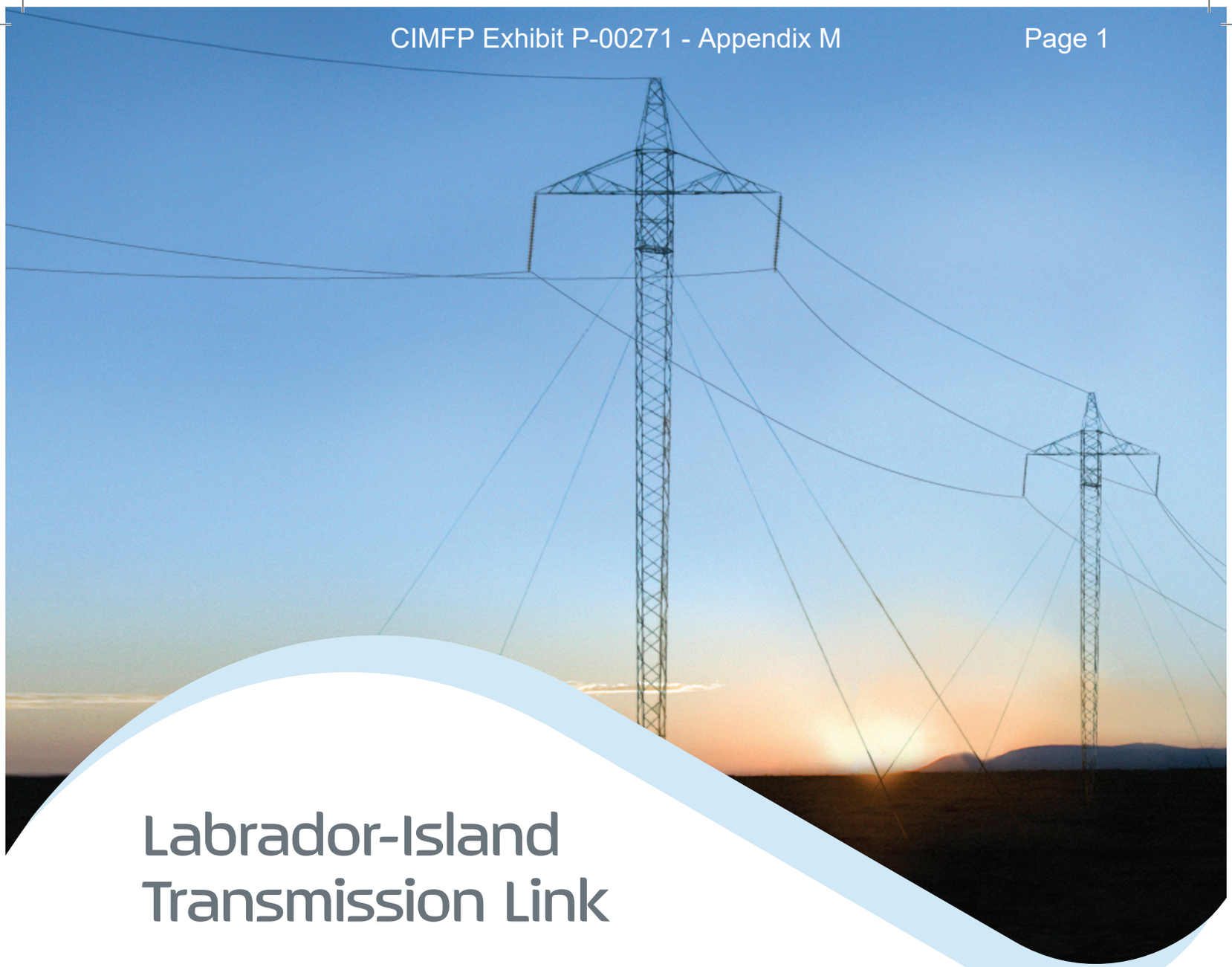


Labrador-Island Transmission Link

Environmental Impact Statement

Volume 1
Project Planning and Description

nalcor energy
LOWER CHURCHILL PROJECT

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PREFACE

Nalcor Energy (Nalcor) is proposing to construct and operate the Labrador – Island Transmission Link (Project), a high voltage direct current (HVdc) transmission system extending from the lower Churchill River in Central Labrador to Soldiers Pond on the Island of Newfoundland's (Island) Avalon Peninsula.

The Project is subject to environmental assessment (EA) review under the Newfoundland and Labrador *Environmental Protection Act* (*NLEPA)* and the *Canadian Environmental Assessment Act* (*CEAA*). This Environment Impact Statement (EIS) is being submitted by Nalcor, as proponent, in accordance with the requirements of the provincial and federal EA processes and the associated *Environmental Impact Statement Guidelines and Scoping Document* issued by the provincial and federal governments in May 2011 (Government of Newfoundland and Labrador and Government of Canada 2011).

The proposed Project will extend over a distance of approximately 1,100 km, and includes the following key components:

- an alternating current to direct current (ac to dc) converter station at Muskrat Falls near the lower Churchill River in Central Labrador;
- an overhead transmission line from Muskrat Falls to the Strait of Belle Isle (approximately 400 km);
- marine cable crossings of the Strait of Belle Isle with associated infrastructure;
- an overhead transmission line from the Strait of Belle Isle to Soldiers Pond on the Island's Avalon Peninsula (approximately 700 km);
- a dc to ac converter station at Soldiers Pond, with some associated Island system upgrades; and
- electrodes, or high capacity grounding systems, in the Strait of Belle Isle (Labrador) and Conception Bay (Newfoundland), connected to their respective converter station by a small overhead transmission line.

Nalcor has prepared this EIS to determine the environmental effects of the Project, and to propose effects management measures that would reduce adverse environmental effects and enhance positive environmental effects. This EIS is available for public review and comment. The EIS is presented in an Executive Summary and volumes 1, 2A, 2B, 3 and 4. Fourteen component studies have also been submitted prior to the submission of this EIS.

The Executive Summary presents key findings of the EIS, focusing on an overview of the Project, its interactions with and effects on the environment, and mitigative measures to eliminate, reduce or control adverse effects, and enhance positive effects. Volume 1 describes the Project, including its need and purpose, components and assessment methodology, and the detailed public and Aboriginal consultation program that Nalcor has carried out, and will continue to conduct, for the Project. Volume 2A describes the existing biophysical environment, and Volume 2B presents the biophysical effects assessment, which includes the atmospheric, terrestrial, freshwater and marine environments. Volume 3 includes a description of the socioeconomic existing environment, and the socioeconomic effects assessment, as well as an overall summary of Nalcor's commitments, the promotion of sustainable development during Project planning and the conclusions of the EIS. Volume 4 includes supplementary environmental studies for the existing environment.

Nalcor has also written a Plain Language Summary to provide a short description of the Project and to describe how the Project will affect the environment. It also explains what Nalcor plans to do if it receives approval from the Government of Newfoundland and Labrador and the Government of Canada to build the Project. The summary is available in: English, French, Innu-aimun (Labrador and Quebec dialects), Naskapi and Inuktitut.

NALCOR ENERGY

LABRADOR - ISLAND TRANSMISSION LINK

ENVIRONMENTAL IMPACT STATEMENT

Study Team

April 2012

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Nalcor Energy

April 2012

NALCOR ENERGY

LABRADOR-ISLAND TRANSMISSION LINK

ENVIRONMENTAL IMPACT STATEMENT

Chapter 1

Introduction

April 2012

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LIST OF ACRONYMS

Acronym	Description
ac	alternating current
CEA Agency	Canadian Environmental Assessment Agency
CEAA	*Canadian Environmental Assessment Act*
dc	direct current
EA	Environmental Assessment
EIS	Environmental Impact Statement
GIS	Geographic Information System
GNL	Government of Newfoundland and Labrador
HVdc	High Voltage direct current
Island	Newfoundland
km	kilometre
MW	megawatt
NLEPA	Newfoundland and Labrador *Environmental Protection Act*
NLH	Newfoundland and Labrador Hydro
Project	Labrador-Island Transmission Link
SI	System International
US	United States
VEC	Valued Environmental Component

1 INTRODUCTION

Nalcor Energy (Nalcor) is proposing to develop the Labrador-Island Transmission Link (Project), a High Voltage direct current (HVdc) transmission system extending from the lower Churchill River in Central Labrador to Soldiers Pond on the Island of Newfoundland's (Island) Avalon Peninsula.

The Project is subject to environmental assessment (EA) review under the Newfoundland and Labrador *Environmental Protection Act* (*NLEPA*) and the *Canadian Environmental Assessment Act* (*CEAA*). This Environmental Impact Statement (EIS) is being submitted by Nalcor, as Proponent, in accordance with the requirements of the provincial and federal EA processes and the associated *Environmental Impact Statement Guidelines and Scoping Document* issued by the provincial and federal governments in May 2011 (Government of Newfoundland and Labrador and Government of Canada 2011).

As an introduction to the EIS, this chapter provides a general overview of the proposed Project, identifies the Proponent, outlines the regulatory and policy contexts for the Project, and describes the purpose of the EIS and the overall organization of the document.

1.1 Nature and Overview of the Project

The proposed Project will involve the Construction, and Operations and Maintenance of transmission infrastructure within and between Labrador and the Island of Newfoundland. The development of this Project is an important aspect of the *Energy Plan* that was released by the Government of Newfoundland and Labrador (GNL) in September 2007 (GNL 2007).

The proposed Project will extend over a distance of approximately 1,100 kilometres (km), and include the following key components (Figure 1.1-1):

- an alternating current to direct current (ac to dc) converter station at Muskrat Falls near the lower Churchill River in Central Labrador;
- an overhead transmission line from Muskrat Falls to the Strait of Belle Isle (approximately 400 km);
- marine cable crossings of the Strait of Belle Isle with associated infrastructure;
- an overhead transmission line from the Strait of Belle Isle to Soldiers Pond on the Island's Avalon Peninsula (approximately 700 km);
- a dc to ac converter station at Soldiers Pond, with some associated Island system upgrades; and
- electrodes, or high capacity grounding systems, in the Strait of Belle Isle (Labrador) and Conception Bay (Newfoundland), connected to their respective converter stations by small overhead transmission lines.

Commencing in 2011 with detailed engineering and conditional on release from environmental assessment in 2012, the current schedule would see construction, including procurement activities, begin in 2012 and conclude in 2016, followed by Project commissioning and operations.

The Project is being proposed and designed based on the concept and principles of sustainable development - which has guided and formed the basis of the Project's overall purpose and rationale, as well as its ongoing planning, as outlined below and throughout this EIS.

The Project is an important part of ongoing efforts towards securing an adequate, reliable and clean electricity supply to address the province's current and future energy needs. It will facilitate the transmission of electricity from the proposed Lower Churchill Hydroelectric Generation Project in Central Labrador to the Island, that will then be distributed through the existing Island grid throughout Newfoundland. This will allow the displacement of existing generation from the Holyrood Thermal Generating Station in eastern Newfoundland, to address the air quality issues currently associated with that facility's emissions, as well as providing additional energy to address projected future requirements and facilitate further economic development.

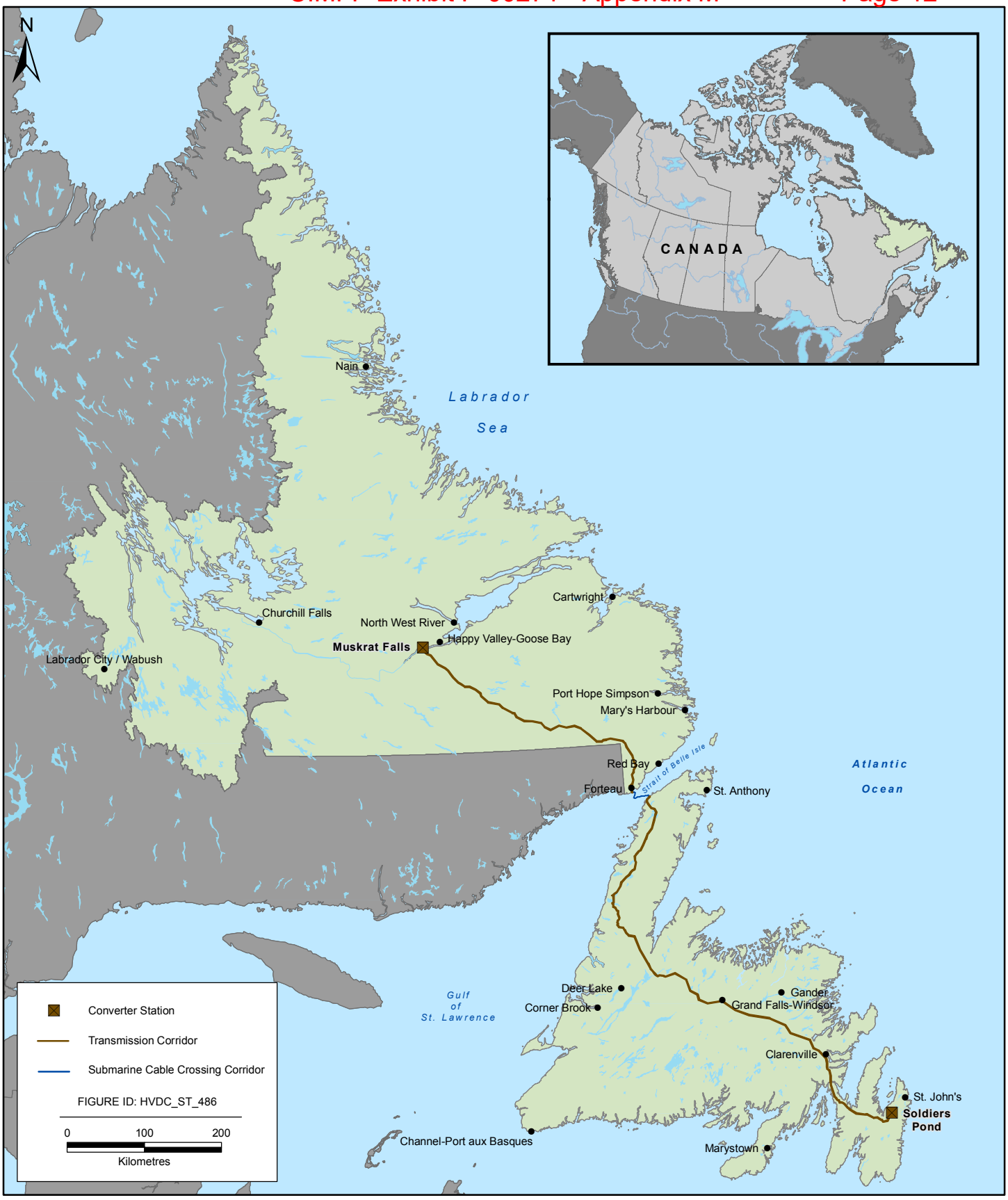


FIGURE 1.1-1

Labrador - Island Transmission Link

The transmission of clean, renewable hydroelectricity from Labrador to the Island through the Project is the most environmentally, technically and economically preferred option for meeting the Island's current and future energy needs. This is discussed further in Chapter 2 of this EIS.

Nalcor is encouraged by the environmental and socioeconomic benefits that will be realized through this Project, and is confident that any environmental issues that may be associated with the Project can be addressed through sound Project planning and implementation. As illustrated throughout this EIS, the EA process, including its associated governmental, Aboriginal and stakeholder consultation, has been and will continue to be a key aspect of Project planning and design.

A full discussion of the purpose of and rationale for the Project – including its environmental and socioeconomic benefits and overall relationship to the principles of sustainable development – is provided in Chapter 2 and a detailed Project description is included in Chapter 3.

1.2 Identification of the Proponent

Newfoundland and Labrador has an immense and diverse energy warehouse. Guided by a long-term *Energy Plan* (GNL 2007) to manage these energy resources, in 2008 the Government of Newfoundland and Labrador created Nalcor Energy, a new provincial Crown corporation. Nalcor is the proponent for the Labrador-Island Transmission Link.

Name of Corporate Body:	Nalcor Energy
Address:	Hydro Place, 500 Columbus Drive P.O. Box 12800 St. John's, Newfoundland and Labrador Canada A1B 4K7 Tel. (709) 737-1833, Toll Free 1-888-576-5454 (within Canada) Fax. (709) 737-1985 Email. *lowerchurchill@nalcorenergy.com*
President and Chief Executive Officer:	Edmund J. Martin
Principal Contact Persons for the Purposes of Environmental Assessment:	Stephen Pellerin Manager, Environmental and Aboriginal Affairs Tel. (709) 737-4218, Toll Free 1-888-576-5454 (within Canada) Email. *stevepellerin@nalcorenergy.com* Gilbert Bennett Vice President, Lower Churchill Project Tel. (709) 737-1836, Toll Free 1-888-576-5454 (within Canada) Email. *gbennett@nalcorenergy.com*

Nalcor's foundation is built on its core business – the generation and transmission of electrical power – and the corporation has a strong commitment to providing safe, reliable and dependable electricity to its utility, industrial, residential and retail customers. Beyond that core business, the corporation's focus has expanded into the broader energy sector, including oil and gas, wind energy, and research and development.

The Newfoundland and Labrador *Energy Corporation Act* authorizes Nalcor to invest in, engage in and carry out activities in the energy sector within Newfoundland and Labrador (and, with approval, outside the province), including:

- the development, generation, production, transmission, distribution, delivery, supply, sale, export, purchase and use of energy from wind, water, steam, gas, coal, oil, hydrogen or other products used in power production;
- exploration for development, production, refining, marketing and transportation of hydrocarbons and products made from hydrocarbons;
- manufacturing, production, distribution and sale of energy-related products and services; and
- research and development.

Nalcor's vision is to build a strong economic future for successive generations of Newfoundlanders and Labradorians. As a proud, diverse energy company, its people are committed to a bright future for the province, united by the following goals and core values:

Goals

Safety: To be a world class safety leader

Environment: To be an environmental leader

Business Excellence: Through operational excellence to provide exceptional value to all consumers of our energy

People: To ensure a highly-skilled and motivated team of employees who are strongly committed to our success and future direction

Community: To be a valued corporate citizen in Newfoundland and Labrador

Core Values

Open Communication: Fostering an environment where information moves freely in a timely manner

Accountability: Holding ourselves responsible for our actions and performance

Safety: Relentless commitment to protecting ourselves, our colleagues and our community

Honesty and Trust: Being sincere in everything we say and do

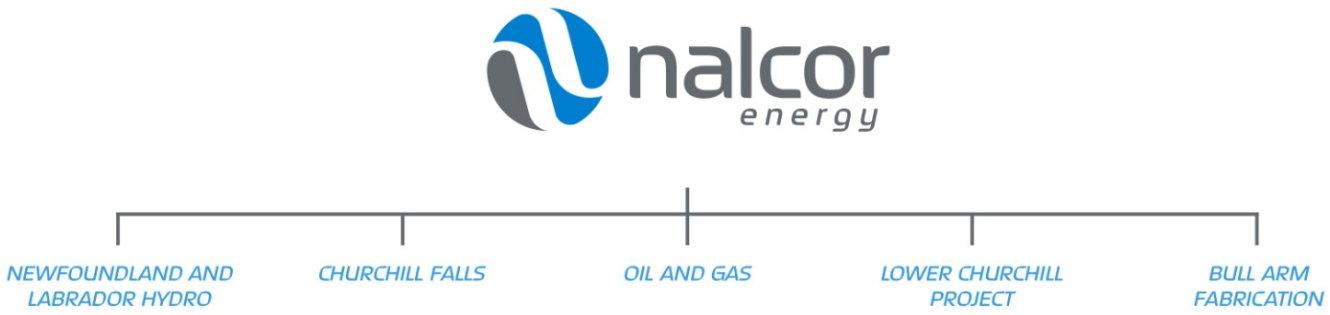
Teamwork: Sharing our ideas in an open and supportive manner to achieve excellence

Respect and Dignity: Appreciating the individuality of others by our words and actions

Leadership: Empowering individuals to help guide and inspire others

Nalcor is leading the development of the province's energy resources, and is focused on environmentally responsible and sustainable growth. The corporation currently has five lines of business (Figure 1.2-1):

Figure 1.2-1 Nalcor Energy Organizational Structure



1) Newfoundland and Labrador Hydro

A Crown corporation and subsidiary of Nalcor, Newfoundland and Labrador Hydro (NLH) generates, transmits and distributes electricity to industrial, utility and rural residential customers throughout Newfoundland and Labrador (Figure 1.2-2).

With an installed generating capacity of 1,635 megawatts (MW), NLH's power generating and transmission assets consist of nine hydroelectric plants, one oil-fired thermal plant, four gas turbines, 25 diesel plants, and thousands of kilometres of transmission and distribution lines. NLH is dedicated to delivering safe, reliable, least-cost power to residents, businesses and industries of the province, and has been doing so for more than 50 years.

NLH is focused on long-term strategic asset maintenance and planning to ensure a continued reliable and dependable source of electricity, and continues to search for the best way to provide power that is safe, cost efficient, sustainable and environmentally sound.

2) Churchill Falls

The Churchill Falls Generating Station is one of the largest hydroelectric generating stations in the world. The plant has 11 turbines with a rated capacity of 5,428 MW. The community of Churchill Falls has a population of 650 people. The company operates the town, including a school, grocery store, theatre, library and recreational facilities.

In 2008, more than 34 terawatt hours of electricity was produced, with the majority of that energy sold to Hydro-Québec through a long-term power purchase contract set to expire in 2041. Most of the remaining production is used for mining operations in Labrador West and Hydro's Labrador Interconnected System. On March 31, 2009, the company's five-year power sale agreement to sell energy to Hydro-Québec expired, and on April 1, 2009, Nalcor signed an Agreement with Hydro-Québec under its Open Access Transmission Tariff for power transmission from Labrador to the Canada-United States (US) border. NLH then began selling power on the Canadian side of the border to Emera Energy Inc., which began selling that power to the energy markets in Canada and the United States on April 1, 2009.

3) Lower Churchill Project

The Churchill River in Labrador is a significant source of renewable electrical energy. While the existing Churchill Falls facility harnesses about 65 percent(%) of the river's generating potential, the remaining 35% is located at two sites on the lower Churchill River - Muskrat Falls (824 MW) and Gull Island (2,250 MW).

The proposed Lower Churchill Project is one of the best undeveloped hydro resources in North America. It is one of the key elements in the province's energy warehouse, and provides an opportunity for Newfoundland and Labrador to meet its own energy needs in an environmentally-sustainable way, with enough power remaining to export to other jurisdictions where the demand for clean energy is growing. Nalcor is actively working towards the development of the Lower Churchill Project.

This business unit of Nalcor also has overall responsibility for the planning and development of the Labrador-Island Transmission Link.

4) Oil and Gas

Nalcor Energy – Oil and Gas holds and manages oil and gas interests in Newfoundland and Labrador onshore and offshore. The company is currently a partner in three offshore developments - the Hebron Oil Field, the White Rose Growth Project and the Hibernia Southern Extension.

Nalcor Energy - Oil and Gas continues to assess growth opportunities for the province's oil and gas resources. Committed to marketing these opportunities around the world, Nalcor Energy – Oil and Gas will maximize benefits from these resources to help attract continued investment that will strengthen the economy in Newfoundland and Labrador.

5) Bull Arm Fabrication

The Bull Arm facility is Atlantic Canada's largest industrial fabrication site, and is strategically located in Newfoundland and Labrador near St. John's, close to international shipping lanes and centrally positioned to service major developments worldwide. The facility has fully integrated and comprehensive infrastructure to support fabrication and assembly of three key project functions, simultaneously, in three separate theatres: Topsides Fabrication and Assembly; Drydock Fabrication and Construction; and a Deepwater Site. This world-class facility is located close to the communities of Sunnyside, Arnold's Cove and Come By Chance and has provided employment and economic spin-off benefits, as well as broader benefits to the province through new infrastructure, technical knowledge and expertise, technology transfer and an experienced labour force.

The Bull Arm facility is an important asset in the development and advancement of the province’s oil and gas industry and fabrication capacity, and the transfer of the site to be operated as a subsidiary of Nalcor ensures it is utilized to maximize the benefits to the province from the number of large-scale construction and fabrication projects on the horizon - locally and around the world.

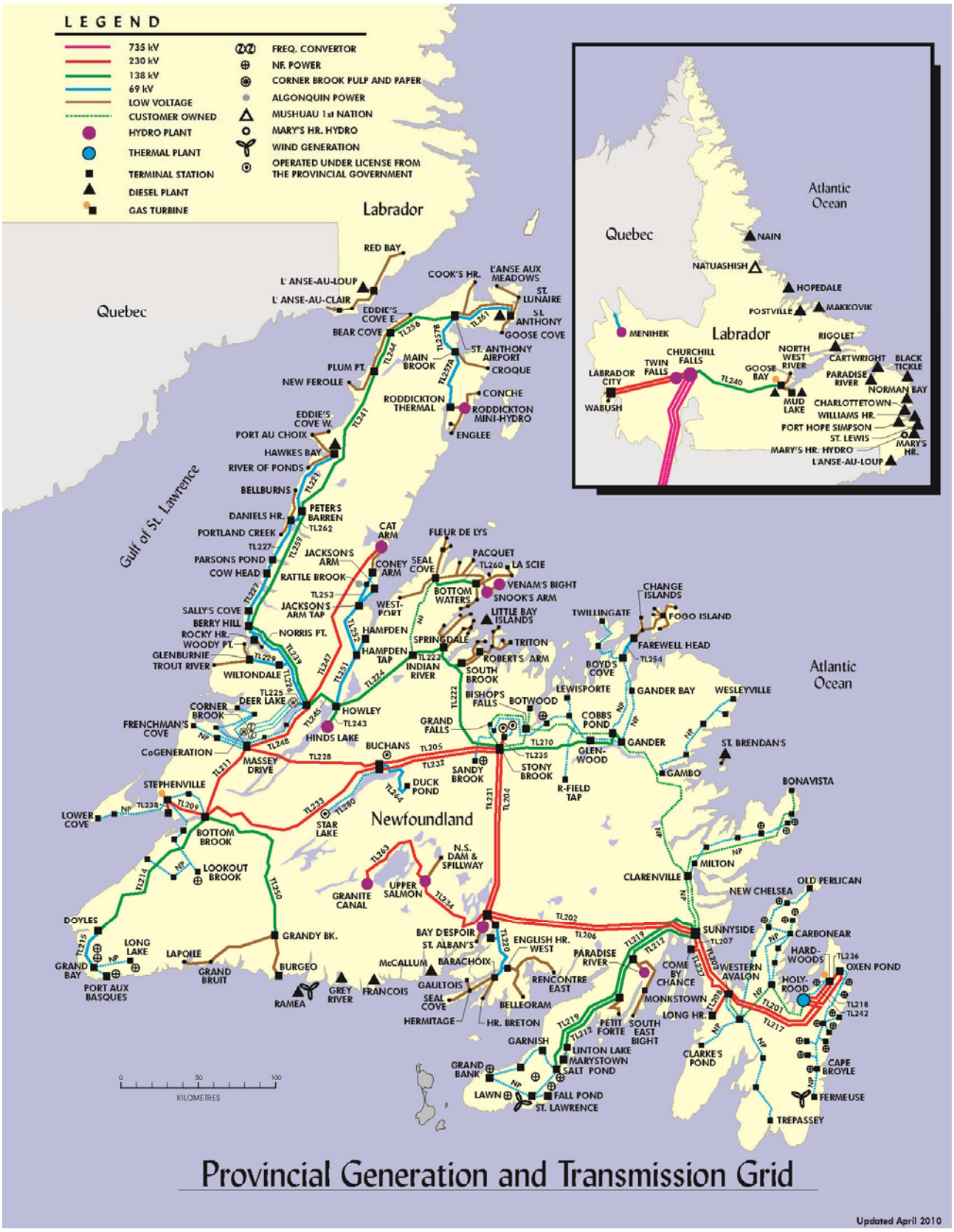
Additional information on Nalcor, including its overall organization, values, priorities and activities, can be found at: *www.nalcorenergy.com.*

As reflected in its above-listed corporate goals and values, Nalcor strives to be a leader in environmental protection and sustainability, and is committed to maintaining a high standard of environmental responsibility and performance. Through its NLH and Churchill Falls subsidiaries, Nalcor has constructed and currently operates an extensive electricity transmission system throughout Newfoundland and Labrador. This includes interconnected electrical power systems on the Island and in Labrador, as well as isolated distribution systems throughout rural areas of the province.

Environmental protection planning is an integral part of Nalcor’s planning, Construction, and Operations and Maintenance programs. The corporation has state-of-the-art and proven policies and procedures related to environmental protection and management which will be implemented throughout this Project. Nalcor has an outstanding record of environmental protection and stewardship, and this objective and experience will be applied to the planning and development of this Project to avoid or reduce potential environmental effects during its Construction, and Operations and Maintenance phases.

A detailed overview of Nalcor’s policies, plans, management systems and other initiatives that are relevant to the Project, and in particular, to addressing environmental issues and associated consultation, is provided throughout the EIS.

Figure 1.2-2 Existing Newfoundland and Labrador Generation and Transmission System



1.3 Environmental Assessment Processes and Requirements

Environmental Assessment (EA) is a regulatory review process that is often applied to proposed developments to proactively identify and seek to address potential environmental effects in project planning and decision-making. Through EA review, environmental issues are identified (often through consultation), likely environmental effects are assessed and evaluated, and measures to avoid or reduce adverse effects and optimize benefits are identified and proposed. The results of an EA are considered in project design, and ultimately, in eventual government (regulatory) decisions regarding whether and how the Project can proceed.

In Newfoundland and Labrador, proposed development projects may be subject to provincial and / or federal EA requirements.

The *NLEPA* requires anyone who plans a project that could have a significant effect on the natural, social or economic environment (an "Undertaking") to present it for examination through the provincial EA process. Under the *NLEPA*, this Project is considered an Undertaking subject to Part X, and pursuant to Section 34(2) of the associated *Environmental Assessment Regulations*:

> *34. (2) An undertaking that will be engaged in the construction of new electric power transmission lines or the relocation or realignment of existing lines where a portion of a new line will be located more than 500 metres from an existing right of way shall be registered.*

The federal EA process under the *CEAA* and its associated regulations applies to projects that involve the federal government - as proponent, regulator, and / or as a source of funding or land. A number of federal departments and agencies have potential decision-making responsibilities in relation to this Project, which have triggered the requirement for a federal EA as outlined below.

On January 29, 2009, Nalcor submitted the *Labrador-Island Transmission Link Environmental Assessment Registration and Project Description* (Nalcor 2009a) to the provincial and federal governments, to formally initiate the provincial and federal EA processes for the Project.

Following governmental and public review of that EA Registration, on March 23, 2009, the provincial Minister of Environment and Conservation announced that an EIS was required for the Project.

On April 2, 2009, an EA Committee comprised of representatives of various applicable provincial and federal government departments was appointed.

On September 15, 2009, Nalcor submitted a revision and update to the initial (January 2009) EA Registration and Project Description to the provincial and federal governments (Nalcor 2009b). That submission specified that the previously included transmission corridor option within Gros Morne National Park in western Newfoundland was no longer being considered, and that the Long Range Mountains crossing alternative was now the proposed transmission corridor for the Project and its EA (Chapter 3).

On November 26, 2009 (subsequently updated on July 19, 2010), the Canadian Environmental Assessment Agency (CEA Agency) issued a "Notice of Commencement" for the federal EA for the Project, indicating that several federal departments were required to ensure that a Comprehensive Study was conducted in relation to the development proposal. Specifically, under Section 5 of the *CEAA*, an EA is required because, for the purpose of enabling the Project to be carried out in whole or in part:

- Environment Canada may take action in relation to Subsection 127(1) of the *Canadian Environmental Protection Act*;
- Fisheries and Oceans Canada may take action in relation to Subsection 35(2) of the *Fisheries Act;* and
- Transport Canada may take action in relation to Section 5 of the *Navigable Waters Protection Act*.

The CEA Agency has been identified as the Federal EA Coordinator for the *CEAA* assessment. The Project has been identified as a major natural resource project, and therefore falls under the federal Major Projects Management Office's process to track and monitor the progress of such projects through the federal regulatory system.

On November 15, 2010, Nalcor submitted a Project description update to the provincial and federal governments, which indicated that it was no longer proposing to place sea electrodes in Lake Melville or Holyrood Bay - as was reflected in the initial EA Registration and Project Description (Nalcor 2009a, b) - nor to develop the associated wood-pole line connections to these sites. Rather, the Project concept would see the use of shore electrodes at locations in the Strait of Belle Isle area (Labrador side) and Conception Bay South (Newfoundland). Through that submission, Nalcor also advised that it would also be assessing the option of locating the Project's Labrador converter station at or near the Muskrat Falls site on the lower Churchill River and an associated transmission line corridor from that location.

On February 7, 2011, following earlier review by Aboriginal communities and organizations, the provincial and federal governments issued *Draft EIS Guidelines and Scoping Document* for public review and comment.

On April 14, 2011, Nalcor submitted a further update to the Project description under the EA process, which indicated that in addition to the originally identified cable landing sites and two marine cable corridors in the Strait of Belle Isle, it would also be assessing a potential option that would see a single cable corridor between Forteau Point (Labrador) and Shoal Cove (Newfoundland).

On May 3, 2011, the *Final EIS Guidelines and Scoping Document* were approved by the Ministers and issued to Nalcor to guide its preparation of this EIS.

From May 2011, to the present, Nalcor Energy has submitted various Environmental Component Studies under the EA process for review and comment by government departments and agencies, Aboriginal and stakeholder groups and the public.

In addition to approvals under the provincial and federal EA processes, the Project will require various other provincial, federal and municipal authorizations. There are a number of other policies, legislation and regulations which apply to the Project and its environmental management and planning that have been considered and incorporated directly and integrally into Project planning and design, and are identified and discussed in detail later in the EIS (Chapters 2, 3 and 6). A discussion of Aboriginal communities and organizations and any associated land claims or other agreements which are relevant to the Project and its EA is provided in Chapters 6, 7, 15 and 16.

1.4 Previous and Other Environmental Assessments

The current planning, engineering and environmental work for the Project is building on previous studies related to the transmission of electricity between Labrador and the Island that began over 30 years ago. Although the current Project proposal has been defined and initiated under the direction of the *Energy Plan* released by the Government of Newfoundland and Labrador in September 2007, the concept of such a transmission link has been the subject of consideration and analysis over several decades, including a number of previous development attempts and EAs.

In the mid-1970s, in advance of the formal establishment of federal and provincial EA processes, a federal-provincial Review Panel was appointed to coordinate an EA review. That process eventually involved the completion and submission of separate EA Reports for the Transmission Link and for the Lower Churchill Hydroelectric Generation Facilities at Gull Island and Muskrat Falls, followed by public hearings and an eventual Panel Report and associated government decisions.

With regard to the Project in particular, the following summarizes the key stages of this previous EA review:

- NLH completed and submitted a *Transmission Line Project Description and Environmental Policy Statement* (EIS) to the EA Panel in July 1978.
- Following review by the Panel, relevant government agencies and the public, a Deficiency Statement was issued to the Proponent in March 1979. In 1979 and 1980, a series of environmental studies were conducted and submitted in support of a Transmission Line EIS Addendum.
- In 1979, a public consultation program was initiated by the proponent which included the establishment of a Liaison Committee in Central Labrador, and public meetings in St. John's, Grand Falls, Daniel's Harbour, Flower's Cove, Forteau, West St. Modeste, Mud Lake, North West River and Happy Valley-Goose Bay.
- In December 1979, a Transmission Line EIS Addendum was submitted to the Panel. In June 1980, the Panel issued the results of the review of the Addendum, which the proponent responded to with further information.
- EA Panel Hearings were held in relation to the Transmission Link and the Lower Churchill Hydroelectric Generation Project in September 1980, which included public meetings in St. John's, Flower's Cove, Forteau, West St. Modeste, Sheshatshiu, North West River and Happy Valley-Goose Bay.
- The proponent subsequently prepared and submitted a Supplemental Brief in September 1980 to address outstanding issues that were raised at the Hearings.
- On December 11, 1980, the federal Minister of Environment released and endorsed the report of the EA Panel, which concluded that the Transmission Link and the Lower Churchill Hydroelectric Generation Projects were environmentally acceptable, provided that certain environmental and socioeconomic measures were implemented.

Some initial construction work on the Transmission Link was carried out, particularly in the Strait of Belle Isle area, but the project was not completed for economic reasons.

Subsequently, in November 1990, NLH prepared and submitted an EA Registration for the transmission and generation developments under the then Newfoundland *Environmental Assessment Act*. The province subsequently determined that an EIS would be required and issued EIS Guidelines in May 1991. The EA process did not progress beyond that point, as failure to reach agreement on access to external markets resulted in suspension of this development effort.

In the late 1990s, the Labrador Hydro Project Office was established to plan and develop the Churchill River Power Project, which for a period included the transmission link project. A number of associated environmental baseline studies were undertaken in 1998.

As a result of these previous EA activities and development efforts, there exists an extensive body of knowledge about the Project, the natural and human environments through which it will extend, and the key questions and issues related to the Project and its potential interactions with the environment. This information and understanding has been, and will continue to be, invaluable in ongoing Project planning and design.

In terms of other ongoing and possible future EAs, as noted above, the proposed Project is intended to transmit a portion of the energy output from the proposed Lower Churchill Hydroelectric Generation Project in Central Labrador to the Island. The EA of that project, including the Muskrat Falls and Gull Island generation facilities and transmission interconnections between them and Churchill Falls, was initiated in December 2006 with Joint Review Panel hearings taking place March to April 2011 and a JRP Report released in August 2011.

A key rationale for the proposed Project is to provide energy and infrastructure for further development and growth in Newfoundland and Labrador's energy sector and overall economy. This could result in future proposals pertaining to, for example:

- new industrial developments (energy consumers) in the province that may utilize the electricity transmitted by the Project;
- new energy generation facilities within the province that utilize the transmission infrastructure / interconnection provided by the Project; and / or
- future transmission infrastructure for energy distribution within the province and / or export, which may be made necessary and viable as a result of the Project and / or the above developments.

Any such future development projects and / or transmission infrastructure which may be associated with such power use, distribution and / or export would be presented for EA review by the relevant proponent(s) of those project(s), once they are determined and defined. In November 2010, Nalcor announced that a term sheet with Emera Inc. of Nova Scotia had been signed. The term sheet contemplates arrangements leading to the construction of a transmission link between the Island and Nova Scotia (the Maritime Link). These arrangements have not been finalized, and the construction of the Project is not dependent on construction of the Maritime Link. With or without the Maritime Link, the Project is the preferred alternative to meet Newfoundland's electricity needs.

1.5 Purpose and Organization of the EIS

This EIS has been developed and is being submitted by Nalcor, as the Proponent of the Project, in accordance with the provisions and requirements of the provincial and federal EA legislation and regulations, as well as the associated final *EIS Guidelines and Scoping Document* (Government of Newfoundland and Labrador and the Government of Canada 2011).

The submission of the EIS is an important step in the EA review process for this Project. It provides the required information on the Project and its potential environmental and socioeconomic outcomes, including the:

- Project purpose, rationale and planning;
- Project description (components and Construction, and Operations and Maintenance activities);
- existing biophysical and socioeconomic environments;
- consultation activities, and the various questions and issues identified;
- likely environmental effects of the Project;
- proposed measures to avoid or reduce adverse effects and enhance benefits; and
- plans for environmental monitoring and follow-up during Project Construction, and Operations and Maintenance.

The EIS will form the basis for further review, consideration and discussion of the Project and these items by governments, Aboriginal and stakeholder groups, the interested public and Nalcor as part of the EA review process. Based on the results of the EA and the associated reviews and input, the provincial and federal Ministers will decide whether the Project can proceed, and if so, under what terms and conditions.

The EIS has been prepared and structured to provide the results of the EA and other required information in a clear, concise and well-organized manner, in keeping with current EA practice and with a view to overall readability and utility for all of its likely readers. This includes relevant government departments and agencies, Aboriginal and stakeholder organizations and the general public.

The EIS document is structured as follows:

***Chapter 1 (this Introduction)**:* Provides a general overview of the Project, identifies the Proponent, outlines the regulatory and policy contexts for the Project, and describes the purpose of the EIS and the overall organization of the document.

***Chapter 2 (Project Rationale and Planning)**:* Sets the overall context for the Project by discussing the following: overall need, purpose and rationale; alternatives to the Project; previous and ongoing Project planning and design activities, including those that led to the current design concept; alternative means of carrying out the Project, including an overall evaluation of technical and economic feasibility and the identification of those options that are subject to detailed environmental analysis; and a description of future (post-EA) Project design activities, including detailed route selection the eventual selection of a specific route for the transmission line. It also provides an overview of various policies, plans and other procedures and initiatives that are relevant to the Project, and in particular, to avoiding or managing potential environmental effects.

***Chapter 3 (Project Description)**:* Provides an overview and detailed description of the Project, including its location, key components and overall layout, Construction, and Operations and Maintenance activities and events, labour force requirements, Project expenditures and schedule.

***Chapter 4 (Effects of the Environment on the Project)**:* Discusses how the existing biophysical and socioeconomic environments have and may affect the Project, including the manner in which environmental conditions and factors have and will influence Project design, and potential associated events and effects which may occur during Project construction and / or operations.

***Chapter 5 (Accidents and Malfunctions)**:* Discusses accidental events and malfunctions that could potentially occur during all phases of the Project, as well as where and how these are considered and addressed in the EA.

***Chapter 6 (Environmental Setting and Context)**:* Gives a general and high-level overview of the existing natural and human environments, as background and context for the Project and its EA.

***Chapter 7 (Aboriginal Consultation and Issues Scoping)**:* Describes Nalcor's previous and ongoing consultation efforts and initiatives with Aboriginal communities and organizations relevant to the Project and its EA, and identifies the questions, issues and concerns raised regarding the Project and its potential effects, and where and how these are addressed in the EIS.

***Chapter 8 (Regulatory, Stakeholder and Public Consultation and Issues Scoping)**:* Describes Nalcor's previous and ongoing regulatory, stakeholder and public consultation programs and activities relevant to the Project and its EA, and identifies the questions, issues and concerns raised regarding the Project and its potential effects, and where and how these are addressed in the EIS.

***Chapter 9 (EA Approach and Methods)**:* Describes the overall approach and methods used to conduct the Project's EA, including each of its key stages.

***Chapter 10 (Existing Biophysical Environment)**:* Provides a description of the existing natural environment that overlaps and may interact with the proposed Project, including its atmospheric, terrestrial, freshwater and marine components (i.e., the baseline).

***Chapter 11 (Atmospheric Environment – Environmental Effects Analysis)**:* Provides the detailed results of the environmental effects assessment for the Atmospheric Environment, including each of the selected Valued Environmental Components (VECs), using the EA approach and methods described in Chapter 9.

***Chapter 12 (Terrestrial Environment – Environmental Effects Analysis)**:* Provides the detailed results of the environmental effects assessment for the Terrestrial Environment, including each of the selected VECs, using the EA approach and methods described in Chapter 9.

***Chapter 13 (Freshwater Environment – Environmental Effects Analysis)**:* Provides the detailed results of the environmental effects assessment for the Freshwater Environment, including each of the selected VECs, using the EA approach and methods described in Chapter 9.

***Chapter 14 (Marine Environment – Environmental Effects Analysis)**:* Provides the detailed results of the environmental effects assessment for the Marine Environment, including each of the selected VECs, using the EA approach and methods described in Chapter 9.

***Chapter 15 (Existing Socioeconomic Environment)**:* Provides a description of the existing human environment that overlaps and may interact with the proposed Project, including each of its associated and relevant components.

***Chapter 16 (Socioeconomic Environment – Environmental Effects Analysis)**:* Provides the detailed results of the environmental effects assessment for the Socioeconomic Environment, including each of the selected VECs, using the EA approach and methods described in Chapter 9.

***Chapter 17 (Summary and Conclusions)**:* Provides a summary of the key results and conclusions of the EIS, including: a summary of the Project; the purpose of the Project; a summary of the key environmental, social and economic benefits that will result from the Project; a summary of the commitments Nalcor has made for this Project; a summary of the residual effects of the Project on the VECs and their significance; a description of the "with Project" environment, namely, an overview of the natural and socioeconomic environments with the Project and its effects; a summary of the post-EIS environmental monitoring and follow-up programs to be implemented if the Project proceeds; and, the overall conclusion of the EIS.

The figures presented in the EIS use a standard Geographic Information System (GIS) mapping (digital) format with maps geo-referenced. The GIS and all associated reports and studies use System International (SI) units of measure and terminology throughout.

1.6 References

GNL (Government of Newfoundland and Labrador). 2007. Focusing Our Energy: Newfoundland and Labrador Energy Plan. Government of Newfoundland and Labrador, September 2007.

Government of Newfoundland and Labrador and Government of Canada. 2011. Environmental Impact Statement Guidelines and Scoping Document, Labrador-Island Transmission Link. Prepared for Nalcor Energy. St. John's, NL.

Nalcor (Nalcor Energy). 2009a. Labrador – Island Transmission Link: Environmental Assessment Registration Pursuant to the *Newfoundland and Labrador Environmental Protection Act*, Project Description Pursuant to the *Canadian Environmental Assessment Act*. Submitted by Nalcor Energy: January 29, 2009. St. John's, NL.

Nalcor. 2009b. Labrador – Island Transmission Link: Environmental Assessment Registration Pursuant to the *Newfoundland and Labrador Environmental Protection Act*, Project Description Pursuant to the *Canadian Environmental Assessment Act*. Revised September 15, 2009. St. John's, NL.

NALCOR ENERGY

LABRADOR-ISLAND TRANSMISSION LINK

ENVIRONMENTAL IMPACT STATEMENT

Chapter 2

Project Rationale and Planning

April 2012

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LIST OF ACRONYMS

Acronym	Description
AFUDC	allowance for funds used during construction
AMEC	AMEC Earth & Environmental
CCCT	combined cycle combustion turbine
CCS	carbon capture and storage
CDM	Conservation and Demand Management
CO_2	carbon dioxide
COS	cost of service
CPI	Consumer Price Index
CPW	Cumulative Present Worth
CT	combustion turbine (simple cycle)
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMS	Environmental Management System
EPCM	Engineering, Procurement and Construction Management
EPP	Environmental Protection Plan
ESP	electrostatic precipitators
FGD	flue gas desulphurization
GDP	Gross Domestic Product
GHG	greenhouse gas
GNL	Government of Newfoundland and Labrador
GNP	Great Northern Peninsula
GWh	gigawatt hour
HDD	horizontal directional drill
HRSG	heat recovery steam generator
HVdc	High Voltage direct current
IDC	Interest During Construction
IRR	Internal Rate of Return
ISO	International Organization for Standardization
kV	kilovolt
kW	kilowatt
kWh	kilowatt hour
LFO	light fuel oil
LNG	Liquefied Natural Gas
LOLH	Loss of Load Hours
MBTU	Millions of British Thermal Units
MMscf/d	million standard cubic feet per day
MWh	megawatt hours

Acronym	Description
NERC	North American Electric Reliability Corporation
NL	Newfoundland and Labrador
NLH	Newfoundland and Labrador Hydro
NOx	nitrous oxide
NUG	Non-utility Generator
°C	degrees Celsius
PIRA	PIRA Energy Group
PLF	Planning Load Forecast
PM	particulate matter
PPA	power purchase agreement
PUB	Public Utilities Board
PV	Photovoltaic
QMI	Quality Management Institute
the Regie	the Regie de l'energie
RFP	Request for Proposals
ROW	right-of-way
RRM	Revenue Requirement Model
SHERP	Safety, Health and Environmental Emergency Response Plans
SO_2	sulphur dioxide
TL	Transmission Line (when referring to specific line number)
TLH	Trans-Labrador Highway
TLH2	Trans-Labrador Highway Phase 2
TLH3	Trans-Labrador Highway Phase 3
TWh	Terawatt hours
US FERC	US Federal Energy Regulatory Commission
WACC	weighted average cost of capital
Westney	Westney Consulting Group Inc.

2 PROJECT RATIONALE AND PLANNING

The Labrador-Island Transmission Link (the Project) is proposed by Nalcor Energy (Nalcor) as the least-cost domestic electricity supply alternative to address the long term energy requirements of residents and industry on the Island of Newfoundland (the Island).

The Project will address the growing demand for electricity by transmitting clean, sustainable source of energy, and with the Project's completion and full in-service, oil -fired generation at the Holyrood Thermal Generating Station (the Holyrood plant) will cease.

The Project has been planned in accordance with the principle of sustainable development. The Environmental Impact Statement Guidelines and Scoping Document issued by the provincial and federal governments in May 2011 (Government of Newfoundland and Labrador and Government of Canada 2011) provides an overview of the nature and objectives of the sustainability concept in relation to the Project and its environmental assessment (EA), including the following (Section 2.4, p. 10):

> *Sustainable development seeks to meet the needs of present generations without compromising the ability of future generations to meet their own needs.*
>
> *The objectives of sustainable development are:*
>
> - *the preservation of ecosystem integrity, including the capability of natural systems to maintain their structures and functions and to support biological diversity;*
> - *the respect for the right of future generations to the sustainable use of renewable and non-renewable resources; and*
> - *the attainment of durable and equitable social and economic benefits.*

In addition to describing and illustrating how the concept of sustainable development has been considered with respect to the Project's overall need, purpose and rationale, as well as how it has guided the ongoing planning and design activities, this chapter of the Environmental Impact Statement (EIS) also provides information on:

- the Government of Newfoundland and Labrador's (GNL) policy directives as articulated in the *Energy Plan* (GNL 2007);
- the need for, purpose of and rationale for the Project;
- the justification for the Project in energy, economic and environmental terms;
- alternatives to the Project that have been identified and evaluated, including criteria used to compare alternatives and a comparative analysis of alternatives;
- previous and ongoing Project planning and design activities, including those that led to the current design concept;
- alternative means of carrying out the Project, including an evaluation of their technical and economic feasibility and the identification of those potential options that are subject to further environmental analysis;
- an overview of future (post-EA) Project design activities, including the eventual selection of a specific route (right-of-way (ROW)) for the proposed transmission line; and
- various policies, plans and other strategies relevant to the Project, and in particular, those for avoiding or managing potential environmental effects and optimizing potential socioeconomic benefits.

This chapter references the publically available report titled *Nalcor's Submission to the Board of Commissioners of Public Utilities with respect to the Reference from Lieutenant-Governor in Council on the Muskrat Falls Project* (Nalcor 2011a) and associated exhibits and responses to requests for information filed with the Newfoundland and Labrador Board of Commissioners of Public Utilities (the Board) by Nalcor. All sources are publically available on the Board's website, and are referenced as such.

2.1 Energy Plan

The Newfoundland and Labrador *Energy Plan* (*Energy Plan*) (GNL 2007) is a comprehensive energy policy for Newfoundland and Labrador (NL). It was released in September 2007 following an extensive public consultation process by the GNL. The *Energy Plan* (GNL 2007) envisions a future where:

> *"our energy resources contribute to a vibrant and sustainable Newfoundland and Labrador where people are proud to live and work, the standard of living is high, and the environment is protected now and into the future; and to ensure that the people of Newfoundland and Labrador take pride and ownership in our energy resources and strategically develop them in such a way that returns maximum benefits to the Province for generations to come".*

Two core objectives of the *Energy Plan*, environmental sustainability and economic self-reliance for the best long-term interests of the people and the province, summarize the need, purpose and rationale for development of the Project. The *Energy Plan* makes meeting NL's current and future electricity needs with environmentally friendly, stable and competitively priced energy a priority, and endorses the development of the Project as a cornerstone public policy action to fulfill this obligation.

The *Energy Plan* (GNL 2007) further states, "the best interests of Newfoundland and Labrador are served by converting the value of our non-renewable energy resources into renewable, environmentally-friendly sources of energy that address our current social and economic priorities and provide a legacy for future generations."

The *Energy Plan* also outlines some of the Project's important environmental and socioeconomic benefits. These include:

- direct, indirect and induced employment and business opportunities and economic benefits to the people of Labrador and the Island during Project construction and operation;
- the provision of a sustainable energy supply for NL, which will enable the province to meet almost all of its electricity requirements with clean and renewable electricity;
- the displacement of existing generation from the Holyrood plant, to address air quality issues that are currently associated with that facility's emissions, as well as reduce the dependence on imported oil for power generation;
- achievement of long-term electricity rate stability and certainty in the province, both for local consumers as well as to help attract new industry to the province; and
- facilitating the development of other energy projects in NL for local use and export.

2.2 Need, Purpose and Rationale

The need for the Project is to meet the long term demand for electricity on the Island in a least-cost manner. This will be accomplished by connecting the Island electricity system to the North American grid. The Island Interconnected system refers to the interconnected electricity grid on the Island of Newfoundland, which serves all Island customers except for those remote communities served by isolated diesel generation. This terminology should not be confused with the Interconnected Island Alternative (discussed in Section 2.6.2) which refers to the generation planning alternative that involves building the Labrador-Island Transmission Link and providing power to the Island of Newfoundland from Muskrat Falls. The purpose of the Project is to establish the necessary transmission infrastructure that will allow for the least-cost provision of electricity to

electricity consumers in NL. The development of the least-cost domestic electricity supply alternative is consistent with the *Energy Plan* and provincial legislation (Section 3 (b) (iii) of the *Electrical Power Control Act, 1994*).

By constructing the Project, Nalcor will develop a long-term asset to meet this requirement for least-cost energy. The rationale for the Project is that its construction enables the transmission of energy from Muskrat Falls in Labrador: the least-cost option to meet long-term supply of power to the Island.

In addition to the review undertaken in this EA, the GNL has asked the Board of Commissioners of Public Utilities (the Board) to confirm Nalcor's analysis that the Project, with energy supplied by the proposed Muskrat Falls hydroelectric generating facility, is Newfoundland's least-cost electricity supply alternative.

Analysis of Project alternatives involved developing a least-cost generation expansion solution for two scenarios: 1) the Isolated Island (no Project) alternative is a continuation of the status quo that relies on the continued operation of the Holyrood Thermal Generating Station, and optimizes the use of proven technologies and supply options, and 2) the Interconnected Island (which includes the Project) alternative is an optimization of generation alternatives primarily driven by the Muskrat Falls hydroelectric generating facility and the proposed Labrador-Island Transmission Link.

In June 2011 the Lieutenant-Governor in Council of Newfoundland and Labrador referred to the Board a Reference Question requesting the Board review and report to Government on whether Nalcor's proposed Muskrat Falls Generating Station and the Project comprise the least cost option for the supply of power and energy to the Island of Newfoundland as compared to the Isolated Island Option.

The Reference Question stated:

> "The Board shall review and report to Government on whether the Projects represent the least-cost option for the supply of power to Island Interconnected Customers over the period of 2011-2067, as compared to the Isolated Island Option, this being the 'Reference Question'."

As part of the review process, Manitoba Hydro International (MHI) was retained by the Board. Analysis by MHI validated Nalcor's conclusion that the Project and the Interconnected Island alternative are the least cost supply option for the Island of Newfoundland (MHI 2012).

As presented in Section 1.2, Newfoundland and Labrador Hydro (NLH) is a subsidiary of Nalcor. NLH's mandate is to provide the least-cost supply of power to meet the electricity needs of the province. Therefore, much of the information presented in this chapter reflects analysis conducted by NLH.

2.3 Project Justification in Energy Terms

Nalcor's justification for the Project in energy terms is based on the requirement to meet the forecasted electricity requirements of residents and businesses in NL. NLH is responsible for developing a long-term electricity capacity and energy forecast for the NL electrical system, and has undertaken this activity for more than 40 years.

The planning process includes three basic functions:

1) The development of a long-term energy and capacity forecast.
2) An evaluation of whether existing supplies are adequate to meet forecasted requirements.
3) The development of expansion plans to meet the forecast.

The first two functions establish the justification for the Project in energy terms, and the third establishes its economic justification. All three functions are discussed in further detail in the following sections.

2.3.1 Long-Term Forecasting

Preparing a long-term load forecast is the first step in the planning process as it establishes the anticipated electricity requirement for the province's consumers. Information concerning the province's future annual energy and peak demand requirements is required to determine the timing and 'plan design' of future generation sources. Electricity demand changes over time, reflecting the overall growth or decline in a region's economic activity. In addition, market factors relating to available fuel choices and pricing have an effect on electricity demand, as well as changes in technology and energy efficiency. The purpose of load forecasting at NLH is to project electricity demand and energy requirements through future periods to ensure sufficient generation resources are available to reliably meet consumers' requirements. The long-term load forecast aims to minimize the operational risks between inadequate capacity and the financial risks of excessive electricity resource capability, and the economic burdens placed on all consumers in either circumstance.

Long lead times are often required following a decision to add new generation capability to the system because sufficient time is needed to design, obtain approvals and permits, and construct the new facilities. The long-term load forecast aims to minimize the economic burdens placed on all consumers due to supply interruption risks caused by inadequate capacity and the financial risks of excessive electricity resource capability.

The majority of the province's generation capability is owned and operated by NLH. The NLH monitors the long-term demand and supply balance and schedules production and transmission for its own assets as well as accounting for those generation assets owned and operated by Newfoundland Power and Non-utility Generators (NUGs). NLH undertakes, within defined reliability criteria approved by the Board, to have resources in place to serve whatever requirement households, businesses and industries may simultaneously demand. As electricity cannot be withdrawn or rationed (except in emergency situations), producer supply is needed to meet simultaneous customer demand.

2.3.1.1 Current Environment

Provincial Economic Overview

Nalcor's long-term forecast used for planning purposes was generated in 2010, and therefore economic inputs from 2010 were used in Nalcor's feasibility analysis. These will be updated prior to Project sanction with the most recently available information. The Province of Newfoundland and Labrador is experiencing significant economic growth with strong gains in Gross Domestic Product (GDP), personal income and employment. According to the Canadian Mortgage Housing & Corporation, indicators of growth for 2011 include strong employment gains and solid growth in consumer spending activity. Economic growth has also come from the province's considerable infrastructure spending program (Canada Mortgage and Housing Corporation 2011, internet site).

In 2010, NL led the country in terms of employment growth. According to the provincial Department of Advanced Education and Skills, employment grew by 3.3 percent (%) from 2009 to 2010 - the highest level recorded for the province in the past 35 years. Comparatively, in Canada, employment grew by 1.4% between 2009 and 2010 (GNL 2011). The strong growth in employment led to a decline in the unemployment rate in 2010. The unemployment rate is expected to continue to trend downward and high levels of consumer confidence will continue to support consumer spending.

The province's Economic Review 2010 (published by the Department of Finance, November 2010) stated the continued strength of the provincial economy is contributing to net in-migration and an increase in the province's overall population. According to the Department of Finance, 2010 marked the second consecutive year of population growth after 16 years of decline. As of July 1, 2010, NL's population stood at 509,739, an increase of 0.3% compared to July 1, 2009 (GNL 2010). While the growth in GDP will vary due to the timelines of major projects and the production profile for oil, other economic indicators such as employment and income are expected to continue to increase because of broadly based economic activity in the province.

Employment incomes have been steadily rising throughout NL. Between 2002 and 2010, the average weekly wage rate for NL increased by 4.2% per year on a compound annual growth rate basis. This compares to the average annual inflation rate for the province of 2.0% for the same period, meaning people have more income to spend (GNL 2011).

Economic growth has continued through 2012. This growth has been largely driven by major project development, including construction on Vale Newfoundland and Labrador Ltd.'s (Vale) nickel processing facility. In addition, developments related to the province's offshore oil resources including the Hebron development, the White Rose expansion fields, and ongoing exploration activity are also contributing factors to the province's economic growth.

Operating Environment

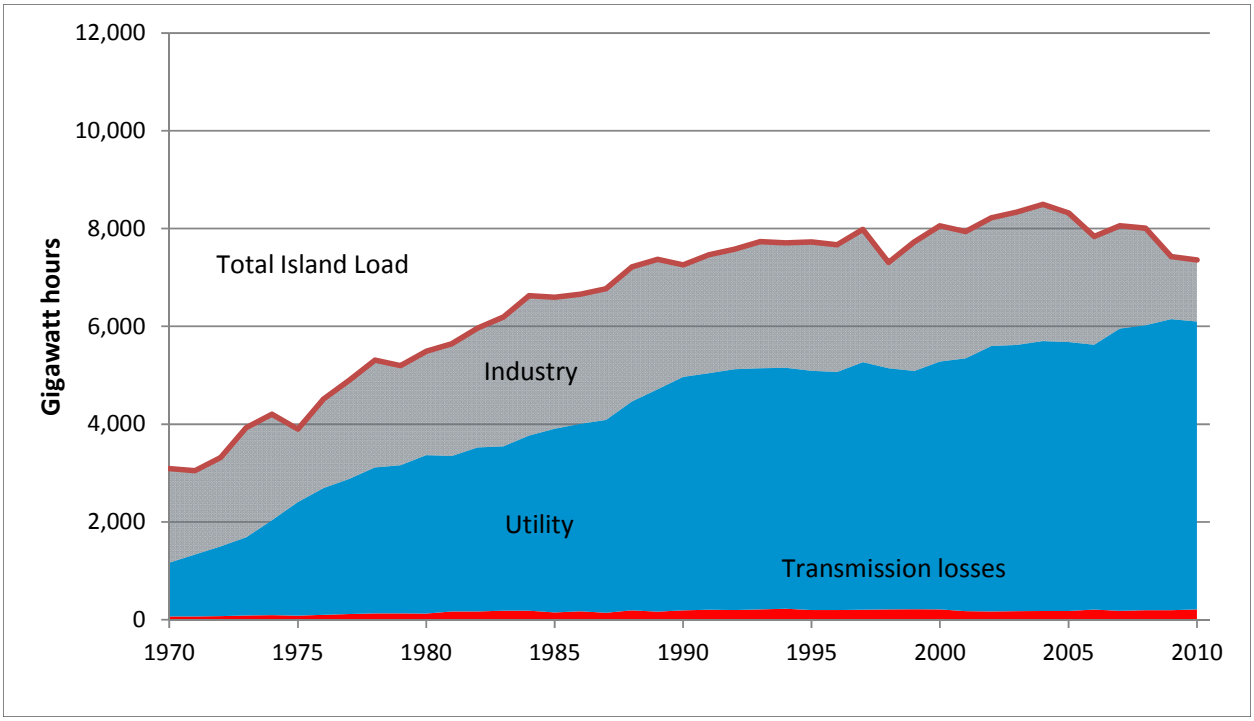
There are recognized challenges and unique characteristics in planning the generation and transmission of electricity in NL. These include low customer density, population migration to the Avalon Peninsula, varying electricity demand by season, topography and the isolation of the Island electricity grid.

For many utilities, the ability to access surplus power from neighbouring producers enables them to postpone investment decisions and rely on neighbouring jurisdictions for back-up generation capability in case of emergencies. For the Island system, NLH does not have the operating flexibility and investment advantages that are enjoyed by interconnected utilities. As a result, generation investment alternatives tend to be more limited and influenced by the lead time to construct new generation.

2.3.1.2 Historical Load Growth

The review of historical electrical load growth on the Island presented in this section provides background to the 2010 Planning Load Forecast (PLF). Figure 2.3.1-1 below shows total Island load from 1970 to 2010, including the breakout of utility and industrial customer load across the same time period. Utility load refers to the domestic and general service class load requirements for the service territories of Newfoundland Power and NLH Rural on the existing Island grid. The domestic class is primarily households, with the general service class comprised of commercial and light industrial accounts. Industrial load refers to the requirements for the Island's larger industrial customers directly served by NLH. It should be noted that although historical patterns are an input to NLH's load forecasting, they do not represent an absolute baseline for future forecasting.

Figure 2.3.1-1 Total Island Load (1970-2010)

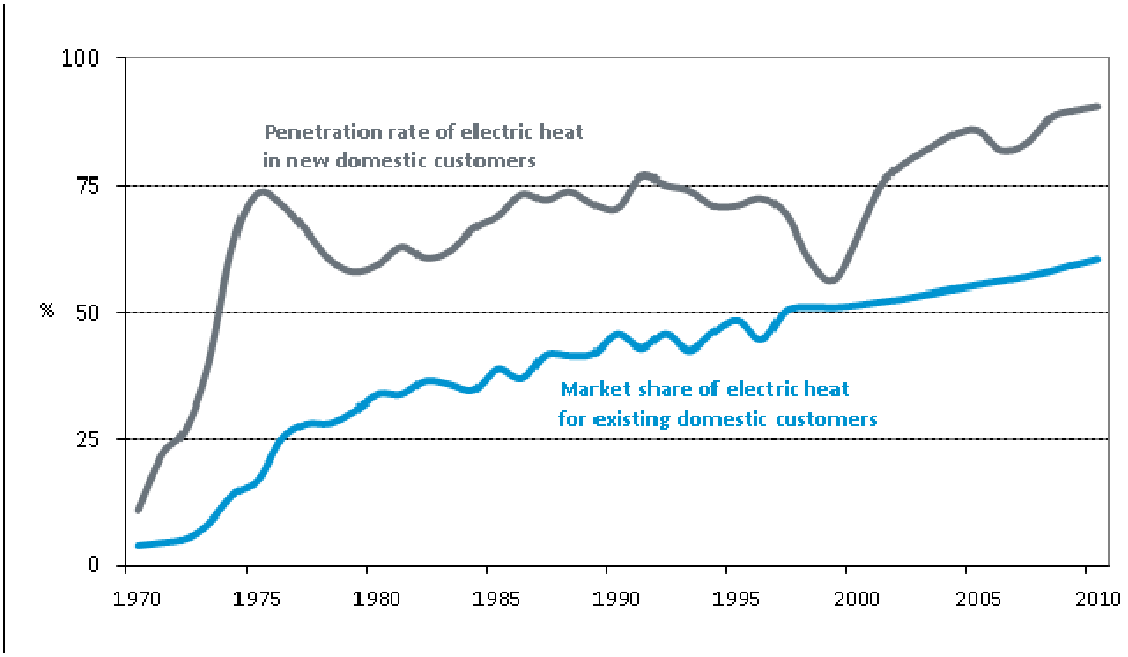


Source: Exhibit 58 (NLH 2011a, internet site).
NLH, System Planning.

Electricity Use From 1970 to 1990

The bulk power supply for the Island, and the Island-wide high voltage transmission network, was constructed and commissioned beginning around the mid 1960s. The years from 1970 to 1990 represent the period of most intensive load growth on the total Island Interconnected System with the compound average growth rate for the period being 4.4% per year. The breakout of this annual compound growth for total utility load was 7.5% per year, while for industrial it was 0.7% per year. In addition to it being a period of robust customer growth (expansion of the Island grid to include many rural communities also contributed), utility customers began adopting electric space and water heating in the majority of new homes and businesses. This was followed by conversions to electric heat in many existing houses. Development of the Island's electric power sector in the mid-1960s resulted in access to electric power supplies at competitive prices, which set the stage for electricity gains in a previously untapped market for home heating. This was subsequently accelerated by the “energy crisis" of the early 1970s when there was a sharp increase in the cost of oil. Over the course of a few years the penetration rate for electric heat in new home construction increased from less than 10% of new customers to about 70% and consistently remained in the 60 to 75% range, generally irrespective of short-term changes in alternative energy prices. Figure 2.3.1-2 presents the historical penetration rates for electric heat experienced in Newfoundland Power’s domestic customer additions and the resulting market share.

Figure 2.3.1-2 Residential Electric Heat Penetration and Market Share



Source: Exhibit 58 (NLH 2011a, internet site).
NLH, System Planning.

During the energy crisis periods in the 1970s, there were accelerated conversions of existing customer accounts from non-electric to electric space heating. Such conversion activity was largely at the expense of home heating fuel oil companies. By the end of 1989, the provincial market shares for electric space heating and hot water, as reported by Statistics Canada, stood at 42% and 82% respectively.

Within the same period, the presence of major residential household appliances such as electric stoves, clothes washers, clothes dryers and freezers, also increased. By the end of 1989, most standard household appliances could be found in the majority of households, with some nearing full market saturation. The automatic dishwasher had the most remaining growth potential as it was reported in less than 20% of households. The provincial saturation levels for electric heating and appliances as reported by Statistic's Canada are provided in Table 2.3.1-1.

Table 2.3.1-1 Provincial Saturation of Electric Appliance Equipment (% of all households)

Electric Equipment	1979	1989	1999	2009
Refrigerators	96%	98%	100%	100%
Cooking	71%	95%	98%	99%
Washers	39%[(a)]	67%[(a)]	93%	95%
Dryers	46%	69%	84%	93%
Freezers	61%	74%	81%	80%
Dishwasher	9%	20%	33%	49%
Hot Water	62%	82%	86%	89%
Space Heat	30%	42%	49%	63%

Source: Statistics Canada (1979-2009, internet site); Statistics Canada (1990).
(a) Saturation for automatic washers.

On the Island Interconnected System the 1970-1990 period started with three major industrial loads and ended the period with four. Across this period, industrial load increased due to the addition of a third newsprint mill on the Island, oil refining and the opening of the gold mine at Hope Brook. Most of this increased industrial load requirement across the period was offset near the end of the period with the closure of the elemental phosphorous plant at Long Harbour.

Electricity Use from 1990 to 2010

During this latter 20-year period, load growth was much less intensive than earlier with the compound annual growth rate for the total Island load at only 0.1% per year for the 20-year period. While the growth rate reflects the actual change in the total Island's interconnected load during that time, the particular important changes that occurred with the utility and industrial load components within this annual growth rate provide insight with respect to the specific trends of these two customer groups.

Following the closure of the paper mills in Stephenville and Grand Falls, as well as the paper machine shut-downs in Corner Brook, industrial load on the Island declined by 45%.

By contrast, the Island's utility load, which includes all residential, commercial and light industrial electricity use, grew by a compound annual growth rate of 1.1% (1.3% on a normalized weather basis) across the 20-year period. This represents adjusted utility sales to account for warmer or colder weather conditions for a given year compared to historical normal weather conditions. A noteworthy aspect of utility load in the 1990s was the virtually flat load growth that coincided with the structural changes within the provincial economy due to the fishery moratoria. Utility customer growth declined, and as oil prices had declined in the late 1990s, the penetration rate for electric space heat dropped to near 50%. By 2000, the initial large structural impacts of fishery adjustment were over and utility load growth began to rebound. Combined with an expanding provincial economy and an increase in global oil prices pushed the penetration rate for electric space heat to historically high levels. Utility growth in the 2000-2010 period was higher than in the previous decade and recorded a 1.5% annual compound growth rate (1.6% on a normalized weather basis). The market share for electric space heating now stands at more than double the share in 1979, reaching 63% in 2009.

2.3.1.3 Forecasting Methodology

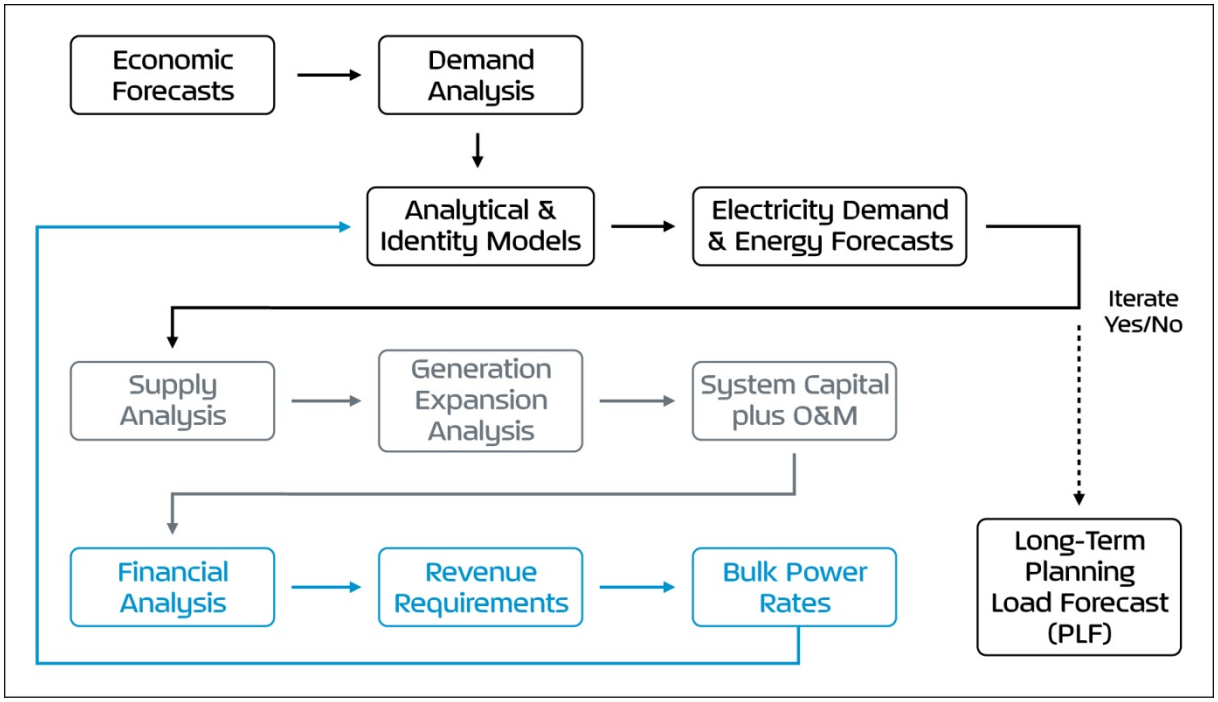
NLH normally completes one long-term load forecast analysis annually beginning in the last quarter of each year. The annual development of long-term load forecasts ensures, to the extent possible, that the constantly shifting set of inputs and parameters affecting the province's electricity demand are incorporated into current utility operating plans and investment intentions.

The load forecasting model utilized by NLH is an econometric based model used to project the Island's energy and peak demand requirements 20 years into the future. Across the historical period, typically from the late 1960s, the relationships between changes in electricity use and various economic measures are quantified using econometric techniques. This information forms the basis of expected demand levels in future periods, given a certain set of economic conditions. The statistical effort behind the load forecast is primarily directed at long-term forecasting for the utility component of the Island's total requirements, which is the load forecast for the combined service territories of Newfoundland Power and NLH Rural. Data sets and econometric equations, along with all other modeling parameters, are reviewed and updated annually. Once updated, the load forecast model builds up to a forecast of utility load by aggregating forecasts of domestic and general service retail rate classes.

Change in general service load is linked to change in provincial GDP and investment levels in commercial building stock, while domestic load changes are linked to average electricity consumption and customer levels. Domestic customer levels are primarily driven by housing starts while average consumption levels are predicated on the basis of changes to personal income, electric heat market share and price. Annual efficiency improvement is also a feature of the load forecast model and includes the energy conservation and technological changes to utility loads as measured from the historical data. Figure 2.3.1-3 details the work flow

and processes involved in completing a long-term load forecast cycle within NLH. Given the prevailing economic and industrial load outlook, this process leads to the demand, capital, operating cost and rate analysis.

Figure 2.3.1-3 Load Forecast Cycle



Source: Exhibit 27 (NLH 2010a, internet site).

To drive the electricity forecast model, a 20-year macroeconomic forecast for the provincial economy is received from the province's Department of Finance. The Department of Finance regularly prepares a five-year provincial macroeconomic forecast for their own purposes, using their own econometric model of the provincial economy. For NLH, the initial five-year period of the provincial macroeconomic forecast is aligned with the provincial government's own five-year economic forecast with an additional 15 years of macroeconomic data provided to meet NLH's requirements. The key load forecast inputs from the Department of Finance include projections of GDP, personal income levels, new housing units and population. Twenty-year projections for petroleum prices are prepared internally using information received from the PIRA Energy Group (PRIA), a consultancy from New York specializing in international energy pricing matters. These internally prepared petroleum prices provide inputs for NLH thermal generation production costing, and retail pricing in Island energy markets that form part of the economic inputs to the load forecast model.

For the large industrial customers directly served by NLH, direct input from those customers forms the basis for NLH's forecast of total industrial electric power requirements. Given the small industrial customer base, it would not be appropriate for NLH to forecast industrial requirements independent of the input provided by the industrial customers themselves.

Once updated, the load forecast model combines the residential and commercial components of utility load with direct industrial loads to derive the total Island Interconnected load, the level at which NLH undertakes system reliability, and the resource requirement analysis.

For the Muskrat Falls and Labrador-Island Transmission Link expansion analysis it was necessary to extend the standard 20-year long-term load forecast for an additional 38 years to coincide with the service life of the transmission link. Given the extended forecast period involved, it was considered prudent not to simply extend

the forecast by applying a fixed growth rate year over year to the 2029 Island load as this would result in compounding effects on load across the 38-year extended period. It was also recognized that the saturation of electric heat within the residential customer class would be reached, at an expected target of about 80%. Once the electric heat market was saturated, continued load growth would reflect an expected conservative level of continued economic growth within the provincial economy.

For the 2010 PLF, the Island load forecast was extended beyond the 20-year econometric forecast period, based initially on the average gigawatt hour (GWh) growth in energy for the last five years in the forecast. This is the period from 2024 to 2029. The annual GWh growth in energy was subsequently reduced in five to 10 year intervals to reflect the growing yet maturing market saturation for electricity in heating markets, while maintaining an annual load increment to reflect basic underlying provincial economic growth. The impacts of material reductions in future load expectations are addressed through discrete load sensitivity cases. Sensitivity analyses are discussed in Section 2.7.1.

2.3.1.4 Key Forecast Assumptions and Drivers

Table 2.3.1-2 presents the 2010 PLF growth rates for the primary drivers of residential, commercial and light industrial electricity sales for the Island Interconnected System. Some of the main factors that play a role in the economic forecast that underscore the long-term load forecast for the Island are:

- Oil production from Hebron begins in 2017 and is still producing in 2030 with oil production from existing projects declining over the forecast period.
- Improvements to ground fish stocks allowing increased landings over the forecast period but lower landings from existing levels of other species.
- Continued newsprint production at Corner Brook over the forecast period.
- The Vale nickel processing facility is constructed, with production of finished nickel from the facility beginning in 2013.
- The Come-by-Chance refinery continues to operate at current capacity over the forecast period.
- No provision for further large, unforeseen industrial load locating on the Island's power system in the forecast period has been included.

Table 2.3.1-2 Provincial Economic Indicators - 2010 Planning Load Forecast

Indicator	Historical	Forecast		
	1989-2009	2009-2014	2009-2019	2009-2029
Adjusted Real GDP at Market Prices[(a)] (% Change Per Year)	1.4%	1.5%	1.0%	0.9%
Real Disposable Income (% Change Per Year)	1.2%	1.5%	1.0%	0.9%
Average Housing Starts (Number Per Year)	2,333	2,575	2,400	2,135
End of Period Population ('000s)	509	515	510	507

Source: GNL, Department of Finance

(a) Adjusted GDP excludes income that will be earned by the non-resident owners of provincial resource developments to better reflect growth in economic activity that generates income for local residents.

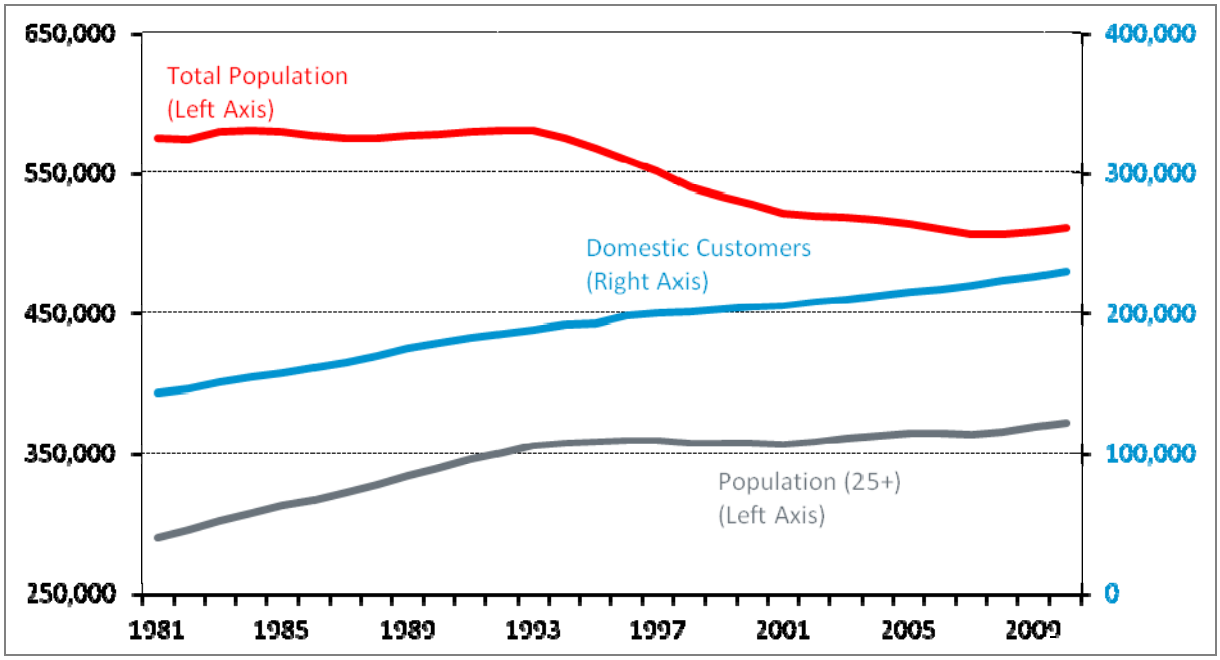
Sustained by the province's oil and nickel processing developments, economic growth to 2014 is forecast to be greater than in the previous 20-year period, contributing to growing utility sales. Economic growth is expected

to moderate once the current resource projects are in place with long-term growth at a somewhat lower growth rate than in the previous 20 years.

Table 2.3.1-2 indicates that population is forecast to increase in the near term and slowly decline out to the end of 2029. While this population trend appears to conflict with the province's outlook for continued housing starts, a closer look at historical provincial population data helps explain, to a large degree, why the provincial housing stock and associated domestic customer base continues to expand.

Figure 2.3.1-4 presents the historical provincial population and Island Interconnected domestic customer growth.

Figure 2.3.1-4 Provincial Population and Island Interconnected Domestic Customers



Source: GNL, Department of Finance.
Newfoundland Power, year-end customer data.
NLH (2011b).

As depicted in Figure 2.3.1-4, the number of domestic customers has continued to grow despite the province's declining population. This has occurred because household and customer formation are naturally more related to the subset of population that is 25 years and older. This is the age subset which predominantly forms households and drives the demand for housing. Changes in real personal income have also been historically linked to customer growth.

Table 2.3.1-3 presents the two key statistics that summarize the effects to the Island's electric heating market as forecast in the 2010 PLF.

The preference for electric space heating across residential and commercial customers continues to be an important source of load growth for the utility sector on the Island.

Table 2.3.1-3 Summary Statistics for Island Residential Electric Heat

	Historical	Forecast		
	1989-2009	2009-2014	2009-2019	2009-2029
Average Penetration Rate of Electric Heat in New Domestic Customers (% Per Year)	75%	86%	84%	86%
End of Period Electric Heat Market Share (%)	61.3%	63.1%	64.7%	68.2%

Source: Newfoundland Power, direct contact and year-end customer data.
Note: For Newfoundland Power Service Territory.

Conservation and Efficiency in Newfoundland and Labrador

Electricity conservation and efficiency programming in NL is delivered by the utilities through a joint utility effort. In 2007, NLH and Newfoundland Power commissioned Marbek Resource Consultants Limited (Marbek) to complete a Conservation and Demand Management (CDM) potential study (Marbek Resource Consultants Limited (Marbek) 2008) that provided analysis and information to assess the potential contribution of specific technologies and efficiency measures, identify ranges for achievable potential, and assist in identifying cost-effective conservation programs. The key CDM achievable estimates from the Marbek study are provided in Table 2.3.1-4.

Table 2.3.1-4 Achievable Energy Conservation Estimates

	Upper Achievable Estimate (GWh)	Lower Achievable Estimate (GWh)	Savings as a % of Base Year Consumption	
			Upper	Lower
Residential	439	236	14%	7%
Commercial	387	261	21%	14%
Industrial	125	59	9%	4%
Total	951	556	15%	9%

Source: Marbek (2008).

takeCHARGE is the joint utility energy efficiency marketing program developed and administered by NLH and Newfoundland Power through which CDM information and programs are delivered. The utilities plan and develop a common portfolio of rebate programs for residential and commercial customers, with each utility delivering the resulting programs to their own customers. In 2008, NLH and Newfoundland Power jointly filed a *Five-Year Energy Conservation Plan: 2008 – 2013* (NLH and Newfoundland Power 2008) with the Board, which outlined proposed energy conservation initiatives to be implemented including technologies, programs, support elements and cost estimates that promote a long-term goal of establishing a conservation and efficiency culture. The joint plan presented a target of 79 GWh per year in savings by the plan's final year in 2013. In addition to this effort, NLH has also launched its Industrial Energy Efficiency Program, providing customized approaches for energy savings for NLH's large direct industrial customers. Table 2.3.1-5 provides the conservation targets and savings achieved thus far.

Table 2.3.1-5 Energy Conservation Targets and Achievements

Sector	2009 Savings (GWh/year)		2010 Savings (GWh/year)	
	5 Year Plan Target	Actuals	5 Year Plan Target	Actuals
Residential	3.1	2.5	6.6	4.6
Commercial	0.7	0.2	1.7	0.7
Industrial	—	—	—	—
Total	3.8	2.7	8.3	5.3

Source: NLH (2011b).

To date, the response to CDM programs and initiatives has been modest and lagging targets. NLH has not explicitly incorporated these utility sponsored program savings targets into its PLF due to the uncertainty of achieving dependable firm outcomes. The annual efficiency gains measured in the load forecast models are forecast to continue to the end of the forecast period. NLH will re-assess what are reasonable assumptions to include regarding sponsored CDM savings over the longer term with each load forecast cycle. For the Isolated Island alternative, sensitivity analyses addressing the economic impact on generation planning of achieving an aggressive CDM target, at 750 GWh per year by 2031, along with a more moderate savings profile of 350 GWh have been included in Section 2.7.1.3. Nalcor has not directly considered a sensitivity case to gauge the impact of CDM on the Cumulative Present Worth (CPW) for the Interconnected Island alternative because, in such an instance, NLH would have opportunities to monetize any conserved energy through short term sales into regional export markets.

As a stand-alone option, CDM is not a reliable alternative and cannot meet the long term electricity demands for electricity consumers in NL. As indicated in Section 2.7.1, even an aggressive CDM target does not change the CPW preference for the Interconnected Island Alternative enabled by construction of the Project.

2.3.1.5 2010 Planning Load Forecast Load Growth

Across the 20-year forecast horizon, the results of the 2010 long-term PLF projects a period of overall load growth for the Island Interconnected system. The compound annual growth rate between 2009 and 2029 is 1.3%.

The growth rates in Table 2.3.1-6 indicate that growth in utility load, as forecast in the 2010 PLF, will be lower in the next 20 years than experienced in the previous 20-year period with decelerating growth post 2014. Forecast Island industrial load growth is solely related to the construction and operation of the Vale nickel processing facility and offsets much of the decline in industrial load experienced in the 1999 to 2009 period when the paper mills at Stephenville and Grand Falls-Windsor closed. The Island system growth rates reflect the combination of both utility and industrial loads. Figure 2.3.1-5 illustrates the forecast growth in electricity demand for the Island Interconnected System from 1990 to present and for the forecast period out to 2029.

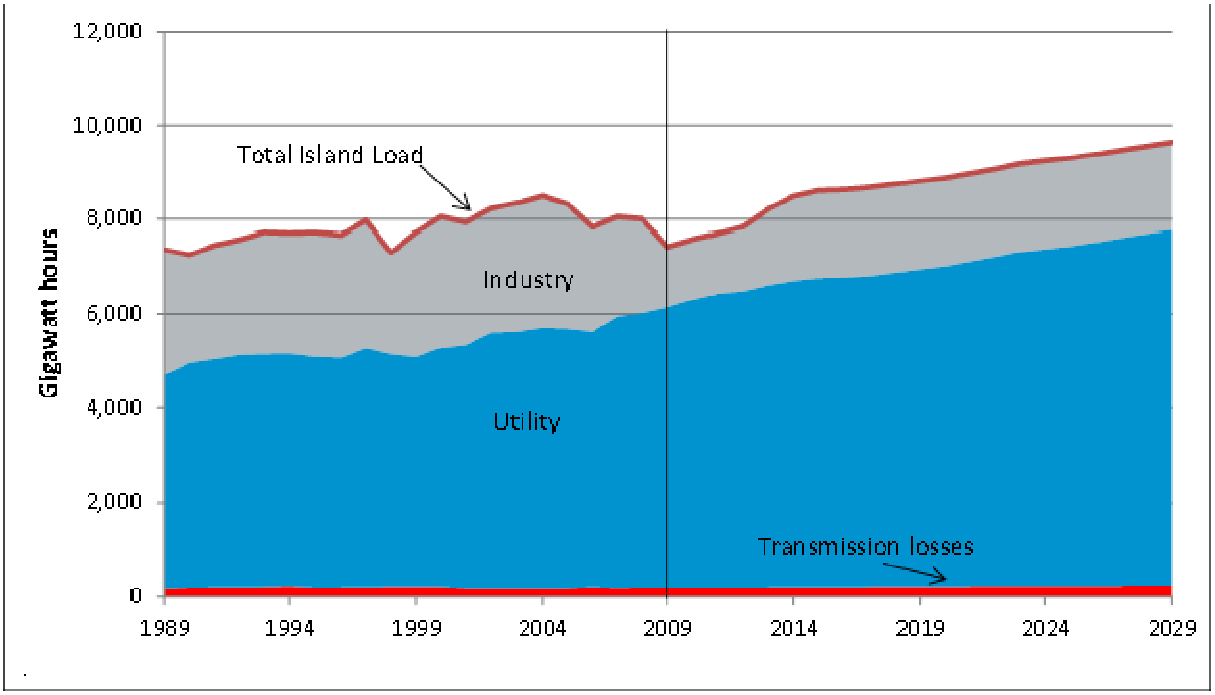
Table 2.3.1-6 2010 Planning Load Forecast Growth Rate Summary

Load Growth[(a)]	Historical	Forecast		
	1999-2009	2009-2014	2009-2019	2009-2029
Island Utility	2.0%	1.8%	1.2%	1.2%
Island Industrial	-7.0%	7.1%	3.8%	1.9%
Island System	-0.4%	2.7%	1.7%	1.3%

Source: Exhibit 27 (NLH 2010a, internet site).

[(a)] Compound annual growth rates based on actual, non-weather normalized energy consumption.

Figure 2.3.1-5 Total Island Load (1989-2029)



Source: NLH (2010a, internet site).

The long-term load forecast was prepared on the basis of a set of underlying assumptions that NLH considers to be conservative. The provincial economic forecast provided by the province's Department of Finance has moderate growth expectations for the 20-year forecast period and assumptions with respect to petroleum pricing are based on price projections provided by PIRA.

While the Island's electricity requirements have declined recently due to structural changes within international pulp and paper markets, by 2015 continued growth of the Island's utility demand, combined with the electricity requirements for Vale's nickel processing facility, will offset the decline experienced in Island load.

Due to the uncertainty of achieving dependable firm outcomes, NLH has not explicitly accounted for the energy efficiency savings targets associated with the takeCHARGE program. However, CDM will continue to be an important initiative for NLH and Newfoundland Power.

The long-term Interconnected Island energy and demand requirements stemming from the 2010 PLF are subsequently used in the next step of the system planning process employed by NLH, that being the assessment of the adequacy of existing generation capacity. Sensitivity analyses that address different Island load growth futures are discussed in Section 2.7.1.3.

2.3.2 Generation Planning Criteria

NLH has established criteria related to the appropriate reliability at the generation level for the Island's electricity system which sets the timing of generation source additions. These criteria establish the minimum level of capacity and energy installed in the system to ensure an adequate supply to meet consumer firm requirements at the designated level of reliability, as indicated below. As a decision rule for NLH's planning activities the following generation planning criteria have been adopted:

- *Capacity*: The Island Interconnected System should have sufficient generating capacity to satisfy a Loss of Load Hours (LOLH) expectation target of not more than 2.8 hours per year.

- *Energy*: The Island Interconnected System should have sufficient generating capability to supply all of its firm energy requirements with firm system capability.

NLH calculates its capacity using LOLH. LOLH is a probabilistic assessment of the risk that the electricity system will not be capable of serving the system's firm load for all hours of the year. For NLH, an LOLH expectation target of not more than 2.8 hours per year represents the inability to serve firm load for no more than 2.8 hours in a given year.

Firm capability for the hydroelectric resources is the firm energy capability of those resources under the most adverse three-year sequence of reservoir inflows occurring within the historical record. Firm capability for the thermal resources (Holyrood plant) is based on energy capability adjusted for maintenance and forced outages.

NLH determines the need for additional capacity on the power system to ensure reliability of supply in case of an unplanned failure to generating units or other generation related system assets. Adequate reserve means that if such failures occur, additional generation is available on the system to ensure that NLH can continue to deliver the power consumers require, at the designated level of reliability.

The process for determining reserve capacity is a common approach used in the utility industry and has been reviewed and accepted by the Public Utilities Board (PUB) (Quetta Inc. and Associates 1999).

Most utilities connected to the North American grid are members of a Regional Reliability Organization. All Regional Reliability Organizations in North America are under the jurisdiction of the North American Electric Reliability Corporation (NERC). NERC planning standards require each Regional Reliability Organization to conduct assessments of its resource and transmission adequacy. Consequently, many Regional Reliability Organizations have adopted an industry planning standard for generation reserve margins based on a loss of load duration, on a probabilistic basis, of one day every 10 years. This typically results in capacity reserve margins in the range of 15-20%, depending on the region. Canadian utilities / system operators that have interconnections with US counterparts are members of Regional Reliability Organizations, and as such, must follow the region's generation adequacy criteria as a minimum. The Regional Reliability Organization criterion of one day in 10 years is more stringent than NLH's LOLH of 2.8 hours per year which equates to about one day in every five years.

Most utilities in North America have interconnections to the North American grid over which they can share generation reserve with their neighbours. The isolated Island grid cannot depend on support from other utilities in times of emergency and therefore must supply all of its reserve. For NLH to apply an accepted reliability criteria of LOLH equivalent of one day in 10 years, additional generating capacity would have to be maintained, the cost of which would be included in NLH's rate base. For this reason a "one day in five year" criterion was adopted instead of the "one day in 10 years".

2.3.3 Transmission Planning Criteria

The development of least-cost technically viable transmission expansion plans to support the generation supply futures while adhering to a transmission planning criteria is an integral part of the electric power system planning process. The technical analysis required to develop viable transmission expansion plans utilizes the industry accepted standard for transmission planning software, *PSS®E* by Siemens PTI. *PSS®E* enables the transmission planner to perform steady state, short circuit and stability analyses on the transmission system to determine when established transmission planning criteria are violated and to test potential solutions to ensure the criteria are met in the future.

NLH follows traditional transmission planning practices similar to those found in the transmission planning standards for NERC. NLH's existing transmission planning criteria are summarized as follows:

- NLH's bulk transmission system is planned to be capable of sustaining the single contingency loss of any transmission element without loss of system stability. In the event a transmission element is out of service, power flow in all other elements of the power system should be at or below normal rating.
- The NLH system is planned to be able to sustain a successful single pole reclose for a line to ground fault based on the premise that all system generation is available.
- Transformer additions at all major terminal stations (i.e., two or more transformers per voltage class) are planned on the basis of being able to withstand the loss of the largest unit.
- For single transformer stations there is a back-up plan in place which utilizes NLH's and / or Newfoundland Power's mobile equipment to restore service.
- For normal operations, the system is planned on the basis that all voltages be maintained between 95% and 105%.
- For contingency or emergency situations voltages between 90% and 110% are considered acceptable.

The established NLH transmission planning criteria includes the requirement that for loss of a transmission line or power transformer that there be no loss of load. Given the Island Interconnected Transmission System is electrically isolated from the North American grid, NLH transmission planning standards permit under frequency load shedding for loss of a generator. The provision of sufficient spinning reserve and increased system inertia for a loss of generation would be difficult to achieve and cost prohibitive for the Island's relatively small rate base.

While the loss of a generator results in temporary loss of load through the under frequency load shedding scheme, the transmission planning process for the Island grid considers the fact that the generator outage may be long-term, requiring the start-up of standby generation including the combustion turbines added by the generation planning process to meet the LOLH target. With the permanent generator outage and start-up of stand by generation, the transmission planning process must ensure there is sufficient transmission capacity to supply all load, including the load temporarily shed during the initial generator contingency.

2.3.4 System Capability

NLH operates an interconnected generation and transmission system, or grid, on the Island portion of the province. The Island grid is isolated from the interconnected North American grid and, as a result, must be self-sufficient with respect to generation supply and transmission capability.

2.3.4.1 Island Grid Generation

NLH operates six hydroelectric generating stations, three mini-hydroelectric generating stations, one oil fired thermal generating station, three combustion turbines and two diesel plants on the Island interconnected electricity grid. At 592 MW of installed capacity, the Bay d'Espoir Generating Station is the largest hydroelectric plant on the Island. Combined with hydroelectric plants upstream at Upper Salmon and Granite Canal, the Bay d'Espoir reservoir system has an installed capacity of 717 MW and a firm energy capability of 2,955 GWh annually. Hydroelectric plants at Cat Arm, Hinds Lake and Paradise River, along with mini-hydro plants at Roddickton, Snook's Arm and Venom's Bight bring NLH's hydroelectric generating capacity on the Island to 927.3 MW with a firm energy capability to 3,961 GWh annually. The 466 MW (net) oil fired thermal Holyrood plant located in the municipality of Holyrood has a firm energy capability of 2,996 GWh annually. The Holyrood plant plays an essential role in the Island's power system in providing critical firm supply as it represents approximately one third of NLH's existing generating capability. The plant is required to supply the Island system peak load requirements from October to May with the number of units operating varying with the amount of customer demand in each month. All three units normally operate during the highest demand

months of December to March. The total energy production and the plant operating factor can vary greatly from year to year depending primarily on the amount of hydraulic production during the year, weather conditions impacting utility load, and by industrial production requirements.

Table 2.3.4-1 provides an overview of the historical production and fuel related statistics for the Holyrood plant since 2000.

Table 2.3.4-1 Holyrood Plant Thermal Production and Heavy Fuel Oil Consumption

Year	Net Production (GWh)	Heavy Fuel Oil (Millions Barrels)	Operating Factor (%)	Annual Fuel Cost ($ Millions)	Holyrood Plant Fuel Expense as a % of Island Revenue Requirement
2000	970.3	1.60	24%	49.4	19%
2001	2,098.5	3.32	51%	98.5	32%
2002	2,385.3	3.68	58%	112.5	36%
2003	1,952.0	3.07	48%	114.8	36%
2004	1,647.6	2.61	40%	80.8	26%
2005	1,328.6	2.14	33%	80.3	26%
2006	740.3	1.26	18%	63.5	22%
2007	1,255.6	2.04	31%	107.4	31%
2008	1,080.2	1.73	26%	123.7	34%
2009	939.9	1.53	23%	80.6	24%
2010	803.1	1.36	20%	100.6	29%

Source: NLH, *General Ledger Annual Bunker Summary.*
NLH, Rates Department.

The recent shutdown of Abitibi's two newsprint mills on the Island, and cutbacks at Corner Brook Pulp and Paper, has resulted in a decline in the total Island energy requirements. This has resulted in a reduction in the quantity of energy produced from the Holyrood plant. However, going forward, almost all incremental load growth, and in particular the addition of Vale's large industrial load for its nickel processing facility in Long Harbour will cause output at the Holyrood plant to materially increase to previous historical levels, and beyond. The Long Harbour facility will, itself, require the consumption of about an additional one million barrels of heavy fuel oil at the Holyrood plant each and every year.

As a thermal electric production facility using heavy fuel oil, the Holyrood plant is a large source of atmospheric pollution emissions in the province. Atmospheric pollution emissions at the Holyrood plant vary with production. As energy production increases for the reasons outlined above, atmospheric emissions will increase. Table 2.3.4-2 provides the emissions at the Holyrood plant since 2000.

Table 2.3.4-2 Atmospheric Emissions at the Holyrood Generating Station (tonnes)

Year	Carbon Dioxide (CO_2)	Sulphur Dioxide (SO_2)	Nitrous Oxide (NO_x)	Particulate Matter (PM)
2000	799,546	10,268	1,733	988
2001	1,636,930	20,784	3,893	2,059
2002	1,817,499	23,235	4,553	2,294
2003	1,518,955	19,551	3,805	1,918
2004	1,290,828	16,819	3,239	780
2005	1,062,231	13,648	2,792	1,374
2006	625,084	5,370	1,710	564
2007	1,012,280	6,234	2,489	551
2008	861,891	4,880	2,077	345
2009	769,209	3,937	1,819	211
2010	677,729	2,994	1,648	216

Source: NLH, Annual Air Emissions Report.

Note: Since 2006 lower emissions have been related to the use of lower sulphur fuel oil in addition to reduced output.

In addition to its own generating capability, NLH has power purchase agreements (PPAs) with a number of NUGs including two 27 MW wind farms. The combined capability of these PPAs is 178.8 MW with a firm energy capability of 879 GWh annually.

Both Newfoundland Power and Corner Brook Pulp and Paper have generating facilities on the Isolated Island System which total 261.5 MW with a firm energy capability of 1,117 GWh annually.

Island Grid Generation Capability

The total interconnected generation capability from all sources on the existing Isolated Island System is 1,958 MW with a firm and average energy capability of 8,953 GWh and 9,843, respectively. Table 2.3.4-3 provides a listing of the Island's generation capability.

Table 2.3.4-3 Island Grid Generation Capability

Existing Island Grid	Net Capacity (MW)	Firm Energy (GWh)	Average Energy (GWh)
NLH Hydroelectric	927	3,961	4,510
NLH Thermal	590	2,996	2,996
Newfoundland Power	140	324	428
Corner Brook Pulp and Paper	121	793	879
Star Lake - Exploits	106	634	761
Non Utility Generators	73	245	269
Total Existing	1,958	8,953	9,843

Source: Exhibit 16 (NLH 2010b, internet site).

2.3.4.2 Island Grid Transmission

NLH has a total of 54 high voltage terminal stations and 3,473 km of high voltage transmission lines operating at voltage levels of 230 kilovolts (kV), 138 kV, and 66/69 kV connecting generating stations to NLH customers including Newfoundland Power, industrial customers and NLH's own rural distribution customers.

NLH's largest bulk transmission system on the Island grid consists of 1,608 km of 230 kV transmission line stretching from Stephenville in the west to St. John's in the east, connecting generating stations with major load centres. Below the 230 kV system, NLH operates a 138 kV transmission loop between Deer Lake and Stony Brook (near Grand Falls-Windsor) and delivers power and energy to Newfoundland Power at Stony Brook, Sunnyside, Western Avalon and Holyrood for its Stony Brook to Sunnyside and Western Avalon to Holyrood 138 kV loops. These 138 kV loops, connected between two points on the 230 kV bulk system, provide power to geographic regions where the total load of the connected communities fall in the 75 MW to 225 MW range.

Beyond the 138 kV loops, NLH operates a number of radial transmission lines at 138 kV and 66/69 kV voltage levels to supply more rural and smaller industrial loads that are remote for the 230 kV bulk system, such as customers on the Great Northern Peninsula, the Connaigre Peninsula, White Bay and the Duck Pond Mine. Generally, the loads on the NLH radial systems are in the five MW to 35 MW range.

At the NLH customer level, Newfoundland Power operates a number of 138 kV and 66 kV transmission lines within the Island grid. Newfoundland Power lines are generally used to connect NLH bulk delivery points to Newfoundland Power customers and generating stations.

Corner Brook Pulp and Paper operates a 66 kV transmission system between its hydroelectric facilities at Deer Lake and Watson's Brook and the mill in Corner Brook.

2.3.5 Transmission Reliability

Having identified the least-cost generation expansion plans for both the Isolated Island alternative and the Interconnected Island alternative, and completed the CPW analysis to determine the least-cost generation expansion alternative for the Island system, an analysis of the potential effect the preferred 900 MW High Voltage direct current (HVdc) interconnection between Labrador and the Island will have on transmission system reliability is warranted. This section assesses transmission system reliability for the Isolated Island alternative, the Interconnected Island alternative and the Interconnected Island alternative with the Maritime Link in terms of level of exposure, measured as availability of energy supply, and level of unsupplied energy for a significant transmission system outage.

2.3.5.1 Reliability Assessment

System reliability issues are discussed in *Technical Note: Labrador-Island HVdc Link and Island Interconnected System Reliability* (NLH 2011c, internet site), NLH's *Transmission Planning Manual* (NLH 2009) and *Island Transmission System Outlook* Report (NLH 2010c, internet site). The following paragraphs provide a synopsis of these documents.

Both the Isolated Island and Interconnection Island alternatives were tested for compliance against NLH's accepted generation planning and transmission planning criteria. These planning criteria adhere to industry accepted practice and compliance with them assures a level of reliability that is at least consistent with historical experience.

Within any electrical system there are always low probability, high consequence events that could result in violation of criteria and the subsequent inability to fully supply customer load. Because of the low probability of occurrence, and the often high cost of mitigating the occurrence, utilities accept the risk and develop response plans to react should the low probability event occur. In the NLH system there are low probability events in the existing system, in the future Isolated Island Expansion Plan, and in the Interconnected Island Expansion Plan that, should they occur, fall into this category. Analysis has been completed to assess the

current day level of risk and exposure in comparison to the risks and exposures associated with future Island Isolated and Island Interconnected expansion plans as a basis to determine whether further mitigation is required.

For the current Island System, the loss of the 230 kV Transmission Line (TL) 202/206 transmission corridor between Bay d'Espoir and Sunnyside is an accepted risk that could, if it happened at certain times of the year, result in an inability to supply full load. Nalcor's analysis indicates that for the system in 2012, the probability of this loss occurring at a time that will result in load curtailment is approximately 2%. The expected level of load curtailment during the event would be between 0 and 80,000 megawatt hours (MWh) depending on what time of year the outage occurs (based on assumptions in the Technical Note). This is representative of the level of risk and exposure that has been present on the Island System for many years. The Technical Note also indicates that for the Isolated Island future, both the probability of occurrence and the maximum exposure associated with this event improve, particularly as more generating capacity is added to the Avalon Peninsula (simple cycle combustion turbine (CT) power plant and combined cycle combustion turbine (CCCT) power plant) and the 230 kV transmission line between Bay d'Espoir and Western Avalon is constructed.

The addition of a 900 MW HVdc transmission line between Muskrat Falls in Labrador and Soldiers Pond on the Island portion of the province has raised questions regarding the effect that such a change will have on the reliability of the Interconnected Island System. The Technical Note also presents a detailed assessment of the reliability implications for the link and determines that a bipole transmission failure resulting in the loss of 900 MW of supply results in risk and exposure numbers at least comparable to those for the TL 202/206 loss in the existing system. While the probability of an occurrence resulting in curtailment of customer load is lower (0.15% to 0.65%) when compared to 2% in the current case, the level of load curtailment could be between 0 and 94,000 MWh by 2036 and declining thereafter.

The Technical Note also discusses the proposed Maritime Link between the Island of Newfoundland and Nova Scotia and the effect this addition would have on system reliability. The analysis demonstrates that the Maritime Link improves the Island Interconnected System reliability. For the case of the loss of the 900 MW supply from Labrador, the probability that this event would result in curtailment of load is reduced to less than 0.1%, and the level of curtailment to between 0 and 16,000 MWh.

Table 2.3.5-1 summarizes the exposure levels and unsupplied energy for the Isolated Island, Interconnected and Interconnected with Maritime Link Scenarios.

The probability of a transmission line failure that results in the inability to supply all customer load is dependent, in part, on the mechanical design of the transmission line itself. Transmission line design methods today consider the meteorological loadings (wind and ice) along the transmission line route, the return periods of weather events, the transmission line materials (wood, steel), and utilize reliability based methods to provide a coordinated transmission line design with known failure rates and modes for expected meteorological conditions. At a high level, a 1:50 year return period for a weather event means that one can expect the design load to occur at least once in 50 years. The probability of the 1:50 year storm occurring in any one year is 2%. Based on NLH's experience with weather related damage to existing 230 kV transmission lines on the Avalon Peninsula, analysis was conducted to determine the return periods of the various storms. The results of the analysis, *Reliability Study of Transmission Lines on the Avalon and Connaigre Peninsulas* (NLH 1996, internet site) filed as Exhibit 85 provides details on the subject. Basic outcomes from this study include the identification of the 1:50 year return period load levels, the design return periods for existing 230 kV transmission lines, and NLH's decision to use the 1:50 year return period loads for all new 230 kV transmission line construction on the Avalon Peninsula.

Table 2.3.5-1 Level of Exposure and Unsupplied Energy

Year	Load Forecast		Island Standby Generation (MW)	Level of Exposure Load Exceeds Generation		Availability (%)	Unsupplied Energy Worst 2 Week Window	
	MW	GWh		Annual Hours	Annual %		MWh	% of Annual
Isolated Island – TL 202/206 Outage								
2012	1,571	7,850	635.1	4,318	49.29	98.02	79,969	1.02
2017	1,704	8,666	965.2[(a)]	865	9.87	99.605	13,435	0.16
2021	1,757	8,967	965.2	1,206	13.67	99.449	19,838	0.22
2022	1,776	9,065	1,085.2[(b)]	200	2.28	99.909	2,622	0.029
2027	1,856	9,464	1,185.2[(c)]	50	0.57	99.977	553	0.006
2032	1,934	9,860	1,235.2[(d)]	0	0	100.0	0	0
2037	2,006	10,228	1,277.7[(e)]	58	0.66	99.974	649	0.006
Island Interconnected – Bipole Outage								
2017	1,704	8,666	1,468.5	637	7.27	99.854	14,384	0.16
2022	1,776	9,065	1,418.5[(f)]	1,431	16.34	99.673	37,019	0.40
2027	1,856	9,464	1,368.5[(g)]	2,279	26.02	99.480	66,883	0.70
2032	1,934	9,860	1,368.5	2,691	30.72	99.386	85,888	0.87
2036	1,992	10,157	1,391.5[(h)]	2,831	32.32	99.354	93,744	0.92
2037	2,006	10,228	1,561.5[(i)]	1,683	19.21	99.616	50,900	0.498
Island Interconnected – Bipole Outage – Maritime Link In Service								
2017	1,704	8,666	1,768.5	0	0	100.0	0	0
2022	1,776	9,065	1,718.5[(f)]	19	0.22	99.996	389	0.004
2027	1,856	9,464	1,668.5[(g)]	281	3.20	99.936	6,019	0.064
2032	1,934	9,860	1,668.5	626	7.14	99.986	15,765	0.160
2037	2,006	10,228	1,861.5[(h)(i)]	118	1.34	99.973	2,342	0.022

Source: Exhibit 106 (NLH 2011c, internet site).

(a) 230 kV transmission line Bay d'Espoir to Western Avalon is built prior to 2017 increasing transfer to east coast for loss of TL 202 and TL 206.

(b) 170 MW CCCT in 2022 at Holyrood and Hardwoods 50 MW CT retired in 2022.

(c) 50 MW CT in 2024 and 50 MW CT in 2027 both assumed on Avalon Peninsula.

(d) 50 MW CT in 2030.

(e) Holyrood units replaced with 170 MW CCCT (1&2 in 2033 + 3 in 2036).

(f) Hardwoods 50 MW CT retired in 2022.

(g) Stephenville 50 MW CT retired in 2024.

(h) 23 MW Portland Creek in 2036.

(i) 170 MW CCCT in 2037.

Given reliability-based designs ranging from a 1:10 year return period for existing wood pole lines, to a 1:25 year return period for rebuilt steel lines on the Avalon and a 1:50 year return period for the proposed Bay

d'Espoir to Western Avalon 230 kV transmission line, NLH adopted the 1:50 year return period as the basis of design for the HVdc transmission line between Labrador and the Island portion of the province.

In the context of the analysis completed in the Technical Note on reliability, increasing the return period of the HVdc transmission line design from 1:50 years to, say 1:150 years, would reduce the probability of the occurrence of the event resulting in inability to supply all customer load. For the Interconnected Island alternative with a 1:50 year return period design for the HVdc line the probability of occurrence is 0.15% to 0.65% (availability 99.35% to 99.85%). If the HVdc line return period were increased to 1:150 years, the probability of occurrence of the event resulting in inability to supply all customer load would be 0.04% to 0.22% (availability 99.78% to 99.95%). However, the level of load curtailment (i.e., quantity of unsupplied energy during the two-week anticipated repair interval after an event), should the event occur, would not change with the change in design return period. In other words, increasing the return period of the line design reduces the probability of a failure for a given storm, but when the line failure happens the same number of customers will be without electricity. In essence, increasing the return period of the line design alone solves only one aspect of the exposure to Island customers for loss of the Labrador–Island Transmission Link.

A comparison of the exposure levels and unsupplied energy between the Interconnected Island alternative and the Interconnected Island with Maritime Link alternative, as shown in Table 2.3.5-1, highlights the reductions in unsupplied energy that can be attributed to the additional 300 MW of capacity available via the Maritime Link following the outage to the Labrador-Island Transmission Link. Although the Maritime Link is nominally rated at 500 MW, import capacity from New Brunswick into Nova Scotia is currently limited to 300 MW. In both the Interconnected Island and the Interconnected Island with Maritime Link alternatives, the Labrador-Island Transmission Link is built to a 1:50 year return period. The availability of a 300 MW import to the Island via the Maritime Link reduces the level of curtailment from 0 – 94,000 MWh to 0 – 16,000 MWh. In other words, the fact that the Maritime Link provides an alternate path for capacity and energy following and outage to the Labrador–Island Transmission Link, the probability of unsupplied energy is reduced and the expected level of unsupplied energy is reduced to less than 20% of what would otherwise be expected without the Maritime Link. This translates to fewer customers being without electricity for a shorter period of time during the outage.

The analysis provided in the Technical Note demonstrates the effect that adding 50 MW CTs in the Interconnected Island alternative has on the exposure levels (the probability of an outage) and unsupplied energy (the amount of energy that will not be supplied as a result of the outage). This section of the Technical Note on reliability provides a useful tool in assessing system additions to meet a predefined target. For example, if one were to assume a desired reliability level based upon an availability value of 99.5% and an unsupplied energy not to exceed 35,000 MWh for a two week outage window, one can determine the number and timing of 50 MW CTs required to maintain the criteria. As an example (not meant to be taken as a recommendation) the number and timing of 50 MW CTs could be as per Table 6 in Exhibit 106:

- 2022: 1 x 50 MW CT for availability of 99.76% and unsupplied energy of 27,000 MWh;
- 2027: 2 x 50 MW CT for availability of 99.82% and unsupplied energy of 31,000 MWh; and
- 2032: availability of 99.71% and unsupplied energy of 35,000 MWh – new CT in 2033.

The analysis indicates that reduction in unsupplied energy due to loss of the HVdc transmission line in the Interconnected Island alternative is better managed through the addition of 50 MW CTs as required to meet the curtailment target, rather than through investments in increasing the HVdc line design return period beyond the existing 1:50 years carried in the basis of design.

Continued operation of the HVdc converter station at Soldiers Pond requires that the underlying 230 kV ac transmission system on the Island remains relatively intact. Analysis has been conducted using *PSS®E* to ensure successful operation following loss of a single 230 kV transmission line. Given that the 230 kV transmission system has been designed with equivalent return periods on the order of 1:10 years for wood pole lines, 1:25 years for rebuilt steel lines and 1:50 years for new 230 kV transmission lines, building the HVdc line to a

design load beyond 1:50 years is viewed as ineffective. Assuming a major storm with a return period in excess of 1:50 years, one can expect damage to most, if not all, 230 kV transmission lines. Building the HVdc line to withstand the 1:100 year storm, for example, would mean that the only transmission line remaining in service would be the HVdc line. Without the support of the underlying 230 kV ac transmission system the HVdc converter station would not be able to function, nor deliver energy to customers.

Based upon the reliability analysis, NLH sees no compelling reason to move away from a 1:50 year return period for the HVdc line design. In the absence of the Maritime Link, the addition of 50 MW CTs is the most effective means to limit exposure and unsupplied energy / load curtailment for the low probability, high consequence event. With alignment on the limit of exposure, 50 MW CT additions can be added to the Island Interconnected System expansion plan to satisfy the criteria.

2.3.5.2 Transmission Reliability Summary

In conclusion, the reliability analysis demonstrates that the Interconnected Island alternative with the Labrador–Island Transmission Link designed for a 1:50 year return period will have a reliability level similar to that of the existing Isolated Island System on measures of probability of exposure and unsupplied energy during the outage. Further, the addition of the Maritime Link or 50 MW CTs to the Interconnected Island alternative are effective in reducing both the probability of exposure to an outage and the level of unsupplied energy during the outage.

Based on the results of the transmission reliability analysis Nalcor is recommending that the Labrador–Island Transmission Link overhead line design be based on a 1:50 year return period. This level of line design provides for an Interconnected Island alternative having a probability of exposure to an outage and a level of unsupplied energy during an outage similar to that of the Isolated Island system today. Therefore, Nalcor sees no justification in increased capital expenditures on additional CTs and is therefore recommending no additional CTs at this time.

2.3.6 Identification of Need for Transmission

As part of the regular system planning process, NLH completes a review of the transmission system to assess its adequacy. The Island Transmission System Outlook Report (NLH 2010c, internet site) provides an overview of the transmission system requirements in the five to 10 year time frame. Given the identified need for new generation supply in the near term, the report offers the following important transmission issues that must be considered when new generation sources are added to the Island system:

- the 230 kV transmission system east of Bay d'Espoir is both thermally and voltage constrained with respect to increasing power deliveries to the Avalon Peninsula load centre;
- new generation sites off the Avalon Peninsula will require additional 230 kV transmission line reinforcement along the Bay d'Espoir to St John's corridor; and
- the 230 kV transmission system west of Bay d'Espoir experiences high voltage levels during the year, which may affect generator ratings for new generation sources in this part of the system.

Following development of generation expansion plans through the generation planning process, the transmission system effects of the proposed generation sites can be more fully assessed and transmission system additions more fully defined.

2.3.7 System Capability versus Load Forecast

Table 2.3.7-1 provides a summary of the 2010 PLF electric power and energy requirements for the system period 2010 to 2029 compared against supply capacity and firm capability to determine the timing and need for new generation resources. For the Isolated Island System, capacity deficits commence in 2015, with firm energy deficits commencing in 2021 (both of which are illustrated by the shaded cells in Table 2.3.7-1). Capacity deficits trigger the need for the next generation source by 2015.

Table 2.3.7-1 Capacity and Energy Balance and Deficits for 2010 Planning Load Forecast (2010-2029)

Year	Island Load Forecast		Existing System		LOLH (hr/year) (limit: 2.8)	Energy Balance (GWh)
	Maximum Demand (MW)	Firm Energy (GWh)	Installed Net Capacity (MW)	Firm Capability (GWh)		
2010	1,519	7,585	1,958	8,953	0.15	1,368
2011	1,538	7,709	1,958	8,953	0.22	1,244
2012	1,571	7,849	1,958	8,953	0.41	1,104
2013	1,601	8,211	1,958	8,953	0.84	742
2014	1,666	8,485	1,958	8,953	2.52	468
2015	1,683	8,606	1,958	8,953	3.41	347
2016	1,695	8,623	1,958	8,953	3.91	330
2017	1,704	8,663	1,958	8,953	4.55	290
2018	1,714	8,732	1,958	8,953	5.38	221
2019	1,729	8,803	1,958	8,953	6.70	150
2020	1,744	8,869	1,958	8,953	8.05	84
2021	1,757	8,965	1,958	8,953	10.14	(12)
2022	1,776	9,062	1,958	8,953	13.05	(109)
2023	1,794	9,169	1,958	8,953	16.75	(216)
2024	1,813	9,232	1,958	8,953	19.94	(279)
2025	1,827	9,290	1,958	8,953	25.76	(337)
2026	1,840	9,372	1,958	8,953	29.92	(419)
2027	1,856	9,461	1,958	8,953	35.57	(508)
2028	1,872	9,543	1,958	8,953	42.35	(590)
2029	1,888	9,623	1,958	8,953	50.71	(670)

Source: Exhibit 16 (NLH 2010b, internet site).

Without new supply, by 2015 demand will increase to a point where additional generation is required to maintain an appropriate generation reserve for the forecast peak demand. Otherwise NLH's reserve capacity will have fallen below the established minimum level standard of 2.8 LOLH to ensure a continuing reliable supply of electricity to meet electricity demand on the Island in the event of system contingencies. In other words, without additional generation in 2015 one of NLH's generation planning criteria will be violated.

As load continues to grow, the Island will experience an energy deficit by 2021 if no additional generation capability is added. This deficit will occur when the Island's overall electricity requirements exceed the combined firm energy capability of NLH's thermal and hydroelectric generation plants.

Adding additional capacity at existing hydroelectric facilities will not address this energy shortfall, as energy production at existing plants is limited by available precipitation, not the capacity of the plants.

2.3.8 Justification in Energy Terms - Summary

Based on NLH's load forecasting processes, peak demand is expected to surpass firm generation capacity on the Newfoundland electrical system by the end of 2015, and an energy deficit is forecast by 2021. Additional capacity and energy supplies will be required to avoid violation of NLH's generation planning criteria.

Following a review of generation and transmission planning criteria, the *Strategist®* modelling framework, and the existing Island grid's generation capability, a need for new generation supply has been identified for capacity and energy in 2015 and 2021, respectively. Given the need for generation additions, the Island Transmission System Outlook Report identifies potential areas of concern that must be addressed under the transmission planning criteria once the generation expansion plans are developed.

A decision was made in 2010 as to what new generation source would be selected to allow sufficient time to bring generation and related infrastructure on line in time (see Section 2.10).

2.4 Economic Analysis of the Project

Having established an energy and capacity shortfall, the next step in the planning process is to develop the least-cost generation expansion plan to meet the forecast requirements. In order to establish the economic justification for the Project, Nalcor developed the optimum expansion plan without the Project using a portfolio of renewable and thermal alternatives and the optimum expansion with the Project and also energy supplied from Labrador developments.

This section also explains the methodology used to evaluate the two generation expansion plans from an economic perspective. It includes a discussion of the thresholds for economic viability and presents the results of the analysis, including a sensitivity analysis which demonstrates how changes in the underlying assumptions affect the results.

2.4.1 Economic Evaluation Methodology

Having determined a need for new sources of electricity, the next step in NLH's system planning process involves the determination of the least-cost option for the supply of electricity to its customers. An important tool in this analysis is a software tool called *Ventyx Strategist®*. It is an integrated, strategic planning computer model that performs, amongst other functions, generation system reliability analysis, projection of costs simulation and generation expansion planning analysis. *Strategist®* is used by many utilities throughout the industry and has broad acceptance by regulatory bodies.

The software can analyze and plan the generation requirements of the system for a given load forecast and for specific parameters as identified by the utility that can include resource limitations, fuel prices, capital costs and operating and maintenance costs. *Strategist®* evaluates all of the various combinations of resources and produces a number of generation expansion plans, including the least-cost plan, to supply the load forecast within the context of the power system reliability criteria and other technical limitations as set by the utility.

Generation expansion planning and analysis provides the incremental production costing for all the operational and capital expenses necessary for NLH to reliably supply electricity to meet the forecasted requirements for power and energy over time. For each year of the planning period, the *Strategist®* software calculates NLH's production expenses given the configuration of thermal and renewable alternative resources in economic order at its disposal, power purchases from third parties, annual capital related expenses as new plants come on line, and Operating and Maintenance costs, including fuel costs.

Strategist® calculates annual production- and capital-related costs estimates in nominal Canadian dollars for each year of the long-term planning period. To convert all future costs to a common present day period, a planning metric called CPW is calculated. CPW is the present value of all incremental utility capital and operating costs incurred to reliably meet a specified load forecast given a prescribed set of reliability criteria. An alternative long-term supply future that has a lower CPW than another supply alternative will be the preferred investment strategy for the utility where all other constraints, such as access to capital, are satisfied. The selection of an alternative investment path with a lower CPW is consistent with the objective of providing least-cost power because an alternative with a lower CPW results in an overall lower regulated revenue requirement from the customers served. Consistent with a discounted cash flow analysis, the CPW analysis likewise requires the selection of a discount rate to account for the time value of money. The discount rate has

been set to match NLH's regulated average long run weighted cost of capital which, for the 2010 generation expansion analysis being reported herein, was 8%.

To facilitate analysis, *Strategist®* was used to develop least-cost Isolated Island (without the Project) and Interconnected Island (with the Project) generation expansion plans. A comparison of the two expansion plans will be provided, and the plan with the lowest CPW is the preferred expansion plan.

2.4.1.1 Key Inputs to the *Strategist®* Cumulative Present Worth Analysis

In preparing to carry out a generation expansion analysis using *Strategist®*, the inputs into the planning model are reviewed and updated as required. Key inputs and parameters are discussed in the following subsections:

Planning Load Forecast

This review utilizes the 2010 PLF as prepared by the NLH System Planning Department and has been presented in detail in Section 2.3.1.

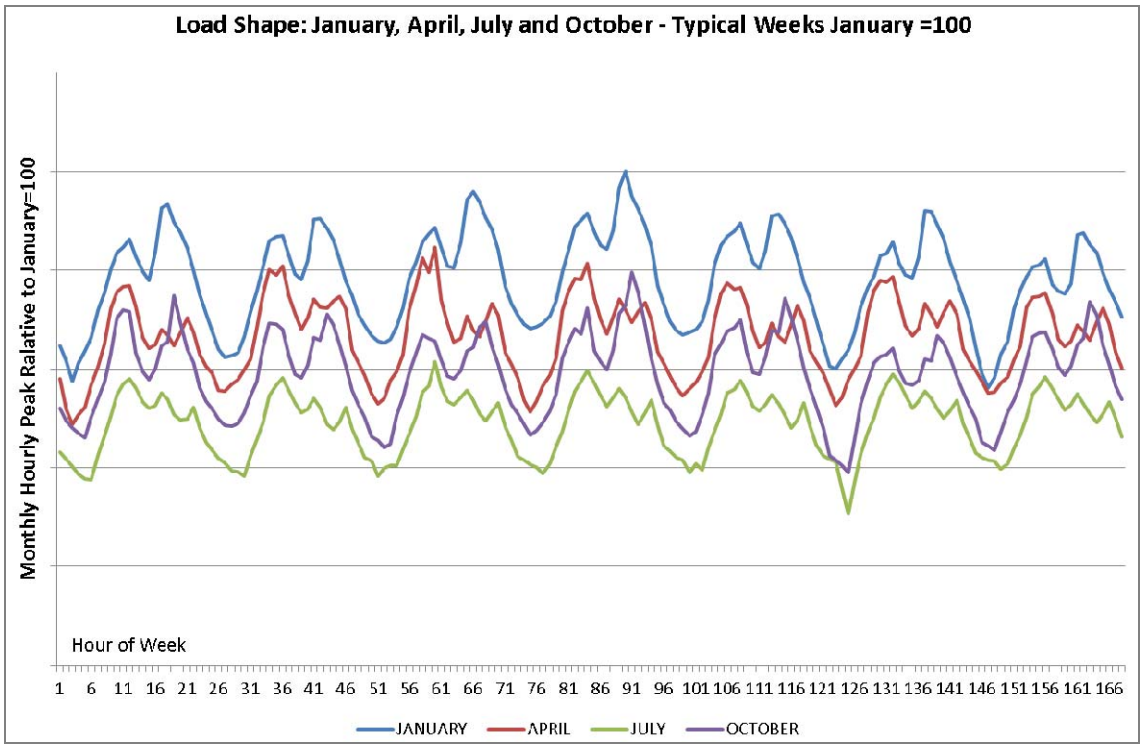
Time Period of Study

The time period that the study will cover must be defined and all other inputs must be developed to cover this period. The time period for the 2010 expansion analysis is 50 years after in service of the Project in order to cover its service life. Thus the full period of analysis is from 2010 to 2067.

Load Shape

Hourly load shapes for each month of the year are required. NLH uses a representative week to model each month, with inputs based on hourly system load readings for the Island grid. The applicable load shape illustrated for the week of the first month of each quarter is provided in Figure 2.4.1-1.

Figure 2.4.1-1 Load Shape Used in *Strategist®* Cumulative Present Worth Analysis



Source: Exhibit 2 (NLH 2011d, internet site).

Escalation Series

Escalation rates for capital, and Operating and Maintenance costs are developed annually based on external projections received from the Conference Board of Canada and Global Insight. In addition to forecasts for general inflation and related Operating and Maintenance costs, escalation cost indices are developed for NLH primary construction projects in generation, transmission and distribution. These composite indices represent a weighting by input construction cost item. Forecasts for Producer Price Indices (PPIs) regularly prepared by Global Insight are used to forecast each composite index. Separate construction project escalation indices have been developed for Muskrat Falls and the Project (Nalcor 2011b, internet site). The escalation rates used in the present analysis are provided in Table 2.4.1-1.

Table 2.4.1-1 Inflation and Escalation Forecast Used in *Strategist®* Cumulative Present Worth Analysis

Year	General Inflation 2009 = 1.000		Electric Utility Construction Price Escalation 2009 = 1.000						Project 2010 = 1.000		Operating and Maintenance 2009 = 1.000			
	GDP Implicit Price Deflator	Canadian CPI	CT Plant	CCCT Plant	Hydraulic Plant	Transmission Line	Transformer Station	Distribution Line	Muskrat Falls	Labrador-Island Transmission Link	More Material Less Labour	Same Material Same Labour	More Labour Less Material	Labour Only
2000	0.825	0.835	0.776	0.763	0.765	0.829	0.873	0.846						
2001	0.834	0.856	0.784	0.773	0.785	0.836	0.894	0.851						
2002	0.843	0.875	0.804	0.792	0.798	0.849	0.911	0.857						
2003	0.871	0.899	0.813	0.798	0.807	0.845	0.884	0.858						
2004	0.899	0.915	0.827	0.812	0.842	0.875	0.894	0.861						
2005	0.930	0.935	0.858	0.850	0.863	0.885	0.910	0.877						
2006	0.953	0.954	0.894	0.884	0.891	0.923	0.935	0.936						
2007	0.983	0.975	0.922	0.913	0.913	0.941	0.949	0.957						
2008	1.021	0.997	0.973	0.967	0.971	1.003	0.981	0.991						
2009	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000			1.000	1.000	1.000	1.000
2010	1.024	1.022	0.982	0.984	0.991	0.993	0.988	0.993	1.000	1.000	1.022	1.025	1.028	1.030
2011	1.048	1.046	0.998	1.000	1.008	1.015	0.993	1.009	1.020	1.020	1.044	1.051	1.057	1.061
2012	1.071	1.069	1.020	1.020	1.028	1.042	1.003	1.029	1.050	1.040	1.067	1.077	1.087	1.093
2013	1.095	1.093	1.046	1.043	1.051	1.072	1.022	1.054	1.110	1.080	1.090	1.104	1.117	1.126
2014	1.118	1.116	1.081	1.074	1.080	1.111	1.051	1.079	1.160	1.120	1.114	1.132	1.148	1.160
2015	1.140	1.138	1.105	1.098	1.103	1.139	1.075	1.102	1.200	1.160	1.139	1.160	1.180	1.195
2016	1.163	1.161	1.108	1.103	1.106	1.141	1.086	1.120	1.230	1.200	1.164	1.189	1.213	1.231
2017	1.186	1.184	1.121	1.116	1.117	1.155	1.096	1.136	1.260	1.240	1.190	1.219	1.247	1.268
2018	1.210	1.208	1.140	1.135	1.134	1.176	1.110	1.154	1.300	1.290	1.216	1.249	1.282	1.306
2019	1.234	1.232	1.162	1.155	1.152	1.198	1.127	1.175			1.243	1.280	1.318	1.345
Post 2019 Annual % Change	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	n/a	n/a	2.2%	2.5%	2.8%	3.0%

Source: Exhibit 3 (Nalcor 2011c, internet site).
Note: CPI = Consumer Price Index.

Heavy Fuel Oil and Distillate Market Prices

The PIRA of New York, an international supplier of energy market analysis and forecasts, and oil market intelligence in particular, independently supplies the fuel oil price forecasts that are used for costing thermal fuel expenses for the provincial power system. These forecasts are updated for the most current long-term projections at the beginning of each generation planning expansion analysis. These market based fuel oil price forecasts are used in production costing for the existing Holyrood plant and CT thermal plants, plus for any new CCCTs or CTs that would be constructed in future periods. The prices used in the 2010 CPW analysis are presented in Table 2.4.1-2, along with a long-term price update as of May 2011 that was included in the CPW sensitivity analysis in Section 2.7.1.1.

Table 2.4.1-2 Thermal Fuel Oil Price Forecast Used in *Strategist®* Cumulative Present Worth Analysis

Year	Reference Forecast at Jan 2010			Reference Forecast at May 2011		
	#6 0.7%s ($Cdn/barrel)	#6 2.2%s ($Cdn/barrel)	Diesel ($Cdn/l)	#6 0.7%s ($Cdn/barrel)	#6 2.2%s ($Cdn/barrel)	Diesel ($Cdn/l)
2010	81.30	79.60	0.674			
2011	83.20	80.50	0.700	102.90	95.70	0.908
2012	90.90	88.00	0.760	118.40	113.70	0.990
2013	98.80	95.50	0.815	122.50	119.20	1.025
2014	102.60	99.00	0.850	126.90	123.40	1.060
2015	106.80	103.00	0.905	130.80	127.10	1.100
2016	111.10	107.00	0.945	135.60	131.60	1.140
2017	116.30	111.50	0.990	140.70	136.00	1.180
2018	121.10	115.60	1.030	144.30	139.00	1.210
2019	124.90	118.60	1.065	147.90	141.80	1.240
2020	129.20	120.30	1.100	151.50	142.80	1.275
2021	132.80	123.10	1.155	153.60	144.20	1.315
2022	136.00	125.80	1.195	155.50	145.80	1.350
2023	139.10	128.50	1.235	157.80	147.70	1.385
2024	142.10	131.10	1.275	160.70	150.20	1.425
2025	145.00	133.70	1.315	162.80	152.00	1.460

Source: Exhibit 4 (Nalcor and NLH 2010, internet site).
Nalcor response to MHI-Nalcor-126 (Nalcor 2011d, internet site).
Note: $Cdn = Canadian dollars
Product prices reflect landed values on Avalon Peninsula.
Diesel represents No. 2 distillate gas turbine fuel for Holyrood.
Post 2025 pricing is forecast at annual inflation of 2%.

Weighted Average Cost of Capital / Discount Rate

The generation expansion analysis for 2010 used a weighted average cost of capital (WACC) for new capital assets of 8.0% consistent with NLH regulated utility WACC assumptions prepared as of January 2010. The WACC reflects a targeted debt equity ratio of 75% for NLH regulated operations, comprised of a forecasted long-term cost of debt at 7.3% and a long-term cost of equity at 10%. All monetary costs were modelled in current (as spent) Canadian dollars and present valued to 2010$ at the defined discount rate of 8.0%.

Capital Cost Estimates

Capital costs estimates for the portfolio of alternative generation assets are based on formal feasibility studies and estimates as developed by consultants and NLH's Project Execution and Technical Services Division. The portfolio of utility projects used in the 2010 generation expansion analysis is provided in Table 2.4.1-3.

Table 2.4.1-3 Portfolio of Utility Projects Used in *Strategist®* Cumulative Present Worth Analysis

Facility	2010$, Millions	In-Service Capital Cost Including Escalation and AFUDC/IDC[(a)] for Isolated and Interconnected Alternatives
Island Pond	$166	$199 million in 2015
Portland Creek	$90	$111 million in 2018, $156 million in 2036
Round Pond	$142	$185 million in 2029
Wind 2 X 27 (new)	$125	$189 to $281 million, various in-service years
Wind 1 x 25 (new)	$58	$98 to $146 million, various in-service dates
Greenfield CCCT #1	$274	$465 to $882 million, various in-service years
Greenfield CCCT #2	$206	$346 to $644 million, various in-service dates
CTs New	$65	$75 to $209 million, various in-service years
Holyrood FGD and ESP	$458[(b)]	$582 million in 2015
Labrador-Island Transmission Link	$1,616	$2,553 million. 75:25 debt equity financing assumption

Source: Exhibit 5H (Aces International Limited 2001, internet site);
Exhibit CE-46 (Hatch Ltd. 2008, internet site);
Exhibits 5F, 5E and 5 (Nalcor 2010a, b, c, d, internet site);
Nalcor response to MHI-Nalcor-1 (Nalcor 2011d, internet site) (see detail in Exhibit 99);
Nalcor response to MHI-Nalcor-49.3 (AFUDC and escalation) (Nalcor 2011d, internet site);
Exhibit CE-51 (Nalcor 2011e, internet site);
NLH (2010d, internet site);
NLH (2011e, f, internet site);.
SGE Acres limited (2004, internet site);
SNC-Lavalin Inc. (1989, 2006, 2007, 2008, 2011, internet site).
Stantec Consulting Ltd.(2008, internet site).

(a) AFUDC = allowance for funds used during construction; IDC = Interest During Construction; CCCT = combined cycle combustion turbine; FGD = flue gas desulphurization; ESP = electrostatic precipitators.

(b) 2009$.

Power Purchase Agreements

The annual power purchase expense incurred by NLH under existing PPAs and future PPAs are projected for input to *Strategist®* and are summarized in Table 2.4.1-4.

Table 2.4.1-4 Power Purchase Agreements Used in *Strategist®* Cumulative Present Worth Analysis

PPA	GWh per Year	End Date	Comment
Fermeuse Wind	84	2028	Re-investment by NLH assumed if Isolated alternative pursued.
St. Lawrence Wind	105	2028	Re-investment by NLH assumed if Isolated alternative pursued.
3rd Wind Farm	88	2034	Isolated Alternative only. NLH re-investment assumed.
Corner Brook Co-Gen	65	2023	
Rattle Brook (hydro)	14	Continuous	
Star Lake (hydro)	144	Continuous	
Exploits Partnership (hydro)	137	Continuous	
Exploits Generation (hydro)	480	Continuous	
Muskrat Falls	Max 4.9TWh	Continuous	See commentary below on pricing.

Source: Exhibit 6 (Nalcor 2011f, internet site).
Nalcor response to MHI-Nalcor-49.2 (Nalcor 2011d, internet site).

Muskrat Falls Power Purchase Expense

The price that NLH pays for power and energy from Muskrat Falls on behalf of Island ratepayers is a cornerstone for the Lower Churchill Project. Nalcor, in consultation with its financial advisors, has approached the issue of electricity pricing for the Muskrat Falls hydroelectric facility in a manner structured to achieve certain ratepayer benefits while still facilitating Project development.

Under a regulated Cost of Service (COS) price setting environment, the annual revenue requirement for a utility asset would be comprised of:

> COS = Operating and Maintenance Costs + Power Purchases+ Fuel + Depreciation + Return on Rate Base

Where Return on Rate Base would be comprised of a cost component for lenders (cost of debt) and a profit component for shareholders (return on equity) for a prescribed debt-equity capital structure. This annual COS would then be divided by the output produced and sold from the asset in question to derive an average selling price or rate (such as cents per kilowatt hour (kWh), or equivalent dollars per megawatt hour (MWh). An important feature of this pricing methodology is that under COS price setting, the unit rate revenue paid by ratepayers for a given asset is highest in the first year. This is because as a new regulated asset goes into rate base, the undepreciated cost of the asset is at its maximum and return on rate base is driven by undepreciated net book value. Another feature of this pricing framework is that as the equity investor earns its regulated return each year, the return in dollars is also highest in the first and initial years. This is not necessarily prudent for the Muskrat Falls development in that the Island ratepayer energy requirements at the time of plant commissioning is projected to be only about 40%, or 2 terawatt hours (TWh), of the plant's average annual production of 4.9 TWh. While the Island's energy requirements increase over time in line with economic growth, the early-year COS rate for Muskrat Falls power would be a significant burden for ratepayers in those years. The required COS revenue for Muskrat Falls would be at its maximum and the power required by ratepayers at a minimum. In an effort to address this issue, an alternative approach to Muskrat Falls power pricing was developed that affords a number of advantages for ratepayers.

To derive an appropriate price for NLH's power purchase requirements for the Island, Nalcor undertook a supply pricing analysis for Muskrat Falls initially assuming that the total firm annual plant production was available for sale. The objective of this analysis was to determine the economic price for the project, in this instance expressed as an "escalating supply price". It is perhaps more common in economic analysis to express economic supply prices as Levelized Unit Energy Costs. In either circumstance, the annual price, when multiplied by output and discounted, equals the present value of the project's costs given the capital and operating costs, other incurred expenses, and the cost and terms of obtaining capital. The escalating supply price is the price per MWh that recovers all costs associated with the Muskrat Falls hydroelectric development – operating and other incurred costs over time, debt service costs for the debt portion of the capital investment (as applicable) and a hurdle return on the equity portion of the capital investment. This escalating supply price is lower than would be indicated initially by the COS framework. Though it escalates evenly over time, the burden on ratepayers in the critical early years is minimized. This is accomplished essentially through the equity investor's flexibility on the timing of its equity return in the early years, relative to that in later years. Nalcor has calculated this escalating supply price for Muskrat Falls power based on the project's cost estimates at the time of Decision Gate 2 (see Section 2.10), coupled with an Internal Rate of Return (IRR) of 11%, to be approximately $76/MWh in 2010$, escalating at 2% annually. The IRR was on firm power, with a 12% IRR on average power taken as an analytical benchmark for analysis purposes.

For the next step in the Muskrat Falls pricing analysis, this $76/MWh escalating supply price was then used to calculate the revenues, cash flows and shareholder returns assuming that the only market for Muskrat Falls output was the Island market. The reduction in the volume of sales assuming only the Island market, as outlined above, as opposed to full annual production quantities at start up, reduced the Muskrat Falls project IRR from 11% to 8.4%. Nalcor deemed this IRR to be acceptable for a case in which only Island sales are available to Muskrat Falls, and adopted this escalating supply price framework for the present analysis. This return on equity is consistent with the present day return on equity for Newfoundland Power, and is only slightly below the long-run projected average for NL electrical utilities. Nalcor considers this acceptable because Muskrat Falls may have opportunities for additional revenues over and above those from the Island market, notably for the earlier part of the operational period before Island demand fully subscribes Muskrat Falls output.

In addition to lower prices for ratepayers for Muskrat Falls power in the early years, a further advantage to this pricing approach rests with fixing the real dollar level for the Muskrat Falls supply price across time. Hydroelectric assets are very long life assets and where a power purchase price for its output is fixed in 2010$ constant real dollars, this helps to address intergenerational equity issues associated with large public investments in durable assets in the power sector – particularly as the full output of Muskrat Falls is not required by ratepayers in the early years of the project.

Service Life / Retirements

The service life and retirement dates for existing and new generation assets must be defined for the *Strategist®* expansion analysis as thermal plant replacement is an important component of generation planning and costing. The service life assumptions used in the present analysis are provided in Table 2.4.1-5.

Table 2.4.1-5 Asset Service Life Assumptions Used in *Strategist®* Cumulative Present Worth Analysis

Facility	Service Lives for Existing and Future NLH Generation Plant and Transmission – Retirement Dates	
	Isolated Island	Interconnected Island
Existing		
Holyrood Units 1 and 2	2033	2021[(a)]
Holyrood 3	2036	2021[(a)]
Hardwoods CT	2022	2022
Stephenville CT	2024	2024
Hydroelectric	perpetuity	perpetuity
Future		
Wind Farms	20 years	
Hydroelectric	perpetuity	
Labrador-Island Transmission Link		50 years
CCCTs	30 years	
CTs	25 years	

Source: Exhibit 7 (NLH 2011g, internet site).

[(a)] In the Interconnected Island alternative, the Holyrood units are retired before their targeted end of service lives.

Operating and Maintenance Costs

Non-fuel Operating and Maintenance costs for the resource projects are derived from feasibility studies and NLH's extensive operating experience. These Operating and Maintenance costs are comprised of fixed expenditures related to asset maintenance and variable costs driven by production output. The Operating and Maintenance assumptions are provided in Table 2.4.1-6.

Table 2.4.1-6 Operating and Maintenance Assumptions Used in *Strategist®* Cumulative Present Worth Analysis

Facility	Fixed Annual Operating and Maintenance Cost ($/kW (2010$))	Variable Operating and Maintenance Cost ($/kWh (2010$))
Island Pond	$15.79	n/a
Portland Creek	$17.97	n/a
Round Pond	$20.66	n/a
Wind (new)	$28.89	$5.90
Holyrood CCCT	$9.22	$5.32
Greenfield CCCT #1	$10.49	$5.32
Greenfield CCCT #2	$9.22	$5.32
Holyrood Existing 3 Units	$41.39	$1.28
CTs Existing	$9.11	n/a
CTs New	$10.49	$5.32
Holyrood FGD and ESP	$11 million (2015) to $24 million (2033) nominal	
Muskrat Falls	$13 million (2018) to $46 million (2067) nominal	
Labrador-Island Transmission Link	$14 million (2017) to $50 million (2067) nominal	

Source: Exhibit 8 (2010d, internet site).

Thermal Heat Rates

Per unit fuel consumption of existing and future thermal generation sources are important inputs in production costing. The heat rates utilized in *Strategist®* reflect a combination of NLH's operating experience, plus external studies and estimates. The heat rates are listed in Table 2.4.1-7.

Table 2.4.1-7 Heat Rates Used in *Strategist®* Cumulative Present Worth Analysis

Facility	Fuel Source	Maximum MBTU per MWh	Minimum MBTU per MWh
Existing Holyrood Units	No. 6	9.78	10.39
Existing CTs	No. 2	12.26	12.26
Existing Diesel Units	No. 2	10.97	10.97
Future CCCTs	No. 2	7.64	8.63
Future CTs	No. 2	9.43	9.43

Source: Exhibit 9 Rev. 1 (NLH 2011h, internet site).
MBTU = Millions of British Thermal Units.

Generation Capacity and Energy Capability - Existing and Future Resources

The monthly and annual average and firm energy production forecasts for all of the existing hydroelectric plants and wind farms are updated to incorporate the latest historical data and operational factors. Production forecasts from new thermal and renewable plants are based on engineering studies estimates. Existing and future generating capacity used in *Strategist®* CPW Analysis is presented in Table 2.4.1-8.

Table 2.4.1-8 Existing and Future Generating Capacity Used in *Strategist®* Cumulative Present Worth Analysis

Source	Net Capacity (MW)	Firm Energy (GWh)	Average Energy (GWh)
Existing Island Grid			
NLH Hydroelectric	927	3,961	4,510
NLH Thermal	590	2,996	2,996
Customer Owned	262	1,117	1,307
Non Utility Generators	179	879	1,030
Total Existing	**1,958**	**8,953**	**9,843**
Future Resources			
Island Pond	36	172	186
Portland Creek	23	99	142
Round Pond	18	108	139
Wind Farm	25	70 to 110	
CCCT	170	1,340	n/a
CT	50	394	n/a
Muskrat Falls	824	4,540	4,910
Labrador-Island Transmission Link	900	NA	NA

Source: Exhibit 16 (NLH 2010b, internet site).
Muskrat Falls firm and average as per Lower Churchill Project for modeling use.

Asset Maintenance Scheduling

Specific outage schedules to accommodate annual maintenance for each existing and future thermal generation asset must be included in the *Strategist®* analysis. Such maintenance scheduling is largely based on NLH's operational experience and asset management planning processes and is presented in Table 2.4.1-9.

Table 2.4.1-9 Asset Maintenance Scheduling Used in *Strategist®* Cumulative Present Worth Analysis

Facility	Weeks for Asset Maintenance	Period
Holyrood Units (3)	8 weeks each staggered across off–peak months	May / June, July / August, September / October
All Other Thermal	2 weeks each	April through November
All Hydroelectric	Maintenance assumed to be undertaken in off–peak months (April to November)	
Labrador-Island Transmission Link	Maintenance assumed to be undertaken in off–peak months (April to November)	

Source: Exhibit 11 (NLH 2011i, internet site).

Forced Outage Rates

All generation production units have an associated involuntary forced outage rate leading to the unavailability of a generating unit. The forced outage rates used in this analysis are based on NLH's operating experience and / or industry norms as tabulated by the Canadian Electricity Association.

Table 2.4.1-10 Forced Outage Rates Used in *Strategist®* Cumulative Present Worth Analysis

NLH Facility	Forced Outage Rate (%)
Combustion Turbine	10.62
Holyrood Thermal	9.64
Combined Cycle Thermal	5.00
Diesel	1.18
Existing and New Hydroelectric	0.90
Labrador-Island Transmission Link (per pole)	0.89

Source: Exhibit 12 (NLH 2011j, internet site).

Environmental Externalities

No environmental externality cost of carbon for carbon dioxide (CO_2) atmospheric emissions associated with thermal electric production has been included in production costing for thermal plants. It was also not included in subsequent CPW analysis, owing to prevailing uncertainties regarding the timing, scope, and design associated with future regulatory initiatives in this regard.

2.4.2 Thresholds for Economic Viability

Two components of economic viability are relevant for this analysis. The first relates to the rate of return required for the Project. The second component of economic viability relates to the legislated requirement that NLH provide least-cost power to its customers. For both the regulated and non-regulated Project components, the WACC is 8%. The cost of this capital is included in the CPW analysis for each alternative and forms part of the comparative analysis of the Isolated Island alternative and the Interconnected Island

alternative. In the case of selecting which alternative with which to proceed, the threshold of economic viability is the alternative with the lowest CPW.

2.5 Alternative Generation Sources

This section presents a summary of the power generation supply options for both the Isolated Island and Interconnected Island alternatives. It represents a portfolio of electricity supply options that could be theoretically considered to meet future generation expansion requirements for the Island. These individual supply options represent a range of choices / alternatives from local indigenous resources, to importing energy fuels from world energy markets, to interconnecting with regional North American electricity markets.

Specific supply options are initially considered and screened based on initial screening principles that align with Nalcor's / NLH's mandate. The initial screening (later referred to as Phase 1) is important as it enables NLH to concentrate further consideration on only the technologies and alternatives that offer the highest potential to ensure effective expenditures of ratepayers' money. In addition, prudent pricing assumptions are essential for fuel based generation alternatives. Those options that remain following the high-level screening are input into the generation planning software models (Nalcor's Phase 2 process) for further analysis and ultimately for the recommendation of the preferred generation expansion plan.

The screening principles used by Nalcor in its evaluation of alternatives are discussed in the following subsections:

Security of Supply and Reliability

Security of supply and reliability are the two most important criteria for evaluating the supply investment decision.

NLH is mandated to provide reliable least-cost electrical supply to the people of the province. As part of its mandate, NLH must maintain a long-term plan that demonstrates its ability to continue to supply the expected requirements. A realistic plan is particularly important for the Island portion of the province as it is isolated from the rest of the North American electrical grid and cannot rely on support from neighbouring jurisdictions should there be problems because of the application of unreliable technologies.

Because of the importance of having a realistic plan, NLH has developed an Isolated Island expansion plan that is a least-cost optimization utilizing only proven technologies to ensure they can meet the required expectations from security of supply, reliability and operational perspectives. There must be a high level of certainty that all elements of the Isolated Island alternative plan can be permitted, constructed and integrated successfully with existing operations. Generation technologies that do not meet these rigorous requirements are excluded from further consideration.

Cost to Ratepayers

NLH's mandate, as defined in Section 3(b) of the *Electrical Power Control Act, 1994* (GNL 1994), is to ensure that all sources and facilities for the production, transmission and distribution of power in the province should be managed and operated in the most efficient manner such that power delivered to consumers in the province is at the lowest possible cost consistent with reliable service. Least-cost for ratepayers is a key objective of the company and guides its business decisions, expansion plans and overall strategic direction.

Environmental Considerations

Environmental stewardship is one of Nalcor's guiding principles. This principle is also embodied in *Focusing Our Energy: Newfoundland and Labrador Energy Plan* (the *Energy Plan*) (GNL 2007) and provides guidance to Nalcor in making investment decisions. The company must meet any current environmental regulations laid out in both provincial and federal legislation and also must consider potential new environmental legislation

due to the longer term nature of its generation expansion decisions. The company must also adhere to any provincial policy provided in this regard.

Risk and Uncertainty

Given the magnitude of the decisions being undertaken for generation expansion and the expenditures proposed, risk and uncertainty are key decision criteria. Nalcor considered this in its decision-making.

Financial Viability of Non-Regulated Elements

Consideration of financial viability is important to ensure that the shareholder makes an adequate rate of return and any project investment can obtain debt financing and meet debt repayment obligations.

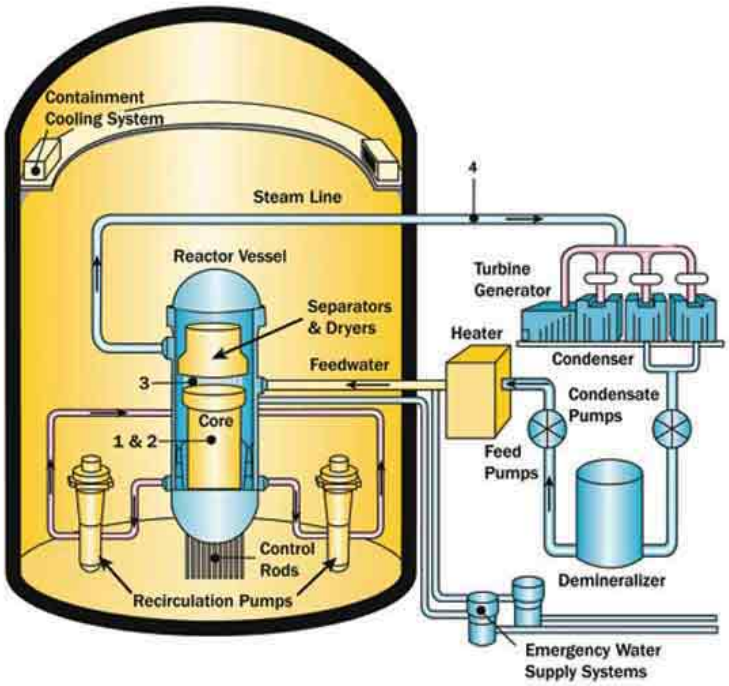
The following subsections provide a summary of Nalcor's screening decisions on electrical generation alternatives that could potentially be used to meet Newfoundland's needs.

2.5.1 Nuclear

A nuclear reactor uses controlled nuclear reactions to produce heat energy. The heat energy is then used to produce steam. The steam is used to turn a steam turbine, which turns an electric generator to produce electricity (Figure 2.5.1-1).

A nuclear power generation plant would not integrate well into the Isolated Island System due to the fact that the nuclear plant must operate at a base load with very little output change. Nuclear plants do not ramp up or down very well, or quickly. Therefore, a nuclear generator would function well in the Isolated Island System where daily load changes are on the order of 400 MW. Furthermore, as most new designs are in the 1,000 MW range, they are sized far greater than the Isolated Island System's minimum load of approximately 400 MW. With an inability to follow the Isolated Island System load pattern, a nuclear generator would be forced off for large portions of the year.

Figure 2.5.1-1 Components of a Typical Nuclear Reactor



Source: United States Nuclear Regulatory Commission (2011, internet site).

Beyond operational issues for the Isolated Island System, there are issues around the safe, long-term storage of nuclear waste associated with nuclear generation.

While nuclear generation has been deployed in many countries around the world, from a public policy perspective, the *Electrical Power Control Act*, *1994* prohibits the construction and operation of nuclear power plants in the province.

Given that nuclear generation: a) is prevented by provincial legislation and b) would not integrate well into the Isolated Island System, nuclear generation was screened out as a possible supply option alternative.

2.5.2 Natural Gas

Natural gas is used as a fuel source for CTs and CCCTs throughout the industry. Technology exists to reconfigure a heavy oil fired facility such as the Holyrood plant to burn natural gas.

The Provincial *Energy Plan* requires all offshore operators to propose a "landed" gas option as part of any development plan for natural gas. To date, no proposal for natural gas development, either export or "landing", has been submitted by the offshore operators despite years of technical and economic study. Nalcor has evaluated a range of natural gas configurations including modification of the Holyrood plant to burn natural gas, and replacement of the Holyrood plant with new high efficiency combined cycle gas turbines. Nalcor is of the view that "landed" Grand Banks natural gas is not a viable option to meet the Island's electricity needs. There are several reasons for this conclusion, as outlined below.

The first barrier to the development of natural gas is that the identified domestic market is too small to absorb the considerable project risks, capital investment and operating costs of a Grand Banks natural gas development. A study prepared by Pan Maritime Kenny – IHS Energy Alliance in 2001 (Pan Maritime Kenny – IHS Energy Alliance 2001) concluded:

> "Delivery of gas for domestic use for power generation, industrial, commercial, and residential is not economically feasible without integral development for delivery to Eastern Canada and the US."

The same report also concluded that the economic threshold for development of Grand Banks gas is a production rate in the order of 700 million standard cubic feet per day (MMscf/d). Given the supply required for thermal generation is in the order of 100 MMscf/d at peak, the confirmed demand is far short of the economic threshold identified in the Pan Maritime Kenny – IHS Energy Alliance report.

This view is also supported by the Independent Supply Decision Review report (Navigant Consulting Ltd. 2011, internet site) in their review of natural gas as a potential supply option for thermal generation.

The limited and varying use of discovered natural gas resources represents another impediment to Grand Banks natural gas development. Pan Maritime Kenny – IHS Energy Alliance concludes:

"To date there is no single known field with gas resources large enough to support the cost of installation of a marine gas pipeline from the Grand Banks to markets in Eastern Canada and the U.S. So the natural gas development will need a basin-wide co-operative approach."

Natural gas is associated with the Hibernia, Terra Nova and White Rose developments, but each operator has its own strategies for the gas associated with their respective development. Natural gas associated with the Hibernia development is re-injected into the reservoir to increase the recovery of oil from the reservoir. This re-injection is a form of enhanced oil recovery. In the case of the Terra Nova development, natural gas is re-injected and is also used to reduce the viscosity of produced crude oil, an enhanced oil recovery technique known as natural gas lift. Finally, natural gas from White Rose is being stored in an adjacent reservoir for future use. Each operator has developed its own strategy for natural gas use, and to date, no concrete plan for domestic natural gas development exists.

Given the lack of a confirmed development plan for Grand Banks natural gas, the small domestic requirement in comparison to the economic threshold for development, as well as the varying uses by operators, Nalcor has screened out domestic natural gas as a supply option.

2.5.3 Liquefied Natural Gas

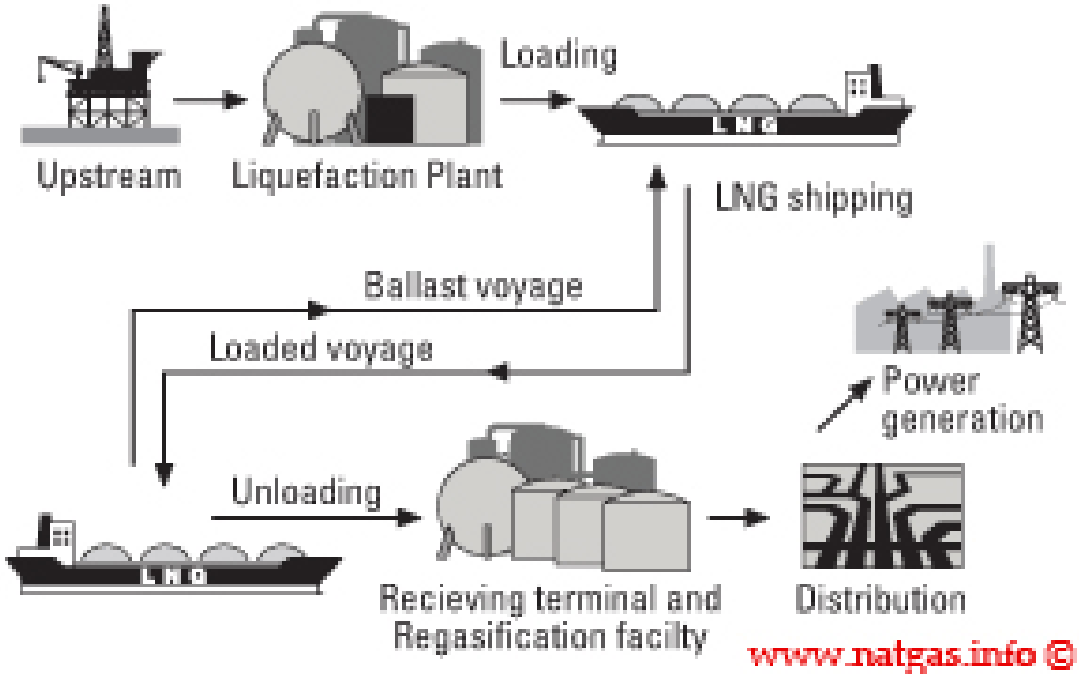
Liquefied Natural Gas (LNG) is natural gas that has been cooled to about minus 163 degrees Celsius (°C) for shipment and / or storage as a liquid. The volume of the gas in its liquid state is about 600 times less than in its gaseous form. In this compact form, natural gas can be shipped in special tankers to receiving terminals. At these terminals, the LNG is returned to a gaseous form and transported by pipeline to distribution companies, industrial consumers and power plants.

When in the reservoir, natural gas is found in three states: non-associated, where there is no oil contact; gas cap, where it is overlying an oil reserve; and associated gas, which is dissolved in the oil. The composition of the natural gas defines how it will be processed for transport. Whether staying in its gaseous state or being transformed into a liquid, natural gas from the well must undergo separation processes to remove water, acid gases and heavy hydrocarbons from the recovered natural gas.

The next step in processing is determined by what type of transport the gas will undergo, and specifications are met according to the transportation system. For LNG, additional processing is required before the condensation of the gas to remove the threat of crystallization in the heat exchangers in the liquefaction plant. When chemical conversion is used to liquefy natural gas, the conversion process determines which preliminary process must be used. Additionally, fractionation between methane and heavier hydrocarbons is performed during liquefaction. This way, after regasification the fuel can be loaded directing into the distribution network of pipelines.

LNG is then introduced into specially insulated tankers and transported to market. LNG is kept in its liquid form via auto refrigeration.

Figure 2.5.3-1 Liquefied Natural Gas Chain



Source: natgas.info (2011, internet site).

Once it has reached its destination, the LNG is offloaded from the tanker and either stored or regasified. The LNG is dehydrated into a gaseous state again through a process that involves passing the LNG through a series of vaporizers that reheat the fuel above the -160°C temperature mark. The fuel is then sent via established transportation methods, such as pipelines, to the end users.

An LNG receiving terminal would require a jetty, offloading equipment, LNG storage tanks, regasification plant, and a pipeline to power a generation station. The power generation plant would use a CCCT.

A key challenge to any scenario for natural gas-fired power generation in Newfoundland is the small market. Natural gas markets are subdivided into industrial, municipal, and utility generation. Currently, NL has no industrial base for use of natural gas. Neither is there a large readily available residential market for distributed natural gas. As a result, the primary and likely only use for natural gas is the electricity sector, but to utilize any amount of LNG, a costly regasification terminal has to be constructed and operated. One advantage of conventional fuels such as diesel fuel or the heavy fuel oil used at the Holyrood plant is that the only infrastructure required is an appropriately sized tank farm. The natural gas volumes required to generate the Island's electricity are very low compared to the scale of cost effective infrastructure being deployed worldwide. To meet the Island's electricity needs, an import facility and regasification plant capacity in the range of 100 MMscf/d would be the required size. The facility would have to be built to meet winter peak electricity demands for a relatively few days and operate at much lower levels for the rest of the year.

LNG is a commodity that is actively traded on the global market by large scale, multi-national suppliers and transported globally on specially designed tankers. In order to consider LNG as a viable alternative source of electrical generation, as a utility Nalcor must be able to enter into long-term supply arrangements with global providers. As the only firm demand for LNG in the Isolated Island alternative would be electricity production, the volume of LNG that would be required would be viewed as small in the global market. Low quantities, combined with the need for long-term supply contracts, would result in Nalcor paying a premium for LNG, likely comparable to prices that are found in the Asian market. Following the initial contract, Nalcor's ability to negotiate future prices at a lower or comparable rate may be frustrated because there is a high probability that suppliers will realize that LNG is Nalcor's only option. For decision making purposes, prudent pricing assumptions which reflect the realities of an existing and established market is essential. In the case of LNG, however, there is currently no certainty around current or future LNG pricing in a market comparable to the Island.

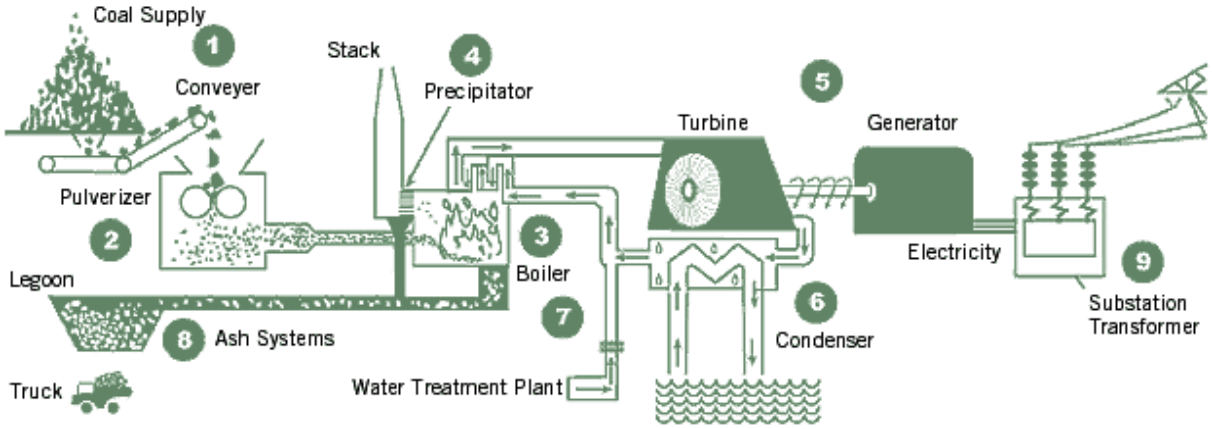
When analyzed from a cost perspective, LNG supplied at Asian prices virtually mirrors the forecasted cost of fuel for the Holyrood plant. This means there is no clear advantage to LNG for rate payers. Nalcor's extensive analysis of supply alternatives show that the Interconnected Island alternative, specifically Muskrat Falls and the Project, is considerably less expensive than the Isolated Island alternative, which is a predominantly thermal future.

2.5.4 Coal

Coal has a long history as a fuel source in North America. It has been used to heat homes, power machinery and transportation, and power electric generators. While most of coal's uses have been phased out, coal remains a significant fuel-source for electrical generation. According to the federal government there are 51 coal burning units in Canada (Government of Canada 2010a, internet site), which account for approximately 19% of the electric generating capacity in the country (Government of Canada 2010b, internet site). The coal fired generating capacity produces 13% of Canada's total greenhouse gas (GHG) emissions (Government of Canada 2010a, internet site). Of the 51 coal fired generating units, 33 are expected to come to the end of their economic lives by 2025 (Government of Canada 2010a, internet site).

Coal-fired electric generation draws its fuel from vast reserves of non-renewable, naturally occurring deposits of coal. Coal reserves are mined, processed and transported to the generation site where they are pulverised and fed into a boiler to generate heat energy. The heat energy is used to produce steam. The steam is used to power a turbine which turns an electric generator. Figure 2.5.4-1 represents a typical coal-fired generator.

Figure 2.5.4-1 Components of a Typical Coal-Fired Generator



Source: Centre for Clean Energy (2011, internet site).

Historically, the benefits of coal-fired generation have been based on economics. With an abundant supply of coal resources, the relative ease to transport the resource by rail and / or sea, and the relatively high energy content meant that significant energy potential could be harnessed at relatively low unit costs.

Technologies such as electrostatic precipitators (ESPs) and scrubbers greatly reduce the amount of non-GHG emissions from coal-fired units. However, pollution abatement technologies come at significantly increased capital and operating costs for new coal-fired facilities. These cost increases reduce the economic case for coal-fired generation in the long run. Pollution abatement equipment costs, coupled with the generally expected increased costs related to the stringent regulation of emissions, render the future of coal-based alternatives questionable.

The future of continued favourable economics for coal-fired generation is under considerable doubt based on the quantity of GHG emissions from these sources. The trend in several jurisdictions is clearly away from coal. Both the Canadian and American governments are committed to limiting the amount of emissions derived from the electricity industry (Government of Canada 2010a, internet site; Government of the United States 2011a, internet site). The pending, and now gazetted, Canadian regulations require new generation facilities to have maximum CO_2 emissions comparable with those of highly efficient natural gas fired CCCTs (375 tonnes per GWh).

Because of uncertainty in costs and feasibility associated with meeting gazetted federal regulations, there is significant risk in pursuing coal-fired generation as a resource option. Carbon capture and storage (CCS) technology would be required for a coal-fired facility to achieve the proposed federal target. This unproven technology is still at the research and development phase and has not been deployed on a commercial scale. Saskatchewan has recently approved a $1.2 billion project to implement a CCS demonstration project on the 110 MW Unit 3 of SaskPower's Boundary Dam thermal facility (Government of Saskatchewan 2011, internet site).

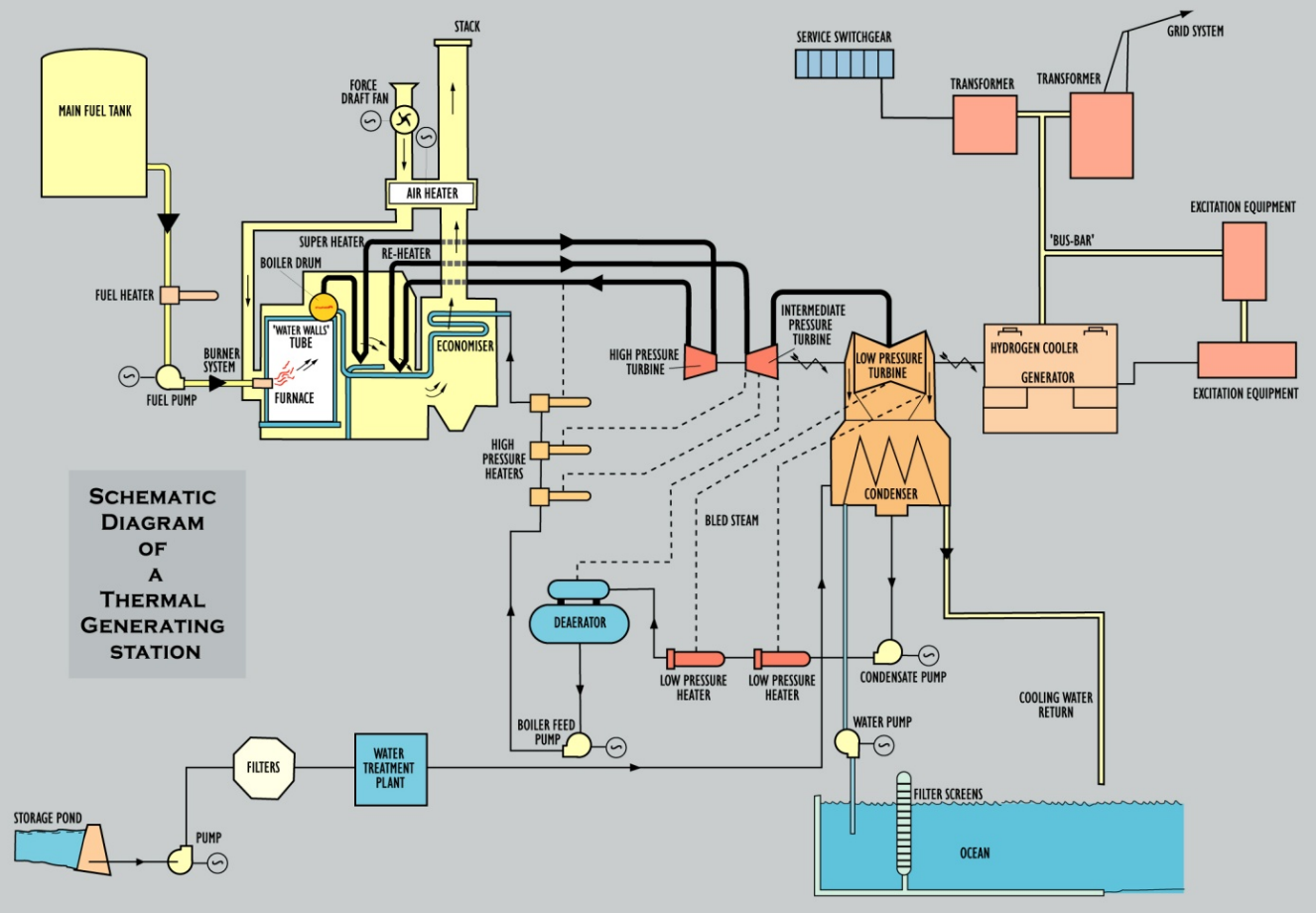
Given the potential for GHG regulation and the uncertainty and cost associated with CCS, coal-fired generation was screened out as an alternative source for the Isolated Island alternative.

2.5.5 Continued Use of the Holyrood Thermal Generating Station

The Holyrood plant is a three unit heavy oil fired, steam cycle generating plant located in the municipality of Holyrood. The plant was constructed in two stages. In 1969, Stage I, consisting of two generating units (Units 1 and 2) each capable of producing 150 MW, was started and placed in service in April 1971. In December 1979, Stage II, consisting of one generating unit (Unit 3) capable of producing 150 MW, was completed. The Unit 3

generator is capable of synchronous condenser operation to assist in grid voltage control during the off peak season. In 1988 and 1989, Units I and 2 were modified to increase their output to 175 MW, respectively. Today, the Holyrood plant has a net rated capacity of 465.5 MW after allowance for station service loads and a firm energy capability of 2,996 GWh per year. At peak production, the plant burns approximately 18,000 barrels of oil per day. Figure 2.5.5-1 presents a schematic of the Holyrood plant.

Figure 2.5.5-1 Thermal Generating Station Schematic



Source: Nalcor (2011a, internet site).

The life expectancy of a base-loaded thermal generating station is generally accepted to be 30 years where the plant operates continuously and downtime is scheduled only to perform routine repairs and maintenance. However, the 30-year life expectancy can vary depending on the operating hours, the cycling between low / no load and peak load, and how well it has been maintained over its life. When a thermal plant has reached or exceeded its life expectancy, life extension work is required to continue safe, reliable and least-cost operation.

Stage I of the Holyrood plant is over 40 years old and Stage II has surpassed the 30-year mark. At this point in the life of the Holyrood plant, condition assessment is required to determine the life extension program necessary for the plant to continue to operate for the next 30 years (i.e., to the end of 2041). To this end, NLH applied to the Board to begin Phase 1 of a condition assessment and life extension program for the Holyrood plant. The Board granted partial approval to proceed and the engineering consulting firm AMEC Earth & Environmental (AMEC) completed the Phase 1 work in March of 2011. The project was limited in scope and considered required Holyrood plant operation to the end of 2016 and maintenance in a standby power mode from 2017 to 2020. Beyond 2020, the project scope limited plant operation to synchronous condenser mode only. Phase 2 of the existing condition assessment and life extension program will enable NLH to identify

equipment and systems that require immediate attention to operate the Holyrood plant to the year 2016. In the context of long-term, continued oil fired operating at the Holyrood plant, additional condition assessment and life extension analysis must be performed. NLH engineering and operating experience and expertise, along with information from the AMEC Phase 1 report, were used to formulate an upgrade program for the Holyrood plant through to the 2041 timeframe. While these cost provisions are based on operating and capital experience it does offer an initial provision of costs where need is known but the full scope for life extension capital is unknown in the expansion plans. The total capital cost for Holyrood plant life extension is estimated at $233 million (in service cost). Additional details are provided in Section 2.7.1.3.

Beyond the life extension issues associated with the wear and tear on the physical equipment, the Holyrood plant is a large source of atmospheric pollution in the province. Particulate, SO_2 and GHGs including CO_2 are of primary concern. At present the Holyrood plant does not have any environmental equipment for controlling particulate emissions or SO_2. To date NLH has managed SO_2 emissions through the burning of lower sulphur content heavy oil. To meet the provincial commitments of the province's *Energy Plan*, NLH has identified ESPs and wet limestone flue gas desulphurization (FGD) systems to control particulate and SO_2 emissions from the plant in the absence of the Lower Churchill Project. The costs associated with these precipitators, scrubbers and low NO_X burners are estimated at $602 million (in service cost). Additional details are provided in Section 2.7.1.3. The cost for pollution abatement has been included in the Isolated Island alternative.

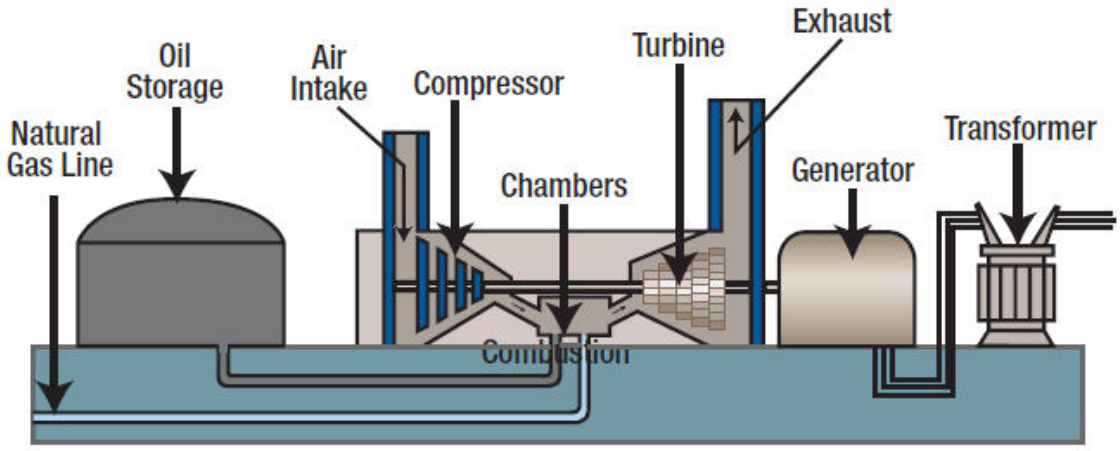
With respect to GHG emissions, federal regulatory action against emitting facilities is increasingly likely. Depending on the federal benchmark for GHG emission intensity levels, there is risk that an oil fired facility such as the Holyrood plant may not be able to legally operate in the long-term.

Continued oil-fired generation at the Holyrood plant is viewed as a viable alternative in both the short- to medium-term. Consequently, the continued operation of the Holyrood plant with the appropriate pollution abatement technology was included in the generation expansion alternatives.

2.5.6 Simple Cycle Combustion Turbines

A CT consists of an air compressor, combustion chamber, turbine and generator. CTs can be operated using either natural gas or light fuel oil (LFO). CT operation begins with air being drawn into the front of the unit, compressed in a compressor, and mixed with natural gas or LFO in the combustion chamber. Next, the mixture of compressed air and natural gas or LFO is ignited producing hot gases that rapidly expand. The expanding hot gas is passed through a turbine which turns an electric generator to produce electricity. Figure 2.5.6-1 shows a diagram of a typical CT.

Figure 2.5.6-1 Components of a Typical Simple-Cycle Combustion Turbine



Source: Tennessee Valley Authority (2011).

Simple cycle CTs are capable of producing large amounts of useful power for a relatively small size and weight. Since motion of all its major components involve pure rotation (i.e., no reciprocating motion as in a piston engine), its mechanical life is long and the corresponding maintenance cost is relatively low. A CT must be started using some external means such as an electric motor, air compressor or another CT. A CT can be started, connected to the power system and loaded to its rated output in minutes.

Combustion turbine installations on the Island System would have a nominal rating of 50 MW (net) per unit and would be located either adjacent to existing NLH thermal operations or at greenfield sites near existing transmission system infrastructure. While CTs have a relatively low capital cost, fuel costs are high. As a result, CTs on the Island System are generally used for only short periods of time. Due to their low simple cycle efficiency, CTs are primarily deployed on the Island System for system reliability and capacity support for peak demand. If required, CTs can be utilized to provide firm energy to the system.

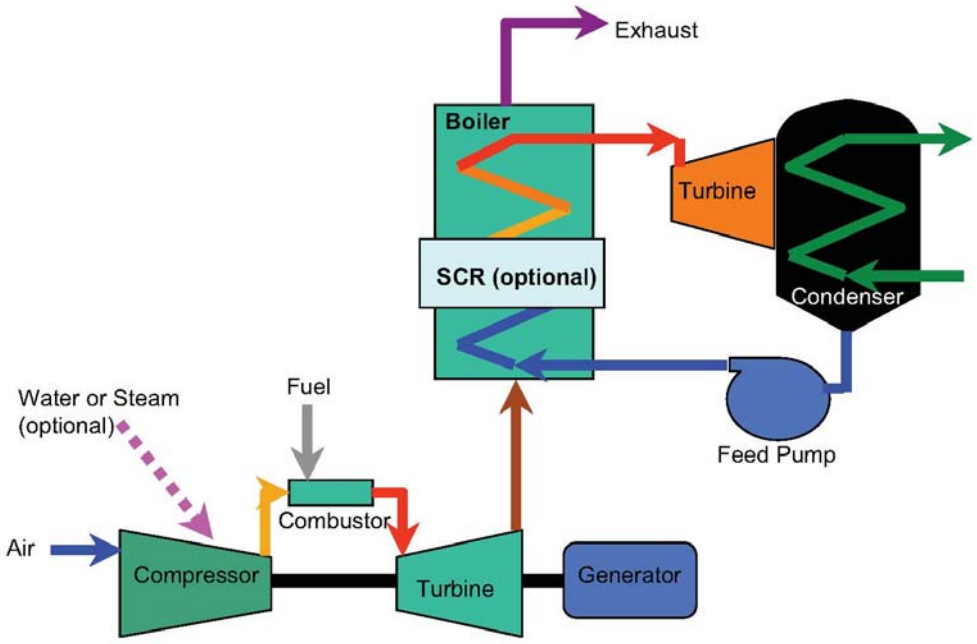
Combustion turbine technology is an integral part of the resource mix on the Isolated Island System today. CTs are an applicable and necessary supply resource for both the Isolated Island alternative and the Interconnected Island alternative. Consequently, the CT technology was included in the generation expansion alternatives.

2.5.7 Combined Cycle Combustion Turbines

A CCCT consists of a simple cycle combustion turbine as described in Section 2.5.6, a heat recovery steam generator (HRSG), and a steam turbine generator. CCCT technology is widely used in North America as a flexible and efficient generating alternative.

The exhaust of the CT is passed through a HRSG to produce steam. Steam from the HRSG powers the steam turbine generator. The condensed steam is then recycled back into the HRSG. The CT provides about two-thirds of the generated power and the steam turbine about one-third. The heat recovery from the CT provides a large efficiency improvement over a stand-alone CT (Tennessee Valley Authority 2011). Figure 2.5.7-1 depicts one form of a CCCT.

Figure 2.5.7-1 Typical Components of a Combined Cycle Combustion Turbine



Source: Tennessee Valley Authority (2011).

One of the primary benefits of a CCCT plant is that it can be used for base load power generation. A CCCT generator is more efficient than either a stand-alone CT or steam turbine. A CCCT plant is essentially an electrical power plant in which CT and steam turbine technologies are used in combination to achieve greater efficiency than would be possible independently. This high fuel efficiency makes it possible for CCCTs to be competitive for intermediate or base load applications at relatively high price fuels.

CCCT plants are subject to the cost variations associated with various fuel markets. This can have an adverse effect on electricity production costs, and in turn, could cause uncertainty around long-term electricity rates if the price of fuel rises over time.

To incorporate CCCT technology into the Island's resource mix, NLH would use LFO rather than natural gas, as natural gas infrastructure is not available locally at this time. As a result, a new CCCT generating facility using LFO would need to be located close to a suitable seaport to reduce bulk fuel shipping costs and to provide plant cooling water.

The applicable power rating for a CCCT connected to the Island System is a 170 MW unit size based on the size of the largest unit on the Island System today and the system's ability to withstand the loss of a large generator. This technology could be used as a replacement for the Holyrood plant or as additional generation to meet load growth. The annual firm energy capability is 1,340 GWh for the 170 MW option (NLH 2010b, internet site).

Combined cycle combustion turbines are an applicable supply resource for both the Isolated Island alternative and the Interconnected Island alternative. Consequently, the CCCT technology was included in the generation expansion alternatives.

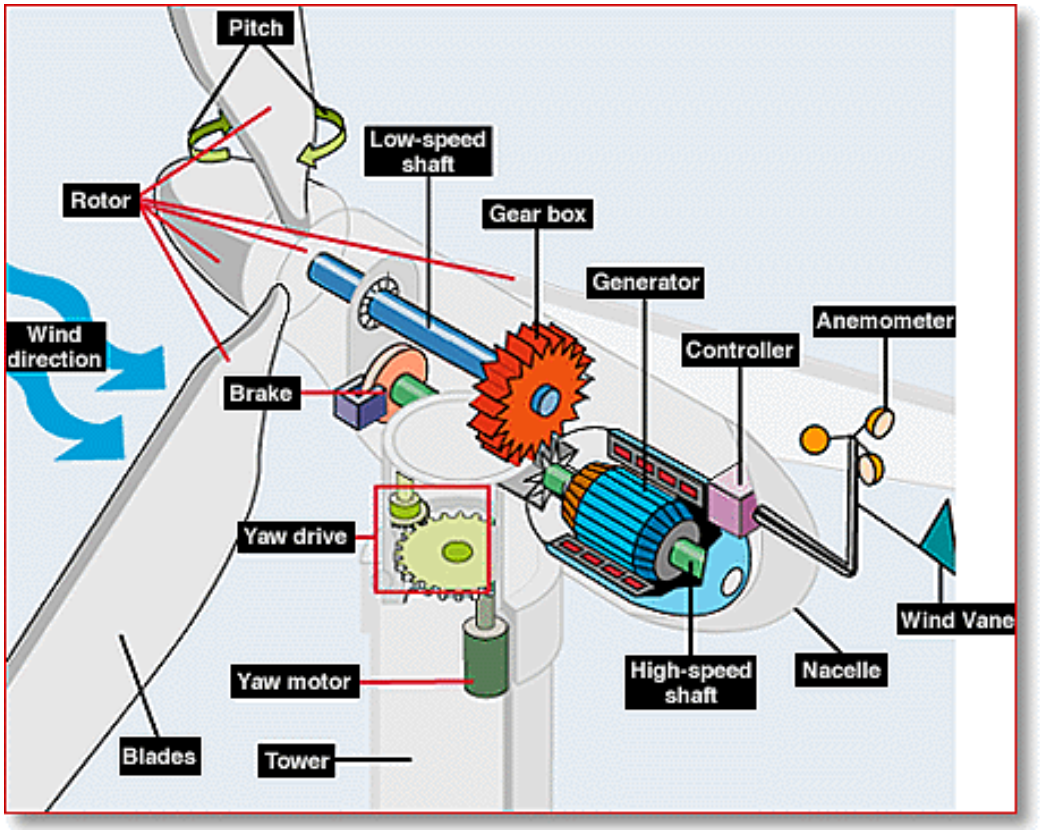
2.5.8 Wind

Wind energy (or wind power) refers to the process by which wind turbines convert the movement of wind into electricity. Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth. Wind energy is harnessed through the use of wind turbines. Wind turbines have three aerodynamically designed blades which spin on a shaft which connects to a generator that produces electricity. Wind passes over the blades, creating lift (just like an aircraft wing) which causes the rotor to turn (The European Wind Energy Association 2011, internet site). Stronger winds will produce more energy. Wind turbines can operate across a wide range of wind speeds - generally from 10 up to 90 km/h (Global Wind Energy Council 2011, internet site). Wind turbines are mounted on a tower to capture the most energy. At 30 metres (m) or more above ground, they can take advantage of faster and less turbulent wind. Figure 2.5.8-1 below shows a typical wind turbine.

The majority of current turbine models make best use of the constant variations in the wind by changing the angle of the blades through "pitch control", by turning or "yawing" the entire rotor as wind direction shifts and by operating at variable speed. Operation at variable speed enables the turbine to adapt to varying wind speeds. Sophisticated control systems enable fine tuning of the turbine's performance and electricity output. Modern wind technology is able to operate effectively at a wide range of sites – with low and high wind speeds, in the desert and in freezing arctic climates (Global Wind Energy Council 2011, internet site).

In a wind farm, individual turbines are interconnected with a power collection system and a communications network. The power is then transferred to the electricity grid.

Figure 2.5.8-1 Components of a Typical Wind Turbine



Source: Government of the United States (2011b, internet site).

There are obvious benefits to wind energy. Wind energy is fueled by the wind, so it is a clean fuel source. Wind energy does not generate air pollution or produce atmospheric emissions that cause acid rain or GHGs.

Electricity generated from wind power can be highly variable at several different timescales: from hour to hour, daily and seasonally; annual variation also exists. Related to variability is the short-term (hourly or daily) predictability of wind plant output. Wind power forecasting methods are used, but predictability of wind plant output remains low for short-term operation. Because instantaneous electrical generation and consumption must remain in balance to maintain grid stability and ensure the electricity is available when the customer needs it, this variability can present substantial challenges to incorporating large amounts of wind power into the Isolated System.

Good wind sites are often located in remote locations, far from places where the electricity is needed. Transmission lines must be built to bring the electricity from the wind farm to the places of high demand.

NL has an excellent wind resource. However, for the Isolated Island System, the amount of wind power that can be integrated into the Island grid is limited. The 2004 NLH study *An Assessment of Limitations For Non-Dispatchable Generation On the Newfoundland Island System* (NLH 2004, internet site) established two limits regarding the possible level of wind generation integration on the Isolated Island System, an economic limit and a maximum technical limit. The study determined that for wind generation in excess of 80 MW there would be a significant increase in the risk of spill at the hydroelectric reservoirs. This would occur when Hydro's reservoir levels were high and system loads were such that the system operator had to decide between curtailing wind generation and allowing water to spill over the dam. Either way, the economic advantage of the wind would be diminished. The study further determined that for wind generation above 130 MW it would not always be possible to maintain system stability particularly during periods of light load

and during these periods wind generation would have to be curtailed, again, reducing the economic benefit of the additional wind generation.

The limits identified in the 2004 study are still applicable today. However, as load grows, the Isolated Island System should be able to accommodate additional wind generation. It has been suggested that the system should be able to accommodate an additional 100 MW of wind in the 2025 timeframe and a further 100 MW around 2035 (Navigant Consulting Ltd. 2011, internet site). NLH will study this prior to Decision Gate 3 (see Section 2.10). As well, as a result of system constraints, and recognizing the inherently intermittent nature of the wind resource, the use of a large-scale wind farm to replace the firm continuous supply capability of the Holyrood plant is not operationally feasible and therefore was not considered in the generation expansion analysis.

NLH has not completed an analysis to establish the level of wind generation that could be sustained in the Muskrat Falls and Labrador-Island Transmission Link option. However, given that this option will include at least one interconnection to the North American electrical grid, and that there will be considerable hydroelectric capacity both in Labrador and on the Island to provide backup, it would be reasonable to consider the addition of up to 400 MW of wind generation on the system.

Onshore wind power typically costs 8 to 12 ¢/kWh, depending largely on how windy the site is and how far it is from existing power transmission lines (The Pembina Institute. n.d). Good wind sites on the Island are at the lower end of this cost range. The estimated average cost incorporates the cost of construction of the turbine and transmission facilities, borrowed funds, return to investors (including cost of risk), estimated annual production, and other components, averaged over the projected service life of the equipment, which is typically around twenty years. Costs associated with any bulk system transmission upgrades that may be required because of the size and / or location of the wind farm are not included in the estimated generation costs.

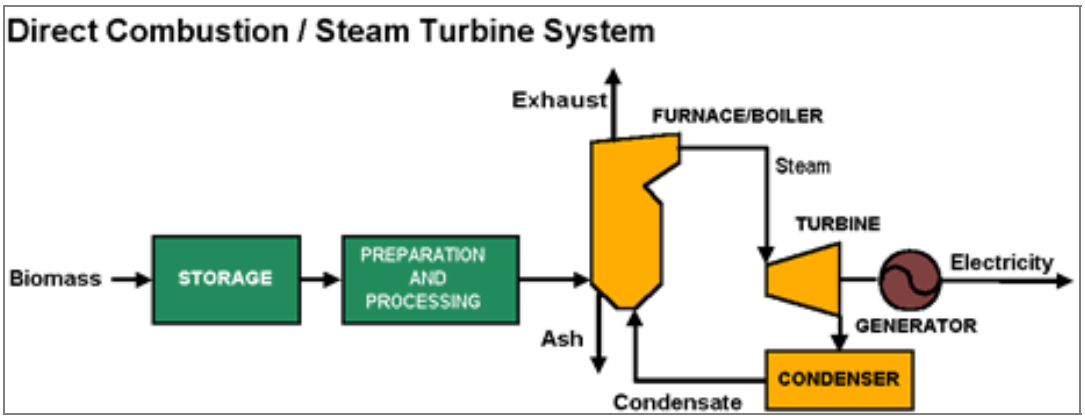
Wind power has a place in the electricity generation mix on the Island and, due to its low environmental footprint, it will be incorporated whenever economically viable. However, technical and operational considerations limit the amount of wind generation that can be operated on the system.

2.5.9 Biomass

Biomass energy is derived from many different types of recently living organic matter (feedstock). However, in the context of producing large-scale energy, it is likely that the focus would be on harvesting forestry products as fuel for the biomass generator. Biomass works similar to many other thermally-based generators in that wood or other biomass products are harvested, treated and then transported to the generation plant to be used in place of other solid fuels such as coal to generate heat. The heat is then used to produce steam. The steam is in turn fed into a turbine that turns a generator to produce electricity.

Figure 2.5.9-1 shows how one type of biomass technology could be deployed.

Figure 2.5.9-1 Typical Biomass Technology



Source: Government of the United States (2011c, internet site).

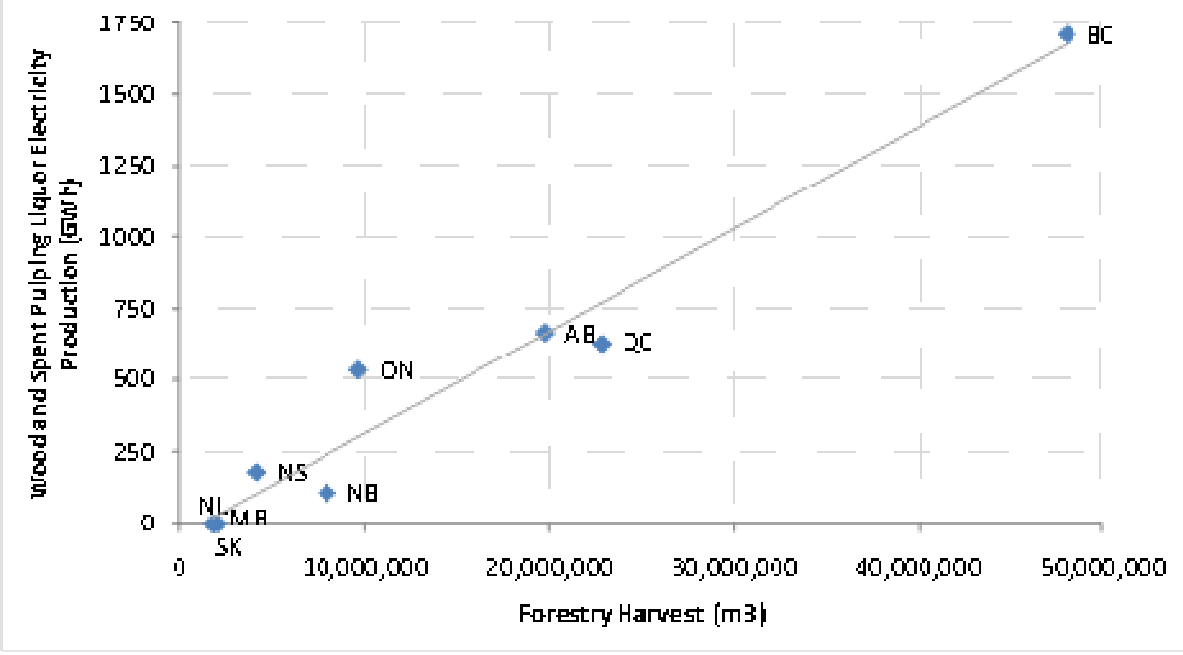
One of the best advantages of biomass is the low GHG production net of the harvesting and transportation operations. Furthermore, biomass is a renewable energy source if forests are properly managed. Biomass could also provide increased markets for the province's forestry industry as any new plants would require significant feedstock.

Biomass plants, which typically operate more efficiently at base load values can load-follow within certain ramp rates. Assuming economics, and that readily available feedstock was not a concern, a biomass plant could reasonably be integrated into the Isolated Island System.

Biomass generation requires significant and steady supplies of feedstock to support generation operations. The security of supply is critical to maintain stable generation. The National Forestry Registry has placed the province's annual forestry harvest seventh of Canadian provinces at some 2 million cubic metres (Government of Canada 2009, internet site). Therefore, significant development of this industry would be required to facilitate the addition of a biomass generator.

Generally speaking, electricity production from biomass leverages the infrastructure used to harvest forestry products for other purposes (such as lumber and pulp and paper production). The strong relationship between forestry harvest and biomass electricity production is shown in Figure 2.5.9-2 in which electricity produced from wood and spent pulping liquor (vertical axis) is plotted against annual forestry harvest (horizontal axis) for nine provinces.

Figure 2.5.9-2 Electricity Production from Wood and Spent Pulping Liquor versus Forestry Harvest by Province



Source: Government of Canada (2009, internet site); Statistics Canada (2009).

As shown, British Columbia has both the highest forestry harvest and the highest volume of electricity produced from wood and spent pulping liquor. Not all of the provinces fall on the line shown in the figure, but there is clearly a relationship between electricity produced from wood, and spent pulping liquor and forestry harvest.

Based on this relationship and NL's annual forestry harvest, it is estimated that the province may have capacity for electricity produced from wood and spent pulping liquor in the range of perhaps 100 GWh by leveraging

the existing infrastructure. This estimate is not the upper limit of electricity production; the province certainly has large areas of forest, but the infrastructure (access roads, vehicles and skilled labour) to harvest sufficient biomass to produce more than the estimated 100 GWh does not likely exist. As a result, higher levels of production are likely to require higher levels of infrastructure investment that ultimately result in higher biomass (and electricity) costs.

Due to the requirement to harvest a large and steady supply of forestry products, manage and maintain the sustainability of the forest harvest, and transportation costs in getting the harvested material to the generation site, the unit costs for energy from biomass plants is usually much higher than other forms of energy.

Navigant Consulting Ltd. has worked with several recent biomass projects and has determined that the capital cost of a new biomass facility is about $3,500 per kilowatt (kW) and the variable fuel cost would be on the order of $50-$100 per MWh giving a unit cost of about $150-$200 per MWh in the province (Navigant Consulting Ltd. 2011, internet site).

While biomass and other co-generation alternatives, when economically feasible, will be considered as future supply alternatives, they are not considered to be appropriate replacements for large-scale generation requirements due to the significant costs and risks around securing an adequate supply of feedstock. On this basis, biomass was screened out as an Isolated Island supply alternative.

2.5.10 Solar Energy

Solar power is the conversion of sunlight into electricity. This is carried out by two main methods:

1. Using sunlight indirectly, Concentrating Solar Power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam to boil water which is then used to provide power.
2. Using sunlight directly, a solar cell, or photovoltaic (PV) cell, is a device that converts light into electric current using the photoelectric effect. Currently in Canada, solar power is focused primarily on PVs.

Photovoltaic (SunEdison 2011, internet site) literally means "*light*" and "*electric*." PV technologies are used to generate solar electricity by using solar cells packaged in PV modules.

The most important components of a PV cell are the two layers of semiconductor material. When sunlight strikes the PV cell, the solar energy excites electrons that generate an electric voltage and current. Extremely thin wires running along the top layer of the PV cell carry these electrons to an electrical circuit.

A PV module is made of an assembly of PV cells wired in series to produce a desired voltage and current. The PV cells are encapsulated within glass and / or plastic to provide protection from the weather. PV modules are connected together to form an array. The array is connected to an inverter which converts the direct current (dc) of the PV modules to alternating current (ac). A typical solar cell array is illustrated in Figure 2.5.10-1.

Figure 2.5.10-1 Solar Cell Array



Source: Stock Photo.

There are a number of issues with using solar power as a generation source on the Island System:

1. Solar power is non-dispatchable; when the sun shines, the system has to take the power generated and when the sun is not shining, during the night, or during cloudy periods, other forms of generation have to be available for backup. The issues with non-dispatchability have been / will be discussed in the sections on "Wind" and "Other Small Hydro".

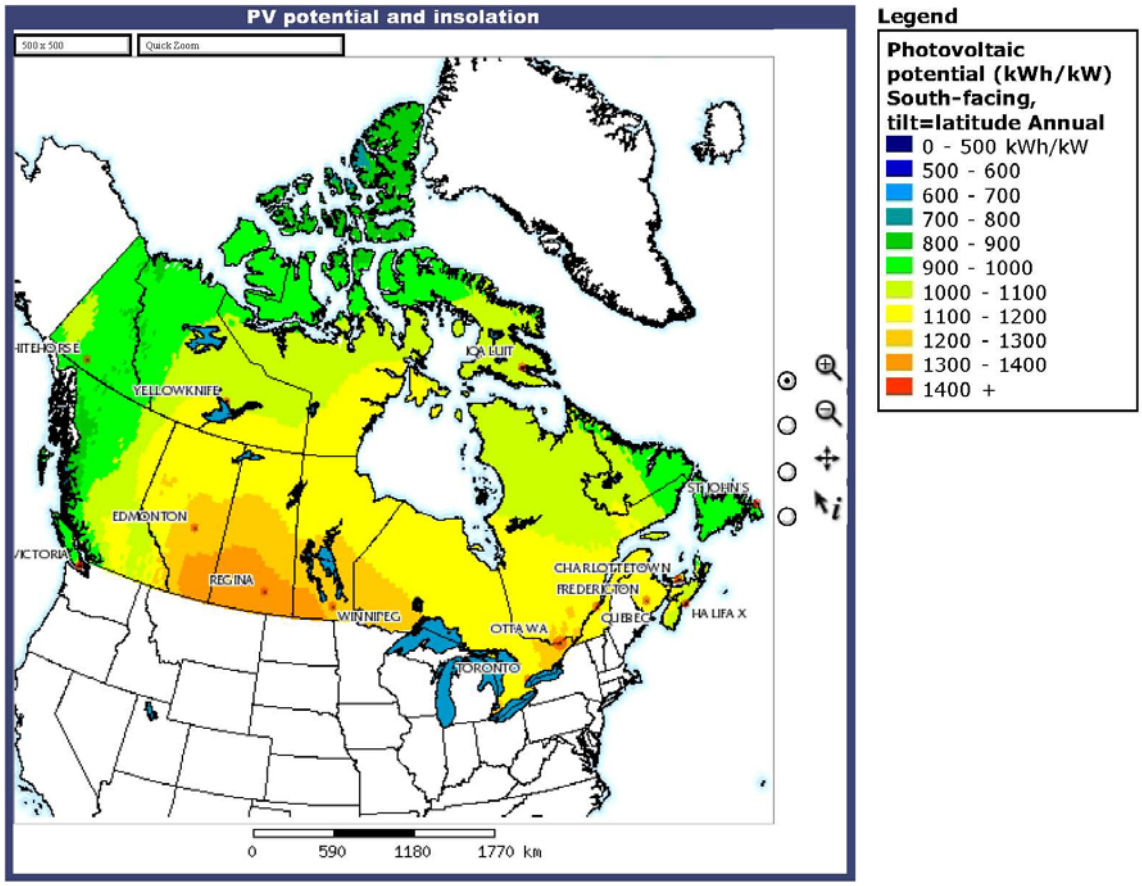
2. NLH's peak demand period typically occurs in the winter during the supper hour. At that time, output from solar power will be nil. Thus, solar power will not provide any capacity at the time of peak demand.

3. NL has one of the lowest rates of solar insolation in Canada, which would result in a low capacity factor and higher unit costs. Even in areas where solar insolation is highest, unit costs for commercial solar energy production are amongst the highest of all generation sources.

According to Natural Resources Canada's (NRCan 2011, internet site), their PV potential and insolation maps indicate that Newfoundland has the second lowest PV potential (kWh/kW) in Canada, as compared to all other provinces.

Figure 2.5.10-2 shows NL's PV potential in relation to the rest of Canada.

Figure 2.5.10-2 Photovoltaic Potential in Canada



Source: Government of Canada (2011a, internet site).

With technology to harness solar energy still under development, panels and other units that collect and store the energy still remain prohibitively expensive on a cost per MW basis. The combination of high cost, lack of availability of power at peak times in winter, lack of dispatchability and the province's low insolation rates resulted in solar being screened out as an Isolated Island supply alternative.

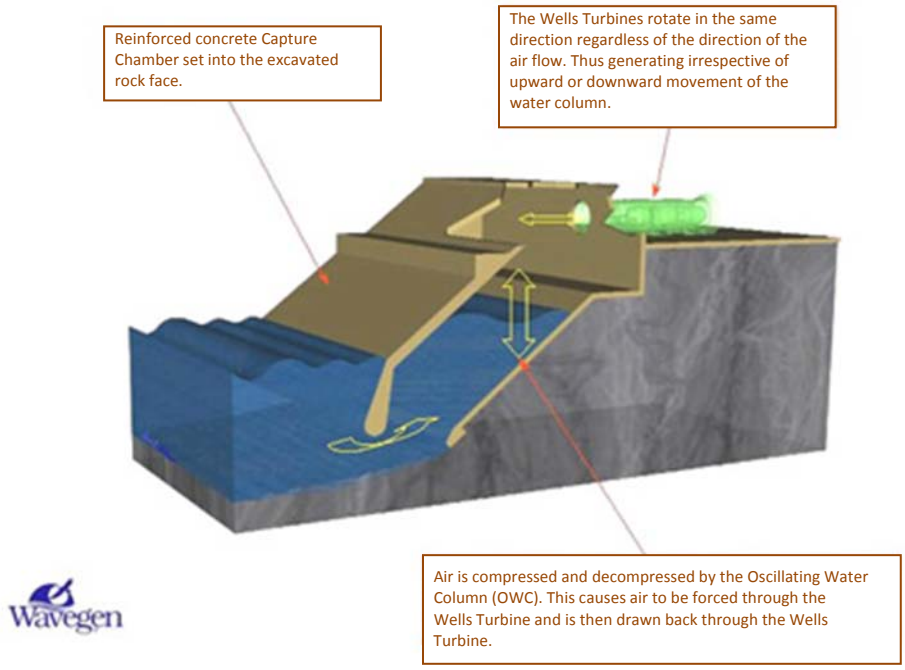
2.5.11 Wave and Tidal Energy

Harnessing energy from the natural motion of the ocean currents and waves has long been considered and studied as a viable option for renewable energy production. Many different technologies have been proposed to approach the problem of extracting the wave and tidal energy to produce electricity.

Wave energy technologies work by using the movement of ocean surface waves to generate electricity. Kinetic energy exists in the moving waves of the ocean. That energy can be used to power a turbine. One type of wave generator uses the up and down motion of the wave to power a piston, which moves up and down inside a cylinder. The movement of the piston is used to turn an electrical generator.

A diagram of one type of wave generator is shown in Figure 2.5.11-1.

Figure 2.5.11-1 Example of a Wave Generator

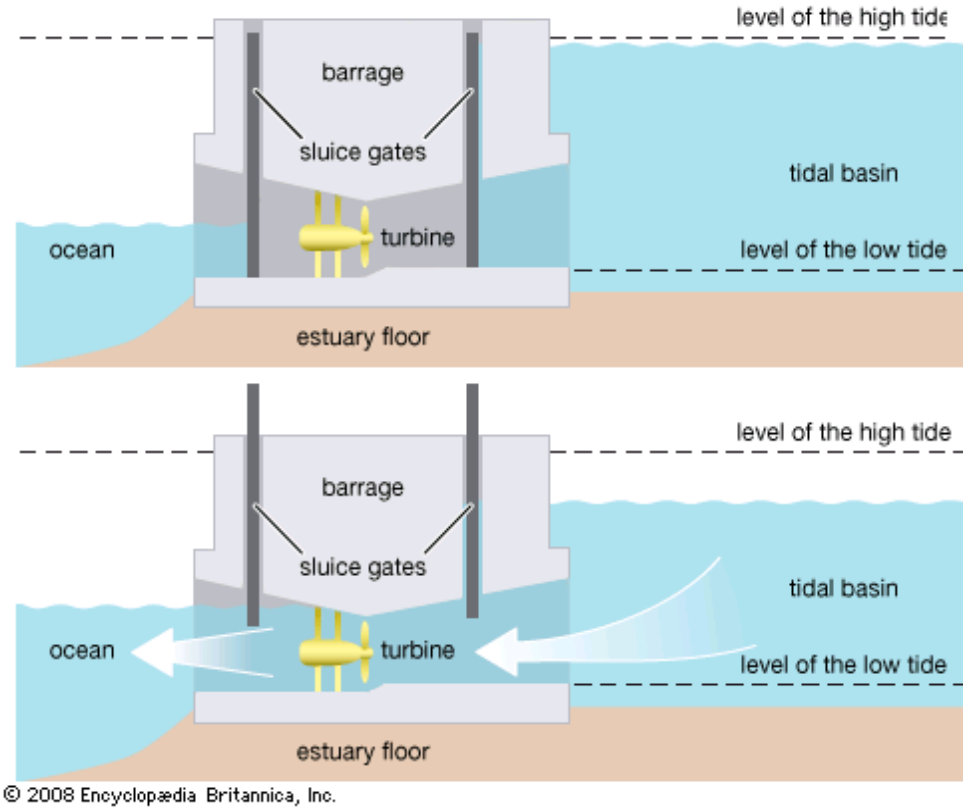


Source: University of Bath (2011, internet site).

Tidal power is based on extracting energy from tidal movements and the water currents that accompany the rise and fall of the tide. When the tide rises, the water can be trapped in a reservoir behind a dam. Then when the tide falls, the water behind the dam can be released through a turbine similar to a regular hydroelectric power plant.

Figure 2.5.11-2 depicts one type of tidal generator. The system uses sluice gates and a barrage to trap the ocean water when it reaches its high tide level. The water is released when the tide falls, and the movement of the water is used to turn a turbine and generator to produce electricity.

Figure 2.5.11-2 Example of a Tidal Generator



Source: Encyclopedia Britannica (2011, internet site).

Wave and tidal energy provide a number of benefits. First, both are a clean energy source and do not emit any GHGs while generating electricity. Ocean tides are predictable and occur on a regular basis. Also, wave energy is less intermittent than wind or solar power (Electric Light & Power 2009).

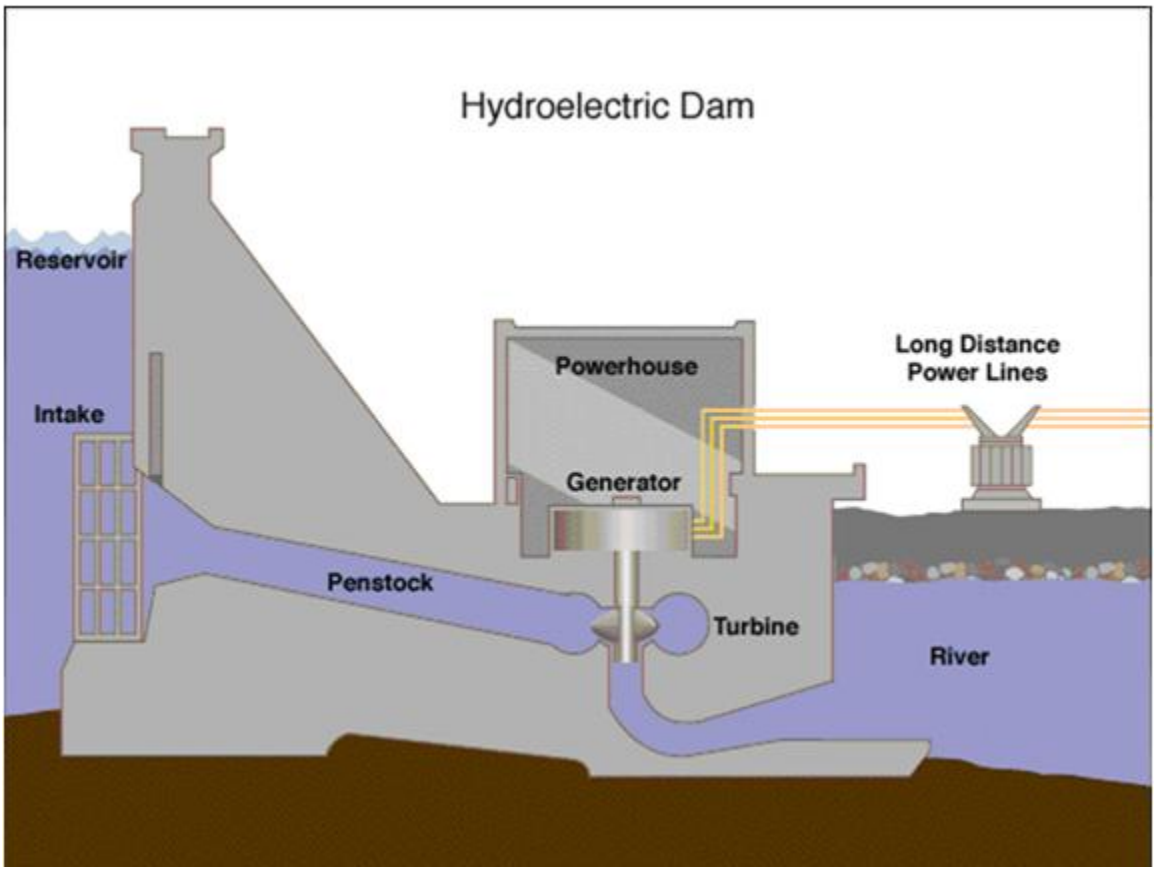
However, wave and tidal energy installations face some limitations. The primary limitation is the fact that the ocean environment can be harsh on the equipment used in wave and tidal installations. As a result, the equipment used must be built robustly to contend with waves and salt water. Consequently, wave and tidal generators can cost approximately three to four times more than wind turbines per megawatt (Electric Light & Power 2009). Another limitation is the fact that in order for a tidal generator to work well, a large variation in tidal levels is required. This limits the locations where tidal generation can be installed to produce large amounts of electricity in an efficient manner (Ocean Energy Council 2011, internet site).

Despite some limited successes, neither tidal nor wave power has become a commercial mainstream source of renewable energy. Consequently, NLH screened out the use of wave and tidal power as an alternative supply option for the Isolated Island supply alternative.

2.5.12 Hydroelectric Generation

Hydroelectric stations generate electricity using the kinetic energy of falling water. Some plants are constructed at natural drops in rivers, while others employ dams to raise the upstream water above downstream levels. Figure 2.5.12-1 presents a diagram of a hydroelectric dam.

Figure 2.5.12-1 Diagram of Hydroelectric Dam



Source: Government of Canada (2011b, internet site).

Typically, a hydroelectric station generates electricity as follows:

- water from a reservoir or river flows through the intake, an underwater opening into a pipe or tube called the penstock;
- water flows down through the penstock under increasing pressure;
- at the end of the penstock, a turbine is mounted, inside a powerhouse;
- as the water pushes its blades, the turbine rotates;
- this turns an internal shaft connected to a generator, and electricity is produced; and
- as the water exits the turbine, it is conducted back to the river by a channel or pipe called a tailrace.

Station capacity can be large or small and is determined by the flow rate of the water and the vertical distance between the level of the source water and the outflow – or head.

Hydroelectric generation has a number of benefits. Since hydroelectric generation converts kinetic energy from the natural water cycle into electricity, it is a renewable source that does not create smog- or acid rain-causing atmospheric pollutants in its typical operations, or generate waste. Minimal GHGs result from normal biological processes occurring at hydro reservoirs, but life-cycle GHG emissions are similar to those of wind power, and much lower than those of thermal combustion plants.

On the economic side, although the upfront costs for constructing hydro generating stations can vary considerably and are generally high, Operations and Maintenance costs are generally low, and the lifetime of hydro plants is very long (e.g., the Petty Harbour Hydro-Electric Generating Station near St. John's has been generating electricity since 1900). As well, the cost of operating a hydroelectric plant is nearly immune to increases in the cost of fossil fuels such as oil, natural gas or coal, and no imports are required.

In addition, hydro is a very reliable and predictable source of power. As a result of the longevity, reliability and flexibility of hydroelectric stations in Canada, hydro is one of the cheapest sources of electricity. According to the National Energy Board, Canada's reliance on hydroelectric generation is largely responsible for the country having some of the lowest electricity prices in the world (National Energy Board 2011, internet site).

NLH carries three hydro developments on the Island in its generation portfolio for potential development. These projects have been screened and evaluated to be both economically viable and environmentally acceptable. Therefore, NLH has undertaken feasibility studies for the following three hydroelectric sites in its portfolio (SNC-Lavalin Inc. 1988, 1989, 2006, 2007), all of which are applicable in both generation expansion alternatives and progressed to phase 2 screening.

2.5.12.1 Island Pond

Island Pond is a proposed 36 MW hydroelectric project located on the North Salmon River, within the watershed of the existing Bay d'Espoir development. The project would utilize approximately 25 m of net head between the existing Meelpaeg Reservoir and Crooked Lake to produce an annual firm and average energy capability of 172 GWh and 186 GWh, respectively.

The development would include the construction of a three kilometre (km) diversion canal between Meelpaeg Reservoir and Island Pond, which would raise the water level in Island Pond to that of the Meelpaeg Reservoir. Also, approximately 3.4 km of channel improvements would be constructed in the area. At the south end of Island Pond, a 750 m long forebay would pass water to the 23 m high earth dam, and then onto the intake and powerhouse finally discharging it into Crooked Lake via a 550 m long tailrace. The electricity would be produced by one 36 MW Kaplan turbine and generator assembly.

The facility would be connected to TL 263, a nearby 230 kV transmission line connecting the Granite Canal Generating Station with the Upper Salmon Generating Station.

A final feasibility-level study and estimate, *Studies for Island Pond Hydroelectric Project* (SNC-Lavalin Inc. 2006, internet site), was completed for NLH by an independent consultant. The report prepared a construction ready update report including an updated capital cost estimate and construction schedule projecting approximately 42 months from the project release date to the in-service date. Figure 2.5.12-2 illustrates the conceptual sketch of the Island Pond development.

Figure 2.5.12-2 Conceptual Sketch of the Island Pond Development



Source: SNC-Lavalin Inc. (2006, internet site).

2.5.12.2 Portland Creek

Portland Creek is a proposed 23 MW hydroelectric project located on Main Port Brook, near Daniel's Harbour, on the Great Northern Peninsula. The project would utilize approximately 395 m of net head between the head pond and outlet of Main Port Brook to produce an annual firm and average energy capability of 99 GWh and 142 GWh, respectively.

The project would require a 320 m long diversion canal, three concrete dams, a 2,900 m penstock, a 27 km 66 kV transmission line from the project site to Peter's Barren Terminal Station; and the construction of access roads. The electricity would be produced by two 11.5 MW Pelton turbine and generator assemblies. Figure 2.5.12-3 illustrates the conceptual sketch of the Portland Creek hydroelectric development.

Figure 2.5.12-3 Conceptual Sketch of the Portland Creek Hydroelectric Development



Source: Nalcor (2011a, internet site).

The current schedule and capital cost estimate for Portland Creek is based on a January 2007 feasibility study, *Feasibility Study for: Portland Creek Hydroelectric Project* (SNC-Lavalin Inc. 2007, internet site), prepared for NLH by an independent consultant. The proposed construction schedule indicates a construction period of 32 months from the project release date to the in-service date.

2.5.12.3 Round Pond

Round Pond is a proposed 18 MW hydroelectric project located within the watershed of the existing Bay d'Espoir development. The project would utilize the available net head between the existing Godaleich Pond and Long Pond Reservoir to produce an annual firm and average energy capability of 108 GWh and 139 GWh, respectively.

The current schedule and capital cost estimate for Round Pond is based on the 1988 feasibility study, *Round Pond Hydroelectric Development* (SNC-Lavalin Inc. 1988, 1989, internet site), prepared for NLH by an independent consultant, and the associated 1989 Summary Report based on the same. In the absence of any further work beyond what was identified in this study, the overall program for the Round Pond development is estimated to be completed in 33 months, including detailed engineering design.

2.5.12.4 Other Small Hydro

There are numerous undeveloped small hydroelectric sites on the Island. An inventory of these sites was developed in a 1986 study undertaken for NLH by Shawmont Newfoundland. The extent to which a significant

quantity of small hydro development can be accommodated is limited because the Newfoundland electricity system is currently isolated from the North American grid. The lack of interconnection to other systems introduces technical and operational system constraints which are generally related to the ability to provide capacity when it is required during peak periods.

Most of the remaining projects do not have storage capability and are referred to as "run of the river" facilities. Run of the river hydroelectric facilities have operating attributes similar to wind generators as they only operate when there is water in the river and there is no certainty that the plants will be available to provide capacity at the time of peak load.

In integrating small hydro and wind energy into the Newfoundland electricity system, planning and operational considerations to ensure reliable electricity supply are paramount. Both wind and run of the river hydro are non-dispatchable (meaning they only operate when either the wind is blowing or when there is water in the river). As discussed in Section 2.5.8, wind is quite variable, and while a run of the river project may be less variable, the fact that there is minimal or no storage means that there is no guarantee that the capacity will be available at the time of peak when it is really needed. Also, river flows during the peak winter season are often lower than during any other season. Consequently, the run of the river project has less capacity and energy available when the system requires it most.

The successful integration of this technology is conditional upon an interconnection to a larger grid where there is sufficient low cost firm reserve capacity to compensate for the variability caused by the non-dispatchability of resources (i.e., the run of the river technology). In the Isolated Island alternative the required firm reserve would be provided by the Holyrood plant or some other thermal generating source, which diminishes much of the economic advantage of the non-dispatchable resource. Since no interconnections to other markets exist, opportunities to export surplus energy to other markets or to rely on other markets to support the Island System do not exist.

Despite the concerns, there is a limited capacity for the integration of a small amount of additional non-dispatchable resource in the Island Isolated alternative. Nalcor considered additional small hydro, but because of an economic preference for wind over small hydro, Nalcor has opted to use wind as the non-dispatchable generation of choice to be included in the Isolated Island alternative in Phase 2 screening.

Small hydro development on the Island is not without controversy and an appreciable level of public opposition. In 1992, NLH Issued a Request for Proposals (RFP) for the purchase of up to 50 MW of small hydro production from NUGs. The process involved a preliminary screening process and at the final submission stage there were eleven projects submitted for consideration. The majority of these projects were for developments that had been identified in the 1986 Shawmont Newfoundland study. NLH accepted four of the eleven proposals of which two were constructed - Star Lake 15 MW and Rattle Brook 4 MW. The others, Northwest River 12 MW and Southwest River 7 MW, were halted prior to construction due mainly to public opposition. Following this chain of events the GNL imposed a moratorium on further small hydro development in 1998. This moratorium is still in effect today.

Since the 1998 moratorium there has been little activity around small hydro development. NLH has completed an analysis based on the 1992 RFP data that supports the decision to screen out the technology as an alternative for the Isolated Island alternative. The seven unsuccessful projects from the 1992 RFP can be considered to be representative of the most attractive of the remaining undeveloped small hydro on the Island. Based on submission data, these projects had an average bid price of 6.64 cents per kWh (1992$), escalating this price to 2010$ using Nalcor's/NLH's "Hydraulic Plant Construction" escalation series, results in a current estimate of 10.4 cents per kWh (2010$). In comparison, NLH is carrying 9.2 cents per kWh (2010$) for the wind PPAs used in current modeling (Nalcor 2011f, internet site). This indicates that NLH would pay a premium of approximately 13% for small hydro. The estimated costs reflect single small scale installations and while this would include basic grid interconnection it does not cover costs associated with major transmission upgrades that may be required for larger or multiple small scale installations.

Based on these factors small hydro other than Island Pond, Portland Creek and Round Pond have been screened from further evaluation.

2.5.13 Labrador Hydroelectric Resources

2.5.13.1 Deferred Churchill Falls

In Phase 1 screening, consideration was afforded to a supply option that entailed a continuation of the Holyrood plant operations and additional thermal generation as required for another three decades, and then to commission a transmission interconnection between Labrador and the Island to avail of electricity production from the Churchill Falls hydroelectric generating facility in 2041 when the current long-term supply contract with Hydro Québec terminates. This option did not advance beyond Phase 1 screening for the following reasons (Nalcor response to MHI-Nalcor-3 (Nalcor 2011d, internet site)):

1. There is inherent uncertainty around guaranteeing the availability of supply from Churchill Falls in 2041 because it is difficult to determine the environmental and policy frameworks that will be in place 30+ years out. There are other issues surrounding the Churchill Falls asset with respect to Hydro Québec, as Nalcor is not the sole shareholder of the Churchill Falls operation.
2. There is also significant risk associated with maintaining reliable supply through continued life extension measures for the Holyrood plant through to 2041. At that time, the first two units at the Holyrood plant will be 70 years old.
3. Deferral of the interconnection would result in significantly higher rates for Island consumers between now and 2041 and does not provide rate stability to Island consumers as rates are tied to highly volatile fossil fuel prices for the first 30+ years of the study period along with escalating maintenance costs for the Holyrood plant and an increasing likelihood that replacement of the plant will be required prior to 2041.
4. Island customers will remain dependent on fossil fuel generation for the first 30+ years of the study resulting in continued and increasing GHG emissions. Given the Government of Canada's decision to introduce GHG emissions regulation for coal fired generating stations, Nalcor's ability to refurbish the Holyrood plant without conforming to GHG emissions regulation is doubtful, and replacement of the plant may be required between now and 2041.
5. Each of the screening criteria above has significant risk and uncertainty that are not present in either the Isolated Island or Interconnected Island alternatives.

   The prospect of requiring substantial investment to the Holyrood plant to extend its life beyond that contemplated in the Isolated Island alternative, or the real possibility of requiring replacement of the Holyrood plant and then retiring it in 2041, increases the probability that this option will be substantially more expensive than projected.

The deferral of construction of Muskrat Falls and the Project introduces other economic disadvantages:

1. Value is lost by the province through the deferral of monetization of NL's energy warehouse. The revenue benefits of Muskrat Falls, Gull Island, other wind and small hydro developments throughout the province will be foregone, thus reducing government's ability to invest in infrastructure and to provide services. Revenue that could have been used to fund long-term assets and infrastructure will have been used to purchase imported oil.
2. Economic and employment benefits from domestic economic activity associated with domestic energy construction projects will be foregone for decades.

In addition, NLH completed a *Strategist®* analysis for a generation expansion plan that includes the deferred transmission interconnection with Labrador coupled with the supply of energy from Churchill Falls in 2041. While this option did not make it beyond Phase 1 screening, it was run in *Strategist®* as a sensitivity and the CPW results, which are presented in Section 2.7.1.5, confirm the decision not to pursue this option further.

2.5.13.2 Recall Power from Churchill Falls

Under the existing power contract between Hydro Québec and Churchill Falls (Labrador) Corporation, there is a provision for a 300 MW block of power which can be recalled for use in Labrador. The 300 MW block is sold to NLH in its entirety. NLH meets the needs of its customers in Labrador first and then sells any surplus energy into export markets.

In addition to its domestic and general service customers in Labrador, NLH has contracts with:

- the Iron Ore Company of Canada for 62 MW of firm power, 5 MW interruptible and secondary power if available; and
- the Department of National Defense in Happy Valley-Goose Bay for 23 MW of secondary power.

In 2010, approximately 38% of the energy available under the 300 MW recall contract was sold in Labrador, with the unused balance being sold into short-term export markets. On average in the winter almost 220 MW of power is used to meet demand in Labrador. With only 80 MW of recall power available in the winter, there is insufficient firm capacity and energy available to meet the Island's electricity needs and to displace the Holyrood plant, which generates almost 500 MW at the time of highest (winter) need for the province. The use of recall power was therefore screened out during Phase 1 as an alternative supply option for the Island.

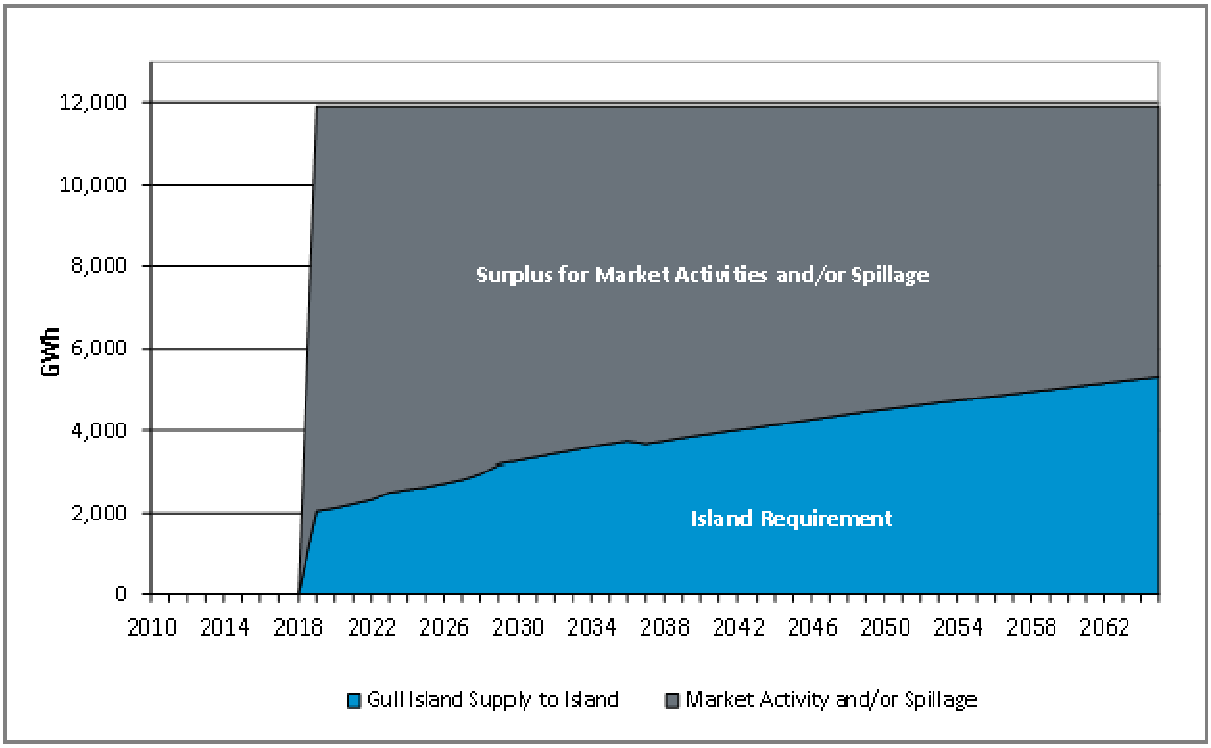
2.5.13.3 Gull Island

Gull Island is a 2,250 MW hydroelectric generation project on the Churchill River with an average annual energy capability of 11.9 TWh. Located 225 km downstream from the existing Churchill Falls power plant, Gull Island has been extensively studied over the years and the engineering work completed has led to a high level of confidence in the planned design and optimization of the facility.

Gull Island is the larger of the two Lower Churchill hydroelectric sites. While offering more favourable economies of scale than Muskrat Falls, and therefore a lower unit cost per MWh of production, if all of the output was assumed sold or used, Gull Island requires significantly greater capital investment. The scale of Gull Island output creates a requirement to either negotiate with neighbouring utilities for export contracts, attract investments in energy intensive industries, or to participate directly in regional wholesale markets to attain the full utilization unit cost. If such opportunities do not exist, and Island supply is the only available market, then the total cost for Gull Island has to be spread over a smaller block of utilized energy. This makes the actual unit cost of Gull Island greater than Muskrat Falls.

Figure 2.5.13-1 shows the forecasted energy requirement for the Island against the annual output for Gull Island. Initially, the Island would require less than 20% of Gull Island's annual production, growing to about 45% by 2065. The development of Gull Island is therefore linked to either the successful negotiation of both power sales agreements and transmission service arrangements for exports, or a significant increase in industrial load in the province, or a combination of both. Because of the magnitude of the investment associated with Gull Island, compared to that of Muskrat Falls, greater certainty is required for these arrangements in advance of sanctioning the project to meet the requirements of potential lenders to the project.

Figure 2.5.13-1 Island-Labrador Electricity Supply Balance with Gull Island



Source: Exhibit 6B (Nalcor 2010e, internet site).

Historically there were no open transmission services available in Canada. Labrador hydroelectric potential was geographically isolated from larger power markets with the exception of Québec. Over the past many years there have been a number of unsuccessful efforts to negotiate power sales arrangements with Hydro Québec and to attract energy intensive industry to the province, especially aluminum smelting.

The unbundling of the electricity industry into its primary services, and introduction of wholesale competition in United States of America electricity markets in the latter 1990s, required the adoption of open non-discriminatory transmission access to facilitate competition in the industry. The US Federal Energy Regulatory Commission (US FERC), which has jurisdiction over the US wholesale electricity trade, has adopted multiple rules designed to prevent undue discrimination and the exercise of market power to ensure fair and competitive markets. All market participants owning transmission facilities have to conform to these rules and must demonstrate they are providing open non-discriminatory transmission access to third parties. The adoption of open access transmission tariffs marked a milestone change for the electricity sector. Hydro Québec is now required to provide open transmission access on its transmission grid in return for being able to participate in the wholesale electricity market in the northeast US. While there is no Canadian federal regulator with jurisdiction to ensure open and fair access over all transmission in Canada, the US FERC does have jurisdiction over the US activities of Canadian entities that participate in US competitive wholesale markets.

NLH, and subsequently Nalcor, have followed these market developments closely. In 2006, NLH made an application to Hydro Québec for transmission service for output from the Lower Churchill Project to multiple markets in accordance with open access rules. This started a multi-stage study process that, ultimately would normally have led to a transmission service agreement. NLH was not satisfied that Hydro Québec was adhering to its own open access rules and procedures and filed formal complaints with the Québec Energy Regulator, (the Regie de l'energie (the Regie)). This led to a prolonged regulatory complaint hearing process that culminated in decisions against NLH. In 2010, NLH sought a revision of the Regie's decisions on grounds that

they contained fundamental errors. In 2011, this application was denied. NLH subsequently has filed an application for judicial review by the Québec Superior Court of the Regie's decisions on grounds that the Regie committed fundamental errors in terms of procedure and in the application of Hydro Quebec's open access rules.

NLH has invested significant time and resources in PPA negotiations and in seeking transmission access in accordance with open access rules on the Hydro Québec transmission system. Nalcor will continue to avail of all appropriate channels to obtain the firm transmission services required to develop an export sales portfolio for the Gull Island project. However, in the absence of the required certainty on being able to access export markets and sell surplus production, it would not be prudent at this time to propose project sanction for the Gull Island project. Similarly, in the absence of substantive commitments from new or existing industrial interests requiring major new power and energy requirements, it is again not prudent for Nalcor to advance Gull Island further at this time.

Because of the large scale of production and investment associated with the Gull Island development, firm transmission access to export markets is required since the internal provincial requirements account for a relatively small percentage of the output for many years. In the absence of such firm transmission service, reasonable financing of Gull Island would be unlikely.

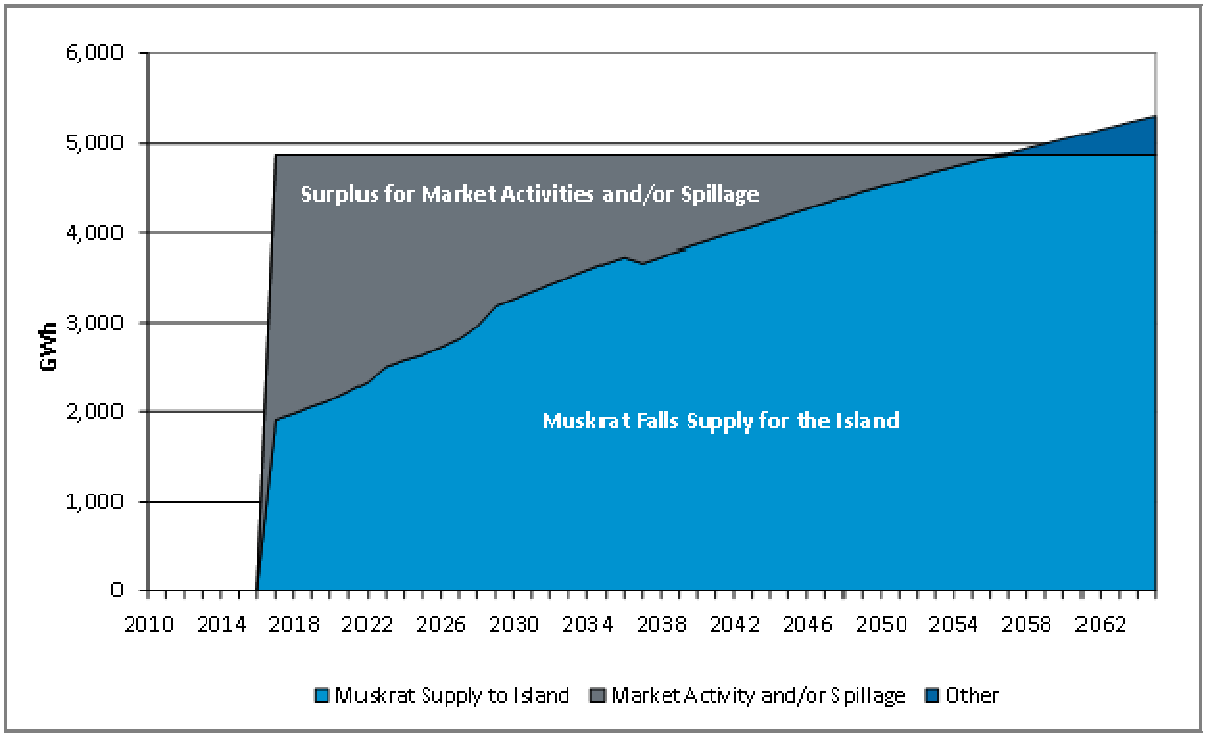
As a result of the high unit cost of energy without external sales or other new use compared to Muskrat Falls, the absence of firm transmission access to export markets at this time and the difficulty of arranging financing in such an environment, Gull Island did not advance past the Phase 1 screening of alternatives.

2.5.13.4 Muskrat Falls

The hydroelectric generation site at Muskrat Falls near the Churchill River is an 824 MW facility with an average energy capability of 4.9 TWh per year.

Figure 2.5.13-2 provides the forecast requirements for the Island Relative to the output of Muskrat Falls across the planning period. The Island can initially use about 40% of Muskrat Falls supply in the early years following commissioning, increasing steadily in line with the Island's economic growth and so that by the mid 2050s, 100% of the Muskrat Falls production would be used within the province.

Figure 2.5.13-2 Island-Labrador Electricity Supply Balance with Muskrat Falls



Source: Exhibit 6B (Nalcor 2010e, internet site).

As noted in the previous Gull Island section, the unit cost of Muskrat Falls, assuming no value for the unutilized energy, is lower than the Gull Island unit cost under the same assumption. Muskrat Falls offers an appropriately sized indigenous and renewable generation project to address the internal energy requirements for the province in the foreseeable future. Surpluses in the initial years can be used for additional local requirements or sold, as possible, into short term export markets. The Muskrat Falls supply option cleared Phase 1 screening for input to further system planning analysis.

2.5.14 Regional Imports

As an alternative to the development of indigenous resources and facilities, NLH could construct a transmission interconnection to regional electricity markets and to then import its power and energy requirement to displace thermal production at the Holyrood plant and meet the incremental growth in electricity demand for the province. Two configurations were considered for Phase 1 screening in this regard:

- a transmission interconnection from Churchill Falls to the Island; and
- a transmission interconnection from the Maritimes to the Island.

For purposes of the screening review, energy was assumed to be ultimately sourced from the New York and New England markets as both regions have competitive wholesale generation markets.

Unrestricted access to firm transmission services were assumed to be available across intervening jurisdictions of Québec and New Brunswick / Nova Scotia, respectively. Accordingly, the extent of transmission system reinforcements that may be required, for example, across Nova Scotia and New Brunswick is unknown, and could not be determined for the screening review. The prevailing assumption was that the existing Open Access Transmission Tariffs for Nova Scotia and New Brunswick, or for Québec, would be the only external transmission expenses to apply.

Each HVdc interconnection configuration would terminate at Soldiers Pond, adjacent to the Avalon load centre, consistent with the Labrador-Island Transmission Link. As load on the Island grows, increasing firm transmission capacity would be required.

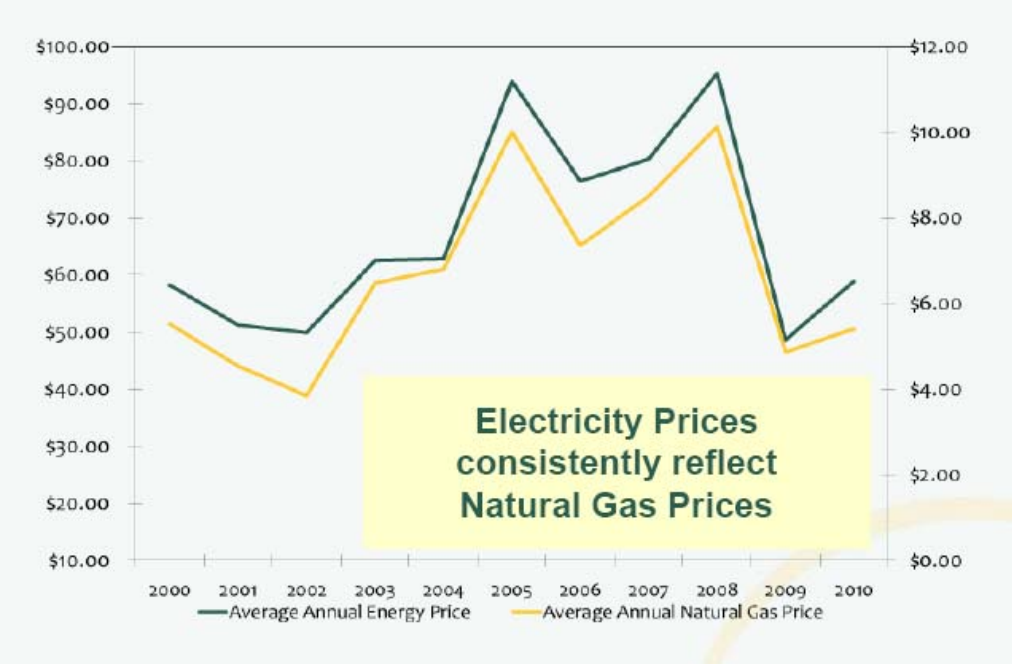
Reliance on electricity imports raised the following considerations in Phase 1 screening:

- exposure to price volatility or significant price premiums;
- security of supply – short- and long-term; and
- potential market structural / transmission impediments.

2.5.14.1 Price Volatility

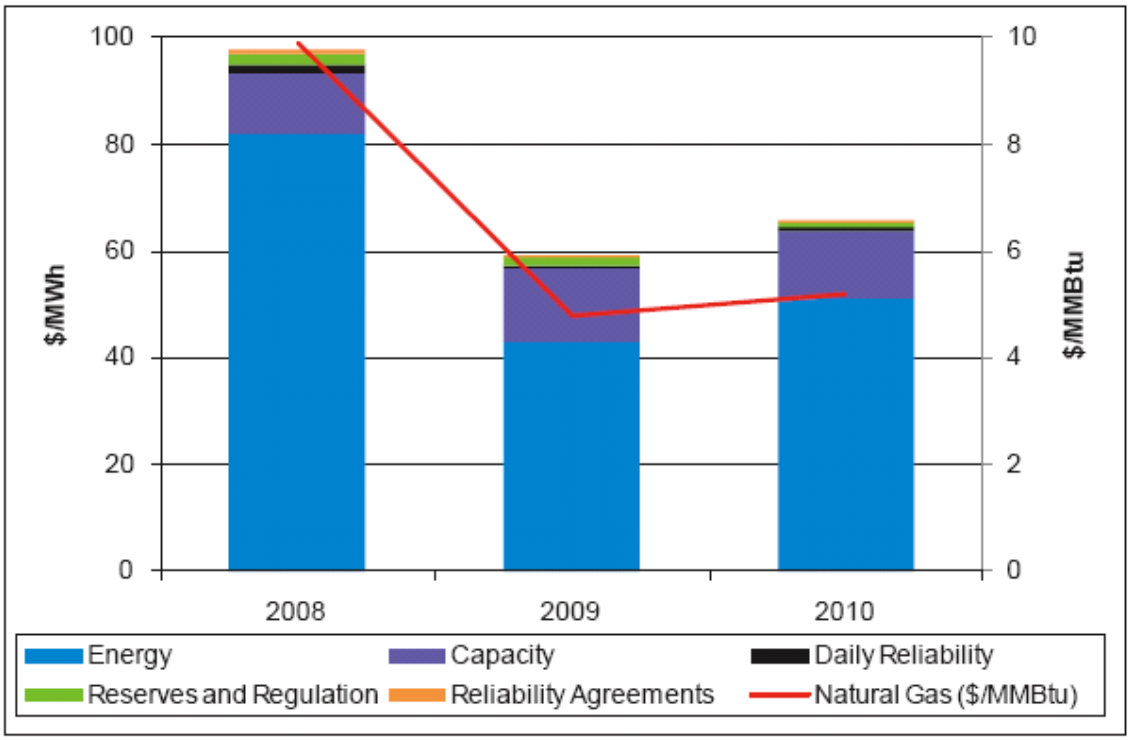
Natural gas-fired generation is typically the marginal supply source and price setter in both the New York and New England wholesale generation markets, as is evident in Figure 2.5.14-1 and Figure 2.5.14-2.

Figure 2.5.14-1 Annual Average Electricity Prices and Natural Gas Prices in New York State



Source: New York Independent System Operator (2011).

Figure 2.5.14-2 All in Cost of Electricity in New England and Natural Gas Prices in New England



Source: ISO New England (2011a).

As a result of the strong correlation between electricity market clearing prices and natural gas prices, these wholesale market prices are exposed to gas price volatility. In addition to gas price volatility, many other local variables affect the short-term clearing prices in these markets, including weather conditions impacting peak demand, unplanned generation or transmission outages and transmission congestion.

2.5.14.2 Security of Supply

Security of supply is continuously assessed by the System Operators in these regions. The latest market reports (ISO New England 2011b, internet site; New York Independent System Operator 2011) indicate that the economic recession has had a significant impact on load in the region, thus providing short term assurance of the adequacy of supply to meet forecast market requirements. However, beyond 2015, both New England and New York are facing potentially significant plant retirements, both because of the age of the generation fleet and because a significant proportion of the baseload generators in the region are carbon fuelled (coal and gas in particular). In New York, 60% of installed generation is pre 1980s generation (New York Independent System Operator 2011) and 53% of capacity is oil- or coal-fired (New York Independent System Operator 2011). The New York Independent System Operator predicts that almost 24,000 MW of generation capacity will be impacted by the more stringent Environmental Protection Agency regulations. As a result of the required expenditures to achieve compliance, certain older facilities may be no longer competitive and forced to close. In New England, coal and oil generation comprise 9,604 MW or 30% of generation capacity. The New England system operator reports estimates for retirements or de-ratings in the range of 5,800 MW to 8,700 MW resulting from Environmental Protection Agency rules (ISO New England 2011b, internet site).

Plant retirements and / or de-rating across the region have implications for the availability and price of supply and are risks which are introduced as a result of relying on imports as a long-term supply source for the province.

2.5.14.3 Potential Market Structural and Transmission Impediments

While reliance on imports reduces control over security of supply, some of this may also be a result of how electricity markets are structured and function. For example in the New England and New York markets there are currently no long-term physical transmission rights (beyond 1 to 2 years), thereby complicating the process of transmitting energy from a power plant in the market to an external customer. While the System Operators are working on addressing this issue it is currently a consideration.

In summary, as a result of the risks outlined on price volatility, security of long-term supply, and transmission impediments, the reliance on electricity imports as a long-term supply option for the Island was not considered further following Phase 1 screening.

2.5.15 Summary of Supply Alternatives

Table 2.5.15-1 summarizes the power supply options considered by NLH in its assessment of long-term generation expansion alternatives for the future supply of power and energy for the province in general and for the Island in particular.

Table 2.5.15-1 Summary of Power Generation Supply Options and Initial Screening

Power Generation Option	Isolated Island	Interconnected Island
Nuclear	×	×
Natural Gas	×	×
Liquefied Natural Gas	×	×
Coal	×	×
Combustion Turbines	✓	✓
Combined Cycle Combustion Turbines	✓	✓
Wind	✓	✓
Biomass	×	×
Solar	×	×
Wave/Tidal	×	×
Island Hydroelectric	✓	✓
Labrador Hydroelectric	n/a	✓
Electricity Imports	n/a	×
Transmission Interconnection	n/a	✓

Source: Nalcor (2011a, internet site).

As previously stated, NLH applied a high level of scrutiny to the screening around security of supply and reliability and this level of scrutiny is deemed necessary because NLH has to demonstrate with confidence that it can fulfill its mandate. The generation supply options that passed the initial screening were included in the portfolio of options that the *Strategist®* utility power system planning software optimized for the least-cost objective function subject to certain constraints like the presence or absence of resources associated with the Lower Churchill Project.

With the screening process completed, the alternatives that pass the screening process are then optimized into a least-cost generation expansion for an Interconnected Island (Project) and Isolated Island (no Project) alternative.

2.6 Development of Least-Cost Generation Expansion Plans

The next step in the economic evaluation process is to develop least-cost generation expansion plans under two scenarios – without the Project (Isolated Island alternative) and with the Project (Interconnected Island alternative). *Strategist®* is used to develop an optimized least-cost solution in each scenario using the supply options that have advanced through the initial screening process. Applicable generation and transmission planning criteria are adhered to in all cases.

2.6.1 Isolated Island (No Project) Alternative

The Isolated Island alternative is an optimization of proven technologies and supply options that passed through the initial screening and that have been engineered to a level sufficient to ensure they can meet the required expectations from reliability, environmental and operational perspectives. There is a high level of certainty that all elements can be permitted, constructed and integrated successfully with existing operations.

The Isolated Island alternative is a least-cost optimization of all costs associated with the development of further Island hydroelectric facilities, additional wind supply, and a combination of replacement capital for existing thermal facilities and the construction of new thermal resources utilizing fossil fuels purchased in global oil markets. Important capital and operating components of the Isolated Island alternative rest with pollution abatement technologies for the Holyrood plant as well as the subsequent installation of CCCT technology utilizing light fuel oil for growth as well as for the replacement of the Holyrood plant.

The generation expansion plan for the Isolated Island alternative is a continuation of the status quo that relies on the continued operation of the Holyrood plant. In addition, the generation alternatives available from those not screened are available for inclusion in the expansion plan. These include:

a. Small hydroelectric developments, and more specifically, Portland Creek, Island Pond, and Round Pond.

b. Wind generation limited to be within existing economic constraints.

c. CTs.

d. CCCTs.

The Isolated Island alternative represents the No-Project alternative, as the Island remains isolated from the rest of the North American electricity grid. It also represents the optimum portfolio of available generation sources without the Project.

The *Strategist®* software was used to develop the least-cost Isolated Island expansion plan. The system additions are listed in Table 2.6.1-1 and have been characterized as generation planning criteria-driven investments versus life extension and replacement capital.

The Isolated Island expansion plan includes multiple capital expenditures driven by the planning criteria mostly due to load growth. These include the addition of the 36 MW Island Pond and 18 MW Round Pond which benefit from the reservoir storage available through the existing Bay d'Espoir system. These facilities offer firm capacity which is beneficial for the Isolated Island generation expansion plan. As well, the 23 MW Portland Creek plant on the Northern Peninsula will produce an annual firm and average energy capability of 99 GWh and 142 GWh, respectively. The Isolated Island alternative will also benefit from the continued operation of existing wind farms. The possibility of additional wind capacity in the Isolated Island alternative has been treated as a sensitivity analysis and is discussed further in Section 2.7.1.5. The Isolated Island expansion plan will also require significant investment to meet life extension and environmental upgrade requirements at the Holyrood plant and replacement of the existing wind farms.

Table 2.6.1-1 Isolated Island Alternative – Installations, Life Extensions and Retirements (In-service capital costs; $millions nominal)

Year	Criteria Driven		Life Extension / Replacement		Retirements
	Description	Cost	Description	Cost	Description
2014	25 MW Wind	PPA			
2015	36 MW Island Pond	$199	Holyrood ESP & Scrubbers	$582	
2016			Holyrood Upgrade	$100	
2017			Holyrood Low No_x Burners	$20	
2018	23 MW Portland Creek	$111			
2019			Holyrood Upgrade	$121	
2020	18 MW Round Pond	$185			
2022	170 MW CCCT	$282			Hardwoods CT (50 MW) Corner Brook Pulp and Paper Co-Generation (PPA)
2024	50 MW CT	$91	Holyrood Upgrade	$9	Stephenville CT (50 MW)
2027	50 MW CT	$97			
2028			Replace 2 Existing Wind Farms (~54 MW)	$189	2 * 27 MW Wind farms (PPA)
2029			Holyrood Upgrade	$4	
2030	50 MW CT	$103			
2033	Holyrood Replacement (2 units) 170 MW CCCT 170 MW CCCT	 $464 $346			Holyrood Unit 1 (161.5 MW) Holyrood Unit 2 (161.5 MW)
2034			Replace 2014 Wind Farm (~25 MW)	$98	25 MW Wind (PPA)
2036	Holyrood Replacement (3rd unit) 170 MW CCCT	$492			Holyrood Unit 3 (142.5 MW)
2042	50 MW CT	$130			
2046	50 MW CT	$141			
2048			Replace 2 Existing Wind Farms (~54 MW)	$281	2 * 27 MW Wind farms
2049	50 MW CT	$149			50 MW CT
2050	170 MW CCCT	$477			
2052	170 MW CCCT	$665			50 MW CT & 170 MW CCCT

Table 2.6.1-1 Isolated Island Alternative – Installations, Life Extensions and Retirements (In-service capital costs; $millions nominal) (continued)

Year	Criteria Driven		Life Extension / Replacement		Retirements
	Description	Cost	Description	Cost	Description
2054			Replace 2034 Wind Farm (~25 MW)	$146	25 MW Wind
2055					50 MW CT
2056	170 MW CCCT	$534			
2063	50 MW CT 50 MW CT 170 MW CCCT	$197 $197 $818			2 * 170 MW CCCT
2064	50 MW CT	$201			
2066	170 MW CCCT	$645			170 MW CCCT
2067	170 MW CCCT	$882			50 MW CT

Source: Exhibit 14 (NLH 2011k, internet site).

As a result of the reliance on thermal generation, this alternative carries fuel price volatility and risk and also exposure to potential carbon costs related to GHG emissions. Nalcor has conducted sensitivity analysis related to fuel price and potential carbon costs which can be found in Section 2.7.1.1.

2.6.1.1 Isolated Island Transmission

Generation Integration

The Isolated Island alternative includes the 36 MW Island Pond, 23 MW Portland Creek and 18 MW Round Pond developments. It is these three developments that will have the greatest effect on the Isolated Island transmission expansion plan.

At present, the Bay d'Espoir 230 kV transmission system consists of two 230 kV transmission lines connecting up-stream generating stations at Granite Canal and Upper Salmon to the Bay d'Espoir Terminal Station and Island Grid, TL 234 (Upper Salmon to Bay d'Espoir) and TL 263 (Granite Canal to Upper Salmon). The 36 MW Island Pond Development will connect to the Island grid via routing of TL 263 in and out of Island Pond on its way to Granite Canal. The integration of the Island Pond development into the existing 230 kV TL 234/TL 263 collector network complies with the existing transmission planning criteria.

The proposed Round Pond development is also located in the Bay d'Espoir water system. At an 18 MW capacity it is proposed that a 69 kV transmission line will be built from the site to the Bay d'Espoir Terminal Station rather than grid tie at the 230 kV level. The single 69 kV transmission line to connect the Round Pond plant meets the existing transmission planning criteria.

The 23 MW Portland Creek development situated on the Northern Peninsula will connect to the existing Peter's Barren Terminal Station via a single 66 kV transmission line and the Portland Creek interconnection complies with all transmission planning criteria.

All costs associated with the interconnection have been included in the generation project costs estimates.

Bulk Transmission System

As indicated in the Island Transmission System Outlook (NLH 2010c, internet site), the 230 kV transmission system between Bay d'Espoir and the St. John's load centre is both thermally and voltage constrained with respect to increased power transfers onto the Avalon Peninsula. In the context of the Isolated Island alternative with the hydroelectric developments at Portland Creek, Island Pond and Round Pond located in the central and west portion of the Island while the load centre is located on the Avalon Peninsula, the third 230 kV transmission line from Bay d'Espoir to the Avalon Peninsula is required to increase power transfers to the load centre while meeting the transmission planning criteria. The new 230 kV transmission line will provide the necessary voltage support and thermal transfer capacity to deliver the new off-Avalon Peninsula generation supply to the load centre. The costs associated with the new 230 kV transmission line between Bay d'Espoir and the Avalon Peninsula are common to both the Isolated Island and Interconnected Island alternatives. Therefore these costs are excluded from the *Strategist®* analysis itself. However, such common costs are included in NLH's total revenue requirement calculations.

2.6.1.2 Isolated Island Cumulative Present Worth

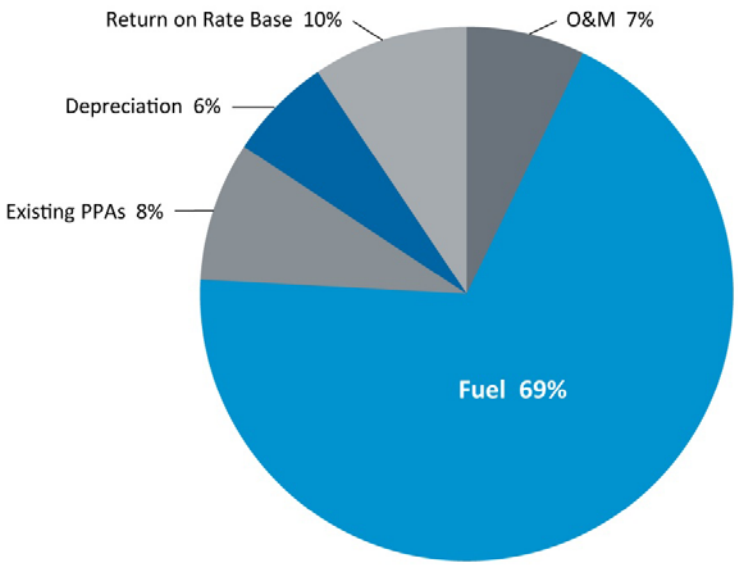
The CPW for the Isolated Island alternative is $8,810 million (2010$). This CPW value includes all of the incremental operating and capital expenses associated with meeting forecastload to 2067 arising from the utility isolated expansion plan as presented in Section 2.7.1. This CPW can be partitioned according to the cost categories outlined in Table 2.6.1-2 and Figure 2.6.1-1.

Table 2.6.1-2 Isolated Island Alternative: Generation Expansion Cumulative Present Worth (2010$, millions)

	Operating and Maintenance	Fuel	Existing PPAs	Depreciation	Return on Rate Base	Total
Isolated Island	$634	$6,048	$743	$553	$831	$8,810
% of Total CPW	7.2%	68.7%	8.4%	6.3%	9.4%	100%

Source: Nalcor response to MHI-Nalcor-1 (Nalcor 2011d, internet site).

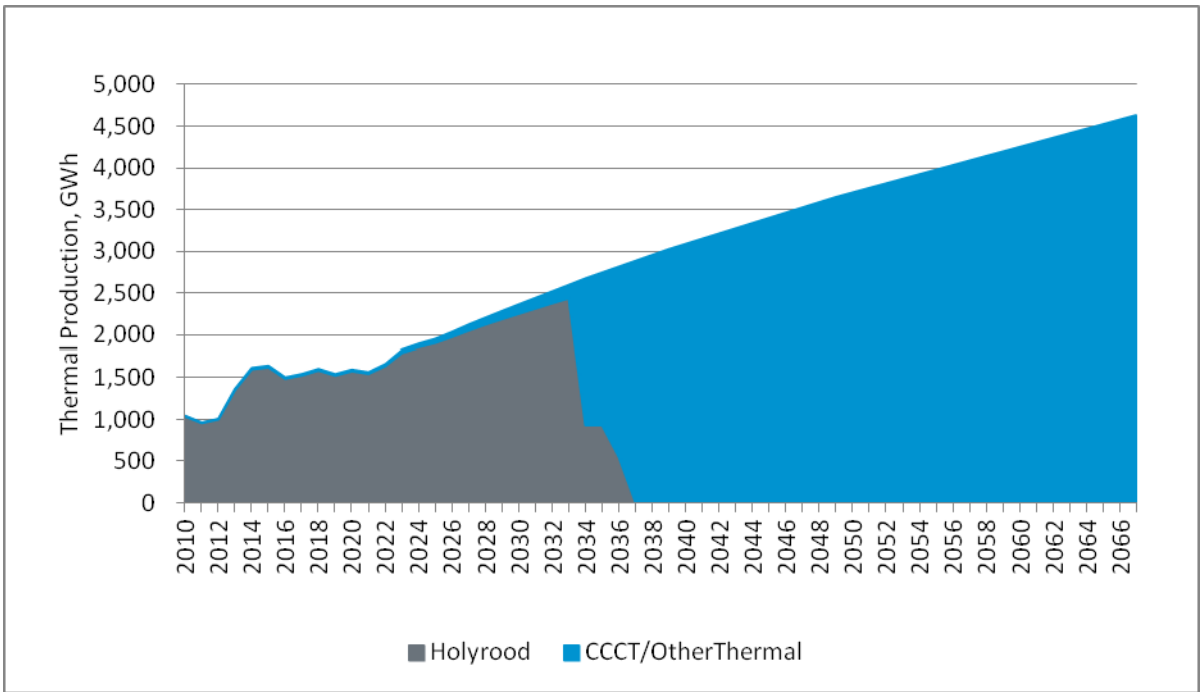
Figure 2.6.1-1 Isolated Island Alternative Cumulative Present Worth Breakdown (% of total)



Source: Nalcor response to MHI-Nalcor-1 (Nalcor 2011d, internet site).

The segmentation of CPW by major production cost component makes clear the future extensive dependence on internationally priced fossil fuels, accounting for almost 70% of NLH's total incremental production costs going forward. This dependence arises due to the limited indigenous alternatives that can be technically, and / or reliably drawn upon to support an Isolated Island economy in the future. These costs relate to thermal fuel requirements both from the Holyrood plant up until its retirement, and from CCCT and CT thermal generating units as required going forward to meet load growth and for replacement of an obsolete plant. Figure 2.6.1-2 provides the thermal power production required for the Isolated Island alternative across the planning period. At present, approximately 15% of NLH electricity production is sourced to thermal production while at the end of the planning period, about 40% of its production is projected to be thermal based (Nalcor response to MHI-Nalcor-97a (Nalcor 2011d, internet site)).

Figure 2.6.1-2 Thermal Production Required – Isolated Island Alternative



Source: Nalcor response to MHI-Nalcor-49.1 (Nalcor 2011d, internet site).

2.6.1.3 Holyrood Plant Pollution Abatement and Life Extension

Because of the importance of continued and reliable operations at the Holyrood plant, additional detailed information is provided below on the issues of the Holyrood plant pollution abatement, GHG risk and life extension.

Holyrood Plant Pollution Abatement

The Holyrood oil-fired facility does not have any environmental equipment for controlling particulate emissions or SO_2. To meet the commitments of the *Energy Plan* to address emission levels at the facility in the absence of the Lower Churchill Project, NLH has identified ESPs and wet limestone FGD systems as the Best Available Control Technology to control particulate and SO_2 emissions from the plant. These technologies are mature and reliable. Such pollution abatement technologies provide the Holyrood plant with operational fuel flexibility.

Electrostatic precipitators negatively charge the ash particles and collect them on positively charged collecting plates. The plates are rapped and the ash is collected in hoppers where it is then transported to storage. ESPs

have been in application for over thirty years and are the standard for collecting fly ash from a power station's flue gas stream. ESPs have typical collection efficiencies of 95%+ for an oil-fired station.

NO_X emissions are a function of the fuel combustion characteristics and boiler operation. The installation of the ESPs and an FGD system at the Holyrood plant would have no impact on NO_X emissions at the station. For this reason, NLH has included low NO_X burners to complete the scope of achievable environmental abatement for the Holyrood plant.

The addition of FGD and ESP will increase station service power demand at the Holyrood plant and increase Operating and Maintenance costs. In addition, a large waste disposal facility must be developed to contain waste from FGD and ESP and there will be an increase in regional truck traffic and on-site heavy equipment. The in-service capital costs for the Holyrood plant's pollution abatement program are summarized in Table 2.6.1-3.

Table 2.6.1-3 Holyrood Pollution Abatement Capital Costs

Item	In-Service Capital Cost ($millions)
Flue Gas Desulphurization and Electrostatic Precipitators	$582
Low NO_x Burners	$20
Total	$602

Source: Exhibit 5L[i] (Stantec Consulting Ltd 2008, internet site).

These capital costs, and associated provisions for operating costs, are included in the Isolated Island generation expansion plan. It is important to note that these pollution abatement controls do not reduce GHG emissions. An increase in station service load at the Holyrood plant associated with FGD operations will actually increase overall GHG emissions.

In the absence of pollution abatement and control technology at the Holyrood plant, in 2006 NLH commenced burning 1% sulphur No. 6 fuel oil to reduce emissions. This improved fuel grade reduced SO_2 and other non-GHG emissions by about 50%. In 2009, NLH improved its heavy fuel oil grade to 0.7% sulphur to reduce emissions by a further 30%.

Holyrood Plant Greenhouse Gas Emissions and Production Costing Risk

GHG emissions and their effect on global warming is another prominent environmental issue. Carbon dioxide is the primary GHG of concern and the Holyrood plant emits CO_2 in direct proportion to its production of thermal based electricity. The regulation of GHG could have an adverse effect on production costing and future generation planning decisions.

Federal regulatory action against GHG emitting facilities is increasingly likely. There is a risk that a facility such as the Holyrood plant could not legally operate if a natural gas combined cycle benchmark for GHG emission intensity levels is applied to oil fired generation. The Government of Canada has gazetted its proposed GHG regulations for coal fired generating facilities and they tie continued operation of these facilities to meeting the natural gas combined cycle benchmark (Government of Canada 2011c). Under the proposed regulations, coal facilities that are commissioned prior to July 1, 2015 and have reached the end of their 45 year design life, may receive an exemption to continue operation until 2025, provided they incorporate CCS technology to reduce their emissions intensity to that of a natural gas fired generating facility. New facilities (those commissioned on or after July 1, 2015) that incorporate CCS technology can apply for a deferral of application of the standard to 2025.

Since the GHG intensity of heavy fuel oil is 77% of coal and 2.2 times higher than natural gas, NLH expects the Government of Canada will impose limitations on heavy fuel oil fired generating facilities that are similar to those proposed for coal fired generation. NLH has not completed any studies to consider the implementation

of CCS at the Holyrood plant, but notes that SaskPower has initiated a $1.2 billion project to implement a CCS demonstration project on Unit 3 of SaskPower's Boundary Dam thermal facility (SaskPower 2011). Based on these considerations, NLH believes there is a risk that the Holyrood plant will not be permitted to operate in its current manner at some point in the next 30 years until 2041.

Holyrood Operations under the Isolated Island Alternative

If the Holyrood plant is required to continue operating as a base loaded thermal generating station after 2016 / 2017, which would be the circumstance in an Isolated Island supply future, extensive and comprehensive investigative work will be required to assess the cost of significantly extending the operating life of the thermal generating systems compared to other alternatives.

For the 2010 generation expansion analysis, an Isolated Island alternative assumed that the Holyrood plant would continue to operate as a generating station until the mid 2030s at which time it would be retired (2033 for Units 1 and 2 and 2036 for Unit 3) and replaced with combined cycle units using LFO. NLH engineering and operating experience and expertise was used to formulate an upgrade program to see the Holyrood plant through to its targeted retirement dates. Under the Isolated Island alternative, capital upgrades included in the *Strategist®* analysis for the Holyrood plant total $233 million between 2011 and 2029. A breakdown of upgrades required is presented in Table 2.6.1-4

Table 2.6.1-4 Holyrood Plant Life Extension Capital

Project	In Service Year	In Service Cost ($ millions)
Upgrade 1	2016	100.0
Upgrade 2	2019	121.0
Upgrade 3	2024	8.5
Upgrade 4	2029	3.6
Total		233.1

Source: Nalcor response to MHI-Nalcor-49.3 (Nalcor 2011d, internet site).

Isolated Island Summary

The preparation of a least-cost generation and transmission plan for the Isolated Island alternative in Phase 2 results in a CPW of $8,810 million ($2010, present value). The development of indigenous renewal resources does not avoid a progressive dependence on thermal energy for the Island. Key risks for the Isolated Island alternative are world oil prices and environmental costs associated with thermal electricity generation, initially with the existing Holyrood plant, and then with CCCT plants using LFO. In the CPW analysis, no costs related to GHG emissions were included. The Holyrood plant has an additional risk regarding the extent of life extension capital required so that this aging facility can reliably sustain operations until its targeted retirement dates in the early 2030s.

2.6.2 Interconnected Island (Project) Alternative

The Interconnected Island alternative is an optimization of generation alternatives primarily driven by the Muskrat Falls hydroelectric generating facility and the Labrador-Island Transmission Link. As indicated in Section 2.5.13.4, Muskrat Falls will have an installed capacity of 824 MW, and will have an average annual production of 4.9 TWh. Production from Muskrat Falls will be transmitted to the Island over the 900 MW Labrador–Island Transmission Link, which extends from the Muskrat Falls site to Soldiers Pond on the eastern Avalon Peninsula.

With the construction and commissioning of Muskrat Falls and the Labrador–Island Transmission Link, production at the Holyrood plant will be displaced. By 2021, after Muskrat Falls and the transmission link have been successfully integrated into the Island Interconnected system, thermal production at the Holyrood plant will cease. The generators at the Holyrood plant will then operate only as synchronous condensers to provide reactive power for the HVdc converter station at Soldiers Pond and voltage support on the eastern Avalon Peninsula. Post 2021, there will be no generation at the Holyrood plant under the Interconnected Island alternative.

The Interconnected Island alternative and the Muskrat Falls and the Labrador-Island Transmission Link practically eliminates the dependence on fuel and therefore the effects and risks of fuel in the Isolated Island alternative. The exposure to GHG emissions and carbon cost is also removed. Muskrat Falls and the Labrador-Island Transmission Link, however, are megaprojects and have large capital expenditures associated with them. In this regard, Nalcor has established a dedicated project team for Muskrat Falls and the transmission link, and has established a comprehensive project planning process for their development.

While the expansion plan is dominated by Muskrat Falls and the Labrador-Island Transmission Link, the generation alternatives available from those not screened out in Section 2.5 are also available for inclusion in the expansion plan. These include:

1. Small hydroelectric developments, and more specifically, Portland Creek, Island Pond and Round Pond.
2. CTs.
3. CCCTs.

It should be noted that generation additions after Muskrat Falls and the Labrador-Island Transmission Link are driven by capacity shortfalls and not by energy shortfalls.

The *Strategist®* software was used to develop the least-cost interconnected expansion plan. The system additions are listed in Table 2.6.2-1 and have been characterized as generation planning criteria-driven investments versus life extension and replacement capital.

Table 2.6.2-1 Interconnected Island - Installations, Life Extensions and Retirements (In-service capital costs; $millions nominal)

Year	Criteria Driven Description	Cost	Life Extension/ Replacement Description	Cost	Retirements Description
2014	50 MW CT	$75			
2017	Holyrood Unit 1 & 2 Synchronous Condensers 900 MW Labrador Interconnection Commencement of Supply from Muskrat Falls	$3 $2,553[(a)] PPA			
2021					Holyrood Unit 1 (161.5 MW) Holyrood Unit 2 (161.5 MW) Holyrood Unit 3 (142.5 MW)
2022					Hardwoods CT (50 MW) Corner Brook Pulp and Paper Co-Generation (PPA)
2024					Stephenville CT (50 MW)

Table 2.6.2-1 Interconnected Island - Installations, Life Extensions and Retirements (In-service capital costs; $millions nominal) (continued)

Year	Criteria Driven Description	Cost	Life Extension/ Replacement Description	Cost	Retirements Description
2028					2 * 27 MW Wind farms (PPA)
2036	23 MW Portland Creek	$156			
2037	170 MW CCCT	$373			
2039					50 MW CT
2046	50 MW CT	$141			
2050	50 MW CT	$152			
2054	50 MW CT	$165			
2058	50 MW CT	$179			
2063	50 MW CT	$197			
2066	50 MW CT	$209			
2067					170 MW CCCT

Source: Exhibit 14 (NLH 2010d, internet site).
[(a)] $2.553 billion includes total capital cost of $2.073 billion plus $480 million in AFUDC.

For the purposes of balancing energy supply late in the study period, NLH has assumed that energy from Churchill Falls will be delivered to the Island at historical power contract prices. Deliveries are forecast to commence in 2057 and reach an annual delivery of approximately 500 GWh per year at the end of the study period in 2067.

The Interconnected Island alternative provides access to a large energy supply. The average annual production potential at Muskrat Falls, at 4.9 TWh, is greater than the approximately 2 TWh per year forecast to be required on the Island in 2017. For the purposes of this CPW analysis, NLH has assumed that no revenue benefits would be derived from that surplus energy. Notwithstanding, approximately 60% of the production from Muskrat Falls will be initially available for either short- term sales into export market sales or for other interconnected requirements in the province, including demands in Labrador.

Muskrat Falls will benefit from the *Water Management Agreement* (Nalcor and Churchill Falls (Labrador) Corporation 2009) in place between Nalcor and Churchill Falls (Labrador) Corporation. This agreement requires that the operation of Muskrat Falls be coordinated with that of Churchill Falls, and increases the ability of Muskrat Falls to schedule production to meet Island needs than without a water management agreement. If the agreement were not in place, Muskrat Falls production would be limited to that available based on natural inflows and production at Churchill Falls.

Holyrood Plant Operations under the Interconnected Island Alternative

Due to the age of the Holyrood plant, and experience with unplanned unit outages caused by equipment failure in recent years, NLH applied to the Board in the summer of 2009 for approval to begin Phase 1 of a condition assessment and life extension program for the plant. The Board granted partial approval to NLH to proceed and the initial work elements have now been completed with a report finalized in March of 2011.

The report, prepared by the engineering consulting firm AMEC, titled *Holyrood Condition Assessment and Life Extension Study 2010* (AMEC 2011, internet site) was filed with the Board on May 2nd, 2011. In summary, the condition assessment and life extension program for the Holyrood plant was based on the following operational assumptions under an Interconnected Island supply future:

1. The Holyrood plant would be required to operate as a generating station until at least the end of 2016.
2. The Holyrood plant would be maintained for standby power mode of operation from 2017 to 2020. To achieve this capability with a high degree of reliability, the power generation systems will be maintained as required.
3. The Holyrood plant would primarily be operated as a synchronous condensing station from 2017 into the future.

The scope of the AMEC Phase 1 study was to determine the basic condition of the power plant, assess its useful life, and identify components, systems or facilities which require further attention. Phase 1 also assists NLH in selecting the sampling and testing methodologies to be used in performing more detailed investigation where recommended. Within a condition assessment and life extension program, the investigative work is used to determine whether the plant is a candidate for life extension and what recommended actions will achieve the extended life. The report prepared by AMEC under Phase 1 was used as a reference for planning Phase 2 of the condition assessment and life extension program. The Phase 2 study will enable NLH to identify equipment and systems that require immediate attention to operate the Holyrood plant as a generating facility safely and reliably up to 2016.

2.6.2.1 Interconnected Island Transmission

The Interconnected Island alternative results in the construction of a 900 MW HVdc transmission line from Labrador to the Island and the cessation of production at the Holyrood plant. With the existing 230 kV transmission system between Bay d'Espoir and the St. John's load centre planned with the injection of 466 MW for the Holyrood plant in mind, substantial reinforcements to the 230 kV transmission system in the eastern portion of the Island would be required following removal of the 466 MW from the Holyrood plant if the HVdc converter station were to be located off the Avalon Peninsula. By locating the HVdc converter station at Soldiers Pond, a location between the Holyrood plant and the St. John's load centre where all critical 230 kV transmission lines on the Avalon Peninsula meet, NLH avoids significant construction of 230 kV ac transmission lines in the Interconnected Island alternative.

Transmission system analysis of the proposed Interconnected Island alternative has determined the system reinforcements required to meet the transmission planning criteria with the HVdc converter station located at Soldiers Pond. The line commutated converter technology requires a significant quantity of reactive power to support its operation – approximately 55% of its MW rating. In addition, proper operation of the converter requires adequate system strength measured in terms of the system's equivalent short circuit ratio (ESCR) at the ac connection point for the converter. Analysis has indicated that conversion of the Holyrood generators to synchronous condensers assists in the supply of reactive power support and adequate ESCR levels. Stability analysis using *PSS®E* has determined that high inertia synchronous condensers and the 230 kV transmission line between Bay d'Espoir and Western Avalon are required to provide acceptable dynamic performance of the Interconnected Island alternative (NLH 2008, internet site). The additional system inertia provided by the high inertia synchronous condensers is required to maintain acceptable system frequency during system disturbances that result in temporary disruptions to the HVdc system. The 230 kV transmission line between Bay d'Espoir and Western Avalon ensures angular stability of the system for short circuits close to the Soldiers Pond converter station that will result in temporary commutation failure of the converter. Short circuit analysis using *PSS®E* has determined the impact on short circuit levels on the system due to the increase in number of synchronous machines (Soldiers Pond synchronous condensers) and reconfiguration in transmission system topology (Soldiers Pond Terminal Station and new 230 kV transmission line). The short circuit levels at a number of stations will increase to the point where existing circuit breaker interrupting rating will be exceeded. In the Interconnected Island alternative, one 230 kV circuit breaker at Bay d'Espoir, nine 230 kV

circuit breakers at the Holyrood plant, and four 66 kV circuit breakers at Hardwoods, will be replaced. The costs associated with these circuit breaker replacements are included in the capital cost estimate for the Labrador-Island Transmission Link. The costs associated with the new 230 kV transmission line between Bay d'Espoir and Western Avalon are common to both the Isolated Island and Interconnected Island alternatives. Therefore, these costs are excluded from the *Strategist®* analysis. However, such common costs are included in NLH's total revenue requirement calculations.

2.6.2.2 Interconnected Island Cumulative Present Worth

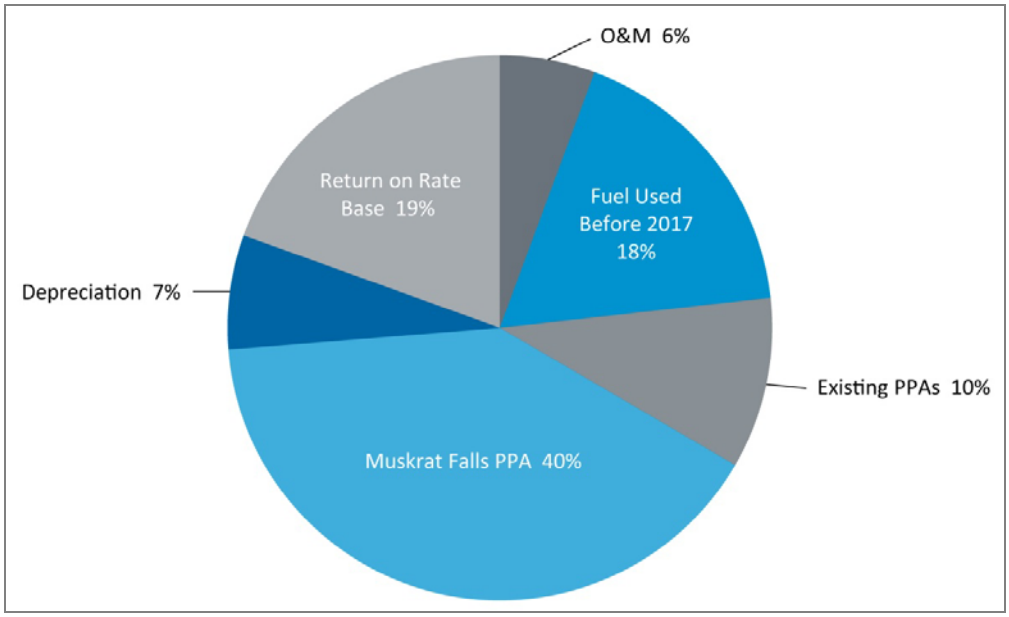
The CPW for the Interconnected Island alternative, which brings together the Island and Labrador power grids, combined with Muskrat Falls hydroelectric power generation located on the Lower Churchill, has a CPW of $6,652 million (2010$). This CPW includes all of the costs associated with the Muskrat Falls generation plant and HVdc transmission interconnection between Labrador and the Island, as well as all other operating and capital costs attributable to the Interconnected Island generation expansion plan as presented in Section 6.1. By breaking out the *Strategist®* CPW into its principal cost categories the shift in cost structure and corresponding risks can be observed. The CPW detail is provided in Table 2.6.2-2 and Figure 2.6.2-1.

Table 2.6.2-2 Interconnected Island Alternative: Generation Expansion Plan Cumulative Present Worth (2010$, millions)

	Operating and Maintenance	Fuel	Existing PPAs	Muskrat Falls PPA	Depreciation	Return on Rate Base	Total
Interconnected Island	$376	$1,170	$676	$2,682	$450	$1,297	$6,652
% of Total CPW	5.7%	17.6%	10.2%	40.3%	6.8%	19.5%	100.0%

Source: Nalcor response to MHI-Nalcor-1 (Nalcor 2011d, internet site).

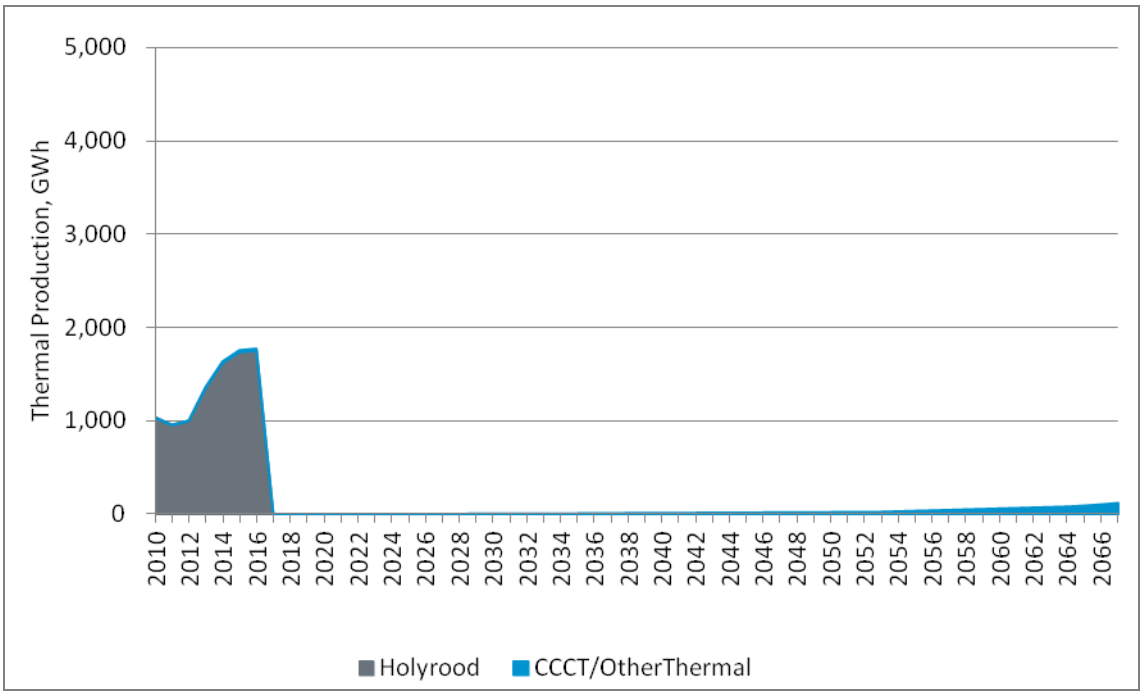
Figure 2.6.2-1 Interconnected Island Alternative Cumulative Present Worth Breakdown (2010$, millions and % of total)



Source: Nalcor response to MHI-Nalcor-1 (Nalcor 2011d, internet site).

The dominance of fossil fuel in the incremental cost structure drops to under 20% with the Island Interconnected electricity supply future, and these fuel costs are predominately thermal fuel expenses incurred prior to the full commissioning of Muskrat Falls in 2017. Costs related to the purchase of power and energy from the Muskrat Falls facility, at stable and known prices now replace the alternative dependence on fossil fuel. In addition, while this alternative will have a higher return on rate base requirement owing to interconnecting transmission infrastructure, the rate of return on rate base is generally stable and will result in declining annual costs once the asset is placed in service. Figure 2.6.2-2 illustrates the effect of the closure of the Holyrood plant on fuel requirements in the Interconnected Island expansion plan. As the reliance on thermal production essentially drops to immaterial quantities, so too does the exposure to future regulation of GHG.

Figure 2.6.2-2 Thermal Production Required – Interconnected Island Alternative



Source: Nalcor response to MHI-Nalcor-49.1 (Nalcor 2011d, internet site).

2.6.2.3 Interconnected Island Summary

The preparation of a least-cost generation and transmission plan for the Interconnected Island alternative in Phase 2 results in a CPW of $6,652 million ($2010, present value). A progressive dependence for the Island portion of the province on thermal fuel is eliminated by 2017 and the Island Grid is interconnected to power generation supply on the Churchill River and to regional electricity markets outside the province. The major risks for this generation expansion alternative are construction project risks which are discussed in Section 2.11 – Risk and Risk Management.

2.7 Discussion of Economic Analysis

The purpose of this section is to compare the CPWs for the Isolated and Interconnected Island long-term generation expansion alternatives and to conclude on the economic preference for one alternative versus another. A number of sensitivity analyses are then presented to evaluate the impact of variation in key inputs to the *Strategist®* economic analysis on the CPW results.

The CPW for the Isolated Island alternative, at $8,810 million, compared against the CPW for the Interconnected Island alternatives, at $6,652 million, yields an economic preference for the Interconnected electricity supply alternative of $2,158 million (2010$). The change in cost structure, from a progressive dependence on international fossil fuels to one funding local power infrastructure, is achieved with the Interconnected Island alternative and at a lower long run cost for consumers (see Section 2.8 for a discussion of impacts on wholesale and retail rates). The comparative CPWs for the two alternatives are summarized in Table 2.7-1 below.

Table 2.7-1 Comparison of Generation Expansion Alternatives: Cumulative Present Worth by Cost Component (Present Value 2010$, millions)

CPW Component	Isolated Island	Interconnected Island	Difference
Operating and Maintenance	$634	$376	($258)
Fossil Fuels	$6,048	$1,170	($4,878)
Existing Power Purchases	$743	$676	($67)
Muskrat Falls Power Purchases	n/a	$2,682	$2,682
Depreciation	$553	$450	($103)
Return On Rate Base	$831	$1,297	$466
Total CPW	**$8,810**	**$6,652**	**($2,158)**

Source: Nalcor (2011a, internet site).

From an economic perspective, the construction of the Project is justified based on the lower CPW compared to the alternative of not constructing the Project and going forward with the Isolated Island generation expansion plan. As illustrated in Table 2.7-1, the primary source of the difference in CPW that results in the preference for the Interconnected Island alternative is the difference between the cost of fuel in the Isolated Island alternative and the cost of the Muskrat Falls PPA.

2.7.1 Sensitivity Analysis

The generation expansion CPW analysis for the Island grid has numerous input and economic and financial levers. A sensitivity analysis, wherein the value for a key input variable is increased or decreased to determine its effect on a reference case result, provides useful information concerning the robustness of the analytical results and investment preferences arising therefrom. During the course of the analysis, a number of sensitivities have been prepared. These sensitivities were related to fuel costs (including carbon costs), capital costs, load forecasting, the importation of energy from the Upper Churchill in 2041 and other variables.

2.7.1.1 Fuel Costs and Carbon Pricing

Table 2.7.1-1 below illustrates the results of the sensitivity analyses regarding fuel price forecasts using various fuel price scenarios as well as a sensitivity analysis on the effects of carbon pricing.

Table 2.7.1-1 Fuel Price Sensitivity Analysis (Cumulative Present Worth 2010$, millions)

	Isolated Island	Interconnected Island	Preference for Interconnected Island
Reference Case	**$8,810**	**$6,652**	**($2,158)**
PIRA High World Oil Forecast	$12,822	$7,348	($5,474)
PIRA Low World Oil Forecast	$6,221	$6,100	($120)
PIRA May 2011 Update For Reference Oil Price Forecast	$9,695	$6,889	($2,806)
Carbon Pricing on Fossil Fuel	$9,324	$6,669	($2,655)

Source: Nalcor (2011a, internet site).

2.7.1.2 Capital Costs

Table 2.7.1-2 illustrates the results of the sensitivity analyses regarding the capital cost estimate where capital costs are increased by 25% and 50%.

Table 2.7.1-2 Capital Cost Sensitivity Analysis (Cumulative Present Worth 2010$, millions)

	Isolated Island	Interconnected Island	Preference for Interconnected Island
Reference Case	**$8,810**	**$6,652**	**($2,158)**
Muskrat Falls and Labrador-Island Transmission Link Capital Cost +25%	$8,810	$7,627	($1,183)
Muskrat Falls and Labrador-Island Transmission Link Capital Cost +50%	$8,810	$8,616	($194)

Source: Nalcor (2011a, internet site).

2.7.1.3 Load Forecasting and Conservation and Demand Management

Other important variables affecting the economic analysis are the load forecasting assumptions and the use of CDM. Table 2.7.1-3 provides the results of several sensitivity analyses relevant to load forecasting.

Table 2.7.1-3 Summary of Cumulative Present Worth Sensitivity Analysis for Load Forecasting and Conservation and Demand Management with Respect to Reference Case and Preference (Present Value 2010$, millions)

	Isolated Island	Interconnected Island	Preference for Interconnected Island
Reference Case	**$8,810**	**$6,652**	**($2,158)**
Moderate Conservation (375 GWh/yr by 2031)	$8,363	$6,652	($1,711)
Aggressive Conservation (750 GWh/yr by 2031)	$7,935	$6,652	($1,283)
Loss of 880 GWh/yr 2013 Forward	$6,625	$6,217	($408)
Loss of 1086 GWh/yr 2013 Forward	$6,121	$6,121	$1[(a)]
Low Load Growth (50% of 2010 PLF post Vale)	$7,380	$6,618	($763)

Source: Nalcor (2011a, internet site).
[(a)] Difference due to rounding.

2.7.1.4 Churchill Falls Deferred Link

The generation expansion alternative of continuing to maintain operations on the Isolated Island grid until the expiry of the Churchill Falls contract and the deferred construction of the Labrador-Island Transmission Link was also analysed within *Strategist®*. The results of this analysis are summarized in Table 2.7.1-4.

Table 2.7.1-4 Summary of Cumulative Present Worth Sensitivity Analysis for a Deferred Link from Churchill Falls with Respect to Reference Case and Preference (Present Value 2010 $, millions)

	Isolated Island	Interconnected Island	Preference for Interconnected Island
Reference Case	$8,810	$6,652	($2,158)
Holyrood to 2041, then Churchill Falls at Market Price	$7,935	$6,652	($1,283)

Source: Nalcor (2011a, internet site).

To allow for additional life extension capital for Holyrood to enable reliable operations to 2041, a total additional expenditure provision of $200 million (in-service cost) for each of the three thermal units was included in Isolated Island Alternative costs. The Labrador-Island Transmission Link capital was escalated for an in-service of 2041 and the pricing assumption for Churchill Falls energy was the projected regional New York market price. The CPW preference of $1.3 billion continued to prevail for the Interconnected Island alternative as compared to a deferred Interconnection in 2041 with access to Churchill Falls thereafter for an energy source.

In addition to the CPW preference of the Interconnected Island alternative, there were uncertainties and risks with the viability of the deferred interconnection alternative when it was evaluated against Nalcor's supply option evaluation criteria:

1) Security of Supply and Reliability

There is inherent uncertainty around guaranteeing the availability of supply from Churchill Falls in 2041 because it is difficult to determine the environmental and policy frameworks that will be in place 30+ years out. There are other issues surrounding the Churchill Falls asset with respect to Hydro Quebec, as Nalcor is not the sole shareholder of the Churchill Falls operation.

There is also significant risk associated with maintaining reliable supply through continued life extension measures for the Holyrood generating station through to 2041. At that time, the first two units at Holyrood will be 70 years old.

2) Cost to Ratepayers

Deferral of the interconnection would result in significantly higher rates for Island consumers between now and 2041 and does not provide rate stability to Island consumers. This is because rates are tied to highly volatile fossil fuel prices for the first 30+ years of the study period along with escalating maintenance costs for Holyrood and an increasing likelihood that replacement of the plant will be required prior to 2041.

3) Environmental Compliance

Island customers will remain dependent on fossil fuel generation for the first 30+ years of the study resulting in continued and increasing GHG emissions. Given the Government of Canada's decision to introduce GHG emissions regulation for coal fired generating stations, Nalcor's ability to refurbish Holyrood without conforming to GHG emissions regulation is doubtful, and replacement of the plant may be required between now and 2041.

4) Risk and Uncertainty

Each of the screening criteria above has significant risk and uncertainty that are not present in either the Isolated or Interconnected Scenarios.

The prospect of requiring substantial investment to Holyrood to extend its life beyond that contemplated in the Isolated Scenario, or the real possibility of requiring replacement of Holyrood and then retiring it in 2041, increases the probability that this option will be substantially more expensive than projected.

2.7.1.5 Other Cumulative Present Worth Sensitivities

Other sensitivities that were run were based on adding additional wind to the Island system and including the federal government's loan guarantee. The results are presented in Table 2.7.1-5.

Table 2.7.1-5 Summary of Other Cumulative Present Worth Sensitivity Analysis with Respect to Reference Case and Preference (Present Value 2010$, millions)

	Isolated Island	Interconnected Island	Preference for Interconnected Island
Reference Case	**$8,810**	**$6,652**	**($2,158)**
200 MW Additional Wind (100 MW in 2025 and 100 MW in 2035)	$8,369	$6,652	($1,717)
Federal Loan Guarantee	$8,810	$6,052	($2,758)

Source: Nalcor (2011a, internet site).

The addition of more wind power (notwithstanding the operational constraints that wind poses on the Island Interconnected System) will lower the CPW for the Isolated Island alternative but not to the point where the preference for the Interconnected Island alternative changes. On the other hand, the inclusion of the federal government loan guarantee improves the CPW preference for the Interconnected Island alternative over the Isolated Island alternative. By lowering interest expense during both the construction period and debt terms for Muskrat Falls and the Labrador-Island Transmission Link, the federal loan guarantee confers benefits that increase the CPW preference for the Interconnected Island alternative by $600 million. This support from the federal Government of Canada for a renewable electricity future increases the economic preference for the Interconnected Island alternative by over 25%.

2.7.1.6 Sensitivity Analysis Summary

The comparison of the CPW for an Isolated Island electricity supply future against an Interconnected Island alternative which includes the development of Muskrat Falls with a transmission interconnection between the Island and Labrador, results in an economic preference for the Interconnected Island alternative of $2.2 billion ($2010, present value). Various sensitivities analyses of variation in key inputs impacting the CPW analysis, show that this economic result is robust.

Overall, the sensitivity analyses undertaken have demonstrated that the CPW preference for the Interconnected Island alternative over the Isolated Island alternative is robust and the decision to select the preferred alternative is not influenced by the changes in economic conditions analysed in this sensitivity analysis. Except for the break-even load sensitivity case, all sensitivities analysed maintained a preference for the Interconnected Island alternative.

2.8 Financial Benefits

The financial benefits of the Project will stem from the lower revenue requirements (as indicated by the lower CPW value) under the Interconnected Island alternative than under the Isolated Island alternative. The lower

revenue requirements means, all things being equal, that wholesale rates (and thus retail rates) will be lower under the Interconnected Island alternative than under the Isolated Island alternative.

2.8.1 Wholesale Rates

To forecast the annual financial costs for utility operations, and for a longer term electricity rate trend analysis, NLH undertakes an analysis of what its financial costs are for each and every year of the analysis period. While the majority of NLH's costs are related to the Island power grid, it also incurs costs for its customers served from the Labrador power grid and from isolated diesel systems. Regulated costs incurred to serve Labrador grid and diesel system customers have been identified and excluded from this revenue requirement analysis. This annual revenue requirement can be summarized as the sum of the following general cost categories:

- operating and maintenance expenses;
- fossil fuel costs;
- purchase power expenses from third or related parties;
- annual capital charges, comprised of:
  - depreciation; and
  - return on rate base, comprised of:
    - interest expenses; and
    - return on equity.
- all other miscellaneous net cost items.

NLH's total revenue requirement in any given year in the planning period entails building up the costs for existing operating expenses and capital assets, with the incremental operating expenses and capital charges for a future long-term generation expansion plan. This is accomplished with the Revenue Requirement Model (RRM). The output of the RRM is an annual revenue requirement due from customers where prices are taken to be set such that revenues are perfectly matched to costs.

As applicable, the RRM uses the same corporate data as those used by *Strategist®* for production costing (e.g., load forecast, fuel prices, capital, cost of capital, escalation) in the determination of customer revenue requirement. This dual input process across two separate modeling environments provides an inherent check on the integrity of the *Strategist®* results.

To develop the annual revenue requirements the RRM draws together a wide range of financial data such as:

- net book value by class for existing assets;
- depreciation schedules for existing assets;
- operating budgets for existing operations;
- forecasts for sustaining capital from 5 and 20 year capital plans;
- various rate base items such as deferred charges, inventories and exchange losses;
- existing debt, cost and term;
- cost of new debt;
- cost of equity; and
- budgeted revenues.

The inputs from *Strategist®* to RRM will be unique to each alternative generation expansion plan under study and analysis. The general categorization of *Strategist®* input costs to RRM are:

- In-Service capital costs for a new generation plant, whether required to maintain appropriate generation planning criteria or replacement capital for an obsolete plant;
- operating costs associated with all new generation plants;
- energy production by type (thermal, hydroelectric, wind); and
- purchased energy and associated costs.

For regulated utilities, return on rate base includes a profit component for shareholders (return on equity) and a cost component for lenders (cost of debt). The recovery of these costs in customer rates enables the utility to finance assets used in the provision of electrical service. For each new generation plant identified by *Strategist®*, the RRM will finance the asset, place it into rate base, and set up a depreciation charge applicable for that class of assets. The return on rate base is calculated on total rate base for the company. While the cost of debt and equity capital are used in a consistent manner with *Strategist®*, the RRM has additional analysis detail on an annual basis for new debt issues (short or long-term), targeted capital structure, dividend policies and weighted cost of capital.

There are key regulated capital parameters that are brought together to enable the calculation for the return on rate base:

- Debt-equity ratio: the capital structure for the company establishes the appropriate levels of debt and equity capitalization. Capital structure is normally approved by the regulator. The target debt ratio for NLH revenue requirement purposes has been set at 75% consistent with its current targets. The target equity ratio has been set at 25%.
- Debt: The cost of debt is a function of both the embedded cost of existing debt and the cost of projected new debt. The historical or embedded cost of debt for NLH is approximately 8.8%. Going forward, the cost of debt will take into account new debt. Projections for the cost of new NLH debt are tied to forecasts prepared by the Conference Board of Canada. The forecasted long-term average cost of new NLH debt is 7.3%.
- Equity: Going forward, Government directive is that the return on equity for NLH will be set on a consistent basis with Newfoundland Power. The forecast longer term average return on equity for regulated utilities is expected to be in the range of 9% to 10%. The return on equity will be no more, or no less, than a regulated industry standard.
- WACC: Combining capital structure weighting with its cost by capital component results in a weighted cost of capital of 8%, which is also used consistently in *Strategist®* and taken as the discount rate for analytical purposes.

The total revenue requirement for any given year is the sum of that year's operating costs, power purchases, fuel expenses, depreciation and return on rate base. Combining the total annual revenue requirement from customers with total wholesale energy to be delivered as per the 2010 PLF provides a projection of the overall wholesale rate trends for the electricity supply futures under analysis. These trends are illustrated in Table 2.8.1-1.

Table 2.8.1-1 Summary of Annual Revenue Requirement and Overall Wholesale Unit Cost Rate Trends for Isolated Island and Interconnected Island Electricity Supply Alternatives

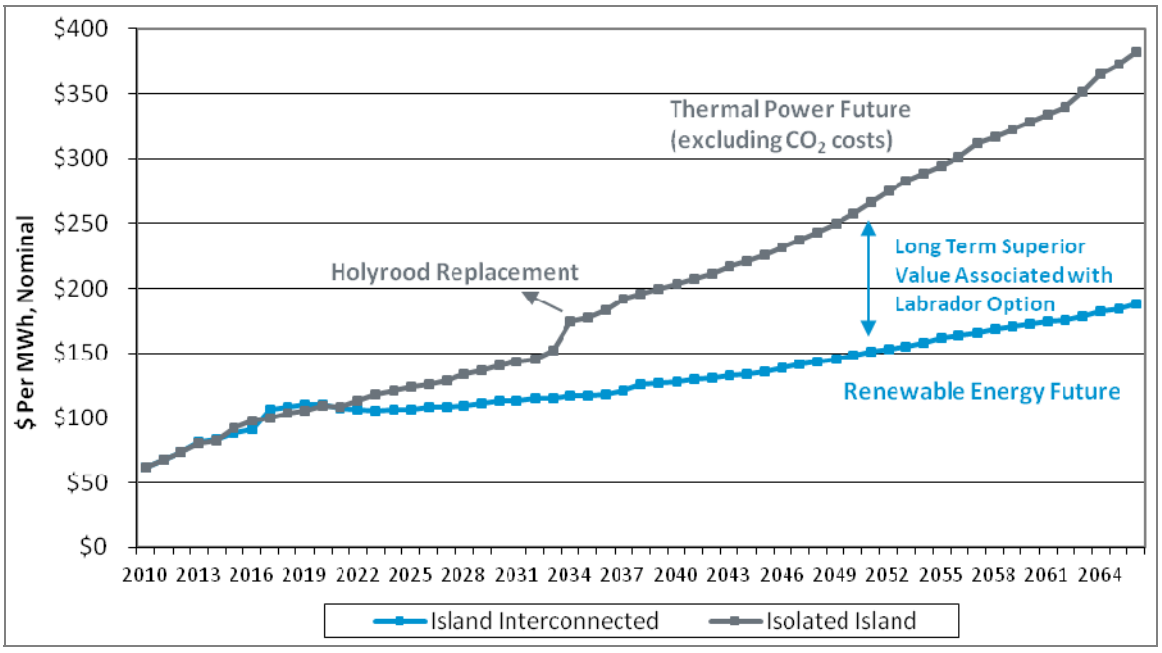
	Isolated Island	Interconnected Island	Total Energy Delivered[(a)]	Unit Cost Rate Trend for Isolated Island	Unit Cost Rate Trend for Interconnected Island
	$ Millions, current		GWh	$/MWh	
2010	$377.6	$377.6	6,044.8	$62	$62
2020	$804.1	$810.7	7,353.1	$109	$110
2030	$1,144.9	$923.8	8,168.9	$140	$113
2040	$1,803.9	$1,1134.6	8,873.9	$203	$128
2050	$2,443.5	$1,401.3	9,472.9	$258	$148
2060	$3,280.3	$1,724.1	10,003.9	$328	$172

Source: Nalcor response to PUB-Nalcor-5 (Nalcor 2011d, internet site).

(a) Energy delivered by NLH at the transmission level represents NLH's wholesale delivery requirement for the Island grid. Starting in 2014, it is derived by subtracting customer-based generation and transmission losses from Total Island Load as per *2010 Planning Load Forecast (PLF) for the Island Interconnected System* (Exhibit 1). See accompanying notes to Nalcor response to PUB-Nalcor-5.

Figure 2.8.1-1 shows the overall wholesale unit cost rate trends for the alternative electricity futures, highlighting a directional change in cost structure for electricity supply to the Island. For the period after 2017, the average annual growth in NLH unit costs is forecast at 2.8% for Isolated Island alternative and 1.1% for the Interconnected Island. Because wholesale electricity costs comprise approximately two-thirds of retail electricity prices on the Island, these growth rates will be correspondingly lower at the consumer level. The integration of the Muskrat Falls hydroelectric plant and the Labrador-Island Transmission Link into NLH's rate base will fundamentally change the cost structure for the Island's electricity supply. As the overall wholesale prices are projected to increase well below the general rate of inflation, the price is declining in inflation-adjusted terms across the planning period. Over time this means that electricity costs less in relative terms, thereby providing increasing value to consumers and providing net financial benefits to all ratepayers on the Island versus what they would pay under the Isolated Island alternative.

Figure 2.8.1-1 Newfoundland and Labrador Hydro: Island Regulated Revenue Requirements



Source: Nalcor response to Request for Information PUB-Nalcor-5 (Nalcor 2001d, internet site).

2.8.2 Retail Rates

NLH has also provided initial estimates for the retail consumer rate effect arising from the alternative generation expansion plans for the Island. Table 2.8.2-1 provides the impact on the average consumer rate for the Island grid resulting from the transition of wholesale costs through to retail. NLH has not factored in periodic rate increases attributable to the retail distribution utility. In addition, while these rate estimates were prepared at Decision Gate 2 (see Section 2.10) before the subsequent retail tax change announced by the Provincial Government, the cumulative percentage change for retail rates would not change.These projected rate impacts are attributable only to the alternative electricity supply futures as analyzed through the preceding revenue requirement analysis.

Table 2.8.2-1 Projected Impact on Average Consumer Rate for the Island Grid

	Isolated Island Alternative ($/MWh)				Interconnected Island Alternative ($/MWh)			
	Overall NLH Wholesale Rate	Utility Wholesale Rate	Utility Retail Rate	Cumulative Retail Rate Increase	Overall NLH Wholesale Rate	Utility Wholesale Rate	Utility Retail Rate	Cumulative Retail Rate Increase
2011	$68	$64	$112	-	$68	$64	$112	-
2012	$73	$71	$120	7%	$73	$71	$120	7%
2013	$81	$83	$133	19%	$81	$83	$133	19%
2014	$83	$85	$136	21%	$84	$86	$137	22%
2015	$92	$95	$146	30%	$88	$92	$143	27%
2016	$97	$103	$154	37%	$91	$96	$147	31%
2017	$100	$106	$158	41%	$107	$113	$164	47%
2018	$104	$110	$161	44%	$108	$115	$166	48%
2019	$106	$112	$164	46%	$110	$118	$169	51%
2020	$109	$116	$168	49%	$110	$118	$170	51%
2030	$140	$149	$198	77%	$113	$123	$174	55%
2040	$203	$213	$252	125%	$128	$138	$189	68%

Source: Nalcor response to PUB-Nalcor-5 and accompanying notes (Nalcor 2011d, internet site).

The favourable change in cost structure associated with the Interconnected Island alternative translates directly through to the average retail rate for all domestic customers on the Island grid. Under the Isolated Island alternative, the average domestic rate is projected to be about 37% higher in 2016 than in 2011. As the respective cost structures for the future supply alternatives begin their diverging trends beginning around 2020, the value of an Interconnected Island alternative begins to accumulate. By 2040, the cumulative rate increase for Island domestic consumers attributable to the Interconnected Island alternative is projected at 68%, in contrast to a cumulative rate increase of 125% for the Isolated Island.

2.8.3 Summary

The preparation of NLH's annual revenue requirement includes all operating and annualized capital costs associated with each respective generation planning alternative, and in addition, all common operating and capital related costs from NLH's existing operations not directly included in the *Strategist®* analysis. The overall

wholesale rate for NLH is derived by dividing its annual wholesale cost by its annual wholesale energy deliveries. The trend in NLH wholesale unit costs is largely the same until 2017 regardless of long-term electricity supply alternative, primarily because of the association with fuel prices and the consumption of fuel at Holyrood. Beyond 2020, the cost trends for Isolated and Interconnected Island generation expansion alternatives begin to diverge, reflecting the change in NLH cost structure under each respective case. Unit cost trends for the Isolated Island alternative increase at an annual rate of change that exceeds the general inflation rate. By contrast, the Interconnected Island wholesale rate trend is stable with an annual percentage change that tracks below the general rate of inflation, thus offering increasing value to consumers over time.

2.9 Environmental Benefits of the Project

Nalcor's analysis of the Interconnected Island (Project) and Isolated Island (no Project) alternatives did not include a cost for GHG emissions. The emissions associated with the two alternatives are significantly different, based on forecasted fuel requirements for each scenario. The GHG emissions associated with the two alternatives are presented in Table 2.9-1, while fuel consumption for NLH's generation for the two alternatives is shown in Table 2.9-2.

Table 2.9-1 GHG Emissions for Newfoundland and Labrador Hydro's Generation Planning Alternatives ('000s tonnes)

Year	Interconnected Island	Isolated Island
2010	820	820
2011	756	756
2012	791	791
2013	1,078	1,078
2014	1,292	1,273
2015	1,382	1,294
2016	1,395	1,188
2017	2	1,219
2018	2	1,266
2019	2	1,217
2020	2	1,259
2025	1	1,522
2030	4	1,831
2035	5	1,814
2040	8	1,826
2045	10	2,005
2050	13	2,187
2055	22	2,345
2060	38	2,504
2065	59	2,658

Source: NLH System Planning.

Table 2.9-2 Fuel Consumption for Newfoundland and Labrador Hydro's Generation Planning Alternatives ('000s barrels)

Year	Isolated Island		Interconnected Island	
	#6 Fuel	#2 Fuel	#6 Fuel	#2 Fuel
2010	1,636	13	1,636	13
2011	1,510	10	1,510	10
2012	1,580	11	1,580	11
2013	2,147	21	2,147	21
2014	2,529	33	2,566	34
2015	2,587	36	2,742	39
2016	2,362	29	2,768	40
2017	2,421	31	3	1
2018	2,512	35	3	1
2019	2,415	33	3	1
2020	2,498	36	3	1
2025	2,997	67	-	3
2030	3,537	158	-	8
2035	1,460	2,452	-	12
2040	-	4,116	-	18
2045	-	4,521	-	23
2050	-	4,930	-	30
2055	-	5,287	-	49
2060	-	5,646	-	86
2065	-	5,992	-	132

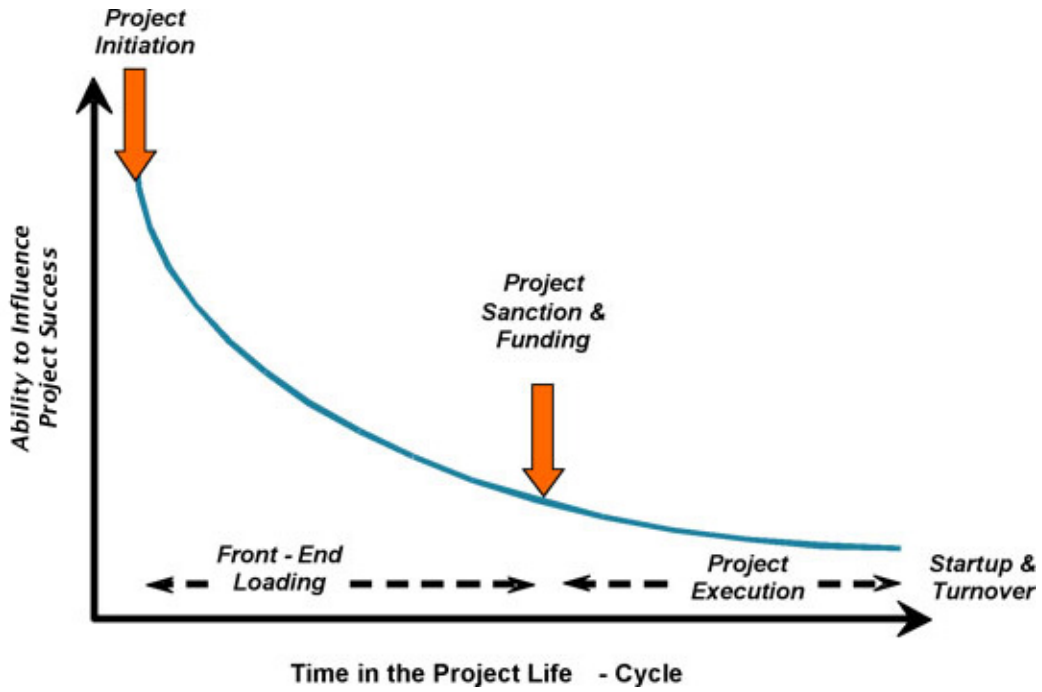
Source: NLH System Planning.

2.10 Risks and Risk Management

Given the scope and scale of the Project and its associated capital cost, Nalcor has implemented a comprehensive risk management framework for the Project. Specific project-level risk management processes, tools and resources have been implemented for the Project underneath the umbrella of Nalcor's corporate Enterprise Risk Management program.

Consistent with the "Project Influence Curve" shown in Figure 2.10-1, Nalcor has made extensive efforts in the early planning phases to identify, evaluate and implement opportunities to capture and maximize value that can be extracted from the Project. Nalcor believes that early risk (both opportunity and threats) planning is the key driving factor in increasing the predictability of the underlying business case for the Project, and has taken extensive steps to ensure the application of best practice for risk planning.

Figure 2.10-1 Project Influence Curve

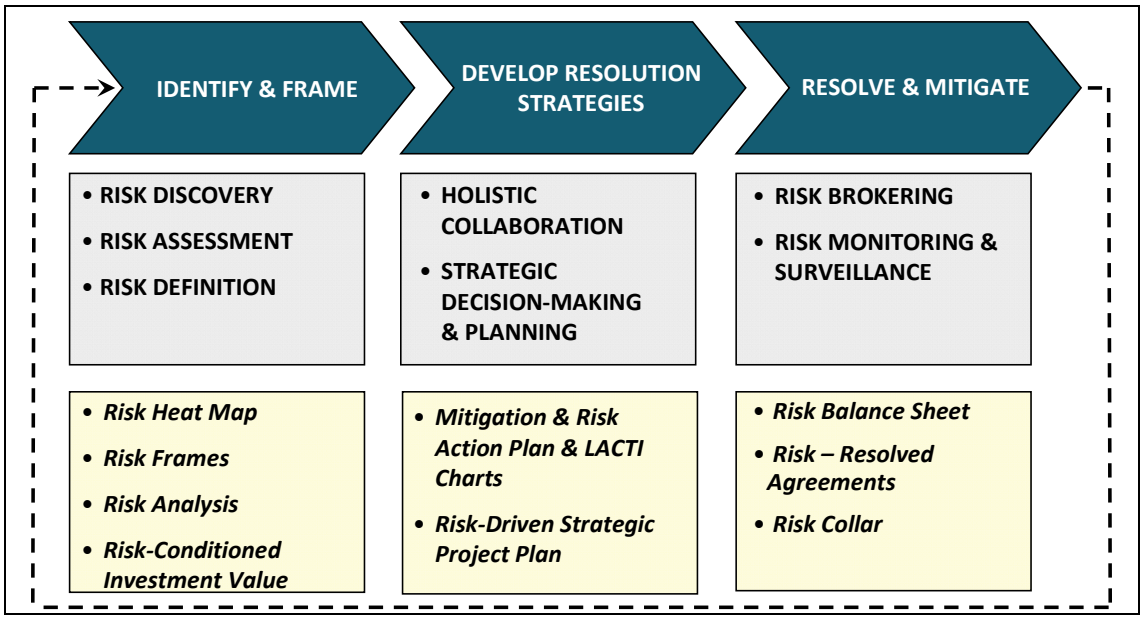


Source: Westney Consulting Group Inc. (Westney) (2008).

To this effect, Nalcor engaged Westney Consulting Group Inc. (Westney) to assist with the full implementation of a holistic risk management program with the Project. Westney are well known within the capital project industry for their leading-edge ideologies and approaches to addressing risks as a means to improve the predictability of the investment decision.

As illustrated in Figure 2.10-2 Nalcor has adopted Westney's Risk Resolution® methodology as the backbone of its risk management process for the Project.

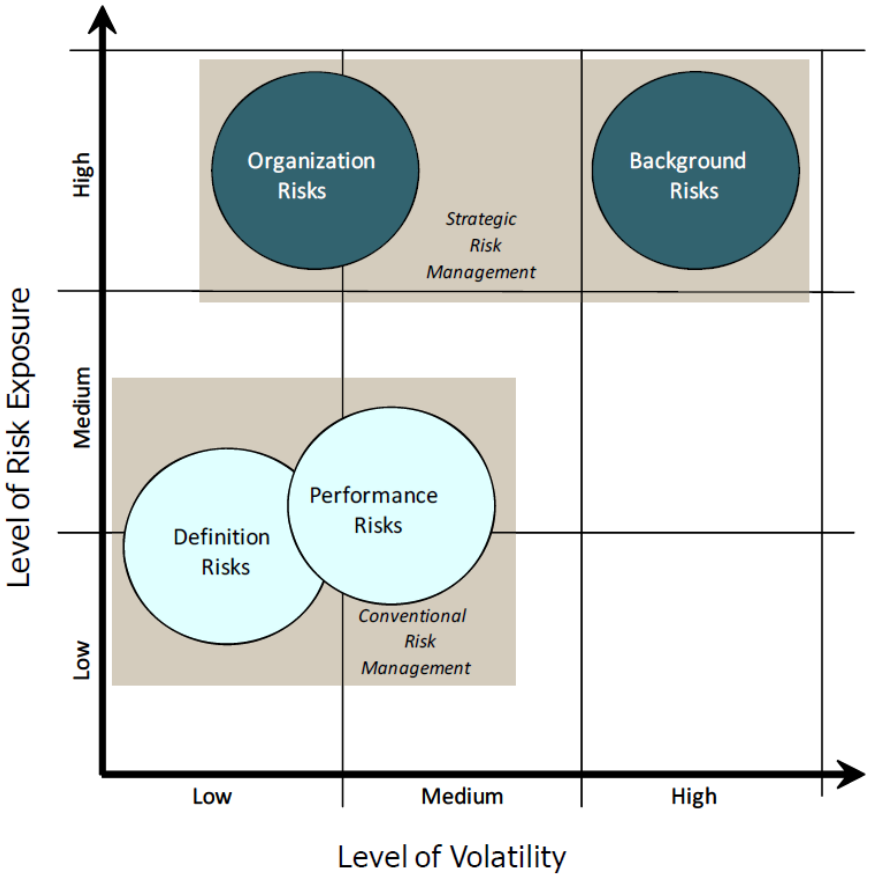
Figure 2.10-2 Nalcor's Application of Westney's Risk Resolution Methodology



Source: Westney (2008).

Westney's Risk Resolution® methodology represents a departure from the conventional approach to project risk management whereby risk analysis is focused on tactical risks. According to Westney, conventional project risk management fails to consider larger "strategic" risks that have had a predominant influence on mega-projects in recent years. As illustrated in Figure 2.10-3, these strategic risks have both large level of volatility and exposure.

Figure 2.10-3 Relationships between Risk Exposure and Volatility



Source: Westney (2009).

Tactical risks and strategic risks are differentiated below:

- Tactical Risks:
  - *Definition Risks* – These risks are associated with the degree of design development and planning definition for the given project scope, including such items as rock quantities, changing design criteria, location-driven factors, etc.
  - *Performance Risks* – These risks are associated with normal / reasonably expected variations in owner and contractor performance, including such items as construction productivity risk, weather delays, material pricing, etc.
- Strategic Risks:
  - *Background (external) Risks* – These are typically associated with changes in scope, market conditions, location factors, commercial or partner requirements and behaviours.

- *Organization (internal) Risks* – These risks are typically associated with an asymmetry between size, complexity, and difficulty of projects and the organization's ability to deliver.

2.10.1.1 Risk Management Approach and Methodology

Application of the Risk Resolution® methodology began when the Project was in its earliest, formative stage and before major business decisions or commercial commitments were made. This methodology started with the identification and framing of all business and project risks with a technique called Risk Framing, which provides a means of assessing risk exposure prior to finalizing input parameters into the economic model used for investment evaluation. Through the use of interviews, surveys and analyses, major sources of risk and possible mitigation strategies were identified. Scenarios were created to represent the best- and worst-case outcomes for each type of risk, and then used as input to purpose-built, Monte-Carlo simulation models for cost and schedule that provide a range of possible values for Risk Exposure as input into risk-informed decision making.

Nalcor's specific risk management programs for the Project are built upon a framework that includes five (5) categories:

- **Commercial**: Including risks to how the capital project will produce revenue via PPAs with suppliers, off-takers, transmission access and tariffs, reservoir production rates, etc.
- **Financial**: Including risks to how the project's capital investment will be paid for via arrangements with partners, lenders, etc.
- **Regulatory & Stakeholder**: Includes risks regarding regulatory approvals, Aboriginal consultations and agreements, stakeholder engagement, etc.
- **Technical**: Including risks of the technology to be used to create the facilities required to produce the expected revenue, and the physical scope of those facilities.
- **Execution**: Including risks to the organization and contracting strategies for performing the engineering, procurement, construction, installation and start-up, and the plans for managing those activities.

2.10.1.2 Risk Management Philosophy

The underlying risk management philosophy adopted by Nalcor has been to package and allocate Project risks to the party who can most effectively manage the risks. The ability of Nalcor to allocate these risks will be very much dependent on the risk appetite of the various stakeholders (e.g., contractors, off-takers, insurance underwriters, etc.). A Risk Resolution Team was formed in 2007 to determine the optimal resolution strategy for the identified risks. Since then, this multi-faceted and disciplinary team has successfully developed and implemented mitigation strategies and plans for a number of risks to the Project.

Nalcor has extensively used risk-informed decision-making techniques to facilitate decision quality assurance for all aspects of the business case evaluation and Project planning. While Nalcor considers it to be impractical to think that it can identify and manage all risks to which the Project may be exposed, the risk-informed decision-making approach facilitates decision analysis that is inclusive of all risk and uncertainty considerations.

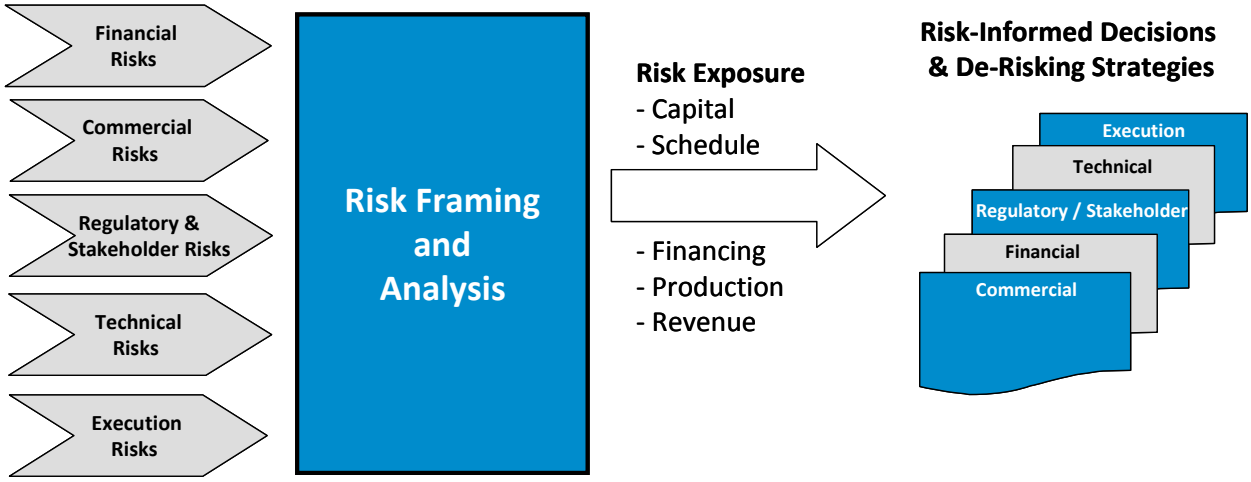
2.10.1.3 Gateway Process

Quality assurance for decision making, as a mechanism to improve project predictability, has been incorporated within the planning and execution of the Project by implementing Nalcor's structured stage-gate process – the Gateway Process. The Gateway Process divides the lifecycle of the Project into several phases starting at opportunity identification and concluding at start-up of the production facility. Each Phase has a list of pre-defined deliverables deemed essential to make a risk-informed decision at the end of that Phase, referred to as a Gate.

A due diligence review is required prior to the decision at each Gate. The due diligence review provides an independent review of the status, progress, plans, issues and risks on each Project Plane, then integrates these into the overall assessment of project risk exposure. These results drive risk-informed decisions and plans on each Project Plane.

As illustrated in Figure 2.10.1-1, Nalcor has leveraged the Risk Resolution® methodology as a key component of its process to facilitate risk-informed decision making within the Phases and each Gate of the Gateway Process.

Figure 2.10.1-1 Risk-informed Decision Making Approach



Source: Nalcor.

2.10.1.4 Project Specific Risks

Extensive risk planning exercises by Nalcor have resulted in the identification and development of mitigation strategies for a number of tactical and strategic project risks. Several of these key risks are discussed below.

Schedule Delays

Schedule delays may occur during either the pre-sanction (Gate 3) period or during the construction execution phase. Nalcor has identified a number of tactical and strategic risks that may result in schedule delays. These include, but are not limited to:

- securing PPAs;
- securing transmission access agreements;
- negotiation of Aboriginal agreements;
- achieving release from EA;
- availability of qualified engineering consultants;
- availability and retention of skilled construction labour and supervision;
- availability of experienced contractors;
- uncertain geotechnical conditions;
- winter construction limitations;
- late design change; and

- site access and logistics.

Consistent with the Risk Resolution® methodology, Risk Frames for these risks have been developed, which thoroughly define the risk and mitigation plans. These Risk Frames include a view of unmitigated and mitigated exposure to each risk, which is used as input to a purpose-built Monte-Carlo simulation model for schedule that provide a range of possible values for Risk Exposure as input into risk-informed decision making. All economic modelling for the Project have considered a range of probabilistic schedule completion dates when assessing the business investment. Westney has leveraged its proprietary PRIMS® modeling technique to facilitate the modeling of schedule risks.

Regulatory Risk

As discussed above, the justification of the Project on energy terms is based partially on the evolution of electricity markets where GHG emissions are restricted. Changes to the regulatory regime therefore represent a risk, as the competitiveness of the Project in the marketplace will change relative to that of other generation alternatives. In particular, a relaxation of proposed GHG emission rules would re-introduce coal fired generation as a viable alternative. In light of the stated policies of both federal and provincial governments, this is considered to be a low risk at this time.

Nalcor continues to actively monitor regulatory policy decisions that may impact the Project so as to effectively ensure the consideration of this risk during Project decision making.

Interest Rates

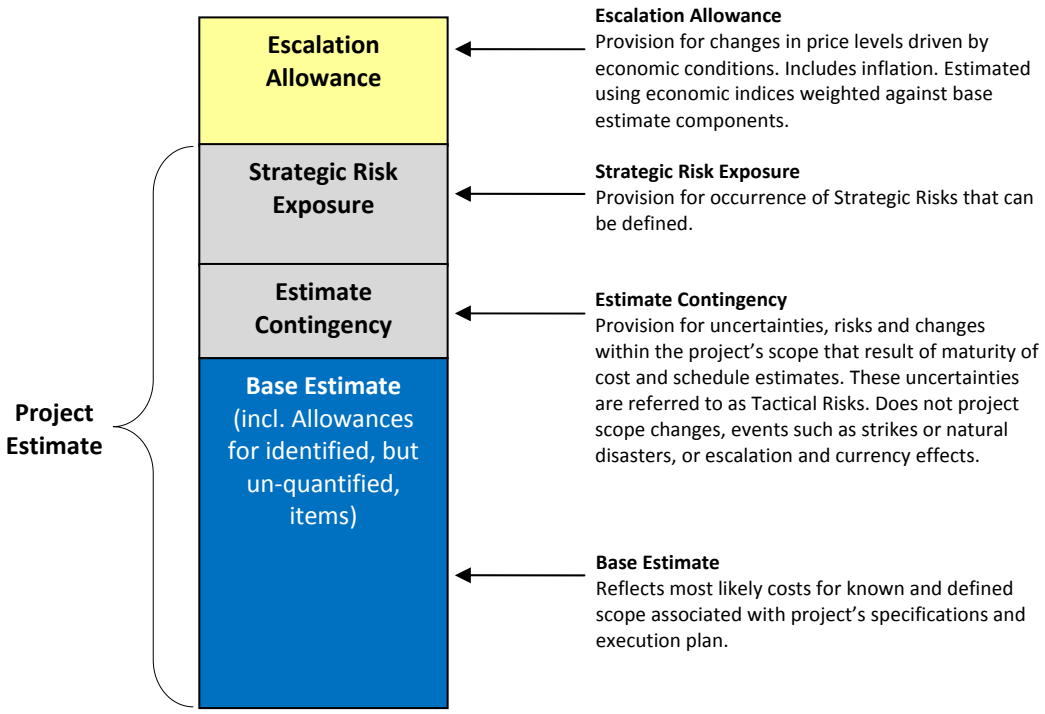
Prior to Decision Gate 3, the Project will have established and secured equity financing, and remaining financing will be provided via debt markets. To mitigate any risk related to interest rate exposure, the Project intends to finance using conventional fixed rate financing obtained in bond markets and / or bank financing where floating rate exposure is eliminated via the purchase of interest rate swaps, effectively creating a fixed interest rate for the debt secured. Accordingly, interest rate risk is mitigated through use of this financing strategy. Project economics have been prepared using an assumption for a fixed interest rate that is viewed as reasonable by the Project and its financial advisors at the date of completing this report. Another component of the risk management strategy for project financing is the negotiation of a loan guarantee from the federal government.

Construction Cost Risk

Consistent with the approach discussed in this section, Nalcor has gone through an extensive process to identify and assess potential construction cost risk, encompassing the four categories of risks: Definition Risks, Performance Risks, Background (external) Risks, and Organization (internal) Risks. Following a detailed qualitative review of identified risks, key risks were further assessed using quantitative methods including the use of Monte-Carlo simulation techniques. When combined with the schedule delay analysis, the results included a range of possible outcomes that is used to make informed decisions on pragmatic levels to include for Estimate Contingency and Strategic Risk Exposure that have been included in economic modeling for the Project. Westney has provided Monte-Carlo simulation modeling tools and techniques to assist in the completion of this analysis.

Consistent with Nalcor's governance plans for the Project, all capital cost and schedule estimates are prepared consistent with industry recognized best practice so as to ensure that all business planning and investment evaluation activities are completed using information commensurate with the level of technical and execution detail available. Capital cost estimates prepared for the purposes of business planning and investment evaluation will be comprised of three distinct components as illustrated and defined in Figure 2.10.1-2.

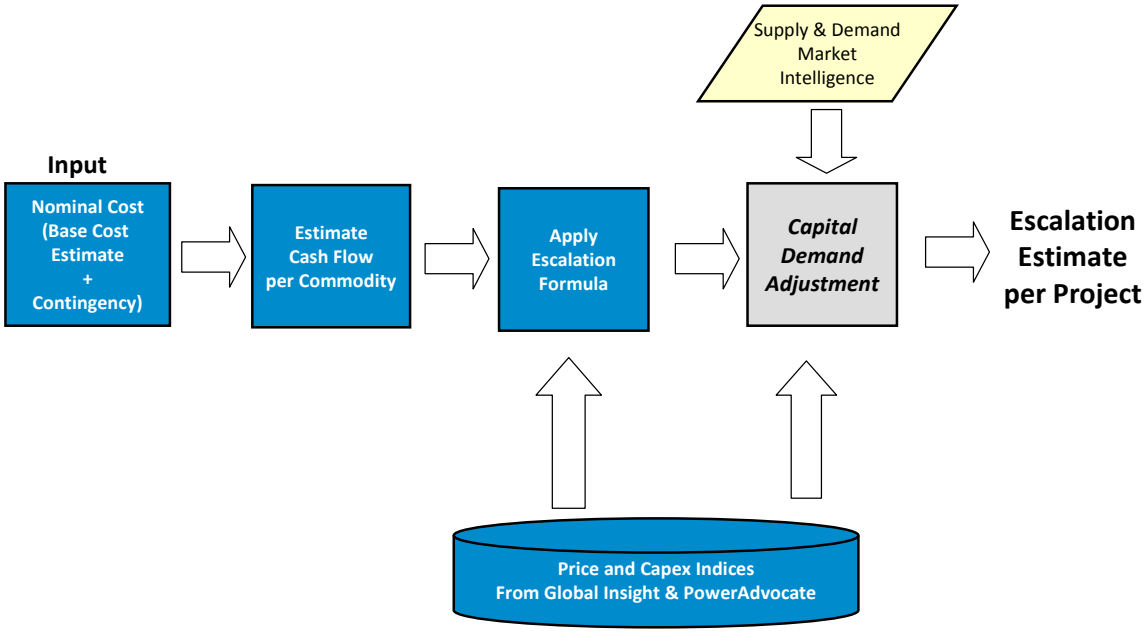
Figure 2.10.1-2 Project Cost Estimate Components



Source: Nalcor.

Understanding and considering construction cost risk due to cost escalation is also a core component of Nalcor's view of the expected outturn cost for the Project. Nalcor has developed an in-house escalation model specifically for the Project as shown on Figure 2.10.1-3 that facilitates the estimation of cost escalation due to both changes in the cost of raw materials, as well as the effects of a supply / demand imbalance. Detailed market supply and demand information for major cost components are gathered in-house from a variety of sources, which is then combined with base escalation indices produced by Global Insight and PowerAdvocate, companies that are recognized industry sources for such information. Upon consideration of all available data, Nalcor is able to produce grounded, well-researched forecast of cost escalation for use in its investment analysis.

Figure 2.10.1-3 Escalation Estimating Process



Source: Nalcor (2011a, internet site).

2.10.1.5 Summary of Risk Management for the Project

Nalcor has implemented a best-in-class risk management program for the Project, which is built upon the lessons learned from other mega-projects. As a key component of Nalcor's project governance structure, this risk management program has effectively allowed Nalcor to work with third party specialist advisors / consultants to identify and manage both tactical and strategic project risks. The fullest application of this program has afforded decision quality assurance through robust risk-based decision making tactics that will help assure the predictability of the outcome of the Project.

2.11 Project Planning

Consideration of environmental issues from the earliest stages of Project planning and design is an integral part of Nalcor's approach to its development projects and activities. This approach allows potential environmental issues and interactions to be identified early so they can be considered in a proactive manner through appropriate Project planning and design. The objectives are to avoid adverse environmental effects where possible and practical and to establish mitigation measures to ensure that they are reduced to acceptable levels.

This approach is especially relevant in the case of transmission line planning and design. As a linear development, there are typically a range of options, including alternative routings, that can be considered to meet project objectives. These can be identified and evaluated on the basis of technical, economic, environmental and socioeconomic considerations, to select and implement a feasible and acceptable option.

Studies related to the transmission of electricity between Labrador and the Island of Newfoundland began over 30 years ago. Most recently, Nalcor has conducted extensive engineering and environmental programs in relation to the proposed transmission link from 2006 to 2011.

Nalcor's ongoing planning and design activities for the transmission line itself are generally based on a process of initially identifying and analyzing potential transmission line study areas approximately 10 km wide, defining transmission corridors 2 km wide within this larger study area, followed by the actual selection of a specific

routing a ROW averaging approximately 60 m wide. At each stage, progressively narrower spatial scales and greater detail, based on technical, economic, social and environmental considerations and constraints, are applied. This process is described further below.

Project planning and design are currently at a stage of having identified a proposed 2 km wide corridor for the overland transmission line and a 500 m wide corridor for the proposed Strait of Belle Isle submarine cable crossing. The corridors will be the subject of further detailed engineering analysis, environmental review and Aboriginal, stakeholder and public consultation, and will remain the focus of the Project's EA and associated consultations. The eventual transmission line itself will, however, once fully designed, occupy only a narrow cleared area within this overall study area. At that time the transmission corridor itself will cease to have any real relevance or meaning.

Following further engineering analysis, environmental review and consultation, and pending EA approval, a specific route for the transmission line will eventually be selected from within this larger 2 km wide corridor described above. The transmission line will be constructed along this route within a ROW averaging approximately 60 m in width. This eventual transmission route will be selected with consideration of technical, environmental and socioeconomic factors, including the results of the EA, and will be subject to further consultation and permitting.

2.11.1 Transmission Study Area Selection

As an initial step, Nalcor identified a 10 km wide transmission line study area from the lower Churchill River in Central Labrador to Soldiers Pond on the Island of Newfoundland's Avalon Peninsula. This exercise was based initially on a transmission proposal first made in the late 1970s, and involved considerable further analysis considering relevant changes in technology, the natural and human landscapes and additional information available since that time, including the extensive engineering and environmental work undertaken by Nalcor since 2006.

Study area selection was completed using 1:50,000 scale mapping and digital topographic data, and was undertaken with a view to reducing the line length, while at the same time identifying and avoiding key known technical, environmental and socio-cultural issues and constraints such as difficult topography and meteorological conditions, protected and other known environmentally sensitive areas.

For the Labrador component of the on-land transmission line, study area selection was undertaken to identify a pathway within Labrador that would minimize the overall length of the transmission line, and which would take advantage of the Trans-Labrador Highway (TLH) to provide construction and maintenance access, while at the same time avoiding unfavourable topography such as large waterbodies, hills and wetlands.

For the Island component, physical environment conditions and constraints were key technical considerations on the Northern Peninsula. HVdc transmission lines are sensitive to salt spray from the maritime environment, so it is necessary to locate the line further inland from the coast than much of the existing highway and transmission lines along the western side of the peninsula. It was also necessary to avoid, as possible, the mountainous terrain at the centre of the peninsula. From the southern end of the Northern Peninsula, an attempt was made to minimize the length of the transmission line across north-central and eastern Newfoundland, while also attempting to take advantage of existing access routes and to avoid unfavourable terrain and existing protected areas. Southeast of Terra Nova National Park, the study area was selected to follow existing transmission lines and roadways to and across the Avalon Peninsula.

In the marine environment, several options for the Strait of Belle Isle submarine cable crossings have been considered over the years, including a range of possible landing sites as well as various potential cable routings between them. In the period 2007-2011 Nalcor has undertaken comprehensive survey programs in the Strait of Belle Isle, the objectives of which have been to identify suitable cable crossing corridors and landing points in the Strait. Information on geology, bathymetry, oceanography, ecology, fisheries, archaeology and other factors were gathered and used as inputs to the survey programs, which has involved detailed side scan and multibeam sonar surveys and sub-bottom profiles, underwater video surveys, drilling programs and other

studies to better understand the geological and marine environments in the region. This eventually led to the identification and evaluation of a number of potential cable landings sites on both sides of the Strait, as well as several marine crossing approaches and corridor options, as described below.

2.11.2 Transmission Corridor Selection

Following the selection and detailed analysis of the on-land transmission line study area described above, a preferred 2 km wide transmission corridor was identified, along with various alternative corridor segments for particular areas.

Similar to the evaluation and selection of a transmission study area, corridor selection was completed with consideration of a number of factors, but at a finer spatial scale. These included attempting to:

- minimize the length of the transmission line to the degree possible and practical;
- avoid unfavourable meteorological conditions (such as heavy icing and / or strong winds);
- avoid difficult terrain where possible;
- minimize the requirement for new access roads and trails;
- minimize watercourse and wetland crossings;
- avoid interactions with communities, protected areas and other known environmentally and socially important areas where possible and practical; and
- avoid areas of known archaeological and historical importance.

At the time of commencement of the EA, the Labrador component of the Project included a proposed converter station facility at Gull Island on the lower Churchill River, as well as a proposed transmission corridor extending from Gull Island to the Strait of Belle Isle. In mid-November 2010, Nalcor advised the provincial and federal governments that it would also be assessing the potential option of locating the Project's Labrador converter station at or near the Muskrat Falls site on the lower Churchill River, as well as an associated transmission corridor that would extend from Muskrat Falls to the Trans-Labrador Highway Phase 3 (TLH3), and then follow generally along the south side of the highway to approximately its southernmost point before meeting and continuing along the previously identified corridor from that location to the Strait of Belle Isle.

This Muskrat Falls to the Strait of Belle Isle transmission corridor has since become the preferred and proposed option for the Project, and is thus the main focus of the EA described in this report. The currently proposed transmission corridor on the Island that is the subject of the EIS generally reflects that which was presented when the EA process was initiated in 2009 (see below).

With regard to the proposed Strait of Belle Isle submarine cable crossings, the information gathered through the above referenced studies led to the initial identification of two potential 500 m wide subsea corridors in which to place the cables under the seabed and across the Strait. These were selected primarily because they would provide natural protection for the cables, giving access to deep water and making use of natural seabed features to shelter the cables in deep valleys and trenches to minimize the possibility of iceberg contact or interaction with fishing activity. Based on these identified corridors, several alternative landing sites were initially identified and considered on the Labrador side, including Forteau Point (the currently preferred option) and L'Anse Amour, whereas on the Newfoundland side, the originally identified potential cable landing sites were at Mistaken Cove and Yankee Point.

Since that time, Nalcor has continued with its project planning and engineering work, and in doing so, has proceeded to evaluate other possible design options and alternatives for the proposed Strait of Belle Isle submarine cable crossing. This is common with any major development project, and included additional engineering and field investigations in 2010 and 2011, which have resulted in an evolution of the proposed design concept for the Strait of Belle Isle cable crossing.

Nalcor is continuing to focus on Forteau Point as the proposed Labrador cable landing site, given its location and topography and site conditions. Although nearby L'Anse Amour site option was initially identified as an option as well, Nalcor has opted to not move forward with this location due to several factors, including the concerns of local residents that Project activity at this site may have an adverse effect on tourism infrastructure and activity at this location.

On the Newfoundland side of the Strait of Belle Isle, ongoing engineering work has also identified Shoal Cove as a site for the cable landing. This location has since become Nalcor's preferred location, as it provides quicker and easier access to deep water through the on-land horizontal directional drill (HDD) technology that is planned to be used to install the cables from these locations. This, in turn, has substantial benefits in terms of Project design and overall reliability.

The Strait of Belle Isle component of the Project is therefore based on the proposed installation of cables between Forteau Point (Labrador) and Shoal Cove (Newfoundland), as described in detail in Chapter 3 of this EIS. The three cables are planned to be installed from these on-land locations using HDD technology, out to and under the Strait for up to several kilometres. From there the HDD drill holes will pierce the seabed and the cables will be placed on the seabed within a single marine corridor (rather than two) across the Strait. This single marine corridor is essentially an amalgamation of the two marine cable corridors initially identified and described above, utilizing portions of each corridor along with a new, short segment into the Shoal Cove area.

Further information on the nature and outcomes of Nalcor's identification and evaluation of proposed and / or alternative concepts and locations for various other aspects and components of the Project (including, for example, the proposed converter stations, electrodes, etc.) is provided in the following sections.

2.12 Alternatives Means of Carrying Out the Project

As an important and valuable planning tool, EA is intended to help inform and influence project design, and in doing so, to help address the potential environmental outcomes of proposed development projects. The EA process therefore allows for the identification, analysis and evaluation of potential alternative project concepts and approaches, to help directly incorporate environmental considerations into project planning at an early stage.

As such, and as required under provincial and federal EA legislation and the associated EIS Guidelines and Scoping Document (Government of Newfoundland and Labrador and Government of Canada 2011), the EIS therefore also considers possible alternative means of carrying out the project that are technically and economically feasible, and the potential environmental effects of any such alternative means.

As indicated earlier, and as described in further detail in Chapter 3, the proposed Project includes the following key components:

- an ac-dc converter station at Muskrat Falls near the lower Churchill River in Central Labrador;
- an overhead transmission line from Muskrat Falls to the Strait of Belle Isle (approximately 400 km);
- marine cable crossings of the Strait of Belle Isle with associated infrastructure;
- an overhead transmission line from the Strait of Belle Isle to Soldiers Pond on the Island's Avalon Peninsula (approximately 700 km);
- a dc-ac converter station at Soldiers Pond, with some associated Island system upgrades; and
- electrodes, or high capacity grounding systems, in the Strait of Belle Isle (Labrador) and Conception Bay (Newfoundland), connected to their respective converter stations by small overhead transmission lines.

The Project, particularly during its construction phase, will also include various additional components and works, including access trails, camps, marshalling and lay-down areas, quarries and borrow pits, and other temporary infrastructure and associated activities.

Provincial and federal EA legislation require consideration of alternative means of carrying out a project, and specifies that this include only those means that are technically and economically feasible. Even with that filter, however, the linear nature and sheer geographic extent of the Project means that there are potentially a large number of potential design options for such a project which may be feasible (although not necessarily preferable) and that may be considered to meet project objectives.

In view of this large number of possible alternative means of carrying out the Project, this section of the EIS focuses on those relevant options that:

1. Are specified in the EIS Guidelines and Scoping Document issued by Governments in May 2011 (and specifically, in Section 4.3.2.2 of that document).
2. Have been identified and evaluated by Nalcor and its engineering consultants as part of Project planning and design processes.
3. Have been identified and suggested by Aboriginal and stakeholder groups and the public as part of Nalcor's consultation activities to date.

The discussion that follows provides a discussion and analysis of various identified and relevant alternatives by major Project component. In doing so, it considers environmental, technical and / or economic factors, both in terms of the potential advantages and disadvantages of each identified alternative, as well as, where applicable, highlighting the rationale for the proposed option(s) that are the focus of the environmental effects assessment presented in this EIS. These evaluations were completed early in the Project planning stages to allow for a focussed and thorough EA of a feasible Project.

2.12.1 HVdc versus HVac Transmission System

Modern bulk electric power systems are primarily alternating current (ac) power systems, with ac being the form in which everyday household and commercial power is delivered and used. HVac transmission lines are characterized by having three separate electrical current carrying conductors (or wires), each referred to as a "phase".

HVdc transmission is an alternate method of power transmission. In contrast to an HVac system, HVdc transmission uses one or two electric current carrying conductors and associated equipment, each referred to as a "pole". For a unit length of transmission line to deliver a fixed amount of electric power, an HVdc configuration requires less conductor material (and as a result, less transmission tower material) than a similar ac system. This, in turn, can greatly reduce the construction cost of the line when compared to an equivalent HVac configuration. By reducing the number and size of towers, and thus the width of the associated cleared ROW over comparable HVac systems (if these are even feasible), an HVdc system will also therefore often have a much smaller environmental footprint. An HVdc system does, however, require the installation of expensive converter stations at each end of the line, to convert the ac electricity into a dc form for transmission, and subsequently, back into ac form. Consequently, there is a break-even distance at which dc systems become more economical than ac systems.

HVdc transmission systems are also preferred when long distances must be traversed under water, and also eliminate the requirement to maintain a synchronous connection between the systems at either end of the transmission line.

The characteristics of the Island power system, the length of the proposed transmission line between Muskrat Falls and Soldiers Pond, and the length of the submarine component of the transmission link are significant technical impediments to using ac transmission. HVdc technology has therefore been selected for this Project for technical, economic and environmental reasons, and this technology is considered to be the only technically and economically feasible alternative for the Project, as well as being environmentally preferable.

2.12.2 Converter Stations and Their Locations

At each end of the proposed HVdc system, the Project includes converter station facilities to convert the power from ac to dc (at Muskrat Falls, Labrador) and then from dc back to ac (at Soldiers Pond, Newfoundland).

The Labrador converter station is proposed to be located on the south side of the Churchill River at Muskrat Falls, adjacent to the switchyard for the Lower Churchill Hydroelectric Generation Project, from which the electricity to be transmitted by the Project will be supplied. Although earlier Project concepts saw the Labrador converter station at Gull Island, Nalcor also explored the option of locating the converter station at the Muskrat Falls site. This has become the preferred option for the Project, as the converter station needs to be located as close as possible to the generating facility, and because there is currently no technical or economic benefit of having the converter facility at any other location. Moreover, no other location has been identified that would have different types or degrees of environmental issues and likely effects associated with it, nor have any alternatives been suggested through the EA and associated consultation processes.

A converter station is also required at or near the termination of the HVdc system on the Island to convert the dc electricity transmitted across the line back into ac form. The proposed transmission link extends to the Avalon Peninsula of the Island because this is the region where much of the province's population resides, and thus, the location of the province's highest electrical demand.

The Newfoundland converter station is proposed to be located at Soldiers Pond, the convergence point of several existing high voltage transmission lines on the Avalon Peninsula. It therefore represents an ideal location at which to inject the electricity transmitted by the Project into the Island grid. For this reason, Soldiers Pond has been the preferred and proposed site for the dc-ac converter station throughout all of the previous development scenarios and attempts over the past decades. Again, there is no identified technical, economic or environmental rationale or benefit of having the converter facility at any other location.

2.12.3 Strait of Belle Isle Cables: Crossing Approaches

As part of its ongoing planning and design work for the Project, Nalcor assessed two potential concepts for crossing the Strait of Belle Isle:

1. *Seabed Crossing*: Drilling out to and under the Strait for certain distances, and from there placing cables on the seafloor and protecting them with rock berms, with details as follows:
   - three (two plus one spare) Mass Impregnated cables;
   - specific cable routes within the identified marine corridor selected to avoid iceberg scour on the seabed and minimize potential for interaction with external influences and activities;
   - dedicated HDD holes from each landing site for up to several kilometres (out to nominally 70 m water depth) for each cable (6 HDD holes, approximately 12 km in total); and
   - each cable protected by a dedicated rock berm (30 km long) between the seafloor exit locations, with approximately 1 million tonnes of rock in total.
2. *Cable Tunnel Crossing*: Placing cables in an approximately 4 to 5 m diameter tunnel under the Strait of Belle Isle.
   - three (two plus one spare) Mass Impregnated cables;
   - an approximately 21 km long tunnel (including 17 to 18 km subsea), tunnel depth at approximately 200 m below sea level;
   - approximately 5 to 6 m outside diameter using a tunnel boring machine; and

- tunnel fully lined (necessary for water ingress management and long-term tunnel stability) with a 4 to 5 m inside diameter.

Over the past number of years, Nalcor has completed detailed analysis and evaluation on both of these potential alternatives. This has included extensive on-land investigations and marine surveys, detailed technical and economic assessments, risk analyses, and the engagement and advice of national and international experts in these techniques and recent experience with them.

Based on extensive analysis and evaluation, and serious consideration of both options, Nalcor has decided to proceed with the seabed crossing approach for the Project. Various factors were considered in making this determination, including because it represents the option that is:

1. *Technically preferred*: The seabed option uses a proven approach and techniques. HDD technology is well known and has advanced significantly in recent years. Considerable Eastern Canada and global marine installation experience and expertise exist with regard to rock placement and cable laying. Drilling and seismic investigations have identified major faults, rock formations with various degrees of permeability, and areas of geological uncertainty, which present significant challenges and risks for cost, schedule and safety.
2. *Financially preferred*: The estimated total capital cost of the seabed option is less, as compared to a cable tunnel. There is a high degree of confidence in cost and schedule for the seabed crossing option, whereas the experience with subsea tunnels and tunnels in general is that geological faults and other conditions and unknowns often result in significant cost overruns.
3. *Safer to construct and operate*: The HDD drilling and marine installation activities associated with the seabed option use standard construction techniques that are regularly employed globally with well-known safety considerations. In contrast, there are significant concerns about water ingress and other issues during tunnel construction, which pose unacceptable safety issues and risks.

The Cable Tunnel Crossing alternative is therefore not considered to be a technically and economically feasible alternative for the Strait of Belle Isle submarine cable crossing component of the Project.

2.12.4 Strait of Belle Isle Cables: Potential Landing Sites and Cable Corridor(s)

In moving forward with the Seabed Crossing approach for the Strait of Belle Isle submarine cables, Nalcor has identified and evaluated a number of potential cable landing sites and associated submarine cable corridors across the Strait over the years. These include possible sites at L'Anse au Clair, Forteau Bay, Forteau Point, L'Anse Amour and others on the Labrador side, and at Yankee Point, Winter Cove, Mistaken Cove, Sandy Cove, Shoal Cove and others on the Island side, as well as various others, and potential cable routings between them. Indeed, the original (2009) Project concept for the proposed Strait of Belle Isle cables saw the preliminary identification of potential cable landing sites at Forteau Point, Labrador and Mistaken Cove, Newfoundland (with alternatives at L'Anse Amour and Yankee Point in Labrador and on the Island, respectively). From there, multiple cables would have been placed in two marine corridors across the Strait.

Nalcor has since refined the Project concept to focus on a single proposed marine corridor between Forteau Point (Labrador) and Shoal Cove (Newfoundland). The rationale for the selection of this option is as follows:

- The location of Forteau Point on the southern Labrador coast helps to minimize the required crossing distance of the Strait, while also providing good site conditions and topography for the HDD process.
- The selection of Forteau Point is also in keeping with the stated preference of stakeholders, so as to avoid important potential socio-cultural issues and interactions with residents and tourism activity at L'Anse Amour.
- Due to its adjacent bathymetry, drilling from the Shoal Cove site provides the best and quickest access to the deeper water, so as to reduce the risk of interactions between the cables and icebergs.

- The proposed placement of the three cables within a single (rather that multiple) cable corridor helps to reduce the overall extent and footprint of the Project in the marine environment, and therefore, its potential effects on its biophysical and socioeconomic components (marine fish and fish habitat, fishing activity, etc.).
- The planned use of an HDD approach from on-land and out to and under the seabed for up to several kilometres on each side of the Strait is also environmentally preferred over other options, such as trenching, as it helps to avoid activity and associated disturbances on the seabed and in and near the water column.

Notwithstanding the environmental benefits associated with the proposed cable landing sites and corridor option, a key rationale for their selection has been to optimize system reliability. Given the key role that the power transmitted through this Project will play in meeting the energy needs to the Island and other jurisdictions, it is imperative that it be designed, constructed and operated at a very high level of reliability. The design option that is feasible and which maximizes this reliability is therefore desired and must be pursued – and so Nalcor will be continuing with its detailed engineering investigations and design on the basis of this option alone.

No other cable landing sites or corridors have been identified that would have different types or degrees of environmental issues and likely effects associated with them, nor have any other alternatives been suggested through the EA's associated consultation processes.

2.12.5 Electrodes

In an HVdc transmission system, the combination of an ac-dc converter, dc transmission line, and dc-ac converter is known as a "pole". This Project has been designed as a bipole system, comprised of two transmission paths and two converters of opposite polarity at each end of the circuit. In order for the HVdc system to operate, a return path permitting the flow of current is required at all times. During normal operation, the two conductors between the two converters provide these paths, and if both poles are in service, the system can operate at capacity.

Electrodes, or high capacity grounding systems, are required to be installed at each end of the HVdc transmission system and connected to their respective converter stations. Although there is no direct physical connection between them, the electrodes utilize the earth (or ocean) as a return path in the event that one of the conductors becomes temporarily unavailable.

The Project includes the proposed installation of electrodes in Labrador and on the Island. During normal Project operations, small amounts of electrical current will flow through the electrode (<1 % of system capacity), as the electrode lines carry small unbalanced currents between the poles more or less continuously. In certain circumstances, the HVdc system can operate in a mono-pole mode during a normal fault (such as when one pole is out of service for maintenance, for up to 100% of design current). Total use of the electrode expected during normal faulting is 10 to 20 hours per year.

Extended electrode use would occur, however, during a significant system failure event, such as if two submarine cables were out of service, or if one overhead line conductor cannot be used. Project design is seeking to minimize the potential for and duration of any such events. The purpose, nature and likely use of the Project's electrodes are described in further detail in Chapter 3 of this EIS.

To provide an acceptable return path, an important design consideration for the installation of such electrodes is ensuring that they are adequately grounded. The electrodes must be established such that conductivity is not obstructed by insulating material, and in general, rock and soil are relatively poor conductors of electricity. Obtaining effective connections therefore often requires the electrodes to be installed in water with suitable salinity. Given the geology of the proposed installation sites at Muskrat Falls and Soldiers Pond, the Project design includes the installation and use of electrodes in the marine environment.

Nalcor originally contemplated the use of sea electrodes installed in Lake Melville in Labrador as well as in Holyrood Bay, Newfoundland, and this concept was reflected in the 2009 EA Registration and Project Description document submitted to initiate the EA process. Further technical review has identified potential issues with these locations, however, including concerns regarding the required salinity levels for the electrode to function properly. Moreover, concerns were also raised by stakeholders during Nalcor's EA consultation activities regarding the potential presence of a wood-pole line to Lake Melville and the presence of a sea electrode at this location, including with regard to environmental, visual and access issues. As a result, Nalcor has subsequently revised its Project planning, and no longer proposes to place sea electrodes in Lake Melville or Holyrood Bay.

The current Project concept would see the use of "shore electrodes" at locations on the Labrador side of the Strait of Belle Isle and Conception Bay where the electrode elements will be placed within a wharf or breakwater-like structure installed adjacent to the shoreline. These locations were identified and selected through an extensive planning and analysis exercise that included consideration of a range of technical, economic and environmental factors and considerations, including: proximity to the proposed converter station site; existing site access and suitability, including any previous development at the site; local infrastructure presence and requirements; detailed electric field simulations using information on required electrode duty, safe voltage gradients, local soils and geology, and anticipated resistivities.

As a result of these analyses, the selected locations for the Project's electrode components are as follows:

1. *Labrador electrode*: L'Anse au Diable (Strait of Belle Isle); and
2. *Newfoundland electrode*: Dowden's Point (Conception Bay).

A wood-pole transmission line connecting the Labrador converter station to the Strait of Belle Isle electrode will follow the same route / ROW as the HVdc transmission line itself from the lower Churchill River to the submarine cable landing site at the Strait. From there it will generally follow the existing Labrador Straits highway and / or power lines north-east to the electrode site. Similarly, a wood-pole line from the Soldiers Pond converter station to the Conception Bay shore electrode will generally follow along existing transmission lines and / or roadways in that region. Nalcor is also studying the feasibility of installing the electrode line on the same structures as the HVdc transmission line between Muskrat Falls and the submarine cable landing site. A final decision will be made during detailed design.

These proposed electrode locations and layouts are currently being brought into the detailed engineering analysis and design phase of the Project, as they have been identified as being technically and economically feasible, and because they meet the Project design requirements and objectives. It is not feasible to carry multiple such options into the detailed engineering and design phase, and given that no site-specific environmental concerns have been identified through the EA and associated consultations to date, there is no identified environmental rationale for further changing the current planning and design of this aspect of the Project.

2.12.6 Overland Transmission Corridor

Project planning and design have identified a proposed 2 km wide corridor for the overland transmission line, extending from Muskrat Falls in Labrador to Soldiers Pond on the Island.

As a linear development, there is potentially an infinite number of alternative transmission corridor routes which may be considered, some of which may, to varying degrees, be considered technically and / or economically feasible, although, not necessarily preferable or environmentally better. The above sections have generally described the process through which the currently proposed transmission corridor was selected, including the proactive consideration of environmental factors.

In view of this large number of possible transmission corridor options, the following focuses on those relevant options that:

1. are specified in the EIS Guidelines and Scoping Document issued by Governments in May 2011;
2. have been identified and evaluated by Nalcor and its engineering consultants as part of the Project planning and design process; and / or
3. have been identified and suggested by Aboriginal and stakeholder groups and the public as part of Nalcor's consultation activities to date.

The EIS Guidelines and Scoping Document (Government of Newfoundland and Labrador and Government of Canada 2011) make specific reference to the consideration of the following transmission corridor options:

1. Following the Trans-Labrador Highway Phase 2 (TLH2) and TLH3 along its entirety across southern Labrador to the Strait of Belle Isle.

   This option would add approximately 150 km of additional length to the proposed transmission line, which would increase construction costs in the order of $100 million or more, as well as increasing the length of transmission line required for maintenance. It is therefore not considered to be an economically feasible alternative for the Project.

2. Following a portion of the TLH3, in combination with new corridor(s) across southern Labrador to the Strait of Belle Isle.

   This option reflects the currently proposed Project that is the subject of this EA.

3. Alternative corridors across the Long Range Mountains, including to the Cat Arm Hydroelectric Project and then following the existing Cat Arm Hydroelectric Project transmission corridor south.

   A Cat Arm corridor option is not possible for several reasons.

   The ice loads on the east side of the Northern Peninsula are known to be even higher than those on the west side. From 1977 to 1987, NLH carried out a Climatological Monitoring Program in the region, including installation of a test tower on the eastern side of the Long Range Mountains in the late 1970s. That tower saw significant accumulation of glaze ice and suffered severe damage in its first year, which was repeated in year 2, leading to an immediate technical recommendation that this not be considered a technically feasible option for the Project.

   Constructing the line down from the highlands on the east side of the Northern Peninsula would be difficult, and would necessitate crossing the floodplains of the Main River where the line would be much more visible.

   The presence of the existing transmission lines from Cat Arm through the narrow valley coming south in that area constrains the ability to construct another large transmission line through that area.

   As a result, this is not considered to be an economically or technically feasible alternative.

   Other identified transmission corridor options on the Northern Peninsula of the Island are described below.

The alternative on-land transmission corridor segments that have been identified and which are subject to further environmental analyses in this EIS are listed and described in Table 2.12.6-1 and illustrated in Figure 2.12.6-1, Figure 2.12.6-2 and Figure 2.12.6-3.

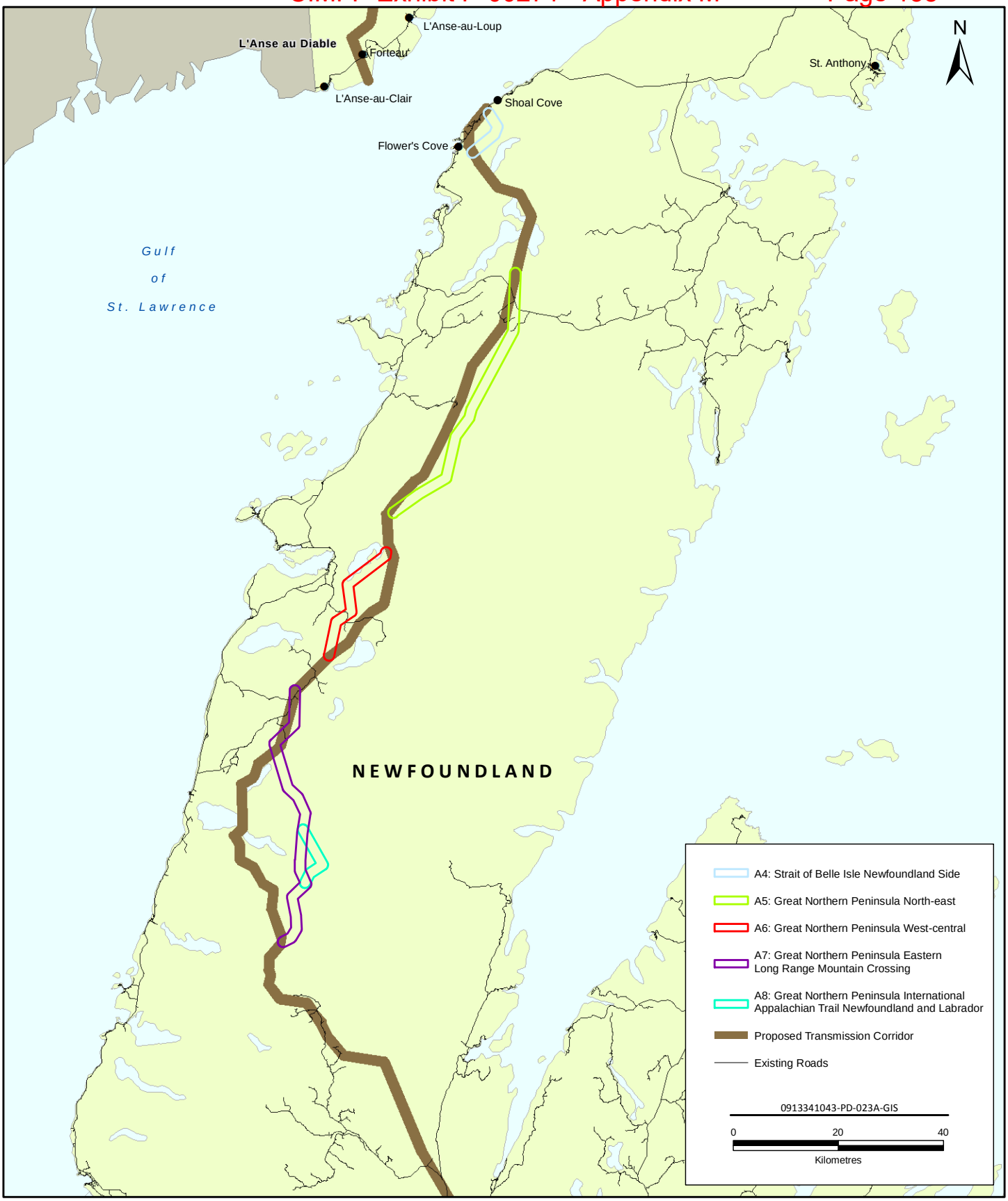
Table 2.12.6-1 Identified Alternative Transmission Line Corridor Segments

Project Alternative (# / Name)	Description
A1: Gull Island to Strait of Belle Isle	Originally identified transmission corridor in Labrador. No longer under consideration.
A2: North-west of Strait of Belle Isle Alternative Segment	Alternate transmission corridor segment near the end of Labrador portion of the transmission corridor, just east of the Quebec border and north of the Strait of Belle Isle.
A3: Point Amour Alternative Segment	Alternate transmission corridor segment to possible Point Amour cable landing site on Labrador side of the Strait of Belle Isle.
A4: Strait of Belle Isle Newfoundland Side Alternative Segment	Alternate transmission corridor segment near the beginning of the Island portion of the transmission corridor, near the Strait of Belle Isle.
A5: Great Northern Peninsula (GNP) North-east Alternative Segment	Alternate transmission corridor segment to the east of the proposed corridor on the northeastern side of the Northern Peninsula.
A6: GNP West-central Alternative Segment	Alternate transmission corridor segment to the west of the proposed corridor near the centre of the Northern Peninsula.
A7: GNP Eastern Long Range Mountain Crossing Alternative Segment	Alternate transmission corridor segment to the east of the proposed corridor where the corridor crosses the Long Range Mountains.
A7: GNP Eastern Long Range Mountain Crossing Alternative Segment + A8: GNP International Appalachian Trail Newfoundland and Labrador Alternative Segment	Another alternate transmission corridor segment in the Long Range Mountains area. Suggested by International Appalachian Trail - NL. Makes use of most of A7 (above) and deviates further east for a section.
A9: Birchy Lake Alternative Segment	Short alternate transmission corridor segment in the Birchy / Sandy Lakes area of west-central Newfoundland.
A10: Newfoundland and Labrador Outfitters Association Alternative Segment	Alternate transmission corridor segment in west-central Newfoundland. Suggested by the NL Outfitters Association.
A11: Avalon Alternative Segment	Short alternate transmission corridor segment in the east-central portion of the Avalon Peninsula



FIGURE 2.12.6-1

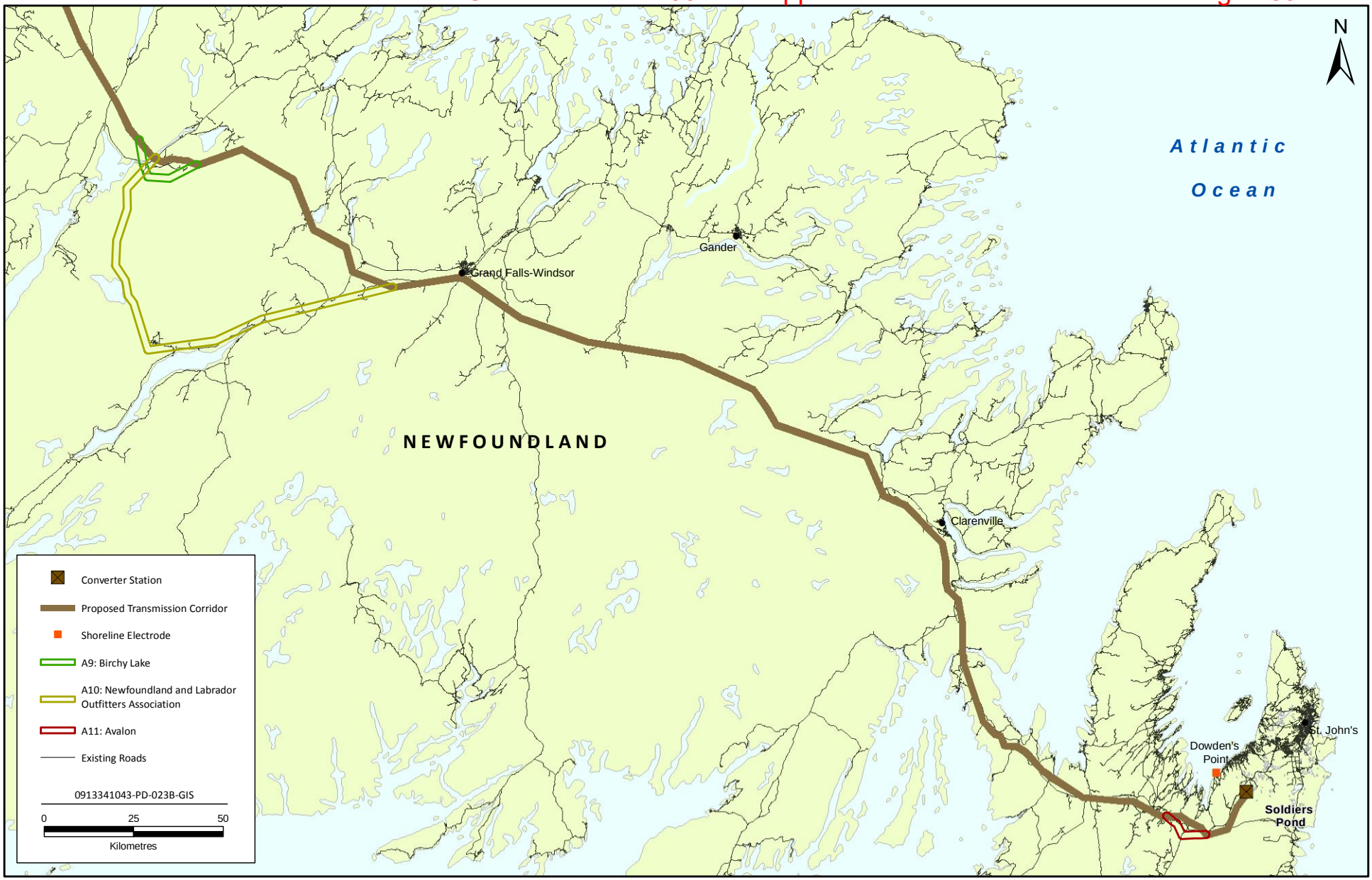
Alternative Transmission Corridor Segments - Central and Southeastern Labrador



nalcor energy

FIGURE 2.12.6-2

Alternative Transmission Corridor Segments - Northern Peninsula



nalcor energy

FIGURE 2.12.6-3

Alternative Transmission Corridor Segments - Central and Eastern Newfoundland and Avalon Peninsula

In Chapters 11-14 and 16 of this EIS, the initial and detailed environmental effects assessment is focussed first on the proposed (preferred) Project design concept (as described in detail in Chapter 3). From there, the various alternative transmission corridor segments listed in Table 2.12-6-1 are then assessed through a comparison to the predicted environmental effects of the proposed transmission corridor that is the subject of the preceding detailed environmental effects assessment. In doing so, this analysis considers and describes whether and how the potential environmental effects of each alternative segment would likely be different in nature and degree from those of the segment of the proposed transmission corridor that it would replace.

2.12.7 Project Construction and Maintenance: Approaches, Sequencing and Infrastructure

The Project, particularly during its construction phase, will also include various additional components and works, including access roads and trails (including associated stream crossings), camps, marshalling and lay-down areas, quarries and borrow pits, and other temporary infrastructure and associated activities.

Chapter 3 (Project Description) provides an overview of the general nature and number / scope of the Project's associated construction and operations components and activities, at a level of detail that reflects the current stages of Project planning and design, and which is appropriate and typical for EA purposes. As a result of this stage of planning and design, however, specific locations and designs for these aspects of the Project have not been developed and finalized, and accordingly, proposed and alternative designs cannot be presented and evaluated in an EIS. These will be evaluated and selected as part of the detailed engineering design of the Project, and many of these activities and elements will in fact be determined later by the eventual construction contractor(s) involved, with final approval by Nalcor.

This eventual design process will include consideration of Project requirements, including technical and economic factors (e.g., distances, volumes, etc.), as well as environmental considerations and the results of the EA process, including its mitigation commitments, and any associated terms and conditions of EA approval. Other principles to be included in the detailed design and site selection process will include attempts to make use of existing access, infrastructure, quarry sites, and other developed areas wherever possible and practical.

The following additional alternatives are also listed specifically in the EIS Guidelines and Scoping Document (Government of Newfoundland and Labrador and Government of Canada 2011):

a. Alternative means of accessing the corridor including, but not limited to, helicopter, permanent access roads, temporary access roads and ice roads:

   - Access to every tower site is required for construction
   - Local conditions contribute to the access selected, including remoteness, terrain, availability of nearby existing access, watercourses, etc.
   - Although helicopters reduce ground travel, the logistical requirements are substantial, given that heavy lift helicopters consume 1900 to 2100 L of fuel per hour, and have a relatively low economical flying time per round trip. Considerations for the use of helicopters for the erection of towers include: i) the cost, ii) the requirement for large lay down areas to allow for the assembly of many towers prior to flight to ensure maximization of helicopter usage, and iii) the large fuel storage requirements. Thus, helicopters are contemplated for specific areas where access is extremely difficult, such as section of southeastern Labrador, as well as the Long Range Mountains on the Northern Peninsula.
   - Since construction for the Project will be year round, transport of materials in the winter using winter trails and roads will be assessed and optimized where possible. The use of ice roads is not contemplated for this Project.
   - An access trail along the transmission line ROW, as well as periodic access points to this trail will be established and maintained throughout Project Operations.
   - As no permanent infrastructure will exist on the transmission line ROW other than the line itself, permanent access roads will not be established in remote areas. There will, however, be access roads

built in areas that may require additional access where a trail would be inadequate given the amount of material that will be required to be distributed. There will also be permanent access roads constructed for key infrastructure such as the electrodes and converter stations.

b. Alternative clearing methods, including mechanical and manual clearing:

- ROW clearing will be carried out in accordance with standard utility practices and procedures, and will involve the removal of all vegetation that exceeds 2 m at maturity.
- Vegetation will be removed primarily by mechanical harvesters, with chain saws or other hand-held equipment potentially used in small areas (e.g., along watercourses).
- Given the size of the area required to be cleared and the volume of wood along the ROW (an approximately 1,100 km long by 60 m wide area), the use of mechanical harvesters is the only technically and economically viable means of clearing the ROW.

c. Construction sequence:

- The process for the construction of transmission lines is standard and defined by the sequence of required steps and elements, as follows: ROW clearing and access, material distribution, tower foundation installation, tower assembly and erection, and conductor stringing.
- Due to the linear nature of transmission lines, construction activities can typically be conducted in succession and concurrently. The start of each activity is often staggered to allow crews to move down the transmission line route completing each construction phase ahead of the next. In addition, work programs can begin and proceed separately in different segments of the line, through a series of strategically placed and timed work fronts.
- Chapter 3 presents an overview of the Project construction process and schedule. The specific timing and sequencing of all specific aspects of Project construction will again be defined as part of the detailed engineering design of the Project, and will primarily be determined by the eventual construction contractor(s) involved with final approval by Nalcor.

d. Construction labour force accommodation:

- As described in Chapter 3, the construction workforce will be housed in a series of work camps located throughout the province at strategic locations along and near the transmission line ROW.
- All camps will be established and operated in accordance will all applicable regulations and permits, including those related to environmental and human (health and hygiene) considerations.
- This Project design decision has been made by Nalcor based on Project requirements, as well as the stated preferences of stakeholders through EA consultations, to reduce interactions between the Project workforce and local communities, as well as to prevent potential effects on the tourism industry by filling up hotel and other accommodations throughout the province during the peak tourist season.

e. Alternative means of controlling vegetation within the ROW, including both mechanical and chemical means:

- Nalcor will incorporate the HVdc transmission line into its integrated vegetation management program for its transmission and distribution systems.
- Vegetation will be controlled manually / mechanically, as well as through the selective application of vegetation-control agents in certain areas.
- As described in Chapter 3, the use of herbicides for vegetation control on transmission line ROWs is a common and highly regulated activity in NL and elsewhere, and is required for this Project given the overall length and scale of the ROW, as well as to ensure effective control of certain species.

- Any and all such herbicide use will be subject to approval from the Department of Environment and Conservation, and will be undertaken in full compliance with the *Pesticides Control Regulations*. As is standard practice, there will be a public notification and an evaluation of any environmental sensitivities wherever herbicides are to be used. Vegetation control personnel will be appropriately trained and qualified.

2.13 Eventual Transmission Line Routing and Detailed Project Design

An important principle of EA is that it should occur at a relatively early stage of, and therefore influence and seek to improve, Project planning and design. Therefore, in conjunction and concurrent with the EA process, Nalcor will be continuing with its technical and environmental analysis of the identified transmission corridors to identify and eventually select a specific routing for the transmission line.

This analysis includes a constraints mapping exercise, which involves the compilation of information on the existing natural and human environments within the transmission corridor, to identify and evaluate key environmental and socioeconomic factors and issues for consideration in the eventual route selection process. Inputs to this analysis and planning process will include existing and available information on the biophysical and socioeconomic environments, any additional information collected and issues identified as part of the EA process, as well as the results of the associated public and stakeholder consultations and any associated terms and conditions of EA approval (e.g., requirements to avoid certain environmental components in eventual route selection).

Based on the results of the above, further engineering analysis and aerial and ground surveys in the final design stage, a preferred transmission line route (for an on-land ROW averaging approximately 60 m wide) will be selected. Again, this route will be evaluated and selected with consideration of technical, environmental and socioeconomic factors through the environmental and engineering work described above. The current transmission corridor is intended to form the basis for eventual detailed route selection, subject to further refinement as Project engineering and environmental work continues.

Once identified, and prior to final Project design and construction, Nalcor will conduct public consultations to present these transmission line routing(s) to the interested public and stakeholders. This will serve as a final check on its overall environmental acceptability, and allow for any final amendments to address any important remaining environmental issues, as required and possible.

Detailed engineering and design for all Project components and activities has recently commenced, and will continue throughout and beyond the EA process. It includes consideration of Project requirements, including technical and economic factors, as well as environmental considerations. Some aspects of Project planning (e.g., temporary camp locations, marshalling yard locations), will be determined by the eventual construction contractor(s) involved, with final approval from Nalcor.

It is also important to note that many such Project components and activities will require specific environmental permits and / or other provincial, federal and municipal authorizations (see Chapter 3).

The post-EA permitting process will provide the opportunity for relevant regulatory departments and agencies to receive and review these detailed designs, and to establish specific terms and conditions to avoid or reduce environmental effects. Nalcor and / or its contractors will identify, apply for and adhere to all require permits and other authorizations that are required for Project construction and / or operations.

2.14 Project Management Systems and Policies

2.14.1 Environmental Management System

This Project will be constructed and operated in accordance with an Environmental Management System (EMS), through which its associated environmental protection measures and mitigations will be managed and

controlled. An EMS monitors environmental performance and integrates environmental management into a company's daily operations, long-term planning and other quality management systems.

Nalcor and its subsidiaries have chosen the ISO 14001 EMS standard developed by the International Organization for Standardization (ISO). This decision has resulted in continual improvement of environmental performance, while fulfilling the corporation's mandate to provide customers with cost-effective and reliable power. Existing Nalcor facilities, including Churchill Falls, have been individually registered by an external auditor (Quality Management Institute (QMI)) as compliant with the ISO 14001 standard.

Nalcor's existing EMS includes the following components:

- **Environmental Policy**: A statement of what is intended to be achieved from an EMS. It determines if all environmental activities are consistent with objectives.
- **Environmental Risk Identification**: Identification and documentation of the actual and potential environmental effects of operations. This is achieved through undertaking an environmental audit. A similar process will be undertaken as part of the planning process for the Project. All planned activities will be audited and the potential environmental risks identified.
- **Objectives and Targets**: The environmental audit forms the basis for environmental objectives and targets. To continually improve, targets will be regularly reviewed. Project-specific objectives and targets will be set.
- **Consultation**: Staff and community consultation are carried out before, during and after establishment of the EMS. This was necessary to obtain the compliance of all staff to be involved in, and committed to, the EMS.
- **Operational and Emergency Procedures**: All procedures are reviewed for compatibility with environmental objectives and targets. Any changes are included with the documentation.
- **Environmental Management Plan**: This details the methods and procedures to be used to meet objectives and targets.
- **Documentation**: All objectives, targets, policies, responsibilities and procedures are documented along with information on environmental performance.
- **Responsibilities and Reporting Structure**: Responsibilities are allocated to staff and management so that the EMS is implemented effectively.
- **Training**: Staff undergo environmental awareness training to familiarize them with their responsibilities for implementing the EMS and with the overall environmental policy and objectives.
- **Review Audits and Monitoring Compliance**: Review audits are undertaken regularly to determine if the EMS is achieving its objectives and to refine operational procedures to meet this goal. In order to determine if regulatory and other requirements are being met, regular environmental monitoring is conducted as necessary.
- **Continual Improvement**: An important component is continual improvement. An EMS comes into its best use when used to review progress towards the targets and objectives set by a company to protect the environment. The procedures set in place to meet these objectives are constantly examined to see if they can be improved or if systems that are more effective can be introduced.

The Project will build upon the existing EMS system in place while implementing Project-specific objectives and targets based on the identification of potential environmental effects.

2.14.2 Environmental Protection and Mitigation

In addition to the concept of reducing or avoiding environmental outcomes through Project planning and design, environmental protection planning is an integral part of Nalcor's construction, and Operations and Maintenance programs.

2.14.2.1 Environmental Protection Plan(s)

As described previously, Nalcor and its subsidiaries currently operate an extensive electricity transmission system in NL. This includes interconnected electrical power systems on the Island and in Labrador as well as isolated distribution systems throughout rural areas of the province. As a corporation with extensive experience in constructing and maintaining transmission infrastructure in NL, Nalcor has state-of-the-art and proven policies and procedures related to environmental protection and management which will be implemented during the construction and operation of this proposed Project.

An Environmental Protection Plan (EPP) is an important tool for consolidating environmental information in a format that provides sufficient detail for the implementation of environmental protection measures in the field during construction, and Operations and Maintenance. An EPP provides concise instructions to personnel regarding protection procedures and descriptions of techniques to reduce potential environmental effects associated with any Project activity. The main objectives are to:

- consolidate information for planning;
- ensure environmental standards are current and complied with;
- provide details of corporate commitments to environmental protection and planning; and
- provide guidelines for field activities and decision-making on environmental issues relevant to construction, and Operations and Maintenance activities.

EPPs have been developed and implemented for the Project's environmental and engineering field studies. These address issues relating to environmental orientation, storage and handling of fuel, waste disposal, vessel operation, hunting and fishing, field policies, encounters with wildlife, discovery of historic resources, spills and forest fires.

Depending on construction sequencing, one or several activity-specific EPPs will be prepared and implemented for the Project's construction phase. Each EPP will be a field-useable document, addressing provisions that will avoid or reduce environmental effects which may be associated with construction. As appropriate, each EPP will include items relating to vegetation clearing, grubbing and grading, storage and handling of fuel, blasting, quarrying, dust control, waste and sewage disposal, work in water, contingency plans for unplanned events such as spills, rehabilitation and compliance monitoring.

2.14.3 Safety, Health and Environmental Emergency Response Plan

In the Construction, and Operations and Maintenance of a large transmission infrastructure project, an accidental release or other unplanned event is an unlikely, but possible, event. Nalcor proactively identifies potential emergency situations and develops response procedures, including Safety, Health and Environmental Emergency Response Plans (SHERPs).

The purpose of a SHERP is to identify responsibilities in the event of an unplanned incident, including the accidental release of oil or other hazardous material, on-site or during transportation, and to provide the information required for the effective response and reporting of such an incident. Nalcor will conform to both provincial and federal legislation with the intent of meeting both its legal and corporate responsibilities.

The establishment and maintenance of emergency response procedures addresses the:

- protection and maintenance of human health and safety;
- identification of the potential for accidents and emergency situations;
- planned response to accidents and emergency situations; and
- prevention and mitigation of potential environmental effects associated with accidents and emergency situations.

SHERPs were also developed and implemented for the Project's environmental and engineering studies. Depending on construction sequencing, one or several site / activity-specific SHERPs will be prepared and implemented for the Project.

Project-specific SHERPs will address roles and responsibilities, personal protective equipment, materials storage, driving safety, working at heights, working near or over water, working near or on ice, vessel operation and safety, animal encounters, emergency response communications, spill response, personnel injury response, search and rescue, fire and explosion response, and vehicle / vessel accidents.

The development and use of EPPs and SHERPs related to Project construction, and Operations and Maintenance are discussed in further detail in Chapter 3 (Project Description). These will include the various relevant environmental effect mitigation measures included in this EIS and associated documentation, as well as the relevant terms and conditions associated with any EA approval and subsequent permits.

2.14.4 Project Benefits Strategy

The economic benefits of the Project will be substantial, and Nalcor is committed to ensuring these benefits are experienced throughout NL.

On July 14, 2010, the *Lower Churchill Construction Projects Benefits Strategy* was released by the provincial government. A Benefits Strategy was to developed for Project work that is performed in the province to help ensure employment and contrct opportunities for the people of NL during the construction phase of both the Labrador-Island Transmission Link and the Lower Churchill Hydroelectric Project.

The Benefits Strategy outlines the kinds of activities and procedures which will be followed by Nalcor, its contractors and sub-contractors regarding employment and business benefits, and is similar to benefits arrangements that the province has had in place for oil and mining companies to ensure that work is performed in the province for the benefit of industry and employees.

The strategy addresses the at least 21.5 million person hours of construction employment estimated to be associated with the two proposed hydroelectric developments at Gull Island and Muskrat Falls, as well as the Labrador-Island Transmission Link, and at least 6.5 million engineering and project management person hours, as well as specific Gender Equity and Diversity Programs.

Some of the highlights of the Benefits Strategy relevant to this Project include:

Project Management

- Project management activities associated with the projects will be executed in the province.
- The Engineering, Procurement and Construction Management (EPCM) contractor will establish its own engineering, procurement, construction management and overall project management office in the province with appropriate personnel and decision-making authority.

Engineering and Project Management

- The Lower Churchill Construction Project team and its EPCM contractors and sub-contractors will perform all engineering and project management, with the possible exception of specialized engineering, for the project in the province.
- All reasonable efforts will be made to have specialized engineering performed in the province. In the event there is specialized engineering undertaken outside the province, Nalcor-Lower Churchill Project will ensure that such work is done in full collaboration with and is integrated into the local engineering effort.
- No less than the following number of engineering and project management hours for the Transmission Link will take place within the province: 1.0 million person hours.

Procurement and Contracting

- Procurement will be managed from the Lower Churchill Project and its EPCM contractor offices in the province.
- Nalcor-Lower Churchill Project and its EPCM contractor will be responsible for the following:
  - issue all Requests for Proposals and procurement related documents;
  - primary point of contact for all inquiries regarding contracts and procurement;
  - co-ordinate supplier development activities;
  - make all decisions related to procurement;
  - issue procurement awards; and
  - conduct all meetings with suppliers related to procurement.
- Contractors and sub-contractors will be aware of, and must comply with, the applicable terms of the benefits strategy.
- Nalcor-Lower Churchill Project will conduct appropriately-timed supplier development workshops to ensure local suppliers and contractors can prepare for bidding and establish business relationships. Workshops will be held on both the Island and Labrador.

Construction and Assembly

- No less than the following number of construction and assembly person hours for the Transmission Link will take place in the province: 2.5 million person hours
- A construction hiring protocol will be established for construction.

Gender Equity

- Nalcor-Lower Churchill Project will implement a gender equity program, including a women's employment plan.
- The program will establish quantitative goals and emphasize continuous improvement which will increase access and employment for women.

Diversity

- The objectives of the diversity program will be to address employment equity for the projects, including access to employment for disadvantaged groups.

Reporting

- The Provincial Government will be provided monthly and quarterly reports for the projects' duration by Nalcor-Lower Churchill Project.
- These reports will include information such as the total number of person hours of work and number of person hours of project management and design work.

The nature and content of the Benefits Strategy is described and considered further in the Socioeconomic Environmental Effects Assessment (Chapter 16), and specifically, in the section dealing with Economy, Employment and Business (Section 16.4).

Other relevant Project policies and plans (existing and future) are referenced throughout the following chapters of the EIS as appropriate and applicable to the management of environmental issues and / or the optimization of benefits.

2.15 References

Aces International Limited. 2001. Holyrood Combined Cycle Plant Study Update (Exhibit 5H). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

AMEC. 2011. Holyrood Thermal Generating Station Condition Assessment & Life Extension Study (Exhibit 44). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

Canada Mortgage and Housing Corporation. 2011. Housing Market Outlook: Canada Edition, Third Quarter. Available at: http://www.cmhc-schl.gc.ca/odpub/esub/61500/61500_2011_Q03.pdf?fr=1319711716485.

Centre for Clean Energy. 2011. How does a thermal power plant work? Available at: http://www.centreforenergy.com/AboutEnergy/Thermal/Overview.asp?page=4.

Electric Light & Power. 2009. Wave and Tidal Power Growing Slowly, Steadily.

Encyclopedia Britannica. 2011. Tidal Power Barrage. Available at: http://www.britannica.com/EBchecked/media/125135/Diagram-of-a-tidal-power-barrage.

Global Wind Energy Council. 2011. Wind energy technology. Available at: http://www.gwec.net/index.php?id=31.

GNL (Government of Newfoundland and Labrador). 1994. *An Act to Regulate the Electrical Power Resources of Newfoundland and Labrador 1994*. Available at: http://www.assembly.nl.ca/legislation/sr/statutes/e05-1.htm.

GNL. 2007. Focusing Our Energy: Newfoundland and Labrador Energy Plan. Government of Newfoundland and Labrador. Available at: http://www.nr.gov.nl.ca/nr/energy/plan/index.html.

GNL. 2010. The Economic Review 2010. Available at: http://www.economics.gov.nl.ca/ER2010/TheEconomicReview2010.pdf.

GNL. 2011. Newfoundland and Labrador Labour Market Outlook 2020. Available at: http://www.hrle.gov.nl.ca/hrle/publications/LMOutlook2020.pdf.

Government of Canada. 2009. National Forestry Database: Forestry Highlights 2009. Available at: http://nfdp.ccfm.org/highlights_e.php. Accessed: 2011.

Government of Canada. 2010a. Government of Canada to Regulate Emissions from Electricity Sector. Available at: http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=E5B59675-BE60-4759-8FC3-D3513EAA841C.

Government of Canada. 2010b. Backgrounder: Canada's Electricity Story. Available at: http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=0A6CF209-AF7A-4913-A27F-527B4ECF811B.

Government of Canada. 2011a. PV Potential and Insolation. Available at: https://glfc.cfsnet.nfis.org/mapserver/pv/pvmapper.phtml?LAYERS=2700,2701,2057,4240&SETS=1707,1708,1709,1710,1122&ViewRegion=-2508487%2C5404897%2C3080843%2C10464288&title_e=PV+potential+and+insolation&title_f=Potentiel+photovoltaïque+et+ensoleillement&NEK=e.

Government of Canada. 2011b. Atlas of Canada: Diagram of a Hydroelectric Dam. Available at: http://atlas.nrcan.gc.ca/site/english/maps/economic/energy/Dams/hydro.jpg/image_view.

Government of Canada. 2011c. Canada Gazette Part I, August 27, 2011 (Exhibit 107). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

Government of Newfoundland and Labrador and Government of Canada. 2011. Environmental Impact Statement Guidelines and Scoping Document, Labrador-Island Transmission Link. Prepared for Nalcor Energy. St. John's, NL.

Government of Saskatchewan. 2011. Government Approves $1.24 Billion Carbon Capture Project, Press Release. Available at: http://www.gov.sk.ca/news?newsId=ae413247-80ce-4c9a-b7e3-4cc39e89da94.

Government of the United States. 2011a. Environmental Protection Agency. Cross State Air Pollution Rule (CSAPR). Available at: http://www.epa.gov/airtransport/.

Government of the United States. 2011b. Department of Energy. How Wind Turbines Work. Available at: http://www1.eere.energy.gov/wind/wind_how.html#inside.

Government of the United States. 2011c. Department of Energy. Guide to Tribal Energy Development: Biomass Energy – Biopower. Available at: http://www1.eere.energy.gov/tribalenergy/guide/biomass_biopower.html.

Hatch Ltd. 2008. CCGT Capital Cost Benchmark Study Final Report (Exhibit CE-46). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

ISO New England. 2011a. 2010 Annual Markets Report. Available at: http://www.iso-ne.com/markets/mkt_anlys_rpts/annl_mkt_rpts/2010/amr10_final_060311.pdf.

ISO New England. 2011b. 2011 Regional System Plan. Available at: http://www.iso-ne.com/trans/rsp/index.html.

MHI (Manitoba Hydro International) 2012. Report on Two Generation Expansion Alternatives for the Island Interconnected Electrical System, Volume 1: Summary of Reviews. Available at: http://www.pub.nl.ca/applications/MuskratFalls2011/files/mhi/MHI-Report-VolumeI.pdf

Marbek Resource Consultants Ltd. 2008. Conservation and Demand Management (CDM) Potential Newfoundland and Labrador.

Nalcor (Nalcor Energy). 2010a. Muskrat Falls Capex 15% Contingency – Quarterly Capex Summary (Exhibit 5F). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm..

Nalcor. 2010b. October 2010 Capital Cost Update – Muskrat Falls HVdc Link (Exhibit 5E). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm..

Nalcor. 2010c. Cashflow Calculations for 2010 Generation Expansion Studies (Exhibit 5). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm..

Nalcor. 2010d. Operating Cost Estimates (Exhibit 8). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm..

Nalcor. 2010e. Energy Over the Infeed/ Labrador HVdc Analysis 2010 – Input to NLH Generation Planning Analysis (Exhibit 6B). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm..

Nalcor. 2011a. *Nalcor's Submission to the Board of Commissioners of Public Utilities with respect to the Reference from Lieutenant-Governor in Council on the Muskrat Falls Project.* Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/files/submission/Nalcor-Submission-Nov10-11.pdf.

Nalcor. 2011b. Cost Escalation Methodology Overview (Exhibit 3 - Part 2). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

Nalcor. 2011c. Nalcor Inflation and Escalation Forecast (Exhibit 3). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

Nalcor. 20011d. Nalcor Responses to Information Requests (PUB-Nalor and MHI-Nalcor). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/rfi.htm.

Nalcor. 2011e. Muskrat Falls Generation Facility and Labrador – Island Transmission Link: Overview of Decision Gate 2 Capital Cost and Schedule Estimates (Exhibit CE-51). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

Nalcor. 2011f. Hydro PPA Details (Exhibit 6). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

Nalcor. 2011g. Information on Wind Farms, Board Letter July 12th, 2011 (Exhibit 25). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

Nalcor and NLH (Nalcor Energy and Newfoundland and Labrador Hydro). 2010. Thermal Fuel Oil Price Forecast: Reference as of January 2010 (Exhibit 4). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

Nalcor Energy and Churchill Falls (Labrador) Corporation. 2009. Water Management Agreement (Exhibit 17). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

natgas.info. 2011. The Independent Natural Gas Information Site. Available at: http://www.natgas.info/index.html.

National Energy Board. 2011. Frequently Asked Questions. Available at: http://www.neb.gc.ca/clf-nsi/rnrgynfmtn/prcng/lctrct/frqntlskdqstn-eng.html.

Navigant Consulting Ltd. 2011. Independent Supply Decision Review (Exhibit 101). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm

New York Independent System Operator. 2011. Power Trends 2011. Available at: http://www.nyiso.com/public/webdocs/newsroom/power_trends/Power_Trends_2011.pdf.

NLH (Newfoundland and Labrador Hydro). 1996. Reliability Study of Transmission Lines on the Avalon and Connaigre Peninsulas, (Exhibit 85). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2004. An Assessment of Limitations for Non-Dispatchable Generation on the Newfoundland Island System (Exhibit 61). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2008. DC1010 - HVdc System Integration Study (Exhibit CE-3). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2009. Transmission Planning Manual, Rev 2, 2009, (Exhibit 105). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2010a. *Summary of Newfoundland and Labrador Hydro 2010 Long Term Planning Load Forecast* (Exhibit 27). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2010b. Generation Planning Issues: 2010 July Update. System Planning Department (Exhibit 16). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2010c. Island Transmission System Outlook (Exhibit 24). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2010d. PLF Strategist® Generation Expansion Plans (Exhibit 14 Rev. 1). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2011a. Total Island Interconnected Load (Exhibit 58). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2011b. System Operations and Customer Services Departments. St. John's, NL.

NLH. 2011c. Technical Note: Labrador – Island HVdc Link and Island Interconnected System Reliability (Exhibit 106). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2011d. Annual Load Shape (Exhibit 2). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2011e. Newfoundland and Labrador Hydro Generation Expansion Analysis, 2010 Island Isolated and Infeed Scenarios (Exhibit 99). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2011f. PUB Letter July 12 Q4b 50 MW Gas Turbine Budget Estimate Update (Exhibit CE-47). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2011g. Retirements – Existing Units (Exhibit 7). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2011h. Thermal Units – Average Heat Rates (Exhibit 9 Rev.1). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2011i. Asset Maintenance Scheduling (Exhibit 11). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2011j. Forced Outage Rates Summary Sheets (Exhibit 12). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH. 2011k. 2010 PLF Strategist Generation Expansion Plans (Exhibit 14). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

NLH and Newfoundland Power. 2008. Five-Year Energy Conservation Plan: 2008-2013.

Ocean Energy Council. 2011. Tidal Energy. Available at: http://www.oceanenergycouncil.com/index.php/Tidal-Energy/Tidal-Energy.html.

Pan Maritime Kenny – IHS Energy Alliance. 2001. Technical Feasibility of Offshore Natural Gas and Gas Liquid Development Based on Submarine Pipeline Transportation System (Exhibit 108). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

Quetta Inc. and Associates. 1999. Technical Review of Newfoundland and Labrador Hydro, Final Report.

SaskPower. 2011. Boundary Dam Integrated Carbon Capture and Storage (BD3 ICCS) Demonstration Project. Available at: http://www.saskpower.com/sustainable_growth/assets/clean_coal_information_sheet.pdf.

SGE Acres limited. 2004. Air Emissions Control Assessment-Holyrood Thermal Generating Station, Final Report (Exhibit 68). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

SNC-Lavalin Inc. 1988. Feasibility Study: Round Pond Hydroelectric Development (Exhibit 5D[ii]). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

SNC-Lavalin Inc. 1989. Feasibility Study Round Pond Development (Exhibit 5D[i]). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

SNC-Lavalin Inc. 2006. Studies for Island Pond Hydroelectric Project (Exhibit 5B). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

SNC-Lavalin Inc. 2007. Feasibility Study for Portland Creek Hydroelectric Development (Exhibit 5C). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

SNC-Lavalin Inc. 2008. Island Pond Hydroelectric Project Final Report, Appendix A - Capital Cost Estimates Back-Up (Exhibit CE-57). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

SNC-Lavalin Inc. 2011. Feasibility Study of HTGS Units 1&2 Conversion to Synchronous Condenser - An Evaluation of Run Up Options for Generators (Exhibit CE-56). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

Stantec Consulting Ltd. 2008. Precipitator and Scrubber Installation Study HTGS (Exhibit 5L[i]). Available at: http://www.pub.nf.ca/applications/MuskratFalls2011/nalcordocs.htm.

Statistics Canada. 1979-2009. Survey of Household Spending. Available at: http://www.statcan.gc.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=3508&lang=en&db=imdb&adm=8&dis=2.

Statistics Canada. 1990. Household Facilities and Equipment. Catalogue No. 64-202. Statistics Canada, Household Surveys Division, Ottawa.

Statistics Canada. 2009. Report on Energy Supply and Demand in Canada.

SunEdison. 2011. How Solar Energy Works. Available at: http://www.sunedison.com/how--solar-electricity-works.php.

Tennessee Valley Authority. 2011. Integrated Resource Plan. Available at: http://www.tva.gov/environment/reports/irp/pdf/simple_cycle_turbine.pdf.

The European Wind Energy Association. 2011. How a Wind Turbine Works. Available at: http://www.ewea.org/index.php?id=1922.

The Pembina Institute. n.d. Wind Power Realities. Available at: http://www.pembina.org/docs/re/web-eng-wind-factsheet.pdf.

United States Nuclear Regulatory Commission. 2011. NRC: Boiling Water Reactors. Available at: http://www.nrc.gov/reactors/bwrs.html.

University of Bath. 2011. Alternative Sources for Electricity Generation - Wave Power. Available at: http://people.bath.ac.uk/dpk20/Website_files/page0006.htm.

Westney (Westney Consulting Group Inc.). 2008. Are Stages and Gates Destroying Predictability? - The Unintended Consequences of Front-End Loading. Available at: http://www.westney.com/publications/Westney%20Advisor/Are%20Stages%20and%20Gates%20Destroying%20Predictability.pdf.

Westney. 2009. Improving the Predictability of the CapEx Portfolio. Available at: http://www.westney.com/publications/Westney%20Advisor/Improving%20the%20Predictability%20of%20the%20CapEx%20Portfolio.pdf.

NALCOR ENERGY

LABRADOR-ISLAND TRANSMISSION LINK

ENVIRONMENTAL IMPACT STATEMENT

Chapter 3

Project Description

April 2012

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LIST OF ACRONYMS

Acronym	Description
µT	micro Tesla
%	percent
Cl	Chlorine ion
H_2O	water (molecule)
OH	Hydroxide ion
ac	alternating current
ATV	all-terrain vehicle
CCA	chromate copper arsenate
CIV	cable installation vessel
Cl_2	Chlorine (molecule)
cm	centimetre
CSA	Canadian Standards Association
dB	decibel
dB(A)	A-weighted decibel
dc	direct current
DFO	Fisheries and Oceans Canada
EMF	electromagnetic field
EMS	Environmental Management System
EPP	Environmental Protection Plan
EPRI	Electrical Power Research Institute
FACE	Field and Corona Effects
GIS	Geographic Information System
GPR	Ground Potential Rise
GPS	Global Positioning System
$H_{2(g)}$	Hydrogen gas
ha	hectare
HDD	Horizontal Directional Drilling
HDPE	high density polyethylene
HVdc	high voltage direct current
IDC	interest during construction
ISO	International Organization for Standardization
kg/yr	kilograms per year
km	kilometre
kPa	kilopascal
kph	kilometres per hour
kV	kilovolt
kV/m^2	kilovolts per square metre

Acronym	Description
L	litre
LiDAR	Light Detection and Ranging
m	metre
MI	Mass Impregnated
mm	millimetre
MW	megaWatt
nA/m^2	nano Amperes per square metre (where nano is 10^{-9})
NLH	Newfoundland and Labrador Hydro
NLDEC	Newfoundland and Labrador Department of Environment and Conservation
NLDEC-WRM	Newfoundland and Labrador Department of Environment and Conservation, Water Resources Management Division
NLEPA	Newfoundland and Labrador *Environmental Protection Act*
º	degrees
O_2	Oxygen
OPGW	Optical overhead groundwire
pH	potential hydrogen
Project	Labrador-Island Transmission Link
PVC	polyvinyl chloride
QMI	Quality Management Institute
ROV	remotely operated vehicle
ROW	right-of-way
SCADA	Supervisory Control and Data Acquisition
SHERP	Safety, Health and Environmental Emergency Response Plan
TCH	Trans-Canada Highway
TL	Transmission Line (when referring to specific line number)
TLH	Trans-Labrador Highway
TLH2	Trans-Labrador Highway Phase 2
TLH3	Trans-Labrador Highway Phase 3
USEPA	United States Environmental Protection Agency
VHF	very high frequency
W/m	Watts per metre

3 PROJECT DESCRIPTION

This chapter describes the Labrador-Island Transmission Link (Project), including converter stations, overhead transmission line, submarine cables, land cables, electrodes and associated infrastructure. It also describes the Construction, and Operations and Maintenance of the Project. As the Project enters the detailed design phase, the Project Description may undergo further definition to refine and optimize technical, economic and environmental features; consequently, specific descriptions of these features are approximate. Such refinements are consistent with the normal planning and design process and with EA as a planning tool and based on the best information available at the time of this submission; these refinements and optimizations will not affect the overall Project footprint or the predicted environmental effects presented in subsequent chapters.

Section 3.1 provides a general overview of the Project, and Section 3.2 describes the Project location. Section 3.3 describes the Project components from north-west to south-east along the transmission line, from the Muskrat Falls converter station to Forteau Point, across the Strait of Belle Isle to Shoal Cove, then across Newfoundland to Soldiers Pond. The Construction schedule, infrastructure and activities are then described in Section 3.4. Schedule and activities associated with Project Operations and Maintenance, including maintenance and repairs, vegetation management and Project inspections, are described in Section 3.5. Section 3.5 also describes emissions during Project Operations and Maintenance. Section 3.6 describes environmental protection and emergency response planning. Workforce requirements for both Project Construction and Project Operations and Maintenance are described in Section 3.7, and estimated Project expenditures are provided in Section 3.8.

3.1 Project Overview

The Project consists of the Construction and Operations of a ± 350 kilovolt (kV) High Voltage direct current (HVdc) electricity transmission system from Central Labrador to the Avalon Peninsula on the Island of Newfoundland (the Island). A two kilometre (km) wide study corridor has been identified within which a transmission line right-of-way (ROW) with an average width of 60 metres (m) will be selected.

The proposed transmission system will include the following key components:

- an alternating current (ac) to direct current (dc) converter station at Muskrat Falls;
- approximately 400 kilometre (km) overhead HVdc transmission line from Muskrat Falls to Forteau Point;
- three, approximately 35 km long, submarine cables across the Strait of Belle Isle (i.e., between Forteau Point and Shoal Cove), with associated onshore infrastructure (transition compounds and land cables at both cable landings);
- approximately 700 km of overhead HVdc transmission line from Shoal Cove to the Avalon Peninsula;
- a dc to ac converter station at Soldiers Pond; and
- shoreline electrodes at L'Anse au Diable and Dowden's Point, and overhead, wood pole electrode lines between the shoreline electrode sites and their respective converter stations.

These components and their Construction, Operations and Maintenance are described in the following sections. A general overview of the main Project components is presented in Figure 3.1-1.



FIGURE 3.1-1

Labrador - Island Transmission Link: Project Overview

3.2 Project Location

The Project and all of its components will be located wholly within the Province of Newfoundland and Labrador, including the Strait of Belle Isle.

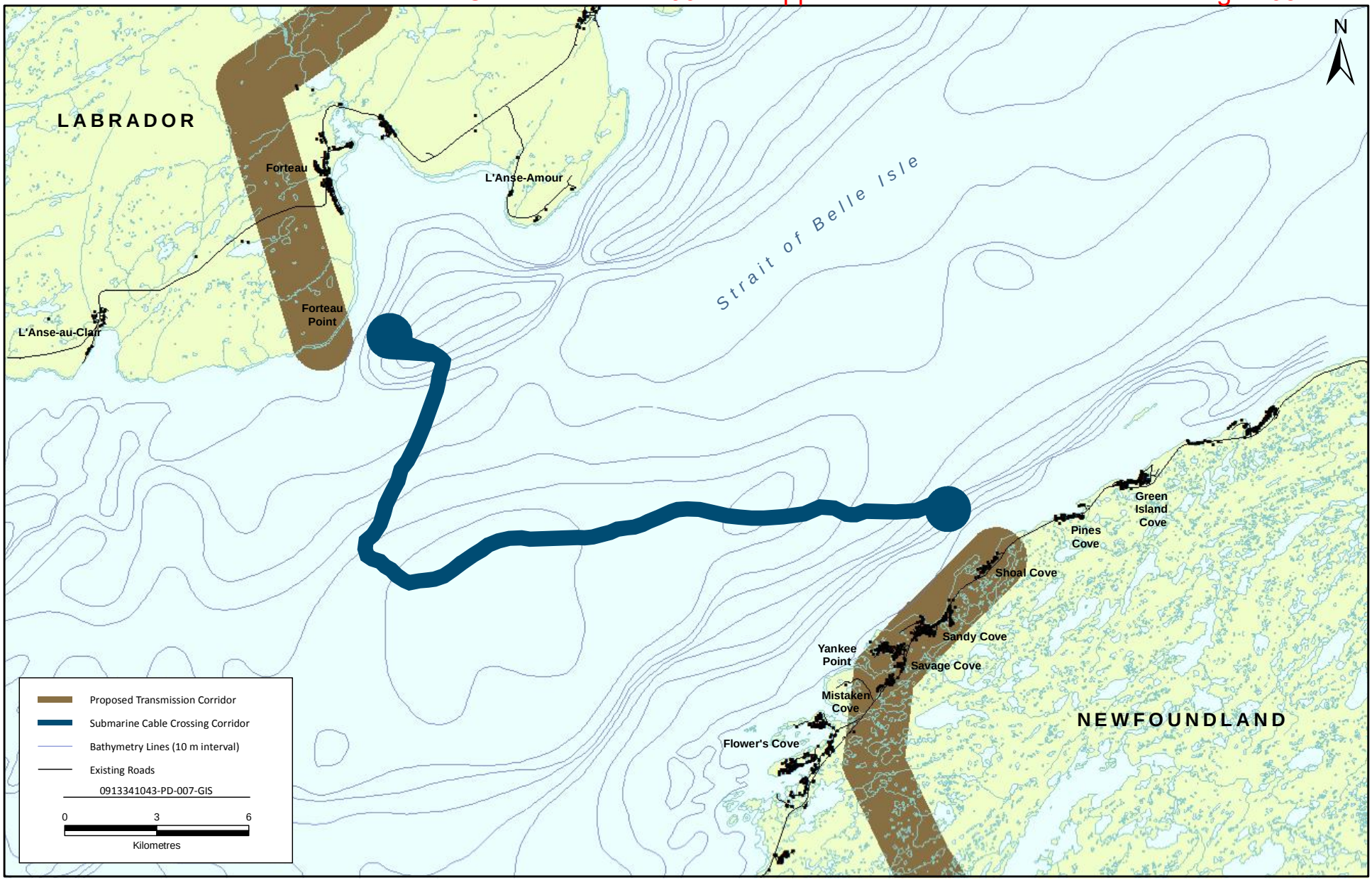
A converter station will be constructed at Muskrat Falls near the ac switchyard for the Lower Churchill Hydroelectric Generation Project in Labrador. From there, the transmission line will travel to the south-east to meet the Trans-Labrador Highway (TLH) corridor, then generally parallels the TLH for approximately 135 km before continuing to extend south-east to Forteau Point (Figure 3.2-1). From Forteau Point, three submarine cables will extend under and across the Strait of Belle Isle and make landfall on the north-western side of the Island, at Shoal Cove (Figure 3.2-2). The transmission line will then head from the landing site, southward along the western portion of the Northern Peninsula, as far as Portland Creek, then in a south-easterly direction across the Island to the Soldiers Pond converter station (Figure 3.2-3 and Figure 3.2-4). Shoreline electrodes will be constructed at L'Anse au Diable in the Strait of Belle Isle (Figure 3.2-5) and at Dowden's Point, Conception Bay (Figure 3.2-6), with electrode lines suspended on wood poles connecting them to their respective converter stations.

At this stage of Project planning, and prior to ROW selection, the various forms of land tenure (e.g., leases, grants) required for the Project are unknown. Once a ROW has been finalized, Nalcor Energy (Nalcor) will obtain all required forms of land tenure and will comply with the *Lands Act*.



FIGURE 3.2-1

Transmission Corridor: Muskrat Falls to Forteau Point



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FIGURE 3.2-2

Strait of Belle Isle Submarine Cable Crossing Corridor

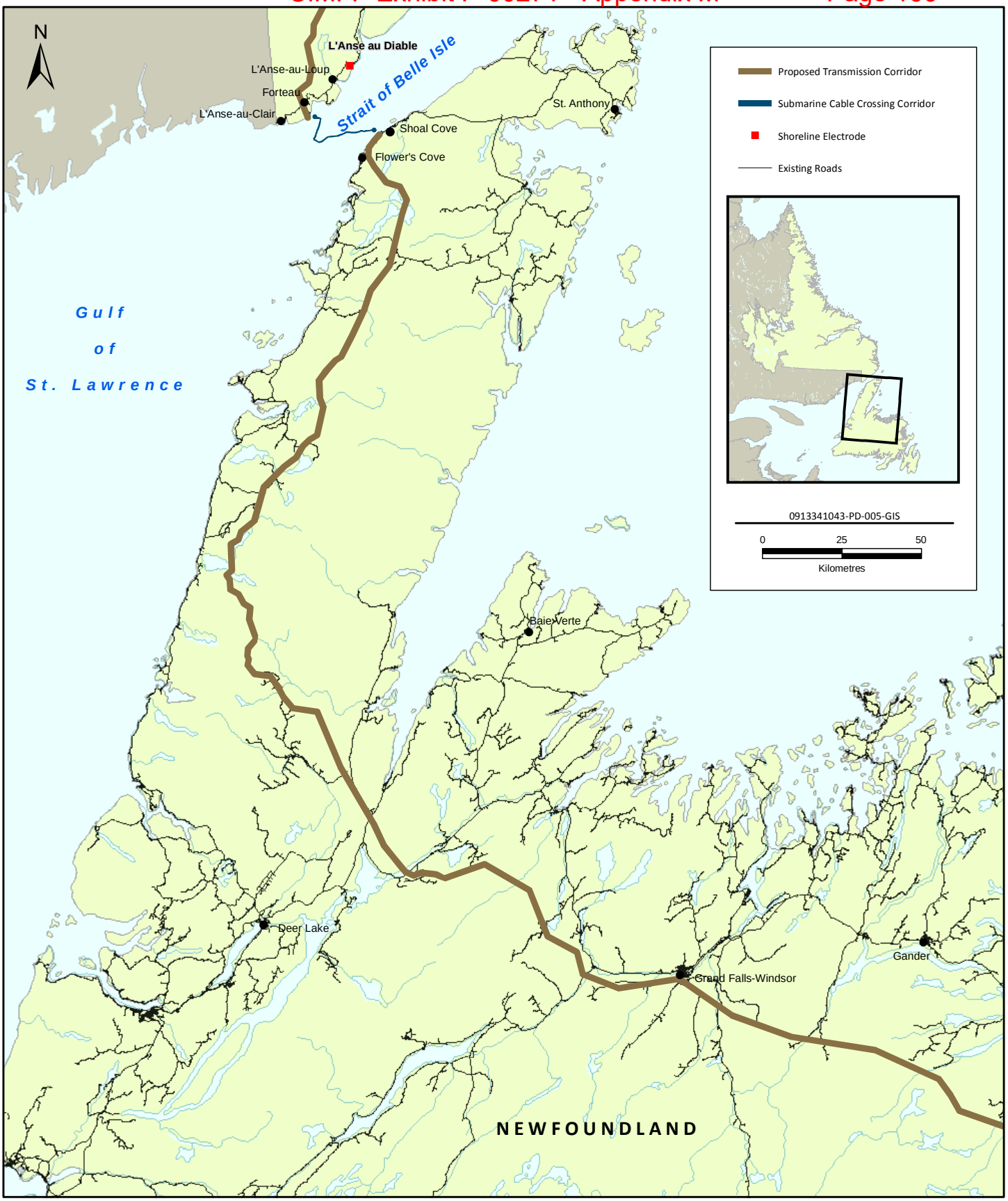
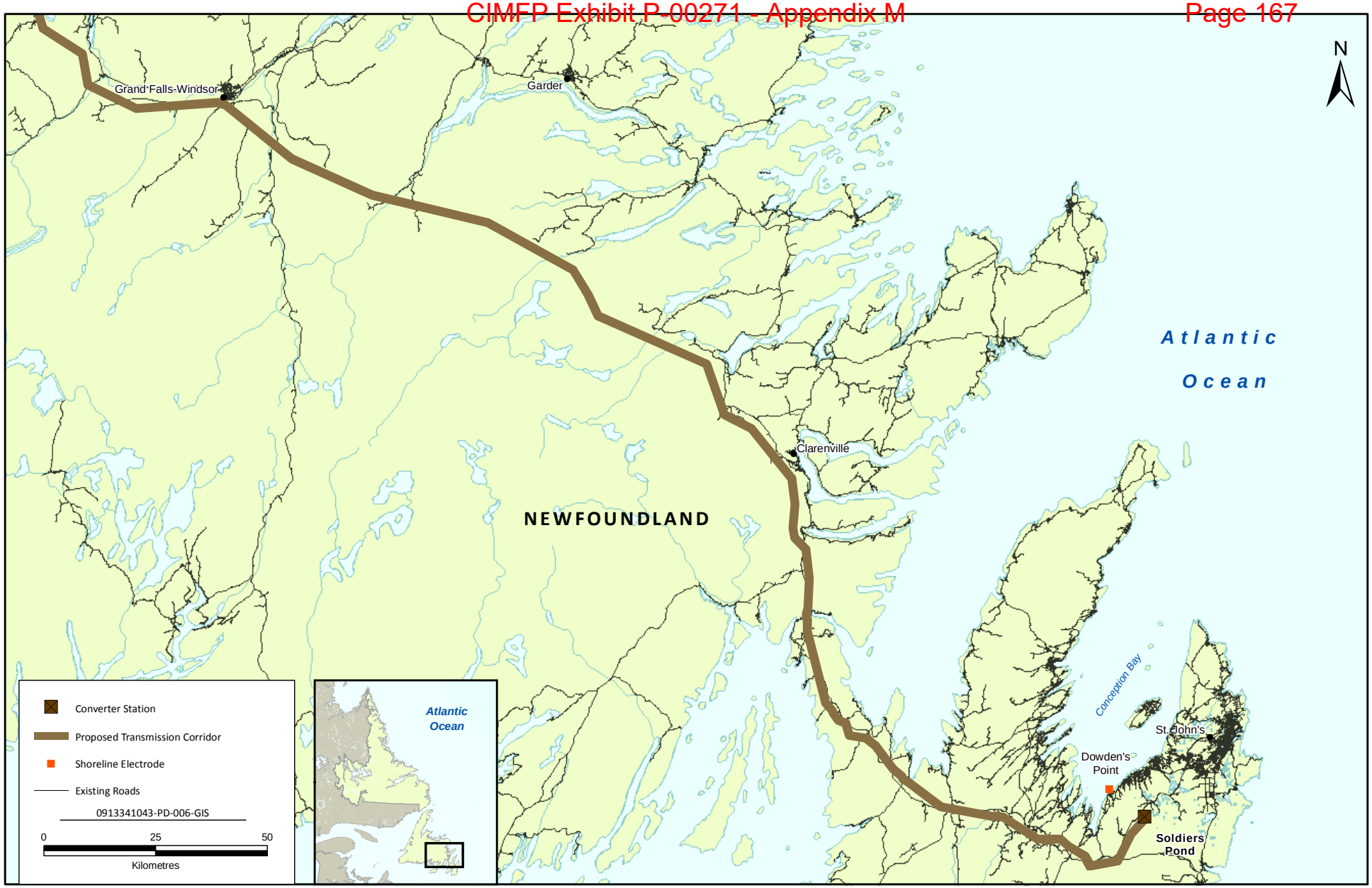


FIGURE 3.2-3

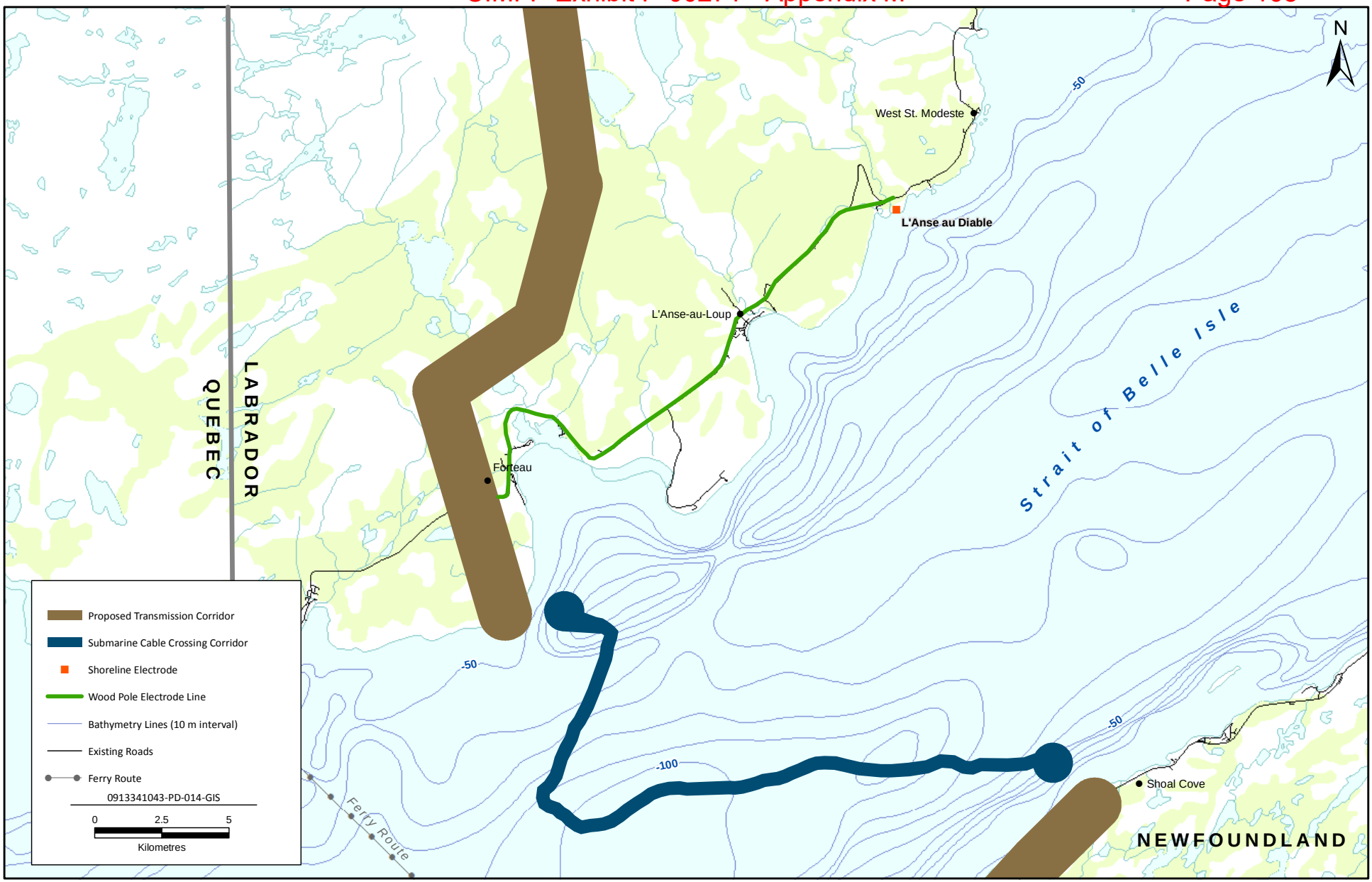
Transmission Corridor:
Strait of Belle Isle to Central Newfoundland



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FIGURE 3.2-4

Transmission Corridor: Central Newfoundland to Soldiers Pond



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FIGURE 3.2-5

Shoreline Electrode and Wood Pole Electrode Line - L'Anse au Diable

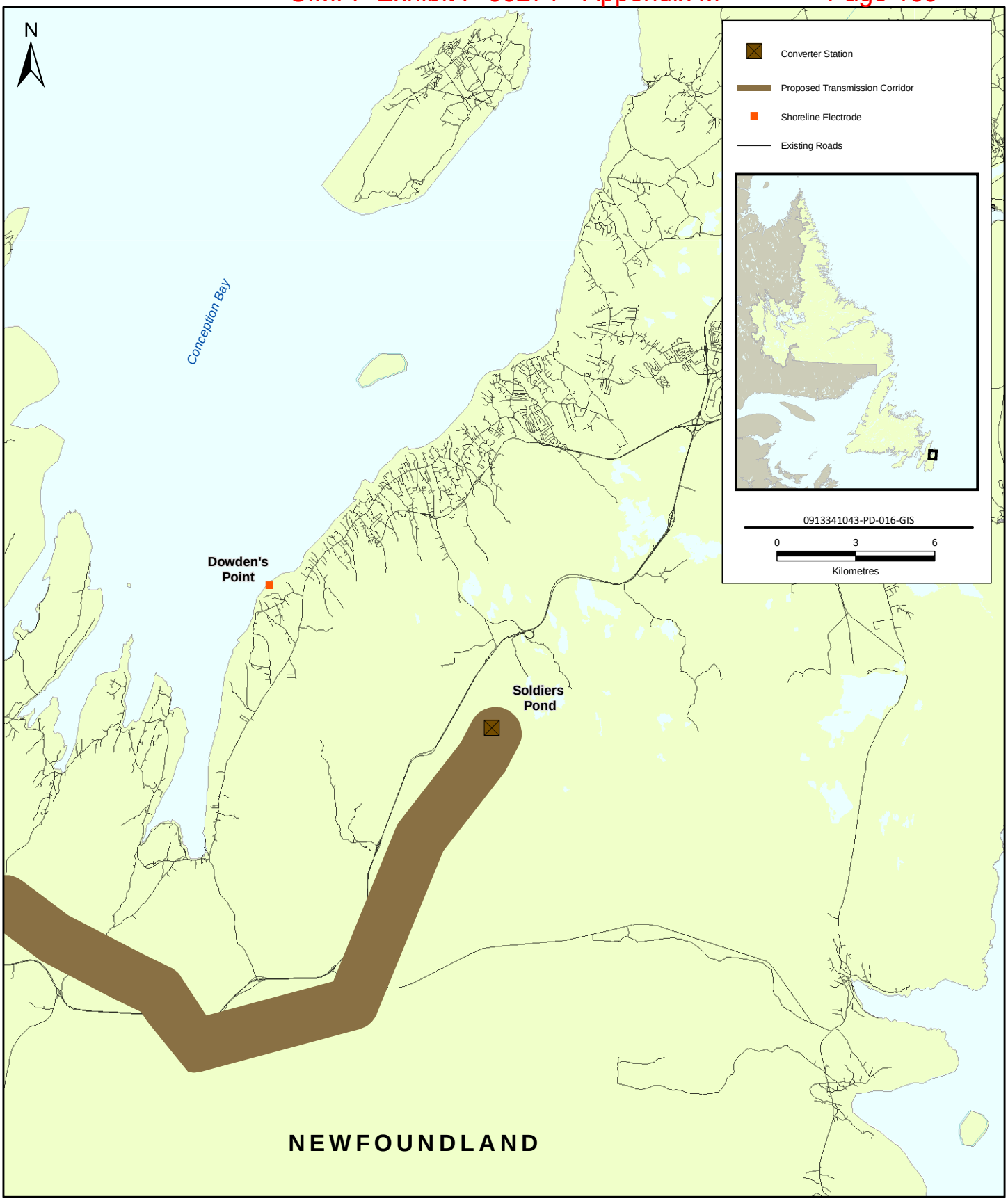


FIGURE 3.2-6

Shoreline Electrode - Dowden's Point

3.3 Project Components and Layout

This section provides a general overview of the Project's key components, including the converter stations, the HVdc transmission line, the Strait of Belle Isle cable crossing, and the shoreline electrodes and connecting wood pole electrode lines. This section also describes some potential upgrades to the Island's existing electricity transmission system that may be required to accommodate the 900 Megawatts (MW) of additional power transmission.

3.3.1 Muskrat Falls Converter Station

A portion of the electricity generated by the Lower Churchill Hydroelectric Generation Project will be converted to dc for transmission. This will be accomplished by converters using semiconductor valves that allow current to flow in only one direction, thus converting the current from ac to dc or from dc to ac. The proposed converter station locations are Muskrat Falls and Soldiers Pond.

The Muskrat Falls converter station will be located near the ac switchyard for the Lower Churchill Hydroelectric Generation Project, at the approximate coordinates 53° 14' 18" N, 60° 45' 30" W, as shown in Figure 3.2-1. The Muskrat Falls converter station will consist of a converter yard that contains HVdc equipment, including converter transformers, converter valves, a valve cooling system, and possibly a standby or emergency diesel generator and fuel storage facilities. This equipment is described in Table 3.3.1-1, and the conceptual layout of the converter yard is provided in Figure 3.3.1-1. The Muskrat Falls converter station will have a dc voltage rating of ± 350 kV and an ac voltage rating of 315 kV.

Table 3.3.1-1 Muskrat Falls Converter Station Equipment

Equipment	Description / Function
Converter transformers	– Establish and maintain system voltages at specified levels – Provide an electrical connection between the ac and dc systems – Provide an impedance to limit fault currents
Converter valves	– Consist of large groups of power electronic switches that allow for the conversion of electricity from dc to ac at the inverter and from ac to dc at the rectifier – Valves are housed in an enclosure known as the valve hall
Valve cooling systems	– Designed to prevent the overheating of electronic equipment – Consist of a closed loop water system that is cooled by forced air – Water in the closed loop system is de-ionized and supplemented with glycol to prevent freezing
Power supply	– Specified to ensure that the HVdc system meets reliability, availability and maintainability requirements – May include a diesel generator (as standby for emergency) and fuel storage facilities
ac filter	– Provide the required reactive power for converter operation – Filter the harmonic currents into the ac system that are generated by the converters
dc yard	– Accommodate dc side bus work, dc filters, arresters, smoothing, reactors, dc side disconnect and grounding switches, and measuring instruments

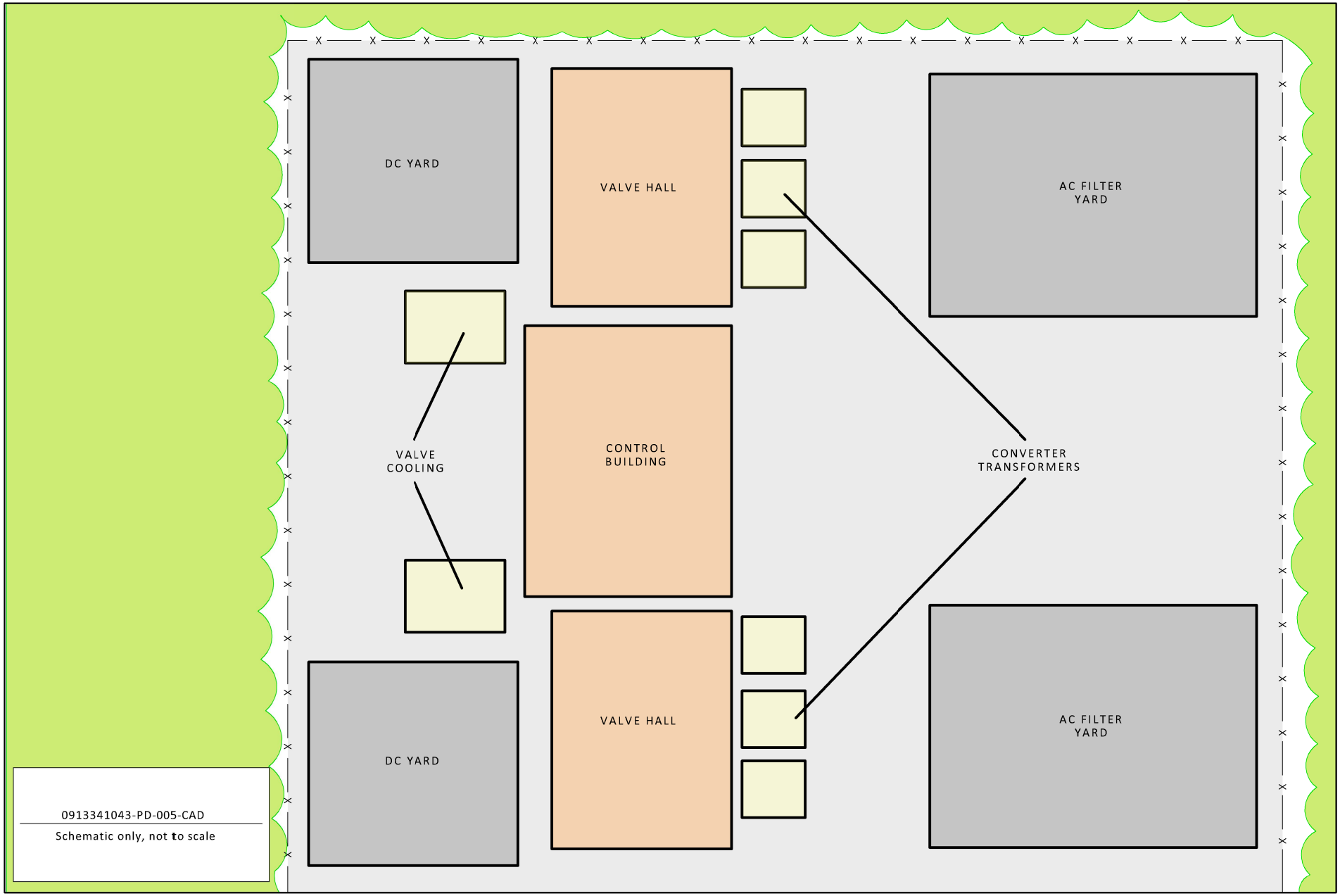


FIGURE 3.3.1-1

Conceptual Layout of Muskrat Falls Converter Station

The Muskrat Falls converter station will occupy an area of approximately 450 m by 600 m. The converter station will have a gravel surface, and a vegetation control program will restrict vegetation growth. Some parking areas or specific roadways within the converter station may be paved. A series of concrete foundations and galvanized steel structures will support the electrical equipment and switchgear. A grounding grid will be installed beneath the foundations. Two types of foundation may be used to support the structures within the converter yard: rectangular strip footings and square pier footings. Equipment that requires shelter from the elements will be enclosed in the valve halls. Unauthorized access to the converter station will be restricted by a galvanized steel security fence and a locked gate. As appropriate, "high voltage" signage will be posted at the converter station.

Four single circuit 315 kV lines, each supported by two to three transmission towers, will link the Muskrat Falls converter station to the Lower Churchill Hydroelectric Generation Project. As the Muskrat Falls converter station is near the Lower Churchill Hydroelectric Generation Project, the converter station will be accessed using existing roads and new access roads that will be established for the Lower Churchill Hydroelectric Generation Project. No new access roads or water supply systems are planned for the Muskrat Falls converter station as part of this Project. New washroom facilities and an associated sewage treatment system are planned which will comply with provincial guidelines and regulations.

3.3.2 Transmission Line

A 2 km wide on-land transmission corridor and a 500 m wide submarine cable crossing corridor were selected for the transmission line, as described in Section 2.11.2. The on-land transmission line will consist of three wires, also referred to as poles, (i.e., two conductors and an optical groundwire (OPGW)) suspended on galvanized steel lattice towers, connecting the Muskrat Falls converter station with Forteau Point and Shoal Cove with Soldiers Pond. The submarine cable crossing will include three cables (i.e., two for electricity transmission, and one spare cable) connecting the Forteau Point on-land transmission line with the Shoal Cove on-land transmission line.

The transmission corridor will be approximately 1,100 km long, with approximately 1,065 km of the corridor being land-based and 35 km being submarine. The transmission corridor selection process considered the following:

- minimizing the length of the transmission line to the extent possible and practical;
- avoiding unfavourable meteorological conditions (such as heavy icing and / or strong winds);
- avoiding difficult terrain where possible;
- minimizing the requirement for new access roads and trails;
- minimizing watercourse and wetland crossings;
- avoiding interactions with communities, protected areas and other known environmentally and socially important areas where possible and practical;
- avoiding areas of known archaeological and historical significance; and
- for the submarine cable crossing, finding the shortest access to deep water and making use of natural seabed features to shelter the cables in deep valleys and trenches, thus minimizing the possibility of interaction with fishing areas and activity, and sea ice and ice bergs.

The specific routing of the transmission line within the selected corridor will be conducted as part of the detailed Project design. This will involve consideration of information on the existing natural and human environments within the transmission corridor to identify and evaluate key environmental and socioeconomic factors and issues for consideration in the final ROW route selection process. Inputs to this analysis and

planning process will include information on the biophysical and socioeconomic environments, any additional baseline information collected, issues identified as part of the environmental assessment process, and the results of the public and stakeholder consultations.

Within the land-based corridor segments, a ROW will be cleared for the transmission line, as appropriate. The width of the ROW will vary between less than 60 m in some areas to approximately 80 m in others, with an average width of 60 m. This width is determined primarily through consideration of the span between towers and the sag of the conductor. The amount that the transmission line can swing in the wind and the resulting ROW width required for obstacle clearance is directly related to the tower span and conductor sag. Although there may be a different ROW width in the different meteorological loading regions (as described in Section 3.3.2.1), the ROW width will not change from span to span within the same region.

3.3.2.1 Muskrat Falls to Forteau Point

Transmission Corridor

The Labrador portion of the transmission corridor connects the Muskrats Falls converter station to Forteau Point (Figure 3.3.2-1 and Figure 3.3.2-2). The corridor begins at the Muskrat Falls converter station then heads south-east to meet the Trans-Labrador Highway (Phase 3) (TLH3). It then follows the TLH3, diverging from the highway at points where the highway makes turns that cannot be negotiated with a transmission line. Approximately 135 km from Muskrat Falls, the transmission corridor diverts away from the TLH3 and heads in a south-easterly direction, crossing a landscape of bogs and unnamed lakes. Approximately 310 km from the Muskrat Falls converter station, the transmission corridor turns south, avoiding several large ponds (e.g., Island Pond, Silver Pond, Stag Pond, Big Pond and Little Pond), then terminates at the Forteau Point transition compound.

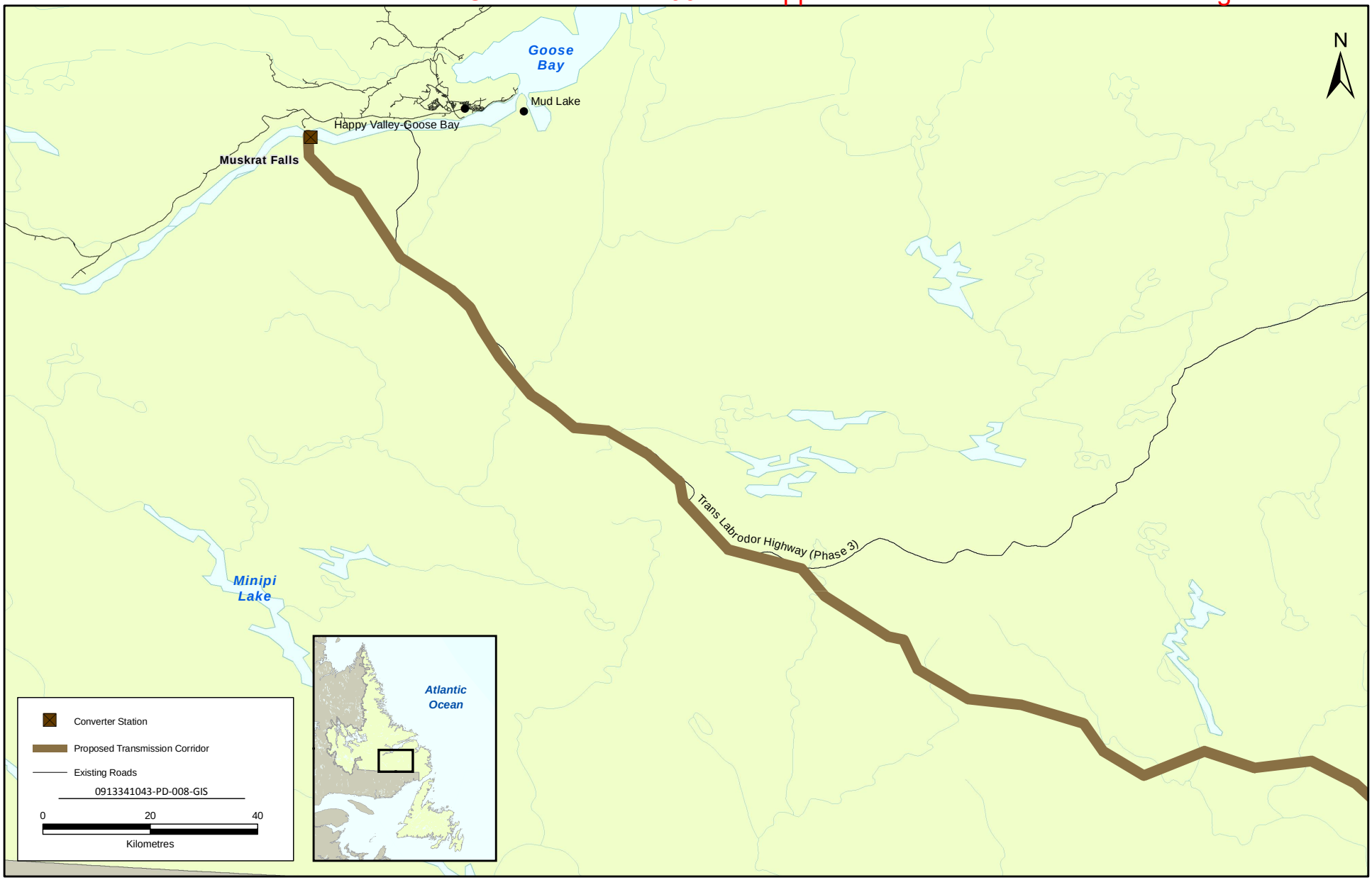
Transmission Infrastructure

The HVdc transmission line will consist of two poles and a shield wire suspended on galvanized steel lattice towers. Two poles will carry power, and an OPGW will provide shielding from lightning strikes. The OPGW includes a fibre optic cable for communication between the converter stations. The Project conductors and transmission towers will be designed to meet Canadian Standards Association (CSA) standards, and they will be of similar design throughout the length of the transmission line, with some variation to address topographic, meteorological and environmental conditions, and technical requirements.

Transmission Towers

Galvanized steel lattice transmission towers approximately 35 to 45 m high will be used for the Project. Tower heights are generally governed by clearance requirements and depend on the local conditions such as meteorological loadings and topography crossed by the ROW. Conductor clearance (i.e., the distance between the ground and the closest point of the transmission line span) will meet CSA C22.3 Standard No. 1-10 for road crossings. The conductor clearance will meet CSA C22.3 Standard No. 1-10 for road crossings. The conductor clearance will be a minimum of 7.4 m, increasing to 9.2 m at highway crossings.

The configuration of the steel lattice transmission towers may be altered due to changes in line angle, design capacity or environmental loading. There are two basic tower configurations: suspension and dead end. Suspension towers hold the conductor in the air, whereas dead end towers support the conductor tension. Figure 3.3.2-3 shows the two basic transmission tower configurations. Nalcor will meet the CSA conductor clearance standard applicable to the type and size of the watercourse and will comply with the *Navigable Waters Protection Act*.



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FIGURE 3.3.2-1

Transmission Corridor: Muskrat Falls Converter Station to Forteau Point (kilometre 0 to kilometre 200)



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FIGURE 3.3.2-2

Transmission Corridor: Muskrat Falls to Forteau Point (kilometre 200 to kilometre 385)

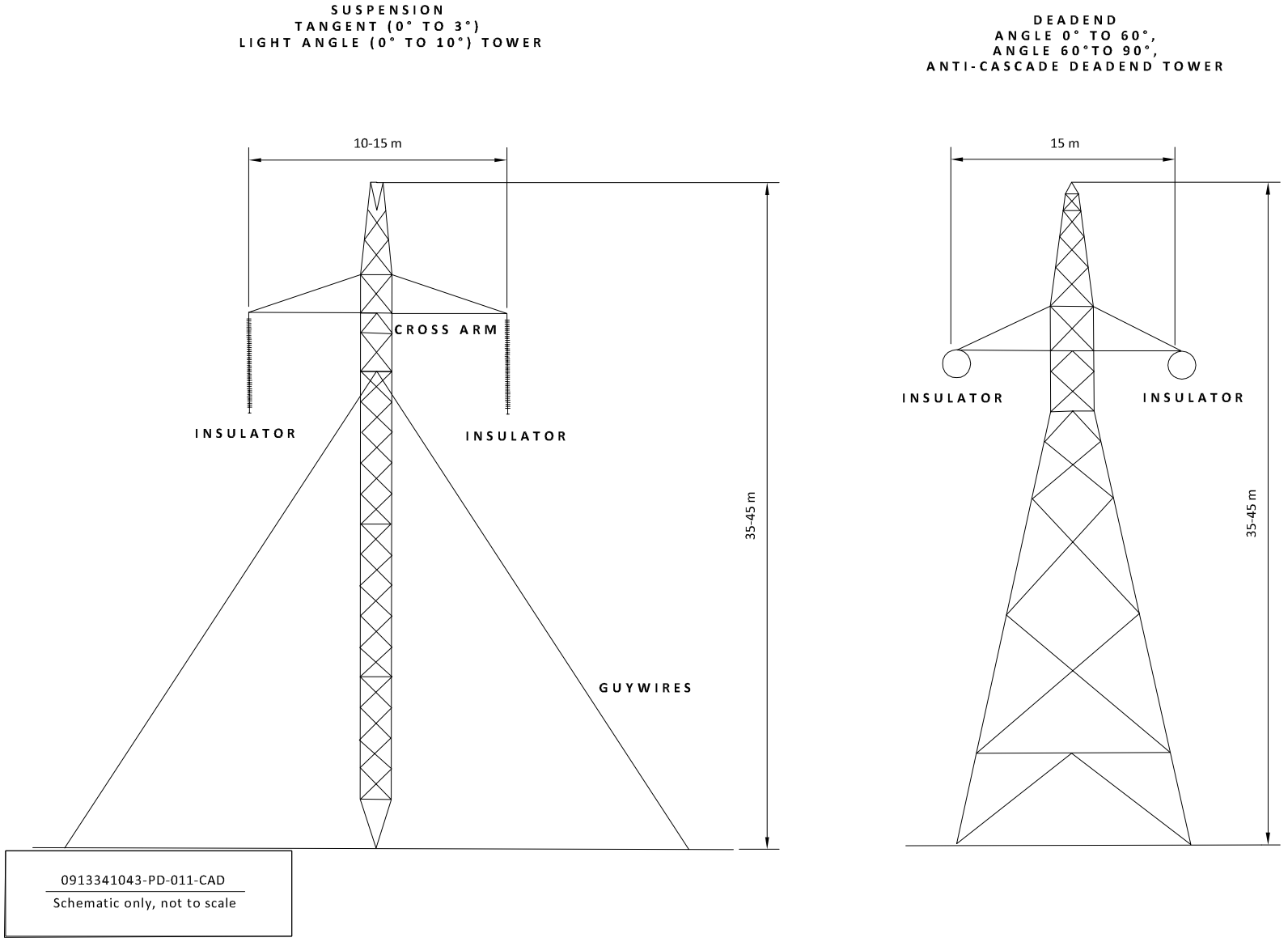


FIGURE 3.3.2-3

Transmission Towers

Where the transmission line changes direction, the towers at the turning points are designed to withstand higher forces. Dead-end towers capable of withstanding large forces are placed at large angle turns. Anti-cascade towers, also capable of withstanding large forces, are placed throughout the line to limit the potential for cascade failure of sequential towers. Anti-cascade towers will be installed at optimal locations such that no more than 15 to 20 towers would fail in a single cascade failure situation.

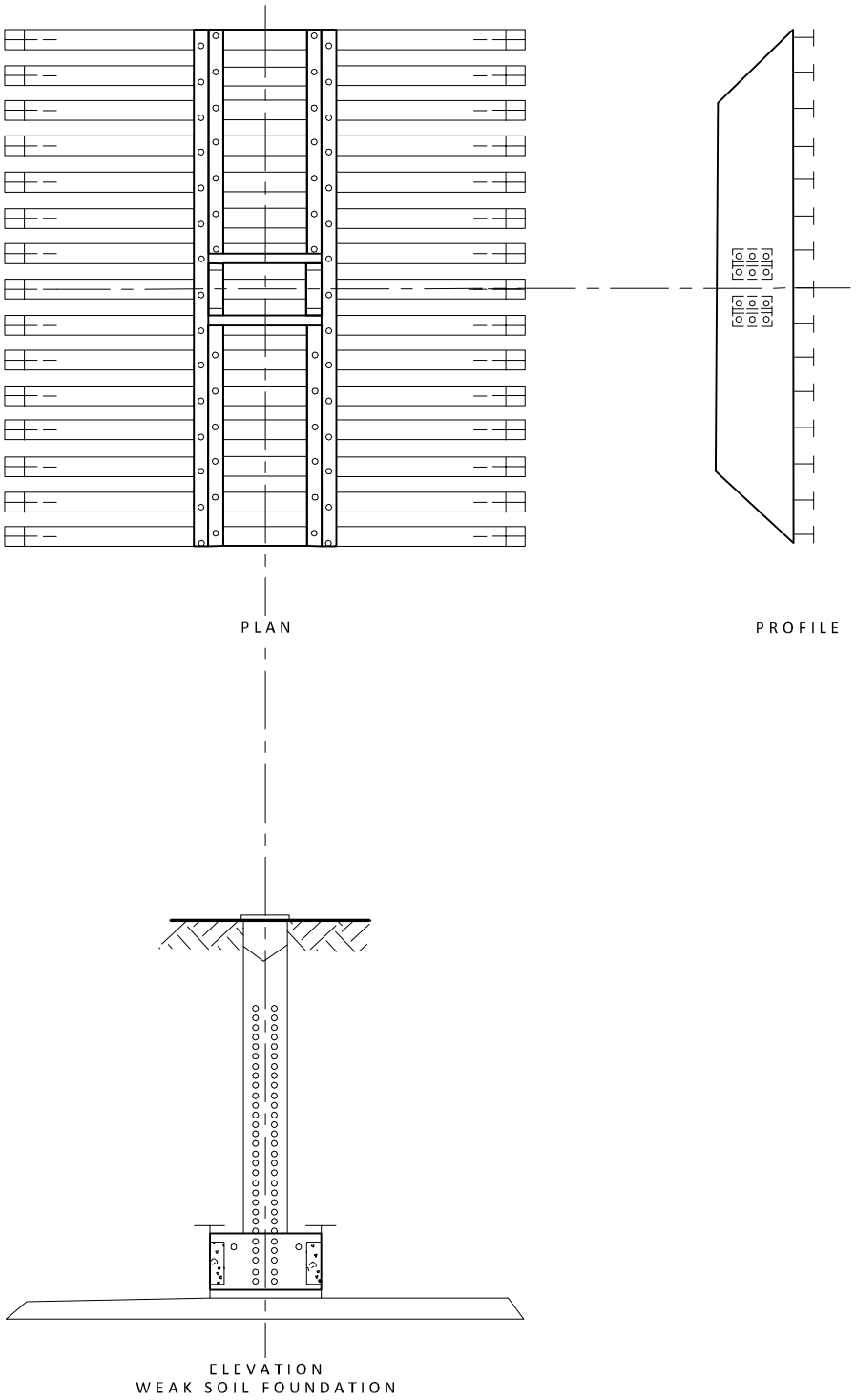
Preliminary foundation design was completed using the forces resulting from the transmission tower analysis and data available from similar existing developments. Based on the soil conditions along the transmission corridor, three basic categories of foundations were selected:

- overburden type footing for a soil with bearing capacity of 300 kilopascals (kPa) (i.e., strong soil);
- overburden type footing for soil with a bearing capacity of 100 kPa (i.e., weak soil); and
- rock type foundation.

Steel grillage type foundations (Figure 3.3.2-4) will generally be used for all soil applications. There is a possibility that other types such as driven piles will be used as required. Weaker soils will require larger and deeper steel grillage structures. Rock foundations (Figure 3.3.2-5) will be used where bedrock is encountered. Suspension transmission towers will have a single tower mast foundation and four guy wire supports connected to foundations in the ground. Larger dead end towers will require four foundations and will be self-supporting, without the use of guy wires. Table 3.3.2-1 summarizes the principal design features of each basic tower type, including foundation design.

The transmission towers are designed to withstand loadings associated with a 50-year return period meteorological event (i.e., a wind or icing event that is statistically expected to occur every 50 years). As part of the design process, three general meteorological loading regions were defined for the corridor between Muskrat Falls and Soldiers Pond:

- normal region, where ice and wind loading are representative of average loading for the province;
- alpine region, where the corridor is subjected to very severe wind and ice loads; and
- eastern region, where high levels of ice are known to occur.

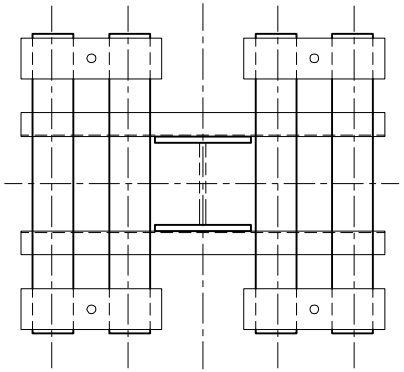


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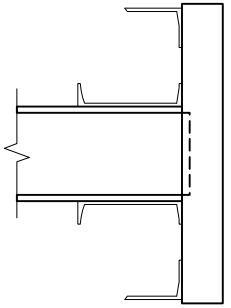
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FIGURE 3.3.2-4

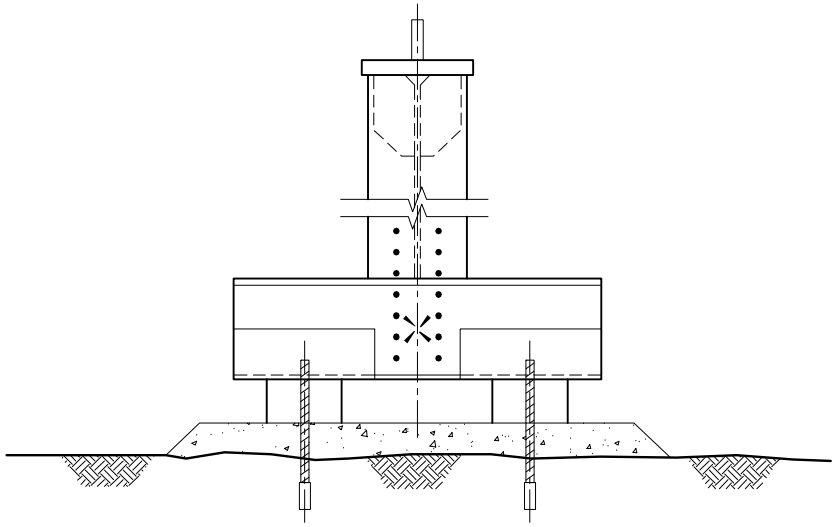
Overburden Steel Grillage Foundation



PLAN



PROFILE



ELEVATION

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FIGURE 3.3.2-5

Rock Type Foundation

Table 3.3.2-1 Transmission Tower Types

Tower Type	Use	Description	Foundation
Suspension – Tangent (0 to 3 degrees (°))	Used on straight line sections of the transmission line	– Approximate height of 45 metres (m) – Cross arm length of 10 to 15 m – Supported by four high strength guy wires	– Guy anchors will be 1 m by 2.5 m, buried 3.5 m deep, with anchor rods to the surface – Mast foundation will be 2.5 m by 2.5 m, buried 2.5 m deep – Rock foundation for guy anchor and tower mast will be 1 m by 1 m, attached to rock surface using rock bolts
Suspension – Light Angle (0 to 10°)	Used for up to 10° angles or heavier loads	– Approximate height of 45 m – Cross arm length of 10 to 15 m – Supported by four high strength guy wires	– Guy anchors will be 1.5 m by 3 m, buried 3.5 m deep, with anchor rods to the surface – Mast foundation will be 2.5 m by 2.5 m, buried 2.5 m deep – Rock foundation for guy anchor and tower mast will be 1 m by 1 m, attached to the rock surface using rock bolts
Dead end (Angle 0 to 60°)	Used at turning angles between 0° and 60°	– Self-supporting towers that stand on four legs. These are heavier and stronger than guyed towers – Self-supporting towers are typically shorter (approximately 40 m) than the light angle structures and have 10 to 15 m long cross arms	– Each foundation will be 4 m by 4 m, buried 3.5 m deep – Rock foundations will be 1.5 m by 1.5 m, attached to the rock surface using rock bolts
Dead end (Angle 60 to 90°)	Used at turning angles between 60° and 90°	– Self-supporting towers that stand on four legs – Approximate height of 40 m – Cross arm length of 15 m	– Each foundation will be 5 m by 5 m, buried 4.5 m deep – Rock foundations will be 2 m by 2 m, attached to the rock surface using rock bolts
Dead end (Anti-cascade)	Installed at optimum locations to limit a cascade failure event to 15 to 20 towers	– Heavier than the other tower types – Self-supporting towers that stand on four legs – Approximate height of 40 m – Cross arm length of 10 to 15 m	– Each foundation will be 5 m by 5 m, buried 4.5 m deep – Rock foundations will be 2 m by 2 m, attached to rock surface using rock bolts

These meteorological loading regions were further classified into 16 zones (Figure 3.3.2-6). The criteria for each of these 16 zones is presented in Table 3.3.2-2.

Table 3.3.2-2 Detailed Meteorological Zones Between Muskrat Falls and Soldiers Pond including Zone Criteria

Meteorological Loading Zone	Zone	Region	Maximum Ice	Maximum Wind	Combined Ice and Wind
Normal	1	Inner Labrador	50 mm (Glaze)	105 km/h	25 mm (Glaze) and 60 km/h
	3	Labrador Coast	50 mm (Glaze)	120 km/h	25 mm (Glaze) and 60 km/h
	4	Northern Peninsula Coast	50 mm (Glaze)	120 km/h	25 mm (Glaze) and 60 km/h
	6	Northern Peninsula	50 mm (Glaze)	120 km/h	25 mm (Glaze) and 60 km/h
	8a	Central-West Newfoundland	50 mm (Glaze)	120 km/h	25 mm (Glaze) and 60 km/h
	8b	Central-West Newfoundland	50 mm (Glaze)	105 km/h	25 mm (Glaze) and 60 km/h
	10	Central-East Newfoundland	50 mm (Glaze)	105 km/h	25 mm (Glace) and 60 km/h
Alpine	2a	Alpine Labrador	115 mm (Rime)	135 km/h	60 mm (Rime) and 95 km/h
	2b	Alpine Labrador	135 mm (Rime)	135 km/h	70 mm (Rime) and 95 km/h
	2c	Alpine Labrador	115 mm (Rime)	135 km/h	60 mm (Rime) and 95 km/h
	5	Highlands of St. John	115 mm (Rime)	150 km/h	60 mm (Rime) and 105 km/h
	7a	Long Range Mountains Crossing	115 mm (Rime)	180 km/h	60 mm (Rime) and 125 km/h
	7b	Long Range Mountains Crossing	135 mm (Rime)	180 km/h	70 mm (Rime) and 125 km/h
	7c	Long Range Mountains Crossing	115 mm (Rime)	180 km/h	60 mm (Rime) and 125 km/h
	9	The Birchy Narrows	75 mm (Glaze)	130 km/h	45 mm (Glaze) and 60 km/h
Eastern	11	Eastern Newfoundland	75 mm (Glaze)	130 km/h	45 mm (Glaze) and 60 km/h

Meteorological loading for the transmission system for the Project was determined using:

- historical assessment and transmission line modelling using data and information collected over a 50-year time frame;
- design maximum ice loads that are realistic for the Newfoundland and Labrador environment, yet exceed the CSA Standard C22.3 (No. 1 Overhead Systems and No. 60826 Design Criteria of Overhead Transmission Lines) (CSA Standard), usually equating to CSA Standard 500-year loads or more; and
- design maximum wind loads that meet CSA Standard 50-year wind speeds, and are higher than historical transmission line design levels (even though Nalcor transmission lines have never failed due to extreme wind events).



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FIGURE 3.3.2-6

Meteorological Loading Regions

Wind Loading

Newfoundland and Labrador Hydro (NLH) has historically designed most of its transmission lines to a maximum wind load case of 175 kilometres per hour (kph) gust wind speed which corresponds to a sustained wind speed of approximately 100 kph. To date, NLH has not had a structural failure of a transmission line due to the maximum wind load case. Based on NLH's operating experience over the past 50 years, and the fact that there have been no failures of the transmission system related to the maximum wind load, NLH considers the 1:50 year wind loads as per the CSA Standard to be appropriate, and that no amplification of these wind loads is required. Therefore, Nalcor has adopted the 50-year CSA Standard wind loads for the design of the Project for all but the alpine region.

Analysis of wind speeds on the Long Range Mountains (LRM) is based on a correlation study between the Environment Canada Meteorological Weather Station at Daniel's Harbour on the Northern Peninsula and a wind speed monitor installed in the LRM. This analysis resulted in a reference wind speed of 180 kph, much higher than any wind load in the province but considered realistic for this area. Considering that topographical features amplify the wind speed profile in the LRM, this reference wind speed of 180 kph as the 1:50 year design wind speed was selected as compared to the 120 kph wind speed specified in the CSA Standard. Nalcor also applied the 180 kph reference wind speed to the other alpine regions (i.e., Highlands of St. John and Labrador coast) along the transmission corridor. The selection of this elevated reference wind speed is considered appropriate for those areas.

Ice Loading

Through decades of experience operating transmission equipment in harsh environments, NLH has gained extensive knowledge of the necessary design criteria for its electricity infrastructure. NLH has designed transmission lines to ice loads higher than the CSA Standard in recent years. Icing amounts for a 50-year return period range from 15 mm of radial glaze ice (ice thickness measured from the conductor surface) in central Labrador up to a maximum of 40 mm on the Avalon Peninsula. CSA Standard recommends a factor of 1.5 times the reference amount to account for the spatial nature of transmission systems, and the elevation correction for conductors which are assumed to be 20 m higher than the reference level of 10 m above ground. This would equate to 50-year design loads from 23 mm to 60 mm across the transmission system. CSA Standard also recommends that spatial factors less than 1.5 may be substantiated by local data and experience.

In the case of Newfoundland and Labrador, Nalcor has determined that the design ice loads should be higher than the CSA Standard based on a significant amount of historical data. Studies completed by Meteorology Research Inc., Teshmont, and RSW for the Project produced loads of up to 100 mm of radial glaze ice. These loads are significantly higher than the CSA Standard loads and there is very little evidence of loads coming close to this level in the history of transmission lines in the province. A study completed by NLH, also for the Project, produced loads that were significantly lower than the CSA Standard loads, loads which have been experienced relatively frequently in the province. The discrepancy in findings between the studies were considered in determining what loads should be used in the design criteria. While the ice loading studies that cover the entire Project area produced up to 100 mm of radial glaze ice, recent meteorological load studies performed by NLH which were focused on more localized loading in the NLH electricity system have produced load cases of 75 mm of radial glaze ice on the Avalon and 50 mm of radial glaze ice for the Granite Canal transmission line in 2001. Both locations are based on an extreme value analysis using 40 years of data and the analyses resulted in what was calculated statistically to be 1:50 year return period load cases. These local studies, the previous Project wide studies, as well as operating experience were all used to determine the final ice load cases.

The alpine regions are areas above 350 m elevation that experience significant levels of rime (in-cloud) ice. Although rime ice can occur at any level, rime ice load cases exceed the glaze ice load cases in alpine areas. Because of this, rime ice load cases are used for transmission line design in alpine regions. Because the CSA Standard does not cover this type of ice, an intense meteorological study including atmospheric modelling and correlation with test spans on the LRM was performed using international experts in rime ice formation on

transmission lines. As a result of this study, Nalcor selected a maximum ice load case of up to 135 mm of radial rime ice for design in all alpine regions.

Tower Numbers and Span

The number of towers required between Muskrat Falls and Forteau Point will depend on tower span distances, as determined by topographic, meteorological and associated technical requirements. Based on an average span of 300 to 430 m in a normal loading region and 165 to 210 m in an alpine loading region, there will be approximately 910 to 1,305 towers between the Muskrat Falls converter station and the Forteau Point transition compound, of which approximately 90 percent (%) will be suspension type structures (Table 3.3.2-3).

Table 3.3.2-3 Preliminary Estimate of Number and Types of Towers to be Constructed Between Muskrat Falls and Forteau Point

Tower Type	Number of Towers in Each Meteorological Region (Span)			Total
	Normal (300 to 430 m)	Alpine (165 to 210 m)	Eastern (255 to 420 m)	
Suspension	790 to 1,170	35 to 45	0	**825 to 1,215**
Dead end	75 to 80	10	0	**85 to 90**
Total	**865 to 1,250**	**45 to 55**	**0**	**910 to 1,305**

Insulators

Insulators made from glass or porcelain will be used to prevent electricity from travelling from the conductor to the tower, thus electrifying the tower and causing a fault in the system (flashover). In most locations, the transmission line will have 30 to 40 insulators per string, depending on contamination level. Contamination such as salt spray and icing can reduce the ability of an insulator to resist flashover, so the transmission corridor avoids coastal areas and areas prone to icing, where possible and practical. In locations where salt spray or icing are expected to occur, the number of insulators may be increased to limit the potential for flashover. Increasing the number of insulators may require increasing tower height and cross-arm length.

Conductors

Two poles will be connected to the two lattice steel cross arms on the transmission towers. Each pole will consist of a single conductor or a bundle of conductors. Conductors are wires (or bundles of wire) that carry the electricity. Transmission lines operating at 350 kV generally include a "bundle" of two or more relatively small conductors. The conductors will be either all aluminum or aluminum with a steel core, and it will have a diameter of approximately 55 to 60 millimetres (mm). As part of detailed design, the type of pole to be used (bundle or single; including material) will be determined.

Optical Ground Wire

An OPGW is a type of cable that combines the functions of grounding and communications, which will be suspended from the tops of the transmission towers. It contains a tubular structure with one or more optical fibres, surrounded by layers of steel and aluminum wire. The OPGW cable is expected to have a diameter of 12 to 22 mm and it will be suspended along the tops of the transmission towers. The conductive part of the cable bonds adjacent towers to the earth ground (i.e., the counterpoise) and shields the conductors from lightning strikes. The optical fibres are used for the high-speed transmission of data between the two converter stations.

Counterpoise

To reduce the electrical resistance between the transmission towers and the ground, counterpoise will be installed along the ROW. It will be attached to the base of each tower to further protect the transmission line against damage from lightning surges. The counterpoise will be a No. 1 galvanized steel wire, ploughed approximately 30 centimetres (cm) beneath the ground and buried. The counterpoise will generally follow the approximate centre line of the ROW throughout the length of the transmission line. Where required and appropriate, the counterpoise will be terminated using grounding rods (i.e., where the transmission line crosses large waterbodies or watercourses). The grounding rods will be made of either copper clad steel or galvanized steel and will typically be 19 mm in diameter and 2,500 mm in length.

Transition Compound

Up to 1,000 m from the shoreline at Forteau Point, the overhead transmission line will enter a transition compound. The location of the transition compound will be determined during the detailed Project design and will depend on the topography near the submarine cable crossing point. The transition compound will be approximately 100 m x 100 m, and will consist of an enclosed shelter approximately 50 m long by 50 m wide and up to 16 m high, and will house the end terminations (i.e., the stand, insulator and ancillary equipment). Control equipment will be housed in a climate controlled building. From the transition compound, the cables will be buried underground, in a backfilled trench approximately 4 m wide and 2 m deep to the cable landfall entry site.

3.3.2.2 Strait of Belle Isle Submarine Cable Crossing

From Forteau Point, cables will extend under and across the Strait of Belle Isle and make landfall on the north-west side of the Island's Northern Peninsula, at Shoal Cove. The proposed Strait of Belle Isle submarine cable crossing is described below.

The evaluation of the submarine cable corridor and landing points included detailed submarine surveys of the crossing area using side-scan and multi-beam sonar, sub-bottom profile surveys and underwater video. It also involved the compilation and analysis of existing environmental information including geology, bathymetry, oceanography, environmental sensitivities, fishing activity, and known historic sites.

As a result of this process, Forteau Point was identified as the landing point on the Labrador side, and Shoal Cove was identified as the landing point on the Island side. A 500 m wide corridor approximately 35 km in length has been indentified for the submarine cables. The landing points and the submarine cable corridor are shown in Figure 3.2-2.

Horizontal Directional Drilling

Near the landing points, the cables will be protected through the use of horizontal directional drilling (HDD) technology. The HDD solution will provide three lined (steel or high-density polyethylene (HDPE)) conduits for each shore approach. These will begin between 15 m and 100 m from the high water mark on the land side and extend 1.5 km to 2.5 km underground and exit into the Strait of Belle Isle. The HDD boreholes will be spaced appropriately apart at the on shore entry point and will diverge toward target exit locations on the sea floor. The borehole locations are shown in Figures 3.3.2-7 and Figure 3.3.2-8.

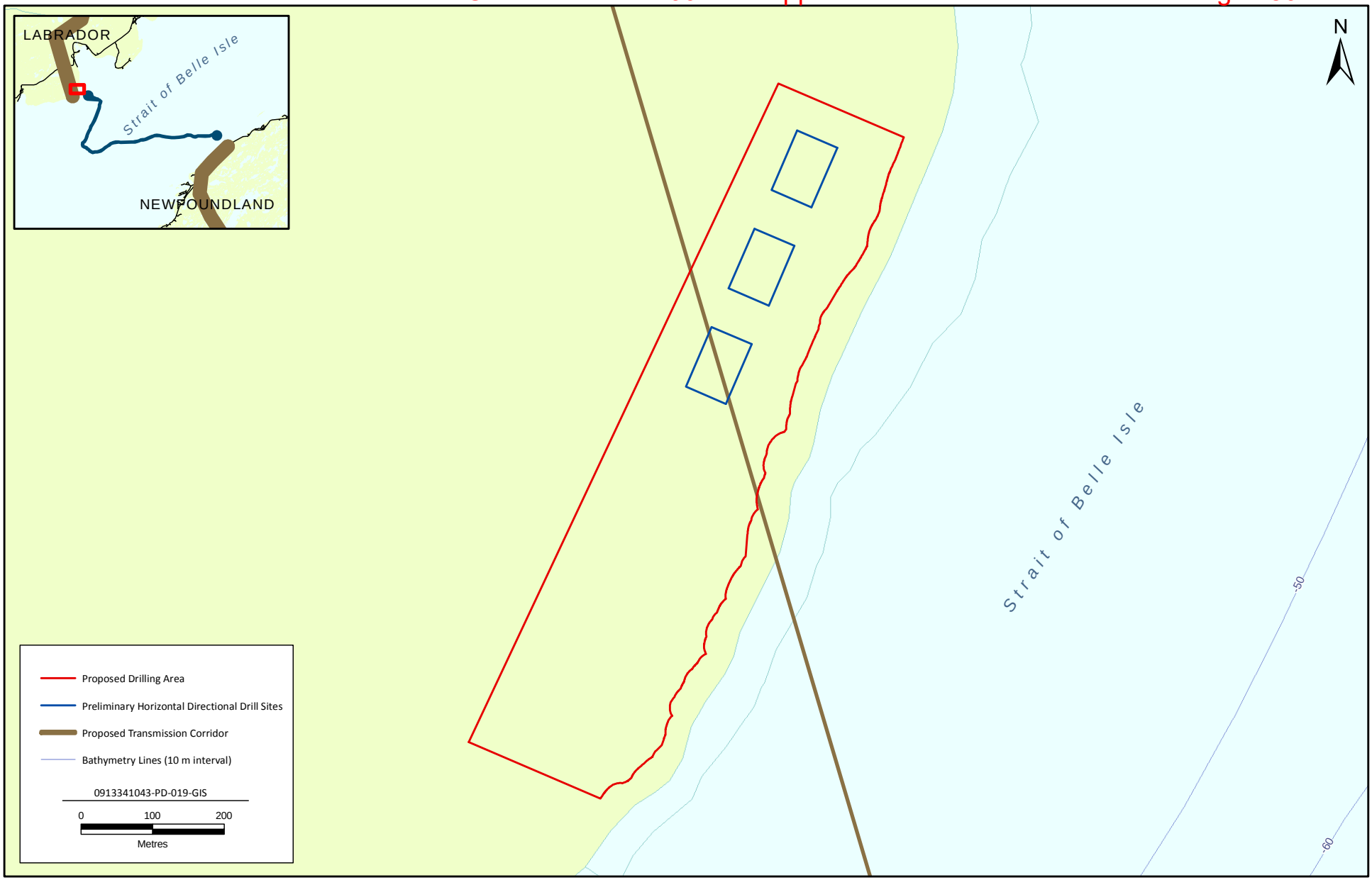
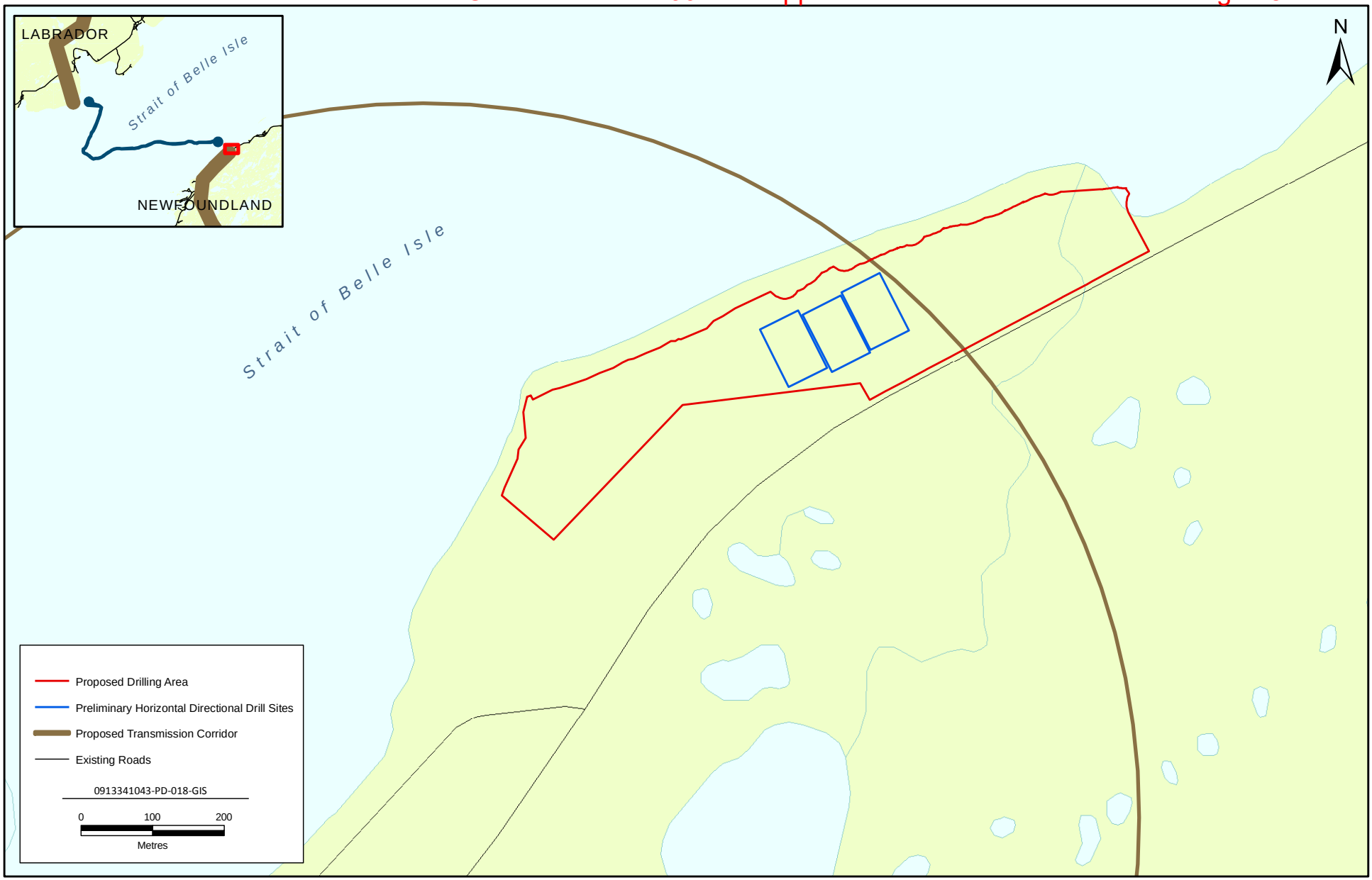


FIGURE 3.3.2-7

Strait of Belle Isle Submarine Cable Crossing - Forteau Point
Preliminary Horizontal Directional Drill Sites



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FIGURE 3.3.2-8

Strait of Belle Isle Submarine Cable Crossing - Shoal Cove
Preliminary Horizontal Directional Drill Sites

Submarine Cable Crossing

The proposed corridor along the sea floor uses natural seabed features to protect the cables and minimize the possibility of interaction with external influences (e.g., fishing activity, icebergs). The Strait of Belle Isle submarine cable crossing will include three cables placed within the 500 m wide corridor approximately 150 m apart. Two cables will be used for electricity transmission and one will be used as a spare. Up to 900 MW can be readily transmitted over two working cables, while the spare cable will improve the overall reliability of the cable crossing in the unlikely event of a cable failure. Within the corridor, the cables will run parallel to each other across the Strait of Belle Isle. While the cables will be installed independently within the corridor, flexibility in the final cable route is required for path optimization, cable protection and reliability.

Each cable will be protected by a rock berm of approximately 8 to 12 m in width and between 0.8 m and 1.5 m high along the entire length of the cables. The berms will have a normal side slope ratio of 1:4 (rise:run). Figure 3.3.2-9 (inset a) shows a typical rock berm cross section.

The cables will be of mass impregnated (MI) design with copper or aluminum conductors, and will have armour layers and a highly abrasion resistant external sheathing. A typical cable cross section is shown in Figure 3.3.2-9 (inset b). Each cable will be approximately 35 km in length and will have an outer diameter between 100 mm and 130 mm. A fibre optic cable may be embedded with the submarine cable to provide a distributed temperature sensing along the cable length. The spare fibre optic may be used for communication as well.

3.3.2.3 Shoal Cove to Soldiers Pond

Transition Compound

At the on shore landfall entry location, the submarine cables will be spliced with land cables that will travel underground, in backfilled trenches approximately 1 m wide and 1 to 5 m deep, to a transition compound (Figure 3.3.2-9 (inset c)). The location of the transition compound will be determined during the detailed Project design and will depend on local topography, and environmental and geological conditions. It is expected to be sited within 1,000 m of the shoreline. The transition compound will be similar to the one located at Forteau Point, as described in Section 3.3.2. A microwave system may also be established at the Shoal Cove transition compound.

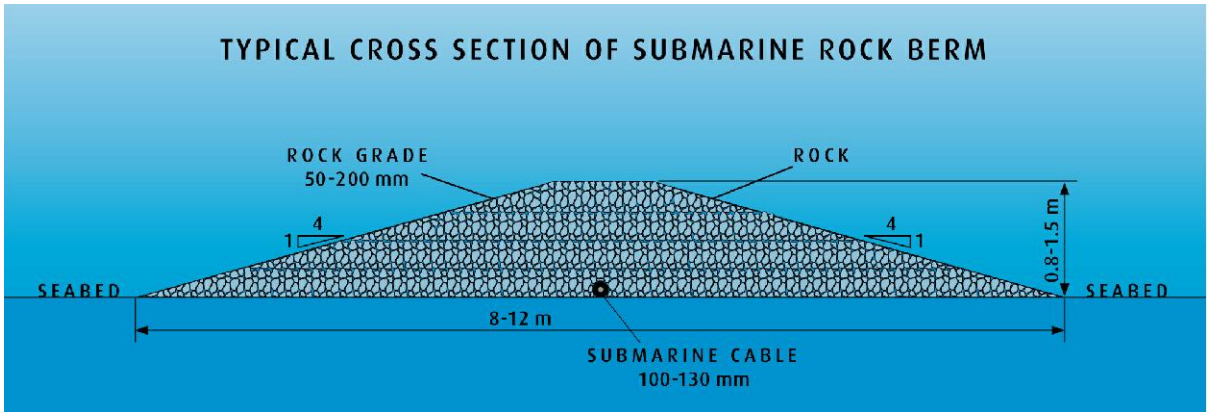
Transmission Corridor

The Newfoundland portion of the transmission corridor connects Shoal Cove to the Soldiers Pond converter station. The corridor between Shoal Cove and Soldiers Pond is shown in Figure 3.3.2-10, Figure 3.3.2-11, Figure 3.3.2-12 and Figure 3.3.2-13.

From Shoal Cove, the transmission corridor generally heads south, winding between several large waterbodies, and crossing Highway 432. The transmission corridor passes along the east side of Western Brook / Middle Pond, heads south and west to avoid elevated terrain, then passes the west side of Eastern Blue Pond. From there, the corridor generally heads south-west, past Brians Pond, Portland Creek Pond and Inner Pond. It then climbs the elevated terrain south of Inner Pond. The transmission corridor continues in a southerly direction, avoiding areas of extreme elevation change and taking advantage of topographic shielding as available.

The transmission corridor turns south-west to avoid the Main River Special Management Area then heads in a south-easterly direction. The transmission corridor along the Long Range Mountains are within a high icing region. From this area, the transmission corridor heads south-east, paralleling the ROW for Transmission Line (TL) 246 and TL 252 until Hampden. It then crosses the ROW for TL 247 and TL 251 near the intersection of Highway 420 and Highway 421. The transmission corridor heads south-east, crossing Birchy Lake at a narrows, turns east to follow a valley, then emerges near a region of high wind and snow known as the Gaff Topsails and descends into Sheffield Brook Basin. The transmission corridor then heads north-east then south-east, avoiding the Gaff Topsails.

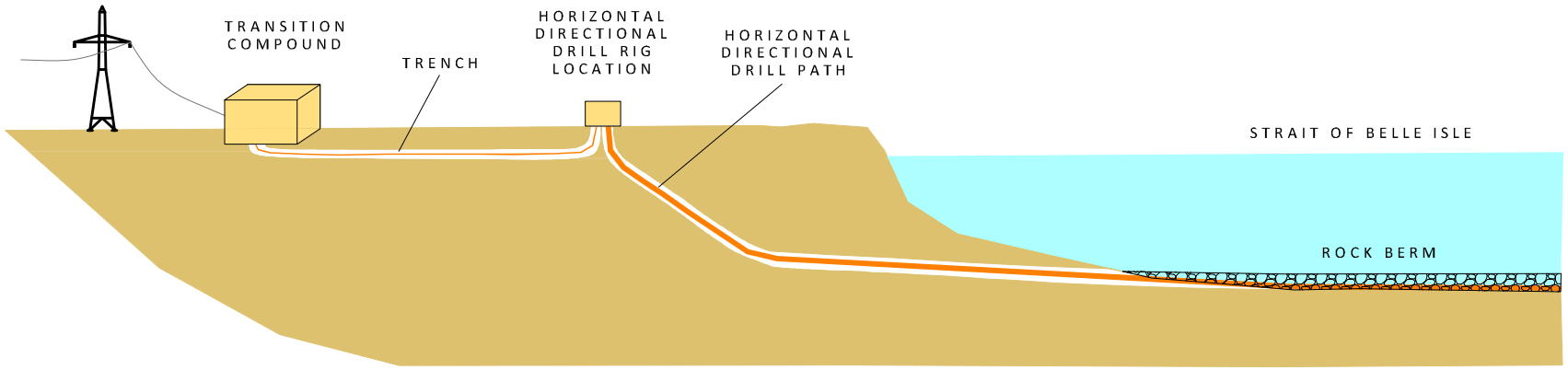
a) TYPICAL CROSS SECTION OF SUBMARINE ROCK BERM



b) CROSS SECTION OF A TYPICAL SUBMARINE CABLE



c) SIDE VIEW OF SUBMARINE CABLE CROSSING



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FIGURE 3.3.2-9

Side View of the Submarine Cable Crossing, Cross Section of Submarine Cable, and Cross Section of Rock Berm



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FIGURE 3.3.2-10

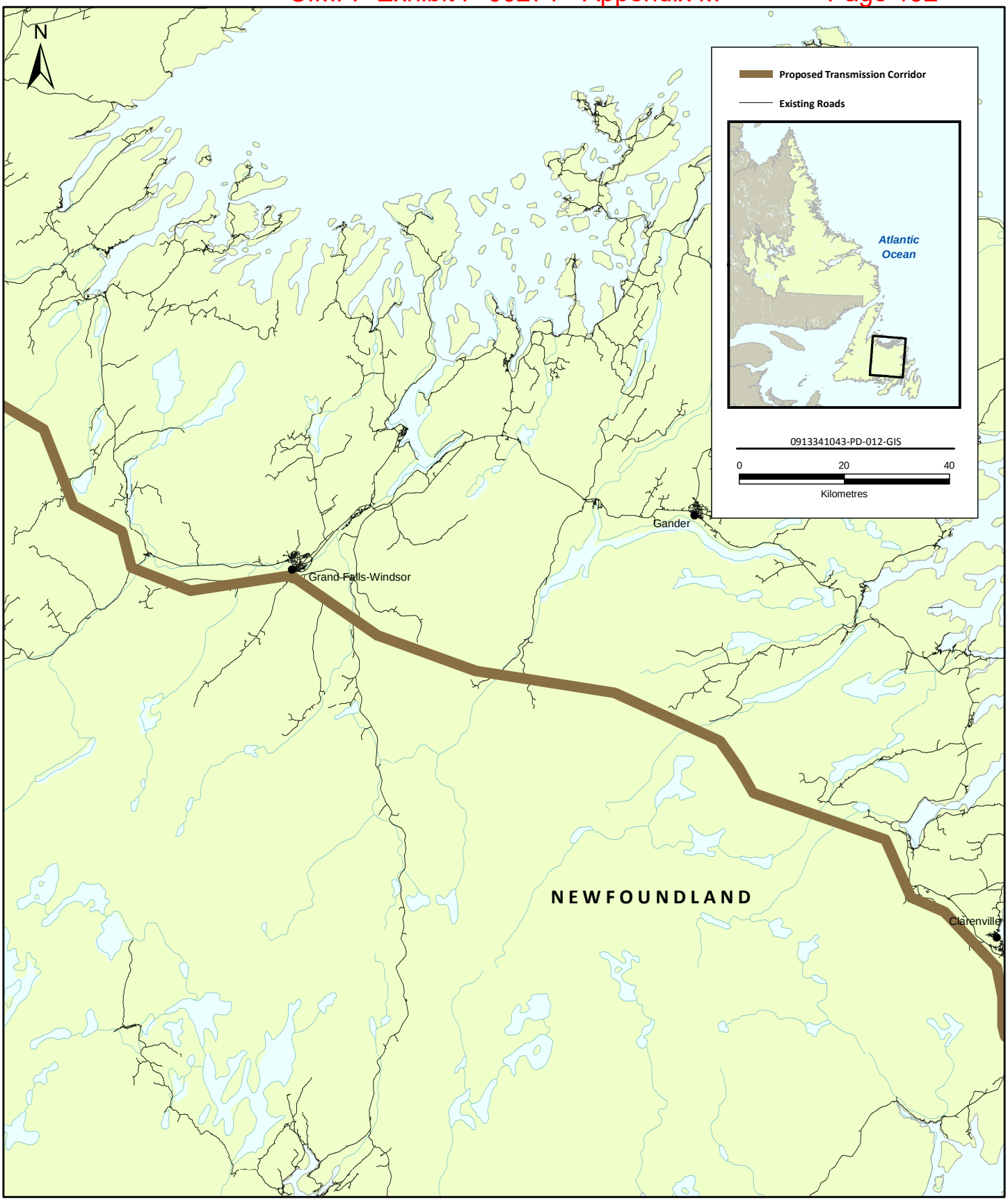
Transmission Corridor:
Shoal Cove to Soldiers Pond (kilometre 0 to kilometre 140)



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FIGURE 3.3.2-11

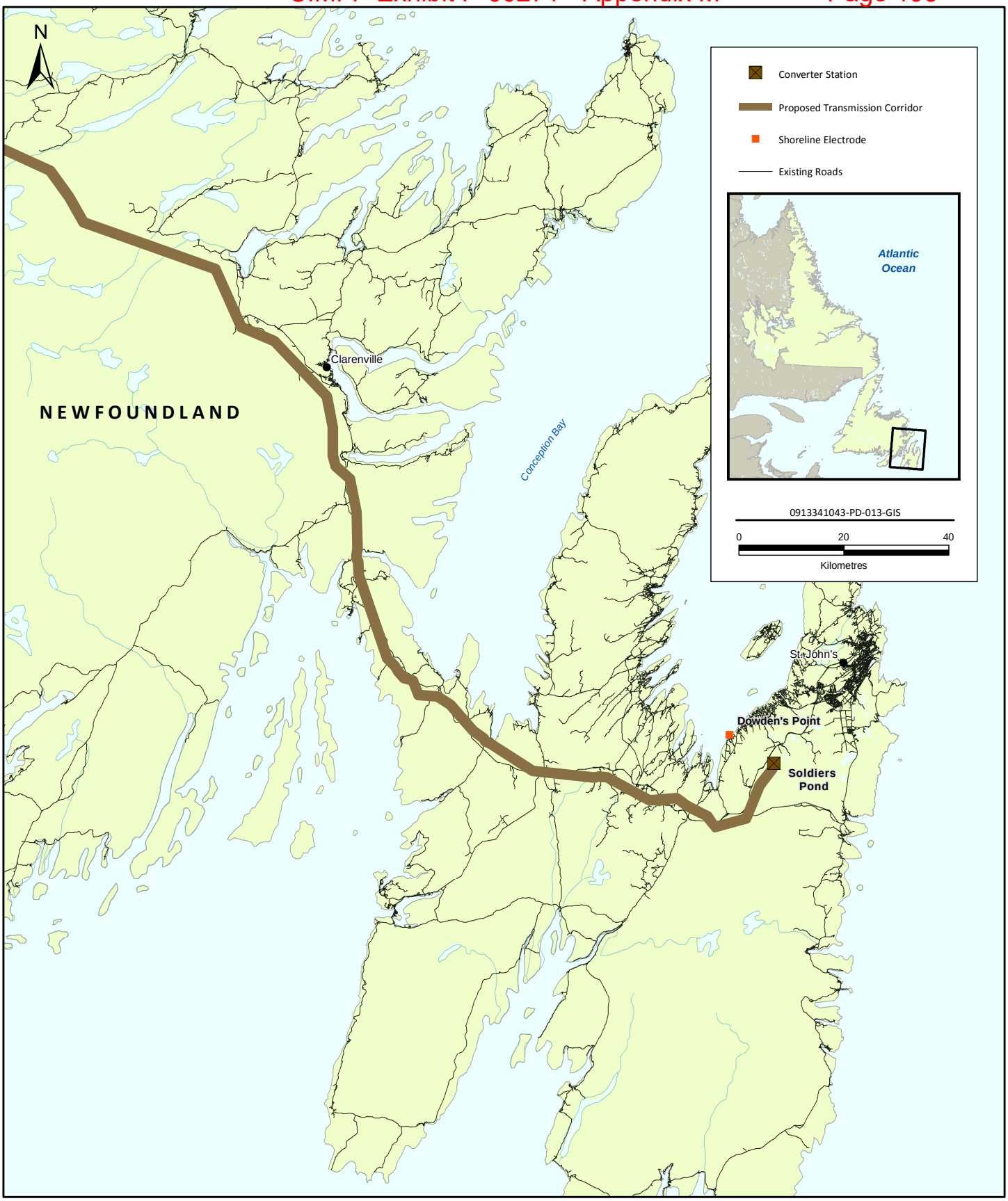
Transmission Corridor:
Shoal Cove to Soldiers Pond (kilometre 140 to kilometre 320)



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FIGURE 3.3.2-12

Transmission Corridor:
Shoal Cove to Soldiers Pond (kilometre 320 to kilometre 530)



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FIGURE 3.3.2-13

Transmission Corridor:
Shoal Cove to Soldiers Pond (kilometre 530 to kilometre 690)

The transmission corridor then heads east, following the ROW for TL 205 and TL 232, and crosses a 69 kV line from Newfoundland Power's Sandy Brook Generating Station. From Grand Falls-Windsor, the transmission corridor heads south-east toward Port Blandford. Between Port Blandford and Sunnyside, the transmission corridor heads south along a Newfoundland Power ROW which contains a single 138 kV line between Port Blandford and Clarenville. A second 138 kV line joins the ROW at Clarenville, and both continue to the Sunnyside substation. The transmission corridor skirts the Sunnyside substation before returning to follow the ROW for TL 203 and continuing across the Avalon Peninsula.

The transmission corridor then follows the ROW of TL 207, then parallels the ROW for TL 203 and TL 237, passing Nalcor's Western Avalon substation at Chapel Arm. The transmission corridor follows the ROW for TL 201 and TL 217, which contain two of Newfoundland Power's 138 kV transmission lines. The transmission corridor crosses several roads, electrical lines and developed areas before turning south-east and crossing Harbour Main Pond at a narrow section at its south end. The transmission corridor then follows the existing ROW for TL 201 and TL 217 until it reaches the Soldiers Pond converter station.

Transmission Towers

Galvanized steel lattice towers will be built along the final ROW within the transmission corridor between Shoal Cove and Soldiers Pond. The transmission towers and associated equipment (i.e., insulators, conductors, OPGW and counterpoise) will be similar in design to that described for the Muskrat Falls to Forteau Point portion of the corridor.

The number of towers required between the transition compound at Shoal Cove and converter station at Soldiers Pond will depend on tower span distances, as determined by topographic, meteorological and associated technical requirements. Based on an average span of 300 to 430 m in a normal region, 165 to 210 m in an alpine region and 255 to 420 m in an eastern region, there will be approximately 2,150 towers included in the transmission line between Shoal Cove and Soldiers Pond (Table 3.3.2-4). Approximately 90% of these will be suspension structures.

Table 3.3.2-4 Number and Types of Towers to be Constructed Between the Shoal Cove and Soldiers Pond

Tower Type	Number of Towers in each Region (Span)			Total
	Normal (300 m to 430 m)	Alpine (165 m to 210 m)	Eastern (255 m to 420 m)	
Suspension	920 to 1,340	350 to 450	440 to 630	1,710 to 2,420
Dead end	85 to 100	30 to 50	55 to 60	170 to 210
Total	**1,005 to 1,440**	**380 to 500**	**495 to 690**	**1,880 to 2,630**

3.3.3 Soldiers Pond Converter Station, ac Switchyard, and Synchronous Condenser Yard

The Soldiers Pond converter station, ac switchyard, and synchronous condenser yard will be located north-east of Soldiers Pond, near existing Nalcor transmission system infrastructure (TL 201, TL 217, TL 218 and TL 242) (Figure 3.2-6). The approximate coordinates of the Soldiers Pond converter station are 47° 25' 00" N and 52° 58' 31" W. The conceptual layout of the Soldiers Pond converter station, including the converter yard, the ac switchyard and the synchronous condenser yard is provided in Figure 3.3.3-1.

The converter station will consist of a converter yard that measures approximately 450 m by 600 m and will contain HVdc equipment, including converter transformers, converter valves, a valve cooling system, diesel generator and fuel storage facilities. The converter yard equipment is described in Table 3.3.3-1, and the layout of the converter yard is provided in Figure 3.3.1-2.

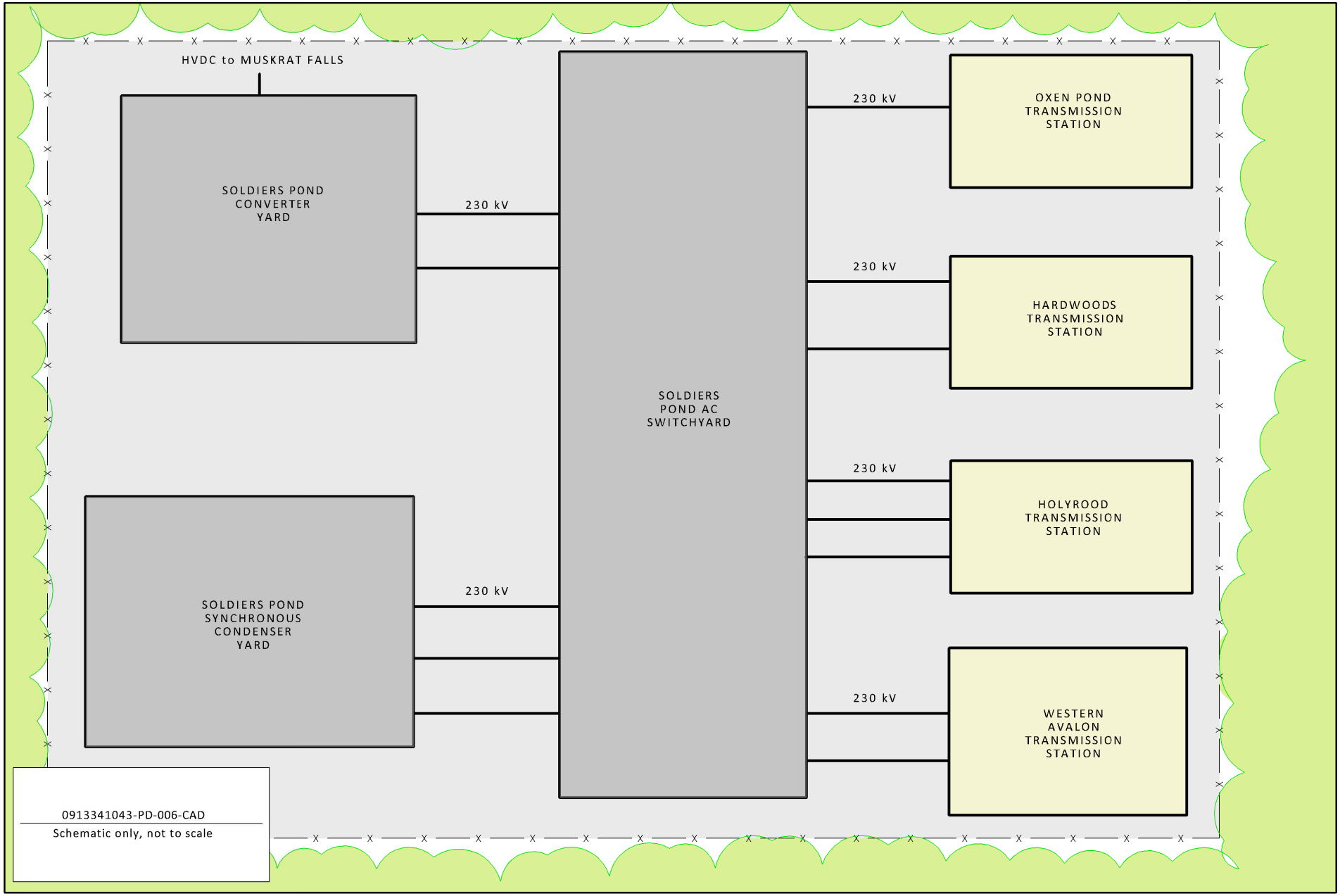


FIGURE 3.3.3-1

Conceptual Layout of the Soldiers Pond Converter Station, Including Converter Yard, Alternating Current Switchyard and Synchronous Condenser Yard

Adjacent to the converter station, a synchronous condenser yard will be constructed at Soldiers Pond. The synchronous condenser yard will measure 150 m by 100 m and will contain three synchronous condensers, used to provide reactive power and system inertia. The Soldiers Pond converter station will have a dc voltage rating of ± 350 kV and an ac voltage rating of 230 kV.

An ac switchyard will be constructed adjacent to the Soldiers Pond converter station. It will be approximately 250 m by 350 m. The ac switchyard is required to provide interconnection to the 230 kV transmission lines. The existing four lines (TL 201, TL 217, TL 218, and TL 242) in this area will be redirected into this switch yard.

The Soldiers Pond converter station, synchronous condenser yard and ac switchyard will all have a gravel surface, and a vegetation control program to restrict vegetation growth. Some parking areas or specific roadways may be paved. A series of concrete foundations and galvanized steel structures will support the electrical equipment and switchgear. A grounding grid will be installed beneath the foundations. Two types of foundations may be used to support the structures within the converter yard: rectangular strip footings and square pier footings. Equipment that requires shelter from the elements will be enclosed in the valve hall. Unauthorized access to the converter station will be restricted by a galvanized steel security fence and a locked gate. Appropriate signage will be posted in high voltage areas.

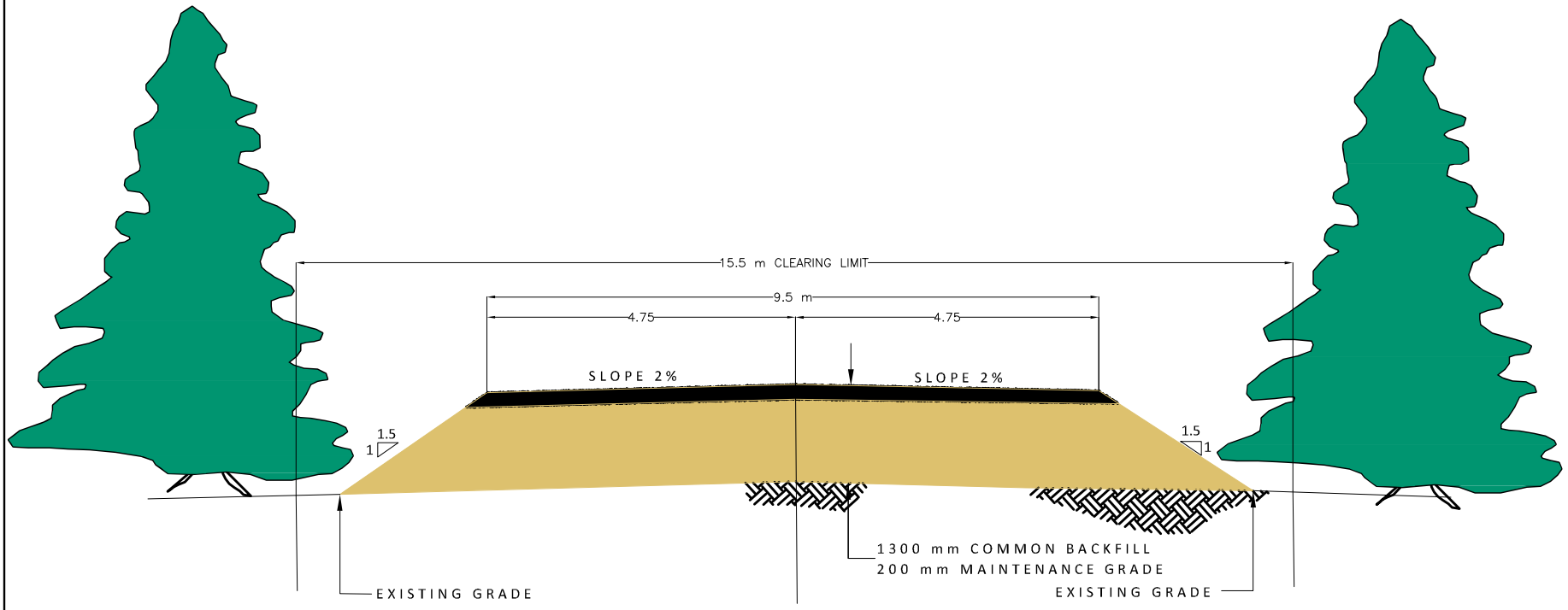
A new access road approximately 1.3 km long will be required for the Soldiers Pond converter station. This access road will connect with the eastbound lane of the Trans-Canada Highway (TCH). The gravel access road will have a 9.5 m wide top with 1.5:1 side slopes, as shown in Figure 3.3.3-2. The road will be constructed with open drainage ditches or swales along the sides. Galvanized steel culverts will be installed where required at stream and river crossings and other areas, as appropriate, to maintain natural drainage patterns.

3.3.4 Shoreline Electrodes

The Project has been designed as a bipolar system with a converter station at each end of the HVdc transmission line, and a shoreline saltwater pond electrode connected to each converter station via an electrode line, providing a ground return path. The shoreline electrodes will be constructed and installed at two locations: L'Anse au Diable North, Labrador (connected to the Muskrat Falls converter station) and Dowden's Point, Newfoundland (connected to the Soldiers Pond converter station).

During normal balanced bipolar operation, the two poles (one positive and one negative with respect to ground) provide a path for the dc current, and small amounts of electrical current due to voltage imbalances will flow through the electrode (i.e., less than 1% of the system's total capacity). The electrode provides a return path for the small amount of current due to voltage imbalances.

If both poles are in service, the system can operate at its full rated capacity. If a transmission conductor failure or a pole fault were to occur, the electrodes can provide a temporary ground return path for the current for the duration of the fault. The electrodes may be used during a pole outage if metallic return is not available. This is expected to occur for a duration of less than 40 hours per year and the ground return duration will be shorter than 40 hours if metallic return is used for some of the outages. The use of the electrodes to provide a long-term return path for the full current is expected to occur only under specific circumstances, such as two of the three submarine cables or the overhead conductor. The likelihood of a conductor failure is reduced through corridor and final ROW selection of the overhead line, cable protection planning, use of a spare cable across the Strait of Belle Isle, and reliable design of the transmission towers and conductors.



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FIGURE 3.3.3-2

Typical Access Road Cross Section

To provide an acceptable return path, the electrodes must provide adequate grounding. Ground Potential Rise (GPR) occurs when large electrical currents enter the ground and the earth becomes charged with electricity. The GPR of the ground decreases with distance from the point where the current entered the ground. In general, rock and soil are relatively poor conductors of electricity. Therefore, adequate grounding often requires the installation of electrodes in highly conductive material, such as salt water. For this reason, Nalcor has selected the use of shoreline saltwater pond electrodes for the Project.

Electrode operation is described further in Section 3.5.1.

3.3.4.1 L'Anse au Diable Shoreline Electrode

Preliminary studies have identified L'Anse au Diable in the Strait of Belle Isle as the preferred site for the Labrador shoreline electrode (Figure 3.2-5). The shoreline electrode will be submerged in a natural cove. The cove will be connected to the Strait of Belle Isle by an engineered, permeable berm that extends beyond the mouth of the cove into the Strait of Belle Isle, as shown in Figure 3.3.4-1.

The electrode design consists of between 40 and 60 silicon cast iron electrode elements installed vertically in the water on the pond side of the permeable berm. Figure 3.3.4-2 shows a conceptual drawing of the electrode. Each electrode will be encased in rigid polyvinyl chloride (PVC) conduit piping and will be attached to an electrode junction box at the top of the permeable berm. The junction boxes will be connected by a distribution cable running the length of the permeable berm. A road will be constructed along the crest of the permeable berm for access during maintenance activities.

The permeable berm will be designed to withstand the expected worst case site conditions, including wave action, tidal effects, pack ice and freezing inside the shoreline electrode pond. The depth of the shoreline electrode pond at the land side toe line will be sufficient to submerge the vertical electrode elements, and to accommodate changes in the water level due to tides and ice formation within the shoreline electrode pond. The depth will be such that the electrode elements are fully immersed in water, below the ice, under various tide conditions. At the land side toe of the permeable berm, where the electrode elements are installed, there will be a natural low-tide sea depth of 4 m. The electrode elements will be connected by a distribution cable to the land-based electrode line termination structure. The termination structure will contain switches that allow a series of electrode elements to be turned off for maintenance or repairs.

It is expected that the permeable berm will be a rubble mound structure consisting of embankment materials obtained from nearby quarries. The majority of the structure will be random quarry material, with larger quarry rocks used as armour stone on the sea side slope to protect the permeable berm from storm waves. A further selection of suitably sized rocks will be made to form the embankment, which must be permeable to allow the natural flushing and transfer of seawater through the embankment.

The size of the permeable berm, its composition and its location relative to the shoreline will depend on electrical performance requirements, structural integrity and operational and maintenance needs. The length of the permeable berm along the centre line will be approximately 205 m. It is expected that the permeable berm centre line will be approximately 15 m above the sea floor. The side slope ratio will be approximately 1:1.5 (rise:run), and the permeable berm will have a crest width of approximately 9.5 m. Figure 3.3.4-2 shows a typical permeable berm cross section.

A layer of uniformly sized rock with an increased void ratio is required to conduct the electrode current through the permeable berm and into the sea, as maintaining the salinity of the water in the shoreline electrode pond is critical to the performance of the electrode. The contact area between the permeable berm and the sea is driven by safety considerations. A minimum contact area must be achieved between the shoreline electrode pond and the permeable berm to ensure a safe voltage gradient on the sea side of the permeable berm. The design uses a conservative void ratio of approximately 20%, and the average size of rock in the permeable zone is anticipated to be 0.5 to 1 m in diameter.

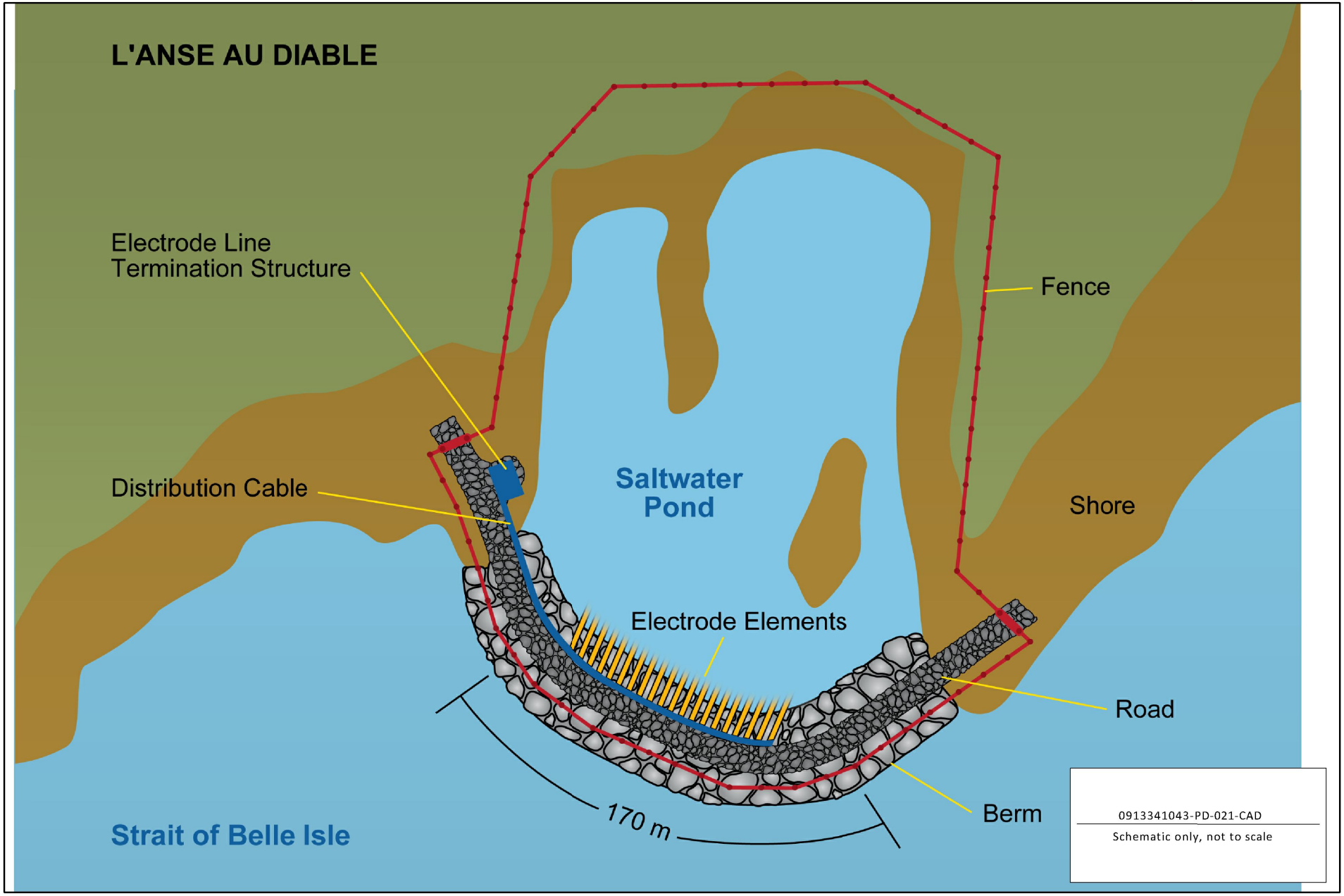


FIGURE 3.3.4-1

L'Anse au Diable Shoreline Electrode

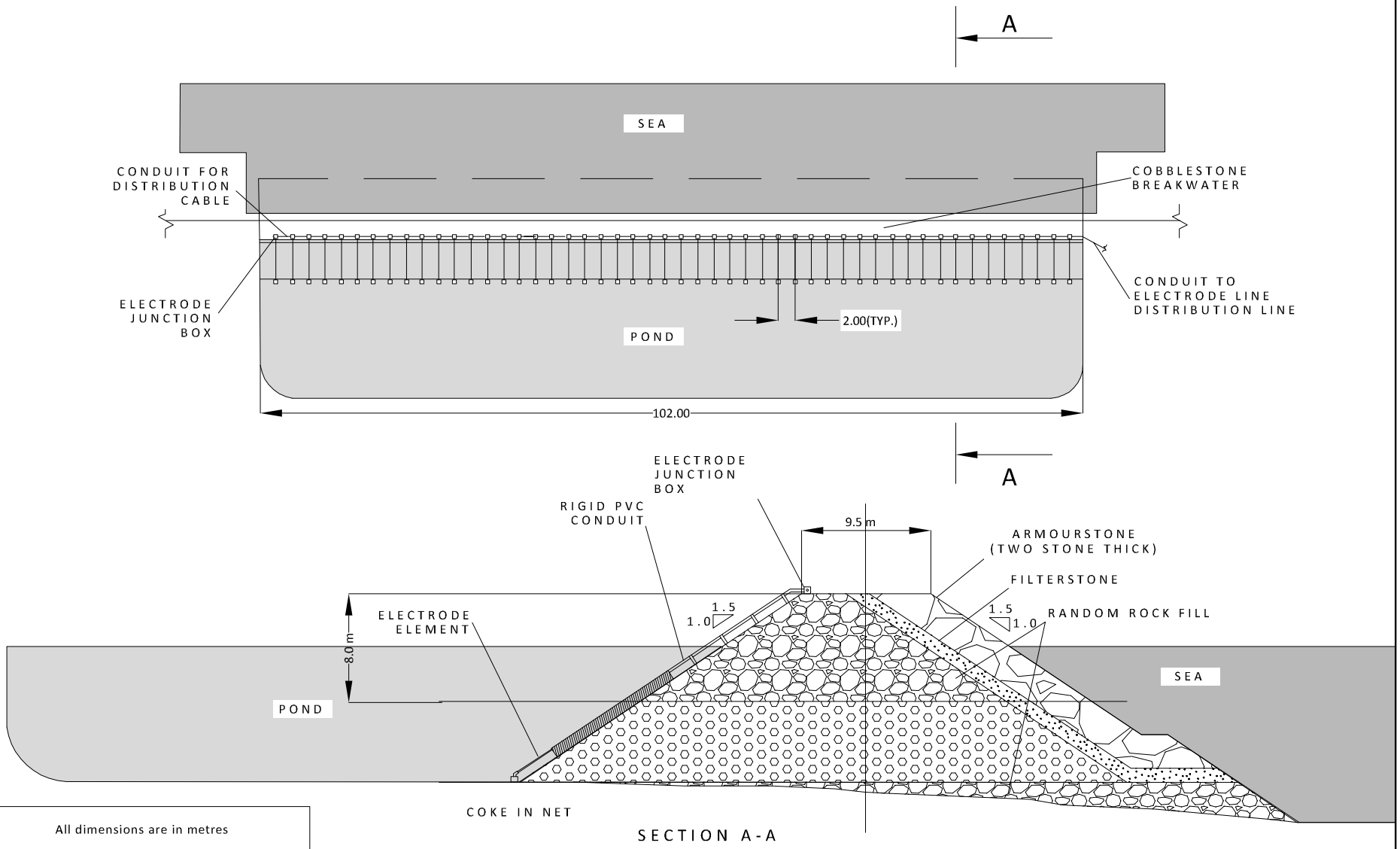


FIGURE 3.3.4-2

Schematic of Shoreline Electrode and Cross Section of Permeable Berm

The electrode site will be enclosed by a locked, chain-link fence to prevent public access from the land and sea sides. Sea side fencing will be installed on the permeable berm crest.

The electrode will be connected to the Muskrat Falls converter station by two low voltage, 43 mm, metallic conductors suspended on standard single wood poles. The treated wood poles (i.e., Penta or chromate copper arsenate (CCA)) will be approximately 10 to 12 m high and spaced approximately 70 to 90 m apart. Where required, the wood poles will be guyed with standard anchor configurations. The wood pole electrode line from the Muskrat Falls converter station will be located within the HVdc ROW, as described in Section 3.3.1, for approximately 350 to 400 km, until it reaches the general area of the Labrador Straits Highway (Route 510). Then, it will generally follow the Labrador Straits Highway and / or an existing distribution line ROW for 25 km to the L'Anse au Diable electrode line termination structure. The approximate location of the electrode wood pole line is shown in Figure 3.2-5.

3.3.4.2 Dowden's Point Shoreline Electrode

The shoreline electrode for the Soldiers Pond converter station will be located at Dowden's Point, on the south-east shore of Conception Bay, approximately 3 km north-east of the Holyrood Thermal Generating Station (Figure 3.2-6). Two permeable berm design options are under consideration for the Dowden's Point electrode site. The first option is to extend the permeable berm into Conception Bay such that, at the pond side of toe of the permeable berm, where the electrode elements are installed, a natural low-tide depth of 4 m is achieved (i.e., no excavation of the seabed is required), as shown in Figure 3.3.4-3. The permeable berm length for this option, measured along the centre line, would be approximately 385 m.

The second option has the crest of the permeable berm aligned with the top of the existing bank and the sea side toe line coincident with the existing low tide shoreline. A channel would be excavated to a depth of 4 m from the inside of the shoreline electrode pond outward to a natural depth of 4 m in Conception Bay, as shown in Figure 3.3.4-4. The depth of the soil above the bedrock at Dowden's Point is anticipated to be approximately 30 m, which would permit excavation without the need for blasting. The permeable berm length measured along the centre line for this option would be approximately 90 m. A regular excavation program may be required during Operations and Maintenance for this option to maintain the seabed depth requirement of 4 m.

The electrode and permeable berm design will be similar to that described for the L'Anse au Diable shoreline pond electrode (Section 3.3.4-1). The electrode design consists of between 40 and 60 silicon cast iron electrode elements installed vertically in the water on the pond side of the permeable berm. The permeable berm will be a rubble mound structure consisting of embankment materials obtained from nearby quarries, and it is expected that the permeable berm centre line will be approximately 15 m high, the side slope ratio will be approximately 1:1.5 (rise:run), and the permeable berm will have a crest width of approximately 9.5 m.

The electrode will be connected to the Soldiers Pond converter station by two low voltage, 43 mm, metallic conductors suspended on standard single wood poles. The treated wood poles will be approximately 10 to 12 m high and spaced approximately 70 to 90 m apart. The wood pole electrode line from the Soldiers Pond converter station will follow an existing transmission corridor to a point near Conception Bay then follow an existing ROW (i.e., existing road or distribution line, or both) to Dowden's Point, a total distance of approximately 15 km (Figure 3.2-6 – note, specific location not shown as it is yet to be confirmed).

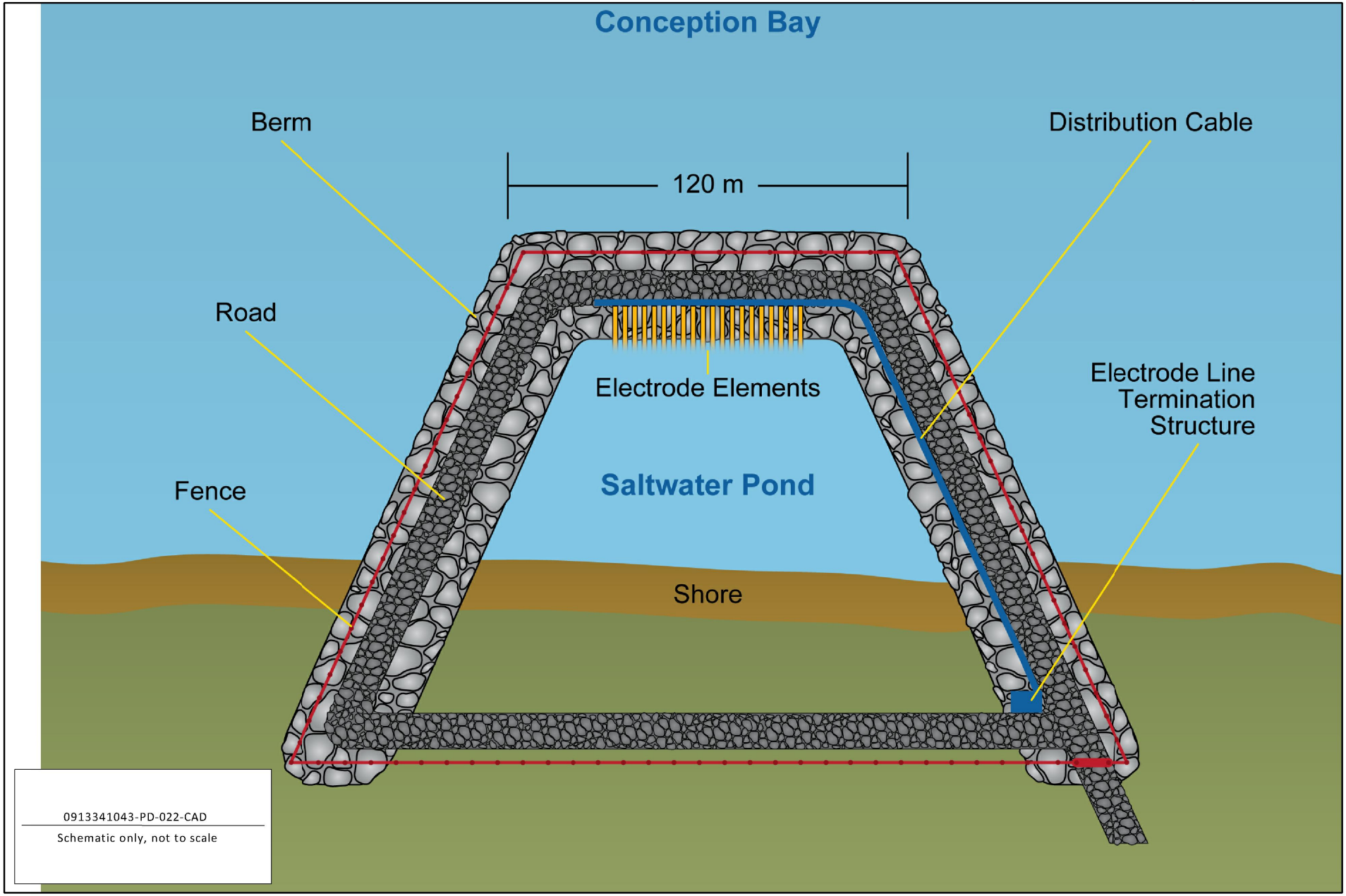


FIGURE 3.3.4-3

Dowden's Point Shoreline Pond Electrode - Design Option 1

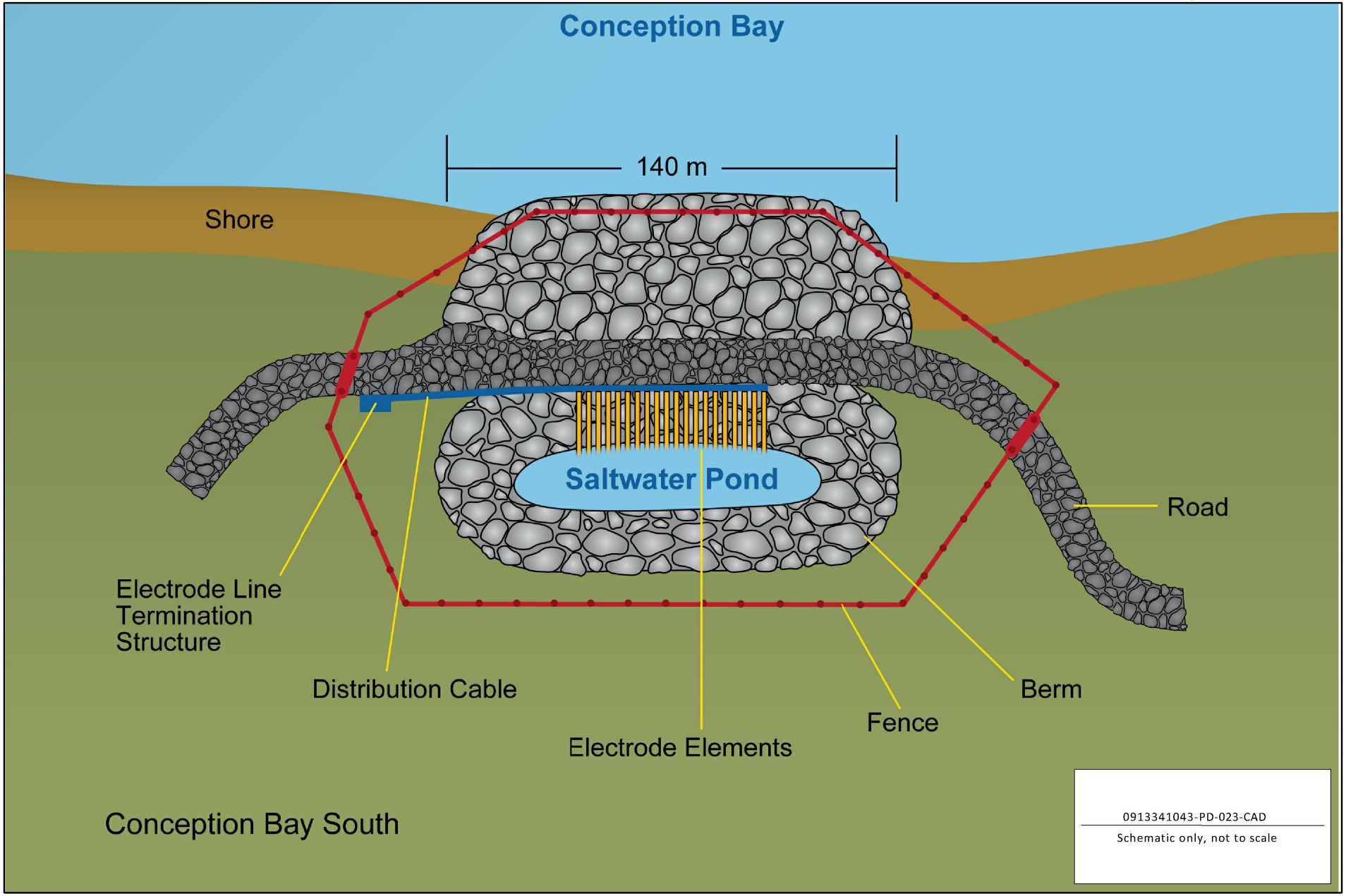


FIGURE 3.3.4-4

Dowden's Point Shoreline Pond Electrode - Design Option 2

3.3.5 Island System Upgrades

Existing transmission lines will be connected to the Soldiers Pond switchyard thus enabling electricity from the Project to be transmitted into the Island grid. Some modifications and additions to the NLH existing Island transmission system may be required to successfully integrate the HVdc system, and to accept the power it transmits into the Island grid. The need for, and nature of, any such modifications will be determined through the completion of power system studies conducted during detailed Project engineering. These will primarily involve standard and routine upgrades to existing infrastructure, occur within and adjacent to existing facilities, and will likely be addressed through the NLH standard and ongoing system maintenance programs. Any additional required components and activities which are specific to the integration of the HVdc system, and which are not part of the NLH ongoing or planned system maintenance program and existing capital plans, will be defined during the next phase of engineering for the Project.

System upgrades include the conversion of two of the Holyrood generating units to synchronous condensers. These upgrades would help maintain system stability and keep voltages at specified levels. Also, the 230 kV and 138 kV circuit breakers at the Holyrood Thermal Generating Station (nine in total), Sunnyside Terminal Station (11 in total) and Bay d'Espoir Hydroelectric Generating Station (four in total) may be upgraded to allow for the isolation of power system components in response to system events (e.g., lightning strike, insulator failure, dropped conductor).

Power will be delivered from the Soldiers Pond converter station to the Island grid via the following eight existing transmission lines:

- TL 217;
- TL 201;
- TL 218; and
- TL 242.

New towers will be built in existing ROWs, within 1.6 km of the converter station for each of these existing transmission lines, and lightning protection (i.e., an overhead ground wire) will be installed. The new towers will be spaced approximately 250 m apart, they will be self-supporting and will carry two overhead groundwires and three conductors. The transmission lines will be re-built within three existing ROWs ranging from 70 m wide (two lines) to 110 m wide (three lines).

3.3.6 Telecommunications Systems

The Project will include a telecommunication system that provides voice, video and data communication. Telecommunications will be established through a combination of the OPGW and either fibre optic submarine cable and / or microwave link across the Strait of Belle Isle. The Project telecommunication system will include:

- a Supervisory Control and Data Acquisition (SCADA) / Operational Data System, which provides remote monitoring and control of electrical equipment and facility systems;
- a teleprotection system to provide reliable communication channels for the operation and control of protection equipment; and
- very high frequency (VHF) radio systems for communication during Construction, Operations and Maintenance of the Project.

The preferred option of communications facilities across the Strait of Belle Isle is optical fibres either embedded in the power cables, or separate submarine optical cables laid adjacent to the power cables. The alternative option is a digital microwave radio facility. The final decision will be made during detailed engineering.

If a microwave radio system is required to be established, it will be established at or near the transition compound. This system would link the on-land fibre optic cable system installed on the transmission structures in Labrador to those on the Island transmission structures. The interconnected telecommunications system would be used for the transmission of control signals for the HVdc system and other operational data and voice traffic. The microwave radio system would consist of a fenced microwave site (approximately 15 m by 30 m) near each transition compound, within the transmission corridor. Each microwave site would include a telecommunications building to house the systems required for the operation of the microwave radios (e.g., communications electronics and battery bank power supply), a structure to house a back-up generator and fuel tank, and a guyed microwave tower structure approximately 35 m to 50 m in height. Nalcor will also consider the potential for coordination with other existing microwave facilities in the area. All aspects of the proposed microwave radio system, including transmission power and frequencies, will be registered with Industry Canada in accordance with applicable legislation.

3.4 Construction

The Project includes the construction of two converter stations, two shoreline electrodes, an on-land HVdc transmission line, and a submarine cable crossing with associated onshore infrastructure (i.e., transition compounds). A general overview of construction schedule, activities and infrastructure requirements are provided in the following sections.

3.4.1 Construction Schedule

The engineering design and construction phase will begin in Year 0 with detailed engineering and the procurement and manufacture of key long-lead components. Construction activity is scheduled to begin in the middle of Year 1 and finish in early Year 5. Project commissioning and the start of operation is expected to occur in Year 5.

Appendix 3-1 provides a list of permits required for the Project. All construction activities will be conducted in accordance with permits and regulations.

Construction of the Labrador components, the Island components and the Strait of Belle Isle submarine cable crossings will be initiated and conducted separately. A general overview of the Project schedule is provided in Figure 3.4.1-1. This figure includes the estimated timing and duration of construction for each Project component.

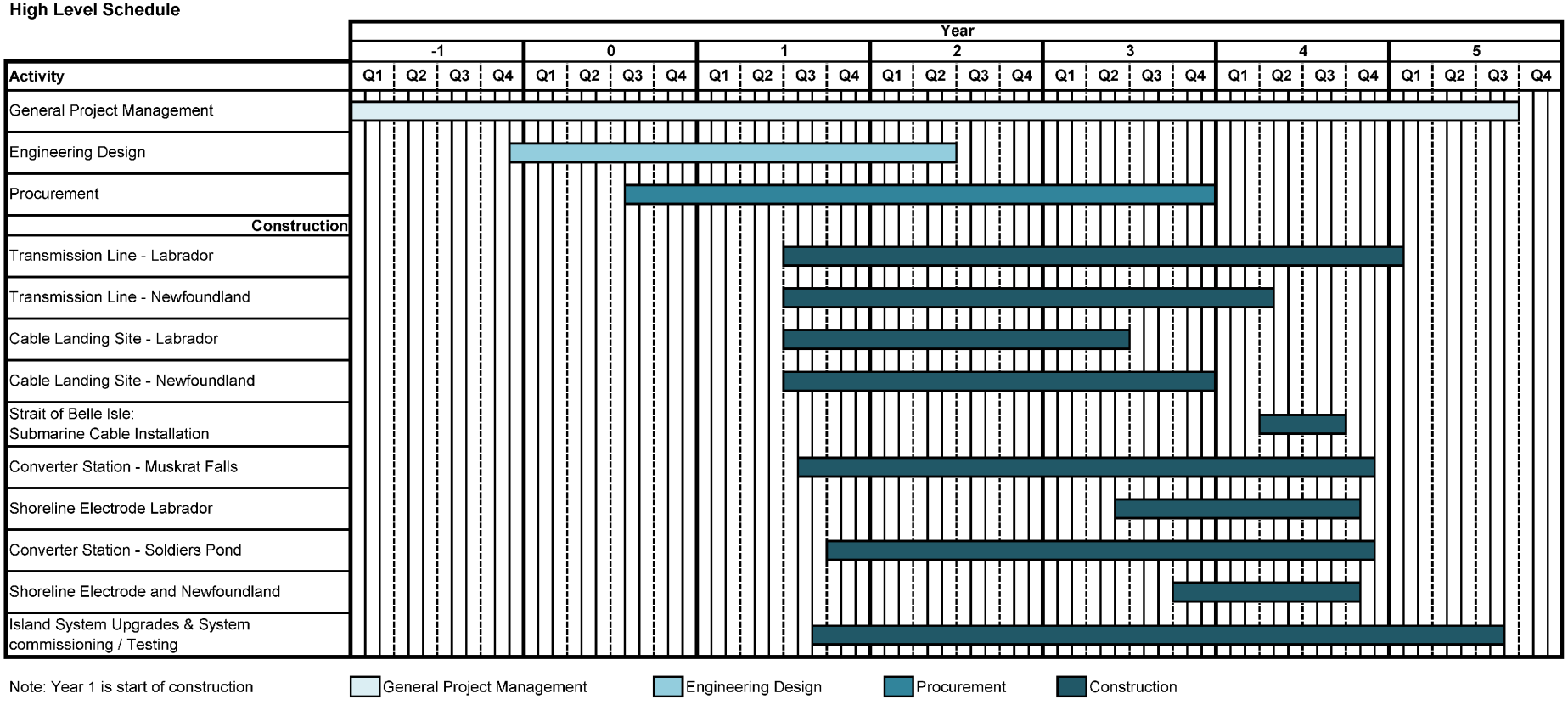
Construction of the on-land transmission infrastructure in both Labrador and on the Island is scheduled to begin in the middle of Year 1, and will be initiated from multiple locations along the ROW. Construction will begin with the establishment of temporary camps, access infrastructure and marshalling yards, followed by ROW clearing, materials distribution and the installation of tower foundations and anchors. The transmission towers will be assembled and erected during Year 2 and Year 3, followed by conductor installation. Construction of the Labrador and Island onshore transition compounds will also occur in Year 2 and Year 3. The Island transmission line is scheduled for completion in early to mid Year 4 and the Labrador line in early Year 5.

Construction activities associated with the submarine cable protection (e.g., HDD) will begin in the middle of Year 1 and will continue until the end of Year 3. Cable installation will be conducted during the ice-free season of Year 4 and will likely be completed by late Year 4.

3.4.1.1 Public Notification of Construction Activities

Nalcor will contact land owners along the transmission corridor during detailed design and route selection. Nalcor will begin one-on-one contact with land owners who are directly affected by construction many months in advance of construction. Communication will continue until after the project construction has been completed.

High Level Schedule



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FIGURE 3.4.1-1

High Level Schedule for Project Construction

Nalcor will also notify the public and land users of ongoing construction activities. Affected municipalities will be notified and Nalcor will work with municipalities and other relevant stakeholders to disseminate construction activity information throughout communities. Nalcor will use various communication initiatives to inform land users of ongoing work, including advertising, Nalcor's website, social media, newsletters, information sheets and Nalcor / Hydro's customer service information line.

Nalcor will also consult with the Department of National Defence during the detailed design phase of the Project and will develop a communications plan to address potential restrictions to low-level flying activities and communication with aircraft Construction Infrastructure.

3.4.2 Construction Infrastructure

3.4.2.1 Access

Access to the ROW is required for the transportation and distribution of personnel, equipment and materials to the work sites. Existing roads and winter trails will be used where practical to limit disturbance resulting from construction of new access. All vehicle movement on Project access roads will be in accordance with applicable regulations and guidelines. Ground access for materials distribution may also be supplemented by helicopter transport, in some areas.

In Labrador, access for the construction of the Muskrat Falls converter station, the western sections of the transmission line and the shoreline electrode site will be via the existing transportation network to and within Central Labrador, including the TLH and the highway between Happy Valley-Goose Bay and North West River (Route 520), and existing resource roads in the area. The existing paved Labrador Straits Highway (Route 510) will provide access to the eastern end of the Labrador transmission line. Along the remainder of the transmission line, one or more additional access trails will be established from select points on the TLH3 and from the southern part of the TLH (Phase 2) (TLH2).

In Newfoundland, considerable access is already available through the existing provincial highway systems and resource road networks, including existing facilities and associated roads and trails (Appendix 3-2). These existing access networks will be of particular use in those areas where sections of the Project follow along, or near, existing transmission lines on the Island. Any modifications or upgrades required to existing access infrastructure will comply with applicable regulations and guidelines.

The specific number, location and characteristics of all new access for the Project will be finalized as part of ongoing Project engineering and design, and will be planned and developed in compliance with applicable legislation, regulations and authorizations. Dust control and de-icing activities are not likely to be required for the access roads or trails. Upon completion of project construction, a select number of access roads and trails will remain in place to provide an appropriate level of access for transmission line maintenance activities.

Access Roads

In Central and Southeastern Labrador, it is expected that an approximately 20 km long access road will be required from the Labrador Straits Highway (Route 510) to the transmission corridor. It is also expected that one new access road, approximately 12 km in length, will be required at the base of the Northern Peninsula. These access roads will be built to a Class C standard; they will be 5.0 m wide and require a ROW width of 20 m. Figure 3.3.3-2 shows the cross section of typical access roads. Nalcor is not planning to build ice roads, including ice bridges and ice crossings, for the Project.

Access Trails

In Central Labrador, short access trails will extend off the western half of the TLH3 to the ROW. An access trail will also be established within the transmission line ROW for use during Construction, and Operations and Maintenance. This access trail will be located, for the most part, within the cleared ROW, however, in some places (e.g., where the ROW spans a waterbody or crosses difficult terrain) the trail may lie outside the cleared ROW. The access trails will be approximately 4 m wide, with this width reduced at watercourse crossings to

3 m for a distance of 20 m. The trails will use local material to create a stable surface for travel (e.g., cleared wood may be used as corduroy for travel across wetlands, bogs and / or low areas). Crushed rock will not be placed on the trail surface.

3.4.2.2 Water Crossings

The construction of access infrastructure for the Project will involve water crossings. These will include fording, culvert installation or bridge installation, depending on local site conditions, environmental characteristics and sensitivities, and other technical, regulatory and economic considerations. In some cases, it will not be possible or practical to cross a waterbody using any method, in which case access to the area will be gained through access trails approaching the watercourse from both sides. In all cases, access trails and any associated watercourse crossings will be selected, designed, constructed and maintained in accordance with industry practices and in compliance with all applicable legislation and regulations. In keeping with Nalcor's corporate policy and practice, and regulatory requirements, each watercourse crossing will be evaluated and applicable permits acquired prior to construction. Nalcor will meet the CSA conductor clearance standard applicable to the type and size of the watercourse and will comply with the *Navigable Waters Protection Act*.

Fording

Fording will be subject to stipulations contained in Certificates of Approval obtained from the Newfoundland and Labrador Department of Environment and Conservation (NLDEC) and authorizations obtained from Fisheries and Oceans Canada (DFO). Crossings will be restricted to a single location and will be conducted at right angles to the waterbody, where possible. All equipment will be inspected for leaks of oil, fuel and hydraulic fluids prior to crossing, and the number of crossings will be kept to a minimum. Where possible, fording locations will be chosen where the banks and substrate are not sensitive to erosion.

If fording must occur where the banks of the waterbody are sensitive to erosion, the bank will be modified to minimize the potential for erosion. This may be accomplished through the placement of a vegetation mat or by sloping and diverting drainage flow. Where bank material is highly erodible, riprap may be required. If banks are sloped for stabilization, no material will be deposited in the waterbody. Sloping will be accomplished by back-blading above the high water mark. If fording must occur where the substrate of the waterbody is sensitive to erosion, the substrate will be modified to minimize the potential for erosion. A temporary timber bridge may also be installed to minimize the siltation of the waterbody.

Fording activities will be conducted such that the depth of the waterbody is not decreased to less than 20 cm. Where the existing depth is less than 20 cm, that depth will be maintained. Temporary silt traps will be installed in highly sensitive areas near waterbodies, as required, and approaches to ford sites will be stabilized to avoid rutting, thereby avoiding the potential for water build-up that is pushed into the watercourse by the equipment.

Permanent Bridges

Permanent bridges may be constructed in areas where regular travel is required across a ford site or where bank stabilization may not adequately prevent watercourse sedimentation. The approach to the permanent bridges will be designed and constructed perpendicular to the watercourse. The bridges will be built entirely above the high water mark and will not be located on meander beds, braided streams, alluvial fans, active flood plains or other unstable terrain. The bridges will be no greater than two lanes in width and will not encroach on the natural channel width by the placement of abutments, footings or rock armouring below the high water mark.

Sediment and erosion control measures will be installed prior to commencing work. These will include measures to prevent the introduction of cement, grout, paint, ditch sediment, preservatives and other deleterious substances from entering the watercourse. Upon completion of bridge construction, banks will be returned to their original profile and stabilized.

Temporary Bridges

Temporary bridges may be constructed where stream banks are stable and have low slope. Temporary bridges will be no greater than one lane in width, and no part of the structure will be placed within the wetted portion of the watercourse. The bridges will be built entirely above the high water mark and will not be located on meander beds, braided streams, alluvial fans, active flood plains, or other unstable terrain. Crossing materials will be removed immediately following the completion of work.

Sediment and erosion control measures, as described for permanent bridges, will be installed prior to commencing work. Upon removal of the crossing materials, the watercourse banks will be returned to their original profile and disturbed areas will be stabilized, as necessary, to prevent soil erosion.

Culverts

Culvert selection will consider site-specific conditions such as the width of the watercourse crossing, fish habitat characteristics, substrate type, and hydrologic characteristics of the watercourse. Culverts will be sized to handle peak flow, and aligned parallel to the watercourse channel on a straight section of uniform gradient. Culverts will extend a minimum of 300 mm beyond the fill, and a minimum water depth of 200 mm will be provided throughout the culvert length. Baffles may be required where site-specific conditions result in high water velocities.

3.4.2.3 Construction Accommodations

Lodging for the construction work force will be provided through small, temporary construction camps established at strategic points along the ROW. As particular construction activities are phased and completed, workers and crews will move between camps. It is anticipated that eleven temporary construction camps will be established along but outside the ROW. Four will be located between Muskrat Falls and Forteau Point, three will be located between Shoal Cove and Taylors Brook, and four will be located between Taylors Brook and Soldiers Pond. The approximate preliminary locations of the camps are provided in Figure 3.4.2-1. Final locations will be based on detail design, contractor preference and field conditions.

Each camp will occupy an area of approximately 135 m by 135 m (1.82 ha) and will accommodate a bunkhouse for 150 workers, a kitchen, a dining hall and a recreation area. Each camp will be equipped with a first aid station, communications system, helicopter pad, water treatment facility, waste water treatment system, water supply and a fuel supply. The typical layout of the camps is provided in Figure 3.4.2-2. Specific features and / or layout may vary due to local topography and site conditions.

The construction of the camps will include clearing, as necessary, and levelling. If bedrock is exposed, some excavation may be required during grading. Vegetation will generally be cleared using mechanical harvesters to remove the timber and bulldozers to remove the remaining woody vegetation. Camps may be designed to be mobile; as construction activities progress away from each camp location, trailers may be transported along the ROW to the next camp location, thus reducing the need for total Project camp site space.

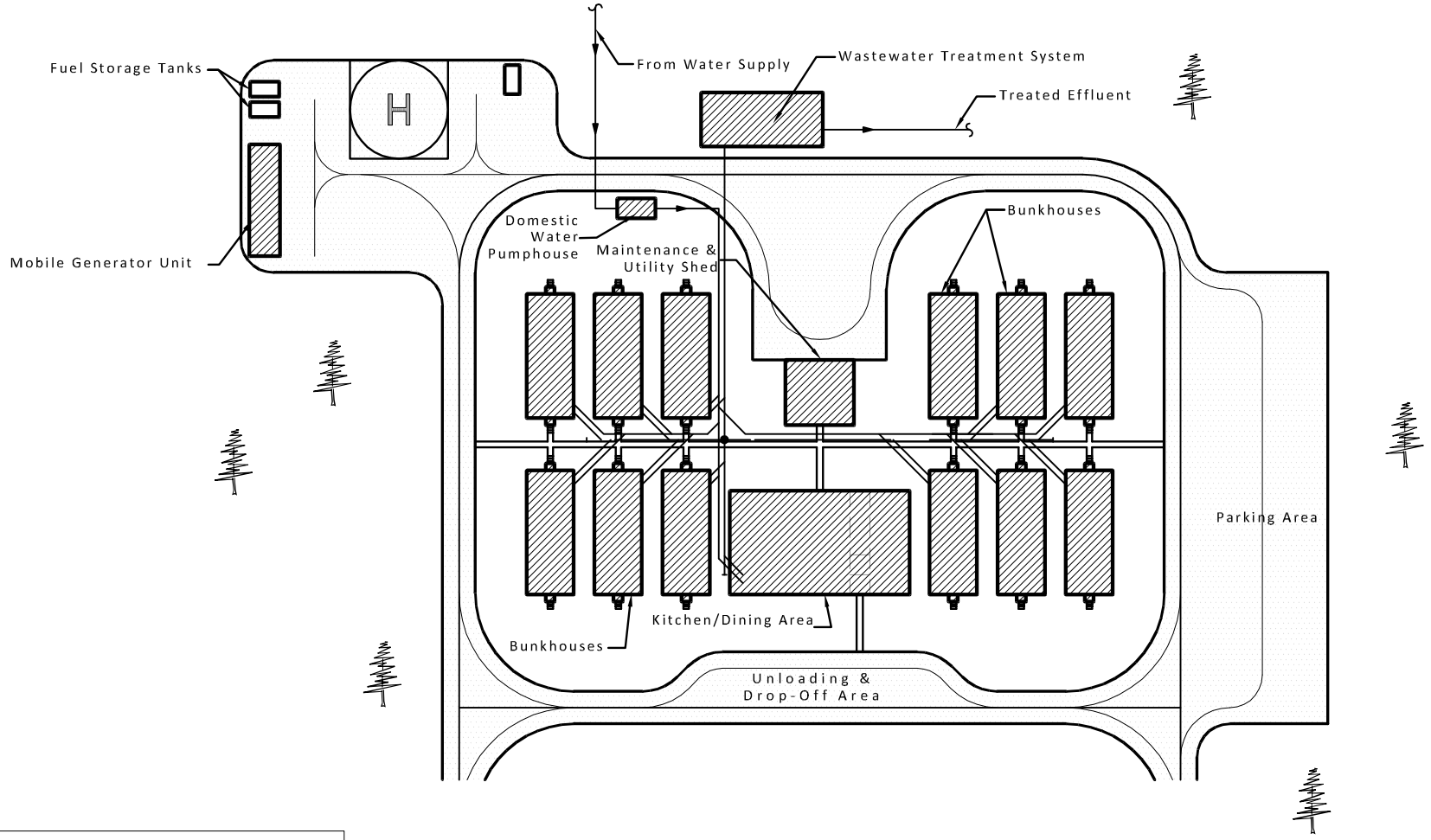
Potable water for most camps will be obtained from nearby artesian wells. A pumphouse, a water treatment system and a water distribution system will be constructed, as required. Camps B and C will draw water from the St. Augustine River and St. Paul River, respectively, and Camp E and Camp G will draw water from adjacent lakes. The camps will use an intake pumping system which will send the water to a wet well. Camp D may obtain water from the community of L'Anse au Loup. All water taken from natural sources will be treated and chlorinated as required to comply with the *Guidelines for Canadian Drinking Water Quality – Summary Table* (Health Canada 2010, internet site). All permits and authorizations required for the development of potable water supplies, as identified in Appendix 3-1, will be obtained prior to camp construction.



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FIGURE 3.4.2-1

Approximate Temporary Construction Camp Locations



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20 0 20

SCALE APPROX. METRES

FIGURE 3.4.2-2

Typical Temporary Construction Camp Layout

A sewage treatment system, designed in accordance with guidelines and regulations of applicable regulatory departments will provide sewage effluent acceptable for discharge. Ground percolation tests will be conducted at the camp locations prior to construction to ensure that they are acceptable for the disposal of wastewater in accordance with the *Guidelines for the Design, Construction and Operation of Water and Sewerage Systems* (Newfoundland and Labrador Department of Environment and Conservation, Water Resources Management Division (NLDEC-WRM) 2010). Camp D may use existing wastewater treatment infrastructure at L'Anse au Loup.

Solid waste disposal at the camps will be in compliance with the Project Environmental Protection Plan (EPP). Solid waste will be temporarily stored in bear-proof containers before being transported to an approved waste disposal site. A recycling program will be implemented at all camps to reduce the amount of solid waste generated.

Electricity will be supplied to the camps using temporary diesel generators. The diesel generators will be operated in compliance with applicable regulations and guidelines. In some locations, power may be drawn from the existing Newfoundland and Labrador power grid.

3.4.2.4 Marshalling Yards and Lay Down Areas

Marshalling yards will be established at strategic points to receive and temporarily store materials and equipment during Project construction. Five marshalling yards (5 ha each) are proposed, two in Labrador and three on the Island. The approximate locations of these marshalling yards are shown in Figure 3.4.2-3. The marshalling yards will be cleared of vegetation, grubbed and levelled. Vegetation will generally be cleared using mechanical harvesters to remove the merchantable timber and bulldozers to remove the remaining woody vegetation. The yards will be equipped with perimeter lighting and fencing for safety and security. A typical marshalling yard layout is provided in Figure 3.4.2-4.

Materials stored at the marshalling yards will typically include foundation steel, anchoring and guy wire material, tower steel, conductor and groundwire reels, insulators and conductor fittings, and miscellaneous hardware. A site office and a workshop will also be constructed within each marshalling yard perimeter. Table 3.4.2-1 describes the approximate location of each marshalling yard and the proposed route of material and equipment delivery to the marshalling yard.

Lay down (staging) areas will also be established for temporary storage. Bulk material will be transported from the marshalling yards to the lay down areas by transport truck. At the lay down areas, smaller loads may be collected by off-road tracked equipment for transportation to the ROW. These sites require no infrastructure (i.e., no fencing or buildings) and, where practical, contractors will use existing disturbance areas such as pits or other clearings for this purpose.

Assembly yards may also be required for the Labrador portion of the transmission line due to isolation. Approximately 10 assembly yards will be required and the location of each is yet to be identified. These yards will contain approximately 20,000 litres of fuel storage. Handling and fuelling procedures will comply with the Storage and Handling of Gasoline and Associated Products regulations.



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FIGURE 3.4.2-3

Approximate Marshalling Yard Locations

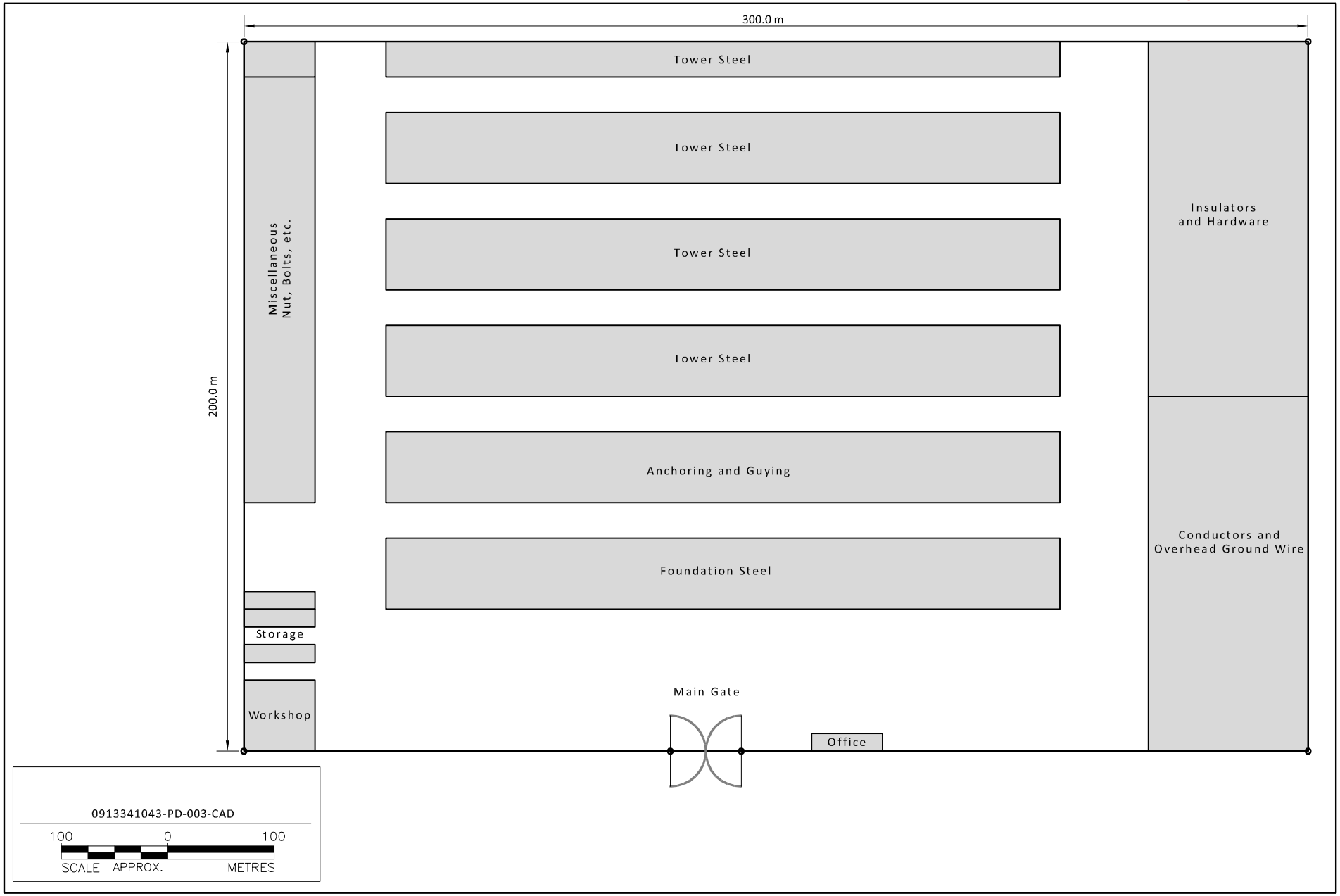


FIGURE 3.4.2-4

Typical Marshalling Yard Layout

Table 3.4.2-1 Approximate Marshalling Yard Locations and Propose Route of Material and Equipment Delivery

Marshalling Yard	Location	Material and Equipment Delivery
A	Located approximately 150 km SE of Happy Valley-Goose Bay near the southern most point of the TLH3.	Material can be transported by road, either from Goose Bay or through Québec, to the marshalling yard.
B	Located on the Labrador side of the Strait of Belle Isle, near the intersection of Route 510 (Labrador Straits Highway) and the secondary road that leads to Point Amour.	Transmission line materials can be transported by ship or barge or the TLH3.
C	Located near the community of Plum Point on the Northern Peninsula. This is considered an auxiliary yard as it will be used for relatively short-term storage only.	Materials can be transported to the marshalling yard via Route 432. Materials and equipment that are brought in from off-Island will either be sent via boat to Corner Brook or via the TCH via the Marine Atlantic Ferry at Port aux Basques.
D	Located near Deer Lake. This will be the main marshalling yard for the Island portion of the Project and will include an administration building and security office.	Materials can be transported to the marshalling yard via the TCH. Materials and equipment that are brought in from off-Island will either be sent via boat to Corner Brook or on the TCH via the Marine Atlantic Ferry at Port aux Basques.
E	Located at the eastern end of the transmission corridor, on the Witless Bay Line (Route 13), near the existing transmission line.	Materials can be transported to the marshalling yard by road. Materials and equipment that are brought in from off-Island will be either sent via boat to Corner Brook or St. John's or on road (TCH and Route 13) via the Marine Atlantic Ferry at Port aux Basques. Alternate docking locations may be available.

3.4.2.5 Quarries and Borrow Material

Project construction will require aggregate and borrow material. Processed aggregate will be required for the construction of the converter stations, marshalling yards and access roads, and for concrete mixing. The total quantity of aggregate required will be determined during detailed Project design. Borrow material may be required for backfilling during the construction of the converter stations, access roads and transmission tower foundations (e.g., when transmission tower foundation is located in bog material). The development of new quarries is not likely, as it is expected that the volume of material required can be obtained from existing quarries and / or purchased from local suppliers. A map showing the location of existing quarries is included in Appendix 3-2. Borrow material will be obtained from the sources listed below, in the order of preference:

- borrow material obtained from the cleared ROW, from within a 25 m radius of the centre point of the excavation for a tower foundation or anchor;
- borrow material obtained from the cleared ROW but outside a 25 m radius of the centre point of the excavation; and
- borrow material obtained from approved areas outside the ROW.

Borrow pits will be developed in the following manner:

- organic layer and topsoil will be removed and kept separate from mineral soil to limit admixing;
- a pit will be excavated;
- unused excavated material will be replaced;
- the area will be graded to a stable contour; and
- topsoil and organic layer will be replaced.

All borrow pits will be identified, established and decommissioned in accordance with applicable regulatory requirements. The excavation of acid generating material is not anticipated for the Project and metal leaching is not expected to occur.

3.4.2.6 Concrete Production

Concrete for the Muskrat Falls converter station will be sourced from the Lower Churchill Hydroelectric Generation Project construction site. Concrete for the Soldiers Pond converter station will be purchased from local suppliers. Along the transmission line, minimal concrete is required for levelling rock foundations. This concrete is typically mixed on-site, but can be sourced from local suppliers, if available. No concrete batch plants will be developed for the Project, and water use will be minimal. Construction water sources and methods of accessing water and delivering water to construction sites for purposes such as mixing cement and the volume required is not known at this stage of Project Planning but will be conducted in accordance with all applicable regulatory requirements. Washwater from the cleaning of mixers, mixer trucks and concrete delivery systems will flow into closed system aggregate rinsing settling basins. In the event that water from the closed settling system is intended for release, it will be tested first for parameters related to concrete additives, pH, and total suspended solids.

3.4.3 Construction Activities and Sequence

3.4.3.1 Converter Stations

Detailed converter station design, and the procurement and manufacture of specialized equipment is expected to take two years. Construction will take place simultaneously at each of the two converter stations during Year 3 and Year 4 of Project construction. The work will include site preparation, delivery of materials and equipment, installation of supporting infrastructure, and testing and commissioning. For planning purposes, converter construction has been divided into four phases, as described below.

Phase One

Phase one of converter station construction will take place in Year 3 of the Project and will include site preparation activities and installation of foundations and infrastructure. The following will be completed during phase one:

- construct access roads;
- site clearing, grubbing and grading, and rock compaction;
- excavate building foundations;
- install station roads and lay down areas;
- prepare valve hall foundation, including footings, formwork and reinforcements;
- install station ground grid;

- install water supply and sewer systems;
- erect security fence; and
- begin installation of valve hall and switchyard concrete foundations.

Potable water for the converter station will be supplied by nearby artesian wells. A pumphouse, a water treatment system and a water distribution system will be constructed as required. All water taken from natural sources will be treated and chlorinated to comply with the *Guidelines for Canadian Drinking Water Quality – Summary Table* (Health Canada 2010, internet site). All permits and authorizations required from the development of potable water supplies, as identified in Appendix 3-1, will be obtained prior to converter station construction.

A sewage treatment system, designed in accordance with guidelines and regulations of applicable regulatory departments, will provide sewage effluent acceptable for discharge.

Phase Two

Phase two of the converter station construction will take place in Year 3 and will include the completion of building construction and the initial stages of valve hall equipment installation. The following activities will be completed during phase two:

- complete the valve hall and switchyard foundations;
- erect the steel building superstructure;
- install roof and cladding;
- begin installation of ac switchgear and filters in the switchyard;
- install transformers, structural components and cable trays inside the valve hall; and
- begin installation of buswork and installation and termination of electrical cables.

Phase Three

Phase three of the converter station construction will take place in Year 4 and will include the interior outfitting of the facility, finalizing the installation of several exterior components, and the installation of interior equipment. Testing and commissioning will be initiated during this phase. The following activities will be completed during phase three:

- complete exterior switchgear and filters;
- install interior, electrical, heating, ventilation and air conditioning systems;
- install converter transformers, transformers, valve hall switchgear, electronics used to protect (i.e., monitor conditions) and control (e.g., open breakers), auxiliary supplies and battery banks;
- install piping for the thyristor (i.e., a solid-state semiconductor switching device) cooling modules;
- begin installation of valve modules and electrical and instrumentation connections;
- complete buswork installation and the installation and termination of electrical cables; and
- install thyristor cooling plant.

Phase Four

Phase four of the converter station construction will take place in Year 4 and will include the completion of installation of interior equipment and final testing and commissioning. The following activities will be completed during phase four:

- complete installation of valve modules and instrumentation connections;
- complete installation of the cooling plant;
- functional testing and partial system testing; and
- initiate start-up and complete system testing.

3.4.3.2 Transmission Line

Transmission line construction will begin after a two-year design and fabrication phase. This two-year period will allow the construction of necessary infrastructure and the clearing of the ROW before the first materials have been fabricated and delivered for system installation.

Land-based transmission line construction activities will be staged in segments: Muskrat Falls to Forteau Point; Shoal Cove to Taylors Brook (km 248); and Taylors Brook to Soldiers Pond. Each transmission line segment will have multiple work fronts that will allow the concurrent execution of construction activities along the transmission ROW. The pattern of work will be different for each section but, overall, it will take about three years to complete construction within each segment.

Transmission line construction will typically include the following activities:

- surveying;
- construction of infrastructure (i.e., access roads, bridges, marshalling yards and temporary construction camps);
- clearing of the transmission ROW and construction of ROW access trail;
- staking of towers and guy locations;
- material distribution;
- installation of tower foundations;
- assembly and erection of transmission towers;
- installation of conductors;
- counterpoise installation;
- cleanup and reclamation; and
- inspection and commissioning.

An overview of each transmission line construction activity is provided below.

Surveying

The first phase of transmission line construction includes surveying the centre line. The transmission corridor was surveyed in 2010 using aircraft equipped with Light Detection and Ranging (LiDAR) equipment. This technology provides accurate and precise geo-referenced survey data from the air with no cutting of survey lines.

Global Positioning System (GPS) technology will guide equipment used to clear the ROW. The location of all transmission towers will be staked using information exported to the GPS equipment from the Project design software.

Construction of Infrastructure and Associated Clearing

Construction of the temporary camp sites, access roads and marshalling yards will begin during the transmission line design and fabrication phase. Section 3.4.1 describes the activities associated with the development of construction infrastructure. Exact timing of camp construction will depend on contract award and contractor schedule.

Clearing of Transmission ROW and Construction of ROW Access Trail

Clearing will be required for the construction of camps, marshalling yards, and transition compounds. The associated clearing will require site clearing, grubbing, and grading.

ROW preparation will be carried out in accordance with standard utility practices and procedures, and will involve the clearing of all vegetation that exceeds 2 m at maturity. Chapter 12.2, the Vegetation Effects Analysis, describes the vegetation types and clearing requirements along the ROW. Clearing will consist of cutting tree trunks parallel to, and within 15 cm of the ground or lower, as well as the removal of all shrubs, debris and other such materials. Grubbing will only occur at tower foundation locations, and may be required to construct the access trail. Clearing of the ROW will consider:

- the location and identification of watercourse crossings along the ROW;
- widths of watercourses;
- location of wetlands;
- areas of commercial timber and the method of cutting and storing commercial timber;
- required buffer zones (e.g., for watercourses); and
- locations of access trails required to bypass zones of difficult access in the ROW.

Vegetation will generally be cleared using mechanical harvesters to remove the timber. Chainsaws may be used for small scale clearings (e.g., tree removal adjacent to a watercourse), as required. All vegetation will be cut within 15 cm of the ground surface. Salvaged timber will be limbed and stacked within the ROW, at right angles to and approximately 6 m from the ROW centre line, in neat piles with a maximum height of 3 m. Slash and debris will be piled in long narrow rows, separate from the merchantable timber, approximately 6 m from the centre line on both sides of the ROW, as appropriate. A 6.5 m wide break in slash windrows will be made at least every 200 m, or as required to address site-specific issues, to allow surface water flow and wildlife passage.

At watercourse and road crossings, the width of the cleared ROW will be reduced to 3 m for a distance of 20 m on either side of the crossing. Selective cutting may be completed in these areas. All woody debris generated at these crossings will be removed from the stream banks and placed in a location within the ROW where it will not enter the watercourse or impede natural drainage.

An access trail will be established within the cleared ROW for use during construction, Operations and Maintenance. The trail will be approximately 4 m wide, with this width reduced at watercourse and road crossings to 3 m for a distance of 20 m. The ROW access trail will use local material to create a safe, surface for travel. Crushed stone will not be placed on the trail surface, however, cleared wood may be used as corduroy for travel across wetlands, bogs or low areas.

Staking of Tower and Guy Locations

Following ROW clearing, field survey crews will physically mark (i.e., stake) the specific locations of the towers, foundations and anchors using GPS technology and data from the LiDAR survey.

Material Distribution

Five marshalling yards will be established at strategic points along the ROW to receive and temporarily store materials and equipment during project construction. Material will be delivered to the marshalling yards primarily by truck, as described in Table 3.4-1. Construction materials will be distributed from the marshalling yards along the ROW using tracked vehicles, such as Nodwells, or other appropriate equipment as dictated by the terrain or other environmental considerations. Distributed materials will include steel foundations, tower sections, guy wire, conductor and hardware. Helicopters may also be used for material distribution, as appropriate and required. Where possible and practical, distribution will be carried out during the winter months, which provides easier access and less ground disturbance (i.e., frozen ground and snow cover).

Installation of Tower Foundations

Foundations are required for both the self-supporting towers and the guyed towers. Foundation installation will require excavation at each tower location, and the installation of a steel grillage structure. If existing material is unsuitable for foundation support, borrow material may be required. Figure 3.3-6 shows the overburden type steel grillage foundation that will be used for the Project. The size of each steel grillage foundation and associated depth will vary with tower size and soil strength.

When constructing in wetlands, cribs made of untreated lumber and backfilled with borrow material will be installed to provide stability to foundations.

Tower foundations may also be on bedrock, which will typically require rock anchors. Figure 3.3-7 shows a rock type foundation. If the bedrock does not provide the stability required (i.e., it contains fractures or it is of inadequate size), blasting may be required. All blasters will have a Blasters Safety Certificate from the Newfoundland and Labrador Department of Human Resources, Labour and Employment. The handling, transportation, storage and use of explosives will comply with all applicable federal and provincial laws, regulations and orders of the Newfoundland and Labrador Department of Human Resources, Labour and Employment and the Mining and Energy branches of the Newfoundland and Labrador Department of Natural Resources and the *Dangerous Good Transportation Act* (RSN, Chapter D-1, plus amendments).

If blasting is required, it will occur as small, localized events. The number of blasts is dependent on the site conditions. Blasting within 200 m of a fish bearing waterbody will be carried out in accordance with DFO guidelines (DFO 2010, internet site). No blasting will occur within 15 m of a fish bearing watercourse.

Assembly and Erection of Transmission Towers

Once the materials are distributed to a foundation location and the foundation is in place, tower assembly and erection will be completed in stages. The steel components will be bolted together on the ground adjacent to the tower location to form the lattice structure. Off-road (tracked) equipment and cranes will be used to attach the tower sections and lift the tower into place. The tower will then be bolted to the foundations. As required, guy wires will be attached to the tower, anchored to the ground using steel grillage foundations, and tensioned to keep the tower in place. Hardware such as insulators will then be attached to the towers in preparation for the installation of the conductor. Typically, it will take a six to eight member crew one to three days to assemble and erect a tower.

Generally, tower assembly will occur at the site where the tower is to be erected. Where helicopter slinging is required, the towers may be assembled in marshalling yards or lay down areas.

Installation of Conductors

Next, the conductor will be installed on the tower structures. The conductor will be rolled onto the line using stringing blocks (i.e., pulleys used to string the conductor from structure to structure) and attached by specialized crews. The conductor is then tensioned and sagged to ensure that the correct design tension is applied and the necessary ground clearance is maintained. A tensioner holds the wire to set the sag, and the wire is then marked, cut, equipped with hardware, and installed. Figure 3.4.3-1 shows the typical conductor installation activities.

Project infrastructure will be inspected prior to commissioning the system. This will include a tower by tower inspection of the transmission line conductors and insulators and testing of converter station equipment.

Counterpoise Installation

The counterpoise will be installed at a depth of 0.3 m along the approximate centre line of the corridor. Counterpoise will be buried along the majority of the length of the ROW. A less than 1 m wide counterpoise trench will be excavated using a small plough, which will feed the counterpoise directly into the trench. The trench will then be backfilled with the removed material using an excavator. The counterpoise will be terminated and a grounding rod will be installed where required and appropriate (i.e., where the transmission line crosses waterbodies or watercourses and authorization to lay the counterpoise on the bed of the watercourse or waterbody cannot be obtained). The grounding rod will be driven below the counterpoise and a bolted connection fixes the counterpoise to the grounding rod.

3.4.3.3 Strait of Belle Isle Cable Crossing

Between the transition compound and the submarine cable landfall onshore entry point, the land cables will be buried in trenches approximately 1 m wide and 1 to 5 m deep. The location of the transition compound will be determined during the detailed Project design, but the length of the trenches is expected to be between 50 and 1,500 m. There will be a maximum of three trenches per landing point, i.e., one or more cables per trench. The trench will be excavated, chaseways installed, and the cable laid. To close the trench an engineered backfilled material may be used to partially or fully fill the trench. Appropriate measures (e.g., signage) will be taken to ensure that there is no excavation or development in the cable areas. There currently is no requirement for surface infrastructure between the landing points and the transition compounds.

To complete the Strait of Belle Isle submarine cable crossing, the Project will employ a combination of HDD technology and a cable installation vessel (CIV). The HDD will provide three lined (steel or HDPE) conduits for each landfall (i.e., Forteau Point and Shoal Cove). The cable will be laid on the sea floor and hauled through the conduit to the onshore landing point. The same connection methods will be used for both landing sites. The construction methods planned for the Strait of Belle Isle cable crossing do not require ocean disposal.

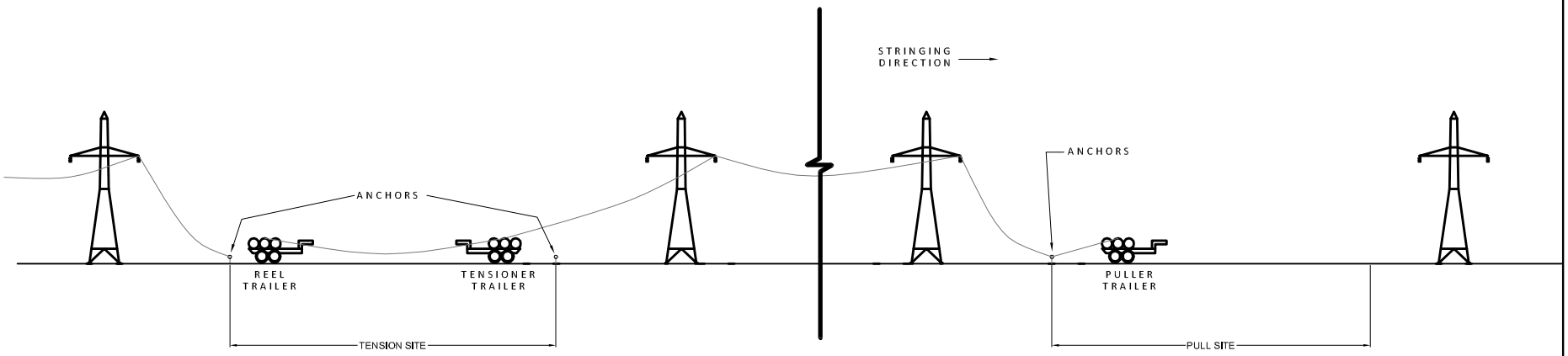
Horizontal Directional Drilling

Each HDD construction site will measure approximately 90 m by 60 m (0.54 ha). The drill sites will contain a drill rig, mud pumps and a drilling mud return pit, and storage facilities for the drill pipes, drill mud and bentonite. Figure 3.4.3-2 shows the typical layout of an HDD site.

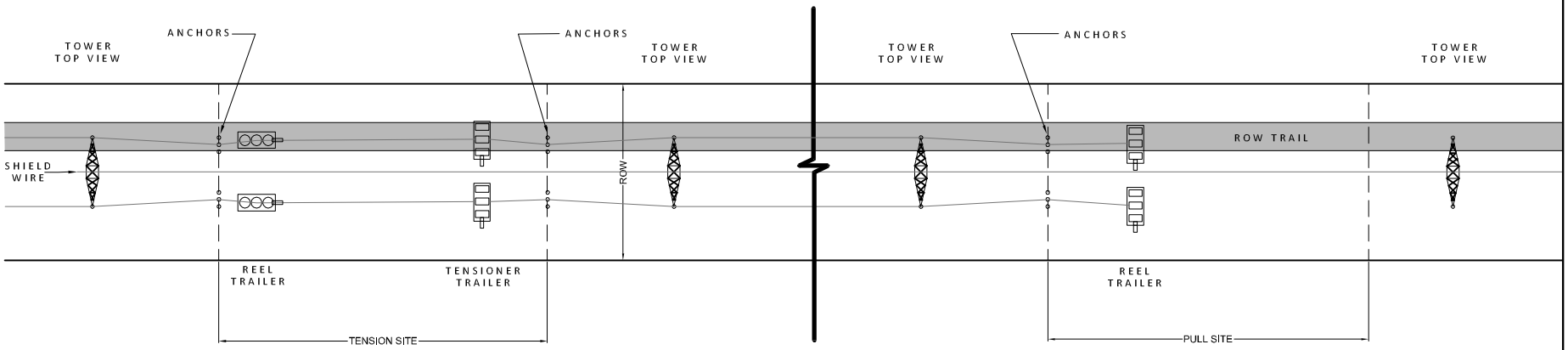
Three boreholes will be drilled for the landfalls at Forteau Point and Shoal Cove. The drill path for each borehole will be downward then out under the sea floor, for a distance of approximately 1.5 to 2.5 km. Figure 3.4.3-3 shows a side view of the HDD process.

It is expected that the HDD process will take place 24 hours a day, seven days a week and it is expected to take approximately 2.5 years to complete the three conduits on each side of the Strait of Belle Isle. Two drill rigs will operate concurrently, one at Forteau Point and the other at Shoal Cove. There will be three separate boreholes at each shore approach (i.e., one per cable) and these will be drilled in sequence. A pilot borehole will be drilled at each location, then one or two additional reaming passes will be completed to achieve the desired borehole diameter. Once the borehole is completed, a liner pipe will be installed in the hole, then the drill rig will move on to start the next pilot hole.

SIDE VIEW



PLAN VIEW



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Schematic only, not to Scale

FIGURE 3.4.3-1

Conductor Installation

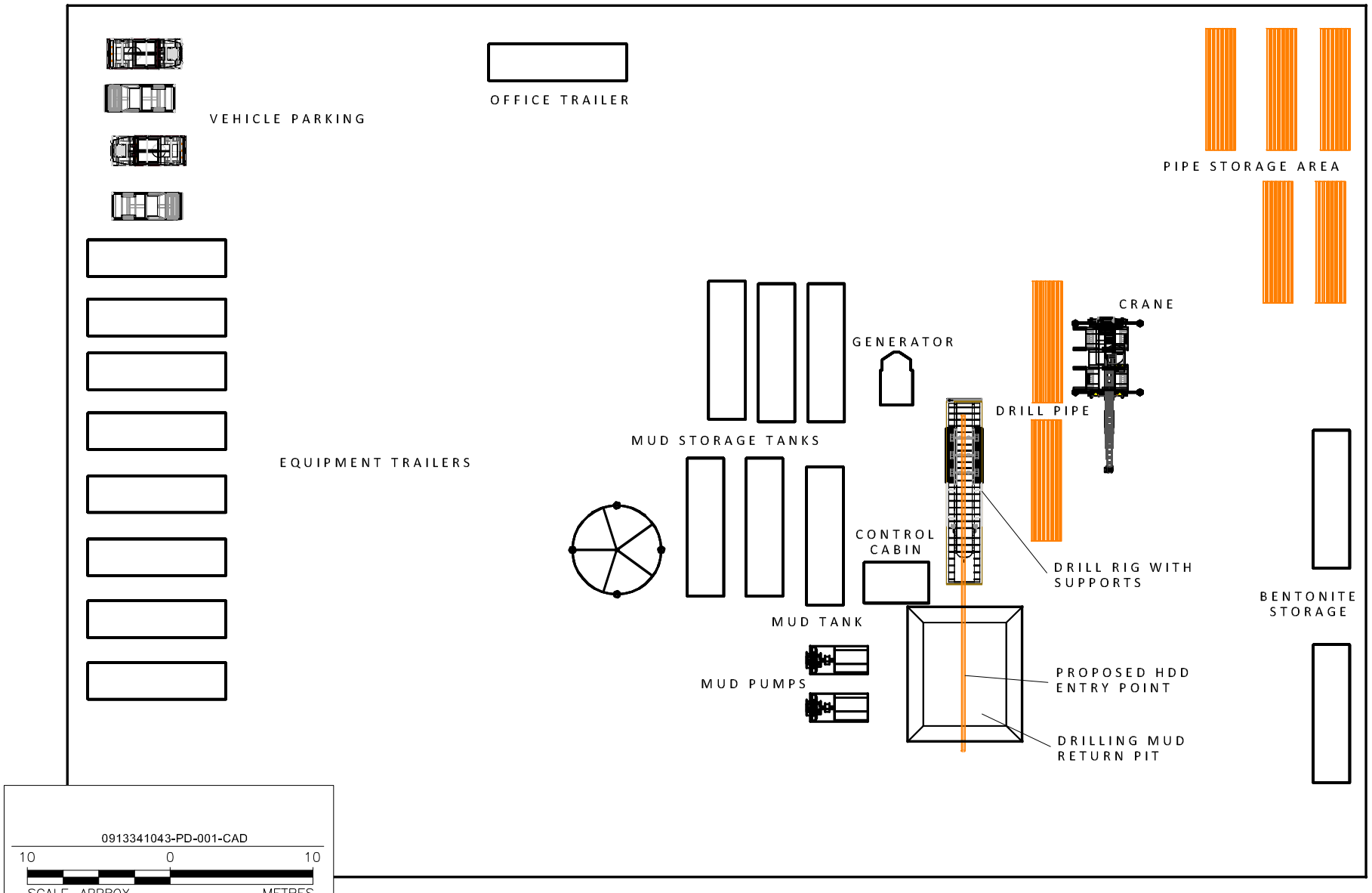


FIGURE 3.4.3-2

Typical Horizontal Directional Drilling (HDD) Site Layout

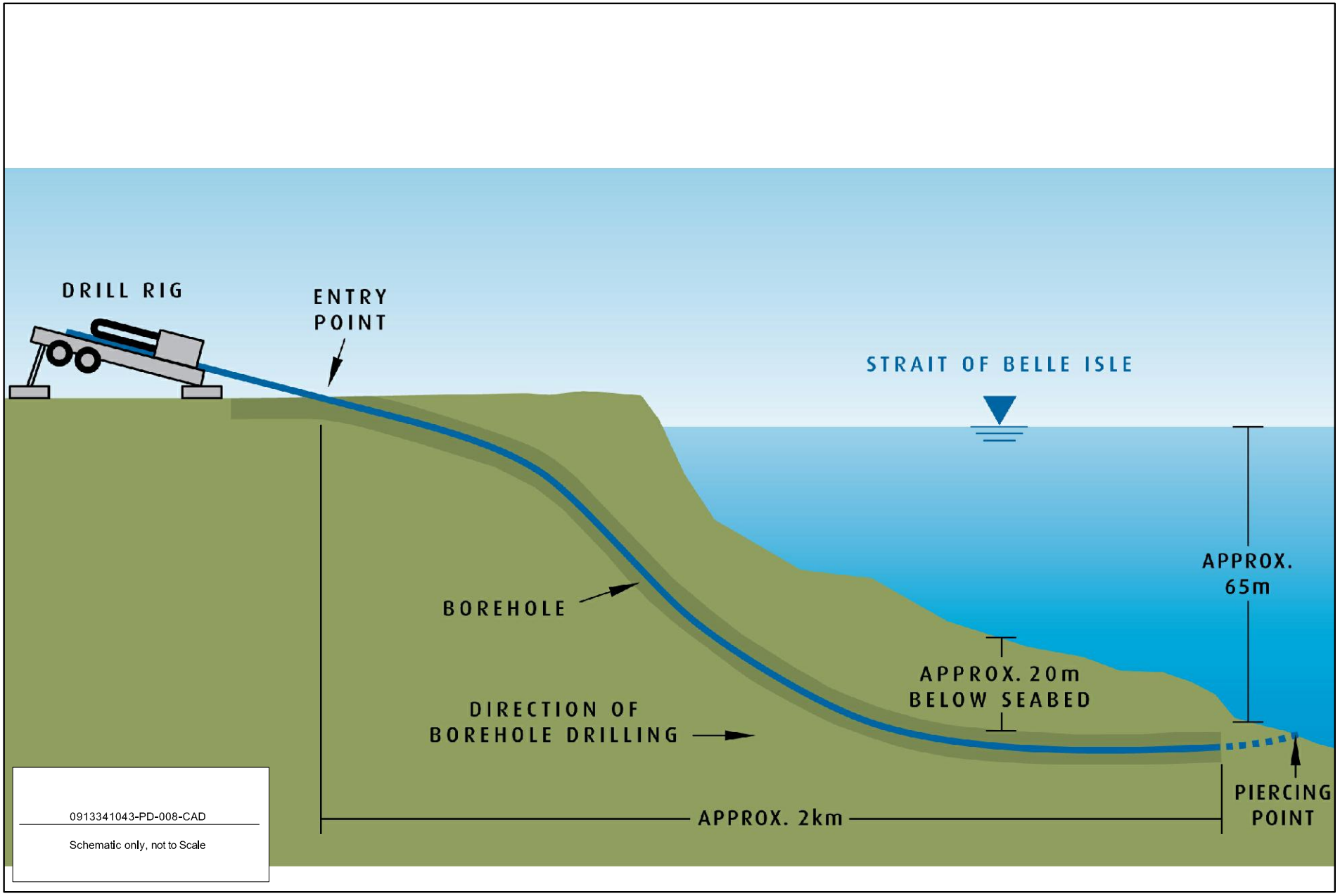


FIGURE 3.4.3-3

Side View of the Horizontal Directional Drill (HDD) Process

The drill rig pumps drilling fluid which is a waterbased mud (i.e., a mixture of bentonite and water, with other additives as needed) down the centre of the drill pipe during pilot hole drilling and reaming operations. The drilling fluid (also known as drilling mud) flows out of the cutting head or reaming tool and flows back to the drill rig. The drilling mud has three primary purposes. First, it carries soil cuttings out of the borehole so that they may be collected at the drill rig for disposal. Second, the pressure that is exerted by the drilling mud is used to support the borehole walls and prevent the borehole from collapsing. Third, the drilling mud may be used to operate a downhole motor immediately behind the cutting head (i.e., a "mud motor" may be required when drilling through bedrock). The mud will be recovered from the borehole, and will be separated from the cuttings. The cuttings will be disposed of in a landfill, quarry or appropriate facility. The drill muds that cannot be re-used will be disposed of in a landfill quarry or appropriate facility. Any unused muds will be returned to the supplier.

The volume of water required for HDD will be finalized during detailed Project design. The recycling of retrieved drilling muds will reduce the water requirements. A local water source will be indentified during detailed Project design, and all applicable permits will be obtained. Water use for HDD will comply with applicable regulations and guidelines.

Submarine Cable Installation

Prior to cable installation, the bathymetry and geology of the submarine cable corridor will be evaluated. Where the bathymetry exceeds the bending radius (i.e., the radius that the cable can bend before it will potentially sustain damage) of the cable or if there is an indication that the bathymetry will cause free spans (i.e., any time that the cable is suspended between two points) of the installed cable, localized seabed levelling may be required. This would only occur if the free spans caused complications. At this stage of Project design, it is considered unlikely that seabed levelling will occur.

The onshore landfall entry site will be equipped with a combination of mattresses, grout bags and sand bags to ensure a smooth transition for the cable. A bellmouth (i.e., a funnel that will be installed at the end of the HDD conduit to limit the bending radius) will be installed at each landfall seafloor exit location to limit the cable minimum bend radius and provide a smooth surface for the cable during pull-in. If there are large pockets of sediment at the borehole exit locations, localized sediment clearing (i.e., clearing of sediment to ensure there are no free spans) may be required. This would only occur if they (i.e., drilling or bellmouth installation) caused complications. At this stage of Project design, it is considered unlikely that sediment clearing will occur.

A CIV will be used to install the submarine cable. The CIV will be between 80 and 140 m long, 20 to 30 m wide, and will have a draft between approximately 4 and 8 m. The cables will be spooled onto the CIV at the manufacturing facility then transported to the Strait of Belle Isle at the required point in the schedule.

The cable installation process will begin with the release of the first end of the cable, capped by a pulling head or prepared with cable grips, near the first landfall seafloor exit on one side of the Strait of Belle Isle. A line will extend from an onshore winch at the mouth of the borehole, through the borehole, to the borehole exit on the seafloor. An ROV will be used to secure the pulling head to the winch line, and the vessel will pay out the cable as the winch hauls it through the borehole. Once the cable is secured onshore, the CIV will lay the cable to a joint location that will be determined during detailed Project design, and the cable will be abandoned. Additional cable length will be provided at the joint location (i.e., approximately three times the water depth) to allow for the jointing operation. This process will then be repeated from the opposite side of the Strait of Belle Isle until the opposite cable is positioned at the joint location.

The procedure used to join the two cable lengths will depend on the sea depth and jointing location. The CIV will position itself over the two cable ends. The CIV will then recover the cable ends, position them in the jointing house, and complete the jointing process. This process will be repeated for the two remaining cables.

Rock Berm Construction

Each of the three submarine cables will be protected by its own rock berm (Figure 3.3.2-9) constructed using a fallpipe vessel. The fallpipe vessel will be approximately 140 to 160 m long, 30 to 40 m wide, and will have a draft of approximately 6.5 m. The fallpipe vessel will be equipped with an ROV on the end of the fallpipe for accurate placement of the rocks over each of the cable(s).

The fallpipe vessel will make multiple passes to build the berm mass. Rock will be loaded onto the fallpipe vessel at a port, the vessel will then travel to the submarine cable corridor, verify the location for rock placement, then place the rock. The rock will be placed in the appropriate location using a fallpipe whose location is controlled both horizontally and vertically by an ROV to achieve the desired distribution of rock on the seafloor. Rock placement will then be checked by ROV survey, and the fallpipe vessel will return to port, re-load, and repeat the rock placement process.

Successive passes will involve the adjustment of rock volume required for achieving the desired berm profile. It is expected that approximately one million tonnes of rock graded from 50 to 200 mm will be used for the berm. Rock berm construction is expected to take the fallpipe vessel approximately 55 trips. Two fallpipe vessels may be used to improve the schedule for the rock berm construction, however, the total number of trips is not expected to change. There are currently operational quarries and port sites in the province. The quarry(s) and port(s) to be used for the rock berm will be determined by the rock supply and installation contractor.

3.4.3.4 Electrodes

The construction and installation of the shoreline electrodes will include site clearing, excavation and building construction. At both Dowden's Point and L'Anse au Diable, a permeable berm will be used to create a saltwater electrode pond. At Dowden's Point the embankment is tied back to the shoreline as required, to create a pond. The natural cove at L'Anse au Diable does not require the embankment to be tied back to the shoreline, but rather will be tied into the outer portions of the cove.

Each permeable berm will be a rubble mound structure consisting of embankment materials obtained from nearby quarries in bedrock. Larger quarry material will be used as armour stone, placed on the sea side slope to protect the permeable berm from storm waves. Larger quarry material will also form the embankment, which needs to be permeable so that saltwater can pass naturally through the embankment, allowing natural flushing.

To construct the permeable berm, trucks will haul appropriately sized material from nearby quarries to the electrode sites. The rock core material will be placed up to the high tide water level, using an excavator or front end loader, from the shore out onto the permeable berm. The armour stone will be placed on the face of the permeable berm, as the core is completed, to protect the core from damage. The permeable berm top core (and armour rock) will then be placed by an excavator as it works back toward the shoreline. A gravel road will cap the crest of the permeable berm, which will facilitate access to the electrodes for Nalcor inspection and maintenance crews.

Construction of the overhead lines connecting the electrodes to the converter stations will be similar to that described for the HVdc transmission line. The erection of single wood poles, however, requires less equipment and smaller excavations than the steel towers proposed for the project. The average pole height for the wood pole electrode line will be between 10 m and 12 m. At each wood pole site, a single hole approximately 2 m deep will be excavated, the pole will be raised and placed into the hole using a crane or backhoe, and the hole will be backfilled with material that came out of the hole to secure the pole in place. If required, guy wires are attached to the pole and connected to buried anchor logs. In bog or wet areas, a crib made of untreated lumber may be placed in the excavation for additional stability. The pole will then be raised and the excavation will be backfilled with borrowed material from a nearby location within the ROW.

3.4.3.5 Island System Upgrades

Upgrades to the Island system will occur within existing infrastructure sites and ROWs. The upgrades include:

- conversion of Holyrood Unit #1 and Unit #2 into synchronous condensers;
- construction of three synchronous condensers at Soldiers Pond;
- replacement of 138 kV and 230 kV breakers at the Holyrood Thermal Generating Station, the Sunnyside Terminal Station and the Bay d'Espoir Hydroelectric Generating Station; and
- rebuilding of eight transmission line sections (i.e., tower and conductor replacement) within 1.6 km of the ac switchyard at Soldiers Pond and removal of the existing lines.

The conversion of Holyrood Unit #1 and Unit #2 from steam powered generators to synchronous condensers will require the modification of electrical and mechanical components within Unit #1 and Unit #2. The modifications will allow Unit #1 and Unit #2 to operate as a generator when connected to a steam turbine or as a synchronous condenser when not connected to a steam turbine. When the Project is in service, the Holyrood plant will be converted to a synchronous condenser to provide system voltage support as well as to provide a backup supply for a short period after the Project comes into service. When operating the generating units as synchronous condensers, the plant is not burning fuel to operate and therefore not releasing emissions into the environment. Following the full commissioning of the infeed, it is intended for the Holyrood plant to remain operable between 2017 and 2020 before all thermal generating aspects of the plant are decommissioned.

The construction of three synchronous condensers at Soldiers Pond is discussed in Section 3.3.3. The construction of these are considered Island system upgrades. However, as a result of the footprint required, and adjacency to the Soldiers Pond converter Station it is discussed in that section.

Breaker replacement at the Holyrood Thermal Generating Station, the Sunnyside Terminal Station and the Bay d'Espoir Hydroelectric Generating Station will include the following activities:

- disconnect all breakers that need replacing;
- remove breakers from their foundations;
- inspect concrete foundations for cracks and deterioration;
- if necessary, replace the foundation with a similar reinforced concrete foundation; and
- install new breakers.

Rebuilding the eight transmission lines within 1.6 km of Soldiers Pond will follow the procedures described in Section 3.4.3 for the construction of the new transmission line. The existing lines will be decommissioned as follows:

- removal of the conductor and insulators from the transmission towers;
- disassembly of the transmission towers using heavy equipment (e.g., cranes);
- decommissioning of in-ground infrastructure as per applicable provincial construction regulations and permits (a list of the permits required for the decommissioning of construction infrastructure is included in Appendix 3-1);
- removal of material (material from the transmission towers, conductor and insulators, will be recycled, where possible, and solid waste disposal will be in compliance with the Project EPP); and
- reclamation and clean-up (i.e., grading disturbed areas, contouring disturbed slopes to a stable profile, removal of refuse, revegetation).

3.4.3.6 Clean-up and Reclamation

Clean-up and reclamation will be conducted as each construction phase is completed. Reclamation and clean-up will include activities such as grading disturbed areas, contouring disturbed slopes to a stable profile and removal of refuse.

At this stage of Project design, the location, capacity and operating conditions of solid waste disposal and recycling sites is not known. All waste disposal / recycling, including hazardous materials, will comply with applicable regulations, and information on solid waste disposal and recycling sites will be provided in the Waste Management Plan.

The disposal of any excavated material will comply with applicable regulations and guidelines.

Reclamation would include site-specific measures to promote natural revegetation of a disturbed area. Disturbed areas will be stabilized, as necessary, to prevent soil erosion.

3.4.4 Construction Equipment

The types and estimated use of vehicles and heavy equipment required for the construction of the overhead transmission line and the converter stations are presented in Table 3.4.4-1.

Table 3.4.4-1 Types and Estimated Use of Heavy Equipment Required for the Construction of the Overhead Transmission Line and Converter Stations

Type of Heavy Equipment	Overhead Transmission Line (hours)	Muskrat Falls and Soldiers Pond Converter Stations (hours)
Excavators	42,000	
Bulldozers	170,000	1,300
Concrete Mixer	5,300	
Graders	40,000	4,400
Muskegs	47,000	
Tracked carrier (e.g., Nodwell)	110,000	
Tracked crane	12,000	78,000
All-terrain crane	31,000	
Truck crane	100,000	
Track drill	36,000	
Dump truck	7,100	150
Tensioner	3,000	
Backhoe		3,900
Boom truck		206,000
Loader	900	490
Generator set		67,000
Hydraulic crane		10,000
Tracked loader	25,000	70
Pick-up trucks	300,000	340,000

3.4.5 Material Requirements and Delivery

The exact material quantities required will be confirmed during detail design. The estimated amount of major civil materials required for the construction of the Project include:

- 2,200,000 m of conductor (2,700 reels);
- 450,000 insulators (approximately 6,250 pallets);
- 3,150 steel towers and 12,000 steel lattice foundations (approximately 76,000 metric tonnes of steel);
- 1,100,000 m each of OPGW and counterpoise (2,750 reels);
- 800,000 m of guy wire (1,000 reels);
- 830,000 m of electrode conductor (1,000 reels);
- 120,000 m or submarine cable;
- 1,000,000 tonnes of rock;
- hardware (nuts and bolts); and
- electrical equipment.

The suppliers of this material will be determined during the procurement phase of the Project, and it is anticipated that material not available locally will be imported from out-of-province suppliers. In addition to these materials, equipment and supplies required to construct the Project include heavy equipment (Table 3.4.4-1), approximately 60,000,000 litres (L) of diesel fuel, and a limited amount of propane (i.e., for camp use). Fuel drums will be cached along the ROW for helicopter use. It is expected that approximately 750 L of Jet-A or Jet-B may be stored in each cache location.

The material distribution plan consists of importing large quantities of material and temporarily storing it at marshalling yards. From each of the marshalling yards, material will be distributed to worksites along the corridor, as described in Section 3.4.2.

Equipment maintenance will be conducted in accordance with manufacturer's requirements and will be completed on-site. All maintenance and repair activities will be undertaken in compliance with environmental rules and regulations and as per the Project Environmental Protection Plan (EPP). Any field servicing will be conducted a minimum of 50 m from any watercourse or wetland, unless otherwise approved or in the event of an emergency. Waste oil will be collected and stored in drums (clearly marked as waste oil) inside a dyked area and will be regularly shipped for disposal. Waste oils, lubricants and other used oil will be disposed of at approved disposal sites.

During construction, fuel will be transported by tanker trucks, in drums or other approved containers. Fuelling stations will be established along the ROW, with self-dyked steel storage tanks. The largest fuel storage tank on-site will hold no more than 125,000 L. When the locations of and requirements for fuel storage are, all mobile storage tanks will be registered under, and in compliance with, the *Storage and Handling of Gasoline and Associated Products Regulations* under the *Newfoundland and Labrador Environmental Protection Act* (*NLEPA*). Records will be maintained of all storage tank contents to reconcile inventories as a check against any undetected leakage. All transport vehicles will be licensed and maintained according to safety requirements.

Fuelling stations at marshalling yards and camps will include concrete pads and drainage controls. Drainage will be retained in a sump where hydrocarbons can be captured and separated prior to release of any rainwater run-off, as appropriate. Equipment with reduced mobility, such as heavy lift cranes and excavators, will have fuel delivered by a mobile tank and re-fuelling will take place on-site. All fuel transfers will follow safety procedures to prevent leaks and drips, and spill response kits will be available on all vehicles used to transport fuel. Fuelling of mobile equipment will not be permitted within 50 m of a waterbody. Handling and

fuelling procedures will comply with the *Storage and Handling of Gasoline and Associated Products Regulations* and any additional requirements set forth by the NLDEC.

3.4.6 Decommissioning of Construction Infrastructure

Construction infrastructure that is not required for Project Operations and Maintenance will be decommissioned upon completion of construction. This will include the decommissioning of temporary camps, some access roads and bridges, borrow pits, marshalling yards and temporary lay down areas, and clean-up and reclamation of construction infrastructure sites.

3.4.6.1 Temporary Camps

All temporary camps constructed along the ROW will be decommissioned upon completion of Project construction. All buildings will be removed and water and sewer systems decommissioned in accordance with regulatory requirements. All in-ground infrastructure will be decommissioned as per applicable provincial construction regulations and permits. A list of the permits required for the decommissioning of construction infrastructure is included in Appendix 3-1. Temporary camps will be graded, as appropriate, to re-establish natural drainage patterns, and topsoil will be replaced. Clean-up and reclamation will be undertaken as described below.

3.4.6.2 Access Roads and Bridges

Upon completion of Project construction, a limited number of access roads and trails will remain in place to provide an appropriate level of access for transmission line maintenance activities. All others will be decommissioned and rehabilitated using applicable and appropriate methods and standards. The extent of road and trail rehabilitation will vary and will range from disturbing the road surface using an excavator and restricting access to complete rehabilitation. Complete rehabilitation will include removing the road way, re-grading the area and backfilling ditches. Sediment and erosion control measures will be installed prior to decommissioning watercourse crossings. Decommissioning will include the removal of any watercourse crossing material and processed aggregate from the access road surface. Upon removal of the watercourse crossing materials, the watercourse banks will be returned to a stable condition. Access roads will be graded, as appropriate, to re-establish natural drainage patterns, and topsoil will be replaced. Clean-up and reclamation will be undertaken as described below.

3.4.6.3 Borrow Pits

Borrow pits excavated along the ROW will be rehabilitated as work is completed in that area. Rehabilitation will include the replacement of unused excavated material, grading to a stable slope, grading to re-establish natural drainage patterns, replacement of topsoil, and installation of erosion control structures, as appropriate. Clean-up and reclamation will be undertaken as described below.

3.4.6.4 Marshalling Yards and Temporary Lay Down Areas

All surface infrastructure will be removed from the marshalling yards and lay down areas. All in-ground infrastructure will be decommissioned as per applicable provincial construction regulations and permits. A list of the permits required for the decommissioning of construction infrastructure is included in Appendix 3-1.

3.4.6.5 Clean-up and Reclamation

Clean-up and reclamation will be conducted after the construction infrastructure has been decommissioned. Reclamation and clean-up will include activities such as removing refuse, grading disturbed areas and contouring disturbed slopes to a stable profile. Reclamation will include site-specific measures to promote the natural revegetation of disturbed areas. Disturbed areas will be stabilized, as necessary, to prevent soil erosion.

3.5 Operations and Maintenance

Upon commissioning, the Project will operate on a continuous basis. During operation there is limited potential for emissions, including audible noise, electric fields and electromagnetic fields (EMF). Maintenance activities will include regular inspection of the Project, any necessary repairs and vegetation management along the ROW. Activities associated with the Operations and Maintenance of the Project will be integrated into Nalcor's existing transmission system inspection and maintenance program.

Appendix 3-1 provides a list of permits required for the Project. All Operations and Maintenance activities will be conducted in accordance with permits and regulations.

3.5.1 Operations

Operations of the Project involves the transmission of electricity through the conductors between the Muskrat Falls and Soldiers Pond converter stations, respectively, the conversion of ac to dc and dc to ac at the converters stations, and the operation of shoreline electrodes. The electrical equipment and facility systems will be remotely monitored and controlled using a SCADA / Operational Data System, monitored from the Energy Control Centre at Hydro Place in St. John's.

During normal Project operations, small amounts of electrical current will flow through the electrode (i.e., less than 1% of the total current). This occurs to offset imbalances in the transmission system. Under some circumstances (e.g., during converter maintenance) the system can temporarily operate at a reduced capacity, and electrode operation is not required. The electrodes may be used during a normal fault (e.g., one pole is out of service for maintenance). This is expected to occur for less than 40 hours per year. The use of the electrodes to provide a return path for the full current is expected to occur only under specific circumstances, such as a submarine cable or overhead conductor failure. Project design criteria (e.g., final ROW selection, cable protection planning, the use of a spare cable across the Strait of Belle Isle, and conservative design of the transmission towers and conductors) minimize the potential for and duration of these events.

3.5.2 Maintenance

3.5.2.1 Inspection

Each year the line will be 100% inspected through ground and / or aerial patrol. Ground-based inspections will be conducted on all-terrain vehicles (ATVs) during summer and snowmobiles in the winter, and aerial inspection will be conducted by helicopter. A further 10% to 20% of the transmission line will be inspected via climbing inspections on a yearly basis by Nalcor personnel. Inspection crews look for signs of physical damage (e.g., broken or missing insulators), loose or eroded parts (e.g., bolts) and condition of the conductors (e.g., frayed or areas of reduced clearance). Minor adjustments such as bolt tightening may be done during the inspections. The wood pole electrode lines will also be inspected annually using the same methods as the transmission line inspections.

Inspection of the submarine cables and rock berms, and the electrodes and permeable berms will consist of an annual visual inspection campaign using an ROV for two years post-installation. These inspections will focus on rock berm condition (i.e., deterioration and general anomalies). Following the two years of inspection, the results of the inspection campaign will be assessed to determine the frequency of future inspections.

Switches located in the wood pole electrode line termination structure can be used to turn off a series of electrode elements. The electrode elements will then be accessed and inspected from the road along the crest of the permeable berm.

3.5.2.2 Maintenance and Repairs

Nalcor follows the principles of asset management. Asset management is defined as the comprehensive management of asset requirements (i.e., planning, procurement, operations, maintenance, rehabilitation,

disposal and replacement) to achieve maximum value based on the required standard of service to current and future generations. Asset Management ensures that there is a comprehensive listing of all assets and that there is single point accountability for the Operations and Maintenance of each asset. There is a clear focus on short- and long-term maintenance planning and execution. Inspection and replacement includes the collection of performance data for reporting and analysis. This analysis ensures that Nalcor applies the most effective level of maintenance and takes the appropriate level of preventative and corrective action when required.

Typical transmission line maintenance activities include minor adjustments and replacements (e.g., replacement of insulators). However, more extensive repairs may be required that could involve the replacement of anchors or guy wires, necessitating the use of heavy equipment such as backhoes or cranes.

The submarine cable has a 50-year design life and is not expected to require repairs during its design life. The rock berms are also designed to be stable and not require repairs. If a fault does occur in a submarine cable, however, repair of the cable would include the following steps:

- locate the fault;
- remove a portion of the rock berm to expose the faulty cable;
- load spare cable and joining kit onto intervention vessel;
- undertake repair using a spare cable and joining kit; and
- apply protection (rock berm) to the repaired section of cable.

The electrode elements can be continuously operated for 3.5 years before they may need to be replaced. Switches located in the electrode line termination structure can be used to turn off a series of electrode elements during maintenance activities. The road constructed along the crest of the permeable berm will allow safe access to the electrodes.

3.5.2.3 Vegetation Management

Vegetation management encourages the growth of plants compatible with utility operations, encouraging natural biological control of vegetation and providing a safe environment. Nalcor will incorporate the Project into its integrated vegetation management program for its transmission and distribution systems. A survey will be undertaken before each vegetation management program is initiated to determine priority vegetation management areas.

Vegetation that exceeds 2 m in height at maturity (e.g., spruce, alders, birch) will be removed because it can encroach on the transmission line clearance and can affect maintenance crew access. Vegetation will be controlled through a combination of herbicide application and manual cutting. The selective use of herbicides after cutting produces a low, dense plant cover that discourages the invasion of nuisance vegetation (i.e., vegetation that exceeds 2 m in height at maturity) while encouraging the growth of compatible vegetation (i.e., vegetation less than 2 m in height at maturity). Approximately 6,600 ha of area will be managed for vegetation, as required, within the ROW. Vegetation maintenance will likely begin during year eight of operations and will be repeated every seven years thereafter, or as required for safety.

Vegetation management program will also be applied to the converter station, and associated ac switchyard, and synchronous condenser yard.

Currently there are two chemical application techniques used on transmission lines by Newfoundland and Labrador Hydro, a subsidiary of Nalcor Energy and an approved operator for the application of herbicides by the Department of Environment and Conservation. The first and most common technique is a directed foliar application. This technique consists of a sprayer system mounted on a tracked machine such as a muskeg (each application vehicle is licensed under the *Environmental Protection Act*, SNL2002-E-14.2 and Pesticide Control Regulations, 2003). The sprayer system is a single nozzle at the end of a long wand controlled with a trigger by

the applicator on the back of the machine. As the name suggests the operator directs the chemical mix to the target vegetation (e.g., spruce, fir, birch, poplar, alder, and maple) as the machine moves along the line. Each operator is also licensed and trained to apply herbicide. Treatment of compatible species also found on the right-of-way is avoided or minimized. Compatible species are low growing and do not grow to a sufficient height to reach energized lines or cause significant impediment or safety concerns to maintenance crews traveling in the right-of-way. Compatible species include berries, Labrador Tea, Kalmia species, Trailing Juniper, Dwarf Birch, and grass. This selective application of herbicide maintains the compatible species within the right-of-way giving them increased growing space with the removal of the target species. Once compatible species have established it makes it more difficult for the target species to re-establish and the length of time between treatments is increased.

The second application technique is a cut and stump treatment. This treatment consists of cutting the target species and applying herbicide to the stump using a back pack sprayer or a sprayer mounted on the brushsaw. This kills the root system and prevents re-sprouting. This system is very expensive and labour intensive. It is typically used in sensitive areas. This vegetation control method will use Tordon 101, Garlon 4, and Glyphosate products.

Buffer zones are applied to all water bodies, private land, wells, and human habitation (temporary or permanent). Buffers on water bodies for foliar treatments are 30 m to 50 m depending on the slope (slopes over 20° get the 50 m buffer). It is possible to cut and stump treat up to 2 m from the water body using glyphosate based products but it is not typically done on a transmission line. Buffer zones for wells, private land, and human habitation are 50 m.

The use of herbicides along the proposed transmission line corridor and other areas requiring vegetation management (e.g., converter yards, ac switchyard) for the Project will be in accordance with the procedures described above and will be applied as appropriate. Approval and appropriate licensing will be obtained from the Department of Environment and Conservation.

Certified crews will use the herbicide Tordon 101 mixed with Sylgard 309, a surfactant that allows easier spreading. The quantities of chemicals used will depend on terrain, and quantity and type of vegetation. The herbicide will be sprayed directly by a person on the vehicle to ensure that only appropriate plants (i.e., tall-growing species) are treated. To the extent practical, short shrubs and bushes will not be sprayed with the herbicide.

All vegetation management activities will be subject to approval from the NLDEC and will be in compliance with the *Pesticides Control Regulations* under the *NLEPA*. Standard practice includes public notification and an evaluation of any environmental sensitivities in areas of herbicide use. Vegetation control personnel will be appropriately trained and qualified, and vegetation management activities will be designed and conducted in accordance with applicable industry and regulatory standards. A list of the permits required for Project Operations and Maintenance is included in Appendix 3-1.

3.5.3 Potential Emissions

HVdc systems and electrodes are commonly used worldwide for the bulk transmission of electrical power over long distances. During the operation of HVdc systems, there are limited emissions and discharges, including audible noise, EMF, electric fields and chemical emissions. This section describes the potential emissions from both the on-land transmission infrastructure and the submarine cable and electrodes during operations. Other emissions (e.g., vehicle exhaust, fugitive dust) are addressed in the appropriate VEC chapters as part of the environmental effects assessment of the Project.

3.5.3.1 Overhead Transmission Line and Converter Stations

Technical analyses have been conducted to estimate the potential audible noise levels, EMF strength and radio interference that may be associated with the on-land Project. These estimates were used for Project planning

and design (e.g., conductor design, and voltage and current specifications) to ensure that noise emissions and EMF remain within acceptable standards, as discussed in the following sub-sections.

Audible Noise Due to Overhead Transmission Lines

Audible noise is emitted by a transmission line when a small amount of electrical energy within the conductor interacts with the air surrounding the conductor surface. These ionization reactions, known as corona, depend on ambient conditions such as temperature, humidity, wind speed, and wind direction. The noise emitted typically resembles a crackling or sizzling sound.

Noise level limits for transmission lines are specified at the edge of the ROW and are measured using A-weighted dB (dBA).

There are currently no Canadian noise control regulations applicable to HVdc transmission lines. The United States Environmental Protection Agency's (US EPA 1974) "levels document" proposes a day-night average (Ldn, 50%) noise limit of 55 dBA based on which several regulating bodies have developed regulations for transmission line applications. Since the HVdc lines produce higher noise under fair weather conditions, contrary to ac lines, it is considered prudent to limit Ldn (10%) value to 55 dBA and the corresponding Ldn (50%) value to 50 dBA. Thus the calculated average audible noise, by the application of industry wide accepted empirical methods, should be limited to 42 dBA. This value has been used by Nalcor in its selection of the HVdc voltage level and conductor size.

Audible Noise due to Converter Stations

The converter stations will be designed to limit the audible noise produced at any point immediately outside the fence to 65 dB(A) and at the nearest residential area to 45 dB(A).

Radio Interference Levels Due to Overhead Transmission Lines

Radio Interference (RI) can be caused by corona discharges on pole conductors. The proposed HVdc overhead transmission line will be designed to comply with the Canadian Standards Associated standard CAN-C108.3.1-M84 dated 2009, the same standard that is applied to HVac transmission lines.

The standard limits the fair weather RI level to 63 dB above 1µV/m (as per Table 1 for 600 to 800 kV AC lines) at a distance of 15 m from the outermost conductor. This value is to be calculated at the mid-span and measured at 0.5 MHz. The calculated fair weather RI value, as per the industry wide accepted empirical methods, at ±350 kV is found to be 55 dB, well below the specified limit of 63 dB. The RI value at the edge of the ROW would be approximately 2 dB lower than 55 dB.

Radio Interference Levels due to Converter Stations

The RI Level of electromagnetic radiation generated by the converter station will be limited to 100 µV/m at locations along the perimeter 500 m from any energized component in the converter station.

Electric and Electromagnetic Fields

The dc electric field is the combination of the "electrostatic field" and the enhanced field due to "space charge".

The electrostatic field is the corona-free field that surrounds an energized conductor which results from charges on or near the conductor surface.

On the other hand, "space charge field" is related to the ions produced by corona discharges. In the case of ac lines, these ions remain confined to an area surrounding the conductor due to the fact that the ions are attracted within a half cycle and repelled within the next half cycle. However in HVdc lines, while a small portion of the corona generated ions reach the other polarity conductor and disappear after recombining,

most of the generated ions make their way to ground and form a stream of ions that transfer electric charges to human bodies or objects underneath the line.

There are currently no Canadian regulations limiting EMF emissions, nor are there any guidelines for EMF exposure (Canadian Electricity Association 2010, internet site). The practice is to set a limit of the maximum allowable electric field and the current density at ground level under the line. Based on the operating experience of HVdc lines around the world and the CIGRE Technical Brochure 388, "*Impacts of HVDC Lines on the Economics of HVDC Projects*" the fair weather enhanced field values will be limited to the following values:

Variable	Units	Maximum within the ROW
Current density	nA/m^2	100
DC Electric field	kV/m	25

Summary of Project Emission Criteria for On-Land Infrastructure

Table 3.5.3-1 summarizes the expected Project emissions of audible noise, radio interference and EMF.

Table 3.5.3-1 Audible Noise, Radio Interference and Electromagnetic Field Emission Criteria

Audible Noise (dBA)	Radio Interference (dB)		Maximum EMF (kV/m)	Ion Current Density (nA/m^2)
	Wet Conditions	Dry Conditions		
50 (EPRI 2008)	77 (Industry Canada 2001, internet site)	77 (Industry Canada 2001, internet site)	25 (EPRI 2008)	100 (EPRI 2008)

Note: Design criteria and reference are indicated in brackets.
Audible Noise is measured at the edge of the ROW.
Radio interference is measured 15 m away from the positive pole.

3.5.3.2 Submarine Cable and Electrodes

Emission calculations presented in this section for the electrode are based on Hatch Ltd. (2011). Two scenarios, 320 kV and 400 kV, were modelled. The values presented are those for the 320 kV system as these systems were 'worst-case' emission values, and the Project (350 kV) will have lower estimated values.

Electric Fields

The submarine cable will have two sheath armour layers, as described in Section 3.3.3. When two conductive surfaces have an electric potential difference between them, any electric field will be confined within this space. In the submarine cables, the electric field exists between the conductor and the metallic sheath or armour wires, depending on design. There will be no electric field outside the submarine cable.

Electromagnetic Fields

The electromagnetic field for a single submarine cable transmitting current at 1,286 A will be approximately 26 micro Tesla (µT), at a distance of 10 m from the cable. By comparison, day to day battery operated appliances function at 300 to 1,000 µT and, depending on the location on the surface of the earth, the natural field from the Earth's core is between 0 and 50 µT.

Heat Effects

Depending upon detailed design, the heat dissipated by the submarine cable will be approximately 23 Watts per metre (W/m). This is equivalent to one small household light bulb installed every metre along the submarine cable, on the seabed and under the rock berm. In projects where cables are buried just under the surface, the seabed immediately under the cable could experience a 2 to 3 degrees Celsius increase in temperature. For this Project, however, the cables will not be trenched or shallowly buried in the seabed. The cables will be laid on the seafloor and buried under a berm. The cable's influence on the temperature of the water column will be minimal. Where the cables travel beneath the seabed through the conduit, the cables will be tens of metres below the seabed, therefore, heating effects on the seabed are not expected.

The dissipation of energy in the form of heat will be produced by the shoreline electrodes. The energy produced at the electrode is directly proportional to the current flowing into or out of the electrode and to the resistivity of the medium surrounding the electrode. Heat dissipation densities through the permeable electrode berm, the sea, and the pond were calculated for three electrode operating modes for monopolar operations (nominal, maximum continuous and maximum 10 minutes) and during bipolar operations (1% of the current during normal operations accounting for system imbalances).

Also the worst case heat dissipation through the seawater density was calculated at the seaside interface of the berm. The minimum area of berm required to achieve a safe voltage gradient is the only section considered in the analysis; in reality the berm surface area will be larger than the area considered on the sea side and the heat dissipation density will be proportionally lower. Also as a conservative approach, 100% of the current in each case is assumed to flow through the minimum berm section in question and the water in the pond and sea side. In reality, some current will flow through the adjacent sections of the berm and some will flow inland.

Table 3.5.3-2 presents the volumetric heat dissipation through the shoreline electrode berm for both L'Anse au Diable and Dowden's Point.

Table 3.5.3-2 Volumetric Heat Dissipation through Shoreline Electrode Berm

Location	Volumetric Heat Dissipation (Watts per cubic metre (W/m^3))			
	Nominal	Maximum Continuous	Maximum, 10-Minute	1% Imbalance
L'Anse au Diable Electrode	<13.7	<30.8	<54.8	0.001
Dowden's Point Electrode	<14.4	<32.5	<57.7	0.001

Source: Hatch Ltd. (2011).

Table 3.5.3-3 presents the summary of the temperature rise in the shoreline electrode ponds for L'Anse au Diable and Dowden's Point for the monopolar maximum continuous current scenario. The temperature rises are less than 0.5°C, except for the recessed pond option at Dowden's Point which has a smaller pond volume. The actual temperature rise in the ponds will be lower than the temperature presented because as a conservative and precautionary assumption the conductive heat loss to the sea and evaporation are not considered in the analysis. The electrode berm temperature rise will be less than the temperature rise of the pond.

Table 3.5.3-3 Estimated Maximum Temperature Rise in Electrode Pond, Monopolar Maximum Continuous Current

Location	Estimated Maximum Temperature Rise in Pond (°C)
L'Anse au Diable Electrode	<0.47
Dowden's Point Electrode (Design Option 1)	<0.33
Dowden's Point Electrode (Design Option 2)	<3.51

Electric Field

The electric field produced is the result of ground potential rise (GPR) which occurs when an electrical current of large magnitude enters into the ground and the earth becomes charged with electricity. Depending on the electrical resistivity of the ground, the current can travel through the earth, resulting in voltages that decrease with distance from the point where the current entered the ground. For a shoreline pond electrode, GPR is a function of the shoreline electrode berm design, its exposure to the open sea, and seawater resistivity. GPR simulations were performed for both the L'Anse au Diable and the Dowden's Point electrodes using Teshmont's GRELEC program (Hatch Ltd. 2011). The modelling results indicate that the GPR gradients in the sea, on the shoreline and on the berm will be lower than the safe step potential, as shown in Table 3.5.3-4.

Table 3.5.3-4 Modelled Ground Potential Rise Gradient at the Shoreline Electrodes

Description	Calculated Ground Potential Rise Gradient (Volt/metre)	Safe Limit (Volt/metre)	Remarks
At the electrode elements	16.73	N/A	Access to the electrode elements is controlled
On the electrode berm	9.62	95	–
In the water on the sea side of the electrode berm	<1.25	1.25	–

Source: Hatch Ltd. (2011).
Note: N/A = Not applicable.

Electromagnetic Field

The magnetic field from the electrode cables and element will be greatest near the shoreline electrode berm and the contribution of these current dipoles will diminish as distance from the electrode increases. The current through the body of sea water induces a magnetic field at the surface and is normally weak due to the low current density in the body of water.

The calculation of the magnetic field is based on current values deduced from the GPR modelling. The current flow between soil volumes is considered as a dipole to calculate the magnetic field contribution. The magnetic field is calculated at the surface of the water only for anodic operation. In cathodic operation, the dc magnetic field will be equal in magnitude but in the opposite direction as the field produced in anodic operation. The magnitude of the resultant field (earth magnetic intensity plus electrode magnetic intensity) will be different and will be oriented in a different direction. However, the compass deviations will be of the same order as the values reported in the tables below.

The induced magnetic effects are focussed on two aspects: compass deviations (i.e., magnetic field at 1 m above sea level) and marine life (i.e., magnetic field at 0 m above sea level).

For the L'Anse au Diable and Dowden's Point electrode, the zone extending into the sea in which the magnetic compass deviation exceeds 0.5° as a result of maximum continuous electrode operation is limited to 500 m from the electrode. During normal bipolar operation, the compass deviation is estimated to be less than 0.1° at a distance of 100 m from the electrode.

The estimated difference between the resultant absolute value of magnetic field at the surface of the sea and that of the earth's natural magnetic field (53.6 µT near L'Anse au Diable North; 51.4 µT near Dowden's Point) is less than 0.8 µT and 2.2 µT for L'Anse au Diable and Dowden's Point electrode, respectively at a distance of 500 m from the electrode for the continuous maximum current. During normal bipolar operation, the estimated difference is less than 0.2 µT and 0.3 µT at a distance of 50 m from the electrode, for L'Anse au Diable and Dowden's Point electrode respectively.

Chemical Emissions

Emissions as a result of electrolysis are produced during electrode operations, for both monopolar (maximum continuous current) and bipolar operations (system imbalances). These emissions include chlorine and other by-products at the anode, and hydrogen at the cathode.

For L'Anse au Diable electrode, when operating at maximum continuous duty as an anode, the estimated chlorine produced per day is 6.89×10^{-4} g/L, assuming the worst case chlorine selectivity of 30%. For operation as a cathode, the estimated hydrogen produced per day is 2.62×10^{-4} g/L, assuming 100% hydrogen selectivity. It is important to note these values do not consider gas exchange with the air or through the breakwater, which is a conservative, precautionary approach.

For L'Anse au Diable electrode, operating as an anode during normal bipolar operation and assuming a current imbalance of 1% of the nominal electrode duty, the estimated chlorine produced per day is 4.59×10^{-6} g/L, assuming the worst case chlorine selectivity of 30%. For operation as a cathode during normal bipolar operation, the estimated hydrogen produced per day is 1.74×10^{-6} g/L, assuming 100% hydrogen selectivity. These values do not consider gas exchange with the air or through the breakwater.

Tidal flushing continuously reduces the emission concentrations in the electrode pond to an expected maximum chlorine concentration from a day of electrode operation as anode to 3.15×10^{-4} g/L. During the bipolar operation, the expected chlorine concentration is 2.10×10^{-6} g/L. The values do not consider gas exchange with the air or exchange with the sea water due to concentration differential, which is a conservative and precautionary approach.

For Dowden's Point electrode, the estimated chemical emissions are presented for Option 2, as Option 1 modelling results are slightly less than the values estimated for Option 2. When operating at maximum continuous duty as an anode, the estimated chlorine produced per day is 7.44×10^{-3} g/L, assuming the worst case chlorine selectivity of 30%. For operation as a cathode, the estimated hydrogen produced per day is 2.83×10^{-3} g/L, assuming 100% hydrogen selectivity. It is important to note these values do not consider gas exchange with the air or through the breakwater, which is a conservative and precautionary approach.

For Dowden's Point electrode, operating as an anode during normal bipolar operation and assuming a current imbalance of 1% of the nominal electrode duty, the estimated chlorine produced per day is 4.96×10^{-5} g/L, assuming the worst case chlorine selectivity of 30%. For operation as a cathode during normal bipolar operation, the estimated hydrogen produced per day is 1.88×10^{-5} g/L, assuming 100% hydrogen selectivity. These values do not consider gas exchange with the air or through the breakwater, which is a conservative and precautionary approach.

Tidal flushing continuously reduces the emission concentrations in the electrode pond to an expected maximum chlorine concentration from a day of electrode operation as anode to 2.70×10^{-3} g/L. During the bipolar operation, the expected chlorine concentration is 1.80×10^{-5} g/L. The values do not consider gas exchange with the air or exchange with the sea water due to concentration differential, which is a conservative and precautionary approach.

The chlorine gas emitted at the anode will be dissolved in the water and form secondary and tertiary products, a small quantity of which could escape to the environment depending on the conditions. Any gas escaping to the air would be dispersed efficiently by the wind. Chlorine concentrations are predicted to be safe (i.e., below 0.4 ppm) (Canadian Centre for Occupational Health and Safety 2011, internet site), in the air outside of the pond limits.

3.5.4 Decommissioning

The Project will be operated for an indeterminate time period and decommissioning is not anticipated. Should decommissioning activities eventually be considered for some or all Project components, decommissioning will be planned and conducted in accordance with relevant standards and regulatory requirements of the day. This

would include the development of a decommissioning plan that considers environmental planning and mitigation measures, socioeconomic mitigation measures, and public health and safety procedures. The decommissioning plan will be submitted to the relevant regulatory authorities for approval.

3.6 Environmental Protection Planning

A construction EPP and an Operations and Maintenance EPP will be prepared for use by all Project personnel, including employees of Nalcor and its contractors. The EPPs will incorporate applicable regulatory requirements and all Construction, Operations and Maintenance related environmental commitments made as part of this EIS. A proposed table of contents for the EPPs is presented in Appendix 3-3. Project construction, Operations and Maintenance will be managed to the standards established by the International Organization for Standardization (ISO) 14001 Environmental Management System (EMS). Existing Nalcor facilities, including Churchill Falls, have been individually registered by an external auditor (Quality Management Institute, QMI) as compliant with the ISO 14001 standard. This Project will be constructed, operated and maintained in accordance with a Project-specific EMS.

3.6.1 Environmental Protection Plan

As a corporation with significant experience in building, operating and maintaining transmission infrastructure in the province, Nalcor has established state-of-the-art procedures related to environmental protection and management. Nalcor's Environmental Policy and Guiding Principles (Appendix 3-4) will be implemented during the Construction, Operations and Maintenance of the Project.

An EPP is an important tool for consolidating environmental information and commitments into procedures and responsibilities for the implementation of environmental protection measures in the field. The main objectives of the EPP are to:

- consolidate information for planning;
- ensure compliance with current environmental standards and regulations;
- ensure Project commitments to environmental protection and planning are met; and
- provide guidelines for field activities and decision-making on environmental issues.

Geographic Information System (GIS)-based mapping has been developed for the Nalcor transmission system to provide environmental information to planning personnel. These maps provide information on:

- ecological reserves, parks and protected areas;
- listed species and their habitat;
- wetlands and other sensitive habitat;
- protected water supply areas;
- existing access trails;
- stream crossing and approved fording sites; and
- terms and conditions of environmental permits and authorizations.

These maps provide Nalcor's personnel with the information relative to environmental considerations that have and will be considered for the Project Construction, Operations and Maintenance.

An EPP has been developed and implemented for the Project's pre-construction environmental and engineering field studies. This EPP addresses issues related to storage and handling of fuel, waste disposal, vessel operation, hunting and fishing, encounters with wildlife, the discovery of historic resources and

rehabilitation measures. This EPP will be used as a starting point, but it will be expanded for construction activities.

The Project-specific Construction, and Operations and Maintenance EPPs will be field-useable documents, addressing provisions for the identification of, and avoidance or reduction of environmental effects. The EPPs will include activity-specific protection measures, contingency measures and reporting protocols for unplanned events (e.g., spills), and reclamation procedures.

The table of contents for the Project's EPP will include:

- Introduction;
- Project Description and Construction Schedule;
- Roles and Responsibilities;
- Relevant Legislation;
- General Environmental Protection Procedures;
- Environmental Monitoring and Follow-up;
- Contingency Plans;
- Contact List;
- Forms; and
- Reference Documents.

3.6.2 Safety, Health and Environmental Emergency Response Plan

Nalcor will proactively identify potential safety, health and environmental concerns related to Project Construction, Operations and Maintenance. Prevention measures and response procedures will be described in the Safety, Health and Environmental Emergency Response Plan (SHERP), and all Project personnel will receive SHERP training.

The SHERP will be a field-useable document that addresses the prevention measures and emergency response procedures for unplanned safety, health and environmental events. The objectives of the SHERP include:

- the protection and maintenance of human health and safety;
- the identification of the potential for accidents and emergency situations;
- the planned response to accidents and emergency situations; and
- the prevention and mitigation of potential environmental effects associated with accidents and emergency situations.

The SHERP will include specific instructions for the prevention of and response to spills or leaks of hydrocarbons or other hazardous material. Spill response kits will be maintained at all activity sites, and the contents will be based on the volume of fluids in use, the type of fluid, proximity to water and other relevant factors at the particular site. All personnel involved in hydrocarbon transport and transfer will be trained in spill response, and spill response kits will be available on all vehicles used to transport fuel. A Response Team will be formed, trained and will receive regular practice in “mock” responses for incidents that require co-ordinated action.

In addition to spill prevention and response, the SHERP will describe roles, responsibilities and procedures related to:

- personal protective equipment;

- materials storage;
- vehicle safety;
- working at heights;
- working near or over water;
- working near or on ice;
- vessel operation and safety;
- HDD operation and safety;
- animal encounters;
- emergency response communications;
- personnel injury response;
- search and rescue;
- fire and explosion response; and
- vehicle / vessel accidents.

3.6.3 Environmental Inspection

A key component of environmental protection during Project construction is provided by on-site environmental inspectors. In addition to advising on compliance with environmental regulations, on-site environmental inspectors will provide information and advice to the planning process. This may include recommended travel routes and fording sites, and the design and implementation of mitigation measures. Responsibilities of the environmental inspectors will include:

- inspection of work areas and activities;
- advising on the avoidance of sensitive areas;
- input into the design and implementation of environmental mitigation measures (e.g., sediment and erosion control measures, and site water management); and
- assistance with the development and implementation of reclamation plans.

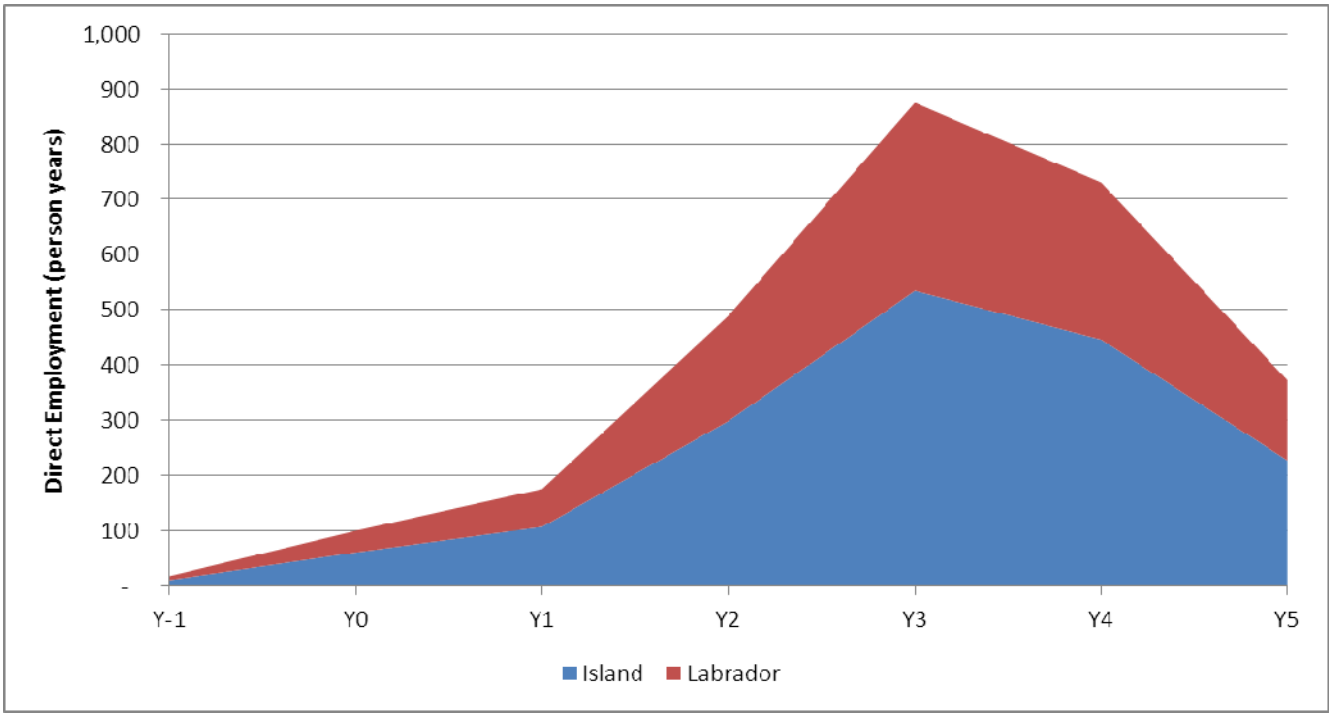
3.7 Project Workforce

Approximately 3,070 person-years are required to construct the Project. Of this total, approximately 1,700 person-years will be located on the Island of Newfoundland and 1,100 person-years will be located in Labrador, with the remainder located elsewhere. The estimated percentage of the workforce required from Newfoundland and / or Labrador is not known at this stage of Project Planning. Peak direct construction employment is expected in Year 3, with 540 person-years of work occurring on the Island and 340 person-years in Labrador. During the Operations and Maintenance phase, approximately 30 additional full-time personnel will be required, in addition to specialized contractors. Working schedules for Construction, and Operations and Maintenance personnel are to be determined during detailed Project Planning.

3.7.1 Construction Workforce

The size of the estimated yearly Project Construction workforce is illustrated in Figure 3.7.1-1. The Project workforce will average approximately 180 direct person-years during Year 1, and is expected to increase in Year 2 to 490 persons, and peak in Year 3 with 880 person-years. The Project workforce for Year 4 is expected to average approximately 730 direct person-years, and will decrease to approximately 370 direct person-years in Year 5.

Figure 3.7.1-1 Required Project Workforce by Year



The two most represented categories of occupations required for the Project will likely be heavy equipment operators and construction trades helpers and labourers. The general occupations expected to be engaged in Project planning, design and construction are listed below:

- heavy equipment operators;
- labourers;
- ironworkers;
- line workers;
- concrete finishers;
- drillers and blasters;
- construction managers;
- carpenters;
- surveyors;
- electricians;
- truck drivers;
- building custodial staff;
- engineers and technologists;
- forestry workers;
- mechanics; and

- building and accommodation staff.

3.7.2 Operations and Maintenance Workforce

The Operations and Maintenance workforce will form part of Nalcor's overall transmission line maintenance program and will consist of Nalcor employees based in Labrador and on the Island. Approximately 30 new managers, technologists and tradespeople will be required (Table 3.7.2-1). It is currently anticipated that 12 of these positions will be located in Labrador and 18 on the Island.

Specialized services will be required on a periodic basis to perform maintenance and technical operations. It is anticipated that these services will be provided by contractors who will supply approximately 6,000 hours of technical support annually.

Table 3.7.2-1 Anticipated Workforce Requirements for Project Operations and Maintenance

Position Description	Quantity
Manager, Labrador – Island Transmission Link	1
Manager, Operations and Work Execution	1
Manager, Long-Term Asset Planning	1
Asset Specialist – Transmission	1
Asset Specialist – HVdc Specialties	1
Supervisor, Short-Term Work Planning and Scheduling	1
Asset Planner	1
Communications / Network Services Technologist	1
Lines Superintendent	2
Line Persons	6
Maintenance Supervisor	2
Electricians / Electrical Maintenance	6
General Maintenance Workers	2
Electrical Engineer	1
Transmission Engineer	1
Administrative	1
Finance and Accounting	1
Total Estimated New Positions	**30**

3.7.3 Workforce Demand Profiles by National Occupation Classification Code

Table 3.7.3-1 presents the total estimated labour demand by National Occupation Classification (NOC) code.

Table 3.7.3-1 Labrador-Island Transmission Link Total Estimated Labour Demand by National Occupation Classification Code

NOC Code	Person-years
A0 - Senior Management Occupations	10
A1 - Specialist Managers	120
A3 - Other Managers, n.e.c.	100
B0 - Professional Occupations in Business and Finance	150
B3 - Administrative and Regulatory Occupations	130
B4 - Clerical Supervisors	20
B5 - Office Equipment Operators	110
C0 - Professional Occupations in Natural and Applied Sciences	580
C1 - Technical Occupations Related to Natural and Applied Sciences	230
D2 - Technical and Related Occupations in Health	10
E0 - Judges, Lawyers, Psychologists, Social Workers, Ministers of Religion and Policy and Program Officers	60
F0 - Professional Occupations in Art and Culture	20
G9 - Sales and Service Occupations n.e.c.	30
H0 - Contractors and Supervisors in Trades and Transportation	120
H1 - Construction Trades	70
H2 - Stationary Engineers, Power Station Operators and Electrical Trades and Telecommunications Occupations	230
H3 - Machinists, Metal Forming, Shaping and Erecting Occupations	110
H4 - Mechanics	80
H5 - Other Trades, n.e.c	10
H6 - Heavy Equipment and Crane Operators, Including Drillers	360
H7 - Transportation Equipment Operators and Related Workers, Excluding Labourers	90
H8 - Trades Helpers, Construction and Transportation Labourers and Related Occupations	390
I1 - Occupations Unique to Forestry Operations, Mining, Oil and Gas Extraction and Fishing, Excluding Labourers	10
J2 - Assemblers in Manufacturing	20
Total	**3,060**

3.7.3.1 Methodological Considerations

The following figures illustrate the demand profile for each occupation listed in Table 3.7.3-1. The totals are quarterly average figures. Therefore monthly peaks could be slightly higher than those illustrated. The estimates were derived through the Decision Gate 2 (DG2) (as discussed in Chapter 2) capital cost estimate where total hours for each activity by each type of occupation were made. The total hours for each occupation were combined and divided by the average hours per month. In the case of trade labour, it was assumed that a 21 and 7 schedule would be used with individuals working an average of 210 hours per month. For non-trade labour, an average of 185 hours per month was used to convert total hours into average person months, which were then converted to person quarters.

Figure 3.7.3-1 Total Labour Demand – Labrador-Island Transmission Link

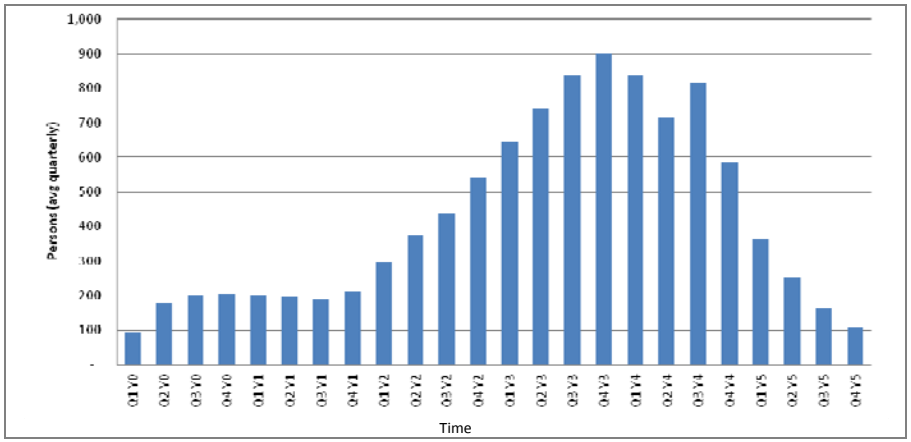


Figure 3.7.3-2 A0 – Senior Management Occupation

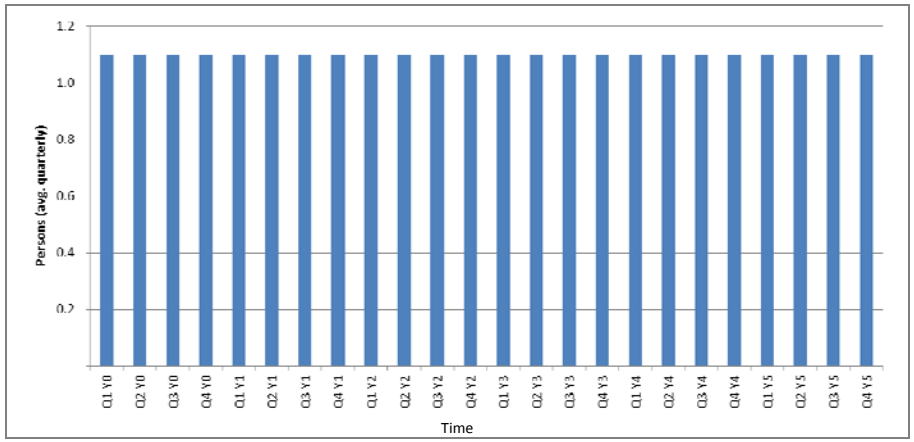


Figure 3.7.3-3 A1 – Specialist Manager

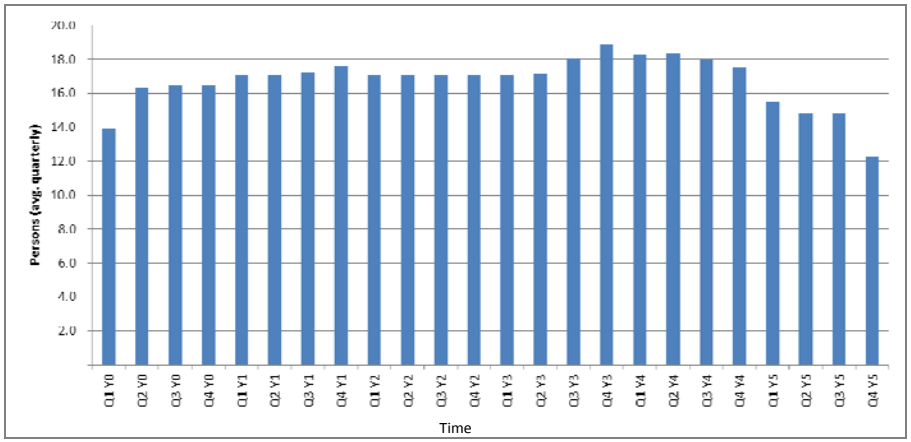


Figure 3.7.3-4 A3 – Other Managers, n.e.c.

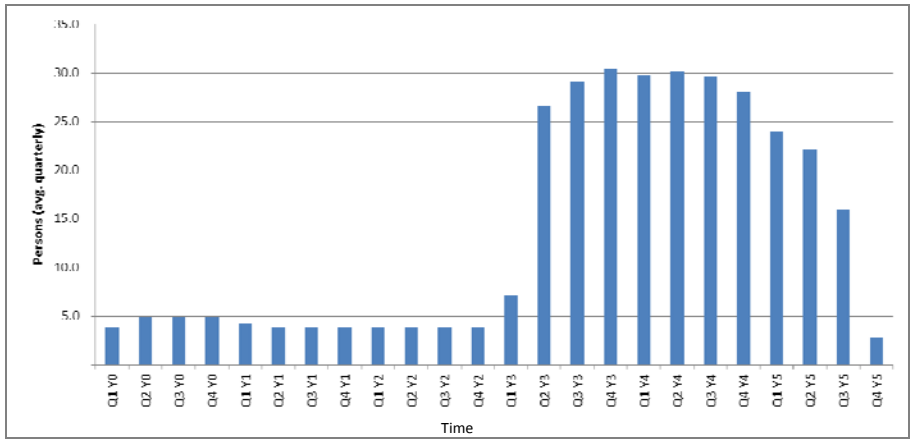


Figure 3.7.3-5 B0 – Professional Occupations in Business and Finance

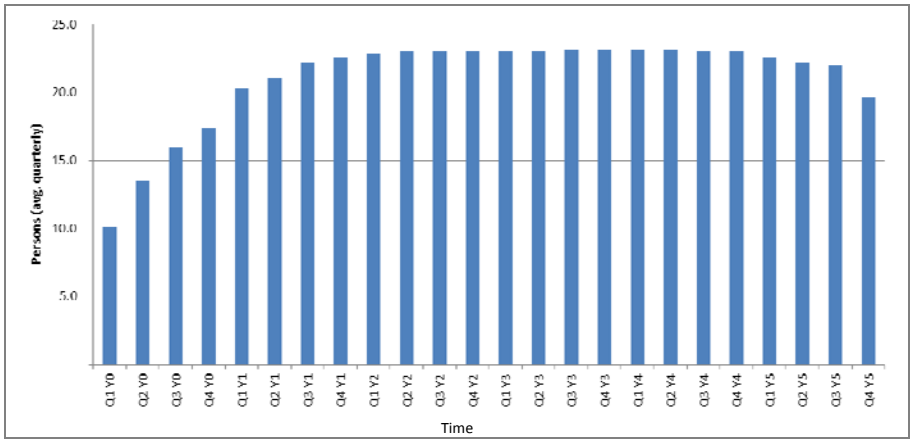


Figure 3.7.3-6 B3 – Administrative and Regulatory Occupations

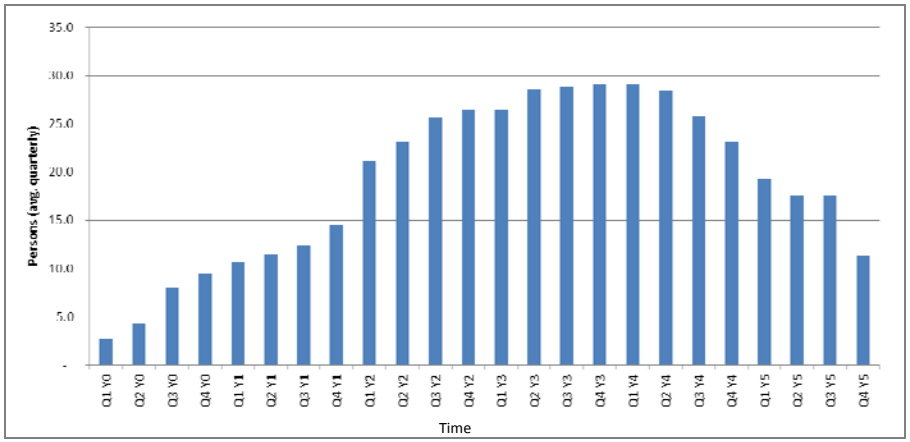


Figure 3.7.3-7 B4 – Clerical Supervisors

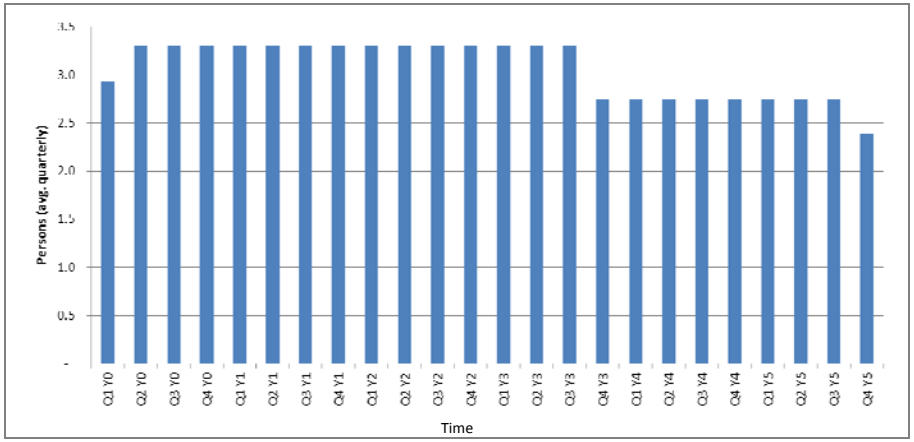


Figure 3.7.3-8 B5 – Office Equipment Operators

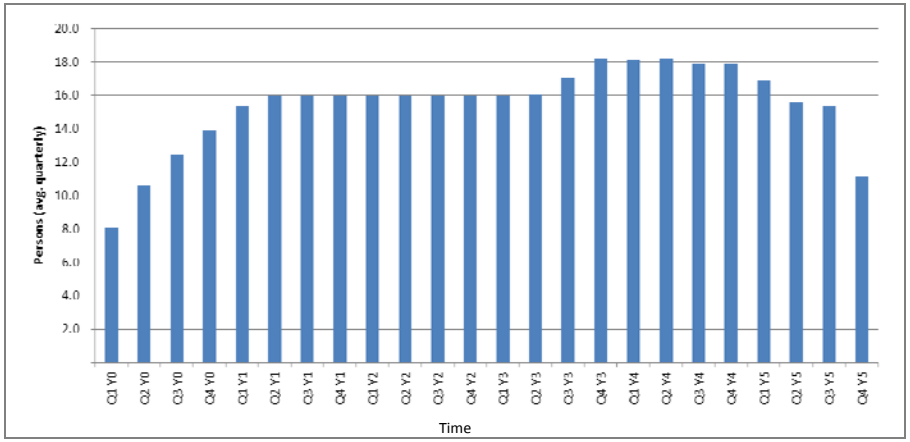


Figure 3.7.3-9 **C0 – Professional Occupations in Natural and Applied Sciences**

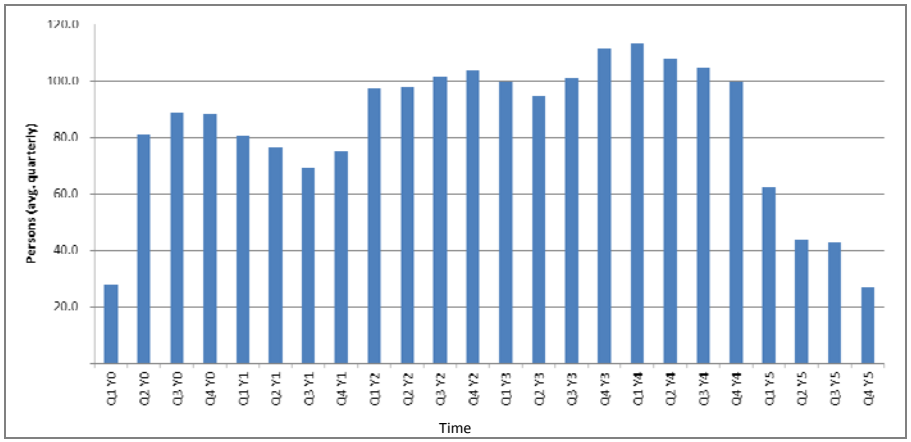


Figure 3.7.3-10 **C1 – Technical Occupations Related to Natural and Applied Sciences**

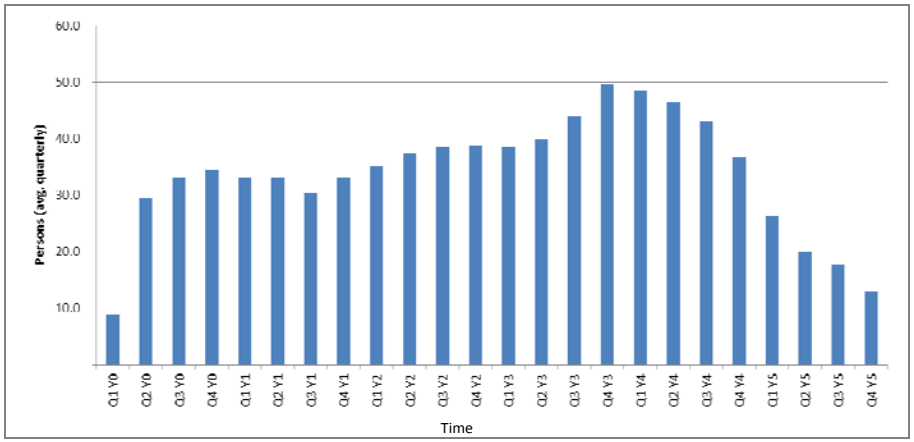


Figure 3.7.3-11 **D2 – Technical and Related Occupations in Health**

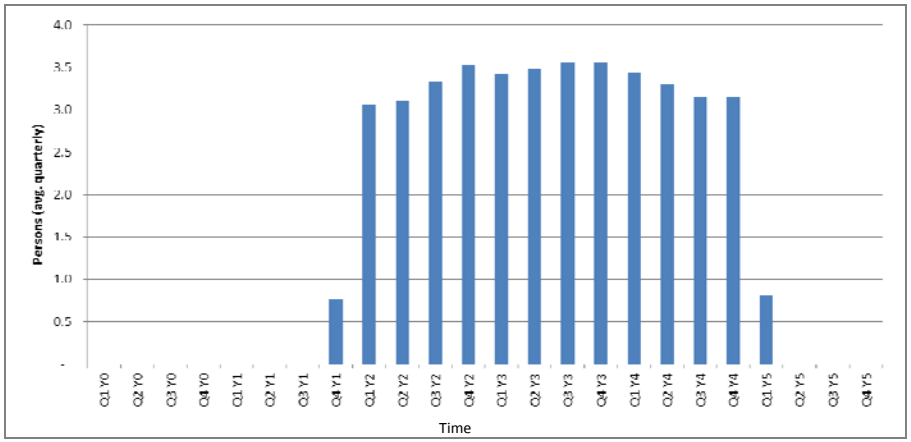


Figure 3.7.3-12 **E0 – Judges, Lawyers, Psychologist, Social Workers, Ministers of Religion and Policy and Program Officers**

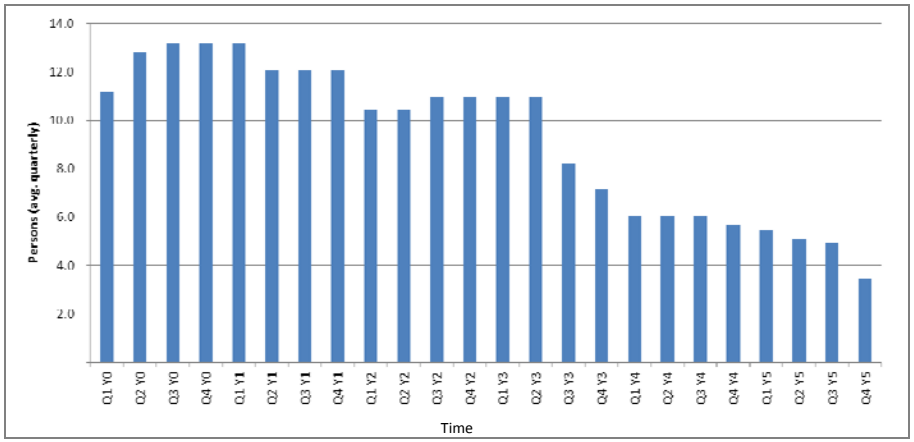


Figure 3.7.3-13 F0 – Professional Occupations in Art and Culture

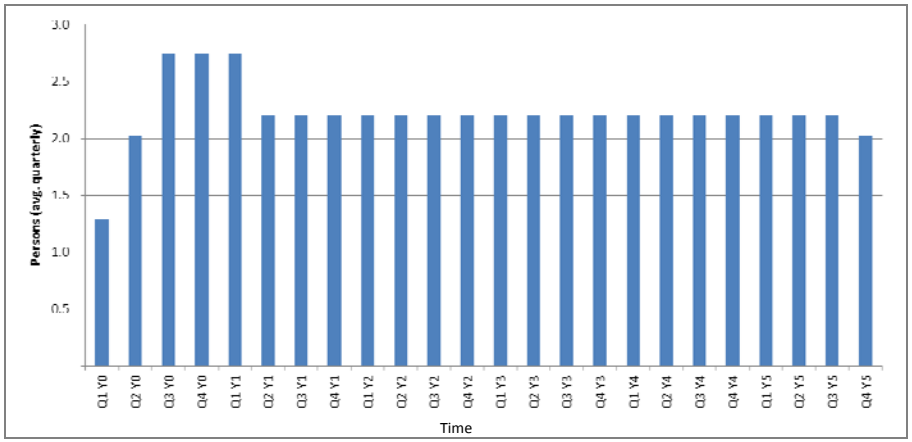


Figure 3.7.3-14 H0 – Contractors and Supervisors in Trades and Transportation

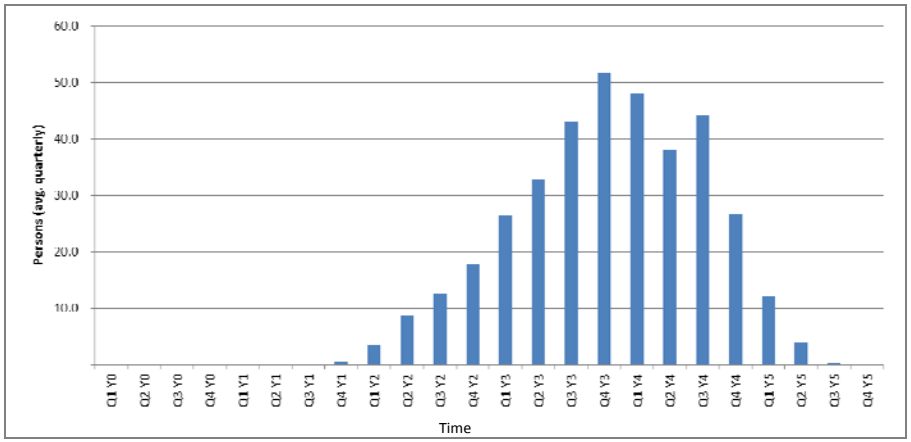


Figure 3.7.3-15 H1 – Construction Trades

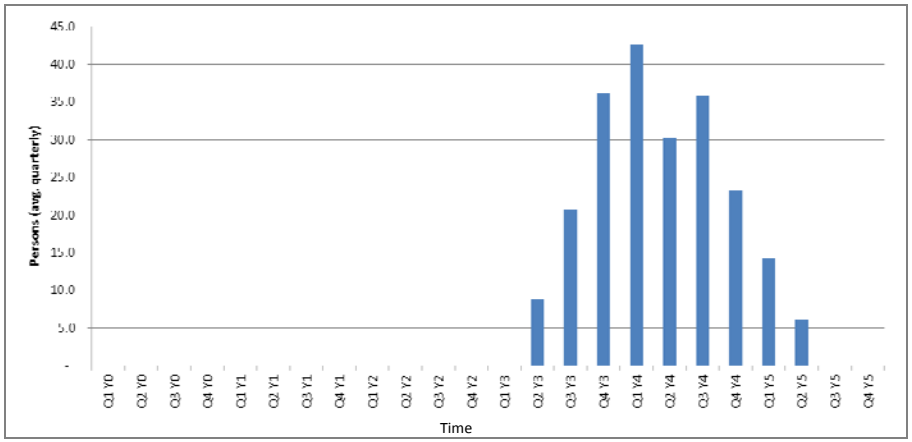


Figure 3.7.3-16 Stationary Engineers, Power Station Operators and Electrical Trades and Telecommunications Occupations

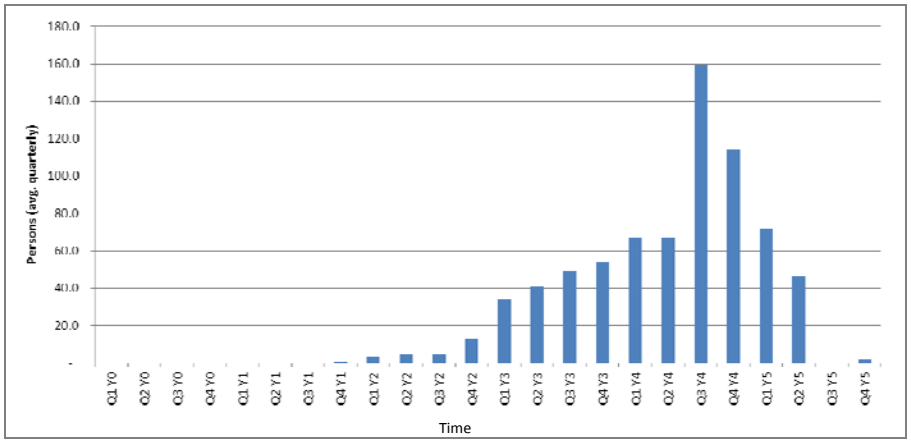


Figure 3.7.3-17 H3 – Machinists, Metal Forming, Shaping and Erecting Occupations

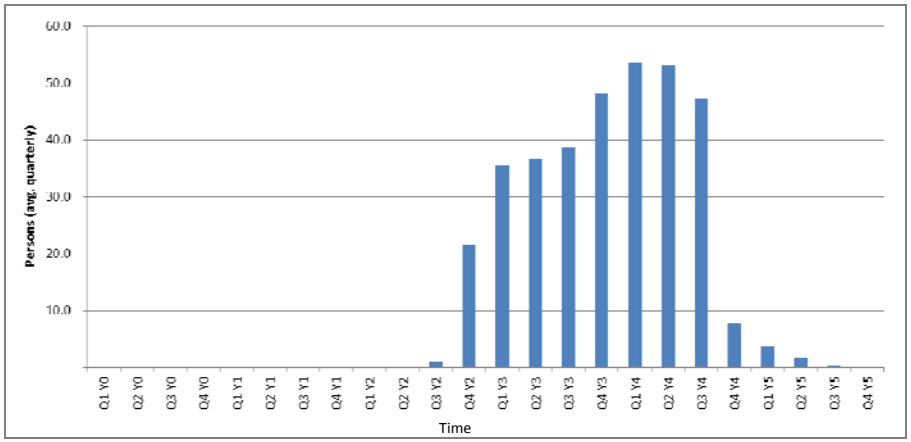


Figure 3.7.3-18 H4 - Mechanics

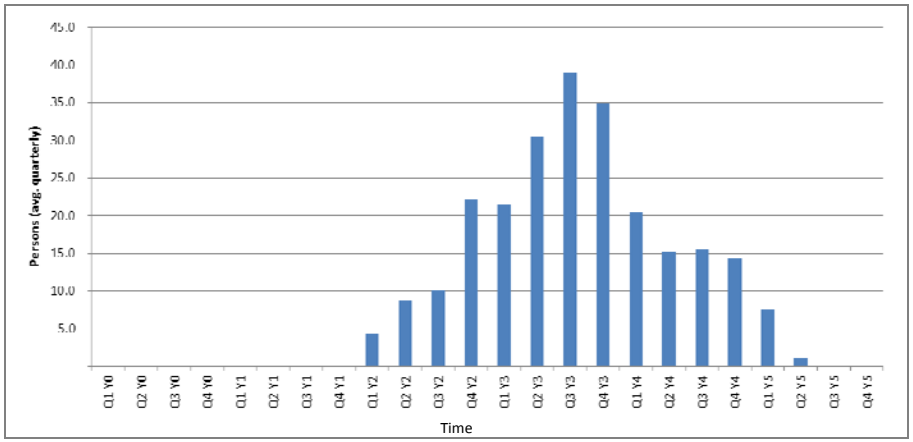


Figure 3.7.3-19 H5 – Other Trades, n.e.c.

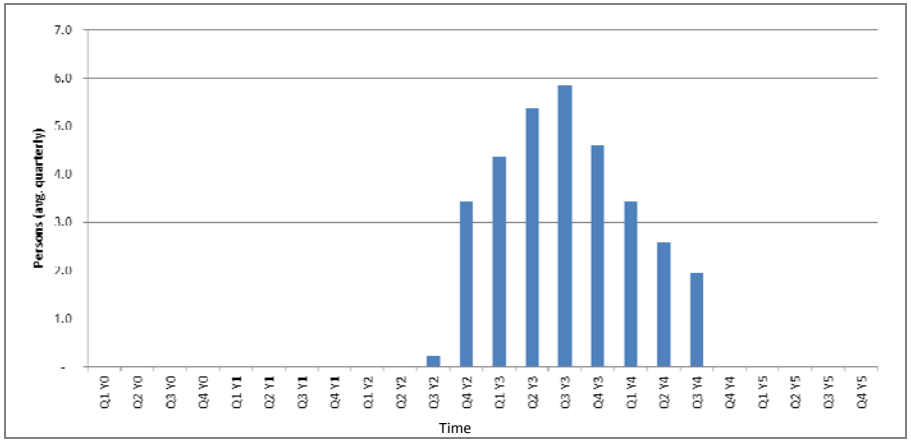


Figure 3.7.3-20 H6 – Heavy Equipment and Crane Operators, Including Drillers

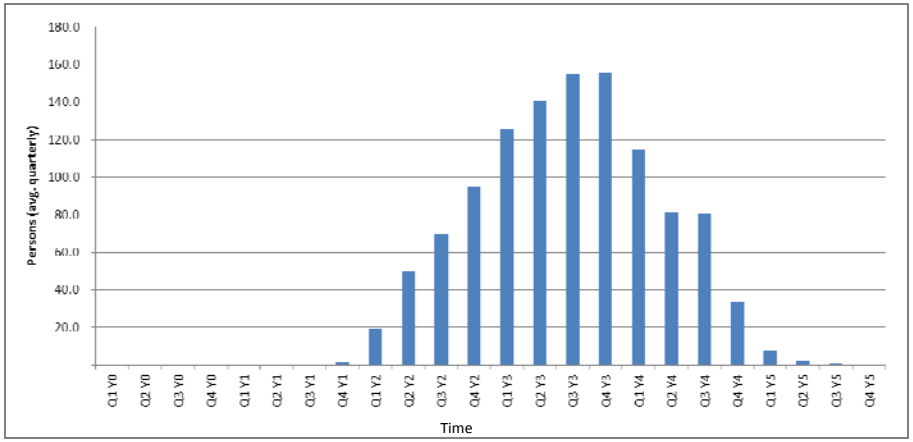


Figure 3.7.3-21 **H7 – Transportation Equipment Operators and Related Workers, Excluding Labourers**

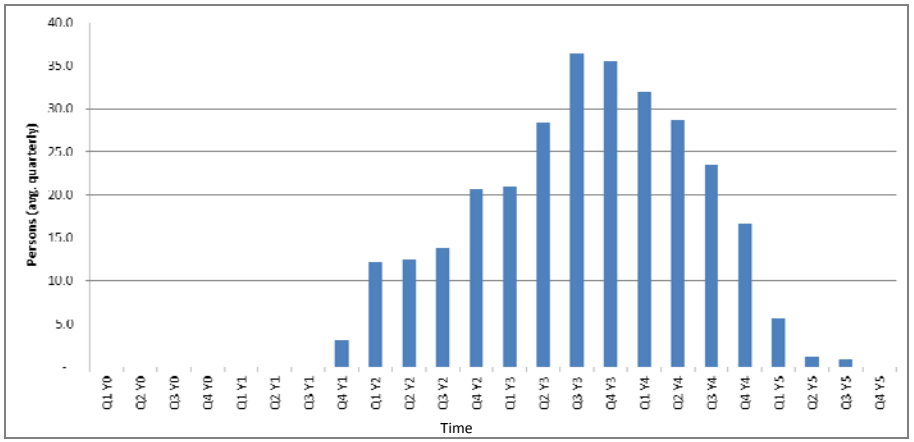


Figure 3.7.3-22 **H8 – Trades Helpers, Construction and Transportation Labourers and Related Occupations**

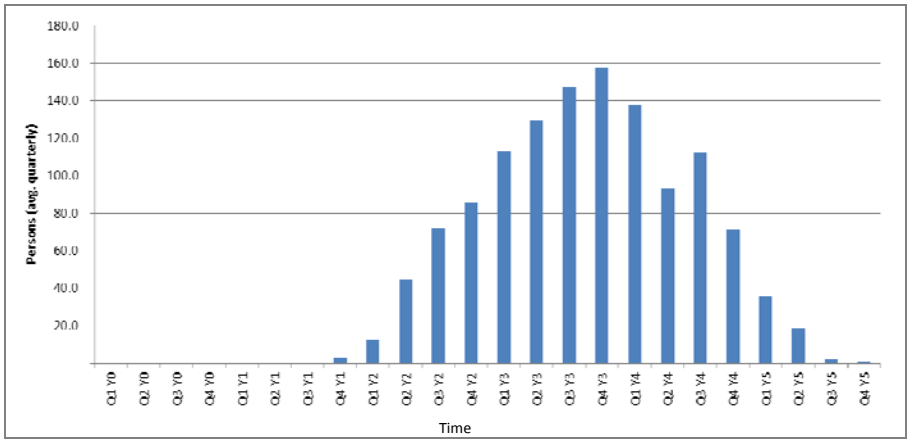


Figure 3.7.3-23 **I1 – Occupations Unique to Forestry Operations, Mining, Oil and Gas Extraction and Fishing, Excluding Labourers**

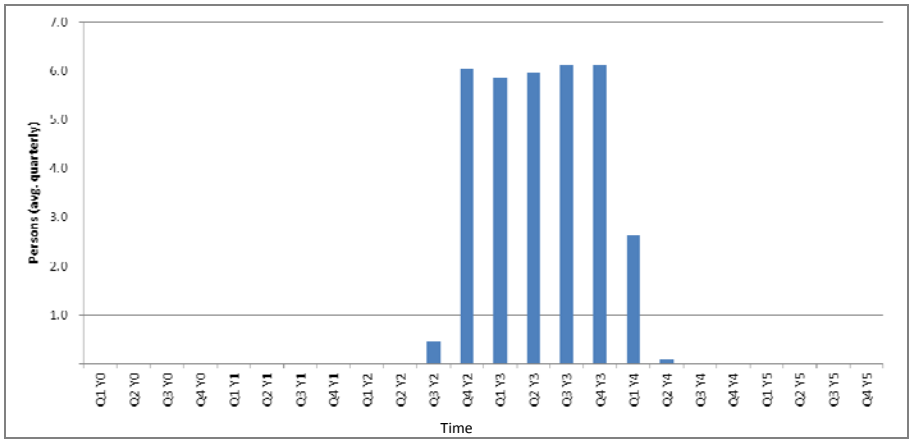
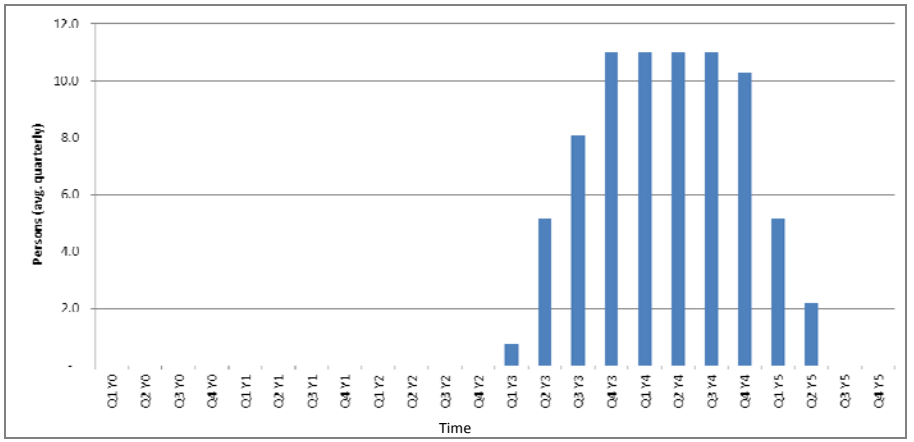


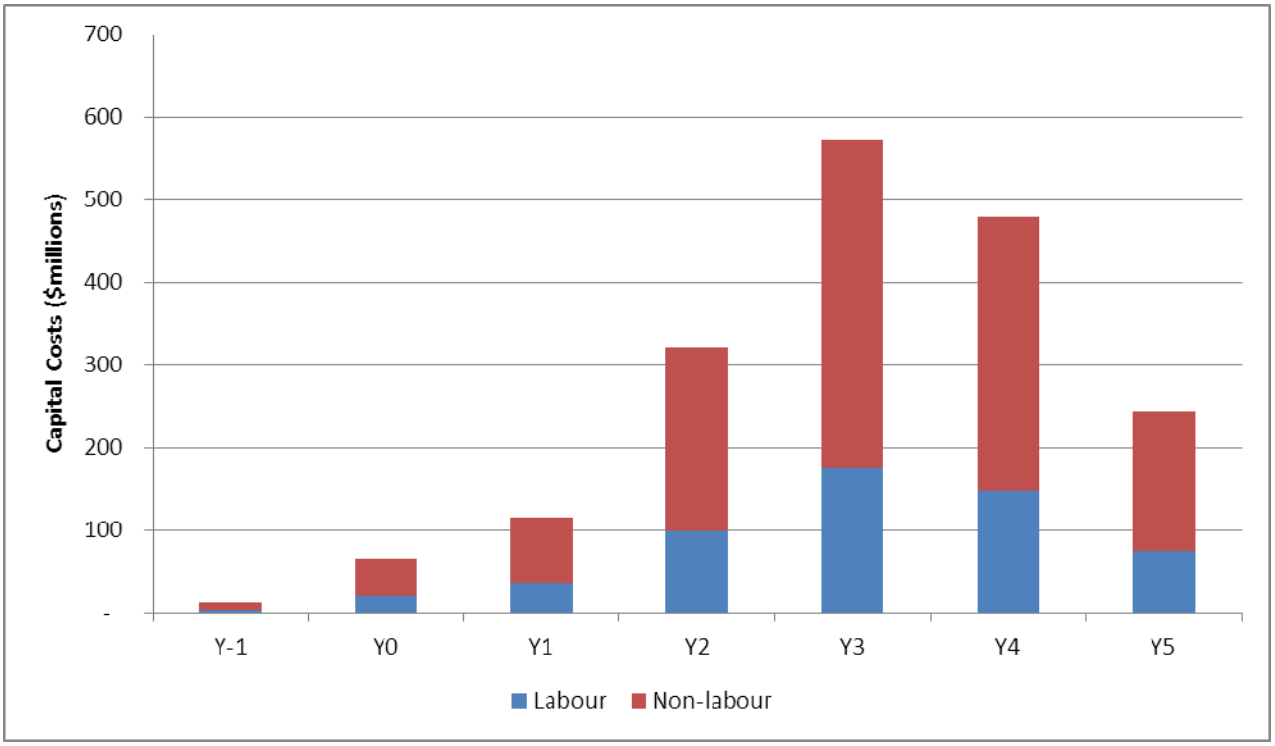
Figure 3.7.3-24 **J2 – Assemblers in Manufacturing**



3.8 Project Cost and Expenditures

The total estimated capital cost for the Project is $2.1 billion in as-spent dollars (including contingency and escalation). Approximately $1.25 billion will be spent on materials and equipment with labour accounting for approximately $560 million of the total capital costs. An escalation allowance of $230 million and historical costs of $42 million account for the remainder of the costs, bringing the total capital cost to approximately $2.1 billion. Most costs will be incurred during the final three years of construction with the highest single year cost occurring in Year 3 (approximately $570 million) (Figure 3.8-1).

Figure 3.8-1 Capital Cost Estimates for Project Construction



The estimated costs associated with each Project component are presented in Table 3.8-1. The Strait of Belle Isle marine crossing is the highest cost item at $337 million, followed by the overhead transmission line on the Island at $305 million. These estimates include all costs up to commissioning of the Project, excluding interest during construction (IDC).

Table 3.8-1 Total Project Costs by Component

Project Component	Approximate Cost (million dollars)
Project management and engineering	273
HVdc Overland Transmission – Labrador / Island	460
Strait of Belle Isle Submarine Cable Crossing and Cable Landing Sites	359
Converter Stations – Muskrat Falls and Soldiers Pond Electrode and overhead line – Labrador and Island	536
Island system upgrades	223
Escalation	227
Total	**2,080**

Note: All costs exclude IDC.

3.9 References

Canadian Centre for Occupational Health and Safety. 2011. Health Effects of Chlorine. http://www.ccohs.ca/oshanswers/chemicals/chem_profiles/chlorine/health_chlorine.html. Accessed: October 2011.

Canadian Electricity Association. 2010. Perspectives: Electric and Magnetic Fields. Available at: http://emf.electricity.ca/PDFs/EMF_Perspective_2010_en.pdf. Accessed: March 2010.

Clairmont, B.A., G.B. Johnson, L.E. Zaffanella and S. Zelingher. 1989. The Effect of HVac – HVdc line Separation in a Hybrid Corridor. IEEE Transactions on Power Delivery, vol. 4, no. 2, pp. 1338-1350.

DFO (Fisheries and Oceans Canada). 2010. Blasting – Fish and Fish Habitat Protection. Available at: http://www.nfl.dfo-mpo.gc.ca/e0005460. Accessed: March 2011.

EPRI (Electric Power Research Institute). 2006. AC Transmission Line Reference Book – 200 kV and Above, 3rd ed.

EPRI. 2008. HVDC Reference Book: Overhead Lines for HVDC Transmission. Technical Update, June 2008.

Hatch Ltd. 2011. Environmental Modeling: Proposed Shore Electrodes for Labrador-Island Transmission Link.

Health Canada. 2010. Guidelines for Canadian Drinking Water Quality – Summary Table. Prepared by the Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial-Territorial Committee on Health and the Environment. http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/2010-sum_guide-res_recom/index-eng.php Accessed: February 2011.

Industry Canada. 2001. ICES-004 – Alternating Current High Voltage Power Systems. Available at: http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf00021.html. Accessed: March 2010.

Manitoba HVdc Research Centre. 2009. Analysis of Field and Corona Performances of Nalcor AC/DC Hybrid Transmission Lines.

Maruvada, P.S., R.D. Dallaire, P. Heroux, N. Rivest and R. Pednault. 1982. Bipolar HVdc Transmission System Between ±600 kV and ±1200 kV: Corona Studies, Phase II. Palo Alto, CA: EPRI EL 2794.

NLDEC – WRM (Newfoundland and Labrador Department of Environment and Conservation, Water Resources Management Division). 2010. *Guidelines for the Design, Construction and Operation of Water and Sewerage Systems.*

US EPA (United States Environmental Protection Agency). 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. EPA 550/9-74-004, March, 1974, U.S. Environmental Protection Agency, Washington, D.C. 20460.

APPENDIX 3-1

PERMITS REQUIRED FOR THE PROJECT

Table 3-1.1: Permits Required for the Project

Approval Potentially Required	Legislation/ Regulation	Activity Requiring Approval or Compliance	Department or Agency	Requirements
Government of Newfoundland and Labrador				
Release from Environmental Assessment	*Environmental Protection Act* and *Environmental Assessment Regulations*	Project	Environmental Assessment Division, Department of Environment and Conservation	The Act applies to any proposed development in the province which may have a significant effect on the environment. The Project requires registration under the Act. After a public and governmental review, the Minister of Environment and Conservation will determine whether the Project may proceed, subject to other applicable legislation, or whether environmental assessment is required.
License to Occupy Crown Land, Crown Land Leases / Grants / Easements	*Land Act*	Development on Crown Lands	Lands Division, Department of Environment and Conservation	Approval is required for Project Activities and infrastructure on Crown Land.
Certificate of Approval for any Alteration to a Body of Water	*Water Resources Act*	Any activities which may alter a water body	Water Resources Division, Department of Environment and Conservation	Permits are required for construction activities within 15 m of the high watermark of any water body. An application form is required for each alteration.
Certificates of Approval for any Instream Activity (including Culvert Installation, Bridges and Fording a Watercourse)	*Water Resources Act*	Any in-stream activity	Water Resources Division, Department of Environment and Conservation	Approval is required for any in-stream activity, including culvert installations and fording activities, before undertaking the work. This also includes any development within 15 m of the high watermark of any water body.
Certificates of Approval for Development Activity in a Protected Public Water Supply Area or Wellhead Protected Public Water Supply Area	*Water Resources Act*	Construction activity in a protected water supply	Water Resources Division, Department of Environment and Conservation	Approval is required for any activity in a protected public water supply area prior to the commencement of any work.

Table 3-1.1: Permits Required for the Project (continued)

Approval Potentially Required	Legislation/ Regulation	Activity Requiring Approval or Compliance	Department or Agency	Requirements
Certificate of Approval for Construction Site Drainage	*Water Resources Act*	Any run-off from the project site being discharged to receiving waters	Water Resources Division, Department of Environment and Conservation	Approval is required for any run-off from the project site being discharged to receiving waters.
Water Use Authorization	*Water Resources Act*	Water withdrawal for use at temporary camps or during Construction and Operations activities	Water Resources Division, Department of Environment and Conservation	Water use authorization is required for all beneficial uses of water.
Application for Water Well Drilling Licence	*Water Resources Act*	Drilling activity for a water well	Water Resources Division, Department of Environment and Conservation	A licence is required to carry on the business of water well drilling in Newfoundland and Labrador.
Application for Permit for Constructing a Non-Domestic Well	*Water Resources Act*	Establishment of a water well	Water Resources Division, Department of Environment and Conservation	A licence is required to establish a non-domestic water well in Newfoundland and Labrador.
Policy Directives	*Water Resources Act*	Project Activities	Water Resources Division, Department of Environment and Conservation	The Department has a number of potentially applicable policy directives in place, including those related to: Infilling Bodies of Water; Use of Creosote Treated Wood in Fresh Water; Treated Utility Poles in Water Supply Areas; Land and Water Developments in Protected Water Supply Areas; Development in Shore Water Zones; and Development in Wetlands.

Table 3-1.1: Permits Required for the Project (continued)

Approval Potentially Required	Legislation/ Regulation	Activity Requiring Approval or Compliance	Department or Agency	Requirements
Compliance Standard, Potential Permit	*Endangered Species Act*	Project Activities	Wildlife Division, Department of Environment and Conservation	Prohibits the disturbance, harassment, injury, or killing of an individual of a species designated as threatened, endangered or extirpated. The Minister may, under certain circumstances, issue a permit for an activity affecting a designated species, the residence of a specimen of a designated species or critical or recovery habitat.
Access to Highway Permit	*Urban and Rural Planning Act, Works, Services and Transportation Act, Protected Road Zoning Regulations*	Construction of access roads and trails	Department of Transportation and Works and/or the Government Service Centre	The construction of an access to a highway that is classified as a Protected Road requires approval.
Permit to engage in an activity that affects an endangered species (Requirement to be based on discussion with regulators)	*Species at Risk Act*	Construction in caribou habitat	Environment Canada	The competent minister may enter into an agreement or issue a permit authorizing a person to engage in an activity affecting a listed wildlife species, any part of its critical habitat or its residences. If entered into or issued, the competent minister must include an explanation of why this was entered into or issued in the Public Registry.
Preliminary Application to Develop Land	*Urban and Rural Planning Act, Protected Road Zoning Regulations*	Construction activity	Department of Government Services	A development permit is required to build on and develop land, whether Crown or privately owned, within the building control lines of a Protected Road or within the boundaries of a Protected Area.
Quarry Permit	*Quarry Materials Act* and *Regulations*	Extracting borrow material	Mineral Lands Division, Department of Natural Resources	A permit is required to dig for, excavate, remove and dispose of any Crown quarry material.

Table 3-1.1: Permits Required for the Project (continued)

Approval Potentially Required	Legislation/ Regulation	Activity Requiring Approval or Compliance	Department or Agency	Requirements
Cutting Permit Operating Permit	*Forestry Act* and *Cutting of Timber Regulations*	Clearing land areas for the right-of-way, borrow pits, camp sites or laydown areas	Department of Natural Resources	A permit is required for the commercial or domestic cutting of timber on crown land.
Permit to Burn	*Forestry Act* and *Forest Fire Regulations*	Any burning required during the Project	Department of Natural Resources	A permit is required to light fires outdoors between April and December. Permits are not issued during forest fire season.
Archaeological Research Permit	*Historic Resources Act*	Any archaeological investigations required	Provincial Archaeology Office, Department of Tourism, Culture and Recreation	A permit is required for any archaeological investigations on land or underwater.
Certificate of Approval for Storing and Handling Gasoline and Associated Products	*Environmental Protection Act,* and *Storage and Handling of Gasoline and Associated Products Regulations*	Storing and handling gasoline and associated products	Engineering Services Division, Government Service Centre	A Certificate of Approval is required for storing and handling gasoline and associated products.
Fuel Cache Permit	*Environmental Protection Act* and *Environmental Guidelines for Fuel Cache Operations*	Temporary fuel storage	Engineering Services Division, Government Service Centre	A permit is required for any temporary fuel storage in a remote location.
Permit for Storage, Handling, Use or Sale of Flammable and Combustible Liquids	*Fire Prevention Act,* and *Fire Prevention Flammable and Combustible Liquids Regulations*	Storing and handling flammable liquids	Engineering Services Division, Government Service Centre	This permit is issued on behalf of the Office of the Fire Commissioner. Approval is based on a review of information provided for the Certificate of Approval for Storing and Handling Gasoline and Associated Products.

Table 3-1.1: Permits Required for the Project (continued)

Approval Potentially Required	Legislation/ Regulation	Activity Requiring Approval or Compliance	Department or Agency	Requirements
Compliance Standard	*Dangerous Goods Transportation Act* and *Regulations*	Storing, handling and transporting fuel, oil and lubricants	Department of Transportation and Works	If the materials are transported, handled and stored fully in compliance with the regulations, a permit is not required. A Permit of Equivalent Level of Safety is required if a variance from the regulations is necessary. Transporting goods considered dangerous to public safety must comply with regulations.
Certificate of Approval for Installation of a Sewage System	*Sanitation Regulations,* under the *Health and Community Services Act*	Sewage disposal and treatment at construction camps	Department of Health and Community Services	Sewage disposal systems designed, constructed or installed to service a private dwelling or a commercial or other building with a daily sewage flow less than 4,546 L must be approved by an inspector before installation.
Certificate of Approval for Septic Systems > 4,546 L per day and Well Approval	*Environmental Protection Act*	Sewage disposal and treatment at construction camps	Engineering Services Division, Government Service Centre	A Certificate of Approval is required for commercial septic systems and wells in an unserviced area, not covered by a municipality.
Certificate of Approval for a Water Withdrawal System of $\geq$ 4,500 L per day	*Water Resources Act*	Water supply at temporary camps, and for use in construction activities	Water Resources Division, Department of Environment and Conservation	Certificate of Approval is required for any private water withdrawal system of 4,500 L/day or greater.
Certificate of Approval for Installation of Water Supply System	*Sanitation Regulations*, under the *Health and Community Services Act*	Water supply at temporary camps and maintenance depots	Department of Health and Community Services	Water supply systems designed, constructed or installed to service a private dwelling or a commercial or other building, including systems not governed by a municipal council, local service district or local water committee, must be approved by an inspector before installation.

Table 3-1.1: Permits Required for the Project (continued)

Approval Potentially Required	Legislation/ Regulation	Activity Requiring Approval or Compliance	Department or Agency	Requirements
Certificate of Approval for a Waste Management System	*Environmental Protection Act* and *Waste Management Regulations*	Waste disposal associated with Construction and Operations	Department of Environment and Conservation, Department of Health and Community Services	Approval is required for waste disposal (e.g., incineration or burying). Used tires must be disposed according to regulations.
Food Establishment Licence – Temporary Facility Permit	*Health and Community Services Act, Food and Drug Act* and *Food Premises Regulations*	Establishing and operating a temporary camp and kitchen facility, or using/upgrading existing facilities	Operations Division, Department of Government Services	A licence is required to operate food premises. Where municipal services are unavailable, two copies of plans and specifications for water supply and sewage disposal must be submitted with application for a licence. Food premises are routinely inspected to ensure compliance.
Permit to Destroy Problem Animals	*Wildlife Act*	Dealing with nuisance wildlife	Department of Natural Resources	The Department provides direction on handling nuisance animals. Details on the situation must be provided for a permit to be issued.
Compliance Standard	*Fire Prevention Act,* and *Fire Prevention Regulations*	On-site structures (temporary or permanent)	Engineering Services Division, Government Service Centre	All structures must comply with fire prevention standards.
Compliance Standard	*Environmental Control Water and Sewage Regulation* under the *Water Resources Act*	Any waters discharged from the project	Pollution Prevention Division, Department of Environment and Conservation	A person discharging sewage and other materials into a body of water must comply with the standards, conditions and provisions prescribed in these regulations for the constituents, contents or description of the discharged materials.
Compliance Standard	*Sanitation Regulations*, under the *Health and Community Services Act*	Sewage and waste disposal	Department of Health and Community Services	Outlines standards for sewage and waste disposal.

Table 3-1.1: Permits Required for the Project (continued)

Approval Potentially Required	Legislation/ Regulation	Activity Requiring Approval or Compliance	Department or Agency	Requirements
Compliance Standard	*Historic Resources Act*	Any known archaeological sites near project area or sites encountered during Construction or Operations	Provincial Archaeology Office, Department of Tourism, Culture and Recreation	All archaeology sites and artifacts are considered to be the property of the Crown and must not be disturbed. Any archaeological materials encountered must be reported to the Provincial Archaeology Office. Any proposed alterations to the project should be referred to the Provincial Archaeology Office for approval.
Compliance Standard	*Occupational Health and Safety Act* and Regulations	Project-related occupations	Department of Human Resources, Labour and Employment	Outlines minimum requirements for workplace health and safety. Workers have the right to refuse dangerous work. Proponents must notify Minister of start of construction for any project greater than 30 days in duration.
Compliance Standard	*Workplace Hazardous Materials Information System (WHMIS) Regulations*, under the *Occupational Health and Safety Act*	Handling and storage of hazardous materials	Operations Division, Department of Government Services	Outlines procedures for handling hazardous materials and provides details on various hazardous materials.
Government of Canada				
Release from Environmental Assessment	*Canadian Environmental Assessment Act* and associated *Regulations*	Project	Relevant Federal Departments (Responsible Authorities)	The requirements of *CEAA* must be fulfilled before any irrevocable decision is made by a federal authority that would allow the Project to proceed.

Table 3-1.1: Permits Required for the Project (continued)

Approval Potentially Required	Legislation/ Regulation	Activity Requiring Approval or Compliance	Department or Agency	Requirements
Authorization or Letter of Advice for Works or Undertakings Affecting Fish Habitat	*Fisheries Act*, Section 35(2)	Construction of cable crossings and watercourse crossings	Department of Fisheries and Oceans	Application must be made if fish habitat may be affected. Where potential for harmful effects to fish habitat can be prevented, a Letter of Advice will be issued outlining appropriate mitigation procedures or conditions to be followed. Authorizations will only be issued where there will be a loss of fish habitat that cannot be avoided by mitigation measures. The authorization requires a habitat compensation plan to be developed and agreed to by DFO and proponent before the authorization is given.
Permit for Construction Within Navigable Waters	*Navigable Waters Protection Act* and *Regulations*	Construction of cable crossings and watercourse crossings	Transport Canada	A permit is required for any works or construction activity located below the high water mark, either over, under, through or across any navigable waters. This could include any structure, device or thing that may interfere with navigation. An application must be submitted for each alteration to a navigable waterway.
Permit for Disposal at Sea	*Canadian Environmental Protection Act, Disposal at Sea Regulations*	Construction of cable crossings	Environment Canada	Disposal at Sea is the deliberate disposal at sea of approved substances from ships, aircraft, platforms or other structures. These substances are primarily dredged sediment from river or marine sources or excavated native till.
Radiocommunication Permit	*Radiocommunication Act* and *Regulations*	Establishment and use of radio equipment and associated towers	Industry Canada	Approval of the Minister of Industry may be required to approve sites on which radio apparatus, including antenna systems, may be located, and approve the erection of all masts, towers and other antenna-supporting structures.

Table 3-1.1: Permits Required for the Project (continued)

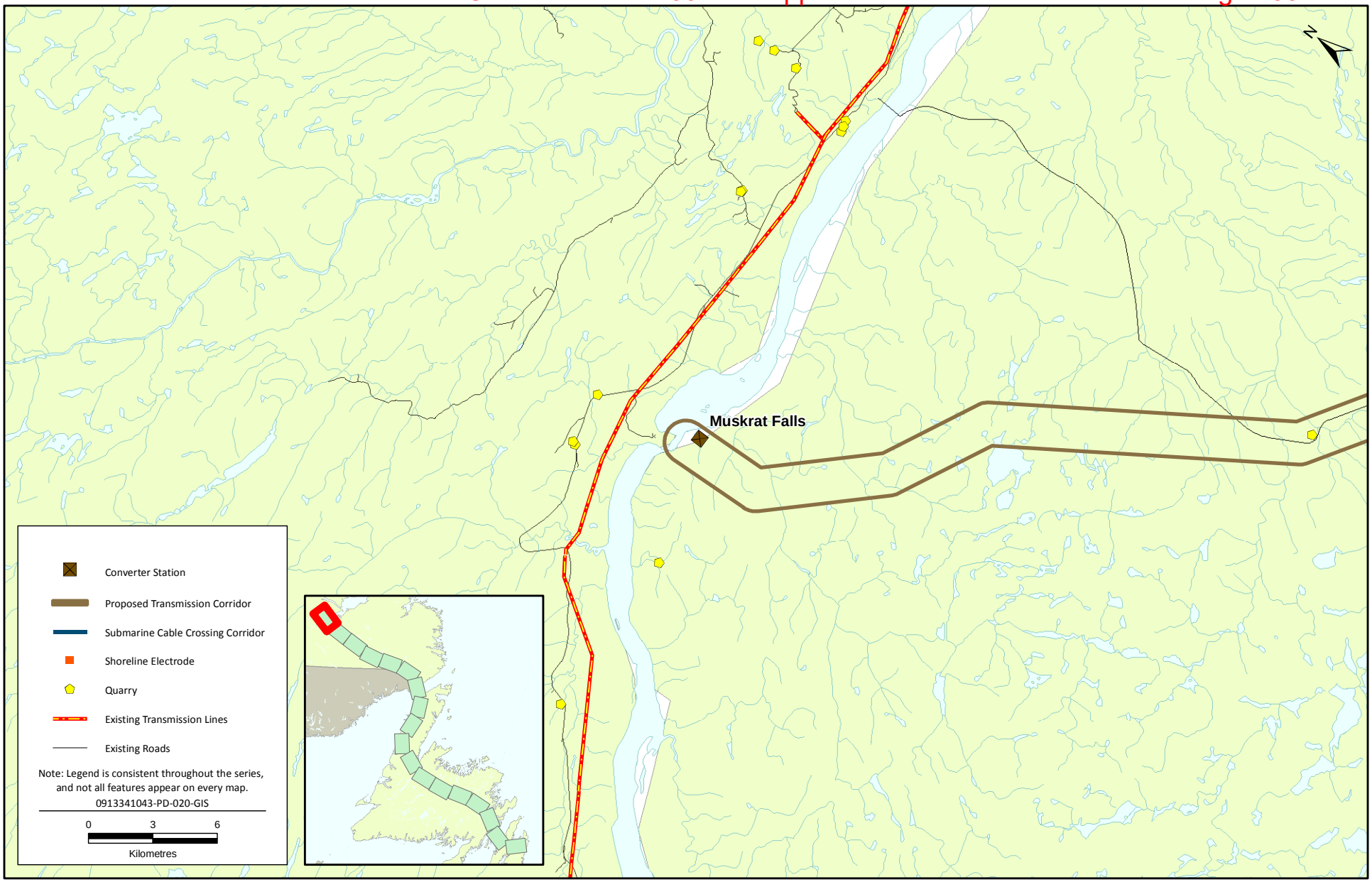
Approval Potentially Required	Legislation/ Regulation	Activity Requiring Approval or Compliance	Department or Agency	Requirements
Temporary Magazine Licence	*Explosives Act*	Temporary storage of explosives at certain construction areas (Storage only - Explosives manufacture is not contemplated).	Natural Resources Canada	A licence would be required to temporarily store explosives on-site.
Explosives Purchase and Possession Permit	*Explosives Act*	Purchase and possession of explosives	Natural Resources Canada	A permit is required to purchase and possess explosives.
Explosives Transportation Permit	*Explosives Act*	Transportation of explosives	Natural Resources Canada	A permit is required for transporting explosives.
Compliance Standard	*Fisheries Act*, Section 36(3), Deleterious Substances	Any run-off from the project site being discharged to receiving waters	Environment Canada, Department of Fisheries and Oceans	Environment Canada is responsible for Section 36(3) of the *Fisheries Act*. However, DFO is responsible for matters dealing with sedimentation. Discharge must not be deleterious and must be acutely non-lethal.
Compliance Standard; Permit may be required	*Migratory Birds Convention Act* and *Regulations*	Any activities which could result in the mortality of migratory birds and endangered species and any species under federal authority	Canadian Wildlife Service, Environment Canada	Prohibits the deposit of oil, oily wastes or any other substances harmful to migratory birds in any waters or any area frequented by migratory birds. The Canadian Wildlife Service should be notified about the mortality of any migratory bird in the project area, including passerine (songbirds) and waterfowl species. Prohibits disturbing, destroying or taking a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird, and possessing a live migratory bird, carcass, skin, nest or egg, except when authorized by a permit.
Policy	Federal Policy on Wetland Conservation	Any disruption of wetland habitat	Environment Canada	The goals of this policy should be considered where a project could affect wetland habitat.
Compliance standards; permits may be required	*Canada Shipping Act* and *Regulations*	Project-related shipping activity	Transport Canada	All shipping activities in Canadian waters must comply with the Act and Regulations.

Table 3-1.1: Permits Required for the Project (continued)

Approval Potentially Required	Legislation/ Regulation	Activity Requiring Approval or Compliance	Department or Agency	Requirements
Compliance standards; permits may be required	National Fire Code	On-site structures (temporary or permanent)	Government Service Centre	Approval is required for fire prevention systems in all approved buildings.
Compliance standards; permits may be required	National Building Code	On-site structures (temporary or permanent)	Government Service Centre	Approval is required for all building plans.
Municipalities				
Development or Building Permit	*Urban and Rural Planning Act, 2000,* and Relevant Municipal Plan and Development Regulations	Development within municipal boundary	Town/Community Council	A permit is required for any development or building within municipal boundaries.
Approval for Waste Disposal	*Urban and Rural Planning Act, 2000,* and Relevant Municipal Plan and Development Regulations	Waste disposal	Town/Community Council	The use of a community waste disposal site in Newfoundland and Labrador by proponents/contractors to dispose of waste requires municipal approval. Restrictions may be in place as to what items can be disposed of a municipal disposal site.

APPENDIX 3-2

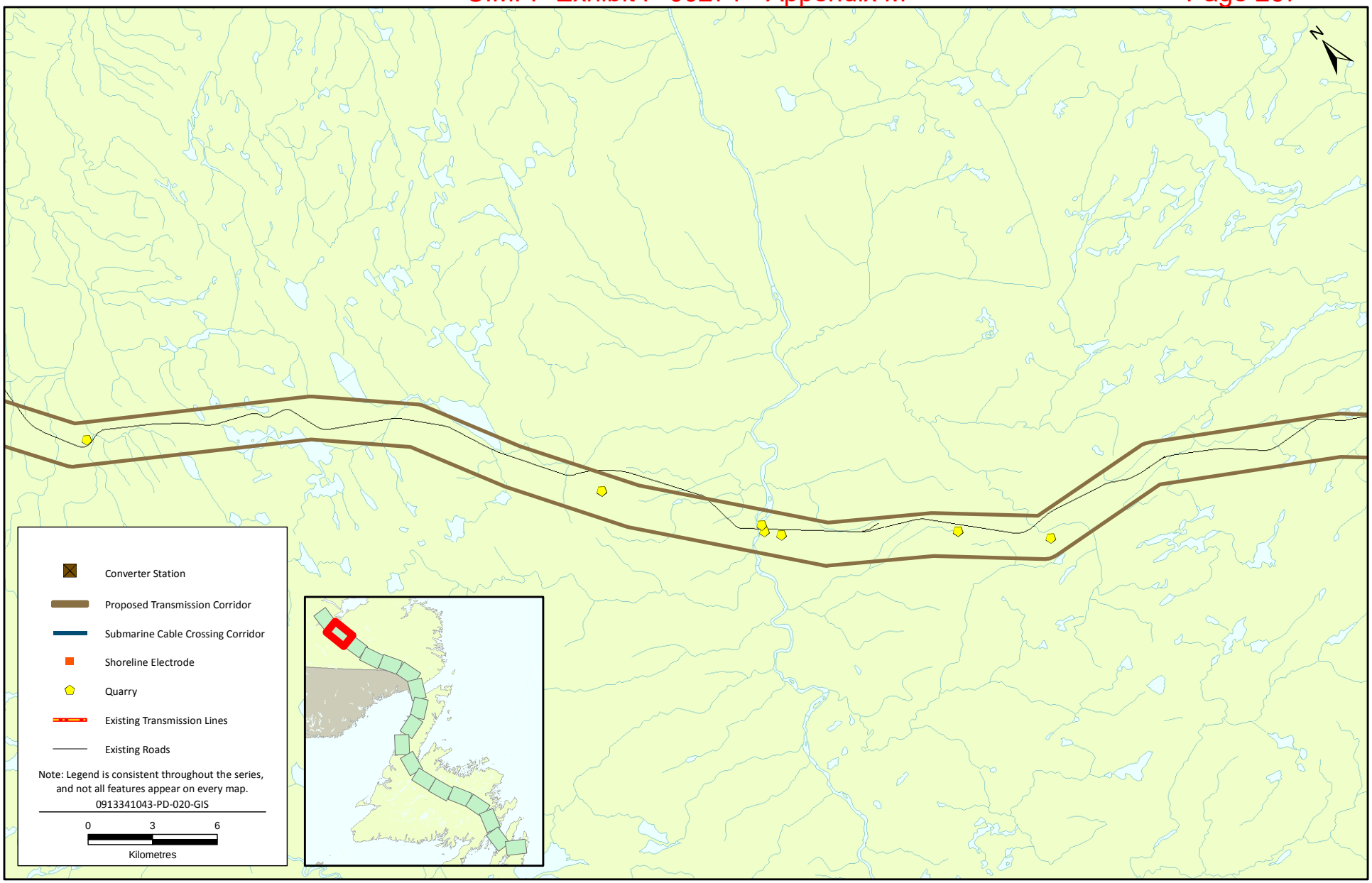
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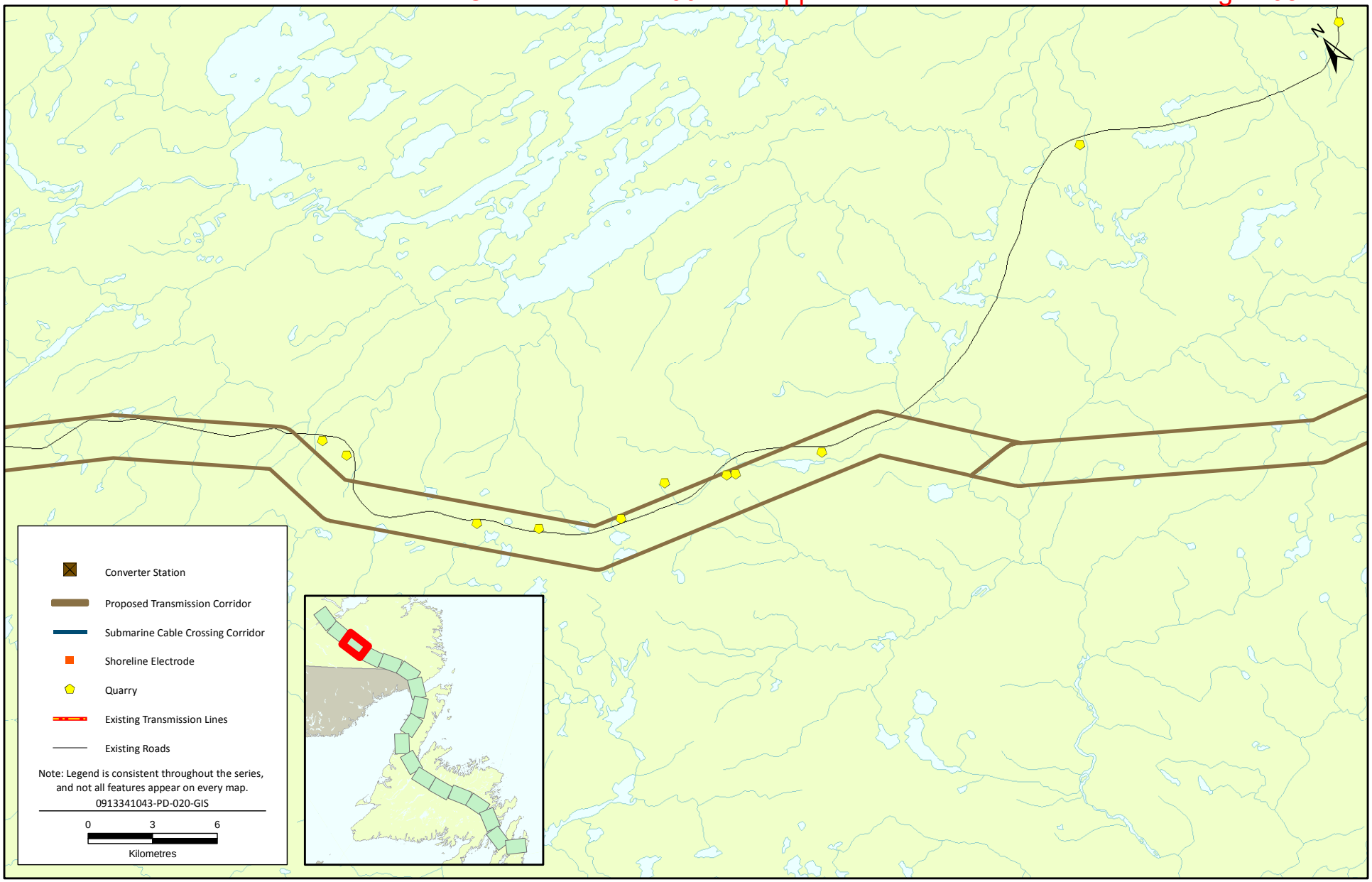
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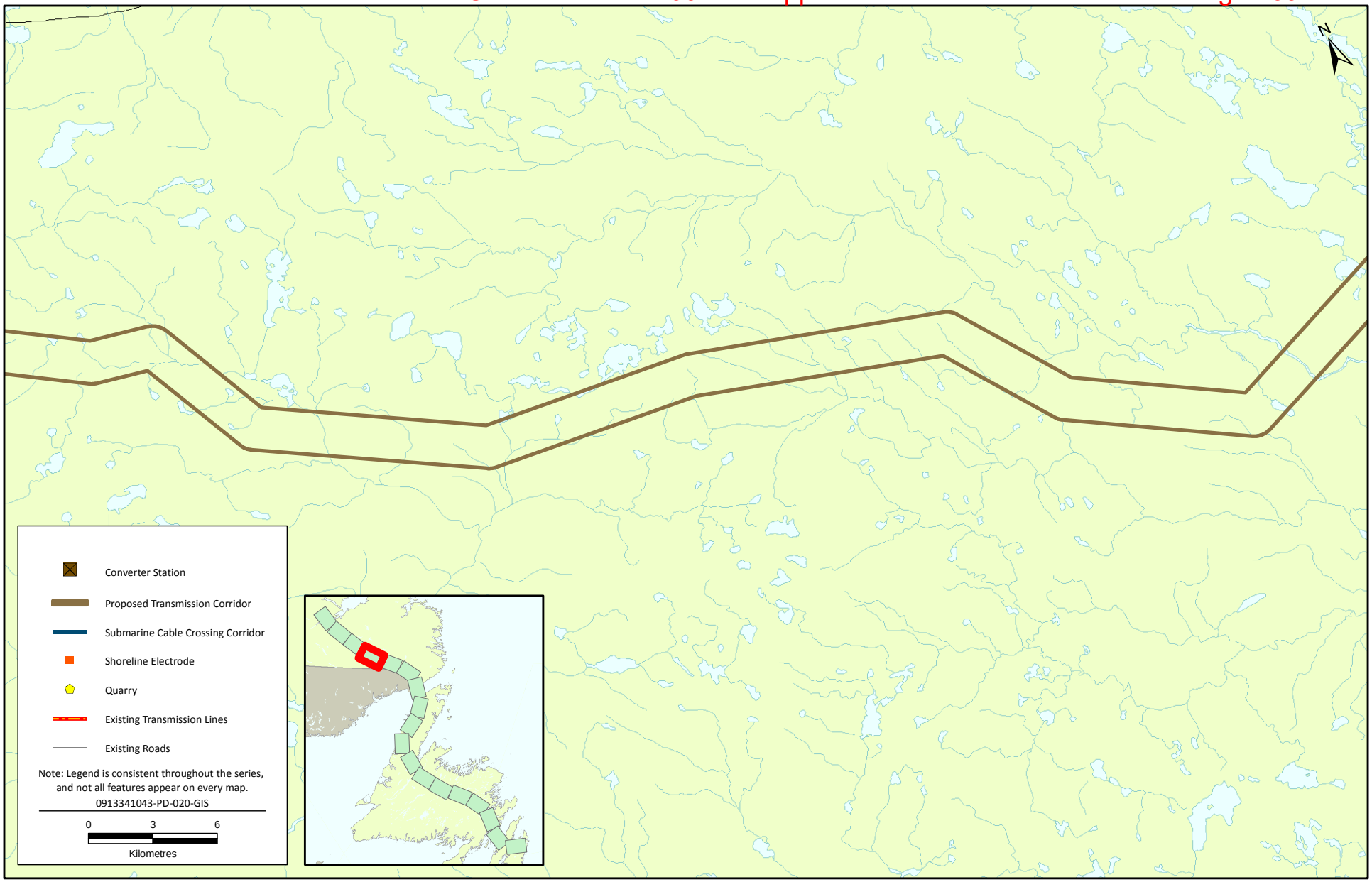
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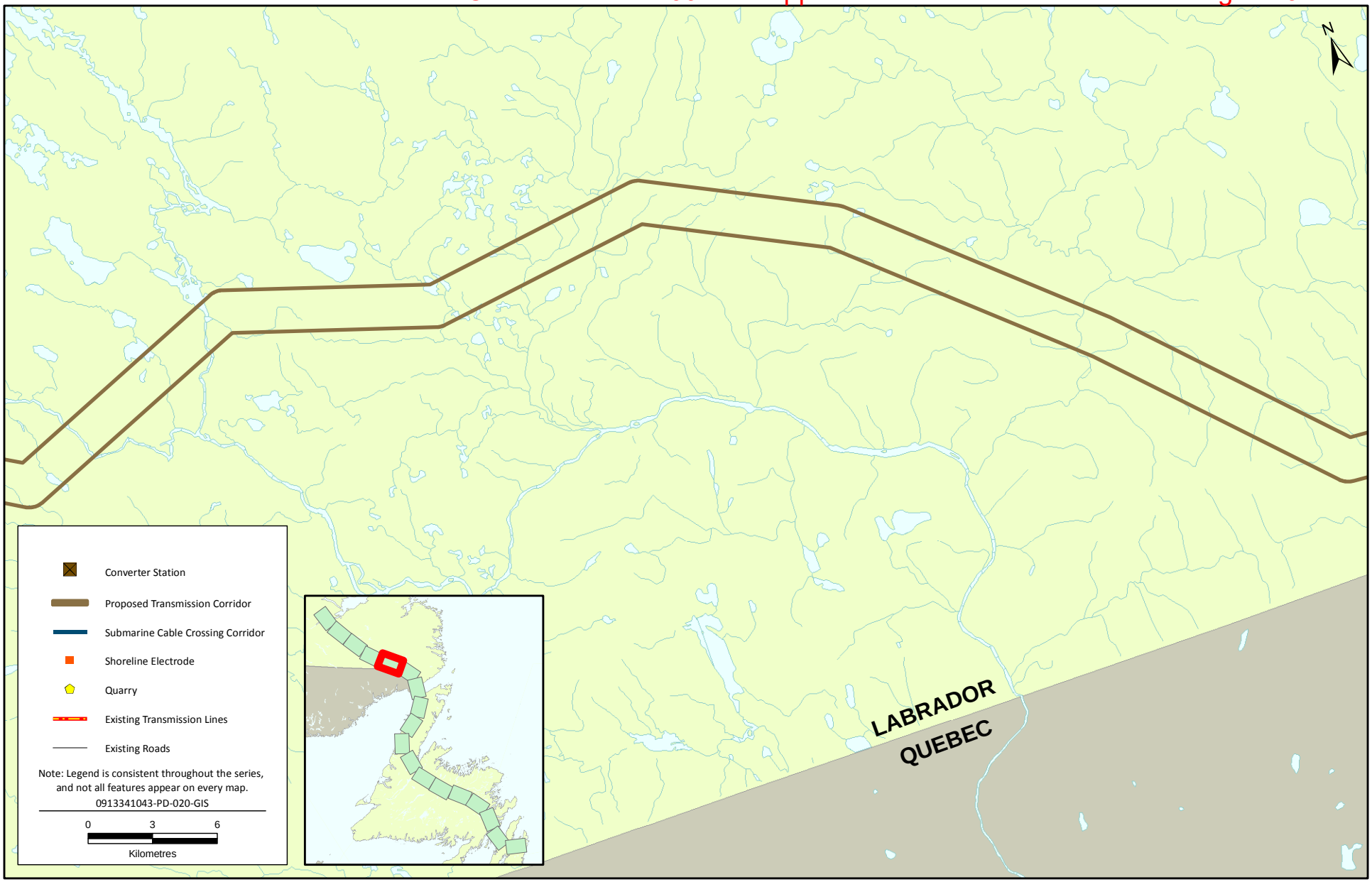
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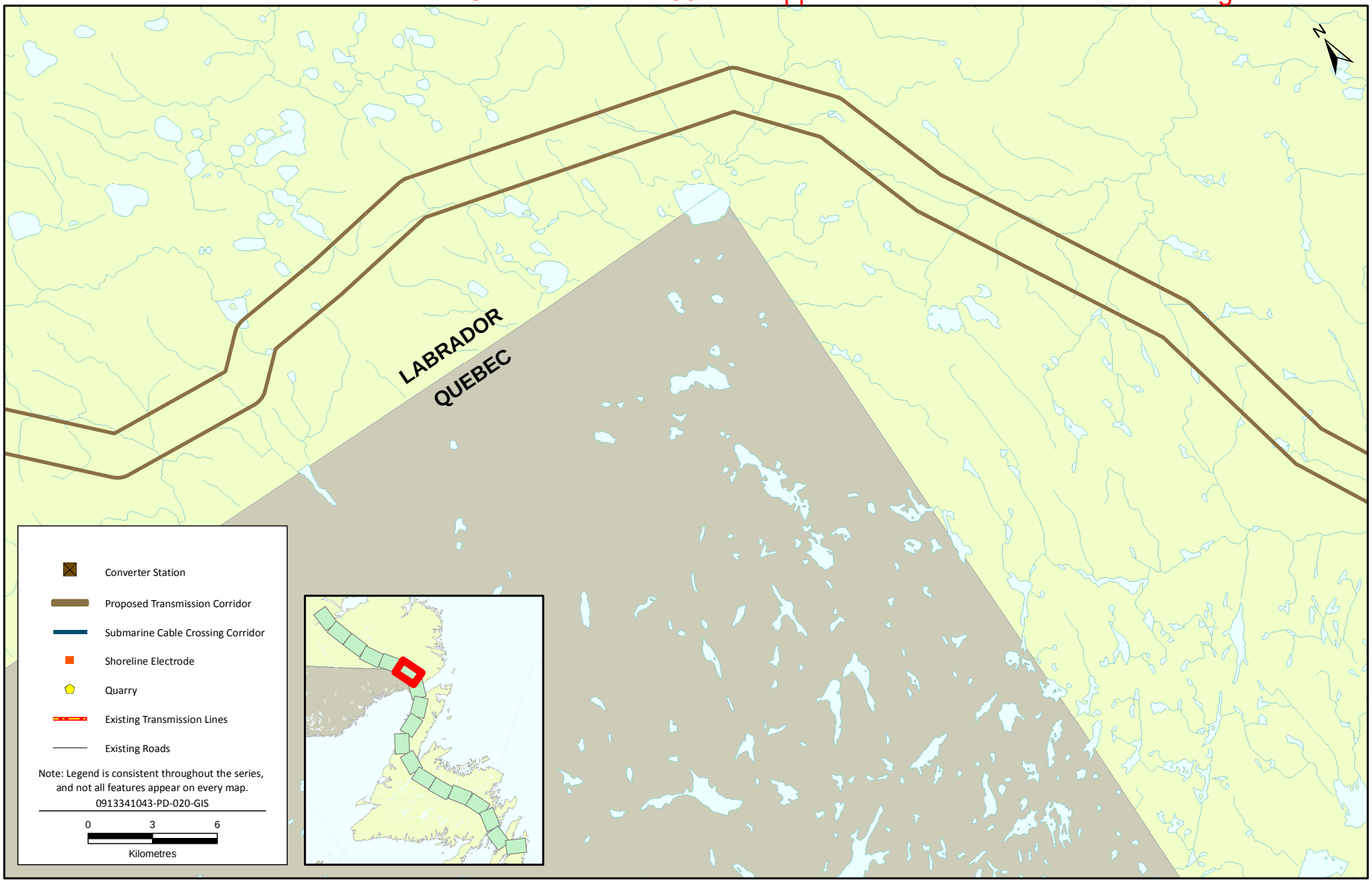
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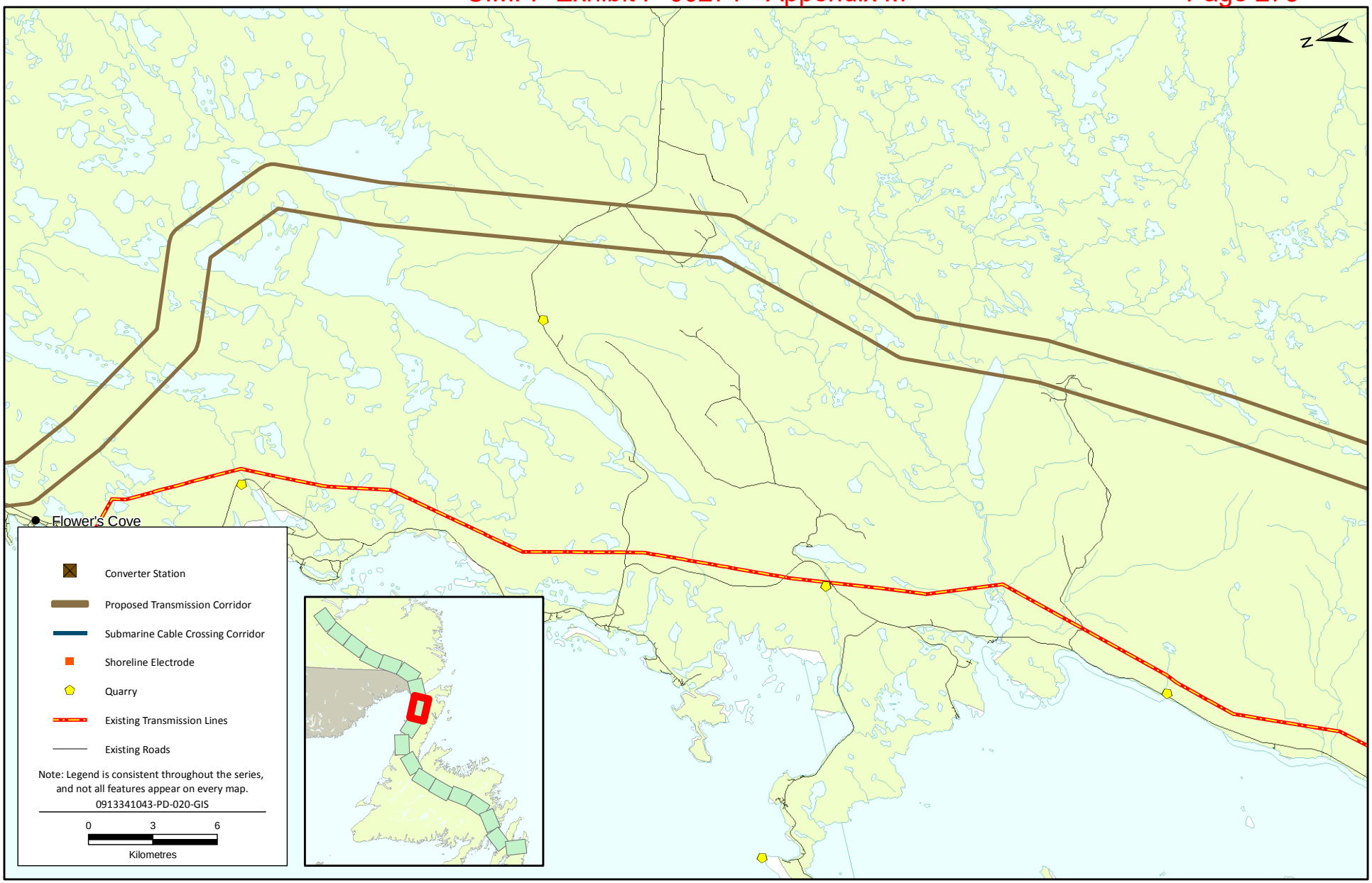
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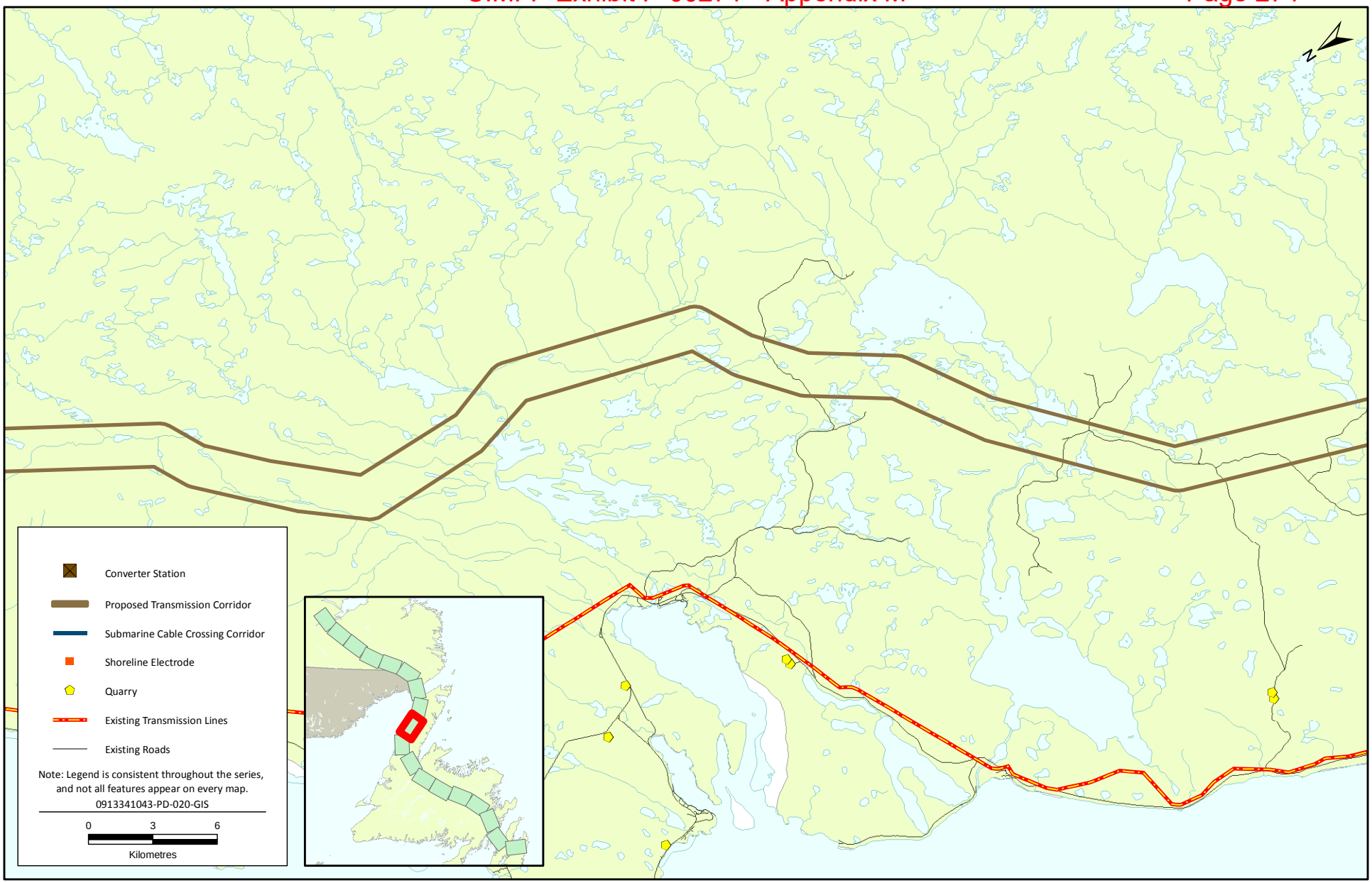
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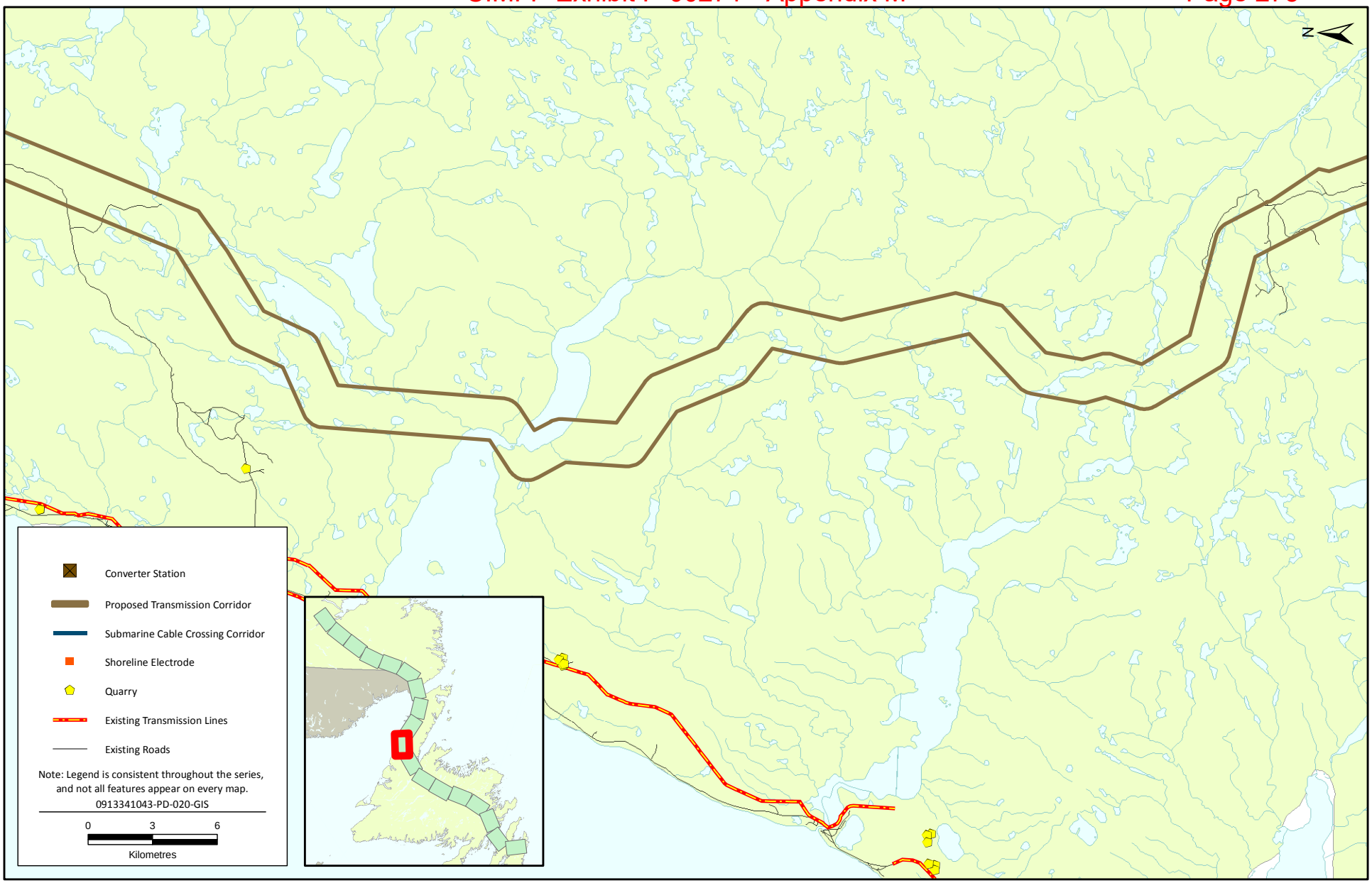
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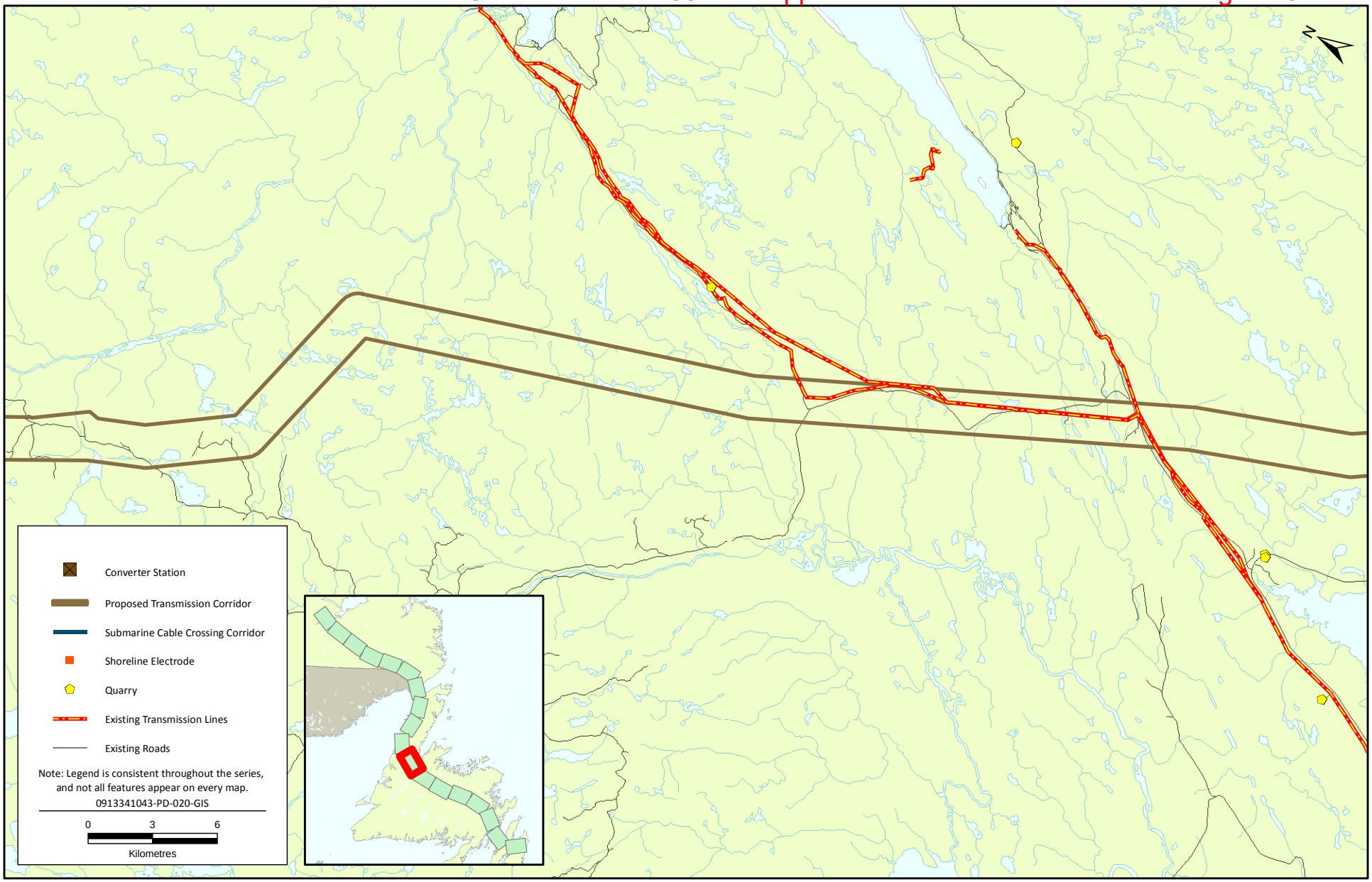
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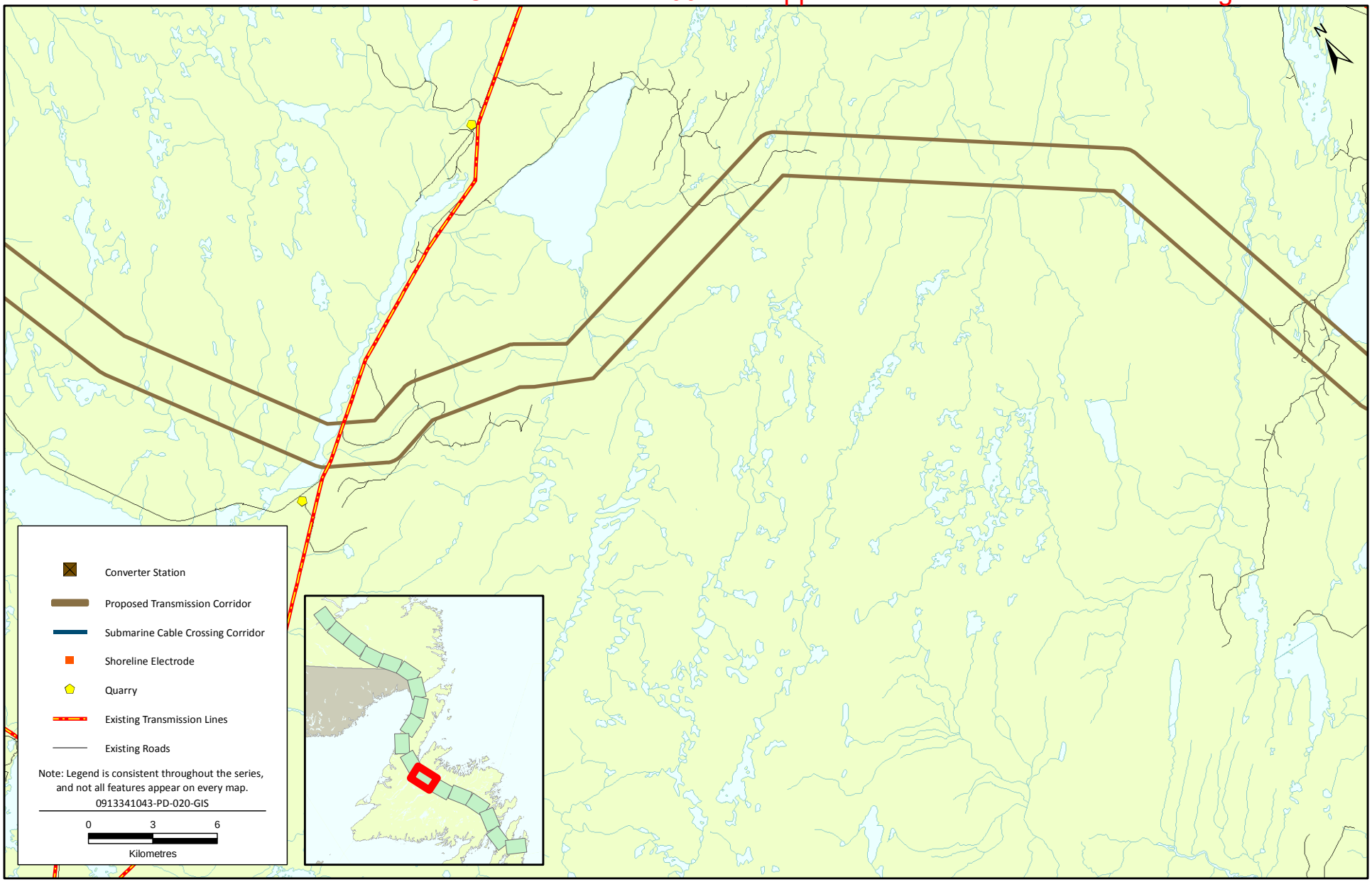
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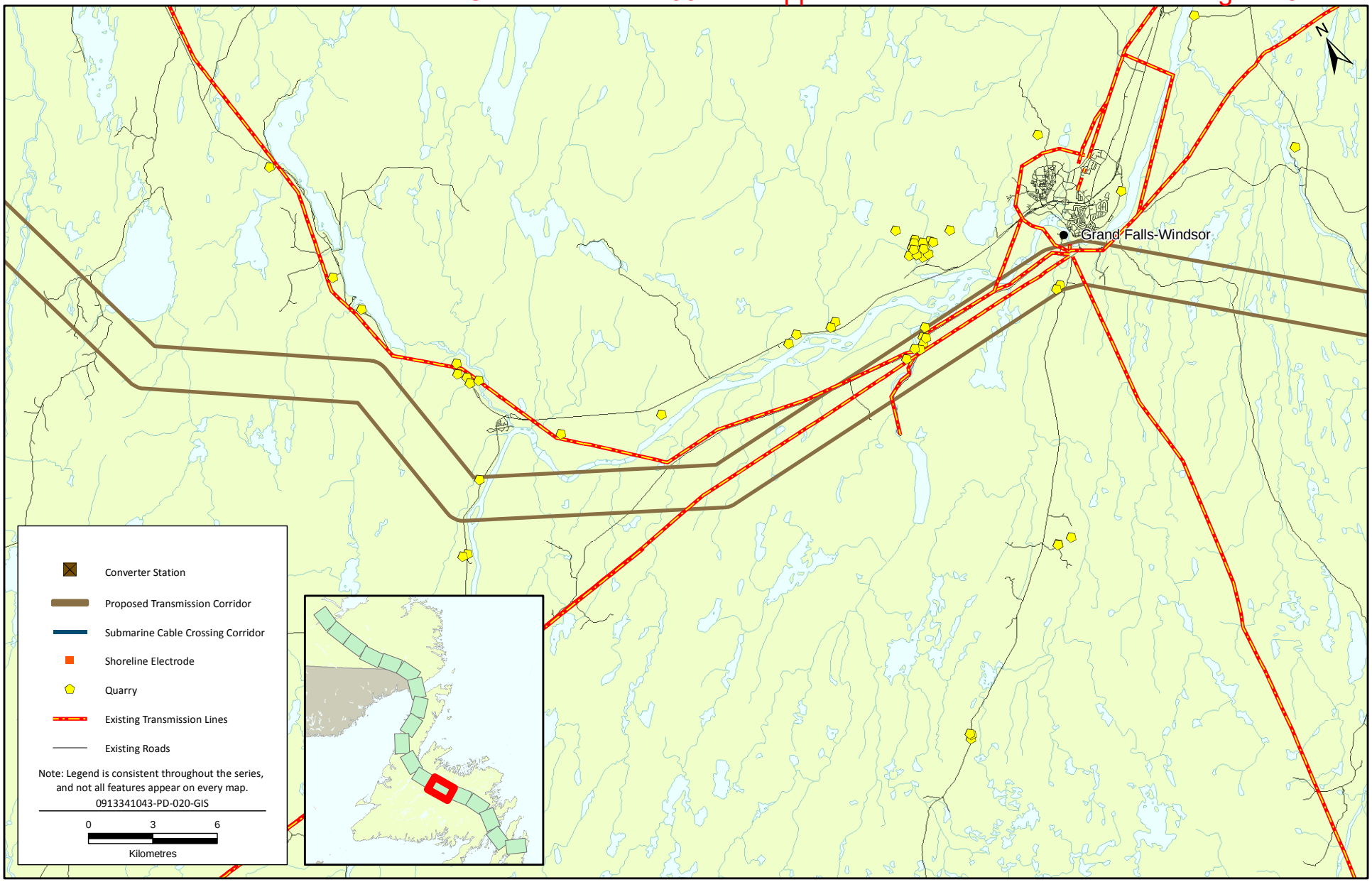
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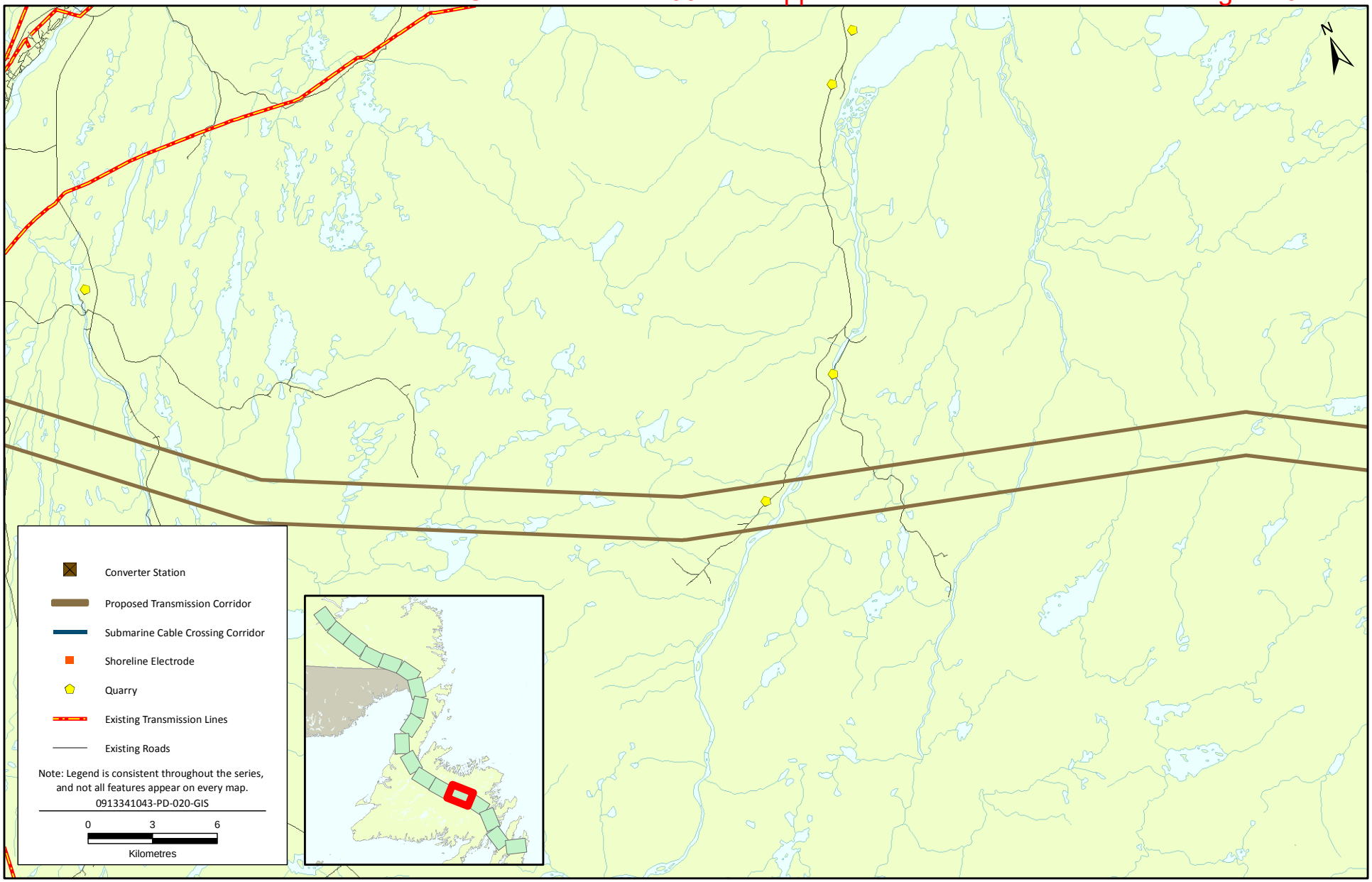
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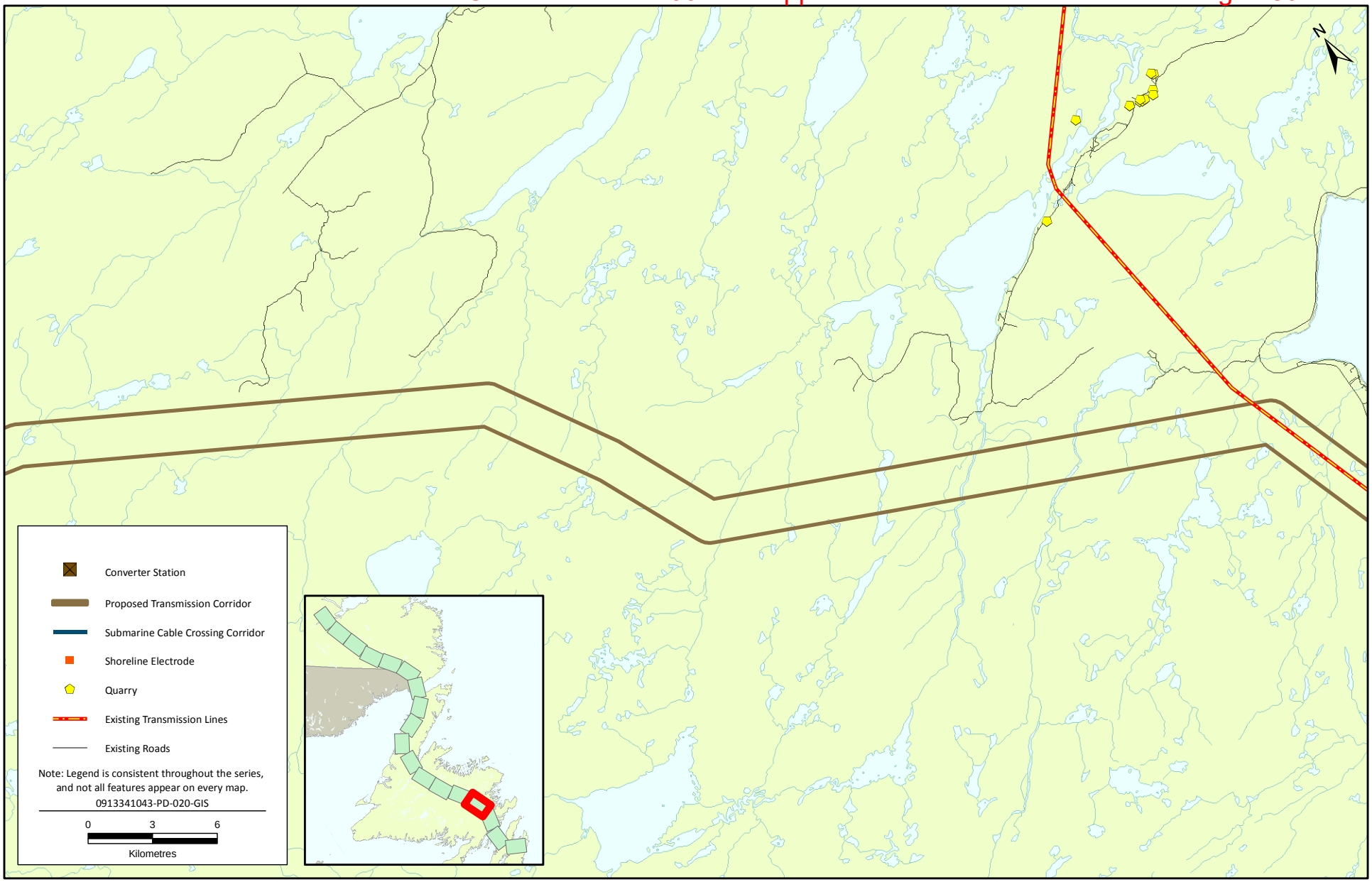
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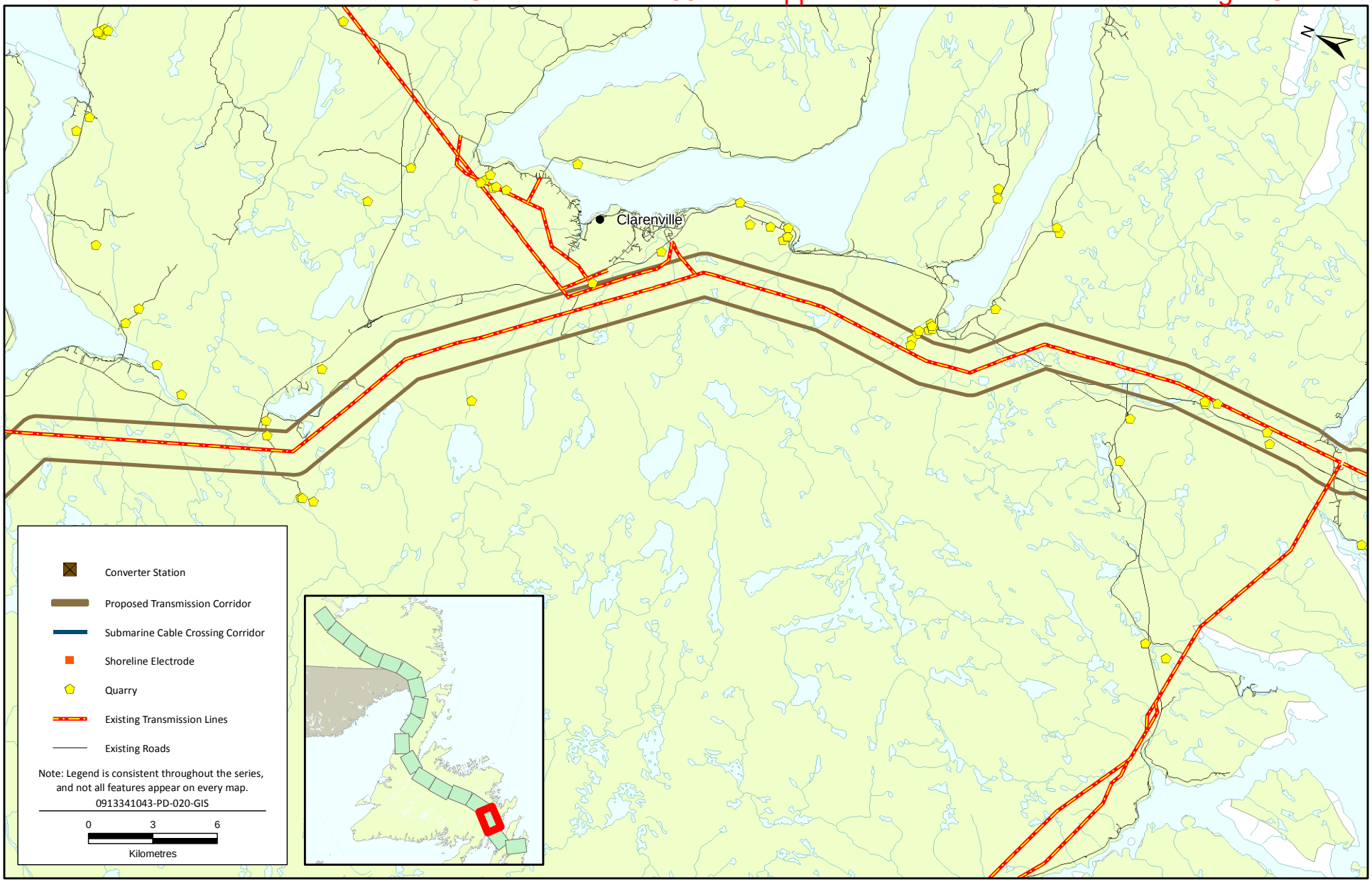
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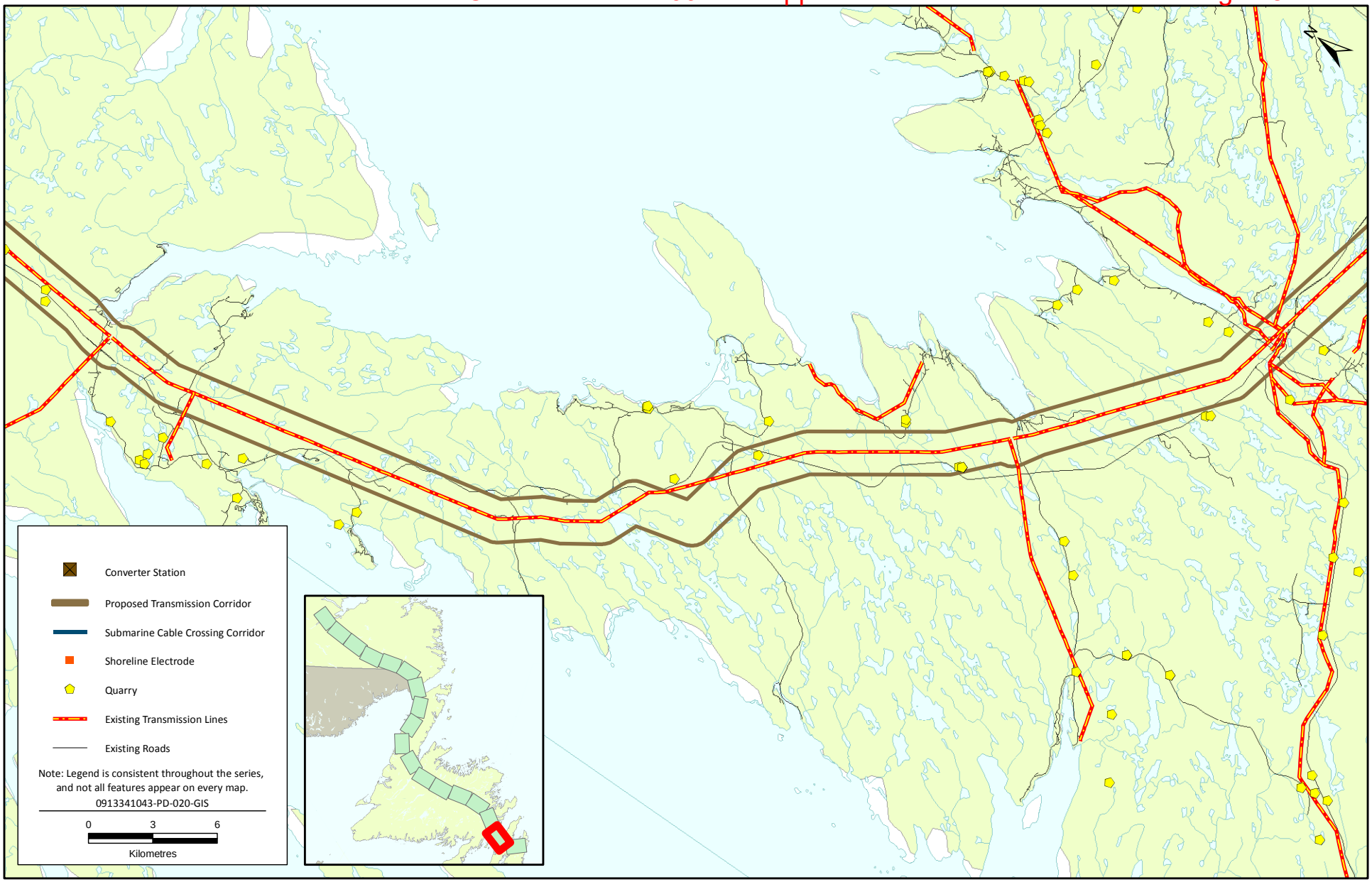
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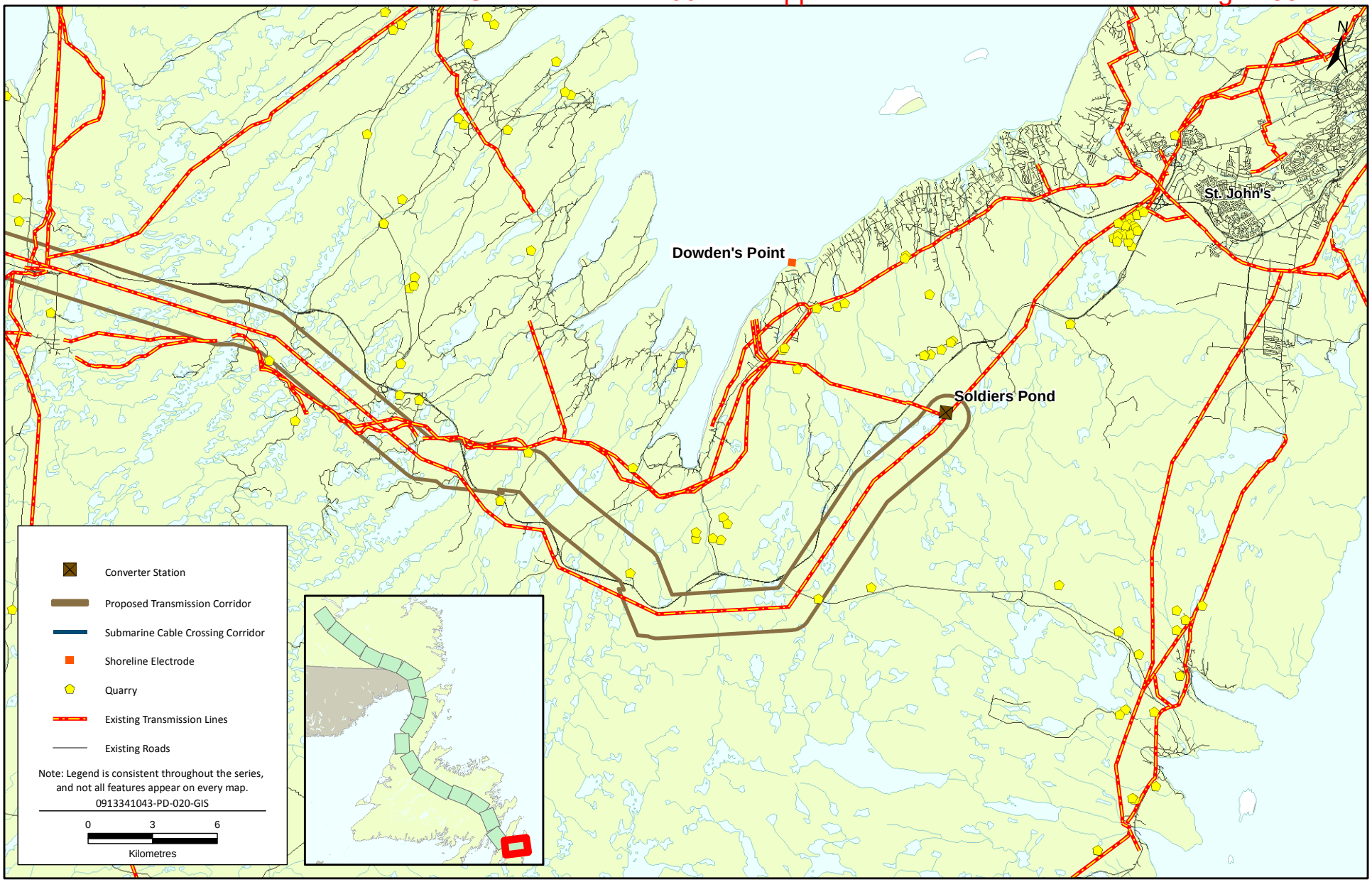
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Existing Roads and Quarries



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Existing Roads and Quarries

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NALCOR ENERGY'S ENVIRONMENTAL POLICY AND GUIDING PRINCIPLES

ENVIRONMENTAL POLICY AND GUIDING PRINCIPLES



Nalcor Energy will help sustain a diverse and healthy environment for present and future Newfoundlanders and Labradorians by maintaining a high standard of environmental responsibility and performance through the implementation of a comprehensive environmental management system. The following guiding principles set out Nalcor Energy's environmental responsibility:

PREVENTION OF POLLUTION

- Implement reasonable actions for prevention of pollution of air, water, and soil, and minimize the impact of any pollution which is accidental or unavoidable.
- Use energy as efficiently as possible during the generation, transmission, and distribution of electricity, and the operation of its facilities and promote efficient use of electricity by customers.
- Maintain a state of preparedness in order to respond quickly and effectively to environmental emergencies.
- Recover, reduce, reuse and recycle waste materials whenever feasible.
- Use the province's natural resources in a wise and efficient manner.

IMPROVE CONTINUALLY

- Audit facilities to assess potential environmental risks and continually improve environmental performance.
- Integrate environmental considerations into decision-making processes at all levels.
- Empower employees to be responsible for the environmental aspects of their jobs and ensure that they have the skills and knowledge necessary to conduct their work in an environmentally-responsible manner.



COMPLY WITH LEGISLATION

- Periodically report to the Board of Directors, executive management, employees, government agencies, and the general public which we serve on environmental performance, commitments and activities.
- Comply with all applicable environmental laws and regulations, and participate in the Canadian Electricity Association's Environmental Commitment and Responsibility Program.
- Monitor compliance with environmental laws and regulations, and quantify predicted environmental impacts of selected activities on the environment.
- Respect the cultural heritage of the people of the province and strive to minimize the

NALCOR ENERGY

LABRADOR-ISLAND TRANSMISSION LINK

ENVIRONMENTAL IMPACT STATEMENT

Chapter 4
Effects of the Environment on the Project

April 2012

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LIST OF ACRONYMS

Acronym	Description
°C	degrees Celsius
%	percent
CH_4	methane
cm	centimetre
CO_2	carbon dioxide
DFA	Department of Fisheries and Aquaculture
DFO	Fisheries and Oceans Canada
EIS	Environmental Impact Statement
ha	hectare
HDD	Horizontal Directional Drill
IEC	International Electrotechnical Commission
km	kilometre
km/h	kilometres per hour
m	metre
m/s	metre per second
N_2O	nitrous oxide
NBCC	National Building Code of Canada
NLDEC	Newfoundland and Labrador Department of Environment and Conservation
NRCan	Natural Resources Canada
OHGW	Overhead Groundwire
OPGW	Optical Overhead Groundwire
PIM	Passive Ice Meters
Project	Labrador-Island Transmission Link
ROW	right-of-way
TL	Transmission Line (when referring to specific line number)

4 EFFECTS OF ENVIRONMENT ON THE PROJECT

This chapter assesses effects that may occur as a result of the environment acting on the Labrador-Island Transmission Link (Project). The *Environmental Impact Statement Guidelines and Scoping Document* for the Project, issued by the Government of Newfoundland and Labrador and the Government of Canada in May 2011 (Government of Newfoundland and Labrador and Government of Canada 2011), also states that environmental changes and hazards that may affect the Project are to be described in the EIS. The environmental conditions and events that might affect the Project, and the potential effects of these conditions or events on Project design, Construction, and Operations and Maintenance are presented. These effects are predicted and described in this section.

For over 50 years, Nalcor Energy (Nalcor) and its subsidiaries have been building, operating and maintaining electricity generation and transmission projects within the Newfoundland and Labrador environment. Throughout Project planning and design, Nalcor drew on its own experience, historical data, published literature and industry standards to design a Project capable of withstanding anticipated environmental conditions.

A comprehensive study was undertaken to determine the preferred transmission corridor. This determination required balancing several, often competing, criteria, including line length, terrain, access, exposure to ice and wind, technical criteria and other environmental considerations. In general, the objective was to select the shortest corridor that avoids or limits conflict with environmental sensitivities and crosses terrain where Project Construction is technically feasible. This chapter describes the known and anticipated environmental conditions that may affect the Project and how these conditions influenced Project design.

An environmental condition is considered to have a potential effect on the Project if it may result in one or more of the following:

- harm to Project personnel or the public;
- substantial delay in Construction (i.e., more than one season);
- long-term interruption in service (i.e., more than one week);
- damage to infrastructure;
- threat to public safety; and
- damage to infrastructure to the extent that repair is not economically or technically feasible.

Historical data, computer modelling and published literature were used to characterize the environmental conditions that may affect the Project. Engineering specifications and design loads were determined based on historical, current and anticipated environmental conditions. Safety, durability and corrosion resistance throughout the life of the Project were considered during material selection. Environmental conditions that either affected Project design or have the potential to affect Project Construction, and Operations and Maintenance, include:

- vegetation;
- lightning;
- forest fire;
- wind, freezing precipitation and ice accretion;
- salt spray;
- bathymetry;
- currents and tides;

- waves;
- sea ice and icebergs;
- seismicity;
- climate change;
- land and resource use; and
- fisheries.

4.1 Biophysical Environment

4.1.1 Vegetation

4.1.1.1 Environmental Conditions

The transmission corridor crosses ten distinct ecoregions, four in Labrador and six in Newfoundland. Each ecoregion can be characterized by its predominant vegetation type, including forest, bog and fen, barren, coastal and highland.

Approximately half of the Labrador transmission corridor lies within the Low Subarctic Forest (Mecatina River) Ecoregion. The most common habitat types crossed by the transmission corridor in Labrador include Open Conifer Forest, Conifer Forest, Conifer Scrub and Wetland, each occupying less than a third of the total area. Uncommon habitat types include Spruce Lichen Forest, Burn, Hardwood Forest and Mixedwood Forest.

Approximately half of the transmission corridor in the Northern Peninsula of Newfoundland lies within the Northern Peninsula Forest Ecoregion, and approximately a third lies within the Long Range Barrens Ecoregion. The dominant habitat types crossed by the transmission corridor within the Northern Peninsula region include Conifer Forest, Scrub / Heathland / Wetland Complex and Open Conifer Forest. Uncommon habitat types crossed by this portion of the transmission corridor include Alpine Vegetated, Conifer Scrub, Kalmia Lichen / Heathland and Rocky Barrens.

Almost all of the Central and Eastern Newfoundland portion of the transmission corridor is located within the Central Newfoundland Forest Ecoregion. The most common habitat type crossed by the transmission corridor is Mixedwood Forest. Uncommon habitat types include Conifer Scrub, Kalmia Lichen / Heathland and Rocky Barrens.

Most of the Avalon Peninsula portion of the transmission corridor is located within the Maritime Barrens Ecoregion. Scrub / Heathland / Wetland Complex is the most common habitat type crossed by the transmission corridor. Uncommon habitat types crossed include Burn, Conifer Scrub and Wetland.

A more detailed description of vegetation is provided in Section 10.3.3.

4.1.1.2 Effects on Project Design, Construction, and Operations and Maintenance

Vegetation affected the Project design primarily during the selection of the transmission corridor and siting of Project components (i.e., converter stations, transition compounds). Corridor selection and component siting involved the compilation of information on existing vegetation to identify and evaluate key, sensitive vegetation communities. The specific transmission line routing and component siting that will occur during detailed Project design will avoid, to the extent practical, vegetation communities that are more sensitive to disturbance (e.g., wetlands, riparian shorelines, habitat types supporting listed plants), those that are more difficult to reclaim, and those that are of stakeholder or management concern (i.e., uncommon Habitat Types, limestone barrens).

Project Construction will be affected by vegetation during siting of construction infrastructure (e.g., temporary camps, marshalling yards, Horizontal Directional Drill (HDD) sites) and clearing activities (e.g., right-of-way (ROW) clearing). Nalcor will attempt to use existing disturbances (e.g., clear cuts) to the extent practical, and will also attempt to use parallel (or otherwise) existing disturbance corridors (e.g. roads, transmission line ROWs) to reduce the amount of new access that is required, and thus the amount of clearing. In addition, the amount and type of equipment required for the clearing process will be determined by the vegetation types within the areas that require clearing.

During Project operation, vegetation, such as trees, can cause power outages if they come into contact with the conductors. To prevent contact between vegetation and the conductor, the transmission line will be located within a cleared ROW 60 metres (m) wide, on average. It is also conceivable that tall trees outside the ROW that pose a risk to the transmission line operation may be selectively removed. During Project operation, vegetation within the ROW will be controlled through a combination of herbicide application and manual cutting, as described in Section 3.5.2.

4.1.2 Lightning

4.1.2.1 Environmental Conditions

Between two and three million cloud to ground lightning flashes were recorded annually in Canada between 1999 and 2008. Although lightning is recorded in Canada during every month of the year, it is most frequently recorded in July, followed by August and June (Environment Canada 2011a, internet site). Lightning activity recorded in major Newfoundland and Labrador cities and towns between 1999 and 2008 is described in Table 4.1.2-1.

Table 4.1.2-1 Lightning Activity in Major Newfoundland and Labrador Cities and Towns

City/Town	Area in Square Kilometres	Cloud to Ground Strikes (1999 to 2008)	Cloud to Ground Strikes per Square Kilometre per Year
Grand Falls-Windsor	11.62	18	0.15
Gander	6.22	7	0.11
Goose Bay	7.52	6	0.08
Mount Pearl	18.74	8	0.04
Corner Brook	14.23	6	0.04
Conception Bay South	21.26	6	0.03
Paradise	9.91	2	0.02
St. John's	39.58	7	0.02
Labrador City	3.07	0	0.00

Source: Environment Canada (2011a, internet site).

The Canadian Electrical Association reports a 30-year average Annual Ground Flash Density of 0.7 flashes per square kilometre (km^2) per year (Canadian Electrical Association 1998) along the transmission corridor. Annual Ground Flash Density is the number of lightning strikes to ground during one year, averaged over the landmass area.

4.1.2.2 Effects on Project Design, Construction, and Operations and Maintenance

Lightning strikes can result in flashovers. The Project was therefore designed to include an Optical Overhead Groundwire (OPGW) that will be suspended from the tops of the transmission towers to protect the system from lightning strikes. In addition, counterpoise will be installed along the ROW to reduce the electrical

resistance between the transmission tower and the ground. The counterpoise will be attached to the base of each tower to further protect the transmission line against damage from lightning. Within 1.6 km of the Soldiers Pond converter station, the transmission towers for existing Transmission Lines (TL) 217, TL 201, TL 218, and TL 242 will be rebuilt so that lightning protection (i.e., an OHGW) can be installed.

During Construction, lightning could strike a tower, which could affect Project personnel in the area.

Given the design measures described above, it is unlikely that lightning will affect Project operation. A lightning strike could result in a flashover; however, it is very unlikely that such an event would result in a power outage. Lightning strikes are also a major cause of forest fires, which could affect the Project. Forest fires are discussed in Section 4.1.3.

4.1.3 Forest Fire

4.1.3.1 Environmental Conditions

Forest fires occur with relatively low frequency in the province. Over the past decade, an average of 55 forest fires have occurred in Newfoundland each year, and an average of 45 forest fires have occurred in Labrador each year, as shown in Table 4.1.3-1. Although the incidence of fires is similar between Newfoundland and Labrador, the average size of fires in the two regions differs. The average extent of forest fires in Newfoundland is less than 3.5 hectares (ha) while the average extent of forest fires in Labrador is 470 ha (Sullivan 2010, pers. comm.). This difference is attributed to the DNR Forest Services Branch policy not to fight fires that do not threaten communities or harvestable resources (Michelin 2008, pers. comm.). As a result, most fires within Labrador do not generate a response, while most fires are actively suppressed in the more densely populated Newfoundland.

Table 4.1.3-1 Provincial Forest Fire Statistics for the Period 2000 to 2009

Year	Eastern Newfoundland		Western Newfoundland		Labrador	
	Number	Average Area (ha)	Number	Average Area (ha)	Number	Average Area (ha)
2000	108	0.49	16	11.17	95	1,564.00
2001	142	0.89	37	5.79	23	40.63
2002	74	1.67	18	10.27	51	21.18
2003	97	6.87	29	0.58	65	546.66
2004	104	11.5	19	1.68	30	37.65
2005	85	1.73	30	1.35	30	754.89
2006	36	1.69	27	3.55	33	99.37
2007	43	1.28	12	3.15	32	337.46
2008	50	1.39	22	1.46	67	75.23
2009	130	2.43	17	0.31	29	1,205.06
Average	**86.9**	**2.99**	**22.7**	**3.93**	**45.5**	**468.21**

Note: This table includes unpublished data provided by the Department of Natural Resources, Forest Services Branch, Forest Engineering and Industry Services Division, Fire Management and Co-ordination Section, Corner Brook (Sullivan 2010, pers. comm.).

In the experience of the provincial Forest Services Branch, fires that are fought rarely exceed 100 ha in size (Michelin 2008, pers. comm.). However, there have been forest fires fought over the past ten years that have exceeded 1,000 ha in Newfoundland and 30,000 ha in Labrador (Hewitt 2010, pers. comm.). Lightning caused

16.6 percent (%) of the 1,551 forest fires that occurred in the province between 2000 and 2009. Most of the other fires were caused by human activity (e.g., grass burning), and a small percentage of forest fires had unknown causes (Sullivan 2010, pers. comm.). Fires caused by lightning often occur in remote areas, resulting in fires that are larger and more difficult to control. Observations of local foresters and studies of lightning activity indicate that a single storm can provide an ignition source for numerous fires across a large area (Kasische and Stocks 2000; Kourtz 1967; Komarek 1966).

According to a study of the history of fire in the boreal forest of south-eastern Labrador (Foster 1983), forest fires occur from early June to late October, with peaks in ignition in late June and early July. Foster (1983) also found a good correlation between extensive fires and below average summer precipitation in south-eastern Labrador. Fires in the fall were generally short in duration and did not result in large areas of burn, as fires were extinguished by rain or early snowfall (Foster 1983).

Vegetation type also influences the probability and extent of a forest fire. Approximately two thirds of the Labrador portion of the transmission corridor crosses coniferous forest. On the Island, approximately half of the habitat crossed on the Northern Peninsula and through Central Newfoundland, and less than one third of the habitat crossed on the Avalon Peninsula is coniferous or mixed wood forest.

4.1.3.2 Effects on Project Design, Construction, and Operations and Maintenance

Although the potential for forest fires did not affect Project design, forest fires can result in damage to Project infrastructure, including the transmission line, wood poles of the electrode lines, and the converter stations during Project Construction, and Operations and Maintenance. The transmission line and associated infrastructure are located within a cleared ROW, where vegetation control measures will be implemented. The limited availability of fuel (i.e., vegetation) along the ROW is expected to limit the effects of a forest fire on transmission line infrastructure. In some cases, the ROW would act as a fire break and retard the spread of a fire. Although forest fires are not expected to affect the steel transmission towers, they could affect the converter stations or the wood poles connecting the transmission line to the electrode sites. The destruction of the wood poles would render the associated electrode unavailable until repairs could be completed. If a forest fire does encroach on the ROW, the transmission line may need to be temporarily taken off-line so that water bombers are not emptying their loads on energized lines.

Forest fire mitigation and response were factored into the effects analysis discussed in Chapter 12.

4.1.4 Wind, Freezing Precipitation and Ice Accretion

4.1.4.1 Environmental Conditions

Wind

The maximum hourly wind speed is commonly used, in combination with ice load, for transmission line design. Maximum hourly wind speed is defined as the maximum wind speed measured during the last two minutes before the hour. For the Project, data were obtained from 20 Environment Canada meteorological stations, located in the regions crossed by the transmission corridor. Five of these stations are located in Labrador, one in Québec (Blanc-Sablon), one on the Newfoundland side of the Strait of Belle Isle, and thirteen in Newfoundland. Seventeen of the 20 stations have collected more than 30 years of data.

Labrador

Labrador's climate is more continental than maritime, so it experiences strong seasonal contrasts in the characteristics and movements of air masses. The predominant air flow is off the land (i.e., from the west). The Torngat Mountains in the north, with peaks above 1,500 m, and the Mealy Mountains in the south, with peaks approximately 1,200 m, confine the moderating influence of the Atlantic Ocean largely to the coastal regions. Compared with the maritime climate of the east coast of Labrador and the Québec north shore of the Gulf of

St. Lawrence, the continental climate of the interior is characterized by much colder winters and warmer summers (Environment Canada 1990).

In Labrador, the mean annual wind speed is 15 km/h. Along the coast (Cartwright) and the Québec north shore (Blanc-Sablon), the mean annual wind speed is between 20 km/h and 25 km/h, and the prevailing wind direction is from the south at Cartwright and from the west at Blanc-Sablon. In Upper Lake Melville, at Happy Valley-Goose Bay, the mean annual wind speed is 15.4 kilometres per hour (km/h) and the prevailing wind direction is from the south-west (Environment Canada 2010, internet site).

In central Labrador, the maximum hourly wind speed for a 50-year return period is between 60 km/h and 80 km/h. Along the east coast of Labrador and the Québec north shore, maximum wind speeds are higher, with 93 km/h recorded at Mary's Harbour, 100 km/h at Cartwright, and 120 km/h at Blanc-Sablon. The Belle Isle station is the windiest location, with a 50-year return period maximum hourly wind speed of 172 km/h, reflecting the funnelling effect of the Strait of Belle Isle. For all sites, January is the month with the highest wind speed (Environment Canada 2007, internet site).

Newfoundland

Newfoundland experiences a wide range of climates and weather, with many climatic features influenced by its unique geography. There are few topographical barriers to protect Newfoundland from weather systems, and Newfoundland's location on the eastern side of North America favours strong seasonal contrasts in the characteristics and movement of air masses. Newfoundland is the most maritime of the Atlantic Provinces, and this maritime climate generally results in more variable weather, with frequent low cloud, heavy precipitation, and strong winds (Environment Canada 1990).

Newfoundland is one of the stormiest parts of the continent, with some of the strongest winds of any province in Canada. Average annual wind speeds in Newfoundland are greater than 20 km/h (Environment Canada 1990). Generally, coastal areas have stronger winds than inland areas, valleys have lighter winds than elevated terrain, and winter is decidedly windier than summer. Winds are predominantly from the west year-round, but geographic and seasonal variations are common. The prevailing wind direction is west in winter and west-south-west in summer (Environment Canada 1990).

The mean wind speed from November to April is higher along the coast than inland, especially in the southern part of Newfoundland where it is 25 to 30 km/h. Bonavista, on the east coast, is the windiest location in Newfoundland, with mean wind speeds between 30 and 40 km/h. Inland (i.e., Deer Lake and Gander), the mean wind speeds are between 15 and 25 km/h (Environment Canada 2010). Calm or light wind occurs approximately 2% to 3% of the time along the coast but more than 10% of the time inland (Environment Canada 1990).

In Newfoundland, Badger and Deer Lake have maximum hourly wind speeds of 75 and 85 km/h, respectively, from November to April. For the other 11 stations, the maximum hourly wind speed is more than 100 km/h from November to April, except during some months in St. Anthony, Gander, Stephenville and Argentia, which are less exposed even though they are along the coast. Along the west coast of the Northern Peninsula, at Daniel's Harbour, the maximum hourly wind speed is 125 km/h and the bays along the coast can funnel the wind, further increasing this speed.

Freezing Precipitation and Ice Accretion

The two types of ice that can affect transmission lines and infrastructure are glaze ice and rime ice. Glaze ice is primarily caused by supercooled rain or drizzle striking a surface but not freezing rapidly on contact. Glaze ice is denser, harder, and sometimes more transparent than rime ice (Federal Aviation Administration 2010, internet site). Glaze ice typically creates a smooth, transparent and homogeneous ice coating. Rime ice typically forms at higher altitudes, on ridges and mountains. Rime ice forms in fog, when water droplets freeze to the outer surface of objects. Rime ice looks similar to frozen snow, is often not as dense as glaze ice and

clings less tenaciously to surfaces. Rime ice occurs at low temperatures, and it can accumulate in large quantities.

In Labrador, extended periods of east or north-easterly winds bring moist air over the coast. This moist air is cooled by the pack ice and forced upward, resulting in freezing drizzle or light freezing rain along the coast (NavCanada 2011, internet site).

Freezing rain storms tend to be more frequent in Newfoundland than in Labrador. The area between St. John's and Gander is particularly prone to freezing precipitation. Freezing precipitation events in this region can last for several hours or occur intermittently over several days. Freezing rain or freezing drizzle occurs in Newfoundland, on average, for 175 hours each winter (NavCanada 2011, internet site).

Since the early 1970s, numerous studies have been undertaken to determine ice loading for the transmission line between Central Labrador and Newfoundland's Avalon Peninsula. These include studies by the Meteorological Research Institute of California during the early 1970s (Meteorological Research Institute of California 1973), RSW Incorporated studies in the 1990s (RSW-EDM 1999; RSW Incorporated 1999, 1995), and monitoring programs conducted by Newfoundland and Labrador Hydro between 1977 and 2002. The latter included the operation of Passive Ice Meters (PIM) at 22 sites and Rosemont Ice Detectors at three other locations between 1977 and 1987 which were located throughout the province. To measure glaze and rime icing events, anemometers and test tower sites were established at 25 locations throughout the province, and an ice monitoring program was conducted at Gull Island from the fall of 1999 to the summer of 2002. In 2009, Nalcor installed three test tower spans in the Long Range Mountains (LRM) which included data collectors. Analysis of the data is a direct input into the design of the HVdc transmission line through the LRM area.

4.1.4.2 Effects on Project Design, Construction, and Operations and Maintenance

In general, daily weather does not have a measurable effect on transmission lines; however, understanding extreme events is important for the prevention of transmission tower collapse or conductor failure. Transmission tower height and configuration and the selection of conductor for the Project considered the potential effects of extreme weather events. An Extreme Value Analysis provides transmission line loading for maximum ice, maximum wind and a combination of ice and wind loading. In some cases, extreme loading can be reduced through routing of the transmission line. For example, alternative corridor segments were considered over the Highlands of St. John and the Long Range Mountains due to high levels of icing in these areas. In other cases Project components are designed to withstand extreme loading conditions.

Through Extreme Value Analysis, the design load magnitude (i.e., the anticipated force on each component due to ice accumulation and wind) for acceptable Project reliability can be determined. The Extreme Value Analysis of transmission line loads considers weather properties such as precipitation amount, temperature, humidity and wind speed. Hourly information collected by weather stations across the province over many years, and the results of mathematical ice accretion modelling, are used to determine the loads that can be expected on the transmission line. Typically, low voltage transmission lines are designed for a 50-year return period (i.e., they are designed to withstand a load that is statistically expected to occur once every 50 years). As per International Electrotechnical Commission (IEC) standards (IEC 2003) and internal Nalcor design requirements, base meteorological loads have been developed to reflect a 50-year return period for the Project. This design standard has been selected to reflect a high and acceptable level of reliability related to safe transmission line Operations and Maintenance.

The meteorological loadings used during Project design consider historical climate records and Nalcor's operational experience with electricity transmission systems. For Project design, the following three loading zones were defined based on broad topographic and climatic features:

- normal region, where ice and wind loading are representative of the average loading for the province;
- alpine region, where the corridor is subjected to severe wind and ice loads; and

- eastern region, where higher levels of ice are known to occur.

In each region, design loads include freezing rain accumulation (i.e., glaze ice) and extreme winds. Design loads in alpine regions also include rime ice.

Despite the design considerations described above, wind, precipitation and ice accretion could affect Project Construction, and Operations and Maintenance. High winds and heavy precipitation could result in schedule delays during Construction and extreme ice accretion and high winds could result in tower collapse or conductor failure.

4.1.5 Salt Spray

4.1.5.1 Environmental Conditions

In maritime environments, wave action releases small droplets of water into the air. These droplets may be carried inland by the wind. Depending on the relative humidity, some or all of the water in these droplets evaporates, leaving smaller droplets of brine or dry salt particles. Typically, areas within 5 kilometres (km) of the ocean can experience some degree of salt spray and salt accumulation.

4.1.5.2 Effects on Project Design, Construction, and Operations and Maintenance

High voltage direct current technology is sensitive to salt spray from the maritime environment, so it is necessary to, wherever possible, locate the line inland and away from the coast. Salt deposition can form a conductive layer on the surface of the transmission line insulators, resulting in current leakage, also called flashover, which can result in the failure of the transmission system (i.e., a power outage). Transmission corridor selection and the design of the transmission towers considered salt deposition and the potential for flashover. For example, the transmission corridor on the Northern Peninsula was routed inland away from salt spray areas to the extent practical. On the Avalon Peninsula isthmus, between Sunnyside and Chapel Arm, the number of insulators on each transmission tower will be increased. To accommodate the additional insulators, the tower height and cross arm lengths were also increased. Washing the insulators, as may be required during Project operation, will also reduce the potential for flashover to occur. These designed-in mitigation measures will reduce the likelihood of salt spray affecting the reliability of the transmission line during Project operation. Salt spray is not expected to affect Project Construction.

4.1.6 Bathymetry

4.1.6.1 Environmental Conditions

The coast on the Labrador side of the Strait of Belle Isle is steep granite, rising to flat-topped ridges and summits from 300 m to 900 m above sea level. The coast on the Newfoundland side of the Strait of Belle Isle only rises to approximately 30 m above sea level. Water depths in the Strait of Belle Isle vary greatly, reaching over 125 m in places. Woodworth-Lynas et al. (1992) identified five physiographic zones in the Strait of Belle Isle defined by their bathymetry. The Labrador Coastal Zone consists of the north-western slope of the Labrador Trough, with depths up to 115 m, a width of 1 km to 2 km, and uniform slopes of 6% to 12%. The Centre Bank South and Centre Bank North zones have depths ranging from 15 m to 85 m and are separated by a narrow 85 m deep trough. The Newfoundland Trough is 5 km to 12 km wide with depths ranging from 70 m to 125 m. The Newfoundland Coastal Zone is bounded by the Newfoundland coastline and a linear escarpment that separates this Zone from the Newfoundland Trough.

Detailed bathymetric data were collected in Conception Bay, at the Dowden's Point location in October 2010. The maximum recorded depth was 5.5 m. The bathymetry shows the sea bed to be uniform with depth increasing with distance from the shoreline. No large depressions or hummocks on the sea bed were detected (Sikumiut 2011).

More information on the bathymetry of the cable crossing corridor and the electrode sites can be found in Section 10.6.1.

4.1.6.2 Effects on Project Design, Construction, and Operations and Maintenance

Bathymetry affected Project design primarily during the selection of the submarine cable crossing corridor and landfall, and during shoreline electrode site selection. The 500 m wide submarine cable crossing corridor was selected primarily because it would provide the greatest natural protection (e.g., protection from iceberg scour) for the cables, give the shortest distance to deep water and make use of natural sea bed features to shelter the cables in deep valleys and trenches. The selection of cable protection methods (i.e., HDD, rock berm) was influenced by water depths, terrain and sea bed geology, and substrate characteristics. Bathymetry is not expected to affect Project Construction, and the design measures described above are expected to reduce the potential for conductor failure during Project Operations and Maintenance.

Shoreline electrode sites were similarly influenced by bathymetry in the Strait of Belle Isle and Conception Bay, where natural sea bed and shoreline conditions affected electrode berm design (e.g., dimensions of electrode berm) and construction methods (e.g., potential excavation requirements for achieving 4 m water depth within the shoreline electrode pond). Bathymetry is not expected to adversely affect electrode operation.

4.1.7 Currents and Tides

4.1.7.1 Environmental Conditions

Tides in the Strait of Belle Isle and along the coast of Newfoundland are semi-diurnal with two highs and two lows during every lunar day (i.e., 24 to 25 hours). Water levels in the Strait of Belle Isle vary by approximately 2.2 m during large tides (DFO 2010, internet site). The timing of high and low tides in the Strait of Belle Isle is variable due to the influence of the Atlantic Ocean at the north end of the Strait and Gulf of St. Lawrence at the south end of the Strait.

There are two basic types of currents that flow through the Strait of Belle Isle and along the coast of Newfoundland. Surface currents are influenced by meteorological conditions (e.g., wind speed and wind direction) and tidal currents are generated by tides. Currents within the Strait of Belle Isle typically follow the orientation of the Strait. A branch of the Labrador Current flows south-west along the Labrador coast into the Gulf of St. Lawrence, while water flows north-east from the Gulf of St. Lawrence through the Strait of Belle Isle along the coast of Newfoundland (Canadian Ice Service 2001, internet site). Maximum surface flows of 2.6 metres per second (m/s) have been recorded near the Labrador coast in the Strait of Belle Isle, and 2.4 m/s near the surface in the middle of the Strait. Maximum tidal flows of 1.6 m/s were recorded both near the Labrador coast and in the middle of the Strait (BIO 2010, internet site).

To add to Nalcor's existing substantial knowledge of the currents in the Strait of Belle Isle cable crossing corridor, Nalcor is conducting a two year current monitoring program, commencing in 2011 and continuing into 2012.

In Conception Bay, tidal changes in water level are typically about 0.9 m, but can be up to 1.3 m for large tides (Canadian Hydrographic Service 2001). Surface flows in Conception Bay are typically less than 0.02 m/s (de Young and Sanderson 1995) but have been recorded at speeds up to 0.43 m/s (Seaconsult 1990). Tidal flows are typically between 0.01 m/s and 0.02 m/s (de Young and Sanderson 1995). Currents along the eastern side of Conception Bay and near the mouth of Conception Bay are stronger than average, typically between 0.1 m/s and 0.2 m/s (de Young and Sanderson 1995).

More detailed information on currents and tides can be found in Section 10.6.2.

4.1.7.2 Effects on Project Design, Construction, and Operations and Maintenance

Currents and tides were considered during the design of the submarine cable crossing and the shoreline electrode sites, and will be further considered during final Project design. Horizontal directional drilling will allow the submarine cables to be installed below the sea bed for the first 1.5 km to 2.5 km on each side of the Strait of Belle Isle. The submarine cables will therefore not be affected by low tides or nearshore currents. When constructed and laid on the seafloor, the submarine cables will be sheltered by rock berms from the currents and any debris carried by the currents. Given these design measures, currents and tides are not likely to affect submarine cable Construction or Operations and Maintenance.

Tides could affect electrode operation if the electrodes do not remain submerged during low tide conditions (i.e., saltwater would not be available to dissipate the electrical current). As a result, the depth of the shoreline electrode ponds were designed to account for the installation of the electrode elements in the shoreline pond and changes in the water level due to tides and / or currents. The depth of the pond will be such that the electrode elements are fully immersed in the water under various tide or current conditions. Tides are expected to affect the construction sequence for the shoreline electrode berm in that the rock core material will be placed up to the high tide water level, then the electrode berm top core will be placed by the excavator as it works back toward the shoreline, as described in Section 3.4.

Given the design measures described above, shoreline electrode operation is not likely to be affected by tides or currents.

4.1.8 Waves

4.1.8.1 Environmental Conditions

Wave activity in the Strait of Belle Isle is influenced by wind speed and direction and, as a result, wave direction and height typically differ between the Labrador and Newfoundland sides of the Strait of Belle Isle. On the Labrador side, wave height is usually less than 0.5 m with an extreme wave height of 7.0 m. Waves on the Labrador side generally travel from a south-westerly direction. On the Newfoundland side, wave height is usually less than 0.5 m with an extreme wave height of 5.5 m. Waves on the Newfoundland side generally travel from a westerly or south-westerly direction (AMEC 2010).

Wave activity on the east coast of Newfoundland is also influenced by wind speed and wind direction. Waves typically travel from the west in the fall and winter and from the south-west during the spring and summer months. Wave height varies throughout the year. The lowest wave heights typically occur in July with an average height of 1.6 m, and the highest waves typically occur in December, with an average height of 3.4 m (Environment Canada, Atlantic Climate Centre 2003).

More detailed information on waves can be found in Section 10.6.3.

4.1.8.2 Effects on Project Design, Construction, and Operations and Maintenance

The Project was designed such that HDD will permit the submarine cables to be installed below the sea bed for the first 1.5 km to 2.5 km on both sides of the Strait of Belle Isle. As a result, there is not likely to be any interaction between the submarine cable and the wave environment as the cable installation will be designed for the wave conditions in the Strait of Belle Isle. High wave conditions may, however, affect the submarine cable crossing construction schedule as construction vessels (e.g., cable installation vessel, fallpipe vessel) will operate on the water surface, within the wave environment.

The shoreline electrode site berms will be designed to withstand the expected worst case site conditions, including wave action. Wave height up to 7 m is expected along the Strait of Belle Isle and wave height up to 5.5 m is expected on the east coast of Newfoundland, thus requiring a significant electrode berm structure and armour for the shoreline electrodes. The electrode berm has therefore been designed as a rubble mound structure with larger sized rocks used as armour stone on the sea side slope to protect the electrode berm

from storm waves. Waves may affect the electrode construction schedule and, under extreme wave conditions, may affect the structural integrity of the electrode berm.

4.1.9 Sea Ice and Icebergs

4.1.9.1 Environmental Conditions

Sea ice in the Strait of Belle Isle is a combination of land-fast ice formation and pack ice, which drifts in from the Labrador Sea. Historical records for the Strait of Belle Isle show a median ice thickness of approximately 0.45 m between 1971 and 2011, and a maximum ice thickness of less than 0.6 m (Environment Canada 2011b, internet site). Freeze-up typically begins in about December and the ice reaches its maximum thickness in about February. The Strait of Belle Isle waters are typically ice-free by May (Environment Canada 2011b, internet site).

Conception Bay contains primarily pack ice during the winter and spring seasons. The majority of ice in Conception Bay is new ice, with some grey ice near the bay mouth (Canadian Ice Service 2001, internet site). Historical records of ice coverage for East Newfoundland waters, including Conception Bay, show a median ice thickness of approximately 0.15 m between 1971 and 2011, and a maximum ice thickness of less than 0.3 m (Environment Canada 2011b, internet site). Freeze-up typically begins in January and the ice reaches its maximum thickness in March. The East Newfoundland waters are typically ice-free by May (Environment Canada 2011b, internet site).

Every year about 40,000 medium- to large-sized icebergs calve from Greenland glacier and are carried southward by the Labrador current. Only about 400 to 800 make it as far south as St. John's, but these numbers can vary greatly from year to year. The chances of observing icebergs in a particular area depend on the number of icebergs, wind direction, ocean currents and temperatures, and the amount of sea ice, or pack ice. Approximately 10% to 15% of the icebergs that pass the latitude of the Strait of Belle Isle move into the Strait. The remainder pass to the east of Newfoundland (C-CORE 2004).

More detailed information on sea ice and icebergs can be found in Section 10.6.4.

4.1.9.2 Effects on Project Design, Construction, and Operations and Maintenance

C-CORE (2004) conducted a study of iceberg scour risk in the Strait of Belle Isle as part of another project. The results of the study suggest that a shoal located north-east of the submarine crossing corridor and Centre Bank North prevents large, deep icebergs from entering the Strait of Belle Isle. C-CORE used iceberg frequency, drift speed, iceberg keel depth, water depth and sea bed slope to determine grounding rates in the Strait of Belle Isle. The C-CORE study predicts the highest grounding rates where sea bed slopes are relatively steep in the 30 to 60 m water depth range. The Project is designed such that HDD will permit the submarine cables to be installed below the sea bed for the first 1.5 to 2.5 km to 60 m to 80 m water depth on both sides of the Strait of Belle Isle, thus protecting the cables from both sea ice in the shallower water and iceberg scour. The exact length and depth of the HDD paths will be finalized during detailed Project engineering and will consider the risk of iceberg scour.

Sea ice could affect the structural integrity of the electrode elements and the voltage gradient during electrode operation (i.e., if the electrodes are located within the ice). The shoreline electrode berms will be designed to withstand the expected worst case pack ice conditions and freezing inside the shoreline pond. The depth of the shoreline pond required at the land side toe line will account for changes in the water level due to ice formation within the shoreline pond. The depth of water will be such that the electrode elements are fully immersed in the water below the ice under various tide conditions.

The ports to be used for the delivery of materials required for Construction have yet to be finalized. These ports will be selected based on the potential effect of sea ice and icebergs on shipping. Given this factor, Project Construction is not likely to be affected by sea ice or icebergs.

The electrodes are located in relatively shallow water and protected by an electrode berm. The size of icebergs that could collide with the electrode berm structure will be limited by the depth of water surrounding the electrode berm. The electrode berm will be designed to withstand the potential force of a collision with smaller icebergs (i.e., bergy bits and growlers) likely at that depth of water.

Construction of the submarine cable crossing and shoreline electrodes will be scheduled to avoid in-water works when sea ice or icebergs are present or likely. As such, sea ice and icebergs are not likely to affect Project Construction. Given the design measures described above, Project Operations and Maintenance are also not likely to be affected by sea ice or ice bergs.

4.1.10 Seismicity

4.1.10.1 Environmental Conditions

Newfoundland and Labrador lies in a region of relatively low seismic risk (Natural Resources Canada (NRCan) 2011a, internet site). NRCan's map of earthquakes that have occurred in or near Canada between 1627 and 2009 show approximately eight historical earthquakes occurring in or near southern Labrador, two occurring within the Strait of Belle Isle and approximately 12 in or near Newfoundland. Each of these earthquakes had a magnitude of less than 4.0 on the Richter scale (NRCan 2011b, internet site).

NRCan (2011c, internet site) defines a significant earthquake as one that meets one or more of the following criteria:

- the magnitude of the earthquake is 6.0 or greater;
- the earthquake had an impact on the built environment or on the natural environment (e.g., landslide, rock fall, liquefaction, tsunami);
- the earthquake was felt by a significant number of Canadians; or
- the earthquake occurrence is supported by paleoseismological evidence (i.e., geological evidence).

NRCan subjectively categorized each historical earthquake as being significant or not based on its magnitude and impact. As a result, 51 of the approximately 60,000 seismic events that have occurred in Canada are considered significant. None of these events occurred in Newfoundland, Labrador or the Strait of Belle Isle.

It is, however, worth noting that in 1929, an earthquake measuring 7.2 on the Richter scale originated approximately 250 km south of Newfoundland along the southern edge of the Grand Banks, and therefore was not included in the information presented above. The earthquake triggered a tsunami which struck the shores of the Burin Peninsula. Sea levels rose by 2 m to 7 m and, at the heads of several long and narrow bays, water levels rose by as much as 13 m. More than 40 coastal communities along the peninsula were affected (NRCan 2011d, internet site).

4.1.10.2 Effects on Project Design, Construction, and Operations and Maintenance

Because Newfoundland and Labrador lies in a region of relatively low seismic risk, the Project is not likely to be affected by seismic activity. All Project buildings, including the converter stations and transition compounds, will be built to the standards of the National Building Code of Canada (NBCC) (National Research Council of Canada 2010). The NBCC uses earthquake probabilities and the nature of the ground motion most likely to occur at a site to determine structural design criteria.

In the unlikely event that a tsunami occurs and affects the cable landing points or the shoreline electrode locations, infrastructure such as the electrodes and transition compounds may be flooded and / or damaged, depending on the wave heights generated.

4.1.11 Climate Change

4.1.11.1 Environmental Conditions

The following discussion includes the consideration of recent climate change, as outlined in section 4.4.4.1 of the EIS Guidelines and Scoping Document (Government of Newfoundland and Labrador and Government of Canada 2011).

Carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) are "greenhouse gases" that help insulate the earth and maintain a temperature that can sustain life. Scientists have concluded that human activities have led to an increase in atmospheric greenhouse gases, which is impacting the global climate. Activities such as the burning of fossil fuels and deforestation have led to a 30% rise in CO_2 levels since the Industrial Revolution. This, in turn, is changing the composition of the Earth's atmosphere. The increasing concentration of atmospheric greenhouse gases is causing temperatures to rise and is affecting the global climate (Newfoundland and Labrador Department of Environment and Conservation (NLDEC) 2005, internet site). Potential effects of climate change on regional resources are of increasing importance for energy producers. This subject is addressed in detail in Chapter 10 of this Environmental Impact Statement (EIS).

Climate is defined as the statistical average of weather conditions over a substantial period of time. Climate change is an acknowledged change in climate documented over two or more periods, each period including a minimum of 30 years (Catto 2006). Over the next century, changes in temperature, precipitation patterns and extreme events are predicted for Newfoundland and Labrador (NRCan 2010, internet site). These changes in climate are expected to be more pronounced inland than at the coastal areas due to the moderating effects of the Labrador Sea.

Temperatures along the coast of Labrador are anticipated to be relatively stable, generally cooler in the spring (-0.5 degrees Celsius (°C)), and warmer in the summer, fall and winter (0°C to 2°C) over the next 80 to 100 years. For the same period, the changes at Happy Valley-Goose Bay are expected to be more noticeable, with much warmer temperatures in the summer, fall and winter (4.5°C to 7°C) by the end of the century, and less change in the spring (1°C) (Lines et al. 2005). This change in average temperature is expected to be gradual and to affect precipitation types and patterns. In Newfoundland, temperatures in St. John's are predicted to rise by 4.5°C in the spring and summer and by 6°C during the fall and winter. In Gander, temperatures are expected to increase by 6°C in the summer and by 2.5°C to 4°C during the remainder of the year (Lines et. al. 2005).

The warmer temperatures during fall and winter are predicted to result in later freeze-up, heavier snow, more rain occurring later into the fall, and possibly more freezing precipitation during the fall and winter. With little change in spring temperatures, differences in ice break-up patterns are expected to be slight over the next century (Lines et al. 2005).

Slight increases in annual precipitation are expected over the next few years, with a 6% to 9% increase in annual precipitation by the end of the 80 to 100 year period (Lines et al. 2005). These precipitation trends are of interest when considered in combination with the predicted increase in temperatures and the seasonality of the predicted changes. A small decrease (3%) in average precipitation amounts are expected over the winter period, and a small increase (6%) is expected during the fall. There is less agreement among the global circulation and regional downscaling models regarding changes in spring and summer precipitation, ranging from a slight decrease in spring (2%) to an increase of as much as 13% during the spring and summer (Lines et al. 2005). The increased precipitation predicted for western portions of Atlantic Canada may result from a greater frequency of downgrading hurricanes and tropical storms reaching the area in the summer and fall months (Lines et al. 2005).

Anticipated changes in sea levels in the Strait of Belle Isle and along the coast of Newfoundland are influenced by both the global rate of change in sea levels (i.e., approximately 3 mm per year) and the local effects of isostatic rebound of the Earth's crust that has been occurring since the last glacial period (Batterson and

Liverman 2010). Given the continued warming of the Earth's oceans and the melting of the polar ice caps, the global rise in sea levels is expected to continue, and it is expected that they will exceed the effects of isostatic rebound. Sea levels in the Conception Bay area are expected to rise approximately 40 cm by 2049 (over 1990 levels), and 100 centimetres (cm) by 2099. In the Strait of Belle Isle, sea levels are expected to rise approximately 30 cm by 2049 and 80 cm by 2099 (Batterson and Liverman 2010). This rise in sea levels may have little effect where the coastline is composed of steeply-sloping bedrock. However, in low-lying and low-sloping coastal areas, sea level changes may have a greater effect (e.g., increased rates of erosion, coastal landslides, loss of beaches).

4.1.11.2 Effects on Project Design, Construction, and Operations and Maintenance

The extent to which the climate will change over the next 100 years is uncertain. However, predictive modelling suggests the potential for changes in temperature, precipitation patterns, the frequency and severity of extreme events, and sea levels. These changes could lead to an increase in ice and wind loading on transmission line infrastructure, the availability of dry vegetation for forest fire propagation, a change in the frequency of lightning strikes, or flooding of onshore or electrode berm infrastructure at the shoreline electrode sites. The potential effects of the changing climate on the Project are mitigated through the selection of an appropriate meteorological return period and the application of safety factors to the design process. Design of the shoreline electrode sites will account for potential sea level changes throughout the life of the Project.

Nalcor will inspect 100% of the transmission line each year via ground patrol or helicopter. Approximately 10% will be completed through climbing inspections, on a yearly basis. During these inspections, the effects of climatic events (e.g., sign of physical damage, general condition of the equipment) will be noted and repairs or equipment replacement will be conducted as necessary. Nalcor will also monitor extreme weather events and have emergency response plans in place to address the effects of these events on the Project.

4.2 Socioeconomic Environment

4.2.1 Land and Resource Use

4.2.1.1 Environmental Conditions

The regions crossed by the transmission corridor have economies that are primarily based on natural resource industries and, in some cases, tourism. Land uses in the Project area include communities and transportation systems, natural resource-based industries (e.g., forestry, mining and agriculture), commercial activities (e.g., hunting, trapping and outfitting), recreational activities (e.g., boating, snowmobiling, cross-country and downhill skiing, kayaking, canoeing, hiking, bicycling, bird watching and riding motorized recreational vehicles) and subsistence activities (e.g., fishing, hunting and other harvesting). The Project area also includes recreation areas (e.g., cottage developments, campgrounds, ski areas, trails, lakes, golf courses and parks) and protected areas.

More information on land and resource use can be found in Section 15.4.

4.2.1.2 Effects on Project Design, Construction, and Operations and Maintenance

Land and resource use affected the Project design primarily during transmission corridor selection, siting of Project components and siting of construction infrastructure (e.g., temporary camps, marshalling yards). A constraints mapping exercise was conducted early in the planning process, during which information on existing land and resource use was compiled to identify and evaluate key socioeconomic factors for consideration in the transmission corridor selection and component siting process. Inputs to this analysis and planning process included existing and available information on the socioeconomic environment, any baseline information collected, issues identified as part of the environmental assessment process, and the results of the associated stakeholder consultations. Land and resource use factors that influenced the selection of the

transmission corridor and siting of components include the avoidance of interactions with communities and protected areas, where possible and practical, and minimizing the creation of new access.

The mitigation measures described in various sections throughout the EIS (e.g., timing of activities, public access restriction) are expected to minimize the effects of land and resource use on the Project during Construction, and Operations and Maintenance. These effects could include interactions between land use activities (e.g., hunting, snowmobiling, riding recreational vehicles) and Project activities / equipment that could lead to schedule delays.

4.2.2 Fisheries

4.2.2.1 Environmental Conditions

The economies of the areas on both sides of the Strait of Belle Isle have traditionally been based on fishing. Fishing in the Strait of Belle Isle, near the submarine cable crossing, is primarily focused on lobster, scallops, pelagic species, and some newer or emerging fisheries. Fishing activity in the area is pursued by fishers from communities near the cable crossing corridor on both sides of the Strait, and by fishers from further away who travel to the area for specific fishing opportunities (e.g., herring). There are currently no licensed aquaculture sites in or near the cable crossing corridor. The closest existing aquaculture operations are more than 75 km away, at the north-eastern tip of the Northern Peninsula in the Pistolet Bay – St. Lunaire-Griquet area (Department of Fisheries and Aquaculture (DFA) 2010, internet site).

In the Dowden's Point area, nearshore fishing grounds are used mainly for the harvest of pelagic species such as capelin, herring and mackerel. Most pelagic fishing activity occurs south of the Holyrood Generating Station (Fisheries and Oceans Canada (DFO) 1990-2009). Lobster, herring and lumpfish are harvested closer to shore in the area between Lance Cove and Dowden's Point. Recreational fishing activities in the immediate vicinity of the proposed electrode site include the harvest of brown trout by trolling gear close to shore, and cod using handlines, usually in water depths between 32 and 36 m (Lear 2011, pers. comm.).

More information on fisheries can be found in Section 15.7.

4.2.2.2 Effects on Project Design, Construction, and Operations and Maintenance

Fisheries affected the design of the submarine cable crossing and the shoreline electrode sites. To minimize the potential for interactions between fishing activity and the submarine cable, HDD will permit the submarine cables to be installed below the sea bed for the first 1.5 km to 2.5 km on both sides of the Strait of Belle Isle. Where the cable lies on the sea floor, it will be covered by a 0.8 m to 1.5 m high and 8m to 12 m wide rock berm to protect from potential dragging of fishing equipment.

The shoreline electrodes will be protected from interaction with fishing activity by a berm to separate the electrodes from the open sea.

In addition to the design features described above, the mitigation measures described in various sections throughout the EIS (e.g., timing of activities, vessel watch protocols) will likely minimize the effects of fisheries on the Project during Construction Phase and, as applicable, during the Operations and Maintenance Phase. These effects could include interactions between fishing boats and Project vessels, which could have schedule implications. The Project includes three submarine cables, one of which is a spare, designed to be used in case of failure of one of the other cables.

4.3 Summary

The environment has played and will continue to play a key role in Project design. Although many effects of the environment have been mitigated through Project design, potential effects of the environment on the Project could result from vegetation; lightning; forest fire; wind, freezing precipitation and ice accretion; salt spray; currents and tides; waves; sea ice and icebergs; seismicity; climate change; land and resource use; and fisheries. Many of these potential effects have been primarily mitigated through the siting of the transmission corridor. Additional mitigation measures are summarized in Table 4.3-1. The effects of the environment on the Project are not likely to affect Project Construction or Operations and Maintenance in a manner that affects the Project's technical or economic feasibility. The effects of the environment on the Project are therefore not considered significant.

Table 4.3-1 Summary of the Potential Effects of the Environment on Project Design, Construction and Operations and Maintenance

Environmental Component	Potential Effect on Project Design, Construction and Operations and Maintenance	Mitigation
Vegetation	**Design** – vegetation affected the transmission corridor selection and siting of Project components. **Construction** – vegetation will affect siting of construction infrastructure and clearing activities. **Operations and Maintenance** – a power outage could result from contact of vegetation with the conductor.	– Selection of transmission corridor, siting of Project components, and siting of construction infrastructure will avoid, to the extent practical, vegetation communities that are sensitive to disturbance, difficult to reclaim or of stakeholder or management concern – Vegetation control during Operations and Maintenance, as and where required
Lightning	**Design** – lightning protection measures are included in Project design. **Construction** – erect tower, could affect project personnel in the immediate vicinity. **Operations and Maintenance** – flashover resulting in power outage.	– Installation of OPGW and counterpoise – Replacement of existing transmission lines TL217, TL201, TL218, TL242 so that OHGW can be installed
Forest Fire	**Design** – no effect anticipated. **Construction** – damage to construction and Project infrastructure. **Operations and Maintenance** – damage to Project infrastructure.	– ROW clearing – Vegetation control during Operations and Maintenance, as and where required
Wind, Freezing Precipitation and Ice Accretion	**Design** – affected transmission corridor selection and design loads. **Construction** – schedule delays. **Operations and Maintenance** – tower collapse, conductor failure, flashover.	– Transmission corridor selected to avoid regions of high wind and ice loads, where practical – Design load calculations based on local meteorological conditions and a 50-year return period

Table 4.3-1 Summary of the Potential Effects of the Environment on Project Design, Construction and Operations and Maintenance (continued)

Environmental Component	Potential Effect on Project Design, Construction and Operations and Maintenance	Mitigation
Salt Spray	**Design** – affected transmission corridor selection and design of insulators. **Construction** – no effect anticipated. **Operations and Maintenance** – flashover.	– Transmission corridor selected to avoid coastal regions, where practical – Number of insulators increased in areas of salt exposure – Transmission tower height and cross arm length increased to accommodate increased number of insulators – Washing insulators, as necessary, during Project Operations and Maintenance
Bathymetry	**Design** – affected submarine cable corridor selection, selection of landfall, selection of cable pull-in location, selection of electrode sites, and design of the electrode berms. **Construction** – no effect anticipated on submarine cable construction. May affect shoreline electrode construction methods (e.g., potential excavation requirement to achieve 4 m water depth). **Operations and Maintenance** – no effect anticipated.	– Submarine cable crossing corridor selected to achieve quick access to deep water, make use of natural sea bed features to shelter the cables in deep valleys and trenches – Selection of cable protection methods (i.e., HDD, rock berm) – Selection of shoreline electrode sites, electrode berm designs, and construction methods
Currents and Tides	**Design** – inclusion of HDD and rock berm, design of shoreline electrode ponds. **Construction** – no effect anticipated on submarine cable crossing. May affect construction sequence for shoreline electrode berms. Cable installation will be designed for installation in the currents present on-site. **Operations and Maintenance** – could affect the operation of the electrodes if the electrodes do not remain submerged during low tide events.	– Construction methods that can withstand the local current and tide conditions – Depth of the shoreline electrode pond will be such that the electrode elements are fully immersed in the water under various tide conditions – Protection of submarine cables by horizontal directional drilling under near-shore areas and protection by a rock berm where the cables lie on the sea bed
Waves	**Design** – inclusion of HDD, design of shoreline electrode berms. **Construction** – high wave activity may affect construction schedule. **Operations and Maintenance** – no effect on submarine cable anticipated. Damage to shoreline electrode berms.	– Use of larger sized rocks as armour stone on the sea side slope of the electrode berms

Table 4.3-1 Summary of the Potential Effects of the Environment on Project Design, Construction and Operations and Maintenance (continued)

Environmental Component	Potential Effect on Project Design, Construction and Operations and Maintenance	Mitigation
Sea Ice and Icebergs	**Design** – inclusion of HDD, design of shoreline electrode berms, depth of shoreline electrode ponds. **Construction** – schedules to avoid in-water works when sea ice or icebergs present. **Operations and Maintenance** – damage to the submarine cables or shoreline electrodes due to iceberg scour. Changes in resistivity of medium (i.e., water versus ice) surrounding the shoreline electrodes.	– Depth of the shoreline electrode ponds will be such that the electrode elements are fully immersed in the water and below the ice under various tide conditions – Electrodes will be located in relatively shallow water and protected by an electrode berm – An HDD will be used to install the submarine cables under the sea bed for the first 1.5 to 2.5 km on either side of the Strait of Belle Isle – A spare cable for the Strait of Belle Isle crossing
Seismicity	**Design** – design standards to consider seismic loading, as appropriate. **Construction** – no effects anticipated. **Operations and Maintenance** – structural damage due to earth movement. Flooding and / or structural damage to shoreline infrastructure from tsunami.	– Project buildings will be designed to National Building Code of Canada standards
Climate Change	**Design** – loads calculations and design of marine infrastructure to account for potential changes to weather patterns and sea level. **Construction** – no effect anticipated. **Operations and Maintenance** – effects associated with a potential increase in ice and wind loading (e.g., tower or conductor failure), availability of dry vegetation to fuel forest fires, change in frequency of lightning strikes, and flooding of electrode sites.	– Design load calculations based on a 50-year return period – Application of safety factors to the design process – Regular transmission line inspections and monitoring of extreme weather events – Design of shoreline electrode sites will account for potential changes in sea level
Land and Resource Use	**Design** – affected transmission corridor selection and siting of Project components. **Construction** – will affect construction scheduling, siting of construction infrastructure and clearing activities. Interaction between land use activities and Project Construction activities. **Operations and Maintenance** – interaction between land use activities and Project Operations and Maintenance activities.	– Selection of transmission corridor, siting of Project components, and siting of construction infrastructure will avoid, to the extent practical, communities and protected areas – Creation of new access will be limited to the extent practical

Table 4.3-1 Summary of the Potential Effects of the Environment on Project Design, Construction and Operations and Maintenance (continued)

Environmental Component	Potential Effect on Project Design, Construction and Operations and Maintenance	Mitigation
Fisheries	**Design** – use of HDD, rock berm and shoreline electrode berms. **Construction** – interaction between fishing activity and submarine cable installation activity and shoreline electrode pond construction. **Operations and Maintenance** – interaction between fishing lines, nets or rakes, and submarine cable.	– An HDD will be used to install the submarine cables under the sea bed for the first 1.5 to 2.5 km on either side of the Strait of Belle Isle – Where the submarine cables lay on the sea floor, they will be protected by a rock berm – Installation of a spare submarine cable – Installation of electrode berms at the shoreline electrode sites

4.4 References

AMEC (AMEC Earth and Environmental). 2010. Marine Flora, Fauna and Habitat Survey – Strait of Belle Isle Submarine Cable Crossing Corridors, 2008 and 2009. Prepared for Nalcor Energy. St. John's, NL.

Batterson, M. and D. Liverman. 2010. Past and Future Sea-Level Change in Newfoundland and Labrador: Guideline for Policy and Planning. Prepared for the Newfoundland and Labrador Department of Natural Resources Geological Survey, Report 10-1, pages 129-141.

BIO (Bedford Institute of Oceanography). 2010. Hydrographic Database and Ocean Data Inventory Database. Available at: http://www2.mar.dfo-mpo.gc.ca/science/ocean/database/data_query.html. Accessed: July 2010. Cited in Sikumiut. 2010a. Marine Fish and Fish Habitat in the Strait of Belle Isle: Information Review and Compilation. Labrador – Island Transmission Link. Prepared for Nalcor Energy. St. John's, NL. 173 pp.

Canadian Electrical Association. 1998. Lightning Ground Flash Density Measurements in Canada, January 1990 to December, 1996.

Canadian Hydrographic Service. 2001. Marine Chart, Conception Bay. Chart Number 484701. Scale 1:60,000.

Canadian Ice Service. 2001. Sea Ice Climatic Atlas, East Coast of Canada, 1971 – 2000. Available at: http://www.ec.gc.ca/glaces-ice/default.asp?lang=En&n=1A01543E-1. Accessed: October 2010.

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, NL, 160 pp. C-CORE. 2004. Iceberg Scour and Risk in the Strait of Belle Isle. Contract report prepared for SGE Acres Limited. C-CORE Report R-04-004-011.

C-CORE. 2004. Iceberg Scour and Risk in the Strait of Belle Isle. Contract report prepared for SGE Acres Limited. C-CORE Report R-04-004-011.

deYoung, B. and B. Sanderson. 1995. The Circulation and Hydrography of Conception Bay, Newfoundland. Atmosphere Ocean. 33: 135-162. Cited in Parrish, C.C. 1998. Lipid Biogeochemistry of Plankton, Settling Matter and Sediments in Trinity Bay, Newfoundland. I. Lipid Classes. Organic Geochemistry. 29 (5-7): 1531-1545.

DFA (Department of Fisheries and Aquaculture, Newfoundland and Labrador). 2010. Licenced Aquaculture Sites 2010, Newfoundland and Labrador. Available at: http://www.fishaq.gov.nl.ca/aquaculture/aquasite.pdf.

DFO (Department of Fisheries and Oceans Canada). 1990 – 2009. Newfoundland and Labrador Region. Commercial fisheries catch and effort database provided in digital form by Statistics Division, Policy and Economics Branch, St. John's, NL.

DFO. 2010. Canadian Hydrographic Service, Tides, Currents and Water Levels. Available at: http://www.waterlevels.gc.ca/english/Canada.shtml. Accessed: October 2010.

Environment Canada. 1990. Climates of Canada. Cat No. EN 56-1/1990E. 176pp.

Environment Canada. 2007. *Canadian climate Normals; Goose Bay and Churchill Falls, Newfoundland.* Available at: http://climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html. Accessed: October 22, 2010.

Environment Canada. 2010. Canadian Climate Normals, 1971 to 2000, Goose A, Newfoundland. Available at: http://climate.weatheroffice.gc.ca/climate_normals/results_e.html?stnID=6777&prov=&lang=e&dCode=1&dispBack=1&StationName=Goose_A&SearchType=Contains&province=ALL&provBut=&month1=0&month2=12. Accessed: June 2010.

Environment Canada. 2011a. Lightning Activity in Major Cities in Canada. Available at: http://www.ec.gc.ca/foudre-lightning/default.asp?lang=En&n=4871AAE6-1. Accessed: June 2011.

Environment Canada. 2011b. Seasonal Climatology. Available at: http://www.ec.gc.ca/glaces-ice/default.asp?lang=En&n=CEC7AE99-1. Accessed: March 2011.

Environment Canada, Atlantic Climate Centre. 2003. Marine Atlas – Atlantic Coast (1958-1997): AES40 Dataset. Environment Canada, Fredericton, NB.

Federal Aviation Administration. 2010. Fact Sheet. Available at: http://www.faa.gov/news/fact_sheets/. Accessed: October 2010.

Foster, D.R. 1983. The History and Pattern of Fire in the Boreal Forest of Southeastern Labrador. *Canadian Journal of Botany 61(9): 2459-2471.*

Government of Newfoundland and Labrador and Government of Canada. 2011. Environmental Impact Statement Guidelines and Scoping Document, Labrador-Island Transmission Link. Prepared for Nalcor Energy. St. John's, NL.

Hewitt, D. 2010. Duty Officer, Fire Services Branch, Gander, NL. Telephone conversation. March 25, 2010.

IEC (International Electrotechnical Commission). 2003. International Standard 60826: Design Criteria of Overhead Transmission Lines.

Kasische, E. and B.J. Stocks. 2000. Fire, Climate Change, and Carbon Cycling in the Boreal Forest. Springer, New York.

Komarek, E.V. 1966. Meteorological basis for fire ecology. In: *Proceedings of the 5th Tall Timbers Fire Ecology Conference,* Tall Timbers Research Station, Tallahassee, FL. p 85-125.

Kourtz, D. 1967. Lightning behaviour and lightning fires in Canadian forests. *Canadian Forestry Branch Department Publication 1179.*

Lear, W. 2011. Fisher. Seal Cove. Personal conversation. April 11, 2011

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.

Meteorology Research Institute of California. 1973. Meteorological Study of the Gull Island-Stephenville-Holyrood Transmission Line Routes, Report for Teshmont Consultants Ltd., November, 1973.

Michelin, S. 2008. Duty Officer, Fire Services Branch, Happy Valley-Goose Bay, NL. Telephone conversation. September 16, 2008.

National Research Council of Canada. 2010. National Building Code of Canada, 2010.

NavCanada. 2011. Local Area Weather Manuals. Available at: http://navcanada.ca/ContentDefinitionFiles/publications/lak/atlantic/4-AE34.PDF. Accessed: May 2011.

NLDEC (Newfoundland and Labrador Department of Environment and Conservation). 2005. Climate Change Action Plan 2005. Government of Newfoundland and Labrador. Available at: http://www.env.gov.nl.ca/env/climate_change/govt_action/climatechangeplanfinal.pdf. Accessed: June 2010.

NRCan (Natural Resources Canada). 2010. CanVec. Available at: http://geogratis.cgdi.gc.ca/geogratis/en/collection/5460AA9D-54CD-8349-C95E-1A4D03172FDF.html. Accessed: May 2010.

NRCan. 2011a. Simplified Seismic Hazard Map for Canada. Available at: http://earthquakescanada.nrcan.gc.ca/hazard-alea/simphaz-eng.php. Accessed: March 2011.

NRCan. 2011b. Earthquake map of Canada. Available at: http://earthquakescanada.nrcan.gc.ca/histor/caneqmap-eng.php. Accessed: March 2011.

NRCan. 2011c. Significant Earthquakes and Seismic Hazard. Available at: http://atlas.nrcan.gc.ca/site/english/maps/environment/naturalhazards/earthquakes/majorearthquakes/1. Accessed: March 2011.

NRCan. 2011d. The 1929 Magnitude 7.2 "Grand Banks" Earthquake and Tsunami. Available at: http://earthquakescanada.nrcan.gc.ca/histor/20th-eme/1929/1929-eng.php. Accessed: May 2011.

RSW Incorporated. 1995. Study to Establish a Maximum Foreseeable Loss for the CF(L)Co. 735 kV Transmission Lines in Labrador, Report to CF(L)Co., April 1995.

RSW. 1999 Upgrading of 735 kV Structures for OHGW Icing, Report for Churchill Falls (Labrador) Corporation Ltd., December, 1999.

RSW-EDM. 1999. Feasibility Study on the Development of EHV Transmission Lines in Labrador, Report for Newfoundland and Labrador Hydro, February, 1999.

Seaconsult. 1990. Data Report: Oceanographic and Weather Data, Conception Bay, Newfoundland, May 16 to November 14, 1988. Volume 1. Prepared for Department of Fisheries and Oceans, St. John's, NL.

Sikumiut. 2011. Marine Water and Sediment Survey – Strait of Belle Isle Submarine Cable Crossing Corridors. Labrador – Island Transmission Link. Prepared for Nalcor Energy. St. John's, NL.

Sullivan, P. 2010. Dispatcher, Fire Services Branch, Corner Brook, NL. Telephone conversation. March 26, 2010.

Woodworth-Lynas, C.M. T., J.Y. Guigné and E.L. King. 1992. Surficial and Bedrock Geology Beneath the Strait of Belle Isle in the Vicinity of a Proposed Power-cable Crossing. Newfoundland Department of Mines and Energy, Geological Survey Branch Report 92-2.

NALCOR ENERGY

LABRADOR-ISLAND TRANSMISSION LINK

ENVIRONMENTAL IMPACT STATEMENT

Chapter 5

Accidents and Malfunctions

April 2012

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LIST OF ACRONYMS

Acronym	Description
/day	per day
CARs	Canadian Aviation Regulations
CEAA	*Canadian Environmental Assessment Act*
CSA	Canadian Standards Association
DFO	Fisheries and Oceans Canada
DND	Department of National Defence
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMS	Environmental Management System
EPP	Environmental Protection Plan
ha	hectare
HDD	horizontal directional drilling
HSEQ	Health, Safety and Environment Quality
HVdc	High Voltage direct current
ISO	International Standards Organization
kg	kilogram
km	kilometre
m	metre
m^2	square metre
m^3	cubic metre
MVC	motor vehicle collision
NLDEC	Newfoundland and Labrador Department of Environment and Conservation
NLDNR	Newfoundland and Labrador Department of Natural Resources
NLEPA	Newfoundland and Labrador *Environmental Protection Act*
NLESA	Newfoundland and Labrador *Endangered Species Act*
non-PCB	non-polychlorinated biphenyl
OHSP	Occupational Health and Safety Plan
PCB	polychlorinated biphenyl
Project	Labrador-Island Transmission Link
ROW	right-of-way
SARA	*Species at Risk Act*
SHERP	Safety, Health and Environmental Emergency Response Plan
SIMOPS	Simultaneous Operations
TC	Transport Canada
TSB	Transportation Safety Board of Canada
VEC	Valued Environmental Component

5 ACCIDENTS AND MALFUNCTIONS

The *Canadian Environmental Assessment Act* (*CEAA*) requires that the environmental effects of accidents or malfunctions that are likely to occur in connection with the Labrador-Island Transmission Link (Project) be considered during the environmental assessment (EA) process. The *Environmental Impact Statement Guidelines and Scoping Document* for the Project, issued by the Government of Newfoundland and Labrador and the Government of Canada in May 2011 (Government of Newfoundland and Labrador and Government of Canada 2011), also includes a requirement in Section 4.5.2 for a description of potential accidents and malfunctions that may occur, their potential consequences, worst case scenarios, and the potential effects of these scenarios.

An accident refers to an unplanned or unexpected event, related to Project activities, that interacts with the environment (i.e., biophysical and / or socioeconomic environment). A malfunction refers to the abnormal operation of a Project component with subsequent environmental consequences. In the following discussion, accidents and malfunctions (i.e., unplanned events) are jointly referred to as "incidents". This section identifies and describes potential incidents related to Project Construction, Operations and Maintenance. It also describes the potential environmental consequences (i.e., magnitude, extent, duration) of these incidents. Only incidents with potential environmental consequences are discussed. Worker health and safety are adequately addressed by the Nalcor Energy (Nalcor) Occupational Health and Safety Plan (OHSP), and are not addressed in the Environmental Impact Statement (EIS).

5.1 Methodology

Over the past 50 years, Nalcor and its subsidiaries have constructed and maintained approximately 6,700 kilometres (km) of electrical transmission and distribution lines. Based on this experience, industry knowledge and government agency statistics, the types of incidents that may occur during Project Construction, Operations and Maintenance are well understood. The methodology used to assess the environmental risk of incidents is illustrated in Figure 5.1-1.

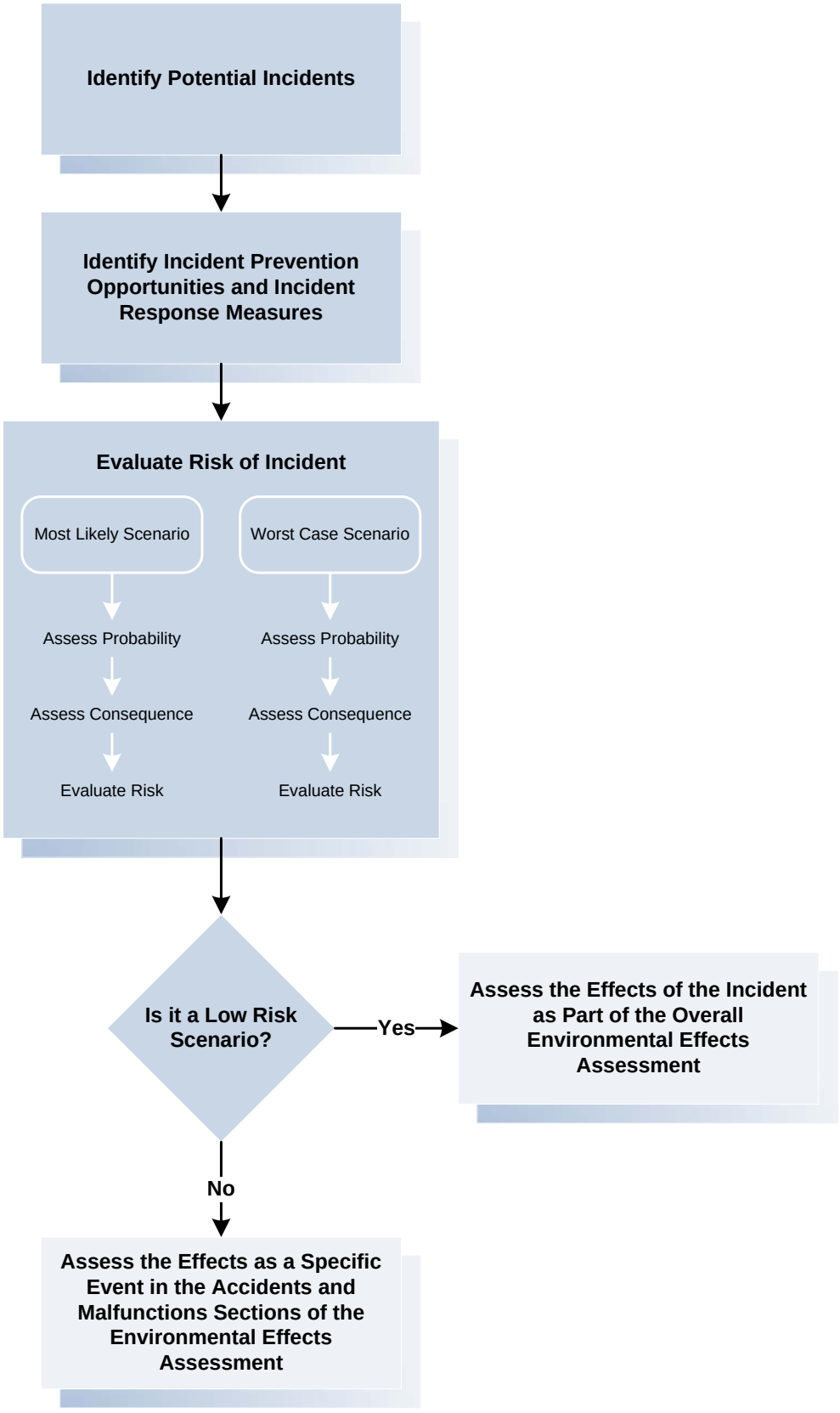
5.1.1 Identification of Potential Incidents

Potential incidents that could interact with the environment and that are likely to occur during Project Construction, or Operations and Maintenance are identified below. The following information was considered during the identification of potential incidents:

- historical incidents;
- Project inputs (e.g., fuel, materials);
- Project outputs (e.g., solid, liquid and hazardous waste);
- environmental threats (e.g., icing, heavy winds);
- hazards inherent to Project Construction (e.g., heavy equipment and marine vessel operation);
- hazards inherent to Project Operations and Maintenance (e.g., electrical hazards);
- management systems (e.g., procedures, training, inspections and monitoring); and
- protection safeguards (e.g., prevention measures, incident response plans and contingency plans).

Nalcor assessed accidents and malfunctions in the EIS, with this section used to screen the manner in which the particular scenario will be assessed. As part of the assessment, significance determination of the likely effects is made.

Figure 5.1-1 Approach to Assessing the Environmental Effects of Accidents and Malfunctions



5.1.2 Incident Prevention and Response

Standard prevention measures are identified for consideration during the assessment of accident and malfunction probability, and incident response measures are identified for consideration during the assessment of consequence. The following information is used during the identification of incident prevention opportunities and incident response measures:

- prevention and response measures described in the Safety, Health and Environmental Emergency Response Plan (SHERP) and the Environmental Protection Plan (EPP);
- conditions of regulatory permits and approvals;
- relevant legislative requirements; and
- capacity and capabilities of existing emergency response infrastructure.

5.1.3 Risk Evaluation

A most likely scenario and a reasonable worst case scenario are considered for each type of incident. A relative probability of occurrence is assigned to each scenario, based on Nalcor's experience, historical records of occurrence, and the judgement of the assessors. The most likely scenarios (e.g., a minor spill of hydrocarbons) typically have a moderate to high probability of occurring. Worst case scenarios (e.g., large forest fire) are possible, but typically have a much lower probability of occurrence. Definitions for low, moderate and high probability are provided in Table 5.1.3-1.

The environmental consequences of each scenario are then described. It is evaluated in terms of the surrounding biophysical environment, and considers the magnitude, geographic extent, duration and frequency of an incident. The most likely scenarios typically have a relatively low consequence (e.g., spill of hydrocarbons involving a small volume of material confined to an area of 1 square metre (m^2)). Worst case scenarios can have much higher consequence (e.g., fire that affects hundreds of hectares of forested land), but are less likely to occur. Definitions for low, moderate and high consequence are provided in Table 5.1.3-1.

The risk of each scenario is then evaluated with respect to probability of occurrence and environmental consequence. The incident risk evaluation matrix that is used to provide a first order characterization of an incident's risk profile is provided in Table 5.1.3-1. Low risk is considered unlikely to pose a serious threat to a Valued Environmental Components (VEC) and unlikely to represent a management challenge. Moderate risk is considered unlikely to pose a serious threat to a VEC but controls and recovery measures may be required. High risk is considered likely to pose a serious threat to a VEC and represents a management challenge.

Incidents that have a low to high probability of occurring and have a low consequence are considered to have a low risk. There are proven and effective prevention and mitigation measures for low risk incidents. These prevention and mitigation measures have been incorporated into Nalcor's standard construction and maintenance procedures, and they are included in the Project EPP. These low risk incidents are assessed as part of the overall environmental effects assessment for relevant VECs. Incidents that are considered to have a moderate to high risk are addressed as specific events in the Accidents and Malfunctions sections of the Environmental Effects Assessment chapters.

Table 5.1.3-1 Incident Risk Evaluation Matrix

Incident Risk Evaluation			Consequence		
			Low	**Moderate**	**High**
			Incident could result in a slight decline in the resource in the study area during the life of the Project. Research, monitoring, and / or recovery initiatives would not normally be required.	Incident could result in a decline in the resource to lower-than-baseline but stable levels in the study area after Project closure and into the foreseeable future. Regional management actions such as research, monitoring and / or recovery initiatives may be required.	Incident could threaten sustainability of the resource and should be considered a management concern. Research, monitoring and / or recovery initiatives should be considered.
Probability	Low	This type of incident has only rarely been reported for electricity transmission projects.	Low	Low	Moderate
	Moderate	Evidence supports the occurrence of this type of incident in some, but less than half, of electricity transmission projects.	Low	Moderate	High
	High	This type of incident is considered common for electricity transmission projects.	Low	High	High

5.2 Management Systems

Nalcor will proactively identify potential incidents related to Project Construction, and Operations and Maintenance. Prevention measures and response procedures will be described in the EPP, the SHERP, and the OHSP. These plans will be field-useable documents that address prevention measures and incident response procedures for unplanned safety, health and environmental events.

Nalcor has adopted the International Standards Organization (ISO) 14001 Environmental Management System (EMS) as their framework for environmental management and continual improvement (i.e., adaptive management). Programs developed under the EMS include emissions control, waste management and recycling, spills management, environmental remediation, and species and habitat diversity. Nalcor annually publishes an Environmental Performance Report, which provides information on accidents and malfunctions that have occurred on their projects and had environmental consequences.

Nalcor will implement Health and Safety, Environment, and Quality (HSEQ) Management Systems to meet the requirements of ISO14001:2004 (Environment), CAN Z1000-06 (Health and Safety), and ISO 9001:2000 (Quality). While each of these systems has its own focus and controls, Nalcor has adopted an integrated approach to common elements of the systems. Some of these common elements include:

- document and records control;

- communication;
- incident preparedness and response;
- compliance and management system auditing; and
- management review.

For these common elements, existing systems within the Nalcor HSEQ Management System will be used for the Project.

All Project Construction, and Operations and Maintenance personnel will be required to maintain a high level of vigilance, undergo regular safety training, and be familiar with the SHERP, the EPP and the OHSP. Third-party contractors will be screened for compatibility with Nalcor policies and procedures and only those that meet the criteria will be hired.

5.3 Identification of Potential Incidents

A list of potentially moderate or high risk incidents has been developed, based on Nalcor's experience in Construction, and Operations and Maintenance of electricity transmission infrastructure, government and industry statistics and the industry knowledge of the assessors. The information used to identify these incidents is described in Section 5.1.1. The EIS does not address all conceivable incidents. Rather, it addresses those that have occurred on similar projects and, based on Project design and the Project's environmental setting, may also occur during Project activities and may have environmental effects.

Potential incidents that may occur during Project Construction, and Operations and Maintenance include:

- transmission tower failure;
- electrocution;
- spills and leaks of hazardous material;
- frac-out during a Horizontal Directional Drill (HDD);
- slope failure;
- fires (except forest fires);
- forest fires;
- waste management incidents;
- motor vehicle collisions;
- marine vessel collisions; and
- aviation accidents.

For each of the potential incidents listed above, the following sections describe the potential incident, the measures that will be taken as part of the Project to prevent the incident from occurring, and response measures to be taken in the event that the incident does occur. This is followed by an assessment of the incident risk and a description of the potential worst case scenario.

5.4 Transmission Tower Failure

As part of the Project, several thousand steel transmission towers will be erected between the Muskrat Falls converter station and the Soldiers Pond converter station. These towers are designed to withstand extreme meteorological loads, however, a transmission tower failure is possible. During Project Construction, a transmission tower could fail as a result of soil conditions, meteorological conditions or work crew error.

During Project Operations and Maintenance, tower failure could result from meteorological conditions (e.g., ice storm), natural erosional processes (i.e., erosion of the supporting soils), or metal fatigue. Typically, if a tower does fail during Project Operations and Maintenance, adjacent towers may also be affected.

A transmission tower failure may have the following environmental interactions:

- collision with wildlife;
- ignition of a brush or forest fire;
- electrocution of fish and / or wildlife;
- disturbance of wildlife along the access trails, roads and right-of-way (ROW) during repairs; and
- risk to public safety.

5.4.1 Incident Prevention and Response

The transmission towers will be designed in accordance with Canadian Standards Association (CSA) (2009) standards.

During engineering design, both the tower type and meteorological forces (e.g., icing and wind conditions) are considered. To limit the extent of damage due to a transmission tower failure, anti-cascade towers will be installed at intervals along the transmission line. Anti-cascade towers are larger, stronger towers used at 15 to 20 tower intervals to contain the sequential failure of adjacent structures. The transmission towers are also designed to withstand loadings associated with a 50-year return period meteorological event (i.e., an event that is expected to occur every 50 years).

The transmission towers will be constructed in accordance with CSA standards and guidelines, and with the principle of Good Utility Practice. Good Utility Practice is defined as:

- The practice, methods and acts engaged in, or approved by, a significant portion of the electrical industry in North America, or any of the practices, methods and acts which, in the exercise of reasonable judgement in light of the facts known at the time the decision was made, are expected to accomplish the desired result at a reasonable cost consistent with good business practices, reliability, safety and expedition. Good Utility Practice is not intended to be limited to one optimum practice, method or act to the exclusion of others, but rather to include all practices, methods or acts accepted in North America.

Following this principle, the construction of the transmission towers will be conducted by qualified, specialized contractors, with workers experienced in the erection of steel lattice tower transmission lines.

5.4.2 Risk Evaluation

Nalcor has experienced two transmission tower failures during conductor stringing, with both occurring during the Avalon Upgrade Project in the early 2000s. The first incident occurred when the conductor hooked into the guy wire of a guyed suspension tower, causing the guy to fail and the tower to fall. The second incident occurred when the conductor was over-tensioned, causing a light angle dead-end transmission tower to collapse. The tower was not capable of carrying the forces of the conductor, so this type of tower is no longer used by Nalcor. Based on Nalcor's experience constructing electrical transmission and distribution lines and considering the Project is designed for a 50-year return period meteorological event, the probability of a transmission tower collapse occurring during erection activities is low-moderate.

The effects of a collapse on the natural environment would be limited to the disturbance of terrestrial or aquatic habitat affected by the collapse, removal and reconstruction of the steel structure. The footprint of a transmission tower collapse would be approximately 100 square metres (m^2), with a small additional area disturbed by tower replacement or repair activities. As the affected area would primarily be contained within the cleared ROW, the consequence of this incident is low. The low-moderate probability of occurrence and the

low consequence indicate a low risk of tower collapse during erection, as shown in Table 5.1.3-1. There are proven and effective prevention and mitigation measures for this type of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 12.2, 12.3, 12.4, 12.5, 13.3, and 16.3).

During Project Operations and Maintenance, there is a potential for a transmission tower failure to cause the collapse of adjacent towers. The transmission towers for the Project will meet Nalcor's current ice load standard and are designed for a 50-year return period meteorological event. The probability of transmission tower failure during Project Operations and Maintenance is low.

The effects to the natural environment would likely be limited to the disturbance of terrestrial and / or aquatic habitat associated with the collapse of up to 20 towers (over a linear distance of less than 10 km), and the effects resulting from the removal and replacement of the steel infrastructure. The collapse of adjacent towers may be limited by the tension in the conductor. Depending on the number of towers that fail, the consequence of tower collapse during conductor installation or Project Operations and Maintenance is low to moderate. The low probability of occurrence and low to moderate consequence indicate a low risk, as shown in Table 5.1.3-1. There are proven and effective prevention and mitigation measures for this type of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 12.2, 12.3, 12.4, 12.5, 13.3, and 16.3).

5.4.3 Worst Case Scenario

The worst case scenario is a tower failure during Project Operations and Maintenance that leads to the successive failure of 20 towers and the associated disturbance over a distance of less than 10 km. This scenario would most likely occur during or after an extreme weather event in the alpine or eastern design regions, where high ice loads are known to occur. Depending on the geographical extent of the storm, multiple groups of up to 20 towers may be affected by the same storm. The low probability of occurrence and moderate consequence indicate a low risk, as shown in Table 5.1.3-1. There are proven and effective prevention and mitigation measures for this type of low risk incident that will be implemented by Nalcor and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 12.2, 12.3, 12.4, 12.5, 13.3, and 16.3).

5.5 Electrocution

During Project operation, an electrical current will travel through the Project converter stations, through on-land transmission lines, through the submarine cables and through the electrodes and wood pole electrode lines. Human or animal contact with a live wire or electrical equipment could lead to electrocution. Human or wildlife contact with high-voltage electricity can result in the following:

- human injury (e.g., burns, loss of limbs, damage to internal organs, and neurological damage) or death; and
- wildlife injury or death.

5.5.1 Incident Prevention and Response

Nalcor will proactively identify potential electrical hazards related to Project Construction, and Operations and Maintenance. Prevention measures and response procedures will be described in the EPP, the SHERP, and the OHSP. The following measures will be implemented to reduce likelihood of electrocution during Project Construction, and Operations and Maintenance:

- The transmission towers will be designed in accordance with CSA standards, as described in Section 5.8.1.
- "High voltage" signage will be posted on High Voltage direct current (HVdc) towers, the converter stations, transition compounds and electrode sites.

- "High voltage" signage will be posted where power lines are buried (e.g., between the transition compounds and their respective landing points) to ensure that there is no excavation or development in the cable areas.
- Public access to the converter stations will be restricted by galvanized steel security fences and locked gates.
- The electrode sites will be enclosed by locked, chain-link fences to prevent public access from the land and sea sides. Sea side fencing will be installed on the electrode berm crest.
- Avian-safe separation of the energized and / or grounded parts of the power line will be incorporated into the transmission line design.
- The submarine cable will be protected from interaction with fishing activity by HDD and the rock berm.

5.5.2 Risk Evaluation

The transmission system will be designed to trip out in the event of a ground fault. The system will attempt to clear the fault by reclosing and re-energizing the line. It will make a fixed number of attempts before remaining off-line. If a conductor failure occurs (i.e., if the conductor breaks), the line will trip out before coming into contact with anything. If a tower failure occurs and the conductor touches the tower, the system will trip out and the risk of electrocution is removed, unless a person or animal is in direct contact with the tower. If the conductor does not touch the tower at any point during the fall, the live conductor could come into contact with a person or animal on its way to the ground. Electrocution resulting from conductor or tower failure requires a specific combination of circumstances (e.g., tower failure during which the conductor does not touch the tower and a person or animal is located in the direct path of the falling conductor). For this reason, the probability of electrocution due to tower or conductor failure is low.

The probability of electrocution due to interactions between fishing equipment and the submarine cable is similarly low, as the cable is protected by HDD and a rock berm.

Electrocution of humans and most wildlife from regular operation of the transmission line is not likely due to the height of the conductors. However, birds travel and perch at transmission line heights. The probability of electrocution resulting in bird injury or death is influenced by the size of the bird, habitat crossed by the power line, prey availability, bird behaviour, age, season and weather. Twenty-nine of the 31 species of diurnal raptors and 19 species of owl that breed in North America have been reported as victims of electrocution; over 30 non-raptor species have also been reported in cases of electrocution (Avian Power Line Interaction Committee 2006). The probability of a bird experiencing electrocution is considered moderate, for electrode lines. The probability of a bird experiencing electrocution from the HVdc transmission line is not considered as the distance between the two conductors is too great for this to occur.

The consequence of electrocution to humans or wildlife depends on the magnitude of the current, the voltage and amperage, the duration of contact, and the electrical resistance of the body. In the case of electrocution of a human, serious injury or death may result, and the consequence is considered high. In the case of wildlife, transmission tower or conductor failure may result in the injury or death of a single animal. Electrocution from perching or colliding with transmission lines is similarly expected to result in a small number of bird injuries or deaths. Electrocution is not likely to have population level effects on wildlife, and the consequence on wildlife is low.

The low probability of occurrence of human electrocution and the high consequence indicate a moderate risk, as shown in Table 5.1.3-1. The moderate probability of occurrence of electrocution of wildlife (i.e., birds) and the low consequence indicate a low risk of wildlife electrocution. The human scenario will be addressed as a specific event in Section 16.10.2 of this EIS. For the wildlife scenario, there are proven and effective prevention and mitigation measures for this type of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 12.3, 13.3, and 14.3).

5.5.3 Worst Case Scenario

The worst case scenario for humans is the electrocution of a person resulting in their death. The probability of this occurring is low and the consequence is high, as discussed in Section 5.13.2, indicating a moderate risk of human electrocution, as shown in Table 5.1.3-1. This scenario is addressed as a specific event in Section 16.10.2 of this EIS.

The worst case scenario for wildlife is the electrocution of an animal listed under the *Species at Risk Act* (*SARA*) or the *Newfoundland and Labrador Endangered Species Act* (Newfoundland and Labrador *Endangered Species Act* (*NLESA*)). The probability of this worst case scenario occurring is much less than the probability of a collision with a non *SARA*- or *NLESA*-listed animal due to the relative abundance of listed and non listed animals. The probability of occurrence depends on the species involved, their abundance, and their behaviour (e.g., perching preferences). Overall, this scenario is a low probability of occurrence. The consequence of this incident may be low to moderate, again depending on the species and its status. The low probability of occurrence and the low to moderate consequence indicate a low risk of electrocution of a *SARA*- or *NLESA*-listed animal, as shown in Table 5.1.3-1. There are proven and effective prevention and mitigation measures for this type of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 12.3, 13.3, and 14.3).

5.6 Spills and Leaks of Hazardous Material

During Project Construction, and Operations and Maintenance, environmentally hazardous materials such as hydrocarbons (e.g., gasoline and diesel), lubricating oils and hydraulic fluid will be used. Within the converter station, transformers will contain non-polychlorinated biphenyl (non-PCB) transformer oils. As part of its standard operating procedures, Nalcor strives to reduce the potential for leaks and spills through the implementation of its HSEQ management systems. Spills or leaks of hydrocarbons could occur along the ROW, at the converter stations, along access roads and in the Strait of Belle Isle as a result of incidents involving heavy equipment, vehicles and marine vessels that contain fuel, oil and lubricants (e.g., excavators, mechanical harvesters, cranes, drill rig, fallpipe vessel and cable installation vessel). During Project Operations and Maintenance, there is a potential for spills or leaks of herbicide used for vegetation management along the ROW. Leaks or spills of fuel, battery acid, and transformer oils could also occur during converter station Construction, and Operations and Maintenance.

Spills or leaks of hazardous material may have the following environmental interactions:

- surface water contamination interactions with fish and aquatic habitats;
- groundwater contamination interactions with human health if the material reaches an aquifer used for human consumption;
- wildlife mortality, wildlife habitat alteration, loss or fragmentation;
- loss or alteration of vegetation; and
- soil contamination.

5.6.1 Incident Prevention and Response

The Project EPP will contain conditions for fuel handling and storage, including procedures for spill response.

The SHERP will include specific instructions for the prevention of and response to spills or leaks of hazardous material. Spill response kits will be maintained at all work sites, and spill kit contents will be based on the volume of fluids in use, the type of fluid, proximity to water and other relevant factors. All personnel involved in hydrocarbon transport and transfer will be trained in spill response. A Response Team will be formed, trained and will receive regular practice in “mock” responses for incidents that require co-ordinated action. Any spills in excess of the amount, concentration, level, or rate of release authorized by the Newfoundland and

Labrador *Environmental Protection Act* (*NLEPA*) or any Project approvals granted under the *NLEPA* will be reported to the Newfoundland and Labrador Department of Environment and Conservation (NLDEC).

Handling and fuelling procedures will comply with the *Storage and Handling of Gasoline and Associated Products Regulations* (CNR 775/96) and any additional requirements set forth by the NLDEC. During construction, hydrocarbon supplies will be transported by tanker trucks and in drums or other approved containers. Fuelling stations will be established along the ROW, with self-dyked steel storage tanks and the largest fuel storage tank on-site will hold no more than 125,000 litres (L). The fuelling stations at marshalling yards and camps will include concrete pads and controls to retain drainage in a sump where any hydrocarbons can be captured and separated prior to release of the runoff. For equipment with reduced mobility, such as heavy lift cranes and excavators, fuel will be delivered by a double walled approved mobile tank and re-fuelling will take place on-site. All fuel transfers will follow safety procedures to prevent even minor leaks and drips.

All mobile storage tanks will be registered under, and comply with, the *Storage and Handling of Gasoline and Associated Products Regulations, 2003*, under the *NLEPA.* Records of all storage tank contents will be maintained to reconcile inventories as a check against undetected leakage. All transport vehicles will be licensed and maintained according to safety requirements. Fuelling or servicing of mobile equipment on-land will not be permitted within 50 m of a waterbody. Additionally, the use of biodegradable lubricants and hydraulic fluids where practical will be implemented with working in waterbodies.

Waste oil will be collected and stored in drums (clearly marked “waste oil”) inside a dyked area and will be regularly shipped for disposal. Waste oils, lubricants and other used oil will be disposed of at approved disposal sites.

Prior to fording a stream, equipment will be inspected to confirm that it is mechanically sound, to limit the potential for leaks of oil, fuel, and hydraulic fluids. Crossings will be at right angles and completed as expeditiously as safety allows.

Spills or leaks of hazardous material in water must be reported to Canadian Coast Guard who then refers the incident to the proper authority (Fisheries and Oceans Canada (DFO), Environment Canada, the province). All spills, regardless of volume, are to be reported. Spills or leaks of hazardous material on land must be reported to Government Services Centre who co-ordinate the provincial response.

5.6.2 Risk Evaluation

It is Nalcor’s experience that, even with best efforts to reduce the potential for leaks and spills, isolated, small (i.e., less than 2 L) spills and leaks could occur during Construction, and Operations and Maintenance activities. These incidents are most often the result of equipment failure (e.g., a break in a hydraulic hose), unanticipated hazards (e.g., vehicle collision) and human error (e.g., failure to follow procedures).

While not necessarily reflective of the type of activities to be carried out as part of the Project, Nalcor had 10 reportable spill or leak incidents within its operations in Newfoundland and Labrador in 2009, up from five in 2008. All of these spills involved petroleum products or petroleum derivatives, including heavy fuel oil, insulating oil, glycol and lubricating oil. The approximate volume for all reportable spills in 2009 was 64,331 L, up from 702 L in 2008. Approximately 64,000 L of the volume spilled in 2009 occurred in a single event at the Holyrood Thermal Generating Station. The release of heavy fuel oil was caused by two loose filters where the oil flows into the generating unit. The source of the release was promptly found and isolated, and clean up was initiated. The spilled oil was contained within the Holyrood plant and did not contaminate any water source (Nalcor 2010, internet site).

Project Construction is scheduled to take approximately four years, with work proceeding year-round on multiple construction work fronts. Small spills during construction typically involve less than 2 L of fluid, often result from hydraulic hose malfunctions, and are cleaned up immediately, as per the SHERP. Based on Nalcor’s experience and given the scale of construction activity for the Project, the probability of a small spill occurring during Project Construction is high. However, the consequence of a small spill is low.

Leaks and small spills could also occur during Project Operations and Maintenance. The entire transmission line will be inspected on an annual basis via ground patrol and / or helicopter, with a portion (10%) of the line being inspected by climbing inspections. Vegetation management will commence eight years following Construction and will be repeated every seven years thereafter. There will therefore be infrequent and brief activity along the transmission line ROW during Project Operations and Maintenance. The converter station will have transformer oils and may have diesel fuel present. These sites will include dykes to prevent release into the environment. Due to the low level of activity during Project Operations and Maintenance, the probability of a small spill is low and the consequence is expected to be low.

The low probability of occurrence and low consequence indicate a low risk of a small leak during Project Construction, Operations and Maintenance, as shown in Table 5.1.3-1. There are proven and effective prevention and mitigation measures for this type of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 12.2, 12.3, 12.4, 12.5, 13.2, 13.3, 14.2, 14.3, and 14.4).

5.6.3 Worst Case Scenario

Two worst case scenarios are considered for spills and leaks of hazardous material. The first is a large spill of diesel fuel from a portable fuel storage system into the environment. Diesel fuel for the re-fuelling of heavy equipment will be transported in a 1,000 L portable fuel storage tank. The large spill scenario involves the breach of this fuel tank due to a mishap (e.g., roll over). Given that approved, double walled fuel storage tanks will be used to transport fuel and the implementation of the other environmental protection measures described in the SHERP and EPP, there is a low probability of a breach of a mobile fuel storage tank resulting in a large scale release of its contents. The consequence of such a spill, however, would be moderate to high, and the subsequent risk to the environment would be moderate.

The first reasonable worst case scenario carried forward in the EIS, therefore, is an accident involving a vehicle transporting 1,000 L of diesel fuel. The accident would cause a puncture or rupture in the fuel tank, resulting in the release of all 1,000 L of diesel fuel. Diesel would spill onto and over the ground and into a stream adjacent to the road. The response procedures described in the SHERP would be implemented by the work crew immediately. This scenario will be addressed as a specific event in Sections 12.6.3, 13.4.3, 14.5.3 and 16.9.2 of the EIS.

The second worst case scenario would be a large spill of fuel into the Marine Environment due to a collision between the fallpipe or cable installation vessel or a material transport ship and another boat or the seabed. The worst case scenario would involve a fully-fuelled vessel releasing all of its fuel into the sea. Given the environmental protection measures described in the SHERP, through the Simultaneous Operations (SIMOPS) system and the EPP and the compliance of Project vessels with the *Canada Shipping Act*, the probability of a large spill of fuel into the Marine Environment is low. The risk of marine accidents is discussed further in Section 5.13. Given the large quantity of fuel on board a fallpipe and material transport ship, the potential consequence of a large spill is high and the subsequent risk to the environment would be moderate to high. This scenario will be addressed as a specific event in Sections 14.5.3 and 16.9.2 of the EIS.

5.7 Frac-out During Horizontal Directional Drill

Three separate boreholes will be drilled on each side of the Strait of Belle Isle (i.e., Forteau Point and Shoal Cove) for the submarine cables. A pilot borehole will be drilled at each site, then one or two additional reaming passes will be completed to achieve the desired borehole diameter. This process will use a drilling mud composed of water and bentonite. During the HDD process, there is a potential for the release of drilling mud into the surrounding environment (i.e., frac-out). Frac-out of drilling mud (also referred to as inadvertent returns to surface) may occur if the downhole mud pressure exceeds the resistance of the soil or rock formation and also can occur through an existing fault / crack in the rock formation. The potential for frac-out is affected by the types of soil or rock that are encountered along the drill path, the depth of ground cover above the borehole, drilling mud properties and how the drill rig and mud pumps are operated.

Bentonite is non-toxic, however frac-out during HDD may have the following environmental interactions:

- terrestrial frac-outs are typically easy to contain, but may result in localized alteration or loss of listed plants; and
- the fine bentonite particles from a marine frac-out may interact with fish eggs, benthic invertebrates and marine plants.

5.7.1 Incident Prevention and Response

A geotechnical assessment has been conducted to assess the suitability of the Forteau Point and Shoal Cove sites for HDD. The drill path (i.e., location, depth) will be designed to minimize the potential for frac-out. A frac-out response plan will be developed and will include a description of HDD monitoring protocols, and procedures for containing and cleaning up a frac-out.

Measures have been or will be incorporated into the HDD process, including:

- the selection of drill sites considered the location of sensitive plants and habitat;
- material and equipment required to contain and clean up drilling mud will be readily accessible at the drill sites;
- the frac-out response plan will describe procedures for stopping work, containing the drilling mud, and notifying appropriate authorities (e.g., DFO);
- the frac-out response plan will assign clean up priority according to risk of potential harm and disposal of drilling mud such that it will not re-enter the Marine Environment;
- clean up procedures will not cause greater damage to the shoreline or Marine Environment than leaving the drilling mud in place;
- a marine frac-out will be monitored to determine whether the drilling mud congeals (bentonite will often harden, thus sealing the frac-out);
- if the drilling mud does not congeal, the drilling mud may be contained using an underwater boom and curtain;
- for a terrestrial frac-out, the drilling mud will be contained with hay bales, sand bags or silt fencing, then pumped into the return pit; and
- for a terrestrial frac-out that affects a vegetated area, reclamation will include site-specific measures to promote natural revegetation of the disturbed area.

5.7.2 Risk Evaluation

Some of the factors that contribute to the probability and consequence of frac-out include:

- local geology not suitable for HDD;
- drill path too shallow; and
- localized scouring of the seabed reducing depth of cover over the HDD path.

Much of the risk of frac-out can be reduced through a pre-drilling geotechnical assessment, and proper HDD planning and execution. A geotechnical assessment conducted for Forteau Point and Shoal Cove indicates that the local geology presents a low risk for frac-out. The depth of the drill path will be designed to minimize the potential for frac-out and will consider the potential effects of seabed scouring (e.g., from icebergs, fishing activity).

Given the results of the geotechnical assessment and the design measures implemented, the probability of a frac-out is low. The extent of a potential frac-out will be limited by careful monitoring of the HDD process, the development of a detailed response plan, and the availability of material and equipment for containing a drilling mud release at each drill site. The effects of a frac-out are expected to be localized, and the consequence is considered to be low.

The low probability of occurrence and a low consequence indicate a low risk of frac-out, as shown in Table 5.1.3-1. There are proven and effective prevention and mitigation measures for this type of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 12.2, 14.2, and 14.3).

5.7.3 Worst Case Scenario

Two worst case scenarios have been identified. The first is a frac-out within the Marine Environment during which the drilling mud does not congeal and seal off the frac-out location. This scenario could result in the release of bentonite particles into the Marine Environment. The deposition of fine bentonite particles on the seabed may smother fish eggs, benthic invertebrates and marine plants depending on the location and the time of year. The second is a frac-out within the Terrestrial Environment that releases drilling mud in a location where *SARA*- or *NLESA*- listed plants are present.

The probability of these scenarios is low given the geotechnical assessment and design of the drill paths. The effects are expected to be localized, and the consequence is low-moderate. There are proven and effective prevention and mitigation measures for these types of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 12.2, 14.2 and 14.3).

5.8 Slope Failure

Topographic conditions along the access roads and ROW are varied and include regions of high relief (e.g., the Long Range Mountains). Terrain along the access roads and ROW may be susceptible to slope movement, particularly where drainage associated with Project access roads results in the undercutting of slopes by streams and rivers during high precipitation events. There is also a potential for erosion of shoreline fill at the electrode sites to result in slope failure, or seabed slope failure to occur during construction of the shoreline electrode ponds.

Slope failure may have the following environmental interactions:

- alteration or loss of wildlife habitat;
- wildlife disturbance or mortality;
- alteration or loss of vegetation cover and timber resources;
- change in surface water runoff patterns, which could affect surface water quality and fish habitat;
- alteration of marine or freshwater habitat due to siltation;
- loss of infrastructure and / or land use; and
- risk to public safety.

5.8.1 Incident Prevention and Response

Where possible, Project components will be sited away from unstable terrain. Further preventive measures will be incorporated into Project design and will include slope stabilization measures, as appropriate.

The EPP will describe slope stabilization and erosion control procedures to be followed during Project Construction. All construction personnel will receive EPP training, and Nalcor and its contractors will comply

with the commitments described in the EPP. The following slope failure prevention measures will be incorporated into Project design or described in EPP, as appropriate:

- geotechnical evaluations of specific locations will be undertaken by qualified engineers, as appropriate;
- in locations where slope instabilities are shallow, the depth of foundation or guy anchors may be increased, and drainage and erosion control measures may be implemented;
- construction of access roads will include drainage structures, where appropriate, and they will be inspected regularly to check that they are functioning properly;
- additional seasonal and end-of-construction drainage measures may be implemented, as necessary; and
- the potential for slope failures resulting from the erosion of shoreline fill at the electrode sites will be mitigated by slope flattening and revetment with riprap stone.

5.8.2 Risk Evaluation

Some factors that contribute to the probability and consequence of a slope failure include:

- additional loading at the top of a slope (e.g., placement of fill or rock at the top of a slope, erection of buildings or towers at the top of a slope);
- removal of lateral support along the surface of the slope (e.g., erosion by water or wind, excavation at the base of the slope);
- increased pressure within the slope (e.g., saturation with water, rapid water extraction); and
- earthquakes (i.e., physical disturbance of slope).

Most of these factors can be controlled through Project design (i.e., transmission tower siting, road design) and construction practices, as described in the EPP. The Project is in an area of low seismic risk (Geological Survey of Canada 2005). Although the resulting probability of slope failure is minimized through Project design and the preventive measures described in the EPP, and risk is also mitigated through site investigations to confirm soil properties prior to construction. Slope failures can occur through a combination of construction activity and natural processes. The probability of slope failure during Project Construction is characterized as low. During Operations and Maintenance, the probability of slope failure is also low, and could result from natural erosional processes affecting the soils supporting Project components.

The consequence of a slope failure is typically limited to the slope itself and an area at the base of the slope. The consequence depends on the extent of the slope failure, which may be affected by the size and steepness of the slope, vegetative cover, geotechnical conditions and the cause of the failure. In general, the effects are expected to be localized, and the consequence is low.

The low probability of occurrence and a low consequence indicate a low risk associated with slope failure, as shown in Table 5.1.3-1. There are proven and effective prevention and mitigation measures for this type of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 12.2, 12.3, 12.4, 12.5, 13.2, 13.3, 14.2, 14.3, 14.4, and 14.5).

5.8.3 Worst Case Scenario

The worst case scenario is a slope failure that affects a riverbank or the marine shoreline (i.e., Strait of Belle Isle or Conception Bay). This scenario could occur where Project Construction is carried out adjacent to a watercourse or the coastline and it could result in a quantity of soil and rock entering the water and affecting fish and fish habitat locally and downstream of the incident. The probability of this scenario is considered low given the construction methods (e.g., HDD) and preventative measures that will be implemented, and the consequence would be low to moderate, depending on the characteristics of the receiving waterbody. There are proven and effective prevention and mitigation measures for this type of low risk incident and these are

described within the Environmental Effects Assessment chapters of this EIS (Sections 12.2, 12.3, 12.4, 12.5, 13.2, 13.3, 14.2, 14.3, 14.4, and 14.5).

5.9 Fires (Except Forest Fires)

The storage of combustible material or waste at the marshalling yards or campsites, and the operation of kitchen appliances within the campsites could result in a fire during Project Construction. The storage of combustible material or waste, or equipment malfunction at a converter station could result in fire during the Project Operations and Maintenance. Flammable liquids within the converter station will be limited to non-polychlorinated biphenyl PCB transformer oils.

A fire may have the following environmental interactions:

- reduction of the air quality due to the release of particulate matter and other contaminants into the atmosphere;
- alteration or loss of wildlife habitat;
- alteration or loss of vegetation;
- loss of infrastructure and / or land use; and
- risk to public safety.

5.9.1 Incident Prevention and Response

The SHERP will include a plan for preventing and combating fires. All Project personnel will be made aware of the SHERP and designated staff will receive SHERP training. The fire prevention plan will be followed by Nalcor and its contractors. The SHERP will address the following fire prevention measures and incident response procedures:

- storage of flammable waste in fire resistant containers;
- appropriate and timely disposal of all flammable waste;
- the use of designated smoking areas;
- the burning of brush or debris will not be permitted; and
- in the event of a fire, immediate steps will be taken to contain or extinguish the fire to the extent practical and safe.

Fire-fighting equipment suitable to the labour force and working conditions will be available at each worksite during construction and at the converter stations and transition compounds during Project operation. This equipment will be maintained in proper working condition. A fire alarm and a fire suppression system will be installed at each converter station and transformers will be equipped with a water deluge system. Fire-fighting equipment will comply with the standards of, and have approvals of, Underwriters Laboratories of Canada Limited and will be maintained in accordance with National Fire Protection Association Codes. Nalcor will ensure that all Project field personnel are trained in the use of fire-fighting equipment and that trained personnel are available to respond immediately to an incident. Detailed information on fire-fighting equipment and procedures will be provided in the SHERP, the EPP and other environmental documents, such as terms and conditions of permits and authorizations.

5.9.2 Risk Evaluation

The implementation of the fire prevention procedures described in the SHERP will minimize the probability of a fire occurring during Project Construction, and Operations and Maintenance. As a result, the probability of a fire occurring on the Project is low.

The fire suppression systems and incident response plans will minimize the extent and duration of a fire, if one does occur. Although emissions from a fire could extend beyond the campsite or converter station, quick suppression of any fires is expected to limit both the terrestrial and atmospheric effects of a fire such that monitoring or recovery initiatives would not be required. The consequence of a fire is therefore expected to be low.

The low probability of occurrence and low consequence indicate a low risk of fire, as shown in Table 5.1.3-1. There are proven and effective prevention and mitigation measures for this type of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 11.2, 12.2, 12.3, 12.4, and 12.5).

5.9.3 Worst Case Scenario

The worst case scenario is a fire that cannot be contained by the site response crew. This scenario is more likely to occur where large amounts of flammable material are present (e.g., fuel storage), and during high wind conditions. In a worst case scenario, the fire would spread outside of the campsite or converter station, igniting a forest fire. Forest fire risk is addressed separately in Section 5.10.

5.10 Forest Fires

The operation of combustion engines (e.g., vehicles, heavy equipment, chain saws), blasting activity and general presence of workers have the potential to ignite forest fires. Both combustion engines and workers are expected to be present during most Project Construction, and Operations and Maintenance activities, and blasting may occur during foundation construction. Several Project activities will occur in forested areas where the ignition source could lead to a forest fire, depending on the season (i.e., the potential for forest fires would be minimal in the winter).

A forest fire may have the following environmental interactions:

- reduction of the air quality due to the release of particulate matter and other contaminants into the atmosphere;
- alteration or loss of wildlife habitat or wildlife mortality;
- alteration or loss of vegetation cover and timber resources;
- change in surface water run-off patterns, which could affect surface water quality and fish habitat;
- loss of infrastructure and / or land use;
- risk to public safety;
- change in the visual aesthetics of the landscape; and
- disruption to the recreational use of the area.

5.10.1 Incident Prevention and Response

The SHERP will include a plan to prevent and combat forest fires. All Project personnel will be made aware of the SHERP and designated staff will receive SHERP training. The forest fire prevention plan will be followed by Nalcor and its contractors. The SHERP will address the following forest fire prevention measures and incident response procedures, as appropriate (i.e., seasonal considerations):

- appropriate and timely disposal of all flammable waste;
- the use of designated smoking areas;
- the burning of brush or debris will not be permitted;

- vehicles will be equipped with spark arrestors;
- the nearest regional office of the Department of Natural Resources (Forest Services Branch) will be notified prior to the initiation of work;
- in the event of a forest fire, immediate steps will be taken to contain or extinguish the fire to the extent practical and safe, and fires will be reported immediately to the nearest regional office of the Forest Services Branch.

An Operating Permit will be obtained from the provincial Forest Services Branch. Operating Permits are issued under the *Forestry Act* and give recipients the permission to carry out logging or industrial operations during the forest fire season. The Project EPP will also include forest fire prevention measures and a response plan.

Fire-fighting equipment, as described in Table 5.10.1-1, that is suitable to the labour force and working conditions will be available at each worksite and will be in proper working condition, as required by the Operating Permit. Fire-fighting equipment will comply with the standards of, and have approvals of, Underwriters Laboratories of Canada Limited and will be maintained in accordance with National Fire Protection Association Codes. Nalcor will ensure that all Project field personnel are trained in the use of fire-fighting equipment and that trained personnel are available to respond immediately to an incident.

Nalcor will require that its contractors have fire-fighting expense coverage as part of the Commercial General Liability requirement. This coverage will have a minimum limit of $250,000 for costs associated with the requirement for additional support (i.e., if a fire cannot be contained by the contractor). Detailed information on fire-fighting equipment and procedures will be provided in the SHERP, the EPP and other environmental documents, such as terms and conditions of permits and authorizations.

Table 5.10.1-1 Required Forest Fire Suppression Equipment

Number of Employees at Worksite	Backpack Pumps	Axes	Grubbers or Shovels
5 or less	1	1	1
6 – 10	2	2	2
11 – 15	3	3	3
16 – 20	4	4	4
Over 20	Add one backpack pump, one axe and two grubbers or shovels to the above numbers for each group of five additional employees or fraction of that number of employees. The backpack pump must have a capacity of 20 litres (L) and be of a type approved by the provincial Forest Service Branch.		

Note: This table shows the ratio of forest fire suppression equipment required by an operating permit issued under section 13, subsection (1) of the *Forest Fire Regulations* under the *Forestry Act.*

The Forest Services Branch is responsible for the province's fire suppression program. The Forest Services Branch operates six CL-215 Air Tankers and a Cessna spotter. Four Bell 206L Long Ranger helicopters are on full-time standby and others are hired as needed. There are approximately 100 fire suppression field staff employed by the Forest Services Branch located at 26 depots throughout the province. Forest fire co-ordination is handled by a Duty Officer for each region who oversees the initial attacks and deploys equipment as required (Newfoundland and Labrador Department of Natural Resources (NLDNR) 2011, internet site).

For co-ordination of fire-fighting, the province is divided into three Regions: Eastern Newfoundland, Western Newfoundland, and Labrador. The Eastern regional office is located in Gander, the Western office is located in Corner Brook, and the Labrador office is located in North West River. The current resources in Newfoundland include four water bombers located in Deer Lake (1), Gander (2), and St. John's (1), and two helicopters. Water

bombers stationed in Happy Valley-Goose Bay and in Labrador City are available for forest fire response on the Island, if required. The current resources available in Labrador include: two standby helicopters, one water bomber stationed in Happy Valley-Goose Bay and one stationed in Labrador City. The four additional water bombers located on the Island are available for forest fire response in Labrador, if required.

5.10.2 Risk Evaluation

In 50 years of constructing, and operating and maintaining transmission and distribution lines, Nalcor is aware of only one incident where a forest fire was caused by its activities. This incident occurred in 2001 during the Avalon Transmission Upgrade Project in the area of Spread Eagle (15 km west of Whitbourne). This fire affected less than 1 hectare (ha) of forest and was extinguished by a single pass of a water bomber.

Forest fires occur with relatively low frequency in the province. Nevertheless, an average of 55 forest fires have occurred on the Island each year over the past decade, and an average of 45 forest fires have occurred in Labrador each year over the past decade (Sullivan 2010, pers. comm.). Although the incidence of fires is fairly equal between the Island and Labrador, the average size of fires in the two regions differs. The average extent of forest fires on the Island is less than 3.5 ha while the average extent of forest fires in Labrador is 470 ha (Sullivan 2010, pers. comm.). This difference is attributed to the Forest Services Branch's policy not to fight fires that do not threaten communities or harvestable resources (Michelin 2008, pers. comm.). Most fires within Labrador do not generate a response, while most fires are actively suppressed on the more densely populated Island. More information on forest fires in Newfoundland and Labrador is provided in Section 4.1.5.

In the experience of the Forest Services Branch, fought fires rarely exceed 100 ha (Michelin 2008, pers. comm.). However, there have been forest fires fought within the past ten years that have exceeded 1,000 ha on the Island and 30,000 ha in Labrador (Hewitt 2010, pers. comm.). Approximately half (47%) of the forest fires recorded in the past ten years (2000 to 2009) were resident-caused (e.g., grass burning), while 3.5% were attributed to industrial activity (e.g., mining camps, brush clearing) and 2.3% to forestry operations (Sullivan 2010, pers. comm.).

Vegetation type and season also influence the probability and extent of a forest fire. Approximately two thirds of the Labrador section of the transmission corridor crosses coniferous forest. On the Island, approximately half of the habitat crossed on the Northern Peninsula and through central Newfoundland, and less than one third of the habitat crossed on the Avalon Peninsula are coniferous forest. According to a study of the history of fire in the boreal forest of Southeastern Labrador (Foster 1983), forest fires occur from early June to late October, with peaks in ignition in late June and early July.

Based on the above information, the most likely event would be a small brush fire inadvertently started along the ROW or an access road during clearing operations. Nalcor is aware of only one small (less than 1 ha) forest fire that was caused by their activities. However, 3.5% of the forest fires fought by the Forest Services Branch in the past ten years were attributed to industrial activity. The implementation of the fire prevention procedures described in the SHERP will minimize the probability of a small brush fire occurring, but the probability of a fire occurring during ROW clearing activities remains moderate.

It is expected that the site response team would be able to contain and extinguish a small brush fire, and the affected area would likely be limited to the ROW. It is expected that monitoring or recovery initiatives would not be required, as fire is a natural event within the province. The consequence of a small brush fire therefore is low.

The moderate probability of occurrence and low consequence indicate a low risk of a small brush fire, as shown in Table 5.1.3-1. There are proven and effective prevention and mitigation measures for this type of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 11.2, 12.2, 12.3, 12.4, 12.5, 13.2, 13.3, 16.3, 16.5 and 16.9).

5.10.3 Worst Case Scenario

The worst case scenario is a forest fire that cannot be contained by the site response crew. This scenario is more likely to occur during Project Construction than during Operations and Maintenance due to the higher level of activity along the ROW and access roads during construction. This scenario is most likely to occur during the summer, when the forest is driest. Given the Forest Services Branch's policy not to fight fires that do not threaten communities or harvestable resources, a forest fire in Labrador could affect large tracts of land. The average extent of forest fires in Labrador is approximately 470 ha (Sullivan 2010, pers. comm.). This scenario has a low probability of occurring, but has a moderate to high consequence with a resulting moderate risk. A similar fire in Newfoundland would be more actively fought but has a greater likelihood of approaching a populated community. The Newfoundland scenario has a low probability of occurring, but has a high consequence with a resulting moderate risk.

Consequently, two reasonable worst case scenarios are carried forward in the EIS: a forest fire affecting 470 ha of forested land in Labrador and a forest fire near a populated community in Newfoundland. Both fires are assumed to originate in the ROW or access road during Project Construction, during the summer. These scenarios will be addressed as specific events in Sections 11.4.2, 12.6.3, 13.4.3, and 16.10.2 of this EIS.

5.11 Waste Management Incidents

Several waste streams will be generated during Project Construction, and Operations and Maintenance, including domestic waste, sewage and wastewater, and industrial waste. Domestic waste from on-land construction will be temporarily stored in bear-proof containers at the temporary camps or work sites then transported by truck to an approved waste disposal or recycling facility. An on-site treatment system will be used to treat wastewater in Camps A, B, C, E, F, and possibly G. Camp D may use the wastewater treatment infrastructure at L'Anse au Loup. Waste generated by marine operations will be temporarily stored on board the vessel. Once docked, solid waste will be removed from the vessel and transported via truck to an approved waste disposal or recycling facility. Treatment and discharge of ship-board wastewater will comply with *Canadian Shipping Act* regulations.

Waste management incidents could include failure of the wastewater treatment system (e.g., a break in the sewage line) or a waste transport accident. A waste management incident may have the following environmental interactions:

- surface water contamination interactions with fish and aquatic habitats;
- interactions with human health if the material reaches an aquifer used for human consumption;
- alteration or loss of wildlife habitat;
- alteration or loss of vegetation; and
- soil contamination.

5.11.1 Incident Prevention and Response

The EPP will describe waste management procedures for the Project, including handling and disposal of domestic waste, industrial waste, and wastewater. The Project will comply with the requirements of the *Health and Community Services Act* (SN1997, plus amendments). Approval will be obtained for the wastewater treatment systems to be used at the temporary camps. For water and sewage systems with a capacity of less than 4,500 L per day (/day), approval will be obtained from the Government Services Centre regional office. For water and sewage systems with a capacity greater than 4,500 L/day, approval will be obtained from the NLDEC.

Wastewater disposal systems will comply with the *Department of Environment and Lands Act* (RSN1990, Chapter D-11, plus amendments), and the *Environmental Control Water and Sewage Regulations* (Consolidated

Newfoundland Regulations 1078/96 under the *Environment Act* (O.C. 96-254)). The tile field at the wastewater treatment facility will be clearly marked and vehicular traffic will not be permitted to operate within this defined boundary. Discharges will be monitored, as per permit requirements, to comply with effluent release standards (i.e., provincial Environmental Control Water and Sewage Regulations and Section 36 (3) of the *Fisheries Act*).

Waste management on marine vessels will comply with the Regulations for the Prevention of Pollution from Ships and for Dangerous Chemicals (SOR/2007-86) under the *Canada Shipping Act, 2001*. Wastewater will be treated prior to discharge and comply with the effluent release standards described in Section 129 (1) of the above-mentioned regulation.

On-land domestic garbage will be stored in bear-proof containers and regularly transported via waste handling truck to an approved waste disposal or recycling facility. Ship-board waste will be temporarily stored on the vessel, and transported from the port via waste handling truck to an approved waste disposal or recycling facility. Construction waste, including scrap metal, wood packaging, tires and various non-hazardous materials will be recycled, where possible. Construction waste will be temporarily stored along the ROW then transported to an approved waste disposal or recycling facility. Permission from the operator of the waste disposal facility will be obtained prior to disposal of any material.

5.11.2 Risk Evaluation

Nalcor has not experienced any Construction, or Operations and Maintenance incidents involving a collision or rollover of a waste disposal truck. The national average number of straight truck (greater than 4,500 kilograms (kg)) casualty collisions (i.e., collisions resulting in injury or mortality) between 2001 and 2005 was 4,792 per year. Straight trucks travelled an average of 7,395 million vehicle kilometres per year, so the average accident rate is 0.65 collisions per million kilometres (Transport Canada (TC) 2010). During the four year Project Construction period, there are expected to be less than 500 two-way trips between the construction sites and the various waste disposal sites. If the average distance between the work sites and the nearest approved waste disposal site is 100 km, it is unlikely that an accident involving a waste handling truck will occur (i.e., 0.065 collisions during Project Construction). These statistics include all casualty collisions but do not provide information on how many collisions resulted in the loss of cargo. The probability of a waste handling truck collision resulting in the release of solid waste to the environment is low.

The consequence of a collision involving a waste handling truck will depend on the severity of the accident (e.g., the contents of the load), the location of the accident (e.g., in the vicinity of a waterbody) and the time of year of the accident (e.g., fish spawning). In general, the consequence to the natural environment is likely to be low as solid waste will not travel far from the collision site, typically along a road or along the cleared ROW. The amount of solid waste spilled would be limited to the total capacity of one vehicle, approximately 40 cubic metres (m^3). The low probability and low consequence indicate a low risk of a solid waste handling incident, as shown in Table 5.1.3-1. There are proven and effective prevention and mitigation measures for this type of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 12.2, 12.3, 12.4, 12.5, 13.2, and 13.3).

The probability of a release of untreated wastewater into the environment is more challenging to estimate. There are no statistics available for sewage line breakage, or other events that could result in the release of untreated wastewater into the environment. A sewage line could break as a result of ground settling or damage from heavy equipment or vehicles. The failure or malfunction of a wastewater treatment system has resulted in the release of untreated wastewater into the environment once on a Nalcor project. The septic system at the Granite Canal construction site experienced some issues with the disposal field and drainage, and these issues were rectified in a timely manner. The probability of a release of untreated wastewater from the Project into the environment is therefore moderate.

The amount of untreated wastewater released due to a break in a sewage line would be limited by the capacity of the treatment system and the time required to detect and halt the flow. A wastewater release is

most likely to occur during high use of the wastewater treatment system, which would be during evening hours (i.e., during the highest level of camp activity). Because a release of wastewater would occur within the camp perimeter, it is likely that the line breakage would be quickly detected. Based on a sewage production of 340 L per person per day (Newfoundland and Labrador Department of Government Services 2006) and a camp population of 150 persons, 4,250 L of untreated wastewater could be released in a two hour period.

Depending on the characteristics of the receiving environment, the release of 4,250 L of untreated wastewater could affect wildlife and vegetation near the spill. A decline in these resources may result, but resources would be expected to return to baseline levels and regional management initiatives or monitoring would likely not be required. The release of untreated wastewater is therefore likely to have a low consequence. The low probability of occurrence and low consequence indicate a low risk of a release of wastewater, as shown in Table 5.1.3-1. There are proven and effective prevention and mitigation measures for this type of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 12.2, 12.3, 12.4, 12.5, 13.2, and 13.3).

5.11.3 Worst Case Scenario

The worst case scenario is the release of 4,250 L of wastewater from one of the temporary camps during Project Construction that travels over land and into a waterbody or watercourse. This would affect fish and fish habitat in the vicinity of the spill as well as downstream from the spill. This scenario has a low probability of occurrence but a moderate consequence. As a result, it is considered to have a low risk, as shown in Table 5.1.3-1. There are proven and effective prevention and mitigation measures for this type of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 12.2, 12.3, 12.4, 12.5, 13.2, and 13.3).

5.12 Motor Vehicle Collisions

The operation of vehicles and heavy equipment on provincial highways, Project access roads and the ROW could result in human or wildlife collision mortality or injury. Human incidents may involve vehicle-vehicle collisions or vehicle-pedestrian collisions. The potential for these types of collisions is influenced by traffic volumes, weather conditions and pedestrian access.

Wildlife incidents may affect both large and small animals including birds, mammals and amphibians. Other wildlife-related incidents could occur as a result of vehicle travel over natural terrain (e.g., crushing nests or dens with young, or slow-moving animals). The potential for vehicle-wildlife interactions is influenced by the time of year (e.g., the spring and summer are sensitive breeding and nesting periods for birds; moose are moving more during the rut in September and October), the surrounding habitat type, and the time of day.

Vehicle collisions may have the following environmental interactions:

- human injury or mortality;
- wildlife injury or mortality;
- wildlife disturbance; and
- destruction of nests or dens.

5.12.1 Incident Prevention and Response

The SHERP will include safety measures for vehicle operation, including collision prevention. All Project personnel will be made aware of the SHERP and designated staff will receive SHERP training. Driver / operator awareness programs will limit the potential for vehicle collisions, and other vehicle-wildlife incidents. The SHERP and driver awareness programs will address the following vehicle collision prevention measures:

- awareness of high potential collision areas, time of day and seasons; and

- speed restrictions on Project roads.

5.12.2 Risk Evaluation

Transport Canada maintains statistical data on Canadian motor vehicle collisions (MVCs). This includes information on the number of collisions, the number of fatalities and the number of injuries. Between 1990 and 2009, an annual average of 2,670 MVCs in Canada resulted in fatalities. An additional 150,000 MVCs resulted in injuries each year (TC 2011, internet site). The number of collisions reported from 1990 to 2009 in Canada that resulted in either fatality or personal injury is provided in Table 5.12.2-1.

Table 5.12.2-1 Canadian Motor Vehicle Traffic Collision Statistics, 1990 to 2009

Year	Number of Fatal Collisions	Number of Injury Collisions
1990	3,445	178,515
1991	3,225	170,693
1992	3,073	169,640
1993	3,121	168,106
1994	2,837	164,642
1995	2,817	161,950
1996	2,740	153,944
1997	2,660	147,549
1998	2,583	145,615
1999	2,632	148,683
2000	2,547	153,300
2001	2,413	148,996
2002	2,583	153,859
2003	2,489	150,545
2004	2,436	145,248
2005	2,551	145,603
2006	2,599	142,531
2007	2,462	138,632
2008	2,182	127,634
2009	2,011	123,192

Source: TC (2011, internet site).

In 2007, 447 moose-vehicle collisions were reported in the province (NLDEC 2010, internet site). Although moose-vehicle collisions can occur any time of year, more than 70% occur between May and October and most occur between dusk and dawn (NLDEC 2010, internet site). In most cases, these collisions resulted in moose fatalities.

During Project Construction, less than 100 vehicles will travel in any given day, and during Project Operations and Maintenance the number of Project vehicles in operation will be much less. Most Project vehicles will travel during daylight hours and speed restrictions will be imposed on Project access roads. These two factors will reduce the probability of vehicle collisions.

The consequence of a vehicle-vehicle or vehicle-pedestrian collision could range from vehicle damage to serious injury or death, that is from low to high. Given the frequency of MVC in Canada, the probability of a Project vehicle being involved in a vehicle-vehicle or vehicle-pedestrian collision that results in a low consequence is moderate. The probability of occurrence of a moderate to high consequence (i.e., serious injury or death) collision is low. The latter case indicates a moderate risk of vehicle-vehicle or vehicle-pedestrian collision. This scenario will be addressed as a specific event in Section 16.10.2 of this EIS.

The probability of a Project vehicle being involved in a wildlife collision involving small animals (e.g., birds, rodents) is considerably higher than one involving large animals. When small and large animals are considered together, the probability of a vehicle colliding with an animal is high. Vehicle-wildlife collisions often result in the death or injury of a single animal. As a result, collisions are not expected to have population level effects, so the consequence of a vehicle-wildlife collision is considered to be low. The high probability of occurrence and low consequence indicate a low risk of a wildlife collision, as shown in Table 5.1.3-1. There are proven and effective prevention and mitigation measures for this type of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 12.3, 12.4, 12.5).

5.12.3 Worst Case Scenario

The worst case scenario for a vehicle-vehicle or vehicle-pedestrian collision is one that results in multiple deaths. The probability of this worst case scenario occurring is much less than the probability of a collision resulting in vehicle damage or minor injury. The probability of occurrence depends on vehicle traffic volumes, pedestrian traffic volume, speed of travel, weather conditions (i.e., visibility) and personal factors such as seat belt use, fatigue, and alcohol use. Overall, this scenario is considered to have a low probability of occurrence, and the consequence of this incident is high. The low probability of occurrence and the high consequence indicate a moderate risk of a vehicle collision resulting in multiple deaths, as shown in Table 5.1.3-1. This scenario will be addressed as specific event in Section 16.10.2 of this EIS.

The worst case scenario for a vehicle-wildlife collision is the collision of a Project vehicle with an animal listed under the *SARA* or the *NLESA* or the destruction (e.g., driven over by a vehicle) of the nest or den of an animal listed under the *SARA* or the *NLESA*. The probability of this worst case scenario occurring is much less than the probability of a collision with a non-listed animal due to the relative abundance of listed and non-listed animals. The probability of occurrence depends on the species involved, their abundance, and their behaviour (e.g., feeding along roadsides, avoidance behaviours). Overall, this scenario is considered to have a low probability of occurrence. The consequence of this incident may be low to moderate, again depending on the species, its status and whether the incident involved an individual animal or a nest or den. The low probability of occurrence and the low to moderate consequence indicate a low risk of a vehicle colliding with a *SARA*- or *NLESA*-listed animal, as shown in Table 5.1.3-1. Proven and effective prevention and mitigation measures for this type of low risk incident are described within the Environmental Effects Assessment chapters of this EIS (Sections 12.3, 12.4, 12.5).

5.13 Marine Vessel Collisions

The operation of marine vessels in the Strait of Belle Isle could lead to a marine accident or incident. Vessel-vessel or vessel-ground collisions are influenced by marine traffic, weather conditions and vessel watch procedures. The potential for vessel-wildlife interactions is influenced by the time of year (e.g., many marine mammals migrate through the Strait of Belle Isle during the summer or fall), the surrounding habitat type, and the time of day. Marine vessel collisions may have the following environmental interactions:

- human injury or mortality;
- wildlife injury or mortality;
- wildlife disturbance;

- loss of habitat; and
- effects on marine water quality.

5.13.1 Incident Prevention and Response

The SHERP will include safety measures for vessel operation, including the prevention of wildlife collisions. All Project personnel will be made aware of the SHERP and designated staff will receive SHERP training. Vessel operator awareness programs will limit the potential for wildlife collisions, and other vessel-wildlife incidents. The SHERP and vessel operator awareness programs will address the following vessel-wildlife collision prevention measures:

- awareness of high potential collision areas, time of day and seasons;
- reduction of marine vessel speed in areas of recent marine mammal sightings and likely high-density areas; and
- marine vessel observation procedures.

In addition, SIMOPS procedures and processes will be used. SIMOPS procedures will be developed by Nalcor to ensure safe and efficient operations of multiple vessels while working in the Strait of Belle Isle.

5.13.2 Risk Evaluation

The Transportation Safety Board of Canada (TSB) compiles statistical data on marine occurrences. Recordable occurrences include accidents or incidents associated with the operation of a ship and situations or conditions which, if left unattended, could induce an accident or incident.

Marine accidents include (but are not limited to) those in which a person sustains serious injury or is killed, the ship sinks, founders or capsizes, the ship is involved in a collision or the ship sustains fire or an explosion. In 2009, the TSB recorded a total of 390 marine accidents and 16 marine-related fatalities. The most frequent types of marine accidents are groundings, followed by fire and striking. Since 2000, 46% of vessels involved in marine accidents were fishing vessels. Bulk carriers and tugs / barges were the next most commonly affected vessel types, at 14% and 13%, respectively. A summary of marine accident statistics between 2000 and 2009 is provided in Table 5.13.2-1. In the Newfoundland region, an average of 68 accidents were recorded per year between 2000 and 2009. There were, on average, four marine-related fatalities per year in the Newfoundland region (TSB 2011a, internet site).

Table 5.13.2-1 Marine Accidents, 2000 to 2009

Accident Type	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Collision	16	16	15	24	12	20	19	13	17	15
Capsizing	15	6	14	11	18	10	18	12	13	8
Foundering / Sinking	38	37	26	30	18	21	24	20	32	22
Fire / Explosion	64	84	53	65	51	69	55	49	62	52
Grounding	123	114	129	118	108	87	112	95	71	110
Striking	68	89	72	76	82	81	62	61	57	50
Ice Damage	6	4	2	28	17	11	2	25	15	0
Propeller / Rudder / Structural Damage	31	19	42	39	36	43	56	41	15	16
Flooding	51	70	52	49	63	59	46	49	45	34
Other	38	20	43	41	37	43	27	32	34	31
Total	**450**	**459**	**448**	**481**	**442**	**444**	**422**	**397**	**361**	**338**

Source: TSB (2011a, internet site).

Incidents include (but are not limited to) situations such as a person falling overboard, a ship (100 gross tons or more) unintentionally contacting the bottom without going aground, a ship fouling a utility cable or underwater pipeline, or the ship sustaining a shifting of cargo or loss of cargo overboard. Between 2000 and 2009, the average number of incidents recorded per year was 228 (TSB 2011a, internet site). A list of the incidents recorded by the TSB, by incident type between 2000 and 2009, is provided in Table 5.13.2-2.

Table 5.13.2-2 Reportable Marine Incidents, 2000 to 2009

Incident Type	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Close-quarters Situation	57	60	29	60	67	56	30	21	20	12
Engine / Rudder / Propeller	105	99	57	83	106	85	112	90	129	124
Cargo Trouble	5	4	5	3	1	4	4	1	6	5
Personal Incidents	6	8	8	14	9	4	12	21	10	9
Other	75	68	76	64	65	78	58	95	83	78
Total	**248**	**239**	**175**	**224**	**248**	**227**	**216**	**228**	**248**	**228**

Source: TSB (2011a, internet site).

Marine vessels will be used for the installation of the submarine cable, and for rock berm construction. Cable laying and rock berm construction activities will be conducted primarily from slow-moving vessels with a high degree of manoeuvrability including redundant positioning systems. Vessel watch procedures will limit the potential for accidents in high traffic areas. All vessels in the field will complete a few tests to ensure they can be towed in case of a blackout which will include the provision of a standby vessel in case a tow is required. The probability of a vessel-vessel collision is considered low. The consequence of a vessel-vessel collision depends on the speed of travel, the size of the vessels involved, and the point / angle of collision. The consequence could range from low (e.g., vessel damage) to high (e.g., injury or death of personnel on board). The low probability of occurrence and the low to high consequence indicate a low to moderate risk of a vessel-vessel collision, as shown in Table 5.1.3-1. This scenario will be addressed as a specific event in Sections 14.6.3 and 16.10.2 of this EIS.

Wildlife incidents may affect both large and small animals including, but not limited to, whales, dolphins and porpoises. Vessel-wildlife collisions are not considered reportable to the TSB unless they lead to an accident or incident, as defined by the TSB. As a result, it is difficult to assess the probability of a vessel-wildlife collision occurring. The baseline studies conducted for this EIS will be used to identify potential high density marine wildlife areas, and vessel watch procedures will assist in the avoidance of vessel-wildlife collisions. The probability of a Project vessel being involved in a wildlife collision is therefore low. Vessel-wildlife collisions often result in the death or injury of a single animal. As a result, collisions are not expected to have population level effects, so the consequence of a vessel-wildlife collision is low. The low probability of occurrence and low consequence indicate a low risk of a wildlife collision, as shown in Table 5.1.3-1. There are proven and effective prevention and mitigation measures for this type of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 14.2, 14.3, 14.4, and 14.5).

5.13.3 Worst Case Scenario

The worst case scenario for a vessel-vessel collision is one that results in multiple deaths. The probability of this worst case scenario occurring is much less than the probability of a collision resulting in vessel damage. The probability of occurrence depends on marine traffic volumes (including fishing activity), weather conditions (e.g., visibility) and personal factors such as fatigue. Overall, this scenario is considered to have a low probability of occurrence, and the consequence of this incident is considered high. The low probability of

occurrence and the high consequence indicate a moderate risk of a vessel collision resulting in multiple deaths, as shown in Table 5.1.3-1. This scenario will be addressed as a specific event in Section 16.9 of this EIS.

The worst case scenario for a vessel-wildlife collision is the collision of a Project vessel with an animal listed under the *SARA* or the *NLESA*. The probability of this worst case scenario occurring is much less than the probability of a collision with a non-listed animal due to the relative abundance of listed and non-listed animals. The probability of occurrence depends on the species involved, their abundance, and their behaviour (e.g., avoidance behaviours). Overall, this scenario is considered to have a low probability of occurrence. The consequence of this incident may be low to moderate, again depending on the species and its status. The low probability of occurrence and the low to moderate consequence indicate a low risk of a vessel colliding with a *SARA*- or *NLESA*-listed animal, as shown in Table 5.1.3-1. There are proven and effective prevention and mitigation measures for this type of low risk incident and these are described within the Environmental Effects Assessment chapters of this EIS (Sections 14.2, 14.3, 14.4, and 14.5).

5.14 Aviation Accidents

During Project Construction, helicopter transport may be used, in some areas, for material distribution. Where helicopters are used, the transmission towers may be assembled in marshalling yards or lay down areas and slung by helicopter to the ROW. In all slinging operations, there is a risk of dropped loads. Helicopters will be used for transmission line inspections during Project operation.

The Project is also located in a region used for low-level flight training by the Department of National Defence (DND). Flight training occurs at altitudes of 30 m above ground level and the transmission towers will reach a height of between 40 and 50 m. As a result, there is a risk of collision between DND aircraft and Project helicopter traffic, and between DND aircraft and the transmission towers and lines during both Project Construction, and Operations and Maintenance. Aviation accidents may have the following environmental interactions:

- human injury or mortality;
- wildlife injury or mortality;
- loss of wildlife habitat; and
- loss of vegetation.

5.14.1 Incident Prevention and Response

- Helicopter operation for Project Construction and operation (including slinging) will comply with Canadian Aviation Regulations (CARs). CARs regulate flight operations, and provides instruction on safety measures / limitations such as:
  - minimum visibility requirements for flight;
  - minimum fuel requirements;
  - weight and balance requirements;
  - pre-flight inspections and safety briefings;
  - horizontal and vertical distance that an aircraft must maintain if flight is conducted over a built up area; and
  - standards for slinging (e.g., requirement for a quick release mechanism and back-up in case of emergency).

Nalcor has provided Project description information to DND and has discussed with them the nature of ongoing military flight activities in the area. The discussion between Nalcor and DND also included potential

concerns, future planning, and design and communication measures to prevent potential interactions between the Project and DND flight activity. Nalcor will continue to consult with DND during detailed Project design to identify issues related to tower design and transmission line routing and will address these issues, where possible, during the design process. Early communication with DND will also allow Project activities (i.e., helicopter traffic) and Project components (e.g., transmission towers) to be incorporated into DND's planning and navigation aids (e.g., charts).

Nalcor and / or its contractor(s) will also provide full and regular briefings to DND authorities regarding its planned and ongoing construction activities, particularly those involving aircraft activity in Labrador to ensure coordinated planning and communication around Project Construction activities. More information on that communication plan can be found in Section 16.5.

5.14.2 Risk Evaluation

The TSB compiles statistical data on aviation occurrences. Recordable occurrences include accidents or incidents associated with the operation of aircraft and situations or conditions which, if left unattended, could induce an accident or incident.

Aircraft accidents include those in which a person sustains serious injury or is killed, the aircraft experiences structural damage and requires major repair, or the aircraft is missing or inaccessible. In 2009, the TSB recorded a total of 297 aviation accidents, with a rate of 5.9 accidents per 100,000 flying hours. Of these 297 accidents, 215 involved airplanes, 32 involved helicopters, and the remaining 7 were balloons, gliders or gyrocopters. Between 2000 and 2009, Canadian registered aircraft were involved in an average of 31 fatal accidents per year. The average number of fatalities per year over the same ten year period was 54. The number of serious injuries recorded per year between 2000 and 2009 was 41 (TSB 2011b, internet site). A summary of the aircraft accident statistics between 2000 and 2009 are provided in Table 5.14.2-1. In Newfoundland and Labrador, an average of 6.5 accidents were recorded per year between 2000 and 2009. There was, on average, one fatal accident per year in Newfoundland and Labrador (TSB 2011b, internet site).

Table 5.14.2-1 Accidents Involving Canadian Registered Aircraft, 2000 to 2009

Accidents	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Fatal accidents	38	33	31	32	24	34	31	33	26	28
Fatalities	65	59	51	60	37	55	52	49	51	64
Serious injuries	53	37	42	42	27	37	40	56	38	34
Total accidents	320	295	274	295	252	259	262	285	252	249
Hours flown (thousands)	3,982	3,885	3,713	3,790	3,961	3,979	4,059	4,180	4,432	4,171
Accident rate (per 100,000 hours)	7.8	7.4	7.2	7.5	6.2	6.4	6.5	6.8	5.5	5.9

Source: TSB (2011b, internet site).

Incidents include (but are not limited to) situations such as engine failure, transmission gearbox malfunction, fire, fuel shortage, and the inadvertent or emergency release of a sling load. Between 2000 and 2009, the average number of incidents recorded per year was 674 (TSB 2011b, internet site). A list of incidents recorded by the TSB, by incident type between 2000 and 2009 that involved Canadian registered aircraft, is provided in Table 5.14.2-2.

Table 5.14.2-2 Incidents involving Canadian Registered Aircraft by Incident Type, 2000 to 2009

Incidents	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Risk of collision / Loss or separation	130	170	169	123	182	150	150	152	149	137
Declared emergency	174	208	231	229	204	152	184	186	235	236
Engine failure	129	157	134	104	118	116	106	108	98	93
Smoke / fire	71	92	83	82	81	85	86	106	90	84
Collision	8	17	19	16	21	8	18	9	7	7
Control difficulties	25	28	28	41	41	41	31	38	32	18
Crew unable to perform duties	15	13	37	48	51	67	56	63	74	57
Dangerous goods-related	2	6	0	2	0	1	2	3	1	3
Depressurization	4	15	18	17	7	12	9	11	15	3
Fuel shortage	1	2	1	6	10	5	6	4	4	4
Failure to remain in landing area	13	4	6	3	10	10	6	7	16	8
Incorrect fuel	0	0	1	0	2	1	1	0	1	0
Slung load released	6	8	3	4	5	1	3	3	5	3
Transmission or gearbox failure	2	2	2	1	2	1	0	1	0	3
Total	**580**	**722**	**732**	**676**	**734**	**650**	**658**	**691**	**727**	**656**

Source: TSB (2011b, internet site).

The extent to which helicopters will be used for material distribution during Project Construction has not been finalized, nor has the extent transmission line inspections will be conducted from the air during Project operation. As a conservative estimate for inspections, the assumption is for 100% use of helicopters. The average accident rate for Canadian registered helicopters between 2000 and 2009 was 7.5 per 100,000 hours of flight time (TSB 2011b, internet site). Considering the limited use of helicopters for the Project, the probability of an accident occurring is low.

Similarly, helicopter slinging operations may be used for some material distribution during construction, but the extent to which will this occur has not been finalized. The average rate of inadvertent or emergency sling load releases in Canada between 2000 and 2009 was four per year. The probability of this occurring during Project Construction is therefore low.

An aviation accident may have a high consequence as it could result in serious injury or death of the passengers. Either an aviation accident or released sling load also has the potential to harm the members of the public, if it occurs in a populated area.

The low probability of occurrence and high consequence indicate a moderate risk of an aviation accident, as shown in Table 5.1.3-1. This scenario will be addressed as a specific event in Section 16.10.2 of this EIS.

5.14.3 Worst Case Scenario

The worst case scenario is an aviation accident or released sling load within a populated area. Given the prevention measures described above, the probability of this occurring is low. The consequence of this worst case scenario (i.e., serious injury or death) is high. The low probability of occurrence and the high consequence indicate a moderate risk of an aviation accident or released sling load within a populated area, as shown in Table 5.1.3-1. This scenario will be addressed as a specific event in Section 16.10.2 of this EIS.

5.15 Summary

Table 5.15-1 summarizes the potential accidents and malfunction incidents that may occur during Project Construction, and Operations and Maintenance. For each incident, one or more reasonable worst case scenarios are identified. Project activities that could result in the incident and summaries of the risk of the incident occurring are listed in Table 5.15-1. Each low risk incident is addressed as part of the overall environmental effects assessment of the relevant VECs. Each moderate to high risk incident is addressed within the Accidents and Malfunctions section of Environmental Effects chapter for relevant VECs. The EIS sections that address each type of incident are identified in Table 5.15-1.

Table 5.15-1 Summary of Accidents and Malfunctions

Potential Incident	Project Activity	Incident Description	Probability	Consequence	Risk	EIS Section
Transmission Tower Failure	**Project Construction**: tower erection, conductor installation **Project Operations and Maintenance**	Failure of a single transmission tower during construction	Low-moderate	Low	Low	12.2, 12.3, 12.4, 12.5, 13.3, 16.3
		Failure of multiple transmission towers during conductor installation or Project Operations	Low	Low to Moderate	Low	12.2, 12.3, 12.4, 12.5, 13.3, 16.3
		Worst case scenario: Failure of 20 transmission towers	Low	Moderate	Low	12.2, 12.3, 12.4, 12.5, 13.3, 16.3
Electrocution	**Project Operations and Maintenance**	Human contact with transmission lines, submarine cable, electrodes	Low	High	Moderate	16.10.2
		Wildlife contact with transmission lines, submarine cable, electrodes	Moderate	Low	Low	12.3, 13.3, 14.3
		Worst case scenario: Death of a person	Low	High	Moderate	16.10.2
		Worst case scenario: Death of a *SARA*-listed or an *NLESA*-listed animal	Low	Low to Moderate	Low	12.3, 13.3, 14.3
Spills and Leaks of Hazardous Materials	**Project Construction**: use and handling of hazardous materials during construction activities, operation of heavy equipment and marine vessels, concrete production **Project Operations and Maintenance**: vegetation control, operation of vehicles and equipment	Small spill (less than 2 L)	High (during Construction) Low (during Operations and Maintenance)	Low	Low	12.2, 12.3, 12.4, 12.5, 13.2, 13.3, 14.2, 14.3, 14.4, 14.5
		Worst case scenario: spill of 1,000 L of diesel fuel during construction that spills over the ground and into a watercourse	Low	Moderate to High	Moderate	11.4.2, 12.6.3, 13.4.3, 14.6.3, 16.10.2
		Worst case scenario: large fuel spill into the Marine Environment, during construction, due to vessel collision	Low	High	Moderate to high	14.6.3, 16.10.2

Table 5.15-1 Summary of Accidents and Malfunctions (continued)

Potential Incident	Project Activity	Incident Description	Probability	Consequence	Risk	EIS Section
Frac-out During Horizontal Directional Drilling	**Project Construction**: horizontal directional drilling for submarine cables	Release of drilling mud to the terrestrial or Marine Environment.	Low	Low	Low-moderate	12.2, 14.2, 14.3
		Worst case scenario: release of drilling mud to the Marine Environment that results in smothering of fish eggs, benthic invertebrates and marine plants or release of drilling mud to the Terrestrial Environment in a location where listed plants are present	Low	Low	Low	12.2, 14.2, 14.3
Slope Failure	**Project Construction:** transmission tower foundation construction, access road construction, electrode site construction **Project Operations and Maintenance**	Localized slope failure	Low	Low	Low	12.2, 12.3, 12.4, 12.5, 13.2, 13.3, 14.2, 14.3, 14.4, 14.5
		Worst case scenario: slope failure during construction that affects a riverbank or the marine coast	Low	Low to Moderate	Low	12.2, 12.3, 12.4, 12.5, 13.2, 13.3, 14.2, 14.3, 14.4, 14.5
Fires (except forest fires)	**Project Construction**: storage of combustible materials or waste, operation of camp kitchen **Project Operations and Maintenance**: storage of combustible materials or waste, equipment malfunction	Small, contained fire	Low	Low	Low	11.2, 12.2, 12.3, 12.4, 12.5
		Worst case scenario: forest fire	Addressed as separate incident – forest fires			

Table 5.15-1 Summary of Accidents and Malfunctions (continued)

Potential Incident	Project Activity	Incident Description	Probability	Consequence	Risk	EIS Section
Forest Fires	**Project Construction**: operation of combustion engines, blasting, smoking workers **Project Operations and Maintenance**: operation of combustion engines, smoking workers	Small brush fire along access or ROW	Moderate	Low	Low	11.2, 12.2, 12.3, 12.4, 12.5, 13.2, 13.3, 16.3, 16.5, 16.9
		Worst case scenario: forest fire affecting 470 ha in Labrador, originating in the access or ROW, during the summer	Low	Moderate to High	Moderate	11.4.2, 12.6.3, 13.4.3, 16.10.2
		Worst case scenario: forest fire in the vicinity of a populated community in Newfoundland, originating in the access or ROW, during the summer	Low	High	Moderate	11.4.2, 12.6.3, 13.4.3, 16.10.2
Waste Management Incidents	**Project Construction:** wastewater treatment, waste transport	Solid waste spill resulting from collision of waste handling vehicle	Low	Low	Low	12.2, 12.3, 12.4, 12.5, 13.2, 13.3
		Release of untreated wastewater, up to 4,250 L	Low	Low	Low	12.2, 12.3, 12.4, 12.5, 13.2, 13.3
		Worst case scenario: release of 4,250 L of wastewater into a watercourse	Low	Moderate	Low	12.2, 12.3, 12.4, 12.5, 13.2, 13.3

Table 5.15-1 Summary of Accidents and Malfunctions (continued)

Potential Incident	Project Activity	Incident Description	Probability	Consequence	Risk	EIS Section
Motor Vehicle Collisions	**Project Construction** and **Project Operations and Maintenance**: operation of vehicles and heavy equipment on provincial highways, access roads and the ROW	Vehicle-vehicle or vehicle-pedestrian collision	Low to Moderate	Low to High	Low to Moderate	16.10.2
		Vehicle-Wildlife Collision	High	Low	Low	12.3, 12.4, 12.5
		Worst case scenario: collision resulting in multiple human deaths	Low	High	Moderate	16.10.2
		Worst case scenario: collision with a *SARA*-listed animal, an *NLESA*-listed animal, or nest / den of a listed animal	Low	Low to Moderate	Low	12.3, 12.4, 12.5,
Vessel Collisions	**Project Construction**: materials transport vessels, fallpipe vessel, CIV **Project Operations and Maintenance**: submarine cable inspection vessels	Vessel-vessel collision	Low	Low to High	Low to Moderate	14.6.3, 16.10.2
		Vessel-wildlife collision	Low	Low	Low	14.2, 14.3, 14.4, 14.5
		Worst case scenario: vessel collision resulting in multiple human deaths	Low	High	Moderate	14.6.3, 16.10.2
		Worst case scenario: collision with a *SARA*-listed animal or an *NLESA*-listed animal	Low	Low to Moderate	Low	14.2, 14.3, 14.4, 14.5
Aviation Accidents	**Project Construction**: materials distribution **Project Operations and Maintenance**: transmission line inspection, low-level DND flight training	Aviation accident (e.g., collision with transmission line structures, collision with ground, dropped sling load)	Low	High	Moderate	16.10.2
		Worst case scenario: aviation accident within a populated area	Low	High	Moderate	16.10.2

5.16 References

CSA (Canadian Standards Association). 2009. Canadian Electrical Code, Part III – Electricity Distribution and Transmission.

Foster, D.R. 1983. The History and Pattern of Fire in the Boreal Forest of Southeastern Labrador. *Canadian Journal of Botany 61(9): 2459-2471.*

Geological Survey of Canada. 2005. 2005 National Building Code of Canada seismic hazard maps. Available at: http://earthquakescanada.nrcan.gc.ca/hazard-alea/index-eng.php.

Government of Newfoundland and Labrador and Government of Canada. 2011. Environmental Impact Statement Guidelines and Scoping Document, Labrador-Island Transmission Link. Prepared for Nalcor Energy. St. John's, NL.

Hewitt, D. 2010. Duty Officer, Fire Services Branch, Gander, NL. Telephone conversation. March 25, 2010.

Michelin, S. 2008. Duty Officer, Fire Services Branch, Happy Valley-Goose Bay, NL. Telephone conversation. September 16, 2008.

Nalcor (Nalcor Energy). 2010. 2009 Environmental Performance Report. Available at: http://www.nalcorenergy.com/2010epr/. Accessed: January 2011.

Newfoundland and Labrador Department of Government Services. 2006. Private Sewage Disposal and Water Supply Standards. Available at: http://www.gs.gov.nl.ca/publications/private_sewage_disposal_and_watter_supply_standards.pdf.

NLDEC (Newfoundland and Labrador Department of Environment and Conservation). 2010. Moose vehicle Awareness. Available at: http://www.env.gov.nl.ca/env/wildlife/moose_vehicle_awareness.html. Accessed: April 30, 2010 and January 12, 2011.

NLDNR (Newfoundland and Labrador Department of Natural Resources). 2011. Forest Fires. Department, St. John's, NL. Available at: http://www.nr.gov.nl.ca/nr/forestry/fires/index.html. Accessed: June 2011.

Sullivan, P. 2010. Dispatcher, Fire Services Branch, Corner Brook, NL. Telephone conversation. March 26, 2010.

TC (Transport Canada). 2010. Heavy Truck Casualty Collisions 2001-2005. TP2436. Available at: http://www.tc.gc.ca/media/documents/roadsafety/tp2436e-rs2010-03.pdf.

TC. 2011. Canadian Motor Vehicle Traffic Collision Statistics: 2009. Available at: http://www.tc.gc.ca/eng/roadsafety/tp-tp3322-2009-1173.htm. Accessed: May 2011.

TSB (Transportation Safety Board of Canada). 2011a. Statistical Summary Marine Occurrences 2009. Available at: http://www.tsb.gc.ca/eng/stats/marine/2009/ss09.asp. Accessed: May 2011.

TSB. 2011b. Statistical Summary – Aviation Occurrences 2009. Available at: http://www.tsb.gc.ca/eng/stats/aviation/2009/ss09.asp. Accessed: May 2011.

NALCOR ENERGY

LABRADOR-ISLAND TRANSMISSION LINK

ENVIRONMENTAL IMPACT STATEMENT

Chapter 6

Environmental Setting and Context

April 2012

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LIST OF ACRONYMS

Acronym	Description
%	percent
2D	two dimensional
ACCDC	Atlantic Canada Conservation Data Centre
BP	before present
DFO	Fisheries and Oceans Canada
EA	Environmental Assessment
EIS	Environmental Impact Statement
ELC	Ecological Land Classification
GIS	Geographic Information System
km	kilometre
km^2	square kilometres
kV	kilovolt
m	metre
MW	megawatt
NAFO	Northwest Atlantic Fisheries Organization
NCC	NunatuKavut Community Council (formerly the Labrador Métis Nation)
Project	Labrador-Island Transmission Link
ROW	right-of-way
TCH	Trans-Canada Highway
TL	Transmission Line (when referring to specific line number)
TLH	Trans-Labrador Highway
TLH3	Trans-Labrador Highway Phase 3

6 ENVIRONMENTAL SETTING AND CONTEXT

The proposed transmission corridor will extend across a considerable portion of Newfoundland and Labrador, including the Strait of Belle Isle, and through a variety of natural and human environments.

The following sections present a general and high-level overview of the Labrador-Island Transmission Link (Project) existing environmental setting for the Labrador-Island Transmission Link, as overall background and context for the Project and its environmental assessment (EA), and to set the stage for the identification of potential environmental issues and the environmental effects assessment.

More detailed descriptions of the existing biophysical and socioeconomic environments are provided later in the Environmental Impact Statement (EIS) (in Chapters 10 and 15, respectively). These should be referred to for further detail, including the sources of the information summarized below. Detailed information on the existing environment is presented in the component studies for the Project.

6.1 The Natural Environment

Newfoundland and Labrador is the easternmost province of Canada, and consists of the Island of Newfoundland (111,390 square kilometres (km^2)) and Labrador (294,330 km^2), which is located to the north-west of the Island on the Canadian mainland. The Strait of Belle Isle divides the province into these two geographical components.

6.1.1 Central and Southeastern Labrador

The Labrador component of the proposed transmission corridor extends from the lower Churchill River at the proposed Muskrat Falls converter station, and across Southeastern Labrador to the Strait of Belle Isle, for a distance of approximately 400 kilometres (km).

6.1.1.1 Climate, Topography and Vegetation

As a result of its northern location and its combination of inland and maritime characteristics, the climatic characteristics of Central and Southeastern Labrador vary from a continental regime in the low-lying interior characterized by warm summers and long, cold winters, to warmer winters and cooler summers with abundant precipitation on the coast.

The region lies on the eastern edge of the Canadian Shield, a vast area of Precambrian rock that forms the central core of the North American continent. The Project lies in the Grenville Province, which extends along the southern edge of the Shield and is comprised mainly of felsic metamorphic rocks.

The area of Labrador crossed by the Project exhibits a varied topography. The area immediately surrounding the lower Churchill River is comprised primarily of undulating upland topography and coastal plain, with flat river terraces. The lower Churchill River valley is highly productive, with boreal plant species assemblages including large conifers such as white and black spruce and balsam fir, and associated deciduous species and understory vegetation typical of the boreal forest.

Moving south-east, the landscape is initially characterized by rolling terrain and broad river valleys covered by shallow till and glacial landforms such as drumlins and eskers. The vegetation is comprised mostly of fairly open black spruce forests, with extensive ribbed fen and string bog complexes, and sporadic hardwoods and lichen-covered wooded areas on drier sites.

Further inland, the Eagle River Plateau occupies much of the area between Lake Melville and the coast. This flat to rolling upland area is comprised of large peatlands, interrupted by glacial landforms and shallow river valleys. Extensive string bogs with considerable open water are surrounded by fen vegetation dominated by sedge grasses and moss. Patches of scrub black spruce and associated plants and mosses are also interspersed throughout.

Along the coastal strip adjacent to the Strait of Belle Isle, low hills are covered primarily with barren vegetation and pockets of scrub spruce and bog.

6.1.1.2 Wildlife

The lower Churchill River valley supports a variety of wildlife species that reside there year-round, seasonally, or use the waterway as a travel route. Mammal species that use the river and valley include beaver, porcupine, muskrat, mink and otter. Large mammals that use the valley for shelter and / or as a travel corridor include caribou, moose and black bear. Waterfowl species include common loons, Canada geese and black ducks.

The interior of Southeastern Labrador, with its open, stunted forests and extensive wetlands, also provides habitat for a range of wildlife species. Caribou numbers are generally low, and other large mammals such as moose and black bear are found in low to moderate densities, particularly in association with forested river valleys. The area supports furbearer and small mammal species such as marten, snowshoe hare, porcupine and voles, as well as upland game birds including ptarmigan and grouse. Raptors are found in the region, particularly in the breeding season, and waterfowl often inhabit the large waterbodies and extensive wetland areas throughout this area during the open water season. A variety of passerine bird species are also present, many of them migrants that come to Labrador to breed.

There are three recognized boreal populations of woodland caribou in Labrador – the Red Wine, Mealy Mountains and Lac Joseph herds, each of which is currently listed as threatened under provincial and federal legislation. A small population of woodland caribou which are currently believed to be associated with the Mealy Mountains herd have also been located in the Joir River area of southern Labrador.

6.1.1.3 Freshwater and Marine Environments

The Labrador section of the proposed transmission corridor will cross and / or be located adjacent to a number of watersheds, including the Churchill, Kenamu, Mecatina, St. Augustine, St. Paul, Pinware and Forteau rivers. Watercourse crossings range in size from small, seasonal or intermittent streams to much larger rivers. Fish species which are known to occur in the region include: Atlantic salmon, brook trout, lake trout, lake whitefish, round whitefish, longnose sucker, white sucker, northern pike, lake chub, burbot, pearl dace, stickleback, sculpin, rainbow smelt, Arctic char and American eel. There are several Scheduled Salmon Rivers in this general area.

6.1.2 Strait of Belle Isle

The Strait of Belle Isle is a marine channel that separates the south-east coast of Labrador from the north-west portion of the Island of Newfoundland, extending for approximately 118 km in a north-east to south-west direction. At its narrowest point the Strait is approximately 17 km wide, between Point Amour and Yankee Point near the south-west end.

6.1.2.1 Physical Environment

The coast along the Labrador side is steep and rises to flat-topped ridges and summits from approximately 300 to 400 metres (m) above sea level, while the Newfoundland coast is much lower with shorelines rising to approximately 30 m. Water depths within the Strait of Belle Isle vary significantly, and reach over 120 m in places. In the general Project vicinity, water depths are greater on the Labrador side and with pronounced drop-offs, while the Island side is comparatively shallow with depths increasing more gradually.

The Strait is underlain by Precambrian gneisses that belong to the Grenville Province and consist of a complex of metamorphic and granitic rocks. The Strait of Belle Isle is topographically complex, with seabed sediments consisting of thin, discontinuous glacial and marine sediments overlying bedrock. Across most of the Strait, the seabed comprises coarse-grained armour of pebbles, cobbles and boulders overlying glacial till and localized glaciomarine deposits. Marine sands form a discontinuous surficial veneer in shallow water areas and are thicker locally in some coastal embayments. Bedrock is exposed at the seabed in places.

Water movement through the Strait of Belle Isle is primarily through strong tidal currents. The inshore branch of the Labrador Current flows south-westerly into the Strait and along the Labrador coast before entering the Gulf of St. Lawrence. Warmer and less saline water from the Gulf of St. Lawrence flows north-easterly into the Strait along the coast of Newfoundland. The turbulence and mixing created by these water masses and movements creates an area of nutrient-rich water and quite high productivity.

Sea ice in the Strait of Belle Isle is a combination of locally formed ice and pack ice that drifts down from the Arctic and Labrador Sea. Icebergs drift into the Strait each year, with the largest number observed in May and June. Iceberg grounding and associated seabed scouring occur seasonally.

6.1.2.2 Marine Fish and Wildlife

A variety of fish species are present in the Strait of Belle Isle, including shellfish such as scallop, lobster, whelk and toad crab, groundfish such as cod, lumpfish, flounder and halibut, and pelagic species such as capelin, squid, herring, salmon and mackerel, as well a range of benthic invertebrates.

Marine mammals, including whales, porpoises, dolphins and seals, are present in the Strait of Belle Isle at specific times of the year, particularly in summer, although spatial and temporal distribution varies considerably between species.

The Strait of Belle Isle is also used by a variety of avifauna for breeding, overwintering and / or as feeding and resting areas during migration through the area. Marine birds and waterfowl often congregate on the rounded headlands along the Strait as they move along the coast.

6.1.3 Island of Newfoundland

The proposed transmission corridor on the Island of Newfoundland extends from the Strait of Belle Isle, down and across the Northern Peninsula, through Central and Eastern Newfoundland, and on to the north-eastern portion of the Island's Avalon Peninsula, a distance of approximately 700 km, ending with a converter station at Soldiers Pond.

6.1.3.1 Northern Peninsula

The Northern Peninsula is the Island's largest peninsula, approximately 300 km long and 80 km at its widest point and comprising an area of 17,500 km^2.

The north-western edge of the peninsula, along the Strait of Belle Isle, is a rocky, flat coastal stretch. Calcareous bedrock is common, and the area is covered by shallow soils with extensive areas of exposed bedrock. The vegetation cover is comprised almost exclusively of barren and tundra-like assemblages, with alternating dry barrens and shallow fens. The calcareous barrens are home to a rich and unique mixture of endemic, arctic and calciphillic plant species, a number of which are protected under provincial and / or federal legislation may be found in the general area.

Along the western side and interior portions of the Northern Peninsula, coastal, forested and barren areas are present. Much of the interior is dominated by mountainous highland areas and plateaus associated with the Long Range Mountains, with mostly barren vegetation and shallow ribbed fen and tuckamoor dominating the landscape. Along the western edge of the peninsula, the lower portions of the Long Range Mountains are characterized by forested areas along the slopes and a flat coastal plain supporting bogs and scrub vegetation.

The region is home to a number of woodland caribou aggregations, as well as other large and small mammals such as moose, black bear, fox, hare and others that occupy the forest, scrub and aquatic habitats throughout the peninsula. Raptors, waterfowl and other avifauna are also found here, including Bald Eagle, Osprey and Merlin in the forested areas, ptarmigan and grouse in the barrens and scrublands and geese, ducks and mergansers in the wetland areas along the coast.

This section of the proposed transmission corridor will also cross and / or be located adjacent to a number of watersheds, which are known to support a variety of fish species. Fish species that commonly occur in waterbodies and watercourses in the region include Atlantic salmon, brook trout, rainbow smelt, stickleback and American eel, with occasional Arctic char. There are Scheduled Salmon Rivers in the general area, including several that are crossed by the proposed transmission corridor.

6.1.3.2 Central and Eastern Newfoundland

This region exhibits the most continental climate on the Island, with comparatively high summer temperatures, low rainfall and harsh winters. The topography is predominantly low and rolling. This is the most heavily forested and distinctly boreal area of Newfoundland, with pure black spruce forests, and white birch and aspen stands, as well as dwarf shrub heath.

Wildlife in this region are typical of the boreal forest, and include moose, snowshoe hare, black bear, beaver, and lynx, as well as small mammals such as voles and shrews. Caribou exist in the general area including near the base of the Northern Peninsula in the White Bay area and to the south-east. Birds that typically live in forested areas are also found throughout, including raptors such as Bald Eagle, Osprey, Merlin, Boreal and Sharp-shinned Hawk, as well as Great Horned Owls and upland game birds such as Ruffed and spruce Grouse. Waterfowl such as Green-winged Teal, Ring-necked Duck and Canada Geese are also present.

Fish species that are common in waterbodies and watercourses in the region include Atlantic salmon, brook trout, rainbow smelt, stickleback, American eel and Arctic char, with rainbow trout, alefish and sea lamprey occurring less commonly. Major river systems such as the Exploits, Gander, Gambo and Terra Nova Rivers are located in this region, some of which are designated as Scheduled Salmon Rivers.

6.1.3.3 Avalon Peninsula

As the proposed transmission line corridor nears the Avalon Peninsula, it passes through an area of extensive maritime barrens. The isthmus and the western and northern portions of the Avalon Peninsula are characterized by undulating terrain with extensive areas of barren heath, small pockets of forest in sheltered valleys (particularly in the north), and bogs and shallow fens interspersed throughout.

The sheltered, central portion of the Avalon Peninsula is characterized by low elevations and hilly terrain with numerous lakes and bogs. This area experiences cool summers and mild winters, high precipitation and frequent fog. The region is forested, and exhibits distinctive vegetation patterns which include pure stands of balsam fir–fern forests with a mixture of yellow birch, scrub black spruce forests with peatmoss understory and ericaceous shrubs, and convex raised bogs. Lichens are abundant on tree stems and branches.

The barren and bog areas and forested pockets on and adjacent to the Avalon Peninsula are home to a number of large and small mammals such as moose, black bear, lynx, fox, hare, mink, beaver, otter, voles and shrews. In addition, raptors, waterfowl and other avifauna are found throughout this region's barren, forest, scrub, wetland and marine habitats. The barren areas are also home to a number of caribou aggregations, particularly the northern and southern portions of the peninsula.

Fish species that are known to commonly occur in waterbodies and watercourses on the Avalon Peninsula include Atlantic salmon, stickleback, brook and brown trout, rainbow smelt and American eel, with rainbow trout, Arctic char and other species found less commonly.

6.2 The Human Environment

As described previously, the Project will extend through much of Newfoundland and Labrador, and will therefore cross and potentially interact with a range of socioeconomic environments and communities.

6.2.1 Central and Southeastern Labrador

Labrador has a rich history and cultural heritage. Today, nearly 30,000 people live in Labrador, distributed in some 30 communities which range from small settlements along the coast to larger centres in central and western Labrador.

6.2.1.1 Historical Overview and Archaeology

Archaeological research in Labrador has revealed a cultural-historical sequence that is long and complex, beginning with the arrival of Maritime Archaic groups in south-eastern Labrador by 8,000 years before present (BP), and culminating with the arrival of the Thule, ancestors of the modern Labrador Inuit, approximately 700 years BP. Archaeological and historical records also confirm a lengthy European presence throughout the region.

Previous archaeological research in Labrador has focused primarily on the coast, and has generally established that historic resources in these areas are rich and abundant, particularly along the shoreline within the major bays. There appears to be a clear distinction between the relatively high archaeological potential of the Strait of Belle Isle coastal strip and the generally lower potential of the interior.

6.2.1.2 Contemporary Socioeconomic Setting

Labrador encompasses a vast area with diverse social, cultural and economic landscapes, and is often thought of as being comprised of a number of regions - Central Labrador, Southern Labrador, the Labrador Straits, Labrador West and the North Coast. The Project itself will extend through two of these regions – Central Labrador and the Labrador Straits, referred to in this EIS as the Central and Southeastern Labrador study region.

Central Labrador (or Upper Lake Melville) includes the Town of Happy Valley-Goose Bay, the Town of North West River, the Innu reserve community of Sheshatshiu and the smaller settlement of Mud Lake. The region has a population of just over 9,000 people, approximately one-third of the population of Labrador. Happy Valley-Goose Bay is the largest community in Labrador and has a well-developed and diverse economy, and a range of services and infrastructure. The communities of North West River and Sheshatshiu are located approximately 25 km north-east of Happy Valley-Goose Bay, and also include a number of businesses and service agencies, while Mud Lake is about 10 km to the south-east.

Happy Valley-Goose Bay, North West River and Sheshatshiu are connected to each other by a paved road, whereas Mud Lake is accessed by boat and snowmobile. The Trans-Labrador Highway (TLH) (Phase 1) also connects the region to Labrador West and beyond, and since opening in 2009, the TLH Phase 3 (TLH3) provides year-round road access to Southern Labrador and on to the Labrador Straits. Year-round air service and seasonal ferry services to coastal Labrador and the Island of Newfoundland are also available.

The Labrador Straits is the region across the Strait of Belle Isle from the Island of Newfoundland. It includes the communities of L'Anse au Clair, Forteau, L'Anse Amour, L'Anse au Loup, Capstan Island, West St. Modeste, Pinware and Red Bay, and has a population of just less than 2,000 persons.

The economy of the Labrador Straits region has traditionally been based on the fishery, but the area has also seen a considerable expansion in the number and diversity of small businesses in recent years. The tourism sector also contributes greatly to the economy of the region, with a number of important natural and historic attractions. Communities in the region are connected to each other and to the Québec North Shore by a paved highway which was constructed in the 1950s. The TLH Phase 2, constructed in the late 1990s, extends from Red Bay north to Cartwright, and a ferry service between Blanc-Sablon and St. Barbe connects the area to the Island of Newfoundland.

Adjacent to the proposed transmission corridor, Southern Labrador is the region between Groswater Bay and Cape Charles. It includes the towns of Cartwright, Charlottetown, Port Hope Simpson, St. Lewis and Mary's

Harbour, and the communities of Paradise River, Black Tickle-Domino, Norman Bay, Pinsent's Arm, Williams Harbour and Lodge Bay. There are also a number of smaller coastal settlements in the region which are inhabited on a seasonal basis.

A number of Aboriginal communities and organizations reside in or near these regions, and undertake land use and harvesting activities and / or claim Aboriginal rights or title to portions of Labrador, including:

- Innu of Labrador, who currently number about 2,500 and reside primarily in two communities - Sheshatshiu in Central Labrador and Natuashish on the North Coast. The Innu claim Aboriginal rights and title to much of Labrador. Agreements related to these land claims and the proposed Lower Churchill and existing Upper Churchill projects were recently concluded and ratified by the Innu people on June 30, 2011, and signed by all relevant parties on November 18, 2011.
- Labrador Inuit, who are primarily resident on the Labrador North Coast in the communities of Nain, Hopedale, Makkovik, Postville and Rigolet, and in various Central Labrador communities. The *Labrador Inuit Land Claims Agreement* came into effect on December 1, 2005, and resulted in the establishment of the Nunatsiavut Government.
- Québec and Naskapi groups, including those that reside on the Lower North Shore and in the Schefferville area. The land claim areas of several of these First Nations extend into Labrador, including: Pakua Shipi (St. Augustine), Unamen Shipu (La Romaine), Nutashkuan (Nastashquan), Ekuanitshit (Mingan), Uashat mak Mani-Utenam (Sept-Îles), Matimekush-Lac John (Schefferville) and Kawawachikamach. The land claims asserted by Québec First Nations for territory in Labrador have not been accepted for negotiation by the Government of Newfoundland and Labrador. Québec Innu and Naskapi people are known to undertake land use and harvesting in certain parts of Labrador.
- NunatuKavut Community Council (NCC, formerly the Labrador Métis Nation), an organization that reports a membership of over 6,000 members who reside primarily in Southern and Central Labrador. Originally established as the Labrador Métis Association in 1985, the NCC has asserted a land claim in the region, but this has not been accepted for negotiation by the federal or provincial governments.

A variety of land and resource use activities are undertaken in the general region, including recreational, subsistence and commercial pursuits by Aboriginal and non-Aboriginal persons. Large and small game are found throughout the area, and hunting has long been an integral part of the lifestyle of area residents. Trapping was historically an important economic activity, but today is pursued primarily for recreation and / or as a supplementary income source. Residents harvest the region's forest resources for firewood and lumber. Fishing is an important recreational and subsistence activity, with salmon, trout, pike, smelt and / or other fish species taken from numerous rivers and ponds through angling and net fisheries.

Cabins are located throughout the area, and are used in association with various recreational and subsistence pursuits. Snowmobiling is a popular activity in the winter months. Local trail networks are also used by residents for hunting, fishing and gathering activities. There are also commercial outfitting camps throughout Labrador, which offer big game hunting, angling and / or ecotourism adventures, including several fishing lodges located throughout Southeastern Labrador. The completion of the TLH3 between Happy Valley-Goose Bay and Cartwright Junction in 2009 has provided increased access to and within the region, and will likely continue to influence local land and resource use patterns.

6.2.2 Strait of Belle Isle

The economy of the areas on both sides of the Strait of Belle Isle has traditionally been based on the fishery. The principal fisheries in recent years have been, by quantity: capelin, cod, shrimp, mackerel and herring, and by value: lobster, cod, seal harvesting, capelin, shrimp and scallop. Fishing in the Strait of Belle Isle generally takes place between May and November, and especially in June and July, primarily by small vessels fishing

quite close to their home communities. Fishing seasons, areas and techniques do, however, vary considerably according to species.

There is a relatively high volume of general vessel traffic in the Strait, particularly between June and late November. There are vessel lanes with designated directions in the Strait, as well as a separation zone between the routing lanes.

The ferry route between St. Barbe, Newfoundland and Blanc-Sablon, Québec is located south of the Project. The marine vessel Apollo makes at least one, and frequently two or more, crossing(s) of the Strait of Belle Isle per day during the operating season, which typically extends from mid-April or early May to mid-January.

6.2.3 Island of Newfoundland

The Island of Newfoundland is, like Labrador, characterized by distinct and varied socio-cultural and economic landscapes. The profile of the existing socioeconomic setting focuses on the general regions of the Island crossed by the proposed transmission corridor, namely the Northern Peninsula, Central and Eastern Newfoundland and the Avalon Peninsula.

6.2.3.1 Historical Overview and Archaeology

Newfoundland and Labrador's cultural history is interesting and complex, and encompasses a period of up to 9,000 years. The first evidence of human occupation comes from sites in the Strait of Belle Isle area, followed by a succession of peoples and cultural traditions throughout various parts of the Island. The history of European exploration and eventual settlement extends over a period of about 1,000 years.

There are several thousand known archaeological sites on the Island of Newfoundland, which range in age from nearly 9,000 years BP to sites dating to the 20th century. Different parts of the Island of Newfoundland clearly have varying degrees of historic resources potential, with a great many of the known sites located along the coast and other concentrations in the north-central and eastern portions of the Island including along major watercourses.

6.2.3.2 Contemporary Socioeconomic Setting

The Island of Newfoundland comprises less than 30 percent (%) of Newfoundland and Labrador's total land area, but is home to nearly 95% of its population. The Island's residents live in approximately 250 municipalities as well as numerous smaller unincorporated communities, which range in size from less than five to over 100,000 persons, and are widely distributed along the Island's nearly 10,000 km of coastline and throughout its interior.

Northern Peninsula

The Northern Peninsula constitutes the largest distinctive geographical region on the Island of Newfoundland, and is home to approximately 18,000 residents in 70 communities. Its population has been steadily declining and aging in recent years, similar to the situation for much of rural Newfoundland and Labrador. The largest community in the region is St. Anthony, which provides key services to other communities throughout the region, as do other centres such as Port au Choix, Roddickton, Rocky Harbour among others. A highway extends from Deer Lake along the western coastline of the peninsula and north to the Straits, and across to communities on the north-east side.

The region has a long-standing linkage to the fishery. The collapse of the groundfish sector and subsequent closure of many of the fish processing plants had a social and economic impact on the region. However, recent years have seen transition, diversification and growth as a result of the harvesting and processing of alternative species such as shellfish. Tourism has also become a key component of the local economy, as a result of world class tourism attractions such as Gros Morne National Park, as well as the L'Anse aux Meadows and Port au Choix National Historic Sites and other attractions, activities and services. Other private sector

enterprises and government services also employ a considerable proportion of the local labour force. There are a number of commercial outfitters in the region, with hunting and / or fishing camps along the northern and eastern sides and concentrated within the south-central part of the peninsula.

Central and Eastern Newfoundland

Central and Eastern Newfoundland is generally defined here as the area located to the south-east of the Northern Peninsula, through the north-central portion of the Island, and south-east to the Isthmus of Avalon. Approximately 72,000 people reside in this area, in numerous communities that stretch along the Trans-Canada Highway (TCH) and various roads that extend into interior and coastal areas. The overall population has been steadily aging and declining, similar to the situation in much of rural Newfoundland and Labrador. However, populations have remained relatively steady in recent years in several parts of the region.

The economy of Central Newfoundland has traditionally been based primarily on natural resource extraction and industrial development. Much of the population lives in the Grand Falls-Windsor and Bishop's Falls area, which is the industrial, service and government centre for Central Newfoundland, as well as in other regional centres such as Clarenville. Manufacturing, commercial, retail and government services employ a significant portion of the labour force, and tourism and recreational activities and associated facilities are also currently a key component of the region's economy.

Avalon Peninsula

The Avalon Peninsula comprises the south-eastern portion of Newfoundland, and is connected to the rest of the Island by a narrow isthmus. The peninsula is home to approximately 250,000 people, nearly half of the population of Newfoundland and Labrador as a whole, and has seen somewhat of a population increase in recent years.

The Avalon Peninsula region includes approximately 200 communities, ranging from larger urban areas such as St. John's (the provincial capital) and Mount Pearl, to towns such as Conception Bay South, Paradise and Bay Roberts, to numerous smaller rural communities throughout. The majority of the region's population live in communities with populations of more than 5,000 people.

The region has a well-developed and diverse economy, being the provincial centre for government and many services and industries. Given its large and concentrated population, portions of the Avalon Peninsula are also subject to fairly intensive land use, such as residential and cottage development, and industrial and agricultural areas.

6.3 Previous and Ongoing Human Activities and Developments

The proposed Project will cross areas of Newfoundland and Labrador that have seen various types, and varying degrees, of past and existing development activities.

These previous and ongoing human activities have influenced the existing environments in these areas, and are reflected in the description of the baseline environment (as described above, and in further detail in Chapters 10 and 15) also and in the component studies prepared for the Project's EA. Also, the current condition of the pre-Project environment as a result of these anthropogenic and / or natural factors - and thus, its likely sensitivity or resiliency to further disturbance or change - has been integrally considered in the environmental effects analyses presented in this EIS, including in assessing potential Project-specific and cumulative effects (Chapter 9).

The following subsections provide an overview of these previous and ongoing developments and other human activities in the general area of the Project, as further background on the environmental setting for the Project. In doing so, and for reference purposes, the overview generally describes the Project area on a segment by segment basis from Central Labrador to the Island's Avalon Peninsula, based on information gathered and

presented elsewhere in the EIS, and / or through associated public and stakeholder consultation activities carried out during the EA.

6.3.1 Central and Southeastern Labrador

The Labrador segment of the proposed transmission corridor extends from the lower Churchill River in Central Labrador to the Strait of Belle Isle, for a distance of approximately 400 km, as described in the following sections.

6.3.1.1 Churchill River Valley to and along the TLH3 (approximately km 0 to km 150)

The Central Labrador region encompasses four communities; Happy Valley-Goose Bay, North West River, Sheshatshiu and Mud Lake, which have a total population of less than 10,000 people, and cover a combined land area of approximately 400 km^2. Development activities in the region are concentrated primarily within and near the communities and associated roadways and other infrastructure.

An Air Force base (5 Wing Goose Bay) has been operating since World War II, and military activities long formed the basis of the area's economy. From the mid-1980s to the late 1990s, a number of countries conducted low-level flying activities at Goose Bay, and various types of training activities continue today. The designated low-level flying training area is located over the interior of the Labrador-Québec Peninsula, and encompasses the western portion of the transmission corridor in Labrador.

The Churchill Falls Generating Station, one of the largest underground powerhouses in the world, has been in operation since 1971 and is located approximately 250 km west of the Muskrat Falls site. Water is stored in the Smallwood Reservoir, which covers an area of 6,988 km^2, and the generating plant at Churchill Falls has 11 turbines with a rated capacity of 5,428 megaWatts (MW). Earlier hydroelectric developments in Labrador include the station constructed at Menihek Lake in the 1950s (currently in operation) and at Twin Falls in the 1960s (maintained but not in operation).

The TLH which extends between Happy Valley-Goose Bay and Western Labrador was completed in the late 1990s, and has been undergoing additional upgrading work in recent years. The existing Nalcor Energy (Nalcor) 138 kilovolts (kV) Transmission Line (TL 240) extends between Churchill Falls and Happy Valley-Goose Bay.

There has been limited previous development activity in the immediate area of the proposed converter station and the initial segment of the transmission corridor, with the exception of the existing access roads and associated clearing and site investigation work at Gull Island and Muskrat Falls, as well as some local land and resource use activities.

The TLH3, an approximately 300 km long all-season gravel-surface road between Happy Valley-Goose Bay and Cartwright Junction, was completed in 2009 and is currently operational. From the south side of the Churchill River at Muskrat Falls, the transmission corridor extends inland for approximately 25 km, at which point it reaches and extends along the highway to approximately its southernmost point. A number of quarries and other cleared areas associated with highway construction are present throughout this area. Several fishing outfitter camps are located to the south-west of the transmission corridor on the Kenamu River / Minipi Lake systems, and to the north-east on the Eagle River system and plateau.

6.3.1.2 TLH3 to Pinware River (approximately km 150 to km 350)

This section of the proposed transmission corridor extends through a vast wilderness area which has seen limited previous human activities, with the exception of localized hunting, fishing and snowmobile use by residents.

6.3.1.3 Pinware River to the Strait of Belle Isle (approximately km 350 to km 400)

As the transmission corridor approaches the Labrador Straits it passes through popular cabin areas, including near Stag Pond and L'Anse au Loup Big Pond, and the general area supports hunting, fishing, wood cutting and snowmobile use by residents.

The Labrador Straits region itself includes eight communities with a total population of just less than 2,000 persons. These communities are connected by a paved highway that extends along the coastline. Development activities in the region are concentrated primarily within and near the communities and the road. The proposed transmission corridor extends to the Forteau Point area which is immediately to the south-west of that community.

6.3.2 Strait of Belle Isle

The economy of the areas on both sides of the Strait of Belle Isle has traditionally been based on the fishery, as described earlier. There is considerable fishing in the Strait of Belle Isle at present, particularly during the summer months.

In addition, there is a high volume of vessel traffic in the Strait of Belle Isle particularly between June and late November, including general vessel movements to and through the area, as well as the seasonal ferry services between St. Barbe and Blanc-Sablon.

6.3.3 Island of Newfoundland

The Island component of the proposed transmission corridor line extends from the Strait of Belle Isle to the Avalon Peninsula, for a distance of approximately 700 km, as described in the following sections.

6.3.3.1 Shoal Cove to Hawke's Bay (approximately km 0 to km 100)

Communities dot the coastline along the northern and western edges of the Northern Peninsula, which are connected by a paved highway (Route 430) with adjacent transmission line(s). The landing area for the proposed submarine cables is accessible by existing roads and is the site of localized development activities.

As the transmission corridor crosses the highway and heads inland and then south, it extends through an area of cabins and several outfitting camps, before crossing the existing highway across the peninsula (Route 432) and other resource roads and associated development areas.

South of this, the corridor passes through and adjacent to several existing resource road networks, with various harvesting and other land and resource use activities occurring throughout this area.

6.3.3.2 Hawke's Bay to the Main River (approximately km 100 to km 200)

In this area the proposed transmission corridor crosses over extensive networks of existing forestry access roads and trails. Much of this area has been subject to past forest harvesting and management activities, dating back to the early 1930s and continuing today. The area also has cabin developments throughout, particularly in proximity to these existing access roads, with other associated harvesting and recreational activities.

As the transmission corridor approaches and crosses the Long Range Mountains, the landscape and topography become considerably rougher, and there is less evidence of human development. This area is, however, the site of several commercial hunting and / or fishing camps, as well as other recreational activities such as snowmobiling and hiking.

6.3.3.3 Main River to Sheffield Lake (approximately km 200 to km 300)

Immediately south of the Main River Provincial Park and east of Gros Morne National Park, the transmission corridor again crosses existing forest access road networks and cutover areas, which increase in number and intensity towards the Silver Mountain and Upper Humber areas.

From there the corridor crosses over and follows along existing transmission lines and highways on the south-eastern portion of the Northern Peninsula and extends to the White Bay area (Routes 420 and 421), eventually crossing the TCH and existing transmission lines in the Birchy Lake area.

Near Birchy and Sheffield lakes, the corridor extends through an area of past forest harvesting and existing resource roads. This area has also seen considerable mineral exploration activity in recent years, and receives considerable use as a cabin, camping, hunting and general recreational area.

6.3.3.4 Sheffield Lake to Grand Falls - Windsor (approximately km 300 to km 400)

Past the Sheffield Lake area, the proposed transmission corridor extends inland in a south-easterly direction, before reaching an area of extensive existing access roads, previous forestry activity and cabin developments in the South Brook / Millertown Junction areas, crossing the Newfoundland T'Railway and then the Buchans Highway (Route 370) near Badger.

From there it travels through another area of existing resource roads and along the south side of the Exploits River, following existing transmission lines to the Grand Falls-Windsor area.

6.3.3.5 Grand Falls-Windsor to Clarenville (approximately km 400 to km 500)

The transmission corridor passes just south of Grand Falls-Windsor, crossing the existing transmission lines and highway to the Bay d'Espoir area (Route 360). From here it travels further inland and to the south-east, removed from the highway and communities in this region, but crossing or passing adjacent to extensive networks of existing access roads and trails and previous forestry activity.

At Port Blandford the transmission corridor reaches, and begins to follow adjacent to, existing transmission lines in this area, to the immediate south-west of the TCH and T'Railway.

6.3.3.6 Clarenville to the Isthmus of Avalon to Soldiers Pond (Approximately km 500 to 700)

The section of the transmission corridor from the Port Blandford / Clarenville area to its termination at Soldiers Pond follows adjacent to existing high voltage transmission lines.

As the transmission corridor approaches the Avalon Peninsula the diversity and intensity of development and other land uses increase considerably, with the corridor crossing or running adjacent to various highways and local roads, communities, trails, quarries, cottage areas, and other human activities.

6.4 Environmental Studies

To assist in ongoing design and planning for the Project and in preparation for its EA, Nalcor has undertaken a series of studies to obtain information on the existing biophysical and socioeconomic environments in the general area of the proposed Project and / or to assist in the eventual analysis of its potential environmental effects in the EA.

This has included environmental studies carried out by Nalcor from 2007 to 2011 related to a range of components, which have built upon previous work completed over the past several decades.

The following sections provide an overview of these environmental studies, which are used and cited extensively in the subsequent chapters of this EIS along with other relevant information sources. These have

also been produced and submitted as Component Studies, as required under the EIS Guidelines and Scoping Document.

6.4.1 Terrestrial Environment

6.4.1.1 Vegetation

The following studies were assembled and submitted as the *Vegetation Component Study* for the Project's EA in May 2011.

Ecological Land Classification (Stantec 2010a): A regional Ecological Land Classification (ELC) identifying and delineating vegetation and habitat types along the transmission corridor and surrounding (15 km wide) area using air photos and satellite imagery with field validation. The study outputs include a detailed ELC study report outlining field and mapping methods, ecological descriptions of habitat types by area and associated mapping, as well as Geographic Information System (GIS) database produced at a scale of 1:75,000 covering the ELC study area. The ELC is a key and integral component of the EA, providing core information that has been used in several of the environmental studies described below, and which is used extensively in the EIS in assessing and quantifying the Project's potential interactions with vegetation and wildlife.

Wetlands Inventory and Classification (Stantec 2010b): The Wetlands Inventory and Classification study identifies and classifies all wetlands within the proposed 2 km wide transmission corridor, based on the ELC and associated imagery and fieldwork. High resolution satellite images, aerial photographs and data collected during field surveys were used in a GIS format to delineate and classify all of the approximately 1,700 wetlands within the proposed transmission corridor. The report provides a detailed wetlands atlas and GIS generated maps at the 1:50,000 scale, as well as a functional analysis overview of each identified wetland class.

Regionally Uncommon Plant Potential Mapping (Stantec 2010c): A modelling and mapping exercise was undertaken to identify the general location and extent of potential habitats for regionally uncommon plant species within the transmission corridor and the larger 15 km wide ELC study area. Information on the known distribution of such plants was acquired from the Atlantic Canada Conservation Data Centre (ACCDC) and other sources, and used to develop a habitat model to determine the potential for these plant species to occur in the various ELC Habitat Types and to identify any specific known locations. The report provides an atlas that indicates the areas predicted to have Low, Moderate, High and Very High potential for the occurrence of regionally uncommon plant species, for use in the EA and eventual transmission line right-of-way (ROW) route selection and any follow-up work.

Timber Resources (Stantec 2011a): The Timber Resources study uses forest inventory data and the ELC in a GIS format to describe and quantify the type and volume of forest resources expected to be harvested or otherwise affected as a result of the clearing of the transmission ROW and associated components.

Vegetation Supplementary Report (Stantec 2011b): A supplement that provides the above described information for the subsequently identified Labrador transmission corridor option from Muskrat Falls.

A supplementary report, *2011 Listed and Regionally Uncommon Plant Survey: Strait of Belle Isle Cable Landing Sites and Shore Electrodes Sites Supplementary Report* (Stantec 2011c) was also prepared. In July 2011, a detailed plant survey was conducted of both cable landing sites, and the electrode sites for listed and regionally uncommon (rare) plant species. The purpose of the surveys was to identify known locations of listed plants and regionally uncommon plant species in the transmission corridor and in the vicinity of Project components.

6.4.1.2 Wildlife

The following studies have been submitted as individual *Component Studies* for the Project's EA in 2011.

Caribou and Other Large Mammals Component Study comprised of the following reports:

- *Caribou and Their Predators* (Stantec 2011d);
- *Moose and Black Bear* (Stantec 2011e; Stantec 2010d);
- *Avifauna Component Study* (Stantec 2011f; Stantec 2010e); and
- *Furbearers and Small Mammals Component Study* (Stantec 2011g; Stantec 2010f).

These studies have identified, reviewed and presented information on these wildlife species and groups in and adjacent to the transmission corridor. In doing so, they have incorporated relevant wildlife and other field surveys undertaken by Nalcor and its predecessors, as well as the published and unpublished literature, information and datasets obtained from government agencies, and other sources.

The study reports present a region by region overview of the likely presence, distribution and status of wildlife species in and near the Project area, followed by more detailed information for a number of key and representative species, including any species of special conservation status.

The studies also use the ELC database to evaluate and map habitat suitability (primary, secondary and tertiary habitats) for select species within the transmission corridor and regional (15 km wide) ELC study area.

6.4.2 Freshwater Environment

Freshwater Environment: Fish and Fish Habitat, Water Resources Component Study (AMEC 2011a; AMEC 2010a): This study uses air photos, topographic mapping and high quality satellite imagery to identify and describe the watercourses and watersheds crossed by the transmission corridor. Each crossing was examined using a GIS system to characterize slope / flow morphology, substrate, wetted and channel widths and adjacent riparian vegetation. A field survey of representative crossing types was then conducted to support these results and to gather additional information on their key physical and biological characteristics, including stream morphology, fish species presence, and water and sediment quality. This information, and that obtained through an associated review of the literature and other available datasets, was used to describe water quality and quantity, fish habitat and known and likely fish species presence in the watercourses crossed by the transmission corridor.

6.4.3 Marine Environment

6.4.3.1 Fish and Fish Habitat and Water Resources

The following studies were assembled and submitted as the *Marine Environment: Fish and Fish Habitat, Water Resources Component Study* for the Project's EA in 2011.

Marine Fish and Fish Habitat in the Strait of Belle Isle: Information Review and Compilation (Sikumiut 2010a): This study involved the identification, compilation, review and presentation of existing and available information on marine fish and fish habitat in the Strait of Belle Isle. This includes information on the physical environment / marine habitats (climate, wind, bathymetry, water temperature and salinity, currents, tides, wave, icebergs and sea ice, and surficial geology) and the biological environment (plankton, benthic invertebrates, algae and fish species presence, abundance and distribution) in the area. The study report supplements Nalcor's marine surveys in the Strait of Belle Isle (as described below).

Marine Flora, Fauna and Habitat Survey – Strait of Belle Isle Submarine Cable Crossing Corridors, 2008 and 2009 (AMEC 2010b): A marine survey field program was conducted in 2008 and 2009 to gather detailed information on marine flora, fauna and habitat along the proposed submarine cable corridors in the Strait of Belle Isle. A 2008 vessel-based survey was conducted using a drop-video camera system, and resulted in seafloor video linear coverage over approximately 85% of the two identified corridor options. A 2009 dive survey in the shallow inshore area on the Newfoundland side covered an additional 2.8 km. The video collected was subsequently reviewed and analysed in detail to identify, classify and map the type, occurrence / abundance and distribution of marine habitat (substrate), macroflora and macrofauna within the submarine cable corridors. A shoreline and intertidal survey was also conducted at four potential cable landing sites on the Labrador and Newfoundland sides of the Strait.

Marine Habitats in the Strait of Belle Isle: Interpretation of 2007 Geophysical (Sonar) Survey Information for the Submarine Cable Crossing Corridors (Fugro Jacques GeoSurveys Inc. 2010): As part of its engineering and environmental programs in the Strait of Belle Isle, Nalcor has collected detailed information on bathymetry and substrate characteristics in the Strait of Belle Isle, including through side-scan sonar, multi-beam and sub-bottom profile surveys in 2007. This study presents a detailed analysis and interpretation of these geophysical survey data to identify and classify the seabed marine habitats (substrate types and water depths) within the cable corridors, also using the 2008 and 2009 marine video survey information (described above) to guide and inform the analysis. This study supplements the above discussed marine flora, fauna and habitat study by providing complete marine habitat analysis coverage for the then identified corridors.

Marine Water, Sediment, Benthos and Nearshore Habitat Surveys: Potential Electrode Sites (Sikumiut 2011a): A 2010 marine sampling survey to collect information on water and sediment quality, benthic invertebrates, bathymetry, substrate, macroflora and macrofauna distribution and backshore characteristics at two proposed shore electrode sites for the Project.

Strait of Belle Isle Submarine Cable Crossing Corridors: Marine Water, Sediment and Benthic Surveys (Sikumiut 2011b): A 2010 vessel-based marine sampling survey to collect information on existing water and sediment quality and benthic invertebrates along the submarine cable corridors.

Marine Flora, Fauna and Habitat Survey: Strait of Belle Isle Supplementary Report (AMEC 2011b): This report presents an 'extraction' of the relevant data from the 2005 to 2009 marine surveys that fall within the proposed single corridor and provides a summary overview of the information.

Marine Habitats in the Strait of Belle Isle: Interpretation of 2007 Geophysical (Sonar) Survey Information Supplementary Report (Fugro Jacques GeoSurveys Inc. 2011): This report presents an 'extraction' of the relevant data from the 2007 marine geophysical surveys and associated interpretation and analyses that fall within the proposed single corridor, and proposes a summary overview of the information.

Strait of Belle Isle Corridor Segment: Marine Water Sediment Benthos and Habitat Survey Supplementary Report (Sikumiut 2011c): This report presents the results of a marine habitat survey for the corridor segment to Shoal Cove. Marine water, sediment and benthic samples were also collected from within this same corridor segment and the results of these surveys are provided.

6.4.3.2 Marine Mammals, Sea Turtles and Seabirds

The following studies were assembled and submitted as the *Marine Environment: Marine Mammals, Sea Turtles and Seabirds Component Study* for the Project's EA in 2011.

Marine Mammals, Sea Turtles and Seabirds in the Strait of Belle Isle: Supplementary Information Review and Compilation (Sikumiut 2010b): This report includes the identification, compilation, review, and presentation of existing and available information on marine mammals, sea turtles and seabirds in the Strait of Belle Isle area, as a supplementary update to the marine mammal and seabird studies described below.

Marine Mammals and Seabirds in the Strait of Belle Isle (Jacques Whitford 2000): Aerial and boat-based marine mammal and seabird surveys were conducted in the Strait of Belle Isle in the summer and fall of 1998, along with a detailed and comprehensive review of known sightings and other information from the available literature and other datasets. The study objective was to describe the occurrence, spatial and temporal distribution, and relative abundance of marine mammals and seabirds in the Strait and surrounding area during the ice-free season.

Strait of Belle Isle: Ambient Noise and Marine Mammal Survey (Jasco 2011a): A 2010 marine acoustic survey of ambient noise and marine mammal vocalizations at three locations within and near identified Strait of Belle Isle cable crossing corridors. The survey included the identification of marine mammal vocalizations to the species level.

6.4.3.3 Marine Environment and Effects Modelling

The following studies were assembled and submitted as the *Marine Environment and Effects Modelling Component Study* for the Project's EA in 2011.

Strait of Belle Isle: Oceanographic Environment and Sediment Modelling (AMEC 2011c): This study models and describes the existing oceanographic environment in the Strait of Belle isle, as well as the likely nature, extent and duration of suspended sediment concentrations that may result from construction activities associated with the installation of the proposed Strait of Belle Isle submarine cables. Using available oceanographic information and additional bathymetric, substrate and tidal data collected by Nalcor in 2007 to 2009, the study included the development of a two dimensional (2D) hydrodynamic model of the Strait of Belle Isle. This was followed by the use of a sediment dispersion model, utilizing the above information and Project engineering inputs, which modelled the likely zones of influence of sediment that may result from Construction activities in the Marine Environment.

Sound Modelling: Proposed Strait of Belle Isle Cable Installation Activities (Jasco 2011b): This study models and describes the noise that may be generated during the construction activities associated with the installation of the proposed submarine cables in the Strait of Belle Isle, for use in the marine effects analyses. The study included the installation of acoustic recording instruments in the Strait of Belle Isle in 2010 to gather information on ambient (baseline) noise levels. This and other oceanographic and Project information were then used to conduct a sound modelling exercise to predict and document the likely nature, intensity and propagation of sound that may be associated with various types and locations of cable crossing Construction activities in the Marine Environment.

Environmental Modelling: Proposed Shore Electrodes (Hatch Ltd. 2011): This study provides the results of a modelling exercise that was undertaken to provide information on the design characteristics, potential emissions, ground potential rise and electromagnetic fields that may be associated with the operation of the proposed shore electrode components of the Project, for use in the environmental effects analyses being completed for the Project's EIS.

6.4.4 Species at Risk

Species of Special Conservation Component Study (Nalcor 2011): A summary compilation of information on provincially and / or federally identified species of special conservation concern that are known or likely to occur near, and which may therefore interact with, the proposed Project. Such species are also considered integrally and in detail within the various individual environmental component studies described above.

6.4.5 Historic and Heritage Resources

Historic and Heritage Resources Component Study (Stantec 2011h; Stantec 2010g): This study includes background research, archaeological field surveys and mapping along the identified transmission corridors, utilizing and building on relevant work undertaken by Nalcor and / or its predecessors and others from 1998 to 2010. This report presents the results of the associated background research and fieldwork, and describes and

maps previously known and newly recorded archaeological and ethnographic sites. This information then contributes to the mapping of archaeological potential along the transmission corridor, for which a detailed map atlas is presented in the report for use in the EA and eventual transmission line ROW route selection. The study also includes an analysis of the age and type of geological formations in the area to identify areas with the potential to contain paleontological resources.

A supplementary report, *2011 Historic and Heritage Resources Assessment and Potential Mapping: Strait of Belle Isle Cable Landing Areas and Shore Electrodes Sites Supplementary Report* (Stantec 2011i) was also prepared. This study included undertaking a detailed historic and heritage resource assessment at the proposed Strait of Belle Isle cable landing sites at Forteau Point (Labrador) and Shoal Cove (Newfoundland), and at the identified shore electrode locations at L'Anse au Diable (Labrador) and Dowden's Point (Newfoundland). Field assessment involved compiling data on previously recorded archaeological and contemporary sites, as well as visual reconnaissance and sub-surface testing and concluded with archaeological potential mapping.

6.4.6 Socioeconomic Environment

The following studies were assembled and submitted as the *Socioeconomic Environment: Communities, Land and Resource Use, Tourism and Recreation Component Study* for the Project's EA in May 2011.

Socioeconomic Environment: Communities, Land and Resource Use, Tourism and Recreation (AMEC 2011d; AMEC 2010c): This study analyzes and describes key aspects of the existing socioeconomic environment for use in the EA. This includes the general regions and communities which are crossed by or adjacent to the transmission corridor, as well as land and resource uses and other outdoor activities in these general areas, including commercial and recreational pursuits. It involved the compilation of information from the published and unpublished literature, existing and available datasets, as well as discussions and interviews with representatives of relevant governmental and non-governmental organizations, to describe and map the following key components: communities; transportation; hunting and trapping; angling and other fishing; hunting and fishing outfitters; motorized recreational vehicles; cabins and cottage development areas; other outdoor recreational activities; parks, reserves and other protected and special areas; forestry; mining and energy; agriculture and other uses and activities.

Analysis of Current Levels of Accessibility Along the Transmission Corridor (Integrated Informatics Inc. 2011): A study which analyzes and describes existing levels of human access to and within the transmission corridor, as additional socioeconomic baseline information and for use in the environmental effects assessment conducted for the EA.

The following studies were assembled and submitted as the *Socioeconomic Environment: Marine Fisheries in the Strait of Belle Isle Component Study* for the Project's EA in 2011.

Marine Fisheries in the Strait of Belle Isle (Canning & Pitt Associates Inc. (C & P) 2010a): A study of marine fishing activity in the area of the Project's submarine cable crossing of the Strait of Belle Isle, based on the compilation and analysis of existing and available datasets, the literature and interviews. The report describes relevant fisheries activities (1989 to 2008) for the wider Strait of Belle Isle area (Northwest Atlantic Fisheries Organization (NAFO) Unit Area 4Ra) and then focuses on current local fisheries near the potential submarine cable crossing corridor. In addition to existing fisheries statistical data from Fisheries and Oceans Canada (DFO), the report also includes the results of consultations with fishers from communities on both sides of the Strait, as well as discussions with relevant governmental and industry representatives.

An attached *Supplementary Report* (C & P 2010b) provides additional information on fishing equipment and activities, with a focus on the Strait of Belle Isle scallop fishery.

A further *Supplementary Report* (Jacques Whitford 2001) presents the results of a previous review of fisheries in the Strait of Belle Isle, as additional background information.

Socioeconomic Environment: Aboriginal Communities and Land Use Component Study (Nalcor et al. 2011): This study provides information on relevant Labrador and Québec Aboriginal communities and their contemporary land use activities in Central and Southeastern Labrador for use in the EA. The study focuses on land use by Aboriginal groups who reside in or claim Aboriginal rights or title along or adjacent to the proposed transmission corridors in Central and Southeastern Labrador. The groups included in the study are Labrador Innu (Sheshatshiu and Natuashish, as represented by Innu Nation), Labrador Inuit (Nunatsiavut Government), NunatuKavut Community Council (formerly Labrador Metis Nation) and Innu and Naskapi of Québec including: Pakua Shipi, Unamen Shipu, Nutashkuan, Ekuanitshit, Uashat mak Mani-Utenam, Matimekush-Lac John and Kawawachikamach. In addition to a description of their contemporary land use, a socioeconomic summary is provided for each Labrador and Québec Aboriginal community or organization. The information upon which the study is based was derived from published and unpublished literature, information provided to Nalcor by Aboriginal groups and from the results of recent consultation activities and socioeconomic data collection initiatives completed for the EA by Aboriginal groups in cooperation with Nalcor.

Viewscapes (Stantec 2011j): The study makes use of Project engineering inputs and spatial imagery, digital elevation data and the vegetation analysis completed for the ELC (as described above) to evaluate whether, and to what degree, the proposed Project infrastructure will be visible from adjacent areas. In addition, particular locations were the subject of detailed visual modelling. Visual modelling used 3D virtual rendering software to develop pre- and post-construction conceptual illustrations (or photosimulations) depicting the view of the proposed transmission line towers from a number of representative habitat types / key sites along the corridor, identified through EA consultations. The results of the viewshed analysis along and adjacent to the proposed transmission corridor are also presented.

6.5 Information Availability and Gaps

As a result of the environmental studies, analyses and consultation activities conducted by Nalcor in relation to this EA, there exists a considerable body of knowledge about the Project, the natural and human environments through which it will extend, and its potential interactions with the environment, for use in the EIS.

6.5.1 Existing Environment

As outlined in the preceding section, extensive environmental study programs have been undertaken in relation to the Project and its EA over several years. The objective has been to gather and present useful and relevant information on key aspects of the existing biophysical and socioeconomic environments, and in doing so, to provide an appropriate and meaningful understanding of existing conditions in and near the transmission corridor for use in the EA.

In planning and conducting these studies, the nature and geographic scale of the Project has been an important consideration. Rather than base the environmental baseline description solely on a “snapshot survey” understanding of the existing environment along the 1,100 km long transmission corridor at one or limited points in time, a range of data collection methods and information sources were used. This included a combination of environmental field surveys, the compilation and analysis of existing and available information and datasets, and associated mapping and analysis. The nature and outcomes of these environmental studies are described above and throughout this EIS, with these studies also being submitted as individual Component Studies for review under the EA process.

The information on, and understanding of, the existing biophysical and socioeconomic environments obtained through these studies and other sources (as reported herein and elsewhere) are considered adequate and appropriate for conducting the Project’s EA.

6.5.2 Environmental Issues and Effects

Through its consultation initiatives with relevant government departments and agencies, Aboriginal and stakeholder groups and the general public (as described in Chapters 7 and 8) Nalcor has a good understanding

of questions and concerns that may be associated with the Project and its potential environmental effects. The environmental effects analyses reported in this EIS (Chapters 11 to 14 and 16) focus on the environmental issues raised through these previous and ongoing consultation activities.

In addition, the potential environmental effects of constructing and operating transmission lines and associated infrastructure are considered to be generally well understood. Nalcor and its subsidiaries have well over four decades of experience in planning, designing, assessing, building and operating transmission infrastructure projects, and currently maintain an extensive electricity transmission and distribution system throughout Newfoundland and Labrador. This direct experience, as well as other sources of information and "existing knowledge" regarding the outcomes and experiences of similar types of projects have also guided and been incorporated into this environmental effects analysis.

6.5.3 Information "Gaps"

Identification of information gaps has been a continual process throughout the Project's planning and EA. Information 'gaps' were identified: (i) through consultation with government agencies, Aboriginal groups and the public; (ii) the result of ongoing engineering and modifications to Project design; and, (iii) the design and information collection for the component studies to describe the existing environment. Where such 'gaps' were identified, Nalcor conducted additional baseline studies to gather and compile information to fill these 'gaps'. For example, the original Project concept for the Strait of Belle Isle submarine cable crossing saw the preliminary identification of potential cable landing sites at Forteau Point and Mistaken Cove. Since that time, through Nalcor's Project planning and engineering, Shoal Cove has been identified as the proposed cable landing site on the Newfoundland side of the Strait of Belle Isle. To address this information 'gap', Nalcor conducted detailed historic and heritage resource surveys and listed and regionally uncommon plant surveys at these sites to identify issues and develop appropriate mitigation options to avoid adverse effects.

Throughout the EIS, any uncertainties in the assessment have been addressed by using conservative estimates and assumptions as per Nalcor's precautionary approach in order to make reliable predictions about likely residual project effects. Discussion of how uncertainty has been addressed in the EIS is provided throughout the assessment where appropriate. Uncertainty will also be further addressed through the monitoring or follow-up programs, and adaptive management.

6.6 Likely Future Environmental Conditions without the Project

Environmental systems are not static in nature, but rather are constantly changing over time, both naturally (e.g., forest fires) and as a result of human activities and influences (e.g., forestry, access). Consideration of the existing, pre-project "baseline" environment must therefore recognize that aspects of the biophysical and socioeconomic environments are dynamic and will continue to change in the future, even without the Project.

This "without the project" future environment should therefore also be considered in an EA in assessing and evaluating the potential future effects of a project. This is reflected in, for example, the definitions provided in the Newfoundland and Labrador *Environmental Protection Act* where environmental effect means "a change in the present *or future environment* that would result from an undertaking" (emphasis added).

Recognizing that it is somewhat speculative and certainly challenging to predict the likely future characteristics of the environment across Newfoundland and Labrador in the long-term and with precision, the following discussion provides a general overview of the manner in which the existing biophysical and socioeconomic environments may change in the future without the Project.

Potential environmental effects that are likely to result from other future projects and activities in conjunction witht he Project are also assessed as part of the cumulative effects analysis presented for each Valued Environmental Component (described in Chapter 9).

The Project is assumed to operate in perpetuity, so this discussion addresses, to the extent feasible, the first 100 years. In the absence of the Project over this time period, natural physical environmental and ecological

processes will likely continue, as will any climate changes that are occurring. Physical developments and activities within the province will also likely continue to occur as part of the social and economic environments. These continuing processes and developments will lead to environmental change and effects on environmental resources.

6.6.1 Atmospheric Environment

The effects of climate change in Newfoundland and Labrador are discussed in detail in section 4.1.11. Over the next century, changes in temperature, precipitation patterns and extreme events are predicted for Newfoundland and Labrador (Natural Resources Canada (NRCan) 2010, internet site). These changes in climate are expected to be more pronounced inland than at the coastal areas due to the moderating effects of the Labrador Sea.

In summary, without the Project it is predicted that over the next 80 to 100 years, temperatures will continue to rise slightly, precipitation will continue to increase, and sea levels will continue to rise. The warmer temperatures during fall and winter are predicted to result in later freeze-up, heavier snow, more rain occurring later into the fall, and possibly more freezing precipitation during the fall and winter. With little change in spring temperatures, differences in ice break-up patterns are expected to be slight over the next century (Lines et al. 2005).

Currently, Newfoundland and Labrador makes a small contribution to the total national GHG emissions with limited variation across the Project regions. The province experiences relatively low emissions of air contaminants with the ambient air quality representative of a rural and clean environment and few industrial facilities located in the Project regions. In the absence of the Project, the province is expected to experience small changes in background air quality and atmospheric deposition from the long-range transport of air contaminant emissions. However, even with planned developments such as highway infrastructure improvements in southern Labrador, continued forest harvesting, potential industrial developments and other economic activities, and the growth of the provincial population, the atmospheric environment will likely experience limited change based on the natural state of much of Newfoundland and, particularly, Labrador.

Ambient sound in Newfoundland and Labrador is dominated by the sounds of nature with minimal contributing sound sources located in the Project regions. Without the Project the ambient sounds are expected to be of the same types and levels, with human generated noises primarily associated with aircraft, vehicle, and vessel traffic.

6.6.2 Terrestrial Environment

Vegetation in the regions crossed by the Project transitions from the more northern Arctic ecosystem of the Taiga Shield Ecozone in central and southeastern Labrador typically associated with upland areas and higher elevations to, primarily, the Boreal Shield Ecozone of southern Labrador and the Island of Newfoundland typically associated with upland coniferous forest interspersed with drainages and wetlands. Without the Project, the disturbance to vegetation (e.g., clearing of the Project components) would not occur, thus allowing the vegetation in those areas to continue to be influenced primarily by such factors as forest fire, insect infestations, disease and commercial forest harvesting, with the result that mature forest will be replaced by younger seral stages over time.

The rate of changes to the existing vegetation mosaic would be expected to be influenced by the demand for natural resource based products (e.g., several mills have closed), and this trend could continue. Considering this, and the slow growth of vegetation in cooler climates (even considering slight warming trends), the changes are expected to be gradual, and primarily reflect natural succession and natural events (e.g., forest fires). As the landscape has been formed by these natural processes, this would be expected to continue without the Project, with the same general landscape patterns that currently exist, present over the next 100 years.

Increased human activities (e.g., off highway vehicle use, consumptive and non-consumptive recreational activities), and changes in vegetation cover and access due to commercial forestry and other industrial

activities would be expected to continue to increasingly affect the distribution and / or abundance of wildlife species, including boreal woodland caribou in Newfoundland, as well as furbearers and avifauna. However, this is expected to be addressed through management actions (e.g., forestry plans) and herd management.

Listed species are expected to be present, with populations benefitting from management actions, including recovery strategies. The fate of the Red Wine Mountain caribou herd may be addressed through deliberate management actions, but if the main stressors continue unchecked, their fate is expected to remain tentative.

The natural succession and changes to habitat resulting from fires will continue to influence the available habitat's ability to support wildlife species (e.g., woodland caribou will avoid burns). It would be expected that pressures on sensitive species, such as the woodland caribou, would continue to occur due to changes in habitat, either from natural or anthropogenic sources, but that regulators responsible for managing these species will respond appropriately to ensure their sustainability.

6.6.3 Aquatic Environment

The freshwater environment is expected to change little over the next 100 years, with potentially slightly higher amounts of runoff resulting from increased precipitation and snow melt. However, the changes would be such that ecosystems are expected to function as they currently do, and support the same types and distributions of fish and fish habitat. This is supported by the highly regulated nature of this resource and ongoing management related to permitting and protection (e.g., permits required for fording, angling regulations).

6.6.4 Marine Environment

The Strait of Belle Isle and Conception Bay will continue to be affected by marine vessel traffic and related spills, air pollutant deposition, and increased sea levels due to climate change. In low-lying and low-sloping coastal areas, sea level changes may have a greater effect (e.g., increased rates of erosion, coastal landslides, loss of beaches). Without the Project, this current, ongoing change is expected to continue.

Without the Project, the protective rock berm to be constructed over each of the submarine cables would not be in place, and would not generate the habitat change that this diverse substrate would facilitate. However, with or without the Project, the Strait of Belle Isle is expected to remain a dynamic, harsh, and relatively pristine marine environment.

6.6.5 Socioeconomic Environment

The socioeconomic environment of the province is expected to continue to be driven by the natural resources sectors (e.g., fisheries, water, nickel and iron ore mining, forestry, offshore oil) and the related support services, as driven by market demand (e.g., less interest in forestry, more interest in offshore oil).

The natural beauty of the province will likely continue to attract increased numbers of people, as they search for vacation destinations, resulting in more tourism and recreation traffic to the province. It is not possible to predict what the level of growth will be in these industries, but the growth will likely be limited by capacity and seasonality, the economic situation and the demand for these resources. Increased transportation systems (e.g., the Trans-Labrador Highway) and the province's promotion of tourism would be expected to increase opportunities for growth.

The province is expected to continue its economic growth into the future, considering the economic benefits of offshore oil, mining in western and northern Labrador, and the Vale nickel processing facility. In addition to these larger projects, economic prospects for the short- to medium-term suggest that many regions could see significant new economic activity, from such activities as the Lower Churchill Hydroelectric Generation Project, mining activity in the Baie Verte area, and construction of mineral processing and offshore petroleum production facilities at Bull Arm. Without the Project this growth is expected to be somewhat slower, recognizing the unrealized Construction, and Operations and Maintenance opportunities that would be created in some of the rural regions of the province.

6.7 References

AMEC (AMEC Earth and Environmental). 2010a. Labrador – Island Transmission Link: Freshwater Environment - Fish and Fish Habitat and Water Resources. Prepared for Nalcor Energy. St. John's, NL.

AMEC. 2010b. Labrador – Island Transmission Link: Marine Flora, Fauna and Habitat Survey – Strait of Belle Isle Submarine Cable Crossing Corridors, 2008 and 2009. Prepared for Nalcor Energy. St. John's, NL.

AMEC. 2010c. Labrador – Island Transmission Link: Socioeconomic Environment - Communities, Land and Resource Use, Tourism and Recreation. Prepared for Nalcor Energy. St. John's, NL.

AMEC. 2011a. Labrador – Island Transmission Link: Freshwater Environment - Fish and Fish Habitat and Water Resources Component Study: Supplementary Report. Prepared for Nalcor Energy. St. John's, NL.

AMEC. 2011b. Labrador – Island Transmission Link: Marine Flora, Fauna and Habitat Survey – Strait of Belle Isle Supplementary Report. Prepared for Nalcor Energy. St. John's, NL.

AMEC. 2011c. Labrador – Island Transmission Link: Strait of Belle Isle: Oceanographic Environment and Sediment Modelling. Prepared for Nalcor Energy. St. John's, NL.

AMEC. 2011d. Labrador – Island Transmission Link: Socioeconomic Environment: Communities, Land and Resource Use, Tourism and Recreation: Supplementary Report. Prepared for Nalcor Energy. St. John's, NL.

C & P (Canning & Pitt Associates Inc.). 2010a. Labrador – Island Transmission Link: Marine Fisheries in the Strait of Belle Isle Component Study. Prepared for Nalcor Energy. St. John's, NL.

C & P. 2010b. Labrador – Island Transmission Link: Marine Fisheries in the Strait of Belle Isle: Fishing Equipment and Activity, With a Focus on the Scallop Fishery. Prepared for Nalcor Energy. St. John's, NL.

Fugro Jacques GeoSurveys Inc. 2010. Labrador – Island Transmission Link: Marine Habitats in the Strait of Belle Isle: Interpretation of 2007 Geophysical (Sonar) Survey Information for the Submarine Cable Crossing Corridors. Prepared for Nalcor Energy. St. John's, NL.

Fugro Jacques GeoSurveys Inc. 2011. Labrador – Island Transmission Link: Marine Habitats in the Strait of Belle Isle: Interpretation of 2007 Geophysical (Sonar) Survey Information – Supplementary Report. Prepared for Nalcor Energy. St. John's, NL.

Hatch Ltd. 2011. Labrador – Island Transmission Link: Environmental Modelling- Proposed Shore Electrodes. Prepared for Nalcor Energy. St. John's, NL.

Integrated Informatics Inc. 2011. Labrador – Island Transmission Link: Analysis of Current Levels of Accessibility Along the Transmission Corridor. Prepared for Nalcor Energy. St. John's, NL.

Jacques Whitford (Jacques Whitford Environment Limited). 2000. Marine Mammals and Seabirds in the Strait of Belle Isle. Prepared for Newfoundland and Labrador Hydro. St. John's, NL. With Updated Executive Summary and Introduction by Nalcor Energy – November 2009.

Jacques Whitford. 2001. Marine Fisheries in the Strait of Belle Isle. Previous (2001) Review of Fishing Activity in the Strait of Belle Isle, Prepared for Newfoundland and Labrador Hydro. St. John's, NL.

Jasco (Jasco Applied Sciences). 2011a. Labrador – Island Transmission Link: Strait of Belle Isle Ambient Noise and Marine Mammal Survey. Prepared for Nalcor Energy. St. John's, NL.

Jasco. 2011b. Labrador – Island Transmission Link: Sound Modelling - Proposed Strait of Belle Isle Cable Installation Activities. Prepared for Nalcor Energy. St. John's, NL.

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.

Nalcor (Nalcor Energy). 2011. Labrador – Island Transmission Link: Species of Special Conservation Status Component Study. Prepared by Nalcor Energy. St. John's, NL.

Nalcor et al. (Nalcor Energy, Stantec Consulting Ltd. and Transfert Environment). 2011. Labrador – Island Transmission Link: Socioeconomic Environment: Aboriginal Communities and Land Use Component Study. Lower Churchill Project, July 2011. Nalcor Energy. St. John's, NL.

NRCan (Natural Resources Canada). 2010. CanVec. Available at: http://geogratis.cgdi.gc.ca/geogratis/en/collection/5460AA9D-54CD-8349-C95E-1A4D03172FDF.html. Accessed: May 2010.

Sikumiut (Sikumiut Environmental Management Ltd.). 2010a. Labrador – Island Transmission Link: Marine Fish and Fish Habitat in the Strait of Belle Isle - Information Review and Compilation. Prepared for Nalcor Energy. St. John's, NL.

Sikumiut. 2010b. Labrador – Island Transmission Link: Marine Mammals, Sea Turtles and Seabirds in the Strait of Belle Isle - Supplementary Information Review and Compilation. Prepared for Nalcor Energy. St. John's, NL.

Sikumiut. 2011a. Marine Water and Sediment and Nearshore Habitat Survey – Potential Electrode Sites. Labrador – Island Transmission Link. Prepared for Nalcor Energy. St. John's, NL.

Sikumiut. 2011b. Marine Water and Sediment Survey – Strait of Belle Isle Submarine Cable Crossing Corridors. Labrador – Island Transmission Link. Prepared for Nalcor Energy. St. John's, NL.

Sikumiut. 2011c. Marine Water, Sediment, Benthos and Habitat Survey – Supplementary Report. Labrador – Island Transmission Link. Prepared for Nalcor Energy. St. John's, NL.

Stantec (Stantec Consulting Ltd.). 2010a. Labrador – Island Transmission Link: Ecological Land Classification. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2010b. Labrador – Island Transmission Link: Wetlands Inventory and Classification. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2010c. Labrador – Island Transmission Link: Regionally Uncommon Plant Species: Potential Mapping. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2010d. Labrador – Island Transmission Link: Moose and Black Bear Component Study. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2010e. Labrador – Island Transmission Link: Avifauna Component Study. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2010f. Labrador – Island Transmission Link: Furbearer and Small Mammal Component Study. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2010g. Labrador – Island Transmission Link: Historic and Heritage Resources Component Study. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2011a. Labrador – Island Transmission Link: Timber Resources. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2011b. Labrador – Island Transmission Link: Vegetation Supplementary. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2011c. Labrador – Island Transmission Link: 2011 Listed and Regionally Uncommon Plant Survey: Strait of Belle Isle Cable Landing Sites and Shore Electrodes Sites Supplementary Report. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2011d. Labrador – Island Transmission Link: Caribou and Their Predators. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2011e. Labrador – Island Transmission Link: Moose and Black Bear Component Study Supplementary Report. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2011f. Labrador – Island Transmission Link: Avifauna Supplementary Report. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2011g. Labrador – Island Transmission Link: Furbearers and Small Mammals Supplementary Report. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2011h. Labrador – Island Transmission Link: Historic and Heritage Resources Component Study: Supplementary Report. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2011i. Labrador – Island Transmission Link: 2011 Historic and Heritage Resources Assessment and Potential Mapping: Strait of Belle Isle Cable Landing Areas and Shore Electrodes Sites Supplementary Report. Prepared for Nalcor Energy. St. John's, NL.

Stantec. 2011j. Labrador – Island Transmission Link: Viewscapes Component Study: Conceptual Illustrations and Viewshed Modelling. Prepared for Nalcor Energy. St. John's, NL.

NALCOR ENERGY

LABRADOR-ISLAND TRANSMISSION LINK

ENVIRONMENTAL IMPACT STATEMENT

Chapter 7

Aboriginal Consultation and Issues Scoping

April 2012

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LIST OF ACRONYMS

Acronym	Description
EA	Environmental Assessment
MOU	Memorandum of Understanding
IBA	Impacts and Benefits Agreement
ITK	Innu Traditional Knowledge
ITKC	Innu Traditional Knowledge Committee
ROW	right-of-way
LMN	Labrador Metis Nation
NCC	NunatuKavut Community Council
Project	Labrador-Island Transmission Link
ftp	file transfer protocol
EIS	Environmental Impact Statement
LILCA	*Labrador Inuit Land Claims Agreement*
TLH	Trans-Labrador Highway
EMF	electromagnetic field
NL	Newfoundland and Labrador (Province)
QC	Québec (Province)

7 ABORIGINAL CONSULTATION AND ISSUES SCOPING

Nalcor Energy (Nalcor) is committed to consulting Aboriginal communities and organizations appropriately on the proposed Labrador-Island Transmission Link (Project). Section 2 of the EIS Guidelines and Scoping Document recommends the proponent provide up-to-date information, as it becomes available, to Aboriginal groups and especially to communities likely to be affected by the Project; involve the main interested parties in determining how best to deliver the information, the type of information that is required, format and presentation methods and the need for community meetings; provide explanations of the results of the EIS in a clear and direct manner to make the issues comprehensible to a wide audience; and for the Proponent to consider and acknowledge all requests for consultation with Aboriginal groups during project approvals and the life of the project.

Based on these guiding principles, the following provides an overview of relevant Aboriginal communities and organizations, as well as Nalcor's previous and ongoing consultation processes and activities with both Labrador and Québec groups, and the outcomes of these initiatives.

7.1 Overview of Aboriginal Consultation Activities and Initiatives

Nalcor has planned, offered and undertaken various consultation processes and activities with Aboriginal groups with the purpose of providing and receiving information on the Project and its potential environmental effects, and collecting Aboriginal Ecological Knowledge on the existing environment for incorporation into the Environmental Impact Statement (EIS). The key objectives and elements of Nalcor's Aboriginal consultation program include:

- providing Aboriginal communities with information on the proposed Project, including its purpose and associated components and activities;
- identifying and documenting any questions or concerns about the Project and its potential environmental and socioeconomic effects and benefits;
- collecting and sharing information on contemporary land use activities by Aboriginal persons in or near the Project area, as well as relevant Aboriginal knowledge; and
- discussing possible approaches and measures to avoid or reduce any likely adverse effects and enhance benefits of the Project on Aboriginal communities and their interests and activities, and on the environment in general.

Consultation with Aboriginal communities and organizations for the Project has been ongoing for several years, including prior to the registration of the Project under the provincial and federal environmental assessment (EA) processes. In January 2009, Nalcor contacted all relevant Labrador and Quebéc Aboriginal communities and organizations within several days of the Project's registration to provide the document and further details on the EA process and, in February 2009 provided a French translation to all French speaking Aboriginal communities in Québec. Further details on Nalcor's correspondence, discussions and other consultation initiatives and offers with individual groups are provided throughout this Chapter.

Nalcor's approach to planning, undertaking and supporting consultation is both group- and Project-specific, given the nature and location of the proposed development and the type and level of interest by a particular Aboriginal community. It is Nalcor's practice, when required or requested, to provide translation of oral presentation in the Aboriginal language spoken by the Aboriginal group. Nalcor recognizes and acknowledges that Aboriginal communities and organizations often require additional resources and support when engaging in consultation processes, particularly with regard to large development projects and their EAs. While there is no legal requirement for formal capacity arrangements, Nalcor has developed an approach to consultation which includes the provision of funding and / or other support to Aboriginal communities and organizations to facilitate Project-related consultation, where appropriate. Consultations and negotiations with the Labrador Innu were carried out between the Proponent and Innu Nation, between 2000 and 2011 pursuant to a series

of Process Agreements and a subsequent Memorandum of Understanding (MOU) signed between Nalcor and Innu Nation in 2009, as well as various subsequent mechanisms. These are discussed in detail in the section that follows.

Commencing in the spring of 2009, Nalcor proposed to enter into community engagement agreements with the following Labrador and Québec Aboriginal communities and organizations, as a basis for further discussion and cooperation related to its proposed development activities in Central and Southeastern Labrador:

- NunatuKavut Community Council (NCC) (formerly the Labrador Metis Nation);
- Pakua Shipi (St. Augustin);
- Unamen Shipu (La Romaine);
- Nutashkuan (Natashquan);
- Ekuanitshit (Mingan);
- Uashat mak Mani-Utenam (Sept-Îles); and
- Matimekush-Lac John (Schefferville).

In 2010, several of these Aboriginal groups were also offered further consultation arrangements specific to the proposed Project and its EA. The nature and outcomes of these discussions are described for each group in the sections that follow.

Although the proposed Project does not cross through or near land areas covered by the *Labrador Inuit Land Claims Agreement* (LILCA), Nalcor remains committed to open discussions with the Nunatsiavut Government and has and will continue to provide information on the Project and its EA to the Labrador Inuit.

Nalcor has also initiated, and continues to seek opportunities to engage in appropriate consultation with the Naskapi Nation of Kawawachikamach, Québec.

On November 24, 2010, further correspondence providing additional information on the proposed Project was sent to each of the above groups, proposing that Nalcor provide a Project presentation in their communities in the near future. In April 2011, another letter was sent to inform these groups of upcoming open houses.

7.2 Labrador Innu

The Innu, formerly known as the Naskapi-Montagnais Indians, are indigenous inhabitants of an area they refer to as Nitassinan, which comprises the eastern portion of the Québec-Labrador peninsula. They were traditionally a nomadic people, whose movements responded to the seasons and the migration of the animals they relied upon. This traditional way of life continued until the mid-twentieth century, when many Innu were settled into communities. The Labrador Innu continue to attach great importance to time spent in Nutshimit (the country), which for many is seen as an opportunity for cultural and physical renewal.

The approximately 2,200 Labrador Innu reside primarily in two communities - Sheshatshiu in Central Labrador and Natuashish on the north-east coast. The Mushuau Innu resettled from Davis Inlet to Natuashish in 2002-2003. Small numbers of Innu also reside in Happy Valley-Goose Bay and elsewhere.

The Sheshatshiu Innu and the Mushuau Innu of Natuashish are separate Labrador Innu Bands and each community is a Reserve with an elected Chief and Council. Both communities are represented by Innu Nation in land claims negotiations and on other matters of common interest.

The Innu of Labrador claim Aboriginal rights and title to much of Labrador. The Labrador Innu land claim area overlaps the proposed Project area, and is the only such claim in the region that has been accepted for negotiation by both the Government of Canada and the Government of Newfoundland and Labrador.

7.2.1 Consultation and Participation

Nalcor's consultation with Labrador Innu has occurred over approximately the past 12 years, and has included consideration of both the proposed Project and the Lower Churchill Hydroelectric Generation Project. Consultation activities for the purpose of issues scoping and the collection of Aboriginal Ecological Knowledge have occurred through the use of various methods such as studies, funding mechanisms and direct consultation with the communities. Sources of Aboriginal Ecological Knowledge include, but are not limited to, land use surveys and interviews, reviews of existing published and unpublished literature and through the provision of information to Nalcor by Labrador Innu. This longstanding relationship was first established in 1999, and included *Process Agreements* negotiated between Newfoundland and Labrador Hydro (Nalcor's predecessor) and Innu Nation. These agreements established and funded mechanisms for ongoing consultation and negotiations related to these projects, with subsequent agreements and extensions occurring throughout the 1999-2003 period.

Consultation and negotiation with the Labrador Innu were resumed in late 2005 under subsequent *Process Agreements*, and focused on three key elements and activities:

1) Impacts and Benefits Agreement (IBA) negotiations;
2) Innu Community Consultation; and
3) Environmental and Engineering Issues and Studies.

While the final Process Agreement expired in late 2008, a number of additional agreements and processes have been established since that time in order to undertake ongoing Labrador Innu consultation and negotiations on, and participation in, the projects. These are also described below.

7.2.1.1 Impacts and Benefits Agreement

Nalcor and Innu Nation have negotiated and concluded an IBA pertaining to both the Labrador-Island Transmission Link and the Lower Churchill Hydroelectric Generation Project. The IBA, which was ratified by the membership of Innu Nation on June 30, 2011 and signed on November 18, 2011, defines how the Labrador Innu will participate in and benefit from these development projects.

The IBA is the outcome of several periods and processes of discussion and negotiation over 10 years between Innu Nation and Nalcor and its predecessors. On September 26, 2008, Innu Nation and the Government of Newfoundland and Labrador announced the signing of the *Tshash Petapen Agreement* (which translates as the "New Dawn Agreement"), which resolved key issues relating to matters between the province and Innu Nation surrounding the Innu Rights Agreement, the Lower Churchill IBA and Innu redress for the Upper Churchill Hydroelectric Development. On February 16, 2010, Innu Nation leaders, the Government of Newfoundland and Labrador, and Nalcor, initialled an agreement that completed the outstanding issues associated with the New Dawn Agreement. Consultation had been ongoing with Innu Nation since the initialling of the agreement, which described the obligations of Nalcor and Innu Nation, until ratification and implementation of the IBA.

The specific nature and provisions of the IBA are and will remain confidential. The IBA does, however, include processes for continued consultation and cooperation throughout the planning, Construction and Operations and Maintenance phases of the projects. The IBA also includes mechanisms intended to help avoid or reduce potential adverse effects on Innu and Innu communities, and for creating and enhancing potential benefits, including compensation. This also includes processes and provisions related to Innu employment, training, business opportunities, workplace policies and conditions, environmental management, revenue sharing and other issues.

7.2.1.2 Innu Community Consultation

Under the previously described Process Agreements, Nalcor and Innu Nation also developed and implemented processes for Innu-led consultations in the communities of Sheshatshiu and Natuashish. These Innu community consultation processes were originally established in 1999 and re-initiated in 2005 and continued to late 2008. With a view to ensuring that such consultation was as effective and meaningful as possible, this consultation was led by Innu Nation at its request, with funding provided by the proponent. An Innu Community Consultation team comprised of an Innu Consultation Coordinator and Consultation Commissioners in each of the two Labrador Innu communities provided information and conducted ongoing consultation related to the projects. A range of approaches and techniques were used, including community meetings, newsletters, radio programs, drop-in centres, site visits and other mechanisms.

As part of that process, Nalcor participated in community meetings in Sheshatshiu and Natuashish, as requested by Innu Nation, to provide information and updates, answer questions and identify issues or concerns. Nalcor also provided Project and other information to the Innu community consultation team on an ongoing basis, as well as through workshops, site visits and other forums.

The Innu community consultation process provided a means to both inform the Innu communities and provide a forum in which they could raise concerns about the nature and status of the projects, including the associated environmental and engineering work, and potential environmental and socioeconomic effects. It also served as a forum for Innu Nation to consult with its membership during the IBA negotiations.

The Innu community consultation team provided reports to both Innu Nation and Nalcor on the activities and findings of the consultation process. These and previous reports from past Innu community consultation processes have provided information essential to both Project planning and issues scoping for the EA.

In addition to the above-listed consultation activities, an open house was held by Nalcor Energy in Sheshatshiu on June 2, 2011. Information on public notifications, open house format, and display materials are presented below, as well as issues and concerns related to the Project that were identified during the open house.

Prior to the open house session, public notification activities included newspaper advertisements, public notices, and invitations. This included advertisements in The Labradorian and The Northern Pen newspapers on May 23 and 30, 2011, as well as radio advertisements, direct distribution of public notices and posting on the Nalcor website, and a press release issued by Nalcor. A letter regarding the open house was also sent by Nalcor to Innu Nation on April 19, 2011.

The Sheshatshiu open house was held at the Sheshatshiu Innu School on June 2, 2011, from 4 to 8 pm. Upon arrival, participants were welcomed by a Project team member who provided an overview of the open house session. There were a total of six information stations, a sign-in table, feedback table, and refreshment table. At least one Nalcor representative was present at each station to answer questions and gather feedback from participants. Before leaving, participants were encouraged to fill out a feedback form.

The six information stations were as follows:

- Station one provided a corporate overview of Nalcor and included information about its five lines of business, vision, values and goals. Take-away material included a corporate brochure.
- Station two provided information about the proposed Project and the Lower Churchill Hydroelectric Generation Project. Take-away material included maps and fact sheets on the projects, and employment and business opportunities.
- Station three provided information about the EA processes and the individual EA reviews for the two projects. Take away material included information sheets on the EA and environmental studies.
- Station four provided information about potential employment and business opportunities.

- Station five provided fact sheets on the Holyrood Thermal Generating Station, electricity rates and demand, and a Nalcor video.
- Station six included models of the projects and their associated components.

Nine people attended the Sheshatshiu open house. Questions and issues raised include the following:

- the need for early training to ensure Innu have access to skilled labour positions and job mobility after construction;
- Nalcor needs to ensure that Innu are aware of employment opportunities so they can take advantage of benefits;
- elders are concerned about destruction of plants and wildlife and that the IBA may only benefit certain people;
- concern that the Project will draw labour from local businesses that cannot compete with Project wages; and
- concern that money made from working on the Project may increase drug and alcohol consumption.

7.2.1.3 Environmental and Engineering Issues and Studies

Under the Process Agreements, a Task Force comprised of representatives from Nalcor and Innu Nation was put into place to facilitate Innu involvement in the planning, conduct and review of environmental and engineering work for the projects.

This technical committee included the participation of Nalcor's environmental and engineering personnel, as well as a technical advisor and Innu community representatives hired by Innu Nation. Resources were also provided for Innu Nation to engage additional technical and expert advice on these matters, as required. A key role of the Innu community representative on the Task Force was to consult with the Innu communities on the environmental and engineering studies and environmental assessment (EA), and to bring this information forward to the Task Force.

Through the Task Force, Nalcor provided regular project updates and briefings, and consulted with Innu Nation in the design, implementation and review of the associated environmental baseline studies and the engineering programs. The Task Force met regularly from 2005-2008 and exchanged significant amounts of project information on a continuous basis through teleconferences, email, a file transfer protocol (ftp) site and other mechanisms. Through these mechanisms, Innu Nation was able to receive and review the following: technical specifications for planned and ongoing environmental and engineering studies; regular updates on the status of this work while it was in progress; as well as draft and final reports associated with these studies.

Aboriginal traditional and community knowledge is recognized as assisting in understanding matters such as: ecosystem functions; resource abundance, distribution and quality; social and economic well-being; and, use of the land resources. The Task Force also provided a forum for Nalcor and Innu Nation to discuss Innu Traditional Knowledge (ITK). The eventual result of these discussions was the development and implementation of an Innu-led process to document and share ITK for the EAs, based on an approach and methodology proposed by Innu Nation. An Innu Traditional Knowledge Committee (ITKC) was established under 2006 and 2007 Process Agreements, as an adjunct to the Task Force. The role and purpose of the ITKC was to discuss, document and share ITK for consideration in the projects' EAs. The ITKC was comprised of Innu Elders and a Researcher / Facilitator, and was in place until April 2007. The ITK documented through this process was provided by Innu Nation to the Task Force for discussion, and as relevant and appropriate, incorporated into the EAs, according to an ITK Protocol developed by Nalcor and Innu Nation.

Nalcor subsequently offered to re-establish the ITKC under a Process Agreement in 2008 in order to undertake a similar ITK gathering exercise for the Project and its EA. Innu Nation subsequently responded that the original ITK Report (discussed above) was equally applicable to the Project and, thus, any reestablishment of the ITKC would be unnecessary. The ITK gathered and documented through the ITKC process that is relevant to this Project and its EA has been incorporated throughout the EIS.

Innu Nation, as copyright owner of the Innu Environmental Knowledge of the Mishta-shipu (Churchill River) Area of Labrador in Relation to the Proposed Lower Churchill Project (ITKC Report) has granted Nalcor a non-exclusive royalty-free licence to use the ITKC Report or extracts there from in this EIS, on condition that the full report is contained as an Appendix to the EIS. The ITKC Report is included as Appendix 10-1 in the EIS. Nalcor acknowledges that Innu Nation's giving of this licence shall not be interpreted as concurrence with Nalcor's interpretation of the information in the ITKC Report as contained in the EIS. This licence was granted at the request of Nalcor.

In 2009, Nalcor and Innu Nation also worked together under an MOU, which provided for Innu Nation's continued involvement in the early planning and review of the Project's environmental and technical studies.

7.2.2 Summary of Project-Related Consultation Activities with the Labrador Innu

A summary of the various Innu consultation initiatives related to this Project is provided in Table 7.2.2-1. The table also highlights key questions and issues identified through these activities, and where these are addressed in this EIS.

Table 7.2.2-1 Consultations with Innu Nation and Key Outcomes

Date	Location	Number of Participants[(a)]	Purpose and Focus[(b)]
July 13, 2006	St. John's, Newfoundland and Labrador (NL)	2	Discussion of planned historic resources study for the Project and EA
August 28 to 30, 2006	Happy Valley-Goose Bay, NL	5	Discussion of historic resource study for the transmission line corridor for Labrador
January 16, 2007	Natuashish, NL	36	Community consultation, included discussion about the Project
May 25, 2007	Teleconference	2	Discussion of transmission line corridor selection and electrodes
May 30 and 31, 2007	Happy Valley-Goose Bay, NL	1	Discussion of engineering and environmental studies related to transmission, specifically corridor selection and alternatives
June 15, 2007	Teleconference	1	Discussion of corridor selection for the transmission line, and other engineering and environmental studies for the Project
July 16, 2007	Happy Valley-Goose Bay, NL	3	Discussion of electrode engineering studies
August 28 and 29, 2007	St. John's, NL	2	Discussion of engineering and environmental study reports
October 18 and 19, 2007	St. John's, NL and teleconference	2	Discussion of transmission corridor selection and the planning of environmental and engineering studies
November 21, 2007	St. John's, NL	2	Discussion of the Labrador electrode and transmission line study areas

Table 7.2.2-1 Consultations with Innu Nation and Key Outcomes (continued)

Date	Location	Number of Participants[(a)]	Purpose and Focus[(b)]
December 19, 2007	St. John's, NL	3	Discussion of transmission line constraints mapping and eventual route selection
January 22, 2008	Teleconference	2	Discussion of transmission line route selection and infrastructure, and ongoing engineering reports
February 13 and 14, 2008	Sheshatshiu, NL and Happy Valley-Goose Bay, NL	5	Discussion of Innu Nation land use within the transmission line study areas
April 23 and 24, 2008	Sheshatshiu, NL and Happy Valley-Goose Bay, NL	5	Discussion of intent to register the Project for EA, the 2008 environmental and engineering studies, and infrastructure for the transmission line
July 8, 2008	Teleconference	4	Presentation of an update on the Project, the environmental baseline studies and EA
February 11, 2009	Sheshatshiu, NL	5	Presentation and discussion of the Project and the environmental baseline studies and EA
July 22, 2009	St. John's, NL and teleconference	3	Presentation and update on the Project and the environmental baseline studies and EA
December 9, 2009	Sheshatshiu, NL	29	Presentation and discussion of Historic Resources Study to Innu Elders by Nalcor Archaeologists
February 16, 2010	St. John's, NL	13	Initialling of the IBA and the Upper Churchill Redress Agreement
June 28, 2010	Conference Call	3	Discussion of Innu Land Use Study
June 29, 2010	Sheshatshiu, NL	34	Presentation and discussion of the Lower Churchill Hydroelectric Generation Project and the Transmission Link
July 9, 2010	Conference Call	2	Discussion of Innu Land Use Study
July 30, 2010	Conference call	3	Discussion of Innu Land Use Study
August 13, 2010	Conference call	3	Discussing draft workplan and data collection guide for Innu Land Use Study jointly developed by Innu Nation and Nalcor
November 3, 2010	Happy Valley-Goose Bay, NL	3	Discussion of information-sharing protocols
November 10, 2010	Conference call	3	Discussion of information sharing and environmental permit review process
June 2, 2011	Sheshatshiu, NL	9	Open House Meeting (see above)
October 6, 2011	St. John's, NL	3	Provide further detail on the archaeological field work at Muskrat Falls
November 18, 2011	Natuashish, NL	Approximately 100	Signing of the IBA

Table 7.2.2-1 Consultations with Innu Nation and Key Outcomes (continued)

Key Questions and Issues Raised	EIS Section
Need for an EIS level review, allowing consideration of alternatives, evaluation of proposed mitigation measures and the development of monitoring programs	Chapter 1 intro, 2.5, 9.3.8, 9.4.6, 11.3, 12.6, 13.4, 14.5, 16.9
Proposed transmission corridor crossings of the Kenamu River	13.2.1.1
Kenamu River's potential eco-tourism development may be affected	NIS[(c)]
Innu traditional use of the Kenamu River, and the transmission line's potential effect on Atlantic salmon	16.5.5.5, 16.5.6.4
Need to consider an alternative routing south of the Kenamu[(d)]	2.11.2
Electromagnetic radiation and its potential environmental effects	3.5.3.1, 3.5.3.2, 14.2.6.5, 14.2.7, 16.3.6.5 and 16.3.6.6
Herbicide use and its potential effects on the quality and abundance of food plants such as berries	16.3.6.5
Potential that transmission corridor may encourage more non-Innu trapping in previously remote areas	16.5.6.3
Historic Resources studies should contain sufficient Innu traditional knowledge, especially as they are not prepared by Innu	16.2.5.1
Attitudes and perceptions about land use studies, and the need to ensure that the Innu feel that their input is valued, and how participating will benefit them	16.3.3.1, 16.4.10, 16.5.3.1, 16.5.4.1, 16.5.5.1, 16.5.5.5, 16.5.6.4, 16.9.1 and Table 16.9.1-1
Potential effect of the Project on the Red Wine caribou herd	12.3.5.3, 12.3.6.3
Concerns about potential workplace discrimination	16.4.5.1
Importance of consultation early in the EA process, and that meetings are held in the community, but not scheduled at the same time as other activities	7.1
Concerns that sometimes those who receive training do not get jobs, including lack of jobs for Innu after Project Construction has ended	16.4.5.1
Requirement for full compliance with environmental regulations, and that the proponent and contractors be accountable for ensuring such compliance	3.4, 3.5, 3.6 and Table3-1.1 in Appendix 3-1

(a) Does not include Nalcor participants.

(b) Some meetings included discussion of both the proposed Project and the Lower Churchill Hydroelectric Generation Project, and possibly other projects and issues. The above focuses on content that is related directly to the Project.

(c) NIS – Not in scope. Consideration of the issue raised is outside the scope of the Project.

(d) EIS may not reference the location directly, but provides rationale for route selection.

7.3 Québec Innu and Naskapi

There are 11 Innu communities and one Naskapi community in Québec. The land claim areas of several of these First Nations extend into Labrador, although these have not been accepted for negotiation by the Government of Newfoundland and Labrador.

To date, Nalcor has been engaged in consultation activities with six Québec Innu communities and one Québec Naskapi community in order to provide information on the Project, and to attempt to identify and discuss the nature of any associated interests and issues. The following lists the seven Québec Aboriginal groups that have been consulted to date regarding the Project:

- Pakua Shipi (Saint- Augustin);
- Unamen Shipu (La Romaine);
- Nutashkuan (Natashquan);
- Ekuanitshit (Mingan);
- Uashat mak Mani-Utenam (Sept-Îles);
- Matimekush-Lac John (Schefferville); and
- Kawawachikamach (Naskapi community).

Consultation and information sharing initiatives have varied between groups, as discussed above, based on their respective locations, nature and level of their interests, and their responses. Consultation for the purposes of issue scoping and gathering of Aboriginal Ecological Knowledge, has included face-to-face meetings, written correspondence, the provision of Project-related information (including brochures and fact-sheets prepared specifically for this purpose and translated into French), and / or the negotiation and implementation of proposed community engagement agreements through various meetings, conference calls, telephone calls and emails. Sources of Aboriginal Ecological Knowledge include, but are not limited to, land use surveys and interviews, reviews of existing published and unpublished literature, and through the provision of information to Nalcor by an Aboriginal group.

7.3.1 Proposed Aboriginal Engagement Agreements and Other Initiatives (2009)

The purpose of the proposed 2009 Community Engagement Agreements was to establish a collaborative and cooperative framework, supported by funding, for the exchange of Project-related information between Nalcor and each relevant Aboriginal group. This was intended to help identify any questions and concerns about the projects and potential effects, for consideration in project planning and EA, and to gather additional information on current land use activities and any relevant traditional knowledge. Nalcor recognizes that populations living in proximity to the Project may have traditional and community knowledge which could be incorporated into the assessment of the effects of the Project, and their mitigation. Aboriginal traditional and community knowledge of the existing environment will be incorporated into the EIS, to the extent that the information is available to Nalcor. The associated workplan would see both parties working jointly in the community to understand and address issues and concerns the community may have regarding the projects.

Nalcor's originally proposed Aboriginal community engagement agreements pertained to both the Project and Lower Churchill Hydroelectric Generation Project, in order to help optimize consultation efficiency and to reduce overall demands on the Aboriginal communities and their resources. It was intended, however, that the nature, level and focus of the associated consultation with each group on each project would vary, based on a group's particular interests, location and activities in relation to the transmission and / or generation projects. Given the relatively advanced stage of the Lower Churchill Generation Project's EA at the time, discussions and activities related to these initial agreements (where concluded) focussed primarily on that project.

In May 2009, several groups (i.e., Pakua Shipi, Unamen Shipu, Nutashkuan, Ekuanitshit, Uashat mak Mani-Utenam, Matimekush-Lac John) were provided with a copy of Nalcor's proposed Aboriginal community engagement agreement, and were invited to review the draft agreement to indicate their response to the terms of the agreement.

Almost a year after the initial proposal was tabled, and despite extensive efforts by Nalcor, an agreement was successfully finalized with the community of Pakua Shipu on April 29, 2010. The Parties developed a jointly agreed upon workplan and work scope for the exchange of Project-related information, identification of community concerns and the collection of contemporary land use information.A second agreement was also signed with representatives of Unamen Shipu on June 17, 2011, allowing for the exchanges of Project information and the collection of land and resource use data. Consultation activities and data collection under that agreement remains in progress. Regardless of the outcome of discussions and negotiations of agreements with these Aboriginal communities, Nalcor has continued to attempt to engage in consultation activities related to the Project with the communities of Nutashkuan, Ekuanitshit, Uashat mak Mani-Utenam and Matimekush-Lac John through meetings, conference calls, phone calls and emails.

In addition, although there was no formalized consultation agreement put in place with Naskapi Nation of Kawawachikamach, Nalcor has and will continue to provide this community with Project-related information and opportunities to identify any interests, issues and concerns.

7.3.2 Proposed Aboriginal Engagement Agreements and Other Initiatives (2010 and 2011)

In 2010, Nalcor moved forward with planning and attempting to carry out an Aboriginal consultation program focussed specifically on the proposed Project and its EA.

The continued consultation has sought to negotiate consultation agreements so as to identify issues and concerns and to continue to collect land use information. In January 2011, a second phase of the above-described Community Engagement Agreement was signed with the Innu of Pakua Shipu, with the objective of continuing consultation with a focus on the Project. Under this agreement, additional information is being collected on potential Project-related issues and concerns, and on any land and resource use in or near the proposed transmission corridors and associated traditional knowledge.

On June 17, 2011, an agreement was signed with representatives of Unamen Shipu allowing for the exchanges of Project information and the collection of land and resource use data. Consultation activities and data collection under that agreement remains in progress.

While formal consultation agreements have not been pursued with the remaining Québec Innu communities or with Naskapi Nation of Kawawachikamach, Nalcor continues to engage in (or offer) consultation with these groups respecting the Project through the provision of information and, with the agreement of the community, through workshops and community meetings to identify any interests and particular issues and concerns.

7.3.3 Summary of Project-Related Consultation Activities with Québec Innu and Naskapi Communities

A summary of the specific consultation initiatives are provided in Table 7.3.3-1, as well as an overview of the key questions and issues raised and where these are addressed in this EIS.

Table 7.3.3-1 Consultations with Québec Innu and Naskapi Communities and Key Outcomes

Date	Location and Group	Number of Participants[(a)]	Purpose and Focus[(b)]
October 22, 2008	Nutashkuan, Québec (QC)	15	Discussion of the Project and its EA, including the transmission of power from Labrador to the Island
January 12, 2009	Uashat, QC (Uashat mak Mani-Utenam)	30	Discussion of the Project and its EA
January 15, 2009	Pakua Shipi, QC (Pakua Shipi)	5	Presentation and discussion of the Project and the EA process
January 16, 2009	Unamen Shipu, QC (Unamen Shipu)	5	Presentation and discussion of the Project and the EA process
June 1, 2009	Ekuanitshit, QC (Ekuanitshit)	6	Discussion of Project and associated issues, including the transmission of power from Labrador to the Island, and a potential consultation agreement
August 6, 2009	Québec City, QC (Nutashkuan)	3	Presentation and discussion of the Project and a potential consultation agreement
January 26, 2010	Québec City, QC (Nutashkuan)	4	Discussion of a potential consultation agreement
January 27, 2010	Québec City, QC (Ekuanitshit)	4	Discussion of a potential consultation agreement
January 27, 2010	Québec City, QC (Pakua Shipi)	3	Discussion of a potential consultation agreement
January 29, 2010	Québec City, QC (Unamen Shipu)	10	Discussion of a potential consultation agreement
March 24, 2010	St. John's, NL (Unamen Shipu)	5	Discussion of a potential consultation agreement
April 26, 2010	St. John's, NL (Pakua Shipi)	3	Signing of Community Engagement Agreement
May 5, 2010	Montréal, QC (Pakua Shipi)	2	Discussion of the workplan associated with the Community Engagement Agreement
June 10, 2010	Pakua Shipi, QC (Pakua Shipi)	1	Discussion of the interview guide for the land and resource use study and execution of the workplan
June 14, 2010	Pakua Shipi, QC (Pakua Shipi)	1	Discussion of roles and responsibilities of the Community Coordinator
June 14, 2010	Pakua Shipi, QC (Pakua Shipi)	2	Discussion of land and resource use studies and interview guide
June 15, 2010	Pakua Shipi, QC (Pakua Shipi)	6	Discussion of the Community Engagement Agreement and the associated land use study
June 16, 2010	Pakua Shipi, QC (Pakua Shipi)	3	Discussion of land use study methodology and interview guide
June 29, 2010	Pakua Shipi, QC (Pakua Shipi)	2	Discussion of land use interview methodology and data analysis
June 29 to July 13, 2010	Pakua Shipi, QC (Pakua Shipi)	22	Conducted interviews with 21 individuals in the community for the land use study, and discussion of study report preparation

Table 7.3.3-1 Consultations with Québec Innu and Naskapi Communities and Key Outcomes (continued)

Date	Location and Group	Number of Participants[(a)]	Purpose and Focus[(b)]
July 21 to 29, 2010	St. John's, NL (Pakua Shipi)	1	Series of meetings to compile notes from interviews and begin to prepare a report presenting interview results to the community of Pakua Shipi
September 13, 2010	Ekuanitshit, QC (Ekuanitshit)	8	Executive briefing, Project description and discussion
October 12, 2010	Pakua Shipi, QC (Pakua Shipi)	1	Discussion of progress of the Community Engagement Agreement and deliverables
October 13, 2010	Pakua Shipi, QC (Pakua Shipi)	5	Discussion of presentation of interview results to community, as well as next steps
October 13, 2010	Pakua Shipi, QC (Pakua Shipi)	1	Discussion of logistics for the community meeting to be held in October 2010. Also discussed the data authentication process to validate the data collected during interviews with community members
October 14, 2010	Pakua Shipi, QC (Pakua Shipi)	2	Further interviews with community members who are hunting on the land
October 25, 2010	Pakua Shipi, QC (Pakua Shipi)	1	Description of the Project, the EA process and the role of the Community Consultation Coordinator
October 25, 2010	Pakua Shipi, QC (Pakua Shipi)	4	Discussion of a Phase II Agreement to carry out further land use study for the Project
October 25, 2010	Pakua Shipi, QC (Pakua Shipi)	12	Presentation and validation of the results of the land use interviews to community members
November 24, 2010	Pakua Shipi, QC (Pakua Shipi)	2	Discussion of the financial details of the Community Engagement Agreement and Phase II of the Agreement
November 24, 2010	Pakua Shipi, QC (Pakua Shipi)	2	Sharing financial details of the Agreement with the co-manager
November 24, 2010	Pakua Shipi, QC (Pakua Shipi)	5	Provided an update on the status of the Community Engagement Agreement and next steps
January 11, 2011	Québec City, QC (Pakua Shipi)	1	Discussion of the Phase I Community Engagement Agreement, including the submission of the final report by Pakua Shipi
February 11, 2011	Québec City, QC (Pakua Shipi)	1	Planning of the Phase II Community Engagement Agreement
February 23, 2011	Pakua Shipi, QC (Pakua Shipi)	6	Executive briefing regarding the Project and the Phase II Community Engagement Agreement
February 23, 2011	Pakua Shipi, QC (Pakua Shipi)	6	Open house to describe and discuss the Project, EA process, environmental studies, and engagement with Aboriginal communities
April 19 to 20, 2011	Pakua Shipi, QC (Pakua Shipi)	3	Planning for the Phase II of the Community Engagement Agreement
May 17 to 18, 2011	Pakua Shipi, QC (Pakua Shipi)	3	Series of meetings held in Pakua Shipi on May 17 to 18, 2011 for execution of Phase II Community Engagement Agreement, including progress of land use interviews

Table 7.3.3-1 Consultations with Québec Innu and Naskapi Communities and Key Outcomes (continued)

Date	Location and Group	Number of Participants[a]	Purpose and Focus[b]
June 17, 2011	St. John's, NL (Unamen Shipu)	3	Signing of Community Engagement Agreement
June 20, 2011	Ekuanitshit, QC (Ekuanitshit)	5	Executive meeting with Band Council regarding the Project and its EA
June 20, 2011	Ekuanitshit, QC (Ekuanitshit)	30	Project presentation to community members of Ekuanitshit
July 12, 2011	Pakua Shipi, QC (Pakua Shipi)	8	Community information session to review preliminary results from land use interviews, provide Project information, and answer any questions from community members
November 4, 2011	Québec City, QC (Unamen Shipu)	4	Implementation of the Community Engagement Agreement
November 14 and 15, 2011	Québec City, QC (Unamen Shipu)	2	Implementation of the Community Engagement Agreement
December 6, 2011	La Romaine, QC (Unamen Shipu)	9	Review of Work Plan for Community Engagement
January 19, 2012	La Romaine, QC (Unamen Shipu)	8	Band Council meeting to discuss the revised work plan and to discuss the forth coming meeting that night
January 19, 2012	La Romaine, QC (Unamen Shipu)	49	Presentation of the Project to the community members

Key Questions and Issues Raised	EIS Section
The transmission line crosses hunting grounds and potential effects on ability to hunt and trap	16.5.5.5, 16.5.6.4
Potential effects of the Project on caribou, particularly on the Red Wine Mountain and the Mealy Mountains Caribou Herds, as well as other wildlife	12.3.5.3, 12.3.6.3, 12.4.5, 12.4.6
Potential effects of the Project on traditional activities, particularly on access, hunting, trapping and fishing	16.5.5.5, 16.5.6.4
Potential effect of Project employment on ability to go into the woods to make a living through hunting, trapping and fishing	16.5
Potential effects of the installation of subsea cables in the Strait of Belle Isle on salmon, which migrate through the Strait	14.2.6.5, 14.2.7
Concern about the use of pesticides and their potential effects on wildlife and berries and the associated potential human health effects	16.3.6.5
Whether the access trails used for construction of the transmission line will be preserved and accessible to the public	3.4.6.2
Desire for meaningful consultation	7.1
Project-related information should be provided in Innu-aimun	Plain Language Summary
Concerned that various Innu groups are being treated differently	7.1
Comment that regardless of whether Nalcor is reducing or mitigating environmental effects, there will still be some effects on the environment	1.3, Chapter 17, Table 17.5-1
Potential for community economic benefits if people cannot work in Labrador	16.4.5.1, 16.4.10
Desire for an IBA, as the transmission lines go through their territory and land claims areas	7.3

Table 7.3.3-1 Consultations with Québec Innu and Naskapi Communities and Key Outcomes (continued)

Key Questions and Issues Raised	EIS Section
The eventual use of wood from the clearing of the right-of-way (ROW)	12.2.5.8
Interest in employment and business opportunities	16.4.1 and 16.4.5.4
Desire to see the transmission line follow the Trans-Labrador Highway (TLH) all the way to the Strait of Belle Isle instead of cutting through the in-land territory	2.11.2
Alternative transmission corridors and their consideration	2.11.2, 2.12.6,
Consideration of other, potentially more environmentally friendly energy alternatives such as wind or solar	2.5
EA approach for the Project	1.3, Chapter 9
Need to ensure that if the Project is approved and proceeds, all the commitments made are implemented and enforced	NIS[(c)]
Potential dangers of subsea cables on marine and human life	14.2.6.5, 14.3.6, 16.3.6.4
Potential effects on climate change	11.2.5.3, 11.2.6.3, 11.2.7
Potential effects on medicinal plants	16.5.5.5, 16.5.6.4
Lack of financial resources to use the territory	NIS[(c)]
Potential for environmental degradation affecting animals, plants, and water bodies	Chapters 11 to 14; 17.6.1, 17.6.2
Concern for community health issues and the need for sources of revenue to improve access to health services	15.3.6.7, 16.3.5.6, 16.3.5.7, 16.3.6.5, 16.3.6.6, 16.3.7.1, Table 16.3.7-1
Concern that significant traditional knowledge of the environment will not be considered in the environmental evaluation process	7.1, 9.5.3, Chapters 11 to 14, Chapter 16, 16.10
Unsure of the need for more electricity and what markets would be supplied	2.2, 2.3
Would like to negotiate compensation or special programs	7.1

(a) Does not include Nalcor participants.

(b) Some meetings included discussion of both the proposed Project and the Lower Churchill Hydroelectric Generation Project, and possibly other projects and issues. The above focuses on content that is related directly to the Project.

(c) NIS – Not in scope. Consideration of the issue raised is outside the scope of the Project..

7.4 Labrador Inuit

The Inuit of Labrador are an arctic-adapted people who migrated across the Canadian Arctic from Alaska and reached Labrador in approximately AD 1300. By the late eighteenth century the Inuit had established themselves along portions of the Labrador coast. The Inuit were a mobile people, but their harvesting efforts focused on the sea. As Europeans settled the Labrador coast, the Labrador Inuit became less mobile and participated increasingly in the fishery and fur trade.

Labrador Inuit are now primarily resident in the north Labrador Inuit communities of Nain, Hopedale, Makkovik, Postville and Rigolet, and in the Central Labrador communities of North West River and Happy Valley-Goose Bay. LILCA, signed by the Labrador Inuit, the Government of Canada and the Province of Newfoundland and Labrador in January 2005, came into effect on December 1 of that year. The Agreement is a modern comprehensive treaty, and sets out the details of land ownership, resource sharing and self-government in the area covered by the Agreement in Northern Labrador. It also resulted in the establishment of the Nunatsiavut Government, which represents the over 6,000 beneficiaries of the Agreement.

Information and documentation supplied by the Labrador Inuit in the course of land claims negotiations and as evidenced in the *Labrador Inuit Land Claims Agreement* does not indicate historical use and occupancy by the Labrador Inuit of the land and resources within the proposed Project area. Although the proposed Project does not cross through or near the land areas covered by the *Labrador Inuit Land Claims Agreement*, Nalcor has met with the Nunatsiavut Government and other Inuit organizations and individuals in order to provide Project information and receive and consider Inuit views on the Project and its potential environmental effects and benefits.

An open house was also held by Nalcor on May 31, 2011, in the Labrador Inuit community of Hopedale. Prior to the open house session, public notification activities included newspaper advertisements, public notices, and direct invitations. This included advertisements in The Labradorian and The Northern Pen newspapers on May 23 and 30, 2011, as well as radio advertisements, direct distribution of public notices and its posting on the Nalcor website, and a press release issued by Nalcor.

The open house took place at the Amos Comenius Memorial School in Hopedale from 4:30 to 8 pm. Upon arrival, participants were welcomed by a Project team member who provided an overview of the open house session. There were a total of six information stations, a sign-in table, feedback table, and refreshment table, similar to the Sheshatshiu open house session (Section 7.2.1.2). A total of 29 people attended the Hopedale open house.

A summary of the consultation initiatives undertaken to date with the Labrador Inuit (Nunatsiavut Government, Inuit Community Governments and Corporations) is provided in Table 7.4-1, as is an overview of the key questions and issues raised and an indication of where these are addressed in this EIS.

Table 7.4-1 Consultations with the Labrador Inuit and Key Outcomes

Date	Location	Number of Participants[(a)]	Purpose and Focus[(b)]
April 11, 2008	Happy Valley-Goose Bay, NL	3	General discussion of the Project
May 14, 2008	St. John's, NL	3+	General discussion of the Project, the EA process, and energy markets
September 16, 2008	Rigolet, NL	5	General discussion of the Project
February 12, 2009	Happy Valley-Goose Bay, NL	1	Presentation and discussion of the Project, environmental baseline studies and the EA process
December 16, 2009	St. John's, NL	1	Presentation and discussion of the Project, environmental baseline studies and the EA process
July 21, 2010	Rigolet, NL	5	General discussion of the Project
May 31, 2011	Hopedale, NL	29	Open House Meeting (see above)

Key Questions and Issues Raised	EIS Section
Electricity needs of Labrador Inuit communities	
The need for further details on the Project description (e.g., towers, ROW, electrodes, construction methods)	Chapter 3
Overall rationale for the Project and the need to consider effects and benefits together for this development	Chapter 2
Perceived knowledge gap with respect to baseline information for Lake Melville and potential role of Inuit knowledge	7.1, 9.5.5

(a) Does not include Nalcor participants.

(b) Some meetings included discussion of both the proposed Project and the Lower Churchill Hydroelectric Generation Project, and possibly other projects and issues. The above focuses on content that is related directly to the Project.

7.5 NunatuKavut Community Council

The Labrador Metis Association was established in 1985, and renamed the Labrador Métis Nation (LMN) in 1998. The organization was again recently renamed the NunatuKavut Community Council (NCC) in February 2010. NCC reports a membership of over 6,000 members, who reside primarily in Central Labrador and along its southeastern coast. NCC members have asserted a land claim that covers much of Labrador, but this has not been accepted for negotiation by the Governments of Canada and Newfoundland and Labrador.

Nalcor's consultation activities with NCC for the purpose of issue scoping and gathering Aboriginal Traditional Knowledge has included a number of initiatives over recent years, including written correspondence, meetings with NCC representatives, the provision of information packages and other data, Project presentations and updates, and ongoing discussions and information exchange by telephone, email and through other means. Sources of Aboriginal Ecological Knowledge collected from NCC include, but are not limited to, land use surveys and interviews, reviews of existing published and unpublished literature, and through the provision of information to Nalcor by NCC.

7.5.1 Community Engagement Agreements

After several years of consultation efforts and associated discussions and negotiations between Nalcor and the NCC, a formal consultation agreement was signed between the Parties in December 2009.

As noted previously, Nalcor's originally proposed Aboriginal community engagement agreements pertained to both the Project and Lower Churchill Hydroelectric Generation Project, in order to help optimize consultation efficiency and to reduce overall demands on the communities and their resources. Given the relatively advanced stage of the Lower Churchill Generation Project's EA at the time, discussions and activities related to these initial agreements (where concluded) focussed primarily on that project. The outcome of the December 2009 agreement between Nalcor and NCC was a report to Nalcor which generally outlined some of NCC members' perspectives and concerns regarding the proposed projects. This Agreement expired on March 31, 2010.

Following the conclusion of the 2009-2010 agreement, negotiations to enter into a Phase II agreement focussed on the Project commenced in March 2010. In January 2011, that agreement was signed between NCC and Nalcor, to provide further Project information, and to gather additional information on the questions and concerns of NCC members regarding the Project and its potential effects, as well as on NCC land use activities and knowledge, recognizing that populations living in proximity to the Project may have substantial and distinct knowledge which may be relevant to the Project and its EA.

Under the 2011 Agreement, Nalcor personnel have provided Project information, and have travelled with NCC representatives to 10 Labrador communities where many of the NCC membership reside, in order to provide Project information through presentations at community meetings. In addition, approximately 150 surveys have been conducted with NCC members to identify Project-related issues and questions, and a further 30 land use interviews have been conducted. A draft version of the "Contemporary Land and Sea Uses" report was received by Nalcor on December 16, 2011. The information and data obtained by Nalcor as a result of this agreement has been incorporated into this EIS.

7.5.2 Summary of Project-Related Consultation Activities with NunatuKavut Community Council

A summary of consultation initiatives with NCC to date is provided in Table 7.5.2-1, as well as an overview of the key questions and issues raised and where these are addressed in this EIS.

Table 7.5.2-1 Consultations with NunatuKavut Community Council and Key Outcomes

Date	Location	Number of Participants[(a)]	Purpose and Focus[(b)]
April 17, 2007	Happy Valley-Goose Bay, NL	3	General discussion of the Project and the EA process
February 26, 2008	Happy Valley-Goose Bay, NL	5	Discussion of various issues, including the transmission of power from Labrador to the Island
July 31, 2008	Happy Valley-Goose Bay, NL	4	Discussion of consultation and next steps
April 7, 2009	Happy Valley-Goose Bay, NL	1	Discussion of the electrode components of the Project
April 23, 2009	Happy Valley-Goose Bay, NL	1	Discussion of potential consultation agreement
June 11, 2009	St. John's	1	Discussion of potential consultation agreement
July 2, 2009	Conference Call	3	Discussion of potential consultation agreement
November 5, 2009	St. John's, NL	2	Discussion of potential consultation agreement
December 10, 2009	Happy Valley-Goose Bay, NL	4	Discussion of the workplan and budget associated with the consultation agreement, resulting in the initialling of the agreement
December 11, 2009	St. John's, NL	1	Signing of the consultation agreement.
January 20, 2010	St. John's, NL	3	Discussion and development of a work plan associated with the consultation agreement
January 26, 2010	Happy Valley-Goose Bay, NL	3	Information meeting regarding the Lower Churchill Hydroelectric Generation Project and the Labrador-Island Transmission Link
February 28, 2010	L'Anse au Clair, NL	80	Presentation at NCC Annual General Meeting
March 1, 2010	Charlottetown, NL	80	Information meeting regarding the Lower Churchill Hydroelectric Generation Project and the Labrador-Island Transmission Link
March 2, 2010	Port Hope Simpson, NL	6	Information meeting regarding the Lower Churchill Hydroelectric Generation Project and the Labrador-Island Transmission Link
March 2, 2010	Happy Valley-Goose Bay, NL	50	Information meeting regarding the Lower Churchill Hydroelectric Generation Project and the Labrador-Island Transmission Link
March 2, 2010	Happy Valley-Goose Bay, NL	7	Information meeting regarding the Lower Churchill Hydroelectric Generation Project and the Labrador-Island Transmission Link
March 3, 2010	Cartwright, NL	6	Information meeting regarding the Lower Churchill Hydroelectric Generation Project and the Labrador-Island Transmission Link
March 25, 2010	St. John's, NL	3	Discussion of potential consultation agreement
May 19, 2010	Conference Call	3	Discussion of next steps for consultation

Table 7.5.2-1 Consultations with NunatuKavut Community Council and Key Outcomes (continued)

Date	Location	Number of Participants[(a)]	Purpose and Focus[(b)]
May 25, 2010	Happy Valley-Goose Bay, NL	2	Discussion and presentation of an update on the Labrador – Island Transmission Link and its EA and associated environmental studies
July 30, 2010	St. John's, NL	2	Discussion of consultation next steps
January 19, 2011	Happy Valley-Goose Bay, NL	3	Signing of consultation agreement - Phase II
February 17, 2011	Happy Valley-Goose Bay, NL	5	Draft work plan, interview guide, survey, and map of study area.
February 21, 2011	St. John's, NL	1	Implementation of the Phase II consultation agreement
March 14, 2011	Red Bay, NL	5	Open meeting with NCC membership and general public to discuss Project, EA, environmental studies, questions and issues
March 14, 2011	Forteau, NL	16	Open meeting with NCC membership and general public to discuss Project, EA, environmental studies, questions and issues
March 15, 2011	Mary's Harbour, NL	9	Open meeting with NCC membership and general public to discuss Project, EA, environmental studies, questions and issues
March 15, 2011	St. Lewis (Fox Harbour), NL	9	Open meeting with NCC membership and general public to discuss Project, EA, environmental studies, questions and issues
March 16, 2011	Port Hope Simpson, NL	17	Open meeting with NCC membership and general public to discuss Project, EA, environmental studies, questions and issues
March 17, 2011	Norman Bay, NL	9	Open meeting with NCC membership and general public to discuss Project, EA, environmental studies, questions and issues
March 22, 2011	Charlottetown, NL	23	Open meeting with NCC membership and general public to discuss Project, EA, environmental studies, questions and issues
March 23, 2011	Cartwright, NL	16	Open meeting with NCC membership and general public to discuss Project, EA, environmental studies, questions and issues
March 30 to April 1, 2011	Happy Valley-Goose Bay, NL	5	Workshop on land use study and survey approach and methodology
April 5, 2011	St. John's, NL	4	Meeting to discuss process issues with Agreement Phase II
April 25, 2011	Happy Valley-Goose Bay, NL	14	Open meeting with NCC membership and general public to discuss Project, EA, environmental studies, questions and issues

Table 7.5.2-1 Consultations with NunatuKavut Community Council and Key Outcomes (continued)

Date	Location	Number of Participants[(a)]	Purpose and Focus[(b)]
April 26, 2011	Labrador City, NL	11	Open meeting with NCC membership and general public to discuss Project, EA, environmental studies, questions and issues
May 4, 2011	Mary's Harbour, NL	2	Meeting to discuss process issues with Agreement Phase II

Key Questions and Issues Raised	EIS Section
EA approach, including need for a comprehensive and thorough assessment	1.3, Chapter 9
Electricity requirements of Labrador coastal communities	NIS[(d)]
Potential effects on local trappers as the corridor passes through traditional trapping grounds	16.5.5.5, 16.5.6.4
Need for consultation and traditional knowledge collection, including resources to do so	7.1
Potential effects on the aquatic environment, specifically on "trophy sized" brook trout in Labrador	13.3.5.3, 13.3.6.3, 13.3.5.4, 13.3.6.4
Potential effects on migratory birds	12.5.5, 12.5.6, 14.4.5.3, 14.4.6.3
Possible fragmentation of caribou habitat resulting from transmission line construction	12.3.5, 12.3.6
Potential effect on caribou as a result of predator use of the corridor, including wolves, coyotes and bears	12.3.6.3, 12.3.5.3, 12.3.9, 12.3.7
Cable crossing of Strait of Belle Isle scallop beds and ability of NCC members to harvest scallops in the area	16.6.6.3
Ability of marshy or boggy land in-land to support structures for the power lines	3.4.3.2
Potential for the transmission line to follow Phase 2 and 3 of the TLH instead of building a new road to service / build the lines	3.2, 2.11.2
Potential effects of heavy equipment and herbicide use during construction and maintenance, as the marshes supply the freshwater supply in some of the southern Labrador communities	13.2.5, 13.2.6, 13.2.7
Suggestion that the proposed converter station at Soldiers Pond be located in Labrador	2.11.2, 2.12.2, 3.2
Potential Project-specific and cumulative effects on fish stocks, specifically the spawning grounds of the Alexis / St. Lewis River, which will be close to the transmission corridor[(c)]	13.3.5, 13.3.6, 13.3.7, 13.3.9
The need for Labrador to benefit from large-scale resource developments	2.1, 16.4.5.1
Advanced notice required for meetings so people can attend	3.4.1.1, 7.1, 7.5.1
Potential increased access to fish and mammals	12.3.5, 12.3.6, 12.3.7, 12.4.5, 12.4.6, 12.4.7, 13.3.5, 13.3.6, 13.3.7
Potential increase in poaching	12.3.5.3, 12.3.6.3
Potential increase in marten trapping along the corridor	12.4.5.3
Perceived EMF effects on health, including animal tissues, miscarriages amongst women, leukemia in children, breast cancer, and the disruption of defibrillators	16.3.6.5
Call for equal benefits for all Aboriginal people and groups	7.1, 16.4.5
Potential for the transmission lines to be put underground to minimize any visual effects	16.8.5.1
Potential effects of the Project on Labrador electricity rates	2.8.1

Table 7.5.2-1 Consultations with NunatuKavut Community Council and Key Outcomes (continued)

Key Questions and Issues Raised	EIS Section
The need for the Project to not proceed until there has been a full environmental review and approval	1.3
The nature and rationale for the use of sea electrodes vs. shore electrodes	2.12.5
Potential effects of chemical use in vegetation control along the ROW	16.5.6.4
Perception that Project should wait until it is known whether there is a market for Gull Island power	2.2, 2.3, 2.5.13.3
Potential to import power from the North American grid	2.5.14
Concern about how the business opportunities in the Innu IBA would affect NCC members' ability to bid on Project contracts	16.4.5.1, 16.4.6.3
Access to wood cleared from the transmission line ROW	3.4.3.2, 16.5.5.1, 16.9.1
Ensuring rigorous and unbiased environmental studies for the Project and its EA	1.5
The need for electricity in Labrador to attract economic development. Access to recall power if needed for industry	2.3.1, 2.5.13.2
Potential effects on fisheries due increased siltation in water during the installation of the electrodes	14.2.5, 14.2.7
The need for "clean" energy in today's world	1.1
The potential environmental effects of electro-magnetic fields	3.5.3.2, 14.2.6, 14.2.6, 14.3.6
The need to ensure that all construction sites are cleaned up afterwards	3.4.6.5
The need to have Aboriginal / community environmental monitors in place	7.1
Full explanation of the environmental studies is required	Chapter 10, Chapter 15
Potential effects of an earthquake on the Strait of Belle Isle aspects of the Project	4.10.1
Potential effects of the Strait of Belle Isle cables and the electrode on marine fish	14.2.6.5, 14.2.5.4
Potential Project effects on caribou	12.3.5
Concerns about the effects of the transmission line on berries	16.5.5.5, 16.5.6.4
The need for long-term jobs in the region	16.4.5.4 and 16.4.6.4
Opening of the territory through transmission ROW and access roads	16.5.5.3
Proximity of proposed transmission corridor to float plane landing point at Forteau area, which could affect local chartering business	16.5.5.3
The need for reliable power	1.1, 2.1, 2.2
Potential effects of transmission line passing through communities' drinking water supplies	16.3.6.5, 16.5.5.3
Economic benefits such as funding for roads and healthcare	7.1, 15.3.6.7, 16.4.5.1
Process for placing rock over the Strait of Belle Isle cables and its possible effects on crab and fish such as turbot, halibut and cod, which dwell on the ocean floor	13.4.3.3, 14.2.5
Potential effects of the Project on salmon, trout and char	13.3.5, 13.3.6, 13.3.7
Concern with water levels within rivers decreasing	13.2
Concern there will be an increase in the osprey population putting added pressure on fish resources	12.5.6.5

Table 7.5.2-1 Consultations with NunatuKavut Community Council and Key Outcomes (continued)

Key Questions and Issues Raised	EIS Section
Concern the construction of the ROW will disturb soil along ponds, rivers and lakes affecting the fish	13.2.5, 13.3.5

(a) Does not include Nalcor participants.

(b) Some meetings included discussion of both the proposed Project and the Lower Churchill Hydroelectric Generation Project, and possibly other projects and issues. The above focuses on content that is related directly to the Project.

(c) EIS may not reference the location directly, but provides rationale for route selection.

(d) NIS – Not in scope. Consideration of the issue raised is outside the scope of the Project.

NALCOR ENERGY

LABRADOR-ISLAND TRANSMISSION LINK

ENVIRONMENTAL IMPACT STATEMENT

Chapter 8

Regulatory and Public Consultation and Issues Scoping

April 2012

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Appendix 8-1 Table of Concordance with EIS Guidelines and Scoping Document

LIST OF ACRONYMS

Acronym	Description
%	percent
ac	alternating current
ATV	all-terrain vehicle
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CS	Component Study
EA	Environmental Assessment
EBSA	Ecologically and biologically significant area
EIS	Environmental Impact Statement
EMF	electromagnetic field
EMS	Environmental Management System
EPP	Environmental Protection Plan
HDD	Horizontal Directional Drill
IATNL	International Appalachian Trail Newfoundland and Labrador
ISO	International Organization for Standardization
km	kilometre
LEK	Local Ecological Knowledge
ML/ARD	metal leaching and acid rock drainage
NL	Newfoundland and Labrador
NOC	National Occupation Classification
NS	Nova Scotia
ON	Ontario
Project	Labrador-Island Transmission Link
ROW	right-of-way
SHERP	Safety, Health and Environmental Emergency Response Plan
SSAC	Species Status Advisory Committee
VEC	Valued Environmental Component

8 REGULATORY AND PUBLIC CONSULTATION

Consultation is the cornerstone of the environmental assessment (EA) process, and is a key aspect of the Nalcor Energy (Nalcor) approach to its planning and development activities. Meaningful consultation can take place when the public has a clear understanding of the nature of the Project early in the EA process. Section 2 of the Environmental Impact Statement (EIS) Guidelines recommends the proponent provide up-to-date information, as it becomes available, to the public and especially to communities likely to be affected by the Project; involve the main interested parties in determining how best to deliver the information, the type of information that is required, format and presentation methods and the need for community meetings; and to provide explanations of the results of the EIS in a clear and direct manner to make the issues comprehensible to a wide audience. The consultation and associated issues scoping activities for the Labrador-Island Transmission Link (Project) involving government departments and agencies, stakeholder groups and the general public are based on these guiding principles, and are described and summarized in this chapter.

Nalcor's consultative initiatives have been designed and implemented from both an "*information out*" and an "*information in*" perspective - using various mechanisms to provide interested and potentially affected groups and individuals with information on the Project, allowing them to review and consider this information and formulate their questions and issues, and then giving them the opportunity to provide their perspectives to Nalcor for consideration in Project planning and the EA. A key purpose and objective of Nalcor's consultation program to date has therefore been to identify questions, concerns and issues related to the Project and its potential environmental effects which require consideration in the EIS.

Over the past few years, nearly 100 meetings have been held with regulatory and / or stakeholder organizations. Nalcor held 12 open houses across the province focused specifically on the Labrador-Island Transmission Link EA in 2010 and 2011. In addition, 17 open houses were held across the province in 2011 that provided information on and discussion of the Project. During these consultation activities, questions and issues related to the Project have been identified and recorded, and are summarized in this chapter.

The following chapter also highlights the EIS Guidelines and Scoping Document requirements for the EIS, including Project-related information, aspects of the existing biophysical and socioeconomic environments, potential environmental issues and interactions, and other factors.

8.1 Consultation with Government Departments and Agencies

A summary of the Project-related consultation activities involving provincial and / or federal government departments or agencies is provided in Table 8.1-1, with a focus on face-to-face meeting events and associated discussions. This includes information on the specific department or agency consulted, location, number of participants, and the general purpose and focus of each meeting. Nalcor's consultation activities with government departments and agencies have also included extensive discussions and ongoing information sharing through various other means (e.g., letters, email, telephone conversations).

8.2 EIS Guidelines and Scoping Document

In January 2011, the provincial and federal governments issued the *Environmental Impact Statement Draft Guidelines and Scoping Document* (Government of Newfoundland and Labrador and Government of Canada 2011a) for the Project's EA for public review and comment. These were finalized in May 2011 (Government of Newfoundland and Labrador and Government of Canada 2011b) and issued to Nalcor to guide its preparation of the EIS.

The EIS Guidelines and Scoping Document specifies a range of information and issues to be addressed in the EIS, including Project-related information, aspects of the existing biophysical and socioeconomic environments, potential environmental issues and interactions, and other factors. This information is captured in a detailed Table of Concordance is provided in Appendix 8-1.

Table 8.1-1 Meetings with Government Departments and Agencies

Date	Department/Agency	Location	Number of Participants[(a)]	Purpose and Focus
May 27, 2008	Environment Canada, Canadian Wildlife Service	Mount Pearl, Newfoundland and Labrador (NL)	4	Project overview, planning and design of environmental baseline studies for the Project
May 28, 2008	Department of Environment and Conservation, Wildlife Division	Corner Brook, NL	3	Project overview, planning and design of environmental baseline studies for the Project
June 19, 2008	Department of Tourism, Culture and Recreation, Provincial Archaeology Office	St. John's, NL	1	Project overview, planning and design of historic resources studies for the Project
June 20, 2008	Fisheries and Oceans Canada	St. John's, NL	5	Project overview, planning and design of freshwater fish and fish habitat, and water resources study for the Project
June 27, 2008	Fisheries and Oceans Canada	St. John's, NL	5	Planning and design of marine flora, fauna and habitat studies for the Project
July 15, 2008	Department of Environment and Conservation, Environmental Assessment Division	St. John's, NL	2	Project overview, environmental studies and EA process for the Project
July 17, 2008	Natural Resources Canada, Major Projects Management Office; Fisheries and Oceans Canada; Environment Canada; Transport Canada; Canadian Environmental Assessment Agency; Health Canada; Department of Environment and Conservation, Environmental Assessment Division	Ottawa, Ontario (ON)	17	Project overview, environmental studies and EA process for the Project
July 29, 2008	Transport Canada, Environmental Affairs	St. John's, NL	2	Project overview and Transport Canada's potential regulatory interest in the Project
July 31, 2008	Environment Canada	Mount Pearl, NL	1	Project overview and Environment Canada's potential regulatory interest in the Project
August 21, 2008	Parks Canada	Rocky Harbour, NL	3	Presentation and discussion of the Project and the previously proposed transmission corridor option
August 26, 2008	Fisheries and Oceans Canada	St. John's, NL	2	Project overview and Fisheries and Oceans Canada's potential regulatory interest in the Project

Table 8.1-1 Meetings with Government Departments and Agencies (continued)

Date	Department/Agency	Location	Number of Participants[(a)]	Purpose and Focus
September 15, 2008	Department of Tourism, Culture and Recreation, Provincial Archaeology Office	St. John's, NL	2	Presentation and discussion of the historic and heritage resources pre-fieldwork assessment report and planned field study for the Project
November 6, 2008	Natural Resources Canada, Major Projects Management Office; Fisheries and Oceans Canada; Canadian Environmental Assessment Agency; Transport Canada; Environment Canada; NL Department of Environment and Conservation	Ottawa, ON	13	Project overview, environmental studies and EA process for the Project
December 16, 2008	Parks Canada	Rocky Harbour, NL	4	Presentation and discussion of the Project and the previously proposed transmission corridor option
February 25, 2009	Fisheries and Oceans Canada, Science Branch	St. John's, NL	5	Discussion of planned marine flora, fauna and habitat survey and freshwater fish and fish habitat and water resources study
March 6, 2009	Parks Canada	Halifax, Nova Scotia (NS)	4	Discussion of the Project and the previously proposed transmission corridor option
May 13, 2009	Environmental Assessment Committee (Including represented provincial and federal departments and agencies)	St. John's, NL	16	Project description, environmental baseline studies, and the EA process for the Project
May 14, 2009	Environment Canada, Canadian Wildlife Service	St. John's, NL	4	Presentation and discussion of the Project and Terrestrial Environment baseline studies
June 9 and 10, 2009	Environmental Assessment Committee (Including represented provincial and federal departments and agencies)	Throughout NL	8 (Day 1) and 4 (Day 2)	Aerial and ground survey of portion of the transmission corridor and Strait of Belle Isle cable landing sites
July 21, 2009	Department of Environment and Conservation, Wildlife Division	Corner Brook, NL	14	Project overview and completed and ongoing baseline studies and potential wildlife issues
September 3, 2009	Department of Tourism, Culture and Recreation, Provincial Archaeology Office	St. John's, NL	2	Project overview and completed and ongoing historic and heritage resources baseline studies
September 10, 2009	Canadian Environmental Assessment Agency (Atlantic Region)	Halifax, NS	3	Discussion of and update on the Project and its EA

Table 8.1-1 Meetings with Government Departments and Agencies (continued)

Date	Department/Agency	Location	Number of Participants[(a)]	Purpose and Focus
September 11, 2009	Department of Environment and Conservation, Environmental Assessment Division	St. John's, NL	2	Discussion of and update on the Project and its EA
September 24, 2009	Natural Resources Canada, Major Projects Management Office	Ottawa, ON	4	Discussion of and update on the Project and its EA
September 29, 2009	Labrador Woodland Caribou Recovery Team (including representatives of government departments and Aboriginal groups)	Port Hope Simpson, NL (via teleconference)	14	Project overview and discussion of key issues related to Labrador woodland caribou
December 16, 2009	Department of Environment and Conservation; Department of Labrador and Aboriginal Affairs; Fisheries and Oceans Canada; Transport Canada; Environment Canada; Canadian Environmental Assessment Agency; Natural Resources Canada, Major Projects Management Office	St. John's, NL	11	Project and EA update, and consultation overview with federal and provincial departments and agencies
December 18, 2009	Environment Canada, Canadian Wildlife Service	St. John's, NL	3	Discussion with Environment Canada on its new approach to managing the incidental take of migratory birds
January 27, 2010	Department of Natural Resources	Happy Valley-Goose Bay, NL	3	Project overview and discussion of land use in Central and Southeastern Labrador
February 23, 2010	Trans-Labrador Highway Phase 3 Environmental Management and Planning Consultative Committee (including representatives of government departments and Innu Nation)	St. John's, NL	20	Presentation and discussion of the Project, with specific attention to the transmission corridor in the southeastern region of Labrador and associated land use issues and planning measures
March 2, 2010	Canadian Wildlife Service, Environment Canada – Caribou Recovery Strategy Workshop	Happy Valley-Goose Bay, NL	10	Environment Canada hosted a workshop on the Caribou Recovery Strategy Workshop with participants sharing their knowledge on Labrador boreal caribou, with a focus on threats
March 22, 2010	Canadian Environmental Assessment Agency (Atlantic Region)	Halifax, NS	3	Discussion of status of EA process and associated Aboriginal consultation initiatives

Table 8.1-1 Meetings with Government Departments and Agencies (continued)

Date	Department/Agency	Location	Number of Participants[(a)]	Purpose and Focus
April 5, 2010	Department of Natural Resources	St. John's, NL	2	Project and EA overview, with a discussion of timber resource information, analysis and requirements for the EA
May 27, 2010	Canadian Environmental Assessment Agency (Atlantic Region)	Halifax, NS	3	Project and EA update, and discussion of Aboriginal consultation processes and activities
August 9, 2010	Department of Environment and Conservation	St. John's, NL	4	Project and EA update, and discussion of EA timelines and EIS Component Studies
August 18, 2010	Fisheries and Oceans Canada	St. John's, NL	3	Project and EA update and a discussion of associated marine and freshwater environmental studies
September 2, 2010	Natural Resources Canada, Major Projects Management Office	Ottawa, ON	1	Project and EA update, discussion of timelines, EIS preparation, and Aboriginal consultation
September 27, 2010	Dept of Environment and Conservation, Parks and Natural Areas Division	Deer Lake, NL (via teleconference)	1	Project and EA update, discussion of proposed protected area in the Highlands of St. John
September 29, 2010	Labrador Woodland Caribou Recovery Team	Makkovik, NL (via teleconference)	15	Project overview and discussion of key issues related to Labrador woodland caribou
September 30, 2010	Canadian Environmental Assessment Agency (Atlantic Region)	Halifax, NS	3	Project and EA update, and discussion of associated Aboriginal consultation processes and activities
November 3, 2010	Department of Environment and Conservation, Wildlife Division	Corner Brook, NL	15	Project overview and update on EA and associated studies
November 18, 2010	Canadian Environmental Assessment Agency (Atlantic Region)	Halifax, NS	4	Update on Project description and EA process and associated timelines
November 19, 2010	Fisheries and Oceans Canada	St. John's, NL	7	Update on Project description, particularly its marine components, and ongoing studies and consultation activities
November 23, 2010	Department of Environment and Conservation, Environmental Assessment Division	St. John's, NL	6	Update on Project description and EA process

Table 8.1-1 Meetings with Government Departments and Agencies (continued)

Date	Department/Agency	Location	Number of Participants[(a)]	Purpose and Focus
November 23, 2010	Environment Canada and Transport Canada - NL Region	St. John's, NL	4	Update on Project description and EA process
November 29, 2010	Natural Resources Canada, Major Projects Management Office	Ottawa, ON	1	Update on Project description and EA process and associated timelines
November 30, 2010	Canadian Environmental Assessment Agency	Ottawa, ON	3	Update on Project description and EA process
November 30, 2010	Fisheries and Oceans Canada	Ottawa, ON	2	Update on Project description, particularly its marine components, and ongoing EA and associated consultation activities
January 14, 2011	Department of Environment and Conservation, Parks and Natural Areas Division	Deer Lake, NL	4	Project overview and discussion of transmission corridor with regard to existing parks and protected areas including the Newfoundland T'Railway
January 19, 2011	Department of Labrador and Aboriginal Affairs, Aboriginal Affairs Branch	St. John's, NL	3	Project overview and discussion of Aboriginal consultation initiatives, EIS and component study structure
January 24, 2011	Fisheries and Oceans Canada	St. John's, NL	3	Update on marine project components and the results of 2008-2010 environmental studies, including the regulatory requirements for the marine components
March 8, 2011	Department of Environment and Conservation, Wildlife Division	Corner Brook, NL	3	Project overview and discussion of provincially listed plants
March 10, 2011	Department of National Defence	Happy Valley-Goose Bay, NL	3	Project overview, potential interaction between the Project and Department of National Defence activities in Labrador and associated planning and communications approaches
May 27, 2011	Canadian Environmental Assessment Agency	Halifax, NS	3	Project and EA update, and discussion of Aboriginal consultation process and activities
April 1, 2011	Department of Transportation and Works	L'Anse au Loup, NL	1	Project overview and planned 2011 engineering program
May 25, 2011	Canadian Environmental Assessment Agency (Atlantic Region)	St. John's, NL	1	EA process and EIS structure and planning

Table 8.1-1 Meetings with Government Departments and Agencies (continued)

Date	Department/Agency	Location	Number of Participants[(a)]	Purpose and Focus
June 16, 2011	Canadian Environmental Assessment Agency	Halifax, NS	5	Project and EA process and consultation update
July 20, 2011	NL Wildlife Division	Corner Brook, NL	3	Discussion of Strait of Belle Isle engineering field program and associated listed plant considerations, including 2011 plant surveys
September 6, 2011	Canadian Environmental Assessment Agency (Atlantic Region)	Halifax, NS	5	Project overview and update on EA and associated studies and EIS structure and planning
September 9, 2011	Department of Environment and Conservation	St. John's, NL	3	Project overview and update on EA and associated studies and EIS structure and planning
September 14, 2011	Department of Environment and Conservation	St. John's, NL	1	Project overview and update on EA and associated studies and EIS structure and planning
December 15, 2011	Department of Environment and Conservation Canadian Environmental Assessment Agency (Atlantic Region)	St. John's, NL	4	Project overview and update on EA and associated studies and EIS Structure and planning.

(a) Does not include Nalcor participants.

8.3 Public and Stakeholder Consultation

A variety of methods and materials have been and are being used to provide all interested stakeholders with opportunities to participate in the EA process for the Project. These have included meetings with individual community and stakeholder groups, public meetings and open houses at locations throughout the province. Nalcor's website (*www.nalcorenergy.com)* also provides relevant information on an ongoing basis, and a toll-free telephone number and dedicated email address have also been established and advertised.

The key purpose of these public and stakeholder consultation initiatives has been to present Project information and to identify questions, issues and other perspectives related to the Project and its potential effects (both adverse and positive) for consideration in the EA, and to collect Local Ecological Knowledge on the existing environment for incorporation into the EIS.

During these public and stakeholder consultation activities, Nalcor has made specific efforts to gather and document information and knowledge from local residents and others on the existing biophysical and socioeconomic environments. This information is presented in Chapters 10 and 15 of this EIS, as relevant.

8.3.1 Stakeholder Consultation Activities

A summary of Project-related consultation initiatives involving the public and stakeholders, including communities, organizations and interest groups, is provided in Table 8.3.1-1. This overview includes the timing, participant(s), location, and purpose and focus of each of these activities.

In addition to the specific meetings and forums listed in the Table 8.3.1-1, Nalcor has also received and responded to Project-related questions and information requests from a number of individuals and organizations by telephone, email and other means. These include the following groups:

- Fish, Food and Allied Workers;
- Four Ponds Outfitting;
- International Appalachian Trail, NL;
- Labrador Straits Development Corporation;
- Labrador Professional Outfitters Association;
- Newfoundland and Labrador Outfitters Association;
- Nordic Economic Development Corporation;
- Parsons Pond Outfitters;
- Portland Creek Hunting and Fishing;
- Protected Areas Association of Newfoundland and Labrador;
- Rack Lake Outfitters;
- Red Ochre Regional Economic Development Board;
- Sierra Club of Canada;
- Southeastern Aurora Development Corporation;
- Town of Daniel's Harbour;
- Town of Forteau;
- Town of North West River;
- Town of Parsons Pond;
- Youth for Environmental Awareness; and
- various interested members of the public.

Table 8.3.1-1 Meetings with Communities, Organizations and Other Interest Groups

Date	Group(s)	Location	Number of Participants[(a)]	Purpose and Focus
February 12, 2009	Central Labrador Environmental Action Network; Grand River Keepers	Happy Valley-Goose Bay, NL	9	Presentation and discussion of the Project, environmental baseline studies and the EA process
February 13, 2009	Newfoundland and Labrador Environment Network; Canadian Parks and Wilderness Society; Northeast Avalon Atlantic Coastal Action Program, Natural History Society; Northeast Avalon Atlantic Coastal Action Program; Protected Areas Association; Newfoundland and Labrador Environmental Industry Association	St. John's, NL	7	Presentation and discussion of the Project, environmental baseline studies and the EA process
March 24, 2009	Newfoundland and Labrador Outfitters Association	St. John's, NL	3	Discussion of the Project, the EA process and potential issues
April 2, 2009	Hospitality Newfoundland and Labrador	Stephenville, NL	12	Presentation and discussion of the Project, environmental baseline studies, the EA process and potential issues
April 8, 2009	Fisheries Advisory Committee, Labrador Straits Development Corporation	L'Anse au Loup, NL	9	Presentation and discussion of the Project, environmental baseline studies, the EA process and potential issues
June 16, 2009	Discovery Regional Development Board and representatives from the Alpine Development Alliance Corporation and the Town of Clarenville	Clarenville, NL	4	Presentation and discussion of the Project, environmental baseline studies and the EA process, and a discussion of potential Project-related benefits and issues
June 16, 2009	Discovery Regional Development Board and representatives of the Towns of Sunnyside, Come By Chance and Arnold's Cove	Arnold's Cove, NL	4	Presentation and discussion of the Project, environmental baseline studies and the EA process, and a discussion of potential Project-related benefits and issues
June 17, 2009	Exploits Valley Economic Development Corporation and representatives from Human Resources Labour and Employment and the Town of Buchans	Grand Falls-Windsor, NL	7	Presentation and discussion of the Project, environmental baseline studies and the EA process, and a discussion of potential Project-related benefits and issues

Table 8.3.1-1 Meetings with Communities, Organizations and Other Interest Groups (continued)

Date	Group(s)	Location	Number of Participants[(a)]	Purpose and Focus
June 17, 2009	Humber Economic Development Board and representatives of the White Bay South Development Association, Pollard's Point Local Service District, Towns of Howley and Reidville, Grand Lake Centre of Economic Development, and the Humber Economic Development Board	Deer Lake, NL	6	Presentation and discussion of the Project, environmental baseline studies and the EA process, and a discussion of potential Project-related benefits and issues
July 7, 2009	Labrador Straits Development Corporation; Towns of L'Anse au Loup, West St. Modeste, L'Anse au Clair; local fishers; Department of Fisheries and Aquaculture	Forteau, NL	9	Discussion of the Project and proposed geotechnical investigations for the Strait of Belle Isle
July 7, 2009	Nordic Economic Development Corporation; Limestone Barrens Habitat Stewardship Program; St. Anthony Basin Research Inc.; Newfoundland and Labrador Wildlife Federation	Flower's Cove, NL	5	Discussion of the Project and proposed geotechnical investigations for the Strait of Belle Isle
July 30, 2009	Town of Conception Bay South	Conception Bay, NL	1	Discussion of the proposed field work pertaining to potential electrode site
August 10, 2009	Town of Conception Bay South	Conception Bay, NL	2	Presentation of an overview of electrode requirements for the Project, and proposed field work
September 25, 2009	Labrador Straits Historical Development Corporation	Forteau, NL	1	Discussion regarding the potential cable landing sites and associated drilling on the Labrador side of the Strait of Belle Isle
September 30, 2009	Cartwright to L'Anse au Clair District Forum (Included participation by several government and private sector organizations)	West St. Modeste, NL	54	Presentation on the proposed Project and the Lower Churchill Hydroelectric Generation Project
October 6, 2009	Parsons Pond Outfitting	Parsons Pond, NL	1	Discussion of the proposed transmission corridor in the Long Range Mountains area and potential caribou and access issues

Table 8.3.1-1 Meetings with Communities, Organizations and Other Interest Groups (continued)

Date	Group(s)	Location	Number of Participants[(a)]	Purpose and Focus
October 6, 2009	International Appalachian Trail Association	Corner Brook, NL	2	Discussion of the proposed transmission corridor in the Long Range Mountains area, and potential visual issues and interaction with the existing and proposed trails
October 13, 2009	Central Labrador Economic Development Board	Happy Valley-Goose Bay, NL	8	Presentation on the Project description, rationale and the EA, and discussion of potential Project-related benefits and issues
October 13, 2009	Town of Happy Valley-Goose Bay	Happy Valley-Goose Bay, NL	9	Presentation on the Project and discussion of potential Project-related benefits and issues
October 14, 2009	Mud Lake Improvement Committee	Mud Lake, NL	4	Project overview and discussion of questions and potential issues
October 14, 2009	Town of North West River	North West River, NL	6	Presentation on the Project description, rationale and the EA, and discussion of potential Project-related benefits and issues
October 15, 2009	Red Ochre Regional Economic Development Board	Deer Lake, NL	8	Presentation on the Project description, rationale and the EA, and discussion of potential Project-related benefits and issues
October 15, 2009	St. Paul's to Bellburns District Advisory Council	Parsons Pond, NL	10	Presentation on the Project description, rationale and the EA, and discussion of potential Project-related benefits and issues
October 20, 2009	Labrador Straits Development Corporation Fisheries Working Group; local fishers; Department of Fisheries and Aquaculture; Fish, Food and Allied Workers	L'Anse au Loup, NL	7	Presentation and discussion of the Project, and specifically the Strait of Belle Isle crossing and potential effects on fish and fisheries
October 22, 2009	Strait of Belle Isle fishers (Island Side): Fish, Food and Allied Workers	Flower's Cove, NL	6	Presentation and discussion of the Project, and specifically the Strait of Belle Isle crossing and potential effects on fish and fisheries
November 18, 2009	Various Northern Peninsula Hunting and Fishing Outfitters	Portland Creek, NL	10	Project overview, rationale for corridor selection through the Long Range Mountains, and discussion of potential effects on outfitters

Table 8.3.1-1 Meetings with Communities, Organizations and Other Interest Groups (continued)

Date	Group(s)	Location	Number of Participants[(a)]	Purpose and Focus
January 19, 2010	International Appalachian Trail Association	Corner Brook, NL	2	Follow up discussion on transmission corridors (preferred and alternative) in the Long Range Mountains area, and potential visual issues and interaction with existing and proposed trails
January 24, 2010	Holyrood Community Liaison Committee	Holyrood, NL	6	Presentation and discussion of the Project, its EA, future of the Holyrood Thermal Generating Facility, and the 2007 Energy Plan
June 24, 2010	Labrador Straits Development Corporation	West St. Modeste, NL	12	Question and Answer session with the Labrador Straits Development Corporation
January 12, 2011	Town of Flower's Cove; Newfoundland and Labrador Rural Secretariat; Flower's Cove Harbour Authority; Sandy Cove Harbour Authority; Department of Innovation, Trade and Rural Development; Nordic Economic Development Corporation; Great Northern Peninsula Joint Council; Fish Food and Allied Workers	Flower's Cove, NL	8	Presentation and discussion of the Strait of Belle Isle cable crossing
January 13, 2011	Labrador Straits Development Corporation; Towns of L'Anse au Clair, West St. Modeste, Red Bay, Forteau, Capstan Island; Fish Food and Allied Workers; Neighbours Without Borders Coalition; Forteau Harbour Authority; Labrador Straits Historical Development Corporation; Riteway Construction Ltd.; Department of Fisheries and Aquaculture; Fisheries and Oceans Canada; Southern Labrador Development Association; local fishers	West St. Modeste, NL	15	Presentation and discussion of the Strait of Belle Isle cable crossing and the proposed shoreline electrode at L'Anse au Diable
February 7, 2011	Forteau Town Council	Forteau, NL	4	Project overview and discussion of infrastructure and economic considerations
February 7, 2011	Labrador Straits Development Corporation	West St. Modeste, NL	55	Presentation at Labrador Straits Development Corporation Annual General Meeting, overview of Project and associated construction activities and economic considerations

Table 8.3.1-1 Meetings with Communities, Organizations and Other Interest Groups (continued)

Date	Group(s)	Location	Number of Participants[(a)]	Purpose and Focus
February 22, 2011	Town of Conception Bay South; Town of Holyrood; Fish Food and Allied Workers; Holyrood Thermal Generating Station; Newfoundland Power	Conception Bay South, NL	6	Presentation and discussion of the Project and the proposed shoreline electrode at Dowden's Point, Conception Bay South
March 7, 2011	Town of Conception Bay South (represented by Tract Consulting)	St. John's, NL	3	Discussion of the proposed shoreline electrode at Dowden's Point, and the Town of Conception Bay South proposed trail system
March 8, 2011	Newfoundland and Labrador Outfitters Association	Corner Brook, NL	1	Overview of the Project and EA process, and questions and concerns regarding outfitters
March 9, 2011	Labrador Professional Outfitters Association	Happy Valley-Goose Bay, NL	1	Overview of the Project and EA process, and questions and concerns regarding outfitters
March 31, 2011	Town of Forteau	Forteau, NL	6	Presentation and discussion of the Project and the planned 2011 engineering field program
April 1, 2011	Labrador Straits Historical Development Corporation	Forteau, NL	1	Presentation of Project overview and 2011 Strait of Belle Isle engineering field program
June 1, 2011	Fish Food and Allied Workers; Newfoundland and Labrador Rural Secretariat; Department of Innovation, Trade and Rural Development; Town of Flower's Cove; Great Northern Peninsula Joint Council; St. Anthony Cold Storage; St. Anthony and Area Chamber of Commerce; Nordic Economic Development Corporation	Flower's Cove, NL	8	An update on the Project and the 2011 Strait of Belle Isle engineering and environmental field programs
June 13, 2011	Labrador Straits Development Corporation	Forteau, NL	5	Overview of the EA process and its application to the Project
June 13, 2011	Labrador Straits Development Corporation; Labrador Adventures; Labrador Straits Historical Development Corporation; L'Anse au Loup Harbour Authority; Southern Labrador Development Association; Representative from the towns of Forteau, L'Anse au Loup, and Capstan Island; Forteau Harbour Authority	L'Anse au Loup, NL	12	An update on the Project and the 2011 Strait of Belle Isle engineering and environmental field programs

Table 8.3.1-1 Meetings with Communities, Organizations and Other Interest Groups (continued)

Date	Group(s)	Location	Number of Participants[(a)]	Purpose and Focus
October 13, 2011	Business community of Happy Valley-Goose Bay	Happy Valley-Goose Bay, NL	23	To provide information on business opportunities generated from the Labrador-Island Transmission Project to the suppliers
October 17, 2011	Business community of St. Johns	St. Johns, NL	>200	To provide information on business opportunities generated from the Labrador-Island Transmission Project to the suppliers
October 18, 2011	Business community of Grand Falls-Windsor	Grand Falls-Windsor, NL	11	To provide information on business opportunities generated from the Labrador-Island Transmission Project to the suppliers
October 21, 2011	Business community of Corner Brook	Corner Brook, NL	24	To provide information on business opportunities generated from the Labrador-Island Transmission Project to the suppliers
October 26, 2011	Business community of Flower's Cove	Flower's Cove, NL	34	To provide information on business opportunities generated from the Labrador-Island Transmission Project to the suppliers
October 27, 2011	Business community of L'Anse au Loup	L'Anse au Loup, NL	19	To provide information on business opportunities generated from the Labrador-Island Transmission Project to the suppliers

(a) Does not include Nalcor participants.

8.3.2 Public Meetings and Open Houses

Nalcor has held a total of 29 public open house sessions related to the Project throughout Newfoundland and Labrador in 2010 and 2011, 12 of which were specific to the Labrador-Island Transmission Link, as well as 17 additional and general sessions that included information and discussion related to both the Labrador-Island Transmission Link and the Lower Churchill Hydroelectric Generation Project.

8.3.2.1 Labrador-Island Transmission Link EA Open Houses – April and May 2010

In April and May 2010, Nalcor held eight open house sessions specific to the Project throughout Newfoundland and Labrador. The purpose of these sessions was to present the Project concept to the public and identify any issues and concerns to be addressed in the EIS. LEK was also captured from participants through verbal and written comments and is incorporated in the EIS, specifically Chapter 10.

This section summarizes the locations of each of these open houses, including date and time, and the number of participants (Table 8.3.2-1). Information on public notifications, open house format, and display material, are also presented. Issues and concerns that were identified during these open houses are included in Section 8.4.

Table 8.3.2-1 EA Open Houses held in April and May 2010

Town	Venue	Date	Time	Number of Participants[(a)]
Clarenville	Clarenville Inn	April 26	4 to 9 pm	10
Grand Falls-Windsor	Royal Canadian Legion	April 27	4 to 9 pm	17
Deer Lake	Deer Lake Motel	April 28	4 to 9 pm	35
Hawke's Bay	Torrent River Inn	April 29	4 to 9 pm	17
Flower's Cove	Lions Club	April 30	4 to 9 pm	30
L'Anse au Loup	Lawrence O'Brien Community Centre	May 1	1 to 6 pm	22
St. John's	Holiday Inn	May 10	4 to 9 pm	59
Happy Valley-Goose Bay	Labrador Friendship Centre	May 11	4 to 9 pm	49

(a) Does not include Nalcor participants.

Public Notification

Prior to the public open house sessions, public notification activities included newspaper advertisements (Table 8.3.2-2), public notices, and invitations, as listed below.

Table 8.3.2-2 Newspaper Advertisements for EA Open Houses held in April and May 2010

Newspaper	Insertion Dates
The Western Star	Saturday April 10, 17, 24
The Telegram	Saturday April 10, 17, 24 and May 1, 8
The Compass – Weekly	April 12-16, April 19 to 23, April 26-30
The Advertiser – Weekly	April 12-16, April 19 to 23, April 26 to 30
The Northern Pen – Weekly	April 12-16, April 19 to 23, April 26 to 30
The Packet – Weekly	April 12-16, April 19 to 23, April 26 to 30
The Labradorian – Weekly	April 12-16, April 19 to 23, April 26 to 30, May 3 to 7

Notices were also sent directly to the following communities and organizations:

- Northeast Avalon Regional Economic Development Board;
- Discovery Regional Development Board;
- Exploits Valley Regional Economic Development Board;
- Humber Regional Economic Development Board;
- RED Ochre Regional Board Inc.;
- Nordic Regional Economic Development Board;
- Labrador Straits Development Corporation;
- Central Labrador Economic Development Board;
- City of St. John's;
- Town of Clarenville;
- Town of Grand Falls-Windsor;
- Town of Deer Lake;
- Town of Hawke's Bay;
- Town of Flower's Cove;
- Town of L'Anse au Loup; and
- Town of Happy Valley-Goose Bay.

Advertisements were also aired province wide on Roger's TV, in partnership with Eastlink, from April 19 to April 25, and Clearview Cable from April 19 to May 2.

A public notice was posted on the Nalcor website at www.nalcorenergy.com and notification of the open houses was sent to all Nalcor employees via email as well as posted on Nalcor's intranet.

Invitations were sent to the mayor of each open house community.

The public notification campaign and open houses resulted in the following media coverage:

- The Western Star published an article "People have the Power" on April 27, 2010. The article was also published in the Nor'Wester on April 29.
- President and Chief Executive Officer, Ed Martin, was interviewed on West Coast Morning-2 (CBY-AM) Corner Brook on April 28, 2010.
- Gilbert Bennett, Vice President - Lower Churchill Project, was interviewed by the Western Star in Deer Lake on April 28, 2010. The article, "Lower Churchill explained at open house" was published in the Western Star on April 29, the Telegram on April 29, and the Georgian on April 30.
- Vice President Gilbert Bennett was interviewed by the Northern Pen. The article, "Nalcor prefers face-to-face approach" was published on May 5, 2010.
- VOCM-AM, St. John's aired an article "Nalcor to host final open house today" on May 11, 2010.
- General public announcements were aired on VOCM throughout the week of April 25 to May 1, 2010.

Open House Format

The format for the open houses was a series of informal drop-in sessions with display stations and take away information sheets. Members of the Project team were available to answer questions, explain the various components of the Project and to receive and record feedback and LEK from the public.

Upon arrival, participants were welcomed by a Nalcor representative who provided an overview of the open house format. There were a total of five information stations, a sign-in table, feedback table, and refreshment table. At least one Project member was located at each station to answer questions and gather feedback from participants. Before leaving, participants were encouraged to fill out a feedback form.

The five information stations were as follows:

- Station one provided a corporate overview of Nalcor and included information about its five lines of business, vision, values and goals. Take-away material included a corporate brochure.
- Station two provided information about the Project purpose and rationale, and employment opportunities. Take-away material included a Project brochure and employment and business opportunities information sheet.
- Station three provided information about Project elements, including converter stations and electrodes, transmission lines, and the Strait of Belle Isle cable crossing. Take-away material included information sheets on electrodes, electromagnetic fields, (EMFs) and an explanation of the transmission study corridor versus eventual transmission route (right-of-way (ROW)).
- Station four provided information about the EA process and the current stage of the Project's review, and the various environmental studies conducted for the Project. Take-away material included information sheets on the EA process and environmental studies.
- Station five displayed large Project maps outlining the Project corridor, and detailed regional topographic map showing the segment of the transmission corridor relevant to each open house community and surrounding area. Smaller versions of the maps were available for participants to take with them.

Participation and Feedback

A total of 239 members of the public participated in the eight 2010 open houses. In addition to numerous verbal comments that were received and recorded by team members, 154 feedback forms were completed. Overall, 90 percent (%) (or greater) of participants agreed or strongly agreed with the following statements: 1) sufficient information was provided; 2) information was relevant; 3) information was easy to understand; 4) Project team members were able to address my questions; and 5) open house format was effective. Issues and concerns identified by participants were recorded and compiled, and are summarized in Section 8.4, and Local Ecological Knowledge is summarized in Chapter 10.

8.3.2.2 Additional Labrador – Island Transmission Link EA Open Houses in 2011

In June and September of 2011, Nalcor held four additional Project-specific public open house sessions in the communities of North West River, Forteau, Sandy Cove, and Conception Bay South. Despite having held open houses in various nearby communities in 2010 and 2011 (Sections 8.3.2.1 and 8.3.2.3), these sessions were added by Nalcor to address the specific requirements from the May 2011 EIS Guidelines and Scoping Document (Government of Newfoundland and Labrador and Government of Canada 2011b) to hold open houses in these communities.

This section summarizes the location of each of these open houses, including date and time, and the number of participants (Table 8.3.2-3). Information on public notifications, open house format, and display material are also presented. Issues and concerns that were identified during these open houses are included in Section 8.4.

Table 8.3.2-3 Additional Labrador – Island Transmission Link EA Open Houses in 2011

Location	Venue	Date	Time	Number of Participants
North West River	Labrador Interpretation Centre	June 29	6 to 8 pm	0
Sandy Cove	Sandy Cove Lions Centre	September 13	4 to 7 pm	34
Forteau	John A. Dumeresque Town Centre	September 14	4 to 7 pm	19
Conception Bay South	Worsley Park	September 29	4 to 7 pm	13

Public Notification

Prior to the open house, public notification activities included newspaper advertisements (Table 8.3.2-4) and public notices as listed below.

Table 8.3.2-4 Newspaper Advertisements for Additional Labrador – Island Transmission Link EA Open Houses in 2011

Newspaper	Insertion Dates
The Labradorian	June 20 and June 27
Northern Pen	August 29, September 5 and 12
The Telegram	Sept 10, 17 and 24

Notices were also sent directly to the following communities and organizations:

- Town of North West River;
- Nordic Regional Economic Development Corporation;
- Public bulletin boards of Sandy Cove;
- Labrador Straits Economic Development Corporation;
- Town of Forteau; and
- Town of Conception Bay South.

The public notification campaign and open houses resulted in the following media coverage:

- Northern Pen, September 19, 2011 – Lower Churchill Project talks transmission.

Open House Format

Similar to the format of the 2010 sessions, there were a total of five information stations, a sign-in table, feedback table, and refreshment table.

Participation and Feedback

A total of 66 members of the public participated in the four additional Labrador – Island Transmission Link EA open houses in 2011. In addition to numerous verbal comments that were received and recorded by team members, 36 feedback forms were completed. Overall, 90% or greater of participants agreed with the

following statements: 1) sufficient information was provided; 2) information was relevant; 3) information was easy to understand; 4) Project team members were able to address my questions; and 5) open house format was effective. Issues and concerns identified by participants were recorded and compiled, and are summarized in Section 8.4, and LEK is summarized in Chapter 10.

8.3.2.3 Nalcor Open Houses April to September 2011

In addition to the above, 17 open houses were held across Newfoundland and Labrador between April and June 2011 by Nalcor. To cover a broad range of Nalcor's proposed development activities and interests, while at the same time maximizing efficiency, these sessions included information and discussion related to both the Project and the Lower Churchill Hydroelectric Generation Project.

This section summarizes the locations, date and time of each of these open houses, and the number of participants (Table 8.3.2-5). Information on public notifications, open house format, and display material, are also presented. Issues and concerns related to the Project that were identified during these open houses are included in Section 8.4.

Two of these open houses were held in Labrador Aboriginal communities, Hopedale and Sheshatshiu. These are included in the summary tables, but are discussed further in Chapter 7 (Aboriginal Consultation and Issues Scoping). The issues, concerns and LEK identified at these two sessions are also presented within that chapter.

Table 8.3.2-5 Nalcor Open Houses held from April to June 2011

Location	Venue	Date	Time	Number of Participants[(a)]
St. John's	Capital Hotel	April 18	3 to 8 pm	45
Holyrood	Star of the Sea	April 20	3 to 8 pm	28
Marystown	Marystown Hotel	April 25	3 to 8 pm	12
Gander	Hotel Gander	April 26	3 to 8 pm	13
Bay d'Espoir	Milltown Lions Club	April 27	3 to 8 pm	13
Corner Brook	Greenwood Inn	April 28	4 to 9 pm	26
St. Anthony	St. Anthony Lions Centre	May 16	3 to 8 pm	9
West St. Modeste	Oceanview Resort	May 17	3 to 8 pm	10
Happy Valley-Goose Bay	Hotel North 2	May 18	3 to 8 pm	17
Labrador City	Two Seasons Inn	May 19	3 to 8 pm.	5
Stephenville	Holiday Inn	May 24	4 to 9 pm	2
Port aux Basques	St. Christopher's Hotel	May 25	3 to 8 pm	8
Grand Falls-Windsor	Royal Canadian Legion	May 26	4 to 9 pm	10
Hopedale	Amos Comenius Memorial School	May 31	4 to 8 pm	29
Cartwright	Cartwright Hotel	June 1	4 to 7:30 pm	15
Sheshatshiu	Sheshatshiu Innu School	June 2	4 to 8 pm	13
Churchill Falls	Churchill Falls Community Centre	June 9	3 to 8 pm	18

(a) Does not include Nalcor participants.

Public Notification

Prior to the public open house sessions, public notification activities included newspaper advertisements (Table 8.3.2-6), public notices, and invitations, as listed.

Table 8.3.2-6 Newspaper Advertisements for Nalcor Open Houses held in April to September 2011

Newspaper	Insertion Dates
The Western Star	April 23, 25 and 27
The Telegram	April 16 and 18
The Coaster – Weekly	April 19 and 26
The Gulf News – Weekly	April 9, 16, 23 and 25
The Shoreline – Weekly	April 15
The Southern Gazette – Weekly	April 19
The Beacon – Weekly	April 21
The Advertiser – Weekly	May 9, 16 and 23
The Northern Pen – Weekly	May 2, 9, 16, 23 and 30
The Labradorian – Weekly	May 2, 9, 16, 23 and 30
The Aurora – Weekly	May 2, 9 and 16
The Georgian – Weekly	May 9, 16 and 23

- Radio advertisements on VOCM (am) between April 14 and 20 (three to five times per day).
- Public notices were emailed to the Regional Economic Development Boards, Municipalities, NL and Chambers of Commerce.
- A public notice was aired on the CET Network in Happy Valley-Goose Bay.
- A public notice was advertised on nalcorenergy.com. Notification of the open houses was sent to all Nalcor employees via email and posted on Nalcor's intranet.
- A press release was issued by Nalcor on April 14, 2011 and posted on the Nalcor website, and emailed to all media and provincial stakeholders on Nalcor's distribution list.
- The open houses public notification campaign resulted in the following media coverage:
  - April 18, 2011, CBC Gander - Lower Churchill;
  - April 19, 2011, Southern Gazette - open houses on Lower Churchill Project;
  - April 26, 2011, NTV News - Nalcor conducting information sessions;
  - April 29, 2011, The Telegram - Economy, environment discussed at Nalcor forum;
  - April 29, 2011, The Western Star - Economy verses environment;
  - May 3, 2011, Southern Gazette - Nalcor tour for Lower Churchill Project stops in Marystown;
  - May 9, 2011, Northern Pen - open house on Lower Churchill; and
  - May 10, 2011, The Coaster - Nalcor officials talk about Lower Churchill.

Open House Format

Upon arrival, participants were welcomed by a Lower Churchill Project member who provided an overview of the open house session. There were a total of six information stations, a sign-in table, feedback table, and refreshment

table. At least one Nalcor representative was present at each station to answer questions and gather feedback and LEK from participants. Before leaving, participants were encouraged to fill out a feedback form.

The six information stations were as follows:

- Station one provided a corporate overview of Nalcor and included information about its five lines of business, vision, values and goals. Take-away material included a corporate brochure.
- Station two provided information about the proposed Project and the Lower Churchill Hydroelectric Generation Project. Take-away material included maps and fact sheets on the projects, including employment and business opportunities.
- Station three provided information about the EA processes and the individual EA reviews for the two projects. Take-away material included information sheets on the EA process and environmental studies.
- Station four provided information about potential employment and business opportunities.
- Station five provided fact sheets on the Holyrood Thermal Generating Station, electricity rates and demand, and a Nalcor video.
- Station six included models of the projects and their associated components.

Participation and Feedback

A total of 273 members of the public participated in the 17 open houses. In addition to numerous verbal comments that were recorded by team members, 128 feedback forms were completed.

Overall, 90% (or greater) of participants agreed or strongly agreed with the following statements: 1) sufficient information was provided; 2) information was relevant; 3) information was easy to understand; 4) Project team members were able to address my questions; and 5) open house format was effective.

Questions and issues identified by participants were recorded and compiled and are presented in Section 8.4 and LEK is summarized in Chapter 10.

8.3.2.4 Nalcor Supplier Information Sessions

In October 2011, six supplier information sessions were held across Newfoundland and Labrador. The purpose of the sessions were to inform the business community of avenues to get involved in both the Project and the Lower Churchill Hydroelectric Generation Project, how to navigate through the procurement process and learn about the products and services to be procured.

This section summarizes the public notification, format, and attendance.

Table 8.3.2-7 Nalcor Supplier Information Sessions 2011

Town	Venue	Date	Time	Number of Participants	Number of One-on-One meetings
Happy Valley-Goose Bay	Royal Canadian Legion	October 13, 2011	9 am to 4 pm	23	26
St. John's	Sheraton Hotel	October 17, 2011	9 am to 5 pm	~200	105
Grand Falls-Windsor	Royal Canadian Legion	October 18, 2011	9 am to 1 pm	10	8
Corner Brook	Pepsi Centre	October 21, 2011	9 am to 1 pm	23	11
Flower's Cove	Flower's Cove Lions Club	October 26, 2011	2 pm to 6 pm	32	13
L'Anse au Loup	Lawrence O'Brien Community Centre	October 27, 2011	2 pm to 6 pm	19	11

Public Notification

Prior to the information sessions, numerous public notification activities were carried out in order to solicit as much involvement from the business community as possible.

Nalcor partnered with the following organizations to help disseminate the public notice and increase awareness:

- St. John's Board of Trade;
- Newfoundland and Labrador Regional Economic Development Associations;
- Labrador North Chamber of Commerce;
- St. Anthony and Area Chamber of Commerce;
- Exploits Regional Chamber of Commerce;
- Corner Brook Board of Trade;
- City of Corner Brook;
- Town of Grand Falls-Windsor;
- Town of Happy Valley-Goose Bay;
- Town of Flower's Cove;
- Town of L'Anse au Clair;
- Town of L'Anse au Loup;
- Town of Forteau;
- Town of West St. Modeste;
- Town of Red Bay;
- Town of Pinware;
- Combined Councils of Labrador;
- Great Northern Peninsula Joint Council;
- Department of Innovation, Trade and Rural Development;
- Department of Business;
- Newfoundland and Labrador Oil and Gas Industries Association (NOIA);
- Newfoundland and Labrador Environmental Industry Association (NEIA);
- Newfoundland and Labrador Business Collation;
- Innu Business Development Centre;
- Labrador Inuit Development Corporation;
- Nunacor (formally the Metis Development Corporation);
- Newfoundland Aboriginal Women's Network;
- Newfoundland and Labrador Organization of Women Entrepreneurs (NLOWE);
- Business Development Bank of Canada;

- Community Business Development Corporation; and
- Rural Secretariat.

Prior to the supplier development sessions, newspaper advertisements were listed in several newspapers as presented in Table 8.3.2-8.

Table 8.3.2-8 Newspaper Advertisements for Nalcor Supplier Information Sessions in 2011

Newspaper	Insertion Dates
The Telegram	October 5, 8, and 15
The Western Star	October 5, 8, and 15
The Labradorian	October 3 and 10
The Advertiser	October 3, 10, and 17
The Northern Pen	October 10, 17, and 24

The public notice was also posted on the CET Network in Happy Valley-Goose Bay, on nalcorenergy.com and Nalcor's Facebook page. A blog was also written about the sessions.

The public notification campaign resulted in the following media coverage:

- October 21, 2011, The Western Star – Businesses can learn about opportunities with lower Churchill project;
- October 22, 2011, The Western Star – Nalcor session an eye-opener for small businesses;
- October 23, 2011, CBN-AM – Muskrat Falls Development good for local business; and
- October 31, 2011, Northern Pen – Nalcor talks opportunity.

Supplier Information Session Format

The sessions began with a Project and Lower Churchill Hydroelectric Generation Project overview/update followed by a presentation on the procurement process including a description of goods and services, procurement forecast and opportunities for small businesses. Direction was provided on where and how contractors and sub-contractors can get up to date information on the status of bids and contact information for successful bidders.

Following the presentations, members of Nalcor's and SNC Lavalin's procurement teams were available for a 15 minute one-on-one meeting with anyone that wanted to discuss their business or joint venture partnerships privately.

8.4 Questions and Issues Identified

A summary of the key Project-related questions and issues raised through the regulatory, public and stakeholder consultation activities described above is provided in Table 8.4-1, categorized by theme. The table also indicates where each item is addressed in this EIS.

Table 8.4-1 Questions and Issues Raised in Consultations

Question / Issue Raised	EIS Section(s)
Project Rationale and Planning	
Perception that transmitting power to the Island not benefiting the entire province	2.1, 16.4.5.1
Other energy alternatives should be explored	2.5, 2.6
Concern that the Project may result in electricity rates increasing in all parts of the province	2.1, 2.8
Would like to get cheaper energy	2.1, 2.8
Questions why the transmission link does not have the capacity to carry Gull Island power	2.5.13.3
Power availability for future industrial development in Labrador	NIS[(a)]
Project Description	
How maintenance will be performed in challenging areas of the Project (e.g., Long Range Mountains)	3.5.2, 4.1.4.2
Technical challenges associated with the Strait of Belle Isle crossing	3.1.7.2, 3.1.8.2, 3.3.2.2, 4.1.6.2, 4.1.9.2, 4.2.2.2
Approximately 4 inch diameter rocks being proposed to construct the rock berms, may not be sufficient to fully protect the cables	3.4.3.3
Rock placement vessel may not be able to dock on the Labrador side of the Strait of Belle Isle	NIS[(a)]
Rock placement vessel and a cable laying vessel having difficulty manoeuvring due to the strong tides and currents in the Strait of Belle Isle	4.1.7.2
Suggestions and Alternatives	
Potential to construct multiple converter stations along the transmission line	2.12.2
Straighter corridor crossing of the Strait of Belle Isle as it may be easier to navigate around	2.12.4
Potential passenger tunnel for the Strait of Belle Isle crossing	NIS[(a)]
Pre-investing in the cables and transmission system that could accommodate Gull Island and Muskrat Falls power	2.1, 2.5.13.3 / NIS[(a)]
Transmission line should follow existing transmission lines wherever possible	3.3.4.2, 3.4.2.1, Appendix 3-2
Transmission line should follow Phases 2 and 3 of the Trans-Labrador Highway	2.11.2, 3.2, 3.3.2.1
Transmission line should be moved more north between Grand Falls and Gander[(b)]	2.11.2
Suggestion for the Labrador transmission corridor be routed directly south across the Québec border thereby avoiding challenging terrain[(b)]	2.11.2
Transmission line should make a more direct crossing of the Long Range Mountains toward the Cat Arm hydro development and then follow the eastern coast of the Northern Peninsula[(b)]	2.11.2
The north side of Conception Bay may be a better location for the Newfoundland electrode[(b)]	2.11.2
Can the power be converted to alternating current (ac) on the Newfoundland side of the Strait of Belle Isle, and added to the Island grid at this location rather than brought another 700 kilometres (km) to Soldiers Pond	NIS[(a)]

Table 8.4-1 Questions and Issues Raised in Consultations (continued)

Question / Issue Raised	EIS Section(s)
EA Process and Consultation	
Stakeholder groups do not have the funding to actively participate in the EA process	NIS[(a)]
Duration of the EA process	1.3, NIS[(a)]
Technical material presented is often too complex for the general public to understand	8.3.2 and Plain Language Summary
Regardless of whether Nalcor is reducing or mitigating the effects, there are still effects on the environment	Chapter 11, 12, 13, 14 and 16
The ability to accurately and confidently predict the potential effects, and what the consequence will be if the assumptions are incorrect	Chapter 9, 11, 12, 13, 14, and 16
Aquatic Environment	
Adjacency of the corridor to spawning habitat and fish stocks and the effect of construction and long-term maintenance activities on the aquatic environment, specifically access roads, trails and tower construction	13.3.5.3, 13.3.5.4, 13.3.6.3
The transmission of a large amount of power over these aquatic environments and the potential effects on fish	3.5.3.1
The use of herbicides to suppress vegetative growth may affect aquatic environments, which may result from drift from aerial spraying extending beyond the extent of the ROW boundaries	13.2.6.3, 13.3.6.3, 13.4.1
Increased access, specifically bridges previously removed (to regulate access to aquatic resources) will be re-established	3.4.6, 13.3.5.4
Water quality for the Portland Creek, Inner Pond area, due to the use of herbicides	3.5.2.3, 13.2.6.3, 13.4.1, Appendix 3-1, Table 3-1.1
Increased access, specifically workers having access to remote fish stocks during the Construction Phase	13.4.1
Terrestrial Environment	
Vegetation	
Protection of the Limestone Barrens and Nalcor's mitigation plan for rare plants	12.2.5.6
Timber	
Productive forest areas and land being taken out of commission permanently	12.2.5.8
Removal of timber and amount to be harvested	12.2.5.8
Removal of "new growth" during clearing activities	12.2.5.8
Vegetation	
Increased access for recreational vehicles into interior areas of the province and the effect on wetlands and the potential of introducing invasive species	12.2.5
Transmission line passing through the Main River watershed may compromise some of the last remaining old growth forests in the province	12.2.5.3
Rare plants on the Northern Peninsula	12.2.5.6, 12.2.5.7, 12.2.6.5

Table 8.4-1 Questions and Issues Raised in Consultations (continued)

Question / Issue Raised	EIS Section(s)
Parks / Protected Areas / Ecosystems	
Concern over the following areas: Canadian Heritage River (Main River) watershed, Butterpot Provincial Park, Jack's Pond Provincial Park, Hawke Hills Ecological Reserve, Pinware Provincial Park, West Brook Ecological Reserve, the proposed Mealy Mountains National Reserve, and the Long Range Mountains (and specifically the Portland Creek area), and the Humber River watershed	16.5.5.6, 16.5.6.5, 16.8.7, 16.8.8
Potential displacement of ecosystems as a result of clearing for ROWs and the construction of concrete and steel structures within these ecosystems	12.2.5.3, 12.5.6.5, 17.6.1.2
The effect the Project may have on the ecological integrity of nearby protected areas (i.e., Main River Park, Gros Morne National Park)	16.5.5.6, 16.5.6.5, 17.6.1
Wildlife	
Potential effect of clearing the ROW, the use of chemical defoliants, and access roads on wildlife	12.3.5, 12.3.6, 12.3.7, 12.4.5, 12.4.7, 12.5.5, 12.5.6, 12.5.7, 12.4.6, 12.4.6.1
Habitat loss or degradation and potential harassment of wildlife	12.3, 12.4, 12.5
Increased harvesting of wildlife resulting from the increased accessibility	12.3, 12.4, 12.5
Herbicide use during maintenance activities on the ROW and the effect on wildlife, including their water supplies	12.3.6.3, 12.3.7, 12.4.6.3, 12.4.7, 12.5.6, 12.5.7, 13.2.6.3
Effect on woodland caribou, specifically: habitat fragmentation potential effect of changes in migratory routes; potential use of the ROWs by predators (e.g., wolves, coyotes, bears); construction in the vicinity of breeding and caribou calving grounds; access (increased disturbance from snowmobiles and recreational vehicle usage in previously inaccessible areas; potential habitat disturbance or fragmentation from increased domestic cutting)	12.3.5, 12.3.6, 12.3.7
Suggestion that construction take place later in the fall to reduce interaction with calving	12.3.5.1
The potential effects of EMFs on wildlife	3.5.3.1
Transmission line being constructed through pine marten habitat resulting in further habitat loss and increased disturbance by humans	12.4.5.3, 12.4.6.3, 12.4.7
Avifauna	
Effect of the transmission lines and towers on migratory birds	12.5.6, 12.5.7
Concerned that increased access could result in an increase in harvesting of endangered birds and in human disturbance in the form of recreational vehicle usage resulting in breeding area destruction or degradation	12.5.6, 12.5.7
Atmospheric Environment	
Air emissions associated with the Project and the effect of these emissions	11.2.5, 11.2.6, 11.2.7
EMFs and audible noise from the transmission lines	11.2.6, 11.2.7, 16.3.6.5, 16.3.6.2, 16.3.6.6

Table 8.4-1 Questions and Issues Raised in Consultations (continued)

Question / Issue Raised	EIS Section(s)
Replacement of the energy produced at the Holyrood Thermal Generating Station with a renewable energy source will greatly benefit the residents of Conception Bay South	2.5.8, 2.5.9, 2.5.10, 2.5.11, 3.4.3.5
Potential interference from the Project on satellite television, radio and cellular use	16.3.6.6
Marine Environment – Electrodes	
Potential effect on marine life, including the fishery, and humans during normal operations and during a system malfunction	3.5.3.2, 14.2.6.5, 14.2.74
Marine Environment - Strait of Belle Isle Cable Crossing	
Submarine cable emissions affecting marine life (fish, marine mammals, sea turtles) and the fishery	14.2.6.5, 14.2.7, 14.3.6, 14.3.7
Species at risk being affected	14.5.2
The short- and long-term effects of construction on pelagic and groundfish species, marine mammals, sea turtles, and mollusks and crustaceans, and the cumulative effects of the construction and the long-term placement of cables on the ocean floor	14.2.5, 14.2.7, 14.2.8, 14.3.5, 14.3.7, 14.3.8
Effect of dredging, drilling, blasting and other activities on and through the sea bed	14.2.5, 14.2.7, 14.2.8, 14.3.5, 14.3.7, 14.3.8
In-water construction during the migration of pelagic and groundfish species may affect migration, specifically the species sensitive to noise and other disturbance (e.g., capelin, herring)	14.2.5.4, 14.2.7
Effect of “electrical wires” on the sea floor on benthic species	14.2.6, 14.2.7
Construction could affect salmon migration as the crossing is near a major salmon river	4.2.7, 14.2.6.5
Potential fishing restrictions near the cable crossings, specifically whether otter trawls and scallop dredges will be permitted in the vicinity of the cable crossings.	16.5.5.3
Timing and duration of construction; if the construction occurs between May and October it will coincide with the opening and closing dates of the commercial fishery.	3.4.1, 16.6.5.3, 16.6.7, Figure 3.4.1-1
Concern the 4 inch diameter rocks proposed for rock berm construction will not be sufficient to protect the cables from fishing activity	3.4.3.3
The potential effect on scallops, and the recently re-opened refugium	14.2.5.4, 14.2.6.5, 14.2.7
Potential effects on the livelihoods of people dependent on fisheries resources, including harvesters and processors	16.6.7
Concern about the Maritime Link and the cumulative effects on marine fish, marine mammals and sea turtles	14.2.8, 14.3.8
Due to the region’s lack of a large, diverse employment base, future employment levels would be affected if the Project harms the area’s fisheries resources	16.6.7
Whether compensation will be provided if there is an effect on the commercial fishery	16.6.5, 16.6.5.3, 16.6.6.1, 16.6.6.3, 16.6.7.2
Effect of noise from the Horizontal Directional Drill (HDD) operation on fish stocks	14.2.5.4, 14.2.7
Increased sedimentation released into the water column during rock berm depositing	14.2.5, 14.2.7

Table 8.4-1 Questions and Issues Raised in Consultations (continued)

Question / Issue Raised	EIS Section(s)
Socioeconomic Environment	
Employment and Business	
Interest in opportunities for employment during the Construction Phase, and the Operations and Maintenance Phase	16.4.5, 16.4.6, 16.4.7
Number, classifications, and duration of jobs, and that most jobs will be short-term	16.4.5, 16.4.6, 16.4.7
Hiring of local workers and contractors and whether there will be an adjacency policy	16.4.5, 16.4.6, 16.4.7
Training and employment opportunities for non-Aboriginal persons	16.4.5, 16.4.6, 16.4.7
Equal representation of women in the Project workforce	16.4.5, 16.4.6, 16.4.7
Training requirements and timelines	16.4.5, 16.4.6, 16.4.7
Whether there are enough qualified people in the province to meet the job demand	16.4.5, 16.4.6, 16.4.7
Whether all jobs will be union contracts	16.4.5, 16.4.6, 16.4.7
Concern that only people who reside in the general vicinity of the Project will be employed	16.4.5, 16.4.6, 16.4.7
Interest in the potential for educational outreach programs for local youth on employment opportunities associated with the Project	16.4.5, 16.4.6, 16.4.7
Possible job loss at the Holyrood Thermal Generating Station	16.4.1
Whether procurement contracts may be awarded to local businesses. Potential for small, local businesses to compete with large global businesses for Project contracts	16.4.5, 16.4.6, 16.4.7
Lack of a port facility in region may limit ability of local businesses to supply rock for rock berm construction	11.2.5.5, 16.3.5.3
Waste management requirements and opportunities	16.3.5.4
Having workers use local accommodations, specifically during the off-season	3.4.2.3. 16.3.5.1, 16.7.5.1
Outfitters	
Potential effects of access, specifically the transmission line and access roads and trails providing access to local hunters, especially via snowmobiles. This may affect caribou and moose wintering areas as a result of increased activity.	12.3, 12.4, 12.5, 16.5.5.3, 16.5.6.3, 16.5.7
Property could be destroyed or stolen due to increased access to remote areas	16.5.5.3, 16.5.6.3, 16.5.7
Ensure that not only the footprint of the Project is assessed, as the potentially affected area for outfitters may be much larger, especially with respect to big game	12.3.2, 12.4.2
Viewscape effects, increased noise level increase during and after construction; degraded wilderness perception of remoteness; degraded product offering resulting in revenue loss for the business also resulting in loss of employment	16.5.5.3, 16.5.6.3

Table 8.4-1 Questions and Issues Raised in Consultations (continued)

Question / Issue Raised	EIS Section(s)
Viewscapes	
Concern over the visibility and visual aesthetic of the transmission system and associated infrastructure from various key locations: – Exploits River transmission line crossing and its location on the south side of the river – Humber River transmission line crossing – Trans-Canada Highway in Central and Eastern Newfoundland and the other highways on the Northern Peninsula – Birchy Lake area – Existing and proposed trails of the International Appalachian Trail Newfoundland and Labrador (IATNL) particularly the trails in the Portland Creek / Inner Pond area – Canadian Heritage River (Main River) – Infrastructure in the vicinity of the cable landing sites (e.g., transition compound, remnants from the HDD activities)	16.8
Communities	
Potential effects on water supplies located in the vicinity of the Project	13.2.6.3, 13.4.1, 16.3.6.1, 16.3.6.5, 16.5.5.3
Effect on the waste management systems in various regions of the province, including through the disposal of HDD tailings, and potential requirement for additional disposal sites	3.4.3.3, 16.3.5.4, 16.3.7
Increased use of ports, roads, landfills, water and sewer and other municipal services in Happy Valley-Goose Bay	16.3.5.3, 16.3.7
EMFs and audible noise from transmission lines and perceived health issues, especially near communities	16.3.6.5, 16.3.6.6
Land and Resource Use	
Potential benefit for increased all-terrain vehicle (ATV) and snowmobiling activity from the development of transmission lines	16.5.5.4, 16.5.6.3, 16.5.7
Potential overlap with municipal and planning boundaries	16.5.5.3, 16.5.6.3, 16.5.7
Proximity of transmission lines to walking and snowmobile trails on the Northern Peninsula (specifically in the Ten Mile Pond area)	16.5.5.4, 16.5.6.3, 16.5.7
Potential land expropriation process	16.5.5.1
Height of conductors across navigable waterways and potential interference with vessels	3.4.2.2, 16.5.5.4
Potential effects on fishing, hunting and cabin use in the Portland Creek area	16.5.5.4, 16.5.6.3
Whether construction infrastructure (e.g., bridges) would remain during project operations, which could have a potential positive benefit to local cabin and resource use	3.4.6.2, 16.5.6.3
Cottage areas of Cormack and Jack's Ladder need to be considered	16.5.5.4, 16.5.6.3
Restrictions on land use near the transmission lines, specifically near the cable landing points	3.3.2.2, 3.3.2.3
Proximity of transmission lines to ski resorts	16.7.5.4
Potential effect on berry picking due to herbicide use	16.3.6.5

Table 8.4-1 Questions and Issues Raised in Consultations (continued)

Question / Issue Raised	EIS Section(s)
Potential effect on traditional fishing, hunting and trapping activities by Aboriginal and non-Aboriginal groups as a result of increased access to the southern interior of Labrador	16.5.5.4, 16.5.6.3, 16.5.7
Proximity of the transmission line to an existing float plane base in the Labrador Straits, and potential effects on its operations	16.5.5.3
Transmission line passing through heavy cabin country on the Northern Peninsula	16.5.5, 16.5.6.3.4
Archaeology	
Potential for Maritime Archaic Indian artifacts near L'Anse Amour to be affected	16.2.5.1
Strait of Belle Isle crossing may affect the "Jersey Rooms" off Forteau Point and / or the fossil reefs near Point Amour	16.2.5.1
Tourism	
Concern the lighthouse in L'Anse Amour and associated tourism activity will be affected	16.2.1, 16.2.5.1
Potential damage to the T'Railway and associated infrastructure as a result of electrode construction in the Town of Conception Bay South	16.5.5.6
Visual and aesthetic effects of the Project on the tourism industry	16.7.5.3, 16.7.6.3, 16.8
Proposed and existing trails of the IATNL and the effect on the tourism industry in the area	16.5.5.4, 16.5.6.3, 16.7.7
Proximity of the transmission line to the Pioneer Footpath along the Labrador Straits	16.5.5, 16.5.6
Interest in local accommodations being used during the off-season	3.4.2.3, 16.3.5.1, 16.7.5.1
Wildlife Management	
Enforcement of wildlife regulations over the long-term throughout the life of the Project	NIS[(a)]
Increased access to wildlife prior to the implementation of an adequate wildlife management plan	12.3.5, 122.3.6, 12.3.7

(a) NIS – Not in scope. Consideration of the issue is outside the Project scope.

(b) EIS may not reference the location directly, but provides rationale for route selection.

8.5 References

Government of Newfoundland and Labrador and Government of Canada. 2011a. Environmental Impact Statement Draft Guidelines and Scoping Document, Labrador-Island Transmission Link. Prepared for Nalcor Energy. St. John's, NL.

Government of Newfoundland and Labrador and Government of Canada. 2011b. Environmental Impact Statement Guidelines and Scoping Document, Labrador-Island Transmission Link. Prepared for Nalcor Energy. St. John's, NL.

APPENDIX 8-1

TABLE OF CONCORDANCE WITH EIS GUIDELINES AND SCOPING DOCUMENT

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document

EIS Guidelines[(a)] Section			Relevant Items	EIS Location(s)	
Section		Page		Chapter(s)	Section(s)
Section 2 – Guiding Principles					
2.0	**Guiding Principles**	9	The EIS shall demonstrate adherence to the basic principles of environmental assessment as set out in the guidelines.	9, 17, All chapters	9.5, 17.4, Throughout the EIS
2.2	**Aboriginal and Public Participation**	9	In preparing the EIS, the Proponent shall inform and consult with all potentially affected Aboriginal and local communities, interested regional and national organizations and resource users.	7, 8, 9	7.1, 7.2, 7.3, 7.4, 7.5 ,8.1, 8.3, 9.5.2, Tables 8.1-1 and 8.3.1-1
2.2		9	The Proponent shall prepare a "plain-language summary" of the EIS in accordance with 4.1.2.	Plain Language Summary	—
2.2		9	Therefore, it is recommended that the Proponent: continue to provide up-to-date information, as it becomes available, to Aboriginal groups and the public and especially to the communities likely to be affected by the Project;	7, 8, 9	7.1, 7.2, 7.3, 7.4, 7.5, 8.3, 9.5.2
2.2		9	involve the main interested parties in determining how best to deliver that information, that is, the type of information required, format and presentation methods, as well as the need for community meetings;	7, 8	7.1, 7.2, 7.3, 7.4, 7.5, 8.3
2.2		9	explain the results of the EIS in a clear and direct manner to make the issues comprehensible to the widest possible audience; and	Executive Summary, Plain Language Summary	—
2.2		9	consider and acknowledge all requests for consultation with Aboriginal groups during project approvals and throughout the life of the project.	7	7.1, 7.2, 7.3, 7.4, 7.5, Tables 7.2.2-1, 7.3.3-1, 7.4-1 and 7.5.2-1
2.3	**Aboriginal Traditional and Community Knowledge**	9	Aboriginal traditional and community knowledge of the existing environment shall be an integral part of the EIS, to the extent that it is available to the Proponent.	9, 10, 15	9.5.3, Chapters 10 and 15 under 'Aboriginal Ecological Knowledge' heading and table in each VEC section

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section			Relevant Items	EIS Location(s)	
Section		Page		Chapter(s)	Section(s)
2.4	**Sustainable Development**	10	The proponent shall strive to integrate the factors of sustainable development into the planning and decision-making process for the Project, including seeking the views of interested parties and shall report on the results in the EIS.	1, 2, 8, 9, 11, 12, 13, 14, 16, 17	1.1, 2 Introduction, 8.4, 9.5.4; Throughout Chapters 11, 12, 13, 14, 16; 17.1, 17.4, 17.6.1
2.4	**Sustainable Development**	10	Promotion of sustainable development is a fundamental purpose of environmental assessment, and the Proponent shall include in the EIS consideration of: – the extent to which biological diversity is affected by the Project; – the capacity of renewable resources that are likely to be significantly affected by the Project to meet the needs of present and future generations; and – the extent, distribution and duration of social and economic benefits.	9, 12, 13, 14, 16, 17	9.5.4; Throughout Chapters 12, 13, 14 and 16; 17.6
2.5	**Precautionary Principle**	10	One of the purposes of environmental assessment is to ensure that projects are considered in a careful and precautionary manner before action is taken in connection with them in order to ensure that such projects do not cause significant adverse environmental effects.	9, 11, 12, 13, 14, 16, 17	9.5.5; Throughout Chapters 11, 12, 13, 14, 16; 17.1, 17.4
			Principle 15 of the 1992 Rio Declaration on Environment and Development states that "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." In applying the precautionary approach, the Proponent shall: demonstrate that the proposed Project is examined in a careful and precautionary manner	9, 11, 12, 13, 14, 16	9.5.5; Throughout Chapters 11, 12, 13, 14, 16

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
2.5	10	– outline the assumptions made about the effects of the Project and the approaches to prevent and minimize these effects	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Construction' and 'Operations and Maintenance' headings and 'Summary of Environmental Effects' table in each VEC section; 11.3, 12.6, 13.4, 14.5, 16.9
2.5	11	– identify where knowledge uncertainty exists in the predictions of the environmental effects of the Project	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Construction' and 'Operations and Maintenance' headings in each VEC section
2.5	11	– identify any follow-up and monitoring activities planned, particularly in areas where knowledge uncertainty exists in the prediction of the effects of the Project	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Construction' and 'Operations and Maintenance' headings and 'Summary of Environmental Effects' table in each VEC section; 11.3, 12.6, 13.4, 14.5, 16.9

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section			Relevant Items	EIS Location(s)	
Section		Page		Chapter(s)	Section(s)
Section 3 – Preparation and Presentation					
3.1	**Study Strategy and Methodology**	12	The Proponent shall explain and justify all methods used in the preparation of the EIS.	2, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Component Studies	2.3.1, 2.4.1, 2.5 Introduction, 2.6 Introduction, 2.10, 2.10.1.1, Figure 2.10-2, 5.1, 7.1, 8.1, 8.3; Throughout Chapter 9; Chapters 11, 12, 13, 14, 16 under the 'Approach to Environmental Effects Analysis' heading in each VEC section
3.1		12	In describing its overall approach, the Proponent shall explain how it used scientific, engineering, Aboriginal traditional and community knowledge.	4, 5, 7, 8, 10, 11, 12, 13, 14, 15, 16	4 Introduction, 5.1, 7.1, 8.3; Chapters 10 and 15 under the 'Information Sources and Data Collection' heading; Chapters 11, 12, 13, 14, 16 under the 'Approach to Environmental Effects Analysis' and 'Valued Environmental Component Selection' headings in each VEC section
3.1		12	All hypotheses and assumptions shall be clearly identified and justified.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Construction' and 'Operations and Maintenance' headings in each VEC section

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
3.1	12	All data collection methods, models and studies shall be documented so that the analyses are transparent and reproducible.	10, 11, 12, 13, 14, 15, 16, Component Studies	Chapters 10 and 15 under the 'Information Sources and Data Collection' heading; Throughout Chapters 11, 12, 13, 14, 16 under the 'Existing Knowledge' heading in each VEC section
3.1	12	The degree of certainty, reliability and sensitivity of models used to reach conclusions shall be indicated.	11, 14, 15, 16, Component Studies	11.2.4.1, 14.2.4.1, 15.8.2, 15.8.3, 16.8.4.1
3.1	12	All conclusions regarding the receiving environment and predictions as well as the assessment of environmental effects shall be substantiated.	5, 11, 12, 13, 14, 16	Throughout Chapters 5, 11, 12, 13, 14, 16
3.1	12	The Proponent shall support all analyses, interpretation of results and conclusions with a review of the appropriate literature, providing all references required and indicating the public availability of all works consulted.	5, 11, 12, 13, 14, 16	Chapter 5 'References'; Chapters 11, 12, 13, 14, 16 under the 'Existing Knowledge' heading in each VEC section, and the 'References' section
3.1	12	Any contribution based on Aboriginal traditional and community knowledge shall be specified and the sources identified.	7, 8, 10, 15	7.2, 7.3, 7.4, 7.5, 8.4; Throughout Chapter 10; 15.5.7
3.1	12	The EIS shall identify all significant gaps in knowledge and explain their relevance to key conclusions drawn. The Proponent shall indicate the measures applied to address these gaps.	9, 11, 12, 13, 14, 16	9.5.5; Chapters 11, 12, 13, 14, 16 under the 'Construction' and 'Operations and Maintenance' headings in each VEC section

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
3.1	12	Where the conclusions drawn from scientific and technical knowledge are inconsistent with the conclusions drawn from Aboriginal traditional or community knowledge, the Proponent shall present the various points of view as well as a statement of the Proponent's conclusions.	10, 15	Chapter 10 under the 'Information Sources and Data Collection' (Aboriginal Ecological Knowledge) heading in each VEC section; 15.5.7
3.2 Presentation of the EIS	12	The Proponent shall present the EIS in the clearest language possible. The EIS shall refer to rather than repeat information already presented in other sections of the document. The Proponent shall present information, where technically feasible, using a standard Geographic Information System (GIS) mapping (digital) format with maps geo-referenced.	Chapters 1 to 17, Executive Summary, Plain Language Summary	1.5; Throughout
3.2	12	The EIS and all associated reports and studies shall use System International (SI) units of measure and terminology throughout.	Chapters 1 to 17, Component Studies	1.5; Throughout
3.2	12	A glossary defining technical words and acronyms shall be included.	Chapters 1 to 17	A 'List of Acronyms' is provided for each chapter; Technical words are defined where they are used in the text
3.2	12	Lines shall be numbered in the margin at appropriate intervals.	Chapters 1 to 17, Executive Summary	Throughout
3.2	12	The EIS shall include a Table of Concordance that cross-references the EIS Guidelines so that information requirements identified in the Guidelines are easily located in the EIS.	8	Appendix 8-1 (Table 8-1.1)
3.2	12	A key subject index is to be provided giving locations in the text by volume, section and sub-section.	At the end of Volume 3	—

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	**Page**		**Chapter(s)**	**Section(s)**
3.2	12	The Proponent shall provide charts, diagrams and maps wherever useful to clarify the text, including a depiction of what the developed Project sites would look like from both an aerial and terrestrial perspective. Maps shall use a limited number of common scales to allow for comparison and overlay of mapped features. Maps shall indicate common and accepted local place names.	Chapters 1 to 17	Throughout Chapters 1 to 17, as required to support text
3.2	13	Throughout the preparation of the EIS, the Proponent should freely cite experiences from other environmental assessments, with emphasis on Newfoundland and Labrador and other Canadian examples, to support the methodology and value of the information provided, or as reasons in support of the selection of a preferred alternative.	11, 12, 13, 14, 16	Throughout Chapters 11, 12, 13, 14, 16, as required to support text
		To facilitate the identification of the documents submitted and their coding in the Canadian Environmental Assessment Registry, the title page of the EIS and its related documents should contain the following information: – project name and location; – title of the document, including the term “environmental impact statement”; – subtitle of the document; – name of the Proponent; – names of the consultants, as appropriate; – date.	Chapters 1 to 17	Each chapter title page

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	**Page**		**Chapter(s)**	**Section(s)**
3.2	13	They shall be written in English and printed or copied on two sides of recycled *Environmental Choice* and/or *Forest Stewardship Council-certified* paper. The paper choice shall be conspicuously stated.	Volume 1 (Chapters 1-9), Volume 2A (Chapter 10), Volume 2B (Chapters 11-14) and Volume 3 (Chapters 15-17); Executive Summary, Plain Language Summary	Paper type is stated on the inside cover page of each volume
3.2	13	The electronic version of the EIS shall be submitted in a format so that it may be posted on the internet and in a manner which shall facilitate downloading and printing in part or in whole.	Volumes 1, 2A, 2B and 3, Executive Summary, Plain Language Summary	Throughout
Section 4 – Outline of the Environmental Impact Statement				
4.1 EXECUTIVE AND PLAIN LANGUAGE SUMMARIES				
4.1.1 Executive Summary of the EIS	14	The executive summary shall include identification of the Proponent, a brief project description, predicted environmental and socio-economic effects, mitigation measures, residual effects, follow-up and monitoring programs, an outline of the component studies, and a summary of the fundamental conclusions of the EIS.	Executive Summary	1.1; Throughout 3, 10, 11, 12, 13, 14, 15, 16, 17
4.1.1	14	The executive summary shall also include a review of Aboriginal concerns about the Project and the key findings of the Aboriginal consultation activities undertaken by the Proponent.	Executive Summary	Section 7
4.1.1	14	The executive summary should be written in terms understandable to the general public and in such a manner as to allow reviewers to focus on items of concern.	Executive Summary	Throughout

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	**Page**		**Chapter(s)**	**Section(s)**
4.1.2 Plain Language Summary of the EIS	14	The plain language summary shall provide a short description of the Project, its predicted effects and their significance, and proposed mitigation. It shall also include a schedule of major Project steps, before, during and after construction.	Plain Language Summary	3, 4, 10, 11
4.1.2	14	The summary should include pictures and maps that will enable the reader to understand the location, size, appearance and function of the project.	Plain Language Summary	3, 4
		The summary shall be available in: English, French, Innu-aimun (Labrador and Quebec dialects), Naskapi and Inuktitut.	Plain Language Summary	Plain Language Summary is available in these languages
4.2 INTRODUCTION				
4.2.1 Identification of the Proponent	14	Shall introduce readers to the Proponent by providing pertinent corporate information.	1	1.2
4.2.1	14	(a) Name of corporate body and mailing address	1	1.2
4.2.1	14	(b) Chief Executive Officer	1	1.2
4.2.1	14	(c) Principal contact person for purposes of environmental assessment	1	1.2
4.2.1	14	(d) Ownership of rights and interests in the Project and associated natural resources	1	1.2
4.2.1	14	(e) Corporate accountability for management of environmental and socio-economic effects. Operational arrangements and corporate and management structures, including the linkage of these factors between the Proponent, its parent companies and any other organizations with operational or ownership rights	1	1.2
4.2.1	14	(f) Environmental and community relations policies	2, 3	2.14, Appendix 3-4
4.2.1	14	(g) Key elements of the Proponent's environment, health and safety management system and how the system will be integrated into the Project	2	2.14
4.2.1	14	In addition the Proponent shall describe its history in Canada's hydroelectricity industry (generation and transmission), with specific reference to the existing hydroelectric generation/transmission project at Churchill Falls, and the proposed Lower Churchill Hydroelectric Generation Project.	1	1.2, Figure 1.2-2

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.2.2 Overview of the Project	15	The Proponent shall briefly summarize the Project, by presenting the project components, associated activities, scheduling details, the timing of each phase of the Project and other key features. If the Project is part of a larger sequence of projects, the Proponent shall outline the larger context and present the relevant references, if available.	1, 3, 17	1.1, Throughout Chapter 3; 17.1, 17.2;
4.2.3 Purpose of the EIS	15	The purpose of the EIS shall be described.	1	1.5
4.2.4 Relationship to Legislation, Permitting, Regulatory Agencies & Policies	15	EIS shall identify and discuss all relationships between the Project and relevant legislation, regulations and policies (municipal, provincial, and federal).	1, 3, 11, 12, 13, 14, 16	1.3, 3.4.1 Appendix 3-1; Chapters 11, 12, 13, 14, 16 under the 'VEC Selection' heading and 'Key Indicators and Associated Measurable Parameters' table in each VEC section
4.2.4	15	Pertinent government policies, such as land and water resources development and use policies that may influence environmental management in the project area, and the Project's compliance with respect to these policies are to be addressed. The EIS shall describe how project siting, design and management have been influenced by compliance with these legislation and policies.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Construction' and 'Operations and Maintenance' headings in each VEC section, and the 'Effects Mitigation Measures' section in each 'Environmental Assessment Summary'
4.2.4	15	The Proponent shall provide a comprehensive list of anticipated permits and regulatory approvals required for the undertaking. The list shall include the following details: – activity requiring regulatory approval	3	3.4.1, Appendix 3-1
4.2.4	15	– name of permit or regulatory approval	3	3.4.1, Appendix 3-1
4.2.4	15	– name of legislation applicable in each case	3	3.4.1, Appendix 3-1
4.2.4	15	– regulatory agency responsible for each permit of approval	3	3.4.1, Appendix 3-1

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.2.5 Land Claims Agreements and Interim Agreements	15	The EIS shall identify any publicly available agreements or arrangements, that may be in effect, entered into between the Proponent and / or the Government of Canada and / or the Government of Newfoundland and Labrador and / or Aboriginal group(s) in the context of land claims, and address how they may affect or be affected by the Project.	7, 16	7.2, 7.3, 7.4, 7.5, 16.4.5.1, 16.5.5
4.2.6 Other Registrations	16	The Proponent shall indicate whether any other registrations have previously been submitted in relation to this Project, or are to be submitted for environmental assessment in the future as a result of this Project.	1	1.4
4.3 THE PROPOSED UNDERTAKING				
4.3.1 Need, Purpose and Rationale of the Project	16	"Need for" and "Purpose of" the Project should be established from the perspective of the Proponent and provide a context for the consideration of alternatives to the Project.	2	2.2
4.3.1	16	The statement of the Project's justification shall be presented in both energy and economic terms, shall provide a clear description of methodologies, assumptions and conclusions used in the analysis, and shall include an evaluation of the following: (precedes the list of 9 items already in the Table).	2	2.3, 2.4, 2.6, 2.7
4.3.1	16	This section of the EIS shall provide a comprehensive explanation of the need, purpose and rationale for the Project.	2	2.1, 2.3, 2.4, 2.5, 2.8, 2.10
4.3.1	16	1. Current and forecasted provincial electricity supply and demand.	2	2.3.1
4.3.1	16	2. Current and forecasted provincial electricity conservation.	2	2.3.1
4.3.1	16	3. Current and future provincial transmission line network.	2	2.3.1
4.3.1	16	4. Current and future interprovincial transmission line network.	2	2.3.1, 2.3.5
4.3.1	16	5. Current exports by the Proponent to markets outside the province.	2	2.5.13
4.3.1	16	6. Export market opportunities, forecasts and expected evolution.	2	2.1, 2.3.1
4.3.1	16	7. Risks to the Project, market prices and schedule delays, interest rates and other risk factors relevant to the decision to proceed with the Project.	2	2.5.14.2, 2.10 and associated figures
4.3.1	16	8. Projected financial benefits, projected expenditures and effects on electricity rates of the Project (including their distribution) as measured by standard financial indicators.	2, 3	2.8, 3.7, 3.8

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	**Page**		**Chapter(s)**	**Section(s)**
4.3.1	16	9. Relationship with the Newfoundland and Labrador's 2007 Energy Plan.	2	2.1, 2.5 Introduction
4.3.2 Alternatives				
4.3.2.1 Alternatives to the Project	17	The EIS shall contain an analysis of alternatives to the Project, including the following: – Management of electricity demand through utility-based energy efficiency and conservation initiatives	2	2.3.1.4
4.3.2.1	17	– Alternative generation sources for the Project (e.g., hydrocarbons, wind, other hydro projects such as run-of-river projects or combinations of generation sources)	2	2.5
4.3.2.1	17	– The addition by the Proponent of more capacity at existing generation facilities	2	2.6.1
4.3.2.1	17	– Status quo (no Project)	2	2.6.1
4.3.2.1	17	Among the alternatives to the Project to be considered, the Proponent shall pay close attention to how they would be integrated within Newfoundland and Labrador's 2007 Energy Plan.	2	2.1, 2.5.1 Introduction, 2.5.5
4.3.2.1	17	This shall include a description of the conditions or circumstances that could affect or alter these choices, such as market conditions, regulatory changes and other transmission line developments, either prior to construction or during the life of the Project.	2	2.5
4.3.2.1	17	The EIS shall include a comparative analysis of the environmental effects and technical and economic feasibility of alternatives that led to the choice of the selected Project alternative.	2	2.5
4.3.2.1	17	The comparative analysis shall indicate how the Proponent took into account the sustainable development objectives outlined previously in these Guidelines in determining criteria for selecting the preferred alternative.	2, 9, 11, 12, 13, 14, 16	2 Introduction, 2.1; Throughout Chapters 11, 12, 13, 14, 16
4.3.2.1	17	The Proponent shall include an evaluation of the thresholds for economic viability of the Project and considerations respecting the timing of phases and components of the Project.	2	2.4.1, 2.4.2

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.3.2.1	17	The Proponent shall also indicate under what circumstances a change in economic conditions may influence its selection of the preferred alternative.	2	2.5, 2.6, 2.7
4.3.2.2 Alternative Means of Carrying out the Project	17	Alternative means of carrying out the Project, which are technically and economically feasible, and the environmental effects of any such alternative means shall be discussed.	2	2.12
4.3.2.2	17	The EIS shall describe design and siting alternatives for the transmission line and ancillary facilities (such as roads, convertor stations, electrodes and temporary infrastructure).	2	2.12
4.3.2.2	17	The preferred alternatives shall be identified, with the selection based on clearly described methods and criteria.	2	2.12, 17.7
4.3.2.2	17	An explanation shall be included of how environmental factors affect the design and consideration of alternatives.	2, 4, 17	2.12, 2.13; Chapter 4 under the 'Effects on Project Design, Construction, and Operations and Maintenance' heading; 17.7
4.3.2.2	17	The Proponent shall provide the rationale for selecting Project components and shall discuss the state of the art of the various technologies being proposed.	2	2.12
4.3.2.2	18	The Proponent shall indicate the known experience with, and the effectiveness and reliability of these techniques, procedures and policies, particularly under arctic or subarctic conditions, in Canada and elsewhere, and their relation to best practice in Canada.	2	2.12
4.3.2.2	18	This discussion shall also show how design, engineering and proposed procedures are compatible with the environment and the local communities and shall minimize adverse environmental and social effects.	2, 11, 12, 13, 14, 16, 17	2.12, 2.13, 2.14; Chapters 11, 12, 13, 14, 16 under the 'Construction' and 'Operations and Maintenance' headings in each VEC section; 17.7

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.3.2.2	18	The EIS shall analyze and compare the design alternatives for the Project in relation to their environmental and social costs and benefits, including those alternatives which cost more to build and / or operate but which result in reduced adverse environmental effects or more durable social and economic benefits.	2, 11, 12, 13, 14, 16	2.11, 2.12; Chapters 11, 12, 13, 14, 16 under the 'Evaluation of Project Alternatives' heading in each VEC section
4.3.2.2	18	Alternatives for the pace and scale of the operation shall be discussed, and the chosen alternative justified.	2	2.11, 2.12
4.3.2.2	18	The Proponent shall also indicate under what circumstances a change in economic conditions may influence its selection of preferred alternative means.	2	2.12, 2.13
4.3.2.2	18	Alternative means of carrying out the Project shall include: (a) Transmission Line Corridor Selection – Following the Trans Labrador Highway Phase 2 and 3 along its entirety across southern Labrador to the Strait of Belle Isle.	2	2.12.6, Table 2.12.6-1, Figure 2.12.6-1
4.3.2.2	18	– Following a portion of the Trans Labrador Highway, Phase 3, in combination with new corridor(s) across southern Labrador to the Strait of Belle Isle.	2	2.12.6, Table 2.12.6-1, Figure 2.12.6-1
4.3.2.2	18	– Alternative corridors across the Long Range Mountains, including to the Cat Arm Hydroelectric Project and then following the existing Cat Arm Hydroelectric Project transmission corridor south.	2, 17	2.12.6, Table 2.12.6-1, Figure 2.12.6-1
4.3.2.2	18	– Alternative corridors across the Strait of Belle Isle including alternative landing sites and configurations.	2	2.12.4
4.3.2.2	18	– Alternative means of constructing/installing subsea cables (e.g., tunnelling entire route) including alternative means/locations for disposal of dredge/side-cast spoils.	2	2.12.3
4.3.2.2	18	– Alternative routes/locations for temporary and permanent access roads, laydown areas, work camps.	2	2.12.7, 2.13
4.3.2.2	18	– Alternative sites for placement of electrodes (marine and land) and associated infrastructure.	2	2.12.5
4.3.2.2	18	– Alternative means of accessing the corridor including, but not limited to, helicopter, permanent access roads, temporary access roads and ice roads.	2	2.12.7, 2.13

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	**Page**		**Chapter(s)**	**Section(s)**
4.3.2.2	18	(b) Layout, Clearing and Siting The Proponent shall evaluate layout and locations, including access roads or trails, quarries, borrow pits and camps, based on a variety of engineering and environmental considerations. For access roads, the EIS shall consider alternative locations of stream crossings and types of crossing structures and the use of winter roads. For clearing, the Proponent shall consider alternative clearing methods, including mechanical and manual clearing. For quarries, access roads, and tower installations, the EIS shall outline the methods for prediction and prevention of acid rock drainage and metal leaching to be used in the site selection process.	2, 12, 13, 16	2.12.7, 2.13; Chapters 12, 13, 16 under 'Construction' and 'Operations and Maintenance' headings in each VEC section
4.3.2.2	19	(c) Construction Sequence The EIS shall consider alternative construction sequences.	2, 3	2.12.7
4.3.2.2	19	(d) Construction Labour Force Accommodation The EIS shall describe alternative labour force accommodation strategies (e.g., number and location of camps, in-community housing). These evaluations are to consider economic, social and worker conditions (including health and hygiene) as well as any other relevant community, including Aboriginal community, considerations and environmental factors.	2, 3, 16	2.12.7
4.3.2.2	19	(e) Operations and Maintenance Alternative means of controlling vegetation within the right of way, including both mechanical and chemical means.	2, 3, 12, 13, 16	2.12.7, 3.5; Chapters 12, 13, 16 under 'Construction' and 'Operations and Maintenance' headings in each VEC section
4.3.2.2	19	Alternative locations of permanent access roads.	2, 3	2.12.7, 2.13, 3.4.2.1
4.3.2.2	19	Where such facilities are yet to be located, a site selection process and evaluation process shall be described to demonstrate how potential environmental effects will be avoided or mitigated.	2	2.12.7, 2.13
4.3.3 Project Description	19	The Proponent shall describe the scope of the Project for which the EIS is being conducted.	1, 3, 17	1.1, 3.1, 17.1

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[a] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.3.3	19	The Proponent shall produce appropriate audiovisual materials describing the Project.	7, 8	7.1[b], 8.3
4.3.3	19	The proposed principal structures and related works to be described include but is not limited to the following: – towers	3	3.3.2.1
4.3.3	19	– conductors	3	3.3.2.1
4.3.3	19	– converter stations	3	3.3.1, 3.3.3
4.3.3	19	– electrodes and related infrastructure	3	3.3.4
4.3.3	19	– cable crossings of the Strait of Belle Isle	3	3.3.2.2
4.3.3	19	– cable landing sites and telecommunications services for Project operations (microwave radio system, fibre optic cable system)	3	3.3.2.1, 3.3.2.3
4.3.3	19	Related works and activities including all temporary facilities required for the construction and operation of the previously mentioned facilities, in particular: – Work camps	3	3.4.2.3
4.3.3	20	– Permanent and temporary access roads, trails and ice roads	3	3.4.2.1
4.3.3	20	– Bridges and watercourse crossings (including fording activities)	3	3.4.2.2
4.3.3	20	– Infrastructure for wastewater treatment & waste management	3	3.3.1, 3.4.2.3, 3.4.3.1
4.3.3	20	– Energy supply for camps and worksites	3	3.4.2.3
4.3.3	20	– Drinking water supply	3	3.4.2.3, 3.4.3.1
4.3.3	20	– Borrow pits and quarries	3	3.4.2.5
4.3.3	20	– Management and disposal of excavated material including that associated with marine works	3	3.4.3.6
4.3.3	20	– Management and disposal of hazardous material and waste	3	3.4.3.6
4.3.3	20	– Construction worksites and storage areas	3	3.4.2.4

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	**Page**		**Chapter(s)**	**Section(s)**
4.3.3.1 Spatial and Temporal Boundaries	20	A precise description of the spatial boundaries of the Project shall be presented accompanied by map(s) of appropriate scale showing the entire project area with the proposed principal structures and related works.	3	3.2
4.3.3.1	20	Detailed digital GIS based files shall be available showing the locations of any camps, structures, routes, clearings, etc.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Construction' and 'Operations and Maintenance' headings in each VEC section
4.3.3.1	20	The Proponent shall provide aerial images that illustrate representative habitats within each study area.	Vegetation Component Study (CS)	Throughout
4.3.3.1	20	The temporal boundaries of the Project shall cover all phases of the project: construction, operation, maintenance, foreseeable modifications and abandonment and decommissioning of works and the rehabilitation of the sites affected by the Project. If the Proponent does not believe the full temporal boundaries should be used for a phase of the Project, the report shall identify the boundaries used and provide a rationale for the boundaries selected.	9, 11, 12, 13, 14, 16	9.3.2; Chapters 11, 12, 13, 14, 16 under the 'Temporal Boundaries' heading in each VEC section
4.3.4 Construction	20	The EIS shall show the construction and commissioning schedules for Project elements, based on the most current information available.	3	3.4.1, Figure 3.4.1-1
4.3.4	20	In addition, the approach, details, materials, methods, locations and security measures of all planned construction activities related to the physical features, including site preparation, permanent and temporary infrastructure and site rehabilitation shall be presented including estimates of magnitude or scale where applicable.	3, 11, 12, 13, 14, 16	3.4; Chapters 11, 12, 13, 14, 16 under the 'Construction' heading in each VEC section
4.3.4	20	– Transmission Line – Describe the construction methods for the transmission line, including: – towers	3	3.4.3.2
4.3.4	20	– poles	3	3.4.3.2, 3.4.3.4
4.3.4	20	– conductors	3	3.4.3.2

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.3.4	20	– telecommunications services for Project operations (microwave radio system, fibre optic cable system)	3	3.3.6
4.3.4	21	– crossings of water bodies	3	3.4.2.2
4.3.4	21	– access roads	3	3.4.2.1
4.3.4	21	– modifications to existing facilities	3	3.4.3.5
4.3.4	21	– Describe the routing, type of line and interconnection points of the transmission lines	3	3.3.2.1, 3.3.2.3
4.3.4	21	– Describe the volume of wood (e.g., merchantable and non-merchantable) within the right-of-way and clearing, salvage and removal methods	3, 12	3.4.3.2, 12.2.5.8
4.3.4	21	– Describe the communications plan, with respect to aircraft, that is required with the Department of National Defence (5 Wing Goose Bay) to prevent any incidents from occurring	3	3.4.1.1
4.3.4	21	– Describe any possible restrictions to low level flying activities	3	3.4.1.1
4.3.4	21	– Describe any possible restrictions to land use, including measures of notifying land users of ongoing construction activities	3	3.4.1.1
4.3.4	21	– Convertor stations	3	3.4.3.1
4.3.4	21	– Describe the construction methods for the buildings, offices, maintenance areas, water and sewage works, electrical equipment and switchgear	3	3.4.3.1, 3.4.2.3, 3.4.2.4
4.3.4	21	– Electrodes	3	3.4.3.4
4.3.4	21	– Describe the construction methods for the onshore junction houses, installation of the bundled individual cables and electrodes	3	3.4.3.4
4.3.4	21	– Cable crossings and landing sites at the Strait of Belle Isle	3	3.4.3.3
4.3.4	21	– Describe the construction methods for the subsea, tidal and on land preparation, protection techniques for cables, tunnelling, drilling, trenching, backfilling and blasting activities, ocean disposal, cable pull-in and laying, onshore landing stations	3	3.4.3.3
4.3.4	21	– Right-of-Way Clearing	3	3.4.3.2

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.3.4	21	– Describe the work required and schedule for right-of-way preparation including volume of merchantable and non-merchantable wood, location of cleared areas, harvesting strategy (e.g., roads, labour)	3, 12	3.4.1, 3.4.3.2, 12.2.5.8
4.3.4	21	– Describe methods for wood clearing/harvesting	3	3.4.3.2
4.3.4	21	– Describe the work required to prepare the sea bed for cable laying and associated infrastructure	3	3.4.3.3
4.3.4	21	– Describe the work required to prepare the cable landing sites	3	3.4.3.3
4.3.4	21	– Access Infrastructure	3	3.4.2.1
4.3.4	21	– Describe the permanent and temporary access infrastructures (including road, air and water) to be constructed, as well as existing infrastructures to be utilized	3	3.4.2.1
4.3.4	21	– Describe new access roads or trails and corridors (including locations, current and anticipated traffic, technical characteristics and general road construction standards such as maintenance, useful life, ditches, bridges and culverts including fording activities, and use of dust-control and de-icers) and any modifications and / or upgrades required to existing access infrastructures	3, 12, 13, 16	3.4.2.1; Chapters 12, 13, 16 under the 'Construction' and 'Operations and Maintenance' headings in each VEC section
4.3.4	22	– Describe the communications plan, with respect to aircraft, that is required with the Department of National Defense (5 Wing Goose Bay) to prevent any incidents from occurring	3	3.4.1.1
4.3.4	22	– Describe any possible restrictions to low level flying activities	3	3.4.1.1
4.3.4	22	– Describe any possible restrictions to land use, including measures of notifying land users of ongoing construction activities	3	3.4.1.1
4.3.4	22	– Borrow Pits, Quarries and Spoil Areas	3	3.4.2.5
4.3.4	22	– Identify the source, quantity and end use of all rock and aggregate materials to be used	3	3.4.2.5
4.3.4	22	– Identify the source, quantity and proposed disposal location of all excavated materials including marine disposal	3	3.4.3.6

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.3.4	22	– If quarrying/excavating/using rock with the potential for acid generation, outline the methods for prediction and prevention of metal leaching and acid rock drainage (ML/ARD), and provide an assessment of potential for impacts of metal leaching and acid rock drainage (ML/ARD)	3	3.4.2.5
4.3.4	22	– Personnel Requirements	3, 16	3.7.1, 16.4.5.4
4.3.4	22	– Present the estimated size of projected workforce by month or quarterly over the construction phase, indicating occupations by National Occupation Classification (NOC) Codes, skills, entry requirements and duration of work	3, 16	3.7.1, 3.7.3, Table 3.7.3-1, 16.4.5.4, Table 16.4.5-2
4.3.4	22	– Whether the positions are full-time equivalent or actual positions. If they are actual positions, the breakdown of full-time and part-time or full-year and part-year positions	3, 16	3.7, 16.4.5.4
4.3.4	22	– The estimated skill composition demands for the workforce (i.e., do the positions require the experience of a journeyperson or apprentice)	3, 16	3.7.1, 16.4.5.4
4.3.4	22	– Estimated percentage of the hired workforce from Newfoundland and Labrador	3	3.7
4.3.4	22	– Estimated percentage of the hired workforce from Labrador	3	3.7
4.3.4	22	– Describe the anticipated working schedule for Project construction activities	3, 16	3.7.3.1, 16.3.5.1, 16.7.5.1
4.3.4	22	– Protected Areas	3, 15, 16	3.3.2, 15.5.12, 16.5
4.3.4	22	– Where the final alignment of the proposed, or alternate corridors or construction infrastructure comes within one kilometre or less of an existing or proposed provincial protected area, the EIS shall describe the placement of towers and associated access and construction infrastructure (i.e., roads, trails, bridges, quarries etc.)	16	16.5.5.6
4.3.4	22	– Temporary Structures and Infrastructure	3	3.4.2

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.3.4	22	– Describe camp locations, drinking water supply source, method of managing wastewater and discharge areas, location and capacity and operating conditions of solid waste disposal sites, power supply, and management of any other installations (including fuel storage depots) required for the camps to function properly and safely	3	3.4.2.3
4.3.4	23	– Provide the scope and location of any communication and telecommunications systems required by the Project (e.g., transmission towers, access roads, energy sources)	3	3.3.6
4.3.4	23	– Identify and quantify the use, management and production of dangerous products and hazardous waste generated by the Project during the construction phase	3, 11	3.4.3.6, 3.6.2, 11.2.5, Table 11.2.5-5
4.3.4	23	– Describe construction-water sources and methods of accessing and delivering water to construction sites for purposes such as mixing cement and drilling rock, Estimate the volumes of water required for construction purposes	3	3.4.2.6, 3.4.3.3
4.3.4	23	– Identify the location, capacity and access to material and fuel receiving, handling and storage areas	3	3.4.2.4
4.3.4	23	– Describe the location, capacity and access to disposal and recycling sites for domestic and construction waste, including those developed during construction and existing sites to be used for the Project	3	3.4.3.6
4.3.4	23	– Identify and describe potential landing areas for wood piles or wood storage sites	3	3.4.3.2
4.3.4	23	– Provide an inventory of equipment and materials required for the Project, including hazardous materials	3	3.4.5
4.3.4	23	– Describe the storage of hazardous materials	3	3.6.2
4.3.4	23	– Describe any storage or use of explosives	3	3.4.3.2, 3.6.2
4.3.4	23	– Describe the communications plan, with respect to aircraft, that is required with the Department of National Defence (5 Wing Goose Bay) to prevent any incidents from occurring	3	3.4.1.1

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.3.4	23	– Describe any possible restrictions to low level flying activities	3	3.4.1.1
4.3.4	23	– Mitigation and Compensation Works:	3, 11, 12, 13, 14, 16	3.6; Chapters 11, 12, 13, 14, 16 under the 'Construction' and 'Operations and Maintenance' headings in each VEC section; 11.3.1, 12.6.1, 13.4.1, 14.5.1, 16.9.1
4.3.4	23	– Describe any physical works proposed as mitigation or compensation measures (e.g., sedimentation control)	12, 13, 14, 16	Throughout Chapter 12; 12.6.1, Tables 12.6.1-1, and 12.6.1-2; 13.2.5.1, 13.2.6.1, 13.3.5.1, 13.3.6.1, Tables 13.4.1-1 and 13.4.1-2; 14.2.5.1, Table 14.5.1-1; 16.6.5.1, Table 16.9.1-1
4.3.4	23	– Describe the communications plan, with respect to aircraft, that is required with the Department of National Defence (5 Wing Goose Bay) to prevent any incidents from occurring	3, 16	3.4.1.1, 16.5.5.1, 16.9.2
4.3.4	23	– Describe any communications plan to notify land users of ongoing construction activities to address potential incidents and conflicts	3	3.4.1.1
4.3.4	23	– Describe any restrictions on worker's fishing, hunting or other land use activities to prevent adverse effects on local fish and wildlife populations	12, 13	12.3.5.1, 12.4.5.1, 12.5.5.1, Table 12.6.1-1; 13.3.5.1, 13.3.6.1, Tables 13.4.1-1 and 13.4.1-2
4.3.4	23	– Demobilization:	3	3.4.6
4.3.4	23	– Describe the approach and conceptual plans for demobilizing all structures used or created during construction that are of a temporary nature	3	3.4.6

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.3.4	24	– Identify, within the limits of the Proponent's knowledge and control, how the operation, use, development, possible rebuilding and eventual dismantling and demobilization of certain installations shall be handled in consideration of other uses	3	3.4.6
4.3.4	24	– Specifically note, to the extent possible, whether some installations, including all of the access infrastructures, may be used as they are, or may be converted or salvaged for other purposes by other proponents or communities, or if they must be dismantled and demobilized at the end of their useful life. The proposed means of rehabilitation of any areas to be abandoned shall be described	3	3.4.6
4.3.5 Operations and Maintenance	24	All aspects of the Operations and Maintenance of the undertaking shall be detailed in this section of the EIS. This shall include: (a) Transmission Lines and Access Roads (or trails): – Maintenance (e.g., vegetation management, dust control, de-icing) of roads or trails and transmission facilities shall be described	3, 11	3.5.1, 3.5.2, 11.2.6
4.3.5	24	– Electromagnetic fields shall be described temporally and spatially	3	3.5.3
4.3.5	24	– Maintenance of underwater cables	3	3.5.2.2
4.3.5	24	– Maintenance of shore electrodes	3	3.5.2.2
4.3.5	24	– Describe the communications plan, with respect to aircraft, that is required with the Department of National Defence (5 Wing Goose Bay) to prevent any incidents from occurring	3, 16	3.4.1.1, 16.9.2
4.3.5	24	– Describe any possible restrictions to low level flying activities	3, 16	3.4.1.1, 16.9.2
4.3.5	24	– Describe any communications plan to notify land users of ongoing Operations and Maintenance activities to address potential incidents and conflicts	3, 16	3.4.1.1, 16.5.6.4
4.3.5	24	(b) Convertor stations:	3	3.5.1, 3.5.2
4.3.5	24	– Electromagnetic fields shall be described temporally and spatially	3	3.5.3
4.3.5	24	(c) Electrodes	3	3.5.1, 3.5.2

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.3.5	24	– Electromagnetic fields shall be described temporally and spatially	3	3.5.3
4.3.5	24	(d) Cable crossings and landing sites at Strait of Belle Isle:	3	3.5.1, 3.5.2
4.3.5	24	– Electromagnetic fields shall be described temporally and spatially	3	3.5.3
4.3.5	24	– Describe any temperature rise in water and sediments adjacent to the cable and any associated environmental effects	3, 14	3.5.3, 14.2.6.1
4.3.5	25	(e) Personnel Requirements:	3, 16	3.7.2, 16.4.6.4
4.3.5	25	– A profile of the estimated work force (including occupations by National Occupation Classification (NOC) Codes, skills, entry requirements and duration of work) shall be provided	3, 16	3.7.3, 16.4.6.4
4.3.5	25	– The estimated number of workers required by occupation by month	3, 16	3.7.2, 3.7.3, 16.4.6.4
4.3.5	25	– Whether the positions are full-time equivalent or actual positions. If they are actual positions, the breakdown of full-time and part-time or full-year and part-year positions	3, 16	3.7.2, 3.7.3,16.4.6.4
4.3.5	25	– The skill composition demands for the workforce (i.e., do the positions require the experience of a journeyperson or apprentice)	3, 16	3.7.2, 3.7.3,16.4.6.4
4.3.5	25	– Estimated percentage of the hired workforce from Newfoundland and Labrador	3	3.7
4.3.5	25	– Estimated percentage of the hired workforce from Labrador	3	3.7
4.3.5	25	– Working schedules for Project Operations and Maintenance activities shall be included.	3	3.7
4.3.5	25	(f) Fuel and Dangerous and Hazardous Products and Waste:	3, 11, 12, 13, 14, 16	3.4.5, 3.6.2; Chapters 11, 12, 13, 14, 16 under the 'Operations and Maintenance' heading in each VEC section; 11.3.1, 12.6.1, 13.4.1, 14.5.1, 16.9.1

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.3.5	25	– Identify and quantify the use, management and production of dangerous and hazardous products and waste generated by the Project during the Operations and Maintenance phase	3, 11, 12, 13, 14, 16	3.4.5, 3.6.2; Chapters 11, 12, 13, 14, 16 under the 'Operations and Maintenance' heading in each VEC section; 11.3.1, 12.6.1, 13.4.1, 14.5.1, 16.9.1
4.3.5	25	– Describe material and fuel receiving, handling and storage areas and provision for management and disposal of waste and discarded equipment	3, 12, 13, 14, 16	3.4.5, 3.6.2; Chapters 12, 13, 14, 16 under the 'Operations and Maintenance' heading in each VEC section; 12.6.1, 13.4.1, 14.5.1, 16.9.1
4.3.5	25	– Describe procedures for management and remediation of spills of hazardous/dangerous material	3, 5, 11, 12, 13, 14, 16	3.6.2, Appendix 3-3, 5.6.1; Chapters 11, 12, 13, 14, 16 under the 'Accidents and Malfunctions' heading in the 'Environmental Effects Summary' in each VEC section
4.3.5	25	(g) Operating Requirements	3	3.5, Appendix 3-1
4.3.5	25	– The Proponent shall describe, in addition to permits and authorizations, all other requirements to operate the Project, including leases and insurance	3	3.5, Appendix 3-1
4.3.6 Decommissioning	25	The EIS will present an approach for the decommissioning phase of the Project, which sets out a commitment to address: (a) environmental planning and mitigation measures	3	3.5.4
4.3.6	25	(b) socio-economic mitigation measures	3	3.5.4
4.3.6	25	(c) public health and safety procedures	3	3.5.4

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.4 Environment				
4.4.1 Identification of Issues and Selection of Valued Environmental Components (VECs)	25	The Proponent shall identify the key issues related to the Project.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Potential Environmental Issues' heading in each VEC section
4.4.1	25	To help focus the environmental assessment, the Proponent shall identify and justify, based on a clearly defined set of criteria, those components of the biophysical and socioeconomic environment that are most valued and / or sensitive, and which have a meaningful potential to be affected by the Project (the "Valued Environmental Components" or VECs).	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Valued Environmental Component Selection' heading in each VEC section
4.4.1	26	In considering VECs, the Proponent shall recognize: – that the value of a component not only relates to its role in the ecosystem, but also to the value placed on it by humans	11, 12, 13, 14	Chapters 11, 12, 13, 14 under the 'Valued Environmental Component Selection' heading in each VEC section
4.4.1	26	– that culture and way of life of those using the area affected by the Project may also be considered as VECs	16	Chapter 16 under the 'Valued Environmental Component Selection' heading in each VEC section
4.4.1	26	– and that functional relationships within the environment may also be considered as VECs	12, 13, 14	Chapters 12, 13, 14 under the 'Valued Environmental Component Selection' heading in each VEC section

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.4.2 Study Areas	26	The Proponent shall determine study areas specific to each VEC.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Environmental Assessment Study Areas' heading in each VEC section
4.4.2	26	Each study area should be inclusive of the landscape necessary to predict the environmental effects of the Project on each VEC. For the purposes of assessing the Project's effects on the socio-economic environment, the study areas shall take into consideration the landscape used to support contemporary and historic Aboriginal and non-Aboriginal land use.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Environmental Assessment Study Areas' heading in each VEC section
4.4.2	27	The rationale used to delineate the boundaries of the study areas shall be provided	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Environmental Assessment Study Areas' heading in each VEC section
4.4.3 Previous Development	27	The EIS should include a concise discussion (where such information is available and relevant to the Projects potential environmental effects) of similar past large scale transmission line projects and any other large scale linear projects within and beyond the boundaries of the province, as appropriate.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Existing Knowledge' heading in each VEC section
4.4.3	27	and the environmental effects that have occurred as a result	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Existing Knowledge' heading in each VEC section
4.4.3	27	where overlapping environmental effects are anticipated	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Cumulative Effects Assessment' heading in each VEC section

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.4.3	27	and the measures that have been taken to mitigate or manage these overlapping environmental effects	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Construction', 'Operations and Maintenance ' and 'Cumulative Effects Assessment' headings in each VEC section
4.4.3	27	Discussion of overlapping environmental effects should include consideration of the degree to which those mitigation measures have been successful.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Existing Knowledge', 'Construction', 'Operations and Maintenance ' and 'Cumulative Effects Assessment' headings in each VEC section
4.4.3	27	Any long-term monitoring or follow-up programs of relevance to these overlapping environmental effects and the key results should also be described. This information will help interested parties to understand the potential environmental effects of the Project and how they may be addressed.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Existing Knowledge', 'Cumulative Effects Assessment' and 'Monitoring and Follow-up' headings in each VEC section
4.4.4 Description of the Existing Environment	27	The EIS shall identify the study area for each VEC and include a description of the existing biophysical and socio-economic environment and the resources within it that will be affected or that might reasonably be expected to be affected, directly or indirectly, by the Project.	10, 15, Component Studies[(c)]	Throughout
4.4.4	27	The EIS shall describe relevant aspects of the existing environment in the study area for each VEC prior to development of the Project, which constitutes the reference state of the environment.	10, 15, Component Studies[(c)]	Throughout

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.4.4	27	This description of the environment must reflect available Aboriginal traditional and community knowledge	10, 15, Component Studies[(c)]	Chapters 10, 15 under the 'Aboriginal Ecological Knowledge' heading; Community knowledge throughout
4.4.4	27	as well as social	15	15.3, 15.5
4.4.4	27	cultural	15	15.2, 15.5.7
4.4.4	27	and economic activities and values related to the described components	15	15.4, 15.5, 15.6, 15.7
4.4.4	27	The description, depending on the study area, would also include physical/chemical characterization of sea bed sediments that may be disturbed and of any proposed marine disposal site.	10, Marine Environment CS[(c)]	10.5.2.2, 10.5.8.3
4.4.4	28	Where appropriate and possible to do so, the Proponent shall present a time series of data and sufficient information to establish the averages, trends and extremes of the data that are necessary for the evaluation of potential environmental and cumulative effects of the Project.	10, 15	Throughout
4.4.4	28	For each VEC, the Proponent should consider and justify how far back in time and how far into the future the environmental assessment should be conducted.	9, 11, 12, 13, 14, 16	9.3.2; Chapters 11, 12, 13, 14, 16 under the 'Temporal Boundaries' heading and 'Cumulative Effects Assessment ' in each VEC section
4.4.4	28	The Proponent will identify any deficiencies in information, and how these deficiencies will be addressed.	6, 10, 15	6.5.3; Chapters 10, 15 under the 'Information Sources and Data Collection Methods' sections
4.4.4	28	Using original and existing qualitative and quantitative surveys and studies, the EIS shall describe the components of the biophysical and human environments likely to be affected by the Project.	10, 15, Component Studies[(c)]	Throughout

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.4.4	28	If the information available from government or other agencies is insufficient or no longer representative, the Proponent shall complete the description of the environment with current surveys and studies.	10, 15, Component Studies[(c)]	Throughout
4.4.4	28	Components of the environment must be described and this shall include the necessary data and the required information to understand, interpret and address the confidence levels of these data (methods, survey dates and times, weather conditions, location of sampling stations, etc. as appropriate)…	10, 15, Component Studies[(c)]	Throughout
4.4.4	28	…and shall employ appropriate methods to identify, understand, analyze and assess the environmental effects of the Project.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Approach to environmental Effects Analysis', 'Construction' and 'Operations and Maintenance' headings in each VEC section
4.4.4	28	If the required information is neither available nor able to be generated, the Proponent shall include an explanation of efforts made to obtain the information and, where possible, reasons why it cannot or will not be provided.	6, 10, 15	6.5.3; Chapters 10, 15 under the 'Information Sources and Data Collection Methods' section
4.4.4	28	In addition, the EIS shall describe environmental interrelationships and sensitivity to disturbance.	10, 15	Throughout
4.4.4	28	If the study results or data have been extrapolated or otherwise manipulated to depict environmental conditions in the study area modeling methods and equations shall be described with calculations of margins of error and / or confidence limits.	10, 15, Component Studies[(c)]	Chapters 10, 15 under the 'Information Sources and Data Collection Methods' section
4.4.4	28	A description of the existing environment shall be developed for each alternative drawing specific reference to the VECs. References are attached at the end of these Guidelines to provide direction to the Proponent.	10, 15	Throughout
4.4.4.1 Atmospheric Environment	28	The Proponent shall describe the relevant components of the atmospheric environment within the study area of the VECs, including the following: – Climate and meteorology	10	10.2.1

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.4.4.1	28	– Indication of recent climate change observations	10	10.2.1.3
4.4.4.1	28	– Any emissions of greenhouse gases	10	10.2.1.4
4.4.4.1	28	– Existing ambient noise level	10	10.2.3
4.4.4.2 Aquatic Environment (Freshwater and Marine)	29	The Proponent shall describe the relevant components of the aquatic environment within the study area of the VECs, including the following: – Biological diversity	10	10.4, 10.5
4.4.4.2	29	– composition	10	10.4, 10.5
4.4.4.2	29	– abundance	10	10.4, 10.5
4.4.4.2	29	– distribution	10	10.4, 10.5
4.4.4.2	29	– population dynamics	10	10.4, 10.5
4.4.4.2	29	– sensitivity to disturbance and habitat utilization (including identification of sensitive/critical habitats) of aquatic species, including fish, semi-aquatic species, seabirds and marine mammals	10, Component Studies (Marine Environment)[(c)]	10.3.6, 10.4.5, 10.5.8, 10.5.9, 10.5.10
4.4.4.2	29	– Species of special interest or conservation concern (including their habitat), with an emphasis on rare, vulnerable or threatened species (e.g., species listed in the *Endangered Species Act*, *Species at Risk Act* as well as COSEWIC and Species Status Advisory Committee (SSAC) assessed species.)	10	10.4.6, 10.5.11
4.4.4.2	29	– Areas of special interest (Strait of Belle Isle is considered an ecologically and biologically significant area (EBSA) characterized by its significance for marine mammals.)	10	10.5.6, 10.5.7, 10.5.9
4.4.4.2	29	– Description of physical oceanography in the Strait of Belle Isle and characterization of the ice regime, including iceberg movement and distribution, groundings, and scour depth	10	10.5.2, 10.5.3, 10.5.4, 10.5.5
4.4.4.2	29	– Details re fish habitat classification and quantification	10	10.4.3, 10.5.8
4.4.4.2	29	– Fish mortality from Construction and Operations	13, 14	13.3.5, 13. 3.6, 14.2.5,14.2.6
4.4.4.2	29	– Human-environment interactions	16	Throughout

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.4.4.3 Terrestrial Environment	29	The Proponent shall describe the relevant components of the terrestrial environment within the study area of the VECs, including the following: – Relative abundance of species/systems to be included to assess potential impacts (looking both inside and outside of impacted area)	10	10.3.3, 10.3.4, 10.3.5, 10.3.6, 10.3.7
4.4.4.3	29	– Bedrock and surficial geology, terrain and soil conditions	10	10.3.1, 10.3.2
4.4.4.3	29	– Any permafrost conditions, including areas of discontinuous permafrost	10	10.3.2
4.4.4.3	29	– Species of special interest or conservation concern (including their habitat), with an emphasis on rare, vulnerable or threatened species (e.g.: species listed in the Endangered Species Act, Species at Risk Act as well as COSEWIC listed species and SSAC assessed species.)	10	10.3.3.3, 10.3.4.3, 10.3.6.3, 10.3.7.3
4.4.4.3	29	– Composition, abundance, distribution, population dynamics and habitat utilization of terrestrial fauna, including:	10	10.3.4, 10.3.5, 10.3.6, 10.3.7
4.4.4.3	29	– mammals	10	10.3.4, 10.3.5, 10.3.6
4.4.4.3	29	– avifauna (e.g., raptors and migratory birds including landbirds, rare fauna, waterfowl and shorebirds)	10	10.3.7
4.4.4.3	29	– fauna (including migratory species)	10	10.3.4, 10.3.5, 10.3.6, 10.3.7
4.4.4.3	29	– fauna species at risk	10	10.3.4.3, 10.3.6.3, 10.3.7.3
4.4.4.3	29	– and potential habitat for fauna species at risk	10	10.3.4.3, 10.3.6.3, 10.3.7.3
4.4.4.3	29	– Composition, distribution and abundance of terrestrial flora, including forest inventories and ecological land classifications. Flora (include lichens), including typical species, rare species, species at risk, non-native species and potential habitat for flora species at risk	10, Component Studies[(c)]	10.3.3.3
4.4.4.3	30	– Existing patterns of habitat and ecotype alteration, disruption and destruction i.e., document existing land uses with the objective of determining existing and projected footprint	10, 15, Component Studies[(c)]	10.3.3.3, 15.5

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.4.4.3	30	– Composition, distribution and abundance of medicinal herbs and plants harvested by affected Aboriginal communities. This should be based in whole or in part on information on importance and use of these herbs and plants as provided to Nalcor by Aboriginal communities	10, Component Studies[(c)]	10.3.3.2, 10.3.3.3
4.4.4.3	30	– Composition, distribution and abundance of wetlands as classified using the Canada Wetland Classification System	10, Component Studies[(c)]	10.3.3.2, 10.3.3.3
4.4.4.3	30	– Further characterization, in terms of a map with wetlands/wetland complexes identified and a table which gives the size and the dominant class of the identified wetlands	10	10.3.3.3
4.4.4.3	30	– A functional analysis (e.g., habitat, water flow regulation, groundwater recharge) shall be conducted only for those wetlands that are expected to be directly affected	12	12.2.5.4
4.4.4.3	30	– Migratory patterns/migratory wildlife river crossings	10	10.3.4.3
4.4.4.3	30	For the Terrestrial Environment some key indicator species/species assemblages were selected to focus the environmental assessment. The species selected are reflective of different phyla, orders, families or guilds of species that represent key components of the Terrestrial Environment. These species were selected as being representative of species groups, importance in the food web (e.g., top predator), and their importance from socio-cultural and economic perspectives. The following is the list of these key indicators:	10	10.3
		(a) Caribou	10	10.3.4
4.4.4.3	30	(b) Harlequin duck	10	10.3.7
4.4.4.3	30	(c) Waterfowl (including early and late breeding, molting and staging)	10	10.3.7
4.4.4.3	30	(d) Shorebirds	10	10.3.7
4.4.4.3	30	(e) Upland game birds (including Willow and Rock Ptarmigan)	10	10.3.7
4.4.4.3	30	(f) Raptors	10	10.3.7
4.4.4.3	30	(g) Landbirds (including passerine and song birds)	10	10.3.7
4.4.4.3	30	(h) Black Bear	10	10.3.5

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.4.4.3	30	(i) Moose	10	10.3.5
4.4.4.3	30	(j) Marten	10	10.3.6
4.4.4.3	30	(k) Lynx/Coyote/Wolves	10	10.3.6
4.4.4.3	30	(l) Flora species (Plants and Lichens)	10	10.3.3
4.4.4.4 Land and Resource Use	30	The Proponent shall describe relevant land and resource use within the study area of the VECs, including the following: – Present and potential timber resource logging/harvesting and utilization (commercial and domestic)	10, 15	10.3.3, 15.5.13
4.4.4.4	31	– existing roads	15	15.5.4
4.4.4.4	31	– transmission lines	1, 15	1.2, Figure 1.2-2, 15.8.4
4.4.4.4	31	– other linear features	15	15.5.4
4.4.4.4	31	– other developments	15	15.5.14
4.4.4.4	31	– and natural disturbances such as fire	10	10.3.3
4.4.4.4	31	– Current use of land and resources (including freshwater and marine aquatic resources) by Aboriginal persons for traditional purposes, including:	10, 15	Chapters 10, 15 under the 'Aboriginal Ecological Knowledge' headings
4.4.4.4	31	– location of camps	15	15.5.7
4.4.4.4	31	– harvested species	10, 15	10.3.3, 15.5.7
4.4.4.4	31	– and transportation routes	15	15.5.7
4.4.4.4	31	– Mapping in relation to Aboriginal land use shall include Aboriginal toponyms, where relevant and available to the Proponent, in addition to common and accepted local place names	15	15.5.7
4.4.4.4	31	– Current use of land and resources (including freshwater and marine aquatic resources) by other users (including agricultural, petroleum and mineral exploration, quarries, structural development such as cabins, outfitting camps, trapper's camps, etc.)	15	15.5, 15.6
4.4.4.4	31	– Other rural land and resource use including:	15	15.5

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.4.4.4	31	– existing and potential recreational and commercial fishing (freshwater and marine) and the fishing gear used	15	15.5.6, 15.5.8, 15.6
4.4.4.4	31	– hunting, gathering of country food	15	15.5.5, 15.5.7, 15.5.8
4.4.4.4	31	– and collection of plant propagules	15	15.5.7
4.4.4.4	31	– Current use of land and water resources for supply of domestic potable water for individuals and communities	15	15.5.3
4.4.4.4	31	– Current navigational use (e.g., vessel/boat traffic) and winter travel in areas of: – Electrodes – Sub sea cables	15	15.5.4
4.4.4.4	31	– temporary/permanent water crossings	15	15.5.4
4.4.4.4	31	– and any other works than are placed in, on, over, through, or across any navigable water	15	15.5.4
4.4.4.4	31	– Location and description of unique sites or special features, including: – any candidate sites for ecological or cultural heritage preservation and conservation	15	15.2.3, 15.2.4, 15.2.5, 15.5.12
4.4.4.4	31	– Environmentally Sensitive Areas	15	15.5.12
4.4.4.4	31	– reserves or protected areas	15	15.5.12
4.4.4.4	31	– conservation agreement lands	15	15.5.12
4.4.4.4	31	– and habitat enhancement projects	12	12.4.5, 12.6.1, 14.2.5.1, Table 12.6.1-1
4.4.4.4	31	– Landscapes, landscape integrity, aesthetics, wilderness values	15	15.5.12, 15.7, 15.8
4.4.4.5 Cultural Heritage Resources	31	The Proponent shall describe relevant cultural heritage resources in the study areas of the VECs, including: – Burial, cultural, spiritual and heritage sites	15	15.2, 15.5.7
4.4.4.5	31	– Historic and archaeological resources, including those underwater	15	15.2.3
4.4.4.5	31	– Palaeontological resources	15	15.2.4

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.4.4.5	31	– Architectural resources	15	15.2.5
4.4.4.6 Communities	31	The Proponent shall describe relevant community elements in the study areas of the VECs, including: – Demographics	15	15.3.4, 15.4.3
4.4.4.6	31	– Community services and infrastructure	15	15.3.5
4.4.4.6	31	– Health services and social programs (e.g., drug addiction, delinquency)	15	15.3.6
4.4.4.6	31	– Human health	15	15.3.6
4.4.4.6	32	– Drinking water sources and quality	15	15.3.5.4
4.4.4.6	32	– Community health	15	15.3.6
4.4.4.6	32	– Family life	15	15.3.6
4.4.4.6	32	– Safety	15	15.3.6
4.4.4.6	32	– Culture	15	15.3.6
4.4.4.6	32	– Education and Training	15	15.3.5.8
4.4.4.6	32	– Housing and accommodation	15	15.3.5.7
4.4.4.6	32	– Property value and land use	15	15.3.5.7
4.4.4.6	32	Mapping in relation to Aboriginal communities shall include Aboriginal toponyms, where relevant and available to the Proponent, in addition to common and accepted local place names.	15	15.5.7
4.4.4.7 Economy, Employment and Business	32	The Proponent shall describe relevant economy, employment and business elements in the study areas of the VEC, including: – Economy of the province	15	15.4.4
4.4.4.7	32	– Taxes and royalties	15	15.4.4
4.4.4.7	32	– Effects on gross domestic product	16	16.4
4.4.4.7	32	– Employment in the province	15	15.4.5
4.4.4.7	32	– Skilled and unskilled labour supply in the province	15	15.4.5

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.4.4.7	32	– Expenditures in the province	15	15.4.4
4.4.4.7	32	– Employment equity and diversity including under-represented groups (e.g., women, persons with disabilities, aboriginal groups)	15	15.4.5
4.4.4.7	32	– Business capacity	15	15.4.6
4.4.4.7	32	– Goods and services	15	15.4.4, 15.4.6
4.4.4.7	32	– Agriculture	15	15.5.15
4.4.4.7	32	– Outfitting	15	15.5.8
4.4.4.7	32	– Tourism	15	15.7
4.4.4.7	32	– Trapping	15	15.5.5
4.4.4.7	32	– Forest Resources Harvesting	15	15.5.7, 15.5.13
4.4.4.7	32	– Mining and Mineral Exploration	15	15.5.14
4.4.5 Component Studies	32	Component Studies shall be prepared for at least the following VECs, including: – Caribou (and predators)	10, Caribou and Their Predators CS; Caribou and Their Predators (Labrador and Newfoundland) Study – Revised CS	Referenced in 10.3.4
4.4.5	32	– Furbearers	10, Furbearers and Small Mammals CS	Referenced in 10.3.6
4.4.5	32	– Avifauna	10, Avifauna CS; Avifauna CS - Revised CS	Referenced in 10.3.7
4.4.5	32	– Species at risk (flora, including lichens and fauna)	10, Species of Special Conservation Concern CS	Referenced in 10.3.3

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.4.5	32	– Marine and Freshwater fish and fish habitat	10, 13, 14, Marine Environment: Fish and Fish Habitat, Water Resources CS	Referenced in 10.4. 5, 10.5.8, 13.2.4, 14.4.4
4.4.5	32	– Marine and Freshwater (quality and quantity)	10, Freshwater Resources: Fish and Fish Habitat, Water Resources CS	Referenced in 10.4.4, 10.5.7
4.4.5	33	– Historic resources	15, Historic and Heritage Resources CS	Referenced in 15.2.3, 15.2.4, 15.2.5
4.4.5	33	– Timber resources	10, Vegetation CS	Referenced in 10.3.3

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.4.5	33	– Socio-economics	15, Socioeconomic Environment: Communities, Land and Resource Use, Tourism and Recreation CS; Socioeconomic Environment: Aboriginal Communities and Land Use CS; Socioeconomic Environment: Marine Fisheries in the Strait of Belle Isle CS; Socioeconomic Environment: Communities, Land and Resource Use, Tourism and Recreation – Revised CS	Referenced in 15.2.2, 15.5.2, 15.6.2, 15.7.2, 15.8.2
4.4.5	33	– Viewscapes	15, 16, Viewscapes CS	Referenced in 15.5.8, 16.2.5, 16.5.4, 16.5.6, 16.8.1, 16.8.4, 16.8.7
4.4.5	33	Study outputs shall be proposed by the Proponent. Information and data generated shall be sufficient to adequately predict the effects on the VEC and determine monitoring and follow-up requirements.	10, 15, All Component Studies listed in cells above	Throughout chapters 10 and 15

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.4.6 Data Gaps	33	Any information gaps from a lack of previous research or practice shall be described indicating baseline/information which is not available or existing data which cannot accurately represent environmental conditions in the study area over four seasons.	6, 9, 11, 12, 13, 14, 16	6.5.3, 9.5.5; Chapters 11, 12, 13, 14, 16 under the 'Construction' and 'Operations and Maintenance' headings in each VEC section
4.4.6	33	If background data have been extrapolated or otherwise manipulated to depict environmental conditions in the study area, modeling methods and equations shall be described and shall include calculations of margins of error and / or confidence limits.	Component Studies	Throughout
4.4.6	33	If data gaps remain, the Proponent shall describe its efforts to resolve the data gaps, including any direct consultation with groups, individuals and others.	6	6.5.3
4.4.7 Future Environment Without the Project	34	The EIS shall describe, to the extent possible, the predicted future condition of the environment within the expected life span of the Project, if the Project were not to proceed.	6	6.6
4.4.7	34	The predicted future condition of the environment shall help to distinguish project related effects from environmental change due to natural processes and shall include a discussion of climate change.	6	6.6.1
4.4.7	34	The socio-economic environment to be described will undergo change regardless of the Project.	6	6.6.5
4.4.7	34	The analysis shall consider the likely trends in the area in the absence of the Project given available information about other planned major projects or social, economic, or institutional changes in the zone of influence within the time frame of the Project.	6	6.6
4.5 Environmental Effects				
4.5.1 General	34	The EIS shall contain a comprehensive analysis of the predicted environmental effects on the VECs of each project alternative.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Evaluation of Project Alternatives' heading in each VEC section

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.5.1	34	If the effects are attributable to a particular phase of the Project (Construction, Operations and / or Maintenance) then they should be designated as such.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Construction', 'Operations and Maintenance' and 'Evaluation of Project Alternatives' headings in each VEC section
4.5.1	34	Predicted environmental effects (positive and negative, direct and indirect, short- and long-term) shall be defined quantitatively and qualitatively for each project alternative and for each VEC.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Construction' and 'Operations and Maintenance' headings in each VEC section
4.5.1	34	Environmental effects predictions shall be explicitly stated and the theory or rationale upon which they are based shall be presented in terms of the following parameters, as appropriate (a) nature	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Environmental Effects Descriptors', 'Construction', 'Operations and Maintenance' and 'Environmental Effects Summary and Evaluation of Significance' headings in each VEC section
4.5.1	34	(b) magnitude (qualitative and quantitative)		
4.5.1	34	(c) geographic (spatial) extent		
4.5.1	34	(d) timing, duration and frequency		
4.5.1	34	(e) degree to which effects are reversible or mitigable		
4.5.1	34	(f) ecological context		
4.5.1	34	– Document the use of existing linear corridors by Newfoundland and Labrador caribou and their predators to provide baseline data on the effects of linear corridors on the landscape	10, 12	10.3.4.3, 12.3.5
4.5.1	34	– Identify the potential effects on remaining pristine areas and important habitat on the Northern Peninsula: the Highlands of St John and the Soufflets-Main River areas	15, 16	15.7, 15.8.4, 16.5.5.6

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.5.1	34	– Conduct botanical and wildlife surveys throughout the footprint of the proposed transmission line, as well as literature research detailing the effects of linear corridors on wildlife, and increased access and use by humans/predators	10, 12, Component Studies	Component Studies referenced in 10.3.3, 10.3.4, 10.3.5, 10.3.6, 10.3.7; 12.2, 12.3, 12.4, 12.5 under the 'Existing Knowledge' heading in each VEC section
4.5.1	34	(g) Cultural heritage and social context	16	16.2, 16.3, 16.4, 16.5, 16.6, 16.7, 16.8
4.5.1	34	(h) level and degree of certainty of knowledge	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Construction' and 'Operations and Maintenance' headings in each VEC section
4.5.1	35	(i) the capacity of renewable resources that are likely to be significantly affected by the Project, to meet the needs of present and future generations	11, 12, 13, 14, 16, 17	Chapters 11, 12, 13, 14, 16 under the 'Environmental Effects Summary and Evaluation of Significance' heading in each VEC section and the 'Residual Project Effects and Significance' section for each chapter; 17.6.2

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.5.1	35	(j) the extent to which biological diversity is affected by the Project	12, 13, 14, 17	Chapters 12, 13, 14 under the 'Environmental Effects Summary and Evaluation of Significance' heading in each VEC section and the 'Residual Project Effects and Significance' section for each chapter; 17.6.1.4
4.5.1	35	(k) environmental protection goals and objectives as set out in applicable legislation, regulations, policies, plans and programs	3, 11, 12, 13, 14, 16	3.6.1, 3.6.2, Appendix 3-1; Throughout chapters 11, 12, 13, 14, 16
4.5.1	35	The Proponent shall prepare a table describing the proposed Project's anticipated effects, which shall enable the reader to review and consider those effects.	11, 12, 13, 14, 16, 17	Chapters 11, 12, 13, 14, 16 in the 'Environmental Effects Analysis Summary' table in each VEC section; Table 17.5-1
4.5.1	35	Among the effects of the Project on the biophysical environment to be assessed, the EIS shall consider the effects on fish and fish habitat and marine mammals (including migration patterns and fish mortality), any greenhouse gas emissions and navigation and navigability. Climate change implications should also be considered.	11, 13, 14, 16	11.2.5, 11.2.6, 11.2.7, 11.3; 13.3.5, 13.3.6, 13.3.7; 13.4, 14.2.5, 14.2.6, 14.2.7, 14.3.5, 14.3.6, 14.3.7; 14.5, 16.6.5, 16.6.6, 16.6.7, 16.9
4.5.1	35	With respect to the fish and fish habitat VEC, the proponent shall conduct a comprehensive analysis of the impacts to fish and fish habitat, including marine mammals, associated with but not limited to: – installation and operation of the Strait of Belle Isle cable crossing, including any blasting activities	14	14.3.5

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.5.1	35	– acoustic outputs into the water, particularly for the Strait of Belle Isle, and its impact on marine mammals and their migration	14	14.3.5
4.5.1	35	– installation and operation of shore electrodes, including but not limited to electromagnetic and thermal fields, generated and induced electric fields and electrolysis products	14	14.2.6.3
4.5.1	35	– long-term effects of electrode functioning	14	14.2.6.3
4.5.1	35	– electromagnetic disturbances and their effects on fish and benthic invertebrates	14	14.2.6.3
4.5.1	35	– fate and effects of chlorine generated by electrodes	11	11.2.6.4, 14.2.6
4.5.1	35	– interference or disruptions to fisheries in the marine and freshwater environments, including the creation of access to remote lakes and rivers	13, 14	13.3.5, 13.3.6, 13.3.7; 14.2.5, 14.2.6, 14.2.7
4.5.1	35	– construction, operation and decommissioning of access roads and multiple watercourse crossings	13	13.3.5, 13.3.6
4.5.1	35	– Effects on fisheries and use of fishing gear in the Strait of Belle Isle as a result of the submarine cable	16	16.6.5, 16.6.6, 16.6.7
4.5.1	35	With respect to greenhouse gases, the Proponent shall describe and analyze any greenhouse gas emissions from the Project.	11	11.2.5.3, 11.2.6.3
4.5.1	35	With respect to effects of the Project on navigation and navigable waters, the Proponent shall describe effects on the navigability and the navigation patterns of all waters existing, altered or created by all phases (construction, installation, operation) of the Project.	16	16.6.5, 16.6.6, 16.6.7
4.5.1	35	Impacts on traditional (e.g., hunting, fishing) and current recreational and commercial waterway use should be identified and assessed.	16	16.5
4.5.1	35	The assessment of the beneficial and adverse effects of the Project on the socio-economic environment shall consider how the Project may affect various segments of the local populations (e.g., youth, elders, men, women, Aboriginal groups, harvesters, existing workforce including professionals). The following should be taken into account when assessing effects of the Project: (a) demographics	16	16.3.5.7, 16.3.6.6

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	**Page**		**Chapter(s)**	**Section(s)**
4.5.1	36	(b) human health	16	16.3.5.6, 16.3.6.5
4.5.1	36	(c) social and cultural patterns	16	16.3.
4.5.1	36	(d) services and infrastructure (including road transportation of workers and materials)	16	16.3.5.3, 16.3.6.3
4.5.1	36	(e) cultural heritage sites	16	16.2
4.5.1	36	(f) land and resource use	16	16.5
4.5.1	36	(g) local, regional and provincial economy	16	16.4
4.5.1	36	(h) employment, education and training	16	16.4
4.5.1	36	(i) governments	16	16.4
4.5.1	36	(j) Aboriginal issues	7, 16	7.1, 7.2, 7.3, 7.4, 7.5, 16.5.7
4.5.1	36	(k) experience gained from previous large developments	16	Throughout
4.5.1	36	In considering the local social and economic effects of the Project, the Proponent shall have due regard for the attitudes, beliefs and perceptions of local residents, and how these are grounded in their culture, social organizations and historical experience.	8, 16	8.3, 8.4, 16.3, 16.5, 16.6, 16.7, 16.8
4.5.2 Accidents and Malfunctions	36	The Proponent will identify and describe the potential accidents and malfunctions related to the Project, including an explanation of how those events were identified	5	5.1, 5.3
4.5.2	36	potential consequences (including the potential environmental effects)	5	5.4 to 5.14
4.5.2	36	the worst case scenarios	5	5.4 to 5.14
4.5.2	36	and the effects of these scenarios	5	5.4 to 5.14
4.5.2	36	The Proponent will explain the potential quantity, mechanism, rate, form and characteristics of the contaminants and other materials likely to be released into the environment during the malfunction and accident events.	5	5.6, 5.7, 5.11

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	**Page**		**Chapter(s)**	**Section(s)**
4.5.2	36	Potential accidents and malfunctions may include those associated with the following occurrences: – fires	5	5.9, 5.10
4.5.2	36	– waste management and disposal	5	5.11
4.5.2	36	– use, handling or spills of chemicals and hazardous materials on land or in the marine and freshwater environments, including vessel operations	5	5.6
4.5.2	36	– any other project components or systems that have the potential, through accident or malfunction, to adversely affect the natural environment	5	5.4 to 5.14
4.5.2	36	The Proponent shall pay special attention to the sensitive elements of the environment (e.g., communities, homes, natural sites of interest, areas of major use) that may be affected in the event of an accident or a major malfunction.	16	16.2, 16.3, 16.5, 16.6, 16.8, 16.9.2
4.5.2	36	The Proponent shall assess the likelihood of occurrence of the accidents and malfunctions.	5	5.4 to 5.14
4.5.2	36	Detailed plans, measures and systems to reduce the potential occurrence of an accident or malfunction shall be provided by the Proponent. They shall indicate how they will reduce the effects or consequences of an accident or malfunction, should it occur.	5	5.4 to 5.14
4.5.3 Cumulative Effects	37	The Proponent shall identify and assess the Project's cumulative environmental effects.	9, 11, 12, 13, 14, 16	9.3.9; Chapters 11, 12, 13, 14, 16 under the 'Cumulative Effects Assessment' heading in each VEC section; 11.3.4, 12.6.5, 13.4.5, 14.5.5, 16.9.4

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.5.3	37	In the cumulative effects assessment, the Proponent shall consider guidance provided by the CEA Agency in its Cumulative Effects Assessment Practitioners Guide (1999) and other literature and experience with environmental assessment in Canada or elsewhere that it finds helpful in framing the cumulative environmental effects analysis.	9, 11, 12, 13, 14, 16	9.3.9; Chapters 11, 12, 13, 14, 16 under the 'Cumulative Effects Assessment' heading in each VEC section; 11.3.4, 12.6.5, 13.4.5, 14.5.5, 16.9.4
4.5.3	37	The Proponent shall: – Identify and justify the VECs that will constitute the focus of the cumulative effects assessment. The Proponent's assessment should examine the likelihood, nature and extent of the predicted cumulative effects of each Project alternative for each VEC. It may be appropriate, during the course of the environmental assessment, to refine the definition of VECs selected for cumulative effects assessment.	11, 12, 13, 14, 16	9.2, 9.3, 11.2.9, 12.2.9, 12.3.9, 12.4.8, 12.5.9, 13.2.9, 13.3.9, 14.2.9, 14.3.9, 14.4.9, 16.2.9, 16.3.9, 16.4.9, 16.5.9, 16.6.8, 16.7.9, 16.8.10
4.5.3	37	– Present a justification for the spatial and temporal boundaries of the cumulative effects assessment. The boundaries for the cumulative effects assessments will again depend on the effects being considered (e.g., will generally be different for different effects). These cumulative effects boundaries will also generally be different from (larger than) the boundaries for the corresponding Project effects.	9, 11, 12, 13, 14, 16	9.3.9; Chapters 11, 12, 13, 14, 16 under the 'Cumulative Effects Assessment' heading in each VEC section
4.5.3	37	– Describe and justify the choice of projects and selected activities for the cumulative effects assessment. These shall include past activities and projects, those being carried out and future projects or activities likely to be carried out. This shall include a discussion of cumulative environmental effects associated with any future increase in capacity of the Transmission Link to enable transportation of additional power from the Lower Churchill along all or part of the proposed transmission line.	9, 11, 12, 13, 14, 16	9.3.9; Table 9.3.9-2, Chapters 11, 12, 13, 14, 16 under the 'Cumulative Effects Assessment' heading in each VEC section; 11.3.4, 12.6.5, 13.4.5, 14.5.5, 16.9.4

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.5.3	37	– Describe the mitigation measures that are technically and economically feasible.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Construction' and 'Operations and Maintenance' headings in each VEC section; 11.3.1, 12.6.1, 13.4.1, 14.5.1, 16.9.1
4.5.3	37	– Determine the significance of the residual cumulative effects.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Cumulative Effects Assessment' heading in each VEC section; 11.3.4, 12.6.5, 13.4.5, 14.5.5, 16.9.4
4.5.3	37	– Assess the effectiveness of the measures applied to mitigate the cumulative effects. In cases where measures exist that are beyond the scope of the Proponent's responsibility that could be effectively applied to mitigate these effects, the Proponent shall identify these effects and the parties that have the authority to act. In such cases, the Proponent shall summarize the discussions that took place with the other parties in order to implement the necessary measures over the long-term.	12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under the 'Construction' and 'Operations and Maintenance' headings in each VEC section; 11.3.1, 12.6.1, 13.4.1, 14.5.1, 16.9.1

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.5.4 Renewable Resources	37	The Proponent shall determine, based on the results of their assessment, whether the Project is likely to cause significant environmental effects on renewable resources.	12, 13, 14, 16, 17	Chapters 12, 13, 14, 16 under the 'Environmental Effects Summary and Evaluation of Significance' heading in each VEC section, and the 'Residual Project Effects and Significance' heading in the 'Environmental Assessment Summary' section for each chapter; 17.6.2
4.5.4	38	The Proponent shall briefly describe the renewable resources that may be affected by the Project.	10, 15	Throughout
4.5.4	38	The Proponent shall clearly establish, taking into account the result of their impact assessment, whether these renewable resources are likely to be significantly affected following the implementation of proposed mitigation measures (residual significant environmental effects).	12, 13, 14, 16, 17	Chapters 12, 13, 14, 16 under the 'Environmental Effects Summary and Evaluation of Significance' heading in each VEC section, and the 'Residual Project Effects and Significance' heading in the 'Environmental Assessment Summary' section for each chapter; 17.6.2

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.5.4	38	Should this be the case, the following points shall be addressed: – a brief description of the Project's environmental effects on the renewable resource	12, 13, 14, 17	Chapters 12, 13, 14 under the 'Environmental Effects Summary and Evaluation of Significance' heading in each VEC section; 12.6.1, 13.4.1, 14.5.1, 17.6.2
4.5.4	38	– an indication as to the way in which the capacity of this resource was measured or evaluated	12, 13, 14	Chapters 12, 13, 14 under the 'Approach to the Environmental Effects Analysis' heading in each VEC section
4.5.4	38	– an indication of the temporal and geographic boundaries used to assess the capacity of the affected resource	12, 13, 14	Chapters 12, 13, 14 under the 'Environmental Assessment Study Areas' heading in each VEC section
4.5.4	38	– a determination of the capacity of the resource to meet current needs	17	17.6.2
4.5.4	38	– a description of any other appropriate mitigation measures	12, 13, 14	Chapters 12, 13, 14 under the 'Construction' and 'Operations and Maintenance' heading in each VEC section; 12.6.1, 13.4.1, 14.5.1
4.5.4	38	– a determination of the significance of the residual effects on the renewable resource and its capacity to meet the need of current and future generations	12, 13, 14, 17	Chapters 12, 13, 14 under the 'Environmental Effects Summary and Evaluation of Significance' heading in each VEC section; 17.6.2

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.5.4	38	– an identification of the risks and uncertainties that remain and the description of the next steps, if any, that will be required to address this effect	12, 13, 14, 17	Chapters 12, 13, 14 under the 'Environmental Effects Summary and Evaluation of Significance' and 'Monitoring and Follow-up' headings in each VEC section; 17.6.2, 17.7
4.5.5 Effects of the Environment on the Project	38	The environmental effects that may occur as a result of the environment acting on the Project shall be assessed.	4	4.1, 4.2, 4.3
4.5.5	38	Environmental changes and hazards that may occur and may affect the Project shall be described (e.g., wind, currents, waves, storm surges, severe precipitation events, flooding, ice, sea ice, icebergs, earthquakes).	4	4.1, 4.2, 4.3
4.5.5	38	The EIS shall take into account the potential influence of climate change scenarios (e.g., sea level rise, iceberg frequency, increased severity and frequency of storms and flooding).	4	4.1.11
4.5.5	38	The influence that these environmental changes and hazards may have on the Project shall be predicted and described.	4	4.1, 4.2, 4.3

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.6 Environmental Protection				
4.6.1 Mitigation	38	The EIS shall identify and discuss the proposed mitigation measures that are technically and economically feasible and that would mitigate the significant adverse effects of the Project and enhance beneficial effects, including the interaction of these measures with existing environmental management plans.	2, 11, 12, 13, 14, 16	2.14.2; Chapters 11, 12, 13, 14, 16 under 'Construction', 'Operations and Maintenance' and Monitoring and 'Follow-up' headings in each VEC section and chapter and under the 'Effects Management Measures' heading in the 'Environmental Assessment Summary' for each chapter
4.6.1	39	The rationale for and effectiveness of the proposed mitigation and enhancement measures should be discussed and evaluated. Available data, survey and study results and detailed monitoring and mitigation measures that demonstrate a particular emphasis on avoidance of environmental effects is to be included in the EIS.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under 'Construction', 'Operations and Maintenance' and Monitoring and 'Follow-up' headings in each VEC section and chapter and under the 'Effects Management Measures' heading in the 'Environmental Assessment Summary' for each chapter

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.6.1	39	The Proponent, where possible, should refer to similar situations where the proposed mitigation has proven to be successful.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under 'Existing Knowledge', 'Construction' and 'Operations and Maintenance' headings in each VEC section and chapter
4.6.1	39	Mitigation failure should be discussed with respect to risk and severity of consequence.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under 'Existing Knowledge', 'Construction' and 'Operations and Maintenance' headings in each VEC section and chapter
4.6.1	39	The Proponent shall identify who is responsible for the implementation of these measures and the system of accountability, including the obligations of all its contractors and subcontractors.	3	3.6.1, 3.6.2, 3.6.3, Appendix 3-3
4.6.1	39	Mitigation measures shall be described for the Construction, Operations, Maintenance and decommissioning phases and shall include: (a) Procedures that would be used to avoid environmentally sensitive areas or periods of the year	12, 13, 14, 16	Chapters 12, 13, 14, 16 under 'Construction' and 'Operations and Maintenance' headings in each VEC section
4.6.1	39	(b) Contingency plans and procedures to respond to accidents, malfunctions & emergencies	5, 11, 12, 13, 14, 16	5.2, 5.4 to 5.14; Chapters 11, 12, 13, 14, 16 under the 'Accidents and Malfunctions' heading in each chapter
4.6.1	39	(c) Description of fish habitat compensation measures to offset adverse effects on fish and fish habitat	14	14.2.5.1, 14.5.1, Table 14.5.1-1

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.6.1	39	(d) Mitigation measures to reduce, eliminate or control impacts of project components and activities, identified in sections 4.3.4 Construction, 4.3.5 Operations and Maintenance and 4.3.6 Decommissioning, on fish and fish habitat (including marine mammals)	13, 14	13.3.5, 13.3.6, 13.4.1, 14.2.5, 14.2.6, 14.5.1
4.6.1	39	(e) Measures to ensure continued unrestricted and safe access and passage on land and sea for harvesting and travel by Aboriginal and non-Aboriginal local residents, and what alternatives shall be provided in the event of disruption	16	16.5.5, 16.5.6, 16.5.7, 16.9.1
4.6.1	39	(f) Measures to reduce or eliminate impacts on safe navigation during the construction, installation, and operation of the subsea cable crossing, electrode sites, temporary and permanent stream crossings, and all aerial transmission lines over navigable waters	16	16.6.5, 16.6.6, 16.6.7, 16.9.1
4.6.1	39	(g) Mitigation measures which would be taken to reduce or offset adverse effects on communities affected by the Project	16	16.3.5, 16.3.6, 16.3.7, 16.9.1
4.6.1	39	(h) Mitigation measures which would be taken to reduce or offset adverse effects on local businesses most directly affected by the Project	16	16.4.5.5, 16.4.6.5, 16.9.1
4.6.1	39	(i) Measures to enhance any beneficial environmental effects, such as economic benefits to businesses affected by the Project	16	16.4.5.5, 16.4.6.5, 16.9.1
4.6.1	39	(j) Measures to maximize labour market opportunities, including Aboriginal labour, and address labour challenges with an emphasis on strategies to enhance recruitment and retention and increase employment and participation. To this end, the Proponent must minimally describe a human resources plan that includes a description of objectives and strategies to address labour force availability, skilled trades recruitment, diversity in recruitment, training and employment equity. This plan should also minimally identify employment objectives and targets for women and other labour force groups if applicable	16	2.14.4, 16.4
4.6.1	40	(k) Contingency plans and procedures to follow in the event cultural heritage resources are accidentally discovered during all phases of the project	16	16.2

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.6.1	40	(l) Development and methods for implementing wildlife (fauna and flora) mitigation protocols and associated monitoring programs. Issues surrounding increased access and potential effects on wildlife and species at risk, must be considered	12, 13, 14	Chapters 12, 13, 14 under 'Construction', 'Operations and Maintenance' and 'Monitoring and Follow-up' headings in each VEC section
4.6.1	40	Other mitigation measures that were considered, if any, shall be identified, and the rationale for rejecting these measures shall be explained.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under 'Construction' and 'Operations and Maintenance' headings in each VEC section and 'Environmental Assessment Summary' in each chapter
4.6.1	40	Trade-offs between costs and predicted effectiveness of the mitigation measures shall be justified.	9	9.5.5
4.6.1	40	The Proponent shall discuss the application of the Precautionary Principle in the identification of mitigation measures. The Precautionary Principle is defined in Section 2.5.	9	9.5.5
4.6.1	40	The best available technology and best management practices shall be considered.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under 'Construction' and 'Operations and Maintenance' headings in each VEC section and 'Environmental Assessment Summary' in each chapter

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	**Page**		**Chapter(s)**	**Section(s)**
4.6.1	40	Consideration shall be given for avoidance of environmental effects through implementation of scheduling and siting constraints and pollution prevention opportunities.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under 'Construction' and 'Operations and Maintenance' headings in each VEC section and 'Environmental Assessment Summary' in each chapter
4.6.1.1 Compensation	40	The Proponent shall describe, in general terms, compensation programs and arrangements as follows: (a) Any compensation programs for damage caused by the Proponent's activities to the environment, to property, business operations, or to the land and resources of others. The Proponent shall describe any existing or proposed compensation programs for losses relating to property, use, access, harvests, added harvesting effort and costs that may be incurred by users of the land and its resource (e.g., tourism operators, outfitters, trappers, subsistence hunters). A comparison with compensation programs for other projects and other resource development activities shall be provided	16	16.5.5.1, 16.6.5.1, 16.6.6.1
4.6.1.1	40	(b) Any compensation arrangements for local, public or private providers whose burdens and costs are increased or who incur losses as a result of the Project	16	16.5.5.1, 16.6.5.1, 16.6.6.1
4.6.2 Emergency Response / Contingency Plans	40	The Proponent shall describe its environmental management plans which shall include consideration of human-wildlife interaction (e.g., bear management plans) and Safety, Health and Environmental Emergency Response Plans (SHERP) to provide an overall perspective on how potentially adverse environmental effects shall be managed over time.	2, 3, 5	2.14.2, 2.14.3, 3.6.1, 3.6.2, Appendix 3-3, 5.6.1

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.6.2	40	The Environmental Management System (EMS) shall include various plans (e.g., emergency response plans, contingency plans, environmental protection plans, waste management plans (shall consider issues with bears near camps, use of bear proof waste material containers, etc.), hazardous spill plans, monitoring plans) and developed in a manner consistent with the International Organization for Standardization (ISO) 14001 program.	2, 3	2.14.1, 3.6
4.6.2	41	It shall show how the Project is consistent with sustainable development efforts in the region.	9, 17	9.5.4; Throughout Chapter 17
4.6.2	41	Appropriate government agencies, Aboriginal groups and local communities shall be involved in the development of the plans.	7, 8	7.1, 8.1, 8.3
4.6.3 Rehabilitation	41	A plan of proposed rehabilitation measures is required to address areas disturbed by temporary activities such as access roads, off-loading facilities, construction camp(s), land clearing etc.	3	3.4.3.6, 3.4.6.5
4.6.3	41	The plan shall discuss the rationale, objectives and procedures for proposed rehabilitation measures.	3	3.6.1
4.6.3	41	A schedule for carrying out the work (e.g., seasonal requirements) shall be included in the plan.	3	3.4.3.6, 3.4.6.5
4.6.3	41	Appropriate materials (e.g., plant species, soils) shall be indicated.	3	3.6.1
4.6.4 Monitoring and Follow-up Programs	41	The EIS shall describe the environmental and socio-economic monitoring and follow-up programs to be incorporated into Construction, Operations and modification activities.	9, 11, 12, 13, 14, 16	9.4.6; Chapters 11, 12, 13, 14, 16 under 'Monitoring and Follow-up' heading in each VEC section and 'Environmental Assessment Summary' in each chapter

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.6.4	41	The purpose of the follow-up program is to verify the accuracy of the predictions made in the assessment of the effects as well as the effectiveness of the mitigation measures. The duration of the follow-up program shall be as long as is needed to evaluate the effectiveness of the mitigation measures.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under 'Monitoring and Follow-up' heading in each VEC section and 'Environmental Assessment Summary' in each chapter
4.6.4	41	The Proponent shall consider guidance provided by the Canadian Environmental Assessment Agency in its follow-up programs under the *Canadian Environmental Assessment Act*.	11, 12, 13, 14, 16, 17	Chapters 11, 12, 13, 14, 16 under 'Monitoring and Follow-up' heading in each VEC section and 'Environmental Assessment Summary' in each chapter; 17.8
4.6.4	41	The proponent shall report on hiring and employment objectives and targets on a quarterly basis.	16	16.4.10
4.6.4	41	If either of these programs identify unforeseen adverse environmental effects, the Proponent shall commit to adjusting existing mitigation measures, or, if necessary, develop new mitigation or compensation measures.	9	9.4.6, 9.5.5
4.6.4	42	The Proponent shall describe how the results of monitoring and follow-up programs will be used to refine or modify the design and implementation of management plans, mitigation measures and Project operations.	9	9.4.6, 9.5.5
4.6.4	42	This section shall also discuss the ways in which holders of Aboriginal traditional and community knowledge, including elders, women and youth, shall be involved in any monitoring and follow-up programs.	9	9.4.6
4.6.4	42	The Proponent shall distinguish as appropriate between monitoring (compliance) and effects follow-up programs.	9	9.4.6
4.6.4	42	The proposed approach for monitoring shall be described and shall include: (a) The objectives of the monitoring program and a schedule for collection of the monitoring data required to meet these objectives	9	9.4.6

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.6.4	42	(b) The sampling design, methodology, selection of the subjects and indicators to be monitored, and their selection criteria	9	9.4.6
4.6.4	42	(c) The frequency, duration and geographic extent of monitoring, and justification for the extent	9	9.4.6
4.6.4	42	(d) The application of the principles of Adaptive Environmental Management	9	9.4.6
4.6.4	42	(e) Reporting and response mechanisms, including criteria for initiating a response and procedures	9	9.4.6
4.6.4	42	(f) The approaches and methods for monitoring the cumulative effects of the Project with existing and future developments in the Project area	9	9.4.6
4.6.4	42	(g) Integration of monitoring results with other aspects of the Project including adjustments to operating procedures and refinement of mitigation measures	9	9.4.6
4.6.4	42	(h) Experience gained from previous and existing monitoring programs	9	9.4.6
4.6.4	42	(i) The advisory roles of independent experts, government agencies, communities, holders of Aboriginal traditional and community knowledge and renewable resource users	9	9.4.6
4.6.4	42	(j) Procedures to assess the effectiveness of monitoring and follow-up programs, mitigation measures and recovery programs for areas disturbed by the Project	9	9.4.6
4.6.4	42	(k) A communications plan to describe the results of monitoring to interested parties.	9	9.4.6
4.6.4	42	The Proponent shall explain how the public and Aboriginal groups shall continue to be involved, including participation in the design and implementation of environmental management and monitoring and follow-up programs.	9	9.4.6

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.6.4	42	The Proponent shall describe plans to maintain communications and working relationships with the affected communities, Aboriginal organizations, municipalities and government agencies throughout the life of the Project. The intent of these plans is to involve those groups in monitoring and follow-up programs, and in identifying and working toward the reduction of adverse physical, biological or socio-economic effects, and the enhancement of beneficial effects.	7, 8, 9, 16	7.1, 9.4.6; Throughout Chapter 16; 16.9.1, Tables 16.9.1-1 and 16.9.1-2
4.6.4	43	To design complete and comprehensive program proposals, the Proponent shall prepare and submit these documents subsequent to the completion of the environmental assessment, but before the initiation of the Project itself.	9	9.4.6
4.7 Residual Effects and Determination of Significance	43	Residual effects are those adverse environmental effects which cannot or will not be avoided or mitigated through the application of environmental control technologies, best management practices or other acceptable means. The EIS shall list and contain a detailed discussion and evaluation of residual effects, including residual cumulative effects, which shall be defined in terms of the parameters outlined in sections 4.5.1 and 4.5.3.	11, 12, 13, 14, 16	Chapters 11, 12, 13, 14, 16 under 'Construction', 'Operations and Maintenance', 'Environmental Effects Summary and Evaluation of Significance' and 'Cumulative Effects Assessment' headings in each VEC section and 'Environmental Assessment Summary' in each chapter

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.7	43	The EIS shall contain a concise statement and rationale for the overall conclusion relating to the significance of the residual adverse environmental effects. The EIS will, for ease of review, include a summary table of the environmental effects, proposed mitigation and residual adverse effects.	11, 12, 13, 14, 16, 17	Chapters 11, 12, 13, 14, 16 under 'Environmental Effects Summary and Evaluation of Significance' heading in each VEC section and 'Environmental Assessment Summary' in each chapter; 17.5, Table 17.5-1
4.8 Consultation With Aboriginal Groups and Communities	43	The EIS shall demonstrate the Proponent's understanding of the interests, values, concerns, contemporary and historic activities, Aboriginal traditional knowledge and important issues facing Aboriginal groups, and indicate how these will be considered in planning and carrying out the Project.	7	7.2, 7.3, 7.4, 7.5 and associated issues and issues concordance tables
4.8	43	The Aboriginal groups and communities to be considered include, in Newfoundland and Labrador, the Innu Nation, the NunatuKavut Community Council and the Nunatsiavut Government and, in Québec, the Innu communities of Uashat Mak Mani-Utenam, Ekuanitshit, Nutaskuan, Unamen Shipu, Pakuashipi, Matimekush-Lac John, and the Naskapi Nation of Kawawachikamach.	7	7.1, 7.3, 7.4, 7.5
4.8	43	The Proponent should offer consultation/information meetings with each of the above-mentioned Aboriginal groups.	7	7.1, 7.3, 7.4, 7.5
4.8	43	The Proponent should communicate with the above mentioned Aboriginal groups to offer oral presentations in Aboriginal communities.	7	7.1, 7.3, 7.4, 7.5
4.8	43	The Proponent shall also offer to provide simultaneous translation of the oral presentations in the Aboriginal language spoken in the particular Aboriginal community.	7	7.1
4.8	43	Presentations should describe the project, its predicted impacts and their significance, and proposed mitigation measures.	7, Plain Language Summary	7.1, 7.2

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.8	43	To assist in ensuring that the EIS provides the necessary information to address issues of potential concern to these groups, the Proponent shall consult with each group for the purpose of: – familiarizing the group with the Project and its potential environmental effects	7, Plain Language Summary	7.2, 7.3, 7.4, 7.5
4.8	43	– identifying any issues of concern regarding potential environmental effects of the Project	7, Plain Language Summary	7.2, 7.3, 7.4, 7.5
4.8	43	– identifying what actions the Proponent is proposing to take to address each issue identified, as appropriate	7, Plain Language Summary	7.2, 7.3, 7.4, 7.5
4.8	43	The Proponent shall explain in the EIS the process undertaken to understand the interests, values, concerns, contemporary and historic activities, Aboriginal traditional knowledge and important issues facing Aboriginal groups including any meetings, presentations and consultations held with the above-mentioned Aboriginal groups and communities including any oral or written translation and interpretation in Aboriginal languages.	7, Plain Language Summary	7.1, 7.3, 7.4, 7.5
4.8	44	If the Proponent is not able or should not address any particular issue(s), the EIS should include supporting reasons.	7	7.2, 7.3, 7.4, 7.5
4.8	44	The results of those consultations are to be presented in a separate chapter of the EIS with an individual section for each of the affected Aboriginal groups. The Proponent must refer readers to the relevant sections of the EIS, as appropriate.	7	7.2, 7.3, 7.4, 7.5
4.9 Public Participation	44	Public consultation meetings are required of the Proponent to present the proposal and to record interests and concerns, including those received in response to the Registration. These concerns shall be addressed in a separate chapter of the EIS.	8	8.3, 8.4, Tables 8.1-1, 8.3.1-1 and 8.4-1
4.9	44	The Proponent shall describe the activities and information sessions that they will hold or that they have already held within the context of the Project at the local, regional and national levels, where applicable.	8	8.3, 8.4

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section		Relevant Items	EIS Location(s)	
Section	Page		Chapter(s)	Section(s)
4.9	44	The Proponent shall indicate the methods used and their relevance, the locations where information sessions were held, the persons and organizations attending, the concerns voiced and the extent to which this information was incorporated in the design of the Project as well as in the EIS.	8	8.3, 8.4, Tables 8.3.1-1, 8.3.2-1 to 8.3.2-6 and 8.4-1
4.9	44	Moreover, the Proponent shall describe how issues were recorded and addressed through the use of tables of concordance. Any outstanding issues shall be clearly identified.	8	Table 8.4-1
4.9	44	Protocol for this meeting shall comply with the legislation and with the Newfoundland and Labrador Department of Environment and Conservation's Environmental Assessment Division's policy on advertisement requirements for public meetings/information sessions included in Appendix B.	8	8.3.2
4.9	44	As a minimum, public meetings in Labrador must be held in the communities, of Happy Valley-Goose Bay, Northwest River, Sheshatshiu and Forteau. On the Island portion of the province meetings must be held in, or at locations easily accessible to, the communities of Flower's Cove, Portland Creek, Deer Lake, Grand Falls, Clarenville, Holyrood and St. John's.	8	8.3.1, Table 8.3.1-1, 8.3.2
4.10 Environmental Protection Plan	44	The Proponent shall prepare an Environmental Protection Plan (EPP) for each main construction site and have them approved by the regulatory authorities before starting construction. They shall be stand-alone documents that shall target the site foreperson, the Proponent's occupational health, safety and environmental compliance staff, as well as government environmental surveillance staff.	2, 3, 17	2.14.2, 3.6.1, Appendix 3-3, Table 17.4-1
4.10	44	The EPPs shall address Construction, Operations and modification phases of the Project.	2, 3	2.14.2, 3.6.1, Appendix 3-3
4.10	44	A proposed Table of Contents and an annotated outline for the EPPs is to be presented in the EIS which shall address the major construction and operational activities, permit requirements, mitigation measures and contingency planning as follows:	3, 17	3.6, Appendix 3-3, Table 17.4-1
	44	– Proponent's environmental policies	3	3.6.1, Appendix 3-4
4.10	45	– Objectives and voluntary commitments	3	3.6.1, Appendix 3-3

Table 8-1.1 Table of Concordance with EIS Guidelines and Scoping Document (continued)

EIS Guidelines[(a)] Section			Relevant Items	EIS Location(s)	
Section		Page		Chapter(s)	Section(s)
4.10		45	– Relevant human resource management plans	3	3.6.1, Appendix 3-3
4.10		45	– Environmental compliance monitoring	3	3.6.1, 3.6.3, Appendix 3-3
4.10		45	– Environmental protection measures	3	3.6.1, Appendix 3-3
4.10		45	– Mitigation measures	3	3.6.1, Appendix 3-3
4.10		45	– Permit application and approval planning	3	3.6.1, Appendix 3-3
4.10		45	– Contingency planning for accidental and unplanned events	3	3.6.1, 3.6.2, Appendix 3-3
4.10		45	– Statutory requirements	3	3.6.1, Appendix 3-3
4.10		45	– Revision procedures and contact lists	3	3.6.1, Appendix 3-3
4.11	**Commitments Made in EIS**	45	Provide a list of all commitments made in the Environmental Impact Statement regarding environmental mitigation, monitoring and follow-up. Included in the list is a reference to the section of the EIS where the commitment(s) are made.	17	17.4, Table 17.4-1
4.12	**References Cited**	45	All references used during the preparation of the EIS shall be cited in the text and listed in this section.	All chapters	'References' section
4.13	**Personnel**	45	The names and qualifications of all key professionals responsible for preparing the EIS and supporting documentation shall be included.	Preface	—
4.14	**Copies of Reports**	45	The Proponent shall prepare a complete and detailed bibliography of all studies used to prepare the EIS. Supporting documentation shall be referenced in the EIS and submitted in separate volumes or attached as an Appendix to the EIS.	Chapter 1 to 17, Component Studies	'References' within the EIS chapters, Component Studies

(a) Source: Government of Newfoundland and Labrador and Government of Canada. 2011b. Environmental Impact Statement Guidelines and Scoping Document, Labrador-Island Transmission Link. Prepared for Nalcor. St. John's, NL.

(b) Nalcor has addressed this guideline through its comprehensive public consultation program, for which Nalcor developed a suite of support material designed to assist the public in understanding the Project. Nalcor produced brochures, information sheets, a Project website, illustrations and diagrams, power point presentations, newsletters, and physical models. In addition, Nalcor representatives used these visual aids at public information sessions to directly respond to questions and better explain the Project.

(c) Descriptions of the existing biophysical and socioeconomic environments are also provided in the Component Studies submitted as part of the environmental assessment process for the Project.

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LABRADOR-ISLAND TRANSMISSION LINK

ENVIRONMENTAL IMPACT STATEMENT

Chapter 9

Environmental Assessment Approach and Methodology

April 2012

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LIST OF ACRONYMS

Acronym	Description
CEAA	*Canadian Environmental Assessment Act*
EA	Environmental Assessment
EIS	Environmental Impact Statement
KI	Key Indicator
LSA	Local Study Area
MP	Measurable Parameter
NLEPA	*Newfoundland and Labrador Environmental Protection Act*
ROW	right-of-way
RSA	Regional Study Area
VECs	Valued Environmental Components
Project	Labrador-Island Transmission Link Project

9 ENVIRONMENTAL ASSESSMENT APPROACH AND METHODOLOGY

This Environmental Impact Statement (EIS) has been developed and submitted by Nalcor Energy (Nalcor) in accordance with the requirements of the provincial Newfoundland and Labrador *Environmental Protection Act* (*NLEPA*) and federal *Canadian Environmental Assessment Act* (*CEAA*) environmental assessment (EA) legislation and associated regulations, and the *Environmental Impact Statement Guidelines and Scoping Document* issued to Nalcor by the provincial and federal governments in May 2011 (Government of Newfoundland and Labrador and Government of Canada 2011).

The following Chapter describes the EA approach and methodology that has been used to conduct the environmental effects assessment reported in this EIS, including each of its key stages and components (Figure 9-1). The methods used are in keeping with current EA approaches and best practice, and have been developed and used to help ensure a thorough and rigorous analysis, while at the same time presenting the results of the EA in a clear, concise and well-organized manner.

9.1 Project Description and Existing Environment

A detailed description of the proposed Nalcor Labrador-Island Transmission Link (Project) is provided earlier in the EIS (Chapter 3), including its location, key components and overall layout, planned Construction, and Operations and Maintenance phases, labour force requirements, expenditures and schedule.

The existing natural and human environments in the general area of the Project were subsequently discussed in Chapter 6 (Environmental Setting and Context) and are described in more detail in Chapters 10 (Existing Biophysical Environment) and 15 (Existing Socioeconomic Environment). Aboriginal traditional knowledge and community knowledge of the existing environment has been integrally included in this EIS.

The environmental effects assessment aspect of this EIS involves predicting and evaluating the likely environmental effects of the Project, which are generally defined as changes that the Project is likely to cause in the environment. The assessment of potential environmental effects in an EA is therefore generally based on the approach of "overlaying" a proposed project over its existing environment, so as to identify and describe whether, how, and to what degree components of the environment are likely to change as a result (Figure 9-1).

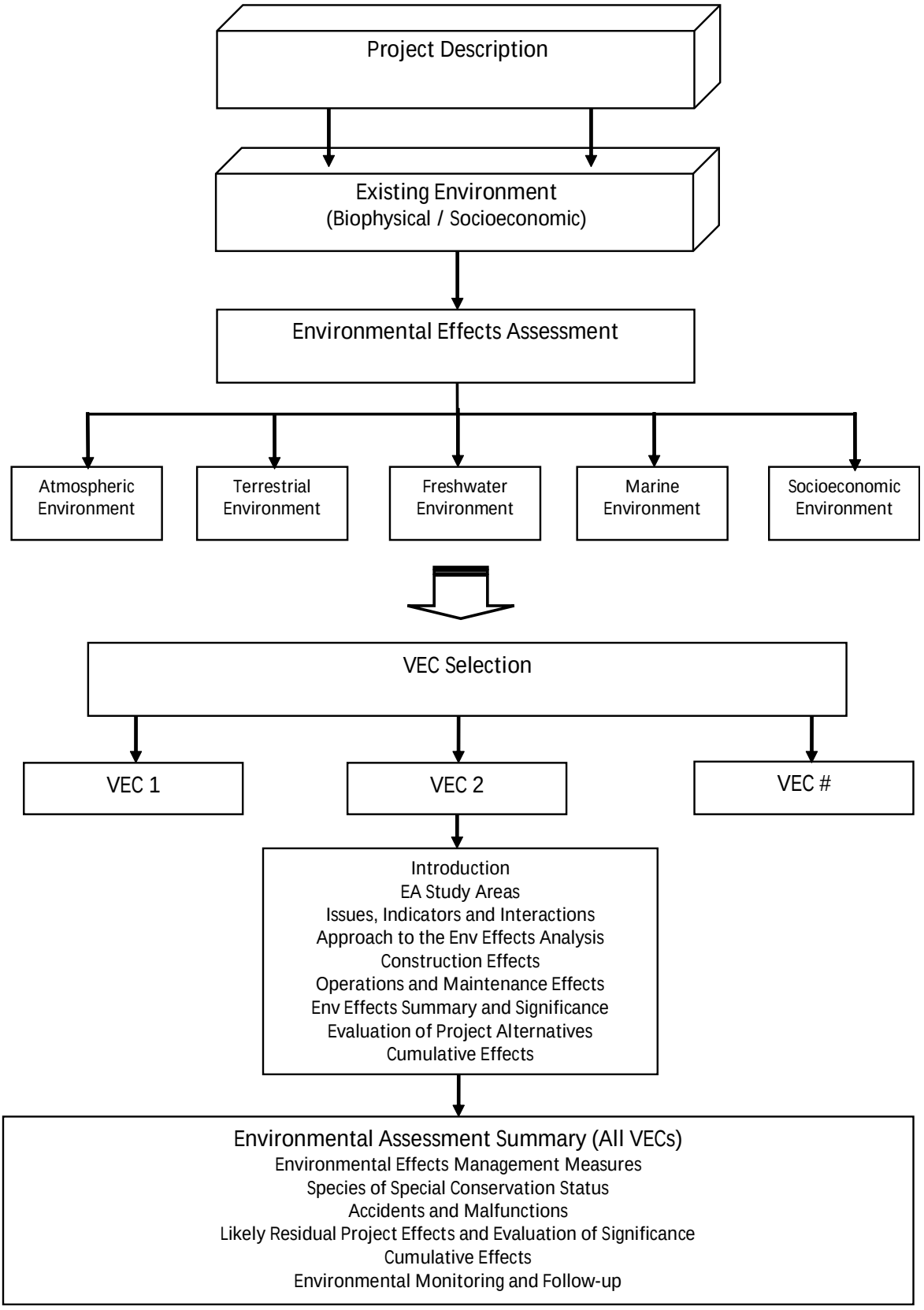
In this EIS, the environmental effects assessment is organized by general "environment", with separate chapters presenting the analysis for the Atmospheric Environment (Chapter 11), Terrestrial Environment (Chapter 12), Freshwater Environment (Chapter 13), Marine Environment (Chapter 14), and Socioeconomic Environment (Chapter 16).

9.2 Valued Environmental Component Selection

In keeping with what has become standard EA practice, and as specified in the EIS Guidelines and Scoping Document, this EA is organized by and focussed on a series of identified Valued Environmental Components (VECs).

VECs are aspects of the biophysical and socioeconomic environments which are of particular ecological and / or social importance, and which will likely be affected (adversely or positively) by the proposed project under assessment. VECs reflect identified scientific and community concerns regarding a project and its potential effects, and are typically identified early in an EA as a result of questions and issues raised through consultations with government departments and agencies, Aboriginal and stakeholder groups and the interested public. The VEC approach is a useful, effective and widely accepted way of helping to ensure that an EA focuses early and throughout on important environmental components and issues.

Initial direction and input into VEC selection were obtained through the EIS Guidelines and Scoping Document issued to Nalcor by the provincial and federal governments in May 2011 following review and input by Aboriginal groups and then the public. Following further consideration and analysis by the EIS study team and as a result of Nalcor's own extensive consultation activities, that initial list of VECs has been expanded and refined to include and reflect the key environmental components and issues that require detailed consideration in the EIS.



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FIGURE 9-1

Environmental Assessment Approach and Methods

Each Environmental Effects Assessment Chapter (Atmospheric, Terrestrial, Freshwater, Marine, Socioeconomic) begins with the identification and discussion of the VEC(s) that have been selected as the focus of the assessment, as well as the rationale for their selection.

For the biological (terrestrial, freshwater, marine) environment chapters, this section also discusses and demonstrates how any Species of Special Conservation Concern have been incorporated and addressed within these VECs and their associated environmental effects assessments.

During the selection of VECs, Nalcor considered that the value of a component not only relates to its role in the ecosystem, but also to the value placed on it by humans. In other words, culture and way of life of those using the area affected by the Project may also be considered as VECs, and that functional relationships within the environment may also be considered as VECs.

9.3 Valued Environmental Component–Specific Environmental Effects Assessments

Within each chapter, and following the above described general introduction and VEC selection sections, the environmental effects assessment is organized and presented on a VEC-by-VEC basis, with each stage of the analysis completed for each VEC in its own separate sub-section.

This is followed eventually by an overall summary of the EA results for that "environment" as a whole (atmospheric, terrestrial, freshwater, marine, socioeconomic), as described later.

9.3.1 Introduction

This section provides a brief overview of the VEC, further defining what it comprises and why it is being considered in the EA.

It also includes a high-level summary of the nature, presence, and distribution of this VEC with respect to the Project, as well as its current condition and status (and thus, it's likely resilience or sensitivity to Project-induced change), which is then considered integrally throughout the effects assessment.

9.3.2 Environmental Assessment Study Areas

EA study areas (spatial and temporal boundaries) have been established for each VEC to direct and focus the environmental effects assessment. These study boundaries are generally VEC-specific, given the differences between the VECs in terms of their overall characteristics and the manner in which they may interact with the Project.

Spatial Boundaries: Two types of spatial boundaries have been defined and are described for each VEC:

- **Local Study Area (LSA)**: The locations within which Project components and activities that may affect the VEC will likely occur (e.g., right-of-way (ROW) clearing activity, transmission tower sites, quarries and access roads). The LSA is defined so as to generally encompass all aspects of the Project that may affect the VEC in question.
- **Regional Study Area (RSA)**: The area over which the Project's potential effects on the VEC may extend, namely, its likely zone of influence. The RSA is based on factors such as the potential geographic extent and mobility of Project-related disturbances (such as air emissions, noise, sediment) and / or the distribution and movements of the VEC itself (the range and migration of affected wildlife, the communities or regions that may see Project benefits or effects).

Temporal Boundaries: In all cases, the temporal boundaries comprise the Construction, and Operations and Maintenance phases of the Project. All VEC assessment sections are based on these generic temporal boundaries, which, given that the Project is assumed to operate in perpetuity, fully encompasses the likely timing of all Project activities and the likely duration of any potential environmental effects.

9.3.3 Potential Environmental Issues, Indicators and Interactions

9.3.3.1 Potential Environmental Issues

In order to identify and focus on key environmental issues, and to ensure that these are fully considered and addressed in the EA, this section summarizes the various questions and issues associated with the Project and its potential effects on the VEC.

This includes those that have been included in the EIS Guidelines and Scoping Document, as well as those identified through Nalcor's Aboriginal, regulatory, stakeholder and public consultation (as outlined in Chapters 7 and 8), by the EIS study team itself, and / or through other Project-related environmental issues scoping activities.

The following table (Table 9.3.3-1) is used to list and organize these issues for each VEC (grouped by theme as appropriate):

Table 9.3.3-1 Identified Issues and Questions

Issue / Question	Nature and Rationale	Specific Considerations
What is the issue?	How and why is this an issue?	Any specific areas, times, species, or other factors identified as being of particular concern

9.3.3.2 Key Indicators and Measurable Parameters

In order to help ensure an appropriate focus and level of analytical rigour for the EA, the environmental effects assessment for each VEC identifies and focuses on relevant *Key Indicators* and associated Measurable Parameters. These are defined generally as follows:

- **Key Indicator (KI)**: An important component or aspect of the VEC which may be affected (changed) as a result of the Project. These may comprise subsets of the VEC itself (e.g., Avifauna VEC – Waterfowl KI, Raptors KI, Passerines KI), certain aspects of the VEC which may be affected by the Project and / or which have a particular importance (e.g., Furbearers VEC – Marten KI; Communities VEC – Services and Infrastructure KI), and / or that can serve as indicators of potential effects on the VEC overall.
- **Measurable Parameter (MP)**: A parameter associated with the KI, to which Project-related changes can be detected and measured (e.g., amount of primary habitat altered and available; regional unemployment and participation rates).

KIs and their associated MPs are identified and listed in the table provided below, and generally form the basis for the focus and structure of the subsequent VEC-specific environmental effects assessment.

Table 9.3.3-2 Key Indicators and Associated Measurable Parameters

Key Indicator	Rationale for Key Indicator	Measurable Parameters	Rationale for Measurable Parameters
KI 1		MP 1 MP #	
KI 2		MP 1 MP #	
KI #		MP 1 MP #	

9.3.3.3 Potential Project-VEC Interactions

This section generally identifies the potential ways that the Project may affect the VEC and each of its identified KIs, to again frame and focus the environmental effects assessment on important and likely issues and interactions.

This is presented in the following table, which lists the various key Project components and activities as well as the VEC-specific KIs. In each cell of the table, a brief note indicates (qualitatively) whether and how that Project component or activity could interact with the VEC and KI in question.

Table 9.3.3-3 Potential Project Interactions

Project Phase / Activity	Key Indicator	
	KI 1	KI #
Construction		
Construction access trails and roads		
Movement and presence of personnel, equipment and materials		
Construction camps		
Marshalling yards and staging areas		
Right-of-way clearing and preparation		
Quarrying and borrowing		
Transmission tower assembly and installation		
Conductor installation		
Converter station site preparation and construction		
Preparation and construction of submarine cable landing sites (on-land works)		
Construction and installation of submarine cables (marine works)		
Electrode site preparation and installation		
Island system upgrades		
Employment / presence of workers		
Contracting / expenditures		
System commissioning		
Operations and Maintenance		
Access trails and roads		
Presence and operation of the transmission system		
Routine line inspections and repairs		
Vegetation management		
Potential major system repairs		
Operation of the electrodes		
Employment / presence of workers		
Contracting / expenditures		

9.3.4 Approach to the Environmental Effects Assessment

As indicated previously, the approach and methods used in this EIS are in keeping with current EA best practice, with a view to ensuring a thorough, structured and rigorous analysis of the likely and important environmental effects of the Project.

This section first provides an overview of the analytical methods used to conduct the environmental effects assessment for the VEC. It includes a general description of the information and methods that have been used to characterize the existing (baseline) environment, as well as the manner in which this information and the Project description were used to predict the likely environmental effects of the Project on the VEC (by KI and MP), using a combination of quantitative and qualitative methods.

As specified in the EIS Guidelines and Scoping Document, and in keeping with standard EA practice, a variety of environmental effects criteria or "descriptors" have been developed and used to describe the nature and degree of the Project's predicted environmental effects. The following general descriptors have been used throughout, although the specific definitions and ratings for each have been developed on a VEC-specific basis:

- **Direction of the Effect**: Adverse, positive or neutral.
- **Magnitude**: The degree of change in the VEC / KI / MP from existing (baseline) conditions.
- **Geographic Extent**: The spatial area within which the effect will occur (Local, Regional or Beyond Regional), based on the specific LSA and RSA developed for the VEC.
- **Duration**: The period of time over which the environmental effect will likely be evident. (Note that effect "reversibility" is not addressed separately, as it is addressed through consideration of the duration of effect and the EA's temporal boundaries.)
- **Frequency**: How often an effect will occur (continuous, or at specific time intervals).

Each VEC section includes a table that describes and defines the various environmental effect descriptors that have been used. The level of confidence in the effects prediction is also indicated throughout.

As noted earlier, "VEC context" — namely, its current condition as a result of natural and / or anthropogenic factors, and its resulting resiliency or sensitivity to further change — has been established in describing the existing (baseline) environment. It has also been considered integrally when assessing the potential environmental effects of the Project (Sections 9.3.5 to 9.3.7) and cumulative environmental effects (Section 9.3.9).

Overall ecological and / or cultural and social context is considered and described as part of the rationale for VEC selection, as well as in the integral consideration of ecological and socioeconomic interactions and linkages between VECs, KIs and others aspects of the natural and human environments as part of the description of the existing environment and the effects assessment.

9.3.5 Construction

This section provides the detailed assessment of the potential environmental effects of the Construction phase of the Project on the VEC.

9.3.5.1 Overview of Project Construction and Associated Effects Management

Recognizing that Project components and activities will have differing degrees of relevance to specific VECs, this section begins with a brief summary of those particular aspects of Project Construction that may interact with the VEC in question, as well as highlighting the relevant environmental effects management measures outlined earlier.

9.3.5.2 Existing Knowledge

This section provides an overview of what is known and understood about the potential effects of the construction of transmission lines and other similar projects on the VEC. This includes relevant information and findings from the literature, reported environmental monitoring of other similar projects, and / or Nalcor's previous development projects and experience. In short, this section presents what is known about whether and how transmission developments affect a particular VEC and its identified KIs.

Such existing knowledge has been incorporated and used to inform the environmental effects assessment for the VEC. To enhance readability and brevity, this information is provided in summary form in Table 9.3.5-1 (organized by KI as appropriate).

Table 9.3.5-1 Existing Knowledge: Effects of Similar Projects on the VEC

Reference	Study / Project Context	Summary of Findings
KI 1		

9.3.5.3 Environmental Effects Assessment

The environmental effects assessment itself considers and describes the nature and degree of potential Project-induced change from the existing (baseline) environment (as described in Chapters 10 and 15).

The Construction environmental effects assessment is structured to address each KI individually and consecutively, assessing and describing the Project's potential effects on the KI with consideration of the relevant environmental effects descriptors outlined above.

Given the nature and overall geographic scale of the Project and its existing environment, the effects assessment is also organized on a regional basis where appropriate, using the following regions or an appropriate aggregation of them: Central and Southeastern Labrador; Strait of Belle Isle; Northern Peninsula; Central and Eastern Newfoundland; and, the Avalon Peninsula (Figure 9.3.5-1).

Environmental effects management (mitigation and optimization) measures are considered integrally and iteratively in the effects assessment. This includes those that have been "built-in" to the Project through its planning and design, so as to proactively avoid or reduce potential environmental issues (e.g., Chapters 2 and 3 - such as transmission corridor selection, construction approaches), as well as the standard environmental protection and benefits optimization measures that have been described earlier (Chapters 3 - 5). As per the CEAA, mitigation in this EA is defined as the elimination, reduction or control of the adverse environmental effects of the Project, and includes restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means. The rationale for and effectiveness of the proposed mitigation and enhancement measures are discussed, as appropriate, and evaluated. Available data, survey and study results and detailed mitigation measures that demonstrate a particular emphasis on avoidance of environmental effects are included in the EIS. From there, and with this base of general mitigation and optimization in place, the environmental effects assessment identifies and proposes further VEC-specific effects management measures as required and appropriate.

As a result, and in keeping with standard EA approaches and to optimize efficiency, the environmental effects assessment is therefore focused upon assessing and describing the likely residual environmental effects of the Project – namely, those adverse environmental effects which cannot or will not be avoided or mitigated through the application of environmental control technologies, best management practices or other acceptable means.



FIGURE 9.3.5-1

Regions used to Present the Potential Effects of the Project

Nalcor does not discuss mitigation failure in this EIS, as the mitigation strategies (e.g., avoidance) and methods proposed for the Project are proven, industry standard, best management practices, and backed by Nalcor's extensive experience with similar projects throughout Newfoundland and Labrador. Nalcor is responsible for the implementation of these measures and all contractors and subcontractors will be required to adhere to the mitigation outlined in this EIS and associated documents (e.g., the Environmental Protection Plan (EPP)). As per Section 4.10 of the EIS Guidelines and Scoping Document (Government of Newfoundland and Labrador and Government of Canada 2011) Nalcor will prepare an EPP for each main construction site, and have the EPPs approved by the regulatory authorities before starting construction.

9.3.6 Operations and Maintenance

The VECs environmental effects assessment for the Operations and Maintenance phase of the Project is presented in this section, using the same approach and structure as that outlined above for the Construction phase.

9.3.7 Environmental Effects Summary and Evaluation of Significance

Up to this point, the environmental effects assessment for the VEC will have focused on the individual KIs and their associated MPs, by Project phase. The purpose of this section is to then summarize these results, providing overall conclusions about the likely residual environmental effects of the Project on the VEC.

9.3.7.1 Summary of Environmental Effects

This section provides a general summary of the overall likely residual environmental effects of the Project on the various KIs (including any differences in these effects between the KIs), as well as for the VEC overall.

This information is summarized in Table 9.3.7-1, using the various environmental effects descriptors that were initially defined for the VEC (as described earlier).

9.3.7.2 Definition and Determination of Significance

Evaluating the significance of the predicted likely environmental effects of a proposed project is one of the most important steps in any EA, and both the provincial and federal EA legislation require consideration of the significance of a project's likely effects.

This typically involves: 1) defining what a *significant* environmental effect is, and 2) on the basis of that definition, evaluating whether a project's likely environmental effects are *significant* or *not significant*. Like all aspects of an EIS, this then forms the basis for review and discussion by government regulators, Aboriginal and stakeholder groups and the public, and eventually, the determined significance of a project's likely environmental effects is a primary consideration in EA decisions by governments as to whether and how the project may proceed.

Significance definitions are developed and used at this stage of the environmental effects assessment for a VEC, which generally incorporate the principles of sustainability and other relevant concepts and considerations as appropriate. Significant environmental effects are those adverse effects that will cause a change in the VEC that will alter its status or integrity beyond an acceptable level. An environmental effect that does not meet the above criteria is considered not significant. Significance definitions are developed on a VEC-specific basis, or on a KI-specific basis as applicable.

This section provides an overall discussion of whether and how any of the likely residual environmental effects of the Project meet the significance criteria and definition established for the VEC / KIs, as well as an overall determination of the significance of the resulting total effect on the VEC.

Table 9.3.7-1 Environmental Effects Assessment Summary

Project Phase/Key Indicator	Likely Residual Environmental Effects Summary Descriptors				
	Direction	Magnitude	Geographic Extent	Duration	Frequency
Construction					
KI 1					
KI 2					
KI #					
Summary of Likely Residual Construction Effects on VEC:					
Operations and Maintenance					
KI 1					
KI 2					
KI #					
Summary of Likely Residual Operations and Maintenance Effects on VEC:					

9.3.8 Evaluation of Project Alternatives

As an important and valuable planning tool, EA is intended to help inform and influence project design, and in doing so, to help address the potential environmental outcomes of proposed development projects. The EA process therefore allows for the identification, analysis and evaluation of potential alternative project concepts and approaches, to help directly incorporate environmental considerations into project planning at an early stage.

In conjunction and concurrent with the EA process, Nalcor will be continuing with its technical and environmental analysis of the identified transmission corridors, including alternative corridors, in order to identify and eventually select a specific routing for the transmission line. This analysis includes a compilation of information on the existing natural and human environments within the transmission corridors, in order to identify and evaluate key environmental and socioeconomic factors and issues for consideration in the eventual route selection process. Inputs to this analysis and planning process will include existing and available information on the biophysical and socioeconomic environments, any additional information collected and issues identified as part of the EA process, as well as the results of the associated public and stakeholder consultations and any associated terms and conditions of EA approval (e.g., requirements to avoid certain environmental components in eventual route selection). The current proposed transmission corridor is intended to form the basis for eventual detailed route selection, subject to further refinement as Project engineering and environmental work continues. Once identified, and prior to final Project design and construction, Nalcor plans to conduct public consultations to present these transmission line routing(s) to the interested public and stakeholders. This will serve as a final check on its overall environmental acceptability, and allow for any final amendments to address any important remaining environmental issues, as required and possible. Detailed engineering and design for all Project components and activities has recently commenced, and will continue throughout and beyond the EA process. It includes consideration of Project requirements, including technical and economic factors, as well as environmental considerations.

As such, and as required under the provincial and federal EA legislation and the associated EIS Guidelines and Scoping Document, the EIS therefore also considers possible alternative means of carrying out the Project that are technically and economically feasible, and the environmental effects of the chosen alternative means. An initial analysis and discussion of potential alternative means of carrying out this Project was provided earlier in Chapter 2, including the identification of those alternatives that have been determined to be technically and economically feasible, and thus, which would be brought forward into the environmental effects assessment.

For each VEC, the initial and detailed environmental effects assessment (as outlined above) is focused specifically on the proposed (preferred) Project design concept (as described in detail in Chapter 3). From there, the various alternative means of carrying out the Project (alternative transmission corridor segments) that were identified in Chapter 2 as being potentially technically and economically feasible are then assessed in this sub-section, using a “comparative approach”.

Here, the potential environmental effects of each of these alternative corridor segments are assessed through a comparison to the predicted environmental effects of the proposed transmission corridor that is the subject of the preceding detailed environmental effects assessment. In doing so, this analysis considers and describes whether and how the potential environmental effects of each alternative segment would be different in nature and degree from those of the segment of the proposed transmission corridor that it would replace.

For each VEC, the results of this alternatives evaluation is provided in this section and summarized in Table 9.3.8-1.

Table 9.3.8-1 Summary Evaluation of Project Alternative Means

Project Alternative Means	Environmental Implications (Compared to the Proposed Project Concept)		
	KI 1	KI 2	KI #
A1			
A2			
A#			

The overall results of the VEC-specific analyses of alternative means are subsequently summarized at the end of each environmental effects assessment chapter, and then for the overall EIS in Chapter 17 (Summary and Conclusions).

9.3.9 Cumulative Environmental Effects

As specified under *CEAA* and in the EIS Guidelines and Scoping Document, the EIS also assesses and evaluates any cumulative environmental effects that are likely to result from the Project in combination with other projects or activities that have been carried out or are reasonably foreseeable.

The cumulative environmental effects assessment for each VEC is reported in this section, and considers the overall (total) effect on the VEC as a result of the Project's likely residual environmental effects (as summarized above) and those of other relevant projects and activities, using the following staged approach:

1) Past and ongoing projects and activities and their environmental effects are, as described earlier, reflected in the existing (baseline) environment (Chapters 10 and 15). Also, an overview of these previous and ongoing developments and other human activities in the general area of the Project was provided as part of the environmental setting and context (Chapter 6).

   The current condition of the VEC as a result of these natural and / or anthropogenic factors, and thus its overall sensitivity or resiliency to further disturbance or change, has been integrally considered throughout the environmental effects assessment. This current condition of the VEC is again briefly summarized here.

2) With this environmental baseline / current VEC condition established, the cumulative effects assessment then summarizes and considers whether and how this existing condition will be changed by the introduction of the Project and its residual environmental effects.

3) From here, other likely future projects and activities that are relevant to this VEC and its cumulative effects assessment are identified. These comprise any reasonably foreseeable future projects or activities whose effects on the VEC would likely overlap in space and time with those of the Project (e.g., overlap with the Project area and / or its zone of influence, affect the same wildlife populations or communities).

4) In cases where the predicted residual environmental effects of the Project on the VEC will overlap in space and time with those of one or more other future projects and activities, the potential cumulative effects of the Project in combination with those of the other relevant future developments are assessed and evaluated.

In summary, the cumulative effects assessment assesses and evaluates the overall (total) environmental effect on the VEC resulting from the likely residual effects of the Project in combination with those of other relevant past, present and reasonably foreseeable future projects and activities. In doing so the cumulative effects assessment:

- considers the effects of past and ongoing projects and activities as part of the pre-Project environment baseline, and integrally considers and incorporates this baseline — and the resulting current "condition" of the VEC — into the environmental effects assessment;
- it then assesses the likely nature and degree of change from this existing (baseline) environment as a result of the Project's effects in combination with other relevant future projects and activities; and
- finally, the VEC-specific cumulative effects assessment concludes by providing an evaluation of the significance of these predicted cumulative effects, using the same significance definition and approach as was used for the Project-specific effects assessment.

Table 9.3.9-1 is used in each VEC section to summarize the key results of the cumulative environmental effects assessment.

As in the earlier Project-specific environmental effects assessment, given the geographic scale involved it has also been necessary to structure and subdivide the cumulative effects assessment by region (i.e., Central and Southeastern Labrador, Strait of Belle Isle, Northern Peninsula, Central and Eastern Newfoundland, Avalon Peninsula) (Figure 9.3.5-1).

Table 9.3.9-1 Cumulative Environmental Effects Summary

Cumulative Effects Analysis	Central and Southeastern Labrador	Strait of Belle Isle	Northern Peninsula	Central and Eastern Newfoundland	Avalon Peninsula
Current (Baseline) VEC Condition (Reflecting the Effects of Past and Ongoing Projects and Activities)					
Likely Residual Environmental Effects of Labrador-Island Transmission Link (Reflecting Current VEC Condition, As Above)					
Likely Cumulative Environmental Effects (within RSA) of Other Future Projects and Activities					
Cumulative Environmental Effects Summary					

The list in Table 9.3.9-2 provides a general indication of the "other future projects and activities" that have been considered in the cumulative effects assessment outlined above. The relevance of each is, of course, somewhat VEC-specific, and others that are relevant to a particular VEC are also identified and considered as required.

5 **Table 9.3.9-2 Other Projects and Activities Considered in the Cumulative Effects Assessment**

Potential Future Project / Activity	Overview and Status	Notes and Considerations
Labrador		
Lower Churchill Hydroelectric Generation Project	– Proposed hydroelectric facilities at Muskrat Falls and Gull Island and interconnecting transmission lines between them and Churchill Falls	– Future Construction, and Operations and Maintenance activities
Trans Labrador Highway, Phase 3 (Happy Valley-Goose Bay to Cartwright Junction)	– Construction completed, Highway opened / operational since late 2009	– Any new / future effects will likely be due to highway operations (presence of the road, increased access, etc.)
Proposed 5 Wing Goose Bay Supersonic Flight Training	– Altitude of 28,000 feet to 5,000 feet, north-west of Happy Valley-Goose Bay and north of Churchill Falls to the Labrador-Quebec border. Approximately 1,250 sorties / year between April to October, fighter jet aircraft such as the CF-18	– Considers future and proposed activity, effects of past low-level flying activity are reflected in the baseline environment
Commercial Forestry Activity	– District 19A (Goose Bay) 5-year Operating Plan (2008-2012) – District 21 (Labrador Straits area) 5-year Operating Plan (2007-2011)	– Including any amendments to the Plans
General Economic and Infrastructure Development	– General municipal and other civil works and development activities throughout the Central Labrador (Upper Lake Melville) and Labrador Straits regions	
Proposed Labrador West Mining and Related Developments	– Elross Lake Area / Direct-Shipping Iron Ore (New Millennium Capital Corp.) – Schefferville Iron Ore Mine - James and Redmond Properties (Labrador Iron Mines Ltd.) – Expansion of existing Labrador West mining development and associated growth	– Especially relevant for socioeconomic VEC(s)
Strait of Belle Isle (Marine Environment)		
Potential future changes to the intensity / nature / distribution of fishing activity in the Strait	– New and / or expanded fisheries activity in the Strait (e.g., since the re-opening of the previously closed scallop refugium in the area in 2009)	

Table 9.3.9-2 Other Projects and Activities Considered in the Cumulative Effects Assessment (continued)

Potential Future Project / Activity	Overview and Status	Notes and Considerations
Maritime Link	– A new transmission line between Cape Ray and Bottom Brook along an existing transmission corridor, Bottom Brook to Granite Canal in a combination of existing and new corridors, and Granite Canal to Bay d'espoir along an existing transmission line – Two subsea cables spanning approximately 180 km from Port Aconi (or Lingan), Nova Scotia to Cape Ray, Newfoundland (crossing the Cabot Strait)	– Outside the Strait of Belle Isle, but considered in relation to the marine environment
Newfoundland		
General Economic and Infrastructure Development	– General and likely works and development activities throughout the regions (e.g., transportation improvements, municipal works, proposed quarries, cottage development areas, small agricultural developments) – See, for example, the following for an indication of Projects currently undergoing provincial EA: – http://www.env.gov.nl.ca/env/env_assessment/projects/index.html	
Commercial Forestry Activity	– The proposed transmission corridor overlaps with portions of several Forest Management Districts: three on the Northern Peninsula, seven in the Central and Eastern portions of the Island and one on the Avalon Peninsula	– Planned activity but also including consideration of closure of several mills in Newfoundland in recent years
Long Harbour Processing Plant	– Initial construction of the processing plant began in April 2009 with construction to conclude in February 2013	– Especially relevant for socioeconomic VEC(s)
Oil and Gas Activities	– Hebron Development, Hibernia Southern Extension, White Rose Expansion, other likely exploration and development activities	– Especially relevant for socioeconomic VEC(s)
Maritime Link	– A new transmission line between Cape Ray and Bottom Brook along an existing transmission corridor, Bottom Brook to Granite Canal in a combination of existing and new corridors, and Granite Canal to Bay d'espoir along an existing transmission line – Two subsea cables spanning approximately 180 km from Port Aconi (or Lingan), Nova Scotia to Cape Ray, Newfoundland (crossing the Cabot Strait)	– Especially relevant for the caribou and socioeconomic VECs

9.4 Environmental Assessment Summary

As described above, the environmental effects assessment is completed on a VEC-by-VEC basis, with each stage of the analysis completed for each VEC in its own section. The various VECs have been grouped into larger chapters by "environment", namely for the: 1) Atmospheric Environment, 2) Terrestrial Environment, 3) Freshwater Environment, 4) Marine Environment, and 5) Socioeconomic Environment. At the end of each environment chapter, the VEC-by-VEC analysis is followed by an overall summary of the results and findings for that "environment" as a whole, which is organized according to the following subsections.

9.4.1 Effects Management Measures

For each VEC, environmental effects management measures that avoid or reduce potential adverse environmental effects and / or optimize Project benefits are presented. Mitigation is an integral element of the Project design and implementation. The effects assessment is based on the Project with identified mitigation in place.

9.4.2 Species of Special Conservation Concern

For the "biological environments" (terrestrial, freshwater and marine), this section provides a summary discussion of the various relevant Species of Special Conservation Concern, including: 1) a summary of those that have the potential to interact with the Project, 2) an indication of where and how these species have been addressed in the effects assessment, and finally, 3) to provide a species by species summary of the Project's potential effects on these species and their significance (Table 9.4.2-1).

Table 9.4.2-1 Species of Special Conservation Concern: Environmental Effects Summary

Species of Concern	How Addressed	Summary of Effects	Determination of Significance
Species 1			
Species #			

9.4.3 Accidents and Malfunctions

As described in Chapters 3 and 5 of this EIS, potential accidents and malfunctions have been assessed herein in several ways. Potential incidents that are of a relatively smaller scale and which, while unfortunate, are considered somewhat likely to occur during the course of the normal Construction, and Operations and Maintenance of a large development project have been addressed integrally as part of the VEC-specific environmental effects assessment for Project Construction, and Operations and Maintenance. This includes the identification of prevention and response measures.

Other potential accidents and malfunctions which are considered unlikely to occur, but which may be of a larger scale and have the potential to have different types and / or levels of environmental issues, are assessed separately in this section.

9.4.4 Residual Project Effects and Significance

This section provides an overall summary of the likely residual environmental effects of the Project on the atmospheric, terrestrial, freshwater, marine or socioeconomic environment, as applicable, including the likely significance of those effects and the basis for those conclusions.

9.4.5 Cumulative Environmental Effects

This section provides an overall summary of the likely cumulative environmental effects of the Project in combination with other projects and activities that have been carried out or are reasonably foreseeable. This includes a summary of: the other activities that were included in the cumulative effects assessment; the general nature of the cumulative effects on each of the VECs and the environment as a whole, and whether these cumulative effects are likely to be significant.

9.4.6 Environmental Monitoring and Follow-up

Each chapter concludes with a discussion of any proposed environmental monitoring and / or follow-up programs related to one or more of the associated VECs during Project Construction and / or Operations and Maintenance.

For the purposes of this EIS, environmental monitoring and follow-up are defined as follows:

- Monitoring programs are those implemented to meet standard regulatory requirements (such as may be required as a result of eventual Project permits), and / or to demonstrate compliance to environmental commitments made in the EIS.
- Follow-up programs are those that may be required and implemented to address any EA-related issues of uncertainty, such as to verify the environmental effects predictions and / or the effectiveness of implemented environmental effects management measures and to determine whether to implement adaptive management measures.

This section provides an overview discussion of any such environmental monitoring and / or follow-up programs that may be required or proposed for one or more of the associated VECs, as outlined in section 4.6.4 of the EIS Guidelines and Scoping Document (Government of Newfoundland and Labrador and Government of Canada 2011).

Monitoring requirements will be stipulated by the regulators in the eventual Project permits, including details such as scheduling, sampling design, frequency, and reporting, and Nalcor will comply with the requirements.

Monitoring programs will include, as appropriate:

- the objectives of the monitoring program and a schedule for collection of the monitoring data required to meet these objectives;
- the sampling design, methodology, selection of the subjects and indicators to be monitored, and their selection criteria;
- the frequency, duration and geographic extent of monitoring, and justification for the extent;
- the application of the principles of Adaptive Environmental Management;
- reporting and response mechanisms, including criteria for initiating a response and procedures;
- the approaches and methods for monitoring the cumulative effects of the Project with existing and future developments in the Project area;
- integration of monitoring results with other aspects of the Project including adjustments to operating procedures and refinement of mitigation measures;
- experience gained from previous and existing monitoring programs;
- the advisory roles of independent experts, government agencies, communities, holders of Aboriginal traditional and community knowledge and renewable resource users;

- procedures to assess the effectiveness of monitoring and follow-up programs, mitigation measures and recovery programs for areas disturbed by the Project; and
- a communications plan to describe the results of monitoring to interested parties.

Nalcor has committed to working with the regulators and other stakeholders to finalize the details of many of the follow-up programs outlined in this EIS.

In association with the above approach, Nalcor will explain how the public and Aboriginal groups will continue to be involved, including participation in the design and implementation of environmental management and monitoring and follow-up programs, as appropriate. This process will include describing plans to maintain communications and working relationships with the affected communities, Aboriginal organizations, municipalities and government agencies throughout the life of the Project, as appropriate. Nalcor will discuss ways in which holders of Aboriginal traditional and community knowledge, including elders, women and youth, could be involved in any monitoring and follow-up programs, with the appropriate Aboriginal groups and communities, during the development of these programs.

Nalcor continues to improve their approaches based on experience gained in the construction and operation of their various projects and systems throughout Newfoundland and Labrador. If unforeseen adverse environmental effects are identified during any of the monitoring or follow-up programs, Nalcor will, as per their ongoing adaptive management process, adjust the existing mitigation measures or, if necessary, develop new mitigation or other measures to address those effects. This could result in Nalcor refining or modifying the design and implementation of management plans, mitigation measures and Project operations, with the final approach selected depending on the issue identified.

9.5 Guiding Principles of the Environmental Assessment

The reader is referred to Chapter 8, Appendix 8-1 of this EIS, for the conformance table that provides the reference to the EIS section that addresses each of the EIS Guidelines and Scoping Document.

9.5.1 Environmental Assessment: A Planning Tool

As noted in section 2.1 of the EIS Guidelines and Scoping Document (Government of Newfoundland and Labrador and the Government of Canada 2011), Nalcor considers this EA to be a planning tool that enables consideration of the potential effects of the Project in a careful and precautionary manner before actions are taken to allow the Project to proceed. As such, the EA is a process for identifying the Project's potential interactions with the environment, predicting environmental effects, identifying mitigation measures and evaluating the significance of residual environmental likely effects in order to promote sustainability, protect the environment, and facilitate the wise management of natural resources. The EA also provides the basis for setting out the requirements for monitoring and reporting to verify compliance with the terms and conditions of approval and the accuracy and effectiveness of predictions and mitigation measures.

9.5.2 Aboriginal and Public Participation

Nalcor considers Aboriginal and public participation to be a central objective of the EA process and a means to ensure consideration and response to Aboriginal and public concerns. During the preparation of the EIS, Nalcor informed and consulted, where possible, with all potentially affected Aboriginal and local communities, interested regional and national organizations and resource users. To facilitate this, Nalcor has prepared a plain language summary of the EIS, in accordance with Section 4.1.2 of the EIS Guidelines and Scoping Document (Government of Newfoundland and Labrador and the Government of Canada 2011).

Nalcor understands that meaningful public involvement can take place when Aboriginal groups and the public have a clear understanding of the nature of the Project as early as possible in the EA process. As such, Nalcor:

- will continue to provide up-to-date information, as it becomes available, to Aboriginal groups and the public, and especially to the communities likely to be affected by the Project;
- will continue to involve the main interested parties in determining how best to deliver that information, that is, the type of information required, format and presentation methods, as well as the need for community meetings;
- will explain the results of the EIS in a clear and direct manner (i.e., plain language summary) to make the issues comprehensible to the widest possible audience; and
- has, and will continue to consider and acknowledge all requests for consultation with Aboriginal groups during Project approvals and throughout the life of the Project.

9.5.3 Aboriginal Traditional and Community Knowledge

Nalcor appreciates that populations living in proximity to the Project may have substantial and distinct knowledge, which can be considered in the assessment of the effects of the Project, and their mitigation. As such, Nalcor considered Aboriginal traditional and community knowledge of the existing environment as an integral part of the EIS, to the extent that it was available.

As outlined in section 2.3 of the EIS Guidelines and Scoping Document (Government of Newfoundland and Labrador and the Government of Canada 2011), in EA, Aboriginal traditional and community knowledge may be regarded as the knowledge, understanding and values that residents of Aboriginal and local communities have in relation to the environment and the potential environmental effects of the Project and proposed mitigation measures. Nalcor understands that this knowledge is based on personal observation, collective experience and / or oral transmissions. This knowledge may also have been studied and inventoried by specialists in such areas as anthropology, sociology, ethnology, heritage, history, medicine, environment, ecology and biology, and all such studies and inventories may be relevant.

Aboriginal traditional knowledge (referred to as Aboriginal Ecological Knowledge in this EIS) and community knowledge (referred to as Local Ecological Knowledge in this EIS) gathered related to the biophysical existing environment are presented in Chapter 10. Knowledge on the socioeconomic existing environment (Chapter 15) is incorporated into the baseline information and not presented separately, but rather integrally considered through the chapter as appropriate.

Nalcor considered the Aboriginal traditional and community knowledge in assisting in its understanding, including the inter-relationships, among such matters as: ecosystem function; resource abundance, distribution and quality; social and economic well-being; and use of the land and resources. Nalcor also considered the traditional and community knowledge that was available, to inform the development of adequate baseline information, identification of key issues, prediction of effects, and assessment of their significance.

9.5.4 Sustainable Development

As discussed in Section 2.4 of the EIS Guidelines and Scoping Document (Government of Newfoundland and Labrador and the Government of Canada 2011), sustainable development seeks to meet the needs of present generations without compromising the ability of future generations to meet their own needs. The objectives of sustainable development are:

- the preservation of ecosystem integrity, including the capability of natural systems to maintain their structures and functions, and to support biological diversity;

- the respect for the right of future generations to the sustainable use of renewable and non-renewable resources; and
- the extent, distribution and duration of social and economic benefits.

Nalcor has promoted sustainable development as a fundamental purpose of EA, and has included the following in the EIS:

- the extent to which biological diversity is affected by the Project;
- the capacity of renewable resources that are likely to be significantly affected by the Project to meet the needs of present and future generations; and
- the extent, distribution and duration of social and economic benefits.

Nalcor integrated these factors into the planning and decision-making process for the Project, including seeking the views of interested parties, by considering the sustainability of populations in the evaluation of likely residual effects, including cumulative effects, of the Project.

In addition, as per Section 4.5.4 of the EIS Guidelines and Scoping Document (Government of Newfoundland and Labrador and the Government of Canada 2011) Nalcor has described the renewable resources that may be affected by the Project, including living (e.g., fish, wildlife, forests) and non-living (e.g., water) renewable resources. This EA clearly establishes, taking into account the effects assessment, whether these renewable resources are likely to be significantly affected following the implementation of proposed mitigation measures. This is addressed primarily through the assessment of the effects of the Project on the VECs selected for vegetation, avifauna (terrestrial / freshwater and marine), caribou, furbearers, fish and fish habitat (freshwater and marine), marine mammals, and water resources (freshwater and marine). In addition, the results of the assessment informed the discussions related to the potential Project effects on sustainability and biodiversity, which are directly related to renewable resources.

9.5.5 Precautionary Principle

Section 2.5 of the EIS Guidelines and Scoping Document (Government of Newfoundland and Labrador and the Government of Canada 2011) states that “one of the purposes of environmental assessment is to ensure that projects are considered in a careful and precautionary manner before action is taken in connection with them in order to ensure that such projects do not cause significant adverse environmental effects.”

Further, Section 2.5 outlines Principle 15 of the 1992 Rio Declaration of Environment and Development, which states that “Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”

In applying a precautionary approach for this Project, within this EIS Nalcor has:

- demonstrated that the proposed Project has been examined in a careful and precautionary manner;
- outlined the assumptions made about the effects of the Project and the approaches to prevent and minimize these effects;
- identified where knowledge uncertainty exists in the predictions of the environmental effects of the Project; and
- identified any follow-up and monitoring activities planned, particularly in areas where knowledge uncertainty exists in the prediction of the effects of the Project.

As outlined in the above subsections, this EIS has been conducted to ensure that the Project was considered in a careful and precautionary manner so that the resulting likely residual effects are not significant. Nalcor recognizes the diverse assemblage of habitat types, and environmental and social sensitivities in the regions

crossed by the Project components (e.g., transmission corridor, electrode lines, shore electrodes, access, temporary camps, laydown areas, quarries) and has gathered information from several sources, including Aboriginal, regulator and stakeholder consultation, to assist in the ongoing planning of the Project and to inform the effects assessment (i.e., accurate data and maps were used).

As part of its careful and precautionary approach, and as requested in Section 4.6.1 of the EIS Guidelines and Scoping Document (Government of Newfoundland and Labrador and the Government of Canada 2011), Nalcor identified mitigation measures which includes best available technology, best management practices, and avoidance through the implementation of scheduling, siting constraints and pollution prevention opportunities. This process has resulted in the initial application of mitigation related to routing of the corridor (e.g., re-routing to avoid Gros Morne National Park); application of proven, minimal disturbance technology (e.g., horizontal directional drill of the shoreline landings for the submarine cable crossings of the Strait of Belle Isle); and use of existing disturbance corridors (e.g., routing the western portion of the transmission corridor along the Trans-Labrador Highway (Phase 3)). All technically and economically feasible mitigation measures that were appropriate were considered. Trade-offs between costs and predicted effectiveness of the mitigation were considered during the development of the mitigation strategies, with the emphasis placed on the effectiveness of the mitigation.

This EIS is also part of Nalcor's commitment to apply the precautionary principle to the Project development (i.e., taking action to protect the public and / or the environment if there is a likely effect, considering the best available science, even if scientific certainty is not available to fully assess the effect). Nalcor is proposing to use cost-effective, proven approaches (i.e., best management practices) and mitigation, regardless of the level of scientific certainty about Project effects, to prevent environmental degradation, and to construct and operate the Project in a manner that conforms to the aim of sustainable development. This consideration of sustainability includes providing the province with a source of reliable, clean, economical electrical power to allow it to meet Newfoundland and Labrador's 2007 Energy Plan.

Regardless of the level of certainty (i.e., confidence in the predictions made in the EA), Nalcor's effects management measures (mitigation) are consistent with taking a precautionary approach to Project development, which also includes application of the Precautionary Principle. Follow-up programs have been proposed, as appropriate, that have been designed to verify the accuracy of effects predictions, and the effectiveness of mitigation. Nalcor will use information provided by Aboriginal and / or stakeholder groups, or obtained from any of the monitoring and / or follow-up programs undertaken to feed into their adaptive management process for continued improvement. The adaptive management process will ensure timely, proactive responses to identified issues to limit the resulting effect.

9.6 References

Government of Newfoundland and Labrador and Government of Canada. 2011. Environmental Impact Statement Guidelines and Scoping Document, Labrador-Island Transmission Link. Prepared for Nalcor Energy. St. John's, NL.

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