complex reaches over 1 km in width, with extensive open water habitat. Within the PDA, the wetland is approximately 640 m wide, and includes floating aquatic shallow water, graminoid marsh, tall shrub swamp and coniferous treed swamp wetland types. The Upper Tantramar Marsh is considered to be an important waterfowl staging area, and represents important waterfowl breeding habitat. This wetland is also considered to be an Ecologically Important Wetland (EIW).

MacDonald's Pond Ducks Unlimited (DU) site, also known as Jones Pond, is located near the eastern end of the Project, south of Bayfield. At this freshwater marsh and shallow water wetland complex, DU has added level ditching and nesting islands to enhance waterfowl habitat.

3.2.2.2.2 Wildlife

The portion of the Project from Memramcook to approximately Timber River lies within the Chignecto Isthmus, an area of New Brunswick and Nova Scotia which represents the only terrestrial route for wildlife species to move between New Brunswick and Nova Scotia (SCI 2015). At its narrowest, the Chignecto Isthmus is approximately 21 km wide. Maintaining connectivity within the isthmus is a conservation priority for the area (CPAWS 2007; NCC 2015), in part because many wildlife species are less common in Nova Scotia than in New Brunswick (e.g., moose (*Alces americanus*) and Canada lynx (*Lynx canadensis*) (MacKinnon and Kennedy 2009; NCC 2015)). The portion of the Project within the Chignecto Isthmus parallels an existing transmission line.

Although the Chignecto Isthmus is a major movement route for terrestrial species, it is also crossed by the Atlantic Flyway, a major North American migration route for birds migrating along the Atlantic coast (including the Bay of Fundy) to and from the north Atlantic Ocean, as far as Greenland (Bird Nature n.d.). Larger wetlands and mudflats within the isthmus are used as staging areas for a variety of shorebirds and water birds during migration periods (CPAWS 2007; IBA Canada 2015).

Birds

Information sources, including the ACCDC, ACNOS, BBS, Christmas Bird Count (CBC), and MBBA, indicate 201 species of birds that have been recorded near the LAA (i.e., within 5 km of the PDA, or within the MBBA squares crossed by the project, Appendix B). Of the species recorded, 17 are SAR and 34 are SOCC (Table 3.16).

Table 3.16 Bird Species at Risk and Species of Special Concern Observed near the Local Assessment Area (ACCDC, ACNOS, BBS, CBC, and MBBA Records)

Common Name	Scientific	*SARA*	NB *SARA*	COSEWIC	ACCDC S-Rank	Data Source
American Coot	*Fulica americana*			not at risk	S2B	ACCDC
American Golden-plover	*Pluvialis dominica*				S3M	ACCDC
American Wigeon	*Anas americana*				S3B	ACCDC, BBS, MBBA
Bald Eagle	***Haliaeetus leucocephalus***		**endangered**	**not at risk**	**S3B**	**ACCDC, MBBA**
Bank Swallow	***Riparia riparia***	**no schedule, no status**		**threatened**	**S3B**	**ACCDC, BBS, MBBA**
Barn Swallow	***Hirundo rustica***	**no schedule, no status**	**threatened**	**threatened**	**S3B**	**ACCDC, BBS, MBBA**
Black Tern	*Chlidonias niger*			not at risk	S2B	ACCDC, BBS, MBBA
Black-headed Gull	*Larus ridibundus*				S2M,S1N	ACCDC
Bobolink	***Dolichonyx oryzivorus***	**no schedule, no status**	**threatened**	**threatened**	**S3S4B**	**ACCDC, BBS, MBBA**
Boreal Owl	*Aegolius funereus*				S1S2B	ACNOS
Brant	*Branta bernicla*				S2S3M,S2S3N	ACCDC
Brown-headed Cowbird	*Molothrus ater*				S3B	ACCDC, BBS, MBBA
Bufflehead	*Bucephala albeola*				S3N	ACCDC
Canada Warbler	***Wilsonia canadensis***	**schedule 1, threatened**	**threatened**	**threatened**	**S3S4B**	**ACCDC, BBS, MBBA**
Chimney Swift	***Chaetura pelagica***	**schedule 1, threatened**	**threatened**	**threatened**	**S2S3B**	**BBS**
Common Nighthawk	***Chordeiles minor***		**threatened**		**S3B**	**ACCDC, BBS, MBBA**
Common Tern	*Sterna hirundo*			not at risk	S3B	ACCDC, MBBA
Eastern Meadowlark	***Sturnella magna***	**no schedule, no status**	**threatened**	**threatened**	**S1S2B**	**BBS**
Eastern Wood-pewee	***Contopus virens***	**no schedule, no status**	**special concern**	**special concern**	**S4B**	**ACCDC, BBS, MBBA**
Gadwall	*Anas strepera*				S2B	ACCDC, MBBA
Greater Scaup	*Aythya marila*				S1B,S2N	ACCDC

Table 3.16 Bird Species at Risk and Species of Special Concern Observed near the Local Assessment Area (ACCDC, ACNOS, BBS, CBC, and MBBA Records)

Common Name	Scientific	*SARA*	NB *SARA*	COSEWIC	ACCDC S-Rank	Data Source
Green Heron	*Butorides virescens*				S1S2B	ACCDC
Horned Lark	*Eremophila alpestris*				S2B	BBS
House Wren	*Troglodytes aedon*				S1B	ACCDC, MBBA
Killdeer	*Charadrius vociferus*				S3B	ACCDC, BBS, MBBA
Long-eared Owl	*Asio otus*				S2S3	ACCDC
Marsh Wren	*Cistothorus palustris*				S2B	ACCDC
Northern Mockingbird	*Mimus polyglottos*				S3B	ACCDC, BBS, MBBA
Northern Pintail	*Anas acuta*				S3B	ACCDC, MBBA
Northern Shoveler	*Anas clypeata*				S2B	ACCDC, BBS, MBBA
Olive-sided Flycatcher	***Contopus cooperi***	**schedule 1, threatened**	**threatened**	**threatened**	**S3S4B**	**ACCDC, BBS, MBBA**
Pine Grosbeak	*Pinicola enucleator*				S2S3B,S4S5N	ACCDC, BBS
Piping Plover (Melodus Subspecies)	***Charadrius melodus melodus***	**schedule 1, endangered**	**endangered**	**endangered**	**S2B**	**ACCDC**
Purple Sandpiper	*Calidris maritima*				S3M,S3N	ACCDC
Red Crossbill	*Loxia curvirostra*				S3	ACCDC, BBS
Red Knot (Rufa Subspecies)	***Calidris canutus rufa***	**schedule 1, endangered**	**endangered**	**endangered**	**S3M**	**ACCDC**
Red-breasted Merganser	*Mergus serrator*				S3B,S4S5N	ACCDC, MBBA
Red-necked Phalarope	***Phalaropus lobatus***			**special concern**	**S3M**	**ACCDC**
Red-shouldered Hawk	***Buteo lineatus***	**schedule 3, special concern**		**not at risk**	**S2B**	**ACCDC**
Ring-billed Gull	*Larus delawarensis*				S3B	ACCDC

Table 3.16 Bird Species at Risk and Species of Special Concern Observed near the Local Assessment Area (ACCDC, ACNOS, BBS, CBC, and MBBA Records)

Common Name	Scientific	*SARA*	NB *SARA*	COSEWIC	ACCDC S-Rank	Data Source
Rusty Blackbird	***Euphagus carolinus***	**schedule 1, special concern**	**special concern**	**special concern**	**S3B**	**BBS**
Sedge Wren	*Cistothorus platensis*				S1B	ACCDC
Short-Eared Owl	***Asio flammeus***	**schedule 1, special concern**	**special concern**	**special concern**	**S3B**	**CBC**
Turkey Vulture	*Cathartes aura*				S3B	ACCDC, MBBA
Upland Sandpiper	*Bartramia longicauda*				S1B	ACCDC, MBBA
Vesper Sparrow	*Pooecetes gramineus*				S2B	BBS
Virginia Rail	*Rallus limicola*				S3B	ACCDC, BBS
Willet	*Tringa semipalmata*				S2S3B	ACCDC, MBBA
Willow Flycatcher	*Empidonax traillii*				S1S2B	ACCDC, MBBA
Wilson's Phalarope	*Phalaropus tricolor*				S1B	ACCDC
Wood Thrush	***Hylocichla mustelina***	**no schedule, no status**	**threatened**	**threatened**	**S1S2B**	**BBS, MBBA**
Note: SAR are indicated in bold text.						

Maritimes Breeding Bird Atlas

Information about the presence of breeding bird species within the LAA was requested from the MBBA via the NatureCounts Website (www.birdscanada.org/birdmon). The search results generated a list of species and records of highest breeding evidence for each species within the atlas squares occupied by the Project.

The LAA lies within MBBA region 14 (Tintamarre), within seven atlas squares (20LR89, 20LR99, 20MR09, 20MS00, 20MS10, 20MS20, and 20MS30). During the atlas period (2006 to 2010) a total of 131 species of bird were recorded across the four squares. The highest recorded breeding status of the 131 species detected in these squares is presented in Table D.1 in Appendix D. Of the 131 recorded species, 70 were confirmed as breeding, 37 were probable breeders, and 24 were possible breeders.

Atlantic Canada Nocturnal Owl Surveys

The LAA crosses two ACNOS survey routes: Route 69 (Migic) and Route 70 (Bourgeois Mills), with one stop as close as 1.7 km from the PDA. The following four owl species have been recorded along these routes:

- barred owl (*Strix varia*)
- boreal owl (*Aegolius funereus*)
- great horned owl (*Bubo virginianus*)
- northern saw-whet owl (*Aegolius acadicus*)

American woodcock and Wilson's snipe have also been detected along both of the routes crossed by the Project.

Barred owl was the most commonly detected species along both Route 69 and Route 70, with 20 detections along Route 69, and 14 detections along Route 70 over six survey years. Boreal owl (ranked S1S2B by the ACCDC) was the least commonly detected species, with only one observation over the six survey years, which occurred on Route 69, approximately 2 km south of the PDA. This species has not been recorded on Route 70. Great horned owl was the second most commonly detected species along Route 70, with nine detections over six survey years. Northern saw-whet owl was the second most commonly detected species along Route 69, with nine detections over six survey years.

Bird Species at Risk (SAR)

Based on data provided by the ACCDC, MBBA, and BBS, 16 SAR have potential to be found within the LAA; these are described below.

<u>Bald eagle</u>

The bald eagle is a large, distinctive bird of prey found across Canada, and much of North America. This species is listed as endangered under NB *SARA* and S3B by the ACCDC.

Bald eagles build the largest nest of any bird in North America, and prefer nesting sites near open water (NBDNR 2015). During winter, individuals from the resident population are often found in the southwestern part of the province, where they have access to the Bay of Fundy for fishing. Suitable habitat, for this species, particularly forested areas near waterbodies, is found within the PDA and LAA. There is potential for this species to be found within the PDA.

The BBS (EC 2014) reports that this species has been increasing in population in Canada and at the province level in NB. The main factors which were once responsible for the species decline include trapping, shooting and poisoning of the birds, as well as the use of the pesticide DDT which contributed to reproductive failure. Continuing threats to this species include lead poisoning from ammunition in hunter-shot prey, collisions with motor vehicles and stationary structures and destruction and alteration of their habitat (Cornell Lab of Ornithology 2015).

Bank swallow

The bank swallow is a small, highly social songbird which feeds primarily on flying or jumping insects (COSEWIC 2013a). This species occurs on every continent except Antarctica and Australia. In North America this species breeds in every province with the possible exception of Nunavut (COSEWIC 2013a). Bank swallow is ranked as threatened by COSEWIC, and has no *SARA* status or schedule. The ACCDC ranks bank swallow as S3B.

Bank swallows breed in a wide variety of natural and anthropogenic sites including riverbanks, aggregate pits, road cuts, and vertical sand banks or stock piles of soil. Nesting sites are generally situated adjacent to open terrestrial habitat used for aerial foraging (COSEWIC 2013a). No suitable nesting habitat was noted in the PDA, although some may be present in the LAA. There is potential for this species to be found within the LAA.

The BBS (EC 2014) reports that this species is in decline in Canada and at the province level in NB. The main factors thought to be responsible for the decline of this species includes the loss of breeding and foraging habitat, and the loss of food sources through the widespread use of pesticides (COSEWIC 2013a).

Barn swallow

The barn swallow is a mid-sized passerine that is closely associated with rural human settlements. This species is the most widespread swallow in the world, and is known to breed in all provinces and territories in Canada (COSEWIC 2011a). The barn swallow is ranked as threatened by COSEWIC and NB *SARA*, and S3B by the ACCDC. It has no *SARA* rank at this time.

Following European settlement of North America, barn swallows shifted from nesting in caves and on ledges to nesting largely in human-made structures. This insectivorous species prefers open habitats for foraging such as pastoral lands, shorelines, and cleared rights-of-way. Foraging habitat for this species exists within the PDA and LAA, No nesting habitat was noted within the PDA, but it is likely that some occurs within the LAA. There is potential for this species to be found within the LAA.

The BBS (EC 2014) indicates that this species is undergoing a decline in population, although the species is still common and widespread (COSEWIC 2011a). The main threats to the species include loss of nesting and foraging habitat, and the large-scale declines in some insect populations which provide food for this species.

Bobolink

Bobolink is a medium-sized passerine that breeds in the southern part of all Canadian provinces from British Columbia to Newfoundland and Labrador. Bobolink is ranked as threatened by COSEWIC and NB *SARA*, and S3B by the ACCDC. It has no *SARA* rank at this time.

Bobolink originally nested in the tall-grass prairie of the mid-western US and south central Canada. As this habitat was converted to agricultural land, and forests of eastern North America were cleared to hayfields and meadows, the range of bobolink expanded (COSEWIC 2010a). Bobolink presently nest in a variety of forage crop habitats, and natural grassland habitats including wet prairie, graminoid peatlands, and abandoned fields dominated by tall grasses. Suitable habitat for this species, particularly agricultural areas, is found within the PDA and LAA. There is potential for this species to be found within the PDA.

The BBS (EC 2014) indicates that this species is in decline at a Canada-wide and province-wide level. The main threats to this species include land-use change, especially the loss of meadows and hay fields, and the early mowing of hay fields in which the species is nesting.

Canada warbler

Canada warbler is a small and brightly colored passerine. Approximately 80% of the entire breeding range of this species is located in Canada (COSEWIC 2008a), where it can be found breeding in every province and territory except Newfoundland and Labrador and Nunavut. Canada warbler is ranked as threatened on Schedule 1 of *SARA*, and under NB *SARA*, and S3B by the ACCDC.

Canada warblers breed in a wide range of forest types, including deciduous, coniferous and mixedwood forests. It is often associated with moist mixedwood forest and riparian shrub forests on slopes and ravines (COSEWIC 2008a). The presence of a well-developed shrub layer also seems to be associated with preferred Canada warbler habitat. Suitable habitat for this species, such as shrub swamps, is found within the PDA and LAA. There is potential for this species to be found within the PDA.

The BBS (EC 2014) reports that this species is in decline Canada-wide and at a province-wide level. Key threats to this species are unclear, but loss of primary forest in the wintering grounds in South America is a potential cause.

Chimney swift

The chimney swift is a small slender bird, with long, narrow wings. The breeding range of this species is limited to eastern North America, with approximately one quarter of the breeding range located in Canada (COSEWIC 2007a). This species is considered threatened under Schedule 1 of *SARA*, and under NB *SARA*. The ACCDC lists this species as S2S3B.

The chimney swift is primarily associated with urban and rural areas where chimneys are available for nesting and roosting. This species is an aerial insectivore, and often concentrates near water, where insects are abundant (COSEWIC 2007a). No suitable nesting habitat for this species was noted in the PDA, but some is likely present in the LAA. This species could potentially be found within the LAA.

The BBS (EC 2014) reports that this species is in decline at a Canada-wide and NB-wide level. The main factor thought to be responsible for the decline of this species is the rapidly falling number of suitable breeding and roosting sites including old abandoned buildings and traditional chimneys (COSEWIC 2007a). Pesticide spraying which reduces the availability of insect prey may also be a factor.

Common nighthawk

The common nighthawk is a medium-sized bird which nests in almost all of North America, and in some parts of Central America. This species occurs in all of the Canadian provinces and territories with the exception of Nunavut (COSEWIC 2007b). The common nighthawk is considered threatened under Schedule 1 of *SARA* and under NB *SARA*.

Common nighthawks are most commonly observed in a wide range of open, vegetation-free habitats including beaches, recently cleared forests, rocky outcrops, and grasslands (*SARA* 2015). The species has probably benefited from newly-opened habitats created by the forestry industry (COSEWIC 2007b). Suitable habitat for common nighthawk, particularly clear cut areas, exists within the PDA and LAA. There is potential for this species to be found within the PDA.

The BBS (EC 2014) reports that this species is in decline at a Canada-wide and NB-wide level. The exact causes of the decline of this species are not well understood, however it may be related to the widespread decline in insect populations which this species relies upon for food. This theory is supported by the widespread declines observed among many other insectivorous bird species (COSEWIC 2007b).

Eastern meadowlark

A medium-sized bird, the eastern meadowlark is a member of the blackbird family. In Canada, this species is found in Ontario, Quebec, New Brunswick, and southern Nova Scotia (COSEWIC 2011b). The eastern meadowlark is ranked as threatened by COSEWIC and under NB *SARA*. The ACCDC ranks this species as S1S2B.

Eastern meadowlarks prefer to nest in grassland habitats including native and non-native pastures, hayfields and weedy meadows. Nests are placed directly on the ground, concealed within the vegetation (COSEWIC 2011b). Suitable agricultural habitat exists within the PDA and LAA, thus there is potential that this species could be found within the PDA.

The BBS (EC 2014) reports that this species is in decline at a Canada-wide and NB-wide level. The main factors thought to be responsible in the decline of the eastern meadowlark include loss of breeding habitat, and the intensification and modernization of agricultural techniques (COSEWIC 2011b).

Eastern wood-pewee

The eastern wood-pewee is a small passerine which breeds in much of Canada from Saskatchewan to the Maritimes provinces (COSEWIC 2012a). This species is ranked as threatened by COSEWIC and NB *SARA*. The ACCDC ranks this species as S4B.

During breeding, the eastern wood-pewee is generally associated with the mid-canopy layer within forest clearings and edges of hardwood and mixed forest stands (COSEWIC 2012a). In migration periods this species utilizes a variety of habitats including edges, and clearings (COSEWIC 2012a). Suitable habitat for this species is found within the PDA and LAA. This species is likely to be found within the PDA.

The BBS (EC 2014) reports that this species is in decline at a Canada-wide and NB-wide level. The main factors thought to be responsible in the decline of the eastern wood-pewee have not been clearly identified, due largely, to a lack of research. Possible threats include loss of habitat, and degradation of habitat quality, changes in availability in flying-insect prey, and changes in forest structure due to white-tailed deer over-browsing (COSEWIC 2012a).

Olive-sided flycatcher

The olive-sided flycatcher is a stout, medium-sized passerine which breeds in scattered locations throughout most of forested Canada (COSEWIC 2007c). This species is listed as threatened under Schedule 1 of *SARA* and NB *SARA*. The ACCDC lists the olive-sided flycatcher as S3B.

Olive-sided flycatchers are most often associated with open areas, where they are found foraging for flying insects, and perching in tall live trees (COSEWIC 2007c). Suitable habitat for this species is found within the PDA and LAA. There is potential for this species to be found within the PDA.

The BBS (EC 2014) reports that this species is in decline at a Canada-wide and NB-wide level. The main factors thought to be associated with the decline of olive-sided flycatchers are habitat loss and alteration (COSEWIC 2007c). Declining insect populations on breeding and wintering grounds may also be a contributing factor.

Piping plover (*melodus* subspecies)

The piping plover is a small shorebird found only in North America. The *melodus* subspecies is listed as endangered on Schedule 1 of *SARA* and NB *SARA*. The ACCDC ranks this species as S2B.

Piping plover nest on wide sandy beaches with little to no vegetation and on various substrates including pebbles, gravel, shells and fine woody material. On the Atlantic coast, they are most often associated with sandy beaches on barrier islands, ocean fronts, bays and sand bars (COSEWIC 2013b). Known piping plover habitat closest to the PDA is at the Cape Jourimain NWA, located approximately 4 km north of the PDA (ACCDC 2014b; EC 2012). Although there is a small amount of beach habitat within the PDA, no plovers were observed in this area during any biophysical surveys.

The BBS (EC 2014) reports that there is insufficient data to estimate trends for this species; however, annual surveys for this subspecies shows a non-significant decline of 13% on the long-term (1991-2013) and a significant decline of 23% over the most recent 10 years (2003-2013) (COSEWIC 2013b). The key threats to piping plovers are predation of eggs and chicks, human disturbance, and habitat loss and degradation (COSEWIC 2013b).

Red knot (*rufa* ssp.)

The red knot is a medium-sized shorebird which breeds in the central Canadian Arctic, and winters in Tierra del Fuego at the southern tip of South America. Consequently, this species migrates thousands of kilometers, with many passing along the north shore of the St. Lawrence in Quebec (COSEWIC 2007d). This species is listed as endangered on Schedule 1 of *SARA* and NB *SARA*. The ACCDC ranks this species as S3M.

During migration, red knots utilize coastal zones swept by tides, usually sand flats, but also lagoons, mangrove areas, and mussel beds, where they feed to refuel to continue migration (COSEWIC 2007d). No suitable habitat for this species was noted within the PDA, and it is unlikely that red knot would be found within the PDA.

The BBS (EC 2014) reports that there is insufficient data to estimate population trends for this species. The key threats to red knot (*rufa* ssp.) include the overfishing of horseshoe crabs in Delaware Bay, which has decimated the supply of this invertebrate's eggs, and the decreased availability of wetland habitats during the migration in eastern North America (COSEWIC 2007d).

Red-necked phalarope

The red-necked phalarope is a small shorebird species, which may be found along marine coasts, bays, lakes ponds, and tundra during the summer months (Audubon n.d.). This species is listed as special concern by NB *SARA* and as S3M by the ACCDC. It has no federal *SARA* rank at this time.

This species spends up to nine months at a time at sea. Nesting occurs in the low Arctic on tundra ponds with marshy shores and bogs (Audubon n.d.). No suitable habitat for this species was noted within the PDA, and it is unlikely that red-necked phalarope would be found within the PDA

The BBS (EC 2014) reports that this species is in decline in Canada. The main threat to this species is direct and indirect habitat loss at staging areas used during migration (Audubon n.d.).

Red-shouldered hawk

The red-shouldered hawk is a medium-sized hawk with broad, rounded wings. In Canada, it may be found in the southern most areas of the eastern provinces. This species is ranked as special concern on Schedule 3 of *SARA*. The ACCDC ranks red-shouldered hawk as S2B.

Red-shouldered hawks are typically found in bottomland hardwood stands, flooded deciduous swamps, and upland mixed deciduous-conifer forests. Stands with open subcanopy are favored by this species, which hunts within the forest habitat (Cornell Laboratory of Ornithology 2015). Suitable habitat for this species exists within the PDA and LAA. There is potential for red-shouldered hawk to be found within the PDA.

The BBS (EC 2014) reports that this species population is increasing slightly at the Canada-wide level. The key threat to the red-shouldered hawk is the continued clearing of habitat for development and the forestry industry (Cornell Laboratory of Ornithology 2015).

Rusty blackbird

The rusty blackbird is a medium-sized passerine most commonly associated with forest wetlands. This species is listed as special concern on Schedule 1 of *SARA* and under NB *SARA*. The ACCDC ranks the rusty blackbird as S3B.

The rusty blackbird nests in boreal forests, generally near the shores of forest wetlands, slow-moving streams, beaver ponds, and pasture edges (COSEWIC 2006). This species' main diet in its breeding range consists primarily of aquatic invertebrates, and occasionally salamanders and small fish. Some habitat for rusty black bird exists within the PDA and LAA. There is potential for this species to be found within the PDA.

The BBS (EC 2014) reports that this species is in decline Canada-wide and at the provincial level in NB. The main factor thought to be associated with the decline of Rusty blackbirds is the conversion of its main wintering grounds (forests in Mississippi Valley flood plains) into agricultural lands or human habitation (COSEWIC 2006). Other factors include destruction of wetlands within the species breeding range, and the spread of dominant, competing, species such as the red-winged blackbird.

Short-eared owl

The short-eared owl is a medium-sized owl of open grasslands. This species may be found across North America, and is known in every province in Canada. Short-eared owl is currently listed on Schedule 1 of *SARA* as special concern, and is also listed as special concern by COSEWIC and under NB *SARA*. The ACCDC ranks short-eared owl as S3B.

This species breeds sporadically in arctic areas, coastal marshes, and interior grasslands where small rodents are abundant (COSEWIC 2008b). A wide variety of open habitats are used for foraging, including arctic tundra, grasslands, peat bogs, old pastures, marshes, and occasionally agricultural fields. Some of these types of habitats, particularly agriculture, but also marshes and bogs, are found within the PDA and LAA. There is potential for this species to be found within the PDA.

The BBS (EC 2014) reports that this species is in decline at a Canada-wide level. There is insufficient data to report a provincial trend in NB. The main threat to this species is thought to be loss and alteration of habitat. Coastal marshland and grassland habitats, which were formerly heavily used by this species, have been especially vulnerable to loss and alteration through drainage of wetlands, urban development and agricultural activity (COSEWIC 2008b).

Wood thrush

The wood thrush is a medium sized bird which breeds in southeastern Canada from southern Ontario east to Nova Scotia (COSEWIC 2012b). This species is listed as threatened by COSEWIC and NB *SARA*, and S1S2B by the ACCDC.

Wood thrush nest mainly in second-growth and mature forests, both deciduous and mixed wood, with saplings and well-developed understory layers. There is suitable habitat for wood thrush within the PDA and LAA. There is potential for this species to be found within the PDA.

The BBS (EC 2014) reports that this species is in decline in Canada and in NB. The main factors thought to be responsible in the decline of this species include habitat degradation and fragmentation due to over-browsing by white-tailed deer and human development (COSEWIC 2012b). High rates of nest predation and parasitism by species such as brown-headed cowbird are also contributing to the decline of the wood thrush.

Other Incidental Wildlife Observations

Evidence of the following mammals was seen in the PDA and surrounding area during the vegetation and wetland surveys:

- American beaver (*Castor canadensis*)
- black bear (*Ursus americanus*)
- eastern chipmunk (*Tamias striatus*)
- eastern coyote (*Canis latrans*)
- meadow vole (*Microtus pennsylvanicus*)
- mink (*Neovison vison*)
- moose (*Alces americanus*)
- muskrat (*Ondatra zibethicus*)
- North American porcupine (*Erethizon dorsatum*)
- northern raccoon (*Procyon lotor*)
- northern river otter (*Lutra canadensis*)
- red squirrel (*Tamiasciurus hudsonicus*)
- snowshoe hare (*Lepus americanus*)
- star-nosed mole (*Condylura cristata*)
- striped skunk (*Mephitis mephitis*)
- white-tailed deer (*Odocoileus virginianus*)
- woodland jumping mouse (*Napaeozapus insignis*)

Evidence of the following herpetiles was seen in the PDA and surrounding area during the vegetation and wetland surveys:

- American toad (*Bufo americanus*)
- blue-spotted salamander (*Ambystoma laterale*)
- bullfrog (*Rana catesbeiana*)
- common garter snake (*Thamnophis sirtalis*)
- green frog (*Rana clamitans*)
- maritime garter snake (*Thamnophis sirtalis pallidulus*)
- northern leopard frog (*Rana pipiens*)
- spring peeper (*Hyla crucifer*)
- wood frog (*Rana sylvatica*)

- yellow spotted salamander (*Ambystoma maculatum*)

Each of these mammal and herpetile species is listed as S5 by the ACCDC, which is considered secure, or "common, widespread, and abundant in the province," with the exception of blue-spotted salamander, which is ranked S4, and considered apparently secure, or "uncommon but not rare; some cause for long-term concern due to declines or other factors" (ACCDC 2015a).

Monarch (*Danaus plexippus*) butterflies were noted at three locations in the LAA, all within 20 m of the PDA (Appendix B, Sheets 12 and 23). Two of the observations were made north of the PDA in the adjacent transmission line RoW, between Cookville Road and Route 940. A third observation was made south of the PDA in a low shrub basin swamp, approximately 600 m east of Route 15. Monarchs are a SAR, listed as special concern on Schedule 1 of *SARA* and NB *SARA*. They are dependent on milkweed plants (*Asclepias* spp.) where they lay their eggs, and which the caterpillars eat after hatching (COSEWIC 2010b). There are two species of milkweed in New Brunswick: common milkweed (*Asclepias syriaca*, S4S5), which grows in open areas such as abandoned agricultural areas, meadows, ditches, and roadsides; and swamp milkweed (*Asclepias incarnata*, S4) which grows in marshes, the edges of swamps, shorelines, and other wet areas (COSEWIC 2010b; Haines 2011). Neither of these species were observed within the PDA or adjacent areas surveyed for vegetation in 2014.

Interior Forest

There are 16 patches of approximately 378.5 ha of interior forest contiguous with the LAA (i.e., at least a portion of the interior forest patch is within the LAA). Interior forest are areas relatively free from fragmentation and defined as patches of mature forest greater than 10 ha in size, and at least 100 m from an "edge" (e.g., clearcut, industrial or other anthropogenic area, linear features such as roads or transmission lines, or waterbodies and open wetlands) (Appendix B, Sheets 7-10, 14, 15, 22-25, 27-29, 33-35, 37, and 38). Patches of interior forest in the LAA range from 10.2 ha to 56.1 ha. Some wildlife species are sensitive to fragmentation and prefer or require interior forest habitat. These species, known as interior species, include bay-breasted warbler, black-throated blue warbler, eastern wood-pewee, Cape May warbler, Canada warbler, and wood thrush (Emera Brunswick Pipeline Company Ltd. 2006), all of which have been observed in the LAA or surrounding area (Appendix D).

3.2.2.2.3 Wetlands

In total, 50.8 ha of wetland habitat were delineated within the PDA, which represents 22.5% of the PDA (Appendix B). The total area of each wetland class is given in Table 3.17. The wetlands identified within the PDA fall within five classes (swamp, bog, marsh, fen, and shallow water), four broad types (treed, shrub, graminoid, and aquatic), and six forms (basin, drainageway, flat, lacustrine riparian, riverine riparian, and unconfined slope). Of the 50.8 ha of wetland within the PDA, 46.2 ha (90.9%) is classified as swamp wetland. The majority of the swamp wetlands are tall shrub type (14.1 ha) followed closely by mixedwood treed swamp (11.2 ha). The wetland classes in the PDA are described below.

Table 3.17 Summary of Wetland Habitat within the Project Development Area by Class, Type (subtype) and Form (subform)

Wetland Types and Forms	Area (ha) by Wetland Class					
	Bog	Fen	Marsh	Swamp	Shallow Water	Total
Coniferous Treed	**1.8**			**9.7**		**11.5**
Basin	1.8			5.6		7.5
Drainageway				0.7		0.7
Flat				0.4		0.4
Lacustrine Riparian				0.04		0.04
Riverine Riparian				0.1		0.1
Unconfined Slope				2.8		2.8
Mixedwood Treed		**0.4**		**11.2**		**11.7**
Basin				3.6		3.6
Drainageway		0.4		2.2		3.7
Flat				1.3		1.3
Riverine Riparian				0.8		0.8
Unconfined Slope				3.2		3.2
Deciduous Treed				**8.0**		**8.0**
Basin				0.5		0.5
Drainageway				1.0		1.0
Flat				0.4		0.4
Unconfined Slope				6.2		6.2
Tall Shrub		**0.2**		**14.1**		**14.3**
Basin				0.6		0.6
Drainageway		0.2		3.9		4.1
Flat				1.2		1.2
Lacustrine Riparian				0.1		0.1
Riverine Riparian				2.8		2.8
Unconfined Slope				5.5		5.5
Low Shrub				**3.1**		**3.1**
Basin				3.1		3.1
Graminoid	**0.3**	**0.2**	**0.6**			**1.1**
Basin	0.3	0.2				0.5
Riverine Riparian			0.5			0.5
Unconfined Slope			0.02			0.02
Floating Aquatic					**1.1**	**1.1**
Basin					0.02	0.02

Table 3.17 Summary of Wetland Habitat within the Project Development Area by Class, Type (subtype) and Form (subform)

Wetland Types and Forms	Area (ha) by Wetland Class					
	Bog	Fen	Marsh	Swamp	Shallow Water	Total
Lacustrine Riparian					0.7	0.7
Riverine Riparian					0.4	0.4
Total (ha)	**2.2**	**0.8**	**0.6**	**46.2**	**1.1**	**50.8**

Bog

Bogs are uncommon in the PDA, comprising only 2.2 ha or 4.2% of the wetland habitat in the PDA. All of the four bogs encountered are basin forms and are characterized by accumulated peat, a dependence on precipitation as the water source, and are typically dominated by sphagnum mosses (*Sphagnum* spp.), ericaceous shrubs, and coniferous tree species. Within the PDA, three of the four bogs encountered are coniferous treed subtypes and the fourth is a sedge/graminoid type. The treed bogs are dominated by black spruce and tamarack. Dominant graminoid species include cottongrass (*Eriophorum* spp.), and various sedges including bog sedge (*Carex magellanica*), three-seeded sedge (*Carex trisperma* var. *billingsii*), and few-seeded sedge (*Carex pauciflora*). Treed bogs can provide habitat for plant SAR including southern twayblade (*Listera australis*), which is listed as endangered under NB *SARA*. Open bogs sometimes provide nesting habitat for common nighthawks and rusty blackbirds.

Fen

A fen is a peatland with a fluctuating water table with waters that are generally rich with dissolved minerals. Fens occupy 1.7% of the wetland habitat within the PDA and are mostly small and disturbed and not typical of larger, naturally formed fens in New Brunswick. Fens in the PDA are either graminoid or shrub dominated nutrient-poor fens that fall within existing cleared areas. Under natural conditions these wetlands would be forested and classified as treed swamps but now are covered with graminoids including sedges and grasses such as blue-joint reed grass, nodding sedge, and mannagrass (*Glyceria* spp.). Fens are often highly diverse and can support a number of SOCC, but all of the fens in the PDA are in disturbed areas lacking the typical high fen diversity.

Marsh

Marshes comprise only 1.1% of wetlands in the PDA (0.6 ha) by area and only one form (graminoid) and two subforms (riverine riparian and unconfined slope). Marshes typically have shallow, but fluctuating water levels and are typically dominated by graminoid species including grasses, sedges (*Carex* spp.), cattails (*Typha* spp.), or rushes (*Juncus* spp.), and may include some shrub cover. The fluctuating water levels and changes in water depth and duration of flooding often result in distinct zones of vegetation (NWWG 1997). The single unconfined slope marsh is very small, occupying less than 0.02 ha, and is in a disturbed area adjacent to the existing transmission line. The three riverine riparian marshes together comprised 0.6 ha in total area and are part of the Upper Tantramar Marsh complex.

Marshes can be highly diverse and support several avian SAR, including rusty blackbird, olive-sided flycatcher, and a variety of wading birds and waterfowl. The Upper Tantramar riverine marsh within the PDA contains two vascular plant SOCC: red disked yellow pond lily (*Nuphar lutea* ssp. *rubrodisca;* S2), dotted smartweed (*Polygonum punctatum;* S3); and one liverwort SOCC: crystalwort (*Riccia fluitans;* S2S4). Additional botanical surveys are scheduled for this area in August of 2015 to be summarized in a supplemental report. When this marsh was established as an ESA, it was known to represent one of the few known breeding locations in New Brunswick for Virginia rail and marsh wren (Tims and Craig 1995). Riverine marshes and adjacent watercourses provide breeding and nursery habitat for a variety of fish, invertebrate, reptile, and amphibian species, and feeding and reproductive habitat for a variety of birds and other species. The Upper Tantramar Marsh is characterized as an EIW based on its large size, important role in supporting SOCC, status as an ESA and an Eastern Habitat Joint Venture site, and hydrological function.

Swamp

Swamp wetlands are generally dominated by at least 30% woody vegetation (trees or tall shrubs) and may occur on organic or mineral soils, and may overlay minerotrophic groundwater (NWWG 1997). The water table is typically at or near the surface and they are not as wet as marshes, fens, or bogs. Swamps are the most abundant class in the PDA (46.2 ha) with multiple forms and types. Approximately 90.9% of the wetland habitat in the PDA is classified as swamp which is typical for Brunswick.

Swamp Forms

The most abundant subforms of swamp in the PDA are unconfined slope (17.8 ha), unconfined basin (13.4 ha), and drainageway (7.8 ha). Less common wetland forms are riverine riparian (3.7 ha), flat swamps (3.2 ha), and lacustrine riparian (0.1 ha). Drainageway swamps and unconfined slope swamps are subforms of slope swamps which characteristically drain across a gradient. In the PDA these are typically fed by a combination of surface and groundwater that drains slowly across a hummocky surface. In drainageway swamps, surface drainage tends to follow more defined tracks. Unconfined slope swamps, tend to be broader and drainage is poorly defined and less obvious. Often there is a small amount of peat accumulation in some areas, but in the PDA, these wetlands are largely on mineral soils with a sub-surface confining layer with elevated clay content. Both subforms can be present in a single wetland in combination with other classes, types and forms, and can have seasonal surface water collecting in hollows between hummocks.

Basin swamps in the PDA tend to have greater peat accumulation, less nutrient supply, and lower pH as evident by the typically coniferous tree and/or ericaceous shrub dominated vegetation cover. Peat accumulation also tends to be somewhat greater in the basin swamps in the PDA. There are some richer, basin swamps (5 ha) that had mixedwood forest cover as a result of heavier groundwater inputs.

Other forms of swamp that occurred in the PDA include lacustrine and riverine riparian swamps that occurred within the flood zones of lakes and watercourses in the PDA that are typically dominated by alder or black spruce and balsam fir. There are also a small number of flat swamps which are a subform of basin swamps and are similar to unconfined slope swamps except there is no obvious direction of drainage across a gradient.

Swamp Types

Within the PDA, the majority of swamps are treed swamps dominated by mixedwood forest or coniferous forest with black spruce and, less commonly, deciduous forest typically dominated by red maple. The coniferous swamps tend to be concentrated on the western half of the PDA while shrub swamps are more common on the eastern half. Deciduous and mixedwood treed swamps tend to be scattered along the PDA in clusters.

Of all wetlands surveyed, treed swamps are the most common type, comprising 57.0% of all wetlands within the PDA. Treed swamps in New Brunswick most often have a water table that is below the surface, and are fed by seepage, rainwater, or runoff with relatively stable hydrology, except in floodplains where treed swamps occur in areas with fluctuating hydrology. Treed swamps occur along sloping seepage tracks and where gently rolling topography provides slower drainage to wide flat valleys. Peat accumulation is typically minor in the treed swamps within the PDA, which include the subtypes coniferous treed, mixedwood treed and deciduous treed swamps.

Shrub swamps cover approximately 27.8% of the wetland area in the PDA (17.2 ha). Tall shrub swamps are the most abundant subtype (14.1 ha) and are typically dominated by speckled alder (*Alnus incana*) sometimes in combination with black ash (*Fraxinus nigra*) and other wetland shrub species such wild raisin (*Viburnum nudum*), winterberry (*Ilex verticillata*), and ericaceous shrubs. These wetlands are most often found in disturbed areas or along watercourses and in drainage swales where the disturbance regime favors species adapted to flooding, ice scouring, beaver activity and widely fluctuating water tables. Low shrub swamps are less abundant (only 3.1 ha) and occur in boggier basins with some peat accumulation and are dominated by ericaceous shrubs.

Coniferous treed swamps are the second most abundant subtype of swamp (at 19.1% of total area) in the PDA after shrub swamps, and are typically dominated by black spruce, with smaller amounts of balsam fir, eastern white cedar, or tamarack. These wetlands are somewhat more concentrated in the western half of the PDA where mixedwood swamps are more abundant in the eastern half. Common understory species include ericaceous and other wetland shrub species such as wild raisin, winterberry, mountain holly (*Nemopanthus mucronata*), as well as various fern species. Coniferous treed swamps have potential to provide habitat for some plant SAR, including southern twayblade. Avian SAR that use this habitat type include olive-sided flycatcher, which commonly nests near the forested edge of a more open wetland type. These wetlands can also provide habitat for game species such as white-tailed deer and moose, as well as various fur-bearers.

Mixedwood treed swamps can contain a variety of tree species, such as red maple, birches, balsam fir, eastern white cedar, and spruces. The understory is typically dominated by regenerating tree species and mixed fern assemblages. Mixedwood treed and deciduous swamps are typically drainage way or slope forms and are more common on productive soils or have heavier groundwater inputs. Avian SAR such as the eastern wood-peewee, Canada warbler, and olive-sided flycatcher may use this habitat type.

Hardwood treed swamps are the least common subtype, and are generally dominated by red maple and white ash in the overstory, and have a wide variety of species in the understory.

Shallow Water

Shallow water wetlands are transitional between deep water bodies and wetlands that are saturated or periodically wet and have standing water that is less than 2 m deep. This wetland class comprises 1.1 ha or 2.1% of wetland habitat in the PDA. One small shallow water wetland (0.02 ha) is in a disturbed excavated pit and is a basin form and floating aquatic type. The remaining shallow water wetland is part of the Upper Tantramar Marsh complex and is identified as an ecologically important wetland as discussed below. These wetlands can serve as important breeding areas for fish, birds, reptiles, and amphibians. Part of the shallow water wetland in this complex on the eastern side, is classified as lacustrine riparian subform. The portion on the western side is riverine riparian. Both are of the floating aquatic subtype and are dominated by floating aquatic species such as pond lilies (*Nuphar* spp.), duckweed, and pickerelweed (*Pontedaria* sp.). Supplemental botanical surveys are planned for this area in August 2015 to be summarized in supplemental reporting.

Provincially Significant Wetlands and Ecologically Important Wetlands

There are no PSWs within the LAA; however, the Upper Tantramar Marsh is considered an EIW. This riparian wetland complex of shallow water, marsh, and swamp classes along the Tantramar River supports a range of valued functions for SOCC. It is also part of a larger wetland complex that is designated as an ESA and an Eastern Habitat Joint Venture site. It is one of few known breeding locations for Virginia rail, sedge wren, and marsh wren within New Brunswick (Tims and Craig 1995). The Upper Tantramar marsh is a mixture of dykeland, bog, shallow marsh, wooded islands and open water lakes, of which only the upper reaches are intersected by the PDA. The islands and surrounding uplands are forest, shrub, and hayland which provide abundant bird nesting habitat. The upper end of the marsh also contains habitat suitable for several species of nesting and staging waterfowl. Several plant SOCC were identified in this wetland during field surveys and additional botanical field surveys occurred in August 2015.

3.2.3 Project Interactions with the Terrestrial Environment

Potential Project interactions with Terrestrial Environment are presented in Table 3.18. These interactions are indicated by check marks, and are discussed in Section 3.2.4 in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects. Following the table, justification is provided for non-interactions (no check marks).

Table 3.18 Potential Project-Environment Interactions and Effects on the Terrestrial Environment

Project Components and Physical Activities	Potential Environmental Effects	
	Change in Vegetation and Wildlife	Change in Wetland Area or Function
Construction		
Site Preparation for Land Based Transmission Lines	✓	✓
Physical Construction of Land-Based Transmission Lines	✓	✓
Landfall Construction	✓	–
Upgrading of Electrical Substation	–	–
Inspection and Energizing of the Transmission Lines	–	–
Clean-Up and Re-vegetation of the Transmission Corridor	✓	✓
Emissions and Wastes	✓	–
Transportation	–	–
Employment and Expenditure	–	–
Operation		
Energy Transmission	✓	–
Vegetation Management	✓	✓
Infrastructure Inspection, Maintenance and Repair (Transmission Lines and Substations)	–	–
Access Road Maintenance	✓	–
Emissions and Wastes	–	–
Transportation	–	–
Employment and Expenditure	–	–
Decommissioning and Abandonment		
Decommissioning	✓	–
Reclamation	✓	✓
Emissions and Wastes	✓	–
Employment and Expenditure	–	–

Notes:
✓ = Potential interactions that might cause an effect.
– = Interactions between the project and the VC are not expected.

Landfall construction occurs in an area that has yet to be surveyed for vegetation and wetlands, as this project component was not finalized at the time of these surveys in 2014. However, aerial imagery indicates there are no wetlands within this part of the Project footprint. Therefore, no interactions are expected between landfall construction and wetland area and function.

Upgrading of the electrical substation will not interact with the Terrestrial Environment in a substantive way. This Project activity will occur within the footprint of the existing substation where no terrestrial features are found.

Inspection and energizing of the transmission lines will occur following other construction activities such as site preparation and physical construction of transmission lines, and will occur over a short period of time within areas that were previously disturbed during these other Project activities. Therefore, no interactions are expected between this Project activity and the Terrestrial Environment.

During all phases, transportation and employment and expenditure are not anticipated to interact with the Terrestrial Environment in a substantive way. Although transportation may result in vehicle collisions with wildlife; these interactions are considered accidental events and are addressed as such in Section 5.

During operation, infrastructure inspection, maintenance, and repair are not anticipated to interact with the Terrestrial Environment in a substantive way. This Project activity will occur periodically using existing roads and will not result in further disturbance to the Terrestrial Environment.

During operation, emissions and wastes are also not anticipated to interact with the Terrestrial Environment in a substantive way. Emissions and wastes can include air contaminants, sound and vibration, surface runoff, and waste disposal. The predicted infrequency and low levels of these emissions and wastes during operation and decommissioning and abandonment phases will limit any interaction with the Terrestrial Environment. During construction, emissions and wastes are not anticipated to interact with wetland area and function. Wetlands are not expected to be responsive to air contaminants or sound and vibration emissions, and wastes will not be disposed of in wetlands. Though wetland function could interact with surface runoff, standard erosion and control measures used on all construction projects will limit this potential interaction.

Project components and activities will interact with wetland area and function. With the exception of vegetation clearing activities, the remaining wetlands outside of the PDA will not be disturbed during operation and decommissioning and abandonment phases.

The environmental effects of these Project activities on the Terrestrial Environment (or portions thereof) will not be considered further.

3.2.4 Assessment of Residual Environmental Effects on the Terrestrial Environment

3.2.4.1 Analytical Assessment Techniques

The assessment of potential environmental effects on the Terrestrial Environment was conducted using desktop information. Vegetation and wetlands field surveys were also conducted within the PDA and surrounding area during the growing season by qualified biologists with experience in botany, wetland delineation and classification, and wildlife surveys. Bird surveys were conducted within the breeding bird season by a qualified avian biologist who conducted an area search of the PDA and surroundings, and will be reported on in a supplemental report.

3.2.4.2 Assessment of Change in Vegetation and Wildlife

3.2.4.2.1 Project Pathways for Change in Vegetation and Wildlife

Construction

The construction of the Project has potential to result in adverse environmental effects resulting in the loss of vascular plant SOCC, the loss of vegetation communities and wildlife habitat, sensory disturbance to wildlife resulting in habitat avoidance, and mortality of wildlife through collisions with construction equipment.

Site preparation of the land-based transmission lines includes preparation of termporary access roads, clearing of the corridor, and grubbing of pole locations, and has potential to result in the direct loss of vascular plant SOCC, vegetation communities, and wildlife habitat. Clearing will remove trees and shrubs and damage other plants. Grubbing will completely remove vegetation, where it occurs. Depending on the extensiveness of the grubbing, topsoil and the associated seedbank could be removed, and machinery working on site will compact remaining soil layers. Removing soil can change the habitat quality for any plants that may later regenerate within the corridor. If these activities occur during the breeding bird season, there is potential that the Project will result in the direct loss of young birds that are unable to leave the nest.

Construction activities are expected to result in a change in a minimum of 190.5 ha of vegetation communities and wildlife habitat; all forested upland, treed swamps, and treed bogs within the PDA will require vegetation clearing. Some tall shrub swamps may also require clearing, which could amount to an additional 17.3 ha of vegetation communities and wildlife habitat cleared. The majority of vegetation communities and wildlife habitat with the potential to experience change resulting from clearing are common within the LAA, with the exception of some wetland types discussed in Section 3.3.2.2. Construction activities will also result in the permanent loss of a minimum of 0.06 ha of vegetation communities and wildlife habitat associated with the footprints of approximately 279 H-Frame structures (totalling 0.04 ha, some of which will likely occur within wetland habitat), and the 0.02 ha footprint of the termination site.

Site preparation activities, can have indirect interactions on adjacent areas beyond potential direct effects on vascular plant SOCC and vegetation communities and wildlife habitat within the corridor, through edge effects. Edge effects can include changes in abiotic factors such as light availability, humidity, wind, and temperature, which can change which plants are able to grow and thrive in an area. Vegetation communities in the PDA and adjacent areas can also change as a result of the introduction of invasive or exotic plants. Many invasive and exotic plants are strong competitors that thrive in disturbed habitats, and could out-compete native vegetation in the area.

Edge effects can also result in changes in indirect mortality though herbivory or predation (i.e., through increasing access for larger herbivores and predators), or through nest parasitism. Nest predators and brown headed cowbirds (nest parasites) occur more frequently closer to forest edges (Lloyd et al. 2005; Rich et al. 1994). Although changes resulting from edge effects will not be as great as those resulting from direct disturbance within the corridor, they represent a change from pre-Project conditions.

Site preparation activities will result in the loss of approximately 7.9 ha of interior forest contiguous with the LAA. The majority of patches within the LAA (10 of 16) will not be affected by the Project. The Project will reduce the average area of the patches from 23.7 ha to 23.2 ha. None of the interior forest patches will be reduced below the 10 ha threshold. The largest patch will be reduced from 56.1 to 54.2 ha, and the largest reduction (of 2.7 ha) is from 22.1 ha to 19.4 ha. The amount of fragmentation of interior forest is relatively low for a project of this size, because the majority of the Project is paralleling an existing transmission line. The section where the Project parallels an existing transmission line is also where it crosses the Chignecto Isthmus. Therefore, the Project does not represent a new source of fragmentation in this area. It will, however, result in a wider cleared area for species to cross.

The physical construction of land-based transmission lines will require excavation of two holes for each pole location. These areas will have been previously cleared and grubbed, so the potential changes to vascular plant SOCC, vegetation communities, and wildlife habitat will be minimal, but these areas represent a permanent loss, whereas vegetation within the majority of the corridor will be allowed to regenerate, although community composition will change. Heavy machinery used for excavation will result in further soil compaction around the excavated areas.

Site preparation and physical construction activities have potential to change ECMC. Although the boundaries are not well-delineated, it is assumed that the Upper Tantramar Marsh ESA encompasses portions of the freshwater marsh and shallow water wetland portions of the larger complex that are crossed by the PDA. Clearing will occur within adjacent treed and shrub swamp portions of the wetland complex, but none is expected to occur within the ESA portion of the wetland. Potential Project pathways with this wetland are further discussed in Section 3.3.4.3.

Construction activities such as clearing, grubbing at pole locations and excavation will produce sensory disturbance in the form of light and noise. This disturbance has potential to result in temporary habitat loss as a result of reduced habitat effectiveness (i.e., avoidance). Breeding and rearing success for some wildlife species could potentially be affected by sensory disturbance (Bayne *et al.* 2008).

The Project may lead to increased bird mortality resulting from collision with construction equipment. Although birds can collide with non-illuminated structures, light sources have been shown to be an attractant to migrating birds. This phenomenon is worse at night or during inclement weather (Avery *et al.* 1976; Ogden 1996; Wiese *et al.* 2001; Longcore and Rich 2004). This interaction would be of short duration, limited in extent to areas near active construction, and would cease at the completion of construction activities.

Increased activity, noise, and illumination at night during construction activities could also cause an increase in indirect mortality risk. Sensory disturbance could result in certain wildlife species suffering reduced productivity and nest abandonment. Some wildlife, including small mammals, reptiles, and amphibians, might move out from cover in response to disturbance (particularly noise or vibration) which could increase mortality risk from exposure to predation.

Operation

During operation, vegetation management, access road maintenance (particularly, vegetation control), and increased ATV use have potential to result in adverse environmental effects resulting in the alteration of vegetation communities and wildlife habitat. These areas will have been disturbed during initial construction activities. Vegetation within these corridors may provide nesting habitat for some bird species. If vegetation management occurs during the breeding bird season, there is potential that the Project will result in the direct loss of young birds that are unable to leave the nest.

The presence of transmission lines has potential to result in wildlife mortality through wildlife strikes. Transmission line collisions have recently been estimated to be the third leading cause of human-related mortality of birds in Canada, behind predation by feral cats and domestic cats (Calvert et al. 2013). In particular, waterfowl and waterbirds are more susceptible to transmission line collisions due to high wing loading (i.e., body weight divided by wing area), which limits their reaction time (APLIC 2012; Bevanger 1998; Rioux et al. 2013). Mortality resulting from transmission line strikes and other wires (such as guywires on communication towers) is a known issue in the Chignecto Isthmus, particularly where lines are perpendicular to migration flightpaths, as occurs in the larger, more southern portions of the Tantramar Marsh (approximately 10.5 km south of the PDA) (MacKinnon and Kennedy 2011).

Birds which are attracted to transmission lines may be electrocuted when there is inadequate separation between energized conductors or energized conductors and grounded hardware. Most electrocutions occur on medium-voltage distribution lines (4 to 34.5 kilovolts (kV)), in which the spacing between conductors may not be adequate to allow birds to pass through (APLIC and USFWS 2005). Poles with energized hardware such as transformers can be especially hazardous, even to small birds, as the numerous energized parts are closely-spaced. Dry feathers can act as insulation, so contact must be made between fleshy parts, such as the wrists, feet, or other skin, for electrocution to occur (APLIC and USFWS 2005).The Project will use H-frame structures with 3.8 m between conductors, 3 m vertical separation between conductors, and overhead ground wires. These structures are considered relatively “avian-safe” as they provide adequate clearances to accommodate a large bird between energized and/or grounded parts (APLIC and USFWS 2005).

In general, nocturnal migrants (i.e., passerines) are high-flyers and are not prone to collision during flight. In contrast, diurnal migrants (e.g., waterfowl, waterbirds, raptors) have flight heights that are more varied. Waterfowl are the species group most susceptible to wire collision (Erickson *et al*. 2001); however, in the absence of potential staging areas (e.g., shallow water wetlands, lakes), they are likely to be flying higher than the height of the transmission lines. Sections of the PDA that are relatively close to potential staging areas include the Upper Tantramar Marsh and near MacDonald's Pond DU site (i.e., Jones Pond). Because of the location of the Project in relation to the Atlantic Flyway, these open water wetlands may be used as stopover and staging areas for migrating birds, especially waterfowl (Bird Nature n.d.). The Upper Tantramar Marsh is currently crossed by an existing transmission line. The Project will parallel this existing line, and therefore does not represent a new interaction with wildlife in the area; however, if the new poles are not lined up with existing poles, the lines will result in increased vertical stratification. Migrating birds that may stop in MacDonald's Pond DU site may need to cross the Project when either arriving or leaving the area.

Decommissioning and Abandonment

It is well known that birds (especially ospreys, but also crows, owls, and hawks) nest on transmission structures. The termination site and transmission line poles could present nesting locations for larger birds, as they are typically the highest point in an area, are stable, and are easily accessible to birds. Decommissioning the termination site and poles may interact with nesting birds, if any are present.

Similar to construction, decommissioning and abandonment activities may also produce sensory disturbance such as light and noise. Such disturbance has potential to result in temporary habitat loss as a result of reduced habitat effectiveness (i.e., avoidance). Breeding and rearing success for some wildlife species could potentially be affected by sensory disturbance (Bayne *et al.* 2008).

Reclamation activities associated with decommissioning will result in an increase in native vegetation communities and wildlife habitat.

3.2.4.2.2 Mitigation for Change in Vegetation and Wildlife

The following well-established practices to reduce the interaction between the Project and vegetation and wildlife will be implemented during Project construction and operation.

- Flag and avoid known locations of individuals of SOCC, when possible.
- Avoid construction, particularly clearing activities, in areas of native vegetation during the breeding season for most migratory birds (April 1 to August 31), if possible.
- If completion of clearing outside the breeding season is not possible, work will be conducted according to an avian management plan which will include breeding bird surveys to determine if any nesting activity is occurring at this time. If active nests are observed in the area to be cleared, additional mitigation will be employed such as flagging the area and avoidance of nests until the young have fledged.
- Use appropriate avian avoidance devices (such as line markers) near potential staging areas, such as Upper Tantramar Marsh and near MacDonald's Pond DU site (Jones Pond).

- Use approved noise arrest mufflers on equipment to reduce potential environmental effects of noise.
- Use full cut-off lighting to reduce attraction to migrating birds, where possible.
- Confine clearing to PDA footprint.
- Reduce grading in native vegetation communities.
- Ensure equipment arrives at the site clean and free of soil or vegetative debris.
- Operate vehicles and equipment on previously disturbed areas, wherever feasible.
- Limit size of temporary workspaces.
- Properly store and dispose of construction site wastes that might attract wildlife.
- Allow for natural regeneration when possible, and when not possible, use a native seed mix for revegetation.
- Restrict vegetation management to necessary areas.
- Restrict travel through wetlands for inspection or maintenance activities, when possible.
- Comply with the conditions of the vegetation management permit received from NBDELG.
- Use existing Environmental Protection Plan.
- Provide a nesting platform during and following decommissioning if any bird species are nesting on the termination site.
- Avoid decommissioning and abandonment activities during the breeding season for migratory birds (April 1 to August 31).
- Restore temporarily disturbed areas to pre-construction conditions.

The mitigation described above will limit the reduction of vegetation communities and wildlife habitat, and will also reduce wildlife mortality that could be caused by the Project. Some loss of vegetation communities and wildlife habitat and mortality of wildlife is predicted, but the mitigation will reduce potential interactions with vegetation and wildlife. Vegetation communities and habitat for wildlife species will remain available in the surrounding landscape.

3.2.4.2.3 Residual Project Environmental Effect for Change in Vegetation and Wildlife

Construction activities will result in a temporary disturbance (single event) during construction to between 190.5 and 207.8 ha of vegetation communities and wildlife habitat. All forested upland, treed swamps, and treed bogs, and potentially tall shrub swamps will require clearing. The majority of this habitat will represent a change, but not permanent loss, of vegetation communities and habitat. With mitigation, permanent habitat loss will be restricted to approximately 0.06 ha of vegetation communities and wildlife habitat within the footprints of permanent structures. The Project will result in a low amount of fragmentation, reducing the amount of interior forest contiguous with the LAA by 7.9 ha, from 378.5 ha to 371.6 ha. This reduction is relatively small for a project of this size, and is not expected to interact with species in the LAA which use interior-forest, or with wildlife migration.

With mitigation, the construction of the Project is expected to interact minimally with SAR or SOCC, e.g., surveys have identified locations of SOCC which will largely be avoided during pole placement and access road upgrades, but will result in low adverse changes to vegetation communities and wildlife habitat within the PDA and LAA, and will increase fragmentation slightly within the LAA which are medium-term (for cleared areas) and permanent (for areas within the permanent footprint) in duration. These changes will occur in a single event, and will be reversible after decommissioning.

During operation, vegetation management and access road maintenance will result in disturbance of vegetation communities and wildlife habitat. These areas will have been previously disturbed during construction. With mitigation, this activity will result in low adverse changes restricted to the PDA, long-term in duration, occurring at regular intervals, and will be reversible.

During operation, there is also potential for the presence of the transmission line to result in direct mortality of birds through transmission line strikes. The majority of the Project will run west-east, parallel to an existing transmission line, and thus the operation of the Project will not represent a new environmental effect in this area. The Project is also parallel to the Atlantic Flyway, the major bird migration pathway, which will reduce interactions compared with a transmission line perpendicular to the migration path (APLIC 2012). In areas where the Project is adjacent to potential staging areas, such as the MacDonald's Pond DU site, birds may need to cross the Project to access these sites. In such areas, appropriate avian avoidance devices (such as line markers) will be used, which can lower collision rates by up to 80% (APLIC 2012), although some studies suggest the effectiveness of these avoidance devices is much lower (Barrientos *et al.* 2011). With mitigation, this activity will result in low adverse changes restricted to the LAA, long-term in duration, occurring continuously, and will be reversible.

During and following decommissioning and abandonment, the site will be restored to natural vegetation. This will represent a low magnitude, positive change to vegetation and wildlife within the LAA, which will be medium-term in duration and occurring in a single event, which will be reversible.

3.2.4.3 Assessment of Change in Wetland Area or Function

3.2.4.3.1 Project Pathways for Change in Wetland Area or Function

Construction

The construction of the Project will result in the loss of wetland habitat, and a change from forested wetland types to shrub or graminoid wetland types. The majority of wetlands with the potential to experience change resulting from clearing are common within the LAA, with the exception of treed bogs. According to the land classification mapping that is available approximately 48% of the treed bogs within the LAA are located within the PDA. Because this mapping for wetlands is less accurate than the field-delineated wetlands within the PDA, it's likely that there are additional treed bogs within the LAA that are not currently mapped, and the percentage of treed bogs within the LAA that are within the PDA is much lower.

Site preparation of the land-based transmission lines includes temporary access roads preparation, clearing of the corridor, and grubbing of the pole locations, which have potential to result in the direct loss of wetland habitat. Clearing will remove trees and shrubs and damage other plants. Grubbing will completely remove wetland vegetation and some soil, where it occurs. Machinery working on site will compact remaining soil layers. These construction activities can result in a change in wetland hydrology, though in many of the areas wetland area will be lost. Cross RoW drainage may be altered where roadways and rutting impound water and culverts are used for access road crossing over areas with heavier surface water flow across the RoW. Removing soil can change the character of wetlands and supported floral and faunal communities.

Site preparation activities can alter wetland habitat directly within the corridor, and indirectly in adjacent areas, through changes in hydrology as well as edge effect. Edge effect results from changes in abiotic factors such as light availability, humidity, wind, and temperature, which can change which plants are able to grow and thrive in an area. The clearing of the corridor and operation of machinery can also provide opportunity for the spread of invasive plants which tend to be strong competitors in disturbed habitats, and could alter the character and habitat suitability of wetlands in and near the RoW.

The physical construction of land-based transmission lines will require excavation of two holes for each pole location. The area around these holes may be subject to additional disturbance that may result in small areas of permanent wetland loss. Although construction activities will result in disturbance to and a small loss of area of wetlands within the PDA, a five year monitoring program on another, larger transmission line project in New Brunswick has demonstrated no long-term loss of wetland function (AMEC 2012).

Site preparation and physical construction activities has potential to change the EIW along the Tantramar River. However, most of this wetland is not currently forested, so alterations will be limited to the areas where pole installation is required and these will be minimized within sensitive wetland areas.

Construction activities are expected to result in a lasting change in approximately 43.6 ha of wetland within the PDA that is currently forested where the trees will be removed. During operation, these wetlands will become shrub, graminoid, or forb-dominated wetlands once vegetation regenerates. This alteration is not considered a significant effect as this wetland area will not be permanently lost, but shifted from the most common wetland type (forested wetlands comprise more than 60% of wetland habitat in the PDA), to less common wetland types. The remaining 28.9 ha of wetland with low vegetation cover such as graminoids or shrubs may be temporarily altered where avoidance is not possible, but recovery is expected where permanent installations such as access roads are not present.

Operation

During operation, vegetation management, access road maintenance (particularly, vegetation control), and increased ATV use have the potential to result in adverse environmental effects resulting in the alteration of wetland habitat. These areas will have been disturbed during initial construction activities but recovery may be impeded by any of these activities. Continued traffic on the corridor can lead to ongoing alterations to cross RoW drainage, vegetation regeneration, and continual or periodic reversion to early successional stages in and around traffic areas. Ongoing disturbance can also provide continued opportunities for invasive species introduction. However, given that most of the PDA follows existing transmission line for most of its length, it is not likely that ATV traffic will increase within the new RoW.

Decommissioning and Abandonment

Decommissioning and abandonment activities have the potential to result in positive environmental effects to wetlands. Vegetation management will no longer be required, and trees will be allowed to regenerate within wetlands. Pole removal will require temporary and localized disturbance to wetlands where poles are located; however, following this, these areas will be allowed to naturally restore to wetland habitat, resulting in a net neutral environmental effect on wetlands.

3.2.4.3.2 Mitigation for Change in Wetland Area or Function

The following well-established practices to reduce the interaction between the Project and wetland area and function will be implemented during construction and operation.

- Restrict clearing activities to the minimum amount required, particularly around wetlands.
- Employ standard erosion and sedimentation control measures, particularly to avoid silt laden runoff into wetlands.
- Implement standard dust control measures to avoid siltation of wetlands.
- Use quarried, crushed material for temporary road access in and near wetlands, to reduce the risk of introducing or spreading exotic and/or invasive vascular plant species.
- Flag wetlands outside of the PDA and restrict additional disturbance such as temporary work areas to upland areas.
- Restrict grading to essential areas when working in or near wetlands.
- Reduce road construction in wetland areas with the use of brush mats and corduroy roads.
- Manage invasive species through minimizing operation activities in wetland areas and clean equipment before entering a wetland.
- Use mechanical clearing in wetlands and adjacent areas.
- If required, compensate for the loss of wetland and EIW function according to a plan to be developed in coordination with, and approved by, NBDELG.
- Monitor the Upper Tantramar Marsh to observe recovery of vegetation and wildlife.

3.2.4.3.3 Residual Project Environmental Effects for Change in Wetland Area or Function

There are approximately 50.8 ha of wetlands within the PDA that may be disturbed during construction. Some wetlands within the PDA will be reclaimed to approximately pre-construction topography and hydrology conditions following construction. In particular, there are 19.5 ha of wetland habitat in the PDA that falls within low-growing vegetation types; if disturbed, this wetland type will likely make a recovery to pre-construction vegetation conditions. There are an additional 31.4 ha of forested wetlands within the PDA that will shift from treed wetlands types to lower growing vegetation types. Transmission line pole and access road upgrades are expected to permanently remove wetlands from the PDA for the duration of operation and will require compensation.

The PDA (and likely LAA) is 22.7% wetland; of this amount, approximately 60% is forested wetland. While coastal wetlands in New Brunswick are thought to have reached critical levels of loss since European settlement, there are no coastal wetlands within the PDA. With 22.7% of the PDA and over 15% of the LAA as wetland habitat, critical levels of loss have not occurred in this area. With forested wetlands as the most common type of wetland in the area, the alteration of some portions of these to other types of wetlands will not result in a net loss of wetland function provided areas of permanent loss are compensated for.

With the proper implementation of mitigation, it is likely that wetlands with low-growing vegetation types will recover, forested wetlands will recover to other native vegetation communities, and pre-disturbance hydrological functions will be restored. However, monitoring will be necessary in the Upper Tantramar Marsh to observe recovery of vegetation and wildlife values in that wetland. Mitigation will be re-evaluated should recovery be impeded or reversed as a result of residual effects of Project-related disturbance.

Although monitoring of other transmission line projects in New Brunswick has indicated that loss of wetland function related to construction is temporary (AMEC 2012), all permanently lost wetland function within the footprint of installations such as poles, temporary access roads, or changes in grade that prevent wetland recovery, will be compensated for (if required) according to a wetland compensation plan developed in cooperation with NBDELG.

Although the Project will result in the small permanent loss of some wetland area within the PDA during the construction phase (amount to be calculated following the final design process), which will not be reversible, the Project is not expected toresult in anet loss of wetland function within the RAA. Thus the loss of wetland area and wetland function will be medium-term (restricted to the period between the start of construction and the completion of wetland compensation (if required) or the return of the wetland to its pre-construction functionality). With successful wetland mitigation the change in wetland area and function during construction will be adverse, low magnitude, and medium term (aside from a small amount of permanent loss associated with pole footprints), restricted to a single event, and reversible.

During operation of the Project there will be integrated vegetation management along the RoW. Mechanical cutting will occur within wetlands along the RoW, which will be managed as shrub, forb, graminoid, or other wetland types. With mitigation, this disturbance will result in a change in wetland area and function that will be adverse, low magnitude, within the LAA, and medium-term in duration, occurring at regular (or slightly irregular) intervals (i.e., depending on the growth rate of the vegetation), and reversible.

During decommissioning and abandonment, vegetation management will cease and trees will be allowed to regenerate within wetlands. During pole removal, there will be temporary and localized disturbance to wetlands where poles are located, but following this, these areas will be allowed to naturally restore to wetland habitat. This activity will be positive, low magnitude, within the PDA, long-term in duration, restricted to a single event, and reversible.

3.2.4.4 Summary of Residual Project Environmental Effects

A summary of residual environmental effects on the Terrestrial Environment is provided in Table 3.19.

Table 3.19 Summary of Project Residual Environmental Effects on the Terrestrial Environment

Residual Effect	Residual Environmental Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socioeconomic Context
Change in Vegetation and Wildlife	C	A	L	LAA	P/MT	S	R	D/U
Change in Vegetation and Wildlife	O	A	L	PDA	LT	R/C	R	D
Change in Vegetation and Wildlife	D	P	L	LAA	MT	S	R	D
Change in Wetland Area or Function	C	A	L	LAA	MT	S	R	D/U
Change in Wetland Area or Function	O	N	L	PDA	LT	R/IR	R	D
Change in Wetland Area or Function	D	N	L	LAA	LT	S	R	D

KEY
See Table 3.13 for detailed definitions.

Project Phase:
C: Construction
O: Operation
D: Decommissioning and Abandonment

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term
P: Permanent

NA: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socioeconomic Context:
D: Disturbed
U: Undisturbed

3.2.5 Determination of Significance

3.2.5.1 Significance of Residual Project Effects

The construction phase of the Project will result in both temporary and permanent disturbance to vegetation communities and wildlife habitat, including wetland, within the PDA. With the exception of treed bogs (and to a lesser extent, bogs), these are limited to vegetation communities and habitat types which are abundant within the LAA. The total amount of these habitats within the PDA is relatively low (1.2 ha and 0.3 ha respectively). Any permanent loss of wetland will be compensated for; therefore, no net loss of function is predicted. With mitigation, the Project is not expected to interact directly with SAR or SOCC. The operation and decommissioning and abandonment phases of the Project will result in limited changes to vegetation, wildlife, and wetlands, through vegetation clearing and some soil disturbance (during pole removal) of a previously disturbed area. With mitigation and environmental protection measures, residual environmental effects on the Terrestrial Environment during all phases of the Project are predicted to be not significant.

3.2.6 Prediction Confidence

Prediction confidence in the assessment of vegetation, wildlife habitat, and wetlands is high because of the quality of the desktop and field data available and application of well-established and proven mitigation and environmental protection measures. Prediction confidence in the assessment of wildlife (specifically birds) is medium because of the lack of results of field data. If the results of the 2015 bird survey work support the results of this environmental assessment, the prediction confidence will then be high.

3.2.7 Follow-up and Monitoring

Follow-up work for this assessment of environmental effects on the Terrestrial Environment will include analysis of 2015 bird survey work, vegetation and wetland field surveys of the landing site at Cape Tormentine, vegetation and wetland surveys of areas of the Upper Tantramar Marsh that were not accessible during the 2014 vegetation and wetland work, and pre-construction southern twayblade surveys in appropriate habitat within the Memramcook to Bayview section of the Project.

Monitoring is suggested for the Upper Tantramar Marsh area to observe recovery of vegetation and wildlife values in that wetland. No monitoring is currently deemed necessary in any other areas for this assessment, but this will be re-evaluated after the above mentioned follow-up work.

3.3 ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS ON LAND USE

Land Use refers to the current and future use of public and private land and resources. It includes industrial and commercial use, private ownership, and use of the land for recreational purposes. Land Use was selected as a VC in consideration of the potential Project interactions with current uses of land in the immediate vicinity of the Project.

3.3.1 Scope of Assessment

The scope of the Land Use VC is based on applicable regulations and policies, professional judgement of the study team, and knowledge of and potential interactions.

Current Use of Land and Resource Use for Traditional Purposes by Aboriginal Persons is addressed separately in Section 3.6. Other VCs linked to the Land Use VC are described in Section 3.1 (Freshwater Environment) and Section 3.2 (Terrestrial Environment).

3.3.1.1 Regulatory and Policy Setting

In New Brunswick, use of Crown Land (e.g., forestry) is managed by the New Brunswick Department of Natural Resources (NBDNR). NBDNR also manages wildlife harvesting on both public and private land.

Land use planning in New Brunswick is based on the *New Brunswick Community Planning Act*. Within incorporated areas, the *New Brunswick Municipalities Act* also applies. Within un-incorporated areas, Regional Service Commissions provide planning and management services including regional and local planning, solid waste management, regional policing, regional emergency measures planning, and regional sport, recreational and cultural infrastructure (GNB 2012).

Additional provincial legislation and regulations relevant to Land Use include:

- *Crown Lands and Forests Act*: Regulates development, use, protection, and management of Crown lands resources.
- *Fish and Wildlife Act*: Regulates hunting, fishing and trapping on private and public land, and establishes protected areas under *Wildlife Refuges and Wildlife Management Areas Regulation*.
- *Protected Natural Areas Act*: Protects the biological diversity of fauna and flora within the Province and the relationship between such fauna and flora and the environment by protecting, conserving and managing natural landscapes and habitat.

Federal regulations relevant to Land Use include the *MBCA, SARA*, and the *Navigation Protection Act* (NPA). Migratory birds and their habitats, as well as their hunting, is managed by the Canadian Wildlife Service (CWS) under the *MBCA*. CWS is also responsible for the protection of listed species under *SARA*. The NPA is administered by Transport Canada.

3.3.1.2 The Influence of Consultation and Engagement on the Assessment

At the time of writing, there are no consultation or engagement results relevant to land and resource use activities within the RAA. NB Power will continue its ongoing consultation and engagement with potentially affected parties in the region.

3.3.1.3 Potential Environmental Effects, Pathways and Measurable Parameters

Based on knowledge of land uses in the vicinity of the Project, and an understanding of the Project and its associated activities, the following potential environmental effect was selected for the assessment of Land Use: change in land use.

Table 3.20 summarizes the potential effects, effect pathways, and measureable parameters for the Land Use VC.

Table 3.20 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Land Use

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Land Use	• Project activities during construction will result in temporary access restrictions. • Project activities will result in disturbance to and loss of private land. • Project footprint will be cleared of merchantable timber and will no longer be available for forestry activities during operations. • Operation activities for the Project (e.g., maintenance of the RoW) will result in permanent loss of habitat for small mammals that are hunted in the area.	• Area (ha) of land use affected (e.g., recreational use). • Habitat loss associated with the Project (ha). • Attribute data on land uses (e.g., forestry, hunting) within area affected (ha/km^2). • Change in Sound Level.

3.3.1.4 Boundaries

3.3.1.4.1 Spatial Boundaries

The spatial boundaries for the environmental effects assessment of Land Use are defined below.

- Project Development Area (PDA): The PDA comprises the immediate area of physical disturbance associated with the construction and operation of the Project. The PDA includes: the existing substation in Memramcook where upgrades to the existing substation will occur within the substation footprint; a 40 km long, 30 m wide transmission line RoW from Memramcook to Melrose and a 17 km long, 60 m wide transmission line RoW from Melrose to Cape Tormentine; a cable termination site; and a 10 m easement around cable lines. The total area of the PDA is approximately 225.6 ha (Figure 3.4).
- Local Assessment Area (LAA): The LAA is the maximum area within which Project-related environmental effects can be predicted to occur or measured with a reasonable degree of accuracy and confidence, and encompassing the likely zone of influence. For Land Use, this area includes the PDA plus an additional 500 m buffer around the PDA (see Appendix B for Figures outlining the assessment area).
- Regional Assessment Area (RAA): The RAA is the area within which Project-related environmental effects may overlap or accumulate with the environmental effects of other projects or activities that have been or will be carried out. For this VC, the RAA is defined as the two ecodistricts that surround the Project (i.e., Kouchibouguac and Petitcodiac Ecodistricts). These ecodistricts are both within the Eastern Lowlands Ecoregion and together total 7,370.1 km2. The RAA encompasses the terrestrial portion of the PDA, and was selected to be consistent with the assessment areas for the Terrestrial Environment (Section 3.2), because it is of central importance to land use (Figure 3.2)).

3.3.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of the Project on Land Use include construction, operation, and decommissioning and abandonment. Construction in the terrestrial environment is expected to occur over a period of 16 months. Construction of the landfall site and transmission line from Melrose to Cape Tormentine is expected to be completed over 9 to 10 months, between March and December 2016. Construction of transmission line between Melrose and Memramcook is expected to begin in September 2016 with completion expected to take place in June 2017. Operation will begin following construction and is anticipated to continue for the life of the Project (approximately 40 years). Decommissioning and abandonment would take place following the useful service life of the Project and which would be carried out in accordance with regulations in place at that time.

3.3.1.5 Residual Environmental Effects Description Criteria

Table 3.21 provides the criteria that are used to characterize and describe Project residual environmental effects on Land Use.

Table 3.21 Characterization of Residual Environmental Effects on Land Use

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect.	**Positive**—an effect that moves measurable parameters in a direction beneficial to Land Use relative to baseline. **Adverse**—an effect that moves measurable parameters in a direction detrimental to Land Use relative to baseline. **Neutral**—no net change in measureable parameters for the Land Use relative to baseline.
Magnitude	The amount of change in measurable parameters (including area of land available for activity, or level of disturbance,) relative to existing conditions.	**Negligible**—affects a minimal number of land users. **Low**—affects a small number of land users. **Moderate**—measurable change but less than the majority of land users. **High**—affects the majority of land users.
Geographic Extent	The geographic area in which an environmental, effect occurs.	**PDA**—residual effects are restricted to the PDA. **LAA**—residual effects extend into the LAA. **RAA**—residual effects extend into the RAA.
Frequency	Identifies when the residual effect occurs and how often during the Project or in a specific phase.	**Single event**—occurs once. **Multiple irregular event**—occurs at no set schedule. **Multiple regular event**—occurs at regular intervals. **Continuous**—occurs continuously.

Table 3.21 Characterization of Residual Environmental Effects on Land Use

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the effect can no longer be measured or otherwise perceived.	**Short-term**—limited to the construction phase. **Long-term**—effects continue throughout the operations phase. **Permanent**—effects continue beyond the life of the Project.
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases.	**Reversible**—the effect is likely to be reversed after activity completion and reclamation. **Irreversible**—the effect is unlikely to be reversed.
Ecological and Socioeconomic Context	Existing condition and trends in the area where environmental effects occur.	**Undisturbed**—area is relatively undisturbed or not adversely affected by human activity. **Disturbed**—area has been substantially previously disturbed by human development or human development is still present.

3.3.1.6 Significance Definition

A significant adverse residual environmental effect on Land Use will occur if proposed activities for the Project are not compatible with land use activities as designated through a regulatory land used process, and/or the proposed use of the land will create a change or disruption that widely restricts or degrades present land uses to a point where the activities cannot continue at current levels and for which this change is not mitigated.

3.3.2 Existing Conditions for Land Use

3.3.2.1 Methods

A combination of spatial analysis and baseline research was used to characterize the types and extent of land use activity in the LAA and RAA. Baseline research included a review of online sources, as well as directed interviews with representatives of relevant groups and organizations. Information on existing conditions was drawn from the following sources:

- GIS databases
- published maps and aerial photography
- Department of Natural Resources
- Department of Energy and Mines
- municipal governments
- community organizations

Existing conditions with respect to VCs linked to Land Use are described in Volume 4, Sections 2.1.2 (Atmospheric Environment), 3.2 (Freshwater Environment), and 3.3 (Terrestrial Environment).

3.3.2.2 Overview

The New Brunswick Project components are entirely located in Westmorland County. An existing substation in Memramcook will be upgraded. The overhead transmission line follows an existing transmission line RoW until it reaches the community of Melrose. The corridor between Melrose and Bayfield, NB, follows an existing and unused NB Power easement approximately 12 km in length. Land easements will be required for the remainder of the transmission line corridor in NB.

The majority of the PDA is forested land, and accounts for 160 ha, or approximately 70% of the PDA. The presence of actively managed woodlots for forest harvesting in the PDA were noted by archaeological field crews during walkover activities in 2014. The crew noted the presence of clear-cutting equipment, as well as recently used logging roads. Within the LAA, forested area accounts for 4,442 ha, or approximately 73% of the LAA.

With the exception of forestry related activity, industrial activity within the PDA is limited. While there are no NBDNR registered gravel pits or quarries within the LAA, sand and rock quarries were identified by field crews during archaeological walkover activities in 2014 near the communities of Bayfield and Malden and where Woodlot and Burnside Road intersects the RoW (Figure 3.2). Petroworth Resources Inc. has a registered shale gas tenure that overlaps the PDA which is noted as being under review. Recently, the New Brunswick government decreed a moratorium on shale gas development.

Agricultural land within the PDA is limited, with a total of 8.9 ha, or approximately 4% of the PDA, irregularly distributed in patches throughout the PDA. Farming activity within the PDA includes raising livestock and crop production, including fruits and vegetables. Based on aerial photo interpretation and site reconnaissance along the existing RoW, a number of potential agricultural areas were noted within the LAA. This area has been calculated at 312 ha, or approximately 5% of the LAA, with areas concentrated near major watercourses and along the eastern end of Route 16 near Cape Tormentine (Ken Holyoke 2015).

Both the PDA and LAA are within Wildlife Management Zone (WMZ) 25. This zone is open to big game and furbearer recreational hunting as well as fur bearer harvesting. No antlerless deer permits were issued for WMZ 25 in 2014 (NBDNR 2015). Cape Jourimain National Wildlife Area (NWA) borders the Northumberland Straight, 2 km northwest of the village of Cape Tormentine, approximately 1.3 km from the PDA. The NWA provides protection of habitats at the coastal site through wildlife habitat and resource management (Cape Jourimain Nature Centre 2015).

Wildlife harvesting occurs within the LAA with rabbit, coyote, fox, weasel, raccoon, mink, muskrat, otter, beaver, fisher, skunk, and squirrel are among the furbearer species trapped or snared (NBDNR 2014). Detailed information regarding the extent of traplines in the LAA is not available. The New Brunswick Trappers and Fur Harvesters Federation (NBTFHF) provides information and education to trappers and facilitates the management of furbearer resources in the Province. Objectives of the NBTFHF include cooperation with national, provincial and regional public authorities (NBTFHF 2015).

Recreational fishing refers to angling, sport fishing and other non-commercial fishing activity. The Province is divided into eight Recreational Fishing Areas (RFAs). The Project is located in the Southeast

RFA (RFA 4), and the Lower Saint John RFA (RFA 6). Both the Tantramar River and the Gasperau River have the potential for recreational fishing. Limited access to the Tantramar River was noted by aquatic field crews. Access to the Tantramar River in the PDA is limited by wetlands in the riparian zone. There is likely little to no fishing in the area of the River that intersects the PDA. The Gasperau River intersects the PDA, and is noted as having potential for American shad, American eel, brook trout, gaspereau, striped bass and rainbow smelt within 1 km of the crossing. There is likely fishing for American shad and brook trout within the PDA (Matt Steeves, pers. Comm., Stantec 2015, Aquatic Biologist). Walking trails were noted by aquatic field crews adjacent to the watercourse. Presence of Atlantic salmon may occur in each of the watercourses, though currently there is a moratorium on all anadromous Atlantic salmon fisheries in the RFA (GNB 2015). Additionally, there is a bag limit for American shad and brook trout set at five individual fish per day (GNB 2015).

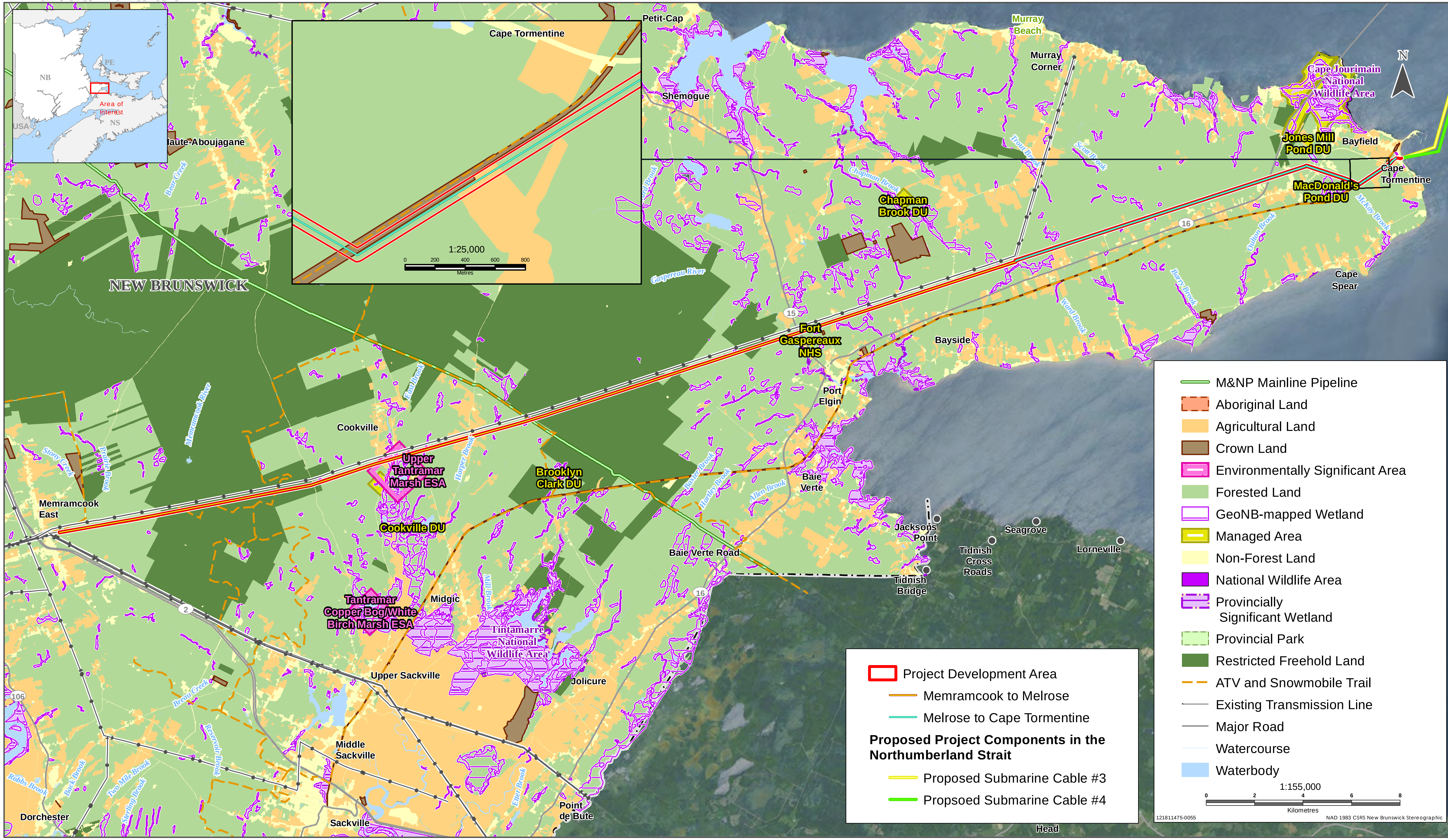
Crown land within the PDA is limited to three properties (Figure 3.3). Three properties designated as crown land are managed by NBDNR and form part of the NB Trail system. Collectively, this area totals approximately 1.6 ha, or less than10% of the total PDA. These three trails form a portion of the TransCanada Trail, an approximately 58 km route that links Sackville with Port Elgin via the original right-of-way of the New Brunswick and PEI Railway and meets the existing transmission line corridor near Cape Tormentine, and travels along the RoW where it ends at the Cape Tormentine lighthouse (Figure 3.3) (NBTC 2015a).

The New Brunswick All-terrain Vehicle Federation (NBATVF) is the designated trail manager for the New Brunswick trail network, which is divided into seven regions (GNB 2011). The RAA is fully contained within Region 5, which includes 14 individual clubs covering trail territory from Miramichi to Saint John. Some of the club trails are known to cross the PDA; however official maps are not available.

The New Brunswick Federation of Snowmobile Clubs (NBFSC) is a non-profit organization that manages the snowmobile trails on behalf of the province (GNB 2009). Club-maintained trails are widespread throughout the RAA. These are maintained by NBFSC. Both officially designated provincial and local NBFSC trails cross the PDA (Figure 3.3). The NBFSC trail network is divided into eight zones and the RAA is located in Zone 8. In addition to the NBFSC network, there are two connector trails, maintained by local clubs which cross the existing transmission line at two locations (Figure 3.3).

An analysis of aerial photography for the area indicates that residential land use is limited in the PDA, and is concentrated in three areas: Memramcook, Bayfield, and Cape Tormentine. There are standalone homes and farms visible from the existing transmission corridor. These properties contain small clusters of four or five buildings, including houses, barns, and other out-buildings.

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_4_land_use\121811475-0055.mxd



Sources: Base Data - Natural Resources (2011).Project Data from Stantec or provided by NB Power / MECL. Imagery - ArcGIS Map Service World Imagery, Natural Resources (2011),

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Stantec

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Land Use Project Development Area

Figure 3.3

3.3.3 Project Interactions with Land Use

Potential Project interactions with Land Use are presented in Table 3.22. Following the table, justification is provided for non-interactions (no check marks).

Table 3.22 Potential Project-Environmental Interactions and Effects on Land Use

Project Components and Physical Activities	Potential Environmental Effects
	Change in Land Use
Construction	
Site Preparation for Land-Based Transmission Lines in New Brunswick	✓
Physical Construction of Land-Based Transmission Lines in New Brunswick	✓
Landfall Construction (New Brunswick)	✓
Upgrading of Electrical Substation (New Brunswick)	✓
Inspection of and Energizing of the Transmission Lines	–
Clean-up and Re-vegetation of the Transmission Corridor	✓
Emissions and Wastes	✓
Transportation	–
Employment and Expenditure	–
Operation	
Energy Transmission	✓
Vegetation Management	✓
Infrastructure and Inspection, Maintenance and Repair (Transmission Lines and Substations)	✓
Access and Road Maintenance	✓
Emissions and Wastes	✓
Transportation	–
Employment and Expenditure	–
Decommissioning and Abandonment	
Decommissioning	✓
Reclamation	✓
Emissions and Wastes	✓
Employment and Expenditure	–

During construction, inspection and energizing of the transmission lines will occur within the cleared RoW. This is a non-invasive activity and the physical presence of inspectors will not interfere with the presence of other land users in the area.

During both construction and operation, the transportation of people and materials is anticipated to be within current traffic norms and as a result will not interfere with land and resource users. Due to the relatively short timeline for construction, employment and expenditures are not expected to interact with land and resource use during construction. During operation, there will be no interaction as a result of the small number of employees. Other Project effects related to the Socioeconomic Environment are assessed in Section 3.4.

3.3.4 Assessment of Residual Environmental Effects on Land Use

3.3.4.1 Analytical Assessment Techniques

Potential Project effects have been identified through a combination of spatial analysis and baseline research into the extent of land use activity in the LAA and RAA. The assessment of potential Project residual effects references, as appropriate, other assessment sections including Sections 2.1.2 (Atmospheric Environment), Section 3.1 (Freshwater Environment), and Section 3.2 (Terrestrial Environment). The analytical methods for these VCs are therefore indirectly applied to the Land Use assessment.

3.3.4.2 Assessment of Change in Land Use

3.3.4.2.1 Project Pathways for Land Use

Approximately 70% of the PDA consists of forested lands, including actively managed private woodlots within the PDA. The PDA also includes agricultural lands and, based on aerial photo interpretation, farmed properties have been identified within the LAA. However, only 4% of the PDA has been classified as agricultural land by Service New Brunswick (SNB 2015). Both woodlots and agricultural properties within the PDA will experience disturbance as a result of site preparation, physical construction of the transmission lines and landfall construction. These activities include vegetation clearing and grubbing that will result in the alteration of lands within the PDA during the construction phase. This disturbance will include harvesting of merchantable timber where required. This disturbance will continue throughout operation as a result of vegetation management activities, which will include regular cutting.

There are a number of trails that intersect the PDA, including portions of TransCanada Trail and individual club trails managed by the NBATVF and NBFSC. These trails are used for a variety of activities, including walking, cycling, and snowmobiling (NBTC 2015b). Outside of established trails, transmission corridors are frequently used as informal trails for a variety of recreational activities, including use of recreational vehicles, cross country skiing and snowshoeing. Site preparation and construction activities noted above will result in temporary access restrictions to trail segments that intersect the PDA. However, maintenance activities during operations will result in increased access throughout the RoW, which can provide additional opportunities for a wide variety of recreational activities including trail use. While not officially permitted by NB Power, it is acknowledged that power transmission RoWs are widely used for a variety of recreational activities by people at their own risk. The RoW also has the potential to improve access to areas used for consumptive recreation (i.e. hunting, fishing, and trapping). The maintenance of roads and access associated with the Project will also provide additional and/or improved access throughout operation.

Site preparation and other construction activities are expected to result in a permanent loss of 0.06 ha of vegetation communities and wildlife habitat, and change/disturbance to a minimum of 190.5 ha of vegetation communities and wildlife habitat. This change/disturbance has the potential to reduce opportunities for trapping in the area and the availability of resources. During operations vegetation management will continue to affect trapping activity as a result of continued habitat disturbance.

Within WMZ 25, big game hunting has been identified as a popular activity and the loss of habitat has the potential to affect target big game species. However, following construction, the presence of the transmission line may provide additional opportunities to access big game hunting areas due to the use of the cleared area by both big game and hunters.

In addition to the disturbance and access restrictions noted above, the Project will result in temporary noise disturbances within the PDA that have the potential to affect the presence of wildlife in the area. Throughout both construction and operations, atmospheric emissions were found to be transient and short term and no adverse effects on users or wildlife were identified. Construction will be limited to daytime hours, if possible, to reduce disturbance and annoyance to the nearest residences.

3.3.4.2.2 Mitigation for Land Use

Interaction with tenured land use will be managed through the use of standard mitigation measures. These measures are described below:

- owners of private land will be consulted and accommodated prior to construction
- if available, local tree harvesters will be used for vegetation clearing, where possible
- all cleared merchantable timber will become the property of the contractor and any remaining vegetation will be stockpiled and/or chipped on site
- access restrictions will be defined in advanced and access restrictions will be limited in size to reduce the interactions with land and resource users
- in order to reduce disturbance, sites requiring little or no modification, such as forestry landings or harvested fields, will be used for temporary staging areas
- activities will be managed by MECL and NB Power in accordance with each company's EPPs and the HSE policies

3.3.4.2.3 Residual Project Environmental Effect for Land Use

Construction will result in the loss of 0.6 ha of lands available for forestry or agricultural activities, with change or disturbance affecting 190.5 ha lands. This area subject to disturbance represents 0.03% of the LAA. However, both disturbance and loss will be mitigated through the measures described in Section 3.3.4.2.

Access restrictions resulting from construction activities will result in short term restrictions to portions of the PDA. These will be limited in extent as a result of Project scheduling. Communication with users regarding access restrictions will allow users to plan activities in advance and reduce the magnitude of lost opportunities. In the long term, the presence of the Project will result in increased access. This is a positive effect on trails in the PDA and LAA, possibly also including increased opportunities for consumptive land use activities (i.e. hunting, fishing and trapping).

Both hunting and trapping have been identified as occurring in the area. However, both the potential loss/disturbance of habitat cannot be quantified at this time and the effect on specific traplines is not known. This will be managed through consultation and engagement; as a result of the lack of information, a conservative approach to characterization has been taken.

As a result of the nature of the Project pathways and the mitigation measures defined in Section 3.3.3, the residual effects on land use are anticipated to be positive and adverse, moderate in magnitude, limited to the PDA, and reversible.

3.3.4.3 Summary of Residual Project Environmental Effects

The residual Project environmental effects for Land Use are summarized in Table 3.23.

Table 3.23 Summary of Project Residual Environmental Effects on Land Use

Residual Effect	Residual Environmental Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socioeconomic Context
Change in Land Use	C/O	A/P	M	PDA	ST/P	C	R	D

KEY
See Table 3.21 for detailed definitions.

Project Phase:
C: Construction
O: Operation
D: Decommissioning and Abandonment

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

NA: Not applicable

Frequency:
S: occurs only once
MIR: Multiple irregular event
MR: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socioeconomic Context:
D: Disturbed
U: Undisturbed

3.3.5 Determination of Significance

3.3.5.1 Significance of Residual Project Effects

Based on the predicted characterization of mitigation measures and residual effects described above, it is anticipated that Project activities will not cause a disruption, wide restriction, or degradation of use to a point where it cannot continue at current levels. Therefore, the residual effects on Land Use are predicted to be not significant.

3.3.6 Prediction Confidence

The level of confidence in the predictions for project-related residual effects on Land Use is high, based upon the understanding of current baseline conditions, the level and nature of the described interaction, and the known effectiveness of mitigation measures.

3.3.7 Follow-up and Monitoring

Follow-up and monitoring programs are not considered necessary for this assessment.

3.4 ASSESSMENT OF POTENTIAL EFFECTS ON SOCIOECONOMIC ENVIRONMENT

Socioeconomic Environment is selected as a VC because of potential interactions between the Project and the local, regional, and provincial economies, accommodations and public services. Project employment and purchases of goods and services from local and regional businesses in New Brunswick (NB) will provide new employment and sources of income for residents and businesses. Interactions between the Project and local, regional, and provincial economies could also have negative consequences in terms of potential for wage inflation, labour shortages, increased demand for accommodations and increased demand for public services (unaccounted for through current municipal planning).

3.4.1 Scope of Assessment

3.4.1.1 Regulatory and Policy Setting

Pursuant to Schedule A of the NB EIA Regulation—*Clean Environment Act* the Project is considered an 'undertaking' and therefore requires registration under the EIA Regulation. Outlined in 'A Guide to Environmental Impact Assessment in New Brunswick' the registration document must consider socioeconomic effects which could result from the Project such as changes in housing availability, income levels, employment opportunities, municipal income, and municipal expenditures, among others (A Guide to Environmental Assessment in New Brunswick 2012).

3.4.1.2 The Influence of Consultation and Engagement on the Assessment

Issues related to the Socioeconomic Environment identified during consultation and engagements activities have been related to employment opportunities for local First Nations.

3.4.1.3 Potential Environmental Effects, Pathways and Measurable Parameters

Potential effects on the Socioeconomic Environment associated with the Project derive from changes in demand for labour (includes consideration of wage inflation and population growth) and Project expenditures on goods and services. Project demands for labour and goods and services can result in both beneficial and adverse effects. The distribution of beneficial effects may not be evenly distributed among populations with some residents in a better position to receive economic benefits than others. Similarly, adverse effects may affect some residents more than others.

Potential environmental effects, effect pathways and measurable parameter(s) and units of measurement are provided in Table 3.24.

Table 3.24 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Socioeconomic Environment

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Employment and Economy	• Project associated demand for labour (direct, indirect, and induced) and goods and services will create employment and business within the LAA and RAA and will generate revenue for governments. • The Project will contribute to GDP in NB and Canada. • The Project will contribute to municipal and provincial government revenue through increased tax revenue.	• Direct employment. • Project expenditures on goods and services.
Change in Accommodations	• The non-resident construction workforce will be housed in short-term accommodations in NB potentially affecting the availability of accommodations (Project camps will not be constructed). • Project-related demographic changes have the potential to affect demand for accommodations throughout the life of the Project.	• Availability of accommodations (vacancy rates, inventory levels).
Change in Public Services	• The Project workforce has the potential to increase demand for public services (emergency and protective services, health care infrastructure and services and community and municipal services).	• Demand and supply of public services (police, fire, paramedic services, hospitals).

3.4.1.4 Boundaries

3.4.1.4.1 Spatial Boundaries

The spatial boundaries for the environmental effects assessment of the Scocioeconomic Environment are defined below.

- Project Development Area (PDA): The PDA comprises the immediate area of physical disturbance associated with the construction and operation of the Project. The PDA includes: the existing substation in Memramcook where upgrades to the existing substation will occur within the substation footprint; a 40 km long, 30 m wide transmission line RoW from Memramcook to Melrose and a 17 km long, 60 m wide transmission line RoW from Melrose to Cape Tormentine; a cable termination site; and a 10 m easement around cable lines encompasses the Project footprint.

- Local Assessment Area (LAA): The LAA encompasses the communities that will potentially experience effects related to Project requirements for labour, goods, and services (see Figure 3.4). The LAA encompasses the PDA and, the Parish of Botsford, the Village of Port Elgin, the Parish of Westmorland, the Village of Cap-Pele, the Rural Community of Beaubassin East, the Parish of Sackville, the Town of Sackville, the Town/Ville of Shediac, and the urban and rural communities comprising the Moncton Census Metropolitan Area (CMA).
- Regional Assessment Area (RAA): The RAA encompasses an area that both establishes context for the determination of the significance of Project effects as well as encompasses an area from which interactions between the Project and past, present, and reasonably foreseeable projects (cumulative effects) could occur (see Figure 3.4). The RAA includes the urban and rural communities comprising the Albert Census Division and the Westmorland Census Division.

3.4.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of the Project on socioeconomic include construction, operation, and decommissioning and abandonment. Construction in the terrestrial environment is expected to occur over a period of 16 months. Construction of the landfall site and transmission line from Melrose to Cape Tormentine is expected to be completed over 9 to 10 months, between March and December 2016. Construction of transmission line between Melrose and Memramcook is expected to begin in September 2016 with completion expected to take place in June 2017. Operation will begin following construction and is anticipated to continue for the life of the Project (approximately 40 years). Decommissioning and abandonment would take place following the useful service life of the Project and which would be carried out in accordance with regulations in place at that time.

3.4.1.5 Residual Environmental Effects Description Criteria

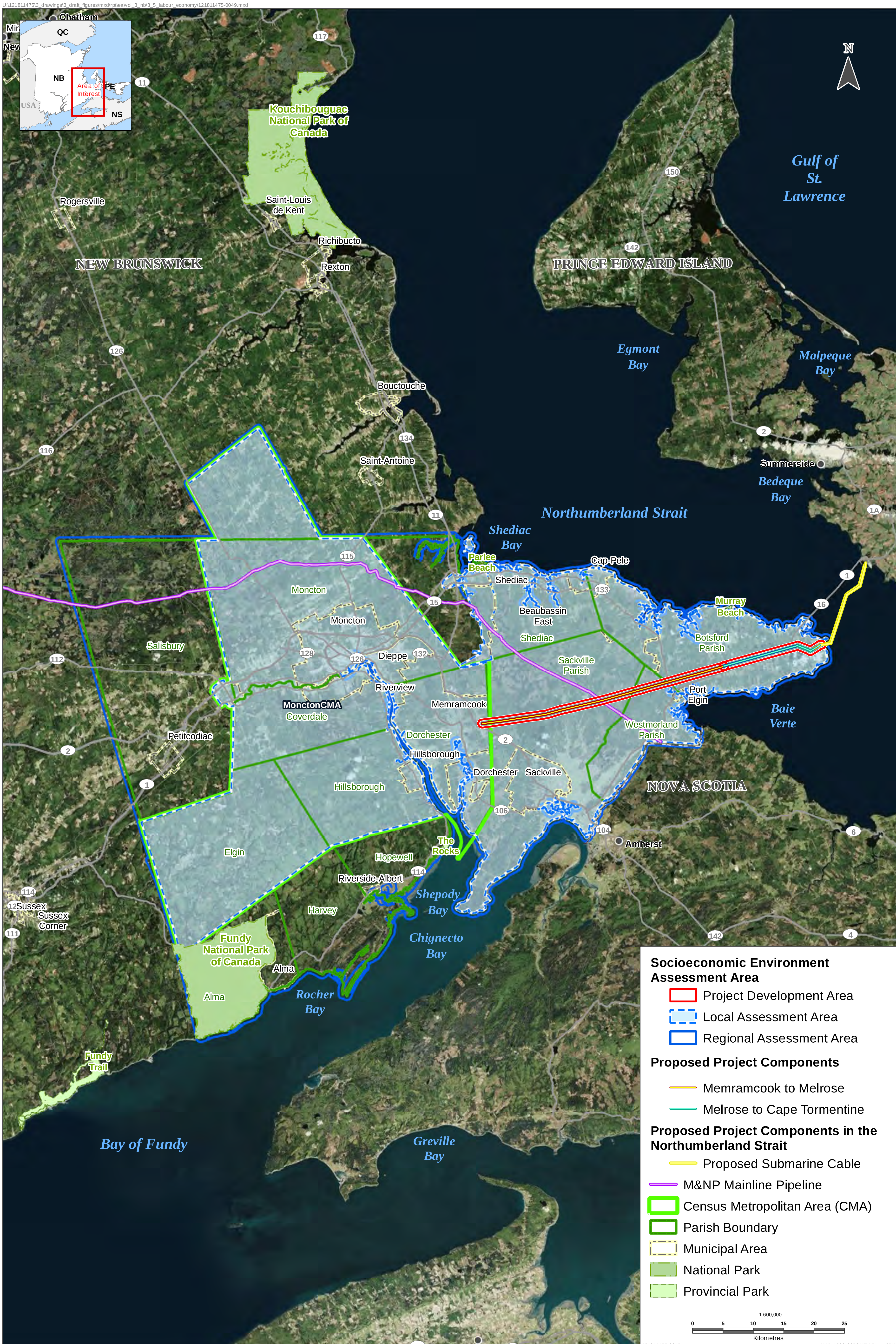
Table 3.25 Characterization of Residual Effects on Socioeconomic Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive**—an effect that moves measurable parameters in a direction beneficial to economic conditions relative to baseline. **Adverse**—an effect that moves measurable parameters in a direction detrimental to economic conditions relative to baseline. **Neutral**—no net change in measureable parameters for the economic conditions relative to baseline.

Table 3.25 Characterization of Residual Effects on Socioeconomic Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible**—no detectable effects. **Low**—a measurable change but within the normal range of variability; cannot be distinguished from baseline conditions **Moderate**—measurable change but unlikely to pose a serious risk or benefit to the VC or to represent a management challenge. **High**—measurable change that is likely to pose a serious risk to the selected VC and, if negative, represents a management challenge.
Geographic Extent	The geographic area in which an environmental, effect occurs	**PDA**—residual effects are restricted to the PDA. **LAA**—residual effects extend into the LAA. **RAA**—residual effects interact with those of other projects in the RAA.
Frequency	Identifies when the residual effect occurs and how often during the Project or in a specific phase	**Single event** – occurs once. **Multiple irregular event**—occurs sporadically at irregular intervals throughout construction, operations or decommissioning and abandonment phases. **Multiple regular event**—occurs on a regular basis and at regular intervals throughout construction, operations, or decommissioning and abandonment phases. **Continuous**— occurs continuously throughout the life of the Project.
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the effect can no longer be measured or otherwise perceived	**Short-term**—residual effect restricted to the duration of the construction period or less. **Medium-term**—residual effect extends through the construction period but less than the life of the Project. **Long-term**—residual effect extends beyond the life of the Project.
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the Project activity ceases	**Reversible**—the effect is likely to be reversed after activity completion and reclamation. **Irreversible**—the effect is unlikely to be reversed.
Socioeconomic Context	Existing condition and trends in the area where environmental effects occur	**Low Socioeconomic Resiliency**—Sparsely populated region with relatively few service centres. **Medium Socioeconomic Resiliency**—A mix of sparsely populated areas along with more populated, urban centres. **High Socioeconomic Resiliency**—Densely populated area with several urban centres.

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_5_labour_economy\121811475-0049.mxd



Sources: GeoNB, NB Power, SNB, NBDNR Imagery: ESRI World

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

Socioeconomic Environment Assessment Area Boundaries

Stantec

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Figure 3.4

3.4.1.6 Significance Definition

There are no defined thresholds for assessing the significance of residual effects on the Socioeconomic Environment. The context for assessing residual effects is whether Project-related changes are consistent with reasonably expected changes in future economic conditions that are anticipated or planned for by municipal, regional, and provincial governments; Aboriginal groups; private businesses; or households; and, if not, the extent to which they will be able to cope with adverse effects associated with the Project.

The following criteria are used to determine significance thresholds for residual effects on economic conditions:

- A significant residual effect is one that is adverse, of high magnitude, is distinguishable from normal variability, and cannot be managed with current or anticipated plans, programs, policies, or mitigation measures.

3.4.2 Existing Socioeconomic Environment

This section describes existing socioeconomic conditions within the assessment areas.

3.4.2.1 Methods

Information on baseline conditions was primarily obtained from statistical data sources and published reports. Principal sources of statistical information included Statistics Canada (Census 2006, Census 2011 and National Household Survey 2011) and the NB Department of Finance. Additional and more recent baseline information was collected from the review of community and regional reports from government agencies, community profiles produced by municipalities, community and regional websites, and socioeconomic community profiles.

3.4.2.2 Overview

3.4.2.2.1 Demographics

Total Population

The 2011 Census (Statistics Canada 2011) reported a total population of 751,171 for the Province of NB. This represents a growth of 2.9% from the numbers recorded in the 2006 census. This is below the national average growth of 5.9% over the same period (Statistics Canada 2013a; 2013d; 2007a). Of the total population of NB, 51.0% were female and 49.0% were male.

Table 3.26 shows the 2011 data for the population by gender for the province and for the LAA and RAA. Table 3.26 shows the population change for the province, LAA and RAA, from 2006 to 2011.

Table 3.26 Population by Gender, RAA and LAA

Location	Total Population	Female*	Male*
Provincial Total	751,171	384,735	366,440
Total RAA	173,003	88,855	84,150
Total LAA	167,420	85,965	81,460

Notes:
* Numbers are rounded by Statistics Canada and are reported herein exactly as they are reported by Statistics Canada. Totals may not necessarily add up as a result of rounding.
Source: Statistics Canada 2012a; 2013a

Table 3.27 Population Data (percent change 2006-2011)

Location	Population 2011*	Population 2006*	Percent Change*
Provincial Total	751,171	729,997	2.9
Total RAA	173,003	160,411	7.8
Total LAA	167,420	154,628	8.3

Notes:
* Numbers are rounded by Statistics Canada and are reported herein exactly as they are reported by Statistics Canada. Totals may not necessarily add up as a result of rounding.
Source: Statistics Canada 2012a; 2013a

Population Distribution

The population in NB continues to age, following a similar trend to that experienced between 2001 and 2006. Between 2006 and 2011, the median age of the population increased by 2.2 years, from 41.5 to 43.7 (Statistics Canada 2013a; 2007a). Females outnumber males in NB in all age groups above 20 years (Figure 3.5).

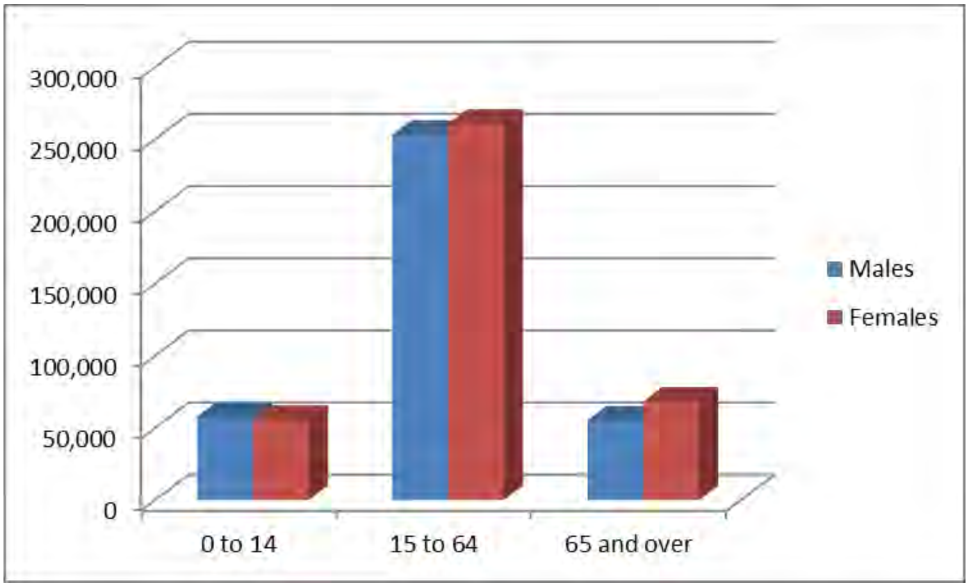


Figure 3.5 Population Data 2011 (males, females)

In 2011, approximately 23% of the provincial population lived within the RAA (Albert and Westmorland Counties). The population of the RAA rose from 160,411 in 2006 to 173,003 in 2011; this represents a change of 7.8%, while the provincial population only grew by 2.9% over the same time frame (Statistics Canada 2013a; 2013b; 2013c). The Population projections for Canada, Provinces and Territories predict that these trends will continue from 2010-2036, with the median age of the population increasing steadily (Statistics Canada 2012b).

Aboriginal Population

As of 2011, about 3.0% of people (22,620 individuals) living in NB identified themselves as being of Aboriginal decent. Aboriginal population data for the LAA and RAA are presented in Table 3.28.

Table 3.28 Aboriginal Population

Location	Aboriginal*
Provincial Total	22,620
Westmorland County	2,650
Botsford Parish	-
Port Elgin	-
Westmorland Parish	-
Cap-Pelé	-
Beaubassin East	205
Town of Sackville	45
Sackville Parish	-
Town of Shediac	70

Table 3.28 Aboriginal Population

Location	Aboriginal*
Shediac Parish	10
Moncton	2,435
Albert County	345

Notes:
* Numbers are rounded by Statistics Canada and are reported herein exactly as they are reported by Statistics Canada. Totals may not necessarily add up as a result of rounding.
- Data not available
Source: Statistics Canada 2013

The Aboriginal communities located closest to the Project are all Mi'kmaq First Nations; there are nine Mi'kmaq First Nations communities in NB:

- Mi'kmaq Nation at Eel River Bar
- Mi'kmaq Nation at Pabineau
- Mi'kmaq Nation at Esgenoopetitj
- Mi'kmaq Nation at Metepenagiag
- Mi'kmaq Nation at Eel Ground
- Mi'kmaq Nation at Indian Island
- Mi'kmaq Nation at Elsipogtog
- Mi'kmaq Nation at Bouctouche
- Mi'kmaq Nation at Fort Folly

The only Aboriginal community located within the RAA is Fort Folly in Westmorland County. It lies about 40 km east of Moncton and has a registered population of 106 (Aboriginal Affairs and Northern Development Canada 2014; Fort Folly First Nations 2014).

3.4.2.2.2 Economy

NB has consistently seen an increase in its GDP from 2004 to 2013; with a 14.0% increase from 2006 to 2010 (Table 3.29). However, GDP has since slowed having grown only 0.8% compared to 4.0% in 2011 and 4.4% in 2010. The year 2013 followed the same trend, with GDP only increasing by 0.5%. This fell short of the Canadian economic growth rate of 3.3% for the same year (NBDF 2014). GDP grew 1.9% in 2014, indicating improvement from the previous year (NBDF 2015a).

Traditionally the NB economy been based on natural resource development, and it centers on its energy, natural resources and manufacturing industries. Tourism and communication technology industries also make substantial contributions to the provincial economy. Although forests occupy 85.0% of the province's land (equivalent to 6.1 million hectares) and have supported an important economic sector for NB, the forestry sector has recently become less of an economic driver within the province due to a decreasing contribution to employment. This decline has occurred over the past decade with the closure of several lumber and pulp and paper mills throughout the province. Within the RAA, employment in the forestry industry is limited; however, it has become a regional centre from which support services such as transportation and distribution are located.

Table 3.29 Gross Domestic Product 2004-2013

Economic Indicator	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Gross Domestic Product (millions of Canadian dollars)	24,116	25,272	26,378	27,869	28,422	28,825	30,082	31,409	31,751	31,900
Source: Statistics Canada 2014										

The Province's major employment sectors are:

- Mining, energy, oil and gas
- Commercial fisheries and aquaculture
- Forestry
- Agriculture
- Tourism
- Military

3.4.2.2.3 Labour and Employment, Income, and Education

Labour and Employment

In 2011, NB had a total labour force of 395,420 persons; 24.6% or 97,300 within the RAA (Table 3.30). The participation rate in the province (*i.e.*, the percentage of the working-age population employed or actively seeking employment) was 63.5%, a slight decrease from 63.7% in 2006. The RAA had a participation rate of 68.1%, a slight increase from 67.5% in 2006 (Statistics Canada 2013a; 2007a).

Table 3.30 Labour Force Data (2011)

Location	Total Population 15 years and Over	Labour Force	Employed	Participation Rate (%)	Employment Rate (%)	Unemployment Rate (%)
Provincial Total	622,435	395,425	351,935	63.5	56.5	11.0
LAA Total	N/A	N/A	N/A	N/A	N/A	N/A
RAA Total	142,910	97,300	89,145	68.1	62.4	8.4

Notes:

Numbers are rounded by Statistics Canada and are reported herein exactly as they are reported by Statistics Canada. Totals may not necessarily add up as a result of rounding.

N/A - not available due to limited publically available data specific to communities within the LAA.

Source: Statistics Canada 2013a, 2013b, 2013c

From 2006 to 2011, the number of persons employed in NB increased by 14.7% from 344,770 to 395,425, while the number of persons employed in the RAA increased by 8.0% from 82,540 to 89,145. In 2011 the employment rate for the RAA was 62.4%, 56.5% for the province, and 60.9 for Canada (Statistics Canada 2013a; 2013d; 2007a).

NB's unemployment rate increased from 10.0% in 2006 to 11.0% in 2011; within the RAA from 7.5% to 8.4%. These rates are higher than the national averages of 6.6% in 2006 and of 7.8% in 2011 (Statistics Canada 2013a; 2007a; and 2013d). Moncton-Richibucto (the most populated area within the RAA) posted the highest employment growth of any region in the province in 2014. The Moncton-Richibucto region saw a gain of 3,100 jobs in 2014 and the unemployment rate dropped to 7.8%, the lowest in the province (NBDF 2015a).

Table 3.31 provides information on employment by sector for NB as of 2011. In 2011, the largest employers in the province included the Irving Group of Companies, the McCain Group, NB Public Service, NB Power, and the Horizon Health Network (Martell Homebuilders, 2011). For the province, in 2011 49,660 persons of a total 395,420 (12.6%) were employed in the health care and social assistance industry (North American Industry Classification System [NAICS]). The second highest industry was retail trade (46,285, or 11.7%), followed by manufacturing (33,325 or 8.4%).

Table 3.31 Employment - Industries (2011)

	NB		RAA	
	Number of Persons	**Percent Employed in the Province (%)**	**Number of persons**	**Percent Employed within the RAA (%)**
Total labour force population aged 15 years and over by industry	395,420	100.0	97,300	100.0
Industry - not applicable	6,350	1.6	1,090	1.1
All industries	389,070	98.4	96,210	98.9
Agriculture, Forestry, Fishing and Hunting	15,480	3.9	1,335	1.4
Mining, Quarrying, and Oil and Gas Extraction	4,860	1.2	830	0.9
Utilities	4,005	1.0	200	0.2
Construction	29,340	7.4	6,180	6.4
Manufacturing	33,325	8.4	7,230	7.4
Wholesale Trade	12,230	3.1	4,560	4.7
Retail Trade	46,285	11.7	12,020	12.4
Transportation and Warehousing	19,240	4.9	6,080	6.2

Table 3.31 Employment - Industries (2011)

	NB		RAA	
	Number of Persons	**Percent Employed in the Province (%)**	**Number of persons**	**Percent Employed within the RAA (%)**
Information and Cultural Industries	7,475	1.9	2,520	2.6
Finance and Insurance	13,065	3.3	5,135	5.3
Real estate and Rental and Leasing	4,200	1.1	1,170	1.2
Professional, Scientific and Technical Services	16,205	4.1	4,170	4.3
Management of Companies and Enterprises	250	0.1	75	0.1
Administrative and Support, Waste Management and Remediation Services	19,025	4.8	5,755	5.9
Educational Services	27,045	6.8	6,485	6.7
Health Care and Social Assistance	49,660	12.6	11,855	12.2
Arts, Entertainment and Recreation	6,170	1.6	2,045	2.1
Accommodation and Food Services	23,805	6.0	6,490	6.7
Other Services (except public administration)	17,895	4.5	3,945	4.1
Public Administration	39,515	10.0	8,125	8.4

Notes:
Numbers are rounded by Statistics Canada and are reported herein exactly as they are reported by Statistics Canada. Totals may not necessarily add up as a result of rounding.
Source: Statistics Canada 2013a

The labour force of NB is concentrated in three major occupations: sales and service (24.3%), trades and transport (16.6%), and business finance and administration (14.3%) as classified by the National Occupational Classification (NOC) system (Table 3.32).

Table 3.32 Employment - Occupations (2011)

	RAA		NB	
	Number of Persons	**Percentage employed in the RAA (%)**	**Number of Persons**	**Percentage employed in NB (%)**
Total labour force population aged 15 years and over by occupation	97,295	100.0	395,425	100.0
Occupation - Not Applicable	1,090	1.1	6,350	1.6
All occupations	96,210	98.9	389,075	98.4
Management Occupations	9,720	10.0	35,930	9.1
Business, Finance and Administration Occupations	15,570	16.0	55,670	14.1
Natural and Applied Sciences and Related Occupations	5,765	5.9	21,290	5.4
Health Occupations	7,110	7.3	28,720	7.3
Occupations in Education, Law and Social, Community and Government Services	11,200	11.5	48,780	12.3
Occupations in Art, Culture, Recreation and Sport	2,190	2.3	7,285	1.8
Sales and Service Occupations	26,100	26.8	94,655	23.9
Trades, Transport and Equipment Operators and Related Occupations	13,465	13.8	64,555	16.3
Natural Resources, Agriculture and Related Production Occupations	1,575	1.6	13,660	3.5
Occupations in Manufacturing and Utilities	3,510	3.6	18,520	4.7

Notes:
Numbers are rounded by Statistics Canada and are reported herein exactly as they are reported by Statistics Canada. Totals may not necessarily add up as a result of rounding.
Source: Statistics Canada 2013a

Income

In 2010, the median income for all census families in NB was $65,384, while the median income for all persons aged 15 and older was $26,582 (Table 3.33). Within the RAA, Albert County had a higher median income for both census families and for individuals aged 15 and older compared to Westmorland County. Throughout the RAA, where information was available, males had a higher median income than females.

Table 3.33 Median Income (2010)

Location	Median Income - All Census Families*	Median Income - Persons 15 Years and Over	Male	Female
Provincial Total	65,384	26,582	32,859	21,649
Westmorland County	68,967	28,778	34,268	23,973
Botsford Parish	-	-	-	-
Port Elgin	-	-	-	-
Westmorland Parish	-	-	-	-
Cap-Pelé	-	-	-	-
Beaubassin East	72,395	29,031	35,479	22,076
Town of Sackville	66,597	26,842	33,482	20,815
Sackville Parish	-	-	-	-
Town of Shediac	66,838	28,396	34,353	23,238
Shediac Parish	72,705	30,960	37,673	26,912
Moncton	71,290	29,720	35,017	25,105
Albert County	72,731	30,403	36,222	25,398

Notes:

Numbers are rounded by Statistics Canada and are reported herein exactly as they are reported by Statistics Canada. Totals may not necessarily add up as a result of rounding.

* Data for median income was collected in 2010.

\- Data not available.

Source: Statistics Canada 2013a

Education

In 2011, 24.9% of NB's population had not completed their high school education, with males making up 51.0% of that total. Within the RAA 20.4% had not completed their high school education, with males making up about 50.8%. This was higher than the Canadian national average of 20.1% and second only to Newfoundland and Labrador (28.0%) for highest in the Atlantic Canadian provinces. Out of NB's working population (those aged 25-64), 56.6% had received some type of post-secondary education or training (61.3% in the RAA), while 18.8% had obtained a university diploma or degree at the bachelor level or higher (22.2% in the RAA).

Within the RAA there are five post-secondary educational institutions: Université de Moncton, Crandall University, Mount Allison University, NB Community College, Collège Communautaire du Nouveau-Brunswick - Dieppe. This allows the RAA to be one of the major providers of post-secondary education in the province, and provides post-secondary educational opportunities to both the Westmorland and Albert Counties (City of Moncton 2014). As a result, 62.0% of Westmorland County's working population had some form of post-secondary education or training, while Albert County had 60.0% with post-secondary education. Both of these totals were above the provincial average (Statistics Canada 2013b; Statistics Canada 2013c).

3.4.2.2.4 Housing

Private Dwellings (Owner-Occupied and Tenant-Occupied)

In 2011, there were 314,035 occupied private dwellings within the province of NB, 72,615 of which were in the RAA. Of the 314,035 occupied private dwellings in NB, 75.7% were owned, 23.8% were rented, and 0.6% were Band owned. Within the RAA, 73.0% of occupied private dwellings were owned, 27.1% were rented, and 0.01% were Band owned.

Housing stock within the RAA is generally of newer construction than the provincial average. In 2011, 13.8% (43,325) of occupied private dwellings were constructed between 2001-2011 (10 years old or newer), 28.1% (88,180) between 1981 and 2000 (11 to 30 years old), 31.4% (98,750) between 1961 and 1980 (31 to 50 years old), and 26.7% (83,775) on or before 1960 (50 years old or greater). Within the RAA, 21.5% (15,615) were constructed between 2001-2011 (10 years old or newer), 28.0% (20,335) between 1981 and 2000 (11 to 30 years old), 27.7% (20,125) between 1961 and 1980 (31 to 50 years old), and 22.8% (16,545) on or before 1960 (50 years old or greater). Condominiums represent a small percentage of occupied private dwellings within NB and the RAA respectively representing 2.9% and 4.2% of the total housing stock. Overall housing in NB and the RAA only require regular maintenance or minor repairs with only 9.8% requiring major repairs within NB and 7.3% in the RAA.

In 2011, 19.0% of households (58,430 of 309,160) spent more than 30% of total household income on shelter costs with 3.3% having spent more than 100% of total household income on shelter costs.

According to the CMHC 2015 Spring Rental Market Survey, the overall vacancy rate for NB's urban centres was 8.0%. This is a decrease from 9.1% in 2014. Of the province's three largest regional centres (Moncton, Saint John, and Fredericton), Moncton has the highest vacancy rate at 8.8%. Between 2010 and 2013, there was a high level of rental market activity in Moncton that resulted from demand generated by significant net migration gains in the local market.

The inventory of available homes is currently at high levels in NB's large urban centres. This trend which is expected to remain due to weaker demand will impact price growth over the forecast period. The MLS average price is expected to move down moderately in 2015 with prices within a range of $153,000 to $167,400. With the possibility of slower sales growth and higher inventory levels in 2016 prices are expected to range from $148,000 to $172,000 (CMHC 2015a). In 2013, The Moncton CMA had an average home price $166,476, making it one of the most affordable housing markets in Canada (City of Moncton 2014).

Temporary Accommodations

In 2013, 1.6 million room nights were sold in NB, a 3.0% decline compared to 2012. The number of room nights available in the province also declined by 5.0% between 2012 and 2013, resulting in an increase of 1.0% in the provincial accommodation occupancy rate (Government of New Brunswick 2014).

The occupancy rate throughout NB was relatively stable from 2011-2013, staying at 50.0% between 2011 and 2012, increasing to 51.0% in 2013 due to the decrease in total rooms available in the province. While the occupancy rate has remained stable during this time frame, there has been a consistent decline in room nights sold, room nights available, and in the average daily rate (Government of New Brunswick 2014). The occupancy rate increased in the southeastern region of NB (where the RAA is located), from 36.0% in 2012 to 42% in 2013 (Government of New Brunswick 2014).

3.4.2.2.5 Public Services

Emergency and Protective Services

Police

The NB RCMP, or "J" Division, is comprised of a variety of professional employees specifically trained to address policing needs in NB communities. In 2013, it employed 898 regular members, 86 civilian members, and had 156.5 public service employee positions (NB Department of Public Safety 2013). “J” Division operates out of 12 district offices, 57 satellite offices, and seven federal offices. Its provincial headquarters are located in Fredericton. Based on a regional policing model, each district consists of several detachments located within a specified geographic region of the province. There are 11 RCMP districts, or regional police forces, in NB. The Codiac Regional RCMP headquarters is in Moncton has 145 regular members, 24 emergency dispatchers and 25 municipal support staff. It polices Dieppe, Moncton and Riverview and service is provided on a contract basis between the communities and the RCMP. The Codiac Regional RCMP is the primary police force within the RAA with support from rural RCMP detachments.

Fire

Fire protection services within the RAA are primarily supported through the City of Moncton’s Fire Department, the City of Dieppe’s Fire Department, the Town of Riverview’s Fire and Rescue Department, the Village of Memramcook’s Fire Department, the Town of Shediac’s Fire Brigade, the Town of Sackville’s Fire Brigade and local volunteer firefighting brigades throughout more rural areas of the RAA. The largest fire department is that of the City of Moncton’s.

The City of Moncton has five fire stations which are located to allow firefighters to arrive at the scene of an emergency as quickly as possible. The department consists of 120 members as well as 40 volunteer firefighters who are on call 24 hours a day (Moncton Industrial Development 2014).

Sackville's fire department has 42 volunteer firefighters and maintains a fleet of modern vehicles.

Health Care

There are two major regional hospitals in the RAA: the Moncton Hospital and the Dr. Georges-L.-Dumont University Hospital Centre. The Moncton Hospital has 381 beds and is the major referral hospital serving communities throughout NB, PEI and northern Nova Scotia (NS). It is part of a large network of hospitals, health centres, services and programs under the direction of the regional health authority Horizon Health Network, which provides health services to the southern, central, and eastern regions of NB (Moncton Industrial Development 2014). The Dr. Georges-L.-Dumont University Hospital Centre, which falls under the regional health authority Vitalité Health Network, offers ambulatory and elevated secondary and primary care, has 302 beds, employs about 180 physicians, 2,000 employees and has a volunteer base of 315.

The Vitalité Health Network, the only francophone regional health authority in the country, provides health care and services to residents residing in northern and southeastern NB. The southeastern coverage area overlaps with services offered by Horizon Health and includes communities within the RAA. Two hospitals, two health centres, one veterans' unit, two community mental health centres, four public health offices, and two extra-mural program offices under the Vitalité Health Network fall within the RAA.

3.4.3 Project Interactions with Socioeconomic Environment

Table 3.3 identifies Project/VC interactions for each potential effect. These interactions are indicated by check marks, and are discussed in detail in Section 3.4.4 in the context of effects pathways, standard and Project-specific mitigation/enhancement, and residual effects. A justification is also provided for non-interactions (no check marks).

Table 3.34 Potential Project-Environment Interactions and Effects on Socioeconomic Environment

Project Components and Physical Activities	Potential Environmental Effects		
	Change in Employment and Economy	Change in Accommodations	Change in Public Services
Land-Based Infrastructure – New Brunswick and PEI			
Construction			
Landfall Construction	–	–	–
Expansion of Electrical Substation	–	–	–
Emissions and Wastes	–	–	–
Transportation	–	–	–
Employment and Expenditure*	✓	✓	✓
Operation			
Energy Transmission	–	–	–
Vegetation Management	–	–	–
Infrastructure Inspection, Maintenance and Repair (Transmission Lines and Substations)	–	–	–
Emissions and Wastes	–	–	–
Transportation	–	–	–
Employment and Expenditure*	✓	✓	✓

Table 3.34 Potential Project-Environment Interactions and Effects on Socioeconomic Environment

Project Components and Physical Activities	Potential Environmental Effects		
	Change in Employment and Economy	Change in Accommodations	Change in Public Services
Decommissioning and Abandonment			
Decommissioning	NA	NA	NA
Reclamation	NA	NA	NA
Emissions and Wastes	NA	NA	NA
Employment and Expenditure*	NA	NA	NA

Notes:
✓ = Potential interactions that might cause an effect.
– = Interactions between the Project and the VC are not expected.
NA = Not applicable
* = All Project activities requiring the presence of workers and/or expenditures.

While all of the Project activities for each Project phase will have labour requirements that could affect the Socioeconomic Environment, it is not possible to isolate the effects of individual activities and so these effects are addressed cumulatively as part of an "employment and expenditure" activity.

The Project has the potential to result in effects on the Socioeconomic Environment through the expenditures on supplies and services and the employment that are involved in all of the Project activities and works. These effects are addressed further in the following sections.

During Project decommissioning and abandonment, the scale of employment will be smaller and of shorter duration than construction and operation; therefore further assessment for this phase is not considered necessary.

3.4.4 Assessment of Residual Environmental Effects on Socioeconomic Environment

3.4.4.1 Analytical Assessment Techniques

Project-related employment and income effects during construction and operation phases are estimated based on Project demand for labour and consideration of estimates of capital expenditures within NB. Demand for accommodations associated with demographic change (stemming from direct, indirect, and induced employment) is compared to the available capacity of short-term accommodations within the LAA and RAA. Demand for select public services associated with demographic change (stemming from direct, indirect, and induced employment) is compared to the available capacity of public services within the LAA and RAA.

3.4.4.2 Assessment of Change in Employment and Economy

3.4.4.2.1 Project Pathways for Change in Employment and Economy

Project associated demand for labour (direct, indirect, and induced) and goods and services will create employment and business opportunities within the LAA and RAA and will generate revenue for governments. Project employment will peak at approximately 200 workers during construction, including approximately 175 for construction of NB components. These workers will be employed by New Brunswick-based construction or engineering firms, where possible. Adverse effects are related to increased demand for skilled labour and changes in labour supply, potentially contributing to wage inflation. Project expenditures on goods and services could generate positive economic effects through contracts with local companies in NB. The Project will also contribute to municipal and provincial government revenue through increased tax revenue.

Operation in NB will require only one FTE, therefore, no residual effects on employment and economy are anticipated.

3.4.4.2.2 Mitigation and Enhancement for Change in Employment and Economy

Project effects on employment and economy are anticipated to be largely beneficial because employment and business opportunities will be created within the LAA and RAA during all Project phases, and taxes will be paid to municipal and provincial government. Where the Project competes for skilled labour and goods and services potential exists for increased labour costs and price inflation. Since anticipated Project demands for labour and goods and services are small and short-term the magnitude of potential adverse effects on labour costs and price inflation are anticipated to be low. Mitigation measures, therefore, work to enhance beneficial effects of the Project.

NB Power commits to the following mitigation and enhancement measures related to employment and economy:

- Develop and implement a strategy to encourage local and Aboriginal content. The strategy will ensure local residents, Aboriginal groups and businesses are informed of job and procurement opportunities and will encourage a hire-local first approach.

3.4.4.2.3 Residual Project Environmental Effect for Change in Employment and Economy

Construction

Land-based construction in NB consists of the development of approximately 57 km of transmission line, a cable termination site and landfall site in Cape Tormentine and the upgrade of a substation in Memramcook. The total capital expenditure for the NB portion of the Project is estimated at $25 million.

175 full-time equivalent (FTE) jobs are anticipated to be generated including construction workers and administrative, engineering and support personnel. The majority of employees will be local with some specialists coming from other parts of Canada or from abroad. Workers are anticipated to be employed on a rotational work shift that will likely be 10-hour days for five days. This is a multi-million

dollar project and includes expenditures on such goods and services as construction materials, equipment, consumables (e.g., fuel, food), and accommodations. Purchases of labour, goods, and services needed for construction would beneficially affect other sectors of the NB economy.

Due to the relatively small number of FTEs (175), the Project is not anticipated to result in labour shortages or affect the supply of goods and services such that wage or price inflation occurs. Residual effects on employment and economy during Project construction are expected to be positive in direction, low in magnitude, to extend throughout the RAA, to be short-term in duration occurring continuously within a moderately resilient socioeconomic context and to be reversible following Project decommissioning and abandonment.

Operation

Since Project operation is anticipated to require approximately only one FTE, no residual effects on public services are anticipated during Project operation.

3.4.4.3 Assessment of Change in Accommodations

3.4.4.3.1 Project Pathways for Change in Accommodations

The construction workforce will be housed in nearby lodging in NB, potentially affecting the availability of short-term accommodations (Project camps will not be constructed). Demographic changes related to In-migrant workers satisfying demand for indirect and induced employment also have the potential to affect demand for accommodations throughout the life of the Project.

3.4.4.3.2 Mitigation for Change in Accommodations

During Project construction, non-local workers will be housed in nearby accommodations in NB. Since no Project camps will be constructed, demand for nearby accommodations will increase. NB Power commits to the following mitigation measures related to accommodations of non-local workers:

- develop preferred accommodations providers, informed through engagement with local community officials
- communicate with community officials where workers are accommodated, as a means of responding to potential community grievances

3.4.4.3.3 Residual Project Environmental Effects for Change in Accommodations

Construction

Peak construction will require approximately 200 workers in New Brunswick and PEI. It is estimated that 175 of these will be required in NB and the majority of these will be local hires. Based on the spatial extent of the RAA, a majority of individuals (representing potential local hires) are estimated to reside within an average of a 1.5-hour commute of Cape Tormentine (the furthest commute being approximately two-hours). These individuals are anticipated to commute from their personal residences to the worksite, and will not increase demand for temporary accommodations as they are already accommodated within the RAA.

Some specialists from outside the RAA may be required for Project construction. These workers will require short-term accommodation while engaged in construction activities. Potential demand for accommodations related to indirect and induced employment during Project construction is not expected to exceed the current availability of accommodations. Based on the size of the construction workforce requiring temporary accommodation, the availability of temporary accommodations within the LAA and RAA, the timing of construction activities, and mitigation measures, the availability of existing temporary accommodations are considered sufficient to meet increased Project-related demand during Project construction. Residual effects on temporary accommodation during Project construction are considered neutral in direction, low to moderate in magnitude, to extend throughout the RAA, to be short-term in duration, to occur regularly, are reversible following the completion of the Project construction and to occur within a moderate socioeconomic resiliency.

Operation

Since Project operation is anticipated to require approximately only one FTE, no residual effects on public services are anticipated during Project operation

3.4.4.4 Assessment of Change in Public Services

3.4.4.4.1 Project Pathways for Change in Public Services

The construction workforce will have a presence in nearby communities potentially increasing demand for public services. Demographic changes related to In-migrant workers satisfying demand for indirect and induced employment also have the potential to increase demand for public services in nearby communities throughout the life of the Project.

3.4.4.4.2 Mitigation for Change in Public Services

During Project construction workers will be housed in nearby accommodations in NB and therefore could increase demand on public services. To manage potential demand on public services NB Power commits to the following mitigation measures:

- encourage carpooling among workers to reduce effects on daily traffic volumes and transportation infrastructure
- require employees and subcontractors to adhere to code of conduct and health and safety programs

3.4.4.4.3 Residual Project Environmental Effects for Change in Public Services

Approximately 175 Project-related jobs are anticipated during Project construction. The majority of these are expected to be satisfied by local hires within the RAA; some specialist hires may be required to come from outside of the RAA. A temporary increase in population can lead to increases in demand for public services.

Construction

Construction workers residing within the RAA are anticipated to choose to commute (daily) to the PDA from their current residences. These workers contribute to the funding of public services through municipal tax payments and pay-per-use services in their home communities; demand from these individuals is already accounted for through municipal planning. Workers who reside within the RAA but outside the LAA may increase demand for public services in communities near the PDA as a result of commuting or from their presence while on-shift (demand from these residents would not be accounted for through current municipal planning). However, considering these workers will only be present in communities near the PDA for a limited duration (while commuting or on-shift), increased demand for public services is not expected to be distinguishable from the normal variability of demand. In general, Cape Tormentine is an entry point to NB and is subject to fluctuations in demand associated with tourism; similarly, the Moncton CA has an established tourism industry and is accustomed to fluctuations in demand for public services. Adverse effects from these workers are therefore expected to be negligible in magnitude. As such no residual effects on public services are anticipated to result from RAA resident workers during Project construction.

During Project construction, temporary and in-migrating workers have the potential to increase demand for public services. Since temporary and in-migrating workers (until they have established residency in the RAA) do not contribute to public funding of services through municipal tax and pay-per-use fees, demand from these individuals may be unaccounted for through municipal and provincial planning. However, considering baseline conditions, the size of the construction workforce, the timing of major construction activities, the duration of construction workers' presence in nearby communities, the normal variability of demand for public services in communities within the LAA, and the application of mitigation measures, increased demand associated with temporary and in-migrant workers during Project construction is expected to result in adverse effects that are negligible in magnitude. As such no residual effects on public services are anticipated during Project construction.

Operation

Since Project operation is anticipated to require only one additional FTE, no residual effects on public services are anticipated during Project operation

3.4.5 Summary of Residual Project Environmental Effects

The residual Project environmental effects for Socioeconomic Environment are summarized in Table 3.35.

Table 3.35 Summary of Project Residual Environmental Effects on Socioeconomic Environment

Residual Effect	Residual Environmental Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Socioeconomic Context
Change in Employment and Economy	C	P	L	RAA	S	C	R	M
Change in Accommodation	C	N	L-M	RAA	S	R	R	M
Change in Public Services	C	NA						

KEY
See Table 3.25 for detailed definitions.

Project Phase:
C: Construction
O: Operation
D: Decommissioning and Abandonment

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term
P: Permanent

NA: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socioeconomic Context:
L: Sparsely populated region with relatively few service centres
M: A mix of sparsely populated areas along with more populated, urban centres
H: Densely populated area with several urban centres

3.4.6 Determination of Significance

3.4.6.1 Significance of Residual Project Effects

For change in employment and economy, a significant adverse residual effect would only occur if the Project results in an adverse effect that is of high magnitude, distinguishable from normal variability, and of which cannot be managed with current or anticipated programs, policies, or mitigation measures. Project residual effects on employment and economy are largely anticipated to be beneficial, creating employment and business opportunities within the RAA. Since Project demands for labour and goods and services are anticipated to be small and short-term in nature with adverse effects on wage and price inflation low and limited to the construction phase of the Project, effects are anticipated to be not significant.

For change in accommodations and public services, a significant adverse residual effect would only occur if the Project results in demand that is not within normal variability and of which exceeds current capacity and cannot be managed with current or anticipated programs, policies or mitigation measures. Considering the available capacity of accommodations and public services, the short-term and low to medium magnitude of potential demand for accommodations and public services, and proposed mitigation measures targeted at managing the variability of demand for accommodations and public services, effects are anticipated to be not significant.

3.4.7 Prediction Confidence

Prediction confidence is considered moderate to high based on available data, NB Power's experience with similar projects in NB and their effects, and proposed mitigation measures. There exist inherent uncertainties about future economic conditions in the LAA and RAA and the extent to which local residents will choose to be involved in project construction, operation, and decommissioning and abandonment.

3.4.8 Follow-up and Monitoring

Follow-up and monitoring programs are not required.

3.5 ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS ON HERITAGE RESOURCES

Heritage Resources are those resources, both human-made and naturally occurring, related to human activities from the past that remain to inform present and future societies of that past. Heritage Resources are relatively permanent, although tenuous, features of the environment; if they are present, their integrity is susceptible to construction and ground-disturbing activities. Heritage Resources has been selected as a valued component (VC) because of interest from: provincial and federal regulatory agencies who are responsible for the effective management of these resources; the general public; and Aboriginal people that have an interest in the preservation and management of Heritage Resources related to their history and culture. For this VC, Heritage Resources include consideration of historical, archaeological, built heritage, and palaeontological resources.

3.5.1 Scope of Assessment

This section defines the scope of the Heritage Resources VC in consideration of the regulatory setting, potential Project-VC interactions, and the existing knowledge of the Project Development Area (PDA).

3.5.1.1 Regulatory and Policy Setting

Known heritage resources in New Brunswick are regulated under the *Heritage Conservation Act*. The regulatory management of heritage resources falls under the New Brunswick Department of Tourism, Heritage and Culture, and is administered by the Heritage Branch. Within the Heritage Branch are the offices of Archaeological Services; Historic Places; and the New Brunswick Museum.

The review for heritage resources has been undertaken through the completion of historical, archaeological, built heritage, and palaeontological research. The Province of New Brunswick provides guidance for conducting heritage assessments, such as the *Guidelines and Procedures for Conducting Professional Archaeological Assessments in New Brunswick* (the Archaeological Guidelines, Archaeological Services 2012).

3.5.1.2 The Influence of Consultation and Engagement on the Assessment

Consultation and engagement activities have been on-going as part of the research for the heritage resources assessment. During the background research, various regional experts, historical societies and regulatory agencies were contacted (Table 3.36).

Table 3.36 Experts Consulted

Name of Expert	Affiliation
Archaeological Services Staff Members (various)	Archaeological Services – New Brunswick Department of Tourism, Heritage and Culture
Geological Surveys Branch- Various Staff	New Brunswick Department of Energy and Mines, Geological Surveys Branch
Dr. Randall Miller	Curator, Geologist, New Brunswick Museum
Mr. Peter Hicklin	Editor, White Fence Newsletter, Tantramar Heritage Trust
Dr. Allan Seaman	Quaternary Geologist, Geological Surveys Branch New Brunswick Department of Energy and Mines
Local Historians	Tantramar Heritage Trust
Gilles Bourque	Manager, Historic Places Branch- New Brunswick Department of Tourism, Heritage and Culture
Representative	Westmorland Historical Society, Keilor House Museum, Dorchester, NB.

Several local landowners were also contacted to gain a better understanding of the general and specific history of the PDA. Details surrounding these contacts are provided in the Archaeological Impact Assessment (AIA) Final Report (Stantec 2015) for the land-based portions of the Project.

NB Power has initiated Aboriginal consultation for the New Brunswick portion of the Project on behalf of the Province to facilitate the Crown's Duty to Consult. As the consultation and engagement process progresses, any areas of interest and concern regarding archaeological resources within the PDA expressed by Aboriginal representatives will be reviewed and considered for the heritage resources assessment. Details outlining NB Power's Aboriginal consultation and engagement process are located in Section 3.2 of Volume 1.

No issues by regulators, regional experts or historians have been raised with respect to heritage resources to date during these consultations. Multiple meetings and discussions with the Provincial regulator, Archaeological Services, have occurred since initiation of the archaeological work in 2014 to discuss the archaeological survey methods.

Consultation with Dr. Randall Miller, Curator, at the New Brunswick Museum revealed no specific concerns with respect to palaeontological resources within the PDA (Miller 2014). A fossilized tree was noted in an abandoned quarry near the PDA and the exact location will be confirmed.

No other issues were raised by individuals or groups who were contacted regarding the assessment of Heritage Resources for the Project.

3.5.1.3 Potential Environmental Effects, Pathways and Measurable Parameters

The environmental assessment of Heritage Resources focuses on the following environmental effect:

- Change in heritage resources

The environmental effect has been selected with recognition of the interest of regulatory agencies, the general public, and potentially affected Aboriginal groups. In general, heritage resources are defined as "*any structure, site or thing that is of historical, archaeological, paleontological or architectural significance*" (*CEAA 2012*).

The measurable parameter used for the assessment of the environmental effect presented above and the rationale for its selection is provided in Table 3.37.

Table 3.37 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Heritage Resources

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Heritage Resources	• Disturbance or alteration of whole or part of a heritage resource from Project ground disturbance during construction and operation.	• Presence/absence of a Heritage Resource.

3.5.1.4 Boundaries

3.5.1.4.1 Spatial Boundaries

The spatial boundaries for the environmental effects assessment of Heritage resoureces are defined below.

- Project Development Area (PDA): The PDA comprises the immediate area of physical disturbance associated with the construction and operation of the Project. The PDA includes: the existing substation in Memramcook where upgrades to the existing substation will occur within the substation footprint; a 40 km long, 30 m wide transmission line RoW from Memramcook to Melrose and a 17 km long, 60 m wide transmission line RoW from Melrose to Cape Tormentine; a cable termination site; and a 10 m easement around cable lines.

- Local Assessment Area (LAA): The LAA is the maximum area within with Project-related environmental effects can be predicted or measured with a reasonable degree of accuracy and confidence. The LAA for Heritage Resources is limited to the PDA.
- Regional Assessment Area (RAA): The RAA is the area within which the Project's environmental effects may overlap or accumulate with the environmental effects of other projects or activities. The RAA is defined as an area of the southeast of the province located within the Eastern Lowlands Ecoregion and the Petitcodiac and Kouchibouguac Ecodistricts. The project transects a topographical divide between watersheds and estuaries draining to the Bay of Fundy to the south, including the Tantramar, Memramcook, and Petitcodiac Rivers and the Northumberland Strait to the east, including the Gaspereau River, east to Cape Tormentine.

3.5.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of the Project on Heritage Resources include construction and operation. Construction in the terrestrial environment is expected to occur over a period of 16 months. Construction of the landfall site and transmission line from Melrose to Cape Tormentine is expected to be completed over 9 to 10 months, between March and December 2016. Construction of transmission line between Melrose and Memramcook is expected to begin in September 2016 with completion expected to take place in June 2017. Operation will begin follow construction and is anticipated to continue for the life of the Project (approximately 40 years). Decommissioning and abandonment would take place following the useful service life of the Project and which would be carried out in accordance with regulations in place at that time.

Particular emphasis is placed on construction as that is the phase where most ground disturbing activities of surface soils associated with the Project are conducted. There is also the potential for encountering heritage resources during operation via heavy equipment during activities associated with vegetation control and access road maintenance.

Ground disturbing activities are not anticipated during decommissioning and abandonment, therefore there is not anticipated to be potential to encounter heritage resources during this phase of the Project.

3.5.1.5 Residual Environmental Effects Description Criteria

This assessment considers residual effects on Heritage Resources after the implementation of recommended mitigation. Definitions for the characterization of these residual effects are presented in Table 3.38.

Table 3.38 Characterization of Residual Environmental Effects on Heritage Resources

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive**—an effect that moves measurable parameters in a direction beneficial to Heritage Resources relative to baseline. **Adverse**—an effect that moves measurable parameters in a direction detrimental to Heritage Resources relative to baseline. **Neutral**—no net change in measurable parameters for Heritage Resources relative to baseline.
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible**—no measurable change to Heritage Resources. **Low to Moderate**—if Heritage Resources are encountered within the PDA and cannot be avoided, mitigation (*e.g.*, removal) will create change to Heritage Resources. **High**—a measureable change resulting in a permanent loss of information relating to Heritage Resources (*e.g.*, destruction that occurs without mitigation).
Geographic Extent	The geographic area in which an environmental, effect occurs	**PDA**—residual effects are restricted to the PDA.
Frequency	Identifies when the residual effect occurs and how often during the Project or in a specific phase	**Single event**—an effect on Heritage Resources occurs only once (*i.e.*, disturbance results in the loss of context).
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the effect can no longer be measured or otherwise perceived	**Short-term**—the residual effect is restricted to the construction phase. **Long-term**—the residual effect will extend for the life of the Project. **Permanent**—Heritage Resources cannot be returned to its existing condition.
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible**—the effect is likely to be reversed. **Irreversible**—the effect cannot be reversed as damage or removal will result in a change to Heritage Resources.
Ecological and Socioeconomic Context	Existing condition and trends in the area where environmental effects occur	**Undisturbed**—area is relatively undisturbed or not adversely affected by human activity. **Disturbed**—area has been substantially previously disturbed by human development or human development is still present.

3.5.1.6 Significance Definition

A significant adverse residual environmental effect on Heritage Resources is one that results in a permanent Project-related disturbance to, or destruction of, all or part of a heritage resource (*i.e.*, archaeological, architectural or palaeontological resource) considered by the provincial heritage regulators and other stakeholders to be of major importance due to factors such as rarity, undisturbed condition, spiritual importance, or research importance, and that cannot be mitigated or compensated.

3.5.2 Existing Conditions for Heritage Resources

3.5.2.1 Methods

As part of the archaeological assessment, background research was undertaken to: determine the location of any known heritage resources within the PDA; to identify likely locations for unknown resources; and to gain an understanding of the general and specific history of the PDA and surrounding area. Consultation was also undertaken as noted in Volume 1, Section 3.2.

The background research included the following activities:

- A review of provincial archaeological potential maps and map data (Archaeological Services 2014a and b) was conducted to identify registered archaeological sites and heritage resources in the Archaeological Services Sites Database, any potential Palaeo-shorelines, and areas of elevated archaeological potential within, or potentially interacting with, the PDA.
- A review of the provincial archaeological site files for any known archaeological sites within or in proximity of the PDA.
- Meetings with representatives from Archaeological Services and regional experts.
- A review of a variety of published, unpublished, and on-line works and databases on relevant local history and environment, and previous archaeological work carried out in the general area surrounding the PDA.
- Review of various documents located in the New Brunswick Provincial Archives.
- Professional experience and judgment of the Stantec Archaeology Team.

An archaeological assessment (walkover) was conducted in consideration of the results of the Archaeological Potential Map information (Archaeological Services 2014a; 2014b). The field assessment followed the Archaeological Guidelines (Archaeological Services 2012).

3.5.2.2 Overview of Existing Conditions

Existing conditions (i.e., baseline) for archaeological resources (Pre-Contact Period and Historic Period), palaeontological resources and built heritage are summarized in the following sections.

3.5.2.2.1 Pre-Contact Period

In general, the PDA transects an area within the traditional Mi'kmaq territory of *Sigenigteoag, Sigunitk,* or *Siknikt* (Hamilton 1996:62; NBDNR 2007; Miller 2004:253) which includes the entire area of southeast New Brunswick from Memramcook to the Cumberland County region of Nova Scotia, or, the Chignecto Basin/Chignecto Isthmus (Chute 2002:66; Miller 2004:253). The area was part of an important portage and overland travel route while the coastal and estuarine environments provided both marine and terrestrial resources for Aboriginal peoples (NBDNR 2007).

Although there is limited physical evidence to date for Pre-Contact settlement in and around the PDA, place names suggest Aboriginal use of the region. Several communities close to the PDA, including Memramcook (*Amlamcook,* meaning "variegated"), Aboushagan/Aboujagan (*Naboujagan*, meaning unknown), Midgic (*Midjic,* "point of highland into a marsh"), and Shemogue (*Simooaquik* or *Sim-oo-a-*

quik meaning "horned river" or "a good place for geese") all derive their names from earlier Mi'kmaq terms, translated to French, and English and then to their modern spellings (Ganong 1896, 1899; Hamilton 1996; NBPA 2014; Rayburn 1975).

Ethnohistoric literature pertaining to the Mi'kmaq suggests Aboriginal peoples were well-adapted for both terrestrial and aquatic subsistence and travelled overland and by canoe throughout this region frequently and on seasonal rounds (Leonard 1996). Although no substantial village sites have been discovered, ethnohistoric literature suggests that large villages existed, for example at Midgic [Midjic], which Ganong (1899) suggests was "…said… to have been formerly one of [the] most important camping grounds". Archaeological evidence suggests, at a minimum, occupation by ancestral Mi'kmaq peoples in this area as far back as the Palaeoindian Period and continuing through to the Protohistoric and Historic Period (Leonard 1996; NBDNR 2007; M. Nicholas, Pers. comm., 2014; 2015).

3.5.2.2.2 Historic Period

The first non-Aboriginal settlers in the general area surrounding the PDA were the Acadians, who arrived in the area of *Beaubassin* in *ca.* 1671 from Port Royal, Nova Scotia (Ganong 1983[1899]; NBDNR 2007). Numerous Acadian-era villages are depicted on historic maps of the region, and Ganong (1983[1899]:66–76) describes 13 villages of varying size located between modern-day Moncton and Baie Verte. An early post-Expulsion British map shows churches (presumably associated with villages) extending to Fort Gaspereau/Fort Monckton (Montresor 1768). In the mid-1700's, the Acadians were pushed off of the land by the British and Pennsylvanian Germans and Planters (NBDNR 2007) and in 1761, New Englanders from Rhode Island (Ganong 1983[1899]) arrived in Sackville. The majority of the villages within 5 km of the PDA were agricultural and lumbering communities (Hamilton 1996; NBPA 2014; Rayburn 1975) that were settled in the mid-1800's and were home to local post offices or stops along the railway.

3.5.2.2.3 Archaeological Resources

A review of the Archaeological Potential Map (Archaeological Services 2014a; 2014b) identified ten Pre-Contact Period archaeological sites and 15 Historic Period sites within 7 km of the PDA; however, no archaeological sites were registered within the PDA at the time of the review. The Archaeological Potential Map also identified five Multi-Component sites (*i.e.*, a site consisting of one or more components from more than one archaeological period). These sites include four Pre-Contact/Historic Period sites and one Proto-historic/Historic Period site located within 15 km of the PDA. Two portage/traditional travel routes were also identified on the Archaeological Potential Map located within 15 km of the PDA. None of these Multi-Component sites or portage/traditional travel will be affected by the Project.

In addition to the background research, an archaeological assessment (walkover) survey was conducted in 2014 for the land-based portions of the PDA in New Brunswick. During the course of the 2014 walkover, a total of seven Historic Period archaeological sites were identified and registered with the Province of New Brunswick. Table 3.39 provides a list of registered archaeological sites within the PDA.

Table 3.39 Registered Historic Period Archaeological Sites within the PDA

Site (Borden No.)	Type/Description	Location (General Area)
CaCx-1	Cultural Feature/Linear Stone Feature	Bayfield
CaDb-1	Historic Cultural Feature/Rock Lined Depression	Centre Village
CaDb-2	Historic Cultural Feature/Stone Hearth and old bellows	Cookville
CaCx-4	Cultural Feature/Linear Stone Feature	Malden
CaCx-5	Cultural Feature/Circular Stone Pile	Malden
CaCx-3	Cultural Feature/Irregularly shaped rock pile	Malden/Bayfield
CaCx-2	Cultural Feature/Linear Stone Feature	Malden/Bayfield

3.5.2.2.4 Palaeontological Resources

A palaeontological report based on known data sources within the PDA, was prepared by the New Brunswick Museum (Miller 2014). The report states there are no known fossil localities located within the PDA; however, the PDA is underlain by Late Carboniferous sedimentary rocks in the Boss Point, Salisbury and Richibucto formations which are known to contain fossils in other locations (Miller 2014). A report cited by Miller (2014) also notes that a fossilized tree was identified in an abandoned quarry off of Highway 16 on Cape Tormentine. Although the exact locality of the fossilized tree was not identified in the report, Miller (2014) noted that it could be located in a quarry near Melrose, south of the PDA.

3.5.2.2.5 Built Heritage

A search of the Canadian Register of Historic Places (CRHP) revealed 23 registered designated historic places in or around Memramcook; however, no there are none located within the PDA.

3.5.3 Project Interactions with Heritage Resources

Table 3.40 identifies, for each potential effect, the Project physical activities that might interact with the VC. These interactions are indicated by check marks, and are discussed in detail in Section 3.6.4 in the context of effects pathways, standard and Project-specific mitigation/enhancement, and residual effects. A justification is also provided for non-interactions (no check marks).

Table 3.40 Potential Project-Environment Interactions and Effects on Heritage Resources

Project Components and Physical Activities	Potential Environmental Effects
	Change in Heritage Resource
Construction	
Site Preparation for Land-Based Transmission Lines in New Brunswick	✓
Construction of Land-Based Transmission Lines in New Brunswick	✓
Landfall Construction (New Brunswick and Prince Edward Island)	✓
Upgrading of Electrical Substation (New Brunswick)	–

Table 3.40 Potential Project-Environment Interactions and Effects on Heritage Resources

Project Components and Physical Activities	Potential Environmental Effects
	Change in Heritage Resource
Inspection and Energizing of the Transmission Lines	–
Clean-Up and Re-vegetation of the Transmission Corridor	–
Emissions and Wastes	–
Transportation	–
Employment and Expenditure	–
Operation	
Energy Transmission	–
Vegetation Management	✓
Infrastructure Inspection, Maintenance and Repair (Transmission Lines and Substations)	–
Access Road Maintenance	✓
Emissions and Wastes	–
Transportation	–
Employment and Expenditure	–
Decommissioning and Abandonment	
Decommission	–
Reclamation	–
Emissions and Waste	–
Employment and Expenditure	–

Notes:
✓ = Potential interactions that might cause an effect.
– = Interactions between the project and the VC are not expected.

The Project will not result in the disturbance to or loss of any buildings of architectural significance. No records of built heritage resources or any buildings of architectural or historical significance within, or immediately near, the PDA were identified (Stantec 2015) and no buildings were encountered during the field assessments of the PDA. Therefore, the environmental effects of the Project on built heritage resources as a component of Heritage Resources during all phases of the Project is not considered further in this assessment.

The Project will not result in the disturbance to or loss of palaeontological resources of significance. There are no known fossil occurrences are located along the corridor and any fossils present would likely be coalified, poorly preserved plant fossils (Miller 2014). Therefore, the environmental effects of the Project on palaeontological resources as a component of Heritage Resources during all phases of the Project is not considered further in this assessment.

During construction, activities that have the potential to interact with Heritage Resources include site preparation for land-based transmission lines in New Brunswick, construction of land-based transmission lines in New Brunswick, and landfall construction. Archaeological resources, where present, are typically located in the upper soil layers of the earth and therefore potential interactions between these resources and the Project will most likely take place during the initial ground breaking phases of construction. Any potentially adverse environmental effects due to construction activities on Heritage Resources will be permanent, as no archaeological site can be returned to the ground in its original state. During site preparation for the land-based transmission lines, clearing, minimal grubbing near pole locations, and grading are required and have the potential to interact with Heritage Resources as these activities will result in ground disturbance. During the construction of the land-based transmission lines, pole placement is carried out by excavation which has the potential to interact with Heritage Resources. During landfall construction, trenching of the submarine cable will be required at Cape Tormentine, NB and a portion will be located on a shoreline.

Activities listed under construction in Table 3.40 that are not anticipated to interact with Heritage Resources include: upgrading of electrical substation, inspection and energizing of the transmission lines, clean-up and re-vegetation of the transmission corridor, emissions and wastes, transportation, and employment and expenditure. The upgrading of the electrical substation will occur within the existing footprint and thus, no new ground disturbing activities will occur. Inspection and energizing of the transmission lines and clean-up and re-vegetation of the transmission corridor will not involve ground breaking activities; therefore, no interaction with Heritage Resources will occur. Emissions and wastes generated by the Project will not involve ground breaking activities; therefore, no interaction with Heritage Resources will occur. Transportation generated by the Project will be via the existing road network and therefore will not result in an interaction with Heritage Resources. Employment and expenditure are related to the amount of employment generated and positive economic activity as a result of the Project and will not involve ground breaking activities, thus interaction with Heritage Resources is not anticipated.

During operation, it is possible that maintenance equipment brought onto the RoW and clearing activities associated with vegetation management and temporary access road maintenance could cause ground disturbance, thus potentially affecting Heritage Resources. Other routine activities associated with operation will not result in ground disturbance; therefore, interaction with Heritage Resources is not anticipated.

All activities in the decommissioning phase of the Project will not result in ground breaking activities outside areas already disturbed by the Project and thus not interact with Heritage Resources.

3.5.4 Assessment of Residual Environmental Effects on Heritage Resources

3.5.4.1 Analytical Assessment Techniques

The assessment of potential effects to Heritage Resources was compiled using background research and an archaeological assessment (walkover) of the PDA. The background research included a review of previous archaeological assessments done in the region, review of historic aerial photography, and information received from regulators. The archaeological assessment was undertaken over the past year and involved examining existing conditions within PDA in order to determine the archaeological potential.

3.5.4.2 Project Pathways for Heritage Resources

Heritage resources are generally located on surface or below ground; therefore any construction or operation activity that disturbs the ground has potential to interact with Heritage Resources.

3.5.4.3 Mitigation for Heritage Resources

Mitigation will be required to avoid or reduce the adverse effects on heritage resource. The primary measure to be taken is to conduct of an archaeological assessment (walkover) in the PDA to accurately determine the existence or potential existence of heritage resources potentially disturbed by Project activities and make site specific recommendations to satisfy Provincial regulatory officials. Seven Historic-Period archaeological sites were identified within the PDA during the archaeological assessment (walkover) conducted in 2014/2015 and were registered with the Province of New Brunswick. Areas of elevated archaeological potential were also identified during the walkover that will be subject to mitigation prior to construction. It is possible that a heritage resource could be encountered during construction or operation even after mitigation has been implemented. The EPP contingency plan for a chance find of a heritage resource during construction and operation phases will also be followed.

The following mitigation measures are recommended arising from the archeological assessment (walkover) of the PDA:

- Planned avoidance of registered archaeological sites located within the PDA and areas determined during walkover survey of the PDA to have elevated potential for archaeological resources.
- Shovel testing, where avoidance is not feasible, to identify potential sites in areas determined to have elevated potential (including potential palaeo-shorelines) for archaeological resources.
- Shovel testing, mapping and recording for age and characterization of recorded Historic Period archaeological sites that cannot be avoided.
- Archaeological monitoring of areas where shovel testing is not practicable.
- Additional mitigation, as required, to be developed with provincial regulators.
- A heritage resource discovery response procedure (i.e., for a chance find of previously unidentified resource) will follow the EPP Contingency Plans during Project-related construction and operation activities.

3.5.4.4 Residual Project Environmental Effect for Heritage Resources

With the implementation of the proposed mitigation, the Project will not result in the unauthorized permanent disturbance to, or destruction of, a heritage resource considered by the provincial heritage regulators to be of major importance that is not mitigated. All archaeological mitigation will be carried out under provincial legislation and authorization and with the knowledge of applicable Aboriginal groups. Any chance finds of previously undetected heritage resources will be limited to the PDA and be managed according to a discovery response procedure to protect the knowledge associated with those resources.

Background research for the presence of Heritage Resources within the PDA, the archaeological assessment (walkover), and the implementation of any additional mitigation required by provincial regulators will reduce the potential for adverse residual effects to Heritage Resources.

Construction and Operation

The mitigation described is intended to identify heritage resources within the PDA before construction activities are initiated. Should any heritage resources be identified during the field assessment, appropriate mitigation up to and including avoidance, would be implemented prior to construction activities. Therefore the only residual environmental effects would be the unplanned discovery of a heritage resource during construction, or, during vegetation management and access road maintenance activities associated with operation. While mitigation is recommended to address this possibility, the discovery of a heritage resource during construction or operation is likely to result in some adverse environmental effect (i.e., disturbance) to the resource.

In the unlikely case of a Project-related interaction with Heritage Resources, during construction, the effects are characterized as follows: adverse in direction as the unmitigated disturbance of a heritage resource may result in the loss of information. The magnitude of the effect would be rated low to moderate, dependent upon the nature of the heritage resource, the extent of the disturbance, and the ability to implement mitigation following the identification of a heritage resource. This effect would occur as a single event, the duration would be permanent and would be irreversible as heritage resources can only be adversely affected once, and when that occurs, it may result in the permanent loss of some information and context relating to the heritage resource. The geographic extent of this effect would be limited to the PDA, as it is the area of physical disturbance during this phase of the Project where archaeological resources could potentially be located. The socioeconomic context of the PDA is disturbed/undisturbed for construction activities; most of the area has been subject to forestry, agricultural, and industrial quarrying activities in the relatively recent past, but there remains some areas where disturbance is minimal. Operation activities have not been assessed as the entire PDA will have been previously disturbed during construction.

3.5.5 Summary of Residual Project Environmental Effects

Table 3.41 summarizes the Project Residual Environmental Effects on Heritage Resources by the Project phases.

Table 3.41 Summary of Project Residual Environmental Effects on Heritage Resources

Residual Effect	Residual Environmental Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socioeconomic Context
Change in Heritage Resources	C	A	L-M	PDA	P	S	I	D/U
Change in Heritage Resources	O	A	L-M	PDA	P	S	I	D

KEY
See Table 3.38 for detailed definitions.

Project Phase:
C: Construction
O: Operation
D: Decommissioning and Abandonment

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term
P: Permanent

NA: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socioeconomic Context:
D: Disturbed
U: Undisturbed
R: Resilient
NR: Not resilient

3.5.6 Determination of Significance

3.5.6.1 Significance of Residual Project Effects

The Project has the potential to interact with Heritage Resources during ground breaking activities required during construction, and during activities associated with vegetation management and access road maintenance during operation. With the implementation of the proposed mitigation, the Project will not result in the unauthorized permanent disturbance to, or destruction of, heritage resources considered by the provincial regulators or other stakeholders to be of importance. Therefore, the residual environmental effects of the Project on Heritage Resources during all Project phases are rated not significant.

3.5.7 Prediction Confidence

This assessment is made with a high level of confidence due to the comprehensiveness of the background research, completeness of the field assessment, and the proposed mitigation for within the PDA.

3.5.8 Follow-up and Monitoring

Follow-up archaeological monitoring may be required during ground-breaking construction activities in proximity to locations where archaeological resources were discovered. All monitoring will be done by an archaeologist permitted by the Province and the results reported to the Province and Aboriginals, as applicable. In the event that the archaeological monitoring identifies any additional archaeological resources, an archaeological resource discovery response procedure will be followed. The procedure will include provisions to halt the work in the areas of the discovery and implement mitigation in consultation with the Province and in accordance with provincial heritage legislation.

3.6 ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS ON CURRENT USE OF LAND AND RESOURCES FOR TRADITIONAL PURPOSES BY ABORIGINAL PERSONS

Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is defined as the known current use of lands, and resources, that are within the footprint of the Project or on adjacent lands where those uses are potentially affected by the Project.

Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is a valued component (VC) because of current and past use of the land and resources by Aboriginal persons in carrying out their traditional activities as an integral part of their lives and culture. Included, are the right to hunt, trap, fish, gather and follow Aboriginal customs, practices and traditions on ancestral lands. Current Use is considered "living memory" of the use of land and resources within the PDA.

The focus of this section is on current use for traditional activities specifically by Aboriginal persons; uses by non-Aboriginal people, such as the effect on recreational fisheries, are addressed in the Land Use VC (Section 3.3). Other relevant VCs used to inform preliminary conclusions in this VC include Section 3.1 (Freshwater Environment VC) and Section 3.2 (Terrestrial Environment VC).

3.6.1 Scope of Assessment

The scope of the VC considers potential interactions between the Project and Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons. These interactions are based on an evaluation of the activities being undertaken by Aboriginal people within the PDA.

Although the Project lies within the traditional territory of the Mi'kmaq First Nations, the majority of the PDA is located on land that is currently privately owned and has been privately owned for several decades (Stantec 2015). The one exception is a former CN Rail right-of-way (RoW) that has been converted into a recreational trail (Sentiers NB Trails) and is now owned by the Province of New Brunswick (i.e., Crown land). Thus, any current use activities that are taking place on privately-owned land on the RoW are anticipated to be incidental (subject to certain terms and conditions related to landowner permission) and not directly related to the rights by Aboriginal people to pursue traditional uses.

The watercourses within the PDA are also considered Crown land; therefore the ability to access and fish watercourses is the primary focus for the discussion of current use of land and resources for traditional purposes by Aboriginal persons for this VC.

3.6.1.1 Regulatory and Policy Setting

A provincial environmental assessment registration is required for this project under the New Brunswick *Clean Environment Act – Environmental Impact Assessment Regulation*. The guidance on this process states that any traditional uses by First Nations must be considered in the registration.

As a Crown agency, New Brunswick Department of Environmental and Local Government (NBDELG) has a duty to consult with First Nations on such regulatory applications. As a Crown corporation, NB Power is also responsible to implement consultation with First Nations. The New Brunswick Duty to Consult Policy (2011) provides direction to the provincial government on consultation with the Mi'kmaq and Maliseet First Nations.

3.6.1.2 The Influence of Consultation and Engagement on the Assessment

The Proponent has initiated consultation with First Nation communities, and will continue to do so during the EIA process. Details of the consultation plan are presented in Volume 1 (Section 3.2). The political leadership (i.e., Chief and Council) within First Nations communities in proximity to the Project location were notified of the Project details (e.g., the location, details, and schedule of the Project) via a letter to determine if these communities have any questions or concerns about the Project and to solicit information regarding Aboriginal traditional uses in the study areas. Should any information regarding First Nations current use of the Project Site be identified during the regulatory approval process for the Project, this information will be presented to NBDELG, the provincial department responsible for the environmental assessment, for consideration in environmental decision-making.

3.6.1.3 Potential Environmental Effects, Pathways and Measurable Parameters

The Project could have an effect on traditional activities where they occur in proximity to the PDA, and there is the potential for an interaction to cause a change in current use of the freshwater environment and resources for traditional purposes.

During the construction and decommissioning and abandonment phases of the Project, there may be a period of time where access to fishing/gathering/hunting/ceremonial grounds is restricted within a localized area.

Table 3.36 outlines the potential environmental effects, pathways and measurable parameters associated with the current use of land and resources for traditional purposes by Aboriginal persons as they relate to this Project.

Table 3.42 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal persons	• Temporary or permanent loss of access to resources on Crown land. The Project may change availability of resources in Crown waters or access to these locations.	• Change in ability to participate in traditional activities due to change in access to watercourses. • Change in ability to participate in traditional activities due to changes in availability of resources (e.g., change in fish species or populations).

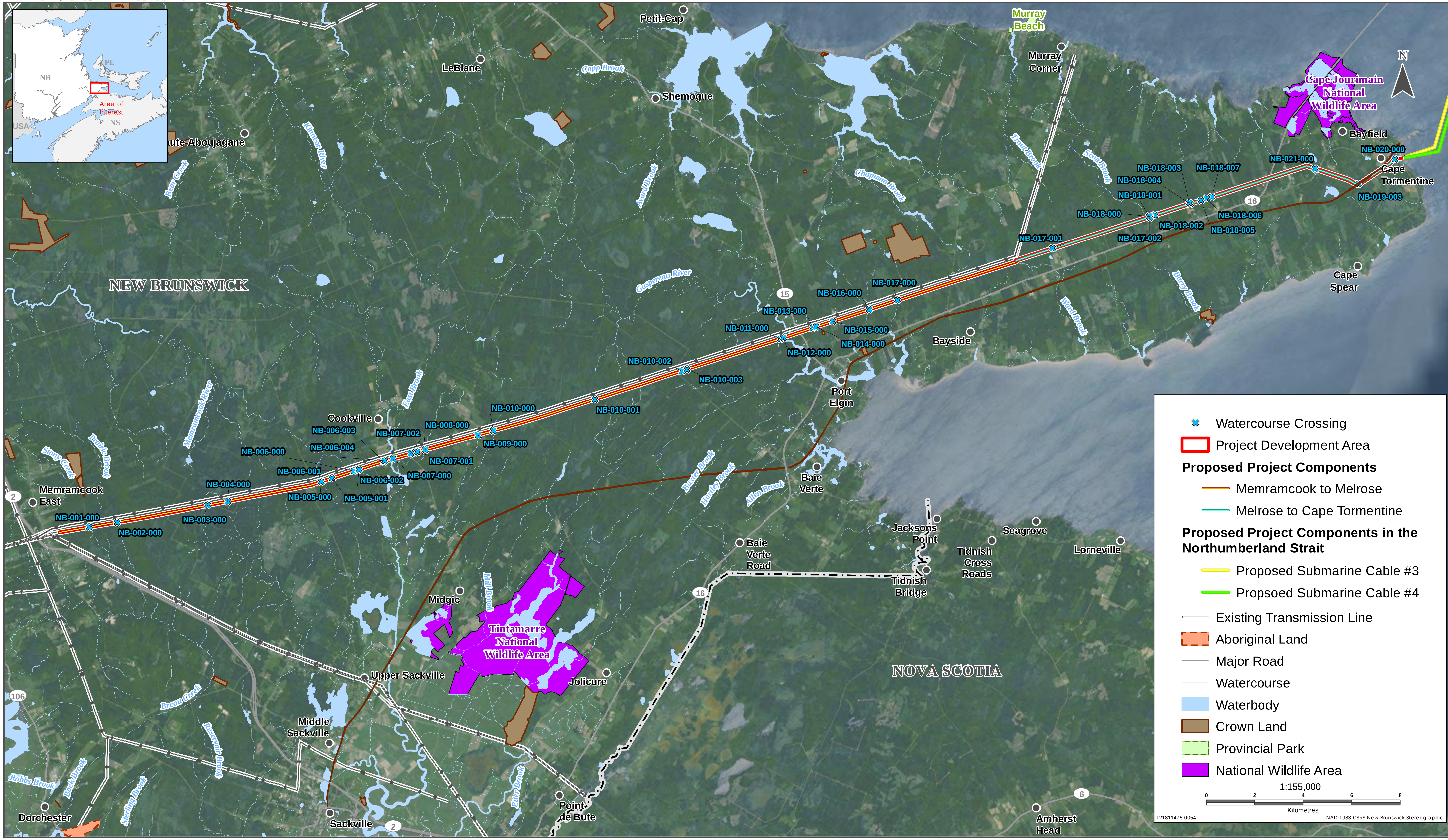
3.6.1.4 Boundaries

3.6.1.4.1 Spatial Boundaries

The spatial boundaries for the environmental effects assessment on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons are defined below (Figure 3.6).

- Project Development Area (PDA): The PDA comprises the immediate area of physical disturbance associated with the construction and operation of the Project. The PDA includes: the existing substation in Memramcook where upgrades to the existing substation will occur within the substation footprint; a 40 km long, 30 m wide transmission line RoW from Memramcook to Melrose and a 17 km long, 60 m wide transmission line RoW from Melrose to Cape Tormentine; a cable termination site; and a 10 m easement around cable lines. The PDA crosses a 55 m wide section of the NB trail network and then parallels the trail for approximately 685 m. The PDA overlaps with approximately 1.6 ha of the NB Trails.
- Local Assessment Area (LAA): The LAA is the maximum area within which Project-related environmental effects can be predicted or measured with a reasonable degree of accuracy and confidence. The LAA for Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons for this Project is based on the areas of Crown Land including the 1.6 ha area of the NB trails RoW that overlaps with the proposed Project, and the portion of the watercourses measuring 100 m upstream and 200 m downstream of the corridor centreline (including a riparian buffer of 30 m on each side of the watercourse). For additional, refer to the Freshwater Environment VC (Section 3.2).
- Regional Assessment Area (RAA): The RAA is the area within which the Project's environmental effects may overlap or accumulate with the environmental effects of other projects or activities that have been or will be carried out. Similarly to the LAA, the RAA for the assessment of Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is based on the areas of Crown Land defined watercourse crossed by the Project. This is estimated to include a section of stream up to 2 km downstream of the transmission line corridor, as well as the NB trails RoW that crosses the proposed Project.

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_7_current_use\121811475-0054.mxd



Sources: Base Data - Natural Resources (2011).Project Data from Stantec or provided by NB Power / MECL. Imagery - ArcGIS Map Service World Imagery, Natural Resources (2011).

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Stantec

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Figure 3.6

3.6.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of the Project on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons include period of potential interaction; that is the three phases of the Project: construction, operation, and decommissioning and abandonment. Construction in the terrestrial environment is expected to occur over a period of 16 months. Construction of the landfall site and transmission line from Melrose to Cape Tormentine is expected to be completed over 9 to 10 months, between March and December 2016. Construction of transmission line between Melrose and Memramcook is expected to begin in September 2016 with completion expected to take place in June 2017. Operation will begin follow construction and is anticipated to continue for the life of the Project (approximately 40 years). Decommissioning and abandonment would take place following the useful service life of the Project and which would be carried out in accordance with regulations in place at that time.

The temporal boundaries for the establishment of existing conditions for the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons will be for the period of consultation and engagement of the First Nation by the Proponent as well as the period of "living memory" of Aboriginal Persons or communities engaged in current use activities on Crown land. Details that emerge from the engagement with First Nations will be reflected in the Final EIA Report and/or supplemental reports.

3.6.1.5 Residual Environmental Effects Description Criteria

Table 3.43 provides the criteria that are used to characterize residual environmental effects on the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons.

Table 3.43 Characterization of Residual Environmental Effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive**—an effect that moves measurable parameters in a direction beneficial to Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons relative to baseline. **Adverse**—an effect that moves measurable parameters in a direction detrimental to Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons relative to baseline. **Neutral**—no net change in measureable parameters for the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons relative to baseline.
Magnitude	The amount of change in measurable parameters or variable relative to existing conditions	**Negligible**—no measurable change from existing baseline conditions. **Low**—a measurable change from existing baseline conditions, but results in no net loss in the availability of or access to water and/or resources currently used for traditional purposes. **Moderate**—measurable change (but less than high) from existing baseline conditions, in the availability of or access to water and/or resources currently used for traditional purposes. **High**—measurable change from existing baseline conditions that is a non-compensated substantive and permanent loss in

Table 3.43 Characterization of Residual Environmental Effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
		the availability of or access to water and/or resources currently used for traditional purposes.
Geographic Extent	The geographic area in which an environmental, effect occurs	**PDA**—residual effects are restricted to the PDA. **LAA**—residual effects extend into the LAA. **RAA**—residual effects interact with those of other projects in the RAA.
Frequency	Identifies when the residual effect occurs and how often during the Project or in a specific phase	**Single event**—Effect occurs once during the construction and operation phases of the Project. **Multiple irregular event**—occurs at irregular intervals during construction and infrequently during the operation phases of the Project. **Multiple regular event**—occurs at regular intervals during the operation phases of the Project. **Continuous**—occurs continuously during the construction and operation phases of the Project.
Duration	The period of time required until the measurable parameter or the Use of Land and Resources for Traditional Purposes by Aboriginal Persons returns to its existing condition, or the effect can no longer be measured or otherwise perceived	**Short-term**—residual effect restricted to the construction period (effects are measurable for days to a few months). **Medium-term**—residual effect extends throughout the construction and up to 50 years during operation. **Long-term**—residual effect extends beyond the life of the project.
Reversibility	Pertains to whether a measurable parameter can return to its existing condition after the project activity ceases	**Reversible**—the effect is likely to be reversed after activity completion and reclamation. **Irreversible**—the effect is unlikely to be reversed.
Ecological and Socioeconomic Context	Existing condition and trends in the area where environmental effects occur	**Undisturbed**—area is relatively undisturbed or not adversely affected by human activity. **Disturbed**—area has been substantially previously disturbed by human development or human development is still present.

3.6.1.6 Significance Definition

A significant adverse residual environmental effect on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is defined as a long-term (one full season for a specific species) loss of the availability of, or access to, land and resources used by Aboriginal persons for traditional purposes within the assessment area that cannot be mitigated. This includes an environmental effect that results in a long-term (more than one season) loss of the availability of, or access to, water resources, the aquatic environment, the terrestrial (wildlife, vegetation, and wetlands) environment, and ceremonial sites on crown land located within the assessment area that cannot be mitigated.

3.6.2 Existing Conditions for Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

There are many areas in New Brunswick which have historical and cultural significance to Aboriginal people. These areas include locations where Aboriginal people continue to pursue traditional activities that are an element of a practice, custom, or tradition integral to the distinctive culture of the Aboriginal group. The following sections present the general environmental setting for the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons.

3.6.2.1 Methods

Information regarding Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons relevant to this assessment was obtained through review of existing literature, online public resources, engagement with stakeholders and formal data requests.

Engagement and consultation activities in First Nations communities in New Brunswick have been initiated and will be on-going. The exact nature, scope and detail of First Nation consultation will be determined with the First Nations involved.

Pending information received from consultation, the preliminary conclusions in this section are derived primarily from the information included in biophysical assessments associated with other VCs, in combination with information from a literature review, past project experience, and professional judgment. The reliance on the other VC assessments is based on the assumption that assessments of resources such as wildlife, fish, and vegetation species can inform an assessment of traditional land and resource use activities. The assessments of effects on fish species may not capture the conditions that influence the act of harvesting (e.g., personal choice). However, the abundance of a species that may be used for traditional purposes and the potential effects on that abundance by the Project will directly affect the current use of that species.

As additional information becomes available through the consultation and engagement process, it will be used to update the relevant conclusions in supplemental reports, as necessary.

3.6.2.2 Overview

Mi'kmaq traditional territory (Figure 3.7) is understood to be comprised of all of Nova Scotia and PEI and the eastern shore of New Brunswick, extending north to the Gaspe. Mi'kmaq territory in New Brunswick extends west, where is meets the neighboring Maliseet nations; the divide is generally understood to be the Saint John River watershed as far north as the Gulf of St. Lawrence and south to the Bay of Fundy (Paul n.d., Berneshawi 1997).

There are 15 First Nations communities within the province of New Brunswick, consisting of six Maliseet Nation communities and nine Mi'kmaq Nation communities (Figure 3.8). Based on ethno-historical accounts, oral histories, archaeological research, and historical texts, the Maliseet and Mi'kmaq Nations and their ancestors have lived and used the land and resources of what is now New Brunswick since the retreat of the glaciers.

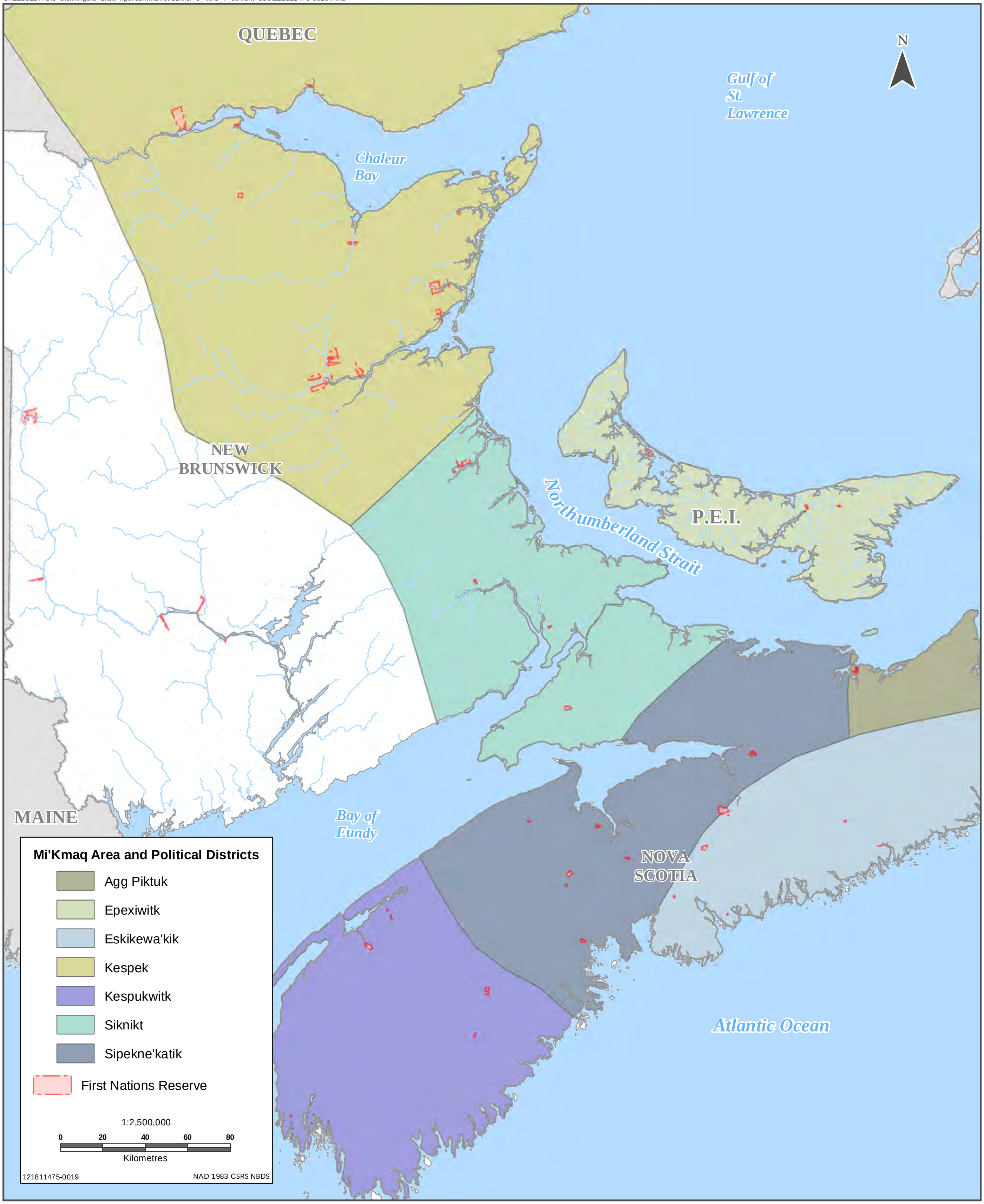
Of the nine Mi'kmaq communities in New Brunswick, four communities fall within close proximity to the Project: Fort Folly First Nation, Bouctouche First Nation, Elsipogtog First Nation and Indian Island First Nation. An overview of these communities is presented in Table 3.44.

Table 3.44 Location of Mi'kmaq Communities in Close Proximity to the Project

Reserve	Size (ha)	Location	Total Population as of January 2015 (On and Off-Reserve)
Fort Folly First Nation			
Fort Folly 1	56.10	11 km southwest of PDA	130
Bouctouche First Nation			
Buctouche 16	62.30	52 km northwest of PDA	118
Indian Island First Nation			
Indian Island 28	38.40	74 km northwest of PDA	183
Elsipogtog First Nation			
Richibucto 15	1742.10	77 km northwest of PDA	3,260
Soegao No. 35	104.5	44 km northwest of PDA	
Source: AANDC, 2014.			

The PDA is located within traditional Mi'kmaq territory. The area from Memramcook to Cumberland County in Nova Scotia was part of a network of portage and overland travel routes and these coastal and estuarine areas provided marine and terrestrial resources for the Aboriginal people. Two portage/traditional travel routes were located within 15 km of the PDA (Stantec 2015); neither of these locations will be affected by the Project.

Based on information gathered to date, the PDA is located mainly on privately owned lands and any use of the lands or resources for traditional purposes is anticipated to be incidental and not related to the right and freedoms of Aboriginal Peoples. The Crown owned land within the Project is limited to the waterways within the PDA and a small section of the provincially owned NB trail near Cape Tormentine. For the purpose of this VC, the potential current use activities are limited to fishing and access via the water ways and the area of the trail.

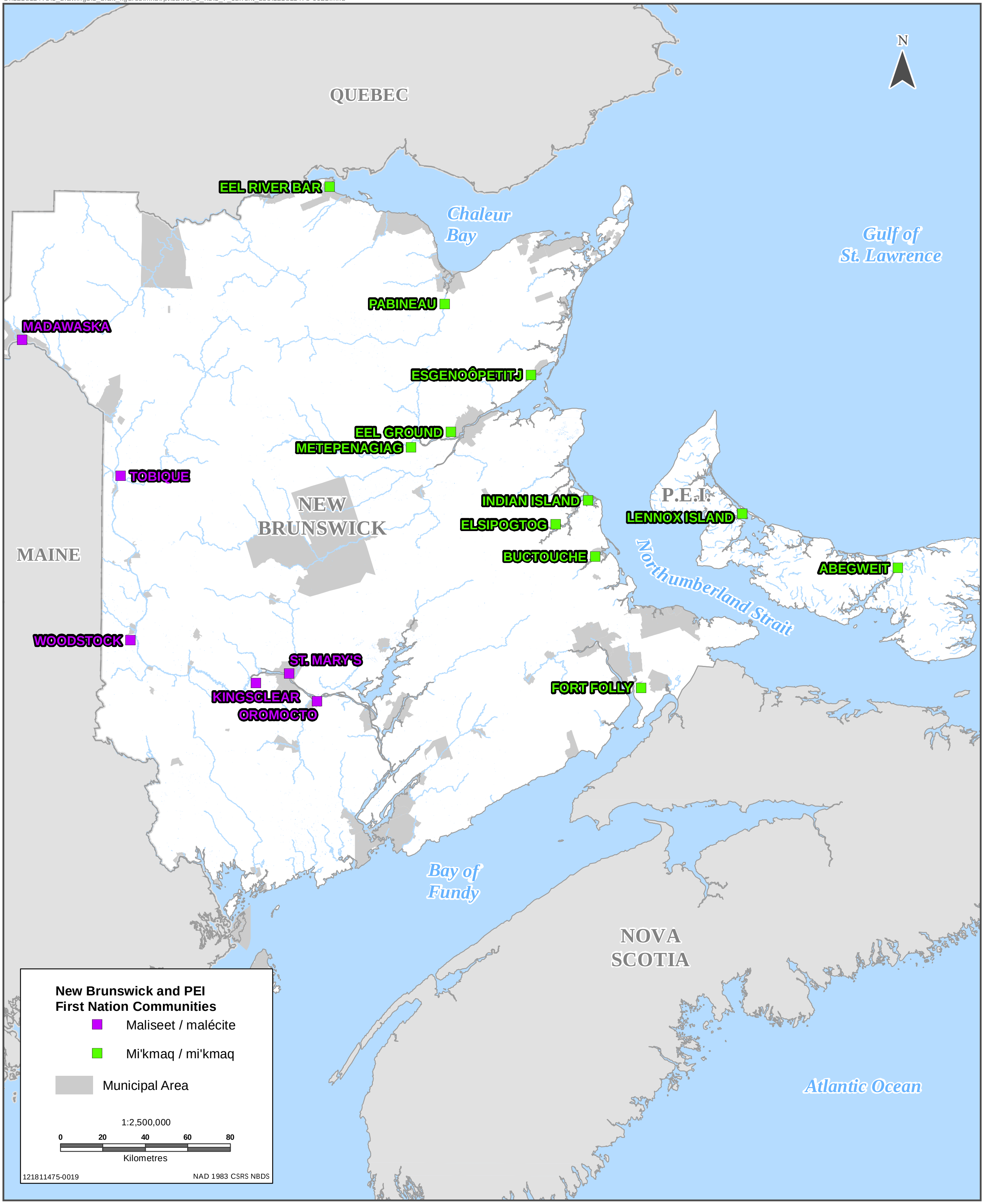


Sources: Base Data - SNB, NBDNR. Mi'Kmaq Areas Data - Paul, Danieln: http://www.danielnpaul.com/Map-Mi'kmaqTerritory.html. Ganong, W.F. 1899. Map of New Brunswick in Prehistory (Indian) Period., Natural Resources (2011).Project Data from Stantec or provided by NB Power / MECL.

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Mi'kmaq Traditional Territory

Figure 3.7



Sources: Mi'Kmaq Areas Data - Paul, Danieln: http://www.danielnpaul.com/Map-Mi'kmaqTerritory.html. Natural Resources (2011).Project Data from Stantec or provided by NB Power / MECL.

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Stantec

New Brunswick and Prince Edward Island First Nation Communities

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Figure 3.8

3.6.3 Project Interactions with Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Table 3.45 identifies potential Project-Environment interactions and effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons. These interactions are indicated by check marks, and are discussed in detail in Section 3.7.4 in the context of effects pathways, standard and Project-specific mitigation/enhancement, and residual effects.

Table 3.45 Potential Project-Environment Interactions and Effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Project Components and Physical Activities	Potential Environmental Effects
	Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons
Construction	
Site Preparation for Land Based Transmission Lines	✓
Physical Construction of Land Based Transmission Lines	✓
Landfall Construction	-
Upgrading Electrical Substation	-
Inspection and Energizing of the Transmission Lines	-
Clean-Up and Re-vegetation of the Transmission Corridor	-
Emissions and Wastes	-
Transportation	-
Employment and Expenditure	-
Operation	
Energy Transmission	-
Vegetation Management	-
Infrastructure Management, Maintenance and Repair	-
Access Road Maintenance	-
Emissions and Wastes	-
Transportation	-
Employment and Expenditure	-
Decommissioning and Abandonment	
Decommissioning	✓
Reclamation	-
Emissions and Wastes	-

Notes:
✓ = Potential interactions that might cause an effect.
– = Interactions between the project and the VC are not expected.

3.6.3.1.1 Construction and Operation

Since the landfall and substation are located on private land, and the substation area is fenced, there is no interaction with current use activities and the landfall construction and upgrading of the electrical substation.

Inspection and energizing of the transmission lines will occur immediately following construction and since the Transmission Lines are suspended overhead, no interaction with current use activities is anticipated.

During the construction of the transmission corridor, emissions and wastes in the form of dust, noise, surface water runoff and erosion may occur as a result of project activities. However, with the appropriate mitigation measures and best management practices in place (as described in Section 3.6.4.2), these interactions are considered Accidents, Malfunctions, and Unplanned Events and assessed in Section 5.0.

The movement of equipment and personnel to and from the PDA is limited to the use of this existing road infrastructure. As described in Section 3.1, temporary watercourse crossings, if required, will be installed to allow equipment to cross over each watercourse. These temporary crossings would be designed in accordance with the Watercourse and Wetland Alteration Program and completely span the watercourse. No watercourses will be forded by equipment. This may result in a temporary restriction to access within the watercourse.

Employment and expenditure includes the procurement of equipment, supplies and materials, taxation and royalties, and employment and income as related to the Project. The Project-related employment and expenditure will not affect the ability of First Nations people to fish, gather, or carry out other traditional activities.

The operation phase of the transmission line is not expected to have an interaction with Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons since the transmission lines are suspended overhead with associated infrastructure located outside of the riparian zone of the water courses. Temporary access restrictions/habitat disturbance due to vegetation clearing will be of very short duration at any given location; areas immediately adjacent to the PDA will remain unaffected by Project activities and will be available for traditional uses. Interactions with fish or wildlife populations due to operation activities is largely discussed in the Freshwater Environment VC (Section 3.1) and Terrestrial Environment VC (Section 3.2); therefore these interactions are not carried forward in this assessment.

3.6.3.1.2 Decommissioning and Abandonment

Decommissioning and abandonment will be assessed at the end of the useful life of the Project. The expected life of the Project is 40 years, at which time it may be decommissioned; however, it is more likely that at that time the Project will be refurbished and will continue to operate on a similar basis in perpetuity. Any decisions made regarding decommissioning and abandonment will be completed in accordance with the applicable regulations at that time and could include either the abandonment or removal of the transmission cables.

Since the available Crown land is generally limited to the water courses and riparian zone, and a 1.6 ha of an active trail, interaction with transportation during construction and decommissioning will be limited to the temporary disruption of access within the watercourses and the trail to allow for the installation/abandonment of the transmission lines and are therefore carried forward in this assessment.

3.6.4 Assessment of Residual Environmental Effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Potential residual effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons include a change to traditional hunting, fishing or gathering opportunities within the LAA due to construction or decommissioning activities.

Potential residual environmental effects on recreational fisheries are discussed in the Land Use VC (Section 3.4), effects on fish species are discussed in the Freshwater Environment VC (Section 3.1) and effects on wildlife and vegetation is discussed in the Terrestrial Environment VC (Section 3.2).

3.6.4.1 Analytical Assessment Techniques

Information regarding Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons in and along the Project PDA was obtained through review of existing literature and online public resources. The conclusions in this section are derived primarily from the conclusions from relevant biophysical assessments, past project experience, and professional judgment. As additional information becomes available through the consultation and engagement process, it will be used to update the relevant conclusions in supplemental reports, as necessary.

3.6.4.2 Assessment of a Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

3.6.4.2.1 Project Pathways for a Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

The overhead transmission line corridor from Cape Tormentine to Memramcook will cross 48 watercourses (and associated riparian areas) and a 1.6 ha area of NB Trail, which is Crown land. During construction, it is anticipated that site activities may result in temporary restrictions to access to the watercourses in the PDA for fishing and plant harvesting (within 30 m of the riparian zone). This restricted access to the Project site could constrain Aboriginal fishing, hunting, gathering opportunities, and ceremonial activities, if practiced, during the construction phase.

3.6.4.2.2 Mitigation for a Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Mitigation for effects related to a change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is closely linked to mitigation measures for the Land Use VC (Section 3.3) and the Freshwater Environment VC (Section 3.1). It is expected that this mitigation will protect habitats and species of traditional importance to the Aboriginal people.

As a general mitigation measure, consultation has been initiated and will continue with Aboriginal communities to avoid or reduce the environmental effects (i.e., temporary access restrictions) of the Project on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons.

Activities will be managed by MECL and NB Power in accordance with each company's EPP and the company's HSE policies.

The following mitigation measures will be implemented for changes in freshwater population, and will be applied during Project construction. They include compliance with regulations, (i.e., NB *Watercourse and Wetland Alteration Regulations),* codified measures (DFO Measures to Avoid Harm), proven mitigation and industry best management practices:

- Span all watercourses and there will be no in-stream work.
- The EPP includes general construction BMPs, a spill management plan and an erosion and sediment control plan. All employees and contractors working on the project will be trained on the EPP prior to starting work.During planning and siting of the transmission line towers NB Power will avoid, where possible, the placement of a transmission line tower within 30 m of a watercourse.
- Clearing of vegetation within the transmission line corridor will occur by hand within 30 m of a watercourse or wetland. Where practical, a riparian buffer with a width of 10 m will remain on each bank.
- Temporary watercourse crossings will be installed to allow equipment to cross over each watercourse, the temporary crossings will be designed in accordance with the Watercourse and Wetland Alteration Program and completely span the watercourse. No watercourses will be forded by equipment.
- If rutting is observed leading up to a watercourse crossing, brush matting or log corduroy will be installed at the approaches.
- If required, transmission line tower construction within 30 m of a watercourse will be constructed in accordance with the *Watercourse and Wetland Alteration Regulations*, including any recommendations made under approval from NBDELG.
- No washing, fueling or maintenance of vehicles or equipment will occur within 30 m of a watercourse or wetland without secondary containment.
- No storage of fuel will occur within 30 m of a watercourse or wetland.

- Machinery will arrive on-site in a clean condition and be maintained free of fluid leaks, invasive species and noxious weeds.
- Vegetation clearing during operation will not occur within 30 m of a watercourse unless the vegetation height violates the clearance requirements for reliability standards to be met by NB Power.

As further mitigation for the potential environmental effects of the Project on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, the Proponent is committed to continuing engagement of, and dialogue with, First Nations about the Project and its potential environmental effects throughout the life of the Project. Should additional interaction be identified, appropriate mitigation will be developed in consultation with the affected First Nations and regulatory agencies, as warranted.

3.6.4.2.3 Residual Project Environmental Effect for a Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

A residual environmental effect leading to a change in current use of land and resources for traditional purposes by Aboriginal persons may occur during construction, operation and decommissioning of the Project. The construction and decommissioning may results in disruptions to access to fishing, hunting, gathering, and ceremonial activities, if practiced, within the PDA. Potential interactions will be short in duration and confined to the PDA. With the implementation of mitigation measures such as implementation of a Communications Plan and mitigation for freshwater habitat, the magnitude of the effect of the Project on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is anticipated to be low. This potential effect on traditional fishing, hunting and gathering activities is anticipated to occur at multiple irregular events during the construction and decommissioning of the Project. Based on existing conditions and past evidence, this environmental effect is anticipated to be reversible and short in duration. After completion of Project construction and decommissioning, it is expected that traditional fishing, hunting and gathering activities within the PDA will return to pre-construction conditions (subject to certain terms and conditions related to landowner permission).

3.6.4.3 Summary of Residual Project Environmental Effects

A summary of the environmental effects assessment and prediction of residual environmental effects resulting from interactions with Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is provided in Table 3.46 and discussed below.

Table 3.46 Summary of Project Residual Environmental Effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Residual Effect	Residual Environmental Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socioeconomic Context
Change in Current Use of Land And Resources for Traditional Purposes by Aboriginal Persons	C	A	L	PDA	ST	IR	R	U
	D	A	L	PDA	ST	IR	R	U

KEY
See Table 3.43 for detailed definitions.

Project Phase:
C: Construction
O: Operation
D: Decommissioning and Abandonment

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term
P: Permanent

NA: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socioeconomic Context:
D: Disturbed
U: Undisturbed

3.6.5 Determination of Significance

3.6.5.1 Significance of Residual Project Effects

A change in current use of land and resources for traditional purposes by Aboriginal persons within the LAA is not expected to be significant during the construction, operation or decommissioning phases of the Project provided mitigation measures are implemented and in consideration of the following:

- The Project is located on private land, with the exception of the Crown Land associated with the water courses within the PDA (including the 30 m wide riparian zone) and the existing NB Trail.
- The small size of the PDA compared to the available fishing/hunting/gathering grounds within the RAA.
- The short timeframe anticipated for the completion of the construction or decommissioning activities of the Project.

With the implementation of the proposed mitigation, the Project will not result in a change in an Aboriginal person's ability to participate in traditional activities due to changes in availability of resources (e.g., change in fish species or populations), with the possible exception of a very small area within the PDA during Project construction. Areas immediately adjacent to the PDA will remain unaffected by Project activities and will be available for traditional uses. Therefore, the residual environmental effects of the Project on Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons during all Project phases are predicted to be not significant.

3.6.6 Prediction Confidence

Confidence in these conclusions is moderate based on reliance on secondary sources for traditional land use information within the PDA. However, regarding the potential environmental effects on freshwater life and terrestrial environment, there is a high level of understanding of the potential environmental effect pathways, and anticipated effectiveness of the mitigation and project planning measures. The overall prediction confidence associated with this VC therefore is moderate to high.

As consultation is ongoing, should Traditional Knowledge information become available, this information will be considered and residual effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons will be reviewed. Given the qualitative and subjective nature of assessing the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, the views of Aboriginal groups may differ from this assessment. Should concerns regarding residual effects be identified through ongoing Aboriginal engagement this information will be provided through additional reporting.

3.6.7 Follow-up and Monitoring

There is no follow up or monitoring proposed for this VC.

The Proponent will continue to consult with the Aboriginal communities to reasonably address Project-specific issues related to residual effects and additional work and/or monitoring may be required pending the results of the engagement process.

4.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Effects of the environment on the Project are associated with risks of natural hazards and influences of nature on the Project. These effects may arise due to forces of nature associated with weather, climate, climate change, seismic activity, forest fires, or marine hazards. Potential effects of the environment on any project are typically addressed through design and operational procedures developed in consideration of expected normal and extreme environmental conditions. Effects of the environment, if unanticipated or unmanaged, could result in adverse changes to Project components, schedule, and/or costs.

As a matter of generally accepted engineering practice, designs and design criteria tend to consistently overestimate and account for possible forces of the environment. Engineering design therefore inherently incorporates a considerable margin of safety so that a project is safe and reliable throughout its lifetime. NB Power will monitor any observed effects of the environment on the Project, and take action, as necessary, to repair and upgrade Project infrastructure and modify operations to permit the continued safe operation of the facility.

4.1 SCOPE OF ASSESSMENT

Potential effects of the environment on the Project relevant to conditions potentially found in New Brunswick include:

- climate, including weather and weather variables such as:
  - air temperature and precipitation
  - fog and visibility
  - winds
  - extreme weather events
  - storm surges and waves
- climate change (including sea level rise and coastal erosion)
- seismic events
- forest fire from causes other than the Project
- marine hazards

4.1.1 Regulatory and Policy Setting

Direction on the scoping of effects of the environment on the Project for this assessment has been provided by the New Brunswick government, as noted in the following section.

4.1.2 The Influence of Consultation and Engagement on the Assessment

As outlined in Volume 1, Section 3.2 (Consultation and Engagement), scoping documents were sent to provincial regulators in New Brunswick and PEI, in addition to PWGSC.

The New Brunswick Department of Environment and Local Government (NBDELG) Technical Review Committee (TRC) has requested that future climate conditions be considered by the Proponent with respect to location, design and construction of the transmission line and its associated infrastructure.

4.1.3 Potential Environmental Effects, Pathways and Measurable Parameters

Potential effects of the environment on the Project may include:

- reduced visibility and inability to manoeuver construction and operation equipment
- delays in receipt of materials and/or supplies (e.g., construction materials) and/or in delivering products
- changes to the ability of workers to access the site (e.g., if a road were to wash out)
- damage to infrastructure
- increased structural loading
- corrosion of exposed oxidizing metal surfaces and structures, perhaps weakening structures and potentially leading to malfunctions
- loss of electrical power resulting in potential loss of production

These and other changes to the Project can result in delays or damage to the Project processes, equipment, and vehicles. The effects assessment is therefore focused on the following effects:

- change in Project schedule
- damage to infrastructure

Some effects, such as damage to infrastructure, can also result in consequential effects on the environment (e.g., spills); these environmental effects are addressed as Accidents, Malfunctions, and Unplanned Events in Chapter 5.

4.1.4 Boundaries

4.1.4.1 Spatial Boundaries

The spatial boundaries for the assessment of effects of the environment on the Project include the areas where Project-related activities are expected to occur. For the purpose of this assessment, the spatial boundaries for effects of the environment on the Project in New Brunswick are limited to the Project Development Area (PDA), as described below.

- Project Development Area (PDA): The PDA comprises the immediate area of physical disturbance associated with the construction and operation of the Project. The PDA includes: the existing substation in Memramcook where upgrades to the existing substation will occur within the substation footprint; a 40 km long, 30 m wide transmission line RoW from Memramcook to Melrose and a 17 km long, 60 m wide transmission line RoW from Melrose to Cape Tormentine; a cable termination site; and a 10 m easement around cable lines.

Where consequential environmental effects are identified, they are considered within the boundaries of the specific zone of influence of those consequences. Accidental events that could arise as a result of effects of the environment (e.g., spills) are addressed in Section 5.0.

4.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of the effects of the environment on the project include construction, operation, and decommissioning and abandonment. Construction in the terrestrial environment is expected to occur over a period of 16 months. Construction of the landfall site and transmission line from Melrose to Cape Tormentine is expected to be completed over 9 to 10 months, between March and December 2016. Construction of transmission line between Melrose and Memramcook is expected to begin in September 2016 with completion expected to take place in June 2017. Operation will begin following construction and is anticipated to continue for the life of the Project (approximately 40 years). Decommissioning and abandonment would take place following the useful service life of the Project and which would be carried out in accordance with regulations in place at that time.

4.1.5 Residual Environmental Effects Description Criteria

A significant adverse residual effect of the environment on the Project is one that would result in:

- a substantial change of the Project schedule (e.g., a delay resulting in the construction period being extended by one season)
- a long-term interruption in service (e.g., interruption in power transmission activities such that electricity demands cannot be met)
- damage to Project infrastructure resulting in a significant environmental effect
- damage to the Project infrastructure resulting in a substantial increase in a health and safety risk to the public or business interruption
- damage to the Project infrastructure resulting in repairs that could not be technically or economically implemented

4.2 EXISTING CONDITIONS FOR EFFECTS OF THE ENVIRONMENT ON THE PROJECT

4.2.1 Climate

Climate is defined as the statistical average (mean and variability) of weather conditions over a substantial period of time (typically 30 years), accounting for the variability of weather during that period (Catto 2006). The relevant parameters used to characterize climate are most often surface variables such as temperature, precipitation, and wind, among others.

The current climate conditions are generally described by the most recent 30 year period (1981 to 2010; Government of Canada 2015a) for which the Government of Canada has developed statistical summaries, referred to as climate normals. The closest weather station to the Project with available historic data is the Sackville station, located approximately 20 km south-east of the Memramcook substation. Limited historic climate data are available for the Sackville station; therefore, data from the Moncton weather station, located approximately 30 km from the Memramcook substation, are also used to supplement information on regional conditions relevant to the PDA in New Brunswick.

4.2.1.1 Air Temperature and Precipitation

The average monthly temperature in Sackville has ranged between -7.5°C (January) and 17.6°C (August) (Table 4.1). Extreme maximum temperature was 31.5°C (August 1993) and the extreme minimum temperature was -31.0 °C (January 1982).

Sackville averages 1,146.5 mm of precipitation per year, of which, approximately 915.2 mm fell as rain and 231.2 cm as snow. Extreme daily precipitation at Sackville ranged from 34.6 mm (February) to 74.2 mm (July). On average, there have been 7.4 days each year with rainfall greater than 25 mm, and snowfalls greater than 25 cm occur on average 0.66 day per year (Government of Canada 2015a).

Table 4.1 Air Temperature and Precipitation Climate Normals, Sackville, NB (1981-2010)

Month	Temperature (°C)					Precipitation (mm)					Mean No. of Days with							
	Averages			Extreme		Rainfall (mm)	Snowfall (cm)	Precipitation (mm)	Extreme daily Rainfall (mm)(Year)	Extreme Daily Snowfall (mm)(Year)	Temperature (°C)				Snow (cm)		Rain (mm)	
	Max	Min	Avg	Max (Year)	Min (Year)						>=30*	>=20*	<=-20	<=-30	>=10	>=25	>=10	>=25
Jan	-3.1	-11.8	-7.5	14 (2000)	-31 (1982)	40.8	62.6	103.4	49.8 (1998)	45 (1982)	0	0	2.9	0.09	2.1	0.32	1.4	0.41
Feb	-2.2	-10.8	-6.5	13 (2000)	-29 (1993)	30.4	44.2	74.6	34.6 (1984)	30 (1992)	0	0	2.3	0	1.6	0.09	1.1	0.18
Mar	1.9	-6.2	-2.2	17.5 (1999)	-25.5 (1989)	47.1	45.4	92.5	37 (1983)	30 (1987)	0	0	0.5	0	1.6	0.05	1.9	0.18
Apr	7.6	-0.7	3.5	23 (1994)	-13 (1995)	68	21.4	89.4	37.2 (2001)	30 (1997)	0	0.19	0	0	0.67	0.05	2.2	0.52
May	14.5	4.4	9.5	28 (1992)	-3.5 (1984)	105.1	3.3	108.4	41.8 (2000)	15 (1995)	0	3.6	0	0	0.19	0	3.2	0.86
Jun	19.2	9.1	14.2	28 (1983)	-0.5 (1992)	94	0	94	52.4 (1995)	0 (1981)	0	12.5	0	0	0	0	3	0.62
Jul	22.4	12.6	17.5	30.5 (1999)	5 (1992)	86.5	0	86.5	74.2 (1983)	0 (1981)	0.05	23.6	0	0	0	0	2.9	0.81
Aug	22.3	12.9	17.6	31.5 (1993)	4.5 (1991)	81.6	0	81.6	51 (1990)	0 (1981)	0.1	23.4	0	0	0	0	2.5	0.71
Sep	18.2	9.4	13.8	30.5 (1999)	-2 (1989)	107	0	107	69.6 (1999)	0 (1981)	0.05	8.1	0	0	0	0	3.1	1.2
Oct	12.2	4.1	8.2	23.5 (2001)	-4.5 (1985)	105.4	0.1	105.5	60 (1998)	2 (1997)	0	0.52	0	0	0	0	3.5	1
Nov	6	-1	2.5	22 (1982)	-16 (1989)	94.9	13.1	108.1	63.6 (1991)	25 (1997)	0	0.05	0	0	0.19	0.05	3.5	0.48
Dec	0	-7.7	-3.8	15.5 (1990)	-27 (1980)	54.5	41	95.5	53.4 (1990)	25 (1991)	0	0	0.81	0	1.3	0.1	2	0.48
Annual	9.9	1.2	5.6	-	-	915.2	231.2	1146.5	-	-	0.2	72	6.5	0.09	7.7	0.66	30.3	7.4

Source: Government of Canada 2015a

4.2.1.2 Fog and Visibility

Fog is defined as a ground-level cloud. It consists of tiny water droplets suspended in the air and reduced visibility to less than 1 km (Environment Canada 2014a). "Days with fog" are days when fog occurs and horizontal visibility is less than 1 km (thick fog) and 10 km (fog) (Phillips 1990). Limited historical climate data for fog and visibility are available for the Sackville station; therefore, fog data from the Moncton weather station, located approximately 30 km from the Memramcook substation, are presented to provide some indication of the magnitude of fog experienced in the region. The hours with the measured increase in hours of reduced visibility (< 1 km) is between January and April (Government of Canada 2015b) (Table 4.2). During the winter, the Petitcodiac River does not fully freeze over, which leaves a source of moisture for cloud or fog to form. A combination of cool temperatures and low winds will lead to fog formation over the river with the tide and travel towards the Moncton area. This can occur during the spring and early summer as well, when warm air flows over the cool water (NAV CANADA 2001). The Moncton weather station has experienced, on average, 171.8 hours (7.2 days) per year when visibility is less than 1 km.

Table 4.2 Visibility - Climate Normals, Moncton (1981-2010)

Visibility (hours with)													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
< 1 km	18	19.5	24.2	18.4	12.5	10.4	11.3	9.5	9.8	9.7	12.6	15.7	171.8
1 to 9 km	107.8	96	111.2	109.6	80.9	69.2	64.5	72	56.4	53.4	82	106.1	1009.1
> 9 km	618.1	562.4	608.6	592	650.6	640.5	668.2	662.5	653.8	680.9	625.4	622.2	7585.1
Source: Government of Canada 2015b													

4.2.1.3 Wind

Monthly average wind speeds measured at the Moncton weather station range from 13.2 to 19.2 km/h (Figure 4.1). From November to March, the dominant wind direction is from the west, with winds predominantly blowing from the north during April, and from the southwest during May to October (Government of Canada 2015b). Maximum hourly wind speeds measured at the Moncton weather station range from 56 km/hr to 103 km/hr, while maximum gusts for the same period range from 89 km/hr to 161 km/hr (Government of Canada 2015b). Occurrences of extreme winds do occur at the Moncton weather station. Over the last three decades, there has been an average of 23.6 days per year with winds greater than or equal to 52 km/h and 6.4 days per year with winds greater than or equal to 63 km/h (Government of Canada 2015b).

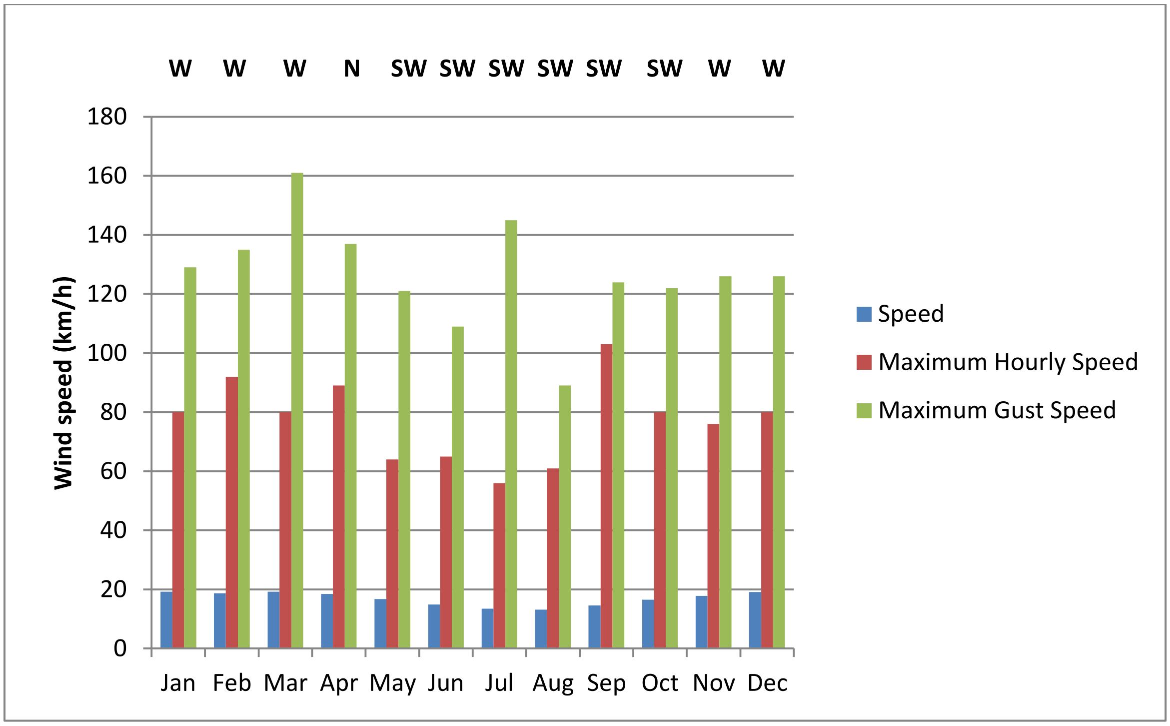


Figure 4.1 Predominant Monthly Wind Direction, Monthly Mean, Maximum Hourly and Maximum Gust Wind Speeds (1981 to 2010) at Moncton Weather Station, NB

4.2.1.4 Extreme Weather Events

Extreme precipitation and storms can occur in NB throughout the year, but tend to be more common and severe during the winter. Winter storms generally bring high winds and combination of snow and rain. Freezing rain has been observed on approximately 12 days a year in New Brunswick, with an average of 59 hours at Moncton.

One of the most noteworthy storms in recent history struck eastern New Brunswick on January 4, 1989, where Moncton experienced 110 km/h winds and 67 cm of snow over a 24 hour period. The Groundhog Day storm in February 1976 was another intense winter storm that caused a great deal of damage in southern New Brunswick (Phillips 1990).

On January 21, 2000, a storm produced a 2.0 m storm surge along the Northumberland Strait coast of New Brunswick. This storm was a result of extremely low atmospheric pressure and powerful onshore winds (R J Daigle Enviro 2011).

Extreme storm events in December 2010 affected much of New Brunswick, where some areas received as much as 200 mm of rain; these events threatened public safety and transportation systems, and damages were estimated to be approximately $50 million (Government of New Brunswick 2015).

In the summer and fall, southern New Brunswick is expected to experience at least one heavy rainstorm every one to two years (Phillips 1990).

In New Brunswick, river valleys and flood plains can pose a risk because of ice jams, harsh weather and the floods of annual spring thaw (Government of Canada 2015). Flooding in New Brunswick is rather common, especially along the Saint John River (Phillips 1990). Therefore, flooding is listed as one of the regional hazards in New Brunswick through the federal governments "Get Prepared" campaign (Government of Canada 2015), and the New Brunswick Emergency Measures Organization monitors flooding as a natural risk and hazard through its "River Watch" program (http://www2.gnb.ca/content/gnb/en/news/public_alerts/river_watch.html).

Electrical storms, or thunderstorms, which are more frequent in New Brunswick than the rest of Atlantic Canada, occur on average 10 to 20 times a year (Phillips 1990). Generally, only one of these storms (per year) is extreme enough to produce hail. Thunderstorms can produce extremes of rain, wind, hail and lightning; however, most of these storms are relatively short-lived (Phillips 1990).

Tornadoes are rare, but do occur in New Brunswick. There have been 85 confirmed and probable F3 Tornadoes[1] in eastern New Brunswick between 1729 and 2009 (Environment Canada 2011). Of Canada's ten worst tornadoes on record, an F3 tornado, occurred in eastern New Brunswick at Bouctouche on August 6, 1879 (CBC News 2013 May 21), which killed 5 people and injured 10.

4.2.1.5 Storm Surges and Waves

Rising sea levels and more frequent and severe weather has also brought about an increase in frequency of storm surges. Storm surges are defined as the elevation of water resulting from meteorological effects on sea level. During the past 15 years, storm surges have resulted in property destruction in all four Atlantic Provinces (Vasseur and Catto 2008). In Atlantic Canada, storm surges have been higher in coastal waters and highest in the Gulf of St. Lawrence (Bernier et al. 2006).

In southeastern New Brunswick, storm surges range from 0.6 m to 2 m in height and surges above 0.6 m in height occur about two to three times per year along the Canadian Atlantic coast (Parkes et al. 1997). Typically, surges were found to last for an average of 2.2 hours, and occasionally over 12 hours. At Saint John, where the vertical difference between the average high water level and the extreme high water level is in the order of 2.3 m, the risk from storm surge flooding is much less than in areas with lower tidal amplitude. Two important storm surges that happened close to the occurrence of tidal high water caused considerable damage throughout the Bay of Fundy. The Groundhog Day storm in 1976 caused a surge off the coast of Saint John estimated at 1.6 m, with maximum wave heights (trough to crest) of 12 m with swells as high as 10 m. The famous Saxby Gale of 1869 is estimated to have created a storm surge between 1.2 m and 2.1 m (Parkes et al. 1997), with the higher surges occurring in the upper Bay of Fundy between Moncton and Burncoat, Nova Scotia.

[1] Tornadoes are classified on a scale known as the Fujita scale. F3 Tornadoes ("severe tornado") have winds ranging between 253-330 km/h and result in roofs and walls torn off well-constructed houses, trains overturned, and most trees in forests uprooted.

4.2.2 Climate Change

While "climate" refers to average weather conditions over a 30-year period, "climate change" is an acknowledged change in climate that has been documented over two or more periods, each with a minimum duration of 30 years (Catto 2006). The Intergovernmental Panel on Climate Change (IPCC) defines climate change as a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes, external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC 2012). The United Nations Framework Convention on Climate Change makes a distinction between climate change attributed to human activities and climate variability attributable to natural causes. Climate change is a change of climate directly or indirectly attributed to human activity that alters the composition of the global atmosphere, which is in addition to natural climate variability observed over comparable time periods (IPCC 2007).

Prediction of effects of climate change are limited by the inherent uncertainty of climate models in predicting future changes in climate parameters. Global and regional climate models can provide useful information for predicting and preparing for global and macro-level changes in climate; however, the ability of models to pinpoint location-specific changes to climate is still relatively limited.

4.2.2.1 Sea Level Rise

Global sea levels have risen 1.8 mm/year over a 40 year period (1961 to 2003) and a more recent rate of 3.1 mm/year between 1993 and 2003 (Bindoff et al. 2007). The sea level has been slowly and steadily rising in most of Atlantic Canada for centuries due to crustal subsidence, warming trends, and the melting of polar ice caps (Government of Newfoundland and Labrador 2003). In particular, the sea level has been gradually rising along the southeastern coast of New Brunswick for several thousand years. The changes associated with that rise have become especially evident along the Northumberland Strait over the last several decades (Daigle et al. 2006) due to the low coast profile and substantive development near the coast line and on lands near mean sea level. Most of Atlantic Canada is also experiencing some crustal subsidence in coastal areas, thus compounding the rise in sea level (Vasseur and Catto 2008).

Sea level rise sensitivity is defined as the degree to which a coastline may experience physical changes such as flooding, erosion, beach migration, and coastal dune destabilization (Natural Resources Canada 2010).

Sea levels are expected to continue to rise at a greater rate in the 21st Century than was observed between 1961 and 2003 due to more rapid warming; this also increases rate of melting of the ice caps and glaciers. By the mid-2090s, global sea levels are projected to rise at a rate of approximately 4 mm/year, and reach 0.22 m to 0.44 m above 1990 levels (Bindoff et al. 2007). It is generally understood that a rise in sea level, coupled with more frequent and severe weather, are likely to bring about storm surges that could flood areas in Atlantic Canada that were once unlikely to flood (Conservation Corps of Newfoundland and Labrador 2008).

At the current sea level, storm surges of 3.6 m are anticipated annually in the southern Gulf of St. Lawrence by 2100 (Parkes et al. 2006). Over the next 100 years, storm surges in excess of 4.0 m are anticipated to occur once every 10 years (Vasseur and Catto 2008).

Climate systems are highly variable, reducing the certainty with which climate projections can be made. While the directions of some climate conditions are nearly certain, there is greater uncertainty in the projected magnitude or extent of the conditions. For example, while it is expected that temperatures will increase over the next 80 years, determining the extent of that temperature increase becomes progressively more difficult at times further into the future. When investing in infrastructure and industries of the future that will be subject to sea level rise and storm surges, precautions must be taken in their design to ensure consideration of the environmental effects of climate change.

Coastal erosion caused by sea level rise and wave action may also be influenced by the strength of the coastal material. A coastal erosion assessment at the landfall site in Cape Tormentine, NB was conducted in 2015. The objective of this assessment was to determine the present shoreline erosion process and rates in the vicinity of the New Brunswick (Cape Tormentine) cable landing site. The findings from this assessment would be used to provide recommendations on long-term protection of the landing sites.

The assessment consisted of two phases:

- A site visit was conducted with a specific focus on the local physiography. The intent was to help gain an understanding of the dynamics that shaped the present day shoreline. An understanding of the landform history would enable a more accurate prediction of future changes to the shoreline.
- A review and comparison of historical aerial photos was carried out for the cable landing site in Cape Tormentine. A visual representation of the changes in the shoreline is shown on Figure 4.2.

The landing site along the NB coastline is currently a camping area with a beach that gently slopes to the water and has approximately 100 m of seafloor exposed near low water. The surficial geology along the shoreline is consistent and generally consists of sand, with no visible bedrock outcrops, and a small bank that leads to the camping area. Moving off the shore, the surficial geology changes to a thin topsoil layer overlying a reddish brown silty sand with gravel glacial till. The topography along the top of the slope is relatively level.

Since 1944, the south portion of the area has experienced a loss in shoreline through erosion, while the north portion has experienced an increase in shoreline. This may be due to construction activities (infilling over the years) and material being carried from the southern portion of the coastline. The average change in shoreline in this area ranges from 0 to 20 m as shown in the inset to Figure 4.2. At the cable landing site, there has been a smaller change in shoreline, with a decrease of approximately 3 m (see Figure 4.2).

4.2.3 Seismic Activity

Seismic activity is dictated by the local geology of an area and the movement of tectonic plates comprising the Earth's crust. Natural Resources Canada monitors seismic activity throughout Canada and identifies areas of known seismic activity in order to document, record, and prepare for seismic events that may occur.

The New Brunswick Project components lie within the Northern Appalachians seismic zone (Figure 4.3) (NRCan 2013a), which includes most of New Brunswick and extends southwards into New England and Boston. It is one of five seismic zones in southeastern Canada, where the level of historical seismic activity is low. Historical seismic data recorded throughout eastern Canada has identified clusters of earthquake activity. Earthquakes in New Brunswick generally cluster in three regions: the Passamaquoddy Bay region, the Central Highlands (Miramichi) region, and the Moncton region (Burke 2011).

Sources: GeoNB, NB Power, . Imagery: Natural Resources (2011). Project Data from Stantec or provided by NB Power.

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Stantec

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Coastal Erosion From 1944 to 2011 at Cape Tormentine

Figure 4.2

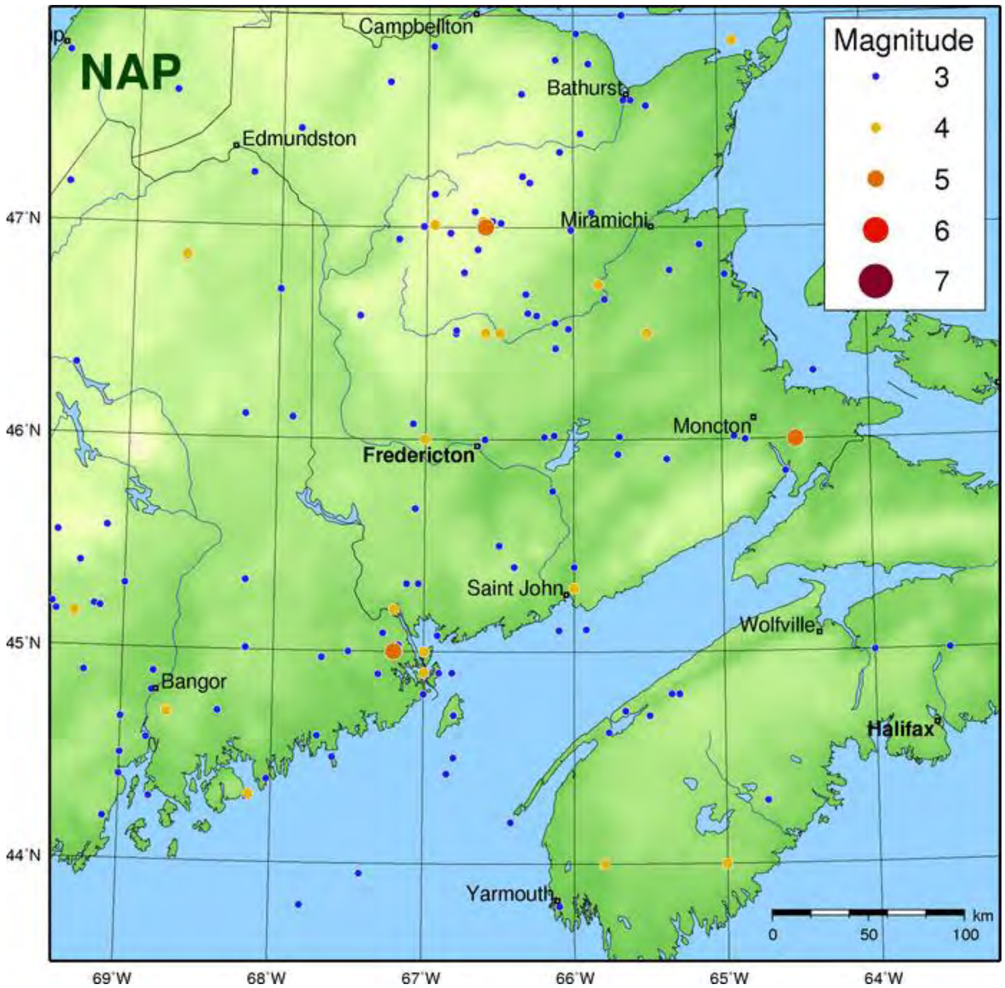


Figure 4.3 Northern Appalachians Seismic Zone

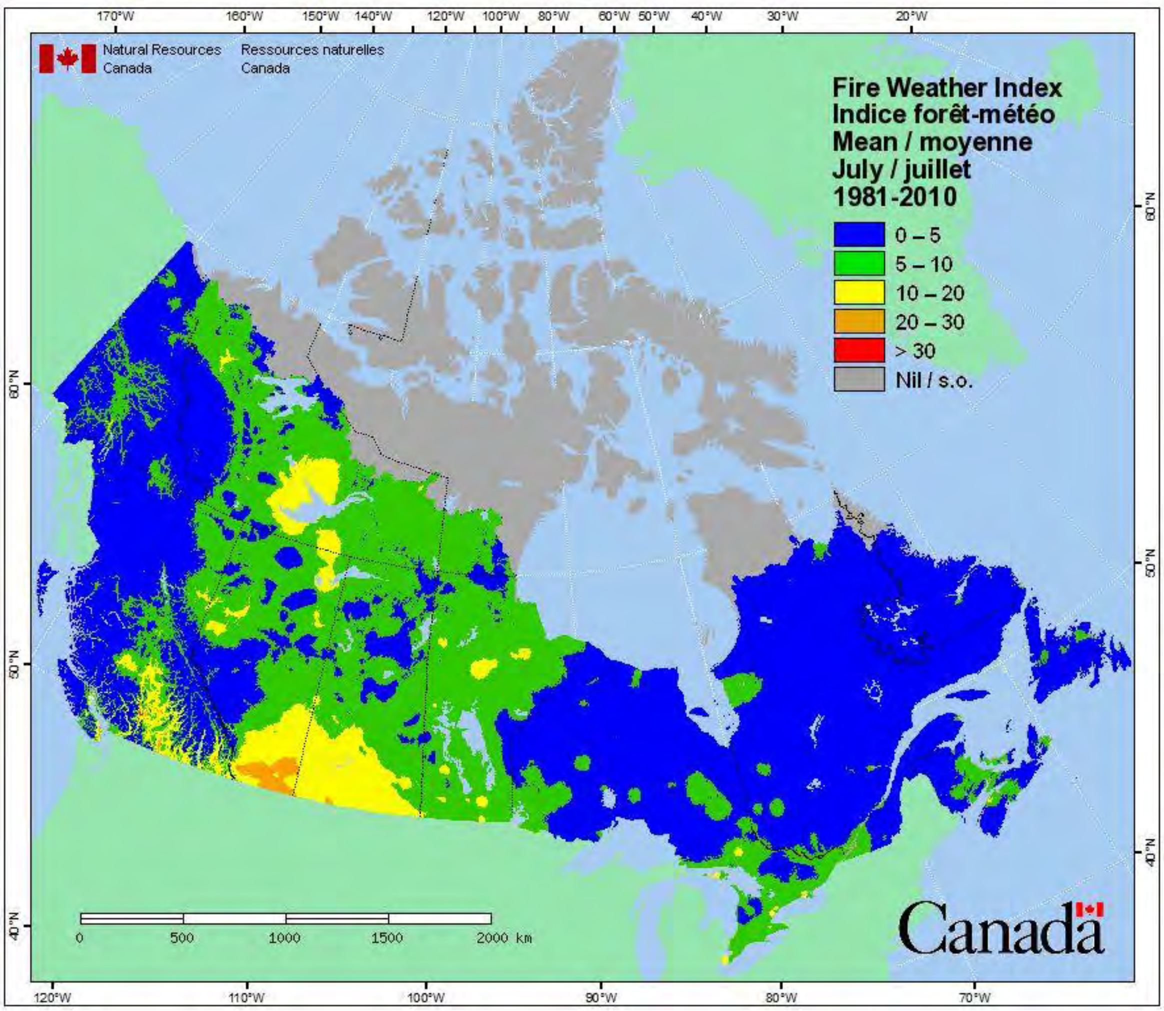
The largest earthquake instrumentally recorded in New Brunswick was a magnitude 5.7 event (on the Richter scale) on January 9, 1982, located in the north-central Miramichi Highlands. This earthquake was followed by strong aftershocks of magnitude 5.1 and 5.4. Prior to 1982, other moderate earthquakes with estimated magnitude in the range of approximately 4.5 to 6.0 occurred in 1855, 1869, 1904, 1922, and 1937 (Basham and Adams 1984). The 1869 and 1904 earthquakes were both located within the Passamaquoddy Bay region, with estimated magnitudes of 5.7 and 5.9, respectively (Fader 2005). The maximum credible earthquake magnitude for the Northern Appalachians region is estimated to be magnitude 7.0, based on historical earthquake data and the regional tectonics (Adams and Halchuk 2003).

There is potential for earthquakes of up to approximately magnitude 7.5 along the fault zones associated with the St. Lawrence River. However, these events would be located more than 200 km from the Project site, and therefore the amplitude of ground motions experienced at the Project site would be low due to attenuation over a large distance. Review of historical earthquake records and regional tectonics indicates that the Project site is situated in a region of low seismicity.

4.2.4 Forest Fires

The Fire Weather Index is a component of the Canadian Forest Fire Weather Index System. It is a numeric rating of fire intensity. It combines the Initial Spread Index and the Buildup Index, and is a general index of fire danger throughout the forested areas of Canada (Natural Resources Canada 2015).

The mean Fire Weather Index for July for New Brunswick (i.e., normally the driest month of the year), when risk of forest fire is typically the greatest, is rated from 5 to10 (for years 1981 to 2010) (Figure 4.4); this is in the lower range of possible risk which, at the highest range, can exceed 30 on the Fire Weather Index (Natural Resources Canada 2015).



Source: Natural Resources Canada 2015

Figure 4.4 Average Fire Weather Index for the Month of July (1981-2010)

The closest fire protection services to the Project would primarily be supported through the City of Moncton's Fire Department, the City of Dieppe's Fire Department, the Town of Riverview's Fire and Rescue Department, the Village of Memramcook's Fire Department, the Town of Shediac's Fire Brigade, the Town of Sackville's Fire Brigade and local volunteer firefighting brigades throughout more rural areas near the Project.

The largest fire department in the region is that of the City of Moncton. The City of Moncton has five fire stations which are located to allow firefighters to arrive at the scene of an emergency as quickly as possible. The department consists of 120 members, including the fire chief, deputy chiefs, assistant deputy chiefs, captains, lieutenants, firefighters, division chiefs, training officers, fire prevention officers, and administration, as well as 40 volunteer firefighters who are on call 24 hours a day (Moncton Industrial Development 2014). Firefighting equipment includes three engines, three ladder trucks, three pumper tankers, one heavy rescue unit, one hazardous material response unit, one rescue inflatable boat with motor, one fire command unit, one fire investigation van, one rescue hovercraft and eight other vehicles for staff, administration and training (Moncton Industrial Development 2014).

Sackville's fire department has 42 volunteer firefighters and maintains a fleet of modern vehicles.

4.2.5 Marine Hazards

Sea spray, fairly common in the Northumberland Strait, results when high winds carry water droplets suspended in air when waves break over rocks. The effects of sea spray would potentially be felt in the PDA at the landfall sites, and at the cable termination site in Cape Tormentine.

Ice scour by sea ice and landfast ice is also an issue at landing sites for submarine cables in cold climates, as it can disturb landfall site and potential interruption of service.

4.3 ASSESSMENT OF EFFECTS OF THE ENVIRONMENT ON THE PROJECT

4.3.1 Effects of Climate on the Project

4.3.1.1 Project Pathways for Effects of Climate on the Project

The potential effects of climate must be considered during infrastructure development, particularly in close proximity to marine environments. Extreme temperatures and severe precipitation, fog and visibility, winds and extreme weather events could potentially cause:

- reduced visibility and inability to manoeuver equipment
- delays in construction/operation activities and delays in receipt of materials
- inability of personnel to access the site (e.g., if a road were to wash out)
- damage to infrastructure
- increased structural loading

During construction, extreme low temperatures have the potential to reduce the ductility of construction materials used in Project components (e.g., ancillary facilities) and increase susceptibility to brittle fracture.

Snow and ice have the potential to increase loadings on Project infrastructure (e.g., substation, termination site). Extreme snowfall can also affect winter construction activities by causing a delay in construction or a delay in delivery of materials, and resulting in additional effort for snow clearing and removal.

Extreme precipitation contributing to unusual flooding during snowmelt and extreme rainfall events could potentially lead to flooding and erosion. Flooding and erosion could in turn lead to the release of total suspended solids (TSS) in runoff and related environmental effects. These activities and associated ensuing events are considered accidental events, and are presented in Section 5.0.

During operation or decommissioning and abandonment phases, the PDA could experience heavy rain, snowfall and freezing rain events that are capable of causing an interruption of services such as electrical power for extended periods of time, or increasing structural loading on the Project components.

Reduced visibility due to fog could make manoeuvring of equipment difficult in the early part of the day. However, these short delays are anticipated and can often be predicted, and allowance for them will be included in the construction schedule. Disruption of construction activities and delays to the schedule will be avoided by scheduling tasks that require precise movements for periods when the weather conditions are favourable.

Wind storm events could potentially cause reduced visibility (due to blowing snow or rain) and interfere with maneuvering of equipment or transporting materials or staff movements. Wind also has the potential to increase loadings on Project infrastructure and cause possible damage. During electrical storms, for example, fault currents (defined as an electric current that flows from one conductor to ground or to another conductor owing to an abnormal connection (including an arc) between the two conductors (IESO 2010)) may arise in electrical systems during a lightning strike. This could result in danger to personnel and damage to infrastructure. These types of adverse effects can occur where Project infrastructure is close to the grounding facilities of electrical transmission line structures, substations, generating stations, and other facilities that have high fault current-carrying grounding networks. A lightning strike could also ignite a fire (see Section 5.3 for a discussion of fire as an accidental event, and Section 4.3.4 for a discussion of forest fire).

Results of the coastal erosion assessment indicate that the site of the cable landing in Cape Tormentine has not been susceptible to substantive coastal erosion in the past, and is not likely to change much in the future.

Storm surges and waves could potentially affect land-based Project facilities if not accounted for in the engineering of and design for near sea level structures (i.e., termination site, substation,and associated infrastructure).

4.3.1.2 Mitigation for Climate

To address the potential effects of climate (air temperature, precipitation, fog and visibility, winds, and extreme weather events), all aspects of the Project design, materials selection, planning, and maintenance will consider normal and extreme conditions that might be encountered throughout the life of the Project. Work will also be scheduled, where feasible, to avoid predicted times of extreme weather for the safety of crews and Project infrastructure.

The Project will be constructed to meet applicable building, safety and industry codes and standards for wind, snowfall, extreme precipitation, and other weather variables associated with climate. The engineering design of the Project will consider and incorporate potential future changes in the forces of nature that could affect its operation or integrity.

These standards and codes provide factors of safety regarding environmental loading (e.g., snow load, high winds), and Project specific activities and events. Design requirements address issues associated with environmental extremes, such as:

- wind loads
- storm water drainage from rain storms and floods
- weight of snow and ice, and associated water
- erosion protection of slopes, embankments, ditches, and open drains

To account for potential weather extremes, engineering specifications of the National Building Code of Canada contains design specific provisions, such as:

- critical structures, piping, tanks and steel selection to prevent brittle fracture at low ambient temperatures
- electrical grounding structures for lightning protection
- maximum motor ambient temperature
- ice and freeze protection

Other mitigation measures implemented as part of the planning process will reduce the potential for adverse effects of the environment on the Project, including:

- adherence to engineering design codes and standards (e.g., power lines, will be built to codes and standards that reduce the likelihood and effects of fault currents, during lighting strikes)
- care in selection of applicable construction materials and equipment
- careful planning of operation activities such as receipt of materials and supplies, and product deliveries
- implementation of a maintenance and safety management program
- contingency plans, including emergency back-up power for necessary operations

4.3.1.3 Residual Effects of Climate on the Project

The potential effects of climate on the Project during the construction, operation, and decommissioning and abandonment phases will be considered and incorporated in the planning and design of Project infrastructure. This will be done to reduce the potential for Project delays and long-term damage to infrastructure, taking into account the existing and predicted climate conditions. Inspection and maintenance programs will reduce the deterioration of the infrastructure and will help to maintain compliance with applicable design criteria and reliability of the transmission system. Significant residual adverse effects of climate on the Project, or interruption to the Project schedule, are not anticipated.

4.3.2 Effects of Climate Change on the Project

4.3.2.1 Project Pathways for the Effects of Climate Change on the Project

Long term increases in temperature and precipitation as a result of climate change predicted for Atlantic Canada can result in changes to conditions that could affect the long term integrity and reliability of Project-related land-based infrastructure through changing extremes in temperature and intense precipitation.

4.3.2.2 Climate Change Predictions

Predicting the future environmental effects of climate change for a specific area using global data sets is problematic due to generic data and larger scale model outputs that do not take into account local climate. Accurate regional and local projections require the development of specific regional and local climate variables and climate change scenarios (Lines et al. 2005). As a result, downscaling techniques have emerged over the last decade as an important advancement in climate modelling. Downscaling is used to introduce micro-scale interactions by including the local climate variables. Downscaling techniques are particularly important for Atlantic Canada due to the inherent variability associated with the predominantly coastal climate. Statistical downscaling uses global climate model (GCM) projections as well as historic data from weather stations across the region, and studies the relationship between these sets of data. Downscaling produces more detailed predictions for each of these weather stations (Lines et al. 2005) and has allowed for a better understanding of future climate scenarios based on precise and accurate historic data sets.

Results tend to differ between a Statistical Downscaling Model (SDSM) and Canadian Coupled General Circulation Model Version 2 (CGCM2). The overall mean annual maximum temperature increase projected for Moncton (the nearest location to the Project) between years 2020 and 2080 ranged from 1.99°C to 3.91°C for the SDSM model results and 1.16°C to 2.47°C for the CGCM2 model results (Lines et al. 2008) (Table 4.3).

Table 4.3 Projected Mean Annual Maximum and Minimum Temperature Change for Moncton, and Precipitation Percent Change for both SDSM and CGCM2 Model Results

Period	T_{max}		T_{min}		% Precipitation	
	SDSM	CGCM2	SDSM	CGCM2	SDSM	CGCM2
2020s	1.99	1.16	1.72	1.77	2	-1
2050s	2.80	1.67	2.36	2.40	3	5
2080s	3.91	2.47	3.30	3.36	6	4

Notes:
1) A positive value denotes an increase, a negative value denotes a decrease.
SDSM = Statistical Downscaling Model.
CGCM2 = Canadian Coupled General Circulation Model version 2.
T_{max} = Mean annual maximum temperature change.
T_{min} = Mean annual minimum temperature change.
Source: Lines et al. 2008

The SDSM projections for maximum temperature for 2050 at Moncton are for summer, fall, winter, and spring increases (1.9 to 4.4 °C) (Lines et al. 2005). By the year 2080, temperatures are projected to increase in all seasons (4.2 to 7.05 °C) (Lines et al. 2005). This average temperature change is expected to be gradual over the period and is likely to affect precipitation types and patterns. The warmer fall and winter temperatures could mean later freeze up; wetter, heavier snow; more liquid precipitation occurring later into the fall; and possibly more freezing precipitation during both seasons. Changes to precipitation patterns due to warmer weather over the fall and winter months could lead to stronger spring run-off (Natural Resources Canada 2001).

There is less agreement among the global circulation and regional downscaling models regarding changes in precipitation. Annual precipitation increases projected for Atlantic Canada between the years 2020 and 2080 range from 18% to 21% for the SDSM model results, and -2% to 2% for the Canadian Coupled Global Climate Model version 1 (CGCM1) model results (Lines et al. 2005). Precipitation trends are of more interest when taken together with the temperature increases and the seasonality of the predicted changes. Statistical Downscaling Model trends for the years 2020 to 2080 indicate a temperature increase of 8% to 12% for the winter months and 21% to 35% for the summer months (Lines *et al.* 2005). It is generally considered that the increased precipitation being projected for portions of western Atlantic Canada may be the result of continued landfall of dying hurricanes and tropical storms reaching into this area in the summer and fall months. While SDSM results highlight an increase in summer and fall precipitation, the CGCM1 results range from no change in the 2020s to a reduction in precipitation over the summer season for 2050 to 2080 (Lines et al. 2005).

The inconsistencies between SDSM and CGCM1 predicted seasonal precipitation changes highlight the inherent variability and uncertainty in climate modelling. Due to the increased precision of localized data used in SDSM relative to global modelling, confidence is considered to be greater in the SDSM results relative to global model results. Results must be interpreted with caution for each of the models, although there is a general consensus in the climatological community concerning the overall anticipated environmental effects of climate change. For example, over the next 100 years, Atlantic Canada will likely experience warmer temperatures, more storm events, increasing storm intensity, and flooding (Vasseur and Catto 2008).

4.3.2.3 Mitigation for Climate Change

The Project will be designed according to engineering design practices that will consider predictions for climate and climate change. Several publications are available to guide design engineers in this regard, including, for example, the Public Infrastructure Engineering Vulnerability Committee (PIEVC) "Engineering Protocol for Infrastructure Vulnerability Assessment and Adaptation to a Changing Climate" (PIEVC 2011). This protocol outlines a process to assess the infrastructure component responses to changing climate, which assists engineers and proponents in effectively incorporating climate change into design, development and management of their existing and planned infrastructure. This and other guidance will be considered, as applicable, in advancing the design and construction of the Project.

4.3.2.4 Residual Effects of Climate Change on the Project

The potential effects of climate change on the Project will be considered and incorporated in the planning and design of Project infrastructure and scheduling. This will be done to reduce the potential for Project delays and long-term damage to infrastructure and risk to workers, taking into account predictions for climate change in the region. Inspection and maintenance programs will reduce the deterioration of the infrastructure and will help to maintain compliance with applicable design criteria and reliability to the transmission system. Significant residual adverse effects of climate change on the Project, or system reliability, are not anticipated.

4.3.3 Effects Seismic Events on the Project

4.3.3.1 Project Pathways for the Effects of Seismic Activity on the Project

Though the Project lies within one of five seismic zones in southeastern Canada, the level of historical seismic activity near the PDA is low. Other areas of the Province (the Passamaquoddy Bay region, the Miramichi region, and the Moncton region) have historically experienced relatively higher levels of seismic activity, but these are sufficiently distant to the Project that the risk that a major seismic event in these areas could adversely affect the Project in a substantive way is low. Though past occurrence of seismic activity in an area is not necessarily an indicator that a major seismic event could not occur in the future, the likelihood of this to occur in the vicinity of the Project that could cause substantive Project damage or interrupt operations during any phase is low.

4.3.3.2 Mitigation for the Effects of Seismic Activity on the Project

The Project and related facilities and infrastructure will be designed to the applicable standard for earthquakes in this area. The intent of these design standards is to maintain the integrity of the facilities based on the level of risk for an earthquake in the area. An earthquake with a magnitude substantively greater than the design-base earthquake could result in damage to the Project facilities. However, design-base earthquake magnitude values are elected based on probability, and it would therefore be very unlikely that the design-base earthquake would be exceeded during the life of the Project.

4.3.3.3 Residual Effects of Seismic Events on the Project

Seismicity is considered not to have the potential to substantially damage Project infrastructure or components during any phase of the Project, due to planned design mitigation and the application of the National Building Code of Canada (NRCan 2010) and other applicable guidelines. Therefore, substantial effects of seismic events on the Project are not anticipated.

4.3.4 Effects of Forest Fires on the Project

4.3.4.1 Project Pathways for the Effects of Forest Fires on the Project

The effects of forest fire on the Project may include:

- reduced visibility and inability to manoeuver construction and operation equipment due to smoke
- delays in receipt of materials and supplies (e.g., construction materials) and in delivering products
- changes to the ability of workers to access the site (e.g., if fire blocks access to transportation routes)
- damage to infrastructure
- loss of electrical power resulting in potential loss of production

4.3.4.2 Mitigation for Forest Fires

In the event of a forest fire in close proximity to Project components, there is potential risk of damage to exposed Project infrastructure. If a forest fire were to break out in direct proximity to the Project, emergency measures would be in place to quickly control and extinguish the flames prior to any contact to flammable structures (i.e., wood).

New Brunswick has a forest fire control program in place to identify and control fires, reducing the potential magnitude and extent of any forest fire, and their potential consequential effects on the Project during any phase. The proposed safety and security programs for the Project are capable of rapid detection and response to any forest fire threat. A cleared buffer will be maintained around Project infrastructure, where feasible, to reduce the potential for a fire to affect the structures (which given the nature of the materials they contain are inherently fire resistant).

Firefighting detection equipment will be used on-site. Safety and security programs will be in place in conjunction with facility, community, and provincial emergency response crews to provide for rapid detection and response to any fire threat. This includes fires that could start within the substation perimeter, as well as fires approaching from outside the substation (i.e., forest fires).

4.3.4.3 Residual Project Environmental Effects of Forest Fires on the Project

If a forest fire were to occur in direct proximity to the Project, emergency measures would be in place to quickly control and extinguish the flames prior to contact with Project components. In addition, the cleared safety buffer zone established around Project components further decreases the likelihood of a forest or a brush fire causing substantive damage to the Project. Although there is potential for natural forest fires to occur in or near the PDA, it is not likely to have a substantive effect on the Project.

4.3.5 Effects of Marine Hazards on the Project

4.3.5.1 Project Pathways for the Effects of Marine Hazards on the Project

Sea spray, often accompanied with high winds, contains salt that may lead to long-term corrosion on exposed oxidizing metal surfaces and structures of the Project, potentially weakening structures with the possibility of disruptions to electrical connections and transformers.

Ice scour by sea ice and landfast ice is an issue at landing sites for submarine cables in cold climates, and has been considered in Project design and are considered in Volume 4, Chapter 4.

4.3.5.2 Mitigation for the Effects of Marine Hazards

The materials used for construction will be, by design, resistive and tolerant of the effects of sea spray. Further, salt spray effects will be mitigated with operational procedures including regular maintenance (i.e., cleaning) and the use of protective coatings as required.

4.3.5.3 Residual Effects of Marine Hazards on the Project

There is potential for surfaces and structures of the Project to be exposed to sea spray and ice scour during the life of the Project. However, these effects on the Project have been considered in the planning and design of the Project, and substantive damage to the Project or interruption to the Project schedule are not anticipated.

4.4 DETERMINATION OF SIGNIFICANCE

The land-based components of the Project will be designed, constructed and operated to maintain safety, integrity and reliability in consideration of existing and reasonably predicted environmental forces in the PDA in New Brunswick. There are no environmental attributes that, at any time during the Project, are anticipated to result in:

- a substantial change to the Project construction schedule (e.g., a delay resulting in the construction period being extended by one season)
- a substantial change to the Project operation schedule (e.g., an interruption in servicing such that production targets cannot be met)
- damage to Project infrastructure resulting in increased safety risk

NB Power will use an adaptive management approach in its activities throughout the life of the Project to monitor any observed effects of the environment and adapt (e.g., repair/replace) the Project infrastructure or operations and closure as needed. , The residual adverse effects of the environment on the Project are therefore rated not significant.

5.0 ACCIDENTS, MALFUNCTIONS, AND UNPLANNED EVENTS

This section provides an assessment of selected accident, malfunction, and unplanned event scenarios potentially associated with Project components and activities within New Brunswick that could, if they occurred, result in adverse environmental effects.

5.1 APPROACH

In this section, the potential Accidents, Malfunctions, and Unplanned Events that could occur during any phase of the Project are described and assessed. The focus is specifically on credible accidents that have a reasonable probability of occurrence, and for which the resulting environmental effects could be significant.

The general approach to assessing the potential environment effects of the selected scenarios involve:

- consideration of the potential event that may occur during the life of the Project
- description of the safeguards established to protect against such occurrences
- consideration of the contingency or emergency response procedures applicable to the event
- significance determination of potential residual adverse environmental effects

5.1.1 Significance Definition

Criteria used for determining the significance of adverse residual environmental effects with respect to Accidents, Malfunctions, and Unplanned Events generally relate to effects on the sustainability of biological and human environments. Where applicable, significance definitions are the same as those for each VC noted in Volume 3.

5.1.2 Identification of Accidents, Malfunctions, and Unplanned Events

5.2 POTENTIAL INTERACTIONS

The Accidents, Malfunctions, and Unplanned Events scenarios considered in this assessment are detailed in Volume 1, Section 2.6.1. The scenarios considered applicable to the New Brunswick-based components of the Project (all phases) are:

- fire
- hazardous material spill
- vehicle accident
- erosion prevention and/or sediment control failure
- wildlife encounter
- discovery of a heritage resource

VCs in Volume 3 with reasonable potential to interact with these scenarios causing adverse environmental effects include (Table 5.1):

- Atmospheric Environment
- Freshwater Resources
- Terrestrial Environment
- Land Use
- Socioeconomic Environment
- Heritage Resources
- Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Table 5.1 Potential Interactions for Land-Based Project Activities in New Brunswick

Accident, Malfunction and Unplanned Event	Atmospheric Environment	Groundwater Resources	Freshwater Environment	Terrestrial Environment	Land Use	Socioeconomic Environment	Archaeology and Heritage Resources	Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons
Fire	✓			✓		✓		
Hazardous Material Spill		✓	✓	✓	✓	✓		✓
Vehicle Accident		✓	✓	✓		✓		
Wildlife Encounter				✓		✓		
Erosion Prevention and/or Sediment Control Failure			✓	✓				
Discovery of a Heritage Resource							✓	✓

5.3 FIRE

5.3.1 Potential Event

There is potential that fire could occur during construction or operation of land-based Project components in New Brunswick. A fire affecting Project components would likely involve Project infrastructure (e.g., a substation) or a vehicle or other heavy equipment used during construction and maintenance activities, and result in effects on the Atmospheric, Terrestrial and Socioeconomic Environments.

Naturally occurring forest fires are considered an effect the environment could have on the Project and are addressed Section 4.3.4.

5.3.2 Risk Management and Mitigation

The following mitigation measures should be applied in general to reduce the probability of a fire and any associated adverse effects:

- vehicles and buildings on-site will be equipped with fire extinguishers sized and rated as appropriate
- Project staff should be trained in the use of fire extinguishers and familiar with the location of the nearest extinguisher
- vehicles are to avoid parking in areas with long grass to minimize the risk of fire caused by the heated vehicle undercarriage
- vegetation growth will be controlled within the transmission line corridor to reduce the fire hazard
- waste that may be soaked with flammable materials (i.e., oily rags) should be kept away from flammable materials and should be disposed of in an appropriate manner as soon as possible

Fire response activities will be carried out in accordance with the Environmental Protection Plan (EPP) for New Brunswick Power Corporation Transmission Facilities (NBPTC 2012). As the Project location is not remote, local emergency response services are available. In the unlikely event that a fire does occur, Project staff will contact emergency response services immediately.

A permit from the New Brunswick Department of Natural Resources is required for all construction and operation activities within New Brunswick and will specify required fire suppressant equipment.

Project staff on-site will be at a high level of training and readiness. The safety and security programs will be in place in conjunction with facility, community, and provincial emergency response crews to provide for rapid detection and response to any fire threat.

5.3.3 Potential Environmental Effects and their Significance

If fire were to occur, there is potential for an effect on the Atmospheric and Terrestrial Environments, through smoke and destruction of habitats, and any loss of infrastructure or equipment may have an effect on the Socioeconomic Environment. As a large portion of the transmission line corridor is within wooded areas, fire prevention and rapid extinguishing of fire, if it were to occur, is essential to reduce effects to the Atmospheric and Terrestrial Environments and prevent loss of infrastructure. As the majority of the transmission line follows an existing transmission line corridor, vegetation management practices in this area should further reduce the risk within the area.

The occurrence of a widespread fire is unlikely. However, in the event a fire was widespread, there is potential to result in wildlife mortality or destruction of sensitive habitats, resulting in a significant environmental effect on the Terrestrial Environment.

5.4 HAZARDOUS MATERIAL SPILL

5.4.1 Potential Event

Hazardous material spills can occur in any environment where fuels, lubricants, hydraulic fluid, paints, and corrosion and fouling inhibitors are used or stored. Hazardous materials may be used during both construction and operation of land-based project components in New Brunswick with construction and maintenance vehicle use being the most common source of hazardous materials on-site. Potential scenarios involving the release of hazardous material would most likely be rupture of a hydraulic line or loss of fuel from a vehicle.

5.4.2 Risk Management and Mitigation

Response to a hazardous material spill will be carried out as outlined in the NB Power EPP (NBPTC 2012). An Emergency Response Plan (ERP) consistent with those used at NB Power's other operations will be developed and will include procedures to prevent and respond to a spill, including:

- relevant staff will be trained in the timely and efficient response to hazardous material spills
- all spills will be dealt with in accordance with the NB Power Spill Response Clean-up and Reporting Procedure (SU2-A65400-0005)
- hazardous materials will not be stored on-site in large quantities
- preventative measures, including routine vehicle inspections and buffers surrounding sensitive areas, will also be implemented

In the unlikely scenario of a hazardous material spill reaching a body of water or other nearby sensitive area, measures will be taken to stop the spill and isolate the affected area as soon as possible. An assessment of the affected area will be conducted and remediation will be completed as required.

5.4.3 Potential Environmental Effects and their Significance

Depending on the quantity and type of material released and the location of the spill, hazardous material spills could potentially affect Groundwater Resources and components of the Terrestrial and Freshwater Environments. Remediation efforts may have an effect on the Socioeconomic Environment (e.g., demand for emergency services). The worst case for a land-based hazardous material spill would likely be a rupture of a hydraulic line near a wetland or watercourse. As hazardous material spills can harm wildlife and fish and fish habitat, efforts will be focused on prevention measures. Any spill, if it occurs, is expected to be a small quantity and rapidly contained and cleaned up.

Given the expected limited spill volume, the likelihood of spill scenarios, and anticipated effectiveness of response plans (including spill containment), it is assumed that none of these spills would result in a release to adjacent properties.

In consideration of the mitigation and response measures to be undertaken, residual adverse environmental effects of a hazardous material spill in New Brunswick are rated as not significant for potentially affected VCs. However, in the unlikely event a protected species was harmed, it could represent a significant adverse environmental effect. A significant effect is considered unlikely.

5.5 VEHICLE ACCIDENT

5.5.1 Potential Event

During the construction phase of the Project, various vehicles will be in motion around the Project site and there is the potential for vehicle-to-vehicle collisions, vehicle accidents with surrounding Project infrastructure, or vehicle collisions with wildlife. Vehicle use is expected to be low during operation and therefore vehicle accidents are not considered likely.

If a vehicle accident were to occur, loss or damage to a vehicle, equipment or Project infrastructure could have an effect on the Socioeconomic Environment. If the incident involved wildlife, it could have an effect on the Terrestrial Environment.

In the event of a vehicle accident there is the potential for loss of life and damage to infrastructure. There is also potential for fire and hazardous materials to be released into the environment. These are addressed in previous sections.

5.5.2 Risk Management and Mitigation

Project related traffic will be controlled as per the NB Power EPP (NBPTC 2012). The following mitigation measures should be applied in general to reduce the probability of a vehicle accident and any associated adverse effects:

- traffic control measures will be implemented, as needed, to reduce the likelihood of vehicle-to-vehicle collisions
- Project staff are expected to operate vehicles with due care and attention while on-site
- Project staff will be appropriately licensed to operate vehicles on-site
- vehicles are to observe traffic rules and trucks will use only designated truck routes
- if a collision does occur, Project staff are to immediately phone local emergency services
- all Project-related vehicles will carefully abide by speed limits to reduce risk of accidents including collisions with wildlife

If a vehicle collision results in a hazardous material spill or fire, a hazardous material spill response (see Section 5.3) or fire response (see Section 5.2) must be implemented in addition to the outlined vehicle accident response.

5.5.3 Potential Environmental Effects and their Significance

The most likely effect of a vehicle accident during construction would be the damage or loss of a vehicle and potential work stoppage. Although the Project area in New Brunswick is through wooded areas, it is anticipated that vehicle speed on the Project site will be low and a substantive collision with wildlife is considered to have low probability. The worst case involving a vehicle collision would most likely involve loss of life of a person or *SARA* species or the release of a hazardous material.

In consideration of the mitigation and response measures to be undertaken, adverse residual environmental effects of a land-based vehicle accident are rated to be not significant for potentially affected VCs. A vehicle accident resulting in a serious injury or loss of life for a Project employee or member of the public or *SARA* listed species would result in a significant effect. However, such an incident is considered unlikely to occur.

5.6 EROSION PREVENTION AND/OR SEDIMENT CONTROL FAILURE

5.6.1 Potential Event

Erosion prevention and/or sediment control failure can occur during construction activities due to the exposure of soil from clearing or excavation of land. If it were to occur in New Brunswick, this would most likely happen during land-based trenching for cable installation or excavation for substation upgrades. Minimal land disruption occurs when erecting transmission line structures. While unlikely, if ground excavation is required during operation, erosion prevention and sediment control measures are expected to be implemented.

This scenario has the potential to interact with the Terrestrial and Freshwater Environments, as failure could result in the unintended erosion of land or the release of silt into the surrounding environment.

5.6.2 Risk Management and Mitigation

For the implementation of erosion and sediment control measures, the focus is on proper installation, maintenance and inspection to avoid the potential for failure. Erosion prevention measures are to be implemented during construction and operation, if necessary, to reduce or eliminate the likelihood of land erosion. On-site control will be carried out as outlined in the NB Power EPP (NBPTC 2012).

Erosion controls may include:

- reducing quantity of open ground on site
- re-vegetating or re-seeding exposed areas
- covering exposed areas with geotextile or mulch until vegetation is established

Sediment controls may include:

- silt fencing – used along contours of exposed land to capture sediment runoff
- silt curtains – used within and along bodies of water to prevent intrusion of sediment into water bodies
- wattles – used on slopes perpendicular to the direction of flow to lessen runoff velocities and capture sediment runoff
- settling ponds – used to capture large volumes of runoff and retain the runoff for a period of time to allow for settling of sediment
- filter bags – used at the discharge point of a settling pond to filter out any remaining suspended sediment

These measures will be reviewed during the detailed engineering phase of Project design. Chosen measures will be installed as per the Project-specific Erosion and Sediment Control Plan (ESCP) and undergo routine inspection, most importantly pre and post rainfall events. Should a failure occur and silt from the Project site reaches a water source, efforts should be made to control the dispersion of sediment and isolate the affected area from unaffected habitat prior to repairing the source of the failure.

5.6.3 Potential Environmental Effects and their Significance

If a failure of erosion prevention and sediment control measures were to occur, the Freshwater and Terrestrial Environments may be affected as failure could result in the unintended erosion of land or the release of silt into the surrounding environment. The worst case involving a sediment control failure would be the accidental siltation of a wetland or water body environment.

In consideration of the mitigation and response measures to be undertaken, residual adverse environmental effects of a land-based erosion prevention and/or sediment control failure are rated to be not significant for potentially affected VCs. However, in the unlikely event a protected species was harmed, it could represent a significant adverse environmental effect. A significant effect is considered unlikely.

5.7 WILDLIFE ENCOUNTER

5.7.1 Potential Event

As a large section of the Project area in New Brunswick is within potential wildlife habitat, an encounter with wildlife during Project construction and operation is possible. As Project construction or operation phases require the use of vehicles and other maintenance equipment, there is potential for a wildlife encounter with this equipment within the Terrestrial Environment. During operation of the Project, transmission lines will be energized and there is a possibility of birds interacting with the lines. The worst case involving a wildlife encounter would be the death of a wildlife species due to interaction with a transmission line or Project vehicle.

5.7.2 Risk Management and Mitigation

Bird diverters or aerial markers may be installed in areas with high bird activity. Vegetation along the transmission line corridor will be controlled; however, construction and maintenance activities will take place outside of the breeding season, if possible. Nesting atop transmission line structures should be discouraged. As outlined in the NB Power EPP (NBPC 2012), if bird nests are discovered during operation activities, the following will take place:

- the nest location will be clearly marked and a buffer will be left untouched until after the nesting period
- the typical nesting habitat for these species will be investigated for potential nests
- the occurrence of identified nests will be documented

As outlined in the NB Power EPP (NBPC 2012), to reduce the likelihood of contact with or harm to other wildlife species the following mitigation measures will be applied:

- firearms are prohibited on the Project site

- food waste must be removed from the transmission line corridor and disposed of off-site
- wildlife will not be harvested, harassed, harmed or fed by NB Power Transmission personnel and contractors
- clearing will be completed in late fall/winter to avoid critical life stages for many species, where possible.

5.7.3 Potential Environmental Effects and their Significance

A wildlife encounter with a Project component could involve a Project vehicle striking a wildlife species; however, the more probable wildlife encounter would likely involve a bird striking an energized transmission line during the operation phase of the Project. A wildlife encounter could have an effect on the Socioeconomic Environment if damage to Project infrastructure or vehicles were to occur as a result. If a wildlife encounter were to occur and cause the death of an individual species, it is not expected to result in population level changes and therefore, the effect on Terrestrial Environment is considered low.

In consideration of the mitigation and response measures to be undertaken, adverse residual environmental effects of a wildlife encounter are rated to be not significant for potentially affected VCs.

5.8 DISCOVERY OF A HERITAGE RESOURCE

5.8.1 Potential Event

A heritage resource is defined as a site that contains features (non-removable indications of past human use and activity, such as a fire hearth, a living floor, or a burial site) in addition to artifacts determined by the provincial regulatory agency to be substantive. The disturbance of an individual artifact is not normally considered significant.

Heritage resources, if present, are generally discovered during activities involving ground disturbance such as construction related excavation. It is unlikely that a heritage resource will be discovered during operation.

5.8.2 Risk Management and Mitigation

Staff will be trained on response to the discovery of a heritage resource as per the NB Power EPP (NBPTC 2012). In the event that a heritage resource is discovered, Project work will cease in the area of the discovery and the Archaeological Services Unit of the Heritage Branch of the Culture and Sport Secretariat of New Brunswick will be contacted by NB Power immediately. Work in the area will only continue if approval is received from the Archaeological Services Unit of the Heritage Branch of the Culture and Sport Secretariat of New Brunswick to resume these activities, and the Project will continue in compliance with mitigation strategies.

5.8.3 Potential Environmental Effects and their Significance

The discovery of a heritage resource has the potential to interact with Heritage Resources, and Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons. In the event that a heritage resource is discovered, Project work will cease in the immediate area of the discovery and the Socioeconomic Environment may be affected as a result.

With the low probability of encountering heritage resource during Project-related activities, and in consideration of the nature of the Project, planned mitigation, and the contingency response procedures that would be used in the unlikely event of such a discovery, the potential residual adverse effect of a discovery of a heritage resource during the Project are rated not significant.

5.9 DETERMINATION OF SIGNIFICANCE

NB Power and MECL have developed EPPs, contingency plans, and emergency response plans to prevent and efficiently respond to accidental or unplanned events. Given the nature of the Project and credible accident and malfunction scenarios and proposed mitigation and response planning, the residual adverse environmental effects of Project-related Accidents, Malfunctions, and Unplanned Events on all VCs during all phases are rated not significant with a high level of confidence.

A vehicle accident resulting in a serious injury or loss of life for a Project employee or member of the public would result in a significant effect. However, such an incident is considered unlikely to occur.

6.0 CUMULATIVE ENVIRONMENTAL EFFECTS: NEW BRUNSWICK

6.1 INTRODUCTION

The residual effects of the Project that may interact cumulatively with the residual environmental effects of other physical activities are identified in this section and the resulting cumulative environmental effects are assessed.

An assessment of cumulative environmental effects is required if:

- the Project is assessed as having residual environmental effects on the VC
- the residual effects could act cumulatively with residual effects of other past, present, or reasonably foreseeable future physical activities

Six categories of physical activities in New Brunswick have been identified as having the potential to result in residual environmental effects that may act cumulatively with those of the Project:

- industrial development
- infrastructure development
- forestry and agriculture
- recreation
- residential development
- current use of land and resources for traditional purposes by Aboriginal persons

In New Brunswick the following six VCs are anticipated to have residual effects and a cumulative environmental effects assessment is undertaken:

- Freshwater Environment
- Terrestrial Environment
- Land Use
- Socioeconomic Environment
- Heritage Resources
- Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Interactions between the Project and the remaining six VCs are not anticipated to result in residual effects, and assessment of cumulative environmental effects is therefore not undertaken.

Table 6.1 highlights the potential for interactions between the residual effects of the Project and the existing or future physical activities identified. These interactions are described in further detail below.

Table 6.1 Potential Cumulative Effects

Planned and Future Activity	Freshwater Environment	Terrestrial Environment	Land Use	Socioeconomic Environment	Heritage Resources	Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons
Industrial Development	✓	✓	✓	✓	✓	✓
Infrastructure Development	✓	✓	✓	✓	✓	✓
Forestry and Agriculture		✓	✓	✓	✓	✓
Recreation		✓	✓			
Residential Development	✓	✓	✓	✓	✓	✓
Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons		✓				

6.2 ASSESSMENT OF CUMULATIVE EFFECTS: NEW BRUNSWICK

Past and existing physical activities that have been or are being carried out have influenced the baseline conditions for the assessment of Project effects. Importantly included in this is the existing transmission line corridor. The effects of other physical activities that have been or are being carried out (i.e., past and current effects) in combination with the predicted effects of the Project are therefore considered in the assessment of the residual environmental effects of the Project.

The residual environmental effects of the Project on the Freshwater Environment include a disturbance to riparian vegetation during the short construction period, which would be expected to recover within a short time following disturbance. Future industrial, infrastructure, and residential development activities have the potential to result in similar effects, however it is unlikely that these future activities would occur in the RAA during the short construction phase of the Project or the recovery period. Future activities would be subject to provincial watercourse regulations and approvals which determine the acceptability of their environmental effects and prescribe any required mitigation. Cumulative effects between the Project and industrial, infrastructure, and residential development activities on the Freshwater Environment are therefore not expected to be substantive.

The effects of the Project on the Terrestrial Environment include a temporary and permanent disturbance to vegetation and wildlife habitat, including wetland, in the PDA. Future industrial, infrastructure, and residential development activities are likely to result in similar effects to the Terrestrial Environment. However, the Project follows an existing transmission line corridor where possible and the footprint of disturbance of the Project is small and is likely to be small for any future industrial, infrastructure, or residential developments. The vegetation communities and habitat types within the

PDA are abundant within both the LAA and RAA. Therefore, potential cumulative effects of the Project and industrial, infrastructure, and residential development activities on the Terrestrial Environment are not substantive.

Effects of recreation and the Current Use of Land and Resources for Traditional Purposes by Aboriginal People on the Terrestrial Environment may include wildlife mortality due to hunting and trapping activities. There is also a low likelihood of wildlife mortality as a result of the Project. Given the low magnitude of the effects of both the Project and hunting and trapping activities, substantive cumulative effects are not anticipated.

Much of the transmission line required for the Project follows an existing transmission line corridor. Only a small portion of private land will be converted into a new right of way, representing a small change in land use. Other activities outlined in Table 6.1 also have the potential to result in a change in land use, however given the small area of change as a result of the Project, cumulative effects between the Project and these activities on Land Use are not substantive.

The effects of existing forestry and agriculture activities on the Terrestrial Environment are captured in the baseline information presented in Section 3.3. The cumulative effect of the Project and these activities has therefore been included in the assessment of the effects of the Project. The development of additional lands for new and expanded forestry and agricultural activities is not anticipated; therefore, cumulative effects with future forestry and agriculture are not anticipated.

The Project will affect the Socioeconomic Environment in New Brunswick, resulting in an increase in demand in the local labour force and accommodations. Industrial, infrastructure, and residential development activities have the potential to effect labour and economy in New Brunswick in a similar way. The combined increase in demand for labour and accommodation of the Project and these activities is not expected to exceed the capacity of the labour market or available accommodations. Positive economic effects are also anticipated. As such, cumulative effects are not expected to be substantive.

Industrial, infrastructure, and residential development activities, as well as forestry and agriculture (*i.e.*, activities that result in ground disturbance), have the potential to interact with heritage resources in a similar manner to the residual effects of the Project. These activities would likely require an environmental review and permitting that would reduce the potential for a substantive cumulative effect.

Overall, the Project in New Brunswick primarily follows an existing transmission line corridor, which will reduce residual and cumulative environmental effects as very little habitat outside of this existing corridor will be disturbed. This existing corridor and past forestry and agriculture activities have affected the existing landscape that was considered in the baseline conditions used to assess the residual effects of the Project. Accordingly, substantive cumulative environmental effects in New Brunswick are not anticipated.

7.0 SUMMARY

In this EIS, Stantec conducted an EIA of the PEI-NB Cable Interconnection Upgrade Project (the "Project") proposed by PEI Energy Corporation (PEIEC). The Project involves the construction and operation of a high voltage alternating current transmission system, spanning three geographic locations – New Brunswick, the Northumberland Strait, and PEI. Volume 3 (this volume) includes an assessment of potential environmental effects associated with land-based Project components and activities located in New Brunswick.

7.1 SCOPE OF THE EIA

An EIA of the land-based Project components and activities in New Brunswick is required under the Schedule A of the New Brunswick Environmental Impact Assessment Regulations, made under the New Brunswick *Clean Environment Act* (NB *CEA*). This EIS follows the Stantec EA Method that has been adapted to meet the requirements of the NB *CEA*.

The EIA evaluated the potential environmental effects of the Project. The scope of the assessment included all activities necessary for the construction and operation of the Project, but excluded the end uses of this electricity. Environmental effects were assessed for each phase of the Project (i.e., construction, operation, and decommissioning and abandonment), where relevant, as well as for credible Accidents, Malfunctions, and Unplanned Events. The assessment was conducted within defined boundaries (spatial and temporal) for the assessment and in consideration of defined residual environmental effects rating criteria aimed at determining the significance of the environmental effects. The EIA considered measures that are technically and economically feasible that would mitigate any significant adverse environmental effects of the Project.

7.2 ENVIRONMENTAL EFFECTS ASSESSMENT

Freshwater Environment, Terrestrial Environment, Land Use, Socioeconomic Environment, Heritage Resources and the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons were the VCs identified for a detailed assessment. These were identified by the Study Team (based on experience and professional judgment) as the key VCs for which substantive interactions with the Project were anticipated or could occur. A separate analysis of the potential Effects of the Environment on the Project was also conducted.

This volume concluded that the potential environmental effects of the Project in New Brunswick for the VCs would be not significant during each phase of the Project and for the activities to be conducted as part of the Project. These conclusions were reached in consideration of the nature of the Project, the nature and extent of its environmental effects, and the planned implementation of proven and effective mitigation. The environmental effects of Accidents, Malfunctions, and Unplanned Events were also rated not significant, with the exception of a large fire. Effects of the Environment on the Project were rated not significant due to design consideration and compliance with codes and standards that will mitigate against a significant adverse effect on the Project. In most cases, the environmental effects and significance predictions were made with a high level of confidence by the Study Team.

7.3 OVERALL CONCLUSION

Based on the results of the EIA for the New Brunswick volume, it is concluded that, with planned mitigation, the residual environmental effects of the Project during each phase is rated not significant.

8.0 REFERENCES

General

AMEC (AMEC Earth and Environmental). 2007. Northumberland Strait Ecosystem Overview Report. Prepared For Fisheries and Oceans by AMEC Earth and Environmental, Moncton, New Brunswick.

AER 2007, Alberta Energy Regulator Directive 038, Noise Control, revised February 16, 2007

Canadian Geographic. 2015. Animal Facts Sheet: New Brunswick. Available online at: http://www.canadiangeographic.ca/kids/animal-facts/animals.asp?region=nb Last accessed on August 11, 2015.

Environment Canada. 2015a. Greenhouse Gas Emissions Reporting Program Online Data Search – Facility Reported Data. Available online at: http://www.ec.gc.ca/ges-ghg/donnees-data/index.cfm?do=search&lang=en. Last accessed on July 6, 2015.

Environment Canada. 2015b. The National Inventory Report 1990-2013. Greenhouse Gas Sources and Sinks in Canada. The Canadian Government's Submission to the UN Framework Convention on Climate Change. Environment Canada, Gatineau, Quebec. Available online at: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8812.php, accessed on July 8, 2015

Government of Canada. 2015. National Climate Data and Information Archive. Available online at: http://www.climate.weatheroffice.gc.ca/climate_normals/index_e.html. Last accessed on June 16, 2015

Health Canada. 2009. Response Statement to Public Concerns Regarding Electric and Magnetic Fields (EMFs) from Electric Power Transmission and Distribution Lines. Health Canada, Federal-Provincial-Territorial Radiation Protection Committee. Issued November 8, 2008 and updated August 5, 2009. Available online at: http://www.hc-sc.gc.ca/ewhsemt/radiation/fpt-radprotect/emf-cem-eng.php. Accessed July 7, 2015.

Jacques Whitford Environmental Limited (JWEL) (2001). Atlas of Ecology and Commercially Important Areas in the Southern Gulf of St. Lawrence. Environmental Studies Research Funds Report (ESRF)140, Calgary. 76p.

New Brunswick Department of Environment and Local Government. 2015. Air Quality Monitoring Results 2012 & 2013. Available online at: http://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Air-Lair/AirQualityMonitoringResults2013.pdf

Historica Canada. 2015. New Brunswick. Available online at: http://www.thecanadianencyclopedia.ca/en/article/new-brunswick/. Last accessed onAugust 11, 2015.

World Atlas. 2015. New Brunswick Weather. Available online at: http://www.worldatlas.com/webimage/countrys/namerica/province/nbzweather.htm. Last accessed on August 11, 2015.

World Resources Institute. 2014. Climate Analysis Indicators Tool (CAIT) 2.0. Washington, DC. Available online at: http://cait2.wri.org. Last accessed on June 27, 2014

Assessment of Potential Environmental Effects on the Freshwater Environment

Fisheries and Oceans Canada, (2013). Fisheries Protection Policy Statement. Ecosystems Programs Policy. Ottawa, Ontario.

Canadian Council of Ministers of the Environment. 1999. Canadian water quality guidelines for the protection of aquatic life. Canadian Council of Ministers of the Environment Winnipeg, Manitoba.

Government of New Brunswick Department of Environment. 2012. Watercourse and Wetland Alteration Technical Guidelines. Sustainable Development, Planning and Impact Evaluation Branch.

Curry, A., M. Gautrea, G. Yamazaki. No date. Inland Fish of New Brunswick. Accessed July 19th, 2015. Online at: http://www.unb.ca/research/institutes/cri/links/inlandfishesnb/index.html.

Canadian Council of Ministers of the Environment. 1999. Canadian water quality guidelines for the protection of aquatic life. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Scott, W. B., & Crossman, E. J. 1998. Freshwater Fishes of Canada. Oakville, Ont., Canada: Galt House.

Environmental Protection Agency, 2001. Issue Paper 3: Spatial and Temporal Patterns of Stream Temperature. Prepared as part of EPA region 10 temperature water quality criteria guidance development project.

Teti, P. 1998. The Effects of Forest Practices on Stream Temperature: A Review of the Literature. B.C. Ministry of Forests.

Gravelle, J.A., and Link, T.E. 2007. Influence of timber harvesting on headwater peak stream temperatures in a northern Idaho watershed. For. Sci. 53(2): 189–205.

Rex, J.F., Maloney, D.A., Krauskpf, P.N., Beaudry, P.G., and Beaudry, L.J. 2012. Variable-retention riparian harvesting effects on riparian air and water temperature of sub-boreal headwater streams in British Columbia. For. Ecol. Manag. 269: 259–270. doi:10.1016/j.foreco.2011.12.023.

Wilkerson, E., Hagan, J.M., Siegel, D., and Whitman, A.A. 2006. The effectiveness of different buffer widths protecting headwater stream temperatures in Maine. For. Sci. 52: 221–231.

Gomi, T., Moore, R.D., and Dhakal, A.S. 2006. Headwater stream temperature response to clear-cut harvesting with different riparian treatments, coastal British Columbia. Water Resources. Bull. 42: WO8437. doi:10.1029/ 2005WR004162.

Blann, K., J.F. Nerbonne, and B. Vondracek, 2002. Relationship of Riparian Buffer Type to Water Temperature in the Driftless Area Ecoregion of Minnesota. North American Journal of Fisheries Management 22:441-451.

Zwieniecki, M., and Newton, M. 1999. Influence of streamside cover and stream features on temperature trends in forested streams of western Oregon. West. J. Appl. For. 14: 106–113.

Cole, E., M. Newton. 2008. Influence of streamside buffers on stream temperature response following clear-cut harvesting in western Oregon. Can. J. For. Res. 43: 993–1005 (2013) dx.doi.org/10.1139/cjfr-2013-0138.

Jayawardana, J.M.C.K. 2010. Thoughts for Stream Restoration: Link Between Riparian, Instream Vegetation and Macroinvertebrates. Environmental Research Journal Volume 4 Issue ¾.

Hynes, H. B. N. 1970. The Ecology of Running Waters. Toronto: Univ. Toronto Press.

Richardson, J. S. 1993. Limits to productivity in streams: evidence from studies of macroinvertebrates. Canadian Special Publication of Fisheries and Aquatic Sciences 118, 9-15.

Horwitz, Richard J., Thomas E. Johnson, Paul F. Overbeck, T. Kevin O'Donnell, W. Cully Hession, and Bernard W. Sweeney, 2008. Effects of Riparian Vegetation and Watershed Urbanization on Fishes in Streams of the Mid- Atlantic Piedmont (USA). Journal of the American Water Resources Association (JAWRA) 44(3):724-741. DOI: 10.1111/j.1752-1688.2008.00201.x

Jones, III, E.B.D., G.S. Helfman, L.O. Harper, and P.V. Bolstad, (1999). Effects of Riparian Forest Removal on Fish Assemblages in Southern Appalachian Streams. Conservation Biology 13:1454-1465.

Johnson, S.L. and A.P. Covich, 1997. Scales of Observation of Riparian Forests and Distributions of Suspended Detritus in a Prairie River. Freshwater Biology 37:163-175.

Fitzpatrick, F.A., B.C. Scudder, B.N. Lenz, and D.J. Sullivan, 2001. Effects of Multi-Scale Environmental Characteristics on Agricultural Stream Biota in Eastern Wisconsin. Journal of the American Water Resources Association 37:1489-1507.

Assessment of Potential Environmental Effects on the Terrestrial Environment

ACCDC (Atlantic Canada Conservation Data Centre). 2014a. Species Ranks. Available at: http://www.accdc.com/en/ranks.html. Date updated: December 2014. Date accessed: July 20, 2015.

ACCDC. 2014b. Data Report 5252: Cape Tormentine, NB. Prepared: August 11, 2014. Sackville, NB.

ACCDC. 2015a. Understanding Ranks. Available at: http://www.accdc.com/enNew/rank-definitions.html. Date updated: 2015. Date accessed: July 15, 2015.

ACCDC. 2015b. About the ACCDC. Available at: http://www.accdc.com/en/about-us.html. Date updated: 2015. Date accessed: July 17, 2015.

AMEC (AMEC Environmental & Infrastructure). 2012. International Power Line Wetland Environmental Effects Monitoring Program 2012 Saint John and Charlotte Counties, NB. November 9, 2012.

APLIC (Avian Power Line Interaction Committee). 2012. Reducing Avian Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute and APLIC. Washington, D.C. Available at: http://www.aplic.org/uploads/files/11218/Reducing_Avian_Collisions_2012watermarkLR.pdf Date accessed: July 17, 2015.

APLIC and USFWS (U.S. Fish and Wildlife Service). 2005. Avian Protection Plan (APP) Guidelines. USDI Fish and Wildlife Service. Washington, D.C.

Audubon. No Date. Guide to North American Birds: Red-necked Phalarope. Available at: https://www.audubon.org/field-guide/bird/red-necked-phalarope. Date accessed: July 29, 2015.

Avery, M., P.F. Springer, and J.F. Cassel. The effects of a tall tower on nocturnal bird migration-a portable ceilometer study. The Auk 93(2): 281-291.

Barrientos, R., J.C. Alonso, C. Ponce and C. Palacin. 2011. Meta-analysis of the effectiveness of marked wire in reducing avian collisions with power lines. Conservation Biology 25: 893-902.

Batáry, P. and A. Báldi. 2004. Evidence of an edge effect on avian nest success. Conservation Biology 18(2): 389-400.

Bayne, L.M., L. Habib., and S. Boutin. 2008. Impacts of chronic anthropogenic noise from energy-sector activity on abundance of songbirds in the boreal forest. Conservation Biology 22: 1186-1193.

Bevanger, K. 1998. Biological and conservation aspects of bird mortality caused by electricity power lines: a review. Biological Conservation 86: 67-76.

Bird Nature. No Date. Migration Flyways: Atlantic Flyway. Available at: http://birdnature.com/upperatlantic.html Date accessed: July 30, 2015.

Calvert, A.M., C.A. Bishop, R.D. Elliot, E.A. Krebs, T.M. Kydd, C.S. Machtans, and G.J. Robertson. 2013. A synthesis of human-related avian mortality in Canada. Avian Conservation and Ecology 18(2): 11.

Canadian Energy Pipeline Association and Stantec. 2013. Migratory Birds Convention Act: A Best Management Practice for Pipelines. Draft September 2013. Available at: http://www.cepa.com/wp-content/uploads/2014/01/Migratory-Birds-Sept-26-2013-for-Publication.pdf.

Cornell Lab of Ornithology. 2015. All About Birds. Available at: http://www.allaboutbirds.org/Page.aspx?pid=1189. Date updated: 2015. Date accessed: July 29, 2015.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2006. COSEWIC assessment and status report on the Rusty Blackbird *Euphagus carolinus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2007a. COSEWIC assessment and status report on the Chimney Swift *Chaetura pelagica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2007b. COSEWIC assessment and status report on the Common Nighthawk *Chordeiles minor* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2007c. COSEWIC assessment and status report on the Olive-sided Flycatcher *Contopus cooperi* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2007d. COSEWIC assessment and status report on the Red Knot *Calidris canutus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa

COSEWIC. 2008a. COSEWIC assessment and status report on the Canada Warbler *Wilsonia canadensis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2008b. COSEWIC assessment and update status report on the Short-eared Owl *Asio flammeus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2010a. COSEWIC assessment and status report on the Bobolink *Dolichonyx oryzivorus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2010b. COSEWIC assessment and status report on the Monarch *Danaus plexippus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2011a. COSEWIC assessment and status report on the Barn Swallow *Hirundo rustica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2011b. COSEWIC assessment and status report on the Eastern Meadowlark *Sturnella magna* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2012a. COSEWIC assessment and status report on the Eastern Wood-pewee, *Contopus virens,* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2012b. COSEWIC assessment and status report on the Wood Thrush *Hylocichla mustelina* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2013a. COSEWIC assessment and status report on the Bank Swallow *Riparia riparia* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2013b. COSEWIC assessment and status report on the Piping Plover circumcinctus subspecies (*Charadrius melodus circumcinctus*) and the melodus subspecies (*Charadrius melodus melodus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

Cornell Lab of Ornithology. 2015. All About Birds. Available at: http://www.allaboutbirds.org/Page.aspx?pid=1189. Date updated: 2015. Date accessed: July 29, 2015.

CPAWS (Canadian Parks and Wilderness Society). 2007. Natural Ecosystem Connectivity across the Chignecto Isthmus – Opportunities and Challenges. Available at: http://cpawsnb.org/images/upload/ChignectoFinalVersionJune06v2.pdf. Date Accessed: July 30, 2015.

EC (Environment Canada). 2012. Recovery Strategy for the Piping Plover (*Charadrius melodus melodus*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa.

EC. 2014. North American Breeding Bird Survey - Canadian Trends Website, Data-version 2012. Environment Canada, Gatineau, QC. Available from: http://www.ec.gc.ca/ron-bbs/P001/A001/?lang=e. Date updated: January 28, 2015. Date accessed: July 20, 2015.

EC. 2015. Incidental Take Avoidance Guidelines. Environment Canada, Gatineau, QC. Available from: http://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=AB36A082-1 . Date updated: June 8, 2015. Date accessed: July 22, 2015.

Emera Brunswick Pipeline Company Ltd. 2006. Written evidence of Environment Canada. Brunswick Pipeline Project NEB Hearing Order GH-1-2006. Submitted to the National Energy Board. Available at: https://docs.neb-one.gc.ca/ll-eng/llisapi.dll/fetch/2000/90464/90550/408788/408789/414082/417836/430910/C-68-3-a_--_A0W1E1_-_Written_Evidence_of_Environment_Canada.pdf?nodeid=430914&vernum=-2. Date accessed: August 4, 2015.

Erickson, W.P., G.D. Johnson, M.D. Strickland, D.P. Young Jr., K.J. Sernka, and R.E. Good. 2001. Avian Collision with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States. National Wind Coordinating Committee (NWCC) Resource Document.

Government of Canada. 1991. The Federal Policy on Wetland Conservation. Director General, Canadian Wildlife Service, Ottawa, Ontario. Available at: http://publications.gc.ca/collections/Collection/CW66-116-1991E.pdf. Date Accessed: July 30, 2015.

Haines, A. 2011. Flora Novae Angliae. New England Wildflower Society. Yale University Press.

IBA (Important Bird Areas) Canada. 2015. Upper Cumberland Basin. Available at: http://www.ibacanada.ca/site.jsp?siteID=NS002&lang=EN. Date accessed: July 30, 2015.

Lloyd, P., T.E. Martin, R.L. Redmond, U. Langner, and M.M. Hart. 2005. Linking demographic effects of habitat fragmentation across landscapes to continental source-sink dynamics. Ecological Applications 15(5): 1504-1514.

Longcore, T. and C. Rich. 2004. Ecological light pollution. Frontiers in Ecology and the Environment 2: 191–198.

MacKinnon, C.M., and A. C. Kennedy. 2009. Canada Lynx, *Lynx canadensis*, use of the Chignecto Isthmus and the possibility of gene flow between populations in New Brunswick and Nova Scotia. Canadian Field-Naturalist 122: 166-168.

MacKinnon, C.M., and A. C. Kennedy. 2011. Migrant common eider, *Somateria mollissima*, collisions with power transmission lines and shortwave communication towers on the Tantramar Marsh in southeastern New Brunswick. Canadian Field-Naturalist 125(1):41.46.

NBDNR (New Brunswick Department of Natural Resources). 2015. New Brunswick Natural Resources – Species at Risk: Bald Eagle. Available at: http://www2.gnb.ca/content/gnb/en/departments/natural_resources/wildlife/content/SpeciesAtRisk/bald_eagle.html Date updated: 2015. Date accessed: March 2, 2015.

NBDNRE (New Brunswick Department of Natural Resources and Energy) and NBDELG (New Brunswick Department of Environment and Local Government). 2002. New Brunswick Wetlands Conservation Policy.

NCC (Nature Conservancy of Canada). 2015. The Moose Sex Project. Available at: http://www.natureconservancy.ca/en/where-we-work/new-brunswick/featured-projects/help-moose-cross-the-chignecto.html?referrer=https://www.google.ca/#.Vbpl3vlVifh. Date Accessed: July 30, 2015.

NWWG (National Wetlands Working Group). 1997. Canadian Wetland Classification System. Second edition. Wetlands Research Station, University of Waterloo, Waterloo, ON.

Ogden, L.J.E. 1996. Collision Course: The Hazards of Lighted Structures and Windows to Migrating Birds. Fatal Light Awareness Program (FLAP) and World Wildlife Fund Canada. Toronto, ON.

Parks Canada. No Date. Canada's Historic Places. Fort Gaspareaux National Historic Site of Canada. Available at: http://www.historicplaces.ca/en/rep-reg/place-lieu.aspx?id=7612. Date accessed: July 29, 2015.

Rioux, S., J.-P. L. Savard, and A. A. Gerick. 2013. Avian mortalities due to transmission line collisions: a review of current estimates and field methods with an emphasis on applications to the Canadian electric network. Avian Conservation and Ecology 8(2): 7. http://www.ace-eco.org/vol8/iss2/art7/ACE-ECO-2013-614.pdf.

Rich, A.C., D.S. Dobkin, and L.J. Niles. 1994. Defining Forest Fragmentation by Corridor Width: The Influence of Narrow Forest-Dividing Corridors on Forest-Nesting Birds in Southern New Jersey. Conservation Biology 8(4): 1109-1121.

SARA (*Species at Risk Act*). 2015. Species Profile: Common Nighthawk. Available at: http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=986. Date Accessed: February 12, 2015.

SCI (Staying Connected Initiative). 2015. Chignecto Isthmus. Date updated: 2015. Date accessed: July 30, 2015.

SNB (Service New Brunswick). 2011. Data Catalogue: Regulated Wetlands. Available at: http://www.snb.ca/geonb1/e/DC/RW.asp. Date updated: January 3, 2011. Date accessed: June 2015.

Tims, J. and N. Craig. 1995. Environmentally Significant Areas in New Brunswick (NBESA). NB Department of Environment and Nature Trust of New Brunswick Inc.

Wiese, F.K, W.A. Montevecchi, G.K. Davoren, F. Huettmann, A.W.Diamond, J. Linke. 2001. Seabirds at risk around offshore oil platforms in the North-west Atlantic. Marine Pollution Bulletin 42(12): 1285-1290.

Assessment of Potential Environmental Effects on Land Use

Cape Jourimain Nature Centre. 2015. Available at: http://capejourimain.ca/en/

GNB (Government of New Brunswick). 2009. New Brunswick Snowmobile Tourism Economic Impact Study: 2008-2009 Snowmobile Season. Prepared by The Department of Tourism and Parks. January 28, 2010.

GNB (Government of New Brunswick). 2011. New Brunswick Impact of ATV Tourism in New Brunswick by NBATVF Trail Permit Holders. 2010-2011. New Brunswick Department of Culture, Tourism and Healthy Living. May 17, 2012.

NBDNR (New Brunswick Department of Natural Resources). 2015. Available at: http://www2.gnb.ca/content/dam/gnb/Departments/nr-rn/pdf/en/Wildlife/BigGame.pdf

NBDNR (New Brunswick Department of Natural Resources). 2014. New Brunswick Furbearer Harvest Report 2013-2014. Available at: http://www2.gnb.ca/content/dam/gnb/Departments/nr-rn/pdf/en/Wildlife/FurbearerHarvestReport.pdf.

NBFSC (New Brunswick Federation of Snowmobile Clubs). 2015. Available online at: http://www.nbfsc.com/html/maps.html.

New Brunswick Trail Council. 2015a. Trail Map Information. Available online at: http://www.sentiernbtrail.com/index.php/en/the-trails/trail-map.

New Brunswick Trail Council. 2015b. Trail Locater. Available online at: http://www.sentiernbtrail.com/.

NBTFHF (New Brunswick Trappers and Fur Harvesters Federation). 2015. Available at: http://www.nbtrappers.ca/profile.html.

SNB (Service New Brunswick). 2015. Real Property Attribute Data Version 2.0. September 2000.

Assessment of Potential Environmental Effects on Socioeconomic Environment

Aboriginal Affairs and Northern Development Canada. 2014. First Nation Profiles New Brunswick. 2014. Available Online at: http://pse5-esd5.ainc-inac.gc.ca/fnp/Main/Search/FNMain.aspx?BAND_NUMBER=9&lang=eng

Canadian Aquaculture Industry Alliance. 2015. Canadian Aquaculture: An Economic Contributor. Available online at: http://www.aquaculture.ca/files/economic-benefits.php CBC News. 2014. Moncton Bucks Regional Trend in Declining Tourism. Accessed July 17, 2015 at: http://www.cbc.ca/news/canada/new-brunswick/moncton-bucks-regional-trend-of-declining-tourism-1.2633205.

City of Moncton. 2014. Moncton Community Profile 2014. Available online at: http://www.moncton.ca/Assets/Business+English/Community+Profile+2014.pdf.

Canada Mortgage and Housing Corporation (CMHC). 2015a. Housing Market Outlook: Atlantic Region Highlights. Second Quarter 2015. Available online at: http://www.cmhc-schl.gc.ca/odpub/esub/64595/64595_2015_Q02.pdf?lang=en.

City of Moncton. 2014. Moncton Statistics. Available online at: http://www.moncton.ca/Business/Moncton_Statistics.htm.

Canada Mortgage and Housing Corporation (CMHC). 2015b. Rental Market Report: New Brunswick Highlights. Available online at: http://www.cmhc-schl.gc.ca/odpub/esub/64495/64495_2015_B01.pdf?lang=en.

City of Fredericton. N.d. City of Fredericton Website. Available online at: http://www.fredericton.ca/en/index.asp.

Department of Fisheries and Oceans Canada (DFO). 2008. Economic Impact of the New Brunswick Ocean Sector 2003 - 2008. Available online at: https://www.gnb.ca/9999/publications/ocean.pdf.

Employment and Social Development Canada (ESDC). 2015. Labour Market Bulletin - New Brunswick: February 2015. Available online at: http://www.esdc.gc.ca/eng/jobs/lmi/publications/bulletins/nb/feb2015.shtml.

Fort Folly First Nations. 2014. About Us. Available online at: http://www.fortfolly.nb.ca/firstpg6.html.

Government of New Brunswick. 2014. New Brunswick Tourism Indicators Summary Report: 2013. Accessed July 17, 2015 at: http://www2.gnb.ca/content/dam/gnb/Departments/thc-tpc/pdf/RSP/NBTourismIndicatorsSummaryReport2013.pdf.

Government of New Brunswick (GNB). 2015. Labour Market Monthly: February 2015. Available online at: http://www2.gnb.ca/content/dam/gnb/Departments/petl-epft/PDF/LMI/LMIFebruary2015.pdf.

Matell Homebuilders. 2010. 10 New Brunswick Companies that Create Jobs. Available online at: http://themartellexperience.com/2010/06/02/10-new-brunswick-companies-that-create-jobs/.

Moncton Industrial Development. 2014. Moncton Community Profile 2014. Available at: http://www.moncton.ca/assets/business+english/community+profile+2014.pdf.

NB Department of Public Safety. 2013. New Brunswick Police Human Resources 2013 Survey Report. Available at: http://www2.gnb.ca/content/dam/gnb/Departments/ps-sp/pdf/Safety_Protection/NBPoliceHumanResources.pdf.

New Brunswick Department of Aboriginal Affair (2015). First Nations Communities.Available online at: http://www2.gnb.ca/content/gnb/en/departments/aboriginal_affairs/fnc.html.

New Brunswick Department of Agriculture, Aquaculture, and Fisheries (NBDAAF). 2013. Sectors in Review: Agriculture 2013. Available online at: http://www2.gnb.ca/content/dam/gnb/Departments/10/pdf/Publications/Agr/ReviewAgriculture2013.pdf.

New Brunswick Department of Energy and Mines (NBDEM). 2015. New Brunswick Monthly Royalty Statistics. Available online at: http://www2.gnb.ca/content/dam/gnb/Departments/en/pdf/Minerals-Minerales/Monthly_Royalties.pdf.

New Brunswick Department of Finance (NBDF). 2014. The New Brunswick Economy: 2013 in Review. Available online at: http://www2.gnb.ca/content/dam/gnb/Departments/fin/pdf/esi/NBEconomy2013InReview.pdf.

New Brunswick Department of Finance (NBDF). 2015a. The New Brunswick Economy: 2014 in Review. Available online at: http://www2.gnb.ca/content/dam/gnb/Departments/fin/pdf/esi/NBEconomy2014InReview.pdf.

New Brunswick Department of Finance (NBDF). 2015b. Third Quarter Report.Available online at: http://www2.gnb.ca/content/dam/gnb/Departments/fin/pdf/Publications/2014-2015ThirdQuarterReport.pdf.

New Brunswick Department of Finance (NBDF). 2011. The New Brunswick Economy: 2010 in Review. Available online at: http://www2.gnb.ca/content/dam/gnb/Departments/fin/pdf/esi/NBEconomy2010InReview.pdf.

Statistics Canada. 2007a. New Brunswick (Code13) (table). 2006 Community Profiles. 2006 Census. Statistics Canada Catalogue no. 92-591-XWE. Ottawa. Released March 13, 2007.http://www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-591/index.cfm?Lang=E. Last aaccessed July 8, 2015.

Statistics Canada. 2012a. Moncton, New Brunswick (Code 305) and New Brunswick (Code 13) (table). Census Profile. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E. Last accessed onJuly 4, 2015.

Statistics Canada. 2012b. New Brunswick (Code 13) (Table 5). Population by age group and sex, medium-growth - 1988 to 1996 trends scenario (M3), July 1st — New Brunswick, 2010 to 2036. Available online at: http://www.statcan.gc.ca/pub/91-520-x/2010001/t388-eng.htm. Last accessed onJuly 4, 2015.

Statistics Canada. 2013a. New Brunswick (Code 13) (table). National Household Survey (NHS) Profile. 2011 National Household Survey. Statistics Canada Catalogue no. 99-004-XWE. Ottawa. Released September 11, 2013. http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/prof/index.cfm?Lang=E. Last accessed onJuly 8, 2015.

Statistics Canada. 2013b. Westmorland, CT, New Brunswick (Code 1307) (table). National Household Survey (NHS) Profile. 2011 National Household Survey. Statistics Canada Catalogue no. 99-004-XWE. Ottawa. Released September 11, 2013. http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/prof/index.cfm?Lang=E. Last accessed onJuly 8, 2015.

Statistics Canada. 2013c. Albert, CT, New Brunswick (Code 1306) (table). National Household Survey (NHS) Profile. 2011 National Household Survey. Statistics Canada Catalogue no. 99-004-XWE. Ottawa. Released September 11, 2013. Available online at: http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/prof/index.cfm?Lang=E. Last accessed onJuly 8, 2015.

Statistics Canada. 2013d. Canada (Code 01) (table). National Household Survey (NHS) Profile. 2011 National Household Survey. Statistics Canada Catalogue no. 99-004-XWE. Ottawa. Released September 11, 2013. http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/prof/index.cfm?Lang=E. Last accessed onJuly 4, 2015.

Statistics Canada 2014. Table 384-0037 - Gross domestic product, income-based, provincial and territorial, annual (dollars), CANSIM (database). Last accessed onJuly 8, 2015.

Tourism Industry Association of New Brunswick (TIANB). 2010. Industry Snapshot. Available online at: http://www.tianb.com/en/factsandfigures/industrysnapshot.asp.

Assessment of Potential Environmental Effects on Heritage Resources

Archaeological Services. 2012. *Guidelines and Procedures for Conducting Professional Archaeological Assessments in New Brunswick*. Archaeological Services, Heritage Branch, New Brunswick Department of Tourism, Heritage and Culture, Fredericton.

Archaeological Services. 2014a. Archaeological Potential Map for the Maritime Electric Transmission Line Project. PDF Map received October 8, 2014.

Archaeological Services. 2014b. Archaeological Potential Map for the Maritime Electric Transmission Line Project. Digital Spatial Data received November 2, 2014.

Ganong, W.F. 1896. A Monograph of the Place-Nomenclature of the Province of New Brunswick. Contributions to the History of New Brunswick No. 2, Transactions of the Royal Society of Canada Second Series:1896–1897, Volume II, Section II:175–289.

Ganong, W.F. 1899. A Monograph of Historic Sites in the Province of New Brunswick. Contributions to the History of New Brunswick No. 4, Transactions of the Royal Society of Canada Second Series – 1899-1900, Volume V, Section II. Ottawa.

Hamilton, William. 1996. Place Names of Atlantic Canada. University of Toronto Press, Toronto.

hute, Janet E. 2002. Algonquians/Eastern Woodlands. In: Aboriginal Peoples of Canada: A short Introduction, edited by P.R. Magocsi, pp. 38–81. University of Toronto Press, Toronto.

Leonard, Kevin J.M. 1996. Mi'kmaq Culture During the Late Woodland and Early Historic Periods. Unpublished PhD Dissertation, Department of Anthropology, University of Toronto, Toronto.

Miller, Randall F. 2014. New Brunswick Museum – Palaeontology Report 14-03. Report prepared for Stantec Consulting Ltd, October 14, 2014. Natural Science Department, New Brunswick Museum, Saint John.

Miller, Virginia P. 2004. The Mi'kmaq: A Maritime Woodland Group. In: Native Peoples: the Canadian Experience, Part V – The Eastern Woodlands, pp. 248–267. Oxford University Press Canada, Don Mills.

Montresor, John. 1768. *Map of Nova Scotia or Acadia with the Island of Cape Breton and St. John's from actual surveys by Captain Montresor, Engineer.* American Geographical Society Library Digital Map Collection.

NBDNR. 2007. Our Landscape Heritage: The Story of Ecological Land Classification. Prepared by New Brunswick Department of Natural Resources, The Ecosystem Classification Working Group.

Vincent F. Zelazny, General Editor. 2nd Edition. Originally issued 2003. ISBN 978-1-55396-203-8 in New Brunswick.

New Brunswick Provincial Archives (NBPA). 2014. Where is Home? New Brunswick Communities Past and Present. Accessed online at: http://archives.gnb.ca/Exhibits/Communities/Home.aspx?culture=en-CA. Last accessed: October 2014.

Nicholas, Michael. 2014. Personal Communication. October 20 and December 16, 2014. Archaeologist, Archaeological Services, Heritage Branch, New Brunswick Department of Tourism, Heritage and Culture, Fredericton.

Nicholas, Michael. 2015. Personal Communication. February 10, 2015. Archaeologist, Archaeological Services, Heritage Branch, New Brunswick Department of Tourism, Heritage and Culture, Fredericton.

Rayburn, Alan. 1975. Geographical Names of New Brunswick. Surveys and Mapping Branch, Department of Energy, Mines and Resources. Ottawa.

Stantec Consulting Ltd. 2015. 2014 Archaeological Impact Assessment (Walkover) for the New Brunswick- Prince Edward Island Transmission Line Interconnection Project – New Brunswick Land-Based Portion. Prepared for Maritime Electric Company, Limited.

Assessment of Potential Environmental Effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Aboriginal Affairs Secretariat. 2011. Government of New Brunswick, Duty to Consult Policy, November 2011. Available online at: http://www2.gnb.ca/content/dam/gnb/Departments/aas-saa/pdf/en/DutytoConsultPolicy.pdf. Last accessed onJune 17, 2015

Aboriginal Affairs and Northern Development Canada (AANDC). 2014. First Nation Profiles Available at: http://fnpim-cippn.aandc-aadnc.gc.ca/index-eng.asp Last accessed onJune 25, 2015.

Berneshawi, Suzanne. 1997. Resource Management and the Mi'kmaq Nation. Available online at: http://www3.brandonu.ca/library/CJNS/17.1/cjnsv17no1_pg115-148.pdf. Last accessed onJune 29, 2015.

Paul, D. n.d. MAP: Land of the Mi'Kmaq – Mi'kma'ki, We were not the Savages, First Nation History. Available online at: http://www.danielnpaul.com/Map-Mi'kmaqTerritory.html. Last accessed onJune 17, 2015.

polygon dataset of Aboriginal Lands, created using ArcGIS software, from sources on Natural Resources Canada, Earth Sciences Sector, Surveyor General Branch. Download 27th April 2015, DSPRY from: http://geogratis.gc.ca/api/en/nrcan-rncan/ess-sst/815dd99d-4fbd-47cc-be02-7ad4b03a23ec.html.

Stantec Consulting Ltd. (Stantec). 2015. 2014 Archaeological Impact Assessment (Walkover) for the New Brunswick – Prince Edward Island Transmission Line Interconnection Project – New Brunswick Land Based Portion. Fredericton, NB.

Effects of Environment on the Project

Adams, J. and S. Halchuk. 2003. Fourth generation seismic hazard maps of Canada: Values for over 650 Canadian localities intended for the 2005 National Building Code of Canada. Geological Survey of Canada, Open File 4459.

Basham, P.W., and J. Adams. 1984. The Miramichi, New Brunswick Earthquakes: Near-Surface Thrust Faulting in the Northern Appalachians. Geoscience Canada, Vol. 11, No. 3, p.115-121.

Bernier, N., J. MacDonald, J. Ou, H. Ritchie, and K. Thompson. 2006. Storm surge and meteorological modelling. In Impacts of Sea Level Rise and Climate Change on the Coastal Zone of South eastern New Brunswick, (ed.) R. Daigle, D. Forbes, G. Parkes, H. Ritchie, T. Webster, D. Bérubé, A. Hanson, L. DeBaie, S. Nichols and L. Vasseur, Environment Canada, 613 pp.

Bindoff, N.L., J. Willebrand, V. Artale, A, Cazenave, J. Gregory, S. Gulev, K. Hanawa, C. Le Quéré, S. Levitus, Y. Nojiri, C.K. Shum, L.D. Talley and A. Unnikrishnan. 2007. Observations: Oceanic Climate Change and Sea Level. *In* Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Avery, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Available online at: http://ipcc-wg1.ucar.edu/wg1/wg1- report.html.

Catto, N.R. 2006. Impacts of Climate Change and Variation on the Natural Areas of Newfoundland and Labrador. Newfoundland Ministry of Environment and Conservation, St. John's NF, 160 pp.

CBC News. 2013 May 21. 10 deadliest tornadoes in Canada and U.S. Available online at: http://www.cbc.ca/news/canada/10-deadliest-tornadoes-in-canada-and-u-s-1.1358411

Environment Canada. 2011. Mapping Tornado-Prone Regions for National Building Codes and Standards. Available at: http://www.ec.gc.ca/scitech/default.asp?lang=En&n=6A2D63E5-1&xsl=privateArticles2,viewfull&po=4008C164. Accessed on July 14, 2015.

Fader, G. 2005. Seismic Hazard, Faults and Earthquakes, Digby Neck, Bay of Fundy. Atlantic Marine Geological Consulting Ltd., Halifax, Nova Scotia.

Government of Canada (GOC). 2015a. Canadian Climate Normals: Moncton, New Brunswick. Available online at: http://climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html. Last accessed on June 23, 2015.

GOC. 2015b. Canadian Climate Normals: Sackville, New Brunswick. Available online at: http://climate.weatheroffice.ec.gc.ca/climate_normals/ index_e.html. Accessed on June 23, 2015.

GOC. 2015c. Get Prepared; Hazards and Emergencies; Regional Hazards: New Brunswick. Available online at: http://www.getprepared.gc.ca/cnt/hzd/rgnl/nb-en.aspx.

Government of New Brunswick (GNB). 2015. Extreme Rainfall. Available online at: http://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/climate_change/content/climate_change_indicators/indicators/climate/extreme_rainfall.html. Accessed on July 3, 2015.

IBC (Insurance Bureau of Canada). 2012. Telling the Weather Story. Prepared by the Institute for Catastrophic Loss Reduction for the Insurance Bureau of Canada, June 2012. Available online at: http://iclr.org/images/Telling_the_weather_story.pdf.

IPCC (Intergovernmental Panel on Climate Change). 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

IPCC. 2007. Appendix I: Glossary; in Climate Change 2007: Impacts, Adaptation and Vulnerability (Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change); (ed.) M.I. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson; Cambridge University Press, Cambridge United Kingdom, p. 869-883, Accessed on June 24, 2015 from https://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-app.pdf.

Lines, G.S., M. Pancura, and C. Lander. 2005. Building Climate Change Scenarios of Temperature and Precipitation in Atlantic Canada using the Statistical Downscaling Model (SDSM). Environment Canada, Meteorological Service of Canada, Atlantic Region. Science Report Series No. 2005-9, October 2005.

NAV CANADA. 2001. The Weather of Atlantic Canada and Easter Quebec. Available online at: http://www.navcanada.ca/EN/media/Publications/Local%20Area%20Weather%20Manuals/LAWM-Atlantic-1-EN.pdf.

New Brunswick Power Transmission Corporation. 2012. Environmental Protection Plan for New Brunswick Power Corporation Transmission Facilities.

NOAA. 2012. National Sea Grant College Program; Climate Change Services for Citizens. National Oceanic and Atmospheric Administration. Available online at: http://www.seagrant.noaa.gov/focus/documents/fact_sheets_and_synthesis_stories/2011%20Fact%20Sheets/2011ClimateFinal.pdf.

NRCan (Natural Resources Canada). 2015. Canadian Wildland Fire Information System. http://cwfis.cfs.nrcan.gc.ca/ha/fwnormals?type=fwi&month=7.

NRCan. 2013. Seismic Design Tools for Engineers: Ground Motion Parameters for Use with the National Building Code of Canada. Natural Resources Canada, Ottawa, Ontario. 2013. Available online at: http://www.earthquakescanada.nrcan.gc.ca/hazard-alea/interpolat/index-eng.php.

NRCan. 2010b. National Building Code of Canada Volume 1. Available online at: http://www.nrc-cnrc.gc.ca/eng/publications/codes_centre/2010_national_building_code.html.

NRCan. 2001. The Tides of Change: Climate Change in the Atlantic Provinces. Shaw, J. Geological Surveys of Canada, Miscellaneous Report no. 75, 2001; 1 sheet, doi:10.4095/212738

Phillips, D. 1990. The Climate of New Brunswick. In *Climates of Canada*. Minister of Supply and Services Canada.

Parkes, G.S., Forbes, D.L., and Ketch, L.A. 2006. Sea-level rise and regional subsidence in southeastern New Brunswick; *in* Impacts of Sea Level Rise and Climate Change on the Coastal Zone of Southeastern New Brunswick, (ed.) R. Daigle, R, Forbes. D., Parkes, G., Ritchie, H., Webster, T., Bérubé, D., Hanson, A., DeBaie, L., Nichols, S. and Vasseur, L. Environment Canada, 24-610.

Phillips, D. 1990. The Climate of New Brunswick. In *Climates of Canada*. Minister of Supply and Services Canada.

PIEVC. 2014. The PIEVC Engineering Protocol for Infrastructure Vulnerability Assessment and Adaptation to a Changing Climate. Public Infrastructure Engineering Vulnerability Committee, Engineers Canada. Available online at: http://www.pievc.ca/e/doc_list.cfm?dsid=43.

R.J. Daigle Enviro. 2012. Sea-Level Rise and Flooding Estimates for New Brunswick Coastal Sections. Available online at: http://atlanticadaptation.ca/sites/discoveryspace.upei.ca.acasa/files/NB-Sea%20Level%20Rise-Coastal%20Sections-Daigle-2012.pdf.

Samuel Engineering. 2013. Canadian National Instrument 43-101 Technical Report on the Sisson Project, New Brunswick, Canada. Prepared by Samuel Engineering, Inc. on behalf of Northcliff Resources Ltd., Greenwood Village, Colorado. January 22, 2013.

Vasseur, L. and N. Catto. 2008. Atlantic Canada; In From Impacts to Adaptation: Canada in a Changing Climate 2007, edited by D.S. Lemmen, F.J. Warren, J. Lacroix and E. Bush; Government of Canada, Ottawa, ON, p. 119-170.

Accidents, Malfunctions, and Unplanned Events

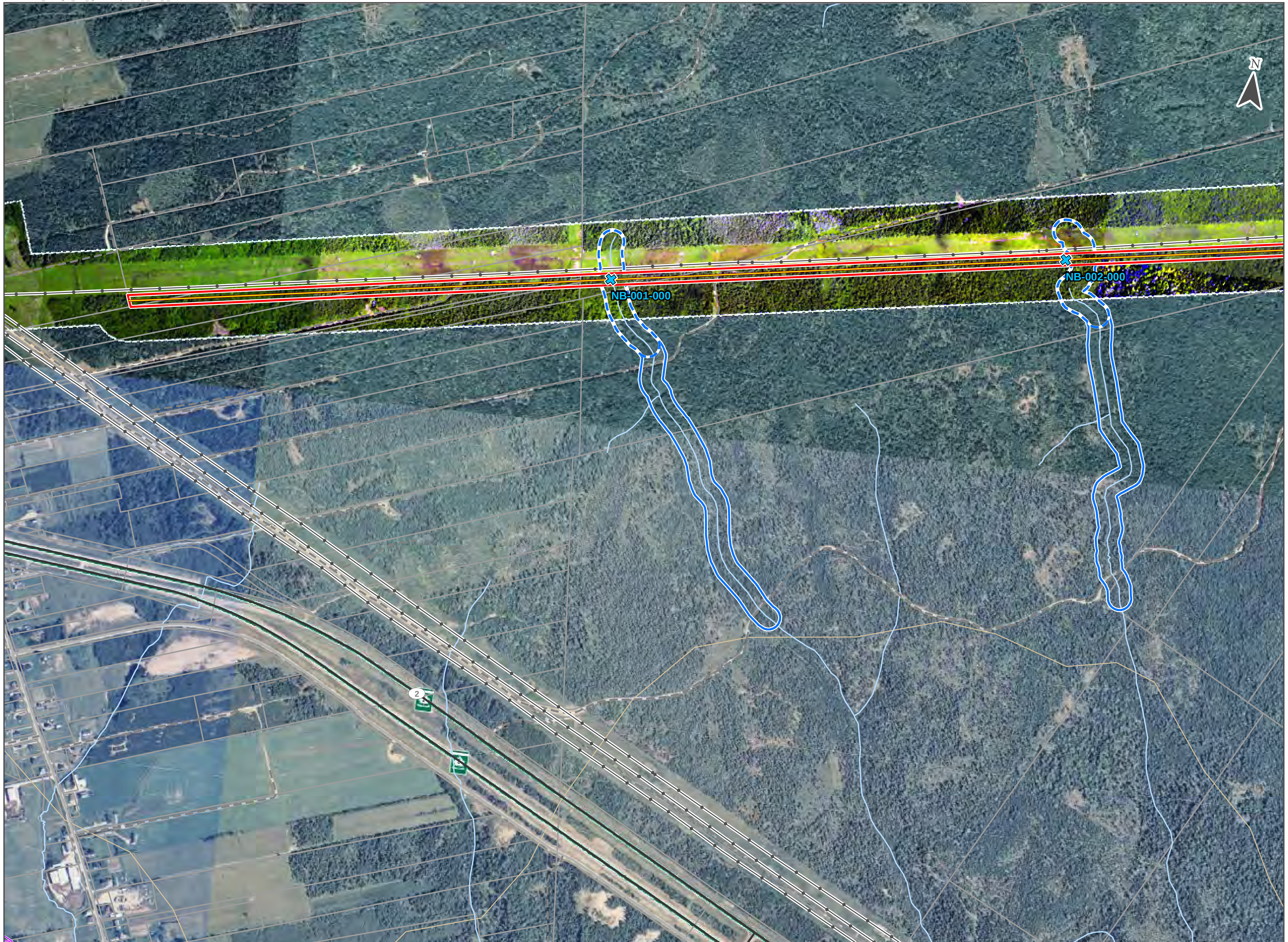
NBPTC. 2012. Environmental Protection Plan for New Brunswick Power Corporation Transmission Facilities, New Brunswick. Prepared by: New Brunswick Power Transmission Corporation (NBPTC). November 1, 2012. Rev. No. 0.

APPENDIX A
FRESHWATER VC MAPBOOK

PEI-NB CABLE INTERCONNECTION UPGRADE PROJECT - VOLUME 3, NEW BRUNSWICK

September 30, 2015

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd



Freshwater Environment Assessment Area Boundaries

Watercourse Crossing

Freshwater Environment Assessment Area

Project Development Area

Local Assessment Area

Regional Assessment Area

Proposed Project Components

Memramcook to Melrose

ExistingTransmission Line

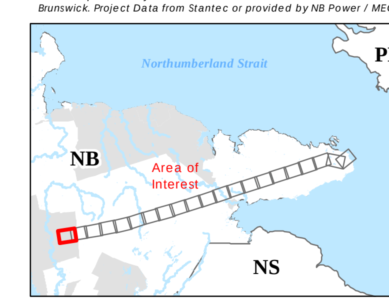
GeoNB-mapped Wetland

Property Boundary

0 100 200 300 400
Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



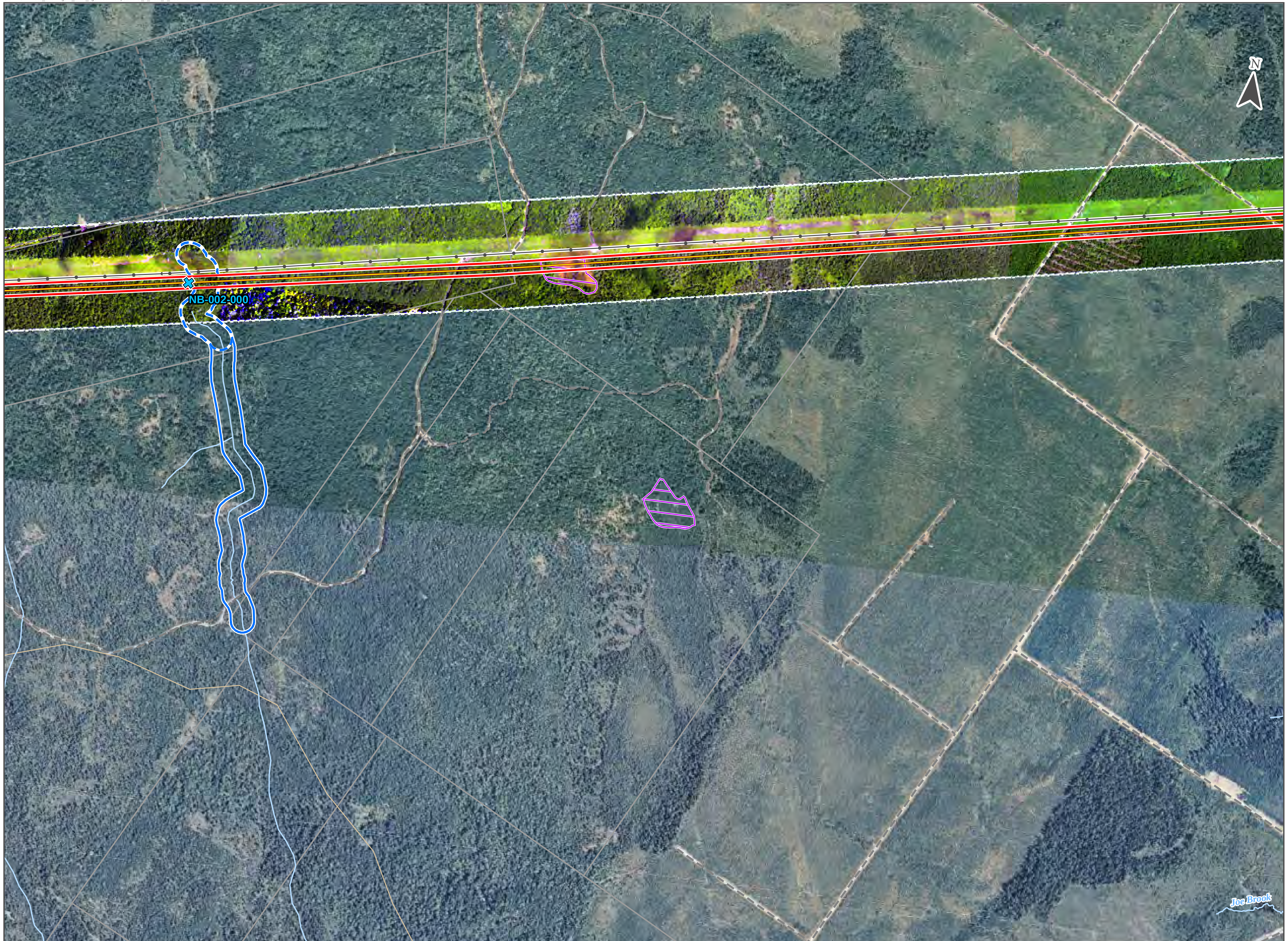
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix A

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd



Freshwater Environment Assessment Area Boundaries

Watercourse Crossing

Freshwater Environment Assessment Area

Project Development Area

Local Assessment Area

Regional Assessment Area

Proposed Project Components

Memramcook to Melrose

ExistingTransmission Line

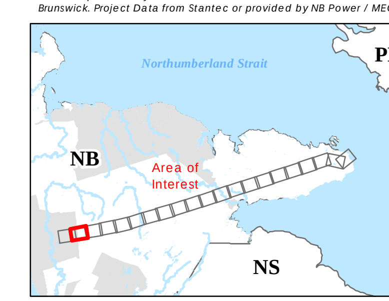
GeoNB-mapped Wetland

Property Boundary

0 100 200 300 400
Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix A

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd

Freshwater Environment Assessment Area Boundaries

Watercourse Crossing

Freshwater Environment Assessment Area

Project Development Area

Local Assessment Area

Regional Assessment Area

Proposed Project Components

Memramcook to Melrose

ExistingTransmission Line

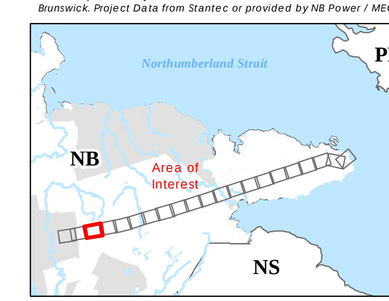
GeoNB-mapped Wetland

Property Boundary

0 100 200 300 400
Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd

Freshwater Environment Assessment Area Boundaries

Freshwater Environment Assessment Area

- Project Development Area
- Local Assessment Area
- Regional Assessment Area

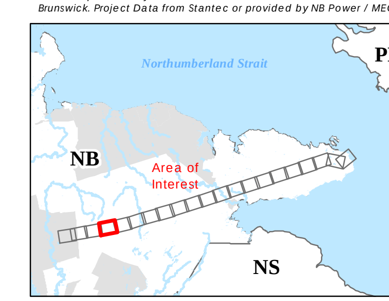
Proposed Project Components

- Memramcook to Melrose
- ExistingTransmission Line
- GeoNB-mapped Wetland
- Property Boundary

0 100 200 300 400
Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



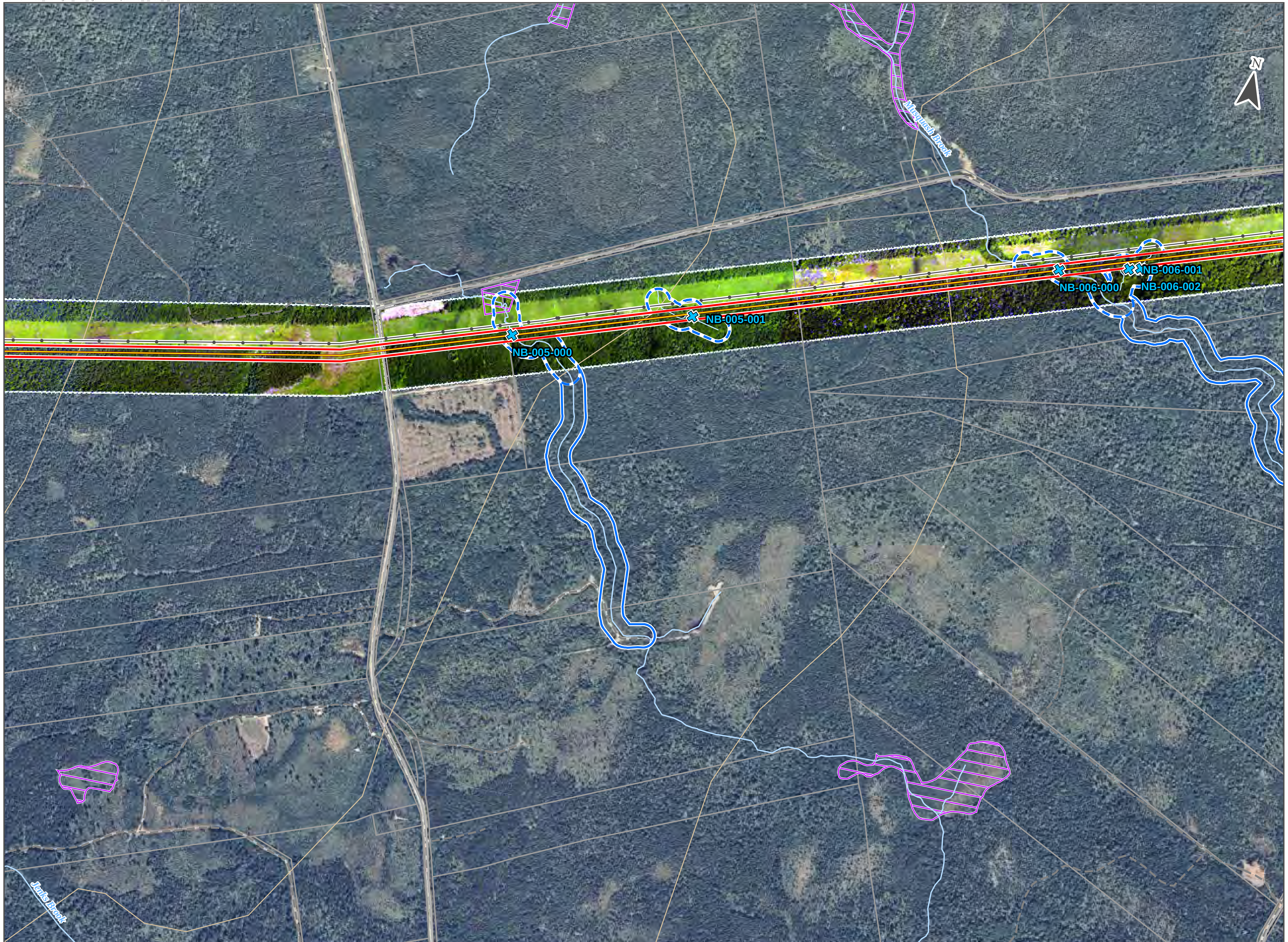
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix A

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd



Freshwater Environment Assessment Area Boundaries

Watercourse Crossing

Freshwater Environment Assessment Area

Project Development Area

Local Assessment Area

Regional Assessment Area

Proposed Project Components

Memramcook to Melrose

ExistingTransmission Line

GeoNB-mapped Wetland

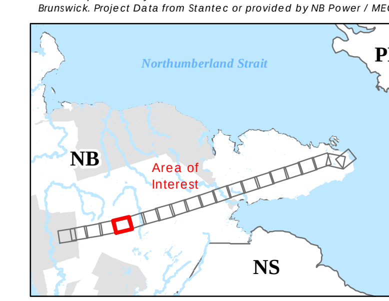
Property Boundary

0 100 200 300 400

Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



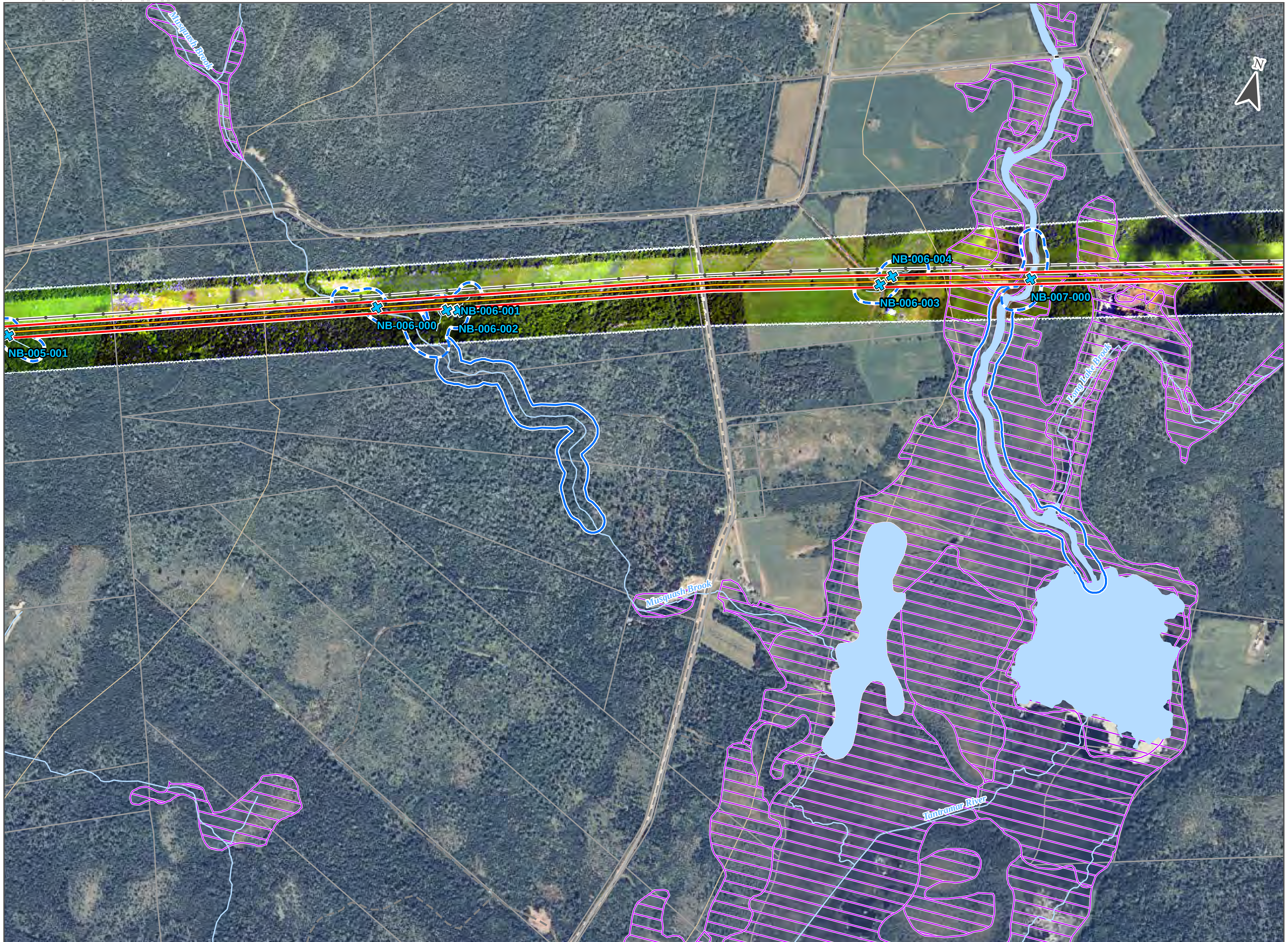
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix A

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd



Freshwater Environment Assessment Area Boundaries

Watercourse Crossing

Freshwater Environment Assessment Area

Project Development Area

Local Assessment Area

Regional Assessment Area

Proposed Project Components

Memramcook to Melrose

ExistingTransmission Line

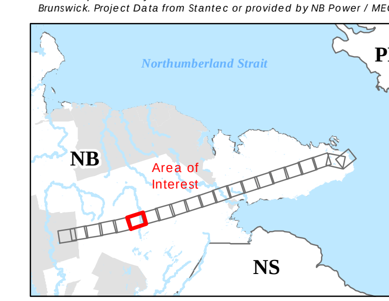
GeoNB-mapped Wetland

Property Boundary

0 100 200 300 400
Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

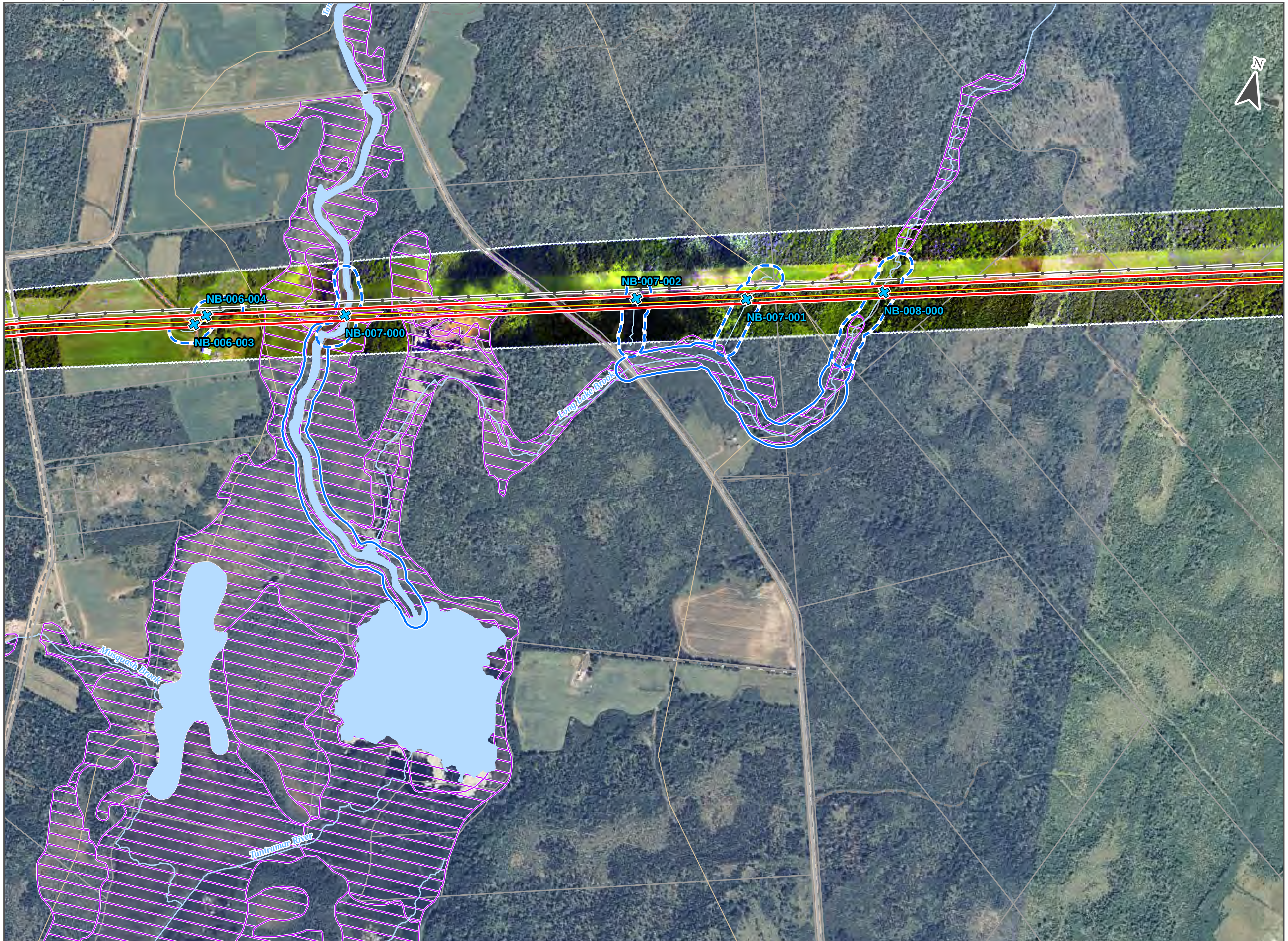


Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd



Freshwater Environment Assessment Area Boundaries

- Watercourse Crossing

Freshwater Environment Assessment Area

- Project Development Area
- Local Assessment Area
- Regional Assessment Area

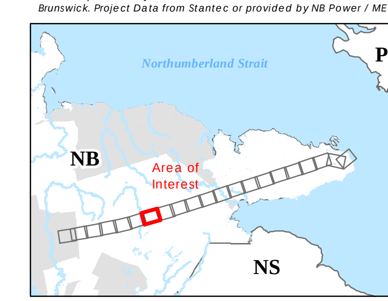
Proposed Project Components

- Memramcook to Melrose
- ExistingTransmission Line
- GeoNB-mapped Wetland
- Property Boundary

0 100 200 300 400
Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd

Freshwater Environment Assessment Area Boundaries

- Watercourse Crossing

Freshwater Environment Assessment Area

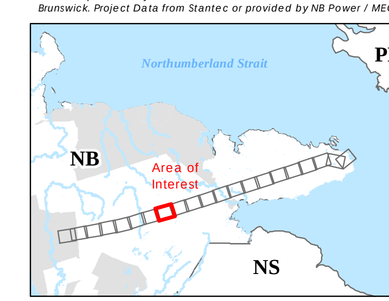
- Project Development Area
- Local Assessment Area
- Regional Assessment Area

Proposed Project Components

- Memramcook to Melrose
- ExistingTransmission Line
- GeoNB-mapped Wetland
- Property Boundary

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix A

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd

Freshwater Environment Assessment Area Boundaries

Freshwater Environment Assessment Area

- Project Development Area
- Local Assessment Area
- Regional Assessment Area

Proposed Project Components

- Memramcook to Melrose
- ExistingTransmission Line

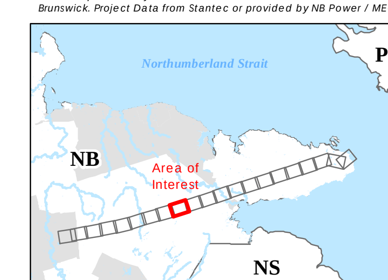
NAME

- M&NP Mainline Pipeline
- GeoNB-mapped Wetland
- Property Boundary

0 100 200 300 400
Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix A
9 of 21

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd

Freshwater Environment Assessment Area Boundaries

Watercourse Crossing

Freshwater Environment Assessment Area

Project Development Area

Local Assessment Area

Regional Assessment Area

Proposed Project Components

Memramcook to Melrose

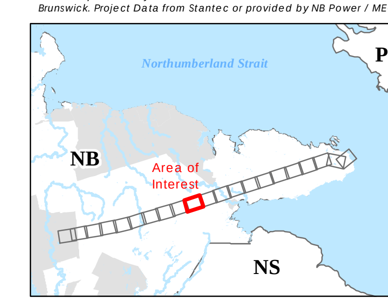
ExistingTransmission Line

Property Boundary

0 100 200 300 400
Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix A

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd

Freshwater Environment Assessment Area Boundaries

Watercourse Crossing

Freshwater Environment Assessment Area

Project Development Area

Local Assessment Area

Regional Assessment Area

Proposed Project Components

Memramcook to Melrose

ExistingTransmission Line

GeoNB-mapped Wetland

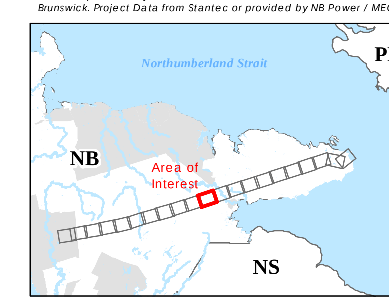
Property Boundary

0 100 200 300 400

Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix A

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd

Freshwater Environment Assessment Area Boundaries

Watercourse Crossing

Freshwater Environment Assessment Area

Project Development Area

Local Assessment Area

Regional Assessment Area

Proposed Project Components

Memramcook to Melrose

ExistingTransmission Line

Crown Lands

GeoNB-mapped Wetland

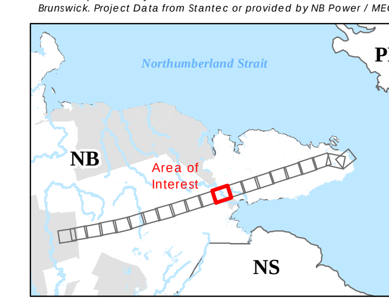
Provincially Significant Wetland

Property Boundary

0 100 200 300 400
Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix A
12 of 21

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd

Freshwater Environment Assessment Area Boundaries

Watercourse Crossing

Freshwater Environment Assessment Area

Project Development Area

Local Assessment Area

Regional Assessment Area

Proposed Project Components

Memramcook to Melrose

ExistingTransmission Line

Crown Lands

GeoNB-mapped Wetland

Provincially Significant Wetland

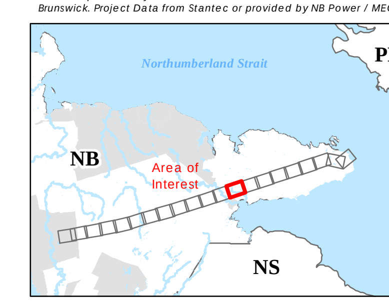
Property Boundary

0 100 200 300 400

Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

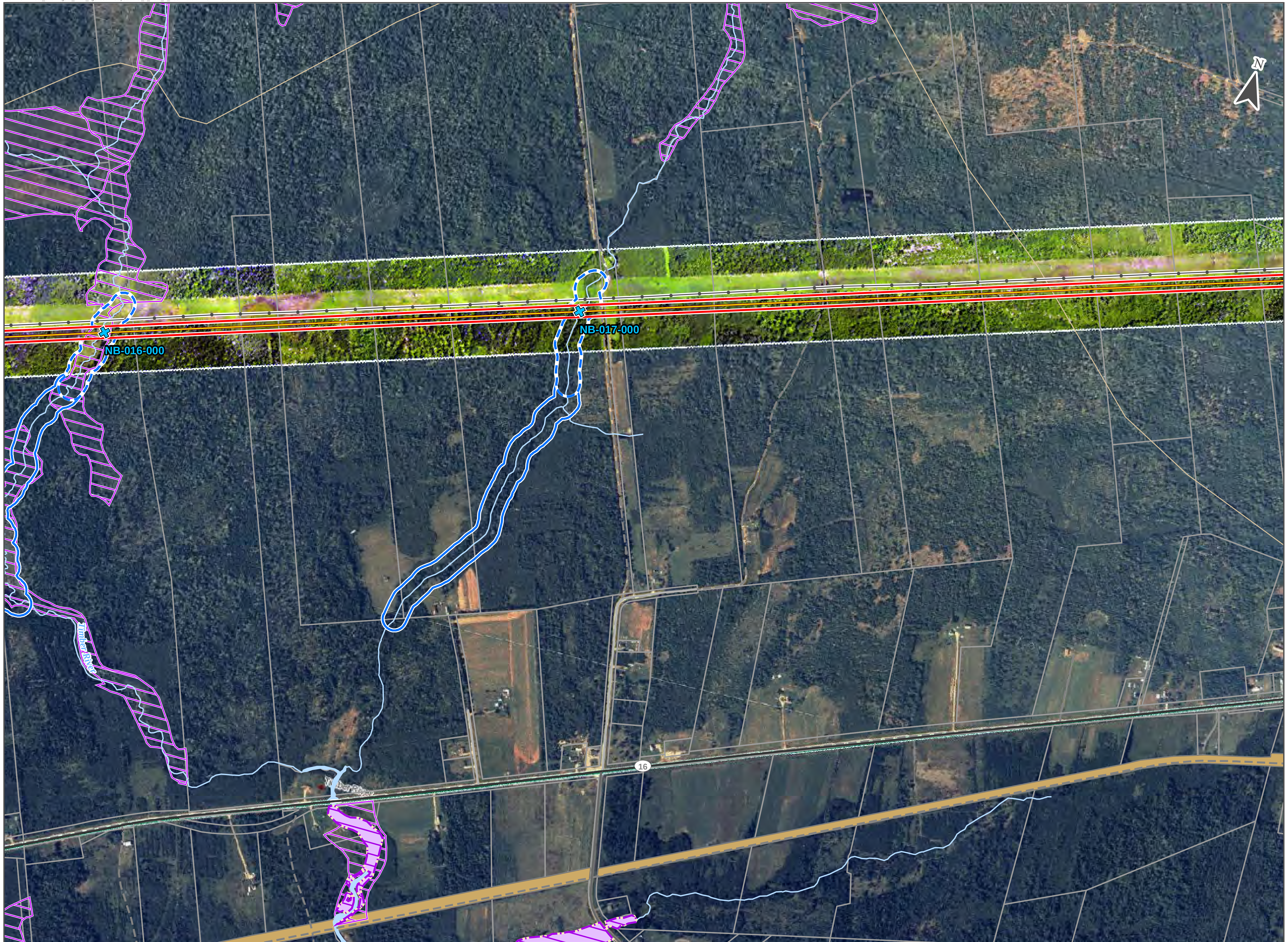


Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd



Freshwater Environment Assessment Area Boundaries

Watercourse Crossing

Freshwater Environment Assessment Area

Project Development Area

Local Assessment Area

Regional Assessment Area

Proposed Project Components

Memramcook to Melrose

ExistingTransmission Line

Crown Lands

GeoNB-mapped Wetland

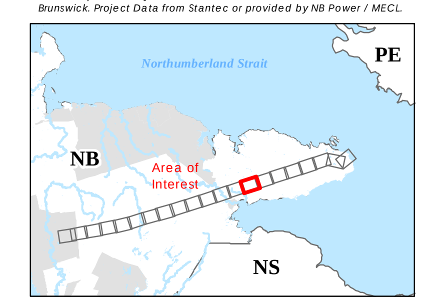
Provincially Significant Wetland

Property Boundary

0 100 200 300 400
Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



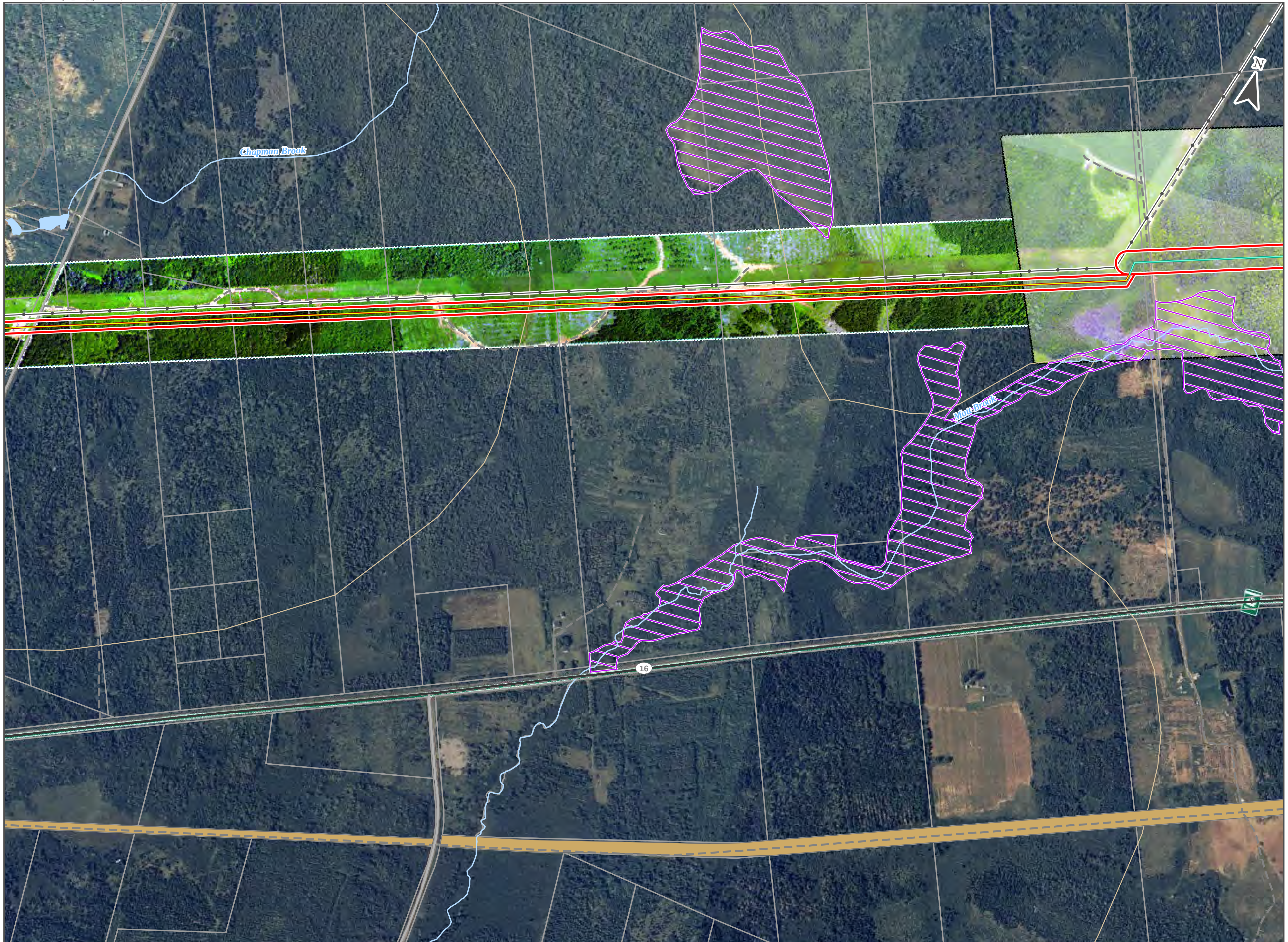
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix A

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd



Freshwater Environment Assessment Area Boundaries

Freshwater Environment Assessment Area

- Project Development Area
- Local Assessment Area
- Regional Assessment Area

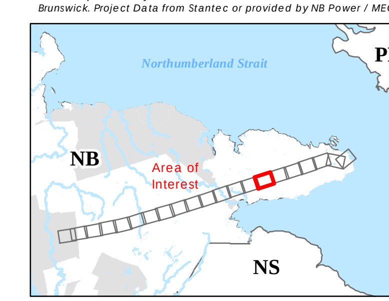
Proposed Project Components

- Memramcook to Melrose
- Melrose to Cape Tormentine
- ExistingTransmission Line
- Crown Lands
- GeoNB-mapped Wetland
- Property Boundary

0 100 200 300 400
Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



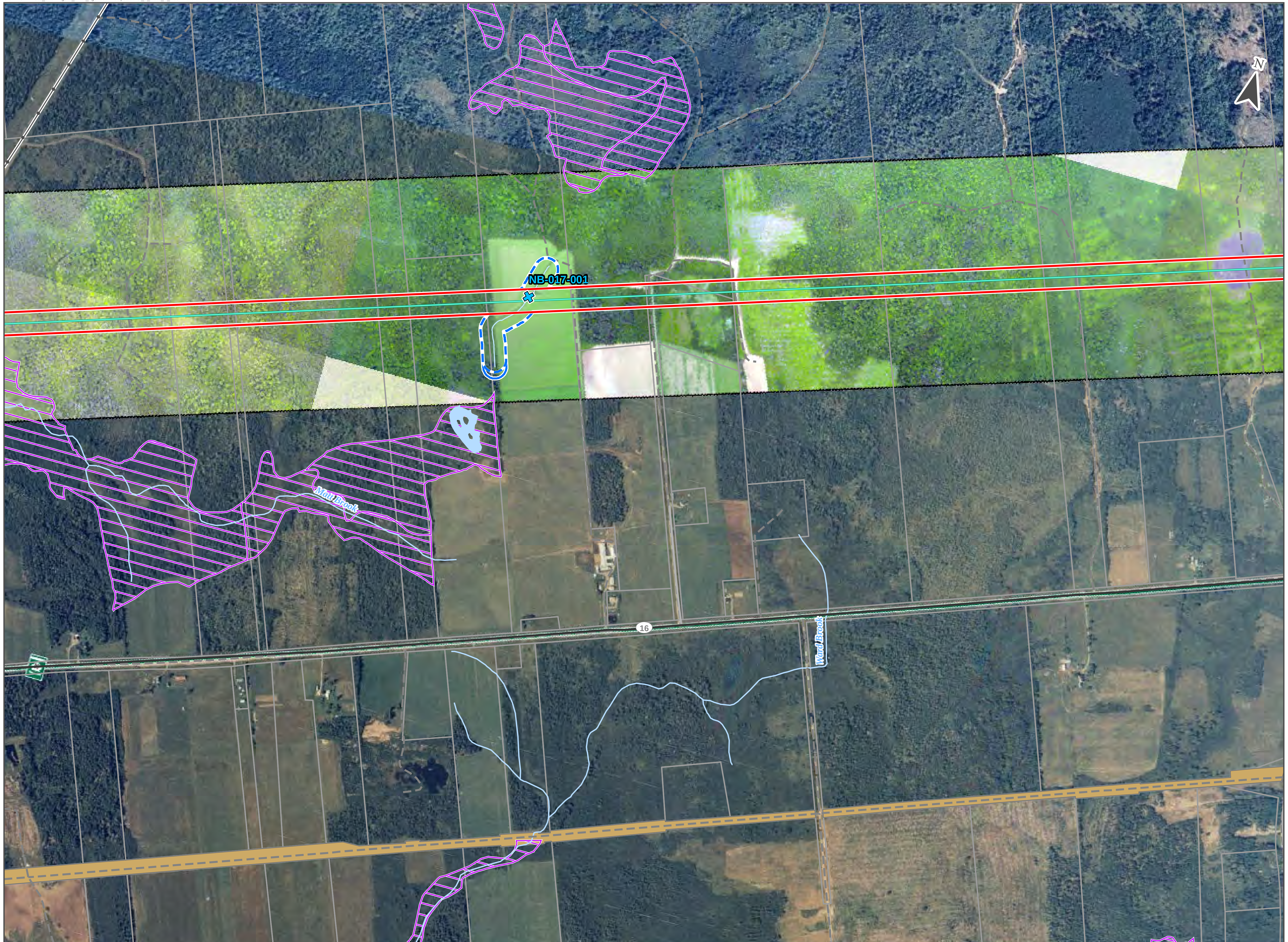
Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix A

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd



Freshwater Environment Assessment Area Boundaries

Watercourse Crossing

Freshwater Environment Assessment Area

Project Development Area

Local Assessment Area

Regional Assessment Area

Proposed Project Components

Melrose to Cape Tormentine

ExistingTransmission Line

Crown Lands

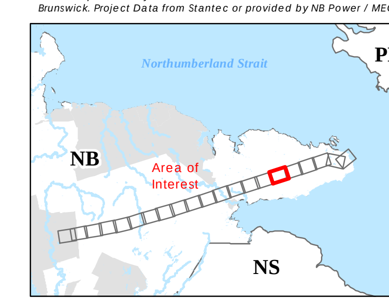
GeoNB-mapped Wetland

Property Boundary

0 100 200 300 400
Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix A

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd

Freshwater Environment Assessment Area Boundaries

- Watercourse Crossing

Freshwater Environment Assessment Area

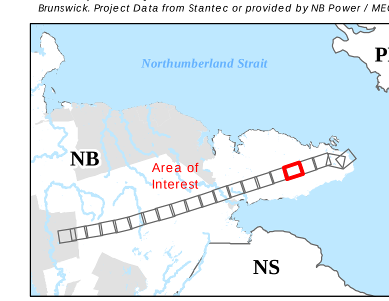
- Project Development Area
- Local Assessment Area
- Regional Assessment Area

Proposed Project Components

- Melrose to Cape Tormentine
- Crown Lands
- GeoNB-mapped Wetland
- Property Boundary

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd

Freshwater Environment Assessment Area Boundaries

Watercourse Crossing

Freshwater Environment Assessment Area

Project Development Area

Local Assessment Area

Regional Assessment Area

Proposed Project Components

Melrose to Cape Tormentine

Crown Lands

GeoNB-mapped Wetland

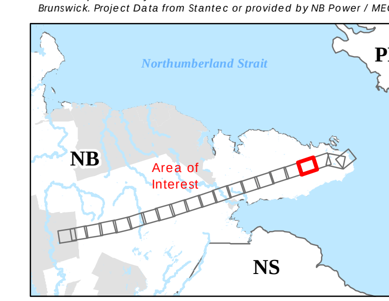
Property Boundary

0 100 200 300 400

Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

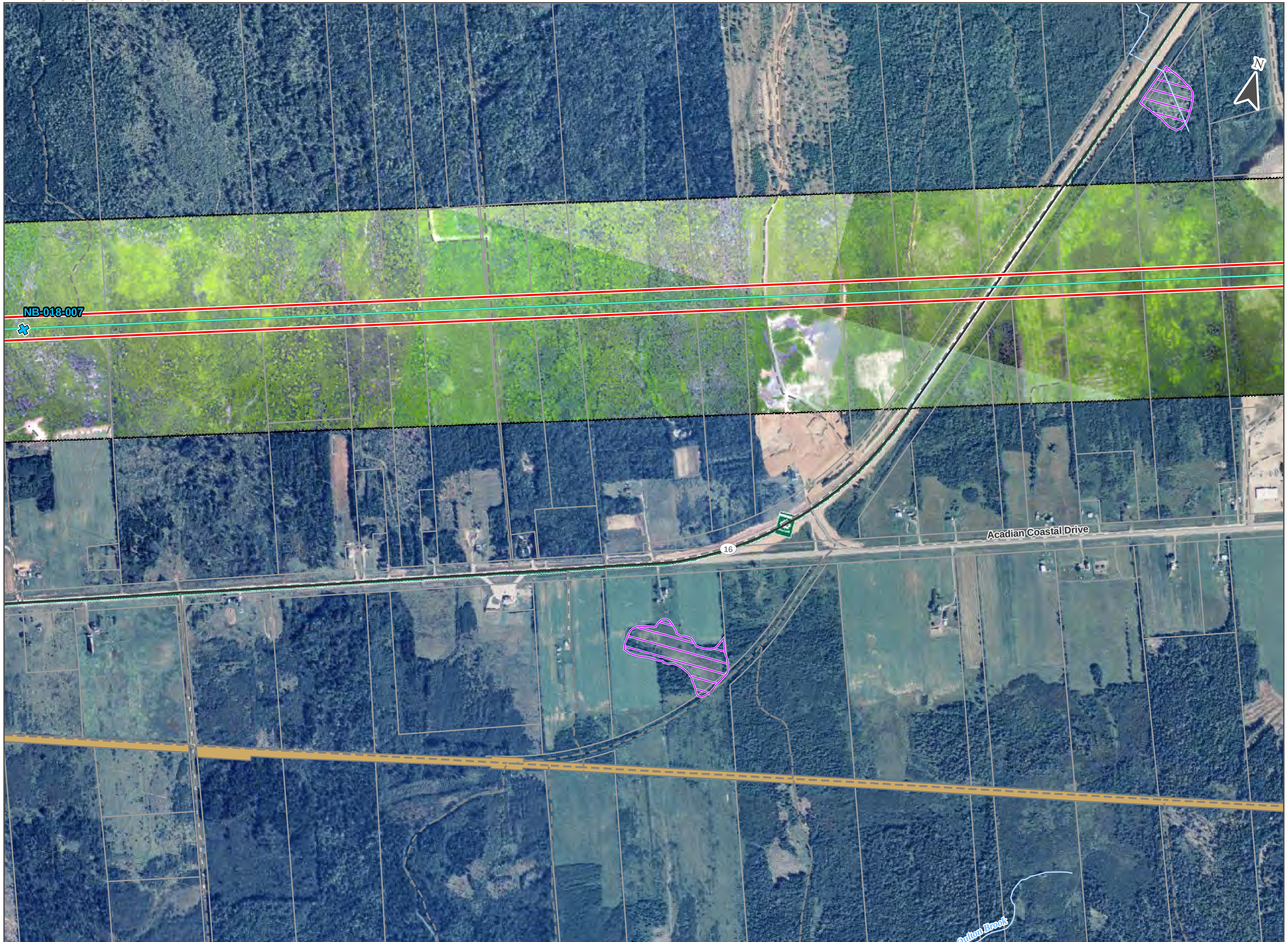


Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd



Freshwater Environment Assessment Area Boundaries

Watercourse Crossing

Freshwater Environment Assessment Area

Project Development Area

Local Assessment Area

Regional Assessment Area

Proposed Project Components

Melrose to Cape Tormentine

Crown Lands

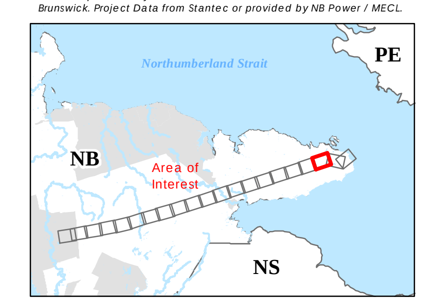
GeoNB-mapped Wetland

Property Boundary

0 100 200 300 400
Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

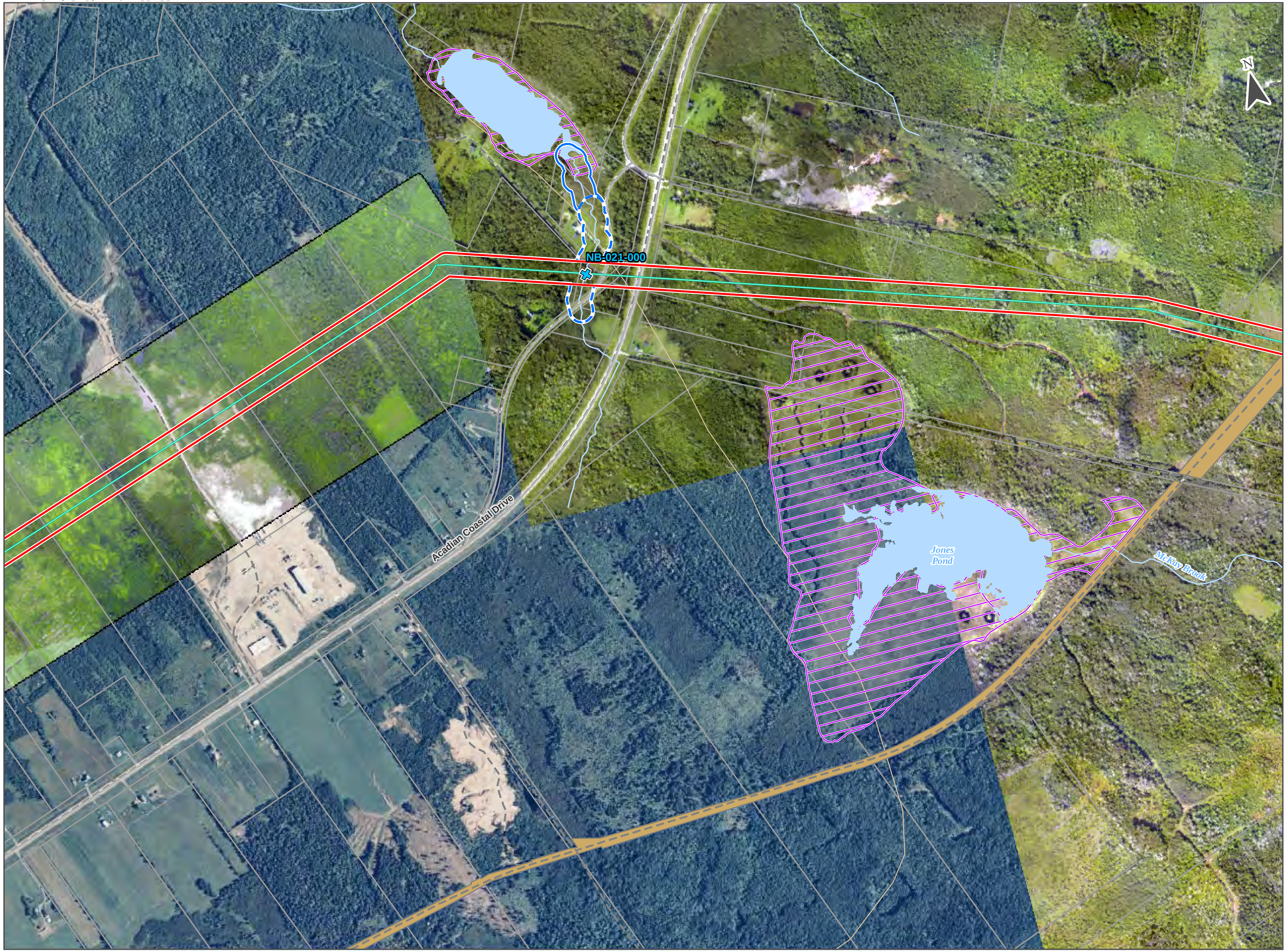


Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd



Freshwater Environment Assessment Area Boundaries

Watercourse Crossing

Freshwater Environment Assessment Area

Project Development Area

Local Assessment Area

Regional Assessment Area

Proposed Project Components

Melrose to Cape Tormentine

Crown Lands

GeoNB-mapped Wetland

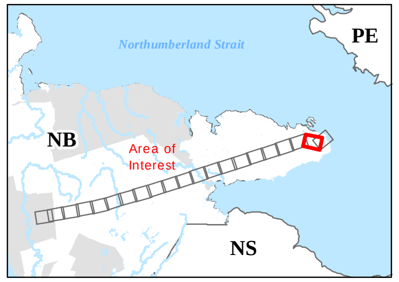
Property Boundary

0 100 200 300 400

Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix A

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_2_freshwater\121811475-0043.mxd

Freshwater Environment Assessment Area Boundaries

Watercourse Crossing

Freshwater Environment Assessment Area

Project Development Area

Local Assessment Area

Regional Assessment Area

Proposed Project Components in the Northumberland Strait

Proposed Submarine Cable #3

Propsoed Submarine Cable #4

Proposed Project Components

Melrose to Cape Tormentine

Proposed Buried Cable

Crown Lands

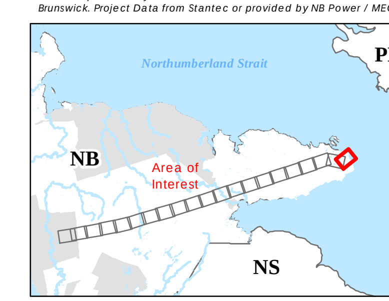
GeoNB-mapped Wetland

Property Boundary

0 100 200 300 400
Metres

121811475-0043 1:10,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB, PEI Government (2010), Natural Resources (2011). Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix A
21 of 21

APPENDIX B
TERRESTRIAL VC MAPBOOK

September 30, 2015

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd

Terrestrial Environment Assessment Area Boundaries

Proposed Project Components

Memramcook to Melrose

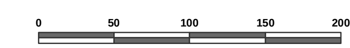
Terrestrial Assessment Area

Project Development Area

Local Assessment Area

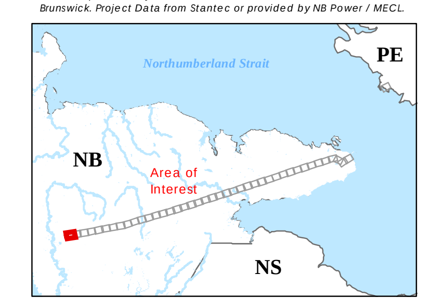
Existing Transmission Line

Memramcook Substation



121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

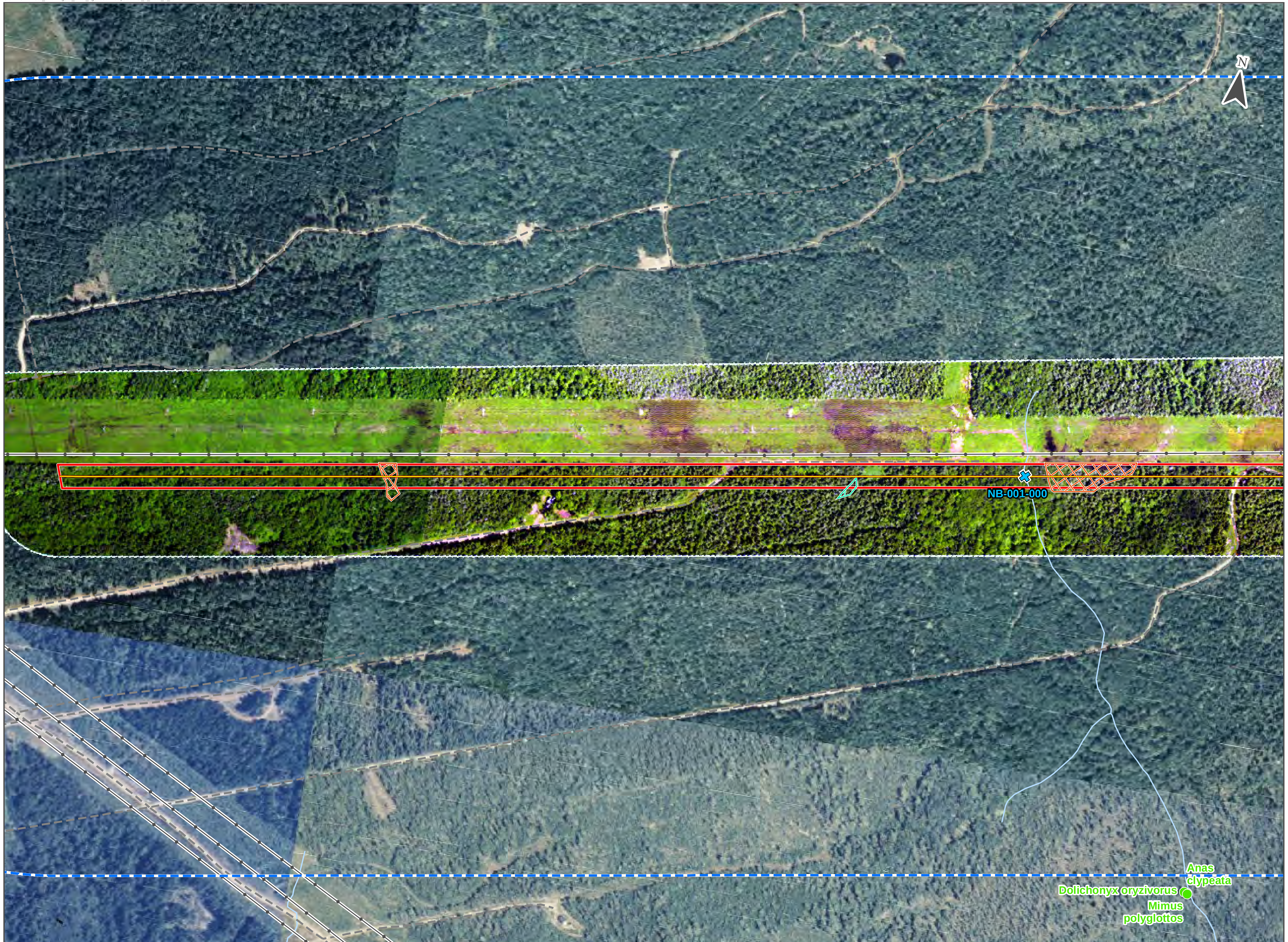


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

- AC CDC Bird Observation
- Watercourse Crossing

Proposed Project Components

- Memramcook to Melrose

Field Delineated Wetland

- Coniferous Treed Swamp
- Mixedwood Treed Swamp

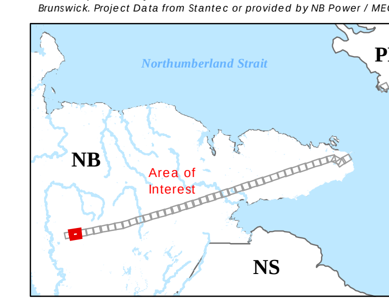
Terrestrial Assessment Area

- Project Development Area
- Local Assessment Area
- Existing Transmission Line

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

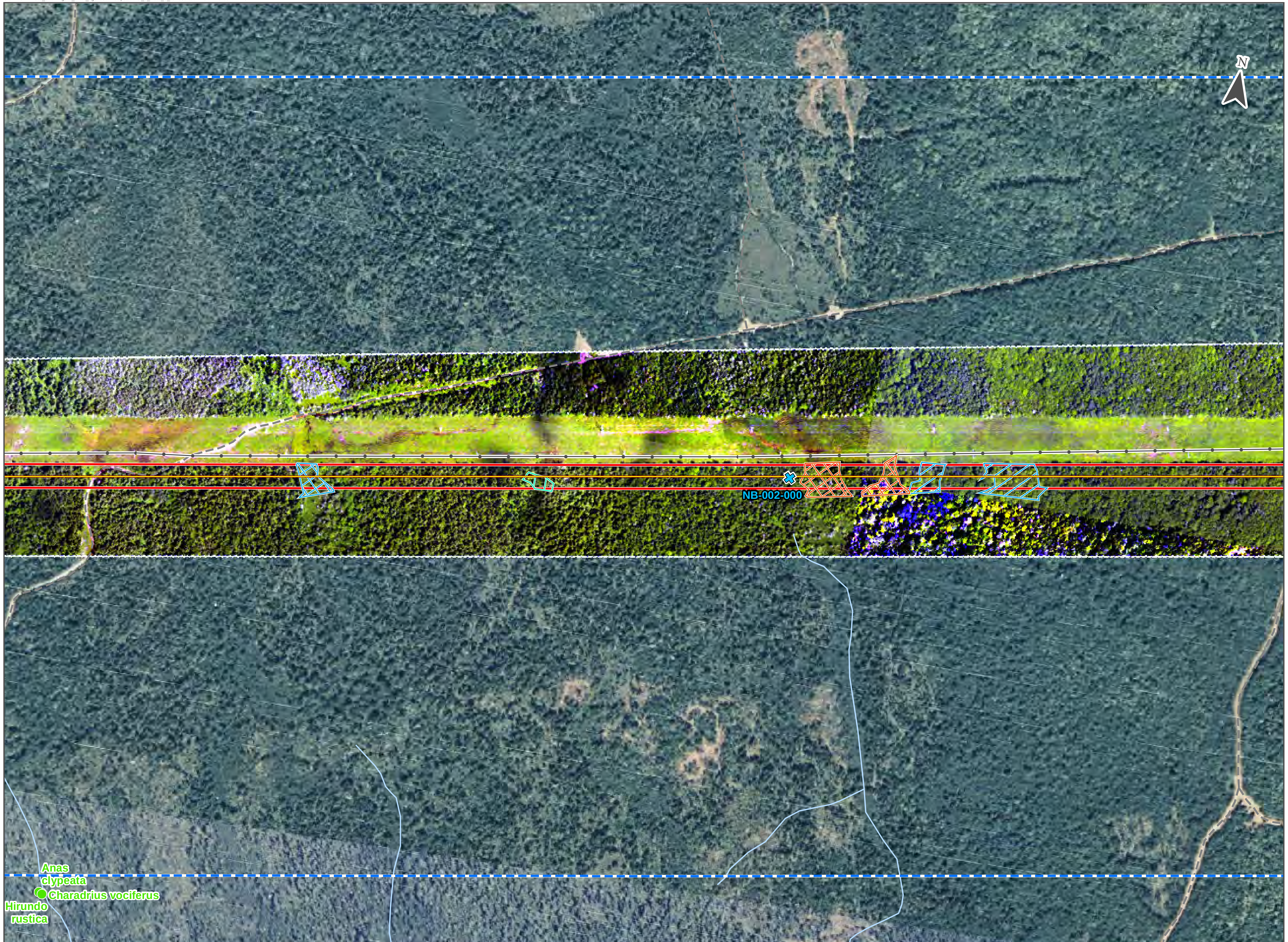


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

- AC CDC Bird Observation
- Watercourse Crossing

Proposed Project Components

- Memramcook to Melrose

Field Delineated Wetland

- Coniferous Treed Swamp
- Deciduous Treed Swamp
- Mixedwood Treed Swamp
- Tall Shrub Swamp

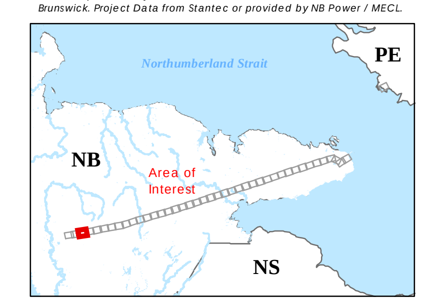
Terrestrial Assessment Area

- Project Development Area
- Local Assessment Area
- Existing Transmission Line

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

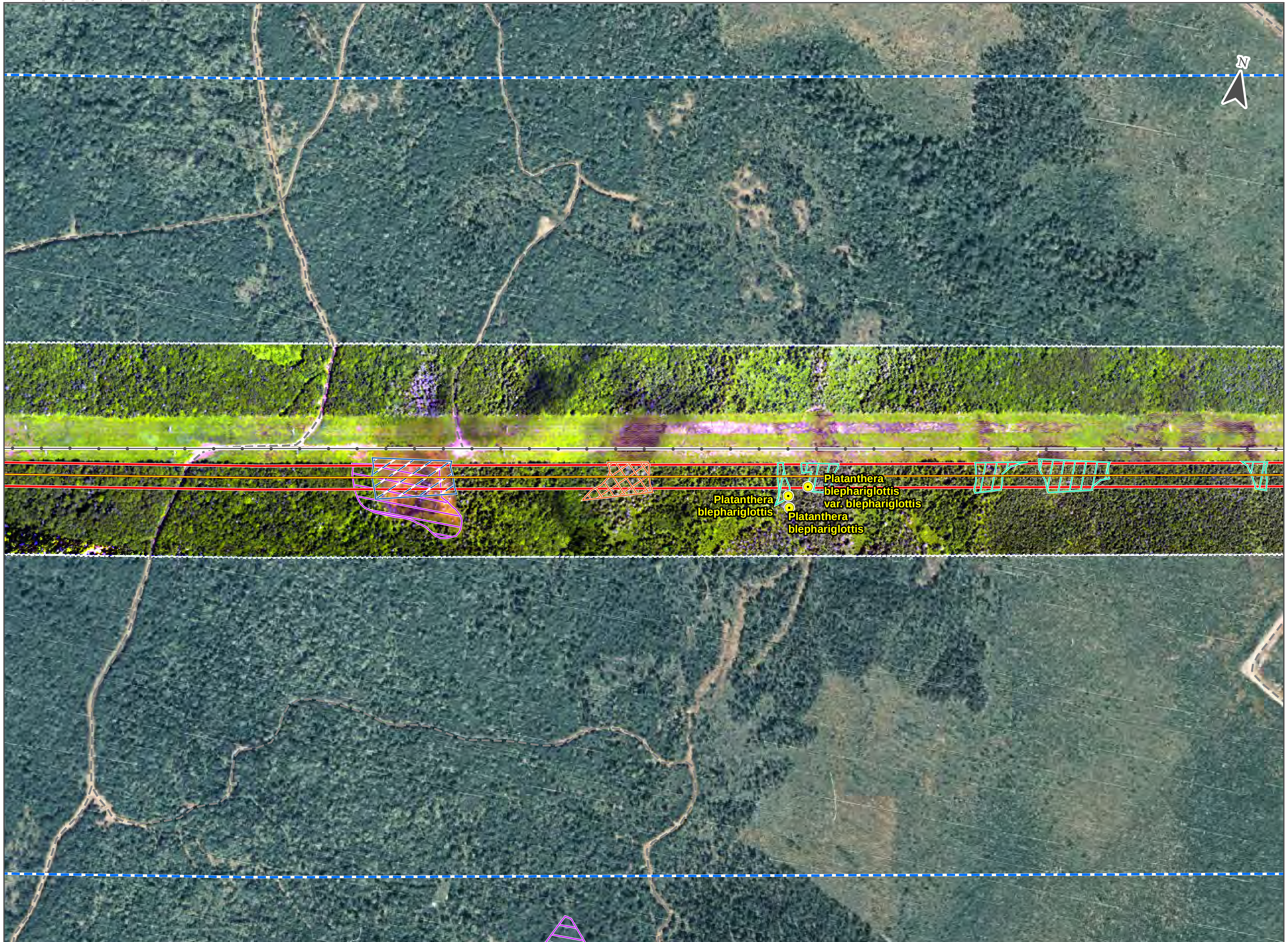


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)

- Vascular

Proposed Project Components

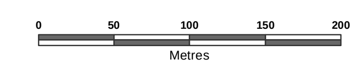
- Memramcook to Melrose

Field Delineated Wetland

- Coniferous Treed Swamp
- Graminoid Bog
- Mixedwood Treed Swamp

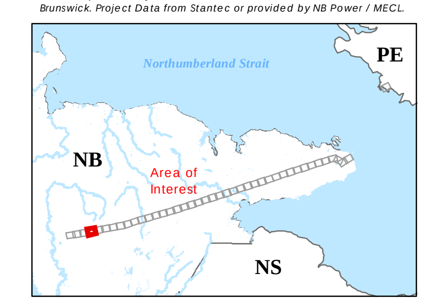
Terrestrial Assessment Area

- Project Development Area
- Local Assessment Area
- Existing Transmission Line
- GeoNB-mapped Wetland



121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

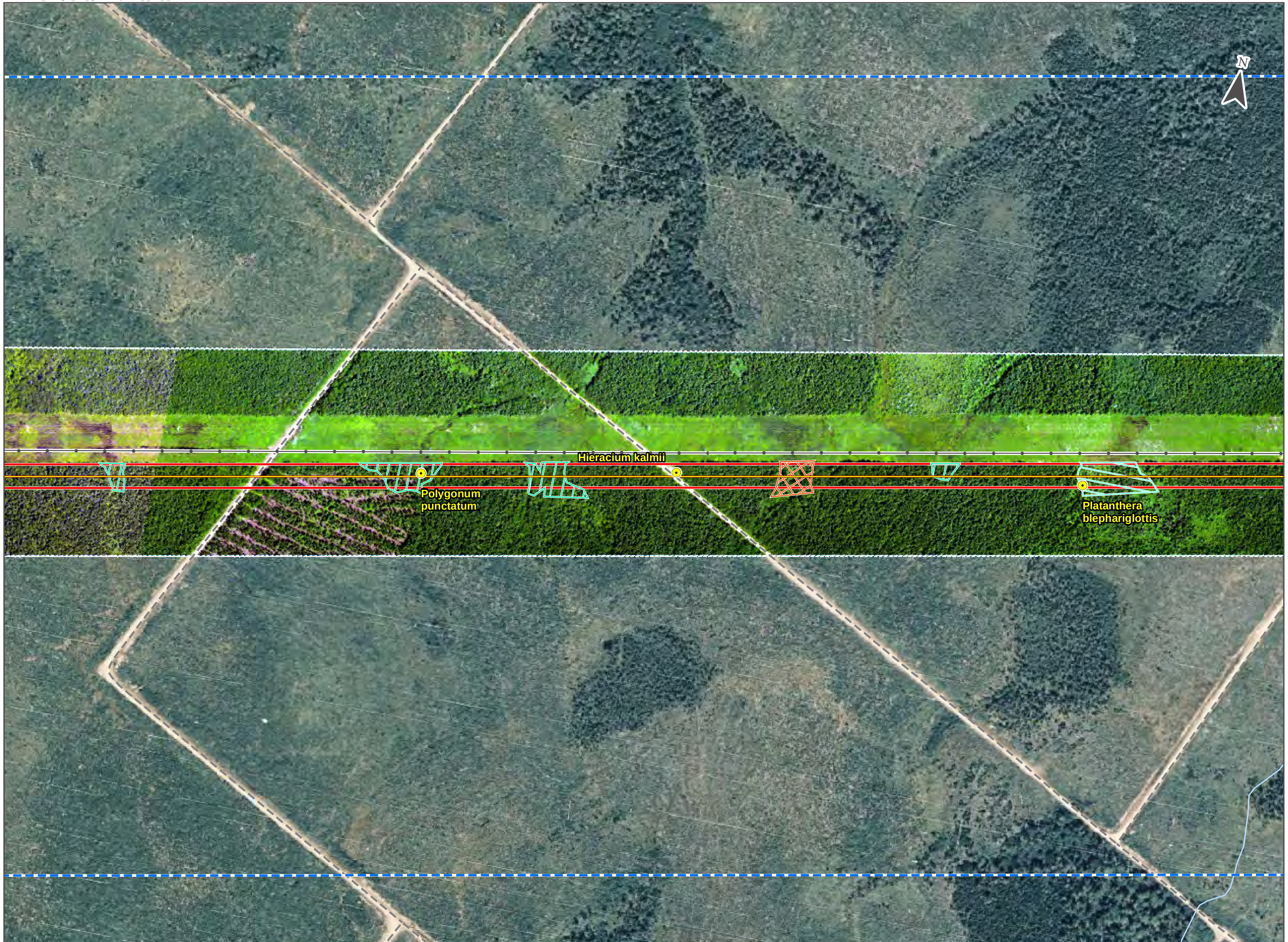


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)
- Vascular

Proposed Project Components
- Memramcook to Melrose

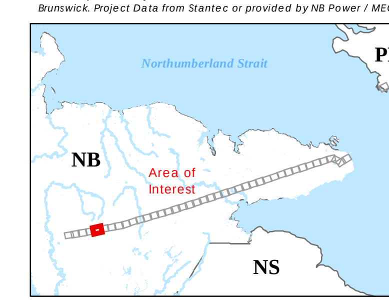
Field Delineated Wetland
- Coniferous Treed Bog
- Coniferous Treed Swamp
- Mixedwood Treed Swamp

Terrestrial Assessment Area
- Project Development Area
- Local Assessment Area
- Existing Transmission Line

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

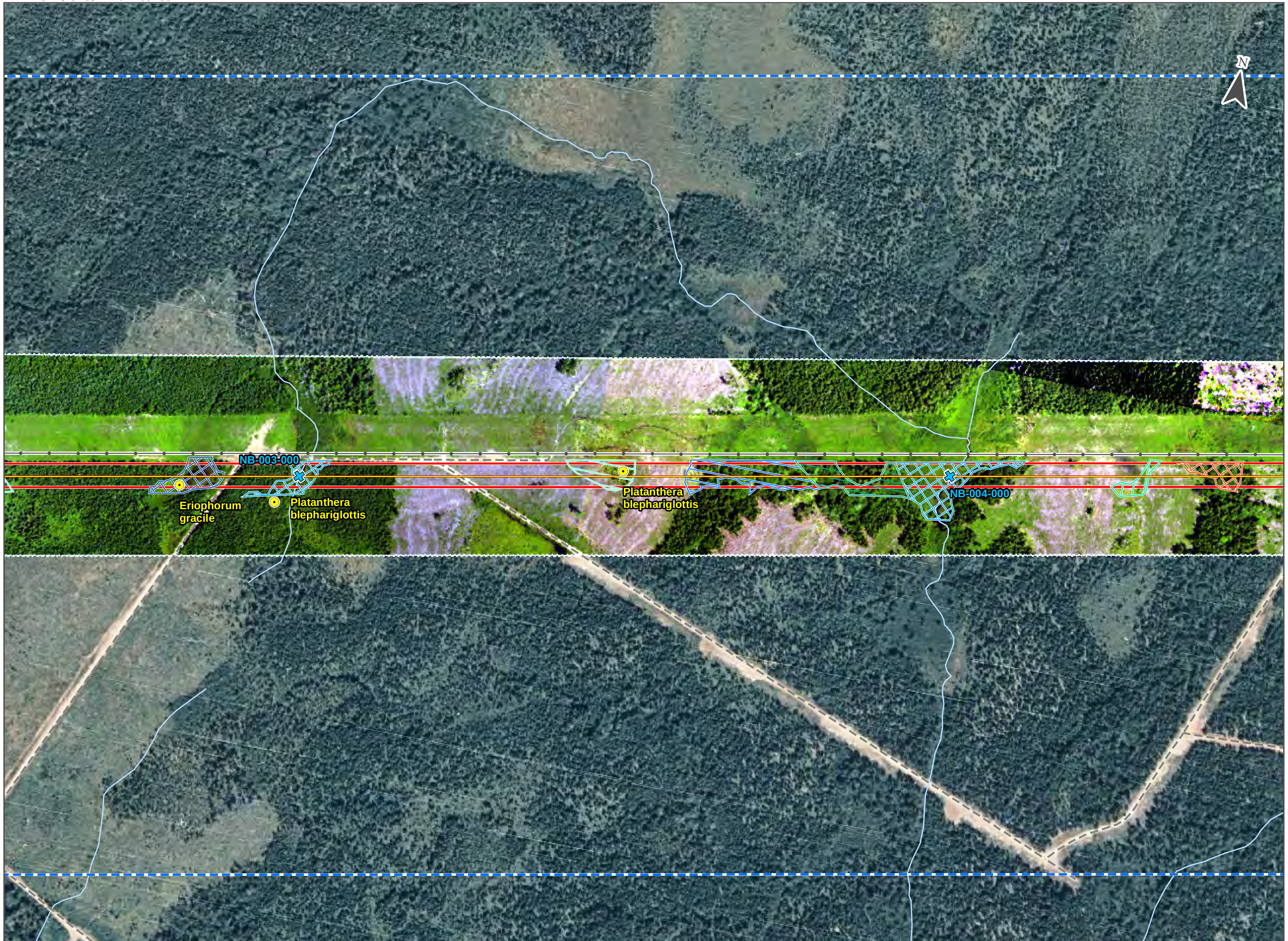


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)
- Vascular
- Watercourse Crossing

Proposed Project Components
- Memramcook to Melrose

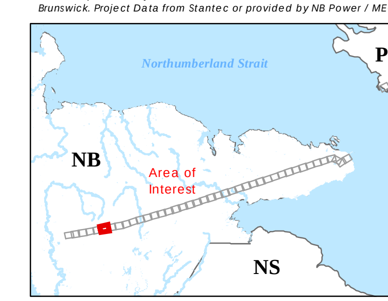
Field Delineated Wetland
- Coniferous Treed Bog
- Coniferous Treed Swamp
- Graminoid Fen
- Mixedwood Treed Fen
- Mixedwood Treed Swamp
- Tall Shrub Fen
- Tall Shrub Swamp

Terrestrial Assessment Area
- Project Development Area
- Local Assessment Area
- Existing Transmission Line

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

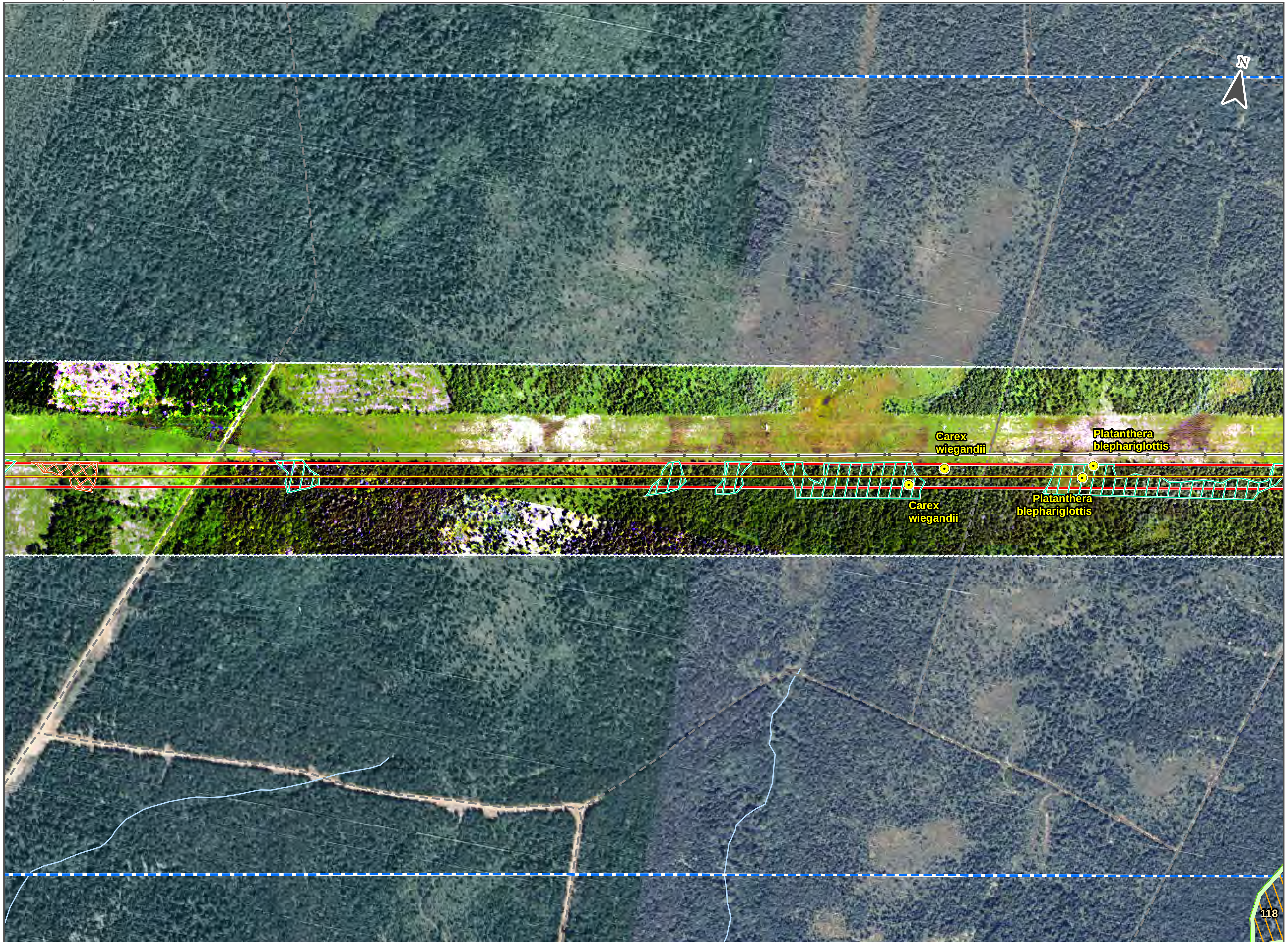


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)
- Vascular

Proposed Project Components
- Memramcook to Melrose

Field Delineated Wetland
- Coniferous Treed Swamp
- Mixedwood Treed Swamp

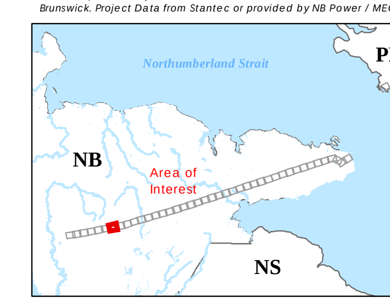
Interior Forest
- Pre-Project Interior Forest
- After Project Interior Forest

Terrestrial Assessment Area
- Project Development Area
- Local Assessment Area
- Existing Transmission Line

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

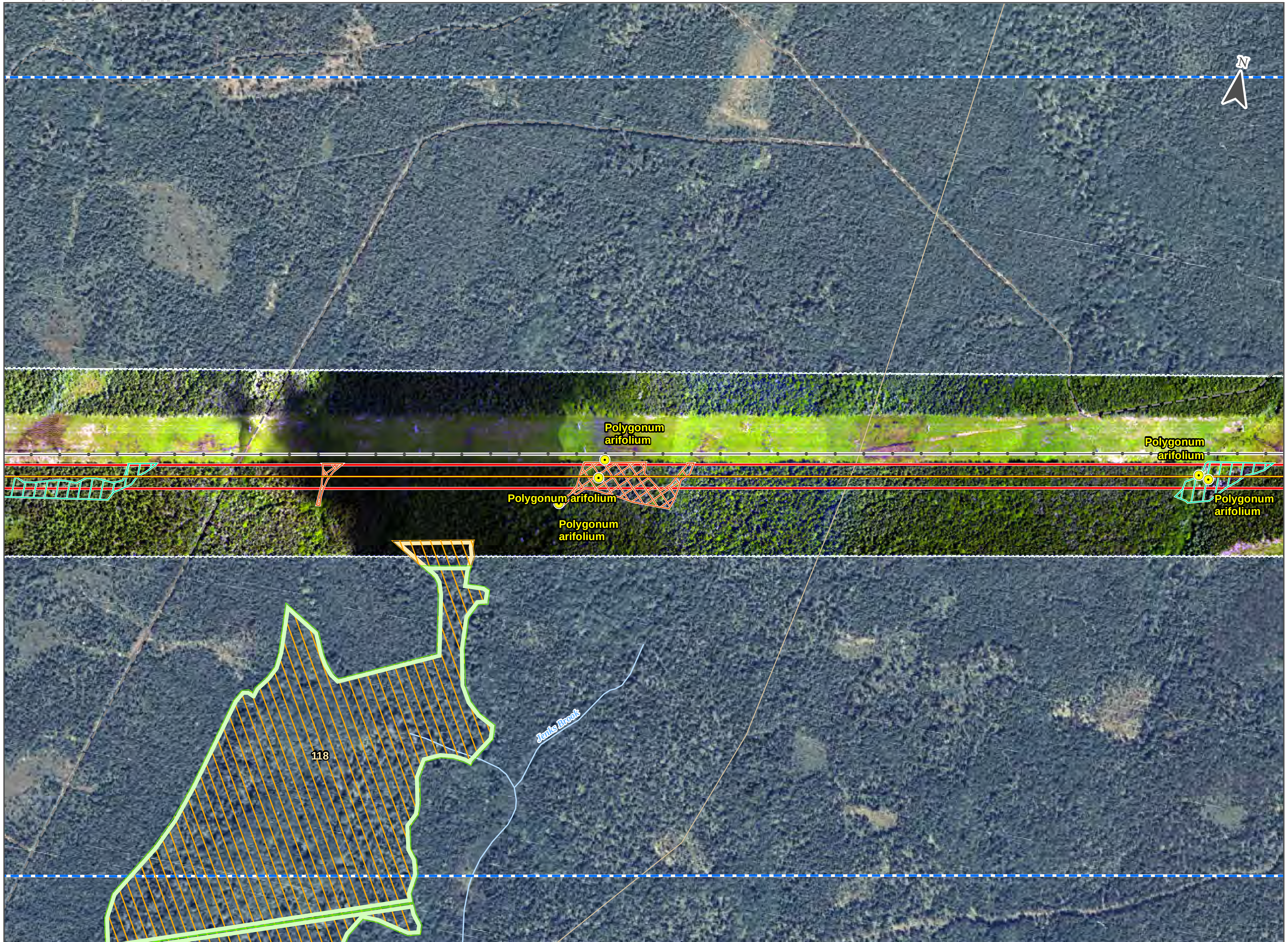


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)

- Vascular

Proposed Project Components

- Memramcook to Melrose

Field Delineated Wetland

- Coniferous Treed Swamp
- Mixedwood Treed Swamp

Interior Forest

- Pre-Project Interior Forest
- After Project Interior Forest

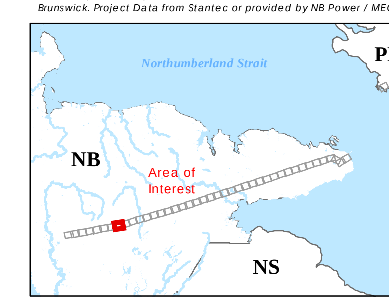
Terrestrial Assessment Area

- Project Development Area
- Local Assessment Area
- Existing Transmission Line

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd

Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)
- Vascular
- Watercourse Crossing

Proposed Project Components
- Memramcook to Melrose

Field Delineated Wetland
- Coniferous Treed Swamp
- Mixedwood Treed Swamp

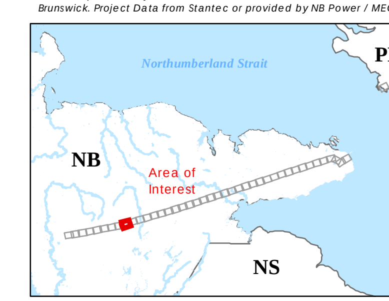
Interior Forest
- Pre-Project Interior Forest
- After Project Interior Forest

Terrestrial Assessment Area
- Project Development Area
- Local Assessment Area
- Existing Transmission Line
- GeoNB-mapped Wetland

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

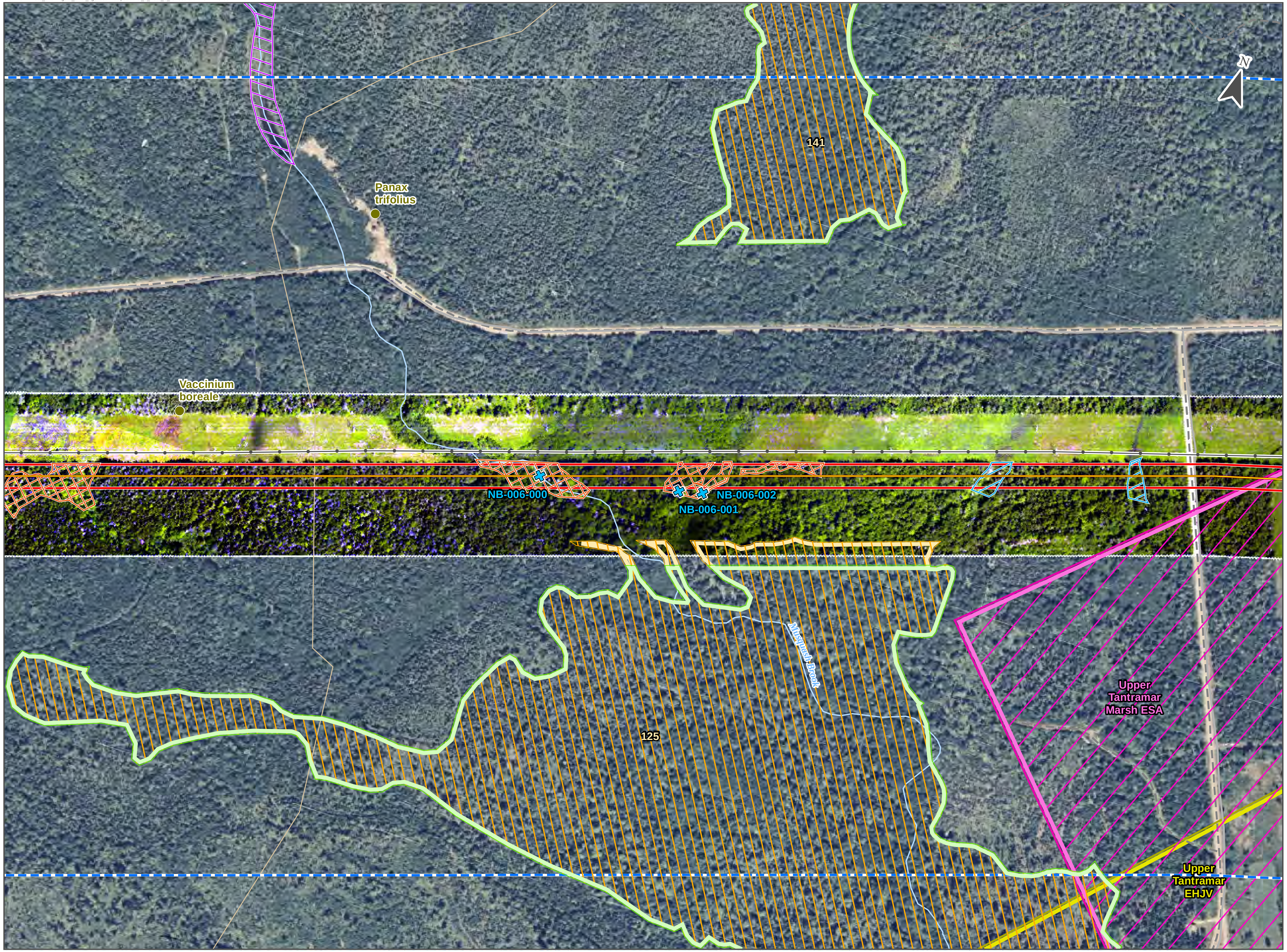


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

- AC CDC Plant Observation
- Watercourse Crossing

Proposed Project Components

- Memramcook to Melrose

Field Delineated Wetland

- Deciduous Treed Swamp
- Mixedwood Treed Swamp

Interior Forest

- Pre-Project Interior Forest
- After Project Interior Forest

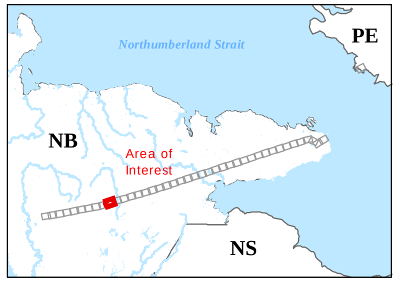
Terrestrial Assessment Area

- Project Development Area
- Local Assessment Area
- Existing Transmission Line
- Environmentally Significant Area
- GeoNB-mapped Wetland
- Managed Area

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

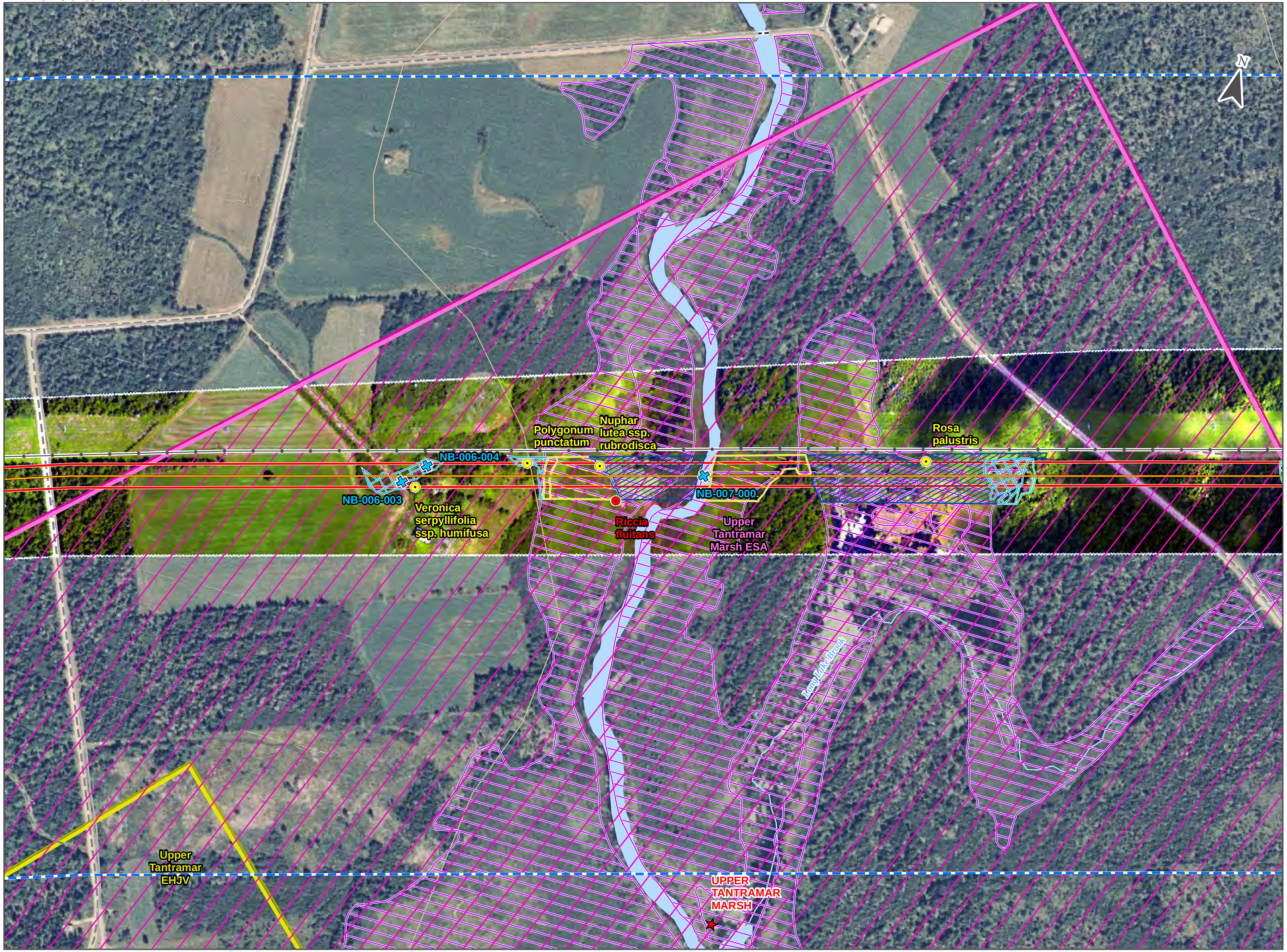


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Environmentally Significant Area

Plant Field Observation (Species of Conservation Concern)

- Non-Vascular
- Vascular

Watercourse Crossing

Proposed Project Components

- Memramcook to Melrose

Field Delineated Wetland

- Coniferous Treed Swamp
- Deciduous Treed Swamp
- Floating Aquatic Water
- Graminoid Marsh
- Tall Shrub Swamp

Terrestrial Assessment Area

- Project Development Area
- Local Assessment Area

Existing Transmission Line

Environmentally Significant Area

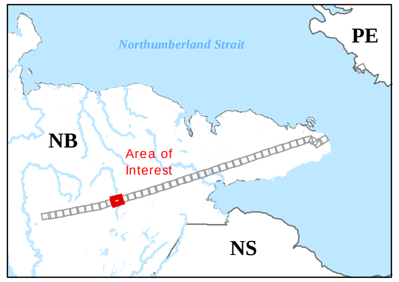
GeoNB-mapped Wetland

Managed Area

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

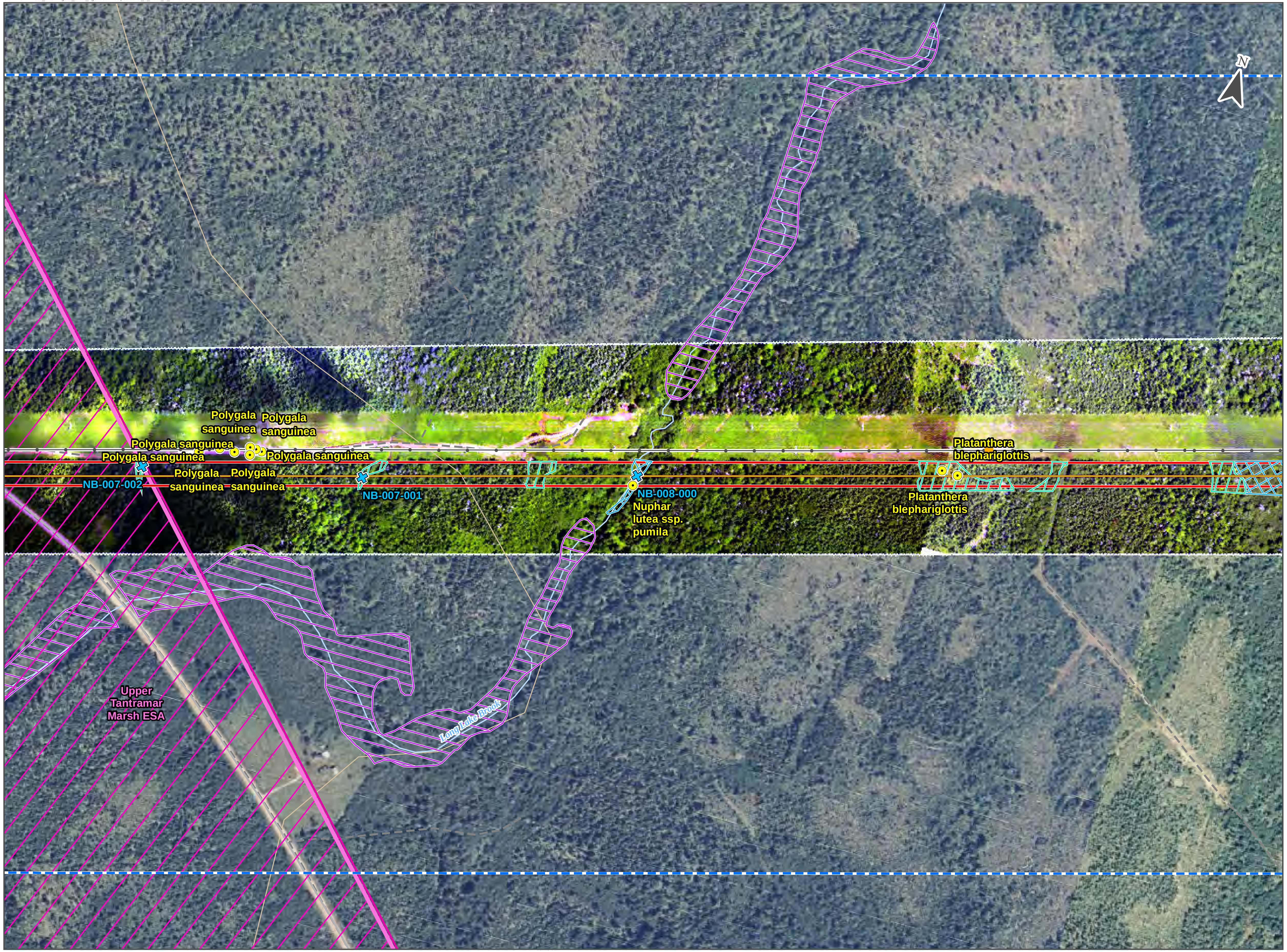


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Monarch Butterfly Observation

Plant Field Observation (Species of Conservation Concern)

Vascular

Watercourse Crossing

Proposed Project Components

Memramcook to Melrose

Field Delineated Wetland

Coniferous Treed Swamp

Tall Shrub Swamp

Terrestrial Assessment Area

Project Development Area

Local Assessment Area

Existing Transmission Line

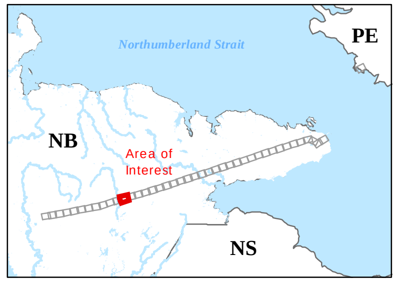
Environmentally Significant Area

GeoNB-mapped Wetland

0 50 100 150 200
Metres

121811475-0044 | 1:5,000 | NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

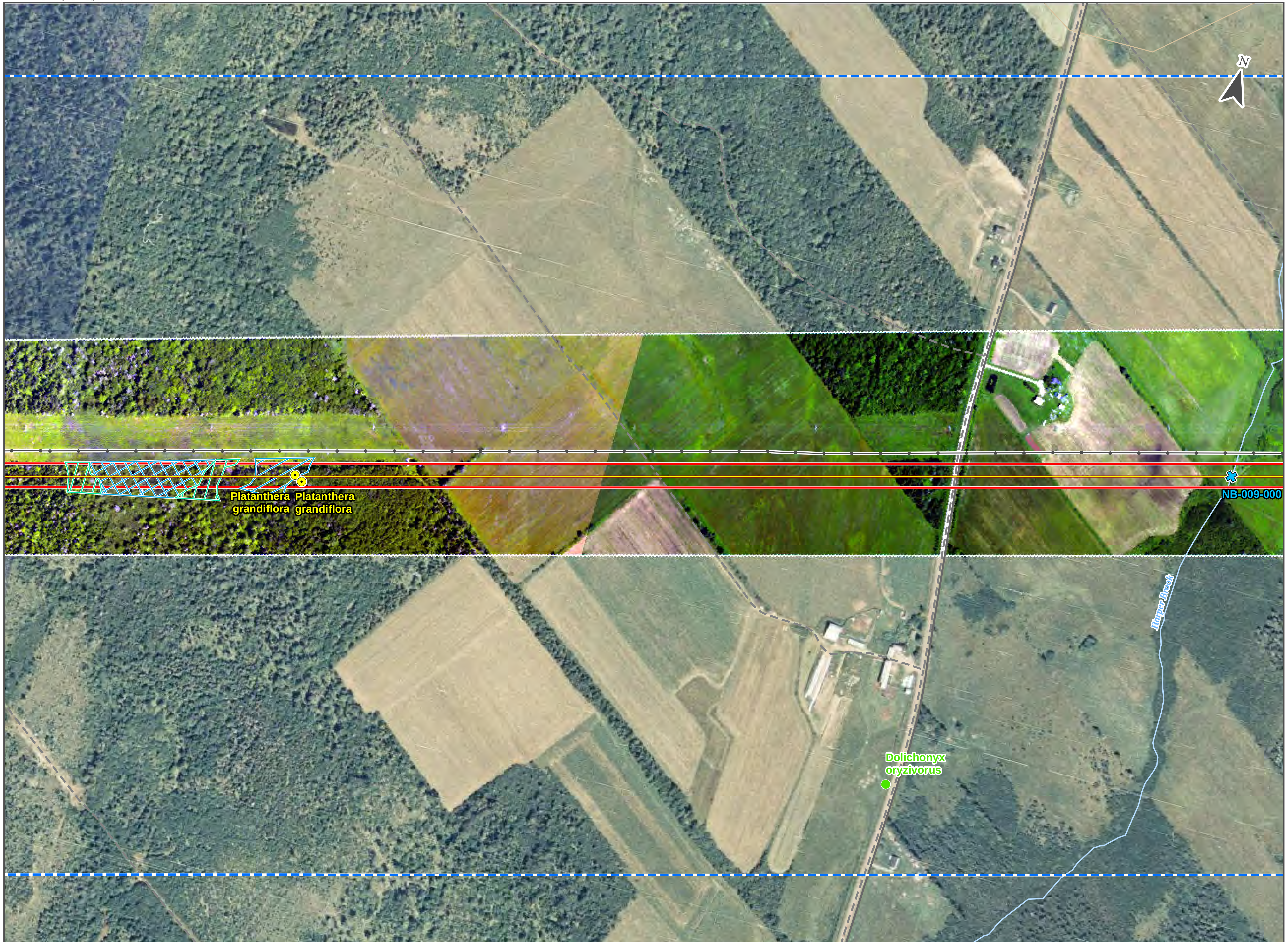


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

AC CDC Bird Observation

Plant Field Observation (Species of Conservation Concern)

Vascular

Watercourse Crossing

Proposed Project Components

Memramcook to Melrose

Field Delineated Wetland

Coniferous Treed Swamp

Deciduous Treed Swamp

Tall Shrub Swamp

Terrestrial Assessment Area

Project Development Area

Local Assessment Area

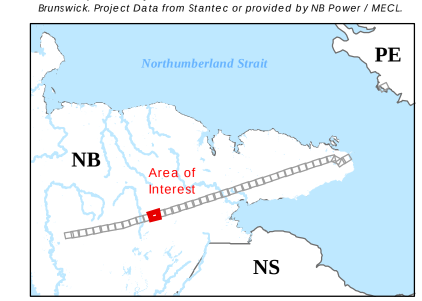
Existing Transmission Line

0 50 100 150 200

Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

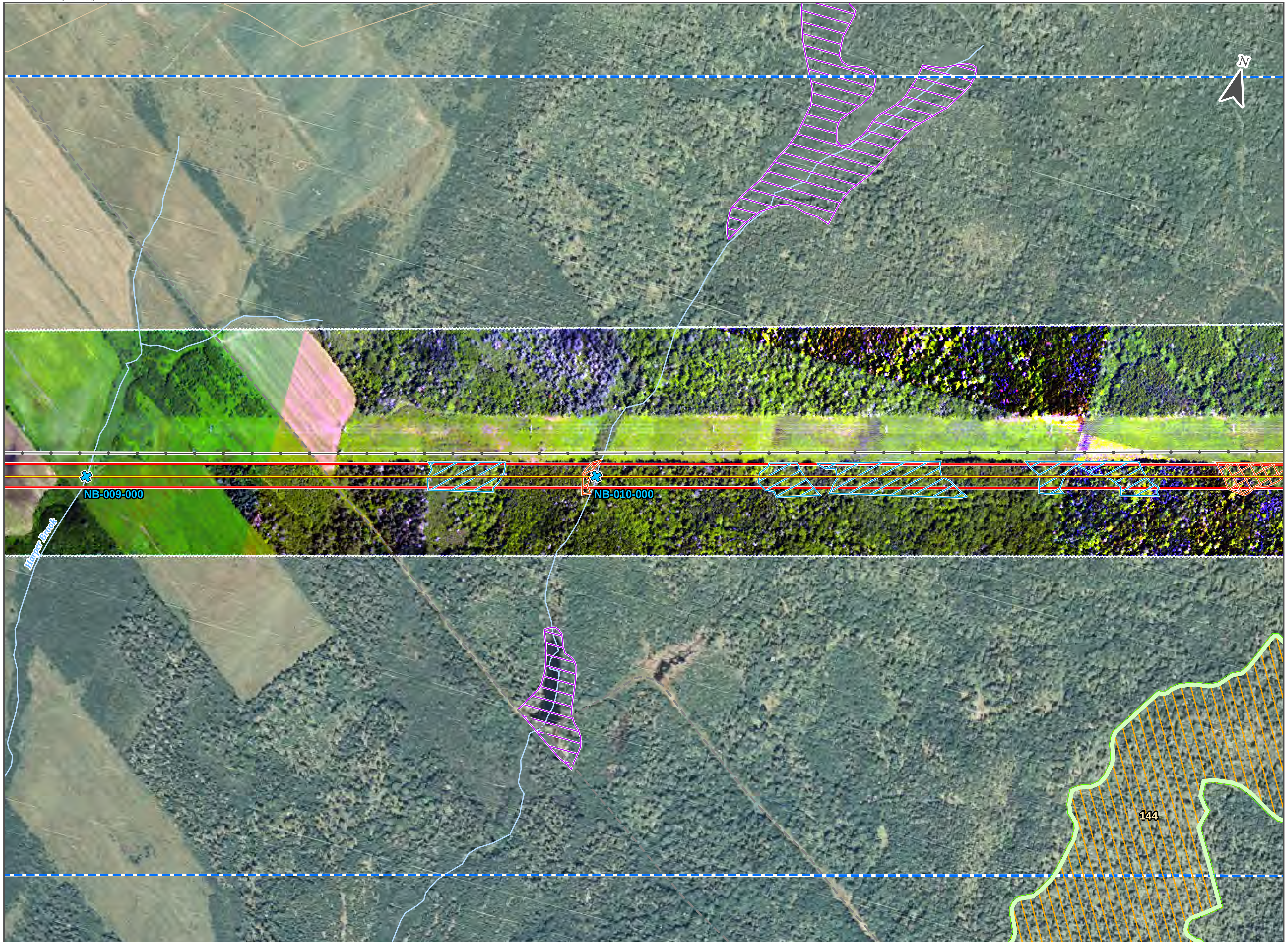


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Watercourse Crossing

Proposed Project Components

Memramcook to Melrose

Field Delineated Wetland

Deciduous Treed Swamp

Mixedwood Treed Swamp

Interior Forest

Pre-Project Interior Forest

After Project Interior Forest

Terrestrial Assessment Area

Project Development Area

Local Assessment Area

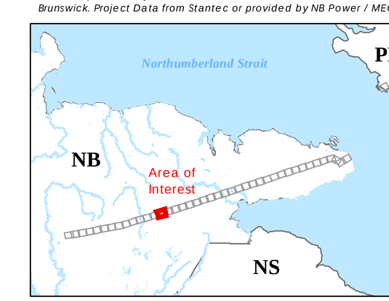
Existing Transmission Line

GeoNB-mapped Wetland

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

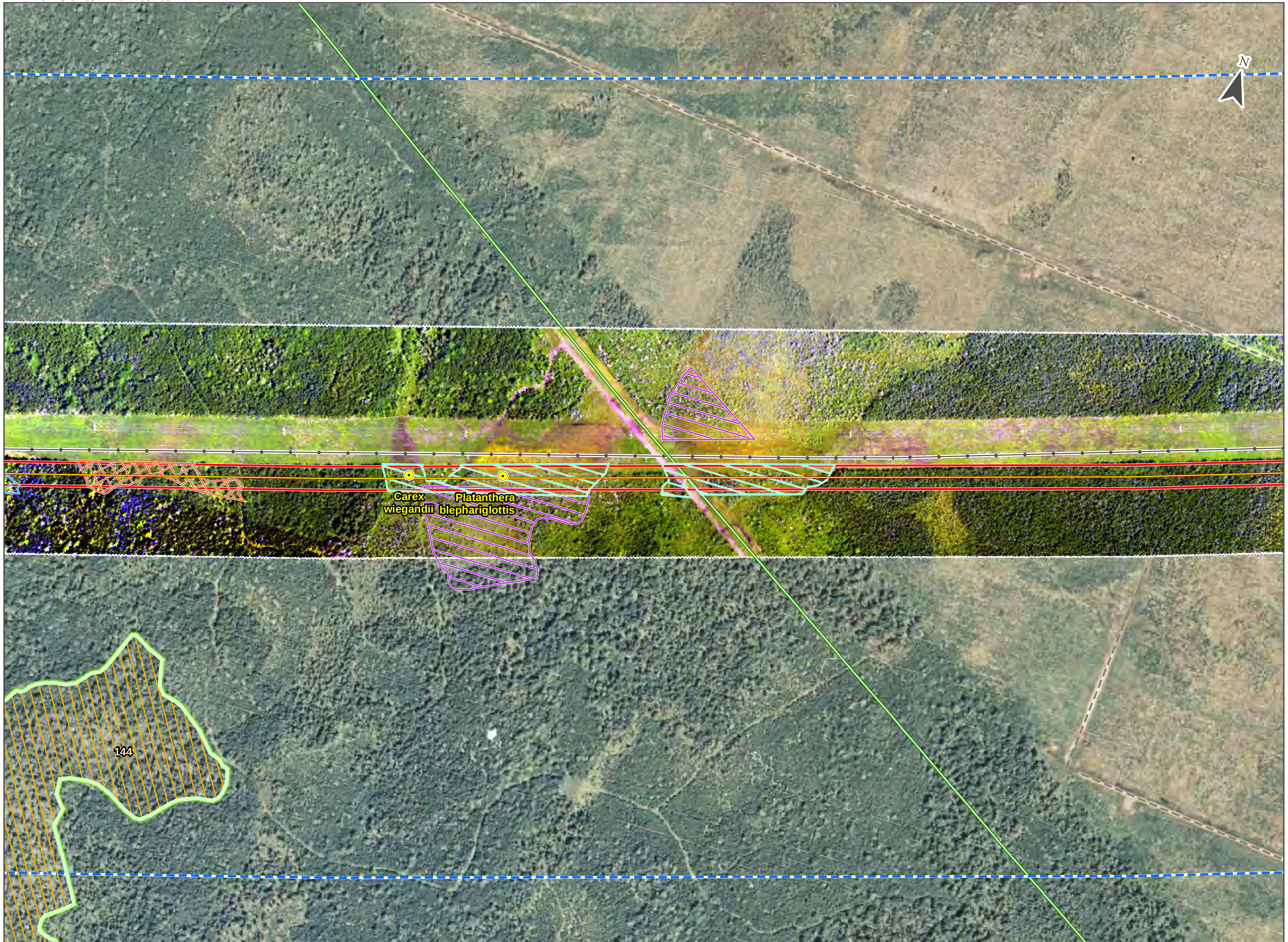


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)
- Vascular

Proposed Project Components
- Memramcook to Melrose

Field Delineated Wetland
- Coniferous Treed Bog
- Deciduous Treed Swamp
- Mixedwood Treed Swamp

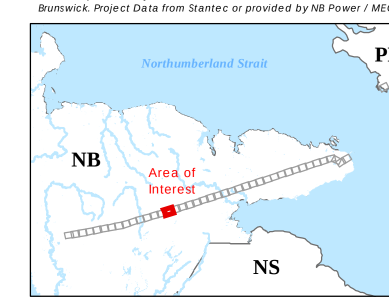
Interior Forest
- Pre-Project Interior Forest
- After Project Interior Forest

Terrestrial Assessment Area
- Project Development Area
- Local Assessment Area
- Existing Transmission Line
- M&NP Mainline Pipeline
- GeoNB-mapped Wetland

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

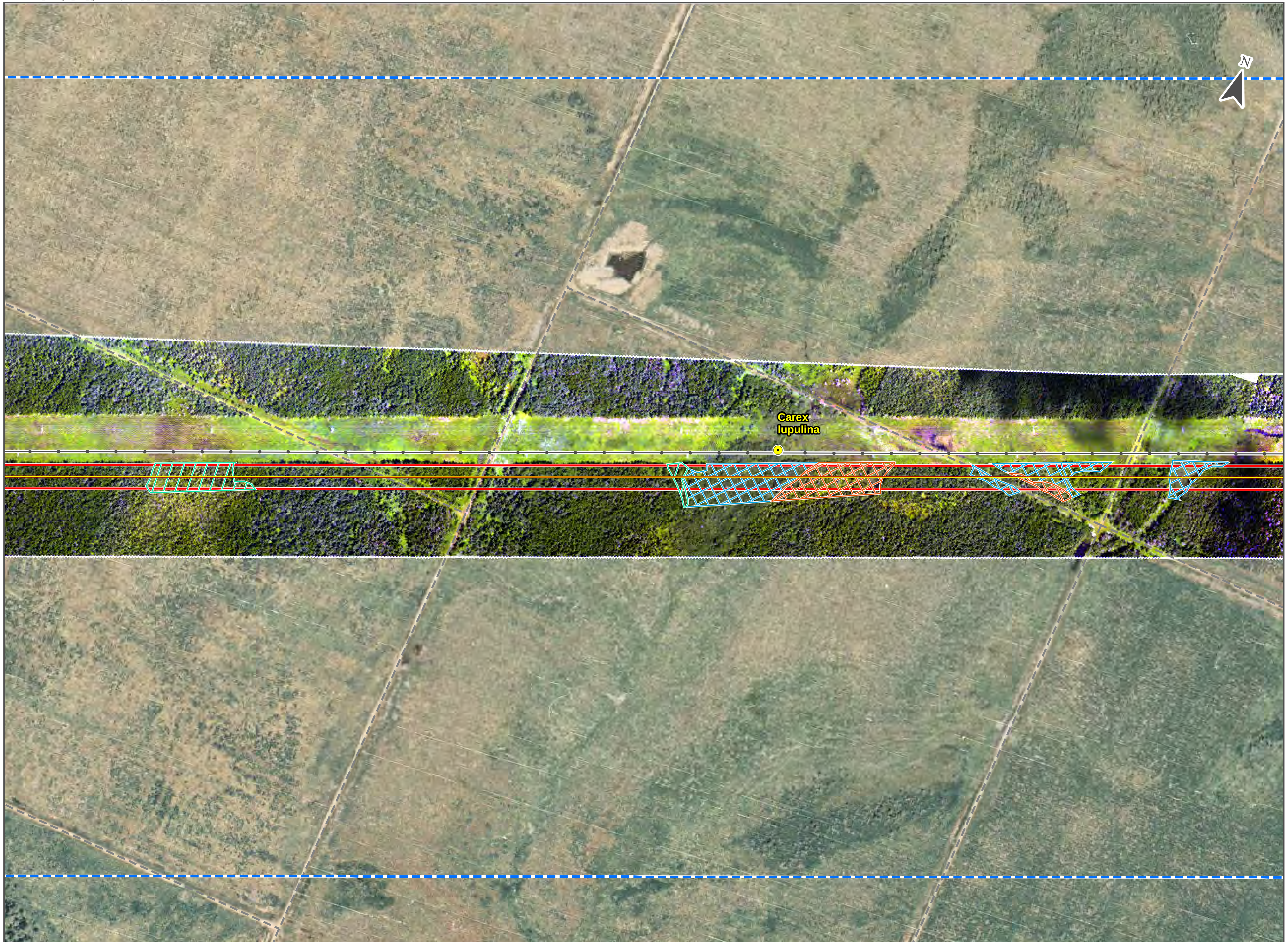


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)

- Vascular

Proposed Project Components

- Memramcook to Melrose

Field Delineated Wetland

- Coniferous Treed Swamp
- Mixedwood Treed Swamp
- Tall Shrub Swamp

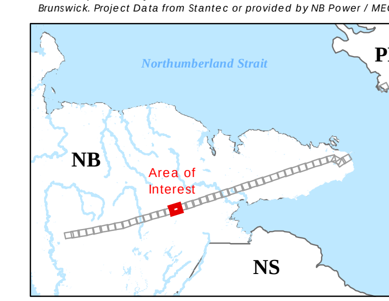
Terrestrial Assessment Area

- Project Development Area
- Local Assessment Area
- Existing Transmission Line

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

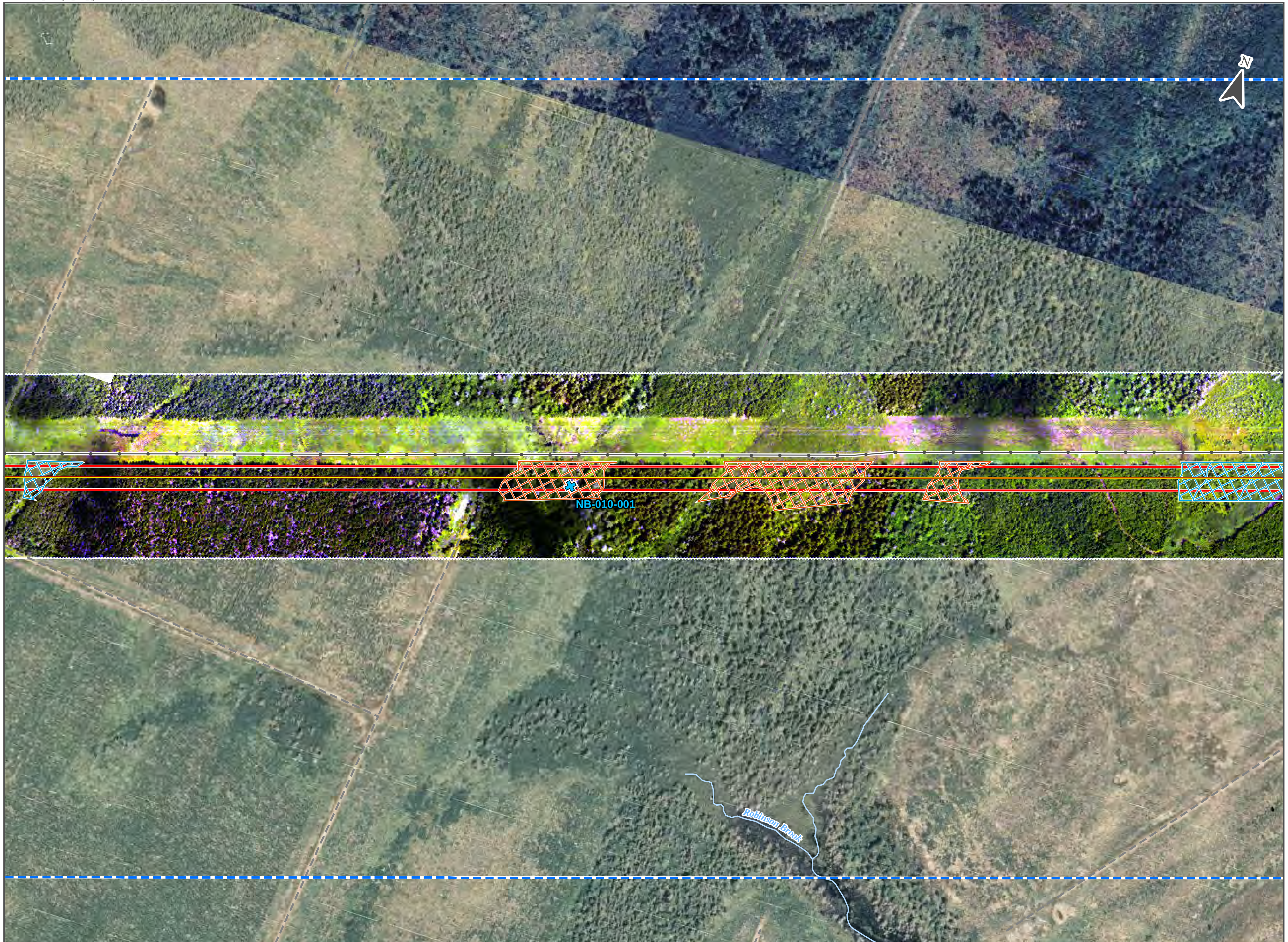
Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec



Terrestrial Environment Assessment Area Boundaries

- Watercourse Crossing

Proposed Project Components

- Memramcook to Melrose

Field Delineated Wetland

- Mixedwood Treed Swamp
- Tall Shrub Swamp

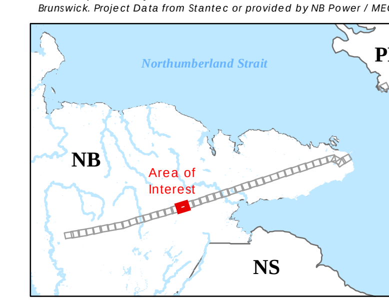
Terrestrial Assessment Area

- Project Development Area
- Local Assessment Area
- Existing Transmission Line

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

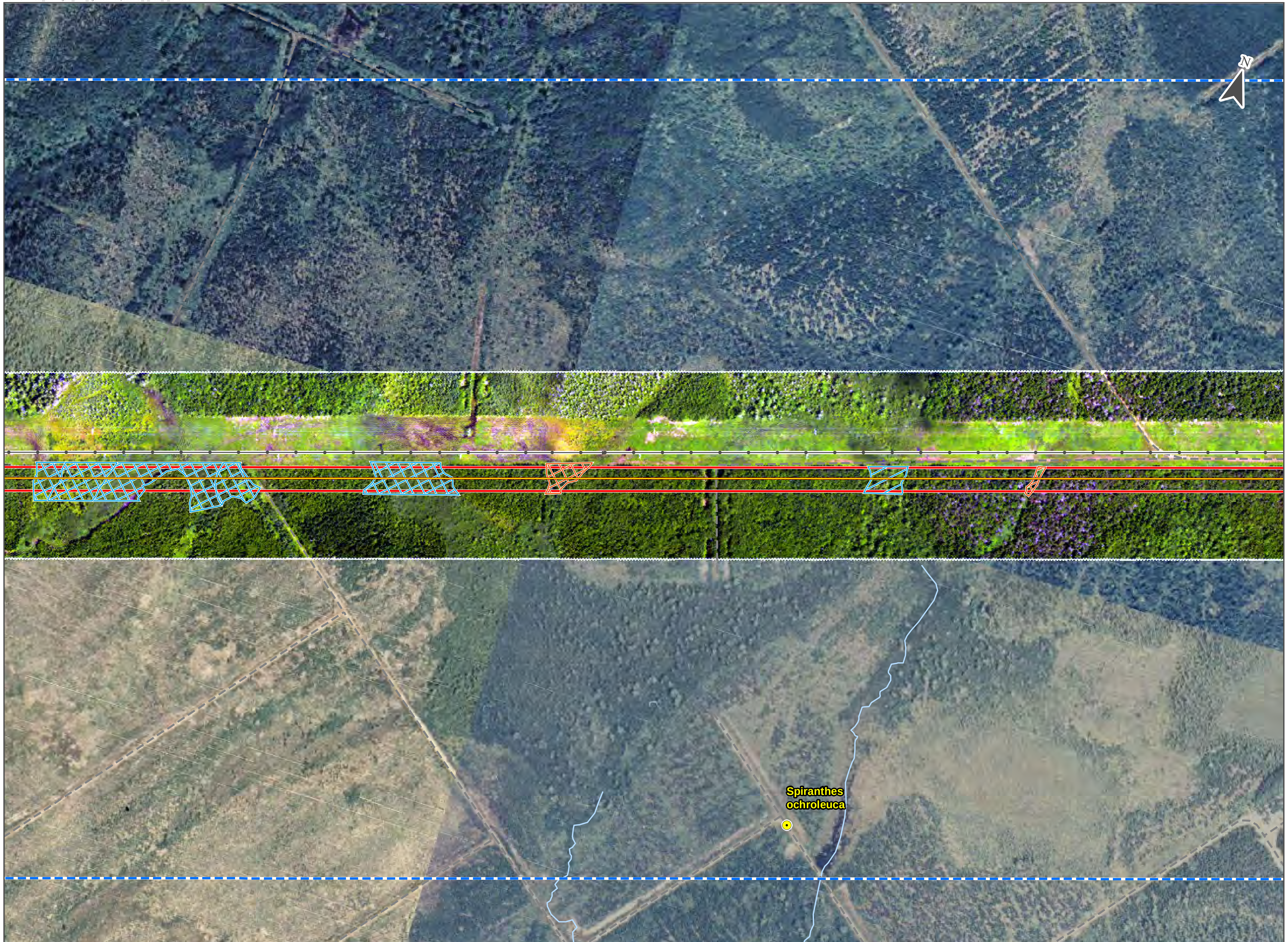


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)
- Vascular

Proposed Project Components
- Memramcook to Melrose

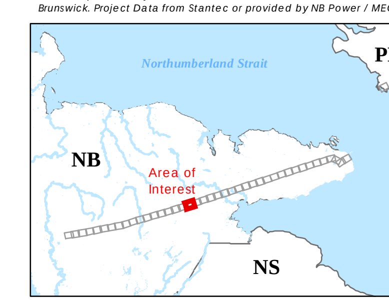
Field Delineated Wetland
- Deciduous Treed Swamp
- Mixedwood Treed Swamp
- Tall Shrub Swamp

Terrestrial Assessment Area
- Project Development Area
- Local Assessment Area
- Existing Transmission Line

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

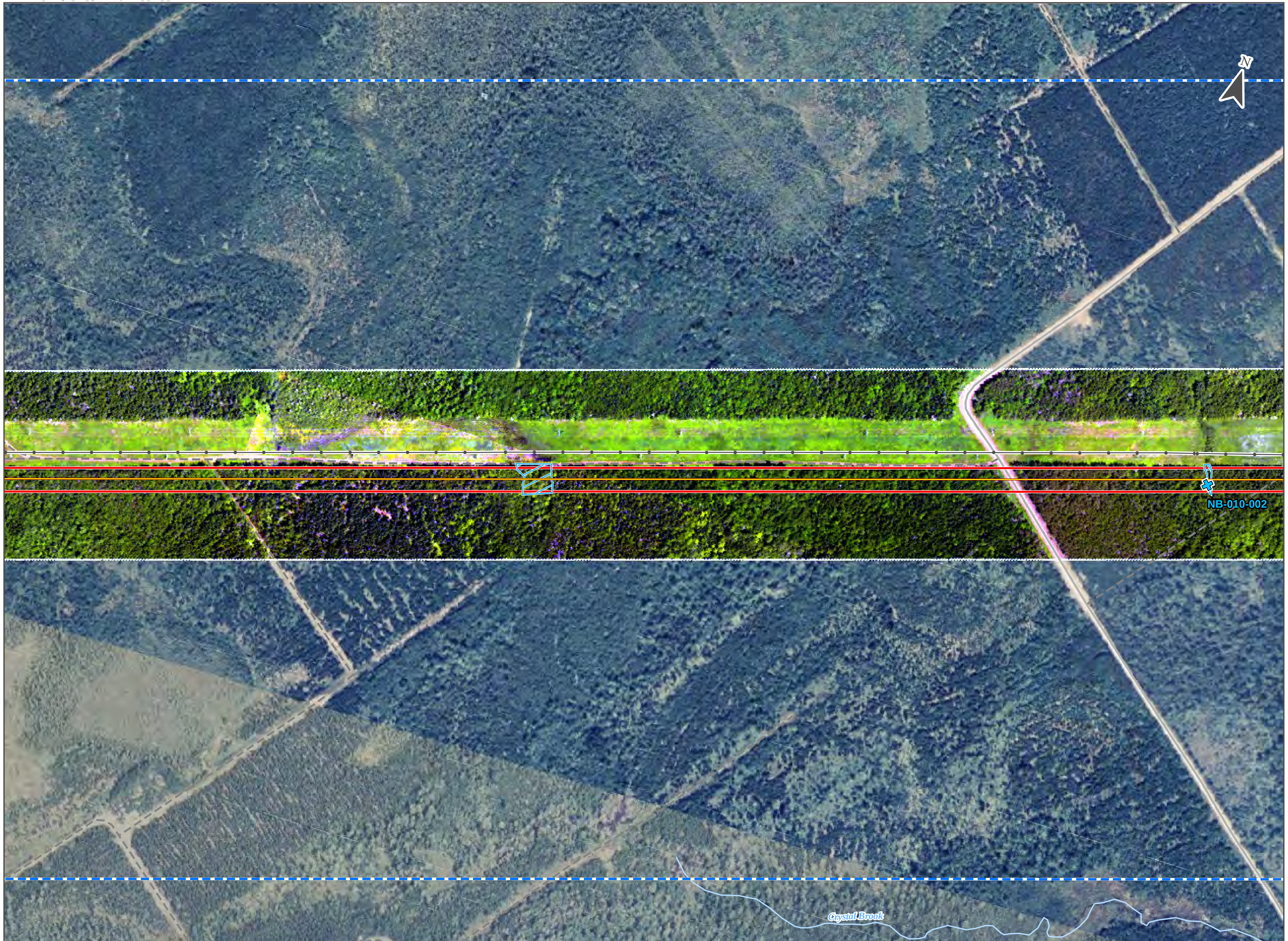


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Watercourse Crossing

Proposed Project Components

Memramcook to Melrose

Field Delineated Wetland

Deciduous Treed Swamp

Tall Shrub Swamp

Terrestrial Assessment Area

Project Development Area

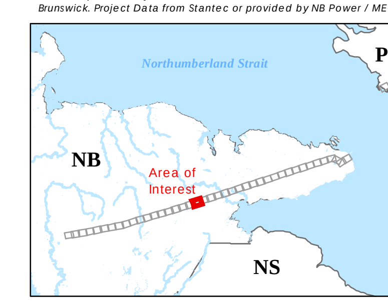
Local Assessment Area

Existing Transmission Line

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

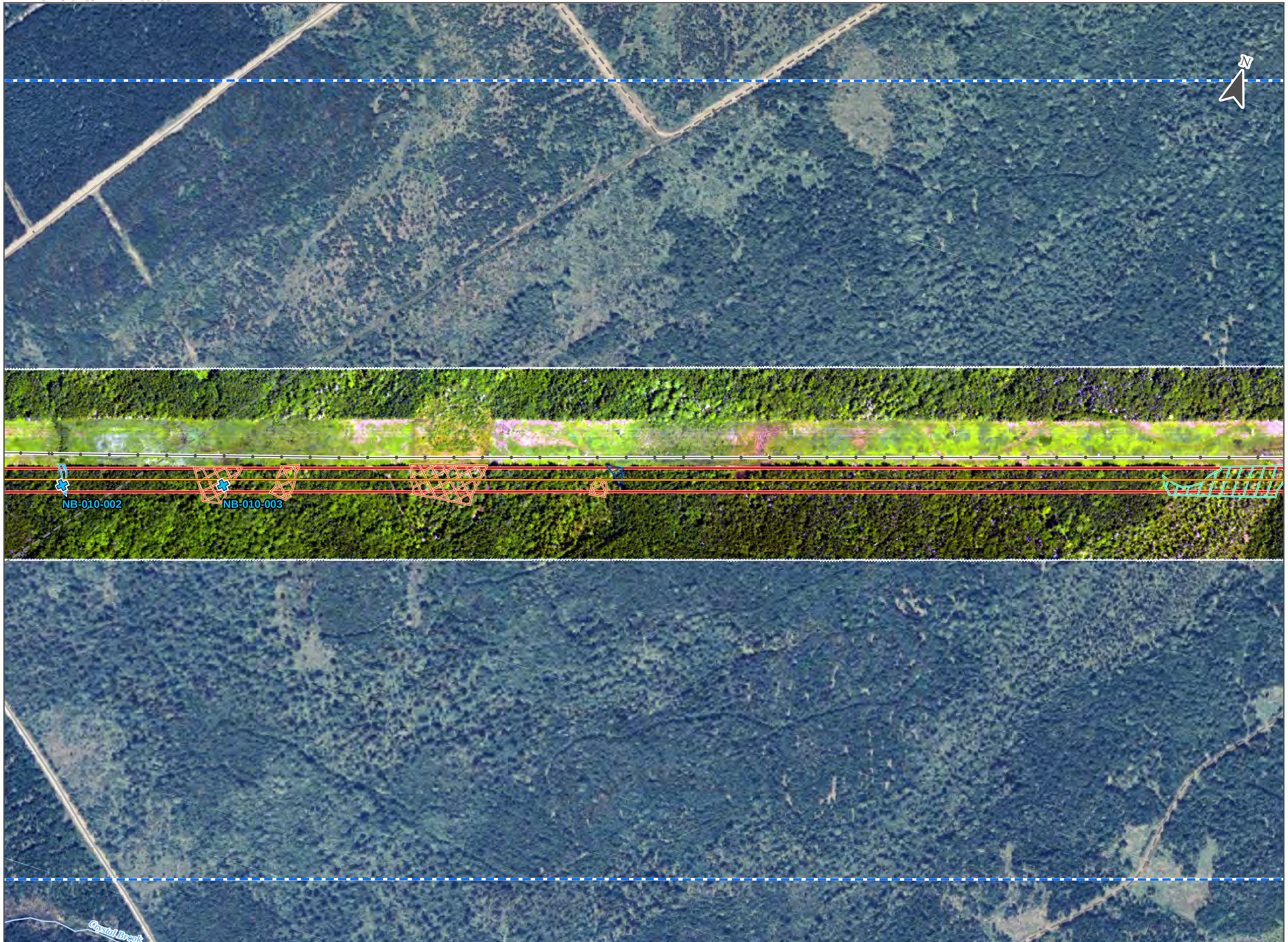


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Watercourse Crossing

Proposed Project Components

Memramcook to Melrose

Field Delineated Wetland

Coniferous Treed Swamp

Floating Aquatic Water

Mixedwood Treed Swamp

Tall Shrub Swamp

Terrestrial Assessment Area

Project Development Area

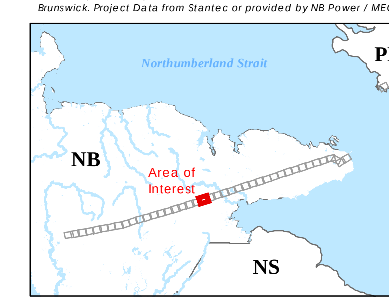
Local Assessment Area

Existing Transmission Line

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

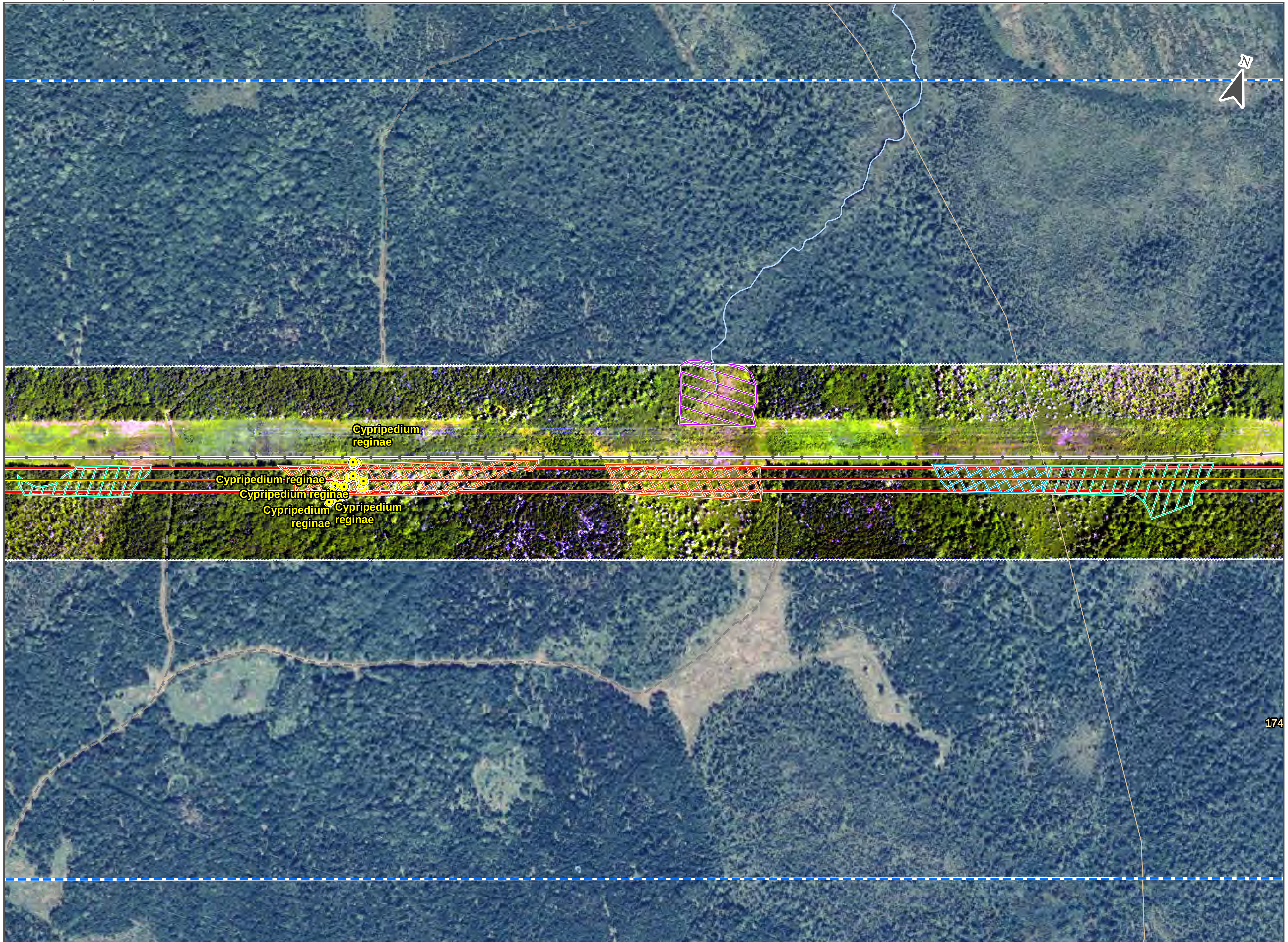


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

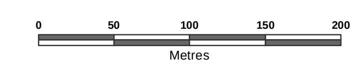
Plant Field Observation (Species of Conservation Concern)
- Vascular

Proposed Project Components
- Memramcook to Melrose

Field Delineated Wetland
- Coniferous Treed Swamp
- Mixedwood Treed Swamp
- Tall Shrub Swamp

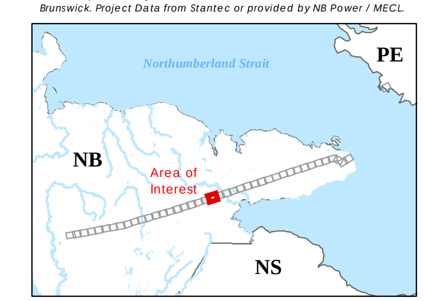
Interior Forest
- Pre-Project Interior Forest
- After Project Interior Forest

Terrestrial Assessment Area
- Project Development Area
- Local Assessment Area
- Existing Transmission Line
- GeoNB-mapped Wetland



121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

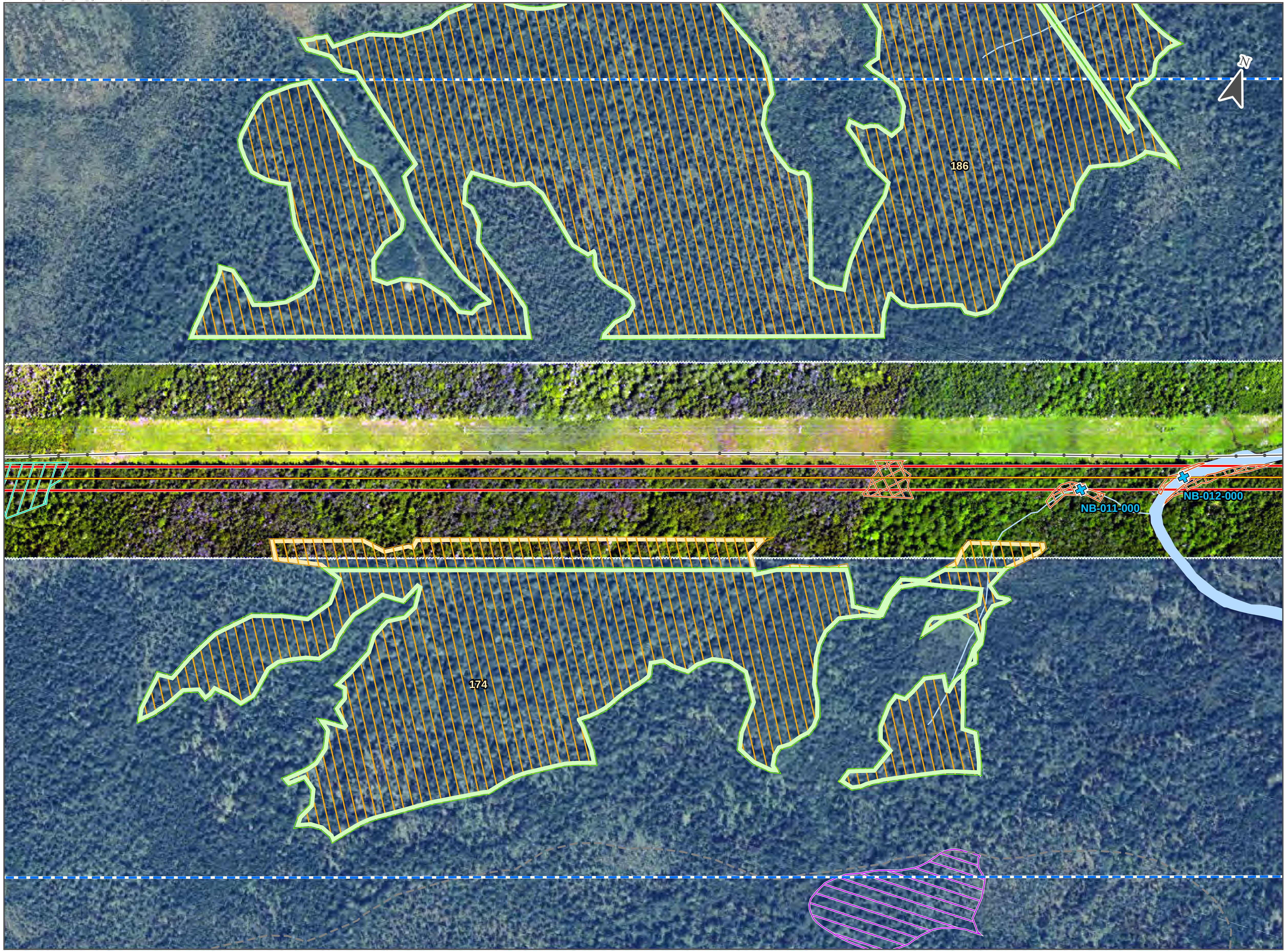


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Watercourse Crossing

Proposed Project Components

Memramcook to Melrose

Field Delineated Wetland

Coniferous Treed Swamp

Mixedwood Treed Swamp

Interior Forest

Pre-Project Interior Forest

After Project Interior Forest

Terrestrial Assessment Area

Project Development Area

Local Assessment Area

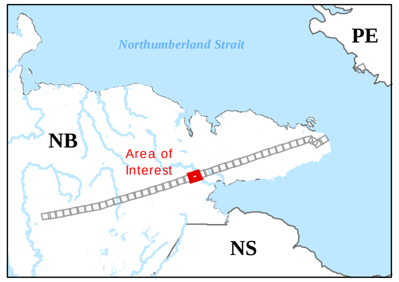
Existing Transmission Line

GeoNB-mapped Wetland

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

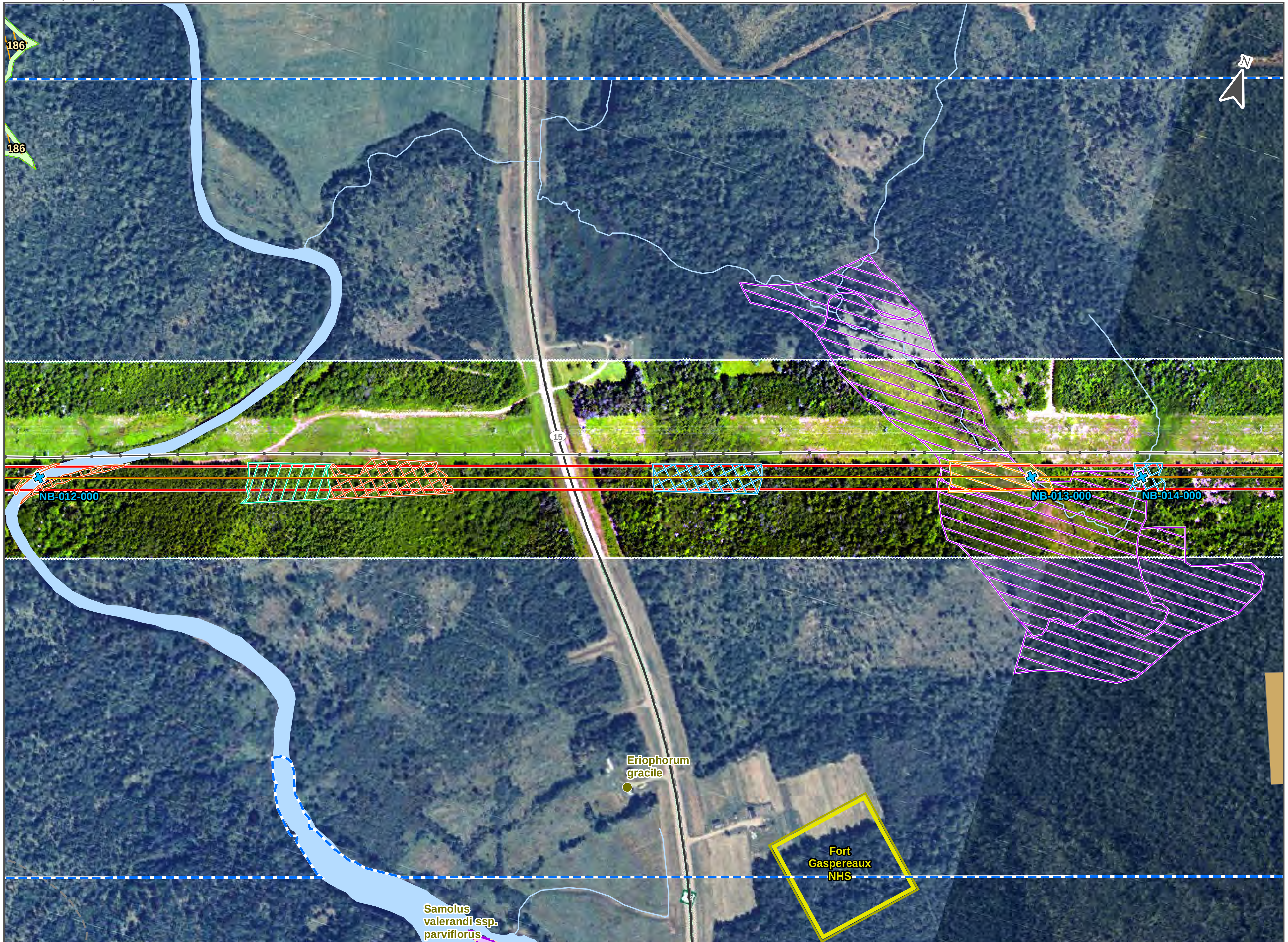


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

- AC CDC Plant Observation
- Monarch Butterfly Observation
- Watercourse Crossing

Proposed Project Components

- Memramcook to Melrose

Field Delineated Wetland

- Coniferous Treed Swamp
- Low Shrub Swamp
- Mixedwood Treed Swamp
- Tall Shrub Swamp

Interior Forest

- Pre-Project Interior Forest
- After Project Interior Forest

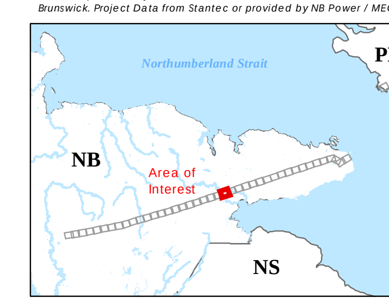
Terrestrial Assessment Area

- Project Development Area
- Local Assessment Area
- Existing Transmission Line
- Crown Land
- Provincially Significant Wetland
- GeoNB-mapped Wetland
- Managed Area

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

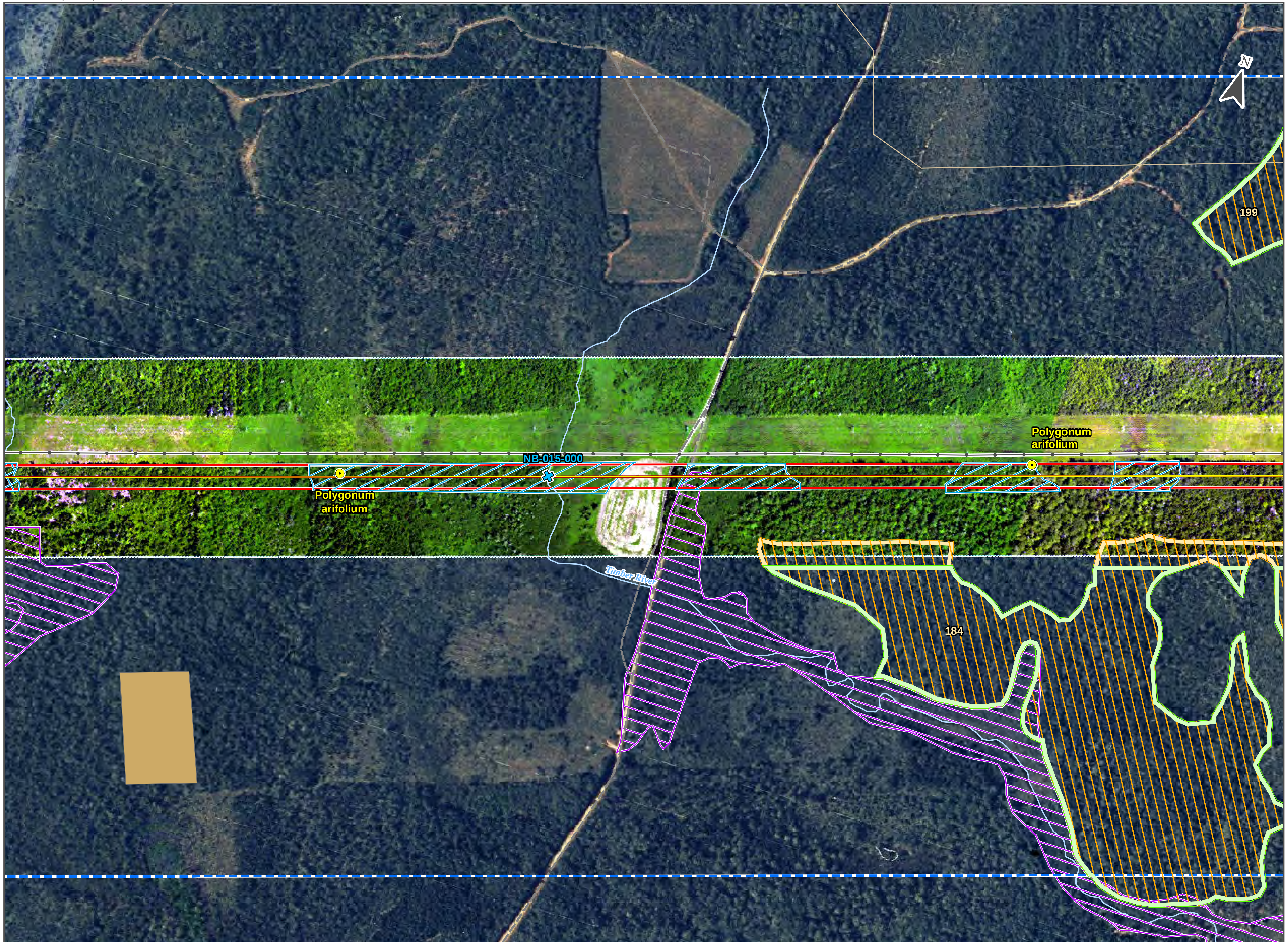


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)
- Vascular
- Watercourse Crossing

Proposed Project Components
- Memramcook to Melrose

Field Delineated Wetland
- Deciduous Treed Swamp
- Tall Shrub Swamp

Interior Forest
- Pre-Project Interior Forest
- After Project Interior Forest

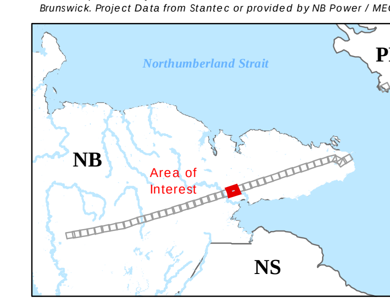
Terrestrial Assessment Area
- Project Development Area
- Local Assessment Area

- Existing Transmission Line
- Crown Land
- GeoNB-mapped Wetland

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

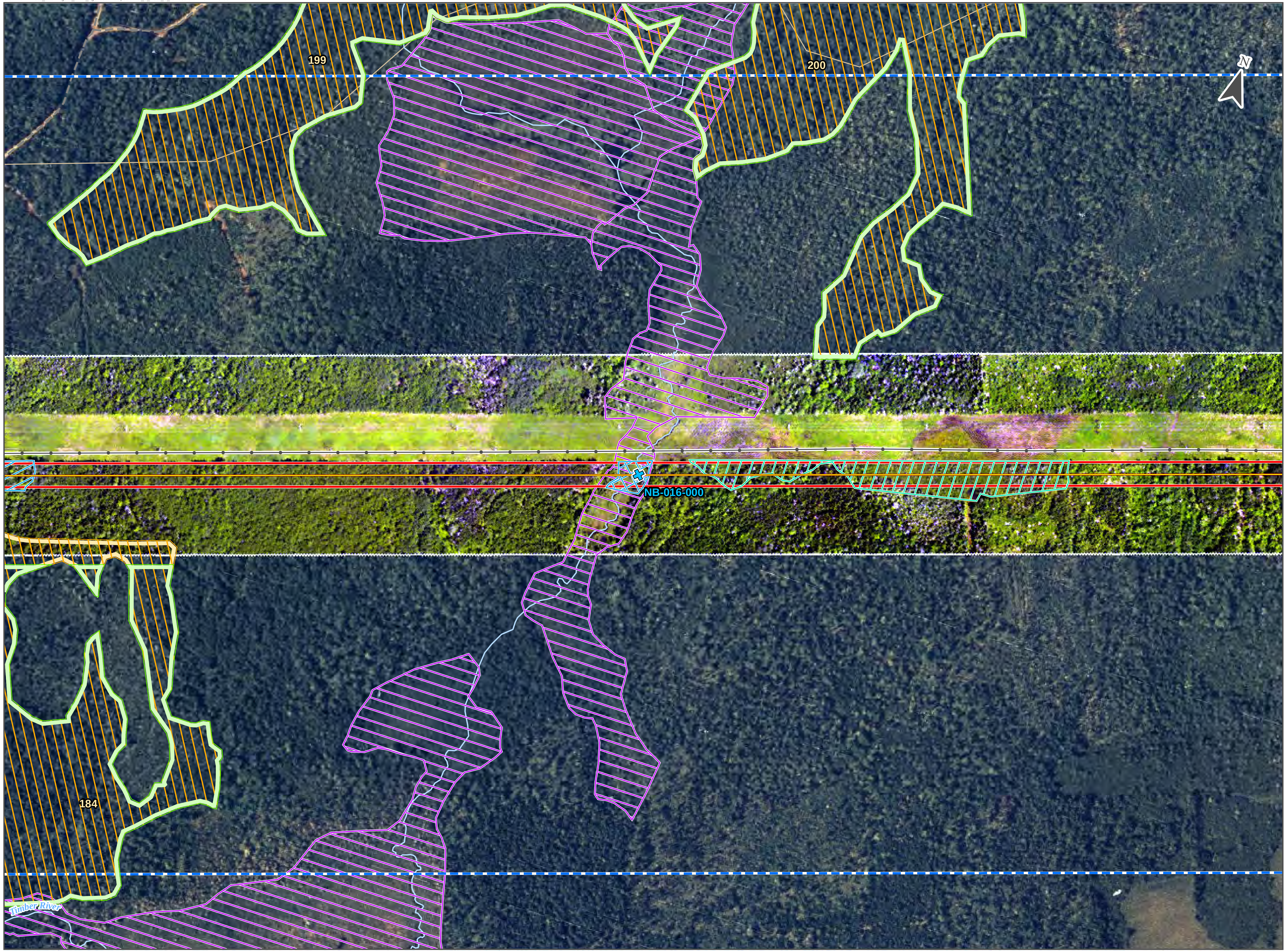


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Watercourse Crossing

Proposed Project Components

Memramcook to Melrose

Field Delineated Wetland

Coniferous Treed Swamp

Deciduous Treed Swamp

Tall Shrub Swamp

Interior Forest

Pre-Project Interior Forest

After Project Interior Forest

Terrestrial Assessment Area

Project Development Area

Local Assessment Area

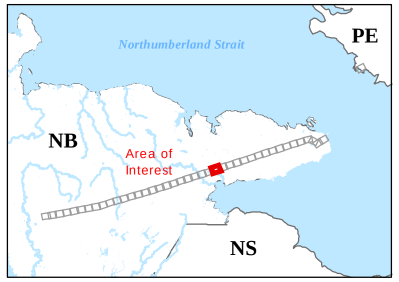
Existing Transmission Line

GeoNB-mapped Wetland

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



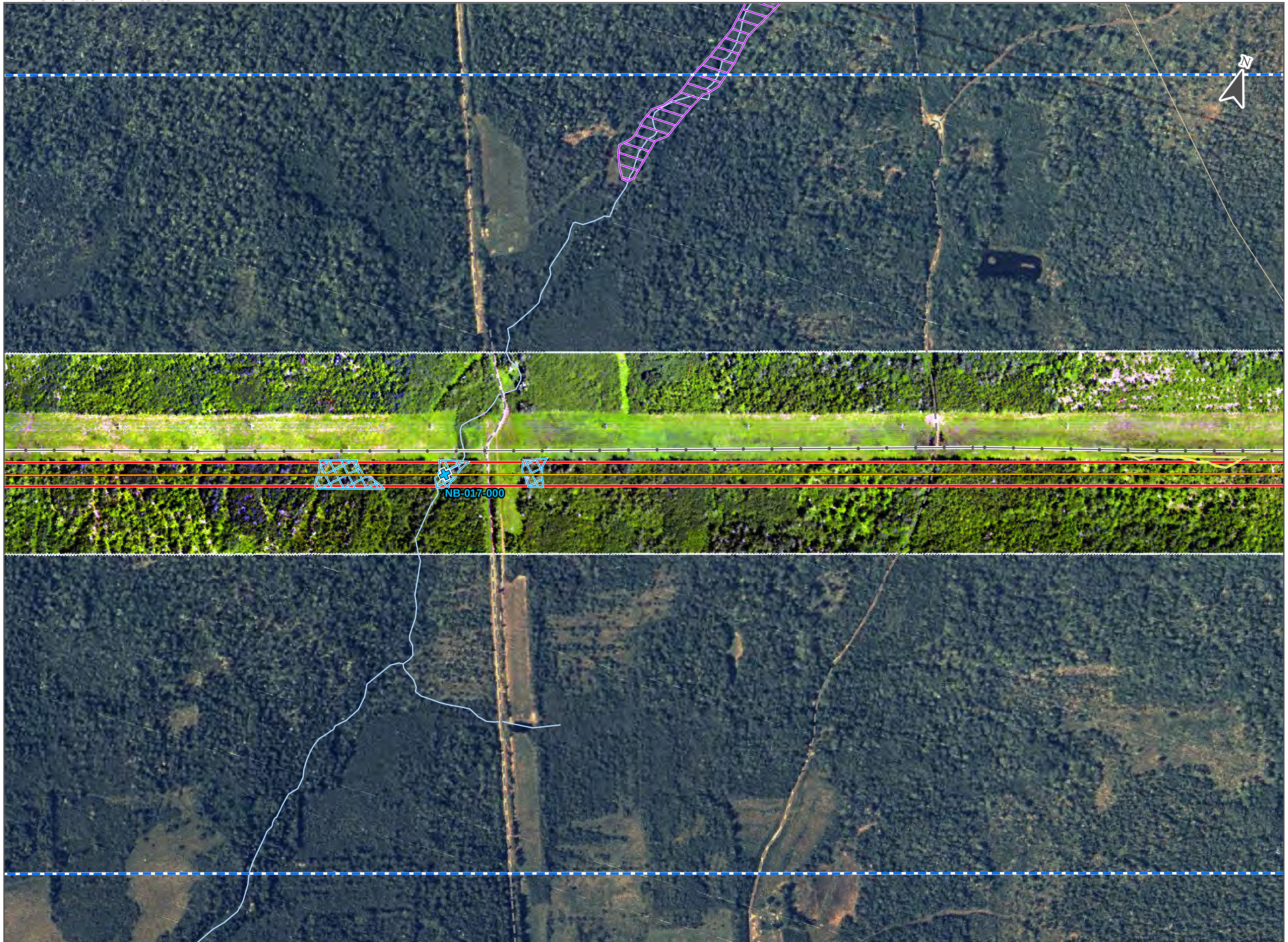
Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix B

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

- Watercourse Crossing

Proposed Project Components

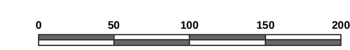
- Memramcook to Melrose

Field Delineated Wetland

- Graminoid Marsh
- Tall Shrub Swamp

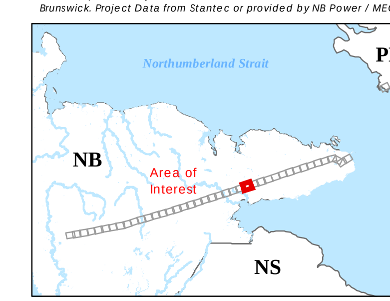
Terrestrial Assessment Area

- Project Development Area
- Local Assessment Area
- Existing Transmission Line
- GeoNB-mapped Wetland



121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

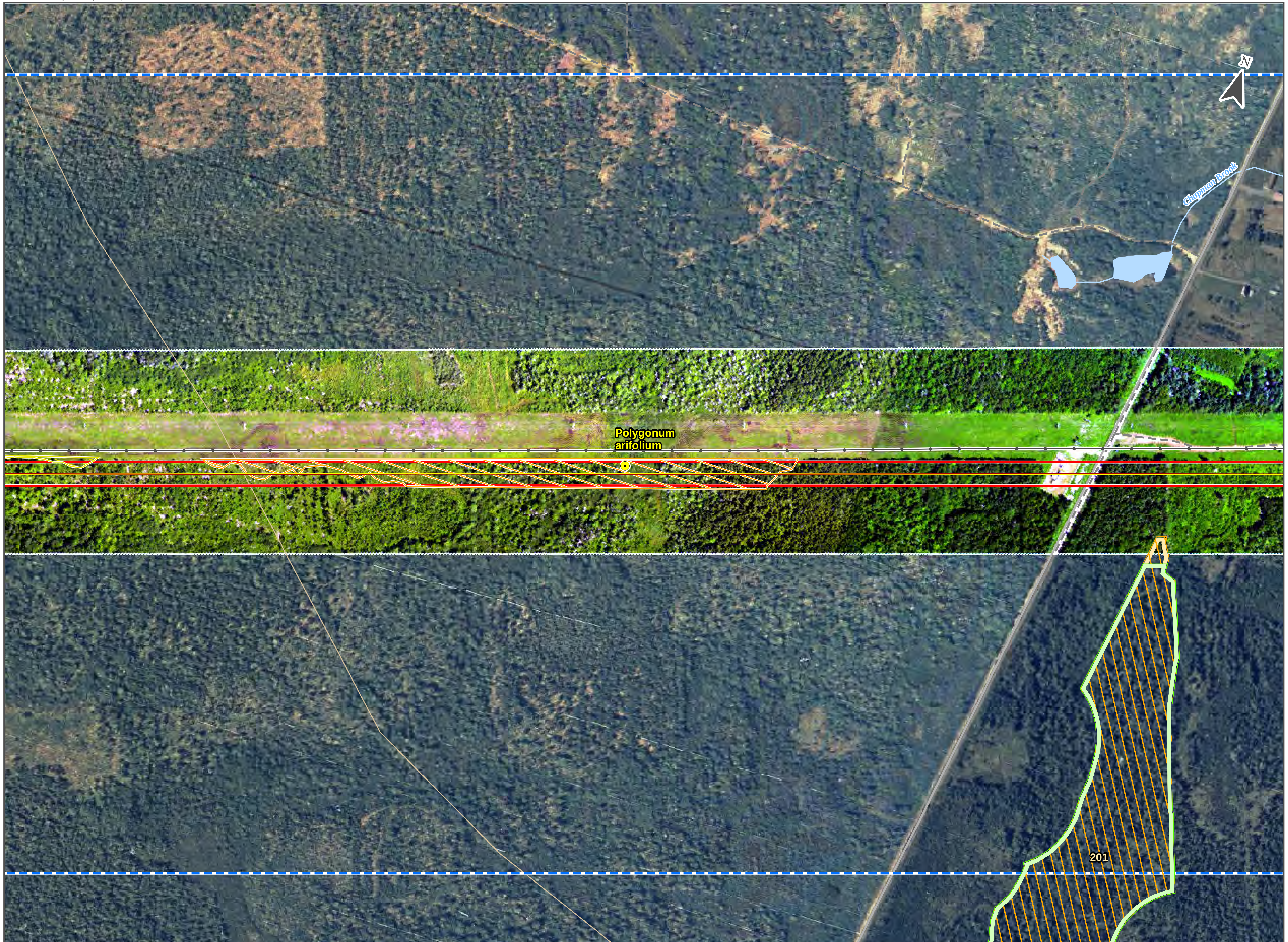


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)
- Vascular

Proposed Project Components
- Memramcook to Melrose

Field Delineated Wetland
- Graminoid Marsh
- Low Shrub Swamp

Interior Forest
- Pre-Project Interior Forest
- After Project Interior Forest

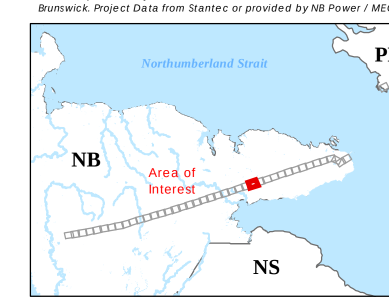
Terrestrial Assessment Area
- Project Development Area
- Local Assessment Area

- Existing Transmission Line

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

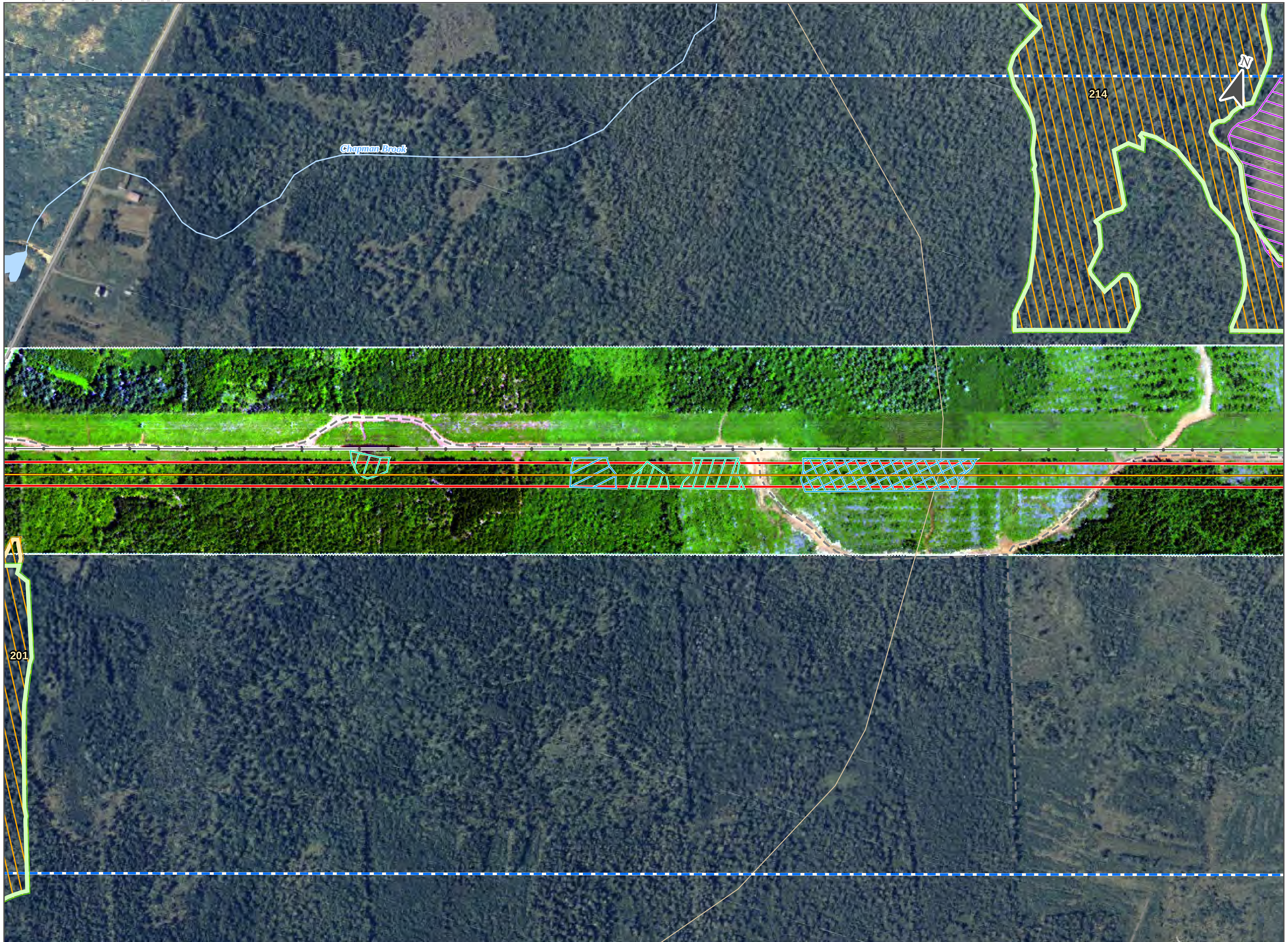


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Proposed Project Components

Memramcook to Melrose

Field Delineated Wetland

Coniferous Treed Swamp

Deciduous Treed Swamp

Tall Shrub Swamp

Interior Forest

Pre-Project Interior Forest

After Project Interior Forest

Terrestrial Assessment Area

Project Development Area

Local Assessment Area

Existing Transmission Line

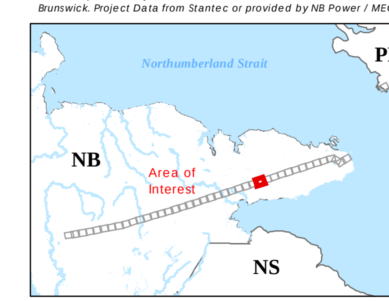
GeoNB-mapped Wetland

0 50 100 150 200

Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

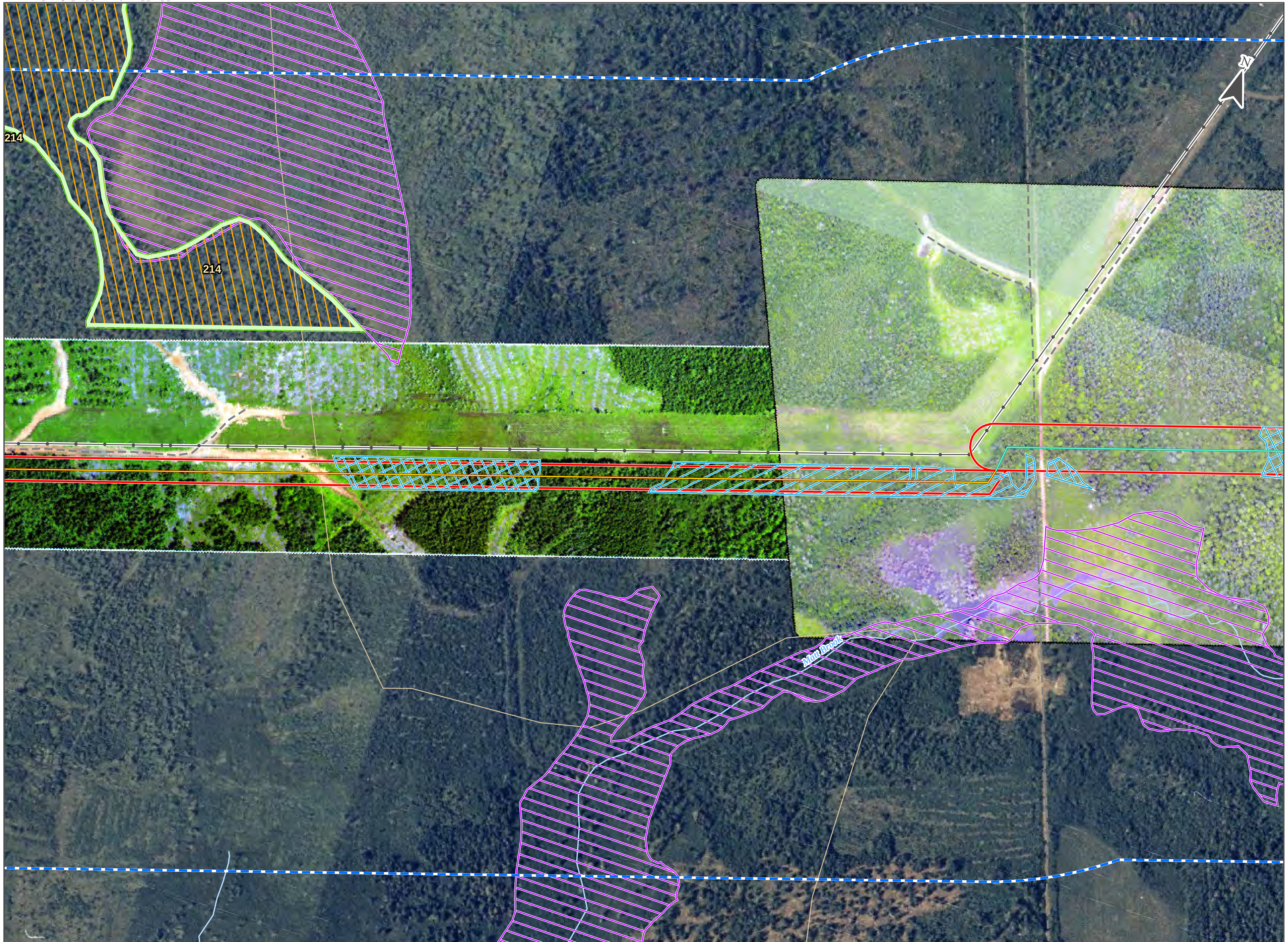


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Proposed Project Components

- Memramcook to Melrose
- Melrose to Cape Tormentine

Field Delineated Wetland

- Deciduous Treed Swamp
- Tall Shrub Swamp

Interior Forest

- Pre-Project Interior Forest
- After Project Interior Forest

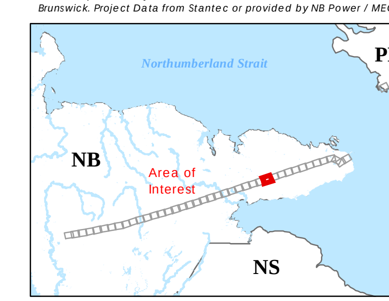
Terrestrial Assessment Area

- Project Development Area
- Local Assessment Area
- Existing Transmission Line
- GeoNB-mapped Wetland

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



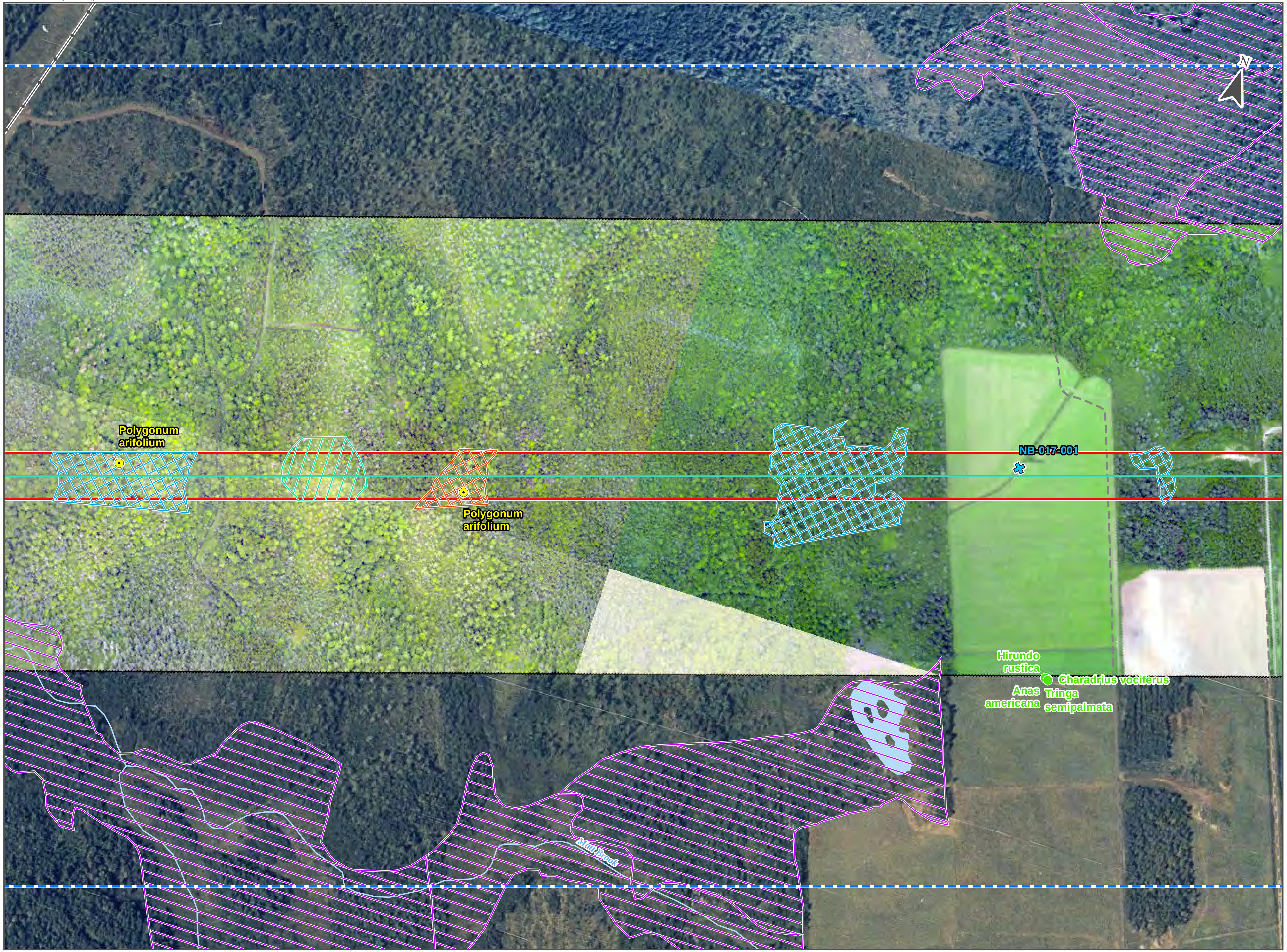
Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix B

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

AC CDC Bird Observation

Plant Field Observation (Species of Conservation Concern)

Vascular

Watercourse Crossing

Proposed Project Components

Melrose to Cape Tormentine

Field Delineated Wetland

Coniferous Treed Swamp

Mixedwood Treed Swamp

Tall Shrub Swamp

Terrestrial Assessment Area

Project Development Area

Local Assessment Area

Existing Transmission Line

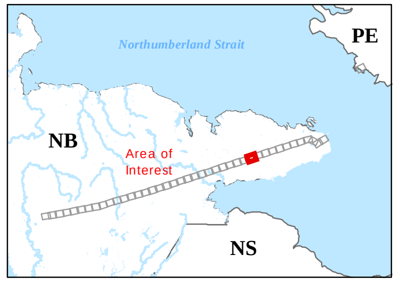
GeoNB-mapped Wetland

0 50 100 150 200

Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

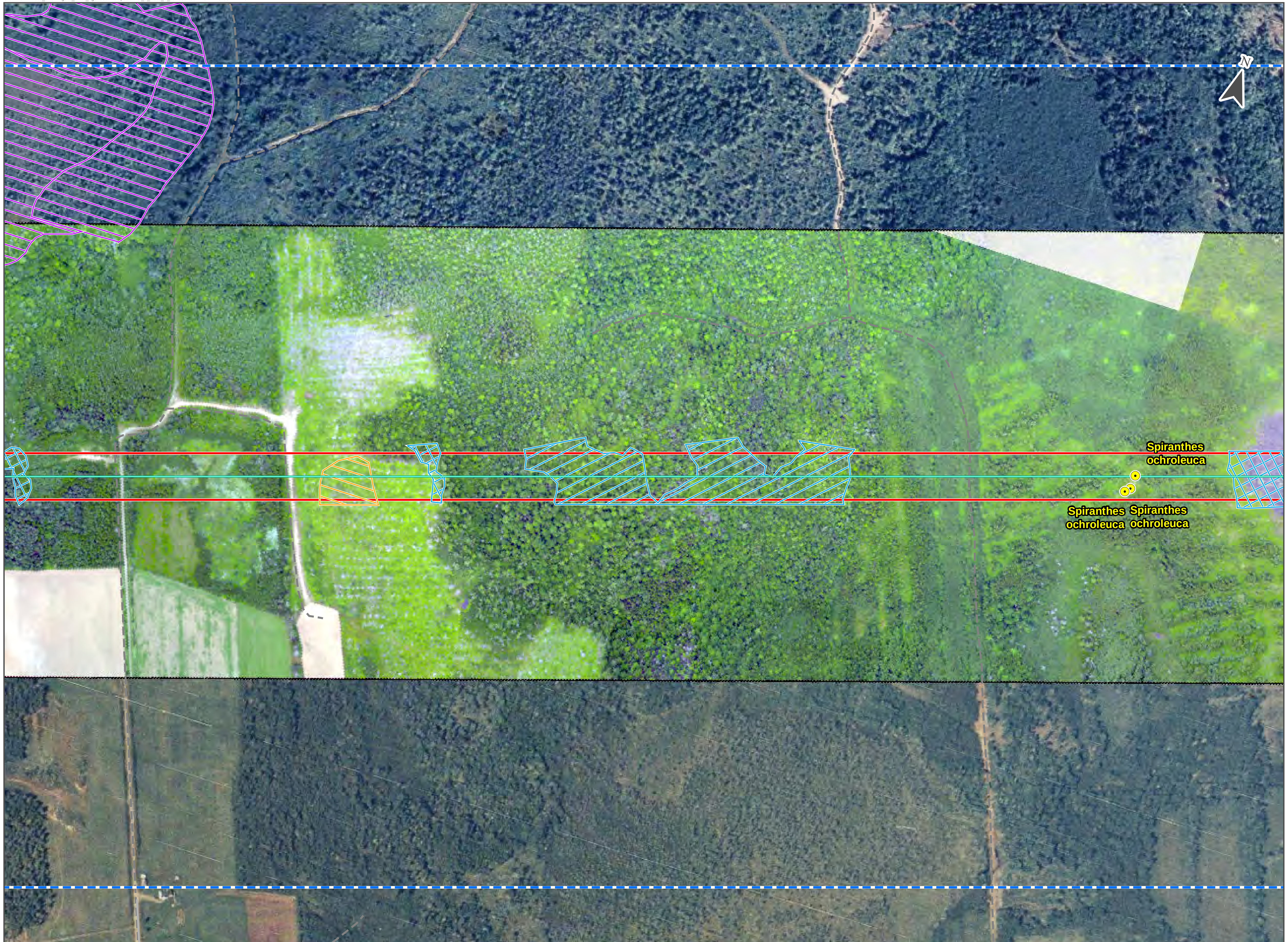


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)
- Vascular

Proposed Project Components
- Melrose to Cape Tormentine

Field Delineated Wetland
- Deciduous Treed Swamp
- Low Shrub Swamp
- Tall Shrub Swamp

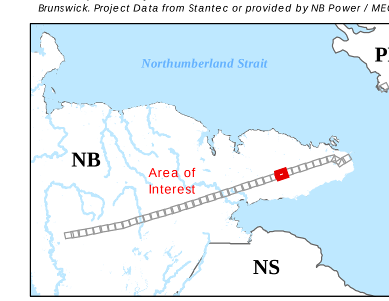
Terrestrial Assessment Area
- Project Development Area
- Local Assessment Area

- GeoNB-mapped Wetland

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

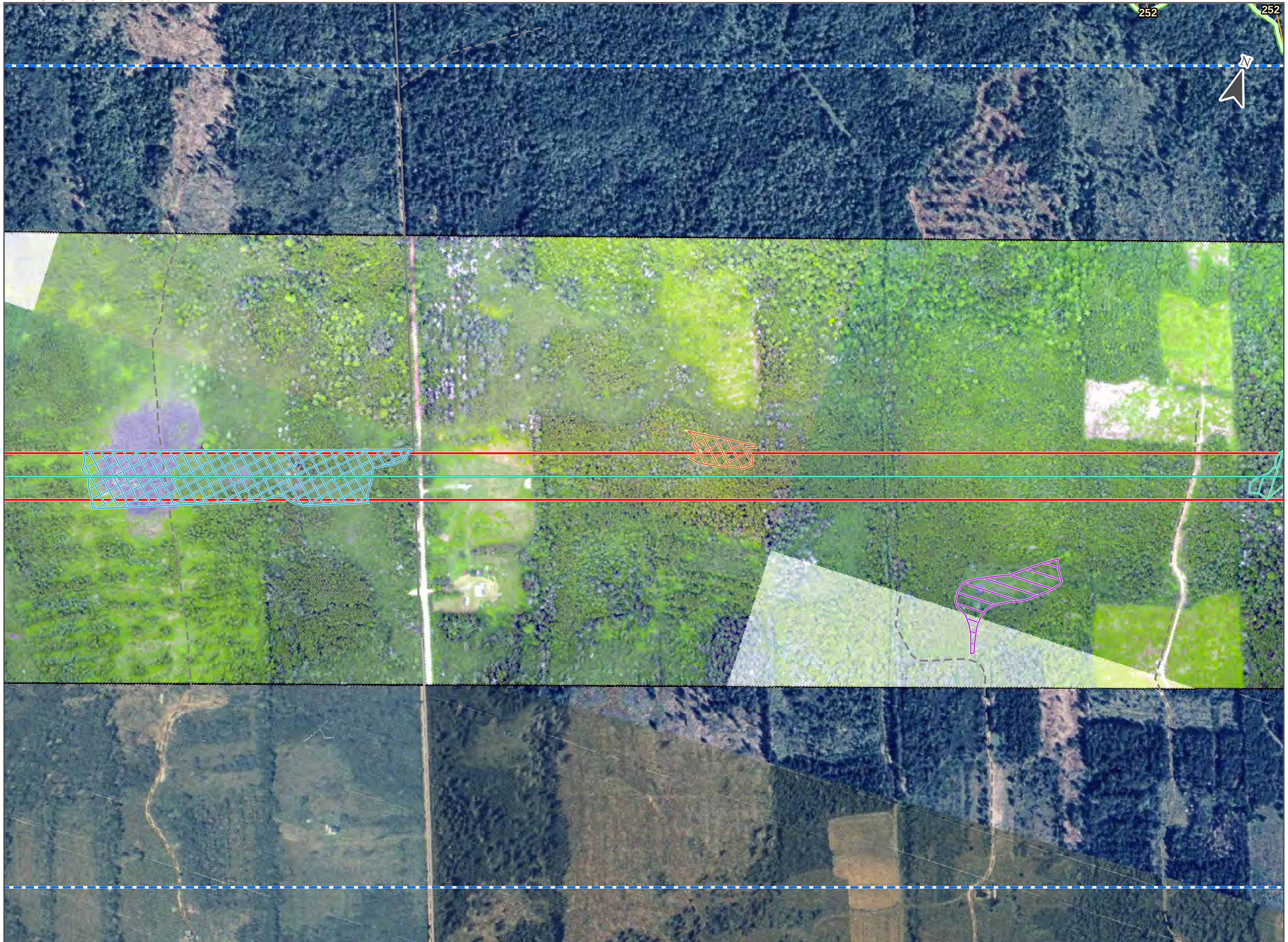


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Proposed Project Components

Melrose to Cape Tormentine

Field Delineated Wetland

Coniferous Treed Swamp

Mixedwood Treed Swamp

Tall Shrub Swamp

Interior Forest

Pre-Project Interior Forest

After Project Interior Forest

Terrestrial Assessment Area

Project Development Area

Local Assessment Area

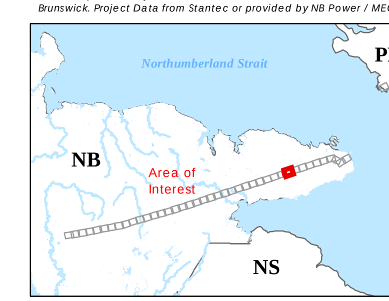
GeoNB-mapped Wetland

0 50 100 150 200

Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

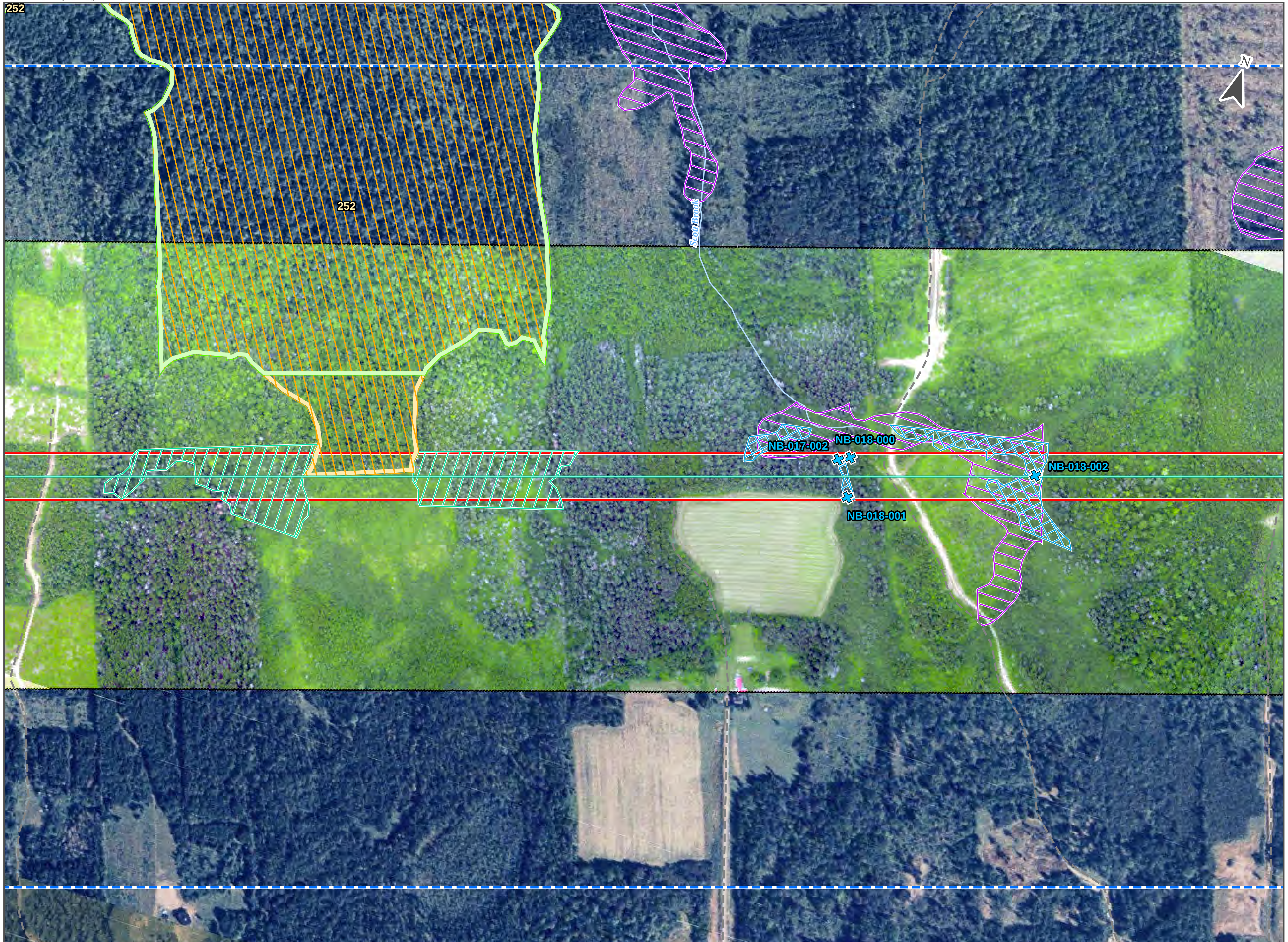


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Watercourse Crossing

Proposed Project Components

Melrose to Cape Tormentine

Field Delineated Wetland

Coniferous Treed Swamp

Tall Shrub Swamp

Interior Forest

Pre-Project Interior Forest

After Project Interior Forest

Terrestrial Assessment Area

Project Development Area

Local Assessment Area

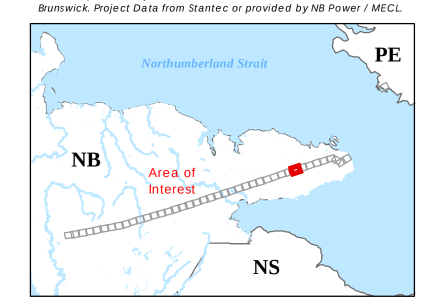
GeoNB-mapped Wetland

0 50 100 150 200

Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

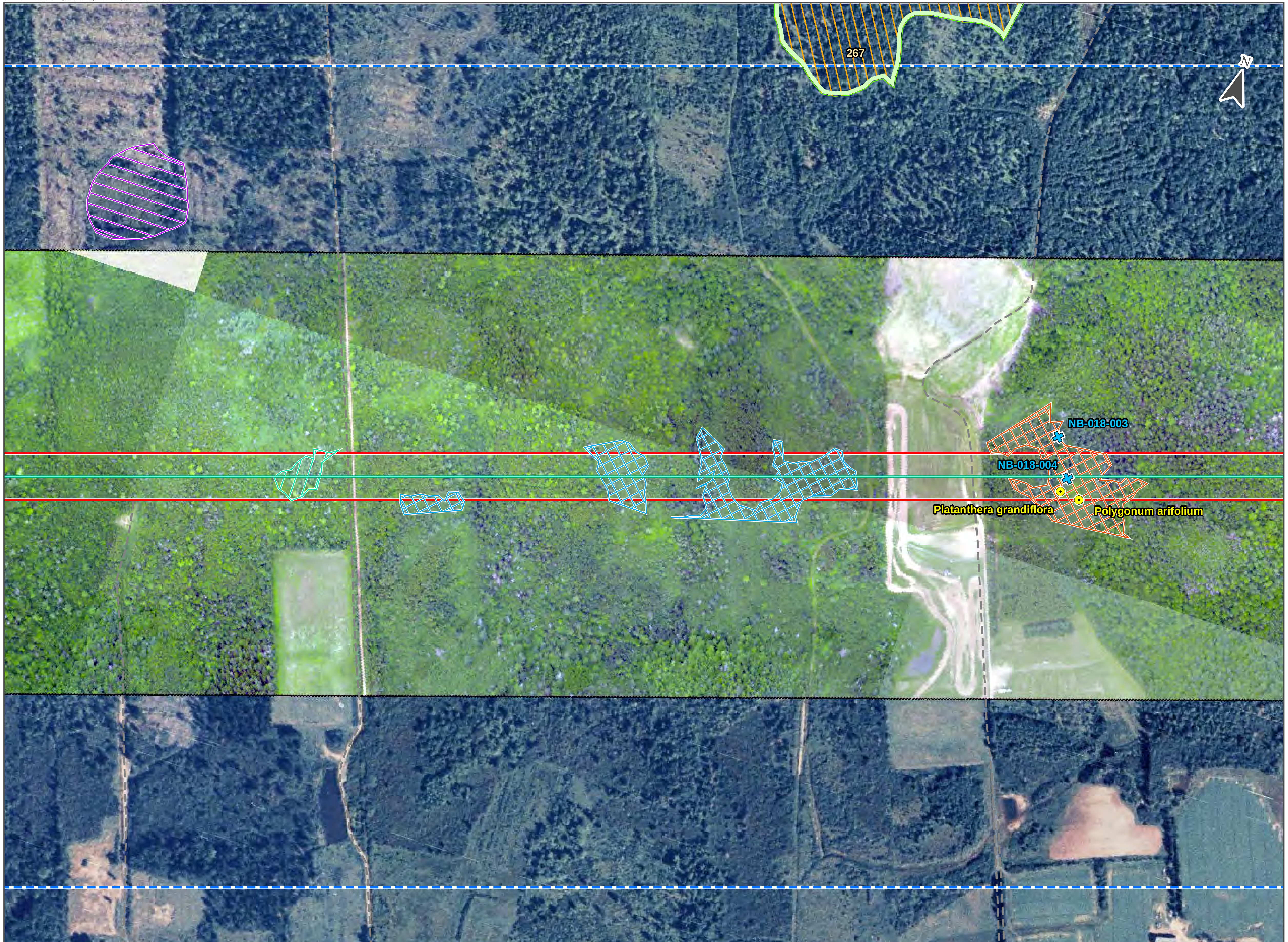


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)
Vascular
Watercourse Crossing

Proposed Project Components
Melrose to Cape Tormentine

Field Delineated Wetland
Coniferous Treed Swamp
Mixedwood Treed Swamp
Tall Shrub Swamp

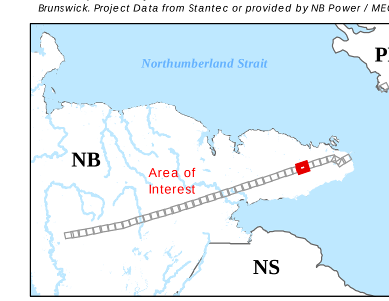
Interior Forest
Pre-Project Interior Forest
After Project Interior Forest

Terrestrial Assessment Area
Project Development Area
Local Assessment Area
GeoNB-mapped Wetland

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

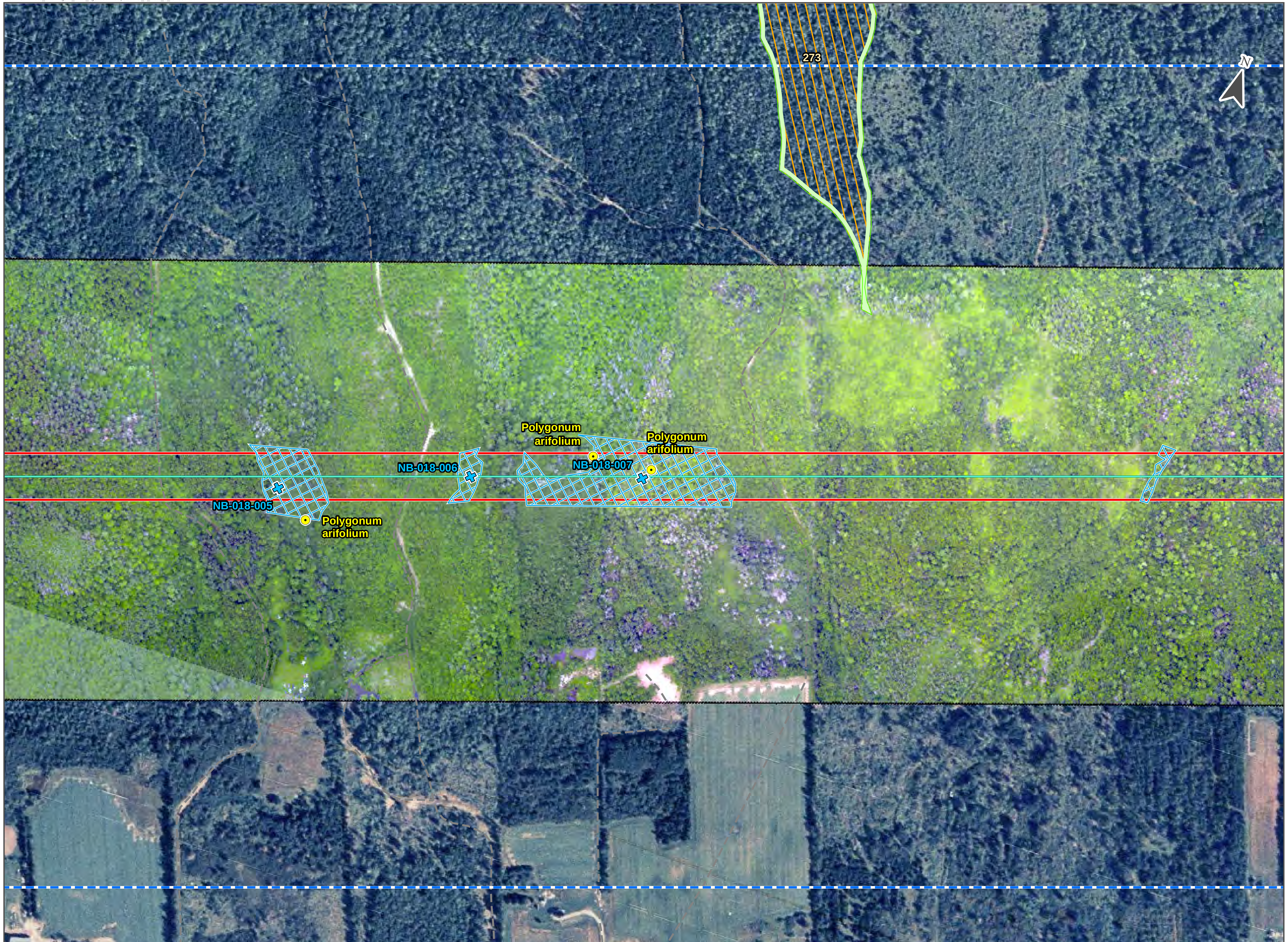


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)

- Vascular
- Watercourse Crossing

Proposed Project Components

- Melrose to Cape Tormentine

Field Delineated Wetland

- Tall Shrub Swamp

Interior Forest

- Pre-Project Interior Forest
- After Project Interior Forest

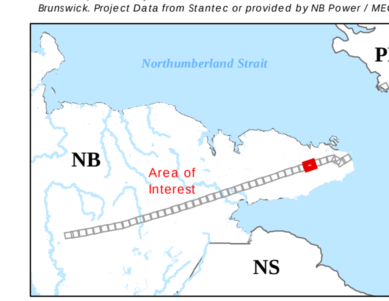
Terrestrial Assessment Area

- Project Development Area
- Local Assessment Area

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

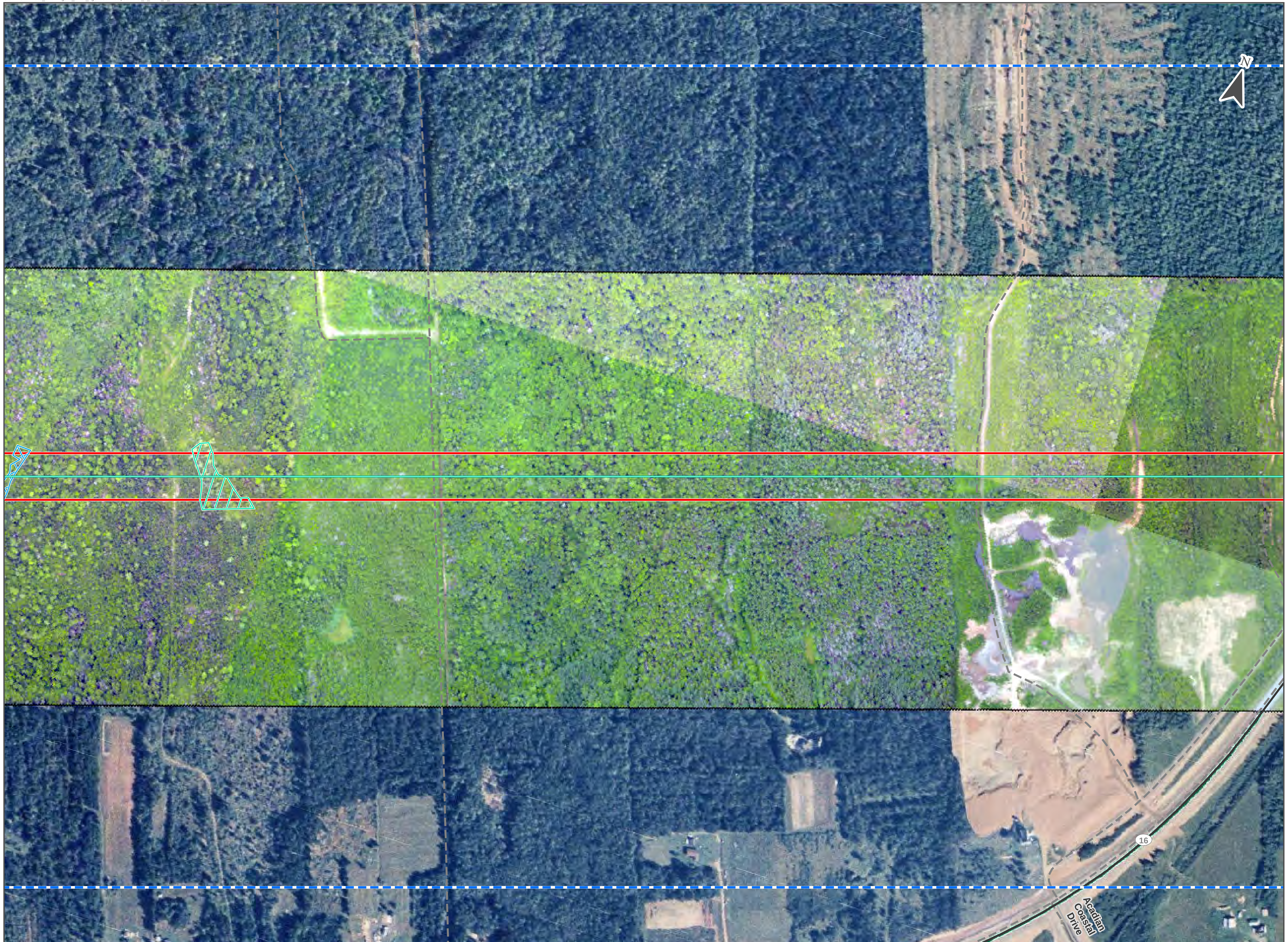


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Proposed Project Components

- Melrose to Cape Tormentine

Field Delineated Wetland

- Coniferous Treed Swamp
- Tall Shrub Swamp

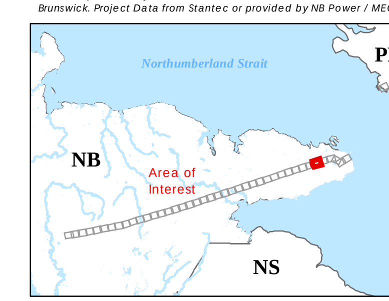
Terrestrial Assessment Area

- Project Development Area
- Local Assessment Area

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

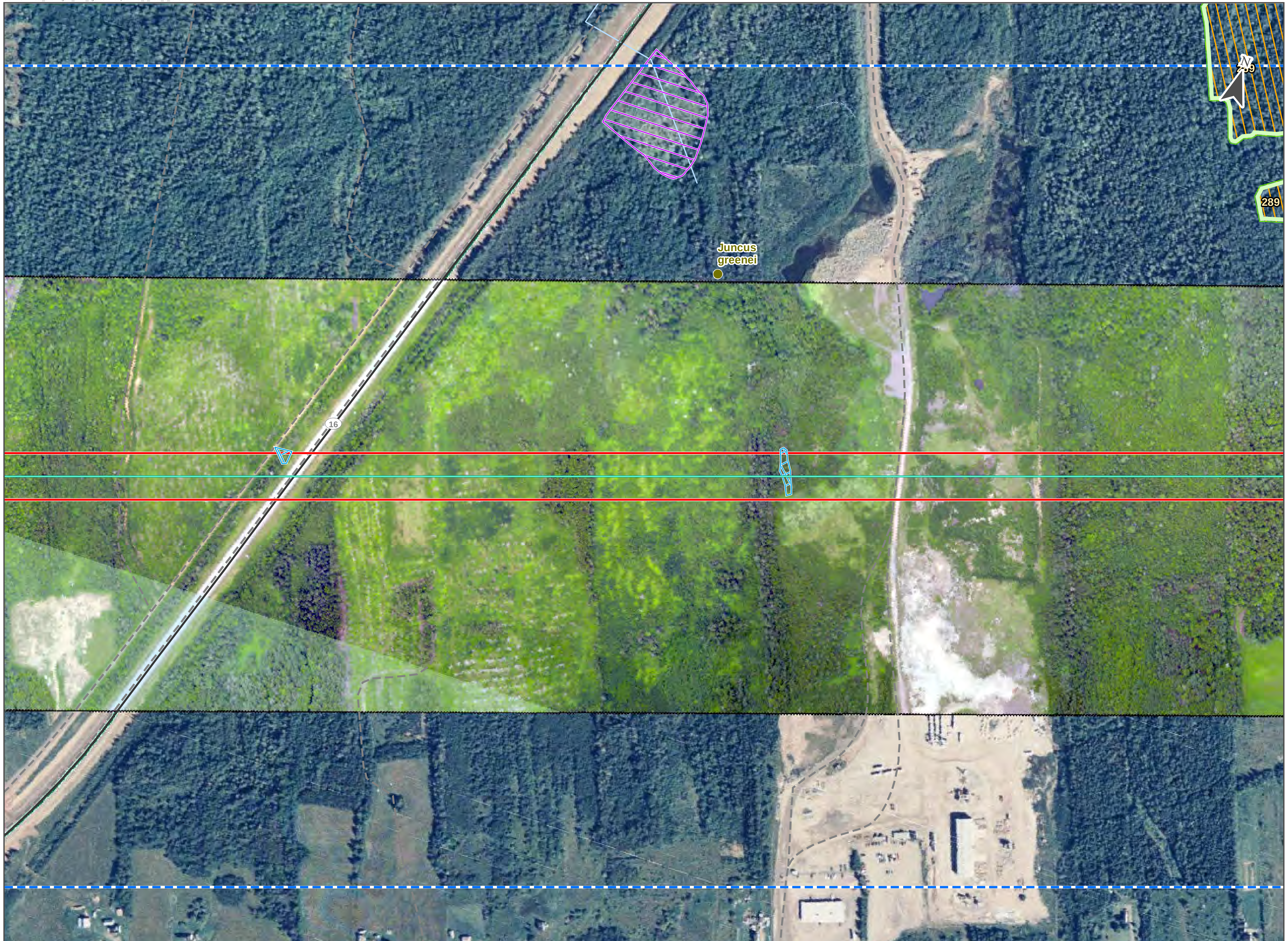


Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

AC CDC Plant Observation

Proposed Project Components

Melrose to Cape Tormentine

Field Delineated Wetland

Tall Shrub Swamp

Interior Forest

Pre-Project Interior Forest

After Project Interior Forest

Terrestrial Assessment Area

Project Development Area

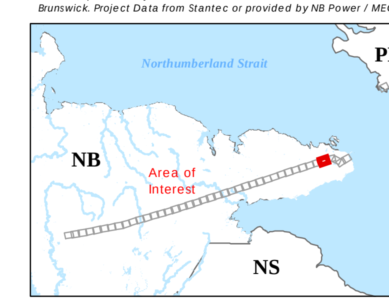
Local Assessment Area

GeoNB-mapped Wetland

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



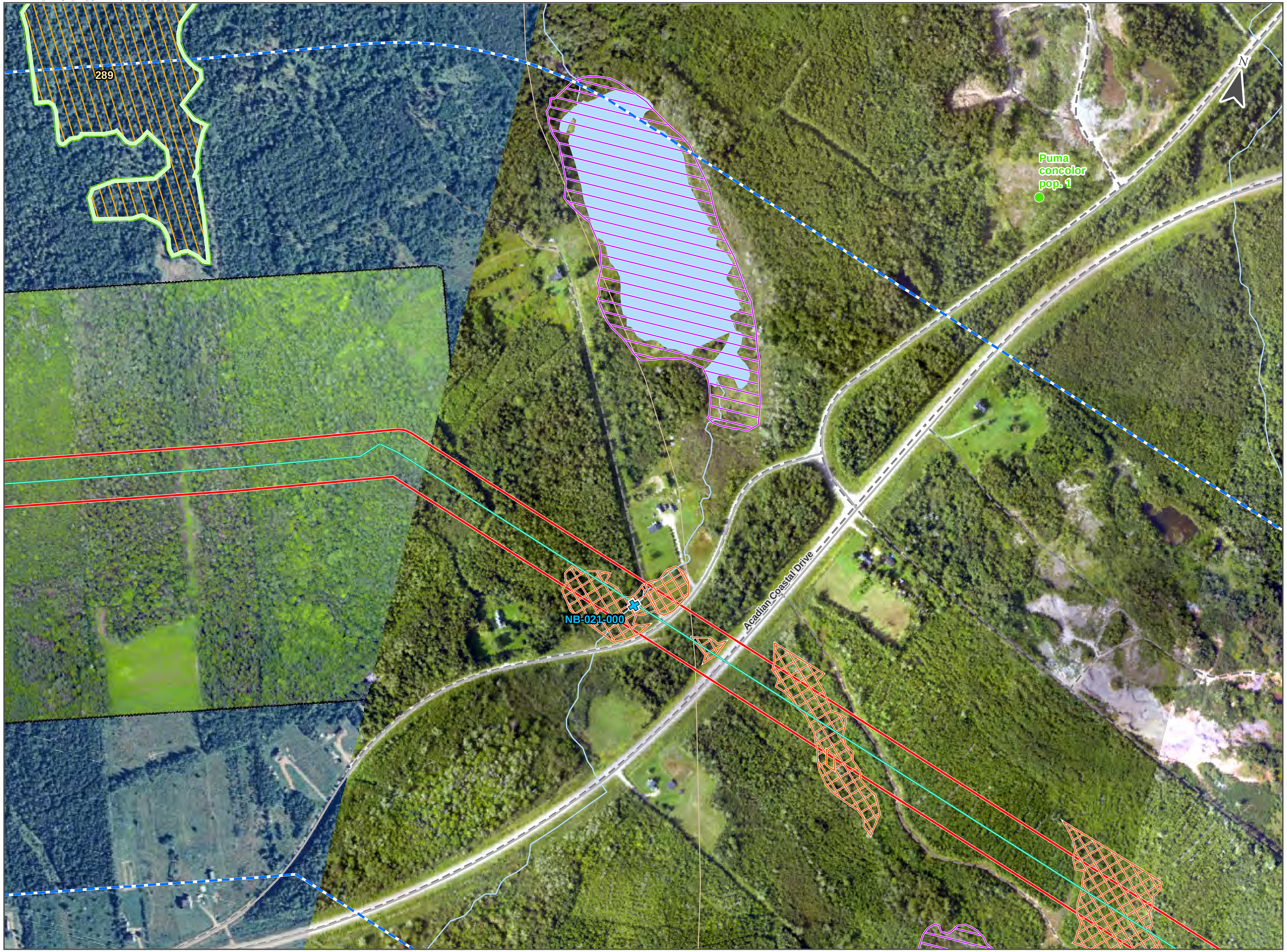
Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix B
37 of 41

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

AC CDC Bird Observation

Plant Field Observation (Species of Conservation Concern)

Vascular

Watercourse Crossing

Proposed Project Components

Melrose to Cape Tormentine

Field Delineated Wetland

Mixedwood Treed Swamp

Interior Forest

Pre-Project Interior Forest

After Project Interior Forest

Terrestrial Assessment Area

Project Development Area

Local Assessment Area

GeoNB-mapped Wetland

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.

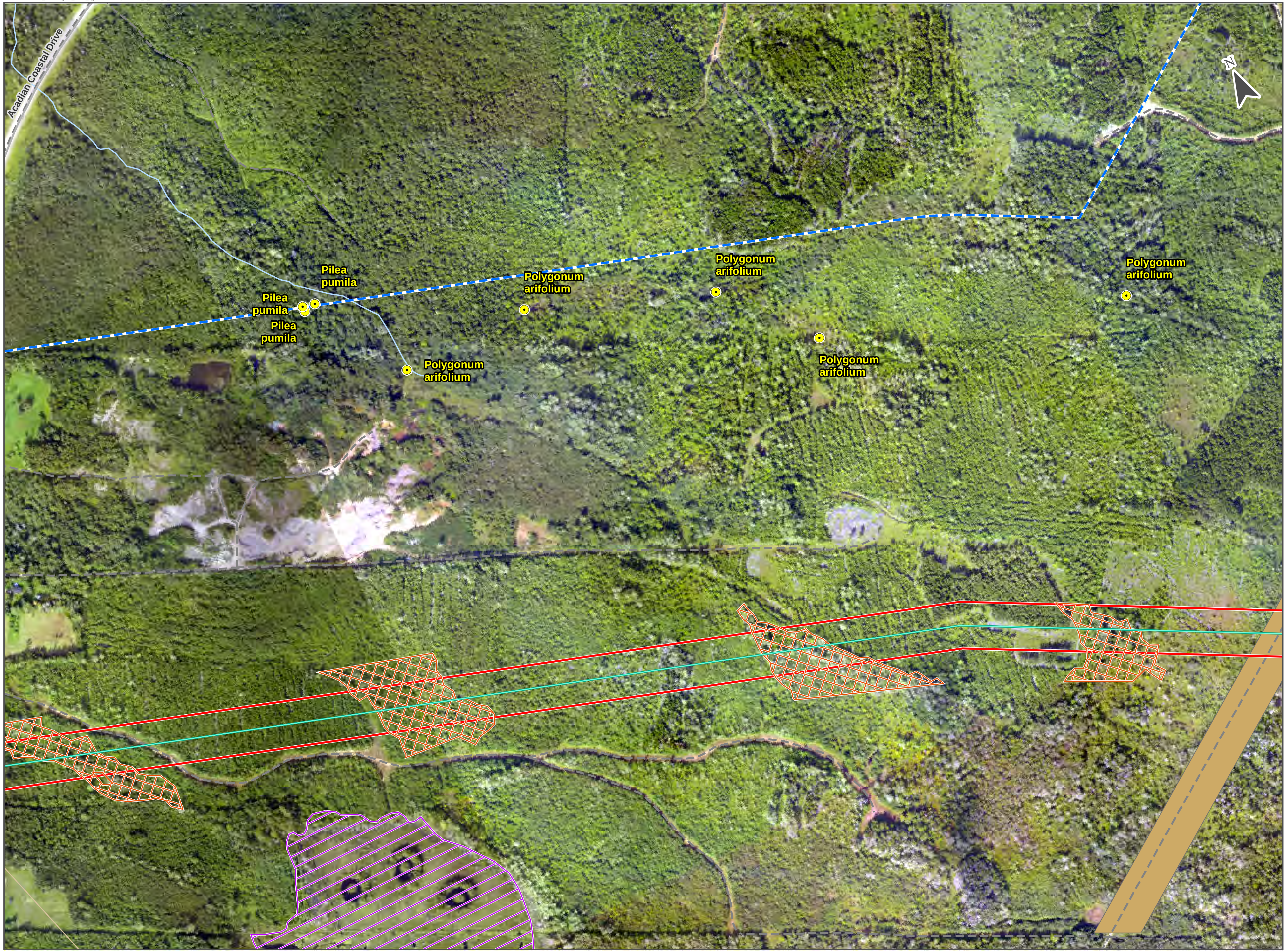
Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix B

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd



Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)

Vascular

Proposed Project Components

Melrose to Cape Tormentine

Field Delineated Wetland

Mixedwood Treed Swamp

Terrestrial Assessment Area

Project Development Area

Local Assessment Area

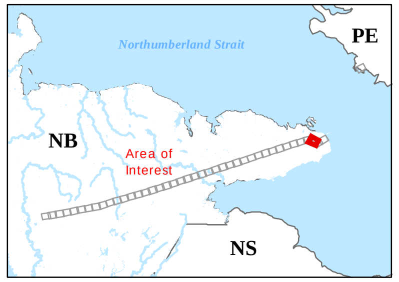
Crown Land

GeoNB-mapped Wetland

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

Appendix B

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd

Terrestrial Environment Assessment Area Boundaries

Plant Field Observation (Species of Conservation Concern)
- Vascular
- Watercourse Crossing

Proposed Project Components
- Melrose to Cape Tormentine

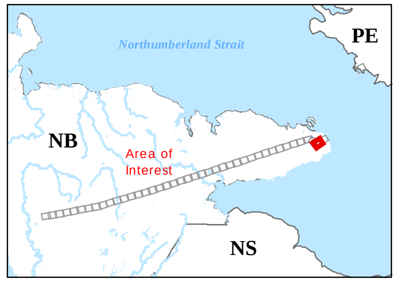
Field Delineated Wetland
- Low Shrub Swamp
- Mixedwood Treed Swamp
- Tall Shrub Swamp

Terrestrial Assessment Area
- Project Development Area
- Local Assessment Area
- Crown Land

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_3_nb\3_3_terrestrial\121811475-0044.mxd

Terrestrial Environment Assessment Area Boundaries

- Watercourse Crossing

Proposed Project Components

- Melrose to Cape Tormentine
- Proposed Buried Cable

Proposed Project Components in the Northumberland Strait

- Proposed Submarine Cable #3
- Propsoed Submarine Cable #4

Field Delineated Wetland

- Deciduous Treed Swamp
- Tall Shrub Swamp

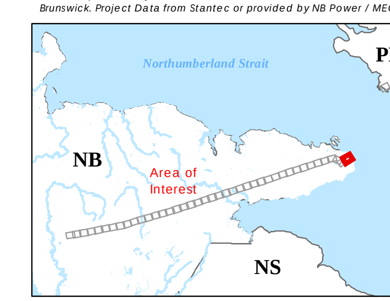
Terrestrial Assessment Area

- Project Development Area
- Local Assessment Area
- Crown Land
- GeoNB-mapped Wetland

0 50 100 150 200
Metres

121811475-0044 1:5,000 NAD 1983 CSRS NBDS

Imagery from ArcGIS Map Service GeoNB. Base data provided by the Governments of Canada and New Brunswick. Project Data from Stantec or provided by NB Power / MECL.



Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

121811475 - PEI-NB Marine Cable Interconnection - Maritime Electric Company Limited

Stantec

APPENDIX C
VASCULAR PLANT LIST

September 30, 2015

September 30, 2015

Table A1 Vascular Plants Observed near the PDA

Common Name	Scientific Name	ACCDC S-Rank
A Hybrid White Panicled American-Aster	*Oclemena x blakei*	SNA
A Hybrid Wood-fern	*Dryopteris x boottii*	SNA
A Hybrid Wood-fern	*Dryopteris x triploidea*	SNA
A Rose	*Rosa sp.*	#N/A
Alder-leaved Buckthorn	*Rhamnus alnifolia*	S4S5
Allegheny Blackberry	*Rubus allegheniensis*	S5
Alternate-leaved Dogwood	*Cornus alternifolia*	S5
American Beech	*Fagus grandifolia*	S5
American Burreed	*Sparganium americanum*	S5
American Cow Wheat	*Melampyrum lineare*	S5
American Golden Saxifrage	*Chrysosplenium americanum*	S5
American Marsh Pennywort	*Hydrocotyle americana*	S5
American Mountain Ash	*Sorbus americana*	S5
American Spikenard	*Aralia racemosa*	S4S5
American Sweetflag	*Acorus americanus*	S4
American Water Horehound	*Lycopus americanus*	S5
Arctic Rush	*Juncus balticus*	S5
Arrow-leaved Smartweed	*Polygonum sagittatum*	S5
Awl-fruited Sedge	*Carex stipata*	S5
Balsam Fir	*Abies balsamea*	S5
Balsam Poplar	*Populus balsamifera*	S5
Balsam Willow	*Salix pyrifolia*	S5
Beaked Hazel	*Corylus cornuta*	S5
Bebb's Willow	*Salix bebbiana*	S5
Bittersweet Nightshade	*Solanum dulcamara*	SNA
Black Ash	*Fraxinus nigra*	S5
Black Chokeberry	*Photinia melanocarpa*	S5
Black Elderberry	*Sambucus nigra ssp. canadensis*	S5
Black Huckleberry	*Gaylussacia baccata*	S5
Black Spruce	*Picea mariana*	S5
Bladder Sedge	*Carex intumescens*	S5
Blood Milkwort	***Polygala sanguinea***	**S2**
Bog Aster	*Oclemena nemoralis*	S5
Bog Buckbean	*Menyanthes trifoliata*	S5
Bog Muhly	*Muhlenbergia uniflora*	S5

September 30, 2015

Table A1 Vascular Plants Observed near the PDA

Common Name	Scientific Name	ACCDC S-Rank
Boreal Bog Sedge	*Carex magellanica*	S5
Boreal Stitchwort	*Stellaria borealis*	S4S5
Bracken Fern	*Pteridium aquilinum*	S5
Branched Centaury	*Centaurium pulchellum*	SNA
Bristly Black Currant	*Ribes lacustre*	S5
Bristly Dewberry	*Rubus hispidus*	S5
Bristly Sarsaparilla	*Aralia hispida*	S5
Bristly-stalked Sedge	*Carex leptalea*	S5
Broad-fruited Burreed	*Sparganium eurycarpum*	S4S5
Broad-leaved Arrowhead	*Sagittaria latifolia*	S5
Broad-leaved Cattail	*Typha latifolia*	S5
Broom Sedge	*Carex scoparia*	S5
Brown-fruited Rush	*Juncus pelocarpus*	S5
Brownish Sedge	*Carex brunnescens*	S5
Bulblet Bladder Fern	*Cystopteris bulbifera*	S4
Bulbous Water-hemlock	*Cicuta bulbifera*	S5
Calico Aster	*Symphyotrichum lateriflorum*	S5
Canada Anemone	*Anemone canadensis*	S5
Canada Blue Grass	*Poa compressa*	SNA
Canada Fly Honeysuckle	*Lonicera canadensis*	S5
Canada Manna Grass	*Glyceria canadensis*	S5
Canada Rush	*Juncus canadensis*	S5
Canada St. John's-Wort	*Hypericum canadense*	S5
Canada Yew	*Taxus canadensis*	S5
Chokecherry	*Prunus virginiana*	S5
Christmas Fern	*Polystichum acrostichoides*	S5
Cinnamon Fern	*Osmunda cinnamomea*	S5
Clasping-leaved Twisted-Stalk	*Streptopus amplexifolius*	S5
Club Spur Orchid	*Platanthera clavellata*	S4
Colonial Bent Grass	*Agrostis capillaris*	SNA
Coltsfoot	*Tussilago farfara*	SNA
Common Apple	*Malus pumila*	SNA
Common Boneset	*Eupatorium perfoliatum*	S5
Common Buttercup	*Ranunculus acris*	SNA
Common Eyebright	*Euphrasia nemorosa*	SNA

September 30, 2015

Table A1 Vascular Plants Observed near the PDA

Common Name	Scientific Name	ACCDC S-Rank
Common Hemp-nettle	*Galeopsis tetrahit*	SNA
Common Hornwort	*Ceratophyllum demersum*	S4
Common Labrador Tea	*Ledum groenlandicum*	S5
Common Lady Fern	*Athyrium filix-femina*	S5
Common Lilac	*Syringa vulgaris*	SNA
Common Marsh Bedstraw	*Galium palustre*	S5
Common Oak Fern	*Gymnocarpium dryopteris*	S5
Common Plantain	*Plantago major*	SNA
Common Self-heal	*Prunella vulgaris ssp. lanceolata*	S5
Common Silverweed	*Argentina anserina*	S5
Common Speedwell	*Veronica officinalis*	S5
Common Tall Manna Grass	*Glyceria grandis*	S5
Common Timothy	*Phleum pratense*	SNA
Common Valerian	*Valeriana officinalis*	SNA
Common Water Parsnip	*Sium suave*	S5
Common Winterberry	*Ilex verticillata*	S5
Common Wood Sorrel	*Oxalis montana*	S5
Common Woodrush	*Luzula multiflora*	S5
Common Woolly Bulrush	*Scirpus cyperinus*	S5
Common Yarrow	*Achillea millefolium*	S5
Creeping Bent Grass	*Agrostis stolonifera*	S5
Creeping Buttercup	*Ranunculus repens*	SNA
Creeping Snowberry	*Gaultheria hispidula*	S5
Crested Wood Fern	*Dryopteris cristata*	S5
Cyperus-like Sedge	*Carex pseudocyperus*	S5
Devil's Beggarticks	*Bidens frondosa*	S5
Dewdrop	*Dalibarda repens*	S5
Dotted Smartweed	***Polygonum punctatum***	**S3**
Downy Goldenrod	*Solidago puberula*	S5
Drooping Wood Reed Grass	*Cinna latifolia*	S5
Drooping Woodland Sedge	*Carex arctata*	S5
Dwarf Clearweed	***Pilea pumila***	**S3**
Dwarf Red Raspberry	*Rubus pubescens*	S5
Eastern Burnweed	*Erechtites hieraciifolia*	S5
Eastern Hay-scented Fern	*Dennstaedtia punctilobula*	S5

September 30, 2015

Table A1 Vascular Plants Observed near the PDA

Common Name	Scientific Name	ACCDC S-Rank
Eastern Marsh Fern	*Thelypteris palustris*	S5
Eastern Teaberry	*Gaultheria procumbens*	S5
Eastern White Pine	*Pinus strobus*	S5
English Plantain	*Plantago lanceolata*	SNA
European Black Currant	*Ribes nigrum*	SNA
European Mountain Ash	*Sorbus aucuparia*	SNA
European Wood Sorrel	*Oxalis stricta*	S5
Fall Dandelion	*Leontodon autumnalis*	SNA
False Waterpepper	*Polygonum hydropiperoides*	S4
Few-Flowered Sedge	*Carex pauciflora*	S5
Fibrous-Root Sedge	*Carex communis*	S5
Fireberry Hawthorn	*Crataegus chrysocarpa*	S5
Flat-Branched Tree-clubmoss	*Lycopodium obscurum*	S5
Fowl Manna Grass	*Glyceria striata*	S5
Fox Sedge	*Carex vulpinoidea*	S4S5
Fraser's Marsh St. John's-Wort	*Triadenum fraseri*	S5
Fringed Black Bindweed	*Polygonum cilinode*	S5
Fringed Sedge	*Carex crinita*	S5
Garden Stonecrop	*Hylotelephium telephium*	SNA
Giant Goldenrod	*Solidago gigantea*	S5
Glossy Buckthorn	*Frangula alnus*	SNA
Golden Groundsel	*Packera aurea*	S4S5
Goldthread	*Coptis trifolia*	S5
Grass-leaved Goldenrod	*Euthamia graminifolia*	S5
Gray Birch	*Betula populifolia*	S5
Great Duckweed	*Spirodela polyrrhiza*	S3S4
Greater Bladderwort	*Utricularia macrorhiza*	S5
Greater Water Dock	*Rumex orbiculatus*	S5
Green Alder	*Alnus viridis*	S5
Green Foxtail	*Setaria viridis*	SNA
Green-fruited Burreed	*Sparganium emersum*	S5
Green-keeled Cottongrass	*Eriophorum viridicarinatum*	S4
Hair Fescue	*Festuca filiformis*	SNA
Hairy Flat-top White Aster	*Doellingeria umbellata*	S5
Hairy Sweet Cicely	*Osmorhiza claytonii*	S5

September 30, 2015

Table A1 Vascular Plants Observed near the PDA

Common Name	Scientific Name	ACCDC S-Rank
Halberd-Leaved Tearthumb	***Polygonum arifolium***	**S3**
Harlequin Blue Flag	*Iris versicolor*	S5
Heart-leaved Birch	*Betula papyrifera var. cordifolia*	S5
Helleborine	*Epipactis helleborine*	SNA
Hickey's Tree-clubmoss	*Lycopodium hickeyi*	S4
Highbush Cranberry	*Viburnum opulus*	S5
Hobblebush	*Viburnum lantanoides*	S5
Hop Sedge	***Carex lupulina***	**S3**
Humped Bladderwort	*Utricularia gibba*	S3S4
Indian Cucumber Root	*Medeola virginiana*	S5
Indian Pipe	*Monotropa uniflora*	S5
Inland Serviceberry	*Amelanchier interior*	S5
Interrupted Fern	*Osmunda claytoniana*	S5
Jack Pine	*Pinus banksiana*	S5
Jack-in-the-pulpit	*Arisaema triphyllum*	S5
Jack-in-the-pulpit	*Arisaema triphyllum ssp. triphyllum*	S5
Japanese Knotweed	*Polygonum cuspidatum*	SNA
Kalm's Hawkweed	***Hieracium kalmii***	**S1**
Large Cranberry	*Vaccinium macrocarpon*	S5
Large False Solomon's Seal	*Maianthemum racemosum*	S5
Large False Solomon's Seal	*Maianthemum racemosum ssp. racemosum*	S5
Large Purple Fringed Orchid	***Platanthera grandiflora***	**S3**
Large Sweet Vernal Grass	*Anthoxanthum odoratum*	SNA
Large Water-starwort	*Callitriche heterophylla*	S4S5
Large-leaved Aster	*Eurybia macrophylla*	S5
Large-leaved Avens	*Geum macrophyllum*	S5
Large-leaved Pondweed	*Potamogeton amplifolius*	S4
Large-toothed Aspen	*Populus grandidentata*	S5
Late Lowbush Blueberry	*Vaccinium angustifolium*	S5
Leatherleaf	*Chamaedaphne calyculata*	S5
Little Yellow Rattle	*Rhinanthus minor*	S5
Low Hop Clover	*Trifolium campestre*	SNA
Low Rough Aster	*Eurybia radula*	S5
Mad-dog Skullcap	*Scutellaria lateriflora*	S5
Marsh Blue Violet	*Viola cucullata*	S5

September 30, 2015

Table A1 Vascular Plants Observed near the PDA

Common Name	Scientific Name	ACCDC S-Rank
Marsh Cinquefoil	*Comarum palustre*	S5
Marsh Cudweed	*Gnaphalium uliginosum*	SNA
Marsh Seedbox	*Ludwigia palustris*	S4
Marsh Skullcap	*Scutellaria galericulata*	S5
Marsh Water-starwort	*Callitriche palustris*	S5
Marsh Willowherb	*Epilobium palustre*	S5
Marshpepper Smartweed	*Polygonum hydropiper*	SNA
Maryland Sanicle	*Sanicula marilandica*	S4S5
Meadow Goatsbeard	*Tragopogon pratensis*	SNA
Meadow Vetchling	*Lathyrus pratensis*	SNA
Morrow's Honeysuckle	*Lonicera morrowii*	SNA
Mountain Blue-eyed-grass	*Sisyrinchium montanum*	S5
Mountain Fly Honeysuckle	*Lonicera villosa*	S5
Mountain Holly	*Nemopanthus mucronatus*	S5
Mountain Maple	*Acer spicatum*	S5
Mouse-ear Chickweed	*Cerastium arvense*	S4
Multiflora Rose	*Rosa multiflora*	SNA
Naked Bishop's-Cap	*Mitella nuda*	S5
Narrow-leaved Burreed	*Sparganium angustifolium*	S5
Necklace Sedge	*Carex projecta*	S5
Needle Spikerush	*Eleocharis acicularis*	S5
New England Sedge	*Carex novae-angliae*	S5
New York Aster	*Symphyotrichum novi-belgii*	S5
New York Fern	*Thelypteris noveboracensis*	S5
Nodding Beggarticks	*Bidens cernua*	S5
Nodding Ladies'-Tresses	***Spiranthes cernua***	**S2**
Nodding Sedge	*Carex gynandra*	S5
Nodding Trillium	*Trillium cernuum*	S5
Northern Arrowhead	*Sagittaria cuneata*	S5
Northern Bayberry	*Morella pensylvanica*	S5
Northern Beaked Sedge	*Carex utriculata*	S5
Northern Beech Fern	*Phegopteris connectilis*	S5
Northern Bog Clubmoss	*Lycopodiella inundata*	S4S5
Northern Bog Goldenrod	*Solidago uliginosa*	S5
Northern Bush Honeysuckle	*Diervilla lonicera*	S5

September 30, 2015

Table A1 Vascular Plants Observed near the PDA

Common Name	Scientific Name	ACCDC S-Rank
Northern Clubmoss	*Lycopodium complanatum*	S4S5
Northern Long Sedge	*Carex folliculata*	S4
Northern Manna Grass	*Glyceria borealis*	S5
Northern Mannagrass	*Glyceria laxa*	S4?
Northern Panic Grass	*Dichanthelium boreale*	S5
Northern Pitcher Plant	*Sarracenia purpurea*	S5
Northern Poison Oak	*Toxicodendron rydbergii*	S5
Northern Sedge	*Carex deflexa*	S5
Northern Shorthusk	*Brachyelytrum septentrionale*	S5
Northern St. John's-wort	*Hypericum boreale*	S5
Northern Starflower	*Trientalis borealis*	S5
Northern Stitchwort	*Stellaria calycantha*	SNA
Northern Sweet Coltsfoot	*Petasites frigidus*	S4S5
Northern Water Horehound	*Lycopus uniflorus*	S5
Northern Water Plantain	*Alisma triviale*	S5
Northern Wild Raisin	*Viburnum nudum*	S5
Northern Willowherb	*Epilobium ciliatum*	S5
Northern Willowherb	*Epilobium ciliatum ssp. glandulosum*	S5
Oak-leaved Goosefoot	*Chenopodium glaucum*	SNA
Old Field Cinquefoil	*Potentilla simplex*	S5
One-flowered Wintergreen	*Moneses uniflora*	S5
One-sided Wintergreen	*Orthilia secunda*	S5
Orange Hawkweed	*Hieracium aurantiacum*	SNA
Ostrich Fern	*Matteuccia struthiopteris*	S5
Oval-leaf Knotweed	*Polygonum arenastrum*	SNA
Ovate Spikerush	*Eleocharis ovata*	S5
Oxeye Daisy	*Leucanthemum vulgare*	SNA
Painted Trillium	*Trillium undulatum*	S5
Pale Bog Laurel	*Kalmia polifolia*	S5
Pale False Manna Grass	*Torreyochloa pallida*	S5
Pale False Manna Grass	*Torreyochloa pallida var. fernaldii*	S5
Paper Birch	*Betula papyrifera*	S5
Partridgeberry	*Mitchella repens*	S5
Path Rush	*Juncus tenuis*	S5
Pearly Everlasting	*Anaphalis margaritacea*	S5

September 30, 2015

Table A1 Vascular Plants Observed near the PDA

Common Name	Scientific Name	ACCDC S-Rank
Pennsylvania Bittercress	*Cardamine pensylvanica*	S5
Perennial Evening Primrose	*Oenothera perennis*	S5
Pickerelweed	*Pontederia cordata*	S5
Pin Cherry	*Prunus pensylvanica*	S5
Pineapple Weed	*Matricaria discoidea*	SNA
Pinesap	*Monotropa hypopithys*	S4
Pink Lady's-slipper	*Cypripedium acaule*	S5
Poverty Oat Grass	*Danthonia spicata*	S5
Prairie Cord Grass	*Spartina pectinata*	S5
Purple-stemmed Aster	*Symphyotrichum puniceum*	S5
Purple-stemmed Beggarticks	*Bidens connata*	S4?
Pussy Willow	*Salix discolor*	S5
Ragged Fringed Orchid	*Platanthera lacera*	S4
Red Ash	*Fraxinus pennsylvanica*	S4
Red Baneberry	*Actaea rubra*	S5
Red Bartsia	*Odontites vernus*	SNA
Red Clover	*Trifolium pratense*	SNA
Red Elderberry	*Sambucus racemosa*	S5
Red Maple	*Acer rubrum*	S5
Red Osier Dogwood	*Cornus sericea*	S5
Red Spruce	*Picea rubens*	S5
Red-disked Yellow Pond-lily	***Nuphar lutea ssp. rubrodisca***	**S2**
Redtop	*Agrostis gigantea*	SNA
Reed Canary Grass	*Phalaris arundinacea*	S5
Rhodora	*Rhododendron canadense*	S5
Ribbon-Leaved Pondweed	*Potamogeton epihydrus*	S5
Rice Cut Grass	*Leersia oryzoides*	S5
Rose Pogonia	*Pogonia ophioglossoides*	S4
Rose Twisted-Stalk	*Streptopus lanceolatus*	S5
Rough Bedstraw	*Galium asprellum*	S5
Rough Bent Grass	*Agrostis scabra*	S5
Rough Cottongrass	*Eriophorum tenellum*	S4S5
Rough Fleabane	*Erigeron strigosus*	S5
Rough Hawkweed	*Hieracium scabrum*	S5
Rough Sedge	*Carex scabrata*	S5

September 30, 2015

Table A1 Vascular Plants Observed near the PDA

Common Name	Scientific Name	ACCDC S-Rank
Rough-Stemmed Goldenrod	*Solidago rugosa*	S5
Round-Branched Tree-clubmoss	*Lycopodium dendroideum*	S5
Round-Leaved Sundew	*Drosera rotundifolia*	S5
Royal Fern	*Osmunda regalis*	S5
Rugosa Rose	*Rosa rugosa*	SNA
Running Clubmoss	*Lycopodium clavatum*	S5
Sallow Sedge	*Carex lurida*	S5
Satiny Willow	*Salix pellita*	S4S5
Sensitive Fern	*Onoclea sensibilis*	S5
Sheep Laurel	*Kalmia angustifolia*	S5
Shining Firmoss	*Huperzia lucidula*	S5
Shining Rose	*Rosa nitida*	S5
Shining Willow	*Salix lucida*	S5
Shinleaf	*Pyrola elliptica*	S5
Short-tailed Rush	*Juncus brevicaudatus*	S5
Showy Blackberry	*Rubus elegantulus*	S4S5
Showy Lady's-slipper	***Cypripedium reginae***	**S3**
Skunk Currant	*Ribes glandulosum*	S5
Slender Cottongrass	***Eriophorum gracile***	**S2**
Slender Ladies'-tresses	*Spiranthes lacera*	S5
Slender Manna Grass	*Glyceria melicaria*	S5
Slender Sedge	*Carex lasiocarpa*	S5
Small Cranberry	*Vaccinium oxycoccos*	S5
Small Enchanter's Nightshade	*Circaea alpina*	S5
Small Purple Fringed Orchid	*Platanthera psycodes*	S4
Small White Violet	*Viola macloskeyi*	S5
Small Yellow Pond-lily	***Nuphar lutea ssp. pumila***	**S3**
Small-fruited Bulrush	*Scirpus microcarpus*	S5
Smooth Bedstraw	*Galium mollugo*	SNA
Smooth Blackberry	*Rubus canadensis*	S5
Smooth Crab Grass	*Digitaria ischaemum*	SNA
Smooth Gooseberry	*Ribes hirtellum*	S5
Smooth Serviceberry	*Amelanchier laevis*	S5
Smooth Twigrush	*Cladium mariscoides*	S3S4
Sneezeweed	*Achillea ptarmica*	SNA

September 30, 2015

Table A1 Vascular Plants Observed near the PDA

Common Name	Scientific Name	ACCDC S-Rank
Soft Rush	*Juncus effusus*	S5
Soft Rush	*Juncus effusus var. conglomeratus*	SNR
Southern Clubmoss	*Lycopodium digitatum*	S5
Speckled Alder	*Alnus incana*	S5
Spinulose Wood Fern	*Dryopteris carthusiana*	S5
Spoon-Leaved Sundew	*Drosera intermedia*	S5
Spotted Jewelweed	*Impatiens capensis*	S5
Spotted Joe-pye-weed	*Eupatorium maculatum*	S5
Spotted Lady's-thumb	*Polygonum persicaria*	SNA
Spotted Water-hemlock	*Cicuta maculata*	S5
Spreading Dogbane	*Apocynum androsaemifolium*	S5
Square-stemmed Monkeyflower	*Mimulus ringens*	S4S5
Star Sedge	*Carex echinata*	S5
Starry False Solomon's Seal	*Maianthemum stellatum*	S4S5
Steeplebush	*Spiraea tomentosa*	S5
Stiff Clubmoss	*Lycopodium annotinum*	S5
Stiff Eyebright	*Euphrasia stricta*	SNA
Striped Maple	*Acer pensylvanicum*	S5
Sugar Maple	*Acer saccharum*	S5
Swamp Rose	***Rosa palustris***	**S3**
Swamp Yellow Loosestrife	*Lysimachia terrestris*	S5
Sweet Gale	*Myrica gale*	S5
Tall Blue Lettuce	*Lactuca biennis*	S5
Tall Hawkweed	*Hieracium piloselloides*	SNA
Tall Meadow-rue	*Thalictrum pubescens*	S5
Tall Rattlesnakeroot	*Prenanthes altissima*	S5
Tamarack	*Larix laricina*	S5
Tawny Cottongrass	*Eriophorum virginicum*	S5
Thread Rush	*Juncus filiformis*	S5
Three-flowered Bedstraw	*Galium triflorum*	S5
Three-leaved False Soloman's Seal	*Maianthemum trifolium*	S5
Three-LEAVED Rattlesnakeroot	*Prenanthes trifoliolata*	S5
Three-petaled Bedstraw	*Galium trifidum ssp. trifidum*	S5
Three-seeded Sedge	*Carex trisperma*	S5
Three-way Sedge	*Dulichium arundinaceum*	S5

September 30, 2015

Table A1 Vascular Plants Observed near the PDA

Common Name	Scientific Name	ACCDC S-Rank
Thyme-leaved Speedwell	***Veronica serpyllifolia ssp. humifusa***	**S3**
Trailing Arbutus	*Epigaea repens*	S5
Tuberous Grass Pink	*Calopogon tuberosus*	S4
Tufted Yellow Loosestrife	*Lysimachia thyrsiflora*	S4
Turion Duckweed	*Lemna turionifera*	S5
Tussock Cottongrass	*Eriophorum vaginatum*	S5
Tussock Sedge	*Carex stricta*	S5
Twinflower	*Linnaea borealis*	S5
Twin-stemmed Bladderwort	*Utricularia geminiscapa*	S4
Two-seeded Sedge	*Carex disperma*	S5
Upland Bent Grass	*Agrostis perennans*	S5
Variegated Horsetail	*Equisetum variegatum*	S4
Variegated Pond-Lily	*Nuphar lutea*	S5
Velvet-LEAVED Blueberry	*Vaccinium myrtilloides*	S5
Virginia Clematis	*Clematis virginiana*	S5
Virginia Rose	*Rosa virginiana*	S5
Water Avens	*Geum rivale*	S5
Water Horsetail	*Equisetum fluviatile*	S5
Water-shield	*Brasenia schreberi*	S4
White Ash	*Fraxinus americana*	S5
White Beakrush	*Rhynchospora alba*	S5
White Bog Orchid	*Platanthera dilatata*	S4
White Buttons	*Eriocaulon aquaticum*	S5
White Fringed Orchid	***Platanthera blephariglottis***	**S3**
White Fringed Orchid	***Platanthera blephariglottis var. blephariglottis***	**S3**
White Meadowsweet	*Spiraea alba*	S5
White Spruce	*Picea glauca*	S5
White Turtlehead	*Chelone glabra*	S5
White-Edged Sedge	*Carex debilis*	S5
Whorled Wood Aster	*Oclemena acuminata*	S5
Wiegand's Sedge	***Carex wiegandii***	**S3**
Wild Calla	*Calla palustris*	S5
Wild Cucumber	*Echinocystis lobata*	S5
Wild Lily-of-the-valley	*Maianthemum canadense*	S5
Wild Sarsaparilla	*Aralia nudicaulis*	S5

September 30, 2015

Table A1 Vascular Plants Observed near the PDA

Common Name	Scientific Name	ACCDC S-Rank
Wild Strawberry	*Fragaria virginiana*	S5
Woodland Agrimony	*Agrimonia striata*	S5
Woodland Horsetail	*Equisetum sylvaticum*	S5
Woolly Blue Violet	*Viola sororia*	S5
Woolly Panic Grass	*Dichanthelium acuminatum*	S5
Yellow Birch	*Betula alleghaniensis*	S5
Yellow Bluebead Lily	*Clintonia borealis*	S5
Yellow Clover	*Trifolium aureum*	SNA
Yellow Iris	*Iris pseudacorus*	SNA
Yellow Ladies'-Tresses	***Spiranthes ochroleuca***	**S1**
Yellow Marsh Marigold	*Caltha palustris*	S4S5
Yellow Sedge	*Carex flava*	S5
Note: SOCC are indicated in bold text.		

APPENDIX D
BIRD SPECIES OBSERVED NEAR THE LAA

PEI-NB CABLE INTERCONNECTION UPGRADE PROJECT - VOLUME 3, NEW BRUNSWICK

September 30, 2015

September 30, 2015

Table D1 Bird Species Observed near the LAA (ACCDC, ACNOS, BBS, CBC, and MBBA records)

Common Name	Scientific Name	*SARA*	NB *SARA*	COSEWIC	ACCDC S-Rank	Data Source
Alder Flycatcher	*Empidonax alnorum*				S5B	ACCDC, BBS, MBBA
American Bittern	*Botaurus lentiginosus*				S4B	ACCDC, BBS, MBBA
American Black Duck	*Anas rubripes*				S5B,S4N	ACCDC, BBS, MBBA
American Coot	***Fulica americana***			**not at risk**	**S2B**	**ACCDC**
American Crow	*Corvus brachyrhynchos*				S5	ACCDC, BBS, CBC, MBBA
American Golden-plover	***Pluvialis dominica***				**S3M**	**ACCDC**
American Goldfinch	*Carduelis tristis*				S5	ACCDC, BBS, CBC, MBBA
American Kestrel	*Falco sparverius*				S4B	ACCDC, BBS, MBBA
American Redstart	*Setophaga ruticilla*				S5B	ACCDC, BBS, MBBA
American Robin	*Turdus migratorius*				S5B	ACCDC, BBS, MBBA
American Tree Sparrow	*Spizella arborea*				S5N	CBC
American Wigeon	***Anas americana***				**S3B**	**ACCDC, BBS, MBBA**
American Woodcock	*Scolopax minor*				S5B	ACCDC, ACNOS, BBS, MBBA
Baird's Sandpiper	*Calidris bairdii*				SNAM	ACCDC
Bald Eagle	***Haliaeetus leucocephalus***		**endangered**	**not at risk**	**S3B**	**ACCDC, CBC, MBBA**
Bank Swallow	***Riparia riparia***	**no schedule, no status**		**threatened**	**S3B**	**ACCDC, BBS, MBBA**
Barn Swallow	***Hirundo rustica***	**no schedule, no status**	**threatened**	**threatened**	**S3B**	**ACCDC, BBS, MBBA**
Barred Owl	*Strix varia*				S5	ACCDC, ACNOS, BBS, CBC, MBBA
Bay-Breasted Warbler	*Dendroica castanea*				S4B	ACCDC, BBS, MBBA

September 30, 2015

Table D1 Bird Species Observed near the LAA (ACCDC, ACNOS, BBS, CBC, and MBBA records)

Common Name	Scientific Name	*SARA*	NB *SARA*	COSEWIC	ACCDC S-Rank	Data Source
Belted Kingfisher	*Megaceryle alcyon*				S5B	ACCDC, BBS, MBBA
Black Tern	***Chlidonias niger***			**not at risk**	**S2B**	**ACCDC, BBS, MBBA**
Black-and-white Warbler	*Mniotilta varia*				S5B	ACCDC, BBS, MBBA
Black-backed Woodpecker	*Picoides arcticus*				S4	ACCDC, BBS, MBBA
Black-bellied Plover	*Pluvialis squatarola*				S4M	ACCDC
Black-billed Cuckoo	*Coccyzus erythropthalmus*				S4B	ACCDC, BBS, MBBA
Blackburnian Warbler	*Dendroica fusca*				S5B	ACCDC, BBS, MBBA
Black-capped Chickadee	*Poecile atricapilla*				S5	ACCDC, BBS, CBC, MBBA
Black-headed Gull	***Larus ridibundus***				**S2M,S1N**	**ACCDC**
Blackpoll Warbler	*Dendroica striata*				S4B	ACCDC, BBS, MBBA
Black-throated Blue Warbler	*Dendroica caerulescens*				S5B	ACCDC, BBS, MBBA
Black-throated Green Warbler	*Dendroica virens*				S5B	ACCDC, BBS, MBBA
Blue Jay	*Cyanocitta cristata*				S5	ACCDC, BBS, CBC, MBBA
Blue-Headed Vireo	*Vireo solitarius*				S5B	ACCDC, BBS, MBBA
Blue-Winged Teal	*Anas discors*				S4B	ACCDC, BBS, MBBA
Bobolink	***Dolichonyx oryzivorus***	**no schedule, no status**	**threatened**	**threatened**	**S3S4B**	**ACCDC, BBS, MBBA**
Bonaparte's Gull	*Larus philadelphia*				S5M	ACCDC
Boreal Chickadee	*Poecile hudsonica*				S4	ACCDC, BBS, CBC, MBBA
Boreal Owl	***Aegolius funereus***				**S1S2B**	**ACNOS**
Brant	***Branta bernicla***				**S2S3M,S2S3N**	**ACCDC**

Table D1 Bird Species Observed near the LAA (ACCDC, ACNOS, BBS, CBC, and MBBA records)

Common Name	Scientific Name	*SARA*	NB *SARA*	COSEWIC	ACCDC S-Rank	Data Source
Broad-winged Hawk	*Buteo platypterus*				S5B	ACCDC, MBBA
Brown Creeper	*Certhia americana*				S5B	ACCDC, CBC, MBBA
Brown-headed Cowbird	***Molothrus ater***				**S3B**	**ACCDC, BBS, MBBA**
Bufflehead	***Bucephala albeola***				**S3N**	**ACCDC**
Canada Goose	*Branta canadensis*				SNAB,S4M	ACCDC, BBS, CBC, MBBA
Canada Warbler	***Wilsonia canadensis***	**schedule 1, threatened**	**threatened**	**threatened**	**S3S4B**	**ACCDC, BBS, MBBA**
Cape May Warbler	*Dendroica tigrina*				S4B	ACCDC, BBS, MBBA
Cattle Egret	*Bubulcus ibis*				SNA	ACCDC
Cedar Waxwing	*Bombycilla cedrorum*				S5B	ACCDC, BBS, MBBA
Chestnut-sided Warbler	*Dendroica pensylvanica*				S5B	ACCDC, BBS, MBBA
Chimney Swift	***Chaetura pelagica***	**schedule 1, threatened**	**threatened**	**threatened**	**S2S3B**	**BBS**
Chipping Sparrow	*Spizella passerina*				S5B	ACCDC, BBS, MBBA
Cliff Swallow	*Petrochelidon pyrrhonota*				S3S4B	ACCDC, BBS, MBBA
Common Eider	*Somateria mollissima*				S4	ACCDC, CBC
Common Goldeneye	*Bucephala clangula*				S4B,S5M,S4N	ACCDC, CBC
Common Grackle	*Quiscalus quiscula*				S5B	ACCDC, BBS, CBC, MBBA
Common Loon	*Gavia immer*			not at risk	S4B,S5M,S4N	ACCDC, BBS, CBC, MBBA
Common Merganser	*Mergus merganser*				S5B,S4N	ACCDC, CBC
Common Nighthawk	***Chordeiles minor***		**threatened**		**S3B**	**ACCDC, BBS, MBBA**

September 30, 2015

Table D1 Bird Species Observed near the LAA (ACCDC, ACNOS, BBS, CBC, and MBBA records)

Common Name	Scientific Name	*SARA*	NB *SARA*	COSEWIC	ACCDC S-Rank	Data Source
Common Raven	*Corvus corax*				S5	ACCDC, BBS, CBC, MBBA
Common Redpoll	*Acanthis flammea*				S5N	CBC
Common Tern	***Sterna hirundo***			**not at risk**	**S3B**	**ACCDC, MBBA**
Common Yellowthroat	*Geothlypis trichas*				S5B	ACCDC, BBS, MBBA
Dark-Eyed Junco	*Junco hyemalis*				S5B	ACCDC, BBS, CBC, MBBA
Double-crested Cormorant	*Phalacrocorax auritus*			not at risk	S5B	ACCDC, BBS, CBC
Downy Woodpecker	*Picoides pubescens*				S5	ACCDC, BBS, CBC, MBBA
Dunlin	*Calidris alpina*				S4M	ACCDC
Eastern Bluebird	*Sialia sialis*			not at risk	S4B	ACCDC, MBBA
Eastern Kingbird	*Tyrannus tyrannus*				S3S4B	ACCDC, BBS, MBBA
Eastern Meadowlark	***Sturnella magna***	**no schedule, no status**	**threatened**	**threatened**	**S1S2B**	**BBS**
Eastern Phoebe	*Sayornis phoebe*				S5B	ACCDC, BBS, MBBA
Eastern Towhee	*Pipilo erhthrophthalmus*				SNA	CBC
Eastern Wood-Pewee	***Contopus virens***	**no schedule, no status**	**special concern**	**special concern**	**S4B**	**ACCDC, BBS, MBBA**
European Golden-plover	*Pluvialis apricaria*					ACCDC
European Starling	*Sturnus vulgaris*				SNA	ACCDC, BBS, CBC, MBBA
Evening Grosbeak	*Coccothraustes vespertinus*				S3S4B,S4S5N	ACCDC, BBS, MBBA
Fox Sparrow	*Passerella iliaca*				S4S5B	CBC
Gadwall	***Anas strepera***				**S2B**	**ACCDC, MBBA**
Glaucous Gull	*Larus hyperboreus*				S4N	ACCDC, CBC
Golden-crowned Kinglet	*Regulus satrapa*				S5	ACCDC, BBS, CBC, MBBA

September 30, 2015

Table D1 Bird Species Observed near the LAA (ACCDC, ACNOS, BBS, CBC, and MBBA records)

Common Name	Scientific Name	*SARA*	NB *SARA*	COSEWIC	ACCDC S-Rank	Data Source
Gray Catbird	*Dumetella carolinensis*				S4B	ACCDC, BBS, MBBA
Gray Jay	*Perisoreus canadensis*				S4B	ACCDC, BBS, CBC, MBBA
Great Black-backed Gull	*Larus marinus*				S5B,S5N	ACCDC, BBS, CBC, MBBA
Great Blue Heron	*Ardea herodias*				S4B	ACCDC, BBS, CBC, MBBA
Great Horned Owl	*Bubo virginianus*				S4S5	ACCDC, ACNOS, MBBA
Greater Scaup	***Aythya marila***				**S1B,S2N**	**ACCDC**
Greater Yellowlegs	*Tringa melanoleuca*				S5M	ACCDC
Green Heron	***Butorides virescens***				**S1S2B**	**ACCDC**
Green-Winged Teal	*Anas crecca*				S4S5B	ACCDC, BBS, MBBA
Hairy Woodpecker	*Picoides villosus*				S5	ACCDC, BBS, CBC, MBBA
Hermit Thrush	*Catharus guttatus*				S5B	ACCDC, BBS, MBBA
Herring Gull	*Larus argentatus*				S5B,S5N	ACCDC, BBS, MBBA
Hooded Merganser	*Lophodytes cucullatus*				S4B	ACCDC, BBS, MBBA
Horned Lark	***Eremophila alpestris***				**S2B**	**BBS**
House Sparrow	*Passer domesticus*				SNA	ACCDC, BBS, MBBA
House Wren	***Troglodytes aedon***				**S1B**	**ACCDC, MBBA**
Hudsonian Godwit	*Limosa haemastica*				S4M	ACCDC
Hudsonian Whimbrel	*Numenius hudsonicus*					ACCDC
Iceland Gull	*Larus glaucoides*				S4N	ACCDC, CBC
Killdeer	***Charadrius vociferus***				**S3B**	**ACCDC, BBS, MBBA**
Least Flycatcher	*Empidonax minimus*				S5B	ACCDC, BBS, MBBA
Least Sandpiper	*Calidris minutilla*				S4M	ACCDC
Lesser Yellowlegs	*Tringa flavipes*				S5M	ACCDC

September 30, 2015

Table D1 Bird Species Observed near the LAA (ACCDC, ACNOS, BBS, CBC, and MBBA records)

Common Name	Scientific Name	*SARA*	NB *SARA*	COSEWIC	ACCDC S-Rank	Data Source
Lincoln's Sparrow	*Melospiza lincolnii*				S4B	ACCDC, BBS, MBBA
Little Gull	*Larus minutus*				SNA	ACCDC
Long-billed Dowitcher	*Limnodromus scolopaceus*				SNA	ACCDC
Long-Eared Owl	***Asio otus***				**S2S3**	**ACCDC**
Long-Tailed Duck	*Clangula hyemalis*				S4N	ACCDC, CBC
Magnolia Warbler	*Dendroica magnolia*				S5B	ACCDC, BBS, MBBA
Mallard	*Anas platyrhynchos*				S5B,S4N	ACCDC, BBS, MBBA
Marsh Wren	***Cistothorus palustris***				**S2B**	**ACCDC**
Merlin	*Falco columbarius*			not at risk	S5B	ACCDC, BBS, MBBA
Mourning Dove	*Zenaida macroura*				S5B	ACCDC, BBS, CBC, MBBA
Mourning Warbler	*Oporornis philadelphia*				S4B	ACCDC, BBS, MBBA
Nashville Warbler	*Vermivora ruficapilla*				S5B	ACCDC, BBS, MBBA
Nelson's Sparrow	*Ammodramus nelsoni*			not at risk	S4B	ACCDC, BBS, MBBA
Northern Flicker	*Colaptes auratus*				S5B	ACCDC, BBS, CBC, MBBA
Northern Goshawk	*Accipiter gentilis*				S4	ACCDC, BBS, CBC, MBBA
Northern Harrier	*Circus cyaneus*			not at risk	S4B	ACCDC, BBS, CBC, MBBA
Northern Mockingbird	***Mimus polyglottos***				**S3B**	**ACCDC, BBS, MBBA**
Northern Parula	*Parula americana*				S5B	ACCDC, BBS, MBBA
Northern Pintail	***Anas acuta***				**S3B**	**ACCDC, MBBA**
Northern Saw-whet Owl	*Aegolius acadicus*				S4B,S4N	ACCDC, ACNOS, MBBA
Northern Shoveler	***Anas clypeata***				**S2B**	**ACCDC, BBS, MBBA**
Northern Shrike	*Lanius excubitor*				S4N	CBC
Northern Waterthrush	*Seiurus noveboracensis*				S4S5B	ACCDC, BBS, MBBA

September 30, 2015

Table D1 Bird Species Observed near the LAA (ACCDC, ACNOS, BBS, CBC, and MBBA records)

Common Name	Scientific Name	*SARA*	NB *SARA*	COSEWIC	ACCDC S-Rank	Data Source
Olive-Sided Flycatcher	***Contopus cooperi***	**schedule 1, threatened**	**threatened**	**threatened**	**S3S4B**	**ACCDC, BBS, MBBA**
Osprey	*Pandion haliaetus*				S4S5B	ACCDC, BBS, MBBA
Ovenbird	*Seiurus aurocapillus*				S5B	ACCDC, BBS, MBBA
Palm Warbler	*Dendroica palmarum*				S5B	ACCDC, BBS, MBBA
Pectoral Sandpiper	*Calidris melanotos*				S4M	ACCDC
Philadelphia Vireo	*Vireo philadelphicus*				S5B	MBBA
Pied-Billed Grebe	*Podilymbus podiceps*				S4B	ACCDC, BBS, MBBA
Pileated Woodpecker	*Dryocopus pileatus*				S5	ACCDC, BBS, CBC, MBBA
Pine Grosbeak	***Pinicola enucleator***				**S2S3B,S4S5N**	**ACCDC, BBS**
Pine Siskin	*Carduelis pinus*				S4	ACCDC, BBS, MBBA
Piping Plover (melodus subspecies)	***Charadrius melodus melodus***	**schedule 1, endangered**	**endangered**	**endangered**	**S2B**	**ACCDC**
Purple Finch	*Carpodacus purpureus*				S4S5B	ACCDC, BBS, MBBA
Purple Sandpiper	***Calidris maritima***				**S3M,S3N**	**ACCDC**
Red Crossbill	***Loxia curvirostra***				**S3**	**ACCDC, BBS**
Red Knot (Rufa Subspecies)	***Calidris canutus rufa***	**schedule 1, endangered**	**endangered**	**endangered**	**S3M**	**ACCDC**
Red-breasted Merganser	***Mergus serrator***				**S3B,S4S5N**	**ACCDC, MBBA**
Red-breasted Nuthatch	*Sitta canadensis*				S5	ACCDC, BBS, CBC, MBBA
Red-eyed Vireo	*Vireo olivaceus*				S5B	ACCDC, BBS, MBBA
Red-necked Phalarope	***Phalaropus lobatus***			**special concern**	**S3M**	**ACCDC**

Table D1 Bird Species Observed near the LAA (ACCDC, ACNOS, BBS, CBC, and MBBA records)

Common Name	Scientific Name	*SARA*	NB *SARA*	COSEWIC	ACCDC S-Rank	Data Source
Red-shouldered Hawk	***Buteo lineatus***	**schedule 3, special concern**		**not at risk**	**S2B**	**ACCDC**
Red-tailed Hawk	*Buteo jamaicensis*			not at risk	S4B	ACCDC, BBS, CBC, MBBA
Red-winged Blackbird	*Agelaius phoeniceus*				S4B	ACCDC, BBS, CBC, MBBA
Ring-billed Gull	***Larus delawarensis***				**S3B**	**ACCDC**
Ring-necked Duck	*Aythya collaris*				S5B	ACCDC, BBS, MBBA
Ring-necked Pheasant	*Phasianus colchicus*				SNA	ACCDC, BBS, CBC, MBBA
Rock pigeon	*Columba livia*				SNA	ACCDC, BBS, CBC, MBBA
Rose-breasted Grosbeak	*Pheucticus ludovicianus*				S4B	ACCDC, BBS, MBBA
Rough-legged Hawk	*Buteo lagopus*				S4N	ACCDC, CBC
Ruby-crowned Kinglet	*Regulus calendula*				S4S5B	ACCDC, BBS, MBBA
Ruby-throated Hummingbird	*Archilochus colubris*				S5B	ACCDC, BBS, MBBA
Ruddy Turnstone	*Arenaria interpres*				S4M	ACCDC
Ruff	*Philomachus pugnax*				SNA	ACCDC
Ruffed Grouse	*Bonasa umbellus*				S5	ACCDC, BBS, CBC, MBBA
Rusty Blackbird	***Euphagus carolinus***	**schedule 1, special concern**	**special concern**	**special concern**	**S3B**	**BBS, CBC**
Sanderling	*Calidris alba*				S4M,S1N	ACCDC
Savannah Sparrow	*Passerculus sandwichensis*				S5B	ACCDC, BBS, MBBA
Sedge Wren	***Cistothorus platensis***				**S1B**	**ACCDC**

Table D1 Bird Species Observed near the LAA (ACCDC, ACNOS, BBS, CBC, and MBBA records)

Common Name	Scientific Name	*SARA*	NB *SARA*	COSEWIC	ACCDC S-Rank	Data Source
Semipalmated Plover	*Charadrius semipalmatus*				SNRB,S5M	ACCDC
Semipalmated Sandpiper	*Calidris pusilla*				S4M	ACCDC
Sharp-shinned Hawk	*Accipiter striatus*			not at risk	S4B	ACCDC, BBS, CBC, MBBA
Short-billed Dowitcher	*Limnodromus griseus*				S4M	ACCDC
Short-Eared Owl	***Asio flammeus***	**schedule 1, special concern**	**special concern**	**special concern**	**S3B**	**CBC**
Snow Bunting	*Plectrophenax nivalis*				S5N	CBC
Snowy Egret	*Egretta thula*				SNA	ACCDC
Snowy Owl	*Bubo scandiacus*			not at risk	S4N	ACCDC
Song Sparrow	*Melospiza melodia*				S5B	ACCDC, BBS, CBC, MBBA
Sora	*Porzana carolina*				S4B	ACCDC, BBS, MBBA
Spotted Sandpiper	*Actitis macularius*				S4B	ACCDC, BBS, MBBA
Spruce Grouse	*Falcipennis canadensis*				S5	ACCDC
Stilt Sandpiper	*Calidris himantopus*				SNA	ACCDC
Swainson's Thrush	*Catharus ustulatus*				S5B	ACCDC, BBS, MBBA
Swamp Sparrow	*Melospiza georgiana*				S5B	ACCDC, BBS, MBBA
Tennessee Warbler	*Vermivora peregrina*				S4B	ACCDC, BBS, MBBA
Tree Swallow	*Tachycineta bicolor*				S4B	ACCDC, BBS, MBBA
Tricolored Heron	*Egretta tricolor*				SNA	ACCDC
Turkey Vulture	***Cathartes aura***				**S3B**	**ACCDC, MBBA**
Upland Sandpiper	***Bartramia longicauda***				**S1B**	**ACCDC, MBBA**
Veery	*Catharus fuscescens*				S4B	ACCDC, BBS, MBBA

Table D1 Bird Species Observed near the LAA (ACCDC, ACNOS, BBS, CBC, and MBBA records)

Common Name	Scientific Name	*SARA*	NB *SARA*	COSEWIC	ACCDC S-Rank	Data Source
Vesper Sparrow	***Pooecetes gramineus***				**S2B**	**BBS**
Virginia Rail	***Rallus limicola***				**S3B**	**ACCDC, BBS**
White-breasted Nuthatch	*Sitta carolinensis*				S5	ACCDC, MBBA
White-rumped Sandpiper	*Calidris fuscicollis*				S4M	ACCDC
White-throated Sparrow	*Zonotrichia albicollis*				S5B	ACCDC, BBS, MBBA
White-winged Crossbill	*Loxia leucoptera*				S4	ACCDC, BBS, CBC, MBBA
Willet	***Tringa semipalmata***				**S2S3B**	**ACCDC, MBBA**
Willow Flycatcher	***Empidonax traillii***				**S1S2B**	**ACCDC, MBBA**
Wilson's Phalarope	***Phalaropus tricolor***				**S1B**	**ACCDC**
Wilson's Snipe	*Gallinago delicata*				S4B	ACCDC, ACNOS, BBS, MBBA
Wilson's Warbler	*Wilsonia pusilla*				S4B	ACCDC, BBS, MBBA
Winter Wren	*Troglodytes troglodytes*				S5B	ACCDC, BBS, MBBA
Wood Duck	*Aix sponsa*				S4B	ACCDC, BBS, MBBA
Wood Thrush	***Hylocichla mustelina***	**no schedule, no status**	**threatened**	**threatened**	**S1S2B**	**BBS, MBBA**
Yellow Warbler	*Dendroica petechia*				S5B	ACCDC, BBS, MBBA
Yellow-bellied Flycatcher	*Empidonax flaviventris*				S4S5B	ACCDC, BBS, MBBA
Yellow-bellied Sapsucker	*Sphyrapicus varius*				S5B	ACCDC, BBS, MBBA
Yellow-rumped Warbler	*Dendroica coronata*				S5B	ACCDC, BBS, CBC, MBBA

Note: SAR and SOCC are indicated in bold text.

September 30, 2015

Table B2 Highest Breeding Evidence of Birds within MBBA Squares Crossed by the Project

Common Name	20LR89	20LR99	20MR09	20MS00	20MS10	20MS20	20MS30
Alder Flycatcher	probable	probable	probable	probable	possible	probable	possible
American Bittern		probable	possible	possible	possible	possible	possible
American Black Duck	probable	confirmed			confirmed	confirmed	confirmed
American Crow	probable	probable	confirmed	confirmed	confirmed	confirmed	possible
American Goldfinch	probable	probable	possible	probable	possible	possible	possible
American Kestrel	probable	probable	possible	confirmed	probable	confirmed	confirmed
American Redstart	probable	confirmed	confirmed	probable	confirmed	probable	confirmed
American Robin	confirmed	confirmed	confirmed	confirmed	confirmed	confirmed	confirmed
American Wigeon	confirmed	confirmed				confirmed	
American Woodcock	probable	confirmed	possible	possible	possible	probable	
Bald Eagle	possible			possible			probable
Bank Swallow	confirmed			probable	possible	confirmed	possible
Barn Swallow	confirmed	probable	confirmed	confirmed	probable	confirmed	probable
Barred Owl	possible	possible	probable	possible	probable		probable
Bay-Breasted Warbler	possible	possible	possible	possible	possible	possible	possible
Belted Kingfisher	probable	possible	possible	possible		confirmed	confirmed
Black Tern		probable					
Black-and-white Warbler	probable	probable	confirmed	possible	possible	probable	
Black-backed Woodpecker				possible			
Black-billed Cuckoo			possible	possible		possible	
Blackburnian Warbler	possible	possible	possible	possible	possible	probable	probable
Black-capped Chickadee	probable	probable	probable	probable	confirmed	possible	confirmed
Blackpoll Warbler						possible	
Black-throated Blue Warbler	possible		possible	possible	possible	possible	

Table B2 Highest Breeding Evidence of Birds within MBBA Squares Crossed by the Project

Common Name	20LR89	20LR99	20MR09	20MS00	20MS10	20MS20	20MS30
Black-throated Green Warbler	probable	possible	possible	probable	probable	probable	possible
Blue Jay	probable	possible	confirmed	probable	confirmed	probable	possible
Blue-headed Vireo	probable	probable	confirmed	probable	probable	possible	possible
Blue-winged Teal		confirmed			possible		probable
Bobolink	possible	confirmed	confirmed	probable	possible	probable	probable
Boreal Chickadee	possible			confirmed			possible
Broad-winged Hawk		possible			possible	possible	
Brown Creeper		possible	possible			possible	possible
Brown-headed Cowbird	possible						
Canada Goose	confirmed	confirmed	probable		possible		
Canada Warbler		possible	possible	possible	possible	possible	possible
Cape May Warbler	possible	possible	confirmed	possible	possible	possible	possible
Cedar Waxwing	probable	probable	confirmed	possible	confirmed	confirmed	confirmed
Chestnut-sided Warbler	probable	probable	probable	probable	confirmed	probable	confirmed
Chipping Sparrow	confirmed	probable	confirmed	possible	possible	possible	possible
Cliff Swallow	confirmed	confirmed	confirmed	confirmed	confirmed		confirmed
Common Grackle	confirmed	confirmed	probable	confirmed	possible	confirmed	confirmed
Common Loon	probable	probable	probable	confirmed	confirmed		
Common Nighthawk	possible	possible					
Common Raven	confirmed	possible	probable	confirmed	possible	confirmed	possible
Common Snipe	probable	probable	possible	probable	probable	probable	probable
Common Tern							confirmed
Common Yellowthroat	probable	confirmed	confirmed	probable	confirmed	probable	confirmed
Dark-eyed Junco	confirmed	probable	confirmed	probable	possible	possible	confirmed

Table B2 Highest Breeding Evidence of Birds within MBBA Squares Crossed by the Project

Common Name	20LR89	20LR99	20MR09	20MS00	20MS10	20MS20	20MS30
Downy Woodpecker	probable	probable	possible		probable	possible	possible
Eastern Bluebird	confirmed					confirmed	confirmed
Eastern Kingbird		possible		possible	possible	probable	
Eastern Phoebe		possible	possible				
Eastern Wood-pewee				possible	possible		possible
European Starling	confirmed	confirmed	confirmed	confirmed	confirmed	confirmed	confirmed
Evening Grosbeak	probable						possible
Gadwall				confirmed			
Golden-crowned Kinglet	probable	possible	possible	possible	probable	probable	possible
Gray Catbird		possible	possible	possible	possible	probable	probable
Gray Jay	probable	possible	confirmed	possible	probable		probable
Great Blue Heron			possible				possible
Great Horned Owl				possible			confirmed
Green-Winged Teal	confirmed	confirmed		probable		confirmed	probable
Hairy Woodpecker	confirmed	possible	possible	possible	possible	probable	possible
Hermit Thrush	probable	probable	confirmed	confirmed	possible	possible	confirmed
Hooded Merganser				confirmed		confirmed	
House Sparrow		possible		confirmed			
House Wren	probable						
Killdeer	probable	confirmed	confirmed	confirmed		possible	possible
Least Flycatcher	possible	possible	possible	probable	possible	probable	possible
Lincoln's Sparrow		possible					
Magnolia Warbler	confirmed	probable	confirmed	probable	possible	probable	confirmed
Mallard	probable	confirmed	possible			confirmed	

Table B2 Highest Breeding Evidence of Birds within MBBA Squares Crossed by the Project

Common Name	20LR89	20LR99	20MR09	20MS00	20MS10	20MS20	20MS30
Mallard X Am. Black Duck		confirmed					
Merlin	probable						confirmed
Mourning Dove	probable	probable	possible	confirmed	possible	probable	confirmed
Mourning Warbler	possible			possible		possible	probable
Nashville Warbler	confirmed	confirmed	possible	probable	confirmed	probable	probable
Nelson's Sparrow	possible				confirmed	possible	possible
Northern Flicker	probable	confirmed	confirmed	possible	confirmed	probable	confirmed
Northern Goshawk	probable	possible	possible				
Northern Harrier	possible	probable		possible	probable	confirmed	possible
Northern Mockingbird	possible					possible	confirmed
Northern Parula	probable	probable	confirmed	probable	probable	confirmed	probable
Northern Pintail	probable						
Northern Saw-Whet Owl		possible	possible	possible	possible		
Northern Shoveler	probable						
Northern Waterthrush		possible		possible			
Olive-sided Flycatcher	possible	possible	probable	possible	possible		
Osprey	confirmed	possible	possible	possible	probable	probable	confirmed
Ovenbird	probable	probable	possible	probable	probable	probable	probable
Palm Warbler		probable	possible	probable	possible	possible	
Pied-billed Grebe	confirmed	probable	probable				
Pileated Woodpecker	probable	possible	possible	possible	possible	probable	probable
Pine Siskin	probable	possible		possible	possible		possible
Purple Finch	probable	probable	confirmed	possible	possible	probable	possible
Red-breasted Merganser						probable	

September 30, 2015

Table B2 Highest Breeding Evidence of Birds within MBBA Squares Crossed by the Project

Common Name	20LR89	20LR99	20MR09	20MS00	20MS10	20MS20	20MS30
Red-breasted Nuthatch	confirmed	possible	possible	possible	possible	probable	possible
Red-eyed Vireo	probable	probable	confirmed	probable	possible	probable	possible
Red-tailed Hawk	probable	possible		possible		possible	
Red-winged Blackbird	confirmed	confirmed	possible	probable	possible	probable	probable
Ring-necked Duck	confirmed	confirmed		possible	probable		probable
Ring-necked Pheasant	probable	confirmed	probable	possible	possible	confirmed	possible
Rock Pigeon	confirmed	probable	probable	confirmed	probable	probable	possible
Rose-breasted Grosbeak		possible			possible	possible	probable
Ruby-crowned Kinglet	possible	possible	probable	probable	probable	probable	probable
Ruby-throated Hummingbird	probable	probable	confirmed	probable		probable	confirmed
Ruffed Grouse	possible	probable	possible	confirmed	probable		confirmed
Savannah Sparrow	possible	confirmed	possible	possible	possible	probable	possible
Sharp-shinned Hawk		possible					
Song Sparrow	confirmed	confirmed	confirmed	probable	probable	confirmed	confirmed
Sora	possible	probable					
Spotted Sandpiper	probable	probable			possible	possible	
Swainson's Thrush	probable	possible	possible	probable	possible	possible	probable
Swamp Sparrow	probable	confirmed	probable	probable	probable	confirmed	confirmed
Tennessee Warbler	possible			possible	possible	probable	possible
Tree Swallow	confirmed	confirmed	probable	confirmed	possible	confirmed	confirmed
Turkey Vulture	possible						
Upland Sandpiper						probable	
Veery	probable			possible	possible	possible	possible
White-breasted Nuthatch		possible					

September 30, 2015

Table B2 Highest Breeding Evidence of Birds within MBBA Squares Crossed by the Project

Common Name	20LR89	20LR99	20MR09	20MS00	20MS10	20MS20	20MS30
White-throated Sparrow	confirmed	probable	confirmed	probable	confirmed	confirmed	confirmed
White-winged Crossbill		probable		possible			possible
Willet					possible	possible	possible
Willow Flycatcher		possible					
Wilson's Warbler		possible	possible		possible	possible	
Winter Wren	possible	possible	possible	possible	possible	possible	
Wood Duck		probable			possible	confirmed	possible
Yellow Warbler	confirmed	confirmed	confirmed	possible	probable	probable	possible
Yellow-bellied Flycatcher		possible	possible	possible			
Yellow-bellied Sapsucker	possible	probable		probable	possible	possible	
Yellow-rumped Warbler	confirmed	probable	confirmed	confirmed	possible	confirmed	possible

PEI-New Brunswick Cable Interconnection Upgrade Project - VOLUME 4, The Northumberland Strait

Project No. 121811475

Prepared for:
Maritime Electric Company, Limited

Prepared by:
Stantec Consulting Ltd.
165 Maple Hills Avenue
Charlottetown PE C1C 1N9

September 30, 2015

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abbreviations

%	Percent
°C	Degree Centigrade
µT	MicroTesla (0.000001 Tesla)
µV	Microvolt (0.000001 Volt)
AC	Alternating Current
ADCP	Acoustic Doppler Current Profiler
AFS	Aboriginal Fishery Strategy
CCME	Canadian Council of Ministers of the Environment
CEAA	*Canadian Environmental Assessment Act, 2012*
CEPA	*Canadian Environmental Protection Act, 1999*
CFIA	Canadian Food Inspection Agency
cm	Centimetres
COSEWIC	Committee on the Status of Endangered Wildlife Species in Canada
CRA	Commercial, Recreational And Aboriginal
CSR	Canadian Seabed Research
CSSP	Canadian Shellfish Sanitation Program
DDT	Dichlorodiphenyltrichloroethane
DFO	Fisheries and Oceans Canada
DND	Department of National Defence
DO	Dissolved Oxygen
EBSA	Ecologically and Biologically Sensitive Area
EC	Environment Canada
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMF	Electromagnetic Field
EPP	Environmental Protection Plan
FSC	Food, Social, and Ceremonial Fisheries
GEV	Generalized Extreme Value
GFA	Ground Fishing Area
GNB	Government of New Brunswick
ha	Hectare
HFA	Herring Fishing Area

HPPA	*Heritage Places Protection Act, 1988*
HVAC	High Voltage Alternating Current
IBA	Important Bird Area
INFC	Infrastructure Canada
IPCC	Intergovernmental Panel on Climate Change
ISQG	Interim Sediment Quality Guidelines
kg	Kilogram
km	Kilometre
km/h	Kilometer per Hour
km^2	Square Kilometer
KP	Kilometre Post
kV	Kilovolt
LAA	Local Assessment Area
LFA	Lobster/Crab Fishing Area
m	Metre
m/s	Metres per Second
m^2	Square Metre
MBCA	*Migratory Birds Convention Act, 1994*
MCPEI	Mi'kmaq Confederacy of Prince Edward Island
MFA	Mackerel Fishing Area
mg	Milligram
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre
mm	Millimetre
MW	Megawatt
NAFO	Northwest Atlantic Fisheries Organization
NB	New Brunswick
NB *SARA*	*New Brunswick Species at Risk Act, 2012*
NBDELG	New Brunswick Department of Environment and Local Government
NBDNR	New Brunswick Department of Natural Resources
NPA	*Navigation Protection Act, 1985*
NWPP	Navigable Waters Protection Program
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PDA	Project Development Area

PEI	Prince Edward Island
PEI *EPA*	*PEI Environmental Protection Act, 1988*
PEIDCLE	PEI Department of Communities, Land and Environment
psu	Practical salinity Unit
PSW	Provincially Significant Wetlands
PWGSC	Public Works and Government Services Canada
RAA	Regional Assessment Area
RDL	Reportable Detection Limit
ROW	Right-of-Way
SAR	Species at Risk
SARA	*Species at Risk Act, 2002*
SFA	Scallop Fishing Area
SOCC	Species of Conservation Concern
SSS	Sidescan Sonar
SST	Sea Surface Temperature
t	Tonne
TAC	Total Allowable Catch
TOC	Total Organic Carbon
TRC	Technical Review Committee
TSS	Total Suspended Solids
USBOEMRE	United States Bureau of Ocean Energy Management, Regulation, and Enforcement
UXO	Unexploded Explosive Ordnance
VC	Valued Component
WAWA	Watercourse and Wetland Alteration

1.0 INTRODUCTION

Prince Edward Island Energy Corporation (PEIEC), with Maritime Electric Company, Limited (MECL) serving as construction agent, proposes to upgrade the electrical power interconnection between Prince Edward Island (PEI) and New Brunswick (NB).

The PEI-NB Cable Interconnection Upgrade Project (the "Project") includes construction and operation of a high voltage alternating current transmission system. The main Project components are:

- two 180 megawatt, 138 kilovolt submarine cables
- two landfall sites (where the submarine cable trenches are brought ashore)
- two termination sites (for converting submarine cables to overhead transmission lines or substation)
- three-phase, 138 KV transmission lines within NB
- expansion of the existing MECL substation in Borden-Carleton, PEI and upgrading of the New Brunswick Power Corporation (NB Power) substation in Memramcook, NB

The Project will span three geographic regions as shown in Volume 1, Figure 1.1 including:

- PEI – a landfall site will be constructed adjacent to the MECL substation in Borden-Carleton, and a termination site will be located within the substation
- The Northumberland Strait – two high voltage alternating current submarine cables will span approximately 16.5 km from Cape Tormentine to Borden-Carleton
- NB – a landfall site and termination site will be constructed in Cape Tormentine, and approximately 57 km of overhead transmission lines within new and existing easements will be built from Cape Tormentine to the existing NB Power substation in Memramcook

To reflect the three geographic regions, the environmental impact statement (EIS) for the Project is divided into four volumes:

- Volume 1 includes a detailed description of the overall Project, regulatory framework, consultation activities, and an overview of EIA methodology
- Volume 2 includes an assessment of potential environmental effects associated with land-based Project components and activities located in PEI.
- Volume 3 includes an assessment of potential environmental effects associated with land-based Project components and activities located in NB.
- Volume 4 (this volume) includes an assessment of potential environmental effects associated with marine-based Project components and activities located in the Northumberland Strait.

The following sub-sections provide an overview of Project components and activities located within the Northumberland Strait. A detailed description of the components and activities related to the Project is provided in Volume 1, Chapter 2.

1.1 DESCRIPTION OF PROJECT COMPONENTS IN THE NORTHUMBERLAND STRAIT

For the Northumberland Strait, the Project will require the installation of two submarine cables between the landfall sites of Cape Tormentine, NB and Borden-Carleton, PEI, a distance of 16.5 km (Figure 1.1).

1.1.1 Submarine Cables

Two submarine cables transmitting 360 MW combined at 138 kV each will be installed under the seabed of the Northumberland Strait. Each cable will be solid dielectric, three-core cable with galvanized steel armour and a medium- or high-density polyethylene (MHPE or HDPE) jacket. Transmission of electricity is through three copper conductors sheathed in lead within the cable interior. Oil is not used as an insulator in the chosen cable design. The cable is insulated with cross-linked polyethylene (XLPE) which is made from high density polyethylene and contains cross-linked bonds in the polymer structure creating a highly durable material.

1.1.2 Installation

The two cables will be installed in separate trenches, up to 200 m apart. The trenches will be excavated up to 1 m below grade where water depth exceeds 12 m and 2 m below grade in shallower or near-shore areas. The cable location in the near shore environment will be pre-trenched several months prior to cable installation and the trenches will be cleared of any in-filled sediment prior to laying of the cable. The method of excavation within nearshore environment will involve trenching with specialized marine excavators and cranes from a barge in water depths up to 12 m and a trenching remotely operated vehicle (TROV) with a saw cutter for the remaining marine sections. The trenches will range in width from less than 1 m to 5 m. The area of disturbance from the TROV is expected to be limited to a 10 m wide corridor, centred on the each cable.

Laying of the cables will be done using a cable-laying vessel. The cables will be placed on the marine bed on top of the planned trench location. Once both cables are placed on the marine bed, the TROV will be moved into the correct position and trenching and laying of the cable in the trench in water great then 12 m deep will be completed simultaneously. To ensure the cable is laid in the correct location within the corridor a dynamic positioning (DP) system will be used during the laying of cable. In the near-shore environment, cables will be laid directly into the pre-excavated trenches.

The land-based cable trench will be infilled with the originally excavated material immediately after cable installation. Trench infilling will extend from land into the near-shore environment to a water depth of up to 2 m, where possible. In waters deeper than 2 m, the trench will be left to infill naturally over time.

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_4_marine\3_1_marine_env\121811475-0046.mxd

Sources: Base data and project data from GeoNB, CHS, SNB and NB Power.
Imagery - Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

Project Components in the Northumberland Strait

Stantec

121811475 - PEI - NB Marine Cable Interconnection - Maritime Electric Company Limited

Figure 1.1

1.1.3 Landfall

Once at the landfall sites, the separate cable trenches will converge and the cables will be buried together in one single trench in NB and separated into two trenches in PEI. Cables will be separated by a minimum distance of 5 m when buried in a single trench. An excavator is generally required to excavate for the near-shore and land-based trenches.

1.1.4 Project Footprint

The Project footprint within the Northumberland Strait is 33 ha.

1.2 PROJECT PHASES AND SCHEDULE

The Project includes three phases: construction, operation, and decommissioning and abandonment.

Construction within the Northumberland Strait is scheduled to be conducted from May through early July 2016 with the pre-trenching of the inshore areas. Intertidal and land trenching, cable installation and connecting the cables to both the New Brunswick and PEI landfall sites will take place in October/November 2016. Energizing of the marine cables is scheduled for December 2016.

Operation will begin in December 2016. The predicted useful service life of the Project is estimated to be 40 years.

Land-based infrastructure will be decommissioned at the end of its useful service life, in accordance with the applicable standards and regulations at that time. It is believed that the cable will be detached from the PEI substation and buried on site, while for the New Brunswick side, the cable will be cut and removed to the high water mark. Within the Northumberland Strait the cable will remain in place.

Key Project timelines are provided in Volume 1, Section 2.5.

2.0 ENVIRONMENTAL SETTING AND POTENTIAL INTERACTIONS

2.1 ENVIRONMENTAL SETTING

The Northumberland Strait is a tidal water body separating PEI and the coasts of eastern New Brunswick and northern Nova Scotia. The Strait extends 225 km and varies in width between 13 and 43 km (Historica Canada 2015). The climate in the region is a moderate, cool and moist maritime climate. The Strait is known for having some of the warmest ocean waters in eastern Canada, reaching up to 20 °C during summer months. This is mainly due to the shallow depths. Additional information on climate is provided in Sections 3.1 and Chapter 4.

Bathymetry in the Strait has an average depth of 22 m, ranging from 6 to almost 70 m. The Project is located in the central part of the Strait. In the area between Cape Tormentine, NB and Borden, PEI the depths average 28 m (AMEC 2007). The complexity of geomorphology in the Strait is primarily due to sand transport, erosion by ice, and bottom fishing activity such as scallop dragging, which results in a dynamic benthic environment. Most of the substrate between Cape Tormentine and Borden is part of the Bouctouche sand and gravel deposit, and is overlain with a layer of sand (AMEC 2007). Detailed information on the physical marine environment is provided in Section 3.1.2.

The Northumberland Strait is home to a wide range of marine flora and fauna including macrophytes, benthic infauna, plankton, fish and shellfish, marine mammals, marine and shore birds, and migrating sea turtles. Many of these species are of economic importance to the local residents through industries such as commercial fisheries and aquaculture. Commercial shellfish species such as lobster (*Homarus americanus*), rock crab (*Cancer irroratus*), eastern oyster (*Crassostrea virginica*) and deep-sea scallop (*Placopecten magellanicus*) have contributed substantially to the local economy. Commercial finfish in the Strait include Atlantic cod (*Gadus morhua*), white hake (*Urophycis tenuis*), American plaice (*Hippoglossoides platessoides*), Atlantic halibut (*Hippoglossus hippoglossus*), winter flounder (*Pseudopleuronectes americanus*), witch flounder (*Glyptocephalus cynoglossus*) and yellowtail flounder (*Pleuronectes ferruginea*), Atlantic herring (*Clupea harengus*), bluefin tuna (*Thunnus thynnus*) and Atlantic mackerel (*Scomber scombrus*). Although most of these species are harvested commercially, the main commercial fisheries in the Strait include lobster, crab, herring and scallop (AMEC 2007; JWEL 2001). Additional information on biota in the Strait is available in Section 3.1.2, and additional information on Commercial, Recreational and Aboriginal Fisheries is available in Sections 3.2 and Section 3.4.

The Project is adjacent to sensitive marine areas on both the New Brunswick and PEI sides of the Strait. The Cape Jourimain National Wildlife Area, which was designated in 1980 due to the variety of waterfowl and shorebirds that inhabit the area, is located approximate 1.8 km west of the cables in New Brunswick. In PEI, there is an Important Bird Area (IBA) in Bedeque Bay adjacent to the Project. This was designated for mudflat habitat for migratory shorebirds. Additional information on sensitive marine areas is available in Section 3.1.2.

The Northumberland Strait is a minor shipping route. There are three commercial shipping ports (PEI: Summerside and Charlottetown; Nova Scotia: Pictou). The majority of marine shipping traffic passes along the Gulf of St. Lawrence to the north of PEI. The Confederation Bridge is adjacent to the Project and acts as the main route from New Brunswick to PEI. Ferry service occurs between Wood Islands, PEI and Caribou, Nova Scotia, at the eastern end of the Northumberland Strait, more than 50 km away from the Project between May and December. Oil and gas exploration has occurred along the Strait in all three Maritime Provinces. The majority of these exploration licenses and permits are for onshore development, with only a small area of the boundaries extending into surrounding marine coastal waters (AMEC 2007; JWEL 2001).

The Strait supports a tourism industry, mainly during summer months. This includes beach facilities, campgrounds, parks and cottage developments.

2.2 POTENTIAL INTERACTIONS

Potential valued components (VCs) were reviewed to determine if there was potential for interaction with Project components located in the Northumberland Strait (Table 2.1). This volume considers Project interactions in the marine environment; therefore terrestrial-based components of the environment are considered separately in Volumes 2 (PEI) and 3 (NB).

Table 2.1 Interactions Between Potential Valued Components and Project Components Located in the Northumberland Strait

Valued Component	Interaction with Project Components Located in the Northumberland Strait?
Atmospheric Environment	No
Groundwater Resources	N/A
Freshwater Environment	N/A
Terrestrial Environment	N/A
Marine Environment	Yes
Land Use	N/A
Commercial, Recreational and Aboriginal Fisheries	Yes
Socioeconomic Environment	N/A
Heritage Resources	Yes
Other Marine Users	No
Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons	Yes
Note: N/A = Not Applicable to Volume 4 (Northumberland Strait)	

Marine Environment, CRA Fisheries, Historic Resources, and Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons are carried through this environmental assessment as VCs (Chapter 3). Socioeconomic Environment is addressed within the PEI and NB volumes.

The following sub-sections provide rationale for not including Atmospheric Environment and Other Marine Users as VCs.

2.2.1 Atmospheric Environment

The Atmospheric Environment can be characterized by three components; air quality, climate and sound quality. The Atmospheric Environment is typically described as:

- Air quality, is characterized by the measure of the constituents of ambient air, and includes the presence and the quantity of air contaminants in the atmosphere.
- Climate is characterized by the composite or generally prevailing meteorological conditions of a region, including temperature, air pressure, humidity, precipitation, sunshine, cloudiness and winds, throughout the seasons, averaged over a number of years (typically a 30 year period of record). In relation to climate change, understood to be influenced by releases of greenhouse gases (GHGs) from human activities as well as natural sources, Project-based releases of GHGs are typically used as an indicator of potential environmental effects on climate. The assessment of potential environmental effects of climate on the Project is addressed in Chapter 4 (Effects of the Environment on the Project).
- Sound quality is characterized by the type, character, frequency, intensity, and duration of noise (unwanted sound) in the outdoor environment. The audible frequencies for humans are in the range of 20 to 20,000 Hertz (Hz). Vibration, identified as oscillations in matter that may lead to unwanted sound or stress in materials, is typically considered as part of sound quality.

For the purpose of Project, components assessed in this volume (Northumberland Strait), combustion gases are considered in relation to air quality, and GHGs released during combustion processes are considered in relation to climate change, as those are the primary air contaminants associated with this type of project. Noise is reviewed on the basis of sound pressure and consideration of vibration.

2.2.1.1 Existing Conditions

The information on existing conditions in relation to air quality, GHGs and sound quality is a high level presentation because the interaction between the marine part of the Project and these attributes of the environment (air quality, GHGs and sound quality) is expected to be limited.

The existing air quality in the vicinity of the Project in the Northumberland Straight is expected to be good most of the time; however, no monitoring data exist to support that. Monitoring of ambient air quality is focused on areas of higher population. Therefore, air quality in the marine environment has not been studied in great detail.

Climate in the Northumberland Straight is a moderate, cool and moist maritime climate. Weather forecasts are available via Environment Canada (Environment Canada 2015); however, no published climate normals are publically available for the Northumberland Strait. Climate normals and GHG emissions for PEI are provided in Volume 2, and those for New Brunswick are provided in Volume 3. Wind and wave height for the Northumberland Strait are addressed below in Section 3.1.2.

Sound quality is typically influenced by natural sounds such as wildlife, noise from waves and marine vessel travel in the area. No baseline data were collected as limited contribution from the Project to sound quality is expected and no sensitive receptors exist in the PDA.

2.2.1.2 Potential Interactions with Project Components

2.2.1.2.1 Construction

Project-related releases of air contaminants will include small amounts of combustion gases from the operation of marine construction equipment required to install the two submarine cables. This installation will require the use of vessels and barges to support cable installation activities across the Northumberland Strait and excavation of trenches near the landfall sites.

Releases of GHGs will occur in small quantities from fuel combustion in heavy marine equipment Project activities.

Combustion gases from the Project are not likely to cause any notable or substantive changes in air quality with the use of well-maintained equipment. The construction phase in the Strait is short in duration and the contractor will be required to follow a preventative maintenance schedule for equipment. As a result, Project-related releases of air contaminants to the atmosphere are not likely to cause the ambient air quality standards to be exceeded.

The quantities of GHGs released to the atmosphere during construction are expected to be very small in comparison to provincial and national totals. These can be mitigated through the use of well-maintained equipment and implementation of an idling awareness program to reduce unnecessary idling.

During construction, sound emissions and vibration may result from the operation of heavy equipment. However, no sensitive receptors exist for the marine component.

2.2.1.2.2 Operation, and Decommissioning and Abandonment

No substantive emissions of air contaminants, GHGs, or noise will occur during Project operation. Emissions during eventual decommissioning and abandonment are expected to be similar or less than those that would occur during construction.

2.2.1.3 Summary

Based on the lack of interactions noted above, and the planned implementation of known and proven mitigation, no substantive interactions between the Project and the Atmospheric Environment are anticipated. Atmospheric Environment is therefore not considered as a VC in the Northumberland Strait for the purpose of environmental assessment.

2.2.2 Other Marine Users

The Northumberland Strait is used by a variety of maritime industries. Potential interactions between marine users and Project components in the Strait are considered in two phases: first, during construction when the submarine cables are being installed in subsurface trenches; and second, during cable operation and maintenance. Potential effects of Project components on commercial and traditional fisheries are discussed in Section 3.2 and 3.4.

2.2.2.1 Existing Conditions

2.2.2.1.1 Federal Law Enforcement and Safety Agencies

Fisheries and Oceans Canada (DFO), including the Canadian Coast Guard and Fisheries Officers, and Transport Canada conduct patrols, provide marine rescue services, and service navigational aids in the Northumberland Strait.

Marine Traffic

The Northumberland Strait is a minor shipping route as there are few commercial shipping ports (PEI: Summerside and Charlottetown; Nova Scotia: Pictou) and the majority of marine shipping traffic passes along the Gulf of St. Lawrence to the north of PEI. During construction, notifications to the appropriate marine agencies (described below) will alert commercial vessel traffic to marine construction activities occurring in the area and transit through the Northumberland Strait will remain accessible. In the long-term, a similar notification procedure will be employed when maintenance is being conducted, and once in place, the position of the submarine cables will be identified on updated mariner charts for the region. Otherwise the submarine cables are unlikely to have any interaction with commercial vessel traffic.

Ferry crossing services between Wood Islands, PEI and Caribou, Nova Scotia are in the eastern end of the Northumberland Strait, more than 50 km away from the submarine cable route. Therefore, it is unlikely there will be any interaction between the ferry services and the Project, both during construction, and operation and maintenance.

Oil and Gas

There are marine oil and gas lease sites along New Brunswick side of the Northumberland Strait, and exploratory drilling has been conducted. No active oil and gas activity is scheduled during the installation of the cables. Once in place, the position of the submarine cables will be identified on updated mariner charts for the region. This will allow future marine oil and gas activities to avoid interaction with the operation of the Project.

Tourism and Recreational Activities

There are several commercial outfitters providing recreational opportunities including, recreational boating, fishing tours, kayaking, and paddleboard rental, as well as recreational diving. During construction, notifications to the appropriate marine agencies (described below) will alert vessel traffic to marine construction activities occurring in the area. Once in place, the position of the submarine cables will be identified on updated mariner charts for the region. During operation, recreational activities and service providers are unlikely to interact with buried cable.

For a review of potential interactions between marine wildlife please refer to the Marine Environment chapter (Section 3.1).

Military Activities

The Canadian military periodically conduct search and rescue exercises in the Northumberland Strait. During construction there is unlikely to be interaction between the Project and military activities as communication of Project activities will alert local safety operators to the location of cable installation and passage through the Northumberland Strait will not be blocked. Once in place, the position of the submarine cables will be identified on updated mariner charts for the region. During operation and maintenance, it is unlikely that military activities will interact with the buried cables.

Research

There are ongoing research programs examining aspects of the fisheries, oceanography, and marine habitats of the Northumberland Strait, such as the Northumberland Strait Environmental Monitoring Partnership (NorST-EMP). It is unlikely there will be interaction between the Project and ongoing research programs as construction will not block access along the Strait, and once installed, there will be no fishing exclusion areas around the cable impeding access.

Existing Ocean Infrastructure

There are two existing submarine electrical transmission cables in the Strait between Murray Corner, New Brunswick and Fernwood, PEI operated by MECL that were installed in 1977. Bell Aliant has two fibre optic telecommunications cables from Caribou, Nova Scotia to Wood Islands, PEI. There is an additional fibre optic cable owned by Eastlink connecting Port Hood, Nova Scotia with Gaspereau, PEI. The nearest subsea ocean infrastructure to the Project is the Confederation Bridge which is 500 m from the Project route at the closest point. At these distances, the Project will not interact with the bridge subsea infrastructure either during construction or operation and maintenance.

2.2.2.2 Potential Interactions with Project Components

2.2.2.2.1 Construction

Project construction will not obstruct passage through the Northumberland Strait and the activities of other marine users will not be impeded. During construction, exclusion zones around Project vessels may be implemented for navigation of vessel traffic. The Canadian Coast Guard will be informed of marine associated work and a Notice to Mariners issued to alert vessel traffic of construction activities. Once construction is complete, no fishing exclusion zones or fishing gear restrictions will be enforced within or around the Project footprint.

2.2.2.2.2 Operation, and Decommissioning and Abandonment

Once submarine cables are installed, there is unlikely to be any interaction with the Project and federal law enforcement and rescue services.

Mitigation measures similar to those used for construction will be implemented during operation and maintenance activities. Once in place, the position of the submarine cables will be identified on updated mariner charts for the region. Users will have continued access to the marine area in the vicinity of the Project with minimal disruption. This is reflective of what is currently in place for the existing submarine cables between New Brunswick and PEI.

2.2.2.3 Summary

Subsea cables have been in operation in the Northumberland Strait since the late 1970s. These cables have not impeded use of the Strait by other ocean users. Due to the short-term construction period and the installation design (i.e., cable burial) and marking of the cables on maritime charts, there will be no substantive interactions between the Project and other ocean users. Therefore Other Marine Users is not considered as a VC in the Northumberland Strait for the purpose of environmental assessment.

3.0 ENVIRONMENTAL EFFECTS ASSESSMENT

3.1 ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS ON THE MARINE ENVIRONMENT

The Marine Environment has been selected as a valued component (VC) based on Project interactions with marine fish and fish habitat and marine wildlife and wildlife habitat. This VC includes marine fish, marine mammals, sea turtles and marine birds. Special consideration is given to marine species at risk (SAR) and Commercial, Recreational and Aboriginal (CRA) fishery species.

The Project has the potential to affect marine populations (foreshore and subtidal) in the Northumberland Strait between PEI and New Brunswick. During construction, installation of the submarine cables has the potential to affect marine populations, including impacts to water quality and disruption of the benthic habitat. During operation, there are potential effects resulting from the electromagnetic fields (EMF) emitted by the two subsea cables.

Marine fish and fish habitat is included in this VC because of regulatory protection of fish and fish habitat and the intrinsic relationship of fish and fish habitat to the local CRA fisheries and local communities. Discussion of marine fish and fish habitat focuses on resident and migratory marine fish and their habitat likely found within the waters surrounding the planned installation of submarines cables in the Northumberland Strait between PEI and New Brunswick.

Marine wildlife and wildlife habitat has been included because of regulatory protection and ecological, economic and recreational importance. Changes in marine wildlife abundance or diversity might adversely alter ecosystem function as well as affect the ability of humans to use and enjoy natural resources.

This VC is closely related to other marine VCs in this volume because of potential changes to marine populations: Section 3.2 - Commercial, Recreational and Aboriginal Fisheries; and Section 3.3 - Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons.

3.1.1 Scope of Assessment

This section defines and describes the scope of the assessment of potential effects on the Marine Environment.

3.1.1.1 Regulatory and Policy Setting

Effects on the Marine Environment associated with the Project are subject to federal and provincial regulatory requirements.

3.1.1.1.1 Federal

Canadian Environmental Assessment Act

The federal requirements for conducting an environmental assessment are described in the *Canadian Environmental Assessment Act, 2012* (*CEAA 2012*) and the Regulations Designating Physical Activities (SOR/2012-147). The Act and associated regulations identify the physical activities that are "designated projects" subject to *CEAA 2012*, and may require environmental assessment by the Canadian Environmental Assessment Agency (the CEA Agency), the Canadian Nuclear Safety Commission (CNSC) or by the National Energy Board (NEB).

A new transmission line may be considered a designated project and be subject to requirements as described in *CEAA 2012* depending on the length of the transmission line and the magnitude of the voltage. The NEB facilitates the EIA process for international or interprovincial transmission line projects that are deemed designated projects. As the new electrical transmission line is to be less than the requirements to be listed as a designated project under the regulations, it is not subject to facilitation by the NEB and an official Project Description for the Project will not be required to be filed with the CEA Agency or other Responsible Authority under *CEAA 2012*.

Section 67 of *CEAA 2012* sets the framework for the environmental assessment of projects being carried out on federal land that are not considered designated projects and for which a full EIA under the Regulations Designating Physical Activities is not required. As the seabed of the Northumberland Strait is federal crown land it is subject to requirements under section 67 of CEAA. Section 67 states "*an authority must not carry out a project on federal lands, or exercise any power or perform any duty or function conferred on it under any Act of Parliament other than this Act that could permit a project to be carried out, in whole or in part, on federal lands, unless:*

> *(a) The authority determines that the carrying out of the project is not likely to cause significant adverse environmental effects; or*
>
> *(b) The authority determines that the carrying out of the project is likely to cause significant adverse environmental effects and the Governor in Council decides that those effects are justified in the circumstances under subsection 69(3)*."

Therefore, this project is subject to review by a federal authority in order to determine whether the carrying out of the project will cause significant adverse effects on the surrounding environment, or if any potential significant adverse effects are justifiable.

Fisheries Act

The federal *Fisheries Act* protects fish, including marine mammals and marine reptiles. The definitions of fish and fish habitat established under the *Fisheries Act* are:

- "Fish" includes (a) parts of fish, (b) shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals and (c) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals.

- "Fish habitat" means spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly to carry out their life processes.

Quality of marine fish habitat incorporates a variety of biophysical parameters, including substrate. Water quality parameters that influence habitat suitability for marine fish include temperature, salinity, dissolved oxygen (DO), total suspended solids (TSS) and turbidity.

CRA fishery species are primarily protected under federal legislation and regulations, and are socially and economically important. They are defined by the *Fisheries Act*, 2012 as follows:

- Commercial fisheries are recognized as fish species harvested under license for the purpose of sale.
- Recreational fisheries are recognized as fish species targeted by anglers for personal use or sport, as well as coarse and forage fish which support this fishery.
- Aboriginal fisheries are recognized as fish species caught by Aboriginal groups for subsistence, social or ceremonial purposes. In the absence of supporting information regarding Aboriginal fisheries, Aboriginal fisheries are considered to include all fish species, including those fished recreationally and commercially, and those that support those fisheries.

Management of CRA Fisheries resources in Canada is the mandate of Fisheries and Oceans Canada (DFO), the regulatory agency that is responsible for implementing the requirements of the *Fisheries Act*. Key sections of the *Fisheries Act* that apply to Project activities for marine fish and fish habitat of CRA Fisheries include:

- Section 35, which addresses serious harm to fish and fish habitat
- Section 36, which addresses pollution of fish habitat

Fishing within the Maritime Provinces (New Brunswick, Nova Scotia and PEI) and adjacent tidal waters is regulated through the Maritimes Provinces Fisheries Regulations under the federal *Fisheries Act*. These regulations define, and are intended, to regulate and manage commercial and recreational fisheries within the Maritimes, and outline acceptable timing and methods for capture. The Maritime Provinces Fishery Regulations list the following estuarine and marine recreational fish species:

- clams (bar clams [Atlantic surf clam, *Spisula solidissima*], bay quahogs [*Mercenaria mercenaria*], razor clams [*Ensis* sp.], and soft-shell clams [*Mya arenaria*])
- gaspereau (*Alosa pseudoharengus* and *Alosa aestivalis*)
- mussels (*Mytilus edulis*)
- oysters (*Crassostrea virginica*)
- anadromous salmon
- American shad (*Alosa sapidissima*)
- Atlantic silverside (*Menidia menidia*)
- rainbow smelt (*Osmerus mordax*)
- striped bass (*Morone saxatilis*)
- sturgeon (*Acipenser* sp.)
- Atlantic tomcod (*Microgadus tomcod*)

- trout (marine *Salvelinus* sp., *Salmo* sp. and *Oncorhynchus* sp.)
- white perch (*Morone americana*)

The *Marine Mammal Regulations* of the *Fisheries Act* are intended to protect marine mammals, specifically Section 7, which states, "No person shall disturb a marine mammal except when fishing for marine mammals under the authority of these regulations". The *Oceans Act* is intended to promote the sustainability of marine species and protects their habitat through the establishment of marine protected areas.

Species at Risk Act

Fish and wildlife species at risk are protected by the *Species at Risk Act* (*SARA)*, which is one part of a three-part Government of Canada strategy for the protection of species at risk. The *SARA* applies to all fish and wildlife species listed in Schedule 1 as being at risk, and their critical habitat, within all federal lands in Canada. The status of fish and wildlife species are assessed and designated by the Committee on the Status of Endangered Wildlife Species in Canada (COSEWIC), which recommends a designation for legal protection by being officially listed under *SARA*. One of the key considerations under *SARA* for protection of listed species at risk is protection of the species' habitat.

Canadian Environmental Protection Act

The *Canadian Environmental Protection Act*, 1999 (*CEPA*), and specifically the *Disposal at Sea Regulations*, protect marine fish and fish habitat indirectly. These regulations (i.e., the Disposal at Sea provisions of Part 7, Division 3 of *CEPA*, under the authority of Environment Canada; *CEPA* 1999), stipulate that dredging and disposal in the marine environment requires a permit and that sediment be screened for potential chemical contaminants.

Migratory Birds Convention Act

The majority of native bird species are protected under the *Migratory Birds Convention Act*, 1994 (*MBCA*), enforced by the Canadian Wildlife Service branch of Environment Canada. The key section of the *MBCA* that applies to the Project is s.5.1 which addresses substances in waters that might harm migratory birds.

3.1.1.1.2 Provincial

Prince Edward Island

<u>PEI *Environmental Protection Act*</u>

The regulatory framework for conducting environmental impact assessments (EIAs) in PEI is set forth in Section 9 of the PEI *Environmental Protection Act* (PEI *EPA*).

The interpretation of the PEI *EPA* is provided in Volume 1, Chapter 1. The term "undertaking" is interpreted to include any project which (i) may cause the emission or discharge of any contaminant into the environment; (ii) have an effect on any unique, rare, or endangered feature of the environment;
(iii) have a significant effect on the environment or necessitate further development which is likely to have a significant effect on the environment; or (iv) cause public concern because of its real or perceived effect or potential effect on the environment.

Section 9(1) of the PEI *EPA* states that "*no person shall initiate any undertaking unless that person first files a written proposal with the Department and obtains from the Minister written approval to proceed with the proposed undertaking*".

Furthermore, Section 9(2) of the PEI *EPA* states that the Minister, in considering a proposal submitted pursuant to Section 9(1), may require the Proponent to carry out an EIA, submit an EIS, notify the public of the proposed undertaking, and to provide opportunity for the public to comment.

Section 9(3) of the PEI *EPA* states that "*an environmental assessment and environmental impact statement shall have such content as the Minister may direct*".

Based on the PEI *EPA*, an EIA must be conducted for the Project, and an Environmental Impact Statement (EIS) must be presented to the Minister for approval of the undertaking. Consultation with the PEI Department of Communities, Land and Environment (PEIDCLE) has confirmed the need for an EIA for the Project.

An EIA must be completed and the corresponding EIS prepared and submitted to enable a review of the Project by the Technical Review Committee (TRC), comprised of provincial regulatory agencies as well as federal regulatory agencies, if required. The outcome of the EIA review process will determine if the Project should be approved, including any approval conditions.

PEI *Wildlife Conservation Act*

Species at risk are provincially protected in PEI under the PEI *Wildlife Conservation Act*. The purpose of this Act is to provide protection to endangered species and their habitats, as listed in *SARA*, *Fisheries Act* and *MBCA*. The PEI *Wildlife Conservation Act* is overseen by the PEIDCLE.

Watercourse, Wetland and Buffer Zone Activity Permit

Fish habitat is indirectly protected under the requirement for a Watercourse, Wetland and Buffer Zone Activity permit for all works in or within 15 m of a watercourse or wetland in PEI. Permits are required for vegetation clearing, soil excavation, construction or landscaping activities within 15 m of a watercourse or wetland, including any stream, spring, creek, brook, river, lake, pond, bay, estuary or coastal body.

New Brunswick

<u>New Brunswick *Clean Environment Act—Water Quality Regulation*</u>

The *Water Quality Regulation* is the main regulatory instrument in NB for regulating the release of effluents to the waters of the Province, which include coastal water within the jurisdiction of the Province, groundwater and surface water. Section 3(1) of the Regulation requires that any source of substances that may directly or indirectly cause water pollution or release of substances to the waters of the Province must apply for and obtain a Certificate of Approval under that regulation.

The Regulation defines "water pollution" as "*(a) any alteration of the physical, chemical, biological or aesthetic properties of the waters of the Province, including change of the temperature, colour, taste or odour of the waters, or (b) the addition of any liquid, solid, radioactive, gaseous or other substance to the waters of the Province or the removal of such substance from the waters of the Province, which renders or is likely to render the waters of the Province harmful to the public health, safety or welfare or harmful or less useful for domestic, municipal, industrial, agricultural, recreational, or other lawful uses or harmful or less useful to animals, birds or aquatic life*."

The activities related to the operation of the source must be conducted in accordance with the terms and conditions outlined in the approval. Approvals define site-specific requirements for individual facilities, including testing and monitoring, discharge limits, reporting, emergency response and environmental management measures.

<u>New Brunswick *Clean Water Act—Watercourse and Wetland Alteration Regulation*</u>

The water quality of watercourses and wetlands (including tidal estuaries) are protected in New Brunswick under the *Clean Water Act*. Activities that could alter water quality of watercourses and wetlands are regulated under the *Watercourse and Wetland Alteration Regulation* of the *Clean Water Act*.

Fish habitat is indirectly protected under the *Watercourse and Wetland Alteration Regulation* 90-80 (WAWA Regulation). Under the WAWA Regulation, watercourse and salt marsh alteration permits are required for vegetation clearing, soil excavation, construction or landscaping activities within 30 metres (m) of a watercourse or wetland, including marine shore drainage areas, intertidal zones and estuarine environments.

<u>New Brunswick Coastal Areas Protection Policy</u>

Further protection for New Brunswick coastal areas is provided under the Coastal Areas Protection Policy for New Brunswick. This policy is governed by the Department of Environment and Local Government (NBDELG) and aims to protect local coastal features such as beaches, dunes and coastal marshes, while maintaining a commitment to manage the sustainable development of provincial coastal areas. To achieve this goal, the policy identifies sensitive areas or zones within which specific types of activities are allowed, prohibited, or subject to environmental review. This policy must be consulted before work is planned near coastal areas.

New Brunswick Wetlands Conservation Policy

Wetlands are regulated in New Brunswick by the NBDELG, according to the objectives of the New Brunswick Wetlands Conservation Policy (GNB 2002), which are to maintain wetland function and to protect wetland habitat through securement, stewardship, education, and awareness. Specifically, the policy does not support most activities that pose a risk to provincially significant wetlands (PSWs). PSWs are defined as wetlands having provincial, national, or international importance, namely: coastal marshes; wetlands designated under other conservation-based agencies; wetlands that contain species listed under the *New Brunswick Species at Risk Act* (NB *SARA*); and wetlands with important ecological, hydrological function, or social (values) functions.

New Brunswick *Species At Risk Act*

Species at risk in New Brunswick are protected under the New Brunswick *SARA*, which shares many similarities with the federal *SARA*. The New Brunswick *SARA* is governed by the New Brunswick Department of Natural Resources (NBDNR) and applies to only those species listed within its Schedule A. The prohibitions state that, "no person shall kill, harm, harass or take any individual that is listed as an extirpated species, an endangered species or a threatened species".

3.1.1.2 The Influence of Consultation and Engagement on the Assessment

As outlined in Volume 1, Section 3.2 (Consultation and Engagement), environmental assessment scoping documents were sent to provincial regulators in PEI and New Brunswick, as well as Public Works and Government Services Canada (PWGSC). Environment Canada, Transport Canada, DFO and CEA Agency received the scoping documents through the provincial technical review committees (TRCs). Responses were received from TRC committees in New Brunswick and PEI no response has been received from PWGSC. Concerns were raised regarding the interaction between fish and EMF emitted from the submarine cables.

A meeting was held with DFO on May 6, 2015 to introduce the Project. Representatives of the habitat protection branch and commercial fisheries branch were present, as well as MECL and Stantec. DFO subsequently provided feedback on issues and concerns to be addressed in the EA. Based on concerns regarding sediment generation in the marine environment, the method of trenching was re-evaluated by MECL and PEIEC and a TROV with a saw cutter will be used in lieu of plowing or water jetting.

First Nations engagement was initiated with the Mi'kmaq Confederacy of PEI (MCPEI) in April 2015. No official correspondence has been received resulting from the meeting, although during the meeting there were concerns regarding potential impacts to fisheries in the Northumberland Strait resulting from the Project. Issues concerning CRA Fisheries are discussed in the CRA Fisheries VC (Section 3.2).

Consultation held with fisheries groups (see detailed descriptions in Volume 1, Section 3.2) resulted in concerns regarding sedimentation, EMF on commercial fish species as well as anticipated decreases in landings resulting from the Project and timing of the marine construction. Issues regarding sedimentation and EMF are discussed in Section 3.1 and issues regarding commercial fisheries are discussed in Section 3.2. The concerns associated with the timing of marine construction was re-evaluated by the

MECL and PEIEC and the installation of the submarine cables is now planned on being conducted in October and November of 2016 after the Fall lobster fishery.

3.1.1.3 Potential Environmental Effects, Pathways and Measurable Parameters

Marine components of the Project have the potential to affect habitat area, water and sediment quality, mortality, underwater acoustic environment and the behaviour of fish and marine wildlife (e.g., migration, feeding, and reproduction) that could result in changes in the populations of marine species in the assessment area. Based on these potential interactions and knowledge of the Project and its associated activities, the potential effect of change in populations of marine species was selected for assessment.

To adequately characterize the potential effects of the Project on the Marine Environment, measurable parameters are used to represent each type of predicted effect. Effective parameters are measurable and quantifiable (e.g., direct habitat loss). Some effects on marine populations lack defined parameters to measure effects and are therefore qualitative and rely on professional judgment and past project experience.

Table 3.1 summarizes the potential effects, effect pathways and measureable parameters for the Marine Environment VC.

Table 3.1 Potential Environmental Effects, Effects Pathways and Measurable Parameters for the Marine Environment

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s)
Change in Marine Populations	• Direct (mortality, injury, health, behaviour) and indirect (habitat loss, sound levels, water quality) mechanisms on marine populations.	• Mortality (loss of individuals). • Habitat area (m^2). • Water quality. • Sediment quality. • Underwater acoustic environment • EMF.

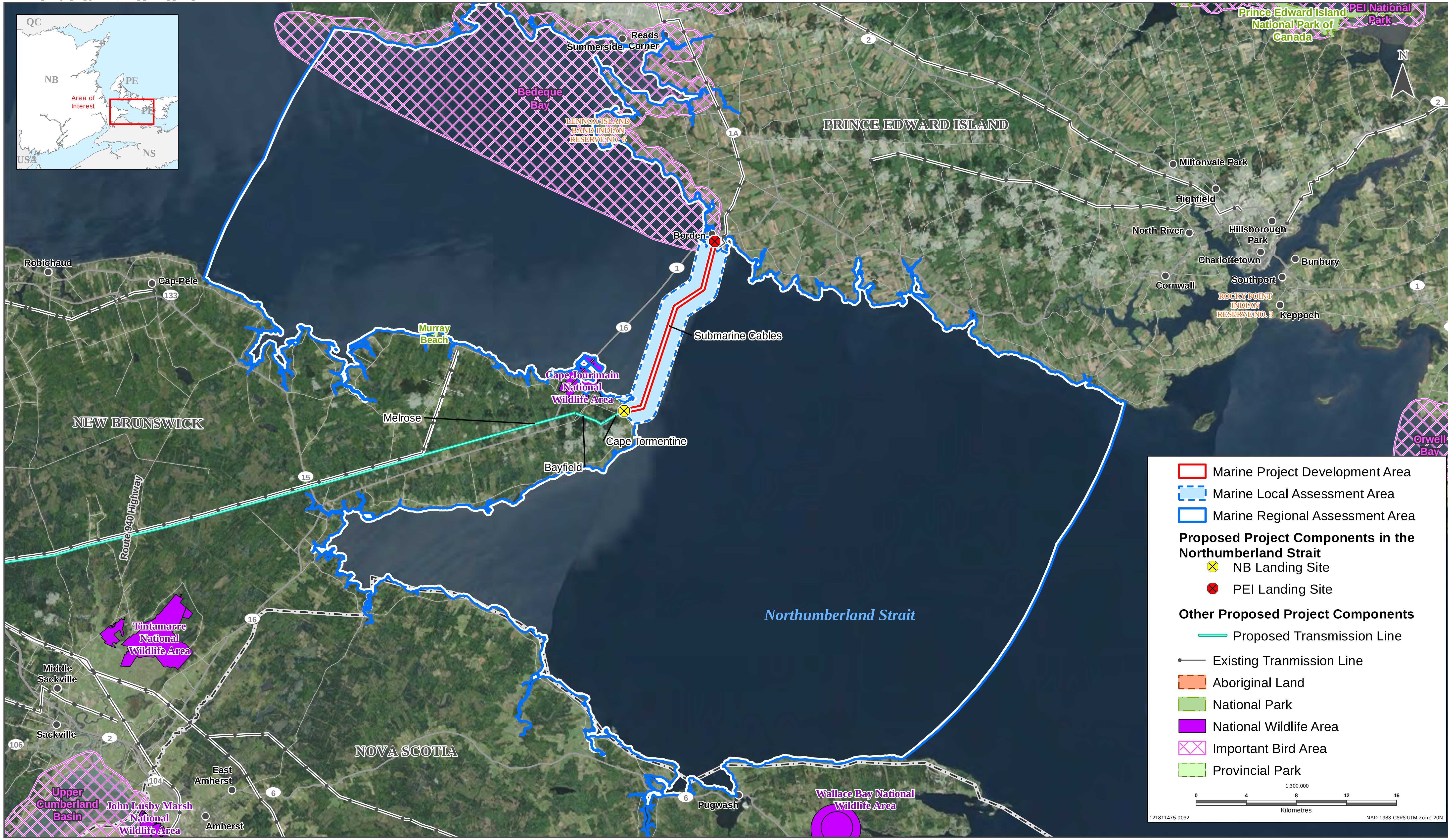
3.1.1.4 Boundaries

3.1.1.4.1 Spatial Boundaries

The spatial boundaries for the environmental effects assessment of the Marine Environment are presented in Figure 3.1 and defined below.

- Project Development Area (PDA): The PDA is a 220 m wide corridor extending approximately 16.5 km between Borden-Carleton and Cape Tormentine. This includes the 10 m wide disturbance area for each submarine cable and the 200 m separation distance between the two cable trenches. The actual area of physical disturbance during construction is approximately 33 ha.
- Local Assessment Area (LAA): The LAA includes the PDA area and extends 1 km on either side of the PDA; the LAA is the maximum area where Project-specific environmental effects can be predicted and measured with a reasonable degree of accuracy and confidence.

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_4_marine\3_1_marine_env\121811475-0032.mxd



Sources: GeoNB, NB Power, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Stantec

121811475 - PEI - NB Marine Cable Interconnection - Maritime Electric Company Limited

Marine Environment Assessment Boundaries

Figure 3.1

- Regional Assessment Area (RAA): The RAA is the area for the assessment of *SARA* or CRA species on a regional scale and is defined as a 70 km wide corridor centered on the subsea cables.

3.1.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of the Project on the Marine Environment include construction, operation and maintenance, and decommissioning and abandonment. Total construction time in the marine environment will take place over a 20 to 25 week period. Pre-trenching in water less than 12 m is scheduled to be conducted from May to early July 2016, while the remaining trenching and cable installation are scheduled to be installed in October and November 2016. Operation will begin following construction and is anticipated to continue for the life of the Project (approximately 40 years). Decommissioning and abandonment would take place following the useful service life of the Project and would be carried out in accordance with regulations in place at that time.

The timing windows for in-water construction has been planned for May through early July in waters less than 12 m to avoid working in the scallop fishing area during scallop fishing season as well as to avoid the lobster migration period within the RAA, if feasible. Construction will resume in October after the lobster fishing season is complete.

3.1.1.5 Residual Environmental Effects Description Criteria

Table 3.2 provides the environmental effects classification criteria that are used to characterize and describe Project residual environmental effects on the Marine Environment.

Table 3.2 Characterization of Residual Environmental Effects on the Marine Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive**—an effect that moves measurable parameters in a direction beneficial to the Marine Environment relative to baseline. **Adverse**— an effect that moves measurable parameters in a direction detrimental to the Marine Environment relative to baseline. **Neutral**—no net change in measureable parameters for the Marine Environment relative to baseline.
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible**—no measurable change from existing baseline conditions. **Low**—a measurable change from existing baseline conditions, but is below environmental and/or regulatory thresholds and does not affect the ongoing viability of marine populations. **Moderate**—measurable change (but less than high) from existing baseline conditions that is above environmental and/or regulatory thresholds, but does not affect the ongoing viability of marine populations.

Table 3.2 Characterization of Residual Environmental Effects on the Marine Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
		High—measurable change from existing baseline conditions that is above environmental or regulatory thresholds and adversely affects the ongoing viability of marine populations.
Geographic Extent	The geographic area in which an environmental, effect occurs	**PDA**—residual effects are restricted to the PDA (i.e., construction footprint associated with the submarine cables). **LAA**—residual effects extend into the LAA. **RAA**—residual effects interact with those of other projects in the RAA.
Frequency	Identifies when the residual effect occurs and how often during the Project or in a specific phase	**Single event**—occurs only once. **Multiple irregular event**—occurs at no set schedule. **Multiple regular event**—occurs at regular intervals. **Continuous**—occurs continuously over assessment period.
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the effect can no longer be measured or otherwise perceived	**Short-term**—residual effect restricted to duration of construction. **Medium-term**—residual effect measurable for up to two years following completion of construction. **Long-term**—residual effect extends throughout operation of the Project.
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible**—the effect is likely to be reversed after activity completion and reclamation. **Irreversible**—the effect is unlikely to be reversed.
Ecological and Socioeconomic Context	Existing condition and trends in the area where environmental effects occur	**Undisturbed**—area is relatively undisturbed or not adversely affected by human activity. **Disturbed**—area has been substantially previously disturbed by human development or human development is still present.

3.1.1.6 Significance Definition

A significant adverse residual environmental effect on the Marine Environment VC is one that causes a change in marine populations in such a way as to cause a decline in abundance or change in distribution such that the populations in the assessment area will not be sustainable.

The applicable legislation and regulations (i.e., *Fisheries Act*, *MBCA*, *SARA*, PEI *Wildlife Conservation Act* and New Brunswick *SARA*) are considered to be an essential part of the framework for the assessment of adverse residual environmental effects on marine populations.

3.1.2 Existing Conditions for Marine Environment

3.1.2.1 Methods

Baseline data and information collected during a literature review and field studies were used to characterize the baseline conditions for the Marine Environment. A review of relevant marine fish, fish habitat, wildlife and wildlife habitat data from various sources was undertaken including: previous environmental assessments; publically available reports from marine groups; and government sources (e.g., DFO, Environment Canada).

Although the review of previous studies and existing information provided some information on the Marine Environment in the Project location, and specifically at the regional and local spatial scales, it was determined additional information and data were required to support the Project assessment. In particular, sediment quality and benthic habitat data were required at the location of the submarine cables. Field studies were undertaken in fall 2014 to supplement the existing marine data. Additional field studies are planned for October 2015 to determine the current profile and water quality in the area. Results from these surveys will be provided as a supplemental report.

3.1.2.1.1 Field Methods

Field programs were conducted during fall 2014, to characterize the marine environment in the vicinity of the location of the submarine cables. Sediment samples were collected for chemical and physical analysis. Underwater video of the marine benthic habitat was collected in the nearshore area of the PDA to identify macroflora and macrofauna and to characterize the substrate. Survey methods for each program are briefly summarized below.

Sediment Quality

In October 2014, marine sediment samples were collected by divers from 10 locations throughout the PDA (see Figure 3.2 for sample locations) by Diversified Divers Inc. The program was conducted with the use of a fishing vessel, held in position by an anchor. Samples were analyzed for total organic carbon (TOC), polycyclic aromatic hydrocarbons (PAHs), total polychlorinated biphenyls (PCBs), trace metals including mercury and particle grain size.

Benthic Habitat

Nearshore underwater video was collected by divers in November 2014 on the PEI side of the Northumberland Strait and in September 2015 for the NB side (see Figure 3.2 for transect locations). The underwater transects were located approximately in the middle of the PDA to get a general overview of the habitat in the area. Lead lines, marked in 10-metre increments, were used to measure transect distances. Attempts were made to collect underwater benthic images across the Northumberland Strait using a towed video camera; however, due to the conditions during the 2014 surveys (time of year) and turbidity of the water, no quality video images were collected.

3.1.2.2 Overview

3.1.2.2.1 Physical Environment

Bathymetry

The proposed submarine cable corridor extends from Cape Tormentine in New Brunswick to Borden in PEI, encompassing a distance of approximately 16.5 km. The corridor is located to the east of the Confederation Bridge in the Abegweit Passage. A general description of the bathymetry in the area is provided by AMEC (2007) and is shown in Charts 4023 and 4406 from the Canadian Hydrographic Service.

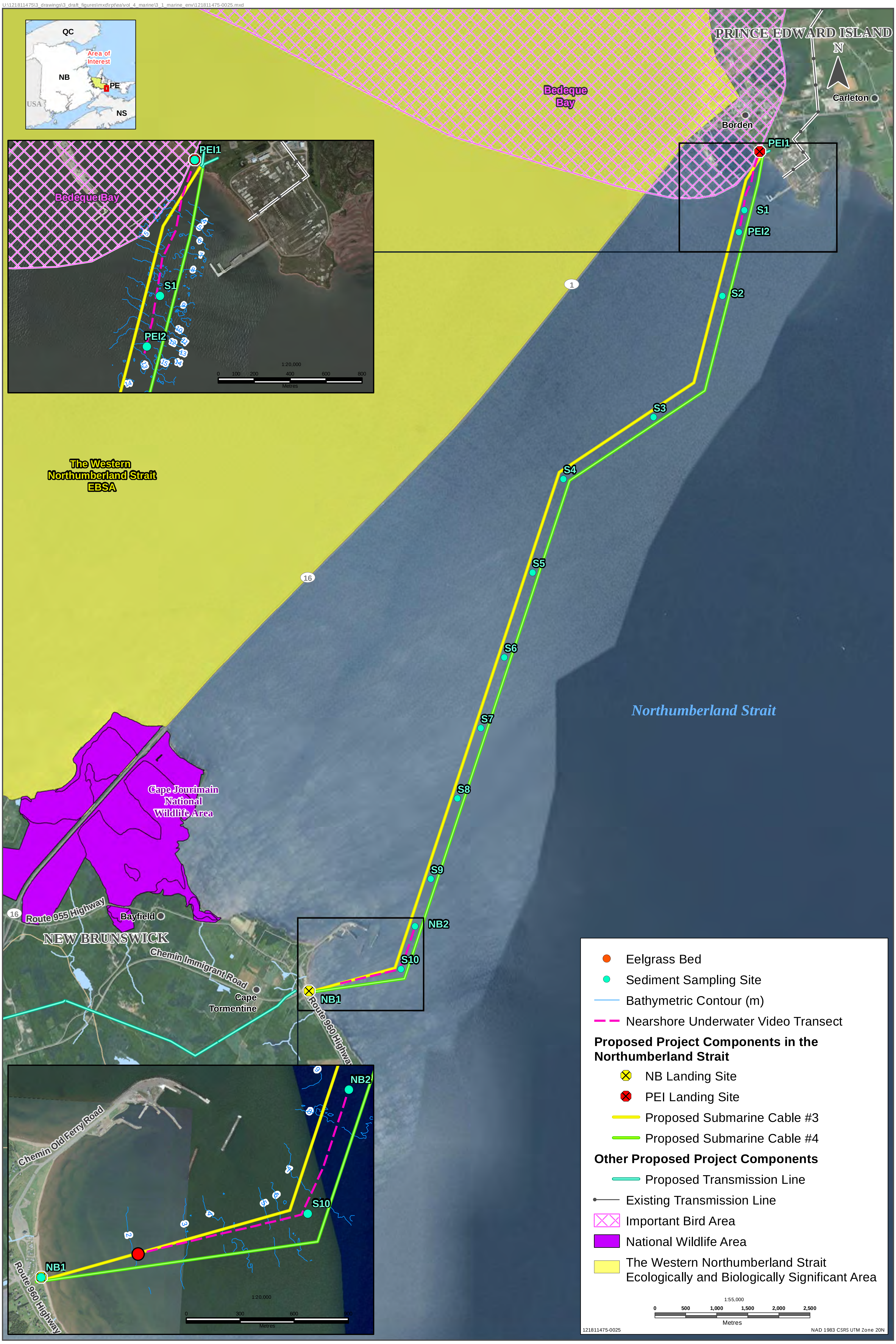
In general, the Abegweit Passage presents gradual slopes from the shore towards a single deep channel in the middle which extends from northwest to southeast with water depths approaching 30 m. Moving further to the east the channel widens and becomes deeper at localized points (water depths near 35 m) while shallow areas (in the 10 m range) are found near both shores. Shallow areas include Baie Verte in the southwest and the Tryon Shoals in the northeast.

Canadian Seabed Research Ltd. (CSR) was commissioned for the Project to carry out a detailed bathymetric survey of the cable corridor (CSR 2015). The survey was completed in summer 2014 and included among other tasks the mapping of the sea floor using single-beam echo sounding and side-scan sonar instruments. According to CSR, the survey was designed to map 100 % of the cable corridor with the side-scan sonar (approximate width of 500 m) as well as coarse line spacing for the entire corridor and detailed line spacing over the landfall areas with the single-beam sounder.

The bathymetric survey started at approximately kilometre posting (KP) 0.7 near Cape Tormentine and extended to KP 16.2 near Borden. The minimum and maximum water depths in the cable corridor range from 2 m to 31 m (chart datum). From Cape Tormentine, a gradual slope towards the main channel is broken by a sand shoal between KP 3 to KP 4.5, which raises the sea floor to an approximate water depth of 4 m. Beyond this point, the sand shoal ends at a water depth of 18 m where the sea floor remains almost flat until KP 6.5 and where the slope then increases towards the main channel reaching water depths near 30 m. The main channel gradually decreases in depth until KP 11.5. Beyond this point there is a rise in the sea floor followed by a flat section near 15 m water depth until KP 15, at which point the slope rises again until the sea floor meets the land. Detailed bathymetric information is presented in CSR 2015.

Surficial Geology and Sediment Characteristics

Summaries of surficial geology are presented in CSR (2015) and AMEC (2007) based on previous regional studies carried out for the Northumberland Strait (Kranck 1971; Loring and Nota 1973; and Fader and Pecore 1989).



Sources: GeoNB, NB Power, PEI Government (2010), Canadian Seabed Research (2014), Surficial Geology, CHS (1972), Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

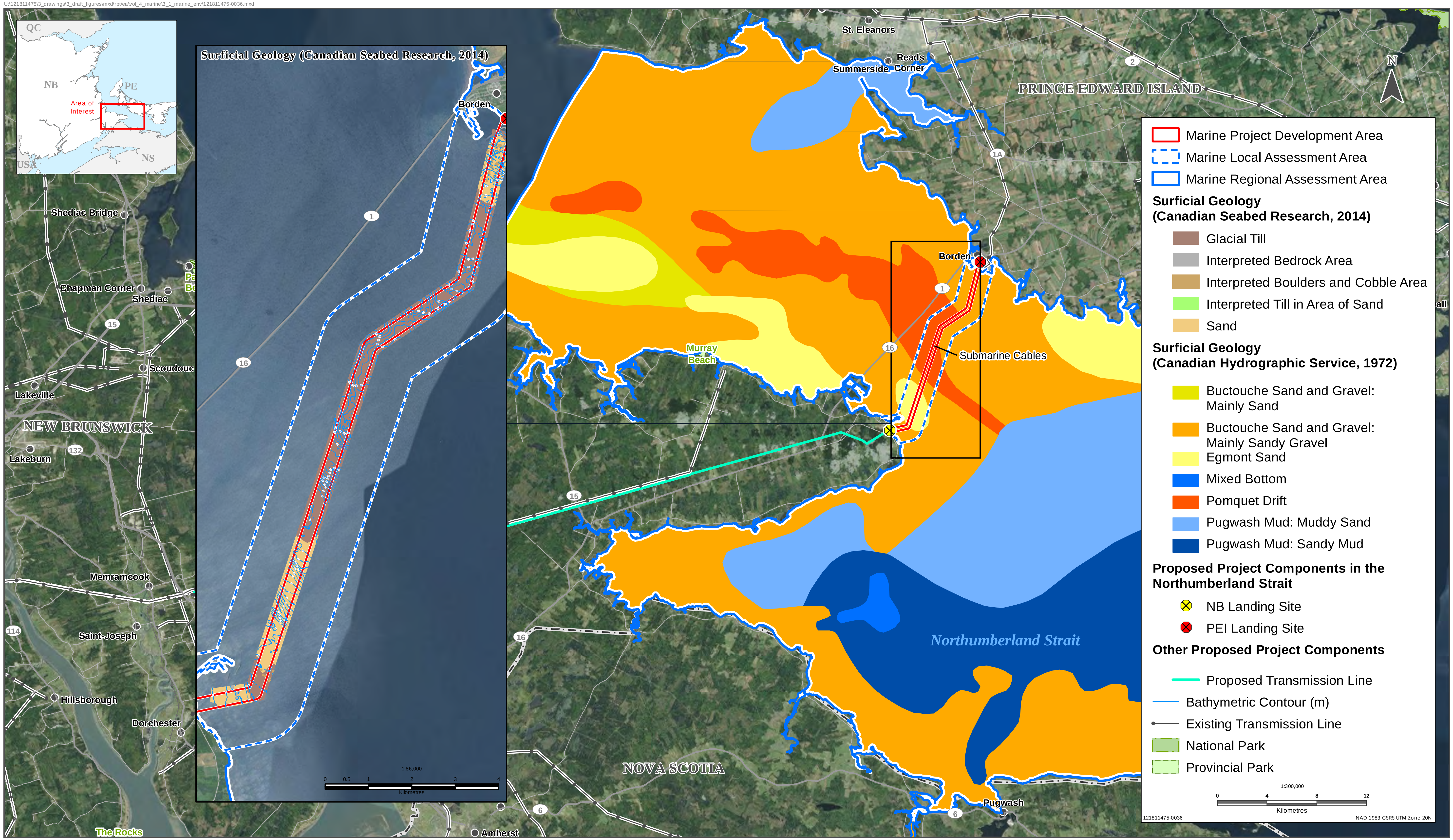
Benthic Habitat Sample Locations

Figure 3.2

Stantec

121811475 - PEI - NB Marine Cable Interconnect - Maritime Electric Company Limited

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_4_marine\3_1_marine_env\121811475-0036.mxd



Sources: GeoNB, NB Power, Canadian Seabed Research (2014), Canadian Hydrographic Service (1972) Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Stantec

Surficial Geology in the Marine Regional Assessment Area

121811475 - PEI - NB Marine Cable Interconnection - Maritime Electric Company Limited

Figure 3.3

Based on the surficial geology map generated by Kranck (1971), there are three distinctive surface geologic features within the cable corridor. These include a small pocket of Egmont Sand near Cape Tormentine, a limited band of Pomquet drift within the deeper middle channel, and an area containing Bouctouche sand and gravel which covers the remaining cable corridor. A description of each feature is included in CSR (2015) (Figure 3.3).

Egmond sands are recent deposits of well-sorted sands with particle sizes ranging from coarse to medium sand. These normally contain abundant shell material. Pomquet drift is the oldest formation in the Strait and is comprised of glacial till and can be found generally within the main deeper channel of the Strait. Finally, Bouctouche sand and gravel contain more than 5 % gravel along the cable corridor.

According to Amec (2007), the distribution of surficial sediments within the Northumberland Strait is mainly dominated by tidal energy inputs. For the Abegweit Passage, the presence of larger particle size fractions suggests higher energy inputs when compared to the wider sections of the Strait where sediments with smaller particle sizes are predominant (i.e., Pugwash mud formations).

Ten surficial sediment samples were obtained by Stantec in fall 2014 along the cable corridor to characterize the particle size distribution and chemical quality of the sediment. The samples were labelled S1 to S10, where the sample number progresses from S1 near Borden, PEI to S10 near Cape Tormentine, NB. A summary of particle size distributions for all samples and their location along the cable corridor (KP) are presented in Table 3.3.

The results of the particle size analysis for all samples indicate sand as the predominant fraction, with variable amounts of gravel and fine particles (i.e., silt and clay) along the cable corridor. These results are in agreement with the surficial geologic characteristics that are present within the corridor.

Table 3.3 Particle Size Distribution of Sediment Samples along the Cable Corridor

Sample No.	KP (km)	% Gravel	% Sand	% Silt	% Clay
S1	15.5	5.8	71	16	7.4
S2	14.0	11	80	3.6	5.7
S3	11.6	28	65	3.1	3.9
S4	9.9	19	71	4.7	5.3
S5	8.3	34	54	5.2	6.7
S6	6.8	10	85	1.5	3.6
S7	5.6	8.2	81	5.6	5.6
S8	4.4	15	77	2.8	4.9
S9	3.1	<0.1	94	2.5	3.9
S10	1.6	11	79	5.4	4.8

Tides

Tides in the Northumberland Strait follow a complex pattern, with variations in the tidal regime and magnitudes that are largely determined by tidal characteristics in the Gulf of St. Lawrence and the dimension of the Strait itself (JWEL 1995).

In the west end of the Strait the tides follow a diurnal pattern (i.e., one high tide and one low tide per lunar day). Along the east end of the Strait the tides are mixed semi-diurnal (i.e., two high tides and two low tides with different magnitudes per lunar day). This is mainly because the diurnal and semi-diurnal signals arrive at the Strait at different times. Tide magnitudes in the east near the location of the cable corridor range from 0.2 to 2.4 m (DFO 2012). Since tidal wavelengths vary with depth, main currents in the Strait reverse themselves near the shore about one hour ahead of the main channel.

Wind and Waves

Extremal analysis of wind and waves within the Strait were obtained from the results of the MSC50 Wind and Wave Reanalysis (Swail et al. 2006), which is the most recent hindcast study in the North Atlantic basin.

The hindcast approach uses numerical wind and wave models in conjunction with historical meteorological data to simulate wind and wave conditions in the region of interest. The hindcast study includes the application of statistical tools (i.e., extremal analysis) to estimate parameters of interest (e.g., wind velocities and the associated significant wave heights for a given frequency). The MSC50 wind and wave reanalysis includes an improved grid resolution of 0.5 degrees for the Atlantic Ocean, including points near the LAA.

The Grid Point 9946 (Latitude 46.2000 N; Longitude 63.7000 W; water depth 18 m) is the nearest point to the cable corridor within the MSC50 data set. This point is located approximately 1.5 km to the east from the cable corridor.

Wind and wave statistics for Grid Point 9946 are presented in Table 3.4. These values were obtained by applying a Generalized Extreme Value (GEV) statistical distribution to the hindcast data (with a total of 59 records) and including both tropical and extratropical events. The annual maximum for each year in record is selected and the GEV distribution is applied to the 59-year record (i.e., one value for each year).

Table 3.4 Significant Wave Height and Wind Speed Near the Cable Corridor for all Compass Directions

Return Period	Sectors															
	337.5-22.5		22.5-67.5		67.5-112.5		112.5-157.5		157.5-202.5		202.5-247.5		247.5-292.5		292.5-337.5	
	HS (m)	WS (m/s)	HS (m)	WS (m/s)	HS (m)	WS (m/s)	HS (m)	WS (m/s)	HS (m)	WS (m/s)	HS (m)	WS (m/s)	HS (m)	WS (m/s)	HS (m)	WS (m/s)
2	1.39	15.01	1.12	13.09	1.40	14.01	2.05	15.83	1.90	14.79	1.81	14.95	2.10	16.94	2.04	17.21
5	1.67	17.69	1.45	16.32	1.75	16.94	2.27	17.33	2.10	16.52	2.10	17.05	2.35	18.74	2.28	19.07
10	1.80	18.93	1.62	18.05	1.91	18.26	2.38	18.05	2.22	17.65	2.28	18.37	2.48	19.68	2.39	20.13
25	1.92	20.06	1.79	19.85	2.05	19.46	2.50	18.74	2.35	19.07	2.50	19.99	2.61	20.64	2.50	21.30
50	1.99	20.68	1.88	20.96	2.13	20.09	2.56	19.12	2.45	20.12	2.65	21.15	2.69	21.21	2.56	22.05
100	2.03	21.15	1.96	21.91	2.19	20.56	2.61	19.42	2.53	21.15	2.80	22.27	2.75	21.68	2.61	22.72

Notes:

HW – significant wave height.

WS – wind speed (m/s).

Sectors - portions of the entire azimuth rose and covering all directions.

Currents

Currents in the Northumberland Strait are mainly driven by tidal and wind effects and are part of the larger circulation dynamics of the Gulf of St. Lawrence. Currents in the Strait are primarily from west to east.

Data showing the variability of near-bottom and near-surface mean currents along the Abegweit Passage can be found in JWEL (1994). These include the results of measurements using an Acoustic Doppler Current Profiler (ADCP) for month-long deployments during the summer and fall of 1993. The results show predominant currents toward the southeast for both summer and fall deployments with the exception of the near-bottom currents measured during the summer, which were to the west.

As indicated in JWEL (1995), current velocities generated by tidal effects normally range between 0.5 to 1.0 m/s, while wind-generated currents typically range between 0.1 to 0.5 m/s. It is noted that during storm events, currents can reach velocities in the order of 1.8 m/s, which were measured during strong northwest winds in November 1994. Storm conditions are most prevalent in the fall and have a maximum effect on currents when winds originate from the northwest because of alignment with the Strait which in turn maximizes the length of fetch.

Ice Conditions

In an average year, ice will initially form along the coastal regions of the Magdalen Shallows and spread eastward. By mid-January, ice usually covers half of the Magdalen Shallows and by mid- February, most of the Gulf is ice-covered. In general, the ice duration has varied from 95 days around the mouth of Gaspe Bay to more than 110 days along the north coast of PEI and along the Northumberland Strait (Chassé et al. 2014).

Ice dynamics in the Northumberland Strait are well understood and summarized in CSR (2015) and DFO (2012). Normally, ice starts to develop in coastal areas of the Strait in the last week of December. By the end of December the Strait is partially covered with grey and new ice. By the first week of January the entire Strait is ice covered, with ice thickness increasing to a maximum of approximately 1 m as the winter progresses.

Usually ice concentrations begin to decrease during the third week of March near the western end of the Strait and gradually progressing towards the east. During this time, ice movement is mostly dominated by wind and tidal effects. Most of the ice in the main channel of the Strait melts by mid-April, with only coastal fast ice remaining which normally melts by the last week of April. Details regarding ice characteristics near the Confederation Bridge can be found in Thomas et al. (2010).

Ice movement can create ice ridges that are formed by the impact of ice floes with coastal fast ice. These ridges have keels that can extend to the seabed, and when transported, have the potential to create ice scour features as the advancing keel pushes sediment material to the sides.

The survey conducted by CSR (2015) included the identification and interpretation of ice scour features along the cable corridor. A total of 133 ice scour features were found during the survey. The analysis included the determination of physical features including their location, orientation, length, width, form, and depth (when possible). A detailed description of these parameters can be found in CSR (2015). With respect to bathymetry, 41 % of occurrences were found at depths between 4 and 5 m, while the majority of occurrences (83 %) were found between 4 to 8 m. This supports the observation of ice ridge formation near the shore.

In terms of ice scour orientation, the majority of occurrences were found between 120 and 140 degrees azimuth, which is aligned with the predominant currents in the Strait. Ice scour lengths were predominantly in the 10 to 70 m range (76 % of occurrences), with a few occurrences exceeding the 100-m threshold. The width of most ice scour marks was less than 4 m (81 % of occurrences). Further details regarding ice keels and their distribution in the Northumberland Strait can be found in Obert and Brown (2011).

Water Mass Characteristics

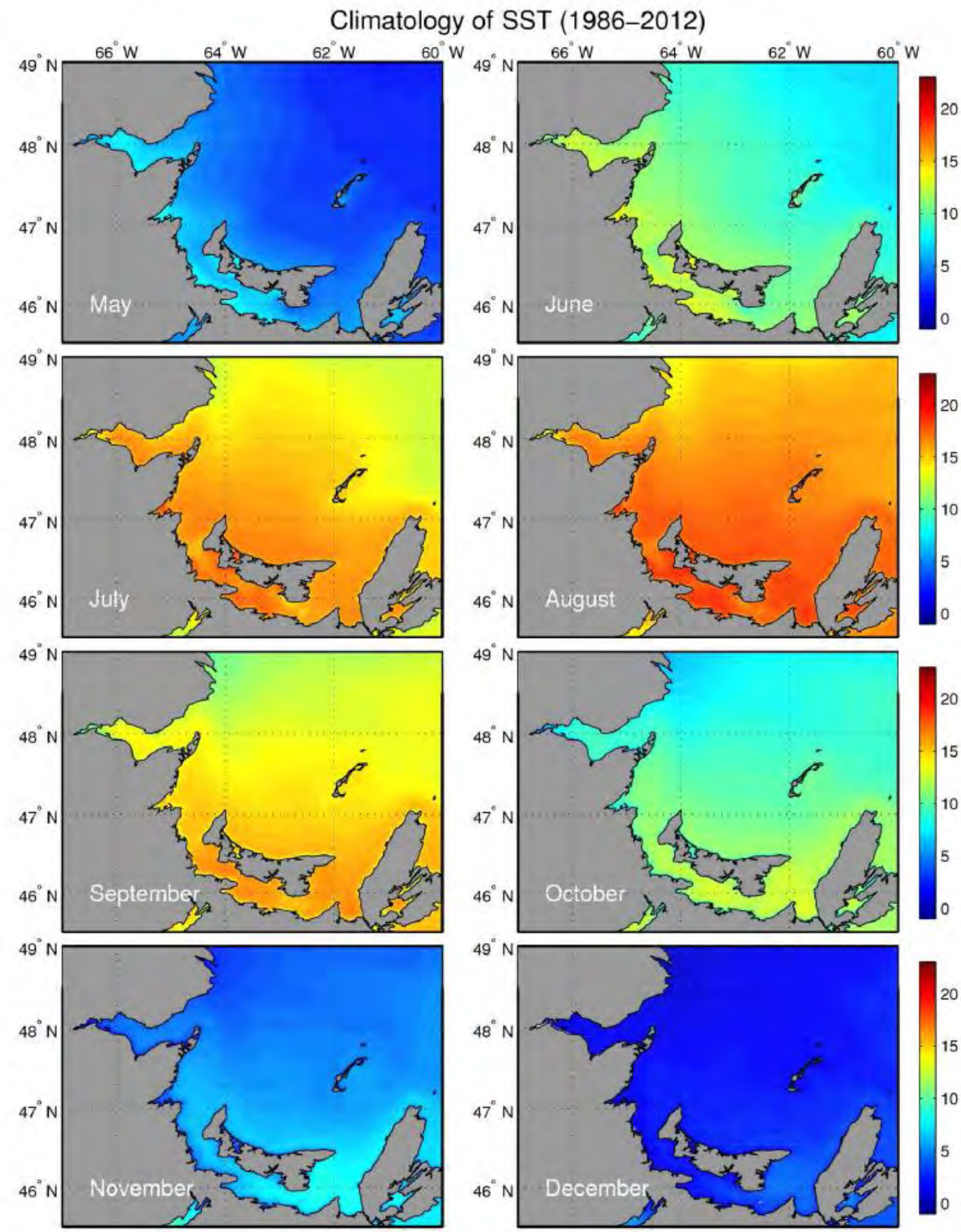
The Northumberland Strait is a long, narrow, shallow body of water located in the Southern Gulf of St. Lawrence (AMEC 2007). The water of the Northumberland Strait is primarily derived from the surface layer of the Gulf of St. Lawrence. The Gulf of St. Lawrence exhibits features of an estuarine environment due to the freshwater input of the St. Lawrence River and the deep saline flow from the Gulf Stream, entering through the Cabot Strait (AMEC 2007).

<u>Water Temperature and Salinity</u>

The average sea surface temperatures (SST) of the Northumberland Strait and the surrounding Magdalen Shallows are presented in Figure 3.4. Typically after the ice melt, sea surface temperatures begin to warm with warmer air masses and solar heating in the spring. Maximum temperatures are typically reached by August, with temperatures reaching 20 °C or greater in the Northumberland Strait. In September the surface waters begin to cool and reach minimum temperatures of -1.5 °C in the winter months before the appearance of ice (Chassé et al. 2014).

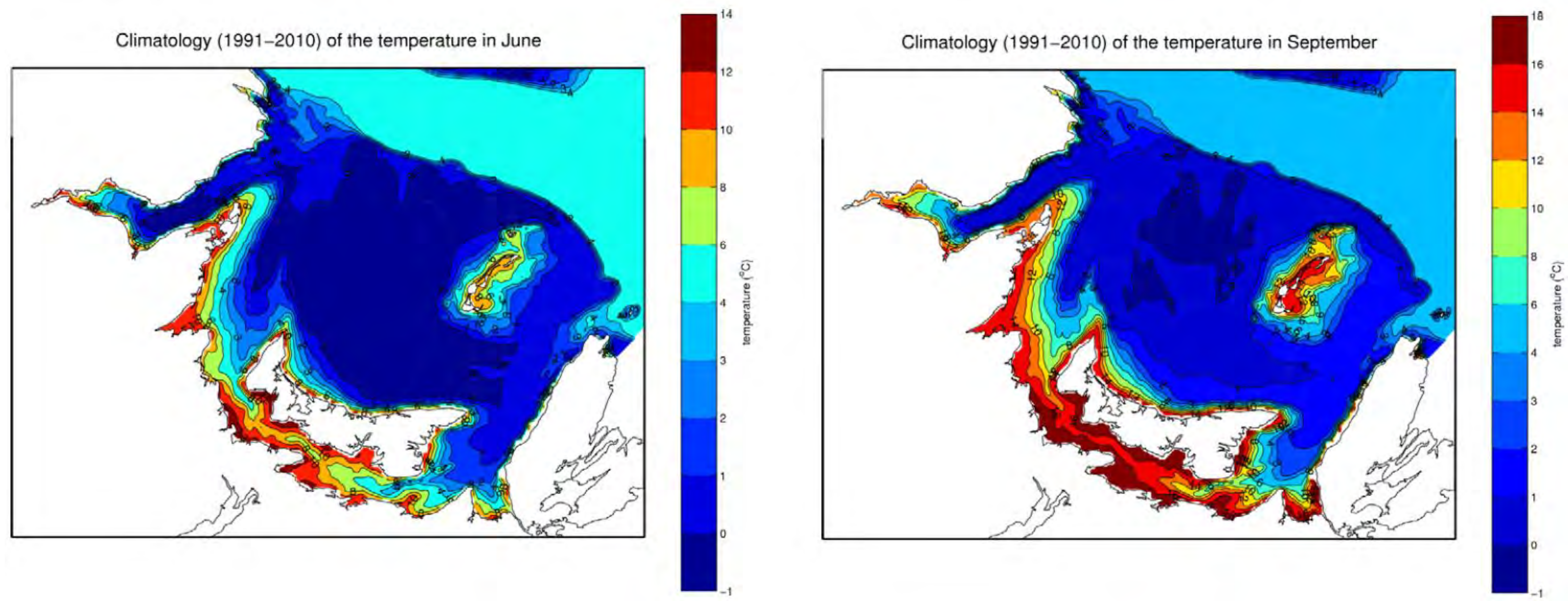
On average the warmest near-bottom water temperatures in the southern Gulf of St. Lawrence can be found in the Northumberland Strait where they can reach temperatures of >23 °C. Figure 3.5 presents the average bottom temperatures in the southern Gulf of St. Lawrence in June and September from 1991 to 2010, including the Northumberland Strait (Chassé et al 2014).

September average sea water temperature and salinity profiles for the southern Gulf of St. Lawrence can be seen in Figure 3.6. The summer warm surface layer is usually composed of waters with salinities ranging from 30 to 31 practical salinity units (psu) in the Magdalen Shallows and Northumberland Strait (JWEL 2001). From 1991 to 2010, average September bottom salinities in the Magdalen Shallows were <34 psu, with the freshest waters being observed along the coast of New Brunswick because of the influence of freshwater runoff. The average September bottom salinities in the Northumberland Strait were 28 to 30 psu. Figure 3-7 presents the average bottom salinities in September between 1991 and 2010 for the southern Gulf of St. Lawrence.



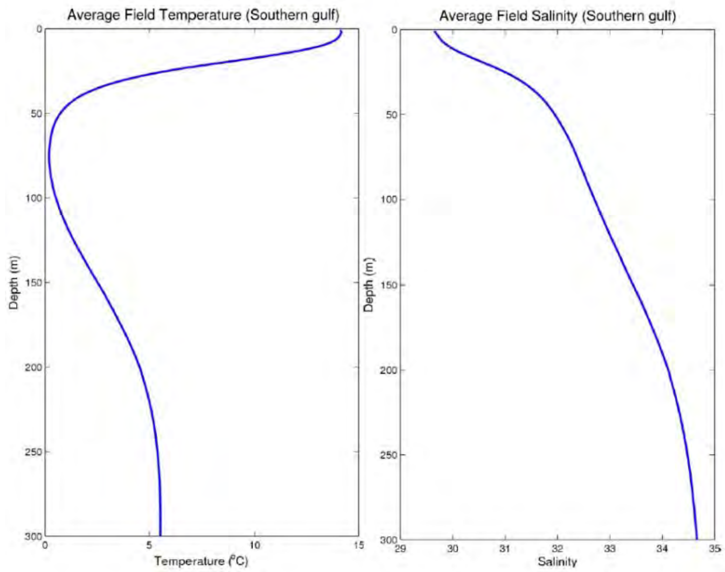
Source: Chassé et al. 2014

Figure 3.4 Sea Surface Temperature (°C) Climatology (1986 to 2012) from May to December in the Northumberland Strait and Magdalen Shallows



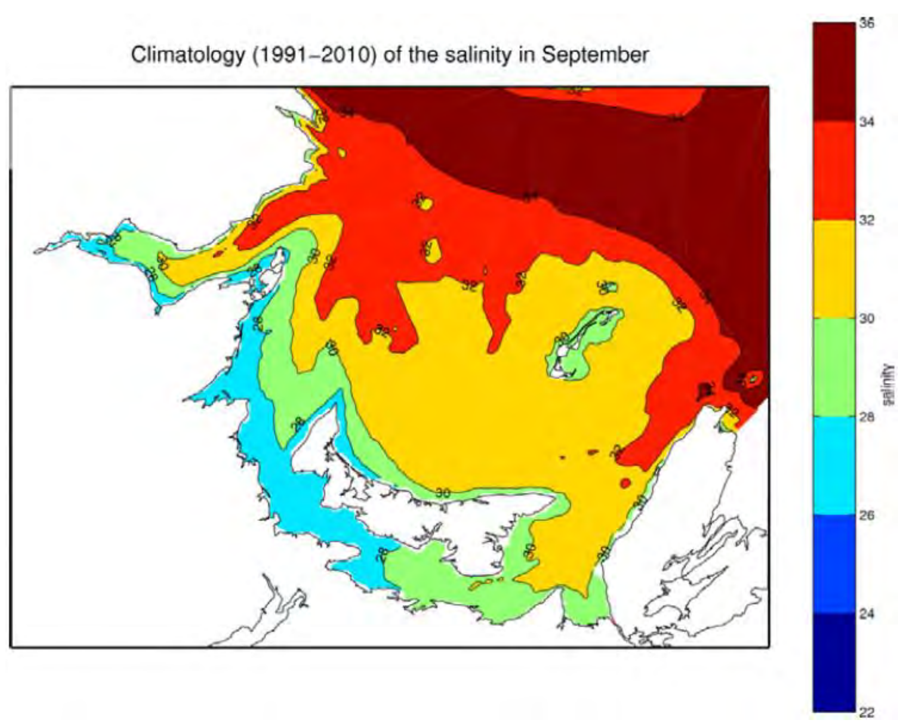
Source: Chassé et al. 2014

Figure 3.5 Average Bottom Temperatures between 1991 and 2010 in June and September for the Southern Gulf of St. Lawrence



Source: Chassé et al. 2014

Figure 3.6 Average Temperature and Salinity profiles for September (1971 to 2010) in the Southern Gulf of St. Lawrence



Source: Chassé et al. 2014

Figure 3.7 Average Bottom Salinity (psu) for September (1991 to 2010) in the Southern Gulf of St. Lawrence

3.1.2.2.2 Nearshore Benthic Habitat

Coastal habitat in the western portion of the Northumberland Strait (on the New Brunswick side) is evenly distributed between mud and sand. Organic content ranged from 1.34 to 3.28 % (Weldon et al. 2005).

Information on non-commercial benthic epifauna in the Abegweit Passage area of the Northumberland Strait is limited; the list provided in Table 3.5 was based on scallop drag samples and videotape records taken during the summer of 1988 (Hurley Fisheries 1989, in AMEC 2007).

Table 3.5 Non-Commercial Epifauna of the Abegweit Passage Area, Northumberland Strait

Group	Species	Comments/Habitat
Sand Dollars	*Echarchnius parma*	Highly abundant, often many thousands in drags over sandy areas. Distribution highly clumped and patchy.
Starfish	*Asterias sp.; Henricia snaguinolenta*	Common throughout stations. Majority of specimens tiny – nursery area?
Mussels (horse mussels)	*Modiolus modiolus*	Two dense beds off Borden and Cape Tormentine. Cobble and sand bottom, 10 to 15 m depth.
Slipper limpets	*Crepidula sp.*	On dispersed rocks in sand close to New Brunswick coast.
Clams	*Astarte sp.*	Commonly encountered.
Source: Hurley Fisheries 1989, in AMEC 2007		

The sampling of infauna from the inshore region of the Abegweit Passage has been studied in the past (Caddy et. al. 1977 and Hurley Fisheries 1989, in AMEC 2007). Samples were also collected as part of the marine environmental effects monitoring programs conducted during the construction of the Confederation Bridge from 1993 to 1995. A summary of the identification of infauna is presented in Table 3.6. The composition of species was similar amongst the various sampling programs (e.g., Maldanidae and Spionidae polychaete families were present throughout and Tellina (a clam) was reported in sandy stations). Shannon-Weiner diversity indices indicate that the benthic infauna was generally diverse (AMEC 2007).

Table 3.6 Summary of Infauna Biota in Marine Environmental Effects Monitoring Samples, 1993 to 1995

Taxa	Comments
Polychaetes	The most common group; 54 genera and/or species identified.
Other Vermiformes	Nematodes were abundant, and present throughout most samples.
Crustaceans	13 species listed including Amphipods, copepods, Gammarus spp.
Marine Spiders	3 unspecified Pycnogonid species
Molluscs	Common, particularly Tellina spp. Also two unspecified nudibranch species.
Echinoderms	Occasional
Source: AMEC 2007	

Benthic habitat surveys were conducted in the PDA in November 2014. Approximately 1,200 m of nearshore habitat perpendicular to the shore was surveyed on the PEI side of the Northumberland Strait. The substrate inshore is a mix of rock (cobble, rubble, boulder) with small amounts of sand and then transitioned to predominantly sand at approximately 350 m from shore. Hermit crabs (not identified to species) were abundant throughout the entire survey area. Periwinkles (not identified to species), Asteriid sea stars (not identified to species), sand dollars (*Echinarachnius parma*), frilled anemones (*Metridium senile*), rock crabs (*Cancer irroratus*) and unidentified fish were also observed throughout the entire survey area. Macroflora throughout the area was predominantly *Fucus* sp., sour weed (*Desmarestia* sp.), and little brown algae (*Elachistea fucicola*); eelgrass (*Zostera marina*), unidentified red algae, dulse (*Palmaria palmata*), kelp (not identified to species), wireweed (*Ahnfeltia plicata*), and unidentified brown algae were also observed, but the coverage was occasional. Unattached vegetation debris was observed throughout the entire study area.

Approximately 2,000 m of nearshore habitat perpendicular to shore was surveyed on the New Brunswick side of the Northumberland Strait. The substrate was primarily sand for the first 1,140 m then transitioned to a mixed substrate of rock (cobble with shell hache and occasional boulders) and sand for the remainder of the survey. Hermit crabs, rock crabs and sea stars were common throughout the entire survey area; unknown colonial organism and sea anemones were common in the rocky section. Additional fauna observed occasionally included unidentified fish, unidentified flounder, unidentified sponge, quahog (*Mercenaria mercenaria*) and winter skate (*Leucoraja ocellata*). Macroflora throughout the area consisted of an eelgrass bed for the first 45 m of the survey area. Occasional blades of eelgrass were observed throughout the remainder of the survey area. Once the habitat transitioned into a sand/rock mixture there was approximately 2 to 20% unidentified brown algae and occasional Fucus sp. Dulse (*Palmaria palmata*) and kelp (*Saccharina latissima*) were identified in several places but were uncommon.

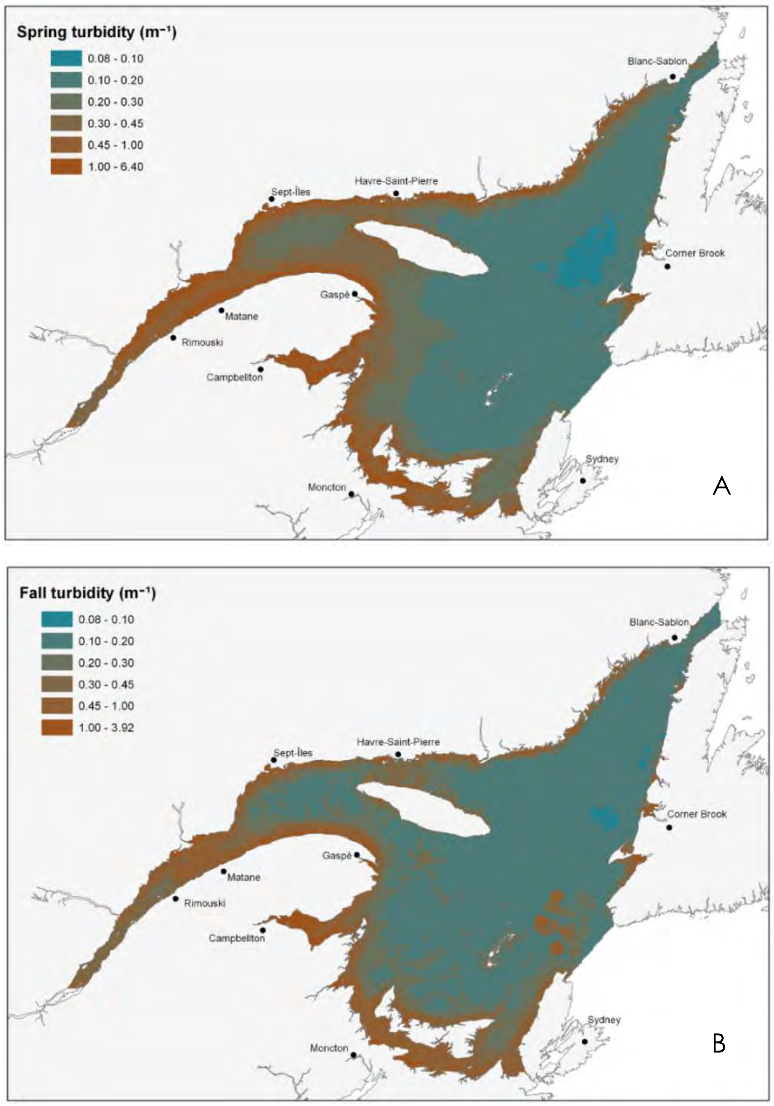
3.1.2.2.3 Water Quality

Existing water quality information in the Northumberland Strait is sparse. No site-specific water quality program was conducted in the 2014 field season, but will be taking place in October 2015. In the past, water quality was monitored for total suspended solids (TSS) and turbidity during the construction of the Confederation Bridge nearshore in PEI, in the middle of the Northumberland Strait, and in nearshore New Brunswick. The results indicate that ambient conditions are affected spatially (nearshore or mid-Strait) and temporally. Storm-induced conditions could result in a very rapid change in water quality, with the middle of the Northumberland Strait requiring a larger magnitude wind disturbance to change TSS and turbidity concentrations. The middle of the Northumberland Strait becomes stratified during the summer months (typically by June), and this influences the TSS and turbidity concentrations above and below the stratification (JWEL 1995).

The water column in nearshore PEI is well-mixed with varying TSS concentrations throughout the year; storm events and surface run-off can affect TSS levels. The TSS concentration ranged from 0 to 28.5 milligrams per litre (mg/L), with the TSS concentration increasing during the year.

The water column in the middle of the Northumberland Strait becomes stratified at varying depths, but typically at depths of 10 m or greater. The TSS concentration ranged from 2 to 19 mg/L, with the TSS concentration increasing during the year. The water column in near shore New Brunswick is well-mixed. The TSS concentration ranged from 2 to 16 mg/L, with the TSS concentration increasing during the year. After a wind and precipitation event, the TSS range increased to 14 to 27 mg/L (JWEL 1995).

Moderate resolution imaging spectro-radiometer satellite data were used by Dutil et al. (2012) to illustrate turbidity in the Gulf of St. Lawrence during the 2002 to 2011 period (Figure 3.8).

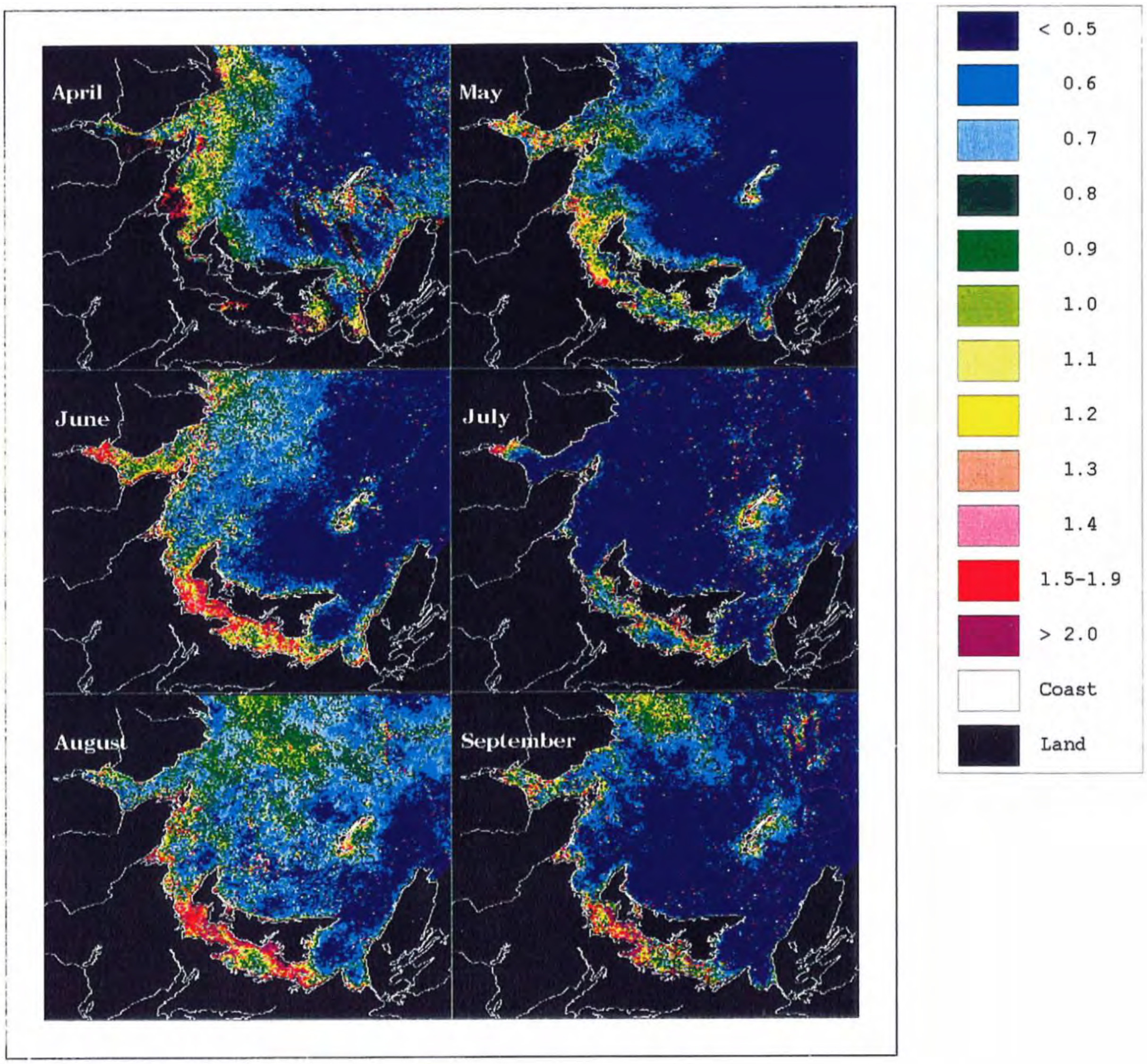


Source: Dutil et al. 2012

Note: Data were downloaded from NASA, satellite AQUA, MODIS spectro-radiometer-based estimate of the diffuse attenuation coefficient of seawater at 490 nm (m^{-1}).

Figure 3.8 Mean Turbidity in (a) Spring [April to June], and (b) Fall [October to December]

Pigment in the water is a good indicator of chlorophyll content. Fuentes-Yaco et al. (1998) studied the spatio-temporal distribution of phytoplankton pigments in Northumberland Strait using Coastal Zone Color Scanner images and in situ data collected during different periods; June, August and September indicate the highest pigment levels in the monthly composite images shown in Figure 3.9.



Source: Fuentes-Yaco et al. 1998

Figure 3.9 Coastal Zone Color Scanner Composite Images of Phytoplankton Pigments (mg/m³) from April to September (1979 to 1981) in the Southern Gulf of St. Lawrence

3.1.2.2.4 Protected and Sensitive Areas

The Western Northumberland Strait Ecologically and Biologically Significant Area

The Western Northumberland Strait Ecologically and Biologically Significant Area (EBSA) is located just west of the LAA (on the western side of the Confederation Bridge) and encompasses the western half of the Northumberland Strait between PEI and New Brunswick. The Western Northumberland EBSA is shallow (<20 m) and modelling reveals distinctive physical phenomena for the entire area including significant retention potential, tidal mixing and annual temperature cycle amplitude (DFO 2007). The area of the Gulf, in which the EBSA is situated, has the highest annual water temperature and annual temperature cycle amplitude.

The area is home to an isolated calico crab population which persists in the area and spends its entire life cycle here (DFO 2007). A large population of winter skate (half of their total population) can be found in the area in the summer and early fall. The winter skate is listed as endangered by COSEWIC. Several other ground fish species with a limited range can be found with large populations in the area, including the white hake and windowpane flounder. Giant scallop beds can be found in the area. The area represents a well-known significant area for seals (DFO 2007).

Bedeque Bay Important Bird Area

The Bedeque Bay Important Bird Area (IBA) is located on the south shore of western PEI, near Summerside. The IBA is approximately 361 km^2 and includes many marshes and mudflats. Bedeque Bay has been designated as an IBA due to its importance as a staging area during spring and fall migration. Many species of geese, ducks and shorebirds can be found making use of the area (IBA Canada 2015).

Cape Jourimain National Wildlife Area

The Cape Jourimain National Wildlife Area was designated in 1980 as a conservation site because of the diversity of waterfowl and shorebirds that use the sites marshes and shores as a staging area during spring and fall migration. Along with staging areas, there are readily available breeding habitats for waterfowl, some species of shorebirds and many species of songbirds (Cape Jourimain Nature Centre 2015).

3.1.2.2.5 Sediment Quality

A sediment sampling program was conducted along the cable route in October 2014; 10 stations (S-1 to S-10) were sampled (Figure 3.2). The route is predominantly sand with higher silt and clay content near PEI. The organic carbon content in the sediment is consistent along the route, ranging from 1.4 to 2.6 milligrams per kilogram (mg/kg).

The samples were analyzed for trace metals, PAHs, PCBs and DDT. All samples were below the reportable detection limit (RDL) for PCB and DDT. Most samples were less than the RDL for PAHs with the exception of the two sample locations closest to the New Brunswick coast (S-9 and S-10). The location closest to the New Brunswick coast (S-10) contained fluoranthene and pyrene, while location S-9 contained fluoranthene and pyrene, as well as benzo(*a*)anthracene, benzo(*a*)pyrene and benzo(*a*)fluoranthene. All samples were lower by an order of magnitude than the available Canadian Interim Sediment Quality Guidelines (ISQG) for PAHs (Canadian Council of Ministers of the Environment [CCME] 2015).

Of the 27 metals analyzed, 11 were below the RDLs (antimony, beryllium, bismuth, boron, cadmium, mercury, molybdenum, selenium, silver, thallium and tin) and 16 were above the RDLs (aluminum, arsenic, barium, chromium, cobalt, copper, iron, lead, lithium, manganese, nickel, rubidium, strontium, uranium, vanadium and zinc) (Table 3.7). None of the metals above the RDL with an ISQG (arsenic, chromium, copper, lead and zinc) exceeded the ISQG limit. The two metals with *CEPA* Disposal at Sea Sediment Screening Criteria (lower level) limits (cadmium and mercury) were not detected in any sediment sample.

Table 3.7 Total Extractable Metals along Cable Route, October 2014

Parameter	RDL	Units	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	CEPA Disposal at Sea Screening Criteria - Lower Level	CCME Sediment Quality Guidelines	
														ISQG[1] Marine	PEL[2] Marine
Aluminum	10	mg/kg	4,600	3,600	4,100	3,700	4,100	4,400	4,800	4,400	4,800	4,500		-	-
Antimony	2	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2		-	-
Arsenic	2	mg/kg	2	5	3	3	7	7	5	5	4	3	-	7.24	41.6
Barium	5	mg/kg	21	10	14	12	13	13	13	14	17	19	-	-	-
Beryllium	2	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-	-	-
Bismuth	2	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-	-	-
Boron	50	mg/kg	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	-	-	-
Cadmium	0.3	mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.6	0.7	4.2
Chromium	2	mg/kg	12	9	10	9	10	10	11	10	10	10	-	52.3	160
Cobalt	1	mg/kg	5	4	4	5	5	5	5	4	5	4	-	-	-
Copper	2	mg/kg	4	3	3	3	3	2	2	2	2	3	-	18.7	108
Iron	50	mg/kg	12,000	11,000	11,000	10,000	12,000	13,000	14,000	13,000	12,000	13,000	-	-	-
Lead	0.5	mg/kg	4.8	4.6	5.2	4.8	5.8	5.1	5.4	5.3	4.4	8.5	-	30.2	112
Lithium	2	mg/kg	13	9	10	9	10	10	11	11	12	11	-	-	-
Manganese	2	mg/kg	170	250	220	220	720	280	250	270	350	230	-	-	-
Mercury	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.75	0.13	0.7
Molybdenum	2	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-	-	-
Nickel	2	mg/kg	10	7	8	8	9	8	9	8	9	9	-	-	-
Rubidium	2	mg/kg	4	3	3	3	3	3	4	3	4	4	-	-	-
Selenium	1	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-
Silver	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-
Strontium	5	mg/kg	10	33	32	44	120	25	12	23	13	15	-	-	-

Table 3.7 Total Extractable Metals along Cable Route, October 2014

Parameter	RDL	Units	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	CEPA Disposal at Sea Screening Criteria - Lower Level	CCME Sediment Quality Guidelines	
														ISQG[1] Marine	PEL[2] Marine
Thallium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-
Tin	2	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-	-	-
Uranium	0.1	mg/kg	0.5	0.3	0.4	0.4	0.3	0.3	0.4	0.4	0.4	0.5	-	-	-
Vanadium	2	mg/kg	22	20	21	19	22	23	23	24	18	26	-	-	-
Zinc	5	mg/kg	21	22	22	21	24	26	28	25	24	23	-	124	271

Notes:

[1] ISQG – Interim Sediment Quality Guidelines as specified in the (Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environmental, 1999, updated 2015).

[2] PEL – Probable Effect Levels as specified in the (Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environmental, 1999, updated 2015).

Analytes detected at or above RDL are reported here.

3.1.2.2.6 Marine Fish

Many marine fish species targeted as CRA fisheries occur in the RAA. The main CRA fisheries are American lobster (*Homarus americanus*), deep-sea scallop (*Placopecten magellanicus*) and rock crab (*Cancer irroratus*). Groundfish in the RAA include Atlantic cod (*Gadus morhua*) and Atlantic halibut (*Hippoglossus hippoglossus*). Pelagic species fished commercially include Atlantic herring (*Clupea harengus*) and Atlantic mackerel (*Scomber scombrus*).

Shellfish species likely dominate the Aboriginal and recreational fisheries, including bar clams (Atlantic surf clam, *Spisula solidissima*), soft-shell clams (*Mya arenaria*), blue mussels (*Mytilus edulis*) and eastern oysters (*Crassostrea virginica*).

There are no marine fish species at risk listed under Schedule 1 of *SARA* found within the RAA. COSWEIC-assessed marine fish species that could occur in the RAA include Atlantic salmon (*Salmo salar*) (Gaspé-Southern Gulf of St. Lawrence population), smooth skate (*Malacoraja senta*) (Laurentian-Scotian population) and thorny skate (*Amblyraja radiate*) (Species at Risk Public Registry 2015).

A brief description of the dominant CRA fishery species in the RAA with the potential to occur in the PDA and LAA is provided in the following sections.

American Lobster

American lobster can be found in shallow subtidal waters to the edge of the continental shelf from North Carolina to Labrador, in water temperatures ranging from -1 °C to 26 °C, with a preferred temperature of 4 °C to 18 °C (Chassé et al. 2014). Lobsters prefer rocky areas and have been known to inhabit sand, gravel and mud bottoms and migrate between deeper offshore waters in the winter and shallower waters in the summer (DFO 2009a).

The reproductive cycle of the female American lobster lasts approximately two years (DFO 2013a). Female lobster mate with a male once molting is complete; the sperm are stored on the underside of its body in a "sperm plug". This initiates an approximately two-year reproductive cycle, with eggs developing internally over a 12-month period, extruded the following summer then fertilized with the stored sperm (DFO 2009a, 2013a). The female then carries the fertilized eggs attached under her abdomen for an additional 9 to 12 months before they hatch. Once hatched, the larvae are planktonic for three to ten weeks, depending on temperature (DFO 2013a). The larvae then settle to the bottom and find suitable shelter to inhabit in the benthic environment; the juvenile lobsters prefer inshore gravel/cobble substrates with kelp cover (Christian et al. 2010).

Juvenile and adult lobsters are omnivorous predators, feeding on species such as gastropods (periwinkle), bivalves such as mussel, crustaceans (rock crab are an important prey item), polychaetes, sea stars, sea urchins, fish and plant material (DFO 2009a, 2013a; Christian et al. 2010). Lobsters have been known to scavenge for food and feed opportunistically on dead animals including fish, marine mammals and discarded bait and on discarded lobster shells (DFO 2009a). Adult lobsters are fed on primarily by humans (DFO 2009a). While it is suggested that small lobster are prey for several fish (such as cod, flounder, sculpin (species dependent upon region)), a study by Hanson (2009) examining the stomachs of 14 demersal fish, 5 pelagic fish and 3 crustacean species, indicated that planktonic lobster larvae were rarely preyed upon, and juvenile lobster predation (during the molt) was restricted to shorthorn sculpin and adult lobster.

Deep-sea Scallop

The deep-sea scallop is a large bivalve mollusc found from North Carolina to Labrador in depths ranging from approximately 10 to 100 m (but may be found in shallower areas) and 15 to 37 m in the RAA (DFO 2011). They are benthic filter-feeders that frequently occur on sand-gravel or gravel-pebble substrates in dense local aggregations (DFO 2011).

Sea scallops are typically between 100 to 150 mm in shell height and annual rings are formed on the shell each year at the time of cold water (DFO 2011; Davidson et al. 2012). The ideal temperature for growth is 13.5 °C (typically ranging from 8 °C to 18 °C); mortality occurs at temperatures of 23.5 °C or higher. Sea scallop growth rates are highly variable (DFO 2011). Scallops sampled and aged during an at-sea program in the southern Gulf of St. Lawrence, conducted between 2001 to 2005, ranged from 3 to 17 years old (DFO 2011).

Sea scallop typically reach shell heights of 100 to 150 mm (Davidson et al. 2012). Sea scallop can spawn once they reach a shell height >70 mm; fecundity varies annually and is exponentially related to the shell height (DFO 2011). Timing for spawning varies from July to early October (Christian et al. 2010) and typically occurs at the end of August in the RAA, with egg and sperm released simultaneously (DFO 2011). The planktonic larvae metamorphose and settle to the bottom after four to five weeks (DFO 2011); however, settlement (and metamorphosis) can be delayed for approximately one month in the search for suitable substrate (Christian et al. 2010).

Adult scallop filter the water column for plankton and detritus. In addition to humans, adult sea scallop are fed upon by lobster, rock crab, sea star, moon snails, burrowing anemones and fish such as cod, plaice, wolffish, sculpins and winter flounder (Christian et al. 2010).

Rock Crab

Rock crab are found from Labrador to Florida (Christian et al. 2010) on all bottom types to a depth of 575 m, although they are found primarily in intertidal areas north of Cape Cod (Gosner 1978) and prefer sandy bottoms in shallow waters (DFO 2013b). The southern Gulf of St. Lawrence population is widespread and abundant (DFO 2013b; Caddy and Chandler 1976, in Rondeau et al. 2014) and is most abundant on seaweed-covered rocky substrates, but they can occur in eelgrass beds and bare rocky or sandy substrates (Christian et al. 2010).

Female rock crab mate with a male in late summer and fall once molting is complete and the female's carapace is still soft. Eggs are not stored but are typically extruded and fertilized soon after mating; eggs are then carried beneath the female's abdomen for approximately 10 months. Once hatched (occurring as early as mid-June), the larvae are pelagic and go through six stages before they settle to the substrate, typically by mid-September (DFO 2013b).

Rock crabs feed on polychaetes, other crustaceans, bivalves (including sea scallop and mussel), sea urchin and brittlestar (JWEL 2001; Christian et al. 2010). Rock crab is a key food item for lobster (DFO 2013a) and are also eaten by groundfish (Christian et al. 2010).

Atlantic Cod

There is no directed commercial fishery for Atlantic cod (*Gadus morhua*); the directed commercial fishery in the southern Gulf of St. Lawrence was closed in 2009. A set amount (300 tonnes [t] in 2012) is allocated to cover Atlantic cod by-catches in other groundfish fisheries, negotiated Aboriginal food, social and ceremonial agreements, a limited recreational fishery, and for scientific purposes (DFO 2012a).

Atlantic cod occur on both sides of the North Atlantic, from southern Baffin Island to North Carolina, preferring temperatures of -0.5 °C to 10 °C and occurring to depths of 450 m (Scott and Scott 1988). Southern Gulf of St. Lawrence Atlantic cod are migratory.

The Atlantic cod start to mature at ages four to five, reaching sexual maturity by age seven (DFO 2009b). Spawning occurs from late April to early July around the Magdalen Islands and in the Shediac Valley at depths influenced by temperature (Scott and Scott 1988; DFO 2009b). Eggs and sperm are released by the adults and fertilization occurs in the water column. Atlantic cod eggs develop near the surface; hatching occurs when the embryos are approximately 3 to 6 mm long and is dependent upon water temperature. The larval Atlantic cod remain pelagic until they are approximately 25 to 50 cm long, at which time they then descend (Scott and Scott 1988).

Atlantic cod feed primarily on the bottom on krill, shrimp, and small fish; however, they may also feed in the pelagic zone. Atlantic cod begin to migrate in late October, overwintering along the edge of the Laurentian Channel. They typically migrate back into the RAA beginning in mid-April (DFO 2009b).

Atlantic Halibut

In the Northwest Atlantic, Atlantic halibut live from Virginia to Labrador (and Greenland), in waters greater than 2.5 °C (Scott and Scott 1988). The Gulf of St. Lawrence stock is one of two in eastern Canada, the other is the Nova Scotia and southern Grand Banks stock. Gulf of St. Lawrence Atlantic halibut migrate between shallower water during the summer and waters as deep as 500 m in the winter; they prefer to remain in the area where they were born (DFO 2009c).

Gulf Atlantic halibut spawn from December to January and May to June. Spawning females are typically between 10 and 14 years old; sexually mature males are typically 8 to 10 years old (DFO 2009c, 2015). The Magdalen Shallows are likely a favourable spot for spawning in the Gulf of St. Lawrence (DFO 2009c). Spawning takes place at water depth of approximately 185 m or greater; the eggs remain pelagic and hatch in approximately 16 days (at 6 °C) (DFO 2009c). The larvae remain pelagic for some undefined period (the yolk sac lasts four to five weeks), but gradually settle to the bottom (Scott and Scott 1988; DFO 2009c).

The diet of the Gulf Atlantic Halibut stock, as determined from stomach contents collected between May and November, is comparable to that described elsewhere in the Atlantic Ocean. In the Gulf of St. Lawrence, invertebrates such as krill and shrimp are the primary food of Atlantic halibut less than 30 cm. Atlantic halibut between 30 and 80 cm can feed on fish and shellfish such as capelin, witch flounder, sculpin, snow crab and squid, among others (DFO 2015).

Atlantic halibut are not typically harvested in the Northumberland Strait RAA (DFO 2015).

Atlantic Herring

In the Northwest Atlantic, Atlantic herring live from North Carolina to Labrador (and Greenland) (Scott and Scott 1988) and are found from the north shore of the Gaspe Peninsula to the northern tip of Cape Breton Island (including the Magdalen Islands) in the in the southern Gulf of St. Lawrence (LeBlanc et al. 2015).

Atlantic herring are a pelagic species, forming schools during feeding and spawning periods. Spawning occurs in the spring (April and May, with some in June in the Northumberland Strait and Chaleur Bay) and fall (mid-August to mid-December in Miscou and Escuminac, New Brunswick; North Cape and Cape Bear, PEI; and Pictou, Nova Scotia) at depths <10 m and 5 to 20 m, respectively (DFO 2014). The eggs and sperm are released simultaneously and remain attached (usually on seaweed) on the bottom until hatching. Eggs spawned in the spring hatch in approximately 30 days, and those spawned in the fall hatch in approximately10 days. Atlantic herring larvae are planktonic and feed on small phytoplankton (JWEL 2001). Adults overwinter off the east coast of Cape Breton, Nova Scotia (LeBlanc et al. 2015).

The primary food source for Atlantic herring is plankton (copepods, euphausiids, fish eggs, pteropods and mollusc and fish larvae) (DFO 2014; LeBlanc et al. 2015).

Atlantic Mackerel

Atlantic mackerel are a pelagic species occurring from North Carolina to the Gulf of St. Lawrence and the east coast of Newfoundland (Scott and Scott 1988). Atlantic mackerel migrate into the Gulf of St. Lawrence in the spring and back into the Atlantic Ocean and deeper, warmer waters at the edge of the continental shelf between September and November (DFO 2012b). Atlantic mackerel are a schooling species and move in large schools (JWEL 2001).

Atlantic mackerel primarily spawn in two areas in the Northwest Atlantic Ocean: between Cape Hatteras and Cape Cod; and in the southern Gulf of St. Lawrence, with limited spawning occurring off the coasts of Newfoundland and Labrador or Nova Scotia (Scott and Scott 1988). The key spawning area is the Magdalen Shallows (Scott and Scott 1988). The main Atlantic mackerel stock spawn in the Northumberland Strait in June and July (DFO 2012b). Female Atlantic mackerel spawn several times during the spawning season at any time of the day and night. Water temperature determines egg development time, with eggs hatching in five to seven days at 11 °C to 14 °C. Larvae are common in the Magdalen Shallows, north of the RAA and measure approximately 3 mm long at hatching; they are considered juveniles at 50 mm in length and begin to form schools (JWEL 2001).

Atlantic mackerel feed primarily on plankton (via filter feeding); however, adults feed on small fish and squid (Scott and Scott 1988; JWEL 2001).

Bar Clams

Bar clams range from Rhode Island to Baffin Island in the Western North Atlantic at water depths from just below the low water mark to approximately 100 m on sandy substrates (Gosner 1978; DFO 1996a, 2010a).

Bar clams in PEI reach sexual maturity at approximately four years (80 to 95 mm shell length) and spawn from late June to August at temperatures greater than 15 °C (Cargnelli et al. 1999; Christian et al. 2010). Fertilization occurs in the water column and the fertilized eggs and larvae are planktonic, settling to the bottom as they become juveniles (occurring approximately 20 to 35 days after fertilization, temperature-dependent) (Cargnelli et al. 1999). They can grow to shell lengths of 175 mm. Bar clams typically burrow 2 to 3 cm into the substrate and can move across the substrate using its muscular foot (DFO 1996a).

Bar clams siphon plankton (primarily diatoms and ciliates) from the water column. In addition to humans, adult bar clams are fed upon by snails, sea stars, crab, and fish including haddock and cod (Cargnelli et al. 1999; Christian et al. 2010).

Soft-shell Clam

Soft-shell clams occur from North Carolina to Labrador in the Western North Atlantic on mud or sand flats in shallow waters, from the intertidal to approximately 9 m. They are an important commercial, recreational and traditional species in the Gulf of St. Lawrence (Gosner 1976; Abgrall et al. 2010).

Spawning typically occurs between early to late June and early July in the southern Gulf of St. Lawrence (DFO 1996b, 2001), with males releasing sperm first into the water column, followed by females releasing eggs (DFO 1996b; Abgrall et al. 2010). The fertilized eggs metamorphose through various stages, first free-swimming larvae (approximately four weeks), then settling to the bottom and exploring the substrate as juveniles. The juveniles gradually lose their mobility and develop into sedentary adults, building a permanent burrow at approximately 6 mm in size (DFO 1993, 1996b; Abgrall et al. 2010).

Soft-shell clam siphon microscopic plant and animal material from the water just above the substrate surface (DFO 1993). In addition to humans, adult soft shell clams are fed upon by starfish, birds (such as sea ducks and shorebirds), worms, crustaceans (such as crabs), fish (such as rays and flounders) and other molluscs (such as moon snails) (DFO 1993; Abgrall et al. 2010).

Blue Mussel

Blue mussels occur attached to submerged surfaces from South Carolina to Baffin Island in the Northwest Atlantic Ocean (Gosner 1976; DFO 2003; Christian et al. 2010). Blue mussels spawn in the warmer months (May to August), with male and female releasing their gametes synchronously (DFO 2003; Christian et al. 2010). The fertilized eggs metamorphose through various stages, first free-swimming larvae for three to four weeks, then settling to the bottom and exploring the substrate as juveniles. The juveniles gradually lose their mobility and develop into sedentary adults, attaching to a hard substrate with byssal threads (DFO 2003; Christian et al. 2010).

Mussels are suspension feeders, actively filtering phytoplankton cells (both living and dead) from the water through the frilled siphons; they also ingest decomposed macrophytes or re-suspended detritus and bacteria (DFO 2003; Christian et al. 2010). In addition to humans, adult blue mussel are fed upon by sea ducks, starfish, crabs, lobster and oyster thief (DFO 2003); they are the most important food item for the common eider (Christian et al. 2010).

Eastern Oyster

The eastern oyster (known as American oyster) can be found on hard substrate from Brazil to the Gulf of St. Lawrence (Comeau et al. 2008), with large concentrations in Chesapeake Bay and off the coast of the Gulf of Mexico (DFO 2010b).

Spawning In the southern Gulf of St. Lawrence is dependent upon water temperatures and occurs from late June to early July (mid-June to August in the Maritimes) (DFO 2009d; Abgrall et al. 2010). Eggs and sperm are synchronously released into the water column (individual eastern oyster can alternate sexes during a spawning season) (Galtsoff 1964, in Abgrall et al. 2010). The fertilized eggs metamorphose through various stages, first free-swimming larvae, then settling to the bottom and attaching itself to a hard substrate with a cement secretion (DFO 2009d; Abgrall et al. 2010).

Adult eastern oyster are suspension filter-feeders, ingesting various sizes of phytoplankton, bacteria, and particles from the surrounding water (Abgrall et al. 2010). In addition to humans, adult Eastern oyster are fed upon by crabs, sea stars, flatworms and birds such as sea ducks and oystercatchers (Gosner 1976; Abgrall et al. 2010).

3.1.2.2.7 Marine Wildlife

Marine Reptiles

The only marine reptile that has been observed in Northumberland Strait is the leatherback sea turtle (*Dermochelys coriacea*). This is the most widely distributed and largest of all marine turtle species, and will undertake annual migrations into Atlantic Canadian waters during the summer months. The main reason for the turtle's migration into Northern Atlantic waters is to feed on jellyfish, which are seasonally abundant in temperate shelf and slope waters off of Eastern Canada. A report by DFO (2011) identified the southeastern portion of the Gulf of St. Lawrence as a primary area of important habitat. While there is no known concentration of leatherback turtles that occurs directly in the Northumberland Strait, turtles do pass through the Abegweit Passage (AMEC 2007). The leatherback turtle is a listed species under Schedule 1 of *SARA*.

Marine Mammals

The Gulf of St. Lawrence provides habitat for a number of marine mammal species, including 13 recorded species of whales and four species of seals (DFO 2005). Within the Northumberland Strait there are nine species of marine mammals that have been recorded, ranging from common sightings to a rare stranding of a sperm whale (*Physeter macrocephalus*) in 1993 (AMEC 2007). These marine mammal species and frequency of occurrence are provided in Table 3.8. Out of the nine marine mammal species that have been known to occur in the Northumberland Strait, the Fin Whale (*Balaenoptera acutorostrata)* is the only mammal that is listed under Schedule 1 of *SARA*.

Table 3.8 Marine Mammal Occurrence in the Northumberland Strait

Common Name	Scientific Name	Frequency
Grey Seal	*Halichoerus grypus*	Common
Harbour Seal	*Phoca vituline*	Common, spring, summer and fall; year-round resident in the Gulf of St. Lawrence
Hooded Seal	*Cystophora cristata*	Occasional
Harp Seal	*Phoca goenlandica*	Occasional
Atlantic White-sided Dolphin	*Lagenorhynchus acutus*	Common, summer and autumn
Harbour Porpoise	*Phocoena phocoena*	Common, summer and autumn
Fin Whale*	*Balaenoptera acutorostrata*	Occasional, rare sightings
Pilot Whale	*Globicephala melaena*	Rare sightings
Sperm Whale	*Physeter macrocephalus*	Stranding occurred, Hillsborough Bay

Note: * Listed under *SARA 2002* as a special concern species.
Source: AMEC 2007

Pinnipeds

Grey seals (*Halichoerus grypus*) are ubiquitous throughout the Gulf of St. Lawrence, and one of the most common species of seal found year-round within the Northumberland Strait. Males can reach lengths up to 2.3 m long and weigh 300 to 350 kg, while females grow to a length of approximately 2 m and weigh 150 to 200 kg (JWEL 2001). Typical breeding season for the grey seal starts around late December to early February. Pups are nursed for a couple of weeks and then weaned from their mother (DFO 2015). Grey seals typically feed on herring, flounder, cod, shrimp, mackerel and a variety of other marine organisms. This variable diet makes grey seals a threat to the commercial fishery both for a reduction of resources and to damage of fishing equipment (JWEL 2001). The grey seal population in the Gulf has increased over the past 20 years; in 1999, COSWEIC designated this population not at risk. In 2014, the North Atlantic population (including pups) was estimated to be approximately 505,000 (DFO 2015).

Harbour seals (*Phoca vituline*) are another common species found in the Strait and throughout the Gulf of St. Lawrence. Males will grow between 1.4 to 1.9 m and weigh 70 to 130 kg, with females being slightly smaller (JWEL 2001). This species typically breeds in late spring to early summer (May to June) and their normal whelping locations are located in aggregations around PEI and the western shore of Cape Breton. Females reach reproductive maturity between three and five years, and will give birth to a single pup. The pup is nurtured for about a month and then weaned (JWEL 2001). Harbour seals have a highly variable diet that can consist of cod, pollock, capelin and squid. Harbour seals have one of the smallest populations among seal species found in the Gulf of St. Lawrence. In 1970 the population was estimated at 12,700 individuals; this was mainly attributed to a bounty hunt program that reduced the population substantially (JWEL 2001). However, now it is estimated that there are approximately 20,000 to 30,000 individuals in Atlantic Canada. In 2007, COSEWIC designated the harbor seal as a not-at-risk species (DFO 2015).

Hooded seals (*Cystophora cristata*) are spotted seasonally in the Northumberland Strait, typically during their breeding period in the winter. There are two major populations of hooded seals, the Greenland population and the Northwest Atlantic population. The majority of the Northwest Atlantic population typically resides in continental shelf waters off of Northern Newfoundland and Southern Labrador. However, there is a small group of seals that occupy the southern Gulf of St. Lawrence from the fall until spring, and will whelp on pack ice during March between the Magdalen Islands and PEI (Hammill et al. 2001). The nursing period for hooded seals is much shorter than other seal species, only four days, in which the pups double in size. The diet of the hooded seal is much the same as other seal species in the Gulf, consisting of a variety of pelagic fish and squid (JWEL 2001). Male seals average approximately 2.6 m in length and weigh 300 to 460 kg, while females average 2 m in length and 145 to 300 kg. The last population estimate in 2005 reported approximately 593,500 individuals, and it is thought that this number is increasing. This species is not at risk according to COSEWIC (DFO 2015).

Harp seals (*Phoca goenlandica*) are the most abundant species of seals in the Northwest Atlantic, with an estimated population of 7.4 million individuals (DFO 2015). Male and female harp seals are similar in size and average 1.6 m in length and weigh 130 to 150 kg. Harp seal breeding season is usually between February and March, with female seals giving birth to one pup per year. The pups are then nursed for approximately 12 days before weaning. The population range is restricted to the North Atlantic and divided into three sub-populations, with the Gulf herd breeding on ice near the Magdalen Islands. The success rate of breeding for harp seals depends on the ice conditions from year to year. While 2014/2015 was a good year for ice conditions and juvenile survival, the total amount of ice present in the Gulf in 2009/2010 was the lowest since 1969. This lead to very little pupping observed in the Gulf, with no whelping concentrations observed in the Southern Gulf due to the lack of ice present (Stenson and Hammill 2012). A study conducted by Bajzak et al. (2011) stated that climate change simulations and models have predicted a general decrease of ice duration in the Gulf of St. Lawrence, up to 70 % by 2050, except in the Northumberland Strait. This could potentially lead to more harp seals moving farther south, and into the Northumberland Strait to breed. The population is not listed under any organization as a species at risk, and it has never been assessed by COSEWIC likely due to the abundance of the species.

Cetaceans

The Atlantic white-sided dolphin (*Lagenorhynchus acutus*) is found in the western North Atlantic from North Carolina to Greenland (Hammill et al. 2001), and it is found seasonally in the Northumberland

Strait during the summer months. This species moves closer inshore during the summer months and moving out into deeper southern waters in the winter. Adult dolphins weigh between 180 to 225 kg, and average between 2.5 to 3 m in length. The Atlantic white-sided dolphin is a very social species and will rarely travel alone. There have been recordings of dolphin pods consisting of a few individuals, all the way up to 500 (NOAA 2014a). Breeding season is typically during May to August, and females will give birth to one calf after an 11-month gestation period. The diet of this species consists of a variety of fish, shrimp and squid, and they are often associated with fin and pilot whales while feeding. There are few data collected on population trends, especially in the Gulf of St. Lawrence. In 2007, the best estimated size of the population in the North Atlantic was 63,000 individuals (NOAA 2014a).

The harbour porpoise (*Phocoena phocoena*) is one of the smallest whales in the world and is found in two distinct populations, the Northwest Atlantic and Pacific populations, with the Northwest Atlantic population spread out along the north coast of Labrador down to the Bay of Fundy/Gulf of Maine (DFO 2008). Harbour porpoises are well adapted to cold water and are rarely found in waters warmer than 16 °C. They average approximately 1.6 m in length and 50 kg at full growth, with females tending to be larger than males, and they often travel in small pods of about 10 individuals. Females reach sexual maturity at three years, and will often give birth to a single calf after a 10 to 11-month gestation period. The calf is then nursed for an additional 8 months before being weaned from its mother. The typical diet of the harbour porpoise consists of herring, capelin, cod, hake and sand lance (DFO 2008). Since many of these fish in the porpoise's diet are commercially fished species, bycatch is one of the main threats to the species population. The harbour porpoise is not listed on the *SARA* Schedule 1 list of species at risk; however, it was assessed by COSEWIC in 2006 as a species of special concern, due to the high rate of bycatch from commercial fisheries. While there are populations throughout the Gulf of St. Lawrence, the harbour porpoise is well known to occur in the Northumberland Strait. While the Pacific population of the harbour porpoise is listed under Schedule 1 of *SARA*, the Atlantic population has not been listed; it is currently listed as threatened under Schedule 2.

The fin whale (*Balaenoptera acutorostrata*) is the second largest species of whale in the world, after the blue whale (*Balaenoptera musculus*). It can range in size from 20 to 27 m in length and weigh between 60 and 80 t. Females typically reproduce every two to three years, giving birth to a single calf. There are two main populations of fin whales that are found in Canadian waters, the Pacific and Atlantic populations. The Atlantic population has a wide distribution and can be found in waters as far north as Greenland, down into the Bay of Fundy and the Gulf of Maine (DFO 2013). Fin whales generally do not travel together and will often migrate alone or in very small pods. The fin whale uses baleen to filter food from the ocean water, and its typical diet consists of krill and small fish such as herring and capelin. While there is a general distribution pattern for fin whales throughout the North Atlantic, there is little information regarding their distribution throughout the Gulf of St. Lawrence. During a series of aerial surveys conducted in 1995/1996, fin whales were observed in the Gulf, but none were reported in the southern Gulf region. Observations of fin whales from whale-watching companies between May and October in 2000 indicate that this species will frequently visit the waters of the southern Gulf, including the Northumberland Strait (Hammill et al. 2001). Currently, the fin whale is the only marine mammal known to occur in the Northumberland Strait that has been listed on Schedule 1 of *SARA*. The population is listed as a special concern species.

The long-finned pilot whale (*Globicephala melaena*) has been known to visit the waters of the Northumberland Strait during the summer and fall months, while spending the winter months at lower latitudes such as the Gulf of Maine and the Northeast US coast (Hammill et al. 2001). This is a medium sized species, with males growing up to 8 m and weighing over 2,000 kg. Females typically tend to be smaller, reaching up to 6 m and weighing between 1,000 to 1,500 kg (NOAA 2014b). Females reach sexual maturity at eight years of age, and will give birth to a calf after a 12 to 18-month gestation period. Pilot whales typically prefer deep pelagic temperate to sub-polar ocean waters, but have been known to occur in some coastal bodies. They can dive to depths of around 600 m to find food, which consists of a variety of fish, cephalopods and crustaceans (NOAA 2014b). There are currently two global populations of pilot whales, one in the North Atlantic and one in the southern hemisphere. The North Atlantic population was known to occupy all areas of the Gulf of St. Lawrence; however, the southern Gulf is recognized as its main area of concentration. Pilot whales represent approximately 20 % of strandings off the coast of PEI since 1988 (Hammill et al. 2001). During the construction of the Confederation Bridge, pilot whale observations were recorded during marine environmental effects monitoring programs (JWEL 1994).

3.1.2.2.8 Marine Birds

The Northumberland Strait provides habitat for a wide variety of marine birds that are present both annually and seasonally. During terrestrial environmental effects monitoring during the Confederation Bridge construction, a 1995 survey identified 69 different species of aquatic and marine birds (Table 3.9).

Table 3.9 Summary of Species Identified During 1995 Confederation Bridge Terrestrial Environmental Effects Monitoring Studies

Bird Group (Guild)	Number of Species
Dabbling Ducks	13
Diving Ducks	3
Sea Ducks	13
Sea Birds	9
Diving Birds	9
Shore Birds	18
Waders	2
Geese	2
Total	69
Source: AMEC 2007	

Common inshore seabirds that inhabit the Northumberland Strait include various species of gulls, terns and cormorants. These are birds that spend substantial time at sea in shallow bodies of water, where food is easily accessible, and then they will return to land at night to rest. Offshore seabirds are less common in the Northumberland Strait due to the lack of islands or rocky cliffs, which these birds use as nesting grounds (AMEC 2007). Some examples of offshore birds include auks and petrels.

Waterfowl are generally classified as being of the order Anseriformes (e.g., geese, swans, ducks and mergansers), and marine waterfowl (i.e., seaducks) which are found in the marine environment outside the breeding season. Of the 69 species of marine birds observed during the 1995 terrestrial environmental effects monitoring for the Confederation Bridge project (AMEC 2007), 45 % were ducks and geese and 32 % were seabirds or sea ducks (Table 3.9). Many of these species of waterfowl are migratory and present in the Strait through the spring and fall as they make their transition between breeding and wintering grounds. Spring migration usually spans from March to May, and fall migration lasts from September to November. Some common species of waterfowl that are found in the Strait include all three species of scoter (Black (*Melanitta americana*), White-winged (*Melanitta fusca*) and Surf (*Melanitta perspicillata*)), Long-tailed Duck (*Clangula hyemalis*), Common Eider (*Somateria mollissima*), American Black Duck (*Anas rubripes*), Green-winged Teal (*Anas crecca*), Greater Scaup (*Aythya marila*), Canada Goose (*Branta canadensis*), Red-breasted Merganser (*Mergus serrator*) and Common Goldeneye (*Bucephala clangula*).

The Northumberland Strait ranks second only to the Bay of Fundy in importance as a stopover location for migrating shorebirds. It is estimated that over 30 species of shorebirds will gather in the Strait during the spring and fall migrations (JWEL 2001). The extensive mudflats that are present throughout the Strait provide a crucial food source that the birds need to gather fat reserves and energy for migration to breeding grounds. Migrating shorebirds typically have staging areas that they will return to year after year, which make them more sensitive to disturbance and habitat loss. Common shorebirds that can be found in abundance during the migrating period include Semipalmated Sandpiper (*Calidris pusilla*), Semipalmated Plover (*Charadrius semipalmatus*), Sanderling (*Calidris alba*), Short-billed Dowitcher (*Limnodromus griseus*), Black-bellied Plover (*Pluvialis squatarola*), Least Sandpiper (*Calidris minutilla*), Greater Yellowlegs (*Tringa melanoleuca*), Dunlin (*Calidris alpina*) and Red Knot (*Calidris canutus*) (JWEL 2001).

While the Northumberland Strait typically serves as a stopping point for a large majority of species during their migration period, there are a number of species that are found year-round and breed in the Strait. Areas of the Strait support sensitive nesting areas for certain species. Species that have been known to breed in the Northumberland Strait include terns, plovers, cormorants, Razorbills (*Alca torda*), Willets (*Tringa semipalmata*), Ring-billed Gulls (*Larus delawarensis*), Great Blue Herron (*Ardea herodias*) and Black Guillemot (*Cepphus grylle*).

Terns are small-to medium-sized birds known for their long pointed wings and their quick agile flying, and are found throughout the Gulf of St. Lawrence. There are 17 different types of terns within the tern family, with the Common Tern (*Sterna hirundo*) and Arctic Tern (*Sterna paradisaea*) found in the Northumberland Strait. Terns typically feed on small inshore fish such as sticklebacks, and will feed on small invertebrates as well. Terns are known as diving seabirds, and will often hover above water for a short period of time before diving after their prey (Cornell Lab of Ornithology 2014). Common Terns usually arrive in early May, with Arctic Terns arriving soon after. They will begin to leave the Maritimes in August, and most will be absent by the end of September (JWEL 2001).

Aside from the Piping Plover (*Charadrius melodus,* listed as endangered on Schedule 1 of the *SARA*), the only other plover species that is known to nest within the Northumberland Strait is the Semipalmated Plover. The Semipalmated Plover is a very common migrating shorebird, and is one of the most abundant plover species to be found in the Northumberland Strait. These birds are known to migrate through the Strait during the fall and spring months, and will breed in areas of the Northumberland Strait during the summer. The plover is more tolerant to human activities and disturbances, and anthropogenic structures such as road margins and drill pads have been known as nesting sites (Cornell Lab of Ornithology 2014). These plovers will begin to arrive in late April, with most passing through the Maritime Provinces during migration. However, there are some that will stay to breed and lay eggs in early May. The fall migration begins in mid-July and ends in November, with peak numbers of plover occurring during July to mid-September (JWEL 2001).

The Double-crested Cormorant (*Phalacrocorax auritus*) and the Great Cormorant (*Phalacrocorax carbo*) are the only two known species of cormorants known to visit and breed in the Northumberland Strait. The Double-crested Cormorant is a large matte-black fishing bird with yellow-orange facial skin. They breed in the summer and will migrate south during the fall to spend the winter at lower latitudes. The diet of the Double-crested Cormorant is almost entirely of fish, with only a few crustaceans and amphibians ever being recorded. They are a diving hunter, and will chase fish underwater using its webbed feet (Cornell Lab of Ornithology 2014). The Great Cormorant is the most widely distributed cormorant in the world; however, it is restricted to the east coast in North America, breeding in only a few colonies from Maine to Greenland. Like the Double-crested Cormorant, the Great Cormorant's diet consists of fish, and it will dive and chase its prey underwater. Both species begin to arrive in late March to early April, and begin to lay eggs in late April. Part of the population is non-migratory and will stay at their breeding grounds during the winter. Fall migration usually reaches its peak in October (JWEL 2001).

Razorbills are piscivorous, deep-diving seabirds that are widely distributed through boreal and low-Arctic Atlantic waters. Most Razorbills from North American colonies overwinter south of their breeding range in ice-free, coastal waters, with the largest numbers frequenting shoal areas in the outer Bay of Fundy and Gulf of Maine. The breeding population of razorbills is designated as sensitive under the NBDNR General Status of Wild Species (NBDNR 2014). Nesting for Razorbills typically begins in late May and Early June, with breeding birds remaining in their colonies during the late spring and summer. There are also additional transient birds that will breed outside of the Maritimes and spend the fall and winter at sea.

Willets are large stocky shorebirds with bills that are flat and considerably longer than their head. They are often observed alone, and will walk along beaches and mudflats, deliberately pausing to probe for food. The diet of the Willet typically consists of small insects, spiders, fish, crabs, worms, clams and other marine invertebrates located on the coast (Cornell Lab of Ornithology 2014). Willets have been observed during the late summer and early fall in Bedeque Bay, PEI, which is classified as an Important Bird Area in Canada (Birds Studies Canada and Nature Canada 2015). In 2006, the NBDNR classified the breeding population of Willet as sensitive (NBDNR 2014). Willets first arrive in late April, and those who breed will begin nesting during May. Most Willets will leave the area in August, with the late sightings usually occurring in October.

Ring-billed Gulls are abundant throughout much of North America, including in the Northumberland Strait. They are medium sized birds with a short bill and long wings, and they have an estimated population size of over 1 million (Environment Canada 2009). While this species is considered a marine bird and is common around coastal waters, they are known to live inland, feeding at landfills and living in close association with humans. Ring-billed Gulls usually arrive in the Maritimes in late April and leave between September and November. Most gulls are migratory, but some small numbers will overwinter in areas where mudflats remain open and accessible. The breeding population for Ring-billed Gull is listed as secure by the NBDNR (2014).

Great Blue Heron are the largest of the North American heron species, with a wingspan that can reach 1.8 m. They are present year round on the east coast of Canada and are found in all of the Atlantic provinces except Newfoundland and Labrador. They live in both freshwater and saltwater environments, typically in open coast or marshes where they have a steady source of food. Herons typically eat a variety of organisms within striking distance, including fish, amphibians, reptiles, insect, small mammals and other birds. Herons will generally nest in trees, but will move to ground if there are no trees available (Cornell Lab of Ornithology 2014). They have been recorded nesting on bushes, mangroves and in anthropogenic structures such as duck blinds and channel markers. As of 2006, the NBDNR classified the breeding population of Blue Heron as secure (NBDNR 2014), while the province of PEI holds approximately 33 % of the Great Blue Heron population in the Maritimes (PEIDCLE 2015). Great Blue Herons typically arrive in late March, with breeding beginning in mid-April and young being fledged in August. The fall migration period typically peaks in September and October.

The Black Guillemot is a member of the puffin family that breeds along the coasts of Canada and Greenland and tends to stay year-round in northern waters, foraging near shore. It is a medium-sized bird with a thin bill and large white wing patches across its black body. The Black Guillemot is a surface diving predator, and can last underwater for over two minutes to find prey, which normally consists of fish and crustaceans (Cornell Lab of Ornithology 2014). The Black Guillemot is known to nest on PEI and in New Brunswick, with both the breeding and wintering populations being assessed as secure in 2006 (NBDNR 2014). Black Guillemots arrive at their nesting sites in mid-April, with eggs being laid in early June.

Aside from marine birds that use the Northumberland Strait to breed, the Strait is home to a number of marine birds that are listed under Schedule 1 of *SARA*. These birds are shown in Table 3.10.

Table 3.10 Marine Bird Species Listed on Schedule 1 of the *Species at Risk Act*

Common Name	Scientific Name	SARA Classification
Piping Plover- melodus subspecies*	*Charadrius melodus*	Endangered
Barrow's Goldeneye	*Bucephala islandica*	Special Concern
Harlequin Duck- Eastern Population*	*Histrionicus histrionicus*	Special Concern
Roseate Tern*	*Sterna dougallii*	Endangered
Note: * Protected under the *Migratory Birds Convention Act, 1994.*		

Harlequin duck is a small to medium-sized diving duck which breeds adjacent to fast-flowing streams and winters along rocky marine coastlines. This species feeds primarily upon marine invertebrates, and occasionally on fish, which it catches while diving (Robertson and Goudie 1999). The eastern population of harlequin duck is listed as special concern on Schedule 1 of *SARA*, and as an endangered species under the New Brunswick *SARA*. Two populations of the Harlequin Duck are found in Canada: the western population along the Pacific Coast, and the eastern population along the Atlantic Coast. Harlequin Ducks of the eastern population mostly breed throughout much of Labrador, along eastern Hudson Bay, and the Great Northern Peninsula of the island of Newfoundland. There are known breeding populations along the north shore of the Gulf of St. Lawrence, the Gaspé Peninsula, northern New Brunswick, and southeastern Baffin Island in Nunavut. Small groups may spend the winter along the Gaspé Peninsula and Anticosti Island of Québec, and a few individuals may spend the winter in PEI.

The barrow's goldeneye is a medium-sized diving duck and is listed as *special concern* on Schedule 1 under *SARA*, special concern under the New Brunswick *SARA*, and as *sensitive* under NBDNR General Status of Wild Species. The barrow's goldeneye breeds along lakes in parkland, and winters along rocky coasts (Cornell Lab of Ornithology 2014). In Canada, the eastern population breed in Quebec; however, a small number of this population winter on sheltered shores of the Maritimes. Approximately 400 birds winter in the Atlantic Provinces and Maine (Environment Canada 2013).

The Roseate Tern is a medium-sized seabird that is related to gulls. They are very similar to Common and Arctic Terns and are frequently found in their company. It is distinguished from these two species primarily by its shorter wings, longer tail and paler grey plumage. In North America, two populations of Roseate Tern breed on the Atlantic coast in distinct locations. The northeastern population extends from the Magdalen Islands, in the Gulf of St. Lawrence, south to New York. The Canadian population of Roseate Terns breeds almost exclusively on a few islands off the Atlantic coast of Nova Scotia, although small numbers of birds breed on islands in Quebec and New Brunswick. They feed on small saltwater fish, most frequently Sand Lance, herring, Atlantic Silversides and hake. Roseate Terns nest in colonies almost exclusively on small coastal islands. They breed at sites covered with vegetation dominated by beach grass and herbaceous plants (Government of Canada 2015a).

The Piping Plover is a small, thrush-sized shorebird that blends well into its setting. It is primarily the colour of dry sand, but has distinctive black markings (a black collar or breastband, a black band above the white forehead, and a partially black tail). The short and stout bill is orange with a black tip, and becomes black in winter. The melodus subspecies of the Piping Plover is a North American bird that breeds along the Atlantic coast from Newfoundland to South Carolina. It winters along the Atlantic coast, from South Carolina to Florida, and in the Caribbean (Cuba, Bahamas). In Canada, the melodus subspecies breeds on the Magdalen Islands of Quebec, New Brunswick, Nova Scotia, PEI and Newfoundland. About 25% of Canada's Piping Plovers are found in the Atlantic provinces, and they nest above the normal high-water mark on exposed sandy or gravelly beaches. On the Atlantic coast they often nest in association with small cobble and other small beach debris on ocean beaches, sand spits, or barrier beaches. They also forage for food on these beaches (Government of Canada 2015b).

Piping Plovers arrive on their breeding grounds in Eastern Canada in late April or May. Clutches usually contain four eggs and both parents participate in the incubation of eggs and care of nestlings. Females can begin to breed at one year of age and will re-nest once or twice in a season if the eggs are destroyed. Along with being federally listed as a species at risk, the Piping Plover is listed provincially under the New Brunswick *SARA* (Government of Canada 2015b).

3.1.3 Project Interactions with the Marine Environment

Potential Project interactions with the Marine Environment are presented in Table 3.11. These interactions are indicated by check marks, and are discussed in Section 3.1.4 in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects. Following the table, justification is provided for non-interactions (no check marks).

Table 3.11 Potential Project-Environment Interactions and Effects on the Marine Environment

Project Components and Physical Activities	Potential Environmental Effects
	Change in Marine Populations
Construction	
Site preparation for submarine cable	✓
Installation of the submarine cables	✓
Inspection and energizing of the submarine cables	✓
Emissions and wastes	✓
Marine transportation	✓
Operation	
Energy transmission	✓
Infrastructure inspection and maintenance	✓
Emissions and wastes	✓
Decommissioning and Abandonment	
Decommissioning	✓
Emissions and wastes	✓
Transportation	✓

Notes:
✓ = Potential interactions that might cause an effect.
– = Interactions between the project and the VC are not expected.

3.1.3.1.1 Construction

Activities associated with marine construction have potential interactions that might cause an effect with the Marine Environment VC, and are further discussed below in Section 3.1.4.

3.1.3.1.2 Operation

Activities associated with marine operation have potential interactions that might cause an effect with the Marine Environment VC, and are further discussed below in Section 3.1.4.

3.1.3.1.3 Decommissioning and Abandonment

Decommissioning and abandonment will be assessed at the end of the useful life of the Project. The life of the Project is 40 years, at which time it may be decommissioned; however, it is more likely that at that time the Project will be refurbished and will continue to operate on a similar basis in perpetuity. If decommissioning activities are determined to be necessary, it is likely that the cables in the marine environment will be abandoned in place to avoid disturbance of the habitat. Given that the cables are solid dielectric and do not contain oil or other harmful chemicals that could leach into the environment or released if the abandoned cable were damaged, there is no expected interaction with this VC. Any decisions made regarding decommissioning and abandonment will be completed in accordance with the applicable regulations at that time and could include either the abandonment or removal of the submarine cable.

3.1.4 Assessment of Residual Environmental Effects on the Marine Environment

3.1.4.1 Analytical Assessment Techniques

Analytical assessment techniques for the Marine Environment VC rely primarily on Canadian government guidelines, where applicable, and published or peer-reviewed scientific articles to support the environmental effects assessment and thresholds that may be exceeded.

3.1.4.2 Assessment of change in marine populations

3.1.4.2.1 Project Pathways for change in marine populations

Construction

Activities during site preparation and installation of the submarine cables (e.g., excavation in the intertidal zone to prepare the cable landing sites and pre-trenching and trenching of the cable bed) could result in an increased risk of mortality or injury to fish and benthic marine invertebrates in the PDA due to impact from the excavator and the potential increase in TSS from sediment disturbance. Sessile or slow-moving organisms may be buried, smothered, or crushed during the trenching and installation of the submarine cables.

Project vessels may contain water in ballasts that were filled in non-Canadian waters and have the potential to introduce marine invasive species to the Northumberland Strait if improperly discharged.

There is no known literature on bird mortality resulting from collisions with barge or boat-mounted cranes; however, there is extensive literature on avian collisions with various tall structures, such as buildings and communication towers (Erickson et al. 2005). As a result, there is the possibility that marine birds could collide with tall structures, such as cranes and booms, which could be used during Project construction.

Many marine birds are nocturnally active, in part to avoid diurnal avian predators such as gulls. Project structures, such as cranes and vessels, will emit artificial light that can increase predation risk or lead to collisions with structures mounted with lights (Bourne 1979; Montevecchi 2006; Mougeot and Bretagnolle 2000; Wiese et al. 2001). There are multiple other effects that have been observed with respect to interactions between marine construction and marine birds (e.g., circling marine platforms to the point of exhaustion); however, because of the short distance between PEI and New Brunswick, the majority of species are shorebirds/coastal birds.

Installation of the submarine cables is expected to result in temporary disruption of the benthic habitat in the footprint of the PDA. The marine footprint includes two 16.5 km long submarine cables, each with a disturbance area of approximately 10 m in width. The installation of the marine cables will result in the direct disturbance of approximately 33 hectares of seabed (not including the separation area between the two cables).

With the exception of eelgrass beds (Austin et al. 2004), sand substrate offers limited attachment points for macroalgae canopy habitat unless shell fragments or rocks are present (Jones and Stokes 2006). No eelgrass beds were identified along the proposed displacement area of the cable line (see Section 3.1.2 for a description of the baseline nearshore habitat). Disturbance to benthic communities is therefore more likely to be limited to burrowing and sessile fauna. Although there is an initial impact on benthic community composition immediately after dredging, there is no significant ($p < 0.05$) variation in macrobenthic community mean abundance, diversity, number of taxa or species richness between control and dredged sandy sites one day after dredging (Constantino et al. 2009). Overall, the potential for displacement, damage and mortality of large invertebrate fauna by dredging activities depends on their abundance in the dredge trajectory; however the majority (80 to 90%) of displaced mobile species are able to re-burrow very quickly after being displaced (Hauton et al. 2003). The remaining organisms that are unable to re-burrow (due to mortality, injury or biomechanically incapable) are consumed by predators or scavengers along the disturbed area (Hauton et al. 2003). In general, deposit-feeding organisms without external protection (including crustaceans, polychaetes and ophiuroids) are most affected by dredging (Constantino et al. 2009). However, in shallower sandy bottom habitats (<20 m) benthic communities are not highly affected by physical anthropogenic disturbances, likely because these communities are continually subjected to natural disturbance such as surface wave impacts on the benthos (Constantino et al. 2009). Consequently, in deeper water habitats (70 to 80 m) where benthic communities are not accustomed to continual natural disturbances, the effects of displacement of macrobenthic invertebrates is likely to persist for more than a year, as is evident by a reduction in densities of large bivalve burrows in the dredge tract (Gilkinson et al. 2003).

Existing sources of habitat disturbance within the RAA may include commercial fishing activities, specifically scallop dragging. This method of scallop fishing has been associated with direct physical and biological impacts on benthic ecosystems such as reducing habitat complexity and heterogeneity (Currie and Parry 1996), direct benthic infaunal mortality (Boulcott et al. 2013) and mobilization of sediment increasing the release of nutrients and reducing sediment food quality (Watling et al. 2001 and O'Neill et al. 2013). The degree of disturbance depends on several factors such as substrate composition, existing environmental conditions (Kaiser et al. 2006) and the scale and intensity of fishing activity (LeBlanc et al. 2015).

While TSS concentrations can become elevated due to natural processes (e.g., heavy rainfall, storm events), or in certain areas (e.g., nearshore coastal environments), construction activities can increase the concentration of TSS.

There is a wide range of tolerance of fish species to levels of TSS with some species being more sensitive than others (Au et al. 2004). Lower levels of dissolved oxygen are associated with high TSS concentrations (Ntengwe 2006). Elevated TSS concentrations have been associated with high levels of stress in benthic invertebrates (Norton et al. 2002). High concentrations of TSS can also affect fish. Oxygen deprivation has been observed due to sediments coating the respiratory epithelia of fish and cutting off gas exchange with water (Au et al. 2004). Avoidance is the primary response of fish to locally high levels of TSS At high TSS concentrations or prolonged periods of exposure, effects of total suspended sediments on fish have been shown to include: decreased feeding success; reduced ability to detect and avoid predators; gill damage; reduced growth rates; decreased resistance to disease or impaired development of embryos; and may impair reproduction for those species relying on visual cues as a part of courtship and mating(CH2M HILL 2000).

Changes to surficial sediment chemistry could occur as a result of bottom disturbance and re-suspension of existing sediments. Sediment samples collected within the PDA in fall 2014 indicate that the sediment meets the CCME Sediment Quality Guidelines (Marine) and the CEPA Disposal at Sea guidelines. Given these low baseline levels, there is limited risk of marine populations being exposed to acute or chronic toxicity caused by re-suspended sediments; therefore sediment chemistry from sediment disturbance or re-suspension by the Project is not likely a pathway that could result in a change in marine populations.

The cable ship and Project support vessels may operate up to 24 hours a day, 7 days a week during construction. Marine vessel lighting will be required for navigational aids and illumination of work areas during night-time vessel operations. A certain amount of lighting is required for navigational and safety purposes; however, deck lighting will be reduced whenever it is practical to do so and the use of unnecessary lighting will be avoided. If possible, waste lighting will be further reduced through the use of directional overhead lighting focused on work areas, rather than floodlights.

Although operation of Project vessels and equipment will have a deterrent effect on most marine species, there is potential for nocturnally migrating marine birds to be attracted and disoriented by artificial night lighting. Disoriented birds may fly into vessel lights or infrastructure, injuring themselves and becoming stranded.While there are a number of additional effects related to marine bird species with respect to artificial light, there are no known strictly marine bird species in the LAA and the distance between PEI and New Brunswick is not great enough that birds would be attracted to the light source and eventually die of starvation, which has been observed in several species in relation to offshore projects.

Underwater noise introduced during marine construction activities may result in changes in behaviour of fish or marine mammals in the vicinity. Project activities and physical works that may produce underwater noise include trenching, laying of cable, infilling of cable trench, installation of ice scour protection (if necessary), and movement of marine vessels associated with these activities. Excavation of the near-shore trenches will likely require an excavator. Sound levels capable of causing decreased hearing sensitivity or auditory injury (i.e., temporary or permanent noise-induced threshold shifts) are not expected as a result of these construction activities.

The degree to which a marine animal responds to underwater noise depends on a large number of variables including: the nature, magnitude, and duration of the sound, distance from the sound source, species and individual involved, and context (i.e., activity at the time of exposure) (Popper and Hawkins 2012; Richardson et al. 1995; Southall et al. 2007). Marine fish may exhibit a temporary startle response or avoid the source area for the duration of the disturbance (Feist et al. 1996; Hastings and Popper 2005; Thomsen et al. 2012; Wardle et al. 2001). Marine mammals have been known to exhibit a range of responses (Nowacek et al. 2007), from overt avoidance behaviours (Southall et al. 2007) or disruption of foraging patterns (e.g., Sundermeyer et al. 2012; Tougaard et al. 2012), to less obvious responses such as changes to communication (e.g., Castellote 2012; Merchant et al. 2014; Risch et al. 2012; Williams et al. 2013) or increased stress (Rolland et al. 2012).

The potential amount of underwater noise created during trenching is highly variable, and depends on several factors including site-specific details (e.g., type of substrate, level of turbidity) and the type of equipment or installation techniques employed. Noise levels during site preparation and cable installation may exceed behavioural response thresholds for marine mammals within the vicinity of the trenching activity but these are expected to dissipate quickly with distance from the source.

In addition to effects from lighting and noise, there remains the potential for marine wildlife to suffer mortality due to collision with Project vessels or equipment.

Operation

Once installed, the submarine cables will have no further interaction with the marine environment other than their continual presence. Because there will be no direction interaction with marine species associated with the presence of the active cable after it has been installed, interactions are not discussed further in this assessment.

Inspections of the cable will be performed periodically to maintain cable integrity and reliability. The frequency of maintenance requirements will be determined following installation and commissioning. These inspections will identify any areas that require additional protection from scouring. Video inspections are typically performed by a diving contractor. Multi-beam and side-scan sonar surveys may be conducted, as required.

The periodic surveys will check the entire marine cable to confirm that the cable is still buried. A buried cable could accidentally be pulled up out of the seabed (typically related to fishing activities and use of anchors), where it would be vulnerable, even if it is not damaged. The primary environmental effect associated with inspection and maintenance is the vessels used to support divers, remotely operated vehicles, or multi-beam and side-scan sonar surveys, which are likely to generate underwater noise and have the potential to strike marine wildlife.

The production of underwater noise is expected to be minimal during operation of the Project. Occasionally there may be vessels in the area conducting inspection and maintenance activities, although noise is not expected to differ from that of existing fishing and recreational boating in the area.

The transmission of energy through the subsea cables will generate electromagnetic fields (EMF). EMF is a force consisting of direct and induced electric and magnetic components. Some species of marine fish have sensitivities to EMF. The generation of EMF from a subsea cable may interact with certain marine species' ability to navigate and locate prey or predators.

Three EMFs are produced by a subsea cable:

- The direct electric field, which is the primary mode of transmitting electricity along the cable. This field is contained within the subsea cable by insulation and sheathing.
- The magnetic field, which is produced by the transmission of electricity. This field is emitted from the subsea cable and cannot be completely insulated.
- The induced electric field, which is produced by the alternating of the AC magnetic field or from water current flows or marine organisms swimming through the field. This field is emitted from the subsea cable and is entirely outside the cable insulation and sheathing. The magnitude of this force is much lower than the direct electric field contained within the subsea cable.

The subsea cables are designed to shield the marine environment from the direct electric field; the cable sheathing and armouring mitigate the effects of direct electric fields to marine organisms (Gill et al. 2008). Magnetic fields and induced electric fields are created by the transmission of power through the subsea cables. The strengths of these fields are dependent on the distance between the receptor and the source, and the amount of power being transferred through the cables. Research on EMF indicates that fish and marine mammals have sensitivities to both the electric and magnetic components (Fisher et al. 2010). Some species of fish such as skates, rays and sharks (Elasmobranchs) use electric and/or magnetic fields as their primary method of locating food and for migration (Gill et al. 2008). Other marine fish and crustaceans such as salmonids, American eels and spiny lobster use magnetic fields to migrate to and from spawning grounds (Gill et al. 2008; Putman et al. 2013; Walker et al. 2002). The introduction of induced electric and magnetic fields into the Northumberland Strait may interact with navigation and predator/prey detection in marine fish.

Among marine mammals, cetaceans (whales and dolphins) have been the focus of investigations on EMF; no evidence has been presented to indicate pinnipeds are sensitive to electric or magnetic fields (Normandeau et al. 2011). With many cetacean species migrating seasonally up to thousands of kilometers, cetaceans appear to be more sensitive to the magnetic field component of EMF. The current hypothesis is that cetaceans use magnetic fields for long range navigation (Kirschvink 1989; Walker 1992; Hui 1994). Sea turtles, such as the loggerhead turtles, are sensitive to magnetic fields and use magnetic fields for orientation during long range migrations (Lohnmann et al 1997). The introduction of magnetic fields into the Northumberland Strait may interact with cetacean and sea turtle navigation.

When power is transferred through subsea cables, particularly as alternating current, heat is dissipated. In general, XPLE HVAC cable sheath operates at approximately 90°C internally, while it is only warm to the touch on the outside of the cable. The operation of a subsea cable (installed at 0.6 m below the seafloor in water greater than 12 m and 1.6 m below the seafloor in water less than 12 m) may result in localized changes to the benthic infauna, resulting in organisms preferring cold temperatures being replaced by more temperate species.

3.1.4.2.2 Mitigation for change in marine populations

Construction

The following mitigation measures will be applied during Project construction:

- Timing of in-water work will be conducted in consideration of sensitive biological periods (e.g., reproductive life stages), where practical, for CRA species, as determined through discussions with DFO and other regulators.
- Prior to beginning marine works, sediment curtains will be put in place around activities at cable landing sites, if practical, to prevent sediment from entering the water column outside the work area.
- Only clean rock (containing less than 5 % fines and non-acid generating) or native material will be used for infilling (acid generating rock may be used in areas that will be submerged by water at all times).
- Construction vessels will operate at reduced speeds when possible, to reduce the amount of underwater noise created and the risk of vessel strikes with marine wildlife.
- Project vessels will comply with applicable legislation, codes and standards of practice for shipping, including the Ballast Water Control and Management Regulations under the *Canada Shipping Act* and the Canadian Ballast Water Management Guidelines, to reduce risk of introduction of marine invasive species.
- Project vessel port of call history and/or records and proof of hull cleaning will be provided prior to entering the Northumberland Strait. Vessel hulls will be cleaned and/or inspected to prior to entering the Northumberland Strait, where necessary.
- Should it be determined that construction activities will result in serious harm to CRA fish or supporting fish species as defined under the *Fisheries Act* and policies a habitat offsetting plan will be prepared for DFO approval and implemented.

- To avoid attracting birds and other wildlife, deck lighting will be reduced whenever it is practical to do so and the use of unnecessary lighting will be avoided.

Operation

The following mitigation measures will be applied during the Project operation:

- The electrical transmission cables will be completely buried to minimizing heat and EMF emissions at the seabed surface.
- Inspection support vessels will operate at reduced speeds when possible, to reduce the amount of underwater noise created and the risk of vessel strikes with marine wildlife.

3.1.4.2.3 Residual Project Environmental Effect for Change in Marine Populations

Construction

Residual environmental effects on the Marine Environment VC caused by Project construction are anticipated to result in fish mortality, disruption of habitat with respect to area disturbed, water quality and the acoustic environment. Behavioral changes are expected for marine fish and wildlife.

While there will be residual environmental effects from cable trenching during construction, the effects will be short-term and confined to a relatively small area. The duration of TSS in suspension and the geographic distance over which the sediment is spread depends on several factors: particle size, duration of disturbance, and local oceanographic (current) conditions. The effects of TSS are limited to the four week construction period and will not be focused on one single location. Based on past evidence, this environmental effect will be reversible within a matter of hours to days.

Immediately after dredging, which is analogous to other forms of surface sediment disturbance such as the use of ploughs, a decrease in median grain size of sand between dredged areas and non-disturbed (control) areas has been reported (Constantino et al. 2009). However the median grain size was observed to be similar 17 days after dredging in shallower habitats (< 20 m) (Constantino et al. 2009). In shallower sandy bottom habitats, high-energy wave events appear to mask the effects of dredging perturbation on sediment, especially at shallower depths (6 m); and in general, recovery is faster in shallower areas (Constantino et al. 2009).

In deeper offshore areas, such as 70 to 80 m deep on the Scotia Shelf, the immediate effect of hydraulic dredging in seabed topography is the reduction of low-relief sandy habitat structural complexity such as those attributed to bivalve burrows and polychaete tubes (Gilkinson et al. 2003). However, there is limited understanding of the functional roles of these structures in unconsolidated sediment (Gilkinson et al. 2003). In deeper water habitats, the combined effects of bioturbation by invertebrates and fish, sediment transport by processes such as by storm generated waves and slumping, facilitate considerable erosion of dredge tracts within a year, such that dredge furrows may no longer be visible in video surveys one year after disturbance (Gilkinson et al. 2003). The residual dredge tract may accumulate empty bivalve shells in higher concentrations than the surrounding substrate. However, they provide suitable habitat as attachment sites for colonization by benthic invertebrates which may result in an increase in the abundance and diversity of benthic communities in sandy bottom habitat regions following disturbance by hydraulic dredging (Gilkinson et al. 2003).

The potential for mortality of marine fish and benthos will be confined to the PDA within highly localized areas affected by disturbance of the seabed and adjacent areas of sediment deposition. Harm to fish and mobile invertebrates because of physical disturbance is unlikely, as these species are typically able to avoid burial or crushing. There may be a loss of a limited number of sessile benthic species from benthic habitats during trenching but this would be limited to the PDA. Studies have shown that one year after installation and burial of submarine cables, there is no visual evidence of the physical disturbance to the seafloor (Andrulewicz et al. 2003). In addition, there were no obvious changes in species composition, abundance or biomass of the macrobenthos fauna present in the area. For species that are able to avoid the construction area, the effect will be reversible; for sessile species that are injured during the trenching process the effect will be irreversible.

Harm to fish from short-term elevations of TSS concentrations will be low because of a tolerance of species in the Northumberland Strait due to strong tidal currents, water turbulence and naturally high concentrations of TSS in the coastal areas (refer to Section 3.1.2 Water Quality). There are low opportunities for effects on fish health due to relatively low levels of contaminants in the sediments (see Section 3.1.2 for sediment results). There is no designated critical habitat for marine species in the PDA or LAA for species at risk or species important to CRA fisheries. The mobility of species in the area will make it possible for them to avoid the area during temporary periods of decreased water quality.

To limit any mortality of CRA species or interfering with seasonal migration patterns, the timing of in-water work will be conducted, where practical, in consideration of sensitive biological periods (e.g., reproductive life stages) for CRA species, as determined through discussions with DFO, fishers and other regulators.

Burial of the subsea cables will temporarily disturb the benthic environment. When compared with other activities such as bottom trawling, anchoring or dredging, the effects of cable laying are relatively less intrusive as they occur during a short period of time, are not repetitive in nature, and occur in a relatively smaller footprint area. Sensitive habitats (e.g., eelgrass) may be directly disturbed or lost as a result of cable installation activities; however, no sensitive habitats (e.g., eelgrass beds) were identified during the benthic habitat surveys of the PDA.

If any aspect of the marine construction requires ocean disposal of excavated material, the activity will be conducted in accordance with a Disposal at Sea Permit to be obtained from Environment Canada. The material will meet the *CEPA* Disposal at Sea guidelines and disposal activities will be approved and regulated by Environment Canada. Should it be determined that construction activities will result in serious harm to CRA fish or supporting fish species as defined under the *Fisheries Act* and policies, an Authorization will be sought in accordance with the *Fisheries Act* and a habitat offsetting plan will be prepared for DFO approval.

Marine transportation activities will contribute to underwater noise; however, construction vessels will operate at reduced speeds when possible, to reduce the amount of underwater noise created and the risk of vessel strikes with marine wildlife. Behavioural responses are therefore expected to be limited in spatial extent, and are thus unlikely to affect the feeding ability or overall population viability of marine species in the area. Project vessels will comply with applicable legislation, codes and standards of practice for shipping, including the *Ballast Water Control and Management Regulations* under the *Canada Shipping Act* and the Canadian Ballast Water Management Guidelines, to reduce risk of introduction of marine invasive species.

The potential for collisions with marine wildlife will be reduced by the slow speed of the cable ship during Project construction. No high speed maneuvers will be conducted by any Project vessels during cable installation. Therefore, the risk to marine mammals and sea turtles from collision is low.

Marine mammals and sea turtles are generally expected to avoid the area where Project vessels are engaged in cable-laying activities and other Project activities generating underwater noise (e.g., cable trenching, excavation nearshore).

Project personnel will be made aware of the potential presence of marine mammals and sea turtles and informed of the requirement to temporarily halt activities if a marine mammal is observed within the specified safety zones.

Mortality to marine birds, caused by disorientation due to artificial lighting, during construction is expected to be minimal assuming mitigation measures noted above and limited duration of construction activities and spatial extent.

Operation

Maintenance vessels will operate at reduced speeds when possible, to reduce the amount of underwater noise created and the risk of vessel strikes with marine wildlife. The vessels will follow *Canada Shipping Act* requirements with respect to discharges into the marine environment.

The transmission of electricity through the subsea cables is anticipated to result in the generation and emission of induced electric and magnetic fields into the marine environment. These fields will be reduced through Project design that includes cable burial and the cable's insulation and sheathing. The strength of the EMF in the marine environment depends on the distance from the source and the amount of power being transferred through the cable. Generally the magnetic and induced electric fields are strongest at the cable surface and decline rapidly with distance (CMACS 2003).

Natural sources of EMF are present in the marine environment and in Northumberland Strait, including the earth's geomagnetic field. The predicted intensity of the natural geomagnetic field in the area of the Northumberland Strait is 50 to 55 μT (Normandeau et al. 2011).

The subsea cables to be installed are high voltage (138 kV) AC cables capable of carrying up to 180 MW each operating with a maximum operating current of 837 A (per phase). Table 3.12 provides values for magnetic and induced fields from similar subsea cables. These values were obtained from a literature review and include calculated values directly over the cable that would represent the highest potential EMF forces. In general, the magnetic field is proportional to the current, meaning if the current passing through the cable increases by three-fold, the magnetic field will increase by three times the original value. The magnetic field is inversely proportional to the distance from the cable, which implies that if the magnetic field of 8 μT is measured at 0.5 m, then at a distance of 1.0 m the theoretical magnetic field would be 4 μT. The sediment type and cable burial depth does not alter the attenuation of the magnetic field; the burial depth of the cable only serves to increase the distance between the cable and the seafloor.

Table 3.12 EMF Emissions from Typical HVAC Subsea Cables

Voltage	Current	Distance above Seabed	Depth of Cable Burial	Magnetic Field	Induced Electric Field	Citation
145kV	100 A	0 m	0.5 m	7.1 μT	-	Olsson et al. 2013[1]
145kV	300 A	0 m	0.5 m	21 μT	-	Olsson et al. 2013[1]
145kV	500 A	0 m	0.5 m	35 μT	-	Olsson et al. 2013[1]
132kV	350 A	0 m	1.0 m	1.6 μT	91.25 μV /m	Olsson et al. 2013[2]
132kV	350 A	7 m	1.0 m	0.7 μT	10 μV /m	Olsson et al. 2013[2]
138kV	100 A	0 m	0.5 m	9.85 μT	-	Normandeau et al. 2011[1]
138kV	100 A	0 m	1.0 m	2.45 μT	-	Normandeau et al. 2011[1]
138kV	100 A	0 m	2.0 m	0.61 μT	-	Normandeau et al. 2011[1]
138kV	536 A	1 m	2.4 m	1.01 μT	-	Tetra Tech 2012[1]
138kV	536 A	1 m	4.6 m	0.46 μT	-	Tetra Tech 2012[1]

Notes:

1 Theoretical calculated values.

2 *In-situ* measured values.

The potential effects of EMF is focused on species which are known to rely on electric or magnetic fields for migration or predator/prey detection and are either a Species of Conservation Concern (SOCC) or a CRA fishery species.

The EMF assessment focusses on benthic fish, crustaceans, and skates as they interact with the benthic marine habitat and are more likely to be in close proximity to electrical and magnetic fields. Marine mammals, sea turtles and pelagic fish species are not included in the assessment as the attenuation of EMF results in values approximating background at distances greater than 15 m.

The species identified to potentially interact with project related EMF include:

- Atlantic cod – Commercial Species and SOCC
- Atlantic lobster - Commercial Species
- rock crab - Commercial Species
- smooth skate (*Malacoraja senta*) (Laurentian-Scotian population) - SOCC
- thorny skate (*Amblyraja radiate*) - SOCC

A literature review was conducted for each species above to determine if an electric or magnetic sensitivity was the primary pathway for potential effects. It was determined that Atlantic lobster and rock crab would be most sensitive to magnetic fields. Atlantic cod, smooth skate and thorny skate individuals would be most sensitive to electric fields, though are now thought to be sensitive to magnetic fields, as well (Normandeau et al. 2011).

The sensitivity to magnetic fields has been examined for a few species of marine crustaceans (Normandeau et al. 2011), most notably spiny lobster (*Panulirus argus*). It was determined through laboratory and field studies that the geomagnetic field can be sensed by spiny lobster, and lobster use this magnetic field for migration and homing (Boles and Lohmann 2005; Cain et al 2005; and Lohmann et al. 2007). Theoretical calculations suggest that magnetic fields would need to be 5 μT to be detectable by spiny lobster. This is likely to only occur within metres of a HVAC subsea cable (Normandeau et al. 2011). The US Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) is currently conducting research into the effects of EMF on adult Atlantic lobster. The results indicate that there were no statistical changes in behavior or localized movement of Atlantic lobster in a tank with magnetic fields between 500 μT and 1,100 μT as compared to a reference tank.

BOEMRE is also researching the effects of magnetic fields from an existing 35 kV AC subsea cable on macroroinvertebrates. Research indicates that magnetic fields on the cable skin were 109 to 112 μT and decreased to 0.2 to 0.3 μT at 1 m (PNNL 2013). The research suggests no response (attraction/repulsion) from crabs to the EMF emitted by the subsea cable (BOEM 2015). An additional experiment off the coast of British Columbia used Dungeness crabs to determine if the crabs would cross a power cable to enter a baited trap. The results suggest that crabs will cross unburied 35 kV AC subsea cables to enter baited commercial traps (BOEM 2015).

Using the modelled data from Normandeau et al. (2011), a 138kV cable buried 1 m below the seafloor and operating at the maximum theoretical current of 837 A (per phase) has a predicted magnetic field of approximately 31 μT at the seafloor and decreases to 5 μT at a distance of 6 m above the seafloor and to 2 μT at 15 m. Effects of magnetic fields on CRA and SOCC species specific to the Project are not yet well understood and Project-specific magnetic field thresholds have not been developed. Publications are available which identify potential biological effects (Normandeau et al. 2011); however, these effects are limited to localized attraction or repulsion and not necessarily related to fish health. The scale at which various physiological effects may occur is thought to extend approximately 15 m in all directions from the cables. With the 200 m separation between the cables no additive effects between cables are expected. This limited spatial extent of magnetic fields associated with the 138 kV HVAC cables and the mitigation planned by Project design (burial, cable sheathing and armouring), the residual adverse environmental effects of magnetic fields on CRA and SOCC species and changes to their population is expected to be not significant.

Direct electric fields are produced within the cable during the transmission of electricity. These direct electric fields are completely mitigated by cable design and insulation. Induced electric fields can be produced in the marine environment by alternating of AC magnetic fields or from water current flows or marine organisms swimming through the field. Very little literature is available on the level of induced electric fields from the operation of subsea HVAC cables. Ongoing studies in the North Sea around wind farm developments indicate that the induced electric fields may result in attraction or repulsion (EPRI 2013).

Fish abundances around a 132 kV AC cable in the North Sea were monitored two years following the initiation of power transmission. The distribution of Atlantic cod was determined to be significantly different during power transmission (Dong and Vattenhall 2006). In that study the Atlantic cod appeared to gather in the area immediately adjacent to the cable in greater numbers. The authors were cautious about the interpretation as the seafloor was not completely restored to baseline conditions and may have resulted in influencing fish behavior (Normandeau et al. 2011.

There is select literature on electric fields interacting specifically with thorny or smooth skates. Raschi and Adams (1988) theorized that the size and distribution of pores on the skin of thorny skates would promote sensitivity to electric fields, though this theory was not tested and a threshold was not determined. Smooth skates and thorny skates are grouped in the same family (thornbacks). Literature is available for skates of the same family indicating that physiological responses are present when electric fields are as low as 100 μV /m (Kalmijn 1971). The sensitivity of electric fields in skates is dependent on the frequency of the electric field; skates are most sensitive to electric fields between 1 to 10 Hz and less sensitive outside this frequency from 0.01 to 25 Hz (New and Tricas 1997; Bodznick et al. 2003). Experimental observations were observed from a COWRIE 2.0 EMF study (Gill et al. 2005). This study indicated that the movement of thornback rays increased when the cable was powered compared to an unpowered cable. The responses indicated a behavioral effect on thornback rays from the operation of a 135kV subsea cable with an operating induced electric field of 36 μV /m.

Considering the lack of demonstrated adverse effects and the limited spatial extent of induced electric fields associated with 138 kV HVAC cables and the mitigation planned by Project design (burial, cable sheathing and armouring), the residual adverse environmental effects of induced electric fields on CRA and SOCC species and changes to their population is expected to be not significant.

3.1.4.3 Summary of Residual Project Environmental Effects

The residual Project environmental effects for the Marine Environment are summarized in Table 3.13.

Table 3.13 Summary of Project Residual Environmental Effects on the Marine Environment

Residual Effect	Residual Environmental Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socioeconomic Context
Change in Marine Populations	C	A	L	PDA	ST	MR	R/I	D
Change in Marine Populations	O	N	L	PDA	LT	C	R	D

KEY
See 3.2 for detailed definitions.
Project Phase:
C: Construction
O: Operation
D: Decommissioning and Abandonment
Direction:
P: Positive
A: Adverse
N: Neutral
Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area
Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

NA: Not applicable

Frequency:
S: occurs only once
MIR: Multiple irregular event
MR: Regular event
C: Continuous
Reversibility:
R: Reversible
I: Irreversible
Ecological/Socioeconomic Context:
D: Disturbed
U: Undisturbed

3.1.5 Determination of Significance

3.1.5.1 Significance of Residual Project Effects

The marine construction phase of the Project will result in temporary, localized disturbance to the benthic habitat in the PDA. Increased ambient sound levels from construction activities may result in minor habitat avoidance during the construction period in the PDA. During operation any potential effects from EMF emissions will be confined to the PDA and are expected to be minor.

In summary, any residual adverse environmental effects related to a change in marine populations during all phases of the Project, are rated not significant.

3.1.6 Prediction Confidence

Prediction confidence is generally considered to be high due to the knowledge related environmental effects associated with marine construction projects such as the installation of submarine cables. Aspects of the effects prediction are considered moderate because studies have produced inconclusive results of adverse environmental effects from electric, magnetic or heat emissions generated by power cables in the marine environment. During operation, however, Project effects on marine species and populations are predicted to be limited to localized avoidance, if any, as a result of electric and magnetic emissions and physical disturbance.

3.1.7 Follow-up and Monitoring

There are no suggested follow-up and monitoring activities for the marine environment.

3.2 ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS ON COMMERCIAL, RECREATIONAL AND ABORIGINAL FISHERIES

Commercial, Recreational and Aboriginal (CRA) Fisheries are important to the local and regional economy, traditions and cultural heritage of the region. These fisheries have been included as a VC due to the regulatory requirements of the *Fisheries Act* and the potential for Project components to interact with CRA fisheries during construction and operation activities. This VC addresses potential Project effects on CRA fisheries, including Aboriginal communal commercial fisheries.

Project activities and components could affect targeted CRA fishery species; therefore this VC is correlated with the assessment of the Marine Environment VC (Section 3.1) including potential biological effects on marine commercial species. Due to the nature of existing and historical Aboriginal fishing activities within the region, the CRA Fisheries VC is closely related with the VC for Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons (i.e., for food, social, and ceremonial purposes), which is addressed in Section 3.4.

3.2.1 Scope of Assessment

3.2.1.1 Regulatory and Policy Setting

CRA fisheries in the Northumberland Strait are guided under the federal *Fisheries Act*. Provisions under the *Fisheries Act* protect fish and fish habitat, including fisheries resources, and apply specific regulations governing CRA fisheries. Section 35 of the *Fisheries Act* restricts work, undertakings or activities that result in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery. Section 36 of the *Fisheries Act* prohibits the release or deposit of deleterious substances in water frequented by fish or in any water where fishing is conducted. CRA fishing activities in the Northumberland Strait fall within the jurisdiction of four sets of regulations under the *Fisheries Act*: *Maritime Provinces Fishery Regulations*; *Atlantic Fishery Regulations*; *Aboriginal Communal Fishing License Requirements*; and *Fishery (general) Regulations*. The mandate of each set of regulations is outlined below.

- The *Maritime Provinces Fishery Regulations* govern fishing activity in inland and adjacent tidal waters of the provinces of New Brunswick, PEI and Nova Scotia.
- The *Atlantic Fishery Regulations* provide for the management and allocation of fishery resources off the Atlantic coast of Canada.

- *Aboriginal Communal Fishing License Requirements* provide for the management and allocation of Aboriginal fishery resources within Canada.
- *Fishery (general) Regulations* provide for the management of fishing activity within Canada that fall outside of the regulations described above including recreational fishing activities under the jurisdiction of DFO and that are beyond the scope of provincial fishery regulations.

Fishery resources are protected from uncontrolled fishing activity through various measures such as area closures, fishing quotas, fishing seasons, and gear and vessel restrictions as described and detailed under the regulations presented above and by Fisheries Management Decisions applied by DFO in accordance with the roles and responsibilities outlined in the *Fisheries Act* (DFO 2013a). Other broad mechanisms for the protection of marine resources are provided in the federal *Oceans Act* which governs the establishment and alteration of fishing zones and Marine Protected Areas within Canadian waters.

Provincial administration of aquaculture falls under the jurisdiction of regulations in both New Brunswick and PEI. In New Brunswick, the Department of Agriculture, Aquaculture and Fisheries and the Department of Natural Resources implement the *Fisheries and Aquaculture Development Act* and the *Fish and Wildlife Act*. In PEI, the Department of Agriculture and Fisheries and the Department of Communities, Land and Environment implement the *Fisheries Act*.

3.2.1.2 The Influence of Consultation and Engagement on the Assessment

Key issues raised during stakeholder and Aboriginal engagement for the Project to date applicable to the CRA Fisheries VC include the potential effects of Project activities and components and accidental events on fish and fish habitat and commercial fishing activities (e.g., loss of access). Questions have been raised regarding the construction and installation methods, materials and scheduling. Other questions pertain to post construction operational conditions such as any restrictions on fishing gear or loss of fishing grounds (e.g., fishing exclusion zones). Other issues raised pertain to electromagnetic fields (EMF) generated during the operational phase of the Project and the potential environmental effects of EMF on species abundance, distribution and migration. Interaction between EMF and the marine environment is discussed in Section 3.1, Marine Environment VC.

Key issues raised during stakeholder engagement are addressed in Section 3.2.4, Assessment of Residual Environmental Effects on CRA Fisheries.

3.2.1.3 Potential Environmental Effects, Pathways and Measurable Parameters

CRA fisheries are important to both the local and regional New Brunswick and PEI economies. CRA fishing activities are an important traditional and cultural activity within the Northumberland Strait and the Project could have an effect on local CRA fisheries. Potential environmental effects, effects pathways and measurable parameters for the assessment of CRA Fisheries are presented in this section.

Construction of the submarine cable, including installation methods and ground disturbance activities and biological effects on CRA species are primarily described in the Marine Environment VC (Section 3.1) and will not be repeated in this VC.

The marine construction phase of the Project has been provisionally scheduled to commence with pre-trenching of inshore areas in spring 2016 with the remaining trenching and cable installation to take place in fall 2016 after the fall lobster fishery. Contractor construction methods or unforeseen circumstances (e.g., adverse weather or equipment malfunction) may require alteration of construction schedules and may result in localized interference with CRA fishing activities.

During Project operation, routine maintenance and inspection activities on the submarine cables will, when feasible, be scheduled during commercial fishing off seasons. In the event of emergency situations, inspection and maintenance activities may be required on short notice and may overlap with commercial fishing seasons.

Decommissioning and abandonment would take place following the useful service life of the Project and would be carried out in accordance with regulations in place at that time.

In consideration of the Project components and pathways described above, the assessment of Project-related environmental effects on CRA Fisheries is focused on the following potential environmental effect:

- Change in commercial or Aboriginal commercial fishing activities

The measureable parameter used for the assessment of this environmental effect is localized commercial fishing effort. This parameter is an indicator of change that may result from a reduction in the local commercial fishing effort in the vicinity of the Project footprint due to access restrictions and may be used to compare past and present conditions. The potential environmental effects, effects pathways and measurable parameters for CRA Fisheries are summarized in Table 3.14.

Table 3.14 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Commercial, Recreational and Aboriginal Fisheries

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Commercial or Aboriginal Commercial Fishing Activities	• Loss of access to fishing grounds.	• Localized commercial fishing effort.

Aboriginal fishing activities discussed in this VC are included in commercial fishing activities; food, social and ceremonial (FSC) fisheries are addressed in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons VC, Section 3.4.

Potential environmental effects on CRA species due to habitat loss or displacement is primarily discussed in Section 3.1, the Marine Environment VC.

Potential effects on local recreational fishing activities are considered to be negligible; they are primarily addressed in Section 3.2.2.

Environmental effects on the aquaculture industry are not anticipated due to distance from the Project footprint. The nearest aquaculture sites in New Brunswick are in Spence Settlement (New Brunswick Agriculture, Aquaculture and Fisheries, n.d.) approximately 7 km west of submarine cable landfall on the New Brunswick shoreline. The nearest aquaculture sites in PEI are located in Cape Traverse (DFO 2013b), approximately 3 km east of cable landfall on the PEI shoreline. Local vessel traffic to the aquaculture sites will continue to have access to local wharves or other required shoreline infrastructure throughout the duration of the Project.

3.2.1.4 Boundaries

The spatial and temporal boundaries for the assessment of the CRA VC are described in this section.

3.2.1.4.1 Spatial Boundaries

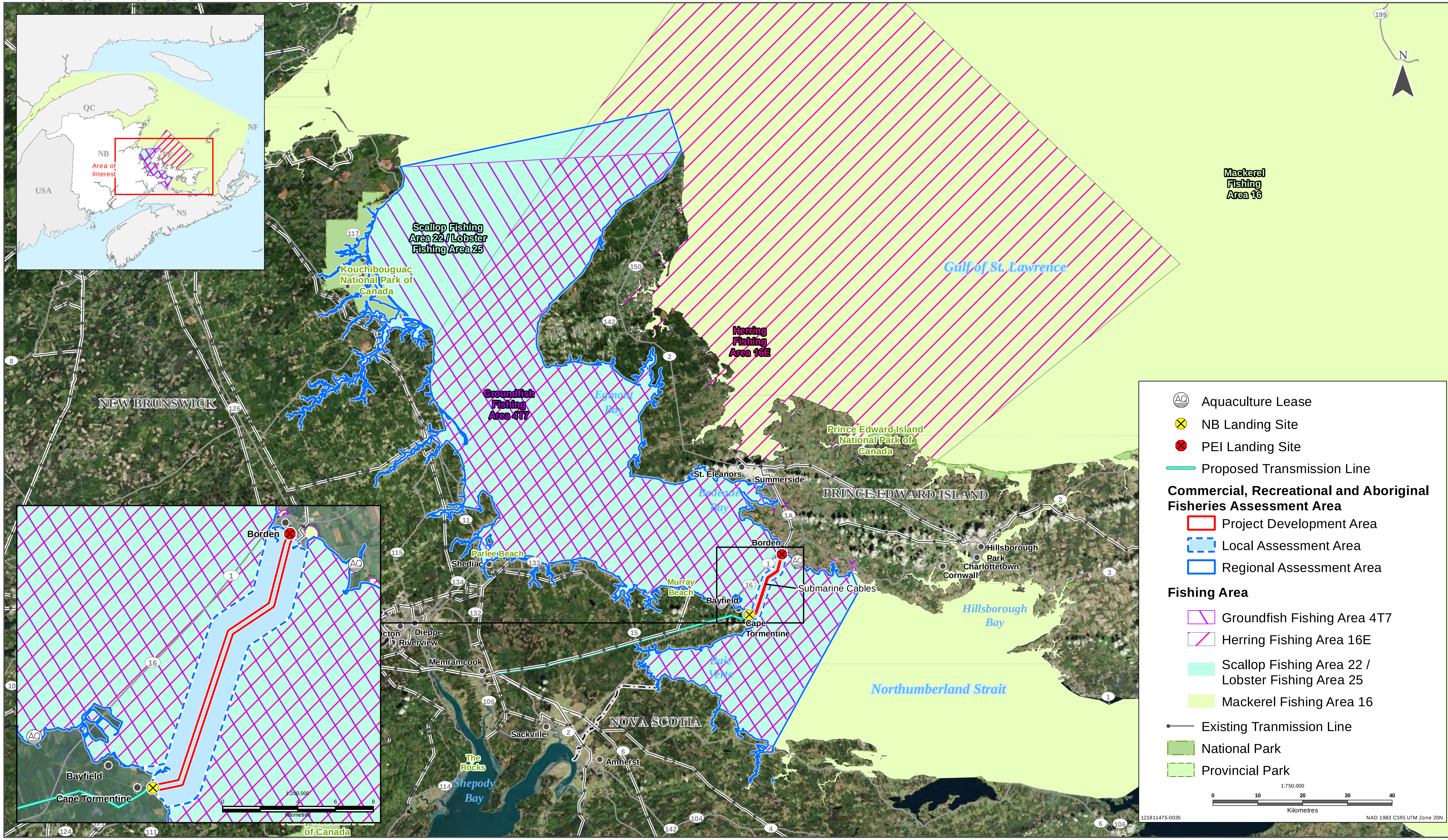
The Project Area is located within the Northwest Atlantic Fisheries Organization (NAFO) Unit Area 4T which encompasses the entire Southern Gulf of St. Lawrence region. These boundaries include the following DFO regulated fishing zones:

- Lobster Fishing Area (LFA) 25
- Scallop Fishing Area (SFA) 22
- Rock Crab Fishing Area (LFA) 25
- Herring Fishing Area (HFA) 16E
- Groundfish Fishing Area (GFA) 4T7
- Mackerel Fishing Area (MFA) 16

The spatial boundaries for the environmental effects assessment of CRA Fisheries are shown in Figure 3.10 and defined below.

- Project Development Area (PDA): The PDA is a 220 m wide corridor extending approximately 16.5 km between Borden-Carleton and Cape Tormentine. This includes the 10 m wide disturbance area for each submarine cable and the 200 m separation distance between the two cable trenches. The actual area of physical disturbance during construction is approximately 33 ha.
- Local Assessment Area (LAA): The LAA includes the PDA area and extends 1 km on either side of the PDA; the LAA is the maximum area where Project-specific environmental effects can be predicted and measured with a reasonable degree of accuracy and confidence.
- Regional Assessment Area (RAA): The RAA includes the marine waters within the administrative boundaries of LFA 25. The RAA was defined as LFA 25 because all Project activities fall within this commercial fishing administrative boundary. SFA 22 and GFA 4T7 maintain the same geographical boundaries as LFA 25. Included within the RAA are sections of the commercial fishing administrative boundaries of HFA 16E and MFA 16.

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_4_marine\3_2_comm_fish\121811475-0035.mxd



Sources: GeoNB, NB Power, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Stantec

121811475 - PEI - NB Marine Cable Interconnection - Maritime Electric Company Limited

Commercial, Recreational and Aboriginal Fisheries Assessment Boundaries

Figure 3.10

3.2.1.4.2 Temporal Boundaries

The temporal boundaries of the Project for the assessment of potential environmental effects on CRA Fisheries include the anticipated period of construction, operation, and decommissioning and abandonment components.

Total construction time in the marine environment will take place over a 20 to 25 week period. Pre-trenching in water less than 12 m is scheduled to take place between May and early July 2016. Timing of the pre-trenching work will be conducted to avoid, where feasible, the commercial rock crab and lobster fishing seasons in Zone 25. The remaining trenching and cable installation are scheduled to be installed in October and November 2016 after the fall lobster fishery. Operation will begin following construction in December 2016 and is anticipated to continue for the life of the Project (approximately 40 years). Decommissioning and abandonment would take place following the useful service life of the Project and would be carried out in accordance with regulations in place at that time.

The timing windows for in-water construction has been planned for May through early July in waters less than 12 m to avoid working in the scallop fishing area during scallop fishing season as well as to avoid the lobster migration period within the RAA, if feasible. Construction will resume in October after the lobster fishing season is complete.

3.2.1.5 Residual Environmental Effects Description Criteria

Table 3.15 provides the environmental effects classification criteria that are used to characterize and describe Project residual environmental effects on CRA Fisheries.

Table 3.15 Characterization of Residual Environmental Effects on Commercial, Recreational and Aboriginal Fisheries

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect.	**Positive**—an effect that moves measurable parameters in a direction beneficial to commercial fisheries relative to baseline. **Adverse**—an effect that moves measurable parameters in a direction detrimental to commercial fisheries relative to baseline. **Neutral**—no net change in measureable parameters for the commercial fisheries relative to baseline.
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions.	**Negligible**—no measurable change to commercial fisheries. **Low**—a temporary loss of fishable ground to either the New Brunswick or PEI fishers adding up to less than or equal to one quarter of the PDA. **Moderate**—a temporary loss of fishable ground to either the New Brunswick or PEI fishers adding up to approximately one half of the PDA. **High**—a temporary loss of fishable ground to either the New Brunswick or PEI fishers across the entire PDA.

Table 3.15 Characterization of Residual Environmental Effects on Commercial, Recreational and Aboriginal Fisheries

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Geographic Extent	The geographic area in which an environmental, effect occurs.	**PDA**—residual effects are restricted to the PDA. **LAA**—residual effects extend into the LAA. **RAA**—residual effects interact with those of other projects in the RAA.
Frequency	Identifies when the residual effect occurs and how often during the Project or in a specific phase.	**Single event**—occurs only once. **Multiple irregular event**—occurs at no set schedule. **Multiple regular event**—occurs at regular intervals. **Continuous**—occurs continuously.
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the effect can no longer be measured or otherwise perceived.	**Short-term**—residual effect restricted to less than one fishing season. **Medium-term**—residual effect extends through approximately one fishing season. **Long-term**—residual effect extends beyond one fishing season but is not permanent. **Permanent**—effects are permanent.
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases.	**Reversible**—the effect is likely to be reversed after activity completion and reclamation. **Irreversible**—the effect is unlikely to be reversed.
Ecological and Socioeconomic Context	Existing condition and trends in the area where environmental effects occur.	**Undisturbed**—Commercial or Aboriginal commercial fisheries are relatively undisturbed due to limited vessel traffic, development and other anthropogenic activities in the area. **Disturbed**—Commercial or Aboriginal commercial fisheries are often disturbed due to interactions with heavy vessel traffic, development or other anthropogenic activities in the area.

3.2.1.6 Significance Definition

For the purposes of this effects assessment, a significant adverse residual environmental effect on commercial fisheries is defined as a residual Project-related environmental effect that results in the following outcome:

- Local commercial or Aboriginal commercial fishers are displaced or unable to access substantial portions of the fishing areas currently used for all or most of a particular fishing season.

3.2.2 Existing Conditions for Commercial, Recreational and Aboriginal Fisheries

3.2.2.1 Methods

Information regarding current CRA fishing activities in the Northumberland Strait was obtained through review of existing literature, online public resources, engagement with stakeholders and formal data requests from DFO Gulf Region.

3.2.2.2 Overview

3.2.2.2.1 Commercial Fishing

Commercial fisheries in the Northumberland Strait are an important source of employment for coastal communities in New Brunswick and PEI and are important to the local and regional economies of New Brunswick and PEI. Fisheries are managed by DFO through regulations under the *Fisheries Act,* and DFO sets the catch or quota limits, fishing seasons and gear restrictions in consultation with industry stakeholders for the targeted species. The federal regulations have been implemented to promote the longevity of the industry and healthy fish populations, and are subject to change based on new data, research and environmental conditions. Fishery specific landing data is gathered by DFO and this data is available through online resources and data requests.

There are four main commercial fisheries within the Project RAA; American lobster, deep-sea scallop, rock crab and Atlantic herring. Groundfish and Atlantic mackerel fisheries are present within the RAA but minimal effort is directed toward these fisheries (Mallet P pers. comm., 2015). Most of the groundfish fishery effort occurs outside of the RAA and targets five species; winter flounder, witch flounder, American plaice , Atlantic halibut and redfish (*Sebastes mentella*) (Lavoie C, pers. comm., 2015). Due to the limited fishing effort within the RAA and the small size of the PDA, the groundfish fishery and mackerel fishery will not be considered a significant fishery within this VC. Due to the limited seasons for most of the fisheries within the RAA, it is common for individual fishers to hold a license for more than one fishery.

Within a given year, effects on CRA Fisheries are most likely to occur within the regulated fishing seasons. Table 3.16 lists the current commercial fisheries and regulated seasons.

Table 3.16 Regulated Seasons for Commercial Fisheries in the RAA

Species	Area Location	Season
Lobster	LFA 25	Typically mid-August to mid-October (subject to change each year).
Scallop	SFA 22	Typically mid-May to mid-June, 6:00 am to 6:00 pm closed on Sundays (30 days).
Rock Crab	LFA 25	Summer (e.g., June 29 to July 25, 2015). Fall: Five calendar days after closure of lobster season to the last Friday in November (e.g., Nov. 27, 2015).
Herring	HFA 16E	Spring (e.g., April 22 – April 29 or June 30, 2015) and gear dependent. Fall: typically late-August to early September.

Table 3.16 Regulated Seasons for Commercial Fisheries in the RAA

Species	Area Location	Season
Groundfish	GFA 4T7	Typically April to December (e.g., April 1 to December 31, 2015).
Mackerel	MFA 16	Typically June to December (e.g., June 1 to December 31, 2015).

Lobster is the principal fishery within the RAA with 711 licenses currently operating within LFA 25. Each license is limited to 250 traps on the New Brunswick shore and 240 traps on the PEI shore. Only lobster that have a carapace length greater than 71 millimeters (mm) may be retained and females with a carapace length of greater than or equal to 114 mm must be released. The fishery is well regulated and managed due in part by limited fishing seasons and the trap design which allows small individuals to escape and reduces the capture of non-target species (DFO Science 2013a). Lobster landings within the RAA as reported by DFO (Lavoie C, pers. comm., 2015) for 2014 were 5,913,437 kilograms (kg).

The number of authorized lobster licences has gradually decreased over the past ten years from a high of 855 in 2005 to a low of 711 in 2014. The number of active licences has also decreased from a high of 791 in 2005 to a low of 651 in 2013. Lobster landings have seen a reverse trend with reported landings gradually increasing from a low of 2,477,554 kg in 2005 to a high of 5,913,437 kg in 2014.

The rock crab fishery is made up of three components; the bycatch fishery, the bait fishery and the directed fishery. The bycatch and bait fisheries are conducted during lobster season by lobster license holders who are permitted to keep an unlimited number of male rock crabs of any size for either bait for the lobster fishery or to sell; female rock crabs must be released. Rock crab bycatch in the lobster industry has been declining since 2006 and is estimated to be less than 10% of the directed fishery landings (DFO Science 2013b). The directed rock crab fishery maintains the same geographical boundaries as LFA 25 and is regulated by the number of licenses issued, trap allocation, gear restrictions, limited seasons and specific catch criteria. License holders are restricted to a total catch allocation of 25,000 kg per season and 100 traps per license. Directed fishing efforts are widely distributed in coastal waters less than 35 m water depth with 239 licenses issued within LFA 25. Rock crab landings within the RAA as reported by DFO (Lavoie C, pers. comm., 2015) for 2014 were 1,131,464 kg.

Directed rock crab licences have remained relatively unchanged over the past ten years varying from 70 to 71 issued licences. The number of licences with reported landings across all three rock crab fisheries (bycatch, bait and directed fisheries) decreased from a high of 396 in 2005 to a low of 109 in 2014. Reported rock crab landings remained relatively stable from 2005 to 2013 ranging from 1,416,831 kg to 1,792,356 kg over this period but decreased to 1,131,464 kg in 2014.

Scallop fishing is considered a secondary fishery within the RAA with 200 licenses issued for SFA 22; approximately 50% of the licenses are currently active. Low scallop density is believed to be an important factor in the low participation of the scallop fishing industry in the Northumberland Strait (DFO Science 2011). Regulations specific to each SFA have been implemented to manage the fishery and include designated scallop fishing areas, scallop fishery buffer zones, restricted fishing seasons and ring size dimension on the scallop dredge. Scallop fishery buffer zones were implemented to protect lobster larval settling areas and were set jointly by DFO and industry. In SFA 22 all habitat in less than 11 m water depth is prohibited to scallop fishing activities. At the request of harvesters in 2005 a large area west of the Confederation Bridge was closed to scallop fishing to allow the stock to rebuild. With these restrictions currently in place, much of SFA 22 is closed to scallop fishing activities. Scallop landings within the RAA as reported by DFO (Lavoie C, pers. comm., 2015) for 2014 were 70,136 kg.

The number of authorized scallop licences has remained relatively unchanged over the past ten years varying from 200 to 203 issued licences. The number of active licences has also remained relatively unchanged over this same period varying from 96 to 110 in any given year. Reported landings have fluctuated over the past ten years with no general increasing or decreasing trends emerging. The lowest reported landings of 52,978 kg occurred in 2006 and the highest of 87,916 kg occurred in 2011.

The herring fishery is divided into seven HFAs within NAFO Unit Area 4T and the RAA falls within HFA16E. For reporting and regulation purposes, DFO manages HFA 16E combined with HFA 16C (Lavoie C, pers. comm., 2015). Herring are fished using two methods; fixed gear (gillnets) and mobile gear (seines). The gillnet fleet operates in the nearshore shallow water areas of the HFAs and the seiner fleet operates in deeper water offshore. The herring fishery within HFA 16E and C is divided into the spring and fall spawner fisheries and is managed using a total allowable catch (TAC) limit imposed on the entire fleet. Total allowable catch is divided between the two fleets with 77% being allocated to the gillnet fleet and 23% allocated to the seiner fleet. A total of 1,022 herring licenses have been issued within HFAs 16 E and C and landings data as reported by DFO (Lavoie C, pers. comm., 2015) for 2014 were: 260 tonnes (t) for New Brunswick and 160 t for PEI giving a total of 420 t representing 92.5% of the TAC set at 454 t.

For the mackerel fishery, the MFA for the region maintains the same geographical boundaries as NAFO Unit Area 4T and is labeled as MFA 16. Atlantic mackerel is fished using several different methods such as gillnets, drift nets, traps and seines. The fishery is divided into two fleets; the inshore fleet (vessels less than 65 feet in length) and the offshore fleet (vessels greater than 65 feet in length). A Canada-wide TAC of 8,000 t has been issued and is divided between the two fleets where 60% has been allocated to the inshore fleet and 40% has been allocated to the offshore fleet. A total of 3015 licenses have been issued for MFA 16 with landings data as reported by DFO (Lavoie C, pers. comm., 2015) for 2014 was 1,016 t from a quota of 8,000 t.

3.2.2.2.2 Recreational Fishing

Recreational fishing in the Northumberland Strait is a social, leisure or sport activity. Recreational fishing activities within the RAA are likely limited to shellfish harvesting, striped bass sport fishing, mackerel fishing and groundfish fishing. Each fishery is managed under specific regulations outlined by DFO and is subject to change based on new data, research and environmental conditions.

Shellfish harvesting is a popular activity throughout the Northumberland Strait and is an easily accessible fishery to the general public. This recreational fishery is monitored by the Canadian Shellfish Sanitation Program (CSSP) which is a federal food safety program jointly directed by the Canadian Food Inspection Agency (CFIA), Environment Canada (EC) and DFO. The goal of the program is to protect Canadians from the health risks associated with the consumption of contaminated bivalve molluscan shellfish (CFIA 2015). Regular water quality testing is carried out by the CSSP to determine levels of biotoxins, bacteria and harmful contaminants in the waters around popular shellfish harvesting areas. If these levels exceed safe limits DFO will issue closure orders and all shellfish harvesting from these areas is prohibited until the closure is lifted (CFIA 2015). Shellfish harvesting is done by hand with small tools such as forks, rakes or spades in intertidal areas where sand bars or flats become accessible at low tide. DFO has set regulations on the number and size of bivalves that are able to be kept during recreational harvesting. In New Brunswick and PEI a person is limited to 300 bivalves in aggregate of the following species per day; bar clam (*Spisula solidissima*), bay quahog (*Mercenaria mercenaria*), razor clam (*Ensis arcuatus*) and soft-shell clam (*Mya arenaria*). In New Brunswick harvested bay quahog, bar clam and soft-shell clam must be greater than 38 mm, 76 mm and 38 mm in length, respectively, and in PEI harvested bay quahog, bar clam and soft-shell clam must be greater than 50 mm, 76 mm and 50 mm in length, respectively (Justice Laws 2015b). The Project will likely have a negligible effect on this recreational fishery due to the small PDA and short construction timeframe.

Recreational mackerel fishing is a popular activity within the Northumberland Strait during the summer migration. Public wharves are common locations for recreational mackerel fishing and several private fishing charters offer fishing excursions from both New Brunswick and PEI. The Project will likely have a negligible effect on this recreational fishery due to the small PDA, short construction timeframe and public wharves remaining accessible during construction, operation, and decommissioning and abandonment.

A recreational striped bass (*Morone saxtalis*) sport fishery has recently been opened by DFO in the Southern Gulf of St. Lawrence. DFO manages the fishery by using limited seasons, bag and size limits, and catch and release policies. In 2015 this fishery is open from May 1 to October 31 with retention periods from May 11 to 31, from August 1 to 23, from September 4 to 7 and from October 24 to 31. All other dates are catch and release only. Anglers are permitted to retain and possess one striped bass per day with legal size of a total length greater than 50 centimeters (cm) and less than 65 cm (DFO 2015a). Due to the limited amount of preferred striped bass habitat within the LAA it is unlikely that recreational fishing for striped bass occurs in the LAA and therefore the Project will likely have a negligible effect on this recreational fishery.

Recreational groundfish fishing in the Southern Gulf of St. Lawrence is managed by DFO. The season is open from April 15 to October 4 in waters within 50 m of the coastline adjacent to New Brunswick and PEI (DFO 2015b). Anglers are permitted to retain a total of 15 groundfish with the exception of the following which cannot be retained: Atlantic cod, white hake, skate (all species), haddock (*Melanogrammus aeglefinus*), Pollock (*Pollachius pollachius*), Atlantic halibut, and wolfish (northern and spotted). Open season for Atlantic cod and white hake in waters adjacent to New Brunswick is from July 11 to August 16 and in waters adjacent to PEI from August 29 to October 4. The Project will likely have a negligible effect on this recreational fishery due to the small PDA and short construction timeframe.

Potential environmental effects on recreational fishing activities are considered negligible due to the short timeframe anticipated for the construction phase of the Project, small PDA compared to the available recreational fishing grounds within the RAA and the limited recreational fishing activity predicted to occur within the PDA. Any restrictions imposed on recreational fishing activities during

Project construction will be short in duration and reversible once construction is complete. Potential environmental effects on recreational fishing activities will therefore not be carried forward in the assessment.

3.2.2.2.3 Aboriginal Fishing

Aboriginal fishing activities take place in two distinct fisheries, the communal commercial fishery, and the Food, Social and Ceremonial (FSC) Fishery. Communal commercial fishery licenses are issued to First Nations communities as a whole and not to individuals. These licenses are commercial licenses that are used for the catch and sale of fish according to the same seasons, gear and quota restrictions that apply to other commercial licenses described above. Communal commercial licenses are therefore included in the evaluation of effects on all commercial fishing activities for the purpose of this assessment.

FSC fishing is a cultural and sustenance activity. DFO negotiates agreements for Aboriginal FSC fishing through the Aboriginal Fisheries Strategy (AFS). DFO recognizes that FSC access to fishery resources has priority over other allocations, provided conservation of the stock is not an issue. Resources fished using an FSC license are used communally to provide food for its members, and support the traditional social and ceremonial activities of the First Nations community or groups (DFO 2012). Potential Project effects on FSC fisheries undertaken by Aboriginal communities are addressed under the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons VC (Section 3.4).

In the RAA, communal commercial fishery licenses have been issued for four species; lobster, herring, scallop, and rock crab. Lobster and herring make up the principal communal commercial fisheries with 89 communal commercial lobster licenses in LFA 25 and 85 communal commercial licenses in HFA 16C/E (Lavoie C, pers. comm., 2015). The communal commercial herring fishery in the RAA is limited to nearshore fishing with gillnets. The scallop and rock crab fisheries make up a much smaller portion of the communal commercial fishery licenses; 24 communal commercial scallop licenses were issued in SFA 22 and 14 communal commercial rock crab licenses were issued in LFA 25. Landings caught under communal commercial licenses are included in species specific totals in the commercial landing information described in the section above.

3.2.3 Project Interactions with Commercial, Recreational and Aboriginal Fisheries

Potential Project interactions with CRA Fisheries are presented in Table 3.17. These interactions are indicated by check marks, and are discussed in Section 3.2.4 in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects. Following the table, justification is provided for non-interactions (no check marks).

Table 3.17 Potential Project-Environment Interactions and Effects on Commercial, Recreational and Aboriginal Fisheries

Project Components and Physical Activities	Potential Environmental Effects
	Change in Commercial or Aboriginal Commercial Fishing Activities
Construction	
Site Preparation for Submarine Cable	✓
Installation of the Submarine Cable	✓
Inspection and Energizing of the Submarine Cable	✓
Emissions and Wastes	–
Marine Transportation	✓
Operation	
Energy Transmission	–
Infrastructure Inspection, Maintenance and Repair	✓
Emissions and Wastes	–
Decommissioning and Abandonment	
Decommissioning	✓
Emissions and Wastes	–
Transportation	✓

Notes:
✓ = Potential interactions that might cause an effect.
– = Interactions between the project and the VC are not expected.

Construction

Emissions and wastes are not expected to interact with Commercial, Recreational or Aboriginal fisheries in the area during the construction phase of the Project. Vessels and other equipment that will be used for the installation of the submarine cables are expected to be similar to that of fishing boats and other vessels currently operating within the LAA. Potential effects from emissions and wastes on CRA species are addressed under the Marine Environment VC, Section 3.1. Construction activities with potential interactions are further discussed below in Section 3.2.4.

Operation

Energy transmission will not interact with commercial fishing activities in the PDA. The cables will be buried to a depth of approximately 0.6 m in areas with a water depth of greater than 12 m; in areas with less than 12 m water depth, the cables will be buried approximately 1.6 m. This will provide protection against ice scour and fishing activities. Fishing activities will be permitted within the PDA post-construction and fishers will not be held responsible in the event that fishing gear comes into contact with the submarine cables.

Emissions and wastes from any Project phase will not interact with commercial fisheries. In particular, EMF generated during operation will not interact with commercial species and is discussed in detail in the Section 3.1, Marine Environment VC. Activities during operation with potential interactions are further discussed below in Section 3.2.4.

Decommissioning and Abandonment

Decommissioning and abandonment will be assessed at the end of the useful life of the Project. The life of the Project is 40 years, at which time it may be decommissioned; however, it is more likely that at that time the Project will be refurbished and will continue to operate on a similar basis in perpetuity. If decommissioning activities are determined to be necessary, it is likely that the cables in the marine environment will be abandoned in place to avoid disturbance of the habitat. Given that the cables are solid dielectric and do not contain oil or other harmful chemicals that could leach into the environment or released if the abandoned cable were damaged, there is no expected interaction with this VC. Any decisions made regarding decommissioning and abandonment will be completed in accordance with the applicable regulations at that time and could include either the abandonment or removal of the submarine cable.

3.2.4 Assessment of Residual Environmental Effects on Commercial, Recreational and Aboriginal Fisheries

Potential residual effects on CRA Fisheries include a change in commercial or Aboriginal commercial fishing activities within the LAA due to construction and operation activities.

Potential residual environmental effects on CRA fish species are discussed in the Marine Environment VC (Section 3.1).

3.2.4.1 Analytical Assessment Techniques

The potential environmental effects were assessed based on current regional fisheries statistics and information provided by DFO through correspondence and data requests. The information provided was used to determine existing fishing activities and conditions within the RAA and the subsequent potential interactions between commercial fishing activities and the Project.

3.2.4.2 Assessment of Change in Commercial Fishing Activities

3.2.4.2.1 Project Pathways for Change in Commercial or Aboriginal Fishing Activities

The Project could result in a change in CRA Fisheries within the LAA if construction timeframes and schedules are not able to avoid commercial fishing seasons. A change in commercial or Aboriginal commercial fishing activities within the LAA may include a temporary loss of access to fishing grounds during a fishing season due to navigational hazards associated with construction of the Project which could restrict fishers from placing gear within the PDA or harvesting the resource at expected levels.

A change in commercial or Aboriginal commercial fishing activities may occur during maintenance components of the operational phase of the Project if the associated work overlaps with commercial fishing seasons and result in a temporary loss of access to fishing grounds.

3.2.4.2.2 Mitigation for Change in Commercial or Aboriginal Commercial Fishing Activities

Mitigation measures to reduce the potential environmental effect of a change in commercial or Aboriginal commercial fishing activities are described below.

Construction

- Liaison and communications will continue with local fishing associations and Aboriginal commercial licensees to keep fishers informed of project or construction delays and potential Project – fishing interactions.
- Marine based construction activities will be scheduled, when feasible, to avoid overlap with commercial fishing seasons in the RAA by attempting to complete these Project activities within the commercial fishing off seasons.
- If construction activities must be scheduled during commercial fishing seasons, liaison and communication will continue to manage and reduce adverse conflicts with fishers in the LAA.
- The Canadian Coast Guard will be informed of submarine cable associated work and a Notice to Mariners and/or a Notice to Shipping may be issued to alert vessel traffic of any changes within the region such as exclusion zones around Project vessels to allow for safe navigation of vessel traffic.
- Navigational charts will be updated post construction to include the location of the submarine cables.

Operation

- Routine inspection and maintenance activities will be scheduled, when feasible, to avoid overlap with commercial fishing seasons in the RAA by attempting to complete these Project activities within the commercial fishing off seasons.
- The Canadian Coast Guard will be informed of submarine cable associated work and a Notice to Mariners and/or a Notice to Shipping may be issued to alert vessel traffic within the region.

3.2.4.2.3 Residual Project Environmental Effect for Change in Commercial or Aboriginal commercial fishing Activities

Construction

A residual environmental effect leading to a change in commercial or Aboriginal commercial fishing activities may occur during construction of the Project. Construction will be scheduled to avoid, when feasible, commercial fishing seasons within the RAA. However in the event of delays or disruptions to project schedules, construction may interact with commercial fishing activities within the LAA. It is reasonable to assume that potential interactions will be short in duration and confined to the LAA. With the implementation of mitigation measures such as effective implementation of the Fisheries Liaison and Communication Plan, the magnitude of the effect of the Project on commercial or Aboriginal commercial fishing effort in the LAA is anticipated to be low. This potential effect on commercial or Aboriginal commercial fishing effort is anticipated to occur irregularly during the construction of the Project. Based on existing conditions and past evidence, this environmental effect is anticipated to be reversible and short in duration. After completion of Project construction it is expected that fishing activity and effort within the LAA will return to normal conditions.

Operation

A residual environmental effect leading to a change in commercial or Aboriginal commercial fishing activities may occur during operation of the Project. Routine maintenance activities of the submarine cable will be scheduled, when feasible, during commercial fishing off seasons however in the event commercial fishing seasons are unable to be avoided interactions with commercial fishing seasons may be unavoidable. It is reasonable to assume that potential inspection and maintenance activities will be short in duration and confined to a small section of the PDA. With the implementation of mitigation measures such as the Fisheries Liaison and Communication Plan, the magnitude of the effect of the Project on commercial or Aboriginal commercial fishing effort in the LAA is anticipated to be low. This potential effect on commercial or Aboriginal commercial fishing effort is anticipated to occur irregularly during Project operation. Based on existing conditions and past evidence, this environmental effect is anticipated to be reversible and short in duration.

3.2.4.3 Summary of Residual Project Environmental Effects

The residual Project environmental effects for CRA Fisheries are summarized in Table 3.18.

Table 3.18 Summary of Project Residual Environmental Effects on Commercial, Recreational and Aboriginal Fisheries: Northumberland Strait

Residual Effect	Residual Environmental Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socioeconomic Context
Change in Commercial or Aboriginal Commercial Fishing Activities	C	A	L	LAA	ST	IR	R	U
Change in Commercial or Aboriginal Commercial Fishing Activities	O	A	L	LAA	ST	IR	R	U

KEY

See Table **Error! Reference source not found.**3.15 for detailed definitions.

Project Phase:
C: Construction
O: Operation
D: Decommissioning and Abandonment

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term
P: Permanent

NA: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socioeconomic Context:
D: Disturbed
U: Undisturbed

3.2.5 Determination of Significance

3.2.5.1 Significance of Residual Project Effects

Construction and operation components of the Project may result in a change in commercial or Aboriginal commercial fishing activities within the LAA due to a temporary reduction or loss in access to fishing grounds in the event that activities cannot be scheduled to avoid fishing seasons. A significant adverse residual environmental effect would occur if commercial or Aboriginal commercial fishers were to be displaced or unable to access substantial portions of the fishing areas currently used for all or most of a particular fishing season.

A change in commercial fishing activities within the LAA is not expected to be significant provided mitigation measures are implemented and in consideration of the following.

- Scheduling guidelines will prevent, when feasible, overlap of Project physical activities with commercial fishing seasons. In the event of overlap between Project components and commercial or Aboriginal commercial fishing activities, potential interactions will be managed through continued liaison and Communication with the local fishers.
- The small size of the PDA compared to the available fishing grounds within the RAA.
- The short timeframe anticipated for the completion of the construction and maintenance activities of the Project.
- Updated navigational charts with submarine cable locations and associated hazards.

Overall, the residual adverse environmental effects on commercial or Aboriginal commercial fisheries are considered to be not significant.

3.2.6 Prediction Confidence

Confidence in the predictions of potential environmental effects on CRA fisheries is high due to the availability of fisheries data for the region, understanding of the potential environmental effect pathways, and anticipated effectiveness of the mitigation and project planning measures.

3.2.7 Follow-up and Monitoring

There is no follow up or monitoring proposed for this VC.

3.3 ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS ON HERITAGE RESOURCES

Heritage Resources are those resources, both human-made and naturally occurring, related to human activities from the past that remain to inform present and future societies of that past. Heritage resources are relatively permanent, although highly tenuous, features of the environment; if they are present, their integrity is highly susceptible to construction and ground-disturbing activities. Heritage Resources has been selected as a valued component (VC) in recognition of the interest of: regulatory agencies who are responsible for the effective management of these resources within the Project Development Area (PDA) (Northumberland Strait); the general public; and Aboriginal groups that have an interest in the preservation and management of heritage resources related to their history and culture.

Within the Northumberland Strait, heritage resources are any physical remnants found on or below the sea floor that inform us of past human use of, and interaction with, the marine environment. Marine heritage resources include marine archaeological sites (i.e., a site that is fully or partially submerged or that lies below or partially below the high-water mark of any body of water) as well as shipwrecks or abandoned vessels and objects/features associated with New Brunswick and/or PEI's maritime history that are located in the marine setting.

Any Project activity that includes surface or sub-surface seabed disturbance has the potential for interaction with Heritage Resources if they are present. Construction represents the Project phase with the greatest potential for interaction with Heritage Resources due to seabed disturbance during the installation of the submarine cable.

From documentary research carried out in support of the Project (AAS 2014; Archaeological Services 2014a, 2014b), and the review of underwater video footage and sidescan sonar (SSS) footage, there were no known heritage resources in the PDA.

3.3.1 Scope of Assessment

This section defines the scope of the EIA of Heritage Resources in consideration of the regulatory setting, potential Project-VC interactions, and the existing knowledge of the PDA.

3.3.1.1 Regulatory and Policy Setting

Jurisdiction for Heritage Resources in the marine environment rests under federal authority; however, consideration has been made within this VC for provincial guidelines regarding the heritage resources in a submerged context. Heritage Resources in the marine context are protected under two separate federal Acts:

- the *Historic Sites and Monuments Act* (e.g., National Historic Places)
- the *Canada Shipping Act* (i.e., if wrecks of heritage value are identified)

This legislation only applies in the context of documented heritage resources; thus, for the purposes of this assessment no further consideration of federal legislation is required as there are no documented heritage resources within the marine portion of the PDA.

In the PEI context, heritage resources are legislated through the *Archaeology Act* and *Heritage Places Protection Act*, and are regulated by Archaeology Branch, Aboriginal Affairs Secretariat, Government of Prince Edward Island.

- *Archaeology Act* – protection is afforded by the Province for archaeological sites/objects, palaeontological objects/sites, protected archaeological sites, human remains
- *Heritage Places Protection Act* (HPPA) – protection is afforded by the Province for heritage places, historic resources defined as "…any work of nature or man that is primarily of value of its palaeontological, archaeological, prehistoric, cultural, natural, scientific or aesthetic nature." Section 1(b).

Section 8(1) of the HPPA outlines the Minister's authority to "…require any person proposing a development that may adversely affect any designated site, structure or area to provide, at the expense of that person, a heritage impact statement which specifies in detail the expected effect of the development."

Known heritage resources in New Brunswick are regulated under the *Heritage Conservation Act*. The regulatory management of heritage resources falls under the New Brunswick Department of Tourism, Heritage and Culture, and is overseen by its Heritage Branch. Within the Heritage Branch are the offices of Archaeological Services; Historic Places; and the New Brunswick Museum.

The review for Heritage Resources has been undertaken through the completion of historical, archaeological, architectural, and palaeontological research. The Province of New Brunswick provides some guidance for conducting heritage assessments, such as the *Guidelines and Procedures for Conducting Professional Archaeological Assessments in New Brunswick* (the Archaeological Guidelines) (Archaeological Services 2012).

The focus of this VC is archaeological resources in a submerged context (*e.g.*, shipwrecks) that may be located within the PDA for the submarine cable corridor. As there is a low likelihood for the discovery of built heritage resources or paleontological resources in the marine environment, these resources are not considered further in this VC.

3.3.1.2 The Influence of Consultation and Engagement on the Assessment

Consultation has taken place for the land-based VCs for Heritage Resources in New Brunswick and PEI (see New Brunswick and PEI volumes, respectively)). No specific consultation has taken place for the Northumberland Strait as no marine heritage resources have been documented in the PDA.

3.3.1.3 Potential Environmental Effects, Pathways and Measurable Parameters

The environmental assessment of Heritage Resources focuses on the following effect:

- Change in Heritage Resources

The effect has been selected in recognition of the interest of regulatory agencies, the general public as a whole, and potentially affected Aboriginal groups First Nations that have an interest in the preservation and management of Heritage Resources related to their history and culture. Federally, the assessment of Heritage Resources is required based on its inclusion in the definition of environmental effect within the *Canadian Environmental Assessment Act, 2012* (*CEAA 2012*):

> *"5. (1) For the purposes of this Act, the environmental effects that are to be taken into account in relation to an act or thing, a physical activity, a designated project or a project are…*
> *(c) with respect to aboriginal peoples, an effect occurring in Canada of any change that may be caused to the environment on…*
>
> > *(iv) any structure, site or thing that is of historical, archaeological, paleontological or architectural significance…*

5. (2) However, if the carrying out of the physical activity, the designated project or the project requires a federal authority to exercise a power or perform a duty or function conferred on it under any Act of Parliament other than this Act, the following environmental effects are also to be taken into account…

(b) an effect, other than those referred to in paragraph (1)(c), of any change referred to in paragraph (a) on…

- *(iii) any structure, site or thing that is of historical, archaeological, paleontological or architectural significance." (CEAA 2012)*

The measurable parameter used for the assessment of change in Heritage Resources, and the rationale for its selection, is provided in Table 3.19.

Table 3.19 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Heritage Resources

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Heritage Resources	• Disturbance or alteration of whole or part of a heritage resource from project ground disturbance during construction.	• Presence of heritage resource confirms an interaction, and absence indicates any discovery (unplanned) would be an accident.

3.3.1.4 Boundaries

3.3.1.4.1 Spatial Boundaries

The spatial boundaries for the environmental effects assessment of Heritage Resources are defined below.

- Project Development Area (PDA): The PDA is a 220 m wide corridor extending approximately 16.5 km between Borden-Carleton and Cape Tormentine. This includes the 10 m wide disturbance area for each submarine cable and the 200 m separation distance between the two cable trenches. The actual area of physical disturbance during construction is approximately 33 ha.
- Local Assessment Area (LAA): The LAA includes the PDA area and extends 1 km on either side of the PDA; the LAA is the maximum area where Project-specific environmental effects can be predicted and measured with a reasonable degree of accuracy and confidence.
- The Regional Assessment Area (RAA): The RAA is the area within which the Project's environmental effects may overlap or accumulate with the environmental effects of other projects or activities. As the potential environmental effects on Heritage Resources are limited to the footprint of physical disturbance associated with the Project for this component, the RAA for Heritage Resources is the Northumberland Strait between the high water lines in New Brunswick and PEI.

3.3.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of the Project on Heritage Resources include the Project construction phase as that is the only phase where ground-disturbing activities associated with the Project will be conducted.

Total construction time in the marine environment will take place over a 20 to 25 week period. Pre-trenching in water less than 12 m is scheduled to be conducted from May to early July 2016, while the remaining trenching and cable installation are scheduled to be installed in October and November 2016. Operation will begin following construction and is anticipated to continue for the life of the Project (approximately 40 years). Decommissioning and abandonment would take place following the useful service life of the Project and would be carried out in accordance with regulations in place at that time.

3.3.1.5 Residual Environmental Effects Description Criteria

Table 3.20 provides the environmental effects classification criteria that are used to characterize and describe Project residual environmental effects on Heritage Resources.

Table 3.20 Characterization of Residual Environmental Effects on Heritage Resources

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect.	**Positive**—an effect that moves measurable parameters in a direction beneficial to Heritage Resources relative to baseline. **Adverse**—an effect that moves measurable parameters in a direction detrimental to Heritage Resources relative to baseline. **Neutral**—no net change in measurable parameters for Heritage Resources relative to baseline.
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions.	**Negligible**—no measurable change to Heritage Resources. **Low to Moderate**—if Heritage Resources are encountered within the PDA and cannot be avoided, mitigation (*e.g.*, removal) will create a measureable change to Heritage Resources. **High**—a measureable change resulting in a permanent loss of information relating to Heritage Resources (*e.g.*, destruction that occurs without mitigation).
Geographic Extent	The geographic area in which an environmental effect occurs.	**PDA**—residual effects are restricted to the PDA.
Frequency	Identifies when the residual effect occurs and how often during the Project or in a specific phase.	**Single event**—an effect on Heritage Resources occurs only once (i.e., disturbance results in the loss of context).

Table 3.20 Characterization of Residual Environmental Effects on Heritage Resources

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The period of time required until the measurable parameter or the VC returns to its existing condition, or the effect can no longer be measured or otherwise perceived.	**Short-term**—the residual effect is restricted to the construction phase. **Long-term**—the residual effect will extend for the life of the Project. **Permanent**—Heritage Resources cannot be returned to its existing condition.
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases.	**Reversible**—the effect is likely to be reversed. **Irreversible**—the effect cannot be reversed as damage or removal will result in a change to Heritage Resources.
Ecological and Socioeconomic Context	Existing condition and trends in the area where environmental effects occur.	**Undisturbed**—area is relatively undisturbed or not adversely affected by human activity. **Disturbed**—area has been substantially previously disturbed by human development or human development is still present (*e.g.*, active and historic scallop dragging on the Northumberland Strait).

3.3.1.6 Significance Definition

A significant adverse residual environmental effect on Heritage Resources is one that results in a permanent Project-related disturbance to, or destruction of, all or part of a heritage resource (i.e., archaeological, architectural or palaeontological resource) considered by the provincial heritage regulators and other stakeholders to be of major importance due to factors such as rarity, undisturbed condition, spiritual importance, or research importance, and that cannot be mitigated or compensated.

3.3.2 Existing Conditions for Heritage Resources

3.3.2.1 Methods and Sources of Information

As part of existing conditions research for land-based portions of the Project in NB (Volume 3, Section 3.6) and PEI (Volume 2, Section 3.3), archaeological site searches were conducted for the waters within the Northumberland Strait. The following was also reviewed for the presence of any heritage resources-related features of note within the PDA: underwater video for a portion of the PDA; SSS footage; marine magnetometer surveys; and bathymetric maps (CSR 2015). Further information on the type of equipment used for the marine-based surveys can be found in Section 3.1 and in CSR (2015). Minimum SSS standards as required by New Brunswick Archaeological Services (Appendix F of the Archaeological Guidelines (2012)) were used for all SSS footage collected for the Project.

3.3.2.2 Overview of Existing Conditions

The heritage resource research has been summarized for New Brunswick (Volume 3, Section 3.6) and PEI (Volume 2, Section 3.3) and concluded that no archaeological or heritage resource sites are located within the PDA for the Project components and activities located in the Northumberland Strait. The closest recorded heritage resources are three suspected shipwrecks located near the New Brunswick landfall of the Confederation Bridge, between approximately 3 and 6 km from the PDA for this Project.

The review of SSS, marine magnetometer surveys, and bathymetric maps determined that there is one unknown underwater linear feature located near the Borden-Carleton end of the of corridor at KP 15.5 and a number of magnetic anomalies on both the New Brunswick and PEI side of the cable corridors. It is notable that there are few magnetic anomalies in the middle of the route, where the depth of the water is greatest. Underwater video footage of the unknown linear feature suggests the feature is likely a boulder pile or pile of concrete. Due to its location nearshore on the PEI side of the Northumberland Strait, and the historic prevalence of scallop dragging activities, it is not anticipated that this feature is the result of a deliberate human effort or a heritage resource. Magnetic anomalies present in the magnetometer survey are likely the result of the magnetometer being pulled quite close to the seabed and likely resulted from a detection of debris from fishing and other vessels and do not appear to be heritage resources.

Underwater video of a portion of the seafloor within the PDA (not associated with either cable bed) identified a number of small objects (e.g., a teapot, a glass bottle, and a wooden board) that will be avoided by Project infrastructure. While it is not possible to date these artifacts, they are not concentrated in one location and do not appear to be the result of a shipwreck and are likely just debris cast or lost overboard from passing vessels. Additional inshore underwater video in the PDA on the NB side was collected in August 2015 but the review was not completed by the time this report was prepared. The results will be provided in the Final Archaeological report as part of the NB Arch Service Archaeological permit.

In general, the area of the PDA within the Northumberland Strait has been subject to recent and historic scallop-dragging operations (see Section 3.2). As identified in CSR (2015), seafloor ice scouring is evident and locally abundant near-shore in NB and PEI.

3.3.3 Project Interactions with Heritage Resources

Potential Project interactions with Heritage Resources are presented in Table 3.21. These interactions are indicated by check marks, and are discussed in Section 3.3.6 in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects. Following the table, justification is provided for non-interactions (no check marks).

Table 3.21 Potential Project-Environment Interactions and Effects on Heritage Resources

Project Components and Physical Activities	Potential Environmental Effects
	Change in Heritage Resources
Construction	
Site Preparation for Submarine Cable	✓
Installation of the Submarine Cable	✓
Inspection and Energizing	–
Emissions and Wastes	–
Marine Transportation	–
Operation	
Energy Transmission	–
Infrastructure Inspection, Maintenance and Repair	–
Emissions and Wastes	–
Decommissioning and Abandonment	
Decommissioning	–
Emissions and Wastes	–
Transportation	–

Notes:
✓ = Potential interactions that might cause an effect.
– = Interactions between the project and the VC are not expected.

Construction

Potential interactions during Project construction phase are limited to ground-disturbing activities. Site preparation and installation of the cable are discussed in further detail in the sections below.

Operation

Once the submarine cable is installed, activities during operation will not affect Heritage Resources as these activities will not result in ground disturbance.

Decommissioning and Abandonment

The life of the Project is 40 years, at which time it may be decommissioned; however, it is more likely that at that time the Project will be refurbished and will continue to operate on a similar basis in perpetuity. If decommissioning activities are determined to be necessary, it is likely that the cables in the marine environment will be abandoned in place to avoid disturbance of the habitat. There are no expected interactions with Heritage Resources during any potential decommissioning activities as any disturbance would be occurring in areas that were previously disturbed during cable installation.

3.3.4 Assessment of Residual Environmental Effects on Heritage Resources

Construction activities as identified in Table 3.21 are the only Project activities with potential to result in residual environmental effects of the Project on Heritage Resources. These interactions, pathways, mitigation and residual effects are described below.

3.3.4.1 Analytical Assessment Techniques

Analytical techniques for the marine environment are limited to the review of background research and archaeological site maps for the land-based portions of the Project in the New Brunswick (Volume 3, Section 3.6) and PEI (Volume 2, Section 3.3), the review of SSS footage of the entire submarine cable corridor, and the review of underwater video footage within portions of the PDA for the submarine cable corridor.

3.3.4.1.1 Project Pathways for Heritage Resources

Heritage Resources in the marine environment (i.e., submerged archaeological resources) would be located on the seafloor, thus, the interaction with Heritage Resources is expected to take place during ground-disturbing activities such site preparation for the submarine cable and installation of the submarine cable.

As there were no Heritage Resources (i.e., submerged archaeological resources) identified within the marine environment during existing conditions research it is anticipated there will be no interaction with Heritage Resources during construction activities.

3.3.4.1.2 Mitigation for Heritage Resources

As there were no submerged archaeological resources identified during research, mitigation for Heritage Resources is limited to:

- Development of an archaeological response protocol in the event of accidental discovery of submerged archaeological resources during construction activities which will be part of the marine EPP.

3.3.4.2 Residual Project Environmental Effects for Change in Heritage Resources

The assessment of potential effects to Heritage Resources was compiled using background research and an archaeological visual assessment of the PDA. The background research included a review of the locations of any known archaeological sites, plane crashes and submerged marine vessels. This information was received from the regulators at Aboriginal Affairs, Province of Prince Edward Island and Archaeological Services, Province of New Brunswick. The archaeological assessment was undertaken in June 2015 and involved reviewing video footage and side scan sonar data of existing conditions within the PDA in order to determine the presence or absence of heritage resources.

3.3.4.3 Summary of Residual Project Environmental Effects

The residual Project environmental effects on Heritage Resources are summarized in Table 3.22 and discussed below.

Table 3.22 Summary of Project Residual Environmental Effects on Heritage Resources

Residual Effect	Residual Environmental Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socioeconomic Context
Change in Heritage Resources	C	A	L/M	PDA	P	S	I	D

KEY
See Table 3.20 for detailed definitions.

Project Phase:
C: Construction
O: Operation
D: Decommissioning and Abandonment

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term
P: Permanent

NA: Not applicable

Frequency:
S: Single event

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socioeconomic Context:
D: Disturbed
U: Undisturbed

3.3.5 Determination of Significance

3.3.5.1 Significance of Residual Project Effects

Construction activities as identified in Table 3.21are the only Project activities with potential to result in environmental effects on Heritage Resources. With mitigation, consisting of the development and implementation of an archaeological response protocol for the Project, the potential residual adverse environmental effects of the construction of the Project on Heritage Resources are rated not significant.

3.3.6 Prediction Confidence

The prediction of significance of Project effects on Heritage Resources has been made with a high level of confidence due to the comprehensiveness of the background research for land-based portions of the Project in New Brunswick (Volume 3, Section 3.6) and PEI (Volume 2, Section 3.3), and archaeological research for the waters within the Northumberland Strait.

3.3.7 Follow-up and Monitoring

There are no suggested follow-up and monitoring activities for Heritage Resources.

3.4 ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS ON CURRENT USE OF LAND AND RESOURCES FOR TRADITIONAL PURPOSES BY ABORIGINAL PERSONS

Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons was selected as a VC in accordance with the requirements of the *Canadian Environmental Assessment Act* (2012) which states that the effect of any change that may be caused to the environment on the current use of land and resource for traditional purposes by Aboriginal persons must be taken into account when conducting an environmental assessment for a project.

For the purposes of this assessment, Current Use is considered "living memory" of the use of land and resources within the PDA. For this VC, current use primarily applies to Aboriginal fishing and hunting in the Northumberland Strait.

This VC is closely related to CRA Fisheries VC (Section 3.2) which addresses Aboriginal commercial communal fishing. It is also closely related to the Marine Environment VC (Section 3.1) which addresses potential biological effects on fish species which may be targeted in a traditional use fishery.

3.4.1 Scope of Assessment

3.4.1.1 Regulatory and Policy Setting

Fisheries Act

Aboriginal fishing activities take place in two distinct fisheries, the communal commercial fishery, and the Food, Social and Ceremonial (FSC) Fishery. The general provisions that are set out under the federal *Fisheries Act* (refer to CRA Fisheries VC Section 3.2) for the communal commercial fishery apply to the FSC in the Northumberland Strait in terms of general protection of CRA species. Provisions under the *Fisheries Act* protect fish and fish habitat, including fisheries resources, and apply specific regulations governing fisheries.

FSC licenses are issued under the authority of the *Fisheries Act* and of subsection 4(1) of the Aboriginal Communal Fishing Licenses Regulations.

Fishery resources are protected from uncontrolled fishing activity through various measures such as area closures, fishing quotas, fishing seasons, and gear and vessel restrictions as described and detailed under the regulations presented above and by Fisheries Management Decisions applied by DFO in accordance with the roles and responsibilities outlined in the *Fisheries Act* (DFO 2013a).

Oceans Act

Other broad mechanisms for the protection of marine resources are provided in the federal Oceans Act which governs the establishment and alteration of fishing zones and Marine Protected Areas within Canadian waters.

3.4.1.2 The Influence of Consultation and Engagement on the Assessment

The Proponent will be engaging with Aboriginal communities in proximity to the Project to identify issues and concerns related to Project development. Details of the Aboriginal engagement plan are presented in Volume 1 (Section 3.2.3). The political leadership (i.e., Chief and Council) within Aboriginal communities in proximity to the Project will be notified of the Project details (e.g., the location, details, and schedule of the Project) via a letter to determine if these communities have any questions or concerns about the Project and determine the need for further engagement to discuss the project. This letter will request information on any known current use of the area within the Northumberland Strait that will be affected by the Project. A meeting regarding the Project was held between MECL and the Mi'kmaq Confederacy in PEI on April 27, 2015.

Consultation with the Fisheries and Oceans Canada (DFO) has identified Aboriginal commercial communal fisheries in the Northumberland Strait; potential interactions between these fisheries and the Project are addressed in the CRA Fisheries VC (Section 3.2.3). Fisheries conducted under the commercial communal licenses are not considered to be current use for traditional purposes by Aboriginal persons for the purpose of this VC.

3.4.1.3 Potential Environmental Effects, Pathways and Measurable Parameters

The Project could have an effect on traditional activities where they occur in proximity to the PDA, and there is the potential for an interaction to cause a change in current use of marine waters and resources for traditional purposes.

During the phases of the Project, (construction, operation and decommissioning and abandonment) there may be a period of time where access to fishing/gathering/hunting grounds is restricted within a localized area. Construction and operation activities will require marine vessel activities that may temporarily disrupt fishing or hunting activities in the Strait. Decommissioning and abandonment will be assessed at the end of the useful life of the Project. The life of the Project is 40 years, at which time it may be decommissioned; however, it is more likely that at that time the Project will be refurbished and will continue to operate on a similar basis in perpetuity. If decommissioning activities are determined to be necessary, it is likely that the cables in the marine environment will be abandoned in place to avoid disturbance of the habitat. Any decisions made regarding decommissioning and abandonment will be completed in accordance with the applicable regulations at that time and could include either the abandonment or removal of the submarine cable.

The potential effect of changes in populations of marine species is discussed in the Marine Environment VC (Section 3.1.4). The results of the assessment of potential Project effects on those resources that may be used for tradition purposes will help to inform the assessment of potential interactions on Current Use of Land and Resources for Tradition Purposes by Aboriginal Persons.

Table 3.23 outlines the potential environmental effects, pathways and measurable parameters associated with the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons as they relate to this Project.

Table 3.23 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Current Use of Marine Waters and Resources for Traditional Purposes by Aboriginal Persons	• Temporary or permanent loss of access to fishing, hunting or gathering areas or opportunities. The Project may change the health or habitat of traditionally harvested species.	• Duration of time that fishing, hunting and gathering is not able to be conducted. • Documented current use resources for traditional purposes by Aboriginal persons.

3.4.1.4 Boundaries

3.4.1.4.1 Spatial Boundaries

The spatial boundaries for the environmental effects assessment of Current Use of Land and Resources for Traditional Purposes by Aboriginal Person are presented in Figure 3.11 and defined below.

- Project Development Area (PDA): The PDA is a 220 m wide corridor extending approximately 16.5 km between Borden-Carleton and Cape Tormentine. This includes the 10 m wide disturbance area for each submarine cable and the 200 m separation distance between the two cable trenches. The actual area of physical disturbance during construction is approximately 33 ha.
- Local Assessment Area (LAA): The LAA includes the PDA area and extends 1 km on either side of the PDA; the LAA is the maximum area where Project-specific environmental effects can be predicted and measured with a reasonable degree of accuracy and confidence

- Regional Assessment Area (RAA): The RAA includes the marine waters within the administrative boundaries of LFA 25. The RAA was defined as LFA 25 because all Project activities fall within this commercial fishing administrative boundary. SFA 22 and GFA 4T7 maintain the same geographical boundaries as LFA 25. Included within the RAA are sections of the commercial fishing administrative boundaries of HFA 16E and MFA 16. While these general fishing areas were selected to represent the potential RAA for current use activities, the proponent acknowledges that potential current use activities may not be limited to this area.

3.4.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of the potential effects of the Project on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons include the construction, operation and decommissioning and abandonment phases of the Project. Total construction time in the marine environment will take place over a 20 to 25 week period. Pre-trenching in water less than 12 m is scheduled to be conducted from May to early July 2016, while the remaining trenching and cable installation are scheduled to be installed in October and November 2016. Operation will begin following construction and is anticipated to continue for the life of the Project (approximately 40 years). Decommissioning and abandonment would take place following the useful service life of the Project and would be carried out in accordance with regulations in place at that time.

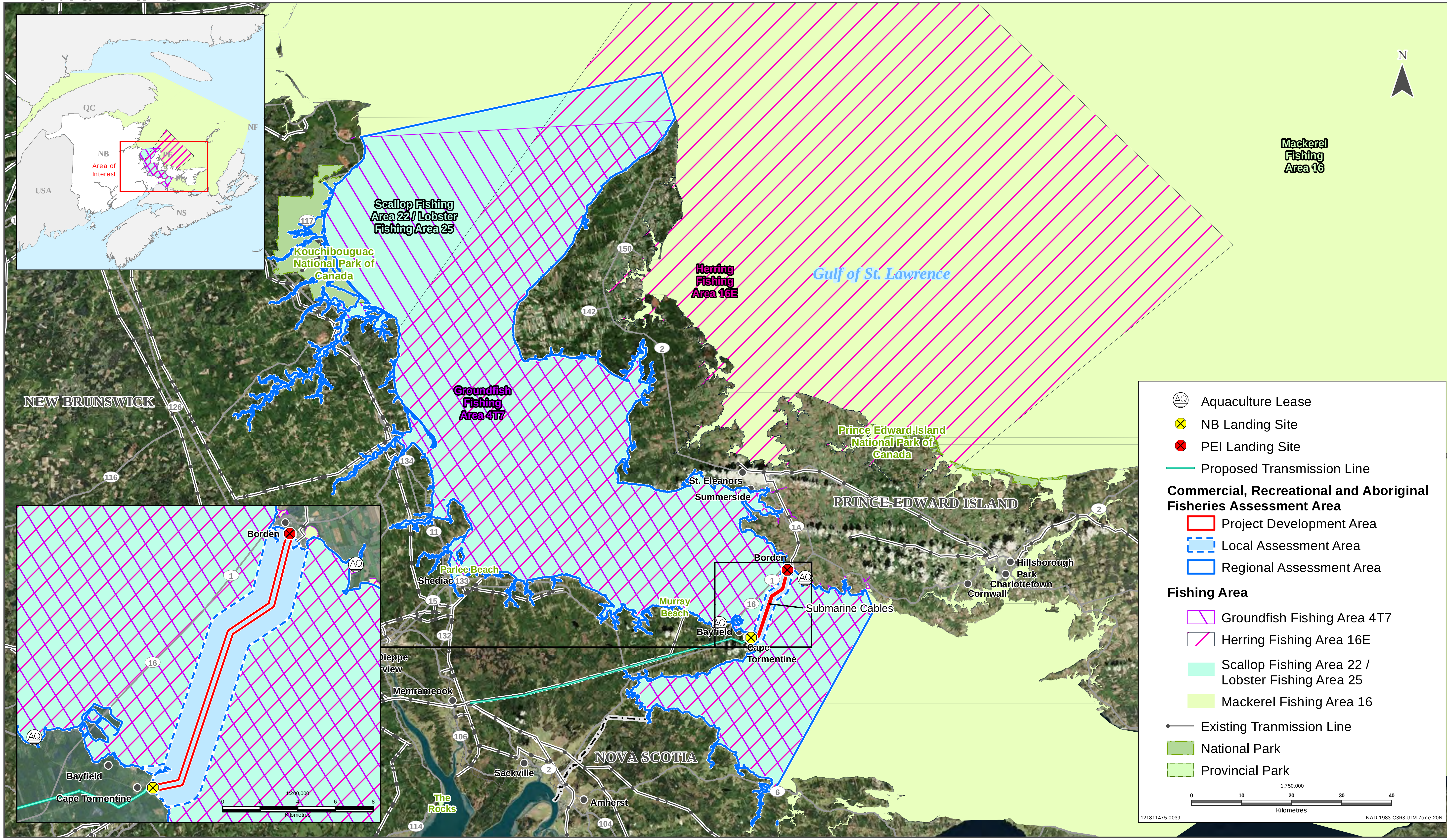
The temporal boundaries of existing conditions for the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is the period of "living memory" of Aboriginal Persons or communities engaged in current use activities within the Strait.

Temporal boundaries pertain to the periods of time the traditional activities (e.g., fishing, hunting, gathering) are pursued, as well as any seasonal limitations associated with terms of food, social, and ceremonial (FSC) licenses.

3.4.1.5 Residual Environmental Effects Description Criteria

Table 3.24 provides the environmental effects classification criteria that are used to characterize and describe Project residual environmental effects on the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons.

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_4_marine\3_4_tlru\121811475-0039.mxd



Sources: GeoNB, NB Power, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Stantec

Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons Assessment Boundaries

121811475 - PEI - NB Marine Cable Interconnection - Maritime Electric Company Limited

Figure 3.11

Table 3.24 Characterization of Residual Environmental Effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect.	**Positive**—an effect that moves measurable parameters in a direction beneficial to Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons relative to baseline. **Adverse**—an effect that moves measurable parameters in a direction detrimental to Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons relative to baseline. **Neutral**—no net change in measureable parameters for the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons relative to baseline.
Magnitude	The amount of change in measurable parameters or variable relative to existing conditions.	**Negligible**—no measurable change from existing baseline conditions. **Low**—a measurable change from existing baseline conditions, but results in no net loss in the availability of or access to water and/or resources currently used for traditional purposes. **Moderate**—measurable change (but less than high) from existing baseline conditions, in the availability of or access to water and/or resources currently used for traditional purposes. **High**—measurable change from existing baseline conditions that is a non-compensated substantive and permanent loss in the availability of or access to water and/or resources currently used for traditional purposes.
Geographic Extent	The geographic area in which an environmental, effect occurs.	**PDA**—residual effects are restricted to the PDA. **LAA**—residual effects extend into the LAA. **RAA**—residual effects interact with those of other projects in the RAA.
Frequency	Identifies when the residual effect occurs and how often during the Project or in a specific phase.	**Single event**—effect occurs once during the construction and operation phases of the Project. **Multiple irregular event**—occurs at irregular intervals during construction and infrequently during the operation phases of the Project. **Multiple regular event**—occurs at regular intervals during the operation phases of the Project. **Continuous**—occurs continuously during the construction and operation phases of the Project.

Table 3.24 Characterization of Residual Environmental Effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The period of time required until the measurable parameter or the Use of Land and Resources for Traditional Purposes by Aboriginal Persons returns to its existing condition, or the effect can no longer be measured or otherwise perceived.	**Short-term**—residual effect restricted to the construction period (effects are measurable for days to a few months). **Medium-term**—residual effect extends throughout the construction and up to 40 years during operation. **Long-term**—residual effect extends beyond the life of the project.
Reversibility	Pertains to whether a measurable parameter can return to its existing condition after the project activity ceases.	**Reversible**—the effect is likely to be reversed after activity completion and reclamation. **Irreversible**—the effect is unlikely to be reversed.
Ecological and Socioeconomic Context	Existing condition and trends in the area where environmental effects occur.	**Undisturbed**—area is relatively undisturbed or not adversely affected by human activity. **Disturbed**—area has been substantially previously disturbed by human development or human development is still present.

3.4.1.6 Significance Definition

A significant adverse residual environmental effect on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is defined as a long-term (loss of an entire season) loss of the availability of, or access to, land and water resources for use. In particular it includes the loss of the availability of, or access to, water resources, the aquatic environment and ceremonial sites located within the assessment area by Aboriginal persons for traditional purposes and cannot be mitigated.

3.4.2 Existing Conditions for Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

3.4.2.1 Methods

Information regarding Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons in the Northumberland Strait was obtained through review of existing literature, online public resources, engagement with stakeholders and formal data requests.

Engagement activities in Aboriginal communities in New Brunswick and PEI have been initiated and will be on-going. The exact nature, scope and detail of these engagement activities will be determined with community leaders.

Relevant information in this section is derived from relevant biophysical assessments, literature review, past project experience, and professional judgment. In particular the assessment of traditional use has been informed by other VC assessments, primarily Marine Environment VC (Section 3.1), which addresses fish species which may be targeted in a traditional use fishery. The assessments of effects on fish species may not capture the conditions that influence the act of harvesting (e.g., personal choice). However, the abundance of a species that may be used for traditional purposes and the potential effects on that abundance by the Project will directly affect the current use of that species for traditional purposes.

3.4.2.2 Overview

The following is a summary of historical and current use by First Nations from research and literature. As additional information becomes available through the engagement process, it will be provided in supplemental reports (if applicable).

Mi'kmaq traditional territory (Figure 3.12) is understood to be comprised of all of Nova Scotia and PEI and the eastern shore of New Brunswick, extending north to the Gaspe. Mi'kmaq territory in New Brunswick extends west, where it meets the neighboring Maliseet traditional territory, the divide with which is generally seen as the drainage area of the Saint John River watershed as far north as the Gulf of St. Lawrence and south to the Bay of Fundy (Paul n.d.; Berneshawi 1997).

There are fifteen First Nations communities within the province of New Brunswick and two First Nation communities on Prince Edward Island. These are comprised of six Maliseet Nation communities and eleven Mi'kmaq Nation communities (Figure 3.13). Based on ethno-historical accounts, oral histories, archaeological research, and historical texts, the Maliseet and Mi'kmaq Nations and their ancestors have lived and use the land and resources of what is now New Brunswick and Prince Edward Island since the retreat of the glaciers in this area.

There are two Mi'kmaq First Nation communities within PEI, Lennox Island and Abegweit. Lennox Island First Nation is located along the northwestern coastal region of the province (Lennox Island First Nation 2013). Abegweit First Nation consists of three reserves in different geographic locations on the eastern portion of the province (Morell Rear Reserve #2, Rocky Point Reserve #3, and Scotchfort Reserve #4) (Abegweit First Nation 2015). The Mi'kmaq Confederacy of Prince Edward Island (MCPEI) is a common forum for the First Nations in PEI to address issues related to Aboriginal and treaty rights (MCPEI 2015).

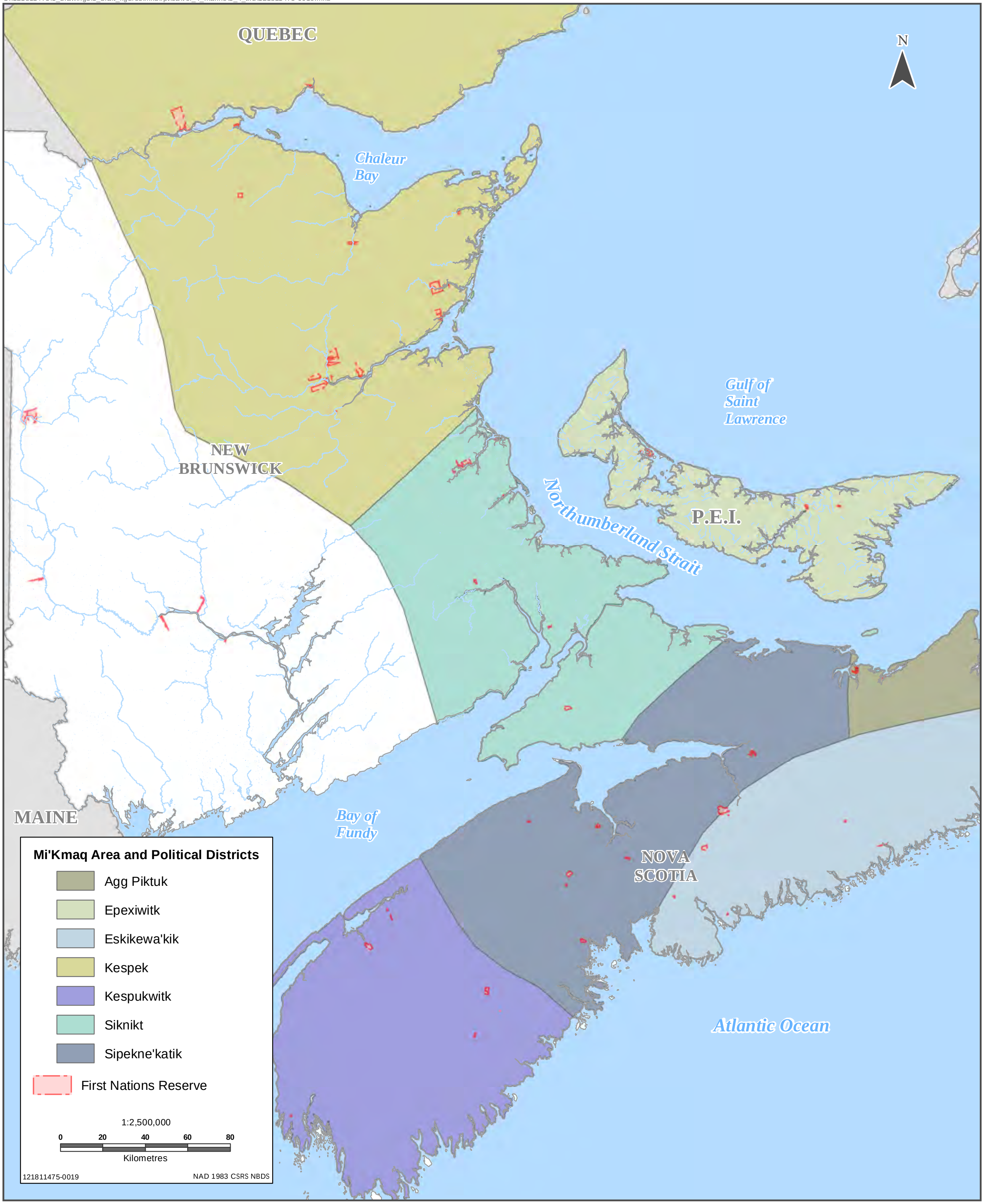
Of the 11 Mi'kmaq communities that are geographically located along the Northumberland Strait in New Brunswick and PEI, six communities are located within the RAA: Fort Folly First Nation, Bouctouche First Nation, Elsipogtog First Nation, Indian Island First Nation, Lennox Island First Nation and Abegweit First Nation. Information on these communities is presented in Table 3.25.

Table 3.25 Characteristics of Mi'kmaq Communities within RAA, 2015

Reserve	Size (ha)	Location	Total Population as of January 2015 (On and Off-Reserve)
Fort Folly First Nation			
Fort Folly 1	56.10	61.07 km southwest of PDA	130
Bouctouche First Nation			
Bouctouche 16	62.30	83.2 km northwest of PDA	118
Indian Island First Nation			
Indian Island 28	38.40	97.6 km northwest of PDA	183
Elsipogtog First Nation			
Richibucto 15	1742.10	106.3 km northwest of PDA	3,260
Soegao No. 35	104.5	89.3 km northwest of PDA	
Lennox Island First Nation			
Lennox Island 1	534.2	42.4 km northeast of the PDA	928
Lennox Island 6	9.7	12.8 km north of the PDA	
Lennox Island 5	18.8	44.4 km northeast of the PDA	
Abegweit First Nation			
Morell 2	83	76.6 km east of the PDA	370
Rocky Point 3	4.8	42.4 km east of the PDA	
Scotchfort 4	113.10	61.6 km east of the PDA	
Source: AANDC 2014.			

The PDA is located within traditional Mi'kmaq territory. In the fall of 2014 and spring of 2015 a request for traditional information along with details regarding the Project were provided by email to MCPEI, and the PEI provincial branch of the Aboriginal Affairs Secretariat. This email request for information was sent as part of the archaeological permit application process in order to conduct an archaeological walkover of the Borden-Carleton landfall site. On June 1, 2015, MCPEI responded with a letter stating that based on the information they have, fish harvesting of mackerel occurs in the area to the south of the landfall site. A copy of the letter is included in Appendix A.

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_4_marine\3_4_tlru\121811475-0019.mxd



Sources: Base Data - SNB, NBDNR. Mi'Kmaq Areas Data - Paul, Danieln: http://www.danielnpaul.com/Map-Mi'kmaqTerritory.html. Ganong, W.F. 1899. Map of New Brunswick in Prehistory (Indian) Period., Natural Resources (2011).Project Data from Stantec or provided by NB Power / MECL.

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

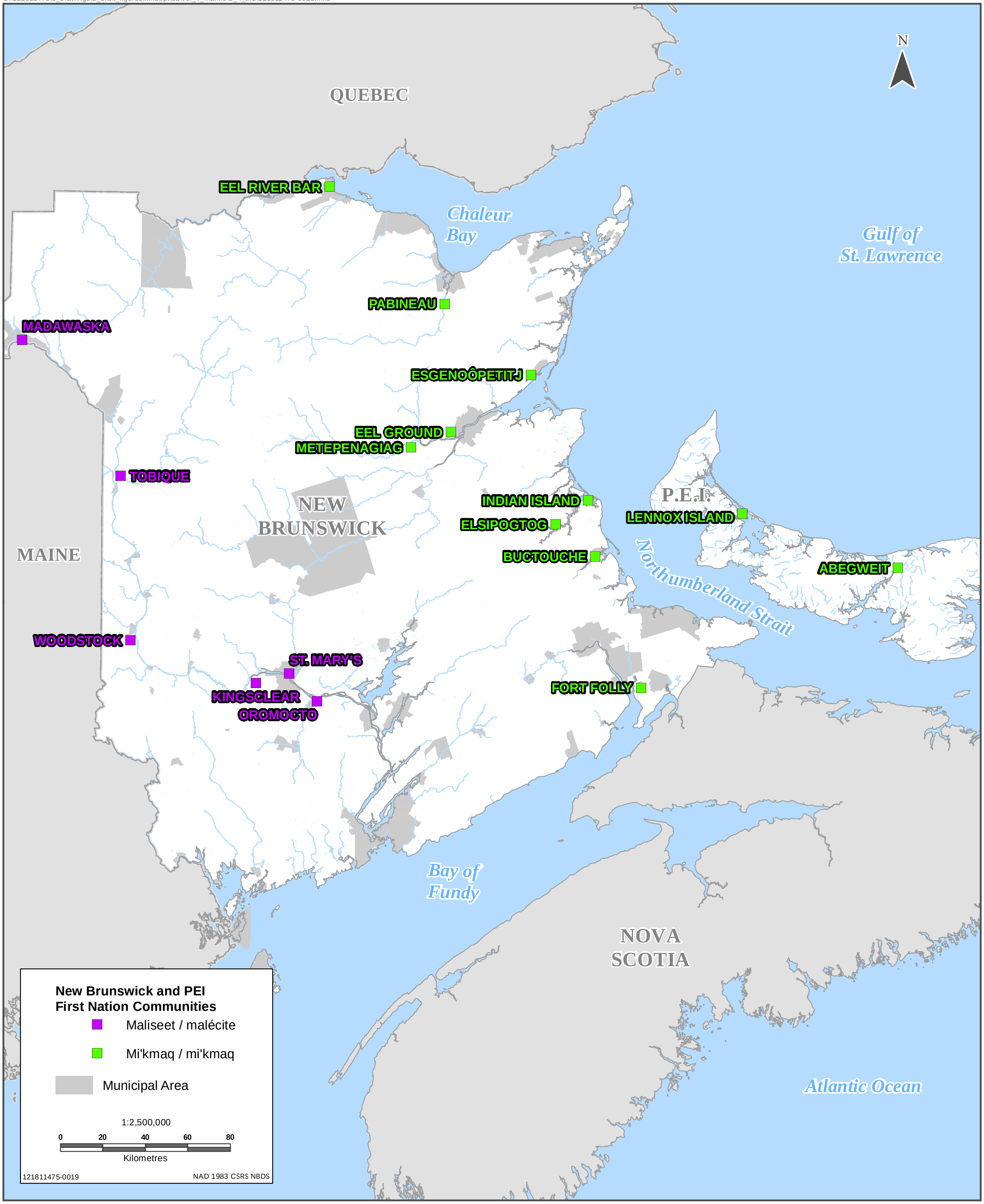
Stantec

Mi'kmaq Areas in Eastern Canada

121811475 - PEI - NB Marine Cable Interconnection - Maritime Electric Company Limited

Figure 3.12

U:\121811475\3_drawings\3_draft_figures\mxd\rpt\ea\vol_4_marine\3_4_tlru\121811475-0021.mxd



Sources: Mi'Kmaq Areas Data - Paul, Danieln: http://www.danielnpaul.com/Map-Mi'kmaqTerritory.html. Natural Resources (2011).Project Data from Stantec or provided by NB Power / MECL.

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Stantec

New Brunswick and Prince Edward Island First Nation Communities

1218111475 - PEI - NB Marine Cable Interconnection - Maritime Electric Company Limited

Figure 3.13

Aboriginal fishing activities take place in two distinct fisheries, the communal commercial fishery, and the Food, Social and Ceremonial (FSC) Fishery. Communal commercial fishery licenses are issued to First Nations communities as a whole as opposed to individuals. Since these licenses are commercial licenses, information on the commercial Aboriginal fishery in the Northumberland Strait is presented in the CRA Fisheries VC (Section 3.2) and is not included in this VC as traditional use.

FSC fishing is a cultural and sustenance activity and DFO negotiates agreements for Aboriginal fishing through the Aboriginal Fisheries Strategy (AFS) for FSC purposes. DFO recognizes that FSC access to fishery resources has priority over other allocations, provided conservation of the stock is not an issue. Resources fished using an FSC license are used communally to provide food for its members, and support the traditional social and ceremonial activities of the First Nations community or groups (DFO 2012).

FSC licenses are issued with a variety of conditions on the timing of fishing activities, the location to be fished, the gear to be used and the quantity allocation. The conditions of each FSC license vary from species to species, and within a single species conditions can vary from one license to another. The principal FSC fisheries in the RAA as indicated by number of licenses issued are for bivalves (including clams, oysters, mussels, and scallops), mackerel, and lobster (Lavoie C, pers. comm., 2015).

FSC bivalve harvesting is carried out in the tidal waters of the Northumberland Strait and at locations mutually agreed upon by Aboriginal Groups and DFO. Allocations range from daily individual harvest limits (e.g. 100 to 350 clams per individual per day) to a quantity that is sufficient to meet FSC needs.

FSC mackerel fishing is carried out throughout MFA 16 and at locations mutually agreed upon by First Nations communities and DFO. For some licenses there is not quota for mackerel, for others, allocations are weight based (e.g., 200 lbs), or based on individual net or daily harvest limits.

FSC lobster fishing is carried out throughout LFA 25 and at locations mutually agreed upon by Aboriginal communities and DFO. Allocations range from weight based (e.g., 50,000 lbs) to number of tags per individual, to quantities that are negotiated with DFO on a case per case basis.

An overview of FSC licenses within the RAA is provided in Tables 3.26.

Table 3.26 FSC Licenses issued to Aboriginal communities within the RAA

Species	Number of Licenses	Species	Number of Licenses
Clams	12	Mussels	4
Cod	2	Oysters	6
Eel	2	Quahog	3
Groundfish	1	Rock Crab	5
Halibut	1	Scallops	2

Table 3.26 FSC Licenses issued to Aboriginal communities within the RAA

Species	Number of Licenses	Species	Number of Licenses
Herring	9	Seals	4
Shellfish	2	Silverside	1
Lobster	7	Smelts	6
Mackerel	10	Toad Crab	1
Note: The administrative boundary for herring extends beyond the area described as the RAA (on the Gulf of St. Lawrence side of PEI). The exact number of herring licenses held by Aboriginal people in the Northumberland Strait portion of the RAA is unknown (Leblanc I, pers. comm., 2015).			

In addition to the species identified in table 3.26, it is possible that other hunting and gathering activities take place in the Northumberland Strait (e.g., gathering seaweed or other species). Further information on Aboriginal harvesting activities will be gathered throughout the ongoing Aboriginal engagement activities.

3.4.3 Project Interactions with Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Potential Project interactions with Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons are presented in Table 3.27. These interactions are indicated by check marks, and are discussed in Section 3.4.4 in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects. Following the table, justification is provided for non-interactions (no check marks).

Table 3.27 Potential Project-Environment Interactions and Effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Project Components and Physical Activities	Potential Environmental Effects
	Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons
Construction	
Site Preparation for Submarine Cable	✓
Installation of the Submarine Cable	✓
Inspection and Energizing of the Submarine Cable	-
Emissions and Wastes	-
Marine Transportation	✓
Operation	
Energy Transmission	-
Infrastructure Management, Maintenance and Repair	✓
Emissions and Wastes	-

Table 3.27 Potential Project-Environment Interactions and Effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Project Components and Physical Activities	Potential Environmental Effects
	Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons
Decommissioning and Abandonment	
Decommissioning	✓
Emissions and Wastes	-
Transportation	✓

Notes:
✓ = Potential interactions that might cause an effect.
– = Interactions between the project and the VC are not expected.

Construction

During the construction phase, the primary interaction with this VC will occur with the site preparation and installation of the submarine cables and generally limited to the PDA. Marine transportation activities during construction will generally be limited to the PDA for a period of less than one season. Fishing activities will not be excluded from the PDA once the submarine cable has been installed and is operational.

Operation

Emissions and wastes (in particular EMF generated during operation) will not interact with commercial fishing activities in the PDA and is discussed in detail in the Section 3.1, Marine Environment VC. Emissions and wastes generated during the construction, when vessels and bottom equipment will be used for the installation or removal of the submarine cables, are expected to be similar to that of fishing boats and other vessels currently operating within the LAA.

Fishing activities will not be excluded from the PDA once the submarine cables have been installed and are operational.

Decommissioning and Abandonment

Decommissioning and abandonment will be assessed at the end of the useful life of the Project. The life of the Project is 40 years, at which time it may be decommissioned; however, it is more likely that at that time the Project will be refurbished and will continue to operate on a similar basis in perpetuity. If decommissioning activities are determined to be necessary, it is likely that the cables in the marine environment will be abandoned in place to avoid disturbance of the habitat. Given that the cables are solid dielectric and do not contain oil or other harmful chemicals that could leach into the environment or released if the abandoned cable were damaged, there is no expected interaction with this VC. Any decisions made regarding decommissioning and abandonment will be completed in accordance with the applicable regulations at that time and could include either the abandonment or removal of the submarine cable.

3.4.4 Assessment of Residual Environmental Effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Potential residual effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons include a change to traditional hunting, fishing or gathering opportunities within the LAA due to construction, operation or decommissioning activities.

Potential residual environmental effects on Aboriginal commercial fisheries are discussed in the CRA Fisheries VC (Section 3.2), and effects on fish species are discussed in the Marine Environment VC (Section 3.1).

3.4.4.1 Analytical Assessment Techniques

Information regarding Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons in the Northumberland Strait was obtained through review of existing literature, online public resources, engagement with stakeholders and formal data requests. The conclusions in this section are derived primarily from the conclusions from relevant biophysical assessments, past project experience, and professional judgment.

3.4.4.2 Assessment of a Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

3.4.4.2.1 Project Pathways for a Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Information provided by DFO indicates that the LAA and surrounding waters are fished for FSC purposes, including mackerel, eel, shellfish (clams, mussels, oysters, quahog) and other species. The subsea cable route is expected to traverse these fishing areas. It is anticipated that construction and operation (maintenance) of the submarine cables may result in a temporary loss of access to areas within the PDA that are used for harvesting through hunting, fishing and gathering. This restricted access to the Project site could constrain Aboriginal fishing, hunting and gathering opportunities.

3.4.4.2.2 Mitigation for a Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Mitigation for effects related to a change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is closely linked to mitigation measures for CRA Fisheries VC (Section 3.2) and the Marine Environment VC (Section 3.1). It is expected that this mitigation will protect traditional uses such as the FSC fishery. These mitigation measures include:

As a general mitigation measure, FSC liaison and has been implemented and will continue with Aboriginal Communities to keep fishers informed of Project, including scheduling and or construction delays. ,

During Project construction, exclusion zones around Project vessels may be implemented to allow for navigation of vessel traffic.

Once construction of the Project is complete, there will be no fishing exclusion zones or fishing gear restrictions within or around the Project footprint. Fishers will be able to continue to access these fishing grounds and conditions are expected to return to pre-construction levels. This is consistent with what is currently in place for the existing transmission cables between New Brunswick and PEI.

Prior to construction of the Project a Notice to Mariners and Notice to Shipping will be issued in conjunction with the Canadian Coast Guard to inform vessel traffic of Project activities. Navigational charts will be updated post construction to include the location of the submarine cables. The following mitigation measures will be implemented for changes in marine population, and will be applied during Project construction:

- Timing of in-water work will be conducted in consideration of sensitive biological periods (e.g., reproductive life stages), where practical, for CRA species, as determined through discussions with DFO and other regulators.
- Prior to beginning marine works, sediment curtains will be put in place around activities at cable landing sites, if practical, to prevent sediment from entering the water column outside the work area.
- Only clean rock (containing less than 5 % fines and non-acid generating) or native material will be used for infilling (acid generating rock may be used in areas that will be submerged by water at all times).
- Construction vessels will operate at reduced speeds when possible, to reduce the amount of underwater noise created and the risk of vessel strikes with marine wildlife.
- Project vessels will comply with applicable legislation, codes and standards of practice for shipping, including the Ballast Water Control and Management Regulations under the *Canada Shipping Act* and the Canadian Ballast Water Management Guidelines, to reduce risk of introduction of marine invasive species.
- Project vessel port of call history and/or records and proof of hull cleaning will be provided prior to entering the Northumberland Strait. Vessel hulls will be cleaned and/or inspected to prior to entering the Northumberland Strait, where necessary.
- Should it be determined that construction activities will result in serious harm to CRA fish or supporting fish species as defined under the *Fisheries Act* and policies a habitat offsetting plan will be prepared for DFO approval and implemented.

The following mitigation measures will be implemented for changes in marine population, and will be applied during Project operation:

- The electrical transmission cables will be completely buried minimizing heat and EMF emissions at the seabed surface.
- Inspection support vessels will operate at reduced speeds when possible, to reduce the amount of underwater noise created and the risk of vessel strikes with marine wildlife.

3.4.4.2.3 Residual Project Environmental Effect for a Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

A residual environmental effect leading to a change in Current Use of Land and Resources for Traditional Purposes by Aboriginal persons may occur during construction and operation of the Project. The construction and operation (maintenance) may result in disruptions to access to fishing, hunting and gathering activities within the LAA. It is reasonable to assume that potential interactions will be short in duration and confined to the LAA. With the implementation of mitigation measures such as effective implementation of an FSC Liaison and Communications Plan, the magnitude of the effect of the Project on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is anticipated to be low. This potential effect on traditional fishing, hunting and gathering activities is anticipated to occur at multiple irregular events during the construction of the Project and is anticipated to occur irregularly during Project operation. Based on existing conditions and past evidence, this environmental effect is anticipated to be reversible and short in duration. After completion of Project construction and operation, it is expected that traditional fishing, hunting and gathering activities within the LAA will return to pre-construction conditions.

3.4.4.3 Summary of Residual Project Environmental Effects

The residual Project environmental effects on Current Use of Land and Resources for Traditional Purposes by the Aboriginal persons are provided in Table 3.28.

Table 3.28 Summary of Project Residual Environmental Effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons: Northumberland Strait

Residual Effect	Residual Environmental Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socioeconomic Context
Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons	C	A	L	LAA	ST	I/R	R	U
	O	A	L	LAA	ST	I/R	R	U

KEY
See Table 3.24 for detailed definitions.

Project Phase:
C: Construction
O: Operation
D: Decommissioning and Abandonment

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term
P: Permanent

NA: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socioeconomic Context:
D: Disturbed
U: Undisturbed

3.4.5 Determination of Significance

3.4.5.1 Significance of Residual Project Effects

A change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons within the LAA is not expected to be significant during the construction or operation phases of the Project provided mitigation measures are implemented and in consideration of the following:

- The small size of the PDA compared to the available fishing/hunting/gathering grounds within the RAA.
- The short timeframe anticipated for the completion of the construction or operation activities of the Project.

Overall, the residual adverse environmental effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons are considered to be not significant.

3.4.6 Prediction Confidence

Confidence in the conclusions is moderate due to the limited availability of information related to the current use of resources for traditional purposes in the Northumberland Strait. However, regarding the potential environmental effects on marine wildlife, there is a high level of understanding of the potential environmental effect pathways, and anticipated effectiveness of the mitigation and project planning measures. The overall prediction confidence associated with this VC therefore if moderate to high.

As consultation is ongoing, should Traditional Knowledge information become available, this information will be considered and residual effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons will be reviewed. Given the qualitative and subjective nature of assessing the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, the views of Aboriginal groups may differ from this assessment. Should concerns regarding residual effects be identified through ongoing Aboriginal engagement, this information will be provided through additional reporting.

The Proponent will continue to work with the First Nations to reasonably address Project-specific issues related to residual effects, and will take Aboriginal concerns and recommendations into account during the Project planning process.

3.4.7 Follow-up and Monitoring

There is no follow up or monitoring proposed for this VC.

The Proponent will continue to consult with the Aboriginal communities to reasonably address Project-specific issues related to residual effects and additional work and/or monitoring may be required pending the results of the engagement process.

4.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Effects of the environment on the Project are associated with risks of natural hazards and influences of nature on the Project. These effects may arise due to forces associated with weather, climate, climate change, marine hazards, or seismic events. Potential effects of the environment on any project are a function of project or infrastructure design in the context of its receiving environment. These effects may act on the Project resulting in adverse changes to Project components, schedule, and/or costs.

In general, environmental conditions that can affect construction of the Project, infrastructure, or operational performance will be addressed through engineering design and industry standards. Good engineering design involves the consideration of environmental effects and loadings or stresses from the environment on a project.

As a matter of generally accepted engineering practice, designs and design criteria tend to consistently overestimate and account for possible forces of the environment. Engineering design therefore inherently incorporates a considerable margin of safety so that a project is safe and reliable throughout its lifetime. The PEI Energy Corporation, MECL and NB Power will also monitor any observed effects of the environment on the Project, and take action, as necessary, to repair and upgrade Project infrastructure and modify operations to permit the continued safe operation of the facility.

4.1 SCOPE OF ASSESSMENT

Potential effects of the environment on the Project relevant to conditions potentially found in Northumberland Strait and considered in this assessment are:

- climate, including weather and weather variables such as:
  - air temperature and precipitation
  - fog and visibility
  - winds
  - extreme weather events
  - storm surges and waves
- climate change (including sea-level rise and coastal erosion)
- sea ice
- seismic events

4.1.1 Regulatory and Policy Setting

Direction on the scoping of effects of the Environment on the Project for this assessment have been provided by PEI and NB governments, as noted in the following section.

4.1.2 The Influence of Consultation and Engagement on the Assessment

As outlined in Volume 1, Section 3.2 (Consultation and Engagement), scoping documents were sent to provincial regulators in PEI and New Brunswick, in addition to PWGSC.

Two comments relevant to scoping of potential effects of the environment on the Project relevant to the Northumberland Strait were received from government representatives. PEIDCLE advised that *"all climate change adaptation impacts on the infrastructure"* (e.g., flooding, erosion, wind, freezing rain) be addressed in the assessment. The NBDELG Technical Review Committee has requested that future climate conditions be considered by the Proponent with respect to location, design and construction of the transmission line and its associated infrastructure.

First Nations engagement with MCPEI was held in April 2015. In July 2015 a letter was sent to MCPEI to provide an update to the environmental assessment process. A response from MCPEI was received on August 6, 2015; no concerns specifically related to the effects of the environment on the Project were expressed.

A letter describing the EIA process for the Project was sent to the Assembly of First Nations' Chiefs in NB Inc. on July 31, 2015. No concerns regarding potential effects of the environment on the Project have been received to date.

4.1.3 Potential Environmental Effects, Pathways and Measurable Parameters

Potential effects of the environmental on the Project may include:

- reduced visibility and inability to manoeuver construction and operation equipment
- delays in receipt of materials and/or supplies (e.g., construction materials) and/or in delivering products
- changes to the ability of workers to access the site (e.g., if waves due to high winds were to prevent access within the Strait)
- damage to infrastructure
- increased structural loading
- corrosion of exposed oxidizing metal surfaces and structures, perhaps weakening structures and potentially leading to malfunctions
- loss of electrical power resulting in potential loss of production

These and other changes to the Project by the environment are generally characterized as delays or damage to the Project processes, equipment, marine vessels and vehicles. As a result, the effects analysis for effects of the environment on the Project is focused on the following effects:

- change in Project schedule
- damage to infrastructure

Some effects, such as damage to infrastructure, can also result in consequential effects on the environment; these environmental effects are addressed as Accidents, Malfunctions and Unplanned Events in Chapter 5.

4.1.4 Boundaries

4.1.4.1 Spatial Boundaries

The spatial boundaries for the assessment of effects of the environment on the Project include all areas where Project-related activities are expected to occur. For the purpose of this assessment, the spatial boundaries for effects of the environment on the Project are limited to the PDA, which is the area of physical disturbance associated with the construction of the Project. This includes the footprint of both submarine cables including the separating distance (width of the PDA is 220 m in total).

Where consequential environmental effects are identified, they are considered within the boundaries of the specific zone of influence of those consequences. Accidental events that could arise as a result of effects of the environment (e.g., severe weather), such as vessel collisions, are addressed in Chapter 5.

4.1.4.2 Temporal Boundaries

The temporal boundaries for the assessment of Effects of the Environment on the Project include construction, operation and maintenance, and decommissioning and abandonment. Total construction time in the marine environment will take place over a 20 to 25 week period. Pre-trenching in water less than 12 m is scheduled to be conducted from May to early July 2016, while the remaining trenching and cable installation are scheduled to be installed in October and November 2016. Operation will begin following construction and is anticipated to continue for the life of the Project (approximately 40 years). Decommissioning and abandonment would take place following the useful service life of the Project and would be carried out in accordance with regulations in place at that time.

4.1.5 Residual Environmental Effects Description Criteria

A significant adverse residual effect of the environment on the Project is one that would result in:

- a substantial change of the Project schedule (e.g., a delay resulting in the construction period being extended by one season)
- a long-term interruption in service (e.g., interruption in power transmission activities such that electricity demands cannot be met)
- damage to Project infrastructure resulting in a significant environmental effect
- damage to the Project infrastructure resulting in a substantial increase in a health and safety risk to the public or business interruption
- damage to the Project infrastructure resulting in repairs that could not be technically or economically implemented

4.2 EXISTING CONDITIONS FOR EFFECTS OF THE ENVIRONMENT ON THE PROJECT

4.2.1 Climate

Climate is defined as the statistical average (mean and variability) of weather conditions over a substantial period of time (typically 30 years), accounting for the variability of weather during that period (Catto 2006). The relevant parameters used to characterize climate are most often surface variables such as temperature, precipitation, and wind, among others.

The current climate conditions are generally described by the most recent 30 year period (1981 to 2010; Government of Canada 2015a) for which the Government of Canada has developed statistical summaries, referred to as climate normals. The closest weather station to the Project with available historical data is in Summerside, PEI, located approximately 20 km north-west of the Project. Limited historic climate data are available for the Summerside station; therefore, data from the Charlottetown weather station, located approximately 60 km from Borden-Carleton, are also used to supplement information on regional conditions relevant to the Northumberland Strait.

4.2.1.1 Air Temperature and Precipitation

The average monthly temperature in Summerside has ranged between -7.7 °C (January) and 19.2 °C (July) (Table 4.1). Extreme maximum temperature was 33.3 °C (July 1963) and the extreme minimum temperature was -29.9 °C (January 1982).

Summerside averages 1,072.9 mm of precipitation per year, of which, approximately 809.1 mm fell as rain and 277.9 cm as snow. Extreme daily precipitation at Summerside ranged from 41.9 mm (February) to 111.8 mm (August). On average, there have been 6 days each year with rainfall greater than 25 mm, and snowfalls greater than 25 cm occur on average 1 day per year (Government of Canada 2015a).

4.2.1.2 Fog and Visibility

Fog is defined as a ground-level cloud. It consists of tiny water droplets suspended in the air and reduced visibility to less than 1 km (Environment Canada 2014a). "Days with fog" are days when fog occurs and horizontal visibility is less than 1 km (thick fog) and 10 km (fog) (Phillips 1990). Limited historical climate data for fog and visibility are available for the Summerside station; therefore, fog data from the Charlottetown weather station, located approximately 60 km from the Project, are presented to provide some indication of the magnitude of fog experienced in the region. The hours with the measured increase in hours of reduced visibility (< 1 km) is between December and April (Government of Canada 2015a) (Table 4.2). Days with fog in PEI are relatively low throughout the year, as the surrounding provinces act as a barrier from the southerly fog off the Bay of Fundy (Phillips 1990). The Charlottetown weather station has experienced, on average, 190.8 hours (7.95 days) per year when visibility is less than 1 km.

Table 4.1 Air Temperature and Precipitation Climate Normals, Summerside and Charlottetown (1981-2010)

Month	Temperature (°C)					Precipitation (mm)					Mean No. of Days with							
	Averages			Extreme		Rainfall (mm)	Snowfall (cm)	Precipitation (mm)	Extreme daily Rainfall (mm)(Year)	Extreme Daily Snowfall (mm)(Year)	Temperature (°C)				Snow (cm)		Rain (mm)	
	Max	Min	Avg	Max (Year)	Min (Year)						>=30*	>=20*	<=20	<=-30	>=10	>=25	>=10	>=25
JAN	-3.2	-12.1	-7.7	12.1 (1979)	-29.9 (1982)	25.2	78.5	96.2	56.6 (1979)	53.6 (1961)	0	0	2.7	0	2.1	0.44	0.69	0.13
FEB	-2.5	-11.2	-6.9	12.8 (1976)	-26.1 (1943)	24.9	53.4	74.9	74.4 (1953)	40.4 (1990)	0	0	2.3	0	1.7	0.19	0.88	0.19
MAR	1.1	-6.8	-2.9	15.6 (1945)	-23.9 (1950)	34.6	47.4	79.4	33.3 (1944)	40.9 (1957)	0	0	0.44	0	1.4	0.19	1.1	0.12
APR	6.9	-1	3	23.3 (1945)	-13.4 (1995)	61.3	22.2	84.2	87.6 (1962)	37.6 (1962)	0	0.33	0	0	0.44	0.06	1.9	0.25
MAY	14.2	4.9	9.5	32 (1977)	-5 (1972)	94.9	3.2	97.7	58.7 (1951)	13.4 (1985)	0	5	0	0	0.13	0	3.1	0.67
JUN	19.4	10	14.7	32.2 (1947)	0 (1947)	91.3	0	91.3	57.9 (1968)	0 (1942)	0.07	13.6	0	0	0	0	3.1	0.44
JUL	23.8	14.6	19.2	33.3 (1963)	6.7(1952)	74.1	0	74.1	71.4 (1979)	0 (1942)	0.33	25	0	0	0	0	2.1	0.67
AUG	22.9	14.3	18.6	33.3 (1944)	4.4 (1953)	92.7	0	92.7	111.8 (1948)	0 (1942)	0.43	24.1	0	0	0	0	2.9	1.1
SEP	18.2	10	14.1	31.7 (1942)	-0.1 (1980)	96.8	0	96.7	109.2 (1942)	0 (1942)	0.1	10.1	0	0	0	0	3.3	0.8
OCT	12.1	4.6	8.4	24.4 (1968)	-5.6(1944)	87	0.7	87.7	69.3 (1968)	20.3 (1974)	0	1.1	0	0	0	0	2.9	0.8
NOV	5.8	-0.7	2.6	21.2 (1982)	-13.3 (1978)	77.2	19.1	97.7	90.4 (1944)	27.2 (1968)	0	0.07	0	0	0.5	0.06	2.6	0.31
DEC	-0.1	-7.5	-3.8	15.6 (1950)	-25.6 (1943)	49.2	53.5	100.3	46 (1944)	44.2 (1963)	0	0	0.53	0	1.4	0.07	1.5	0.47
Annual	9.9	1.6	5.7	-	-	809.1	277.9	1072.9	-	-	0.93	79.3	5.9	0	7.6	1	26	6

Note: * Data taken from the Charlottetown weather station, as these data are not available for Summerside.
Source: Government of Canada 2015a, 2015b

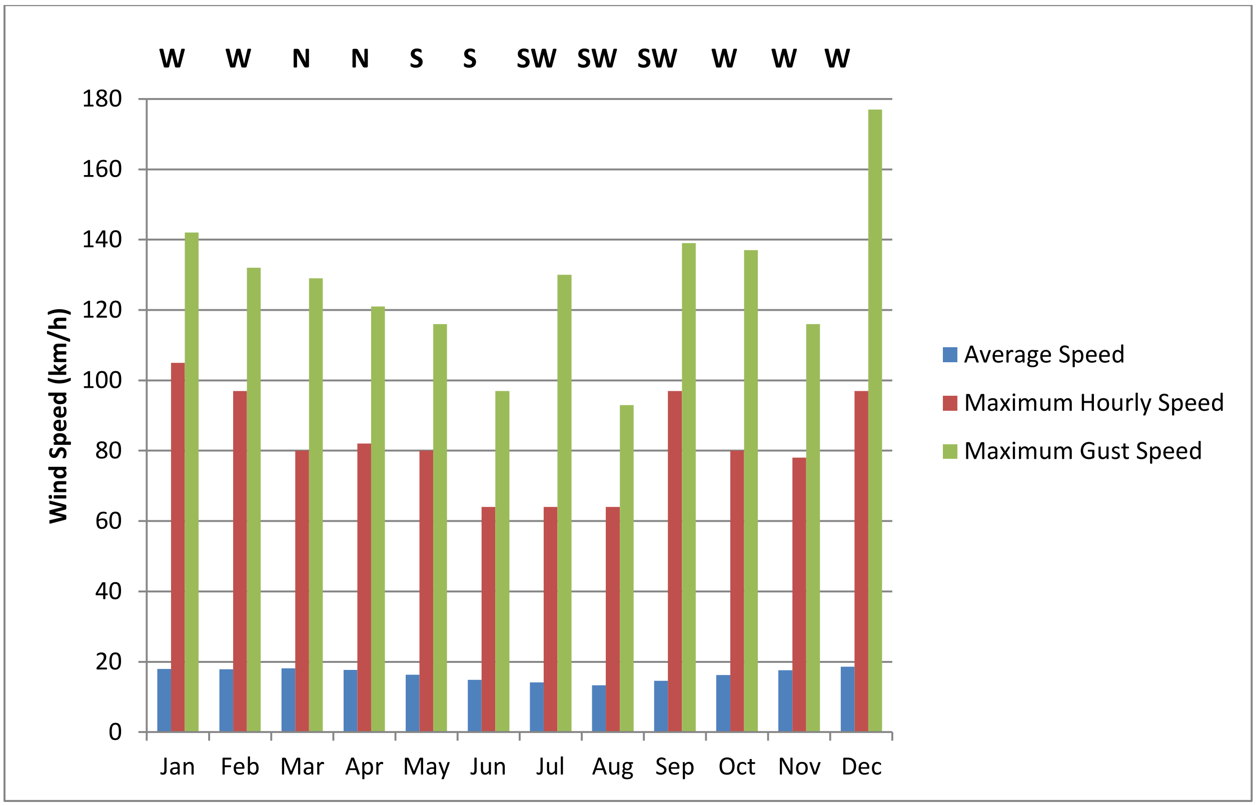
Table 4.2 Visibility - Climate Normals, Charlottetown (1981-2010)

	Visibility (hours with)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
< 1 km	29.4	25.1	28.4	25.4	17	10.9	5.7	4.5	4.2	2.8	11.4	26.1	190.8
1 to 9 km	136.6	117.6	116.5	107	90.1	80	69.2	73	56.3	58.1	91.6	135	1130.9
> 9 km	578	534.2	599.1	587.7	636.9	629.2	669.1	666.5	659.5	683.1	617	582.9	7443.1

Source: Government of Canada 2015b

4.2.1.3 Wind

Monthly average wind speeds measured at the Charlottetown weather station range from 13.3 to 18.6 km/h (Figure 4.1). From October to February, the dominant wind directions are from the west, with winds predominantly blowing from the north during March and April, from the south during May and June, and from the southwest during July to September (Government of Canada 2015b). Maximum hourly wind speeds measured at the Summerside weather station range from 64 km/h to 121 km/h, while maximum gusts for the same period range from 98 km/h to 145 km/h (Government of Canada 2015a). Occurrences of extreme winds are uncommon at Charlottetown; over the last three decades, there has been an average of 7.9 days per year with winds greater than or equal to 52 km/h and 1.8 days per year with winds greater than or equal to 63 km/h (Government of Canada 2015b).



Note: Monthly average wind speed and direction taken from Charlottetown data; Maximum hour and gust speed taken from Summerside data.

Figure 4.1 Predominant Monthly Wind Direction, Monthly Mean, Maximum Hourly and Maximum Gust Wind Speeds (1981 to 2010) at Summerside and Charlottetown, PEI

4.2.1.4 Extreme Weather Events

Extreme precipitation and storms can occur in the Northumberland Strait throughout the year, but tend to be more common and severe during the winter. Winter storms generally bring high winds and combination of snow and rain. More recently, extreme snowfall events in the winter of 2014/2015 affected much of PEI and New Brunswick. Some areas in PEI received as much as 551 cm of snow which broke the provincial record for the most snowfall recorded in one year (University of Prince Edward Island 2015). As a result, the Confederation Bridge was closed to traffic this winter more than most winters (CBC News 2015a). These winter conditions also delayed the ice melt in the Northumberland Strait, causing ferry services to postpone seasonal services and lobster and scallop fisheries to postpone the opening day for the fishery season (CBC News 2015b).

Thunderstorms during the early summer typically attenuate as they cross the Northumberland Strait, from New Brunswick, due to the cold waters of the Strait. As the summer progresses, however, water temperatures warm up and are able to sustain or strengthen thunderstorms as they travel across the Strait to PEI (NAV CANADA 2000).

4.2.1.5 Storm Surges and Waves

Rising sea levels and more frequent and severe weather events have brought about an increase in frequency of storm surges. Storm surges are defined as the elevation of water resulting from meteorological effects on sea level. During the past 15 years, storm surges have resulted in property destruction in all four Atlantic Provinces (Vasseur and Catto 2008). In Atlantic Canada, storm surges have been higher in coastal waters and highest in the Gulf of St. Lawrence (Bernier et al. 2006). A study from 1997 (Parkes et al. 1997) reported that storm surges in southeastern New Brunswick ranged from 0.6 m to 2 m in height and surges above 0.6 m in height occurred about two to three times per year along the Canadian Atlantic coast. Typically, surges were found to last for an average of 2.2 hours, and occasionally over 12 hours.

Run-up waves are produced from wind blowing over the surface of water. Maximum wave height is primarily a function of wind strength, wind duration and the length of exposed water (“fetch”). Substantial run-up waves usually occur during extreme storm events such as tropical cyclones and nor’easters.

4.2.2 Climate Change

While “climate” refers to average weather conditions over a 30-year period, “climate change” is an acknowledged change in climate that has been documented over two or more periods, each with a minimum duration of 30 years (Catto 2006). The Intergovernmental Panel on Climate Change (IPCC) defines climate change as a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes, external forces, or to persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC 2012). The United Nations Framework Convention on Climate Change makes a distinction between climate change attributed to human activities and climate variability attributable to natural causes. Climate change is a change of climate directly or indirectly attributed to human activity that alters the composition of the global atmosphere, which is in addition to natural climate variability observed over comparable time periods (IPCC 2007a).

Predictions of effects of climate change are limited by the inherent uncertainty of climate models in predicting future changes in climate parameters. Global and regional climate models can provide useful information for predicting and preparing for global and macro-level changes in climate; however, the ability of models to pinpoint location-specific changes to climate is still relatively limited.

4.2.2.1 Sea Level Rise

Global sea levels have risen 1.8 mm/year over a 40 year period (1961 to 2003) and a more recent rate of 3.1 mm/year between 1993 and 2003 (Bindoff et al. 2007). The sea level has been slowly and steadily rising in most of Atlantic Canada for centuries due to crustal subsidence, warming trends, and the melting of polar ice caps (Government of Newfoundland and Labrador 2003). In particular, the sea level has been gradually rising along the southeastern coast of New Brunswick for a long time (several thousand years) and the changes associated with this rise have become especially evident along the Northumberland Strait over the last several decades (Daigle et al. 2006) due to the low coast profile and substantive development near the coast line and on lands near mean sea level. Most of Atlantic Canada is also experiencing some crustal subsidence in coastal areas, thus compounding the rise in sea level (Vasseur and Catto 2008).

Sea level rise sensitivity is defined as the degree to which a coastline may experience physical changes such as flooding, erosion, beach migration, and coastal dune destabilization (Natural Resources Canada 2010a).

Sea levels are expected to continue to rise at a greater rate in the 21st Century than was observed between 1961 and 2003 due to more rapid warming, which in turn increases rate of melting of the ice caps and glaciers. By the mid-2090s, global sea levels are projected to rise at a rate of approximately 4 mm/year, and reach 0.22 m to 0.44 m above 1990 levels (Bindoff et al. 2007). It is generally understood that a rise in sea level, coupled with more frequent and severe weather, are likely to bring about storm surges that could flood areas in Atlantic Canada that were once unlikely to flood (Conservation Corps of Newfoundland and Labrador 2008).

As the sea level continues to rise, the frequency of higher storm surges will increase (Vasseur and Catto 2008). At the current sea level, storm surges of 3.6 m are anticipated annually in the southern Gulf of St. Lawrence by 2100 (Parkes et al. 2006). Over the next 100 years storm surges in excess of 4.0 m are anticipated to occur once every 10 years (Vasseur and Catto 2008).

Climate systems are highly variable, reducing the certainty with which climate projections can be made. While the directions of some climate conditions are nearly certain, there is greater uncertainty in the projected magnitude or extent of the conditions. For example, while it is expected that temperatures will increase over the next 80 years, determining the extent of that temperature increase becomes progressively more difficult further into the future. When investing in infrastructure and industries of the future that will be subject to sea level rise and storm surges, precautions must be taken in their design to ensure adequate consideration of the effects of climate change.

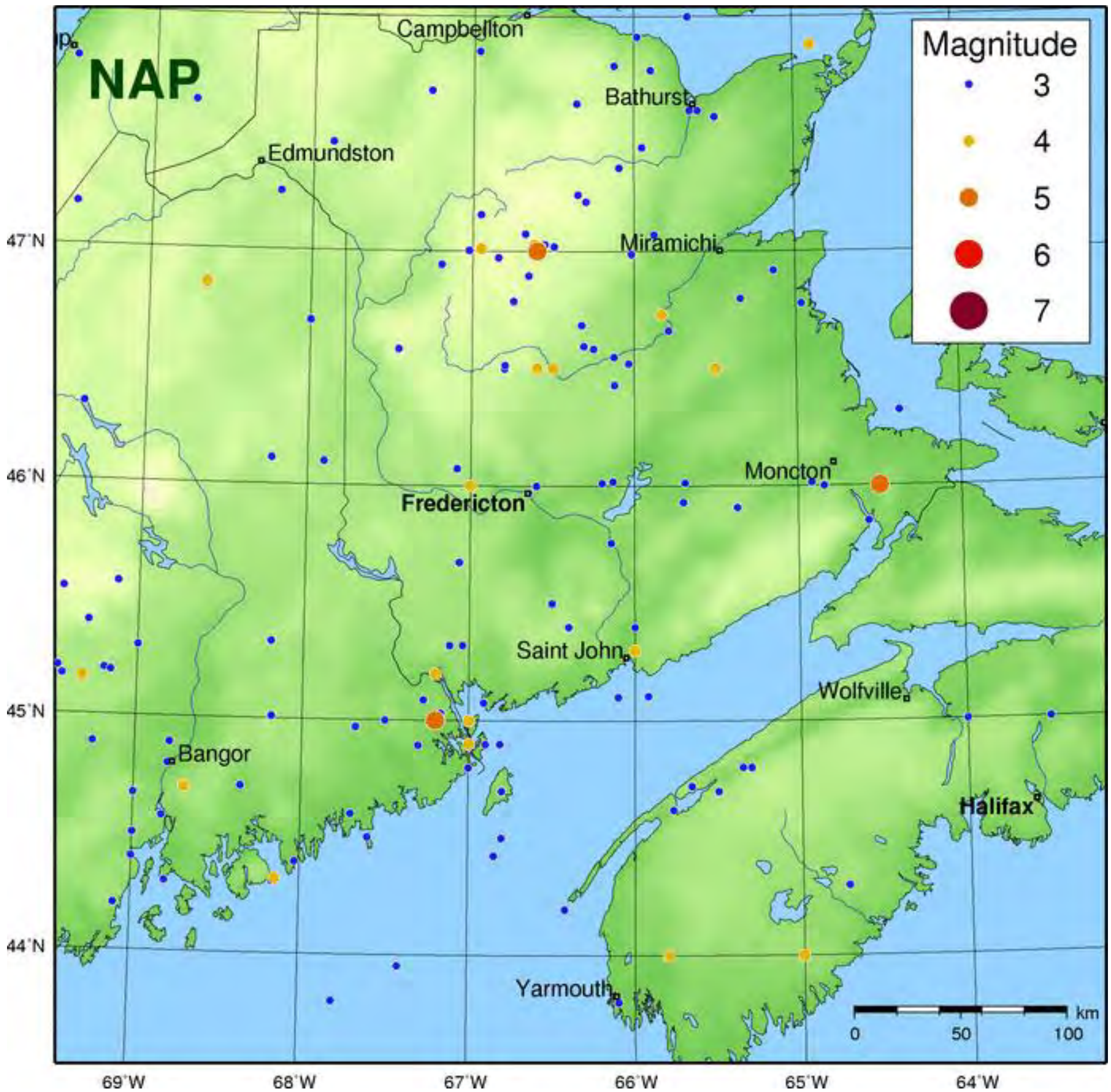
Sea-level rise is occurring in Nova Scotia, Prince Edward Island, and most of New Brunswick due to a rising sea and a sinking earth surface. Sea-level rise is most significant in areas with low-lying shorelines of estuaries, lagoons and coastal plains, and most sensitive to barrier islands, spits, and salt marshes (PEIDELJ 2011).

Coastal erosion caused by sea-level rise and wave action may also be influenced by the strength of the coastal material. The sedimentary rocks (i.e., sandstone and shale) and sand that is common in PEI is extremely vulnerable to erosion, due to the weak resistance of the material (PEIDELJ 2011). A coastal erosion assessment for both PEI and New Brunswick landing sites was conducted by Stantec in 2014. Refer to the Effects of the Environment on the Project VCs in Volumes 2 and 3, Sections 4.2.2.1 and 4.2.2.1, respectively, for methods and results of the assessment.

4.2.3 Seismic Activity

Seismic activity is dictated by the local geology of an area and the movement of tectonic plates comprising the Earth's crust. Natural Resources Canada monitors seismic activity throughout Canada and identifies areas of known seismic activity in order to document, record, and prepare for seismic events that may occur.

The Project lies within the Northern Appalachians seismic zone (Figure 4.2), one of five seismic zones in southeastern Canada (NRCan 2013). Figure 4.2 indicates that there was one seismic occurrence within the Northumberland Strait of a magnitude of 3. Natural Resources Canada (2013b) explains that it is very unlikely that an earthquake of magnitude less than 5 could cause damage. The level of historical seismic activity in this zone is low. Due to the low frequency and magnitude of seismic activity within the Strait, the likelihood of seismic activity occurring during the life of the Project is low and is therefore not assessed further.



Source: NRCan 2013

Figure 4.2 Northern Appalachians Seismic Zone

4.2.4 Sea Ice

During the last week of December, ice starts to form in the coastal areas of the Northumberland Strait. The Strait is typically completely covered in ice during the first week of January. Ice begins to melt in the third week of March and the Strait is typically ice-free late April (Obert and Brown 2011). In the Strait, there were 633 freezing degree days in 2008 and 580 freezing degree days in 2007 (IFN Engineering 2007, 2008). The ice thickness between those years was on average less than one meter (Brown 2007).

The Strait develops a range of ice floes and ice thicknesses throughout the winter months. In combination with the ice development and the wind and currents, ice ridges and rubble fields are created in the Strait during these months (Obert and Brown 2011).

Geophysical surveys were conducted in 2014 by the Canadian Seabed Research Ltd. over the proposed cable routes in the Northumberland Strait. These surveys were conducted in order to characterize the surficial and shallow sub-surface geology, and to identify potential submarine hazards to the cables. Ice scour surveys were conducted at both landfall sites using SSS and singlebeam bathymetry.

There were 133 ice scour events reported from the SSS data collected in 2014. Scour measurements were taken from unscoured, smoothed seabed datum to the deepest point of the scour. The ice scour events identified occurred in water depths from 2 to 13 m. Scour was most frequent in water depths of 4 to 5 m. Sediment transport within the Northumberland Strait highly influences scour degradation and the extent of infilling that occurs (CSR 2015).

As a result, navigation can be hindered due to thick ice formation in the Strait (Canadian Coast Guard 2013), and ice scouring could affect the submarine cables.

4.3 ASSESSMENT OF EFFECTS OF THE ENVIRONMENT ON THE PROJECT

4.3.1 Effects of Climate on the Project

4.3.1.1 Project Pathways for Effects of Climate on the Project

The potential effects of climate must be considered during infrastructure development, particularly in marine environments. Extreme temperatures and severe precipitation, fog and visibility, winds and extreme weather events could potentially cause:

- reduced visibility and inability to manoeuver equipment
- delays in construction/operation activities and delays in receipt of materials
- inability of personnel to access the site (e.g., if waves due to high winds were to prevent construction in the marine environment)
- damage to infrastructure
- increased structural loading

During construction, extreme low temperatures have the potential to reduce the ductility of construction materials used in Project components (e.g., ancillary facilities) and increase susceptibility to brittle fracture.

Snow and sea ice have the potential to increase loadings on Project infrastructure (e.g., ship decks of cable laying vessel and support vessels). Extreme snowfall and sea ice can also affect winter construction activities by causing a delay in construction or a delay in delivery of materials, and resulting in additional effort for clearing and removal. Construction activities will, however, only be occurring during the late spring/early summer and fall, and therefore, extreme snowfall during construction is not anticipated.

During operation or decommissioning and abandonment phases, the PDA could experience heavy rain, snowfall and freezing rain events that could delay project maintenance. Ice scour or sea bed movements could affect the integrity of marine cables.

Reduced visibility due to fog could make maneuvering of equipment (e.g., support vessels) difficult in the early part of the day. However, these short delays are anticipated and can often be predicted, and allowance for them will be included in the construction schedule. Disruption of construction activities and delays to the construction schedule will be avoided by scheduling tasks that require precise movements for periods when the weather conditions are favorable.

Wind storm events could potentially cause reduced visibility and interfere with maneuvering of equipment (e.g., support vessels) or transporting materials or staff movements (e.g., during cable laying or maintenance activities).

Coastal erosion as a result of sea level rise, storm surges and waves can affect land-based Project facilities located near the shoreline (e.g., cables at the landing site, termination site) if not properly accounted (e.g., shoreline protection).

4.3.1.2 Mitigation for Climate

To address the potential effects of climate (air temperature, precipitation, fog and visibility, winds, and extreme weather events), all aspects of Project, design, materials selection, planning, and maintenance will consider normal and extreme conditions that might be encountered throughout the life of the Project. In particular, construction and maintenance of marine infrastructure (i.e., cables), will be undertaken by specialized vessels and crews that are fully capable of working under normal and extreme weather conditions associated with the Northumberland Strait. Work will also be scheduled where feasible to avoid predicted times of extreme weather for the safety of crews and Project infrastructure.

The Project will be constructed to meet applicable building, safety and industry codes and standards. The engineering design of the Project will consider and incorporate potential future changes in the forces of nature that could affect its operation or integrity. For example, storm surges and waves will be considered in engineering of and design plans for the submarine cables. Project infrastructure will be built to meet the current and anticipated extreme future environmental loads. The Project components will be designed to meet CSA standards and other design codes and standards for wind, snowfall, extreme precipitation, and other weather variables associated with climate.

4.3.1.3 Residual Effects of Climate on the Project

The potential effects of climate on the Project during the construction, operation, and decommissioning and abandonment phases will be considered and incorporated in the planning and design of Project infrastructure and scheduling. This will be done to reduce the potential for Project delays and long-term damage to infrastructure and risk to workers, taking into account the existing and predicted climate conditions. Inspection and maintenance programs will prevent the deterioration of the infrastructure and will help to maintain compliance with applicable design criteria and reliability of the transmission system. Significant residual adverse effects of climate on the Project, or interruption to the Project schedule, are not anticipated.

4.3.2 Effects of Climate Change on the Project

4.3.2.1 Project Pathways for the Effects of Climate Change on the Project

Long term increases in temperature and precipitation as a result of climate change predicted for Atlantic Canada can result in changes to sea states and other conditions that could affect the long term integrity and reliability of Project-related marine infrastructure. The historical and projected extremes in temperature, intense precipitation, or other storm events must be accounted for in the design of the Project and in all other aspects of Project planning, construction and maintenance.

4.3.2.2 Climate Change Predictions

Predicting the future environmental effects of climate change for a specific area using global data sets is challenging due to generic data and larger scale model outputs that do not take into account local climate. Accurate regional and local projections require the development of specific regional and local climate variables and climate change scenarios (Lines et al. 2005). As a result, downscaling techniques have emerged over the last decade as an important advancement in climate modelling. Downscaling is used to introduce micro-scale interactions by including the local climate variables. Downscaling techniques are particularly important for Atlantic Canada due to the inherent variability associated with the predominantly coastal climate. Statistical downscaling uses global climate model (GCM) projections as well as historic data from weather stations across the region, and studies the relationship between these sets of data. Downscaling produces more detailed predictions for each of these weather stations (Lines et al. 2005) and has allowed for a better understanding of future climate scenarios based on precise and accurate historic data sets.

Results tend to differ between a Statistical Downscaling Model (SDSM) and Canadian Coupled General Circulation Model Version 2 (CGC^{M2}). The overall mean annual maximum temperature increase projected for Charlottetown (the nearest modelled location to the Project) between years 2020 and 2080 ranged from 1.70°C to 3.51°C for the SDSM model results and 1.16°C to 2.47°C for the CGCM2 model results (Lines et al. 2008) (Table 4.3).

Table 4.3 Projected Mean Annual Maximum and Minimum Temperature Change, and Precipitation Percent Change for both SDSM and CGCM2 Model Results

Period	T_{max}		T_{min}		% Precipitation	
	SDSM	CGCM2	SDSM	CGCM2	SDSM	CGCM2
2020s	1.70	1.16	1.69	1.77	13	0
2050s	2.46	1.67	2.33	2.40	16	5
2080s	3.51	2.47	3.34	3.36	18	4

Notes:
A positive value denotes an increase, a negative value denotes a decrease
SDSM = Statistical Downscaling Model
CGCM2 = Canadian Coupled General Circulation Model Version 2
T_{max} = Mean annual maximum temperature change
T_{min} = Mean annual minimum temperature change
Source: Lines et al. 2008

The SDSM projections for maximum temperature for 2050 at Charlottetown are increases for all seasons (1.7°C to 4.2°C) (Lines et al. 2005). By the year 2080, temperatures are projected to increase again in all seasons, with greater warming (3.7°C to 6.6°C) (Lines et al. 2005). This average temperature change is expected to be gradual over the period and is likely to affect precipitation types and patterns. The warmer fall and winter temperatures could mean later freeze up; wetter, heavier snow; more liquid precipitation occurring later into the fall; and possibly more freezing precipitation during both seasons. Changes to precipitation patterns due to warmer weather over the fall and winter months could lead to stronger spring run-off (Natural Resources Canada 2001).

There is less agreement among the global circulation and regional downscaling models regarding changes in precipitation. Annual precipitation increases projected for Atlantic Canada between the years 2020 and 2080 range from 18% to 21% for the SDSM model results, and -2% to 2% for the Canadian Coupled Global Climate Model Version 1 (CGCM1) model results (Lines et al. 2005). Precipitation trends are of more interest when taken together with the temperature increases and the seasonality of the predicted changes. Statistical Downscaling Model trends for the years 2020 to 2080 indicate a temperature increase of 8% to 12% for the winter months and 21% to 35% for the summer months (Lines et al. 2005). It is generally considered that the increased precipitation being projected for portions of western Atlantic Canada may be the result of continued landfall of dying hurricanes and tropical storms reaching into this area in the summer and fall months (Lines, G., Personal communication, March 5, 2006). While SDSM results highlight an increase in summer and fall precipitation, the CGCM1 results range from no change in the 2020s to a reduction in precipitation over the summer season for the years 2050 to 2080 (Lines et al. 2005).

The inconsistencies between SDSM and CGCM1 predicted seasonal precipitation changes highlight the inherent variability and uncertainty in climate modelling. Due to the increased precision of localized data used in SDSM relative to global modelling, confidence is considered to be greater in the SDSM results relative to global model results. Results must be interpreted with caution for each of the models although there is a general consensus in the climatological community concerning the overall anticipated environmental effects of climate change. For example, over the next 100 years, Atlantic Canada will likely experience warmer temperatures, more storm events, increasing storm intensity, and flooding (Vasseur and Catto 2008).

4.3.2.3 Mitigation for Climate Change

As discussed in Section 4.3.1.2, the Project will be designed according to engineering design practices that will consider predictions for climate and climate change. Several publications are available to guide design engineers in this regard, including, for example, the Public Infrastructure Engineering Vulnerability Committee (PIEVC) "Engineering Protocol for Infrastructure Vulnerability Assessment and Adaptation to a Changing Climate" (PIEVC 2011). This protocol outlines a process to assess the infrastructure component responses to changing climate, which assists engineers and proponents in effectively incorporating climate change into design, development and management of their existing and planned infrastructure. This and other guidance will be considered, as applicable, in advancing the design and construction of the Project.

4.3.2.4 Residual Effects of Climate Change on the Project

The potential effects of climate change on the Project will be considered and incorporated in the planning and design of Project infrastructure and scheduling. This will be done to reduce the potential for Project delays and long-term damage to infrastructure and risk to workers, taking into account predictions for climate change in the region. Inspection and maintenance programs will prevent the deterioration of the infrastructure and will help to maintain compliance with applicable design criteria and reliability of the transmission system. Significant residual adverse effects of climate change on the Project or system reliability are not anticipated.

4.3.3 Effects of Sea Ice on the Project

4.3.3.1 Project Pathways for the Effects of Sea Ice on the Project

The formation of ice ridges and rubble fields are common in the Northumberland Strait during the winter months.

As such, ice scour may be an issue for the submarine cables, and has been considered in the design of the submarine cables.

Sea ice presence is also an issue for construction and maintenance activities in the Northumberland Strait. Installation and maintenance of the submarine cables cannot occur during the ice season.

4.3.3.2 Mitigation for the Effects of Sea Ice on the Project

Ice scour protection is necessary for shallow, near-shore sections of cable (i.e., waters less than approximately 12 m depth). Protection will consist of cable burial beneath the influence of ice scour. The cable is to be buried at a trench depth of 2 m in sand and silt and only 1 m in areas of bedrock, extending from the foreshore to a water depth of 12 m. In areas where cable burial is not possible, concrete mats or similar protection methods will be used as protection against ice scour.

Sea ice will be avoided during construction and maintenance through scheduling. Installation of the submarine cables is scheduled to take place during the ice-free season. Similarly, regular maintenance of the submarine cables will be scheduled during periods when the Strait is free from ice. In the event of emergency repairs or maintenance required during the winter, specialized vessels and crews familiar with working in such conditions will be contracted.

4.3.3.3 Residual Effects of Sea Ice on the project

There is potential for marine cables to be exposed to sea ice during the life of the Project. However, the potential adverse effects on the Project during construction and maintenance activities have been considered in the planning and design of the Project including scheduling of cable installation, and properly mitigated such that substantive residual adverse effects of sea ice on the Project, or interruption to the Project schedule, are not anticipated.

4.4 DETERMINATION OF SIGNIFICANCE

The marine components of the Project will be designed, constructed and operated to maintain safety, integrity and reliability in full consideration of existing and reasonably predicted environmental forces in the PDA of the Northumberland Strait. There are no environmental attributes that, at any time during the Project, are anticipated to result in:

- a substantial change to the Project construction schedule (*e.g*., a delay resulting in the construction period being extended by one season)
- a substantial change to the Project operation schedule (*e.g.*, an interruption in servicing such that production targets cannot be met)
- damage to Project infrastructure resulting in increased safety risk

PEI Energy Corporation, MECL and NB Power will use an adaptive management approach in its activities throughout the life of the Project to monitor any observed effects of the environment and adapt (e.g., repair/replace) the Project infrastructure or operations as needed. Accordingly, the effects of the environment on the Project are rated not significant.

5.0 ACCIDENTS, MALFUNCTIONS AND UNPLANNED EVENTS

This section provides an assessment of selected accident, malfunction, and unplanned event scenarios potentially associated with Project components and activities in the Northumberland Strait that could, if they occurred, result in adverse environmental effects.

5.1 APPROACH

In this section, the potential accidents, malfunctions, and unplanned events that could occur during any phase of the Project are described and assessed. The focus is on credible accidents that have a reasonable probability of occurrence, and for which the resulting environmental effects could be significant.

The general approach to assessment of the selected accident scenarios includes the following steps:

- consideration of the potential event that may occur during the life of the Project
- description of the safeguards established to protect against such occurrences
- consideration of the contingency or emergency response procedures applicable to the event
- determination of significance of potential residual adverse environmental effects

5.1.1 Significance Definition

Criteria used for determining the significance of adverse residual environmental effects with respect to accidents, malfunctions, and unplanned events relate to population and resource sustainability. Where applicable, definitions are the same as determined in the respective VC sections in this volume.

5.2 POTENTIAL INTERACTIONS

The accidents, malfunctions, and unplanned events scenarios considered in this assessment are detailed in Volume 1, Section 2.6.1. The scenarios considered applicable to the marine components of the Project (all phases) are:

- fire
- hazardous material spill
- vessel accident

VCs in this volume with reasonable potential to interact with these scenarios causing adverse environmental effects include (Table 5.1):

- Atmospheric Environment
- Marine Environment
- Commercial Fisheries
- Other Marine Users

- Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Table 5.1 Summary of Potential Interactions for Marine-Based Project Activities within and along the Northumberland Strait

Accident, Malfunction or Unplanned Event	Atmospheric Environment	Marine Environment	Commercial Fisheries	Other Marine Users	Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons
Fire	✓				
Hazardous Material Spill		✓	✓	✓	✓
Vessel Accident		✓	✓		✓

5.3 FIRE

5.3.1 Potential Event

There is potential that fire could involve a vessel or equipment used for construction or maintenance activities; other Project infrastructure is submerged. If fire were to occur, there is potential for an effect on the Atmospheric Environment.

5.3.2 Risk Management and Mitigation

The following mitigation measures should be applied in general to reduce the probability of a vessel fire and any associated adverse effects:

- Project-related marine vessels will be equipped with fire detection and suppression equipment in accordance with the *Transport Canada Fire Detection and Extinguishing Equipment Regulations* (2007) made under the *Canada Shipping Act* (2001).
- Project staff working on vessels will be trained in fire suppression.
- Vessel-to-vessel and vessel-to-land communication systems are expected to be in place and functioning.
- Vessel operators will be required to provide appropriate certification to operate including fire suppression plans.
- Vessel operators must adhere to applicable Acts and Regulations administered by or in conjunction with Transport Canada.

As the Project location within the Northumberland Strait is not considered remote, local emergency response services, including the Canadian Coast Guard, are available.

5.3.3 Potential Environmental Effects and their Significance

As the majority of the construction and maintenance equipment within the Marine Environment will be submerged, the primary risk of fire is on-board a support vessel. A fire on-board a vessel could potentially affect workers and members of the public in close proximity, damage Project infrastructure, and result in emissions to the Atmospheric Environment. It is expected that fire, if it were to occur, would be small and easily extinguished using on-board fire suppression systems, resulting in minimal smoke generation and subsequent effects on the Atmospheric Environment.

In consideration of the mitigation and response measures to be undertaken to prevent and respond to a fire, residual adverse environmental effects of a marine-based fire are rated as not significant for potentially affected VCs.

5.4 HAZARDOUS MATERIAL SPILL

5.4.1 Potential Event

Hazardous material spills can occur in any environment where fuels, lubricants, hydraulic fluid, paints, or corrosion and fouling inhibitors are used or stored. Hazardous materials required for Project components and activities in the Northumberland Strait are most likely associated with vessel fuel and hydraulic equipment used during construction, and operation and maintenance of the marine cables. As the new marine cables are solid-state design, no lubricant is present in the cable. Therefore, rupture of the cable during construction, and operation and maintenance does not pose a risk for a hazardous material spill into the Marine Environment.

The worst case for a marine-based hazardous material spill would likely be a rupture of a hydraulic line associated with trenching equipment or the loss of fuel from a vessel grounding or collision.

5.4.2 Risk Management and Mitigation

A Project-specific Emergency Response Plan (ERP) will be developed and will include procedures to prevent and respond to a spill into the marine environment. These procedures will include:

- routine preventative maintenance and inspection of hydraulic equipment is to be undertaken to avoid a hazardous material release from submerged equipment
- hazardous materials will not be stored on vessels in large quantities and vessels will not be fueled at sea (if possible)
- relevant Project staff will be trained in the timely and efficient response to hazardous material spills
- vessels are to be equipped with appropriately sized spill kits equipped to handle the quantity and type(s) of hazardous materials that may be onboard the vessel
- vessel-to-vessel and vessel-to-land communication systems are expected to be in place and functioning
- any spill will be reported to Coast Guard Emergency Response

- vessel operators must adhere to applicable Acts and Regulations administered by or in conjunction with Transport Canada

Any accidental release of material onboard a vessel should be mitigated before it has the potential to reach the marine environment. Spill containment and remediation will be required immediately if a release occurs in the marine environment.

5.4.3 Potential Environmental Effects and their Significance

As Project work takes place in the Northumberland Strait, accidental releases of hazardous materials have the potential to affect components of the Marine Environment, Commercial Fisheries, Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, and Other Marine Uses. This is most likely through harm to or mortality of marine species caused by a hazardous material and a potential disruption to fisheries and recreational water use until clean-up efforts are completed. A release due to a vessel accident or malfunction of submerged equipment would most likely be a small quantity due to the limited amount of hydraulic fluid and fuel.

In consideration of volumes of hazardous materials potentially used during the Project, the mitigation and response measures to be undertaken to prevent and respond to accidental releases of hazardous materials, residual adverse environmental effects of a marine-based hazardous material spill are rated as not significant for potentially affected VCs. Although unlikely, if a large spill of hazardous materials occurred, it could potentially result in change in distribution or decline in abundance of marine populations, and result in a significant residual adverse environmental effect.

5.5 VESSEL ACCIDENT

5.5.1 Potential Event

During Project construction and, to a lesser extent, during operation and maintenance of the Project, a number of marine vessels will be in motion along the Project route. There is potential for vessel-to-vessel and vessel-to-wildlife collisions. Potential collisions with wildlife include collisions of marine mammals, and sea turtles with the underside of a vessel, or the collision of a bird with a vessel due to attraction to vessel lighting.

These consequences may have an effect on Marine Environment, Commercial Fisheries and the Current Use of Resources for Traditional Purposes by Aboriginal Persons.

The worst case scenario for a vessel collision would be the loss of human life, followed by loss of a *SARA*-listed species which could potentially lead to population-level effects. There is also potential for vessel-based fire and release of hazardous materials (fuel). These are addressed in previous sections.

5.5.2 Risk Management and Mitigation

The following mitigation measures should be applied in general to reduce the probability of a vessel-to-vessel collision or vessel interaction with marine wildlife and any associated adverse effects:

- deck lighting will be minimized whenever it is safe and practical to do so and the use of unnecessary lighting will be avoided, to reduce the risk of attracting marine wildlife
- due to the nature of the work submarine cable vessels will move slowly. Support vessels will operate at reduced speeds when possible, to reduce the risk of vessel-to-vessel collision and vessel collisions with marine wildlife
- safety zones will be identified around work areas
- high speed vessel maneuvers are not to be conducted by any Project vessel during marine-based Project activities
- vessel-to-vessel and vessel-to-land communication systems are expected to be in place and functioning
- vessel operators must adhere to applicable Acts and Regulations administered by or in conjunction with Transport Canada, including the Transport Canada Collision Regulations (2014).

Vessels involved in the Project must abide by the guidelines, restrictions and navigation channels within the Guidelines for Navigation Under the Confederation Bridge (Transport Canada 2009) and Northumberland Strait Traffic. As the central navigation channel of the Confederation Bridge is a compulsory pilotage area, ships navigating the channel must have a licensed pilot on board. Vessels over 20 m in length are required to maintain contact on marine VHF Channel 12 (Vessel Traffic Regulating) and Channel 16 (Distress, Safety and Calling of Marine Vessels).

5.5.3 Potential Environmental Effects and their Significance

Vessel collisions, either with other vessels or marine wildlife, have the potential to affect components of the Marine Environment, Commercial Fisheries, the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, and Other Marine Uses. This is most likely through vessel damage or harm to or mortality to humans or marine wildlife species, especially SARA-listed species.

As construction and maintenance activities will be limited in duration, the probability of an encounter with a bird species is low. Due to the dispersed nature of marine mammal and turtle populations, the short duration of the construction phase and the limited number and slow speeds of vessels involved, a ship strike involving a marine species is considered a low probability. If a wildlife encounter were to occur, it is not expected to result in population level changes.

In consideration of the mitigation and response measures to be undertaken to prevent and respond to vessel collisions, residual adverse environmental effects of a vessel collision are rated as not significant for potentially affected VCs.

5.6 DETERMINATION OF SIGNIFICANCE

MECL is developing emergency response plans to prevent and efficiently respond to accidental or unplanned events.

Although unlikely, if a large spill of hazardous materials occurred, it could potentially result in a change in distribution or decline in abundance of marine populations, and result in a significant residual adverse environmental effect. However, given the overall nature of the Project and credible Accidents, Malfunctions, and Unplanned Events considered, and in light of the nature of the Project and proposed mitigation and emergency response planning, the residual adverse environmental effects of Project-related Accidents, Malfunctions, and Unplanned Events on all VCs during all phases are rated not significant with a high level of confidence.

6.0 CUMULATIVE ENVIRONMENTAL EFFECTS: NORTHUMBERLAND STRAIT

6.1 INTRODUCTION

The residual effects of the Project that may interact cumulatively with the residual environmental effects of other physical activities are identified in this section and the resulting cumulative environmental effects are assessed.

An assessment of cumulative environmental effects is required if:

- the Project is assessed as having residual environmental effects on the VC
- the residual effects could act cumulatively with residual effects of other past, present, or reasonably foreseeable future physical activities

Three categories of physical activities in the Northumberland Strait have been identified as having the potential to result in residual environmental effects that may act cumulatively with those of the Project:

- commercial fishing
- recreation
- vessel traffic

In the Northumberland Strait, 4 VCs are anticipated to have residual effects. Interactions between the Project and the remaining 7 VCs are not anticipated to result in residual effects and an assessment of cumulative environmental effects is therefore not undertaken. An assessment of cumulative environmental effects is provided for the following VCs:

- Marine Environment
- Commercial, Recreational and Aboriginal Fisheries
- Heritage Resources
- Current Use of Land and Resources for Traditional Purposes

Table 6.1 below highlights the potential for interactions between the residual environmental effects of the Project and those of the physical activities identified. These interactions are described in further detail below.

Table 6.1 Potential Cumulative Environmental Effects

Other Physical Activities with Potential for Cumulative Environmental Effects	Marine Environment	Commercial Fisheries	Heritage Resources	Current Use of Land and Resources
Commercial Fishing	✓	✓		
Recreation	✓			
Vessel Traffic	✓	✓		

6.2 ASSESSMENT OF CUMULATIVE EFFECTS: NORTHUMBERLAND STRAIT

Past and existing physical activities that have been or are being carried out have influenced the baseline conditions for the assessment of Project effects. The effects of other physical activities that have been or are being carried out in combination with the effects of the Project are therefore considered in the assessment of the residual environmental effects of the Project.

Environmental effects on Heritage Resources may occur with any project or activity that involves ground disturbance. However, none of the activities listed in Table 6.1 involve ground disturbance and therefore do not have the potential to interact with Heritage Resources. As such, cumulative environmental effects on Heritage Resources are not predicted.

Commercial fishing, recreational activity and vessel operation will not result in increased disruption to access of areas used for Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons. Therefore, cumulative environmental effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal People are not anticipated.

The residual effects of the Project on the marine environment have the potential to interact cumulatively with the environmental effects of commercial fishing activities. However, residual effects of the Project on the marine environment are limited to the physical area of disturbance, during the construction phase only. As this is a short period of time, and a relatively small geographic area, cumulative environmental effects are not expected to be substantive.

Recreational activities may result in changes to marine populations through either direct or indirect disturbance. The magnitude and extent of any such changes (*e.g.,* to fish populations through recreational harvesting) is expected to be very small, and interactions with the residual environmental effects of the Project on the marine environment would not be substantive.

Vessel traffic within the RAA may interact with the marine environment by increasing underwater sound levels, and increasing the potential for direct mortality to fish and wildlife through collisions. Future vessel traffic is not expected to be notably higher than current levels, so cumulative effects to the marine environment would be similar to the residual environmental effects of the Project, which consider existing vessel traffic. Accordingly, cumulative environmental effects of the Project in combination with vessel traffic are not expected to be substantive.

The residual environmental effects of the Project on Commercial, Recreational and Aboriginal Fisheries have the potential to interact with the environmental effects of commercial fishing activities and vessel traffic. The temporary loss of access to fishing grounds as a result of the Project will be limited to the area of physical disturbance of the Project, and Project activities will be schedule outside of commercial fishing seasons to the extent possible. As the PDA is relatively small, and Project activities will be scheduled outside of commercial fishing seasons to the extent possible, cumulative effects on Commercial, Recreational and Aboriginal Fisheries will not be substantive. The temporary loss of access to fishing grounds is not anticipated from recreational activities and therefore no cumulative environmental effects with the environmental effects of these activities are anticipated. Accordingly, cumulative environmental effects of the environmental effects of the Project in the Northumberland Straight with the environmental effects of other physical activities are rated not significant.

7.0 SUMMARY

In this EIS, Stantec conducted an EIA of the PEI-NB Cable Interconnection Upgrade Project (the "Project") proposed by PEI Energy Corporation (PEIEC). The Project involves the construction and operation of a high voltage alternating current transmission system, spanning three geographic locations – New Brunswick, the Northumberland Strait and PEI. This volume includes an assessment of potential environmental effects associated with marine-based Project components and activities conducted in the Northumberland Strait.

7.1 SCOPE OF THE EIA

An EIA of the marine-based Project components and activities in the Northumberland Strait is required under Section 67 of *CEAA*. This EIS follows Stantec EA method that has been adapted to meet the requirements of both federal and provincial environmental assessments.

The EIA evaluated the potential environmental effects of the Project. The scope of the assessment included all activities necessary for the construction and operation of the Project (including presence of the infrastructure), but excluded the end uses of this electricity. Environmental effects were assessed for each phase of the Project (i.e., construction, operation, and decommissioning and abandonment), where relevant, as well as for credible Accidents, Malfunctions, and Unplanned Events. The assessment was conducted within defined spatial and temporal boundaries and in consideration of defined residual environmental effects rating criteria. The EIA considered measures that are technically and economically feasible that would mitigate any significant adverse environmental effects of the Project.

7.2 ENVIRONMENTAL EFFECTS ASSESSMENT

Marine Environment, CRA Fisheries, Heritage Resources, and Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons were identified for detailed assessment. These were identified by the study Team (based on experience and professional judgment) as the key VCs for which substantive interactions with the Project were anticipated or could occur. A separate analysis of the potential Effects of the Environment on the Project was also conducted.

The assessment concluded that the potential environmental effects of the Project in the Northumberland Strait for each of the VCs would be not significant during each phase of the Project. These conclusions were reached in consideration of the nature of the Project, the nature and extent of its environmental effects and the planned implementation of proven and effective mitigation. The environmental effects of Accidents, Malfunctions, and Unplanned Events were also rated not significant. Effects of the Environment on the Project were rated not significant due to design consideration and compliance with codes and standards that will mitigate against a significant adverse effect on the Project. The environmental effects and significance predictions were made with a high level of confidence by the study team.

7.3 OVERALL CONCLUSION

Based on the results of the EA for the Northumberland Strait, it is concluded that, with planned mitigation, the residual environmental effects of the Project during each phase is rated not significant.

8.0 REFERENCES

Environmental Setting

AMEC Earth and Environmental (2007). Northumberland Strait Ecosystem Overview Report. Prepared For Fisheries and Oceans by AMEC Earth and Environmental, Moncton, New Brunswick.

Historica Canada. 2015. Northumberland Strait. Available online at: http://www.thecanadianencyclopedia.ca/en/article/northumberland-strait/. Last Accessed on July 15, 2015.

Jacques Whitford Environment Limited (JWEL) (2001). Atlas of Ecology and Commercially Important Areas in the Southern Gulf of St. Lawrence. Environmental Studies Research Funds Report (ESRF)140, Calgary. 76p.

Atmospheric Environment

Environment Canada. 2015. Marine Weather forecasts available at: https://weather.gc.ca/marine/region_e.html?mapID=15, Last accessed on July 7, 2015

Other Marine Users

NorST-EMP. n. d. Northumberland Strait – Environmental Monitoring Partnership. Available at http://www.cwn-rce.ca/initiatives/canadian-watershed-research-consortium/northumberland-strait-environmental-monitoring-partnership-norst-emp/. Last accessed July 16, 2015.

Marine Environment

Abgrall, M.-J., S. Bastien-Daigle, G. Miron and M. Ouellette. 2010. Potential interactions between populations of Softshell Clams (*Mya arenaria*) and Eastern Oysters (*Crassostrea virginica*) in temperate estuaries, a literature review. Can. Tech. Rep. Fish. Aquat. Sci., 2892: vii + 88 pp.

AMEC Earth and Environmental. 2007. Northumberland Strait Ecosystem Overview Report. Prepared by AMEC Earth and Environmental for Fisheries and Oceans Canada, Moncton, NB. 252 pp.

Au, D.W.T., C.A. Pollino, R.S.S. Wu, P.K.S. Shin, S.T.F. Lau, and J.Y.M. Tang. 2004. Chronic effects of suspended solids on gill structure, osoregulation, growth, and triiodothyronine in juvenile green grouper Epinephelus coioides. Mar. Ecol. Prog. Ser. 266: 255-264.

Bajzak, C.E., M.O. Hammill, G.B. Stenson and S. Prinsberg. 2011. Drifting away: Implications of change in ice conditions for a pack-ice-breeding phocid, the harp seal (*Phoca goenlandica*). Can. J. Zool., 89: 1050-1062.

BERR (Department for Business Enterprise and Regulatoy Reform). 2008. Review of Cabling techniques and environmental effect applicable to the offshore wind farm industry. Technical Report: 164 pp.

Birds Studies Canada and Nature Canada. 2015. Important Bird Areas Canada. Available online at: http://www.ibacanada.ca/mapviewer.jsp?lang=en. Last accessed July 3, 2015.

Boulcott, P., Millar, C. P. and Fryer, R. J. 2014. Impact of scallop dredging on benthic epifauna in a mixed-substrate habitat. ICES Journal of Marine Science: 71(4), 834-844 pp.

Bourne, W. R. P. 1979. Birds and gas flares. Marine Pollution Bulletin, 10(5), 124-125.

Cargnelli, L.M., S.J. Griesbach, D.B. Packer and E. Weissberger. 1999. Essential Fish Habitat Source Document: Atlantic Surfclam, Spisula solidissima, Life History and Habitat Characteristics. NOAA Technical Memorandum NMFS-NE-142: v + 13 pp.

Castellote, M., C.W. Clark and M.O. Lammers. 2012. Acoustic and behavioural changes by fin whales (Balaenoptera physalus) in response to shipping and airgun noise. Biological Conservation 147:115-122.

CH2M HILL. 2000. Appendix A: Suspended Sediment Effects on Fish – A Literature Review. 13 pp.

Chassé, J., N. Lambert, M. Comeau, P.S. Galbraith, P. Larouche and R.G. Pettipas. 2014. Environmental Conditions in the Southern Gulf of St. Lawrence Relevant to Lobster. DFO Can. Sci. Advis. Sec. Res. Doc., 2014/031: v + 25 pp.

Christian, J.R., C.G.J. Grant, J.D. Meade and L.D. Noble. 2010. Habitat requirements and life history characteristics of selected marine invertebrate species occurring in the Newfoundland and Labrador Region. Can. Manuscr. Rep. Fish. Aquat. Sci., 2925: vi + 207 pp.

Comeau, L.A., F. Pernet, R. Tremblay, S.S. Bates and A. LeBlanc. 2008. Comparison of eastern oyster (*Crassostrea virginica*) and blue mussel (*Mytilus edulis*) filtration rates at low temperatures. Can. Tech. Rep. Fish. Aquat. Sci., 2810: vii + 17 pp.

Constantino, R., M.B. Gaspar, J. tata-Regala, S. Carvallo, J. Cúrdia, T. Drago, R. Taborda and C.C. Monteiro. 2009. Clam dredging effects and subsequent recovery of benthic communities at different depth ranges. Mar. Enviro. Res., 67: 89-99.

Cornell Lab of Ornithology. 2014. All About Birds. Available online at: www.allaboutbirds.org.

CSR (Canadian Seabed Research). 2015. Northumberland Strait Cable Route Assessment, 2014 Marine Geophysical Survey. Prepared for Maritime Electric Company, Charlottetown, Prince Edward Island. CSR Project Number 1401.

Currie, D. R. and Parry, G. D. 1996. Effects of scallop dredging on a soft sediment community: a large-scale experimental study. Marine Ecology Progress Series: Vol. 134, 131-150 pp.

Davidson, L.-A., M. Biron and M. Niles. 2012. Scallop fishery assessment of the southern Gulf of St. Lawrence in 2010: Commercial fishery data. DFO Can. Sci. Advis. Sec. Res. Doc., 2012/007. vi + 40 pp.

DFO (Fisheries and Oceans Canada). 1993. Underwater World: Soft Shell Clam. Communications Directorate, Fisheries and Oceans Canada, Ottawa, ON. 6 pp.

DFO. 2010b. Aquatic Species - Details for American Oyster. Available online at: http://www.dfo-mpo.gc.ca/species-especes/aquatic-aquatique/american-oyster-huitre-eng.htm. Last accessed June 25, 2015.

DFO. 1996a. Scotian Shelf Atlantic Surf Clam. DFO Atl. Fish. Stock Status Rep., 96/122E: 2 pp.

DFO. 1996b. Southern Gulf soft shell clam. DFO Atl. Fish. Stock Status Rep., 96/101E: 3 pp.

DFO. 2001. Integrated Management Plan Clam Fishery Eastern New Brunswick Area Gulf Region, 2001-2006. viii + 56 pp. Available online at: http://www.dfo-mpo.gc.ca/Library/258964.pdf. Last accessed July 5, 2015.

DFO. 2003a. Profile of the Blue Mussel (*Mytilus edulis*), Gulf Region. Policy and Economics Branch, Gulf Region, Fisheries and Oceans Canada, Moncton, NB. viii + 36 pp. + Appendices.

DFO. 2003b. Profile of the Eastern Oysters (*Crassostrea virginica*), Gulf Region. Policy and Economics Branch, Gulf Region, Fisheries and Oceans Canada, Moncton, NB. ix + 34 pp. + Appendices.

DFO. 2005. The Gulf of St. Lawrence, A Unique Ecosystem: The Stage for the Gulf of St. Lawrence Integrated Management (GOSLIM). Oceans and Science branch, DFO. 30 pp. Available online at: http://www.dfo-mpo.gc.ca/library/318989e.pdf. Last accessed June 28, 2015.

DFO. 2007. Ecologically and Biologically Significant Areas (EBSA) in the Estuary and Gulf of St. Lawrence: Identification and characterization. DFO Can. Sci. Advis. Sec. Res. Doc. 2007/016.

DFO. 2008. Aquatic Species at Risk – Harbour Porpoise (Northwest Atlantic Population). Available online at: http://www.dfo-mpo.gc.ca/species-especes/species-especes/harbourporpoiseAtl-marsouinat-eng.htm. Last accessed June 27, 2015.

DFO. 2009a. Underwater World: North American Lobster. Available online at: http://www.dfo-mpo.gc.ca/science/publications/uww-msm/articles/americanlobster-homarddamerique-eng.html. Last accessed June 24, 2015.

DFO. 2009b. Assessment of Cod in the Southern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep., 2009/007: 15 pp.

DFO. 2009c. Underwater World: Atlantic Halibut - Estuary and Gulf of St. Lawrence (Canadian East Coast). Available online at: http://www.dfo-mpo.gc.ca/science/publications/uww-msm/articles/atlantichalibut-fletanatlantique-eng.html. Last accessed June 24, 2015.

DFO. 2009d. Underwater World: American Oyster - North American Atlantic Coast. Available online at: http://www.dfo-mpo.gc.ca/Science/publications/uww-msm/articles/americanoyster-huitreamericaine-eng.html. Last accessed June 24, 2015.

DFO. 2010a. Aquatic Species - Details for Surf Clam. Available online at: http://www.dfo-mpo.gc.ca/species-especes/aquatic-aquatique/surf-clam-mactre-amerique-eng.htm. Last accessed June 25, 2015.

DFO. 2011. Assessment of the scallop fishery (*Placopecten magellanicus*) of the southern gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep., 2011/039: 17 pp.

DFO. 2011. Using satellite tracking data to define important habitat for leatherback turtles in Atlantic Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep., 2012/036: 13 pp.

DFO. 2012. Ice Navigation in Canadian Waters. Cat. No. Fs154-31/2012E-PDF. ISBN 978-1-100-20610-3. Ottawa, ON.

DFO. 2012a. Atlantic Cod in the Northern and Southern Gulf of St. Lawrence. Available online at: http://www.dfo-mpo.gc.ca/decisions/fm-2012-gp/atl-028-eng.htm. Last accessed on June 27, 2015

DFO. 2012b. Assessment of the Atlantic mackerel stock for the Northwest Atlantic (Subareas 3 and 4) in 2011. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep., 2012/031: 17 pp.

DFO. 2013. Aquatic Species at Risk – Fin Whale (Atlantic). Available online at: http://www.dfo-mpo.gc.ca/species-especes/species-especes/finwhale-atlantic-rorqual-commun-atlantique-eng.htm. Last accessed July 3, 2015.

DFO. 2013a. American lobster, *Homarus americanus*, stock status in the southern Gulf of St. Lawrence: LFA 23, 24, 25, 26a and 26b. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep., 2013/029: 21 pp.

DFO. 2013b. Assessment of the Rock Crab (*Cancer irroratus*) fishery in the southern Gulf of St. Lawrence for 2006 to 2011. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep., 2013/030: 17 pp.

DFO. 2014. Assessment of Atlantic herring in the southern Gulf of St. Lawrence (NAFO Div. 4T) to 2013. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep., 2014/040: 20 pp.

DFO. 2015. Seal Species. Available online at: http://www.dfo-mpo.gc.ca/fm-gp/seal-phoque/facts-faits/facts-faitsa-eng.htm#grey. Last accessed June 28, 2015

DFO. 2015. Stock Assessment of Atlantic Halibut of the Gulf of St. Lawrence (NAFO Divisions 4RST) for 2013 and 2014. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep., 2015/023: 15 pp.

Dufour, R. and P. Ouellet. 2007. Estuary and Gulf of St. Lawrence marine ecosystem overview and assessment report. Can. Tech. Rep. Fish. Aquat. Sci., 2744E: vii + 112 pp.

Dutil, J.-D., S. Proulx, P. S. Galbraith, J. Chassé, N. Lambert and C. Laurian. 2012. Coastal and epipelagic habitats of the estuary and Gulf of St. Lawrence. Can. Tech. Rep. Fish. Aquat. Sci., 3009: ix + 87 pp

ECL (Envirosphere Consultants Limited). 2003. Environmental Monitoring at the Black Point Ocean Disposal Site: Assessing Long-term Impacts of Dredge Spoil Disposal in Saint John Harbour, New Brunswick. Report for Environment Canada, Atlantic Region, Dartmouth, NS. 90 pp.

Environment Canada. 2009. Status of Birds in Canada. Available online at: http://www.ec.gc.ca/soc-sbc/oiseau-bird-eng.aspx?sL=e&sY=2011&sB=RBGU&sM=a. Last accessed June 29, 2015.

Erickson, W.P., G.D. Johnson, D.P. Jr. Young. 2005. A summary and comparison of bird mortality from anthropogenic causes with an emphasis on collisions. In: Ralph, C. John; Rich, Terrell D., editors 2005. Bird Conservation Implementation and Integration in the Americas: Proceedings of the Third International Partners in Flight Conference. 2002 March 20-24; Asilomar, California, Volume 2 Gen. Tech. Rep. PSW-GTR-191. Albany, CA: U.S. Dept. of Agriculture, Forest Service, Pacific Southwest Research Station: p. 1029-1042.

Fader, G.B.J. and S.S. Pecore. 1989. Surficial Geology of the Abegweit Passage Area of Northumberland Strait, Gulf of St. Lawrence. Geological Survey of Canada Open File #2087, 5 pp. and 6 maps.

Feist, B.E., J.J. Anderson and R. Miyamoto. 1996. Potential Impacts of Pile Driving on Juvenile Pink (Onchorhynchus gorbuscha) and Chum (O. keta) Salmon Behavior and Distribution. Fisheries Research Institute, School of Fisheries, University of Washington. Seattle, WA. viii+58 pp pp

Fisher C., M.Slater. Electromagnetic Field Study: Effects of Electromagnetic fields on marine species: A literature review. Oregon Wave Energy Trust. 2010.

Fuentes-Yaco, C., A.F. Vézina, T. Platt, W.G. Harrison, P.G. Connier, L.E. Waite, and L. Devine. 1998. Spatio-temporal distribution of phytoplankton pigments in Northumberland Strait: CZCS imagery and in situ data. Can. Tech. Rep. Hydrogr. Ocean Sci., 195: vii + 30 pp.

Gilkinson, K.D., G B.J. Fader, D.C. Gordon, Jr., R. Charron, D. McKeown, D. Roddick, E.L R. Kenchington, K. MacIsaac, C. Bourbonnais, P. Vass and Q. Liu. 2003. Immediate and longer-term impacts of hydraulic clam dredging on an offshore sandy seabed: Effects on physical habitat and process of recovery. Cont. Shelf Res., 23: 1315-1336.

Gill, A.B., Y.Huang, J. Spencer, I. Gloyne-Philips. Electromagnetic Fields emitted by High Voltage Alternating Current Offshore Wind Power Cables and interactions with marine organisms. 2008.

GNB (Government of New Brunswick). 2002. New Brunswick Wetlands Conservation Policy. Prepared by the New Brunswick Departments of Natural Resources and Energy and Environment and Local Government. 14 pp.

Gosner, K.L. 1978. A Field Guide to the Atlantic Seashore. The Peterson Filed Guide Series published by Houghton Mifflin Company, Boston, MA. xvi + 329 pp.

Hammill, M.O., G.B. Stenson and R.A. Myers. 2011. Hooded seal (*Cystophora cristata*) pup production In the Gulf of St. Lawrence. Can. J. Fish. Aquat., 49: 2546-2550.

Hammill, M.O., V. Lesage, Y. Dubé and L.N. Measures. 2001. Oil and Gas Exploration in the Southern Gulf of St. Lawrence: A Review of Information on Pinnipeds and Cetaceans in the Area. DFO Can. Sci. Advis. Sec. Res. Doc., 2001/115: 39 pp.

Hanson, J.M. 2009 Predator-prey interactions of American lobster (*Homarus americanus*) in the southern Gulf of St. Lawrence, Canada. New Zealand J. Mar. Fresh. Res., , 43:1, 69-88, DOI: 10.1080/00288330909509983

Hastings, M.C. and A.N. Popper. 2005. Effects of sound on fish. Report for the California Department of Transportation. Sacramento, CA.

Hauton, C., R.J.A. Atkinson and P.G. More. 2003. The impact of hydraulic blade dredging on a benthic megafaunal community in the Clyde Sea area, Scotland. J. Sea Res., 50: 45-56.

Jones & Stokes. 2006. Critical Areas Assessment Report and Habitat Management Plan for Whatcom County. Vancouver Island Transmission Reinforcement Project. August. (J&S 05197.05.) Bellevue, WA. Prepared for British Columbia Transmission Corporation.

JWEL (Jacques Whitford Environment Limited). 1994. Northumberland Strait Bridge Crossing Project, Marine Environmental Effects Monitoring Program 1993 Results. Prepared for Northumberland Strait Crossing Project. Fredericton, NB.

JWEL. 1995. Northumberland Strait Bridge Project, Marine Environmental Effects Monitoring Program 1994. Prepared for Northumberland Strait Crossing Project. Fredericton, NB.

JWEL. 2001. Atlas of Ecologically and Commercially Important Areas in the Southern Gulf of St. Lawrence. Prepared for Environmental Studies Research Funds, Calgary, AB. ESRF Report, 140: 76 pp.

JWEL. 2008. Marine Biophysical Environment Technical Study. Project Eider Rock – Proposed Petroleum Refinery and Marine Terminal in Saint John, New Brunswick. Report for Irving Oil Company Ltd., Saint John, NB. Report No. 1013263.03-005.

Kaiser, M. J., Clarke, K. R., Hinz, H., Austen, M. C. V., Somerfield, P. J., Karakassis, I. 2006. Global analysis of response and recovery of benthic biota to fishing. Marine Ecology Progress Series: Vol. 311, 1-14 pp.

KIS-ORCA Offshore Renewable and Cables Awareness. Available online at: http://www.kis-orca.eu/subsea-cables/cable-burial). Last accessed on July 8 2015.

Kranck, K. 1971. Surficial geology of the Northumberland Strait. Geological Survey of Canada, Paper 71-53. Ottawa, ON.

LeBlanc, C.H., A. Mallet, T. Surette and D. Swain. 2015. Assessment of the NAFO Division 4T southern Gulf of St. Lawrence Atlantic herring (*Clupea harengus*) stocks in 2013. DFO Can. Sci. Advis. Sec. Res. Doc., 2015/025. vi + 142 pp.

Leblanc, S. N., Benoit, H. P., Hunt, H. L. 2015. Broad-scale abundance changes are more prevalent than acute fishing impacts in an experimental study of scallop dredging intensity. Fisheries Research. 161, 8-20 pp.

Loring, D.H. and D.J.G. Nota. 1973. Morphology and sediments of the Gulf of St. Lawrence. Fish. Res. Board Can. Bull., 182: 147 pp.

Merchant, N.D., E. Pirotta, T.R. Barton and P.M. Thompson. 2014. Monitoring ship noise to assess the impact of coastal developments on marine mammals. Marine Pollution Bulletin 78:85-95.

Montevecchi, W.A. 2006. Influences of artificial light on marine birds. Ecological consequences of artificial night lighting, 94-113.

Mougeot, F., and V. Bretagnolle. 2000. Predation risk and moonlight avoidance in nocturnal seabirds. Journal of Avian Biology, 31(3), 376-386.

NBDNR (New Brunswick Department of Natural Resources). 2014. General Status of Wild Species. Available online at: http://www2.gnb.ca/content/gnb/en/departments/natural_resources/wildlife/content/GeneralStatusWildSpecies.html. Last accessed July 2, 2015.

NOAA (National Oceanic and Atmospheric Administration). 2014a. Office of Protected Resources: Atlantic White-sided Dolphin. Available online at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/whitesideddolphin_atlantic.htm. Last accessed June 24, 2015.

NOAA. 2014b. Office of Protected Resources: Long-Finned Pilot Whale. Available online at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/pilotwhale_longfinned.htm. Last accessed June 23, 2015.

Norton, S.B., S.M. Cormier, M. Smith, R.C. Jones, and M. Schubauer-Berigan. 2002. Predicting levels of stress from biological assessment data: empirical models from the Eastern Corn Belt Plains, Ohio, USA. Environ. Toxicol. Chem. 21(6): 1168-1175.

Nowacek, D.P., L.P. Thorne, D.W. Johnston and P.L. Tyack. 2007. Responses of cetaceans to anthropogenic noise. Mammal Review 37(2):81-115.

Ntengwe, F.W. 2006. Pollutant loads and water quality in streams of heavily populated and industrialized towns. Physics Chem. Earth. 31: 832-839.

O'Neill, F. G., Robertson, M., Summerbell, K., Breen, M., Robinson, L. A. 2013. The mobilization of sediment and benthic infauna by scallop dredges. Marine Environmental Research: 90, 104-112 pp.

Obert, K.M. and T.G. Brown. 2011. Ice ridge keel characteristics and distribution in the Northumberland Strait. Cold Reg. Sci. Technol., 66(2-3): 53-54.

PEIDCLE (Prince Edward Island Department of Communities, Land, and Environment). 2015. Birds of PEI. Available online at: http://www.gov.pe.ca/birds/index.php3. Last accessed June 27, 2015.

Popper, A.N. and A. Hawkins (Eds.). 2012. Effects of Noise on Aquatic Life (Vol. 730). New York. Springer.

Putman, N.F.,K.J.Lohnmann, E.M. Putman, T.P.Quinnn, A.P. Klimley, D.L.G. Noakes. Evidence for Geomagnetic Imprinting as a Homing Mechanism in Pacific Salmon. Current Biology 23, 312-316. 2013.

Richardson, J., C.R. Greene Jr, C. Malme and D. Thomson. 1995. Marine Mammals and Noise. Academic Press. San Diego.

Risch, D., P.J. Corkeron, W.T. Ellison and S.M. Van Parijs. 2012. Changes in humpback whale song occurrence in response to an acoustic source 200 km away. PLoS ONE 7(1):e29741, 29741-29746.

Rolland, R.M., S.E. Parks, K.E. Hunt, M. Castellote, P.J. Corkeron, D.P. Nowacek, S.K. Waaser and S.D. Kraus. 2012. Evidence that ship noise increases stress in right whales. Proceedings of the Royal Society of Biology 279(1737):2363-2368.

Rondeau, A., J.M. Hanson and M. Comeau. 2014. Rock crab, *Cancer irroratus*, fishery and stock status in the southern Gulf of St. Lawrence: LFA 23, 24, 25, 26A and 26B. DFO Can. Sci. Advis. Sec. Res. Doc., 2014/032: vi + 52 pp.

Santos, C. D., Miranda, A. C., Granadeiro, J. P., Lourenço, P. M., Saraiva, S., and Palmeirim, J. M. 2010. Effects of artificial illumination on the nocturnal foraging of waders. Acta Oecologica, 36(2), 166-172.

Scott, W.B. and M.G. Scott. 1988. Atlantic Fishes of Canada. Can. Bull. Fish. Aquat. Sci., 219: 731 pp.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas and P.L. Tyack. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33(4).

Species at Risk Public Registry. 2015. Advanced Species Search for Taxonomy: Fishes (marine); Range: New Brunswick, Nova Scotia, Prince Edward Island, Quebec; COSEWIC Status: Endangered, Special Concern, Threatened; Schedule: No schedule, Schedule 1, Schedule 2, Schedule 3; SARA Status: All. Available online at: http://www.sararegistry.gc.ca/search/SpeciesSearch_e.cfm. Last accessed June 25, 2015.

Stenson, G.B. and M.O. Hammill. 2012. Living on the edge: Observations of Northwest Atlantic harp seals in 2010 and 2011. DFO Can. Sci. Advis. Sec. Res. Doc., 2011/108: iv + 12 pp.

Sundermeyer, J.K., K. Lucke, M. Dahne, A. Gallus, K. Krugel and U. Siebert. 2012. Effects of Underwater Explosions on Presence and Habitat Use of Harbor Porpoises in the German Baltic Sea. In A. N. Popper & A. Hawkins (Eds.), Effects of Noise on Aquatic Life. Vol. 730, 289-291.

Swail, V.R., V.J. Cardone, M. Ferguson, D.J. Gummer, E.L. Harris, E.A. Orelup and A.T. Cox. 2006. The MSC50 Wind and Wave Reanalysis. 9th International Wind and Wave Workshop, September 25-29, Victoria, BC. 29 pp.

Thomas G.B. J.S. Tibbo, D. Tripathi, K. Obert and N. Shrestha. 2010. Extreme ice load events in the Confederation Bridge. Cold Reg. Sci. Technol., 60(1): 1-14.

Thomsen, F., C. Mueller-Blenkle, A. Gill, J. Metcalfe, P.K. McGregor, V. Bendall, M.H. Andersson, P. Sigray and D. Wood. 2012. Effects of Pile Driving on the Behavior of Cod and Sole. In A. N. Popper & A. Hawkins (Eds.), Effects of Noise on Aquatic Life. Vol. 730, 387-388.

Tougaard, J., L.A. Kyhn, M. Amundin, D. Wennerberg and C. Bordin. 2012. Behavioral Reactions of Harbor Porpoises to Pile-driving Noise. In A. N. Popper & A. Hawkins (Eds.), Effects of Noise on Aquatic Life. Vol. 730, 277-280.

Walker, M.M., T.E., Dennis, J.L. Kirschvink. The magnetic sense and its use in long-distance navigation by animals. Current Opinion in Neurobiology, 12, 735-744.

Wardle, C.S., T.J. Carter, G.G. Urquhart, A.D.F. Johnstone, A.M. Ziolkowski, G. Hampson and D. Mackie. 2001. Effects of seismic air guns on marine fish. Continental Shelf Research 21(8-10):1005-1027.

Watling, L., Findlay, R. H., Mayer, L. M., Schick, D. F. 2001. Impact of a scallop drag on the sediment chemistry, microbiota, and faunal assemblages of a shallow subtidal marine benthic community. Journal of SEA Research: 46, 309-324 pp.

Weldon, J., D. Garbary, S. Courtenay, W. Ritchie, C. Godin, M-H. Thériault, M. Boudreau and A. Lapenna. 2005. The Community Aquatic Monitoring Project (CAMP) for measuring marine environmental health in coastal waters of the southern Gulf of St. Lawrence: 2004 Overview. Can. Tech. Rep. Fish. Aquat. Sci., 2624: viii + 53 pp.

Wiese, F.K., W.A. Montevecchi, G. Davoren, F. Huettmann, A.W. Diamond and J. Linke. 2001. Seabirds at risk around offshore oil platforms in the North Atlantic. Marine Pollution Bulletin 42: 1285-1290.

Williams, R., C. Erbe, E. Ashe, A. Beerman and J. Smith. 2013b. Severity of killer whale behavioural responses to ship noise: A dose-response study. Marine Pollution Bulletin http://dx.doi.org/10.1016/j.marpolbul.2013.12.004.

Williams, R., C.W. Clark, D. Ponirakis and E. Ashe. 2013a. Acoustic quality of critical habitats for three threatened whale populations. Animal Conservation 17(1):12.

Commercial Fisheries

CFIA. 2015. Canadian Shellfish Sanitation Program. Available online at: http://www.inspection.gc.ca/food/fish-and-seafood/shellfish-sanitation/eng/1299826806807/1299826912745. Last accessed July 10, 2015.

DFO Science. 2011. Assessment of the Scallop Fishery (Placopecten magellanicus) of the Southern Gulf of St. Lawrence. Canadian Science Advisory Secretariat Science Advisory Report 2011/039.

DFO Science. 2013a. American Lobster, Homarus Americanus, Stock Status in the Southern Gulf of St. Lawrence: LFA 23, 24, 25, 26A and 26B. Canadian Science Advisory Secretariat Science Advisory Report 2013/029.

DFO Science. 2013b. Assessment of the Rock Crab (Cancer Irroratus) Fishery in the Southern Gulf of St. Lawrence for 2006 to 2011. Canadian Science Advisory Secretariat Science Advisory Report 2013/030.

DFO. 2012. Government of Canada: Aboriginal Fisheries Strategy. Available online at: http://www.dfo-mpo.gc.ca/Fm-Gp/aboriginal-autochtones/afs-srapa-eng.htm. Last accessed July 10, 2015.

DFO. 2013a. Fisheries Management Policies online at: http://www.dfo-mpo.gc.ca/fm-gp/policies-politiques/index-eng.htm. Last accessed July 15, 2015.

DFO. 2013b. Aquaculture Sites Cape Traverse-Victoria. Available online at: http://www.inter.dfo-mpo.gc.ca/Gulf/PEI-Aquaculture-Leasing/Maps?todo=region&region_map=capetraverse-victoria. Last accessed July 10, 2015.

DFO. 2015a. Notice to Recreational Anglers: Striped Bass Recreational Fishery in the Southern Gulf of St. Lawrence for 2015 and 2016. Available online at: http://www.glf.dfo-mpo.gc.ca/Gulf/FAM/Recreational-Fisheries/2015-16-Striped-Bass. Last accessed July 10, 2015.

DFO. 2015b. Notice to Recreational Anglers: 2015 Recreational Groundfish Fishery – Southern Gulf of St. Lawrence. Available online at: http://www.glf.dfo-mpo.gc.ca/Gulf/FAM/Recreational-Fisheries/2015-Recreational-Groundfish-Fishery. Last accessed July 10, 2015.

Justice Laws. 2015a. Government of Canada: Fisheries Act online at: http://laws-lois.justice.gc.ca/eng/acts/F-14/. Last accessed on July 30, 2015.

Justice Laws. 2015b. Government of Canada: Maritime Provinces Fishery Regulations. Available online at: http://laws-lois.justice.gc.ca/eng/regulations/sor-93-55/index.html. Last accessed July 10, 2015.

Lavoie, Cécile. Personal communication, July 6, 2015. Regional Fisheries and Aquaculture Management Officer, DFO, Moncton, New Brunswick.

Mallet, Pierre. Personal communication, July 6, 2015. Regional Senior Fisheries and Aquaculture Management Officer, DFO, Moncton, New Brunswick.

New Brunswick Agriculture, Aquaculture and Fisheries. No date. Aquaculture site locations. Available online at: http://daafmaapextweb.gnb.ca/spatialfusionviewer/mapViewer/map.action?request_locale=en&zoom=8&lat=5846515.41867&lon=-7392072.13037&theme=Aquaculture%20Sites. Last accessed July 10, 2015.

Archaeology and Heritage Resources

Aboriginal Affairs Secretariat (AAS). 2014. Holland (1765), Meecham (1860), and Lake (1863) historical maps for the Borden/Carleton area. Prince Edward Island Aboriginal Affairs Secretariat, Department of Intergovernmental and Public Affairs, Charlottetown.

Archaeological Assessments in New Brunswick. Archaeological Services, Heritage Branch, New Brunswick Department of Tourism, Heritage and Culture, Fredericton.

Archaeological Services. 2012. *Guidelines and Procedures for Conducting Professional*

Archaeological Services. 2014a. Archaeological Potential Map for the Maritime Electric Transmission Line Project. PDF Map received October 8, 2014.

Archaeological Services. 2014b. Archaeological Potential Map for the Maritime Electric Transmission Line Project. Digital Spatial Data received November 2, 2014.

Canadian Seabed Research Ltd. (CSR). 2015. *Northumberland Strait Cable Route Assessment: 2014 Marine Geophysical Survey*. Report prepared for Maritime Electric Company Ltd., CSR Project Number 1401, March 23, 2015.

Use of Land And resources for Traditional Purposes by Aboriginal Persons

Aboriginal Affairs and Northern Development Canada (AANDC). 2014. First Nation Profiles Available at: http://fnpim-cippn.aandc-aadnc.gc.ca/index-eng.asp Last accessed on June 25, 2015.

Berneshawi, Suzanne. 1997. Resource Management and the Mi'kmaq Nation. Available online at: http://www3.brandonu.ca/library/CJNS/17.1/cjnsv17no1_pg115-148.pdf. Last accessed on June 29, 2015.

DFO. 2012. Government of Canada: Aboriginal Fisheries Strategy online at: http://www.dfo-mpo.gc.ca/Fm-Gp/aboriginal-autochtones/afs-srapa-eng.htm. Last accessed on July 10, 2015.

Fisheries and Oceans Canada (DFO) 2014. Lobster Fishing Areas. Available online at: http://www.glf.dfo-mpo.gc.ca/Gulf/Fishing-Area-Maps/Lobster. Last accessed on July 8, 2015.

Ganong, W.F. 1899. Map of New Brunswick in Prehistory (Indian) Period.

Lavoie, Cécile. Personal communication, July 6, 2015. Regional Fisheries and Aquaculture Management Officer, DFO, Moncton, New Brunswick.

Leblanc, Isabelle. Personal communication, July 3, 2015. Regional Manager, Aboriginal Fisheries, Fisheries and Aquaculture Management Branch, DFO, Moncton, New Brunswick.

Paul, D. No Date. MAP: Land of the Mi'Kmaq – Mi'kma'ki, We were not the Savages, First Nation History. Available online at: http://www.danielnpaul.com/Map-Mi'kmaqTerritory.html. Last accessed on June 17, 2015.

polygon dataset of Aboriginal Lands, created using ArcGIS software, from sources on Natural Resources Canada, Earth Sciences Sector, Surveyor General Branch. Download 27th April 2015, DSPRY from: http://geogratis.gc.ca/api/en/nrcan-rncan/ess-sst/815dd99d-4fbd-47cc-be02-7ad4b03a23ec.html.

Stantec Consulting Ltd. (Stantec). 2015. 2014 Archaeological Impact Assessment (Walkover) for the New Brunswick – Prince Edward Island Transmission Line Interconnection Project – New Brunswick Land Based Portion. Fredericton, NB.

Effects of Environment on the Project

Bernier, N., J. MacDonald, J. Ou, H. Ritchie, and K. Thompson. 2006. Storm surge and meteorological modelling. In Impacts of Sea Level Rise and Climate Change on the Coastal Zone of South eastern New Brunswick, (ed.) R. Daigle, D. Forbes, G. Parkes, H. Ritchie, T. Webster, D. Bérubé, A. Hanson, L. DeBaie, S. Nichols and L. Vasseur, Environment Canada, 613 pp.

Bindoff, N.L., J. Willebrand, V. Artale, A, Cazenave, J. Gregory, S. Gulev, K. Hanawa, C. Le Quéré, Canadian Coast Guard. 2013. Chapter 3: Ice Climatology and Environmental Conditions in Ice Navigation in Canadian Waters. Available online at: http://www.ccg-gcc.gc.ca/Icebreaking/Ice-Navigation-Canadian-Waters. Last accessed July 9, 2015

Catto, N.R. 2006. Impacts of Climate Change and Variation on the Natural Areas of Newfoundland and Labrador. Newfoundland Ministry of Environment and Conservation, St. John's NF, 160 pp.

CBC News. (2015a, March 22). Confederation Bridge closed to all traffic. Available online at: http://www.cbc.ca/news/canada/prince-edward-island/confederation-bridge-closed-to-all-traffic-1.3004821. Last accessed July 9, 2015.

CBC News. (2015b, May 4). Northumberland Strait ferry service expected to begin Friday. Available online at: http://www.cbc.ca/news/canada/nova-scotia/northumberland-strait-ferry-service-expected-to-begin-friday-1.3059948. Last accessed June 17, 2015.

Daigle, R., D. Forbes, G. Parkes, H. Ritchie,T. Webster, D. Bérubé, A. Hanson, L. DeBaie, S.

Environment Canada. 2014. Weather and Meteorology – Glossary. Available online at: http://www.ec.gc.ca/meteo-weather/default.asp?lang=En&n=B8CD636F-1&def=allShow#wsglossaryF. Accessed on July 13, 2014. Last accessed June 29, 2015

GOC (Government of Canada). 2015a. Canadian Climate Normals: Summerside, PEI. Available online at: http://climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html. Accessed on June 23, 2015.

GOC. 2015b. Canadian Climate Normals: Charlottetown, PEI. Available online at: http://climate.weatheroffice.ec.gc.ca/climate_normals/ index_e.html. Accessed on June 23, 2015.

GOC. 2015c. Get Prepared; Hazards and Emergencies; Regional Hazards: New Brunswick. Available online at: http://www.getprepared.gc.ca/cnt/hzd/rgnl/nb-en.aspx. Last accessed June 25, 2015.

Government of Newfoundland and Labrador. 2003. Newfoundland and Labrador Climate Change Discussion Paper, Department of the Environment. 28 pp. Available online at: http://www.env.gov.nl.ca/env/Env/PollPrev/pdf/climatechange_paper.pdf. Last accessed June 27, 2015.

IBC (Insurance Bureau of Canada). 2012. Telling the Weather Story. Prepared by the Institute for Catastrophic Loss Reduction for the Insurance Bureau of Canada, June 2012. Available online at: http://iclr.org/images/Telling_the_weather_story.pdf. Last accessed June 23, 2015.

IESO (Independent Electricity System Operator. 2010. Glossary of Standard Operating Terms, Part 7.6 *in* Market Manual 7: System Operations. Document ID IMP_GOT_0002 Available online at: http://www.ieso.ca/Documents/systemOps/so_Glossary.pdf. Last accessed July 13,2015.

IPCC (Intergovernmental Panel on Climate Change). 2007. Appendix I: Glossary; in Climate Change 2007: Impacts, Adaptation and Vulnerability (Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change); (ed.) M.I. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson; Cambridge University Press, Cambridge United Kingdom, p. 869-883. Available online at: https://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-app.pdf. Last accessed June 24, 2015.

IPCC. 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

Lines, G.S., M. Pancura, and C. Lander. 2005. Building Climate Change Scenarios of Temperature and Precipitation in Atlantic Canada using the Statistical Downscaling Model (SDSM). Environment Canada, Meteorological Service of Canada, Atlantic Region. Science Report Series No. 2005-9, October 2005.

Lines, G.S., M. Pancura, C. Lander, and L. Titus. 2008. Climate Change Scenarios for Atlantic Canada Utilizing a Statistical Downscaling Model Based on Two Global Climate Models. Environment Canada, Meteorological Service of Canada, Atlantic Region. Science Report Series 2009-1, July 2008.

NAV CANADA.2000. The Weather of Atlantic Canada and Eastern Quebec. Available online at: http://www.navcanada.ca/EN/media/Publications/Local%20Area%20Weather%20Manuals/LAWM-Atlantic-EN.pdf. Last accessed July 2, 2015.

Nicholos, and L. Vasseur (ed). 2006. Impacts of Sea Level Rise and Climate Change on the Coastal Zone of South eastern New Brunswick. Environment Canada, 613 pp.

NRCan (Natural Resources Canada). 2001. The Tides of Change: Climate Change in the Atlantic Provinces. Shaw, J. Geological Survey of Canada, Miscellaneous Report no. 75, 2001; 1 sheet, doi:10.4095/212738Phillips, D. 1990. The Climate of New Brunswick. In *Climates of Canada*. Minister of Supply and Services Canada.

NRCan. 2010a. Potential Impacts: Coastal Sensitivity to Sea-Level Rise. Available online at: http://geogratis.gc.ca/api/en/nrcan-rncan/ess-sst/dc9817c0-8893-11e0-82bc-6cf049291510.html. Last accessed July 15, 2015.

NRCan. 2010b. National Building Code of Canada Volume 1. Available online at: http://www.nrc-cnrc.gc.ca/eng/publications/codes_centre/2010_national_building_code.html. Last accessed July 15, 2015.

NRCan. 2013a. Seismic Design Tools for Engineers: Ground Motion Parameters for Use with the National Building Code of Canada. Natural Resources Canada, Ottawa, Ontario. 2013. Available online at: http://www.earthquakescanada.nrcan.gc.ca/hazard-alea/interpolat/index-eng.php. Last accessed July 2, 2015.

NRCan. 2013b. Frequently Asked Questions about Earthquakes (FAQ). Available online at: http://earthquakescanada.nrcan.gc.ca/info-gen/faq-eng.php#magnitude. Last accessed July 15, 2015.

Parkes, G.S. Ketch, L., and C.T. O'Reilly. 1997. Storm surge events in the Maritimes. *In* Skafel, M.G. (Ed) Proceedings of the 1997 Canadian Coastal Conference May 1997, Guelph, Ontario. Canadian Coastal Science and engineering association, pp 115-129.

PEIDELJ. 2011. Coastal Erosion and Climate Change. Available online at: http://www.csrpa.ca/sites/default/files/fichiers/coastal_erosion_and_climate_change_0.pdf. Last accessed July 15, 2015.

Phillips, D. 1990. The Climate of New Brunswick. In *Climates of Canada*. Minister of Supply and Services Canada.

PIEVC. 2014. The PIEVC Engineering Protocol for Infrastructure Vulnerability Assessment and Adaptation to a Changing Climate. Public Infrastructure Engineering Vulnerability Committee, Engineers Canada. Available online at: http://www.pievc.ca/e/doc_list.cfm?dsid=43. Last accessed July 6, 2015.

S. Levitus, Y. Nojiri, C.K. Shum, L.D. Talley and A. Unnikrishnan. 2007. Observations: Oceanic Climate Change and Sea Level. *In* Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Avery, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Available at http://ipcc-wg1.ucar.edu/wg1/wg1- report.html.

Samuel Engineering. 2013. Canadian National Instrument 43-101 Technical Report on the Sisson Project, New Brunswick, Canada. Prepared by Samuel Engineering, Inc. on behalf of Northcliff Resources Ltd., Greenwood Village, Colorado. January 22, 2013.

Stantec Consulting Ltd. 2013. Environmental Protection Plan – Maritime Electric Company, Limited High Powered transmission Construction, Prince Edward Island. Prepared for Maritime Electric Company, Limited.

University of Prince Edward Island. 2015. It's Official! 2014-15 Snowiest Winter on Record – UPEI Climate Lab. Available online at: http://projects.upei.ca/climate/2015/04/29/its-official-2014-15-snowiest-winter-on-record/. Last accessed July 14, 2015.

Vasseur, L. and N. Catto. 2008. Atlantic Canada; In From Impacts to Adaptation: Canada in a Changing Climate 2007, edited by D.S. Lemmen, F.J. Warren, J. Lacroix and E. Bush; Government of Canada, Ottawa, ON, p. 119-170.

Accidents and Malfunctions

Transport Canada. 2009. Guidelines for Navigating Under the Confederation Bridge. December 2003. Revised December 2009. Available online at: http://www.tc.gc.ca/publications/EN/TP13681/PDF/HR/TP13681E.pdf. Last accessed July 4, 2015.

Transport Canada. 2010. Construction Standards for Small Vessels TP 1332E. 2004. Revised 2010. Available online at: https://www.tc.gc.ca/eng/marinesafety/tp-tp1332-docinfo-2152.htm. Last accessed July 4, 2015.

APPENDIX A

MCPEI Letter

PEI-NEW BRUNSWICK CABLE INTERCONNECTION UPGRADE PROJECT - VOLUME 4, THE NORTHUMBERLAND STRAIT

September 30, 2015

Mi'kmaq
Confederacy of
Prince Edward Island

200 Read Drive
Summerside, PE
C1N 5N7
Tel: (902) 436-5101
Fax: (902) 436-5655

Polyclinic
Professional Centre
Suite 501
199 Grafton Street
Charlottetown, PE
C1A 1L2
Tel: (902) 626-2882
Fax: (902) 367-3779

GCB

RECEIVED
JUN 05 2015

WITHOUT PREJUDICE

1 June 2015

Greg C. Buchanan, M.Sc., R.P.A.
Archaeologist
Stantec
845 Prospect Street Fredericton NB E3B 2T7

Dear Mr. Buchanan:

Re: Archaeological Impact Assessment: Maritime Electric transmission line and substation in Borden, PID 380477, Prince County, Prince Edward Island,

Further to your email message of May 07, 2015, I am writing in relation to the archaeological impact assessment for Maritime Electric transmission line and substation in Borden, PID 380477, your organization is reviewing. Based on our research, historical and traditional Mi'kmaq use occurs outside of the area you have designated for the archaeological impact assessment. This use includes: campsites along the now Confederation Trail area to the north of the area, and a travel route to the east of the area. As well, fish harvesting of mackerel occurs in the waters to the south of the area.

It must be remembered that the MCPEI database is, to date, a partial inventory of existing knowledge. As such, it does not mean that the subject area was not used (or used for additional purposes), rather that evidence of use, if it exists, has not yet been collected.

I trust this is the information required. Please advise as to what the next steps might be in this archaeological impact assessment process.

The response provided herein is specific to the particular activity (ies) in the particular area(s) specified in the information provided by you. Should you have any questions, please do not hesitate to contact me.

Yours truly,

Donald K. MacKenzie
Executive Director
Mi'kmaq Confederacy of PEI

cc. Tammy MacDonald
Randy Angus
Lennox Island FN
Abegweit FN
Helen Kristmanson
Barry MacPhee

Abegweit
First Nation

Lennox
Island
First Nation

www.mcpei.ca