COMPREHENSIVE STUDY REPORT

Eider Rock Project, Marine Terminal, Saint John Harbour

IRVING OIL COMPANY, LIMITED
SAINT JOHN, NEW BRUNSWICK

Canadian Environmental Assessment Registry (CEAR) # 07-03-28779

COMPREHENSIVE STUDY REPORT

REPORT TO	Fisheries and Oceans Canada, Transport Canada, and Environment Canada
AND	Canadian Environmental Assessment Agency
ON	Comprehensive Study Report (CSR): Eider Rock Project, Marine Terminal, Saint John Harbour (Canadian Environmental Assessment Registry # 07-03-28779)
PREPARED PURSUANT TO:	Section 21.1(1)(a) of the *Canadian Environmental Assessment Act*
PREPARED ON BEHALF OF	Irving Oil Company, Limited 10 Sydney Street Saint John, NB, E2L 4K1 Tel: (506) 202-2000 Fax: (506) 202-7002

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PREPARED BY:

Jacques Whitford Stantec Limited
130 Somerset Street
Saint John, New Brunswick E2K 2X4

Phone: 506-634-2185
Fax: 506-634-8104
www.jacqueswhitford.com

Table of Contents

List of Appendices

1.0 INTRODUCTION

This is the Comprehensive Study Report (CSR) for the environmental assessment (EA) of the marine terminal for Project Eider Rock ("the Project") proposed by Irving Oil Company, Limited ("Irving Oil", "the Proponent") in Saint John Harbour, New Brunswick. Project Eider Rock (the "Development Proposal") involves the proposed construction and operation of a new petroleum refinery and marine terminal in Saint John.

The CSR is intended to address the specific requirements for a federal environmental assessment (EA) under the *Canadian Environmental Assessment Act* (*CEAA*) for the marine terminal. The scope of EA under *CEAA* includes the marine terminal and other facilities and infrastructure being constructed in the marine waters of Mispec Bay in Saint John Harbour, New Brunswick. As such, this CSR is focused on the assessment of those features and structures in the marine environment that are proposed as part of the Development Proposal, which are subject to the requirements of *CEAA*.

For the purpose of this CSR, the project to be assessed is the marine terminal proposed as part of the Development Proposal, including the proposed jetty, barge landing facility, and other marine infrastructure that will be constructed to support the Development Proposal in its entirety. Other components of the Development Proposal on land (e.g., the proposed petroleum refinery and other land-based infrastructure) are being assessed under a separate environmental impact assessment (EIA) under the New Brunswick *Environmental Impact Assessment Regulation - Clean Environment Act* and are not assessed under *CEAA*. The Responsible Authorities (RAs) and several other federal authorities have been participating in the provincial EIA process to advise the Province of New Brunswick on environmental matters relating to the environmental effects of the proposed refinery and other land-based infrastructure.

The CSR has been developed in response to the Environmental Assessment Track Report ("EA Track Report") and Scoping Document (Government of Canada 2007a) issued on November 21, 2007 by the RAs for the EA—namely Fisheries and Oceans Canada (DFO); Transport Canada (TC); and Environment Canada (EC). The CSR documents the results of the EA of the Project and evaluates potential environmental effects of the Project, optimizes the positive environmental effects, reduces adverse environmental effects resulting from the Project through mitigation, and recommends a follow-up and monitoring program as appropriate.

It is important to emphasize that the scope of project for the federal EA is focused on the construction, operation, decommissioning and/or abandonment of those components of the proposed development that are likely to require approvals (and therefore trigger *CEAA*) from the three identified RAs. Based on the EA Track Report and Scoping Document (Government of Canada 2007a), the EA under *CEAA* examines:

> *"the construction, operation, decommissioning and/or abandonment of the following triggered components of the development proposal, and the related activities (e.g., blasting, dredging, infilling, disposal at sea):*

- *the pier or monobuoy for crude tanker unloading, and/or the use of the existing monobuoy at Canaport;*

- *the pier and associated breakwater for loading of petroleum coke products onto ships and for shipping the refined petroleum products to their intended markets; and*
- *the barge landing facility, constructed on either a temporary or permanent basis, for unloading large equipment during the construction phase or as required thereafter."*

In the Scoping Document, the RAs also proposed that the scope of project would include docking and deberthing of vessels. However, the scope of project does not include shipping, as shipping issues will be addressed via a TERMPOL Review Process.

The scope of project also includes a fourth component, as noted in Section 4.4 of the EA Track Report:

- *"in-water physical structures, constructed on either a temporary or permanent basis, in the marine environment, and any navigational dredging that may be required."*

Jacques Whitford Stantec Limited prepared this CSR on behalf of Irving Oil, who was formally delegated the responsibility to prepare the CSR by the RAs pursuant to their authority under Section 17(1) of *CEAA*.

1.1 The Proponent

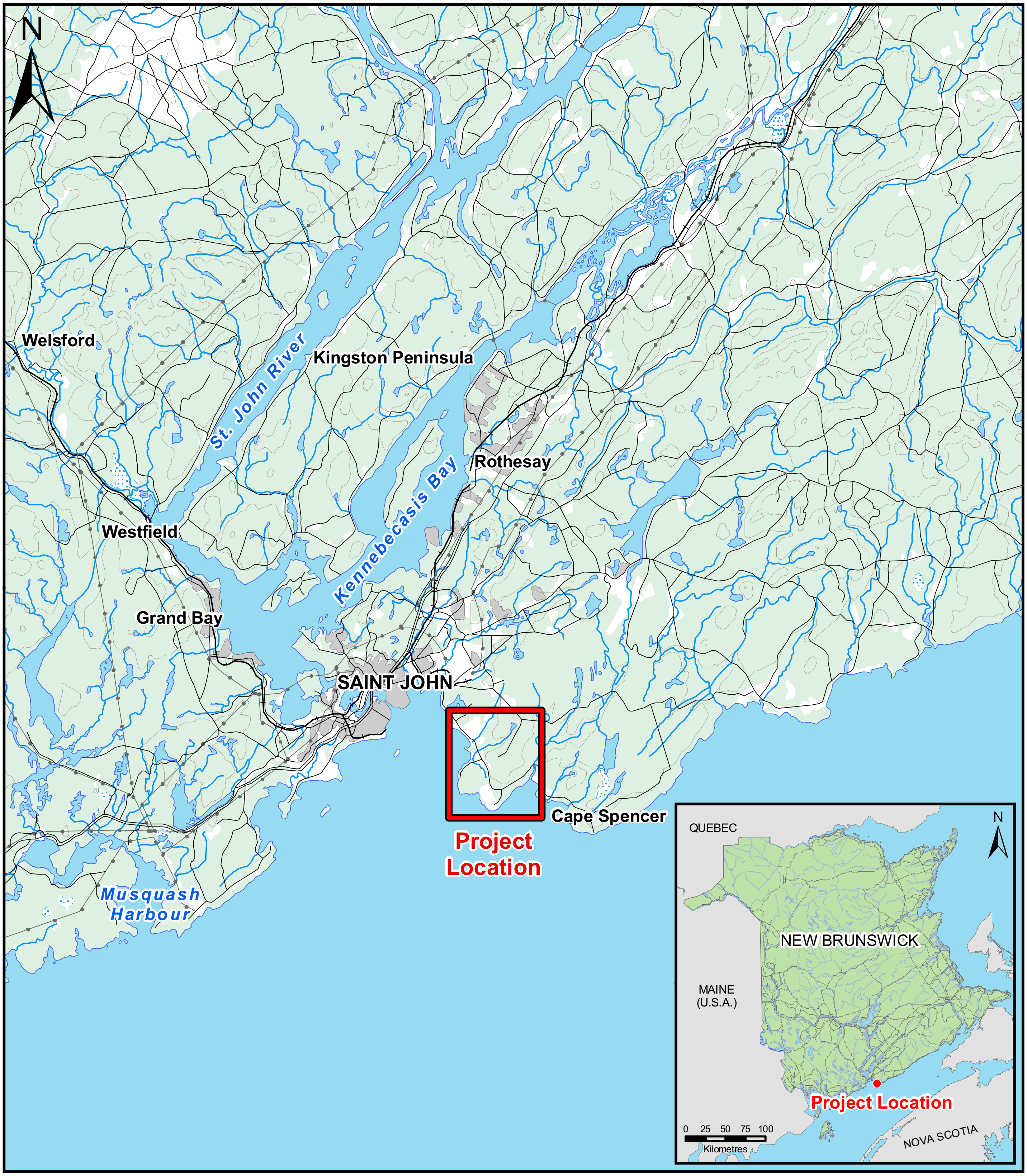
The Proponent of the Project is Irving Oil Company, Limited, a body corporate governed by the laws of Canada and the Province of New Brunswick. The contact details of the Proponent are as follows:

Irving Oil Company, Limited
10 Sydney Street
Saint John, NB E2L 4K1
Tel: (506) 202-2000
Fax: (506) 202-7002

1.2 Overview of the Development Proposal, and Overview of the Project

Although the CSR is focussed on those components of the Development Proposal that will be built in the marine environment, in the interests of providing overall context for the Development Proposal, it is appropriate to provide the following brief overview of the Development Proposal as a whole, which is the subject of the separate EIA Report developed to meet the provincial EIA requirements (Jacques Whitford Stantec Limited 2009a). The Project is one component of the Development Proposal as a whole which is subject to the requirements of *CEAA*.

The Development Proposal involves the construction and operation of a new petroleum refinery, marine terminal, and associated land-based and marine-based infrastructure in the Red Head area, in Saint John, New Brunswick. The refinery will be designed with a rated nameplate capacity of up to 40,000 m^3/d (250,000 bbl/d, nominal) of crude oil, for refining petroleum products and feedstocks from imported crude oil. The refinery will be designed to produce up to 48,000 m^3/d (300,000 bbl/d, nominal) of a variety of petroleum products including diesel fuel, gasoline, coke, sulphur and other petroleum products for transportation fuel, home heating, and industrial energy use in North America and elsewhere. The Development Proposal also includes the development of a new marine terminal for transferring crude and products to and from the refinery. The marine terminal is defined as "the Project" in this document and requires an environmental assessment under *CEAA*. The location of the Development Proposal including the Project is shown in Figure 1.1.



Map Parameters
Projection: NB Stereographic
Scale: 1:320,000
Date: August 8, 2008
Project No.: 1013263.

Data Source: ESRI,
Natural Resources Canada

Figure 1.1
Project Location: Project Eider Rock

0 5 10 20
Kilometres

Jacques Whitford

The Development Proposal is currently undergoing provincial review (with federal participation); the reader should refer to the EIA Report (Jacques Whitford Stantec Limited 2009a) for additional detail on the refinery and land-based components of Project Eider Rock that have been assessed under the provincial EIA.

The Project being assessed in this EA is focused on the marine terminal to be built as part of the Development Proposal. A new marine terminal consisting of a jetty equipped with up to five berths for crude and product ships on a common trestle will be built near Mispec Point, to support the refinery operation for the receipt of crude oil and shipment of products from the refining operation. A cooling water intake structure and wastewater outfall may also be constructed at Mispec Point to support the refinery operation. A new barge landing facility will be constructed in Mispec Bay to receive large construction modules during Construction of the Project. A heavy haul road will be constructed between the barge landing facility and the new refinery to allow for the transportation of the large modules to the construction site.

1.3 Project Purpose

The purpose of the Project to be assessed under the *Canadian Environmental Assessment Act* (*CEAA*) is to build and operate a marine terminal and associated marine-based infrastructure at Canaport in Saint John, New Brunswick, for the transfer of crude oil and finished products used or produced by the Eider Rock refinery.

1.4 Rationale and Need for the Project

Irving Oil has put forth the Development Proposal to increase its petroleum refining capacity in Saint John, New Brunswick. The marine terminal being assessed in this CSR is an integral part of the Development Proposal, and is intended to support the Proponent's goal and overall vision: The Project will facilitate the transfer of crude and petrolieum products to and from the Development Proposal and enable the shipping of products to market.

The sole purpose of the marine terminal is to support the Development Proposal in terms of shipping, receipt, transfer and storage of raw materials and products for the Development Proposal. In doing so, the Development Proposal will secure the existing and future refining infrastructure in the region, contribute to and maintain economic prosperity in the province, support the further development and stability of the Energy Hub, and increase the supply of ultra-low sulphur gasoline and diesel fuel for the North American market.

1.5 Purpose and Organization of the CSR

This CSR has been developed to meet the requirements of the EA Track Report and Scoping Document that specify the specific requirements to be assessed as part of the EA of the Project under *CEAA*. The CSR is organized in 18 chapters, as follows.

- Chapter 1 provides an introduction to the CSR, identifies the Proponent and provides a brief Project overview, and outlines the structure and content of the CSR.
- Chapter 2 provides a discussion of the applicable regulatory framework, including the regulatory requirements for the EA; the scope of the Project and the scope of the EA

- Chapter 3 provides a detailed Project Description, including alternative means of carrying out the Project, and describes how the Project will be constructed, operated, and ultimately decommissioned and abandoned. Emissions and wastes, and a summary of key technical studies undertaken as part of the EA of Project to assist in characterizing its potential environmental effects, are also provided.
- Chapter 4 provides a summary of public, stakeholder, and Aboriginal consultation and engagement efforts conducted both by Responsible Authorities for the EA as well as by the Proponent.
- Chapter 5 provides a description of the methodology used to conduct this EA to meet the requirements of the EA Regulation and *CEAA*. Additionally, the selection of valued environmental components (VECs) for the EA and a list of other projects and activities that are considered for the assessment of cumulative environmental effects are provided.
- Chapter 6 provides a summary of the existing environmental setting of the Saint John Region, including the ecological and socio-economic context of the region.
- Chapters 7 to 14 provide an assessment of potential environmental effects, including cumulative environmental effects, for each VEC of relevance and importance to this EA.
- Chapter 15 provides an assessment of the effects of the environment on the Project.
- Chapter 16 provides an assessment of potential accidents, malfunctions, and unplanned events.
- Chapter 17 provides closing remarks and a statement of limitations in respect of this EA.
- Chapter 18 provides the references cited in the CSR.

Additionally, a number of appendices appear at the end of the CSR to support the document, as follows.

- Appendix A provides a glossary of selected technical terms used in this CSR.
- Appendix B provides a list of acronyms and units used in this CSR.
- Appendix C outlines preliminary considerations for marine habitat compensation for the Project.
- Appendix D contains the Environmental Assessment Track Report and Scoping Document developed by the RAs to outline the scope of project, factors to be considered, and scope of factors to be considered for the federal EA of the Project under *CEAA*.
- Appendix E contains a summary of the results of the federal coordination process conducted by RAs.
- Appendix F contains a list of tables and figures contained in the CSR; this has been placed at the end of the document for convenience.

2.0 REGULATORY CONTEXT FOR THE ENVIRONMENTAL ASSESSMENT

This chapter:

- Provides an overview of the EA/EIA processes for the Development Proposal that are being conducted at the federal and provincial levels;
- Summarizes the regulatory framework applicable to the Project, with particular emphasis on the federal EA requirements;
- Describes the scope of the EA as determined by the federal regulatory agencies responsible for the EA of the Project (Responsible Authorities) under their respective scoping processes, including the scope of project factors to be considered, and scope of factors to be considered to meet the requirements of the Comprehensive Study Scoping Document, issued pursuant to Section 21(1) of the *Canadian Environmental Assessment Act*; and
- Provides a brief description of other approvals, permits, and authorizations that may apply to enable the Project to be carried out.

2.1 Overview of EA/EIA Processes for Project Eider Rock

Certain elements of Project Eider Rock have triggered the requirement of a federal EA, pursuant to Section 5(1) of the *Canadian Environmental Assessment Act*.

Additionally, although not discussed in this CSR, several elements of Project Eider Rock have triggered the requirement for an EIA pursuant to Section 5(1) of the New Brunswick *Environmental Impact Assessment Regulation 87-83* filed under the *Clean Environment Act.* An EIA of the Development Proposal as a whole is being concluded in parallel to this EA by the Province of New Brunswick, and several federal agencies are participating in that review.

2.1.1 Federal Environmental Assessment

The *Canadian Environmental Assessment Act* (*CEAA*), originally enacted in 1992, defines the requirements for federal EA for projects or activities that fall under federal jurisdiction. Several levels of assessment exist under *CEAA*, including: screening, comprehensive study, mediation, and review panel. All EAs under *CEAA* are screenings unless they are on the *Comprehensive Study List Regulations* or unless they have been referred to a review panel or mediation.

The Project requires an EA under *CEAA* because of the requirement for authorizations that are listed in the *Law List Regulations* to enable the Project to be carried out. These include, in relation to the construction and operation of the marine terminal (the Project):

- The requirement for an authorization for harmful alteration, loss, disruption or destruction (HADD) of fish habitat under the *Fisheries Act*;
- The requirement for an authorization for the destruction of fish by means other than fishing under the *Fisheries Act.*
- The requirement for a permit under the *Navigable Waters Protection Act* (*NWPA*); and/or

- The requirement for a permit for disposal at sea under the *Canadian Environmental Protection Act*.

As currently conceived, there are no triggers for *CEAA* to apply to any of the land-based components of the Development Proposal.

Section 28(c) of the in the *Comprehensive Study List Regulations* states that a comprehensive study is required for the proposed construction, decommissioning or abandonment of a marine terminal designed to handle vessels larger than 25,000 dead weight tonnes (dwt), unless the terminal is located on lands that are routinely and have been historically used as a marine terminal or that are designated for such use in a land-use plan that has been the subject of public consultation. As such, the marine terminal to be constructed as part of the Project requires a comprehensive study under *CEAA*.

2.1.2 Federal Coordination

On January 25, 2007, the EIA Registration/Project Description document for the Project was submitted as a “project description” under *CEAA* to the Canadian Environmental Assessment Agency (the “Agency”) and the likely RAs – namely Fisheries and Oceans Canada (DFO), Environment Canada, and Transport Canada (TC), for the purpose of initiating the EA under *CEAA*.

In accordance with the *Regulations Respecting the Coordination by Federal Authorities of Environmental Assessment Procedures and Requirements* (known as the Federal Coordination Regulations), the Agency, acting as the Federal Environmental Assessment Coordinator (FEAC) under Section 12 of *CEAA*, distributed the Project Description to the federal authorities that were or may be RAs, as well as those that may be in possession of specialist or expert information or knowledge with respect to the Project. The Agency distributed the Project Description to:

- Environment Canada (EC);
- Fisheries and Oceans (DFO);
- Health Canada (HC);
- Indian and Northern Affairs Canada (INAC);
- Industry Canada (IC);
- National Energy Board (NEB);
- Natural Resources Canada (NRCan);
- Canadian Transportation Agency (CTA);
- Saint John Port Authority; and
- Transport Canada (TC).

These federal authorities were asked to determine if they would be required to exercise a power, or perform a duty or function pursuant to Section 5(1) of *CEAA* that would necessitate an EA. Federal authorities were also asked to confirm if they were in possession of expertise or specialist knowledge that would be pertinent to such an EA.

On May 7, 2007, DFO, EC, and TC declared that they were RAs for the EA of the Project under *CEAA* and that they would conduct a comprehensive study of the marine terminal and other marine-based infrastructure associated with the Development Proposal. NRCan and Health Canada, as federal authorities under *CEAA*, identified areas of expertise that they could make available to the RAs upon request. A summary of the results of the federal coordination process under *CEAA* is provided in Appendix E.

On May 23, 2007, the RAs released a draft Scoping Document to outline the scope of the EA under *CEAA* (Government of Canada 2007b). The draft Scoping Document outlined the draft proposed scope of the Project, factors to be considered, and scope of factors to be considered for the EA under *CEAA* as determined by the Responsible Authorities. The draft Scoping Document proposed that the scope of the EA under *CEAA* consider the aspects of the Development Proposal that are to be constructed and operated in the marine environment (*e.g.,* jetty, outfall). The public comment period on the draft Scoping Document ended on June 30, 2007.

After considering the comments received from the public on the draft Scoping Document, the federal Minister of the Environment released his Comprehensive Study Track Decision ("Notice of Decision to Continue as a Comprehensive Study" (Government of Canada 2007c) on November 21, 2007, in which the Minister outlined the form of the EA under *CEAA*. At the same time, the Scoping Document was finalized and released to the public. The federal Minister determined that the EA under *CEAA* would continue as a Comprehensive Study of the marine terminal and marine infrastructure associated with the Project. The Minister also released an EA Track Report (Government of Canada 2007a) that outlined the scope of Project, factors to be considered, and scope of factors to be considered as part of the EA under *CEAA*. The EA Track Report and the Scoping Document for the EA of the Project are provided in Appendix D.

This CSR is being submitted to the federal RAs in parallel to the EIA Report (submitted April 30, 2009) to satisfy the requirements of the sub-paragraph 21.1(1)(a) of *CEAA*, and to allow for public comment on the conclusions and recommendations, or any other aspect of the report, in accordance with Section 22 of *CEAA*.

Fisheries and Oceans Canada, Transport Canada, and Environment Canada have each determined that certain components of the Irving Oil development proposal require approvals that trigger *CEAA*. The following specific triggers have been identified:

- Issuance of authorizations pursuant to subsection 35(2) of the *Fisheries Act* for the harmful alteration, disruption or destruction of fish habitat and/or section 32 of the *Fisheries Act* for the destruction of fish;
- Issuance of a permit for disposal at sea of dredged material under subsection 127(1) of the *Canadian Environmental Protection Act*; and,
- Issuance of an approval to allow for an interference to navigation under Section 5(1)(a) of the *Navigable Waters Protection Act* (*NWPA*).

2.1.3 Federal/Provincial Coordination

In parallel to the EA under *CEAA* for the marine terminal, a comprehensive EIA review is being conducted by the Province of New Brunswick for all land-based and marine-based elements of the Development Proposal. Federal agencies (Fisheries and Oceans Canada, Transport Canada, Environment Canada, and Health Canada) are active participants in that review.

Under the New Brunswick *Environmental Impact Assessment Regulation – Clean Environment Act*, Irving Oil was required to register the Development Proposal as an undertaking for review. On January 25, 2007, Irving Oil registered the Development Proposal with the New Brunswick Department of Environment ("NBENV"). On February 7, 2007, the provincial Minister of Environment ("provincial Minister") determined that a comprehensive environmental impact assessment ("EIA") would be required for the entire Development Proposal. The comprehensive EIA process described at http://www.gnb.ca/0009/0377/0002/11-04-e.pdf is managed by NBENV, with input from the public and a technical review committee ("TRC"). The TRC is composed of federal and provincial authorities with pertinent expertise, along with other experts as required. DFO, TC, EC, and Health Canada are all members of the TRC for the Irving Oil development proposal.

The scope of the provincial EIA process currently ongoing includes the refinery, marine terminal, linear facilities, and all associated land-based and marine-based components of the Development Proposal. The reader is referred to the Final EIA Report for the Development Proposal entitled "Environmental Impact Assessment Report: Project Eider Rock – Proposed Petroleum Refinery and Marine Terminal in Saint John, New Brunswick" dated April 30, 2009 (Jacques Whitford Stantec Limited 2009a), for further details on the provincial EIA, including results of the EIA of the Development Proposal.

The federal EA has been coordinated, to the extent possible, with the provincial process. As with any project subject to both federal and provincial legislation, the federal and provincial governments each make decisions on matters within their own legislative authorities.

2.2 Regulatory Framework

2.2.1 *Canadian Environmental Assessment Act*

CEAA defines the requirements for the federal environmental assessment (EA) process. For an EA under *CEAA* to be required, there must first be a "project" as defined under *CEAA*, and there must also be a "trigger" for the project. Thus, an EA is not automatically required for a project; rather, *CEAA* does not require an EA unless there is a project as defined in the *Act*, and there are one or more triggers in respect of the Project.

A federal EA is triggered under Section 5(1) of *CEAA* when a federal authority (Responsible Authority (RA)):

- Proposes a project;
- Provides financial assistance to a proponent to enable a project to be carried out;
- Sells, leases, or otherwise transfers control or administration of federal land to enable a project to be carried out; and/or
- Provides a license, permit or an approval that is listed in the *Law List Regulations* that enables a project to be carried out.

The "Federal Coordination Regulations" process conducted upon receipt of the project description determined that an EA was required under *CEAA* and determined the role to be played by each of those federal authorities in the EA. The process also determined the level of EA required (*e.g.,* screening or comprehensive study). These decisions were made in consideration of the Project as described in the Project Description and in light of other factors such as the nature and scope of the EA or EIA to be conducted by other jurisdictions.

The Marine Terminal and Other Marine-Based Infrastructure (the Project) is a “project” as defined under *CEAA*. The federal government is not the proponent, nor is it transferring federal land or providing funding to enable the Project to be carried out. However, there are potential triggers under the *Law List Regulations* (discussed later), which required an EA of the Project to be conducted under *CEAA*.

2.2.2 Environmental Assessment Process under *CEAA*

When *CEAA* is triggered, all EAs under *CEAA* are screenings unless the project is on the *Comprehensive Study List Regulations* or it is referred to a mediator or review panel. The following discussion focuses on the process for screenings and comprehensive studies.

The EA process under *CEAA* is initiated by filing a project description with a federal authority or the CEA Agency. The submission of the project description initiates a process referred to as federal coordination. The federal departments or agencies (federal authorities) review the information and determine whether or not they are an RA under *CEAA* in respect of the Project. An RA is a federal authority that exercises some form of decision-making authority in respect of the project (*e.g.,* issues an authorization, transfers land, provides funding).

Although it is the RA’s responsibility to conduct an EA of the Project, typically, the proponent prepares the EA Report if it is delegated the responsibility to do this by the RAs under Section 17(1) of *CEAA*. This was the case for this Project. The EA Report is reviewed by RAs and may require iteration before it is accepted. Once accepted by RAs, and as may be required under *CEAA*, the EA Report (especially for comprehensive studies) is released to the public for review. The RAs address any comments from the public, and issue a final EA decision following the completion of the public review period.

The *Comprehensive Study List Regulations* describe those types of projects that must be assessed through a more detailed study, and identifies those types of projects that, if triggered, require as a minimum a comprehensive study (as opposed to a screening). Comprehensive studies involve some additional factors to be considered over that required for screening reports, including the purpose of the project and alternative means of carrying out the project. As well, the decision-making and public consultation requirements, and timeframes are more and longer.

Section 28(c) of the *Comprehensive Study List Regulations* states that a comprehensive study is required for the proposed construction, decommissioning or abandonment of a marine terminal designed to handle vessels larger than 25,000 dead weight tonnes (dwt), unless the terminal is located on lands that are routinely and have been historically used as a marine terminal or that are designated for such use in a land-use plan that has been the subject of public consultation. The marine terminal to be constructed as part of the Development Proposal exceeds this threshold.

RAs have determined the scope of the Project to be assessed through the federal coordination process under the authority of Section 15 of *CEAA* (Government of Canada 2007a, 2007b). There are no known triggers for the refinery itself, and thus the refinery has been determined to not form a part of the Project to be assessed pursuant to *CEAA*. There are no current plans to alter watercourses for the pipelines and rail spur for the Development Proposal that would require an authorization listed in the *Law List Regulations.* Regardless, those elements of the Development Proposal are not on the *Comprehensive Study List Regulations* and therefore, would not trigger a comprehensive study, but would be addressed through separate screenings in the unlikely event that watercourse crossings triggered the need for an EA under *CEAA.*

2.2.3 *Law List Regulations*

The *Law List Regulations* under *CEAA* identify the federal laws and regulations that can trigger the requirement for an EA under *CEAA*. Laws identified under this regulation are those for which a federal authority is asked to provide a license, permit, certificate, or other form of regulatory authorization before a project can proceed.

The relevant legislation that applies to the Project, as listed under the *Law List Regulations*, includes the *Fisheries Act, Navigable Waters Protection Act (NWPA),* and the *Canadian Environmental Protection Act (CEPA).* These acts and regulations and their relationship to the EA of the Project are explained in more detail below.

Fisheries Act authorizations that are triggers for an EA under *CEAA* include the potential for destruction of fish and larvae from physical construction activities or from impingement or entrainment at any cooling water intake structures (Section 32), or the harmful alteration, disruption or destruction of fish habitat (HADD) as a result of the construction of jetty elements of the Project (Section 35(2)). A HADD authorization is required for the construction of the Marine Terminal and any other in-water work in the marine environment. DFO is an RA due to these triggers.

NWPA approvals that are triggers for an EA under *CEAA* include the approval required for the construction of any in-water structures in the marine environment that could interfere with navigation (Section 5(1)(a)). Transport Canada is an RA as a result of this trigger.

The sections of *CEPA* that are *Law List Regulations* triggers for *CEAA*, and of potential relevance to the Project, relate to the requirement for a permit for ocean disposal. As dredging and disposal in the marine environment will likely be required for the Project, a permit would be necessary under Section 127(1) for the disposal of the dredge spoils in the marine environment. This would trigger *CEAA*, and Environment Canada is thus an RA.

2.2.4 Comprehensive Study Track Decision

Based on the EA Track Report (Appendix D), and upon the recommendation of the RAs, the federal Minister of Environment decided that the EA of the Project would continue as a comprehensive study; as a result, the project cannot be referred to a mediator or review panel. This study track decision represented the final scope determination for the Project, and documented RA decisions in respect of the scope of the project, factors to be considered and the scope of the factors to be considered pursuant to authority entrusted to them by Sections 15 and 16 of *CEAA*.

Upon acceptance of the Comprehensive Study Report (CSR) by the RAs, it is submitted to the Minister of Environment and the CEA Agency for approval. RAs will ensure there are opportunities for public participation and First Nations engagement during the comprehensive study process. Following submission and acceptance of the CSR, the CEA Agency will invite the public to comment on the report prior to the Minister of Environment making his determination. There are no timelines but the CEA Agency normally targets to complete this review and decision within 60 days of the acceptance of the CSR for public review. The Minister of Environment may request additional information or require that public concerns be further addressed before issuing the EA decision statement. Once the EA decision statement is issued, the Minister of Environment will refer the Project back to the RAs for action.

2.3 Scope of the EA for the Project

The scope of the environmental assessment, as determined by the RAs to satisfy the requirements for the EA under *CEAA*, is described below.

2.3.1 Scope of the Project

The RAs, as authorized under subsection 15(1) of *CEAA,* confirmed in Section 3.3 of the EA Track Report (Government of Canada 2007a) that the federal scope of the Project, as was outlined in the Scoping Document, would be focused on:

> *"the construction, operation, decommissioning and/or abandonment of the following triggered components of the development proposal, and the related activities (e.g., blasting, dredging, infilling, disposal at sea):*

- *the pier or monobuoy for crude tanker unloading, and/or the use of the existing monobuoy at Canaport;*
- *the pier and associated breakwater for loading of petroleum coke products onto ships and for shipping the refined petroleum products to their intended markets; and*
- *the barge landing facility, constructed on either a temporary or permanent basis, for unloading large equipment during the construction phase or as required thereafter."*

In the Scoping Document, the RAs also proposed that the scope of project would include docking and deberthing of vessels. However, the scope of project does not include shipping, as shipping issues will be addressed via a TERMPOL Review Process.

The scope of project also includes a fourth component, as noted in Section 4.4 of the EA Track Report:

- *"in-water physical structures, constructed on either a temporary or permanent basis, in the marine environment, and any navigational dredging that may be required."*

Section 4.4 of the EA Track Report clarifies that the inclusion of the existing monobuoy within the scope of project is only in the context to any proposed modifications to the structure, not to the existing use of the structure.

The EA Track Report also identified that the potential environmental effects of Accidents, Malfunctions, and Unplanned Events shall also be assessed.

The EA Track Report confirmed that the EA under *CEAA* would take the form of a comprehensive study, as it involves the construction of a marine terminal for vessels having a capacity greater than 25,000 dwt. The RAs would conduct their assessment of the Project based on their scope of Project associated with the marine environment. Several federal departments/agencies that are RAs or FAs are also members of the provincial TRC for the EIA under the EIA Regulation, and may thus participate in the provincial EIA to achieve their respective mandates under federal legislation for other components of the Project that are not being assessed under *CEAA*.

2.3.1.1 TERMPOL

Irving Oil has volunteered to complete a "Technical Review of Marine Terminal Systems and Transshipment sites" (TERMPOL) for the Project as outlined in Transport Canada's publication TERMPOL Review Process 2001 – TP 743 E (Transport Canada 2001). The purpose of TERMPOL, which is administered by Transport Canada, is to objectively appraise operational ship safety, route safety, and to assess management and environmental concerns associated with the location, construction and operation of a marine terminal. It is noted that the scope of the TERMPOL review process would be focused on the Project only, and not associated with the existing Canaport operations.

Although TERMPOL is separate voluntary process that exists outside the scope of a federal EA, it remains an important code for the guidance of proponents that transport hazardous cargoes in bulk. Detailed information on the TERMPOL process can be found at: http://www.tc.gc.ca/marinesafety/tp/tp743/toc.htm.

2.3.2 Factors to be Considered

All environmental assessments conducted under *CEAA* require specific factors to be considered. Section 16(1) of *CEAA* establishes the mandatory factors to be considered for all EAs under *CEAA*.

As outlined in the EA Track Report and Scoping Document, the Comprehensive Study will consider the mandatory factors outlined in Sections 16(1) (a) to 16(1) (d) of *CEAA*, as follows:

- *"the environmental effects of the project, including the environmental effects of malfunctions or accidents that may occur in connection with the project and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out;*
- *the significance of the [environmental] effects referred to in paragraph (a);*
- *comments from the public that are received in accordance with this Act and the regulations;*
- *measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project."*

Section 16(1) (e) of *CEAA* establishes additional factors to be considered. Additional factors that can be determined as relevant by the RAs include:

- *"any other matter relevant to the screening, comprehensive study, mediation or assessment by a review panel, such as the need for the project and alternatives to the project, that the responsible authority or, except in the case of a screening, the Minister after consulting with the responsible authority, may require to be considered."*

In addition, Section 16(2) of *CEAA* requires consideration of the following additional mandatory factors as part of the EA of the scoped Project for a Comprehensive Study:

(a) "the purpose of the project;

(b) alternative means of carrying out the project that are technically and economically feasible and the environmental effects of any such alternative means;

(c) the need for, and the requirements of, any follow-up program in respect of the project; and

(d) the capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and those of the future."

In addition, the EA Track Report identified the following additional factors to be considered in accordance with subsection 16(1) (e) of *CEAA*:

(e) the "need for" the project; and

(f) "alternatives to" the project.

The reader is referred to the official text of the EA Track Report and Scoping Document (Appendix D) for further details on the specific requirements for the EA of the Project under *CEAA*.

2.3.3 Scope of Factors to be Considered

As outlined in the EA Track Report and Scoping Document, the EA should account for the following factors:

- The physical environment, including but not limited to marine water quality, sediment quality and dispersion, air quality, climatic conditions, ocean currents, tides, waves and ice; and acoustic environment;
- The biological environment, including but not limited to vegetation, wetlands, ecologically sensitive or significant areas or other designated areas, species of conservation concern (including species at risk and their habitats), fish and fish habitat, migratory birds and their habitats (especially areas of concentration, and marine mammals; and
- The human environment, including but not limited to the current use of land and resources for traditional purposes by Aboriginal persons, fisheries, human health, physical and cultural heritage, and structures/sites of archaeological, palaeontological or architectural significance.

The environmental effects of Construction, Operation and Decommissioning and Abandonment of marine structures could include interactions summarized in Table 2.1. It is important to note that these tables are meant to provide examples of environmental effects that could occur in the absence of planned mitigation measures.

Table 2.1 Examples of Potential Environmental Effects

Examples of Project Activities	Key Aspects of Valued Environmental Components	Examples of Potential Environmental Effects
Construction		
▪ Vessel transportation; ▪ Barging; ▪ Assembly and placement of offshore structures; ▪ Delivery of construction materials and equipment; ▪ Construction of jetty; ▪ Dredging, side casting of spoils; ▪ Driving or drilling / grouting, of piles; ▪ Placement of decking pier deck equipment installation; and ▪ Site preparation of terrestrial components – clearing, grubbing, blasting, grading.	Marine water quality	▪ Accidental spills, and the release of bilge and ballast waters, could contaminate marine water; ▪ Land-based erosion could impact receiving fish habitat; and ▪ Pile-driving and other in-water activities could affect marine water quality.
	Sediment quality	▪ Accidental spills could contaminate marine sediment; and ▪ Pile-driving and other in-water activities could affect sediment quality.
	Marine fish and marine fish habitat	▪ Destruction of fish; ▪ Harmful alteration, disruption or destruction of fish habitat including spawning, nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes from physical structures; ▪ Land-based erosion could impact receiving fish habitat; ▪ Pile-driving and other in-water activities could affect fish; and ▪ Accidental spills could result in contamination.
	Migratory birds	▪ Harmful interactions with birds (noise, lighting, accidental spills, habitat destruction and alteration).
	Wetlands	▪ Accidental spills could contaminate coastal wetlands.
	Air quality	▪ Contribution to an increase in ambient air quality concentrations of certain pollutants.
	Greenhouse gases	▪ Contribution of greenhouse gases.
	Species at risk	▪ Harmful interactions with species at risk (*e.g.,* direct or indirect mortality, accidental spills, habitat loss or alteration).
	Marine mammals	▪ Accidental collisions with marine mammals could result in mortality; and ▪ Accidental spills could harm marine mammals.
	Health and socio-economic factors	▪ Changes to marine water quality and habitat could affect fisheries, including Aboriginal fisheries; and ▪ Changes to air quality from construction vessel emissions could affect human health.
Operation		
▪ Vessel transportation; ▪ Vessel loading and unloading; ▪ Delivery of maintenance materials and equipment (via land or barge); ▪ Maintenance of pier; ▪ Maintenance dredging - side casting of spoils and disposal at sea; ▪ Maintenance and replacement of decking; and ▪ Maintenance and repair of terrestrial components of marine terminal.	Marine water quality	▪ Accidental spills and release of ballast and bilge waters could contaminate marine water; and ▪ Land-based erosion could impact receiving fish habitat.
	Sediment quality	▪ Accidental spills could contaminate marine sediment.
	Marine fish and marine fish habitat	▪ Land-based erosion could impact receiving fish habitat.
	Migratory birds	▪ Harmful interactions with birds (noise, lighting, accidental spills, habitat destruction and alteration).
	Wetlands	▪ Accidental spills could contaminate coastal wetlands.
	Air quality	▪ Contribution to an increase in ambient air quality concentrations of certain pollutants.
	Greenhouse gases	▪ Contribution of greenhouse gases
	Species at risk	▪ Harmful interactions with species at risk (*e.g.,* direct or indirect mortality, accidental spills, habitat loss or alteration).
	Marine mammals	▪ Accidental collisions with marine mammals could result in mortality; and ▪ Accidental spills could harm marine mammals.

Table 2.1 Examples of Potential Environmental Effects

Examples of Project Activities	Key Aspects of Valued Environmental Components	Examples of Potential Environmental Effects
	Health and socio-economic factors	▪ Marine structures could alter current and wave patterns which could affect navigation; and ▪ Changes to air quality from berthing and deberthing vessels could affect human health.
Decommissioning and Abandonment		
▪ Vessel transportation; ▪ Barging; ▪ Removal of offshore structures; ▪ Delivery of decommissioning equipment; ▪ Decommissioning or removal of pier, removal of piles; and ▪ Marine and terrestrial based site reclamation.	Marine water quality	▪ Accidental spills, and release of ballast and bilge waters could contaminate marine water; and ▪ Land-based erosion could affect receiving fish habitat.
	Sediment quality	▪ Accidental spills could contaminate marine sediment.
	Marine fish and marine fish habitat	▪ Decommissioning land-based erosion could impact receiving fish habitat; and ▪ Accidental spills could result in contamination.
	Air quality	▪ Contribution to an increase in ambient air quality concentrations of certain contaminants.
	Greenhouse gases	▪ Contribution of greenhouse gases.
	Wetlands	▪ Accidental spills could contaminate coastal wetlands.
	Migratory birds	▪ Harmful interactions with birds (noise, lighting, accidental spills, habitat destruction and alteration).
	Species at risk	▪ Harmful interactions with species at risk (*e.g.,* direct or indirect mortality, accidental spills, habitat loss or alteration).
	Marine mammals	▪ Accidental collisions with marine mammals could result in mortality; and ▪ Accidental spills could harm marine mammals.

The reader is referred to the EA Track Report and Scoping Document (Government of Canada 2007a) (Appendix D) for further information on the specific details of the scope of project, factors to be considered, and scope of factors to be considered for the EA of the Project under *CEAA*.

2.4 Other Legislation that may be Applicable to the Project

2.4.1 *Fisheries Act*

Marine fish, fish habitat, water quality and sediment quality are protected primarily through the federal *Fisheries Act.* Fish habitat is protected under the *Fisheries Act*, and by the DFO *Policy for the Management of Fish Habitat*. This policy applies to all Projects and activities in or near water that could *"alter, disrupt or destroy fish habitat by chemical, physical, or biological means"*. Sections 20, 32, 35, and 36 of the *Fisheries Act* apply to the Project. Section 20 requires that fish passage be maintained at all times during Construction and Operation. Section 32 prohibits the destruction of fish by any means other than fishing. Section 35 protects fish habitat from harmful alteration, disruption or destruction (HADD), and Section 36 prohibits the deposit of a deleterious substance in waters frequented by fish.

DFO has overall responsibility for the administration of the federal *Fisheries Act*. Environment Canada administers Section 36 of the *Fisheries Act*.

2.4.2 *Canadian Environmental Protection Act*

Other federal legislation that also protects fish habitat indirectly includes the *Canadian Environmental Protection Act* (*CEPA*) and specifically the *Disposal at Sea Regulations*. These regulations (*i.e.,* the

Disposal at Sea provisions of Part 7, Division 3 of *CEPA,* administered by Environment Canada), stipulate that dredging and disposal in the marine environment requires a permit and that sediment be screened for potential chemical contaminants. These provisions state that no person shall load a substance for the purposes of disposal at sea, or dispose of a substance at sea unless the loading and disposal is done in accordance with a permit. Further, the purpose of the Disposal at Sea provisions of *CEPA*, in addition to indirectly protecting fish habitat, is also to allow Canada to meet international obligations under the *London Convention* (1972) and the subsequent *Protocol to the Convention* (1996).

2.4.3 *Navigable Waters Protection Act*

The construction and operation of the marine terminal is subject to the *Navigable Waters Protection Act* (*NWPA*) due to its potential environmental effects on navigation in Saint John Harbour. Approvals under *NWPA* trigger the need for an EA under *CEAA*. However, environmental effects of the Project on navigation are taken into consideration as part of the EA only when the environmental effects are indirect (*i.e.,* resulting from a change in the environment affecting navigation). Direct environmental effects on navigation are not considered in the EA under *CEAA*; any measures to mitigate direct environmental effects are considered as possible conditions of the *NWPA* approval that will need to be obtained.

2.4.4 *Canada Shipping Act*

The *Canada Shipping Act, 2001* governs safety in marine transportation, and the protection of the marine environment. It applies to Canadian vessels operating in all waters and to all vessels operating in Canadian waters.

The objectives of the Act are to:

(a) *"protect the health and well-being of individuals, including the crews of vessels, who participate in marine transportation and commerce;*

(b) *promote safety in marine transportation and recreational boating;*

(c) *protect the marine environment from damage due to navigation and shipping activities;*

(d) *develop a regulatory scheme that encourages viable, effective and economical marine transportation and commerce;*

(e) *promote an efficient marine transportation system;*

(f) *develop a regulatory scheme that encourages the viable, effective and economical use of Canadian waters by recreational boaters;*

(g) *ensure that Canada can meet its international obligations under bilateral and multilateral agreements with respect to navigation and shipping;*

(h) *encourage the harmonization of marine practices; and*

(i) *establish an effective inspection and enforcement program."*

The Minister of Transport has the primary responsibility for administration of the *Canada Shipping Act, 2001*, *Canada Marine Act*, *Navigable Waters Protection Act*, and associated regulations.

Transport Canada will be responsible to ensure that all shipping activities associated with the Project are in compliance with all *Canada Shipping Act* requirements for inspection and certification of the vessel, and adequate training and appropriate certificate of competency for the operator.

It will also need to ensure that the Proponent and all vessels associated with the Project will have procedures in place to safeguard against marine pollution such as, but not limited to: awareness training of all employees; means of retention of waste oil on board and discharge to shore based reception facilities; and capacity of responding to and clean-up of accidental spill caused by vessels.

2.4.5 *Species at Risk Act*

The *Species at Risk Act* (*SARA*) generally limits exposure of listed endangered species or threatened or critical habitats for listed species to be interfered with, disturbed, or destroyed.

SARA defines a "wildlife species" as a species, sub-species, variety or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and (a) is native to Canada; or (b) has extended its range into Canada without human intervention and has been present in Canada for at least 50 years. *SARA* is co-administered by Environment Canada, the Parks Canada Agency, and DFO.

The purposes of *SARA* are to prevent Canadian indigenous species, subspecies and distinct populations of wildlife from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species, and to encourage the management of other species, to prevent them from becoming at risk. General prohibitions include Section 32(1), which states that no person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species as listed in Schedule 1 of *SARA*.

No approvals under *SARA* are likely required for marine species with respect to the Project. However, species identified in Schedule 1 will be considered in this EA and mitigation will be developed where an interaction exists. Critical Habitat, as defined under *SARA*, is the habitat that is necessary for the continued survival of a SAR, or for the recovery of a SAR. Critical Habitat that has been identified for a given SAR and is part of an active recovery plan is listed on the Species at Risk webpage (www.sararegistry.gc.ca). No critical habitat for any SAR has been established in Southern New Brunswick.

2.4.6 *Migratory Birds Convention Act*

Migratory birds are protected under the *Migratory Birds Convention Act*, administered by Environment Canada. The *MBCA* and regulations afford protection to all birds listed in the Canadian Wildlife Service Occasional Paper No. 1, "Birds Protected in Canada under the *Migratory Birds Convention Act*". The Act and regulations state that no person may disturb, destroy, or take/have in their possession a migratory bird (alive or dead), or its nest or eggs, except under authority of a permit.

2.4.7 Other Approvals, Permits, and Authorizations

Table 2.2 provides a summary of the federal legislation that may be applicable to the Project, including the regulatory agency responsible and summary details on the activity/activities that are subject to the legislation, as well as possible approvals, permits, and authorizations that may be required.

Table 2.2 Selected Summary of Federal Legislation that May be Applicable to the Project, and Possible Approvals, Permits or Authorizations Required

Legislation	Department/Agency	Approval, Permit, or Authorization Required	Activity or Component
Canadian Environmental Assessment Act	Fisheries and Oceans Canada, Transport Canada, Environment Canada	▪ Approval of Comprehensive Study Report.	▪ Construction, Operation, and Decommissioning and Abandonment of the Marine Terminal and Other Marine-Based Infrastructure.
Canadian Environmental Protection Act	Environment Canada	▪ Disposal at Sea Permit under S. 127(1); ▪ S. 185 and S.190 require a permit for import/export of hazardous materials; ▪ *Environmental Emergencies Regulations.*	▪ Ocean dredging and disposal at sea for marine terminal; ▪ Hazardous material and Petroleum Oil and Lubricants storage, NPRI Reporting, *Environmental Emergencies Regulations*.
Fisheries Act	Fisheries and Oceans Canada	▪ HADD authorization (S. 35(2); ▪ Authorization for destruction of fish (S. 32).	▪ Construction of Marine Terminal and Other Marine-Based Infrastructure; ▪ Operation of seawater cooling water intake structure (if applicable).
Fisheries Act – Section 36 (release of deleterious substances)	Environment Canada	--	▪ Release of wastewater.
Petroleum Refinery Liquid Effluent Regulations under the *Fisheries Act*	Environment Canada	--	▪ Release of wastewater.
Navigable Waters Protection Act	Transport Canada	▪ *NWPA* permit under S. 5(1)(a) to allow for interference to navigation.	▪ Works or construction activity in, over, or under navigable waters. Applies to the proposed marine terminal structures in the Bay of Fundy as well as to any watercourse crossings that might be required for the linear facilities.
Migratory Birds Convention Act	Environment Canada	--	▪ Construction of land-based facilities, particularly from disturbance during clearing and site preparation.
Species at Risk Act	Fisheries and Oceans Canada, Environment Canada	▪ S. 73 requires agreement or a permit to engage in an activity that affects a listed wildlife species or its habitat.	▪ Construction of land-based facilities, particularly from disturbance during clearing and site preparation.
Canada Shipping Act, 2001 and Regulations	Transport Canada	--	▪ Shipping activities during Construction and Operation; ▪ Oil Handling Facility Oil Pollution Emergency Plan; ▪ TERMPOL review (TERMPOL Review Process 2001 (TP 743 E).

Table 2.2 Selected Summary of Federal Legislation that May be Applicable to the Project, and Possible Approvals, Permits or Authorizations Required

Legislation	Department/Agency	Approval, Permit, or Authorization Required	Activity or Component
Canada Marine Act	Transport Canada	▪ S. 56 – Clearance to Enter Waters of a Port; ▪ S. 27 may require authorizations for specified activities such as travelling through or docking at the Port of Saint John.	▪ Shipping activities during Construction and Operation; ▪ Anchorage, pilotage, berthing, and deberthing activities.

It is noted that this list is intended to summarize the main pieces of environmental legislation and authorizations that are likely to be applicable to the Project, mainly for illustrative purposes; the list of permits, approvals and other forms of authorization listed in Table 2.2 is not intended to be all-inclusive.

3.0 PROJECT DESCRIPTION

A description of the Project as it is currently conceived at this stage of preliminary engineering design is provided in this chapter. The chapter is organized as follows.

- First, the marine terminal and other marine-based facilities and infrastructure associated with the Project, including but not limited to the marine terminal itself, jetty, berths, barge landing facility, intakes, and outfalls, are described. The Project schedule, and environmental management initiatives to be implemented are also discussed.
- Project alternatives, including alternatives to the Project and alternative means of carrying out the Project, are described.
- A description of how the Project facilities and infrastructure will be constructed, operated, and ultimately decommissioned and abandoned at the end of their service life is also provided.
- Finally, the emissions and wastes associated with the Project are described, and estimates of the quantities of emissions, effluents, and wastes are provided.

3.1 Description of the Project: Marine Terminal and Other Marine-Based Infrastructure

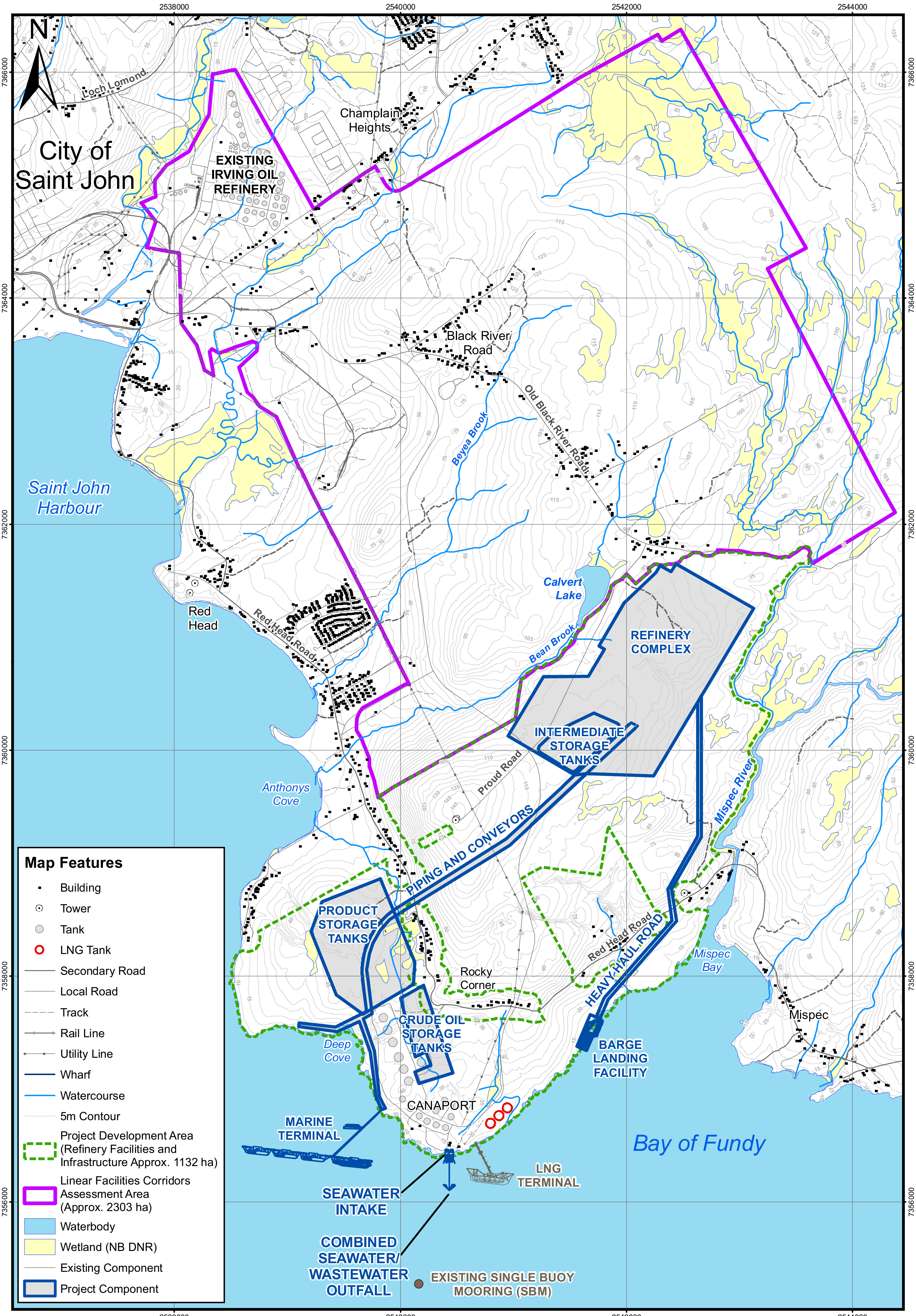
3.1.1 Overview

The marine terminal consists of integrated berths on a common trestle for the transfer of crude oil, refined products, and coke to and from vessels berthed at the terminal. A barge landing facility for unloading large equipment modules during Construction is also required. The existing single buoy mooring (SBM) at Canaport will continue to be used for crude oil tanker unloading.

The Marine Terminal and Other Marine-Based Infrastructure to be constructed and operated as part of the Project includes:

- Facilities for the receiving and unloading of crude oil and intermediate feedstocks from other refineries, consisting of a new crude oil berth fitted with infrastructure for the transfer of crude oil, to be constructed on a common jetty with berths for the transfer of finished products and coke;
- Facilities for the transfer of finished products and coke (consisting of two finished product transfer berths and two coke loading berths, fitted with infrastructure for the transfer of products);
- A barge landing facility for unloading large modules during Construction, constructed on a temporary or permanent basis; and
- Other marine-based infrastructure including the seawater cooling intake structure (if retained as the preferred alternative for the refinery cooling system), and the wastewater/cooling water outfall.

The marine terminal will serve to transfer the crude, intermediate feedstocks, finished products, and coke for the operation of the Project, as well as for the possible trans-shipment of petroleum products and other products in the future, should these commercial opportunities arise. Further details on the marine terminal facilities and infrastructure are provided in the following sections.



Map Parameters
Projection: NB Stereographic
Scale: 1:32,000
Date: August 8, 2008
Project No.: 1013263.

Data Source: Service New Brunswick, NB DNR, Fluor, Sandwell Engineering Inc.

Figure 3.1
Location of Major Project Components

0 0.5 1 2
Kilometres

Project Eider Rock

Jacques Whitford

3.1.2 Location and Layout

The marine terminal will be located near the Port of Saint John, proximal to the existing marine terminal currently operated by Canaport Limited, an affiliate of the Proponent. The marine terminal facilities will be constructed mostly within the submerged water lot owned by the Proponent, which is associated with its existing Canaport operations, surrounded by submerged Crown land. The general location of the various facilities, assets, components, processes, and infrastructure associated with the Development Proposal is shown in Figure 3.1. The location and preliminary layout of the marine terminal is provided in Figure 3.2. It is noted that the configuration, location, layout, and/or alignment of marine terminal structures and other marine-based infrastructure (*e.g.,* jetty, barge landing facility, seawater cooling intake and outfall) is preliminary at this conceptual engineering stage and may vary slightly from that presented herein as detailed engineering design progresses. Any minor changes to these structures that might arise as a result of detailed engineering are not expected to substantially change the overall footprints or environmental effects resulting from their construction and/or operation.

Connections to shore will be located along the coastline between Deep Cove and Mispec Point. A 1,300 m long trestle/jetty structure containing four berths accessed by a common trestle, to be used for product transfer, crude transfer and coke loading, will be located approximately 450 m offshore. The jetty will be connected to shore via a trestle, approximately 450 m in length. A fifth berth for coke loading on smaller vessels and barges will be located approximately 300 m offshore, on a separate jetty that is mounted on the same trestle as the other jetty.

The marine terminal will be located offshore where sufficient draft for the anticipated vessels is available, thereby eliminating the need for substantial dredging of the sea floor to facilitate navigation. Some limited dredging, cleaning and/or levelling of the sea floor may ultimately be required where piles, caisson, or jacket structures would be installed for the jetty and trestle construction.

While the siting of these marine facilities is generally understood according to the details provided in Figure 3.2, their precise location and configuration may be adjusted as necessary to allow for their technically and economically feasible constructability and to minimize environmental effects. The precise location, configuration, and construction of the jetty and trestle structure will thus be determined as part of a detailed engineering design and will be provided in the application for a permit under the *Navigable Waters Protection Act* (*NWPA*).

3.1.3 Description of the Marine Terminal Facilities

A marine terminal would be constructed as part of the Project to facilitate the transfer of crude oil required as a raw material for the new refinery, and the transfer of finished products onto ships for transportation to intended markets. The marine terminal will consist of the following elements:

- Facilities for the transfer of crude oil (and intermediate feedstocks from other refineries) between ships and the terminal, consisting of a new crude oil tanker berth and including the use of the existing SBM at Canaport;
- Two finished product tanker berths for the transfer of finished products onto ships, for shipping of finished products to their intended markets;

- Two berths for loading of coke onto barges or ships, one located on the jetty adjacent to the crude oil transfer berth, the second on a separate jetty mounted to the common trestle, located nearer to the shore; and
- A barge landing facility, constructed on either a temporary or permanent basis, for unloading large equipment during Construction or as required thereafter.

The marine terminal will also include pipelines and loading arms for crude oil and finished products, a conveyor system for coke, fire detection and fighting equipment, a gas detection system, lighting and electrical distribution systems, navigational aids (including docking radar and fog horns), and a control room.

Further details on the facilities to be constructed and operated as part of the marine terminal are provided in the following sub-sections.

3.1.3.1 Use of Existing Single Buoy Mooring

The existing SBM (also sometimes referred to as a monobuoy) operated as part of the Canaport facility transfers crude oil between vessels and the terminal for use in the existing Saint John refinery. Vessels up to 350,000 dead weight tonnes (dwt) can be accommodated at the SBM. This includes very large crude carriers (VLCC), Suezmax, and Aframax class ships.

With the construction of a new crude oil transfer berth on the common jetty as part of the Project, vessels up to 150,000 dwt can be accommodated at the new crude oil berth, with the intention that the SBM will primarily accommodate the vessels over 150,000 dwt. Thus, VLCCs delivering crude oil for the existing Saint John refinery as well as those supplying the Project will transfer crude oil at the existing SBM. Deliveries of crude oil using smaller ships, both for the Project and for the existing Saint John refinery, will be diverted to the new crude oil berth. Advantages of this concept include:

- The need for an additional SBM is eliminated;
- Some redundancy and reliability of operation is provided as crude oil can be transferred at the SBM or tanker terminal;
- Lower costs; and
- Allows the SBM to be used primarily for larger crude carriers.

There are no physical modifications required to the existing SBM or underwater crude pipeline to accomplish this mode of operation for the Project.

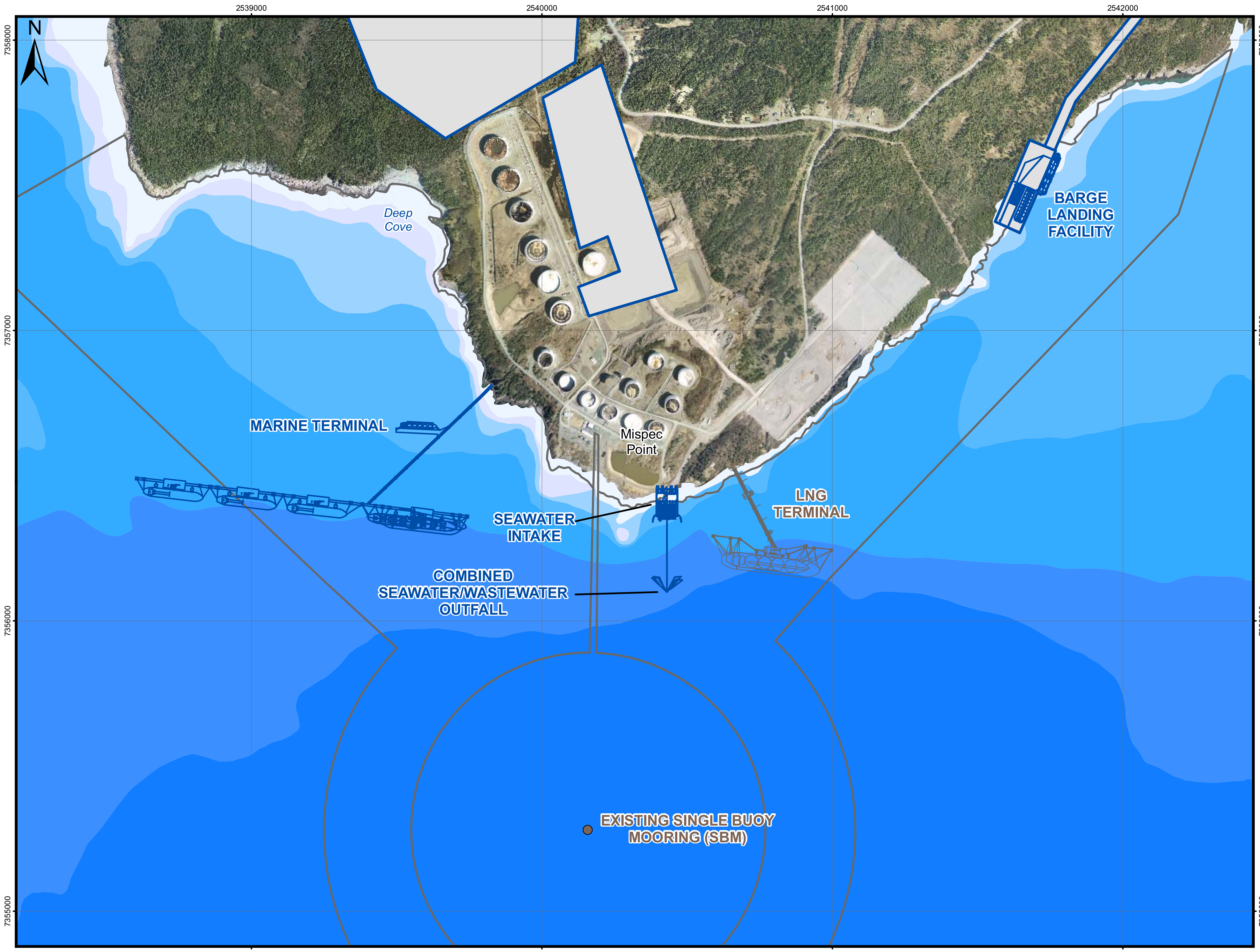


Figure 3.2

Location and Conceptual Layout of Marine Terminal

Project Eider Rock

Map Features

- Marine Terminal
- Existing Component
- Project Component
- Canaport Water Lot Boundary

Bathymetry

- 0-2m
- 2-5m
- 5-10m
- 10-20m
- 20-30m
- 30-40m
- 40-50m

0 100 200 400 600 800
Metres

Map Parameters
Projection: NB Stereographic
Scale: 1:13,000
Date: August 8, 2008
Project No.: 1013263.
Data Sources: City of Saint John, GIS Division, Service New Brunswick, Fluor, Sandwell Engineering Inc., Canadian Hydrographic Service

Jacques Whitford

3.1.3.2 Jetty

A jetty for the transfer of crude oil, intermediate feedstocks, finished products, and coke will be constructed approximately 650 m to the northwest of Mispec Point. The jetty will be sited offshore where sufficient draft for the anticipated ships is available, eliminating the need for dredging of the sea floor to accomplish navigation. A single trestle, approximately 450 m in length would be constructed to connect the jetty to shore. A conceptual rendering of the jetty and trestle structure is provided in Figure 3.3.

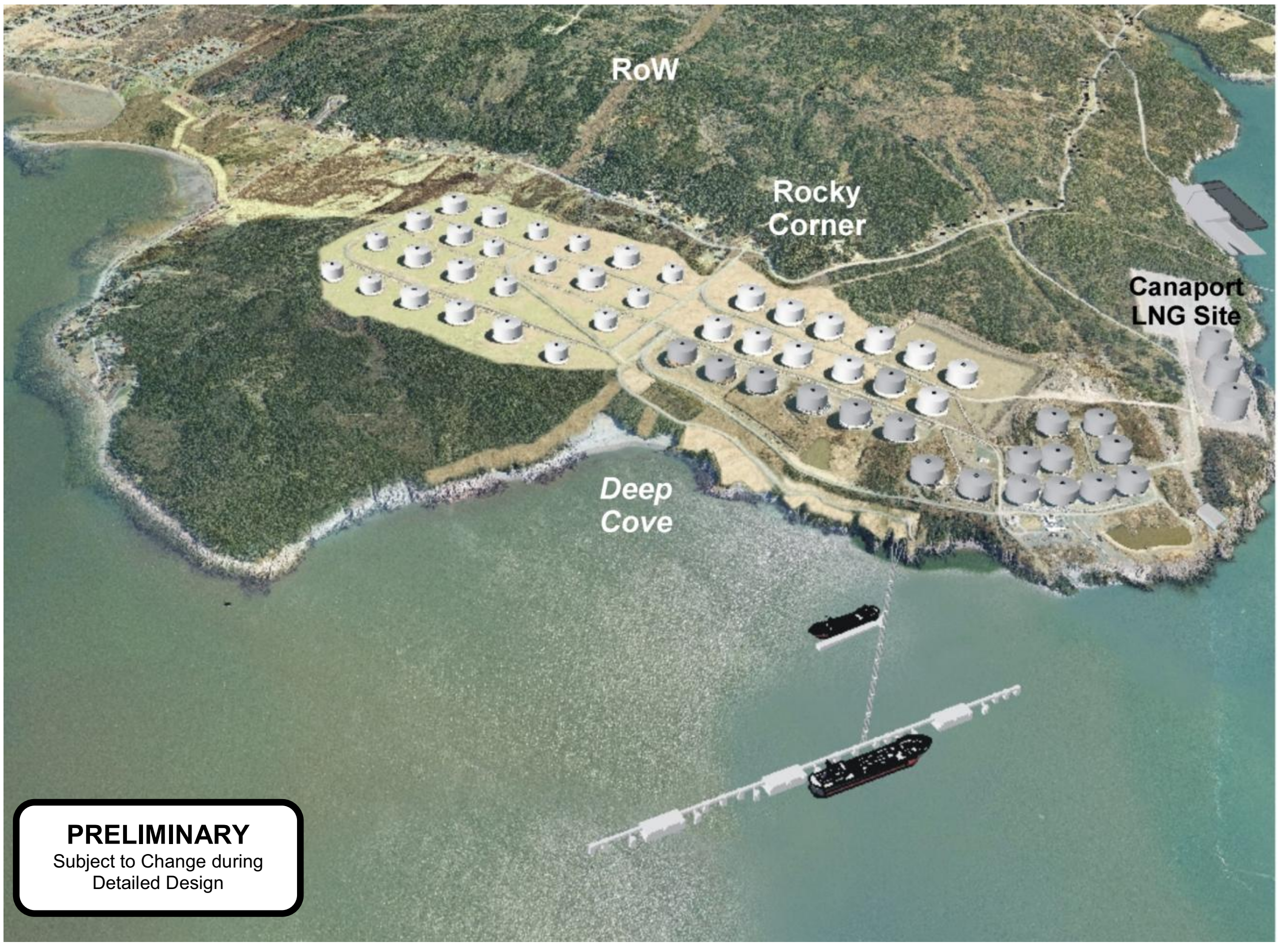


Figure 3.3 Conceptual Rendering of Marine Terminal (Jetty and Trestle Structure)

The proposed crude oil/finished product jetty will consist of five berths for ships to dock to the marine terminal, and is further described as follows.

- One crude oil berth, approximately 350 m in length, will be located at an approximate 20 m depth. This berth will facilitate the docking of a one crude tanker sized between 70,000 and 165,000 dwt.
- Two refined product berths, approximately 630 m in total length, will be located at an approximate 20 m depth. These berths will facilitate the simultaneous handling of cargo with two product tankers sized between 37,000 and 165,000 dwt.
- A coke loading berth, approximately 320 m in length, will be located at an approximate 20 m depth. This berth will facilitate the docking of a one dry bulk coke vessel sized between 34,000 and 70,000 dwt.

- A second coke loading berth/platform will be constructed on a separate jetty from the other four berths (though on the same trestle), located approximately 300 m offshore to facilitate loading of coke onto smaller coastal barges or ships. This berth will be connected to the single trestle common to all berths.

Pipelines and a conveyor supported by the trestle will convey crude, finished products and coke between the marine terminal and the land-based facilities.

Jetty and Trestle Structure

The marine terminal will consist of a jetty and trestle connected to the sea floor by supporting structures. Depending on the supporting structure selected, some dredging or side casting of sea floor material will be required. Two options are being considered for the supporting structures of the trestle and jetties in the marine environment:

- a jacket structure; or
- a caisson structure.

Additionally, regardless of the option selected for the supporting structures of the jetties, the trestle in the near-shore area will be supported by pile structures on the sea floor.

Each supporting structure and method of construction is discussed briefly below.

Option 1: Jacket Structure

The jacket is a three-dimensional, steel space frame that rests on the sea floor and extends approximately 11.6 m above the mean water level (MWL) and approximately 7.8 m below MWL. Steel piles are inserted into the tubular jacket legs and driven into bedrock. The construction of a typical jacket structure is shown schematically in Figure 3.4.

Under current design alternatives being considered, approximately 67 jacket structures would be required. This design would require the preparation of the sea floor over an area of approximately 19,815 m^2. Based on the alternatives being considered, the total volume of material to be dredged is approximately 59,409 m^3. Regardless of method of construction chosen, the dredging and disposal activities associated with the construction of the jetty/trestle structure will be conducted under a Disposal at Sea Permit to be obtained from Environment Canada.

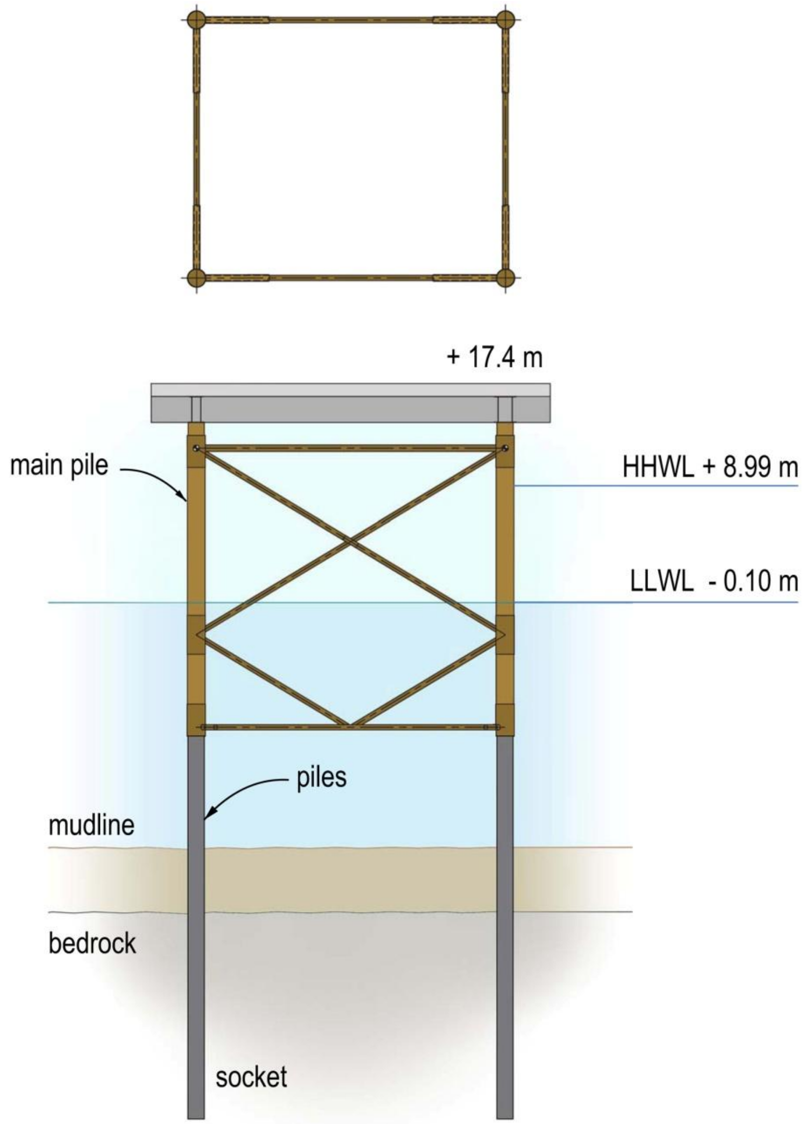


Figure 3.4 Schematic of Typical Jacket Structure

Option 2: Caisson Structure

A caisson is a hollow concrete or steel cylinder that would be fabricated onshore and floated to the marine terminal site by tugboats. Once in the proper location, each cylinder would be sunk into position and filled with rock until it is stabilized. Each caisson would be 25-28 m in diameter, and sit on a mattress of rock fill, with either a permanent rock-placed ring surrounding it or the use of a temporary steel caisson to prepare the surface for placement of the permanent caisson. The rock fill placed around the full circumference of the caisson will provide scour protection. The construction of a typical caisson structure is shown schematically in Figure 3.5.

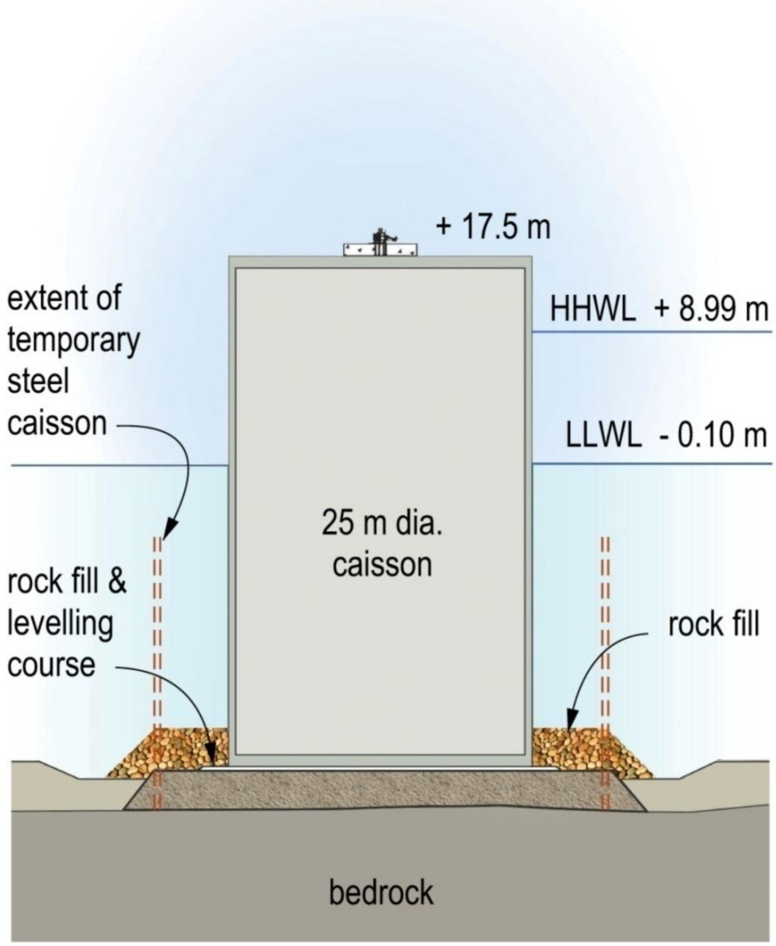


Figure 3.5 Schematic of Typical Caisson Construction (Temporary Steel Caisson Method)

Under current design alternatives being considered, up to 39 caisson structures would be required. Based on the alternatives being considered, this design would require the preparation/dredging of the sea floor over an area of up to 118,457 m^2. The total volume of material to be dredged is up to 250,541 m^3.

It is important to note that the area of sea floor and volumes of material to be dredged, as listed under Options 1 and 2 above, are limited to the areas of physical disturbance only, and currently do not include the entire area influenced by potential dredging, sidecasting, and/or the disposal of spoils. However, once the construction method and disposal method for the spoils have been confirmed, through detailed engineering design, the volumes and affected areas will be updated accordingly, and appropriate habitat compensation will be developed.

Piled Access Trestle

Regardless of whether jackets or caissons are ultimately selected for the construction of the jetties, the common trestle from shore leading to the jetties will be constructed by piling due to shallow water depth at the shore end of the trestle. A pile structure would consist of hollow steel piles about 1 m diameter. Sockets would be drilled into bedrock. The socket and the bottom portion of the steel pile would be filled with concrete. Under current design, approximately 48 piles would be required. The area of the sea floor covered by the piled access structure and the volume of material to be dredged are incorporated in the above areas and volumes for the jacket structure or the caisson structure. A schematic of the pile construction method is shown in Figure 3.6.

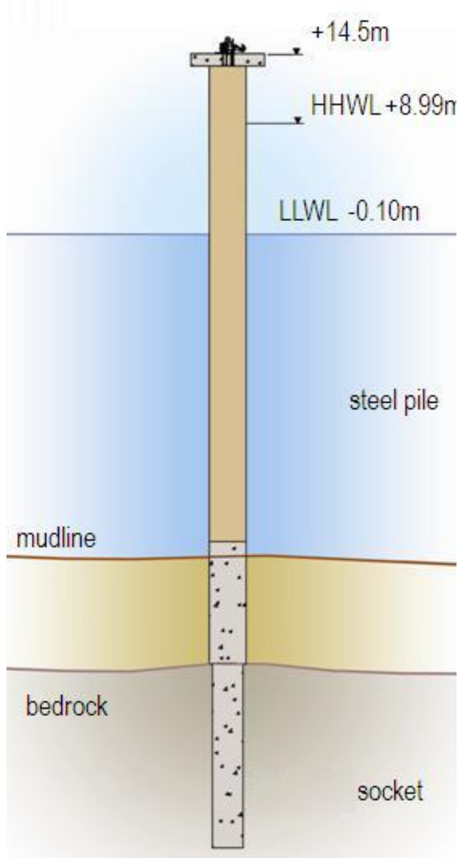


Figure 3.6 Schematic of Pile Construction

The preferred structure will be determined following a detailed study analysis for each competing design. For the purpose of this EA, both construction and support structure options (jacket/pile or caisson/pile) for the jetty and trestle have been carried and assessed.

3.1.3.3 Marine Oil Handling and Transfer Facilities

The marine oil handling and transfer facilities for crude and finished products will consist of the infrastructure required for the transfer of crude oil with tankers, the transfer of finished products to tankers, and the loading of coke to ships/barges. The infrastructure will include loading arms that facilitate the transfer of crude oil with crude tankers and finished products with product tankers, conveyors that load coke onto coke barges and ships, and pipelines that transfer the crude or finished products between the ships and shore.

Although the existing SBM will be used for the transfer of crude oil from tankers to support the Project, its presence and operation are already well-established and no modifications are required. Thus, the existing SBM and associated infrastructure is not described further in this document.

Loading Arms

Loading arms are used for both the loading of, and discharging of liquid cargoes between ships and the jetty. Each loading arm will consist of a pair of counter-balanced pipe sections connected by a swivel joint. The base of the arm will be connected to the jetty, while the end of the arm will be coupled to ship's valves. Moveable joints at each end of the arm will allow for freedom of movement to accommodate wave and tide action induced on the ship. The loading arms will be equipped with hydraulic positioning controls, automatic shut-off valves, an emergency release coupling, and a manual quick connect/disconnect coupler. Secondary containment for pipe and associated fittings will be provided.

The loading arms will be designed to operate within a pre-determined range of motion and their position will be continuously monitored by sensors. If the ship drifts too far from the dock, the sensors will engage the automatic shut-off valve built into each arm system and the transfer of crude oil stops. Because oil flow is automatically interrupted in such emergency situations with this design, thereby minimizing the potential for spills, it is not necessary to boom vessels during transfer of crude of finished products.

Each loading arm will have an emergency release system, whereby two valves on the end of the arm will close and split apart should the vessel be drawn from the berth unexpectedly. There will be an area around each arm that will capture any potential spills. This area will rely on curbs and a sump with a sufficient capacity to hold the entire contents of one arm. If there is contaminated water in the sump, the contents will be pumped into a truck on the shore or to the oily water system.

Pipelines

Several pipelines are required to facilitate the movement of crude oil and finished products on the jetty and trestle. The pipelines will serve to:

- Transfer crude oil between crude tankers and the crude oil storage tanks located on shore; and
- Transfer finished products between the product storage tanks and the product tankers located at the jetty.

It is likely that a single crude oil pipeline will be required between the crude oil transfer berth and the storage tank area, while several pipelines (one for each type of finished product) will be required between the product storage tanks and the product berths for routing the various finished products to the loading arms.

3.1.3.4 Barge Landing Facility

A barge landing facility for the unloading of large equipment during Construction is required. The barge landing facility will be generally located along the shoreline in an area known as Russell's Beach, located between Deep Cove and Mispec Bay, with the precise location to be determined. The barge landing facility may be decommissioned following Construction, or may remain in place permanently following construction for other uses. A conceptual rendering of the barge landing facility is provided in Figure 3.7.

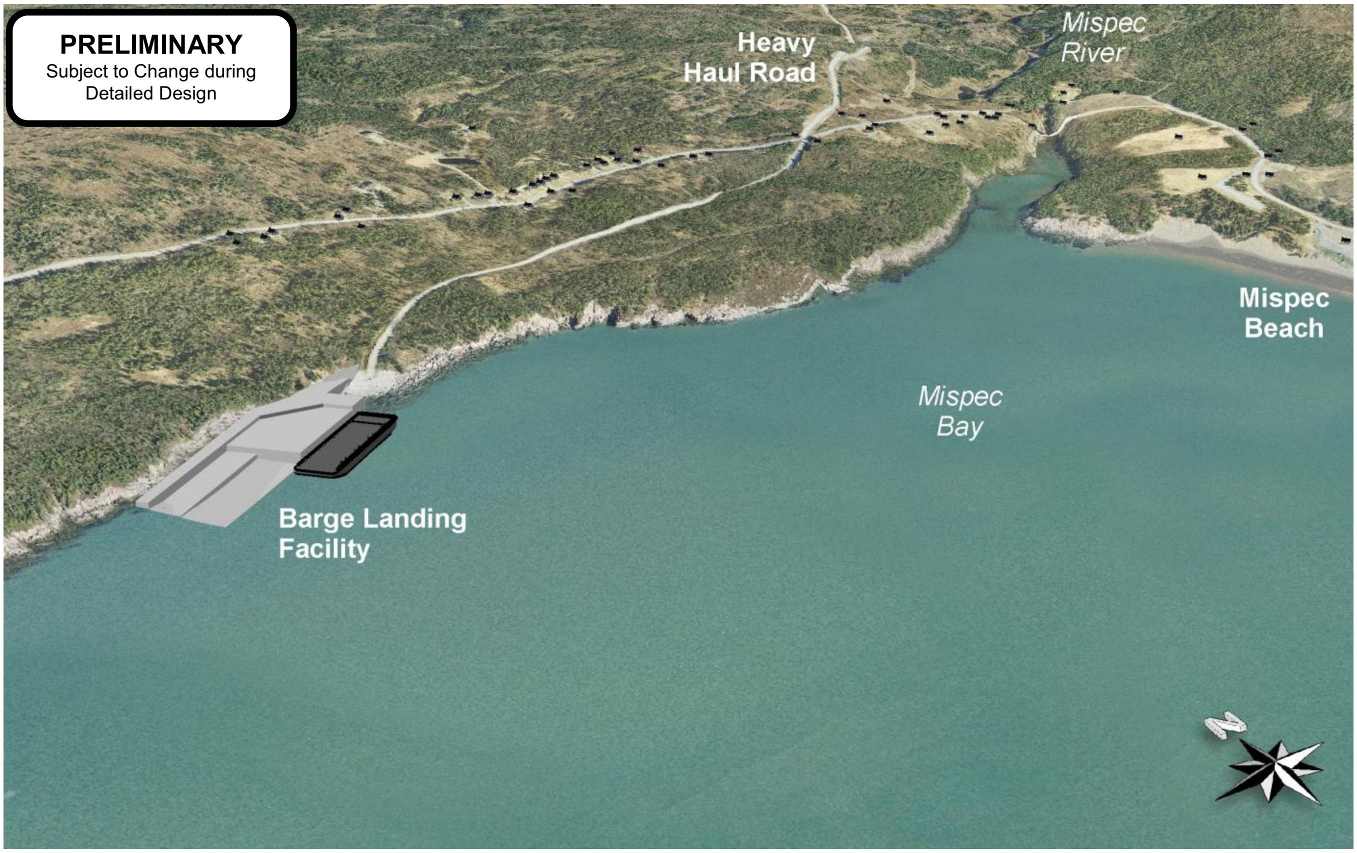


Figure 3.7 Conceptual Rendering of Barge Landing Facility

The barge landing facility, covering an area of approximately 3.5 ha, will consist of a dock and mooring points. As the coast at the proposed location is relatively steep and rocky, a substantive amount of rock and earth will be required to be added or removed, depending on if the dock is cut into the shore or built out into the sea, for the construction of the barge landing facility, particularly to build up the approach to the dock. The majority of the construction for the barge landing facility will be accomplished by blasting on land. There is no planned dredging of the marine environment to accomplish construction, although side casting is possible. At this early stage of engineering design, it is estimated that an area of approximately 24,000 m^2 in the near shore will require blasting in order to accomplish construction of the barge landing facility. If any infilling of the marine waters or blasting are required below the ordinary high water mark (to be determined as part of detailed engineering design), the precise areas to be in-filled or blasted and the quantities of lost fish habitat will be clarified during permitting of the Project and provided as part of the HADD authorization application. DFO blasting guidelines will be followed.

Self-propelled modular transporters (SPMTs) will be used for transporting large components from the barge to the refinery complex. The SPMTs will be loaded on the barge at the component's port of origin.

3.1.3.5 Seawater Cooling Intake Structure

A seawater cooling intake structure may be required. The seawater cooling intake structure will likely be constructed near Mispec Point to the east of the jetty/trestle structure, to withdraw seawater from the Bay for use as cooling medium against a closed circulating water system. Warmed process water will be circulated and cooled in a heat exchanger before it is pumped back to the heat source. Seawater will be drawn via an intake pump house located at the shoreline approximately 10 m below mean sea level, and near where the marine effluent pipe enters the Bay of Fundy. Blasting will be required on shore and below the ordinary high water mark to connect the intake of the pump house with the Bay of Fundy. The anticipated location of the seawater intake structure was shown in Figure 3.2.

A typical seawater intake system is shown schematically in Figure 3.8. The seawater intake system will include seawater pumps, the intake structure itself, travelling screens and inlet filters. On-shore piping and a heat exchanger system are also required. The intake structure will receive seawater and pumps will convey the seawater to the plate and frame heat exchanger where it will exchange heat with the closed loop circulating water. Warmed seawater will be discharged, along with the treated effluent, via the outfall to the Bay of Fundy.

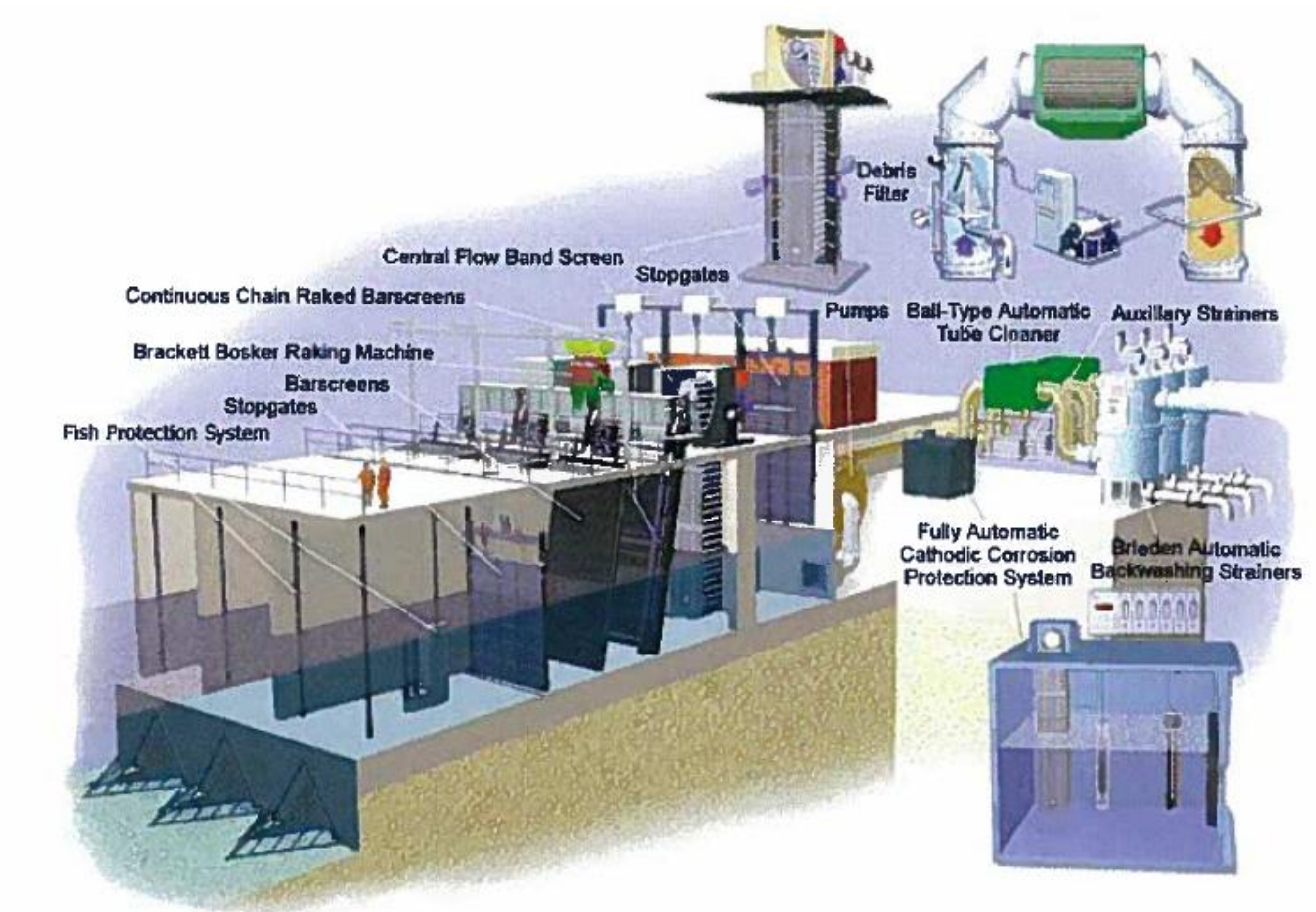


Figure 3.8 Schematic of Typical Cooling Water Intake Structure

Some dredging and/or the installation of support structures in the marine environment may be required to install the intake structure. At this time, it is estimated that an area of approximately 4,250 m^2 in the near shore will require blasting and/or side casting in order to accomplish construction of the seawater cooling intake and outfall facilities. Localized scraping/sweeping or side-casting of unconsolidated sea bed material may be needed to clean and prepare support structure locations. Depending on-site conditions, crushed rock may be required as bedding material and placement of rip-rap or armour stone for scour and wave protection.

3.1.3.6 Wastewater Release Outfall (Potentially Including Cooling Seawater)

If seawater cooling is used, treated wastewater as well as warmed seawater will be discharged to the Bay of Fundy via a common outfall pipe. The anticipated location of the outfall was shown in Figure 3.2.

Seawater (if used) and wastewater will be discharged to the Bay of Fundy via the common outfall pipe equipped with a diffuser at its point of release. Seawater piping and wastewater piping will combine on-shore into a common discharge pipe, with wastewater sampling facilities being installed prior to the location where both pipes combine.

The outfall will be located in the Bay off Mispec Point and consist of a discharge pipe or tunnel, approximately 200 to 250 m in length and extending offshore, to a depth of approximately 23 m. The precise configuration of the release point has not been determined. If seawater cooling is selected, the outfall would have an approximate diameter of 2.7 m (9 ft) and the outfall would have an approximate diameter of 0.51 m (20 in) if seawater cooling were not used. An open pipe or diffuser may be used, which is to be determined during detailed engineering design. For the purpose of this CSR, it has been assumed that a diffuser (or similar technology that will be designed to facilitate effluent dispersion) at the outfall location will be used to mix and disperse.

Some dredging and/or the installation of support structures may be required to install the discharge pipe, which has been accounted for in the calculations for the seawater cooling intake structure discussed above. Localized scraping/sweeping or side-casting of unconsolidated sea bed material may be needed to clean and prepare support structure locations. Depending on site conditions, crushed rock may be required as bedding material and placement of rip-rap or armour stone for scour and wave protection.

The outfall may also consist of a tunnel that is drilled from shore and blasted at the outlet. This will be determined during detailed engineering design.

3.1.3.7 Project Visibility

The marine terminal will be visible from various areas in Red Head, Mispec, Anthonys Cove, and other areas of Saint John. Visual representations of the possible appearance of the Marine Terminal and Other Marine-Based Infrastructure have been created from several key vantage points to represent the possible visual aesthetics of the marine terminal in comparison to its surroundings. These photo montages, created using geographical information system (GIS) based applications overlaid on actual photography from these vantage points where available, are shown in Figures 3.9 to 3.13.

Figure 3.9 3-D Photo Montage of Marine Terminal from Crown Street, Saint John (Viewpoint 1)

Figure 3.10 3-D Photo Montage of Marine Terminal from Mispec Beach (Viewpoint 4)

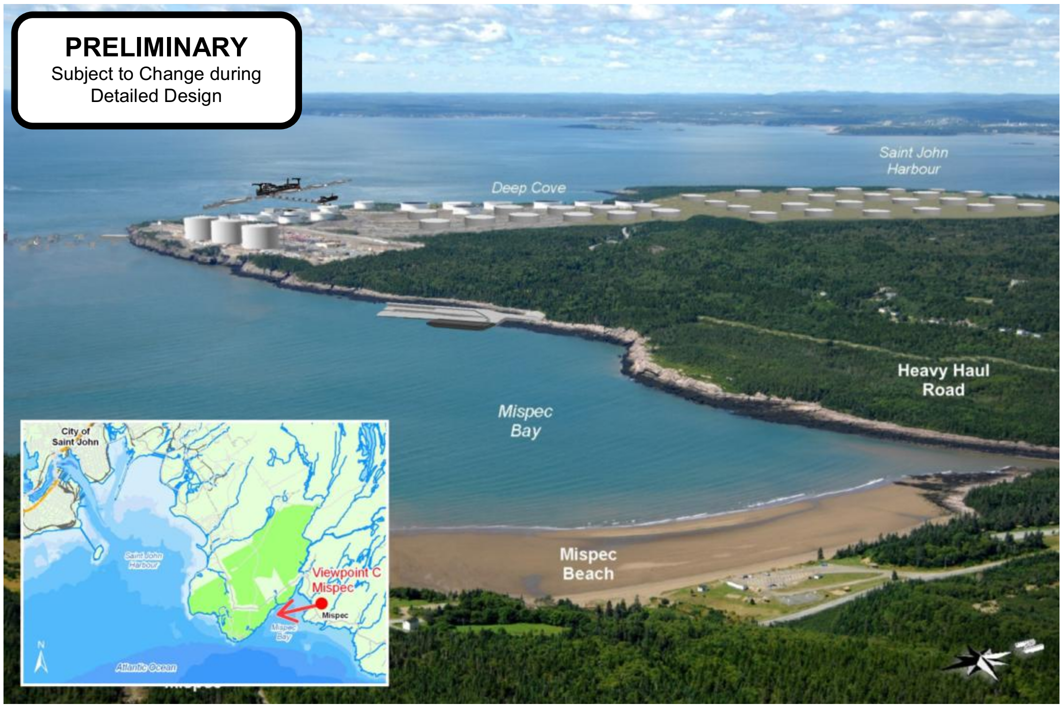


Figure 3.11 3-D Photo Montage of the Marine Terminal and Marine-Based Infrastucture from Mispec Beach (Viewpoint C)

Figure 3.12 Representation of Potential Night Time Lights of Marine Terminal from Red Head Road (Viewpoint 8)

Figure 3.13 Aerial Representation of Potential Night Time Lights of Marine Terminal from Saint John Harbour

3.1.4 Project Schedule

It is proposed that the Project would be constructed in two phases over an approximate 6-8 year period. The updated overall schedule for the Development Proposal, including a two-phased pace and sequence of Construction, is illustrated in Figure 3.14.

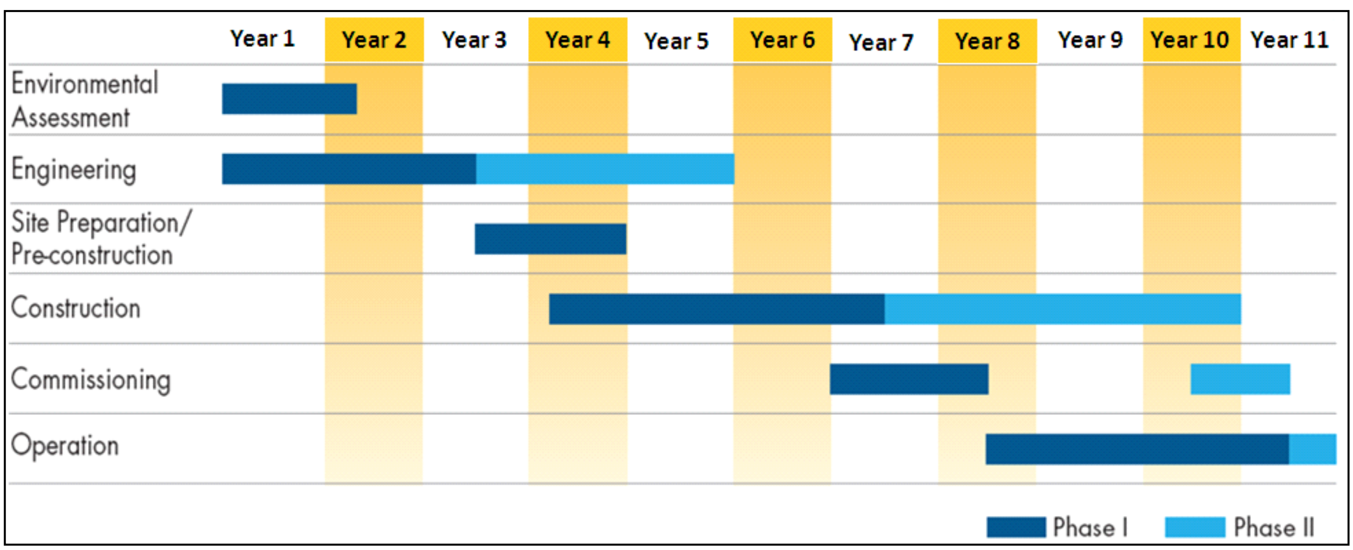


Figure 3.14 Overall Project Schedule

3.1.5 Environmental Management

A variety of environmental management policies, procedures, and systems will be developed for the Project. They are generally described in the following sections.

3.1.5.1 Health, Safety, and Environmental Management System

A Health, Safety, and Environmental (HSE) Management System will be developed and implemented as part of the Operation of the Project. Elements of the system will be in place during Construction (*e.g.,* environmental protection and contingency planning). Irving Oil would periodically audit these HSE practices and where necessary, the internal audit group would contract third party experts to assist with audit engagements. Audit reports will be circulated to management and to executive management for review and action. Finally, all audit reports will be subjected to routine follow-up to ensure that recommendations including any required process enhancements are appropriately resolved on a timely basis.

All Project procurement decisions (*e.g.,* hiring contractors) will be made in conjunction with the HSE Management System.

3.1.5.2 Building Design Codes

Specific codes and standards in the National Building Code of Canada, the Canadian Standards Association (CSA), and the Province of New Brunswick acts and regulations, among others, address specific issues related to environmental activities as summarized below. These Codes or standards may include, but are not necessarily limited to, those summarized in Table 3.1. Note, this is not an exhaustive list and is intended only to be illustrative. The design team will identify and follow all applicable codes.

Table 3.1 Selected Codes and Standards That May be Applicable to the Project

Code or Standard	Title
National Research Council of Canada	
NBC 2005	The National Building Code of Canada 2005
Canadian Standards Association	
CSA-A23.3	Design of Concrete Structures
CAN/CSA-A23.1/A23.2	Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete
CAN/CSA-S16-01	Limit States Design of Steel Structures
CAN/CSA-S136	North American Specification for the Design of Cold-Formed Steel Structural Members
CAN/CSA-G40.20/G40.21	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
CSA-W59	Welded Steel Construction (Metal-Arc Welding)
American Society for Testing and Materials	
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A572	Standard Specification for High-Strength Low-Alloy Columbian-Vanadium Structural Steel
ASTM A992	Standard Specification for Structural Steel Shapes
ASTM F436	Standard Specification for Hardened Steel Washers

Table 3.1 Selected Codes and Standards That May be Applicable to the Project

Code or Standard	Title
American Concrete Institute	
ACI 306.1	Standard Specification for Cold Weather Concreting
Other	
DFO	Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters
Transport Canada TP 743 E	TERMPOL Review Process 2001, Technical Review Process of Marine Terminal Systems and Transshipment Sites

The Project will be constructed to meet all applicable building, safety and industry codes and standards. The engineering design of the Project will consider and incorporate potential future changes in the forces of nature that could affect its operation or integrity (*e.g.,* climate change), and all Project components and infrastructure will be designed and built to adapt to or withstand these effects. The facility components will be designed to meet the National Building Code for wind, snowfall, extreme precipitation, and other weather variables.

3.1.5.3 Environmental Protection Plan for Construction

An Environmental Protection Plan (EPP) will be developed to guide the Construction of the Project in accordance with applicable federal and provincial environmental protection legislation and regulations. The EPP will be submitted to the appropriate regulatory agencies for review. In addition to referencing key aspects of design mitigation, the EPP would outline all environmental protection, mitigation, and response measures to be employed during Construction.

The EPP will be designed to be a site-specific field-usable document that will identify responsibilities, provide mitigation measures, desirable contingency plans, and provide a list of permits, approvals, authorizations, and key personnel to be contacted in the case of an emergency.

An EPP will be developed prior to the commencement of Construction, and will be submitted to the appropriate regulatory agencies for review.

3.1.5.4 Oil Pollution Emergency Plan

The marine terminal to be constructed as part of the Project will be designated as an “Oil Handling Facility” under the *Canada Shipping Act, 2001*. Given the Proponent’s extensive history of successfully operating a marine terminal at Canaport and the presence of fully equipped, trained and available spill response capability on land (through internal and external resources) and in the marine environment (through ALERT), the development of a detailed Oil Pollution Emergency Plan is not required or feasible at this early planning stage of the Project. However, prior to Operation of the Project, if and as required, an “Oil Handling Facility Oil Pollution Emergency Plan” will be prepared.

The Oil Handling Facility Oil Pollution Emergency Plan for the Project will be developed to meet the requirements of Section 168 of the *Canada Shipping Act, 2001*, and as prescribed by regulation. The plan will address issues such as resources, mobilization, health and safety, training and exercises, and response strategies. The plan will be compliant with the *Canada Shipping Act, 2001* and is reviewed by Transport Canada at each recertification application.

ALERT Inc., based in Saint John NB, is the Transport Canada approved response organization for the Bay of Fundy. ALERT provides on-water oil spill response management services through dedicated staff, trained in house responders and trained contractors. ALERT provides training on an ongoing basis to all direct and contracted personnel. ALERT conducts drills and exercises as required by the

Canada Shipping Act, 2001 with both ALERT and Irving Oil/Canaport personnel. The marine terminal for the Project will be required to enter into an agreement with ALERT Inc. and a similar service will be provided.

Overall Response Strategies

For spills in port, there will be an immediate and active on-water spill response capability. The type of response will be dictated by the nature of the incident and the weather and sea conditions at the time of the spill. Containment and recovery equipment to deal with small and modest-sized spills will be pre-staged in the area of the marine terminal and at ALERT Inc. such that it can be quickly deployed in the event of a spill. The most effective means of responding to a hydrocarbon spill on water is to contain it rapidly, then recover the spilled product. The response strategy will likely include the following elements.

- Activities related to vessel movements and cargo transfer will be monitored such that an immediate response can be implemented in the event of a spill.
- Containment equipment will be pre-staged at the marine terminal to facilitate rapid response.
- Upon discovery or notification of a spill, a response strategy will be developed and executed based on the actual wind and sea conditions being experienced at the time.
- In the event of a spill, containment booms will be rapidly deployed to surround the spill, and a recovery plan will be implemented.
- For oil that escapes containment, slick movements would be monitored and modelled to develop an appropriate response strategy, containment, and eventual recovery. Such recovery would be either on water or on the shoreline, or both.

For larger spills at the marine terminal, or for those that may result from a tanker incident away from the marine terminal, the response will require the activation of additional resources, as prescribed in the planning standards outlined in Sections 168 and 169 of the *Canada Shipping Act, 2001.* These standards mandate a tiered response capability through a Transport Canada certified response organization. The volume of oil handled at the refinery will lead to the location being classified as a Primary Area of Response, so the response time standards will be:

- 150 tonne (t) response capability: within 6 hours (h), equipment to be deployed on-site;
- 1,000 t response capability: within 12 h;
- 2,500 t response capability: within 18 h; and
- 10,000 t response capability: within 72 h.

Spill Response Equipment Requirements

A designation as an Oil Handling Facility under the *Canada Shipping Act, 2001* commits an operator of a marine terminal so designated to satisfy several planning requirements. First, the operator must have a contingency plan. The guidelines for Oil Handling Facilities also specify that an inventory of equipment be maintained that is commensurate with the size of the facility. Based on a planned maximum transfer rate of 9,200 m^3/h (58,000 bbl/h) for the Project, the Project will likely be classed as a Level 4 facility, and will therefore be required to consider a 50 m^3 spill for planning purposes.

The spill behaviour modeling for this size of spill indicates an initial slick width (of thick oil) of 31 m. Based on this, and the planning standards for this size of spill, a reasonable amount of boom for initial spill containment would be 500 m of 61 cm boom. A basic inventory of equipment for the facility should include:

- 500 m of protected water containment boom;
- Small workboats for deploying and positioning the boom;
- Skimmer suitable for recovering fresh and weathered oil;
- Temporary storage, and a pump and hose to transfer the recovered product to on-land storage; and
- Sorbent boom and pads for recovering sheen and lesser concentrations of oil.

Spill Management Simulations

Spill management simulations are used to exercise the important management aspects of spill response. Participants in such exercises should include the terminal management and staff, response organization spill manager and command centre staff (planning, operation, logistics, and finance), the field supervisors, and responders. The key areas to be covered in the simulation include spill assessment, resource mobilization, and operation.

Spill management simulations are designed in association with the response organization. The goals of the exercises and training are to ensure that a high level of preparedness is maintained by staff and contract personnel, and equipment is deployed to demonstrate use.

Operational Response Drills

Operational Response Drills are used to practice countermeasures, strategies, and techniques, and will be held on a regular basis with all operational staff. Topics to be covered include:

- Initial at-source actions;
- Communications;
- Spill tracking exercises;
- Nearshore containment and recovery; and
- Shoreline protection and containment.

For the Project, the main active response effort will be a containment and recovery response for oil that may be spilled at or near the loading facility. This may involve the deployment of a boom to contain spilled oil, deployment and operation of a skimmer to recover the oil, deployment of a temporary storage device, and use of pumps and hoses to transfer the oil to storage for recycling or disposal. Drills will likely be carried out on at least an annual basis to practice boom deployment, to ensure that personnel are familiar with the procedures and that the equipment is in a ready condition.

3.1.5.5 Marine Terminal Operation

The marine terminal will develop safety procedures and contingency plans to minimize the risks of an accident or unplanned event throughout the life of the facility. The TERMPOL review process and the

Marine Terminal Manual will contribute to the safe operation of the marine terminal and are described below.

TERMPOL Review Process

The Proponent has committed to completing a TERMPOL review process (2001 edition) at the appropriate time following the completion of the EA for the Project and when sufficient design information is available. TERMPOL is a voluntary process directed by Transport Canada to evaluate operational ship safety, route safety, and management and environmental concerns associated with the location, construction and operation of a marine terminal handling bulk petroleum products and related concerns. Details of the TERMPOL process can be found at http://www.tc.gc.ca/marinesafety/tp/tp743/menu.htm (Transport Canada 2001). It is noted that the scope off the TERMPOL review process would likely be focused on the Project, and not incorporate the ongoing existing operations at the Canaport Limited marine terminal.

Overall, the rationale of the TERMPOL review process is to consider the potential environmental effects of shipping activity related to the Project, risks associated with the proposed routing, navigational safety of ships, the level of service required to facilitate safe navigation, ship designs, pollution prevention, and contingency planning.

The berthing and deberthing of ships at the marine terminal will require tugboats and the development of dedicated navigation procedures. These activities will be included in the TERMPOL review process.

Marine Terminal Manual

A Marine Terminal Manual would be developed to address the specific requirements and operations of the marine terminal in accordance with federal and provincial legislation and the Proponent's policies. This would be developed in association with the TERMPOL review process.

The draft Marine Terminal Manual would be provided to the Transport Canada for review and approval. The manual will be developed in association with key stakeholders such as the Canadian Coast Guard, Atlantic Pilotage Authority, Transport Canada, and the Saint John Port Authority.

3.1.5.6 Decommissioning and Abandonment Plan

A Decommissioning and Abandonment Plan will be developed near the end of the useful life of the Project, to guide decommissioning, abandonment and closure activities that may be associated with the Project at the end of its life.

3.1.5.7 Follow-Up and Monitoring Initiatives

A follow-up and monitoring program will be designed and conducted, as appropriate, during Construction, Operation, and Decommissioning and Abandonment. The follow-up program will determine the effectiveness of mitigation and verify the accuracy of the environmental assessment.

Monitoring will involve the collection of a series of repeated measurements over time, and may be categorized as compliance monitoring or environmental effects monitoring. Compliance monitoring will be undertaken by the Proponent to ensure that regulated levels of parameters in releases from the Project are met. Environmental effects monitoring, including that of environmental incidents, will also be implemented to confirm whether or not the mitigation measures to lessen or minimize potential environmental effects have been successful.

3.2 Project Alternatives

Alternatives to the Project and alternative means of carrying out the Project, as required by the EA Track Report and Scoping Document, are described in this section.

3.2.1 Alternatives to the Project

The Proponent has considered the "Null" or "Do Nothing" alternative, alternative energy supply, and other alternatives to the Project to meet the requirements of the EA Track Report. These are discussed below.

3.2.1.1 "Null" or "Do Nothing" Alternative

The "Null" or "Do Nothing" alternative would involve not building or carrying out the Project or the land-based components of the Development Proposal as described in the Project Description. The null alternative would obviously not result in environmental effects, positive or adverse. Given that the potential adverse environmental effects of the Project are not likely to be significant, and while the positive environmental effects are substantial, those positive outcomes would not be realized. Overall, the Null alternative is not a reasonable or viable alternative to the Project and does not meet the Project purpose as described in Section 1.2, and it is not considered further in this CSR.

3.2.1.2 Alternative Siting

The sole purpose of the marine terminal to be built is to support the Development Proposal, thus the marine terminal must be built in proximity to the Development Proposal. The Development Proposal and its marine terminal could conceivably be sited together at other locations in east Saint John; Saint John; New Brunswick; or elsewhere. At the onset, the Proponent focused its siting efforts to east Saint John for carrying out the Development Proposal. Site locations outside of east Saint John were not considered viable because the Proponent's existing infrastructure is located there. Many commercial synergies between the Development Proposal and existing infrastructure in Saint John would not be possible by locating it elsewhere. It would not improve and likely adversely affect the economic feasibility of the Development Proposal if the land-based components were located at a distance from the existing single buoy mooring (SBM), which, along with the proposed marine terminal, will be used to unload crude oil.

Given this, building the Project at other locations would not meet the Project purpose as described in Section 1.2. Accordingly, alternative locations to Saint John were not considered further in this CSR.

3.2.1.3 Other Alternatives to the Project

No other alternatives to the Project are considered as they would not meet the Project purpose as outlined in Section 1.2.

3.2.2 Alternative Means of Carrying Out the Project

Alternative means of carrying out the Project beyond those described in this chapter for the Project as currently conceived and planned are discussed below.

3.2.2.1 Use Existing Infrastructure

The existing infrastructure consists of the existing SBM located at Canaport for crude oil transfer and the East Saint John Marine Terminal located in Courtenay Bay for product transfer. As the existing SBM is currently under-used, additional deliveries of crude oil can easily be accommodated, particularly if smaller crude ships are unloaded at the proposed marine terminal.

The existing East Saint John Marine Terminal is operating near capacity, and there is little space available for additional berths. This terminal is located more than 8 km from the Project site. Thus, the existing infrastructure at the East Saint John Marine Terminal is not considered to be technically or economically feasible to service the Project.

3.2.2.2 Construct Second Single Buoy Mooring

An alternative for receiving of the crude oil could include the construction of a second SBM. However, this would still require a jetty to be constructed as part of the Project to facilitate the shipping of finished products. Additionally, as the infrastructure and mitigation required could be more extensive, this option is not being considered at this time to service the Project. Further, since the existing SBM is used only 30% of time, construction of a second SBM is not required.

3.2.2.3 Alternative Marine Terminal Configurations

Several alternative marine terminal configurations were considered as part of the Project. After evaluating various permutations of crude and product berths, both to the east and to the west of Mispec Point, the proposed location and preliminary layout shown in Figure 3.2 has been determined to be the preferred alternative. This may continue to evolve during the course of detailed engineering design, but the location, configuration, footprint, and orientation of the marine terminal shown in Figure 3.2 would not be expected to be considerably different to that presented.

A second design, with a layout similar to the selected configuration but with the jetty and trestle sited to the east of the Canaport LNG marine terminal, was evaluated and could be selected as a feasible alternative, but requires a longer and more costly trestle (approximately 900 m long). The conceptual layout of this alternative also required some substantive dredging of accumulated sediments in the Mispec Bay area. For these reasons, while this alternative is technically feasible and likely economically feasible, it is not currently being considered further.

While the alternatives considered may have minor differences in the environmental effects experienced, because the facilities occur on the same footprint, a complicated consideration of environmental effects of other alternatives is not warranted.

3.2.2.4 Alternative Designs, Locations, and Construction Methods for the Marine Terminal

The Design Team evaluated up to 11 alternative means and scenarios of locating the marine terminal and associated jetty. These scenarios have included different locations, configurations, and methods of construction for the jetty. Multiple design options, including the use of caissons, jackets, piles and causeways, have been considered. In each case, the footprint of the marine terminal on the ocean bottom and the potential for associated HADD of fish habitat due to infilling, dredging and/or side casting, quantity of dredging required, and navigational concerns for berthing and while at berth were some of the factors considered in determining whether the design option would be considered further.

For example, all of the scenarios and construction methods listed below were considered and abandoned in part because of potential environmental effects on benthic fish habitat and/or substantive dredging requirements.

- A breakwater was considered as part of several design configurations. However, the use of this type of structure was not considered further once the benthic habitat footprint and the resultant potential HADD of fish habitat, and the changes to current patterns and sediment transport processes were determined.
- A traditional dredging/side casting method for caisson construction was considered early in the design process, but was subsequently dismissed because it could have resulted in a potential area of fish habitat HADD approximately three times—and a total volume of dredged spoils approximately six times—that which would result from the rock-placed ring method currently being considered.
- Marine terminal components on the east side of Mispec Point in Mispec Bay were included in several design configurations. However, this option was abandoned due to the length of the trestle structure that would be required to reach water of sufficient depth offshore, the larger area that would be required to be dredged to accommodate the draft of tanker vessels, and navigation safety concerns.

In addition to the design configurations described above, multiple construction methods have also been considered including the use of a rock-placed ring versus a temporary steel caisson for the caisson option. Both these options continue to be evaluated by the Design Team and both are carried through the environmental effects analysis in this CSR.

The ongoing analysis inherent to the design process has resulted in one general location with two design options (caissons or jackets for pier structures) currently being carried forward for the marine terminal and jetty for the Project. In addition, the rock-placed ring versus a temporary steel caisson for the caisson option construction method is also being carried forward. The volume of dredging material required for the jetty and construction method options could range from approximately 59,409 m^3 to 250,541 m^3 and which may even be further reduced upon completion of the final design. Further details on these aspects are provided in Chapter 10 of the CSR.

3.2.2.5 Alternatives to Dredging for Constructing the Marine Terminal

The construction of the jetty for the Marine Terminal as described in Section 3.2 requires some dredging of the ocean bottom to install the jetty and trestle structures. The need for dredging cannot be avoided for the Project, even if the trestle is extended into much deeper water as the dredging is necessary only to install the jetty/trestle structures and not to accommodate the draft of vessels intend for the marine terminal and at berth. As will be discussed in Section 3.7.3 and in Chapter 10, the Mispec Bay area in general has considerable sediment accumulated upon the sea floor (with some areas, such as Area A in Figure 10.2 exhibiting less sediment accumulation than others). If a stable construction of the jetty/trestle structures is to be accomplished, the sediment must be dredged, removed, or side cast to allow for construction of the jetty structures on a geotechnically stable surface upon the seabed.

The only other alternative to a jetty that would eliminate the need for dredging is to construct one or more single buoy moorings (SBM) offshore and akin to the existing Canaport SBM to receive crude oil from tankers. This option was rejected by the Design Team in its review of potential marine terminal options, and it would not likely easily accommodate the shipping of finished products. The construction of any new SBMs would have to be several hundred metres to kilometres offshore to avoid interfering with the operation of the existing Canaport SBM, and new SBMs would require appropriate swing circles for the moored vessels. In addition, they would require several sub-sea pipelines to shore and Canaport. This alternative for a marine terminal would not likely be feasible because of the likely interference with existing navigation and vessel traffic in the Saint John Harbour, limited space available in the harbour for the siting of new SBMs, and pipeline infrastructure extending several hundred metres to kilometres from shore.

As such, there are no technically or economically feasible alternatives to dredging of the sea floor to accommodate the construction of the jetty at the proposed location of the marine terminal. No other alternatives to dredging have thus been carried further in the environmental effects analysis in this CSR

3.2.2.6 Alternative Means for Disposal of Dredged Material

Practicable alternative means for the disposal of dredged material were also considered. The alternatives considered included: land disposal, localized side casting, use of the nearby Black Point ocean disposal site (managed by Environment Canada), creation of a new ocean disposal site, and use of other more distant existing ocean disposal sites.

In keeping with Schedule 6 (Paragraph 17) of *CEPA*, disposal of dredged materal will be determined so that environmental effects are minimized and benefits maximized. Beneficial uses will be assessed as part of the Disposal at Sea regulatory process by way of a comparative assessment.

The creation of a new ocean disposal site was dismissed as not technically or economically feasible due to the potential for increased HADD and the likely requirement for ongoing maintenance of the site.

Disposal at other more distant existing ocean disposal sites has been dismissed as not economically feasible due to the high transportation costs associated with barging large quantities of dredged materials from the Project location to the disposal site.

The preferred means for disposing of dredged materials that is most technically and economically feasible is the local disposal (side casting) of dredged material. However, the HADD footprint affecting fish habitat is likely to be higher with this method for disposal at sea, depending on the option retained for the final design of the jetty.

The other two potential alternatives for disposal of dredged material include disposal on land, and disposal at the Black Point ocean disposal site. Both of these alternative disposal methods require more handling of the dredged material compared to side casting, leading to potentially greater environmental effects such as increased concentrations of total suspended solids, and higher machinery and operator requirements and energy costs compared to the preferred option of local on-site disposal. An alternative means to land disposal with a barge would be the use of a hydraulic suction dredger to remove material, with a pipeline connection to shore disposal approximately one kilometre away from the dredging site. However, disposal on land is not favoured because of the likely requirement for a suitable disposal site to be identified, approved, engineered, constructed, and operated and maintained. As such, disposal on land was ruled out as not technically or economically feasible.

Thus, the preferred options for disposal of dredged material for the Project are thus sea disposal of dredged material, either locally (via side casting) or at the Black Point ocean disposal site. Both options are technically and economically feasible, and their environmental effects and mitigation are similar. As a result, disposal at the Black Point ocean disposal site and side casting are both carried through the environmental effects analysis in this CSR and alternative means of disposal of dredged material will be re-assessed during the permitting phase.

3.2.2.7 Alternative Locations and Configurations to Seawater Cooling Intake Structure

Alternatives to seawater use as cooling water include fin fan cooling and cooling towers, previously discussed. These alternatives and configurations will continue to be evaluated and optimized throughout the course of detailed engineering design of the Development Proposal. At the present time the cooling needs of the refinery to be built for the Development Proposal will either be conducted using seawater cooling, cooling towers, or a combination thereof, with the preferred alternative to be determined during detailed engineering design. The use of other technologies such as fin fan cooling and cooling towers would be considered mitigation for the use of cooling sea water.

Alternative locations to the proposed seawater cooling intake structure would include locations along the shoreline from Anthonys Cove to Mispec Bay. The selected location is preferred because of suitable construction characteristics in the Mispec Point area (*e.g.,* relatively low accumulation of sediments on the sea floor), proximity to refinery facilities (thereby requiring less piping and conveyance easily achieved via the piping and conveyors corridor), and suitable bathymetry that is conducive to its construction. Alternative locations, while likely technically feasible, would likely result in added cost to the proposed location and thus they are not considered further in this CSR.

While the alternatives considered may have minor differences in the environmental effects experienced, because the facilities occur on the same footprint and do not have substantive differences in discharges or wastes, a complicated consideration of environmental effects of other alternatives is not warranted.

3.2.2.8 Alternative Locations and Configurations for Wastewater Outfall

Alternative configurations to the combined seawater/wastewater outfall (or outfall for wastewater alone, if seawater cooling is not used) include the use of two separate outfalls for each type of effluent, and the use of diffuser compared to no diffuser. Two separate outfalls are technically and likely economically feasible. Such a configuration would likely require additional disturbance of the sea floor to accomplish their separate construction to result in suitable mixing zones for thermal and chemical plume dispersal. The use of a diffuser at the end of the outfall increases mixing and enhances effluent plume dispersion, and is likely preferable from this perspective. The precise configuration of the release point for the outfall will be determined during detailed engineering design and will be developed to result in equivalent to or superior effluent dispersion than that presented in this CSR. As such, alternative configurations to the combined seawater/wastewater outfall proposed are not considered further in this EA.

The release of effluent to the freshwater environment (such as to the Mispec River) as opposed to a marine environment was not considered because of the potential for adverse environmental effects to aquatic organisms in the freshwater environment from the receipt of up to 25.2 m^3/s (400,000 USgal/min) of warmed seawater (potentially increasing the salinity of the receiving freshwater watercourse) and treated wastewater containing residual quantities of trace chemicals that could accumulate in the Mispec River, a protected river under the *Species at Risk Act* (*SARA*). Because Mispec Bay waters have similar salinity to the warmed seawater from the cooling system, and because of the dynamic environment in the Bay that facilitates mixing and dispersion of residual treated effluent release in the marine environment was favoured as the preferred approach to release of warmed seawater and treated wastewater. As such, the release of treated effluent to the freshwater or estuarine environment is not considered further in this CSR.

Alternative locations and depths for the combined seawater/wastewater outfall were considered in detail in this CEA through two-dimensional hydrodynamic modelling of the combined effluent streams at various locations between Deep Cove and Mispec Bay (NATECH 2008a). While other locations for the outfall would likely be technically and economically feasible, the selected location at Mispec Point is preferable to other locations for several reasons:

- It is located off the southernmost point of land near Mispec Bay, thereby receiving the benefit of relatively unobstructed current flows from land features of the shore;
- It has suitable construction characteristics (*e.g.,* relatively low accumulation of sediments on the sea floor), and is very proximal to refinery facilities (thereby requiring less piping and thus minimizing piping and pumping costs and associated energy requirements); and
- The bathymetry at Mispec Point is such that the sea floor drops quickly to a suitable depth at a relatively close distance from the shoreline (Figure 3.2).

Further, from the hydrodynamic modelling conducted, the above features result in increased mixing and dispersion of the combined effluent compared to other modeled locations, thus likely resulting in lesser environmental effects. As such, while other locations for the combined seawater/wastewater outfall would likely be technically or economically feasible, they are not considered further in this CSR at this time.

While the alternatives considered may have minor differences in the environmental effects experienced, because the facilities occur on the same footprint and do not have substantive differences in discharges or wastes, a complicated consideration of environmental effects of other alternatives is not warranted.

3.2.2.9 Alternative Shipping

Alternative means of shipping products to markets would include truck and rail transportation, product pipelines, and shipping using different-sized ships.

Shipping of crude oil to supply the Development Proposal can only be economically conducted by marine vessel, given the location of the Development Proposal and the lack of nearby crude oil sources. Most of the crude will originate from other parts of the world, including the Middle East, South America, Africa, the North Sea, and other oil producing regions. While a very limited amount of crude oil may be sourced from North American locations (*e.g.,* the southern US, western Canada, or offshore Newfoundland), depending on availability and economics, these areas are not expected to supply a substantive portion of crude for the Development Proposal, nor is the construction of a pipeline to supply crude from these areas considered economical currently.

Shipping of finished products from the Development Proposal to markets by truck would require a large number of trucks to ship up to 40,000 m^3/d (250,000 bbl/d) of refinery products. Conservatively, this could require up to 1,600 trucks per day arriving and leaving the refinery (assuming 25,000 L per truck). The existing road infrastructure in east Saint John and Red Head area would not likely be able to support this added volume of traffic. Additionally, as the products from the refinery are solely intended for export and not for domestic use, the use of trucks to ship the products to their intended markets would not be technically or economically feasible.

Shipping of products by rail may be possible, although there would need to be adequate rail infrastructure at all areas where the products are intended to be shipped. A substantive amount of rail traffic would be expected in east Saint John to accomplish this shipping if rail were solely used, which could lead to disruptions to road transportation. The existing rail infrastructure system in Southern New Brunswick, while currently under-used, may be insufficient to accommodate the approximate 80 trains per day that could result from shipping all products by train (assuming 20,000 L per rail car and 25 rail cars per train). As such, the shipping of products solely by train to its intended markets would not likely be technically feasible.

Shipping of products by pipeline would require a large pipeline infrastructure system between markets in the United States and Saint John. While the Eastern Seaboard of the United States already incorporates a substantive network of crude and petroleum product pipelines, these pipelines do not extend any farther northward than New York State, and thus the use of this mode of conveyance for the Project would require substantive new pipeline construction to service the Project. The environmental effects and mitigation for siting and constructing of pipelines require careful consideration, planning, and assessment, and may be undertaken in the future as part of a separate Project. They are not considered as part of the Development Proposal at this time.

Finally, the Project will use a wide variety of vessel types and sizes for shipping both crude oil and finished products. As such, transportation by ship using different sized vessels has been established and requires no further evaluation.

While the alternatives considered may have minor differences in the environmental effects experienced, they do not have substantive differences in emissions, discharges or wastes, and as such a complicated consideration of environmental effects of other alternatives is not warranted.

3.3 Construction

3.3.1 Construction and Installation of Jetty and Other Marine-Based Infrastructure

The construction of the jetty and other marine-based infrastructure includes:

- Land-based site preparation of the barge and trestle landings;
- Preparation of the sea bed, including dredging or side casting, and installing the support structures (piles and jackets or caissons) on the sea floor;
- Installation of the trestle and jetty support structures and deck; and
- Fitting the marine terminal with equipment to facilitate the transfer of crude oil and finished products.

The majority of the marine terminal will be constructed using barges equipped with on-board, heavy-lifting cranes. Major jetty components (*e.g.,* jackets) would be fabricated off-site and barged to the site for installation at the appropriate location on the sea floor. Once the structure is completed, large equipment (loading arms and pipelines) will be installed on the jetty using barges where necessary or land-based vehicles. Smaller equipment would be delivered to the marine terminal by truck for installation.

The major pieces of equipment will be delivered to the marine terminal as packaged units (*e.g.,* the piles and jacket structures or caissons) and installed as required. Equipment to be installed on the jetty and trestle include crude oil loading arms, product loading arms, mooring points, crude and product pipelines, fire suppression equipment, and ancillary equipment. The equipment installation is expected to be relatively straightforward and result in minimal environmental effects, with careful design and execution of the installation tasks.

3.3.1.1 Site Preparation and Installation

Land-based site preparation for the marine terminal would likely include blasting for the heavy haul road down to the barge unloading facility, and for the terminal trestle landing. No blasting is expected to be required below the water line or within the inter-tidal zone for the marine jetty/trestle structure, but some blasting is expected to be required for the construction of the barge landing facility and the seawater cooling intake structure and pump house. The amount of blasting would depend on the final elevation and required slopes determined during detailed engineering design.

Site preparation is also required for the sea floor. In order to install the structures on the sea floor, unconsolidated sea bed material will likely be swept/side-cast. Some limited dredging may be required. The quantity of dredged material varies depending on the supporting structure selected for the marine terminal, as discussed previously. Following sweeping/side-casting, bedding material may be required, based on the stability of the sea bed. Following preparation of the sea floor, barges and cranes would lower the structures into place.

Blasting

Blasting times and locations will be controlled to minimize risk to non-blasting construction workers and noise nuisance to the surrounding area. Blasting activity will only be carried out during daylight hours, Monday to Saturday, in order to minimize noise nuisance to surrounding neighbours. Pre-blast surveys and sampling of potable water wells will be conducted at all owner-occupied residences within 500 m of the proposed blasting activity. As required, vibration monitoring during the blast will also be conducted in accordance with the *Blasting Code* under the New Brunswick *Municipalities Act*. Any blasting on land and in close proximity to freshwater or marine fish habitat will be carried out to the extent feasible in accordance with DFO's *Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters.*

Pile Driving

The design philosophy is to use mass concrete foundations anchored where necessary. Extensive piling is not expected. However, in areas where soils are not geotechnically stable enough for construction of the units, pile driving will be necessary. Where this is required, piles will be driven by conventional impact pile drivers. The number of piles required will be confirmed in the detailed design phase.

Where piling is required, piling times and locations will be controlled to minimize risk to construction workers and noise. Piling activity will be carried out during daylight hours, Monday to Saturday, wherever feasible. Periodic vibration monitoring will also be conducted.

3.3.1.2 Dredging and Disposal

As mentioned above, some side-casting is required for site preparation. Some limited dredging may also be required to facilitate the installation of the jackets, piles and intake/outfall structures. If selected, caisson structures may require more extensive dredging. However, navigational dredging and disposal is not expected to be required.

The transfer berths will be located off-shore where sufficient draft is available for the anticipated vessel type, thus avoiding dredging to the extent possible. Side-casting is not expected to require transportation of material away from the structures. Dredged material removed during dredging activities (if required) will be disposed at an approved disposal at sea site, likely at the nearby Black Point ocean disposal site. Disposal of drill cuttings for piling installation, which fall under Section 122(1)(h) of *CEPA,* are considered part of the normal operation of a vessel. Although a Disposal at Sea permit is not required for these activities considered to be normal operation of a vessel, environmental quality associated with the disposal of drill cuttings will be assessed and any potential concerns addressed by Environment Canada under Section 36(3) of the *Fisheries Act*. Overall, ocean disposal of dredge spoils will be conducted in accordance with a Disposal at Sea permit obtained under the *Canadian Environmental Protection Act.*

Water and suspended sediments from the drill cuttings return mixture will be allowed to settle and will be monitored to meet regulated discharge criteria prior to being released over the side of the drill barge. Cuttings will be stored and returned to shore for disposal in an approved landfill or at sea under the authority of a Disposal at Sea permit.

3.3.2 Marine Vessel Berthing and Deberthing

3.3.2.1 Marine Vessel Transportation and Unloading

The established shipping lanes in the Bay of Fundy (Figure 3.15) will be used by construction vessels for equipment deliveries associated with the construction of the marine terminal itself as well as for other land-based components of the Development Proposal. The final details of the route and site-specific guidelines/procedures for marine vessel transportation will be established once the final design of the marine facilities has been completed.

The majority of the marine terminal will be constructed using barges equipped with on-board, heavy-lifting cranes. Once the structure is completed, large equipment (loading arms and pipelines) will be installed on the jetty using barges where necessary or land-based vehicles. Smaller equipment would be delivered to the marine terminal by truck for installation.

Ships have been assumed in this CSR as burning 1.5% sulphur marine diesel. However, new MARPOL regulations coming into effect in 2020 would limit the sulphur content of marine fuels to 0.5%. Once these measures are in place, the environmental effects of marine vessel transportation would be further mitigated by the use of cleaner fuels.

3.3.2.2 Anchorage of Marine Vessels

Temporary anchorage may be required for construction vessels or equipment barges due to weather or enforced exclusion zones. During unloading, barges will be held in place using on-board thrusters or tug boats.

Currently, there are four anchorages in the Saint John Harbour area (designated as Anchorages A, B, C, and D, Figure 3.15). Although not expected to be required for the Project, if there is a need for additional anchorages, this will be determined by the Saint John Port Authority Harbour Master in consultation with stakeholders.

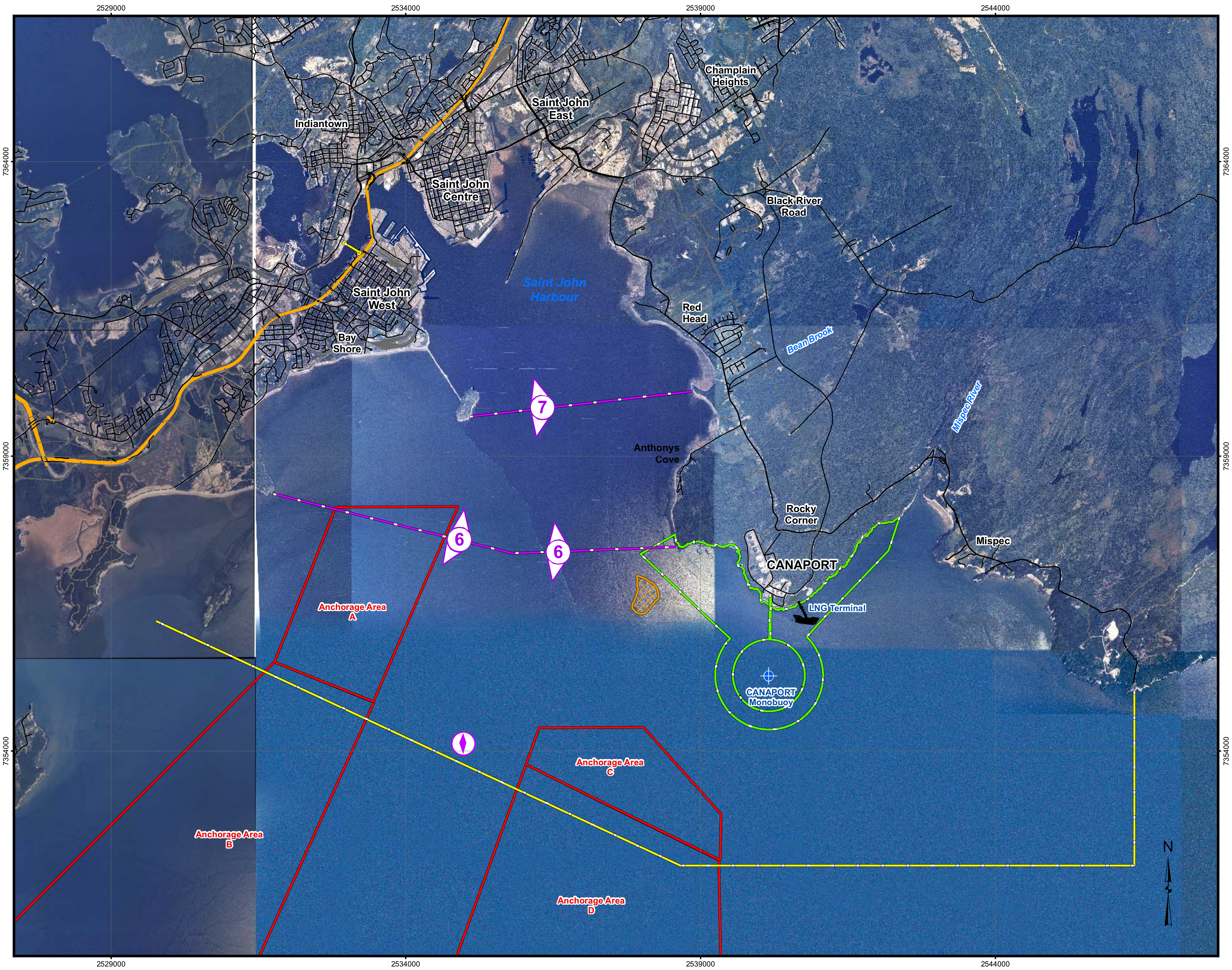


Figure 3.15

Shipping Lanes and Anchorages in the Bay of Fundy

Map Features

- **Call in Point**
- **Pilot Boarding Station**
- Call in Area Limits
- Compulsory Pilotage Area Limit
- Canaport Water Lot Boundary
- Anchorage Areas
- Black Point Ocean Disposal Site
- Wharf
- Utility Line
- Major Road
- Secondary Road
- Local Road
- Track
- Rail Line

Data Source: Service New Brunswick 2006
Anchorage and Pilotage data provided by the Canadian Hydrographic Service.

0 0.5 1 2
Kilometres

Map Parameters
Projection: NB Stereographic
Scale 1:60,000
Date: March 16, 2009
Project No.: 1013263.

Jacques Whitford

3.3.2.3 Berthing and Deberthing of Vessels at Barge Landing Facility

Heavy land-based equipment for the Development Proposal will be delivered by barge. These barges will unload their cargo at the new barge landing facility. In general, barges would depart at the end of the shipping lanes and approach the barge landing facility from the southwest and proceed north to the facility.

Approximately 200 or more barge trips will be required to transport construction materials and heavy equipment.

3.4 Operation

3.4.1 Marine Vessel Berthing and Deberthing

3.4.1.1 Shipping Activities

The Development Proposal will result in additional shipping in the Bay of Fundy during Operation. Shipping is not included as part of the scope of the EA under *CEAA*, although is discussed briefly herein for context.

All tanker traffic in the Bay of Fundy is monitored by the Canadian Coast Guard's Marine Communications and Traffic Services (MCTS) centre. Tanker traffic within Saint John Harbour is assisted by the Atlantic Pilotage Authority (APA) and the Saint John Port Authority. All tanker traffic is via two established shipping lanes (one for entry and one for departure from the Bay of Fundy). The existing shipping lanes were established for navigational safety of vessels within the Bay of Fundy transiting between Saint John and the Atlantic Ocean. There are no shipping lanes within Saint John Harbour. Currently, there are four anchorages in the Saint John Harbour area. The existing shipping lanes in the Bay of Fundy and anchorages for the Port of Saint John are shown in Figure 3.15.

Vessels associated with the Project (crude, product, coke) will use the established shipping lanes and existing anchorages in the Bay of Fundy. All Irving Oil owned and operated ships are double-hulled. Third parties carrying crude oil or products for the Project will be encouraged to use double-hulled ships.

Any alternative shipping corridors and anchorages that may be required (although none are currently envisioned) will be developed by the applicable regulatory authorities and stakeholders.

The shipping corridor into the Saint John Harbour area will be similar to the existing route used for the delivery of crude oil to the existing Canaport SBM. This will be determined through navigational simulations as part of the TERMPOL review process and in association with Transport Canada. Approaches and schedules may vary depending on tide and wind conditions.

3.4.1.2 Marine Vessel Transportation and Crude Oil Transfer

Ships of various sizes will be used to supply crude oil and intermediate feedstocks to the Development Proposal and to transport intermediate products, finished products, and coke to markets. Typical ship classes include:

- VLCC (Very Large Crude Carrier), with a capacity of approximately 2,100,000 bbl of crude;

- Suezmax – approximately 1,000,000 bbl capacity of crude;
- Aframax – approximately 650,000 bbl capacity of crude or product;
- Dry Bulk Vessels – approximately 70,000 dwt (for coke); and
- Smaller product tankers will transport finished products (gasoline, Eurodiesel, ULSD, coke) to markets, and may transport intermediate products (VGO, naphtha, and vacuum residual) to and from Saint John.

Approximately 30-35 VLCCs, 25-45 Suezmax tankers, and 3-15 Aframax tankers are anticipated to arrive at the marine terminal and/or SBM per year to deliver crude oil and intermediate feedstocks to support the Development Proposal. The actual number of such vessels may vary depending on the type, origin of the crude, and the volume transported, and the carrier. VLCCs will berth at the existing SBM, while the smaller tankers will berth primarily at the marine terminal, though they may berth at the SBM if needed (*e.g.,* if terminal berths are full and the SBM is not occupied).

The number of product tankers and coke vessels per typical year will vary, depending on the composition of the crude oil and resulting products that are refined. However, on average, approximately 280 product tankers and 22-30 coke vessels are anticipated to transport Development Proposal products to markets each year.

The established shipping lanes in the Bay of Fundy and other existing established routes will be used by tankers and coke ships. The shipping route within the Saint John Harbour limits will and site-specific guidelines/procedures (*e.g.,* Marine Terminal Manual) for Project tankers will be established once the final design of the marine terminal has been completed, and following detailed analysis to be conducted as part of the TERMPOL review process.

3.4.1.3 Anchorage of Marine Vessels

Temporary anchorage may be required for tankers or coke vessels due to traffic, weather or enforced exclusion zones.

Currently, there are four anchorages in the Saint John Harbour area. Although not currently expected to be required, alternative anchorages will be considered as necessary in consultation with Transport Canada and the Saint John Harbour Master.

3.4.1.4 Berthing and Deberthing of Vessels at the Existing SBM and Transfer Berths

Berthing and deberthing procedures for tankers that use the existing SBM are already well established. The VLCC ships would be expected to follow these procedures.

For other vessels, the berthing and deberthing procedures will be established as part of the Marine Terminal Manual following the completion of the TERMPOL review process, in consultation with stakeholders. However, in general, other crude and product tankers would depart at the end of the shipping lanes and approach the jetty from the southwest towards the terminal, then northward towards the proposed berth. Final manoeuvring in the vicinity of the new berths will be east to west or west to east. Vessels transporting coke would also depart the end of the shipping lanes and approach the coke loading berths from west to east.

Exclusion zones or navigational restriction on the movement of tankers and support vessels may be permanently or periodically established in the interests of safe navigation. These exclusion zones or navigational restrictions would be established and posted in the "Practices and Procedures" by the Saint John Port Authority as per Section 56(1)(b) of the *Canada Marine Act*. Advance notice would continue to be made to fishers of tanker arrivals and departures as currently occurs.

3.4.2 Crude Oil and Finished Product Transfer

3.4.2.1 Crude Oil Transfer at the Existing SBM and the Jetty

The transfer of crude oil from tankers at the SBM is already well established. The additional vessels expected will not alter these procedures.

At the berth, loading arms would be connected to the vessel to facilitate the transfer of crude oil. The arms are designed to operate within a pre-determined range of motion and their position is continuously monitored by sensors. If the ship drifts too far from the dock, the sensors would engage the automatic shut-off valve built into the arm system and the transfer of crude or product stops.

3.4.2.2 Finished Product Transfer at Berths

Once at the berths, loading arms would be connected to the vessel to facilitate the transfer of finished products. The arms are designed to operate within a pre-determined range of motion and their position is continuously monitored by sensors. If the ship drifts too far from the dock, the sensors would engage the automatic shut-off valve built into the arm and the transfer of crude or product stops.

At the coke loading berths, conveyors would be used to transfer coke from the coke storage area to the barge. The conveyor system would be fully enclosed to minimize fugitive dust emissions.

3.4.3 Wastewater, Seawater, and Storm Water Release

Ultimately, wastewater, seawater and storm water will be released into the Bay of Fundy via a common outfall pipe located within Mispec Bay.

Wastewater that is not collected for recycling will be discharged via the outfall. Storm water will be collected for recycling, however, during extreme storms, excess storm water that cannot be recycled will be discharged along with the wastewater streams.

Seawater will be discharged via the common effluent pipe.

3.5 Decommissioning and Abandonment

The Project will be designed, built, and maintained to operate efficiently for at least its anticipated life span (minimum 30 years, but likely extended by refurbishment or maintenance). Eventually, the marine terminal will be decommissioned and abandoned. A Decommissioning and Abandonment Plan will be developed. The Plan will have a contingency to allow for shutdown at any time during the anticipated project life and will contain measures to achieve targeted environmental goals. At that time, all structures will be dismantled and removed from the site. Any hazardous materials will be collected and disposed of at a government approved hazardous material disposal site. Disturbed areas (shore landings) will be landscaped and re-vegetated. In the event of decommissioning, a more detailed plan will be developed in accordance with applicable regulations.

3.5.1 Removal of Facilities and Site Reclamation

The activities to be conducted during Decommissioning and Abandonment are likely to involve the removal of all physical structures and units, the disposal of wastes and transport to an appropriate disposal site, and the rehabilitation of the site to acceptable standards. It is possible that the Project-related facilities are used for other purposes or by other users, or plans for adaptive reuse of the facilities could be made. In such a case, the removal of facilities and site reclamation may be deferred until such time as the marine terminal no longer serves any useful purpose, either for the Project or other uses that might be determined for it. There may also be some environmental benefit to retaining some of the features of the Project even beyond decommissioning, *e.g.,* retain materials on the sea floor as they provide habitat for fish and other marine species from the artificial reef effect.

Once it has been determined that the facilities are no longer used for any purpose, the removal of facilities and site reclamation will be undertaken. The main activities associated with the removal of facilities and site reclamation are expected to include but are not limited to the following.

- All physical structures including the berths, jetties, trestle and related infrastructure will be removed from the site.
- All remaining materials, equipment and supplies will be removed from the site, including any remaining fuels and hazardous materials.
- The berths, trestle, and pilings/jackets will be removed. The pilings will be cut near the sea floor. If necessary, blasting will be used to remove the pilings.
- All structures and disassembled materials will be stacked in designated areas for removal.
- Reusable materials no longer required by the company at other sites will be offered for sale.
- All waste will be disposed in an approved manner.
- When a pipeline system is decommissioned (crude and product pipelines extending from the jetties to shore), all products will be removed from the system, and the piping removed. Any contamination will be removed and the site cleaned and restored.
- All hazardous wastes will be transported to approved waste storage or disposal sites. All disturbed areas will be rehabilitated and re-vegetated (where appropriate at shore landings). Re-vegetation will be accomplished with plants and trees that are common to the area.

Further specific details will be provided in the Decommissioning and Abandonment plan, once developed at the appropriate time during the life of the facility.

3.6 Emissions and Wastes

Emissions and wastes resulting from the Project as currently conceived at this early stage of conceptual engineering design of the Project are discussed in this Section.

As an important note for the remainder of this chapter and for other parts of the CSR (where appropriate), attempts have been made throughout this chapter to present emissions data, dispersion modelling results, and other numerical figures with an appropriate number of significant figures. Also, individual numbers have been rounded, and totals may therefore be slightly different from the sum of individual numbers.

Emissions and wastes discussed here are those originating from the Marine Terminal.

3.6.1 Air Contaminant, GHG, and Sound Emissions

3.6.1.1 Air Contaminant and GHG Emissions

Detailed air contaminant and GHG emissions inventories were developed for Construction and Operation (Jacques Whitford 2008b). Emissions to the atmosphere of air contaminants and sound will be released during Project activities. In the following sections, the Project-related emissions predicted to occur during Construction and Operation are described. Emissions from Decommissioning and Abandonment are not estimated, as this phase is expected to occur many years into the future. The development of these emissions inventories is presented in the following sub-sections.

Emissions Inventory Methodology and COPC/GHG List Development

Jacques Whitford (2008b) provides detailed information on the processes followed by the Study Team to develop the list of chemicals of potential concern (COPC) and the emissions inventory for the Project. In conjunction with establishing the specific sources of emissions for the Project, the specific COPC and GHG with the potential to be emitted in substantive quantities were identified. The term "substantive quantities" refers to the magnitude of emissions for each compound that, based on experience and professional judgment of the Study Team, has the potential to cause an adverse environmental effect (although not necessarily a significant one as defined by the significance criteria in Section 7.1). This list of COPC and GHG has been prepared on the basis of a comprehensive review of the available literature, as well as from information provided by the Proponent and comments from the public, stakeholders, and regulatory agencies. Existing knowledge of the Saint John region was used in creating this list, including the results of air quality monitoring within the airshed.

A detailed literature search was conducted. The review was focused on the following data sources:

- The National Pollutant Release Inventory (NPRI) (Environment Canada 2007a);
- The NBENV ambient air quality monitoring network in Saint John (NBENV 2008a);
- AP-42 emission factors from the United States Environmental Protection Agency (US EPA 2007a); and
- The United States Environmental Protection Agency WebFIRE database (US EPA 2005a), among other sources.

From this review, a preliminary COPC/GHG list was developed. The compounds on the COPC/GHG list were categorized as follows:

- Criteria Air Contaminants, or CAC (including SO_2, NO_2, CO, H_2S, PM, PM_{10}, $PM_{2.5}$, O_3, and NH_3);
- Greenhouse gases, or GHG (including CO_2, CH_4, and N_2O); and
- Non-Criteria Air Contaminants, or Non-CAC (PAH, BTEX, metals, and other individual chemicals not otherwise categorized).

Emissions of air contaminants and GHG can be estimated using several techniques including emission factors, mass balances, or using actual measurements such as those reported from source emissions testing of specific point sources of emissions (Jacques Whitford 2008b).

Construction Emissions

Air contaminant and GHG emissions during construction may occur due to the fuel combustion which is required to power the construction equipment. Construction emissions were estimated for the Development Proposal in its entirety as part of the Final EIA Report (Jacques Whitford Stantec Limited 2009a), including the refinery other land-based infrastructure as well as for the marine terminal.

The level of effort to build the facilities associated with the Project, relative to construction of the Development Proposal, is considerably smaller and consequently, the quantities of emissions are expected to be small. Since the work will occur over or near the water, fugitive dust emissions are expected to be negligible. The work will be temporary, short-term, and localized at the marine terminal. Thus, emissions during these construction activities associated with the Construction of the Project are not expected to be substantive and are not considered further in this EA.

Operation Emissions

The air contaminant and GHG emissions during Operation of the Project will be from marine vessel traffic and marine vessel loading activities. Each of these is described in the following sub-sections.

Marine Vessel Traffic Emissions

Exhaust emissions from marine vessel transportation activities were calculated by estimating the amount of fuel being combusted at the marine terminal and applying emission factors based on fuel type and engine load.

The traffic estimates for crude and product ships were adapted from design information provided by the Design Team based on anticipated daily crude and product volumes and ship capacities. Dock times for ships at the new marine terminal were assumed similar to those associated with the operation of the Canaport marine terminal. Hourly fuel consumption was estimated on the basis of data and experience at the existing Canaport marine terminal. Emission factors and engine load factors were estimated using the “Best Practices in Preparing Port Emission Inventories” document (ICF Consulting 2005).

Emissions are considered for three vessel categories including crude ships, product ships, and tugboats. Crude ship estimates were performed for the following sizes: Very Large Crude Carrier (VLCC) (315,000 dwt), and LRII (150,000 dwt). Product ships were categorized as two sizes: 37,000 dwt and 70,000 dwt.

For each ship type, the following parameters were used to calculate annual fuel consumption within the area near the marine terminal: Ship visits per year, manoeuvring time per visit, fuel consumption while manoeuvring, hours at dock per visit, fuel consumption while docked, tugboat hours per ship visit, and tugboat fuel consumption: After calculating annual fuel consumption for each ship, emission factors for No.6 fuel oil from “Best Practices in Preparing Port Emission Inventories” (ICF Consulting 2005), and US EPA – AP 42 section 1.3, “Fuel Oil Combustion” (US EPA 1998) were used to estimate the emissions of individual air contaminants and GHG. For benzo(a)pyrene, the emission factor was taken from the “Methodology for calculating emissions from ships: Update of emission factors” (SMED 2004).

For dispersion modelling purposes, hourly emission rates of CAC and GHG have been calculated for all vessel types while they are docked at the marine terminal. This was done because normalizing the annual emissions would not be representative for such a short averaging period due to the intermittent nature of the marine vessel traffic. For example, VLCCs are anticipated to visit the marine terminal only 26 times per year, or once every 2 weeks. Normalizing the annual emissions over every hour in the year would result in emissions substantially lower than those that actually occur while the marine vessel is present. The estimated hourly emission rates from each vessel type while they are docked at the marine terminal are presented in Table 3.2.

Table 3.2 Estimated Marine Vessel Combustion Emissions – CAC – Maximum Overall Hourly Emissions

Parameter	Emissions by Vessel Type (kg/h while docked)			
	VLCC (315,000 dwt crude)	LRII (150,000 dwt crude)	70,000 dwt product ship	37,000 dwt product ship
SO_2	128	59.3	10.8	10.6
NO_X	52.5	24.3	18.6	18.2
CO	19.7	9.09	1.42	1.39
PM_{10}	3.08	1.43	0.26	0.26
$PM_{2.5}$	2.47	1.14	0.21	0.21

The normalized hourly emissions associated with each type of vessel were estimated and are presented in Tables 3.3 to 3.7. The tugboat emissions associated with each vessel type are included in these estimates.

Table 3.3 Estimated Marine Vessel Combustion Emissions – CAC and GHG – Normalized Hourly Emissions

Parameter	CAC and GHG Emissions (kg/h) by Vessel Type			
	VLCC (315,000 dwt crude)	LRII (150,000 dwt crude)	70,000 dwt product ship	37,000 dwt product ship
Criteria Air Contaminants (CAC)				
SO_2	18.3	12.9	7.65	5.50
NO_x	9.00	7.94	17.7	12.8
CO	2.95	2.21	1.45	1.06
PM_{10}	0.52	0.452	0.444	0.322
$PM_{2.5}$	0.416	0.362	0.355	0.257
Greenhouse Gases (GHG)				
CO_2	1,980	1,440	948	686
CH_4	0.0794	0.0577	0.0379	0.0274
N_2O	0.0087	0.0063	0.0042	0.0030

Table 3.4 Estimated Marine Vessel Combustion Emissions – PAH – Normalized Hourly Emissions

Parameter	PAH Emissions (kg/h) by Vessel Type			
	VLCC (315,000 dwt crude)	LRII (150,000 dwt crude)	70,000 dwt product ship	37,000 dwt product ship
Acenaphthene	1.67E-06	1.22E-06	8.01E-07	5.79E-07
Acenaphthylene	2.01E-08	1.46E-08	9.60E-09	6.94E-09
Anthracene	9.68E-08	7.04E-08	4.63E-08	3.35E-08
Benzo(a)anthracene	3.18E-07	2.31E-07	1.52E-07	1.10E-07
Benzo(a)pyrene	2.87E-06	2.09E-06	1.37E-06	9.93E-07
Benzo(g,h,i)perylene	1.79E-07	1.30E-07	8.57E-08	6.20E-08
Benzo(b,k)fluoranthene	1.17E-07	8.54E-08	5.61E-08	4.06E-08
Chrysene	1.89E-07	1.37E-07	9.03E-08	6.53E-08
Dibenzo(a,h)anthracene	1.33E-07	9.63E-08	6.34E-08	4.58E-08
Fluoranthene	3.84E-07	2.79E-07	1.84E-07	1.33E-07

Table 3.4 Estimated Marine Vessel Combustion Emissions – PAH – Normalized Hourly Emissions

Parameter	PAH Emissions (kg/h) by Vessel Type			
	VLCC (315,000 dwt crude)	LRII (150,000 dwt crude)	70,000 dwt product ship	37,000 dwt product ship
Fluorene	3.55E-07	2.58E-07	1.70E-07	1.23E-07
Indo(1,2,3-cd)pyrene	1.70E-07	1.23E-07	8.12E-08	5.87E-08
Naphthalene	8.97E-05	6.52E-05	4.29E-05	3.10E-05
Phenanthrene	8.33E-07	6.06E-07	3.98E-07	2.88E-07
Pyrene	3.37E-07	2.45E-07	1.61E-07	1.17E-07

Table 3.5 Estimated Marine Vessel Combustion Emissions – BTEX – Normalized Hourly Emissions

Parameter	BTEX Emissions (kg/h) by Vessel Type			
	VLCC (315,000 dwt crude)	LRII (150,000 dwt crude)	70,000 dwt product ship	37,000 dwt product ship
Benzene	1.70E-05	1.23E-05	8.12E-06	5.87E-06
Toluene	4.92E-04	3.58E-04	2.35E-04	1.70E-04
Ethylbenzene	5.05E-06	3.67E-06	2.41E-06	1.75E-06
o-Xylene	8.65E-06	6.29E-06	4.14E-06	2.99E-06

Table 3.6 Estimated Marine Vessel Combustion Emissions – Metals – Normalized Hourly Emissions

Parameter	Metals Emissions (kg/h) by Vessel Type			
	VLCC (315,000 dwt crude)	LRII (150,000 dwt crude)	70,000 dwt product ship	37,000 dwt product ship
Antimony	4.17E-04	3.03E-04	1.99E-04	1.44E-04
Arsenic	1.05E-04	7.61E-05	5.01E-05	3.62E-05
Barium	2.04E-04	1.48E-04	9.75E-05	7.05E-05
Beryllium	2.21E-06	1.60E-06	1.05E-06	7.63E-07
Cadmium	3.16E-05	2.30E-05	1.51E-05	1.09E-05
Chromium	6.71E-05	4.87E-05	3.21E-05	2.32E-05
Chromium VI	1.97E-05	1.43E-05	9.41E-06	6.80E-06
Cobalt	4.78E-04	3.47E-04	2.28E-04	1.65E-04
Copper	1.40E-04	1.01E-04	6.68E-05	4.83E-05
Lead	1.20E-04	8.71E-05	5.73E-05	4.14E-05
Manganese	2.38E-04	1.73E-04	1.14E-04	8.23E-05
Mercury	8.97E-06	6.52E-06	4.29E-06	3.10E-06
Molybdenum	6.25E-05	4.54E-05	2.99E-05	2.16E-05
Nickel	6.71E-03	4.87E-03	3.21E-03	2.32E-03
Selenium	5.42E-05	3.94E-05	2.59E-05	1.87E-05
Vanadium	2.52E-03	1.83E-03	1.21E-03	8.73E-04
Zinc	2.31E-03	1.68E-03	1.10E-03	7.98E-04

Table 3.7 Estimated Marine Vessel Combustion Emissions – Selected Individual Chemicals – Normalized Hourly Emissions

Parameter	Individual Chemicals Emissions (kg/h) by Vessel Type			
	VLCC (315,000 dwt crude)	LRII (150,000 dwt crude)	70,000 dwt product ship	37,000 dwt product ship
Formaldehyde	2.62E-03	1.90E-03	1.25E-03	9.05E-04
1,1,1-Trichloroethane	1.87E-05	1.36E-05	8.95E-06	6.48E-06
OCDD	2.46E-10	1.79E-10	1.18E-10	8.51E-11

Marine Vessel Loading Emissions

Emissions of VOC due to displaced organic vapours from the loading of finished products into marine vessel tanks were estimated using daily production volumes, emission factors based on the volume of product transferred, and an assumed emission control efficiency due to the use of a vapour recovery unit (VRU) on land (assessed as part of the refinery in the Final EIA Report, Jacques Whitford Stantec Limited 2009a). All marine loading emission factors were taken from AP 42 section 5.2 "Transportation and Marketing of Petroleum Liquids" (US EPA 1995b). The emissions of VOC were speciated according to the CPPI Code of Practice using the profile for refinery terminals (CPPI 2007). The products considered were gasoline, ultra-low sulphur kerosene, Eurodiesel, and ultra-low sulphur diesel (ULSD). The emission factor used for gasoline was based on that presented in the reference document for typical operation (CPPI 2007). The kerosene emission factor was based on jet kerosene. The emission factor for Distillate Oil No. 2 was used for both diesel products (Eurodiesel and ULSD). The control efficiency of the VRU was conservatively estimated to be 90%. The VRU control efficiency has been applied to gasoline transfers only as the most volatile component, since all other products are considerably less volatile and are not expected to contribute substantively to the overall emissions.

The resulting estimated normalized hourly emissions of VOC from marine loading activities are presented in Tables 3.8 and 3.9.

Table 3.8 Estimated Marine Vessel Loading Emissions – Total VOC – Normalized Hourly Emissions

Product	Emissions of VOC (kg/h) from Marine Vessel Loading
Gasoline	18.8
Jet Kerosene	0.16
EuroDiesel	0.74
Ultra-low sulphur diesel	0.24
Total	20.0

Table 3.9 Estimated Marine Vessel Loading Emissions – Speciated VOC – Normalized Hourly Emissions

Contaminant	Emission Rate of Individual VOC (kg/h) from Marine Vessel Loading
Benzene	0.235
Butane (mixed isomers)	7.16
Butene (mixed isomers)	0.654
Chlorobenzene	0.002
Cycloheptane (mixed isomers)	0.068
Decane	0.008

Table 3.9 Estimated Marine Vessel Loading Emissions – Speciated VOC – Normalized Hourly Emissions

Contaminant	Emission Rate of Individual VOC (kg/h) from Marine Vessel Loading
Heptane (mixed isomers)	0.890
Hexane (mixed isomers excluding n-hexane)	1.56
Hexene	0.269
N-hexane	0.369
Nonane (mixed isomers)	0.046
Octane (mixed isomers)	0.293
Pentane (mixed isomers)	5.68
Pentene (mixed isomers)	0.642
Propane	0.235
Toluene	0.269
Trimethylbenzene (mixed isomers, excluding 1,2,4)	0.014
1,2,4-trimethylbenzene	0.016
Xylene (mixed isomers)	0.128

Overall Summary – Total Emissions During Operation

An overall summary of the total predicted annual emissions for the Operation phase of the Project has been prepared for selected air contaminants of concern as well as for GHG. The annual totals are presented below in Table 3.10.

Table 3.10 Overall Summary – Total Emissions of CAC, Total VOC, and GHG During Operation of the Project

Contaminant	Emissions from Marine Terminal and Other Marine-Based Infrastructure During Operation (t/a)
Criteria Air Contaminants (CAC)	
Sulphur dioxide (SO_2)	389
Nitrogen oxides (NO_x)	415
Carbon monoxide (CO)	67
Hydrogen sulphide (H_2S)	NQ
PM	15
PM_{10}	15
$PM_{2.5}$	12
Ammonia (NH_3)	NQ
Volatile Organic Compounds (VOC)	
Total VOC	163
Greenhouse Gases (GHG)	
Carbon dioxide (CO_2)	44,000
Methane (CH_4)	2
Nitrous oxide (N_2O)	0.2
CO_2-equivalent	44,000

Notes:
NQ = not quantified because this COPC is not expected to be emitted from the specific source.

3.6.1.2 Sound Emissions

The anticipated sound emissions from Project-related activities during Construction and Operation of the Project are discussed in this Section. Sound emissions from Decommissioning and Abandonment are not discussed in any substantive detail, as Decommissioning is not currently envisioned and would require a separate assessment to be conducted several decades into the future towards the end of the useful life of the Project. In general, sound emissions during Decommissioning and Abandonment would likely be very similar to those that will occur during Construction, due to similar activities being conducted.

As was discussed previously, initial forecasts for the Project were made at the onset of Project design, whereby construction activities were anticipated to be conducted over 4-5 years, beginning no earlier than 2010 and peaking in 2013 to 2014. With the phasing of the pace and sequence of Construction activities over a 6-8 year period, the annual average and peak construction activity would be less than the initial forecasts. However, to be conservative, the discussion that follows is based on the original Construction forecasts over a 4-5 year period and do not account for phasing of the Construction period. The sound emissions estimated under the compressed schedule considered in the analysis below, remain a conservative estimate of the total sound emissions from Construction. This is to ensure that a conservative approach is taken for the environmental effects assessment, such that the outer envelope of potential emissions would be assessed.

Construction

During Construction, sound emissions will be generated from site preparation work (*e.g.*, blasting) as well as physical construction and equipment installation (*e.g.*, pile driving). Vehicle and heavy truck traffic will also generate sound emissions during movements to and from the site. As with air contaminant and GHG emissions, sound emissions during Construction were estimated for the Development Proposal as a whole.

The sound emissions associated with the Construction of Project facilities, relative to construction of the Development Proposal, are considerably smaller and consequently, the extent of sound emissions are expected to be small. The work will be temporary and short-term. Thus, sound emissions during these construction activities associated with the Construction of the Project are not expected to be substantive and are not considered further in this EA.

Operation

Sound emissions will be generated during Operation from the operation of pumps and crude ships docked at the Marine Terminal.

The sound power levels associated with Operation are presented in Table 3.11.

Table 3.11 Estimated Sound Power Levels from Selected Equipment During Operation

Operation Equipment	# of Units	Sound Power Level, L_w (dB_A)
Pumps – Crude Oil Transferring	2	85
Pump – Crude Oil Unloading	1	85
Pump – Product Transferring	1	85
Pumps – Product Loading	2	85
Product Ship at Marine Terminal	1	85
Crude Ship at Marine Terminal	2	85
Pump – Seawater Intake Structure	1	85

Reference: Europa (2001), HGC Engineering (2007), US Department of Transportation (2006)

The Proponent is committed to managing all substantive sources of sound emissions associated with Operation. Mitigation will be employed wherever possible to minimize adverse environmental effects to Sound Quality.

For further detail on sound emissions modelling during Construction and Operation, the reader is referred to the Final EIA Report (Jacques Whitford Stantec Limited 2009a).

3.6.2 Wastewater

3.6.2.1 Process Wastewater

The total estimated combined volume of effluent released by the Development Proposal will be approximately 25.6 m^3/s (405,600 USgal/min). Of this, treated wastewater from the wastewater treatment plant associated with the Development Proposal will account for approximately 0.36 m^3/s (5,600 USgal/min), with the remainder consisting of warmed seawater from the once-through cooling water system. Wastewater generated during Operation of the Development Proposal will primarily consist of process water, boiler blowdown, cooling seawater, site run-off, and domestic wastewater. Sources of wastewater expected as a result of the refinery operation and their associated estimated volumes are provided in Table 3.12.

Table 3.12 Estimated Wastewater Volumes During Operation

Source	Estimated Flow (m^3/s)	Estimated Flow (USgal/min)
Treated Process Wastewater		
Desalter Effluent	0.023	365
Sour Water	0.108	1,710
Spent Caustic	0.000	2
Tank Farm	0.002	26
Raw Water Treatment Waste	0.000	0
Boiler Blowdown	0.001	12
Steam Generator Blowdown	0.007	119
Rain Water (Process Units)	0.081	1,290
Ballast Water	0.000	0
Tank Field Water	0.028	445
Flare Seal Water	0.000	5
Contingency	0.044	700
Total Treated Wastewater (A)	0.294	4,670
Other Process Wastewater		
Demin Waste	0.001	15
RO Reject	0.031	496
Ultra Filtration Rejects	0.014	220
Miscellaneous	0.013	200
Total Other Process Water (B)	0.058	931
Total Wastewater Release (A + B)	0.353	5,600
Seawater Cooling		
Seawater Cooling Discharge (C)	25.2	400,000
Total Seawater and Wastewater Released to Bay of Fundy via Outfall (A + B + C)	25.6	405,600

Following treatment, wastewater will be sampled prior to release into the common outfall. Treated wastewater quality will meet the federal and provincial water quality discharge standards that are expected to be defined as part of the provincial Approval to Operate under the *Water Quality Regulation – Clean Environment Act*. The wastewater will meet the requirements of the federal *Petroleum Refinery Liquid Effluent Regulations* as well as the requirements of the federal *Fisheries Act*.

3.6.3 Wastes

3.6.3.1 Solid Waste

Solid waste generated by Construction activities is expected to consist of general construction wastes (*e.g.,* steel, wood, off-spec concrete), office waste, and overburden and aggregate. These materials will be reused for construction wherever possible, or recycled or disposed (as appropriate) at approved facilities.

Scrap material will be sorted by category. Metallic scrap will be sorted by metallurgy (*e.g.,* carbon steel, alloy steel, and stainless steel) so that it is saleable for recycling.

Packing material (*e.g.,* wood, plastic, and cardboard) will be segregated. These materials that can be disposed of at a Construction and Demolition (C&D) debris disposal facility will be disposed in this manner, and those that cannot be will be sent to an appropriate recycling or disposal facility. Any materials that can be re-used during Construction, including wood, will be saved.

Contaminated containers (*e.g.,* paint drums, adhesive tubs, and like items) will be segregated according to their contents in designated containers for controlled disposal at licensed disposal facilities.

Recyclable material that cannot be sent to a C&D site will be destined to facilities that are approved to receive each type of material for recycling or disposal as feasible or appropriate. All applicable guidelines and regulations will be followed, and best practices will be implemented, as will be detailed in the Environmental Protection Plan for Construction.

3.6.3.2 Seabed Dredging Materials

Dredging of the seabed to complete the construction of the jetty, if necessary, will require disposal of the dredged materials. The seabed materials in the approximate location of the jetty were characterized for physical and chemical properties to assess sediment quality. Surface sediment samples were collected in December 2006 and in March-April 2007 at seven stations in Area A of the Marine PDA (Figure 10.2). Laboratory analyses on sediment samples included total organic carbon (TOC), polycyclic aromatic hydrocarbons (PAH), petroleum hydrocarbons including fuel range and lube range hydrocarbons, total polychlorinated biphenyls (PCBs), volatile organic compounds (VOC), formaldehyde and acetaldehyde, acid extractables, total dioxins and furans, trace metals, and particle grain size. Analytical results were compared to the CCME *Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, Marine Sediment, 1999*, updated in 2002, and the *CEPA* disposal at sea sediment screening criteria. Additional information and results of the sediment sampling program are provided in Section 10.2.4.2 of the CSR.

The surficial material to be dredged can be characterized as mostly sandy silts to clayey silts that are poorly sorted and with a relatively low organic content ranging from < 0.1 % to 2.5 % (Table 10.8). Most of the chemical parameters analyzed (Table 10.9) were below the limits set by the CCME and the *CEPA Disposal at Sea Regulations*, except for three stations S12, S13 and S14A (Figure 10.2) located near the Black Point ocean disposal site. The *CEPA Disposal at Sea* screening criteria for total PAH were exceeded at stations S12 and S13, and total PCB levels were above the *CEPA* limit at station S13. It should be noted, however, that sediment at station S13 is at the outset of the footprint of the jetty and not likely to be dredged. Analytical results of sediment samples from other locations within the approximate footprint of the jetty and the overall Marine PDA reveal relatively unaffected sediment, either as not detected or below guideline values for all chemical parameters tested. It can be therefore concluded that any material to be dredged, and if disposed locally by side casting, is not contaminated and well below Environment Canada screening level concentrations. This will also be confirmed when a detailed sediment sampling plan is prepared and submitted to Environment Canada and additional sediment sampling and waste audit is conducted to support the application of a Disposal at Sea Permit, once the final design and footprint of the jetty are known.

The waste from dredging and disposal will occur as a one-time and single event for the lifetime of the jetty. The options to minimize environmental effects of dredging and disposal will be further explored, where economically and technically feasible. The currently estimated range of possible dredging volumes from approximately 59,409 m^3 to 250,541 m^3 may not be necessary, and it is possible that less will be required.

A waste management plan for any dredged material is not necessary because there are no sources of contamination or point and non-point sources of pollution in the footprint area of the jetty if construction in close proximity to the Black Point ocean disposal site is avoided for the footprint of the jetty, as currently proposed. Combined with the preferred option for adjacent on-site side casting of this material, disposal management techniques would not be required at controlled sea or land disposal sites. The disposal material is composed of “clean” mud and may have little potential for re-use or value, unlike sand that could be used as beach fill or construction material. Therefore, there may be little advantage to re-use or recycle off-site the disposal material, and side casting and on-site marine disposal may be the selected and preferred option. Alternative disposal options at land disposal sites would provide higher risks to human health or the environment or disproportionate costs (depending on disposal location and associated transportation costs), and thus favouring the more feasible options for controlled ocean disposal or on-site disposal of dredged material via side casting. Further characterization of the dredged material and the assessment of beneficial uses will be conducted during the permitting stage, and preferred options for re-use or disposal of the material will be identified during permitting, in consultation with Environment Canada.

Further details on the characteristics of the existing environment, including sediment quality at various sampling stations in Mispec Bay, as well as estimates of materials to be dredged for each construction option being considered are provided in Chapter 10.

3.6.3.3 Sanitary Waste

During Construction, sanitary wastes from amenities provided for staff will be directed to septic tanks or portable toilets at various locations on-site. These tanks and portable facilities will be serviced by vacuum tankers and their contents disposed of by the supply contractor at the Saint John sewage treatment works or similar facilities.

During Operation, an on-site treatment system will be designed for the expected number of workers. Alternatively, sanitary wastes could be directed to existing nearby facilities or to the municipal system, if feasible.

3.6.3.4 Office Waste

Office waste consists primarily of paper, cardboard, and spent copier and printer cartridges. These will be segregated into designated recycle bins for storage until collected by recycling companies for delivery to recycling facilities.

3.6.3.5 Maintenance Waste

Routine maintenance will be carried out in designated areas of the site. Only emergency maintenance will be allowed at machine work locations or operational areas of the site. All waste oils, mechanical fluids, and oily rags will be disposed of in properly labelled storage containers and drums on-site until picked up by licensed contractors for disposal.

3.6.3.6 Hazardous Waste

A variety of other fuels and potentially hazardous materials could be used during the Project. Gasoline, diesel fuel, propane, grease, motor oil, and hydraulic fluids are needed for heavy equipment.

Other potentially hazardous materials that could be used routinely include acetylene, oxygen and other compressed gases, paints, epoxies, cleaners and solvents, and glycol/methanol. All hazardous materials would be inventoried and monitored and the inventory would be developed and updated as the Project proceeds. Site inspections, good housekeeping, and maintenance of equipment and systems would be an integral part of environmental protection. Further, such practices are important in reducing the potential for leaks or spills of dangerous goods. All waste materials generated would be tracked through a waste management program as part of the facility's Environmental Management System.

4.0 CONSULTATION AND ENGAGEMENT

Public, stakeholder and First Nations participation and engagement is the cornerstone of any successful environmental assessment of a project. Not only is public, stakeholder and Aboriginal engagement required as part of EA legislation, an open and transparent public engagement program, undertaken as part of the EA of a project, contributes to building positive community relations, and generally assists in the development of an acceptable project.

Both federal and provincial EA/EIA guidelines recommend that potentially affected public, First Nations, and other stakeholders be given an opportunity to provide comment and raise any concerns they may have about a project. In addition, the proponent is normally required to incorporate the relevant feedback received from such stakeholders into the CSR for a project, and demonstrate how it has considered or addressed (or how it intends to consider or address), as appropriate, the issues raised by the public into the CSR and subsequent development plans for the project.

4.1 Consultation and Engagement Conducted by Responsible Authorities

4.1.1 Public Participation

Public participation in a comprehensive study is mandatory under *CEAA*. The comprehensive study process prescribes three distinct opportunities for the public to participate in the EA: during scoping; when conducting the comprehensive study; and during the comment period coordinated by the Agency upon completion of the CSR.

As required by *CEAA*, the Eider Rock EA is listed on the Canadian Environmental Assessment Registry (CEAR) Internet Site (CEAR reference number 07-03-28779). Key EA documents are available on the Internet site. In addition, *CEAA* requires the maintenance of a CEAR Project File. The Eider Rock Project File is held by DFO, on behalf of the three RAs, and contains all records produced, collected or submitted with respect to the environmental assessment, including: all records included in the Internet site; any report relating to the assessment; any comments filed by the public in relation to the assessment; and any records related to follow-up or mitigation. The Project File is available to the public upon request; a contact is provided on the Internet site.

To facilitate and encourage public participation in the Eider Rock EA, the Government of Canada also made available $60,000 under its Participant Funding Program, which is administered by the CEA Agency.

4.1.1.1 Scoping

As required by Section 21(1) of *CEAA*, the RAs invited written public comments on the draft Scoping document, and the ability of the comprehensive study to address issues relating to the Project, from May 23 to June 30, 2007. A public notice was placed in provincial and community newspapers, as well as on the CEAR Internet site, explaining the process and providing details of how the public could submit comments. Copies of the draft Scoping document were available from DFO, as well as at various viewing locations in the Project area. A copy of the notice is available on the CEAR Internet site.

Concurrent with the release of the draft Scoping document, and contained in the same notice, the CEA Agency announced the availability of $60,000, under its Participant Funding Program, to assist groups and/or individuals to take part in the environmental assessment of the Project, along with instructions on how to apply for funding. Details of the participant funding allocation are described in the Participant Funding Program Review Committee's Report, which is available on the CEAR Internet site. The funding recipients were the Fundy North Fishermen's Association, the Conservation Council of New Brunswick, and the Sierra Club of Canada.

In response to the public notice, approximately sixty submissions were received, originating from local residents, residents of other parts of Canada, individuals living outside of Canada, and interested organizations. The majority of the comments dealt with the proposed scope of the project to be assessed; specifically, that the scope be enlarged to encompass not only the marine terminal but the refinery itself as well as shipping activity.

In addition to commenting on the proposed scope of project, submissions also discussed factors, and the scope of those factors, which should be included in an EA. The following factors were identified by members of the public as of specific concern to them:

- Air quality, including trans-boundary issues;
- Greenhouse gases;
- Fish and fish habitat;
- Mammals and birds;
- Water quality;
- Health and socio-economic issues;
- Accidents/malfunctions; and
- Cumulative environmental effects.

After receiving comments, the RAs revisited the rationale supporting the proposed scope of project and factors for assessment as identified in the Scoping document. The triggers for the federal EA are all directly related to Project components and activities to be conducted in the marine environment. As well, the triggers for all three RAs are associated with permits of a very specific nature and scoping under these circumstances is guided by the "Cabinet Directive on Implementing the *Canadian Environmental Assessment Act*" (CEA Agency 2005). Based on information provided in the Project description, the RAs increased the scope of project to include in-water physical structures, constructed on either a temporary or permanent basis, in the marine environment, and any navigational dredging that may be required. As well, the RAs clarified that the inclusion of the existing monobuoy within the scope of project is only in the context to any proposed modifications to the structure, not to the existing use of the structure.

All submissions were analyzed and responded to by the RAs prior to finalizing the Scoping document. Relevant issues, included the majority of the factors identified by the public, are addressed in this CSR for marine terminal portion of the Development Proposal. A more complete analysis of the submissions, as well as the government's responses, is contained in the document entitled Environmental Assessment Track Report, which has been posted on the CEAR Internet site and is contained in Appendix D.

4.1.1.2 Public Participation in the Comprehensive Study

Section 21.2 of *CEAA* requires the RAs to ensure that the public is provided with an opportunity, in addition to the opportunity to comment on the scope and on the final CSR, to participate in the comprehensive study.

As previously noted, the Development Proposal is also subject to a provincial comprehensive environmental impact assessment (EIA) under the New Brunswick *Environmental Impact Assessment Regulation - Clean Environment Act*. After considering input from the public and a technical review committee, EIA guidelines were finalized by New Brunswick Department of Environment on July 5, 2007. Based on the EIA guidelines, the Proponent was required to produce Terms of Reference, which describe in greater detail the approach to be used in the EIA. The public was provided with an opportunity to review the Terms of Reference, as part of the provincial EIA process.

The RAs chose to delegate the Section 21.2 requirement to the Proponent, and base it on the Terms of Reference, thereby also integrating it with the provincial process. The Proponent conducted a public review of the Terms of Reference for the EIA, which included an open house, a technical workshop and making the Terms of Reference available on its website for public comment. Members of the public who made submissions during the draft scoping phase were notified, and a notice was placed on CEAR Internet site. In addition, the Proponent prepared written responses to all comments received; those responses were provided to the RAs for review prior to incorporating them. Further details of the Proponent's public consultation activities, including a summary of the issues identified, are provided in Section 4.2 below. Since the Terms of Reference were ultimately used to prepare the EIA Report, which in turn was the basis for the CSR, all public comments received were thus considered in the EA and in the preparation of the CSR.

4.1.1.3 Review of Completed CSR

In accordance with Section 22 of *CEAA*, the public will have its final opportunity to comment after the completed CSR is submitted to the CEA Agency and the federal Minister of the Environment. At that time, the CEA Agency will invite public comment on the report, its conclusions, recommendations, or any other aspect. The Minister will consider the CSR and any public comments filed during this stage of the review before releasing an EA decision. The EA decision will include a statement setting out the Minister's opinion as to whether, taking into account the implementation of any mitigation measures that the Minister considers appropriate, the Project is or is not likely to cause significant adverse environmental effects; and setting out any mitigation measures or follow-up program that the Minister considers appropriate.

4.1.2 First Nations Engagement

Consultation is legally required if the Crown has real or constructive knowledge of the potential existence of Aboriginal or treaty rights and contemplates conduct that might adversely affect such rights. The Government of Canada's policy and procedures with respect to this obligation are set forth in its publication entitled "Aboriginal Consultation and Accommodation - Interim Guidelines for Federal Officials to Fulfill the Legal Duty to Consult" (INAC 2009). The interim guidelines formed the basis for the Government's actions in the evaluation of the existence of asserted rights, current traditional use, and the strength of any claim in relation to the Project.

In general, as a collective, the Mi'kmaq and Maliseet communities of New Brunswick have made blanket assertions of Aboriginal and treaty rights to the Province. In addition, Project-specific assertions were made by the St. Mary's First Nation. Because there is a blanket assertion of Aboriginal rights to New Brunswick and the possibility that First Nations and off-reserve Aboriginal peoples could be using or have used the area for traditional purposes, it was decided to include all communities in pre-consultation by the Crown. Therefore, the Government of Canada contacted all fifteen First Nation communities in New Brunswick, as well as key umbrella organizations such as the Union of New Brunswick Indians (UNBI) and the MAWIW Council, to solicit their specific concerns (if any) with the Eider Rock project.

In addition to the Crown's broader obligations, *CEAA* requires that all federal EAs consider the effect of any change in the environment caused by the Project, as well the effect of that change on current use of land and resources for traditional purposes by Aboriginal persons. The Act also requires consideration of the effect of any Project-induced change in the environment on physical and cultural heritage, as well as any structure, site or thing that is of historical or archaeological significance, such as sites historically occupied by Aboriginal persons.

Accordingly, the federal government directed the Proponent to conduct a Current Use Study to determine the nature and extent of current Aboriginal use of land or resources for traditional purposes in the Project area (if any). The Proponent also carried out a study of heritage and archaeological resources as part of the provincial EIA process. These were instrumental in providing a factual basis for assessing the potential for the Project to cause adverse environmental effects in those realms.

In addition to the studies, multiple opportunities were afforded to all communities to enter into discussion and bring forward specific issues of concern. In May 2007, very early in the process, the RAs directed the Proponent to contact the fifteen First Nation communities in New Brunswick to inform them of the Project and to offer a presentation or further discussion as may be desired by their leadership. The CEA Agency, on behalf of the Government of Canada, also wrote to all fifteen First Nation communities and umbrella organizations in June 2007 to invite them to comment on the proposed scope of the environmental assessment, and to apply for Participant Funding. No comments or applications were received by First Nations communities or umbrella organizations.

In November 2007, the Government notified all communities and organizations of the Minister's decision that the federal EA would continue as a comprehensive study. Then, on July 22, 2008, the Government again wrote to all parties to invite them to meet and discuss the Project.

Over the course of carrying out the EA, the Government met with the UNBI and/or their Natural Resources Committee on four occasions (February 21, 2008; April 24, 2008; January 14, 2009; and March 17, 2009), as well as with the MAWIW Council on January 14, 2009. Several offers to meet, both in writing and by telephone, were made to the St. Mary's First Nation, which had asserted Project-specific impacts on their fishing rights; however, no meeting was requested by that community.

During the course of these events (primarily during the UNBI meetings), a number of issues were identified. These are not specific to the Project; rather, they relate to the manner in which the Government carries out its Aboriginal engagement and consultation duties, and the resources/capacity provided by the Government to enable or improve the quality of Aboriginal input. These were enumerated and responded to in detail in correspondence to the UNBI dated June 25, 2009.

In light of the outcome of the studies that were conducted, and discussions held, the Government of Canada is satisfied that the Project is unlikely to adversely affect established or potential Aboriginal and treaty rights under Section 35 of the *Constitution Act, 1982*. A letter to that effect was transmitted to the leadership of the fifteen First Nation communities on July 23, 2009, but also offering one more opportunity to bring forward any issues which had not previously been identified. The letter also indicated that all First Nations would be directly notified when the final CSR was available for comment. To this date, no further issues have been identified.

4.2 Consultation and Engagement Conducted by the Proponent

The Proponent has engaged the public and the community-at-large in open, meaningful and responsive public involvement opportunities to understand and address any concerns that may arise. Accordingly, several methods of information sharing and gathering will be employed to facilitate this process. Given the numerous and varied methods to be used, it is expected that all those concerned or potentially affected by the Development Proposal have been given opportunity to become involved.

The public has been notified of the Development Proposal through various media, which may include the issuance of news releases, public service announcements (PSAs), information brochures, print advertisements, electronic media (*e.g.,* website), and open public fora. In addition, issue-specific meetings and/or workshops have been held with the public or selected stakeholders to ensure they are aware of, and have the opportunity to share their views on, specific environmental issues of concern (such as air quality or human health risks).

An overview of the public engagement activities conducted by the Proponent as part of the CSR has been provided below.

To achieve its consultation and engagement goals, the Proponent was and continues to be committed to a public and stakeholder consultation and First Nations engagement program based on open, forthright and responsive communication with the public, regulatory agencies, First Nations, and other stakeholders.

4.2.1 Proponent-Led Consultation and Engagement Tools

A website dedicated to Project Eider Rock, http://www.irvingoil.com/company/erock.asp, was established by the Proponent following the registration of the Development Proposal with regulatory authorities. The website carries the most recent, up-to-date information concerning the Project. Visitors can access among other resources, media releases made to date, information about the Project, a copy of the EIA Registration Document/Project Description, Final Terms of Reference and, baseline technical studies conducted in support of the Development Proposal and contact information. This site is updated as new information becomes available.

A Toll-Free Information Line, 1-888-525-1777, has been set-up to receive public comments. A direct mailing address and Project-specific email address have also been available since the Project was announced. The phone number and email address is made available on all Project-related information materials.

The flow of information from the Proponent to the public will continue through face-to-face conversations, telephone conversations, media releases, print advertisements, information brochures, and website announcements and postings. When important Project developments come to light, the public will receive notification and additional information as required. Lines of communication, including the toll-free information line and email address, will remain open to receive comments, questions and concerns. When warranted, responses will be issued efficiently.

4.2.1.1 Open Houses and Workshops

Three informational open houses have been held to date to share information about the Project with the public at various stages of the CSR. All open houses were held at the Saint John campus of the New Brunswick Community College (NBCC) located on Grandview Avenue, and followed the same general format. Booths, consisting of informational poster boards and handouts, were staffed by members of the Project Team having expertise in the topic.

- Open House #1 – February 2007: The first open house focused on the EIA Registration/Project Description, which had been recently submitted to regulatory agencies. Project Team members were available to answer questions from the more than 400 members of the public in attendance.
- Open House #2 – December 2007: The second open house focused on providing information to the public regarding the draft Terms of Reference for the Development Proposal. Technical experts and Team Leaders from the Study Team were present at the event to answer questions relating to the proposed work plans, from approximately 150 people in attendance.
- Open House #3 – November 2008: The third open house focused on presenting the results of baseline Technical Studies, sharing the more details on the proposed locations of the Development Proposal-related facilities, and to obtain input from the public on the potential corridors for the linear facilities for the Development Proposal. In addition to baseline Technical Studies, the Proponent presented updated Project information, including an updated Project schedule (Phased Approach) and visual representations of the Project's facilities from various viewpoints. Approximately 200 members of the public attended the event. Several of the baseline technical studies were subsequently released to the public on the Eider Rock website.

In addition to these open houses, two technical workshops were held, as follows.

- Air Quality and Human Health and Ecological Risk Assessment Workshop: Selected stakeholders with a particular technical interest in air quality issues, human health issues, or the air quality and HHERA studies to be conducted in support of the Development Proposal were invited to the Air Quality and Human Health and Ecological Risk Assessment (HHERA) workshop in May 2007. A total of 13 key stakeholder groups attended the workshop. Jacques Whitford experts were present to present technical information and work plans for the Air Quality and HHERA studies to the stakeholders present, to obtain feedback from stakeholders on these work plans, and to assist stakeholders in understanding the results of the study once they are available.
- Terms of Reference Workshop: A workshop was held in January 2008 in Saint John to discuss the Terms of Reference for the EIA/EA. The Workshop was led by Jacques Whitford with participation from the Proponent and government representatives. Study team leaders and experts presented their work plans and answered questions from those in attendance. The workshop was open to the public by registration. Approximately 50 individuals and/or groups were represented at the workshop. All questions and concerns raised in respect of the technical workplans and methodologies that were proposed to carry out the EIA/EA were documented and subsequently responded to in a standalone report. The Terms of Reference were subsequently finalized and accepted by governments for carrying out the EIA/EA.

4.2.2 Key Stakeholder Engagement

Meetings have been held with a wide variety of stakeholders and community members concerning the Project. The goal of these meetings, was to share information about the Project and to collect comments, questions and concerns from those in attendance.

Meetings with stakeholders were conducted for the purpose of gathering information on existing conditions with respect to various VECs to be assessed in the EA. These included, but were not limited to, interviews and meetings with:

- Public health and social services organizations (including several NGOs), to gather information on existing emergency, health, education, and outreach programs;
- Commercial fishermen, including the Fundy North Fishermens' Association (FNFA) and several Mispec-based fishermen, to obtain information about existing commercial fisheries conditions and potential concerns;
- Regulatory agencies and transportation agencies (*e.g.,* Transport Canada, Saint John Port Authority), to assess existing conditions on local capacities of the port facilities, and to obtain information on existing vessel traffic to the Port; and
- Discussions with marine mammal stakeholders regarding potential environmental effects on whales and other marine mammals.

Where relevant, the issues and concerns identified by each of these groups are reported in Chapters 7 to 14 inclusive. It should be noted that attempts were also made to engage other environmental stakeholders such as the Conservation Council of New Brunswick and the World Wildlife Fund, but they declined such requests for meetings.

4.2.3 Key Issues Raised by the Public and Key Stakeholders

The majority of concerns recorded from attendees of the open houses and workshops can be categorized as representing the following general categories: environmental concerns, potential environmental effects on adjacent or nearby properties, and general residual concerns regarding development in general and specifically with past projects in the region (Jacques Whitford 2007b). The main environmental concerns included the effects of the Development Proposal on local air quality, including concerns over potential health risks, and unpleasant odours; excessive light and noise associated with the Project. All comments received during the first and second open houses were considered, and when necessary, the proposed scope of the EA and/or the Terms of Reference were amended. Light emissions, as an example, were of concern to several members of the public.

The attendees of the third open house were largely interested in the new information on the Project being provided, particularly the specific location of Project facilities and the visual representations of the Project. General interest in the baseline technical studies presented was expressed, and a strong desire was expressed by some members for more information being made available in the near future (in particular, the EA report itself).

Overall, a summary of key issues and concerns raised by the public during the open houses is provided in Table 4.1.

Table 4.1 Summary of Key Issues and Concerns Raised by the Public During Open Houses

Valued Environmental Component (VEC)	Key Issues and Concerns Raised by the Public During Open Houses
Atmospheric Environment	▪ How will air quality be affected? ▪ Will there be a smell? ▪ What will the carbon dioxide emissions be? ▪ How will the new refinery contribute to climate change? ▪ How much noise will the new refinery make, and from how far away will it be heard? ▪ How much light will be created by the new refinery?
Public Health	▪ Will the new refinery contribute to poor health in the area? ▪ Will increased marine tanker traffic pose a safety risk? ▪ How will security concerns be addressed? ▪ Will the new facilities pose a threat due to terrorism?
Coastal Wetland Environment	▪ What compensation will there be for loss of wetlands?
Marine Environment	▪ Will the Project pose an increased risk to Right Whales in the Bay of Fundy? ▪ Will the increased tanker traffic pose a risk to marine mammals? ▪ What size of marine tankers will be used? ▪ What the marine terminal facility look like? ▪ By how much will the tanker traffic increase? Can the Saint John Harbour accommodate the increase?
Commercial Fisheries	▪ What implications might the Project have on fishermen fishing out of Mispec?
Heritage and Archaeological Resources	▪ How will the study of archaeology resources be conducted?
Effects of the Environment on the Project	▪ Is the possibility of an earthquake assessed?

4.2.4 First Nations Engagement

The Proponent, assisted by Jacques Whitford and Aboriginal Resource Consultants (ARC, a New Brunswick Aboriginal firm specializing in Aboriginal relations), initiated a thorough Aboriginal engagement program with the Mi'kmaq and Maliseet communities of New Brunswick. Engagement included the Aboriginal umbrella organizations that represent these communities (Union of New Brunswick Indians and MAWIW Council) as well as the New Brunswick Aboriginal Peoples' Council and representatives of the Passamaquoddy people in New Brunswick.

Its objectives were to:

- Share information about the Project;
- Establish how Aboriginal leadership wished to have the Proponent engage their respective communities;
- Gather information on the current use of land and resources for traditional purposes by Aboriginal persons in the vicinity of the Project as it relates to the EA;
- Assist in the identification of potential issues and concerns from Aboriginal persons in relation to the Project; and
- Facilitate any formal consultation activities with First Nations that may be conducted by the provincial and/or federal Crown at some time during the EA.

Participants were asked to share their comments, questions, and concerns about the Project in general, and specifically about traditional activities (*e.g.,* hunting, fishing, gathering, and/or spiritual/ceremonial activities) currently ongoing in the vicinity of the Project and specifically at the Project location.

4.2.4.1 Engagement Activities Conducted

The Chiefs of the 15 Maliseet and Mi'kmaq First Nations communities of New Brunswick were initially contacted by telephone or in person to inform them of the Project and the CSR. Meetings were held individually with all Chiefs to brief them regarding the Project, and to determine if they desired more detailed information and in what format. Several Chiefs indicated a desire for more information to be provided in the form of an open house in their community. Others requested a briefing of the Chief and Council, and others simply wanted to be kept informed via mail, or not at all.

Permission was requested of the Chiefs to visit their communities in order to gather information about any traditional activities currently carried out. Chiefs were also asked of their personal knowledge of the prevalence of traditional activities in the vicinity of the Project. If a Chief was aware of any individuals they felt might be able to provide information relevant to the CSR, he or she was asked to provide contact information for this person so that they could be interviewed.

Following initial discussions with the Chiefs, open houses were held in the First Nations communities that desired such an event. The locations, dates, and approximate number of attendees of the First Nations open houses are provided in Table 4.2.

Table 4.2 Locations, Dates, and Attendees of First Nations Open Houses

First Nation	Date of Open House	Approximate Number of Attendees
Metepenagiag (Red Bank) First Nation	February 12, 2008	12
Esgenoopetitj (Burnt Church) First Nation	February 12, 2008	17
Oromocto First Nation	March 11, 2008	4
Woodstock First Nation	March 12, 2008	7
Indian Island First Nation	March 18, 2008	12
Elsipogtog (Big Cove) First Nation	March 18, 2008	40
Eel River Bar First Nation	March 25, 2008	10
Tobique First Nation	March 26, 2008	13
Kingsclear First Nation	June 3, 2008	9
Eel Ground First Nation	February 16, 2009	10

Additionally, a presentation was provided to Chief Hugh Akagi, a representative of the Passamaquoddy people in New Brunswick, on April 14, 2008.

An open house was also scheduled for the Madawaska First Nation on March 26, 2008, but it was cancelled by the Chief while the Study Team was in transit to the open house. It was not possible to coordinate a suitable date for an open house at the Pabineau First Nation (originally scheduled for March 25, 2008); the Chief of this community has since indicated that an open house is no longer required but the community would like to be kept informed of progress regarding the Project.

It is noted that the Chiefs of the Fort Folly, Buctouche, and St. Mary's First Nations did not wish to be further engaged in respect of the Project.

Interviews were conducted with community elders and other members of the First Nations communities potentially having information relevant to the Project. In addition to these engagement activities, a review of available information concerning current uses of land and resources for traditional purposes was conducted.

4.2.4.2 Summary of Key Issues Raised by First Nations and Aboriginal Persons

A summary of the key issues raised by First Nations and Aboriginal persons during the engagement activities conducted is provided in Table 4.3. Predominantly, First Nations participants indicated the need for Crown consultation and accommodation in respect of the Project; the desire for Aboriginal inclusion policies or set aside policies; and potential interactions with the Aboriginal fishery in the Bay of Fundy.

Table 4.3 Summary of Key Issues Raised During Aboriginal Engagement Activities

Key Issues Raised During Aboriginal Engagement Activities
▪ Need for the federal and provincial governments to consult with, and accommodate, First Nations people in respect of the Project.
▪ Concerns about potential interactions between the Project (particularly increased ship traffic) and the Aboriginal fishery (both the commercial fishery and the food fishery in the Bay of Fundy).
▪ Consideration of Aboriginal Inclusion Policies, set asides, and Impact-Benefit Agreements in respect of the Project.
▪ Historical use of land and resources for traditional purposes (hunting, fishing, trapping, gathering, spiritual, or subsistence).
▪ First Nations participation in the establishment of traditional and ecological knowledge regarding the Project.
▪ Consultation vs. information exchange/engagement.
▪ Benefits to Aboriginal communities.

4.2.4.3 Current Use of Land and Resources, and Traditional Ecological Knowledge

Based on the results of the Aboriginal engagement program and specifically as an outcome of interviews conducted with leadership, elders, and other key Aboriginal individuals, the current use of land and resources for traditional purposes by Aboriginal persons in the vicinity of the Project appears to be largely limited to fishing in the Bay of Fundy (though not specifically at the Project location). The main fishery, both for commercial and food purposes, appears to be lobster fishing in the Bay of Fundy, with a limited amount of scallop fishing in the Bay of Fundy. No commercial fishing activities are apparently conducted in the marine waters near the Project by Aboriginal fishermen (Jacques Whitford and ARC 2008).

There does not appear to be any current use of land or land-based resources in the vicinity of the Project, although this area may have been used by Aboriginal people in the past, possibly as far back as pre-contact times.

Further information will be provided in Chapter 12 of this report.

5.0 ENVIRONMENTAL ASSESSMENT METHODS

The methods that will be used to conduct the EA of the Project (presented later in this CSR) are described in this Chapter. The EA will be completed using the methodological framework developed by the RAs to meet the requirements of *CEAA*. These environmental assessment methods are based on a structured approach that:

- Considers the mandatory and discretionary factors under Section 16 of *CEAA*;
- Focuses on issues of greatest concern;
- Considers all federal requirements for the assessment of environmental effects, as defined by *CEAA*, with specific consideration of the requirements of the EA Track Report;
- Considers the issues raised by the public, Aboriginal persons, environmental non-governmental organizations (ENGOs), and other stakeholders during consultation and engagement activities conducted; and
- Integrates engineering design and programs for mitigation and monitoring into a comprehensive environmental planning process.

For the purpose of this EA, the term “environment” refers broadly to the combined biophysical and human environment and encompasses the definition of environment in *CEAA* where:

> *"environment" means the components of the Earth, and includes*
>
> *(a) land, water and air, including all layers of the atmosphere,*
>
> *(b) all organic and inorganic matter and living organisms, and*
>
> *(c) the interacting natural systems that include components referred to in paragraphs (a) and (b).*

The EA will focus on specific environmental components (called Valued Environmental Components or VECs) that are of particular value or interest to regulatory agencies, the public, and other stakeholders. VECs are typically selected for assessment on the basis of regulatory issues, guidelines, and requirements; consultation with regulatory agencies, the public, and stakeholders; field reconnaissance; and the professional judgment of the Study Team.

For the purpose of this CSR, the term “environmental effect” is as defined in *CEAA* and broadly refers to a change in the environment in response to a Project activity. Specifically:

> *“environmental effect" means, in respect of a project,*
> *(a) any change that the project may cause in the environment, including any change it may cause to a listed wildlife species, its critical habitat or the residences of individuals of that species, as those terms are defined in subsection 2(1) of the Species at Risk Act,*
> *(b) any effect of any change referred to in paragraph (a) on*
> *(i) health and socio-economic conditions,*
> *(ii) physical and cultural heritage,*

(iii) the current use of lands and resources for traditional purposes by aboriginal persons, or

(iv) any structure, site or thing that is of historical, archaeological, paleontological or architectural significance, or

(c) any change to the project that may be caused by the environment, whether any such change or effect occurs within or outside Canada.

It is noted that in the context of this CSR, the term "environment" includes the biophysical, human, and socio-economic components as defined in *CEAA*.

5.1 EA Methodology

5.1.1 Overview of Approach

The environmental assessment methods will address both Project-related and cumulative environmental effects. Project-related environmental effects are changes to the physical, biological or human environment that may occur in connection with the project, as defined by the EA Track Report and Scoping Document and described in the Project Description (Chapter 3). Cumulative environmental effects are changes to the physical, biological or human environment that are likely to result from the project in combination with other projects that have been or will be carried out.

Project-related environmental effects and cumulative environmental effects will be assessed sequentially using a standardized methodological framework for each VEC. The methodological framework will be generally consistent among VECs and standard tables and matrices will be used to facilitate the evaluation. The Project-related environmental effects will be discussed first, taking into account Project design measures and mitigation that may be implemented to reduce or avoid Project-VEC interactions that could result in this environmental effect. The residual Project-related environmental effect will then be characterized in light of planned mitigation. At minimum, all Project-related environmental effects will be characterized using specific criteria (*e.g.,* direction, magnitude, geographic extent, duration, frequency, and reversibility) that are specifically defined for each VEC. The significance of the Project-related environmental effects will then be determined based on pre-defined criteria or thresholds for determining the significance of the environmental effects (also called significance criteria). If applicable, the likelihood of significant environmental effects will be characterized.

A cumulative environmental effects screening will then be conducted for that residual environmental effect to determine if there will be potential for cumulative environmental effects (the environmental effects of other projects and activities that would overlap with those of the Project) to occur. A series of questions will be used to screen cumulative environmental effects. On the basis of these questions, if there is potential for substantive cumulative environmental effects arising from the Project in combination with other past and likely future projects and activities that have been or will be carried out, it will be assessed to determine if those cumulative environmental effects could be significant and to consider the contribution of the Project to them.

The environmental effects assessment approach to be used in this EA will involve the following steps.

- **Scoping.** Scoping of the overall assessment, including the selection of Valued Environmental Components (and, if required, key indicators for the VEC); description of measurable parameters; description of temporal, spatial, and administrative/technical boundaries; definition of the parameters that will be used to characterize the Project-related environmental effects and cumulative environmental effects; identification of the standards or thresholds that will be used to determine the significance of environmental effects; and discussion of existing conditions. This step relies upon the scoping undertaken by regulatory authorities as outlined in the federal EA Track Report and Scoping Document; consideration of the input of the public, stakeholders, and First Nations; and the professional judgement of the Study Team.

- **Assessment of Project-Related Environmental Effects.** Project-related environmental effects will be assessed. The assessment will include descriptions of how an environmental effect will occur, the mitigation and environmental protection measures proposed to reduce or eliminate the environmental effect, and the characterization of the residual environmental effects of the Project. The focus will be on residual environmental effects, *i.e.,* the environmental effects that remain after mitigation has been applied. All mandatory factors under Section 16(1) of *CEAA* and additional factors for comprehensive studies under Section 16(2) of *CEAA* will be assessed for all phases of the Project (*i.e.,* Construction, Operation, and Decommissioning and Abandonment), as well as for Accidents, Malfunctions, and Unplanned Events. The evaluation will also consider the effects of the environment on the Project. For each VEC, a determination of significance will be made based on the identified significance criteria. If significant environmental effects are predicted, the assessment will include consideration of the capacity of renewable resources that are likely to be significantly affected by the Project to meet the needs of present and those of the future.
- **Identification of Cumulative Environmental Effects.** Cumulative environmental effects of other projects and activities that overlap with those of the Project, for all phases of the Project (*i.e.,* Construction, Operation, and Decommissioning and Abandonment), as well as for Accidents, Malfunctions, and Unplanned Events, will be identified. An assessment of potential interactions will be completed to determine if an assessment of cumulative environmental effects is required (*i.e.*, there is potential for substantive interaction) for that specific Project-related environmental effect.
- **Evaluation of Cumulative Environmental Effects.** The residual cumulative environmental effects of the Project in combination with other past and future projects and activities that have been or will be carried out will be evaluated, including the contribution of the Project to those cumulative environmental effects.
- **Determination of Significance.** The significance of Project-related and residual cumulative environmental effects will be determined, in consideration of the significance criteria.
- **Recommendations for Follow-up.** The follow-up and monitoring required to verify the environmental effects predictions and assess the effectiveness of the planned mitigation will be recommended, where applicable.

Further details on the environmental assessment methodologies that will be used in this EA are provided in the sub-sections that follow.

5.1.2 Scoping of the Assessment

Issues identified through scoping will be analyzed and grouped into categories to assist in the selection of VECs. VECs are defined as broad components of the biophysical and human environments that, if altered by the Project, would be of concern to regulatory agencies, Aboriginal persons, resource managers, scientists, and/or the general public. These issues, along with the requirements of the

EA Track Report, form the scope of the environmental assessment (*i.e.,* scope of Project, factors to be considered, and scope of factors to be considered).

5.1.2.1 Rationale for Selection of Valued Environmental Component, Regulatory Setting, and Consultation

The rationale for the selection of each VEC will first be described in its own dedicated environmental analysis section. The regulatory setting, ecological and socio-economic context of each VEC, and the influence of consultation or engagement on the assessment (as applicable) will also be described briefly.

5.1.2.2 Identification of Environmental Effects

The environmental effects for each VEC (and if applicable, key indicators) will be defined in consideration of the regulatory context for the VEC, issues identified through consultation or engagement, and existing conditions.

5.1.2.3 Selection of Measurable Parameters

For each VEC, one or more measurable parameters will be selected to facilitate the measurement of potential Project-related environmental effects and cumulative environmental effects. The degree of change in these measurable parameters will be used to characterize Project-related and cumulative environmental effects, and to evaluate the significance of the potential environmental effects.

5.1.2.4 Temporal Boundaries

The temporal boundaries for the assessment will be defined based on the timing and duration of Project activities and the nature of the interactions with each VEC. The purpose of a temporal boundary is to identify when an environmental effect may occur in relation to specific Project phases and activities. Temporal boundaries for the Project generally include the following Project phases:

- Construction;
- Operation; and
- Decommissioning and Abandonment.

In some cases, it will be necessary to further refine the temporal boundaries beyond simply limiting them to a specific phase of the Project. This will be carried out as necessary within each environmental effects analysis chapter. Temporal boundaries for the assessment may reflect seasonal variations or life cycle requirements of biological VECs or forecasted trends for socio-economic VECs.

5.1.2.5 Spatial Boundaries

Spatial boundaries will be established for the assessment of potential Project-related environmental effects and cumulative environmental effects for each VEC. The primary consideration used in the establishment of the boundaries of these assessment areas will be the probable geographical extent of the environmental effects (*i.e.*, the zone of influence) to the VEC.

Spatial boundaries represent the geographic extent of the VEC, as they pertain to potential Project-environment interactions. Spatial boundaries will be selected for each VEC to reflect the geographic extent over which Project activities will or are likely to occur, and as such, they may be different from one VEC to another depending on the characteristics of the VEC. Generally, the spatial boundaries will be referred to as the Assessment Area. The Assessment Area may be further sub-divided as the Project Development Area (PDA), the Local Assessment Area (LAA), and the Regional Assessment Area (RAA), as required.

- The PDA is the most basic and immediate area of the Project. The PDA typically includes the area of physical disturbance associated with the construction or operation of the Project. In the case of this CSR, the PDA generally includes the area of disturbance associated with the Project. Areas to be developed in the marine environment include the marine terminal, jetty, barge landing facility, and other marine-based infrastructure.
- The LAA is the maximum area within which Project-related environmental effects can be predicted or measured with a reasonable degree of accuracy and confidence. The LAA includes the PDA and any adjacent areas where Project-related environmental effects may reasonably be expected to occur. In the case of this EA, the LAA generally includes outer Saint John Harbour up to the entrance of the major shipping lanes in the Bay of Fundy, depending on the VEC.
- The RAA is the area within which cumulative environmental effects for the VEC may potentially occur, depending on physical and biological conditions, and the type and location of other past, present or reasonably foreseeable projects or activities. In this EA, the RAA boundaries are chosen as applicable and appropriate depending on the VEC.

5.1.2.6 Administrative and Technical Boundaries

As appropriate, Administrative and Technical Boundaries will be identified and justified for each VEC. Administrative boundaries include specific aspects of provincial and federal regulatory requirements, standards, objectives, or guidelines, as well as regional planning initiatives that are relevant to the assessment of the Project's environmental effects on the VEC.

Technical boundaries are the technical limitations for the evaluation of potential environmental effects of the Project, and may include limitations in scientific and social information, data analyses, and data interpretation.

5.1.2.7 Thresholds for Determining the Significance of Residual Environmental Effects

Threshold criteria or standards for determining the significance of environmental effects will be identified for each VEC, beyond which a residual environmental effect would be considered significant. These will be generally selected in consideration of federal and provincial regulatory requirements, standards, objectives, or guidelines that are applicable to the VEC, as developed in the Boundaries section.

In some cases, and particularly where standards, guidelines or regulatory requirements do not specifically exist, standards or thresholds will be defined for measurable parameters or environmental effects for a VEC. Thresholds will reflect the limits of an acceptable state for an environmental component based on resource management objectives, community standards, scientific literature, or ecological processes (*e.g.*, desired states for fish or wildlife habitats or populations), and in the absence of standards, will be suggested by the Study Team for consideration by the decision-making regulatory authorities.

5.1.3 Existing Conditions

The existing conditions for each VEC will then be described, including:

- The status and characteristics of the VEC within its defined spatial and temporal assessment boundaries;
- Information from past research conducted in the region;
- Traditional and ecological knowledge (if applicable); and
- Knowledge gained from the collection of baseline data through literature review, qualitative and quantitative analyses, and field programs carried out as part of the EA.

5.1.4 Project Interactions with the Environment

Interactions between all relevant Project activities and each VEC will be summarized in tabular format. Detailed information on the Project activities is provided in Chapter 3. Interactions will be ranked according to the potential for an activity to interact with each VEC, according to the following.

- If there is no interaction or no potential for substantive interaction between a Project activity and a VEC, an assessment of environmental effects will not be required. These interactions will be categorized as 0, and will not be considered further in the EA. The environmental effects of these activities will thus, by definition, be rated not significant.
- If a potential interaction between a Project activity and a VEC is identified, but not likely to be substantive in light of planned mitigation, the interactions will be categorized as 1. Such interactions are well understood and are subject to prescribed mitigation or codified practices. These interactions will be subject to a less detailed environmental effects assessment and rated not significant; however, justification will be provided for such categorizations and the proposed mitigation described. Such interactions can be mitigated with a high degree of certainty with proven technology and practices.
- If a potential interaction between a Project activity and a VEC is identified that may result in more substantive environmental effects despite the planned mitigation, or if there is less certainty regarding the effectiveness of mitigation, the interactions will be categorized as 2. These potential interactions will be subject to a more detailed analysis and consideration in the EA in order to predict, mitigate, and evaluate potential environmental effects.

Justification for assigning these ranks for each VEC will then be provided following the ranking. The Study Team will take a precautionary approach, whereby interactions with a meaningful degree of uncertainty will be assigned a rank of 2, ensuring that a detailed environmental effects assessment is conducted.

5.1.5 Environmental Effects Assessment

5.1.5.1 Assessment of Project-Related Environmental Effects

Description of Project-Related Environmental Effects

For each Project-related activity ranked as a 2, as discussed above, the assessment of each Project-related environmental effect will begin with a description of the mechanisms whereby specific Project activities and actions could result in the environmental effect. Where possible, the spatial and temporal extent of these changes (*i.e.*, where and when the environmental effect might occur) will also be described.

The EA will focus on residual environmental effects; environmental effects before mitigation are not quantified or characterized. The significance of the environmental effect before mitigation is not described or assessed.

Mitigation of Project Environmental Effects

Mitigation measures that will help reduce or eliminate an environmental effect will be described, with an emphasis on how these measures will help to reduce the environmental effect. Mitigation is defined as changes in the temporal or spatial aspects of the Project and/or the means in which the Project will be constructed, operated, or decommissioned or abandoned, over and above the Project design aspects described in Chapter 3. In addition, mitigation can include specialized measures such as habitat compensation, replacement, or financial compensation.

Characterization of Residual Project Environmental Effects

Residual environmental effects (*i.e.,* the environmental effects that remain after mitigation has been applied) will be described for a VEC during each Project phase, taking into account how the proposed mitigation would alter or change the environmental effect. The analysis will include both direct and indirect interactions between the Project and the VEC. The analysis will consider mitigation measures to reduce adverse environmental effects or to enhance positive environmental effects, as applicable and appropriate. Once mitigation measures are applied, any remaining environmental effect will be residual. Only residual environmental effects will be assessed for significance.

Environmental effects for each VEC will be characterized for each applicable Project phase and presented in an environmental effects summary table. The following criteria will be used to characterize potential residual environmental effects:

- **Direction** – the ultimate long-term trend of the environmental effect (*i.e.,* positive, neutral, or adverse);
- **Magnitude** – the amount of change in a measurable parameter or variable relative to existing (baseline) conditions;
- **Geographic Extent** – the area where an environmental effect of a defined magnitude occurs;
- **Frequency** – the number of times during the Project or a specific Project phase or activity that an environmental effect might occur (*e.g.*, one time or multiple times) in a specified time period;

- **Duration** – the period of time required until the VEC returns to its baseline condition or the environmental effect can no longer be measured or otherwise perceived (*e.g.*, short-term, mid-term, long-term, or in some cases permanent);
- **Reversibility** – the likelihood that a measurable parameter will recover from an environmental effect, including through active management techniques (*e.g.*, habitat restoration); and
- **Ecological or Socio-economic Context** – the general characteristics of the area in which the Project is located, as indicated by past and existing levels of human activity.

A key for each environmental effects summary table will provide summary criteria that will be modified as necessary for each VEC based on the specific boundaries (temporal, spatial, administrative, and technical) and significance criteria selected for each VEC. Where possible, these characteristics will be described quantitatively for each residual environmental effect. Where these characteristics cannot be expressed quantitatively, they will be described using qualitative terms that were defined specifically for the VEC or environmental effect.

Following the rating, residual environmental effects will be described and discussed for the VEC during each Project phase, taking into account how the proposed mitigation will alter or change the environmental effect.

5.1.5.2 Assessment of Cumulative Environmental Effects

Screening for Cumulative Environmental Effects

After completing the assessment of potential Project-related environmental effects on the VEC, where residual environmental effects are identified, a cumulative environmental effects assessment will be conducted for those Project-related environmental effects that may overlap with other projects and activities that have been or will be carried out.

The screening for cumulative environmental effects will be conducted to determine if there is potential for a cumulative environmental effect. A series of three questions is used to screen cumulative environmental effects:

- Is there a Project-related environmental effect;
- Does the Project-related environmental effect overlap with those of other past, present and future projects and activities that have been or will be carried out; and
- Is the Project contribution to cumulative environmental effects substantive and measurable or discernible such that there is some potential for substantive cumulative environmental effects that are attributable to the Project?

If, based on these three questions, there is potential for cumulative environmental effects, it will be assessed to determine if it has the potential to shift a component of the natural or human environment to an unacceptable state.

Residual environmental effects for each VEC will be reviewed for potential spatial and temporal overlap with similar environmental effects of other projects and activities. Only projects and activities that overlap with the Project residual environmental effects both spatially and temporally will be included in the assessment of potential cumulative environmental effects.

Identification of Other Projects and Activities

Other projects and activities that have been or will be carried out will be identified for inclusion in the cumulative environmental effects assessment, based on their potential for residual environmental effects that could overlap spatially and temporally with the residual environmental effects of the Project. The environmental effects of other past and present projects or activities are generally reflected in the existing baseline environment and will therefore be considered in the Project-related environmental effects assessment for each VEC. The assessment and evaluation of the cumulative environmental effects of the Project in combination with other projects and activities that will be carried out will consider the nature and degree of change from these baseline environmental conditions in combination with the Project.

The screening of other projects and activities relevant to the cumulative environmental effects assessment is generally based on the criteria described in Table 5.1. The specific list of other projects and activities identified for inclusion in the cumulative environmental effects assessment for this EA will be described in Section 5.3.

Table 5.1 Criteria for Identification of Other Projects and Activities That Have Been or Will Be Carried Out, for the Cumulative Environmental Effects Assessment

Criteria	Rationale and Application
Status of other project or activity: Past or present project, or a project or activity that is certain, planned, or reasonably foreseeable.	The environmental effects of past and present projects and activities are evaluated in the assessment of environmental effects of the Project. With some exceptions, the cumulative environmental effects assessment does not specifically consider past and present projects and activities because the environmental effects resulting from past and present projects and activities are captured in the description of baseline conditions. The exceptions are recently initiated projects and activities (*e.g.,* Canaport LNG) where the environmental effects are recent and may not be fully reflected in the baseline conditions, or projects/activities that will probably change in scope in the foreseeable future. Certain/planned projects or activities are those that have a high probability of being implemented, and include the following projects proximal to the Project: ▪ Those that are currently registered under the New Brunswick *Environmental Impact Assessment Regulation* (under review), and are listed on the NBENV website; ▪ Those currently undergoing an EA under *CEAA*, and are listed on the Canadian Environmental Assessment Registry website; and ▪ Those that have been publicly announced as being under serious consideration by proponents but have not yet registered, or that will be registered in the near future. Reasonably foreseeable projects and activities are highly likely to be implemented and include those identified in approved development plans or those that are in advanced stages of planning. Hypothetical and speculative projects and activities are not considered as part of the cumulative environmental effects assessment.
Potential for overlap related to timing of the project and/or activity: Other project or activity must be carried out or implemented during the time frame that is relevant to the Project.	The Development Proposal could involve the following timeframes. ▪ **Construction**: Construction in two sequential phases spanning a period of six to eight years, commencing in 2010. ▪ **Operation**: Phase 1 of the Development Proposal commencing commercial operation in 2015, and Phase 2 of the Project commencing operation in the 2018-2020 time period, for a period of approximately 30 years. The implementation of a proactive and effective maintenance and reliability program could result in the facility being operational for a longer period of time. The timeframe for other projects and activities relevant to the cumulative environmental effects assessment must overlap with these periods for the Project, in that they will extend through Construction and/or Operation.

Table 5.1 Criteria for Identification of Other Projects and Activities That Have Been or Will Be Carried Out, for the Cumulative Environmental Effects Assessment

Criteria	Rationale and Application
Potential for a spatial overlap of environmental effect: Other project or activity must be located within the RAA as defined in the environmental effects analysis for each VEC.	Projects with an identified or expected zone of influence that may overlap with the geographic area likely to be affected by the Project (including VEC spatial boundaries) are of interest.

Where a cumulative environmental effects assessment is completed for a VEC, only those projects and activities that could result in an overlapping environmental effect are included in the cumulative environmental effects assessment. The specific projects and activities and actions considered for each environmental effect will be outlined in the assessment for the VEC.

Description of Cumulative Environmental Effects

The assessment of each cumulative environmental effect will begin with a description of the environmental effect and the mechanisms whereby the Project environmental effects may interact with other projects and activities in the RAA. Where possible, the cumulative environmental effect will be quantified in terms of the degree of change in the appropriate measurable parameter(s) and the spatial and temporal extent of these changes (*i.e.*, where and when the interactions between the Project's residual environmental effects and the residual environmental effects of other projects and activities might occur).

As the assessment focuses on residual environmental effects, cumulative environmental effects before mitigation are not characterized. The significance of the environmental effect before mitigation will not be described.

Use of Temporal Cases

Where several environmental effects are evaluated in a particular VEC, or where the screening of cumulative environmental effects identifies that a detailed evaluation of these cumulative environmental effects is required, temporal cases will be defined where appropriate and helpful to assist in the assessment of cumulative environmental effects. Where this occurs, cumulative environmental effects will generally be described for three cases, as follows.

- **Base Case** – describes the current status of the measurable parameter(s) for the environmental effect prior to the start of the Project, including all appropriate past and present projects and activities. Present projects and activities include all projects or actions that currently exist, as well as projects that have been approved under some form of regulatory permitting. The Base Case will normally be presented in the existing conditions of the VEC, with explicit reference to the fact that the Base Case reflects the contributions of past and present projects and activities.
- **Project Case** – describes the status of the measurable parameter(s) for the environmental effect with the Project in place, over and above the Base Case. This will usually be assessed using the peak environmental effect of the Project or the maximum active footprint for the Project.
- **Future Case** – describes the status of the measurable parameter(s) for the environmental effect as a result of the Project Case in combination with all reasonably foreseeable projects and activities. Reasonably foreseeable projects are defined as future projects and activities that will occur with

certainty, including projects that are in some form of regulatory approval process or where a public announcement to seek regulatory approval has been made (*i.e.*, they are likely to occur).

Although this methodology will not be applied universally to every VEC, the comparison of the Project Case with the Future Case allows the Project contribution to cumulative environmental effects of all past, present, and reasonably foreseeable projects and activities (*i.e.*, Future Case) to be determined.

Mitigation of Residual Cumulative Environmental Effects

As with Project-related environmental effects, mitigation measures that would reduce the cumulative environmental effects will be described, with an emphasis on those measures that would help to minimize the interaction of the Project-related environmental effect with similar environmental effects from other projects, activities, and actions. Three types of mitigation measures will generally be considered, as applicable:

- Measures that can be implemented solely by the Proponent;
- Measures that can be implemented by the Proponent in cooperation with other project proponents, government, Aboriginal organizations, the public, and/or other stakeholders; and
- Measures that can be implemented independently by other project proponents, government, Aboriginal organizations, the public, and/or other stakeholders.

Characterization of Residual Cumulative Environmental Effects

Residual cumulative environmental effects will be described and assessed, taking into account how the proposed mitigation will alter or change the cumulative environmental effect. As described for Project-related environmental effects (Section 5.1.5.1), cumulative environmental effects will be characterized where applicable and appropriate in terms of the direction, magnitude, geographic extent, frequency, duration, reversibility, and ecological or socio-economic context. The contribution of the Project to cumulative environmental effects will be assessed where there will be a potential for substantive overlapping environmental effects to occur.

5.1.6 Determination of the Significance of Residual Environmental Effects

5.1.6.1 Determination of Significance of Project-Related Residual Environmental Effects

A determination of the significance of Project environmental effects will be made using standards or thresholds of significance defined for the VEC and/or the measurable parameters (Section 5.1.2.4), beyond which a residual environmental effect would be considered significant. The determination of significance may be made along with the assessment of Project-related environmental effects, or in a separate Determination of Significance section.

Where the environmental effects are determined to be significant, the determination will include consideration of the level of confidence in the prediction based on the following criteria:

- Scientific certainty (professional judgment) of the rating, in consideration of the Technical Boundaries; and
- Likelihood of the environmental effect occurring.

If significant residual environmental effects that are likely to occur are predicted, the assessment will include consideration of the capacity of renewable resources that are likely to be significantly affected by the Project to meet the needs of present and those of the future.

5.1.6.2 Determination of Significance of Residual Cumulative Environmental Effects

A determination of the significance of residual adverse cumulative environmental effects will then be made using the same standards or thresholds for significance developed for the VEC and/or the measurable parameters. As with residual Project-related environmental effects, the determination of residual cumulative environmental effects will include a discussion of the level of confidence in the prediction (Section 5.1.6.1). The determination of significance may be made along with the assessment of cumulative environmental effects, or separately in the Determination of Significance section.

5.1.7 Follow-up and Monitoring

Follow-up programs are used, where applicable, to verify environmental effects predictions and effectiveness of mitigation measures. Monitoring programs are compliance programs used to verify that mitigation was applied. Appropriate follow-up and/or monitoring programs are proposed where a need has been identified or where the scientific certainty of the environmental effects predictions or the effectiveness of mitigation warrants the need for such programs.

5.1.8 Potential Accidents, Malfunctions and Unplanned Events

Accidents, Malfunctions and Unplanned Events will be assessed for the Project in Chapter 16. Potential accidents, malfunctions, and unplanned events will be identified based on the Project Description using historical performance data for other similar projects at a regional, provincial, national or international scale, as appropriate. Where applicable, for each accident, malfunction, or unplanned event, one or more scenarios relating to how the accident, malfunction, or unplanned event might occur during the life of the Project will be developed. The focus of the evaluation will be on credible accidents, malfunctions, and unplanned events that have a reasonable likelihood of occurring during the lifetime of the Project based on the nature of the Project and the environmental effects that may occur, or for those that could result in significant environmental effects even if their likelihood of occurrence is low. Details on the types of accidents, malfunctions and unplanned events considered in this EA are provided in Chapter 16.

For each event and/or scenario, a preliminary screening will be conducted to determine if the event and/or scenario is likely to affect the VEC. Potential interactions will be ranked using the same criteria as for Project interactions with the environment (Section 5.1.4).

For interactions that are ranked as 2, potential environmental effects of the event and/or scenario on the VEC are assessed. Environmental effects are characterized using the same terms as routine Project-related environmental effects (Section 5.1.5.1).

Cumulative environmental effects of accidents, malfunctions, or unplanned events, however, will not be assessed as it is not reasonably foreseeable to have overlapping Project-related accidents with those from other projects and activities that will be carried out.

The significance of the Project-related environmental effects for each accident, malfunction, or unplanned event and its likelihood of occurrence will then be determined using the same thresholds as determined for the Project-related environmental effects on each applicable VEC.

5.2 Valued Environmental Components

Broad components of the biophysical and human environments that, if altered by the Project, would be of concern to regulatory agencies, Aboriginal persons, resource managers, scientists, and/or the general public are known as valued environmental components, or VECs. VECs are selected based on knowledge of the project, its components and activities; knowledge of existing conditions where the project will be located; issues raised by the public and stakeholders; and the scope of factors to be considered in the EA as determined by RAs. It is noted that since *CEAA* defines "environment" to include not only biological systems but also human, social, and economic conditions, VECs can relate to ecological, social, or economic systems that comprise the environment.

Based on the EA Track Report and Scoping Document as determined by the RAs for the Project and the scope of factors to be considered as outlined in Section 2.3 of this CSR, the VECs considered and ultimately selected for this EA to meet the requirements of *CEAA* are presented in Table 5.2.

Table 5.2 Valued Environmental Components Considered in the EA

Valued Environmental Component (VEC)	Included in the EA?	Comment / Scope of Assessment / Rationale for Inclusion or Exclusion in the EA under *CEAA*
Atmospheric Environment	Yes	The Atmospheric Environment has intrinsic value in that the atmosphere and its constituents are needed to sustain life and maintain the health and well-being of humans, wildlife, and other biota. The potential environmental effects of the marine terminal on air quality, greenhouse gas emissions, and sound quality are assessed in the EA.
Water Resources	No	Water resources are not identified in the EA Track Report and Scoping document as a component to be assessed in the EA. There is no interaction between the marine terminal and water resources.
Health and Safety	Yes (Public Health only)	Public Health aspects of the marine terminal are assessed in the EA in terms of the potential effects of the marine terminal on human health. Public safety is not identified in the EA Track Report and Scoping document as a component to be assessed in the EA.
Freshwater Aquatic Environment	No	Freshwater aquatic environment (including freshwater fish, fish habitat, or hydrology) are not identified in the EA Track Report and Scoping document as a component to be assessed in the EA. There is no interaction between the marine terminal components and the freshwater aquatic environment.
Terrestrial Environment	No	Terrestrial environment (including wildlife, wildlife habitat, species of conservation concern, and migratory birds) is not identified in the EA Track Report and Scoping document as a component to be assessed in the EA. There is no interaction between the marine terminal components and the terrestrial environment. Marine birds are assessed as part of Marine Environment.
Wetland Environment	Yes (coastal wetlands only)	The wetland environment is identified in the EA Track Report and Scoping document a component to be assessed in the EA, only as it relates to coastal wetlands in the vicinity of the marine terminal. There is no interaction between the marine terminal components and the wetland environment on land.
Marine Environment	Yes	The marine environment provides habitat for fish and other marine biota and is valued by humans for ecological, economic, and recreation activities. There is direct interaction between the marine terminal and the marine environment (including marine fish, fish habitat, marine mammals, marine birds, and species of conservation concern). Also assessed are marine water quality and sediment quality.

Table 5.2 Valued Environmental Components Considered in the EA

Valued Environmental Component (VEC)	Included in the EA?	Comment / Scope of Assessment / Rationale for Inclusion or Exclusion in the EA under *CEAA*
Commercial Fisheries	Yes	Commercial fisheries are important to the local and regional economy, and a valued way of life for some residents of southern New Brunswick. The EA Track Report and Scoping document require an assessment of the marine terminal on commercial fisheries.
Labour and Economy	No	Labour and Economy are not identified in the EA Track Report and Scoping document as components to be assessed in the EA. While the construction and operation of the marine terminal will create economic activity and create employment, these interactions are not assessed further in the EA.
Community Services and Infrastructure	No	Community Services and Infrastructure is not identified in the EA Track Report and Scoping document as a component to be assessed in the EA. While the Development Proposal as a whole will interact with Community Services and Infrastructure, the construction and operation of the marine terminal itself (assessed in this CSR) will not interact in a substantive way with emergency services, ongoing support services (health, social, and public education systems), housing and accommodation, or entertainment or recreation facilities.
Land Use	No	Land Use is not identified in the EA Track Report and Scoping document as a component to be assessed in the EA. While there may be limited interactions between the marine terminal and Land Use, these are not considered as a VEC in the EA. The area of the marine terminal is zoned industrial. There are few recreational uses where the marine terminal will be built, and property values are not likely to be affected. Nuisance environmental effects are addressed as part of Atmospheric Environment.
Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons	Yes	An assessment of the potential environmental effects of the marine terminal on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is required by the EA Track Report and Scoping document. Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is part of the definition of "environmental effect" under *CEAA*.
Heritage and Archaeological Resources	Yes (coastal terrestrial environment and marine environment only)	The EA Track Report and Scoping document require an assessment of the environmental effects of the Project on physical and cultural heritage, as well as on structures/sites of archaeological, paleontological, or architectural significance. Given the scope of the Project in the marine environment, the assessment is focussed on the marine environment as well as on the coast of the terrestrial environment only. Heritage and Archaeological Resources on land are assessed as part of the Final EIA Report.
Land-Based Transportation	No	Land-Based Transportation is not identified in the EA Track Report and Scoping document as a component to be assessed in the EA. Other than for some limited transportation on land for the construction and operation of the marine terminal (which is assessed in the Final EIA Report), there is no interaction between the marine terminal and land-based transportation.
Marine Safety	Yes (marine safety aspects of berthing and deberthing only	The EA Track Report and Scoping document specifically exclude navigation and shipping as factors to be assessed in the EA, as they will be addressed via a TERMPOL review process. However, the marine safety aspects of berthing and deberthing are included in the scope of factors to be considered in the EA. Direct environmental effects on navigation will also be considered during the *Navigable Water Protection Act* process.

Based on the information in Table 5.2 above, the following VECs are carried forward in the EA and the environmental effects of the construction, operation and decommissioning and abandonment of the marine terminal are assessed in this CSR:

- Atmospheric Environment;
- Public Health;
- Coastal Wetland Environment;

- Marine Environment;
- Commercial Fisheries;
- Marine Safety;
- Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons; and
- Heritage and Archaeological Resources.

There is no interaction between the marine terminal assessed in this CSR and the following VECs, and thus they are not considered further in the EA:

- Water Resources;
- Freshwater Aquatic Environment;
- Terrestrial Environment;
- Labour and Economy;
- Community Services and Infrastructure;
- Land Use; and
- Land-Based Transportation.

5.2.1 Selected Valued Environmental Components for this CSR

Based on the requirements of the EA Track Report and Scoping Document, and in response to the issues and comments received from the public, stakeholders, First Nations, and regulatory agencies, eight VECs have been selected for conducting the environmental effects assessment of the Project. The following VECs were selected for this CSR:

- Atmospheric Environment (found in Chapter 7);
- Public Health (found in Chapter 8);
- Coastal Wetland Environment (found in Chapter 9);
- Marine Environment (found in Chapter 10);
- Commercial Fisheries (found in Chapter 11);
- Marine Safety (found in Chapter 12);
- Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons (found in Chapter 13); and
- Heritage and Archaeological Resources (found in Chapter 14).

Additionally, the Effects of the Environment on the Project (Chapter 15) have also been selected for assessment in consideration of the nature and location of the Project, the changing global climate, and the potential expenditures that could result from an adverse effect of the environment on the Project.

Finally, in recognition of public concern and the importance of a defensible and comprehensive assessment of accidents, malfunctions, and unplanned events that could occur during the various phases of the Project, a separate chapter on Potential Accidents, Malfunctions, and Unplanned Events (Chapter 16) has been prepared which considers the potential environmental effects of each applicable accident, malfunction or unplanned event on all VECs listed above.

5.3 Other Projects and Activities

The consideration of other projects and activities that have been or will be carried out in the Assessment Area is a necessary component of the assessment of cumulative environmental effects to meet the requirements of *CEAA*. For convenience, the specific projects and activities that are planned or under construction are grouped with other similar projects, to facilitate the assessment of cumulative environmental effects in logical groupings. The other projects and activities considered in the cumulative environmental effects assessment in this CSR (*i.e.,* "other projects and activities that have been or will be carried out") are listed and in Table 5.3.

Table 5.3 Other Projects and Activities for Consideration of Cumulative Environmental Effects

Categories of Future Projects and Activities	Name of Specific Project or Activity	Brief Description of Specific Project or Activity	Key Potential Residual Environmental Effects that may Overlap with the Residual Environmental Effects of the Project
Project Eider Rock (Land-Based Components)	Petroleum Refinery and Other Land-Based Infrastructure for Project Eider Rock	The petroleum refinery and other infrastructure that will be built on land as part of the Development Proposal is the subject of a provincial EIA under the New Brunswick *Environmental Impact Assessment Regulation.* Although not contained in the federal scope of Project for the EA under *CEAA*, some environmental effects of the land-based components may overlap with those of the marine terminal assessed herein. Where overlap occurs, the environmental effects of the marine terminal overlapping with those of the refinery and land-based infrastructure are assessed as a cumulative environmental effect.	▪ Air contaminant and greenhouse gas emissions. ▪ Sound emissions. ▪ Economic activity and demand for labour. ▪ Demand on community services and infrastructure. ▪ Effluent release.
Industrial Land Use	Past industrialization of Saint John and Surrounding Area	The population growth of the area now known as Saint John and its surroundings has resulted in its development as a major urban and industrial centre since the 18th and 19th Centuries. The Saint John area has become known as a major leading manufacturing and industrial centre in the Maritimes—along with environmental changes associated with industrial development; the land use has changed considerably since the arrival of Europeans to the area	▪ Air contaminant and greenhouse gas emissions. ▪ Change in Land Use.
	Projects at the Existing Saint John Refinery	The Proponent has recently replaced its existing Tail Gas Unit installed in 2000. The project, which started up in Spring 2008, consisted of the construction and operation of a Hydrogenation Amine Tail Gas Unit (HATGU) at the existing Saint John refinery. The project will reduce SO_2 emissions from the sulphur block by approximately 70%.	▪ Emission reductions, particularly SO_2. .

Table 5.3 Other Projects and Activities for Consideration of Cumulative Environmental Effects

Categories of Future Projects and Activities	Name of Specific Project or Activity	Brief Description of Specific Project or Activity	Key Potential Residual Environmental Effects that may Overlap with the Residual Environmental Effects of the Project
		A recent RFCCU Reliability and Optimization Project has also been registered to undertake internal modifications to the residue fluid catalytic cracking unit (RFCCU) and gas desulphurization unit (GDU) to enhance their reliability and optimize their production.	▪ Slight increase in SO_2 emissions (less than 0.5%). ▪ Labour and economic activity during Fall 2009 construction period.
	Irving Pulp & Paper Lime Kiln Replacement	In 2004-2008, Irving Pulp & Paper replaced its lime kilns at the Reversing Falls mill, and undertook other process upgrades aimed at reducing emissions from the operation of the mill while allowing for future production increases.	▪ Emission reductions.
	Gypsum Wallboard Manufacturing Plant	In 2008, Atlantic Wallboard Limited Partnership began operation of a new gypsum wallboard manufacturing plant at the former Saint John Shipbuilding yard in Saint John. It produces commercial grade wallboard products using synthetic gypsum produced by the NB Power Coleson Cove Generating Station. This project included the construction of a rail line to connect to the existing rail system.	▪ Emissions and noise during construction. ▪ Emissions during operation. ▪ Rail traffic.
	Coleson Cove Generating Station Fuel Conversion Project	In 2008, the NB Power Generation Corporation modified one of the three boiler units at Coleson Cove, formerly fuelled by heavy fuel oil, so that it is capable of co-firing petroleum coke with heavy fuel oil.	▪ To be determined at the conclusion of the environmental monitoring phase.
	Liquefied Natural Gas (LNG) Receiving and Gasification Facility	Canaport LNG Limited Partnership (a partnership between the Proponent and Repsol YPF S.A.) is completing the construction of a facility to receive, store and regassify LNG for North American markets. The facility, scheduled to begin commercial operation in 2009, will have a design capacity of 28.3 million m^3/d of natural gas (1 billion scf/d).	▪ Emissions and noise during construction.
	Irving Paper Long Term Steam Supply Project	Irving Paper Limited is now operating a new fuel oil-fired boiler as part of a long term steam supply for a mill. The project involved the installation of a new boiler and refurbishment of an existing boiler, to replace the use of NB Power Courtenay Bay Unit #2 for producing steam for the mill.	▪ Emission reductions from phase out of Courtenay Bay Unit #2.
	Brine Pipeline Replacement Project	PCS Cassidy Lake Company plans to replace approximately 31.6 km of the 34 km existing brine pipeline located between the PSC – Cassidy Lake Mine site and the Bay of Fundy in St. Martins.	▪ Potential environmental effects on groundwater resources as a result of blasting operations.
	Potash Corporation - Expansion of Mining Operations	PCS New Brunswick is expanding its existing potash mining operations near Sussex to augment production by 1.2 million tonnes annually. Construction was initiated in early 2008.	▪ Demands to local labour market.
	Point Lepreau Nuclear Generating Station Refurbishment	The Point Lepreau nuclear generating station was shut down for 18 months in April 2008 for a refurbishment outage that involves the upgrading of key reactor components, which will ultimately increase the life of the facility by another 25 years.	▪ Demand on the local labour market. ▪ Increased reliance on fossil fuel burning generators during the refurbishment.

Table 5.3 Other Projects and Activities for Consideration of Cumulative Environmental Effects

Categories of Future Projects and Activities	Name of Specific Project or Activity	Brief Description of Specific Project or Activity	Key Potential Residual Environmental Effects that may Overlap with the Residual Environmental Effects of the Project
Planned or Future Industrial/Energy Projects (not currently registered or proposed)	Point Lepreau II	The Government of New Brunswick is exploring the feasibility of constructing a second nuclear reactor at Point Lepreau, which would generate electricity for export markets in the northeastern United States. This could be conducted by NB Power or other parties.	▪ Labour demands on the local economy. ▪ Economic input to Southwestern New Brunswick. ▪ Emissions and noise during Construction.
	Potential Irving Oil Projects and Other Developments in the Saint John Region	The Proponent is continuing to review projects at the existing Saint John refinery to maintain its commercial viability and improve its environmental performance. Should other energy projects or developments be considered in the future, they would be subject to a separate EIA/EA process under the New Brunswick *Environmental Impact Assessment Regulation* and/or the *Canadian Environmental Assessment Act*.	▪ Emissions, habitat loss, competition for labour. ▪ To be determined through future EIA/EA processes if and as necessary (overlapping cumulative environmental effects with the Development Proposal to be assessed as part of the EIA/EAs to be conducted for those projects or activities).
	Potential Tidal Power Projects	The development of tidal power generation in the Bay of Fundy is being considered. Although not formally registered, the Proponent in partnership with the Huntsman Marine Science Centre is conducting feasibility studies on the potential tidal power at 11 sites in the Bay of Fundy. Generators driven by the flow of tidal currents would be placed at selected locations in the Bay.	▪ Changes to fish habitat and the benthic environment within the Bay of Fundy. ▪ Potential displacement of commercial fishing activities.
Infrastructure Land Use	Past Urbanization of the Saint John Area	With the urbanization of Saint John as a major metropolitan centre since the 18th Century came the eventual development of modern infrastructure and services to support the growth in population. This included the development of transportation, telecommunications, utilities, business centres, neighbourhoods, and other services to support increased residential and commercial growth—a – Along with environmental changes associated with urbanization; the land use has changed considerably since this expansion began in the mid 1800's.	▪ Atmospheric emissions. ▪ Change in Land Use. ▪ Increased demand for public services and infrastructure.
	Eastern Wastewater Treatment Facility	In concert with the Saint John Harbour Cleanup project announced in late 2007, Saint John Water & Wastewater plans the design and construction of a secondary wastewater treatment plant to treat sewage generated in the Central/Eastern Drainage Sub-areas of Saint John. An activated sludge wastewater treatment facility will be built at Hazen Creek, to treat an average flow of 35,000 m^3/day. The outfall pipe will extend 1,100 m into the Saint John Harbour.	▪ Emissions and noise during construction. ▪ Reduction of untreated wastewater released into freshwater and marine systems.
	Development project at Saint John Coast Guard site	The project, to be located on the waterfront in the Uptown area, will link with the existing uptown pedway system and will include a hotel; condominiums; an educational facility; office, commercial, and retail spaces; and public areas.	▪ Labour demands during construction. ▪ Increased public open areas.

Table 5.3 Other Projects and Activities for Consideration of Cumulative Environmental Effects

Categories of Future Projects and Activities	Name of Specific Project or Activity	Brief Description of Specific Project or Activity	Key Potential Residual Environmental Effects that may Overlap with the Residual Environmental Effects of the Project
Marine Use	Development of the Port of Saint John	Early growth in shipbuilding and maritime transportation has solidified Saint John as "the port city" with development of the port beginning in the mid 1800's and continuing today (Saint John Port Authority 2007a). The development of infrastructure and services to support this early port expansion (*e.g.,* dry docks, marine terminals) is also accompanied by environmental changes.	▪ Vessel traffic in Saint John Harbour and Bay of Fundy shipping lanes. ▪ Increased demand for tourist services in the Saint John area. ▪ Competition for the marine resource from traditional to modern uses.
	Aquaculture in Bay of Fundy	Existing, planned, new or future expansions of aquaculture activities in the Bay of Fundy. One announced activity includes the expansion of salmon aquaculture in the Doctors Cove area, Bay of Fundy.	▪ Potential additional displacement of commercial fisheries. ▪ Increased release of waste to the marine environment. ▪ Potential mixing of escaped farm fish with native, wild populations.
	Increased Ship Traffic to Port of Saint John	The Saint John Port Authority plans to implement initiatives to increase the activity in the Port. In addition to any future initiatives that may be undertaken, some recent additions to shipping are planned, including the following. ▪ Additional cruise ships to the Port of Saint John. ▪ Petroleum coke imported for use as fuel at the Coleson Cove Generating Station, and unloaded at a storage facility on the west side of the inner Saint John Harbour. ▪ Potential future shipping and unloading of natural gypsum for the Atlantic Wallboard facility. ▪ Shipping and unloading of liquefied natural gas (approximately 120 LNG tankers per year) at the Canaport LNG terminal. Safety exclusion zones will be put in place around LNG tankers at all times.	▪ Vessel traffic in Saint John Harbour and Bay of Fundy shipping lanes. ▪ Increased demand for tourist services in the Saint John area. ▪ Emissions from marine vessel traffic. ▪ Potential increase in steaming time for local commercial fishermen around exclusion zones.

The list of other projects and activities that will be carried out as outlined in Table 5.3 considers projects or activities that are proximal to the Project (*e.g.,* in the Saint John area or within Southern New Brunswick). Other more distant projects and activities could have environmental effects that could possibly overlap with the Project (*e.g.,* for greenhouse gas emissions affecting global climate). However, it is not possible to assess their cumulative environmental effects with any reasonable degree of accuracy or meaningfulness due to the more global nature of such overlapping environmental effects.

The list of other projects and activities in Table 5.3 considers all past and present projects that have been or are currently being carried out, as well as those projects and activities that, as of March 2009, have been formally proposed by project proponents (*i.e.,* have been registered under the New Brunswick EIA Regulation and/or for which an EA under *CEAA* has been initiated). Other potential projects, proposals, concepts, ideas, visions, or initiatives that may be under consideration, but which have not been formally registered provincially or federally, are not included in this list; their cumulative environmental effects with the Project are thus not assessed in this EA. Once these other potential projects or activities are formally proposed and assessed provincially and/or federally, their environmental effects that overlap with those this Project and other projects and activities would need to be assessed as part of a cumulative environmental effects assessment in those EAs. Cumulative environmental effects in the region will be managed in this way in the future.

6.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

The Project is located in the City of Saint John. Saint John is located in Southern New Brunswick, where the mouth of the Saint John River meets the Bay of Fundy. Saint John was incorporated as a city in 1785, making it the oldest incorporated city in Canada (Tourism Saint John 2008). The largest city in New Brunswick with a metropolitan population of 122,389 (Statistics Canada 2006), it is a commercial and manufacturing centre, an important year-round seaport, and is a developing energy hub.

This chapter describes the environmental setting of the Project and the Greater Saint John Area, including general information on the historical, environmental, and socio-economic and cultural context of these areas. The information presented in this chapter is intended to supplement, at a high level, the detailed existing conditions information that will be provided in each respective chapter that describes and assesses the environmental effects of the Project on each VEC.

6.1 Biophysical Setting

The Project is located near the coast of the Bay of Fundy, which is renowned for its dark red mudflats, rocky beaches, and the highest tides in the world. The land-based components of the Project lie within the Fundy Coastal Ecoregion, which includes the entire coastline of southern New Brunswick from the east side of Passamaquoddy Bay to the east side of Shepody Bay. The ecoregion includes the Fundy Isles of Grand Manan, Deer, Campobello, and Machias Seal, and is a popular destination for tourists interested in the natural wealth of wildlife viewing and outdoor pursuits.

Further details on the ecological setting of the Assessment Area are provided below.

6.1.1 Physiography and Geology

The Project lies within the Caledonian Highlands physiographic region (Rampton *et al.* 1984). The Caledonian Highlands are part of the New Brunswick Highlands, which lie east of the Saint John River, between the Bay of Fundy to the south and the New Brunswick Lowlands to the north. The Caledonian Highlands have complex geomorphology and geology. These highlands include a central plateau area underlain primarily by Precambrian rocks and boundary areas underlain primarily by folded and faulted Carboniferous rocks and local areas of older rocks. The boundary areas are typically characterized by ridge and valley topography.

Physiographically, this area is characterized by northeast to southwest drainage following the major tectonic axis of the Caledonian Highlands (northeast to southwest trend). The regional landscape is characterized by hills sloping down to tidal marshes and/or headlands at the edge of the Bay of Fundy.

6.1.1.1 Localized Seismic Activity

Seismicity is the characterization of seismic event likelihood and magnitude. The seismicity of southern New Brunswick has been extensively characterized for the Point Lepreau Generating Station Environmental Assessment (MacLaren Atlantic Limited 1977) and other seismic investigations (Burke 1974, 1984; NB Power 2003; Parnian and Duff 1975; Rast 1974). A summary of localized seismic activity in the Assessment Area, as was described in the EIA Report for the Canaport LNG project (Jacques Whitford 2004), follows.

Historically, seismic activity in New Brunswick has been clustered in three main areas: Passamaquoddy Bay, Moncton, and the Central Highlands. The highest known magnitude events are:

- March 21, 1904: Passamaquoddy earthquake of magnitude 5.9 (all earthquake magnitudes are on the Richter scale);
- February 8, 1855: Moncton earthquake of magnitude 5.2; and
- January 9, 1982: Miramichi earthquake of magnitude 5.7 (Jacques Whitford 2004).

Since 1975, five earthquakes, ranging in magnitude from 2.7 to 3.1, have been recorded within 20 km of the Assessment Area, all with epicentres in the Bay of Fundy.

- October 13, 1975, 45.09°N 65.92°W, magnitude 2.7;
- October 15, 1975, 45.11°N 65.89°W, magnitude 3.1;
- April 20, 1979, 45.18°N 66.00°W, magnitude 2.8;
- September 4, 1982, 45.12°N 65.93°W, magnitude 2.9; and
- February 24, 1989, 45.15°N 65.85°W, magnitude 2.9.

The mechanisms and forces that cause seismic events in the Bay of Fundy (including those near Mispec Point) have been studied extensively (*e.g.,* Fader 1989; Gates 1989; Gehrels and Belknap 1993; NB Power 2003; Pecore and Fader 1990); yet, they remain poorly understood.

6.1.2 Atmospheric Environment

A brief summary of existing conditions with respect to climate and air quality in Saint John is provided below. More detailed information is provided in Chapter 7.

6.1.2.1 Climate

The Greater Saint John region, like much of Southern New Brunswick, has a marine climate, classified as such because maximum precipitation occurs during the cold season and less than 25% of the total annual precipitation occurs as snow (Environment Canada 2008c). The Bay of Fundy and Lurcher marine areas west of Nova Scotia provide a strong moderation of air temperature over the region in both summer and winter. During the winter, cold air frequently flows across New Brunswick from the centre of the North American continent. Most storms originate over the North Atlantic or the Gulf of Mexico. In summer, the main air mass is warm continental, with occasions of hot, humid air from the Gulf of Mexico.

At locations near the Bay of Fundy, the continental air masses are modified by the influence of the ocean. There is a blending of the continental and maritime influences, which produce a moderating effect on temperature. Coastal locations such as Saint John experience moist Atlantic air most of the year, producing relatively mild periods in the winter and relatively cool weather for the remainder of the year (Environment Canada 2008c).

Saint John experiences a considerable amount of fog, especially during the summer months when the contrast in temperature is greatest between the sea surface and the surrounding air (Environment Canada 2008c). Fog is typically observed on more than one quarter of the days in the year, 36% of which typically takes place in July alone. Fog is more common during the night and early morning, and generally dissipates by 14:00 each day (Environment Canada 2008c).

The flow of large air masses over a large body of cold water such as the Bay of Fundy can strongly influence the vertical temperature gradient and hence the air density and stability of the flow. As the air mass moves over the water body it is often cooled, and as a result the flow becomes stable and the vertical motions are reduced somewhat in the cooler bottom layer.

The physiographic and climatic conditions near the Bay of Fundy produce abundant precipitation, as well as blankets of coastal fog. This affects the local climate and results in cool summer temperatures and mild winters.

The southern landscape in New Brunswick is characterized by hills sloping down to tidal marshes at the edge of the Bay of Fundy. Topography has little effect on the climate of New Brunswick, except that there may be localized effects due to elevation and an influence on the direction of air motion near the ground surface.

Climate Normals

The description of the climate for the region is based on climate normals from 1971-2000 for the Saint John Airport weather station, operated by Environment Canada, as well as the weather extremes observed since 1946, where applicable. The Saint John Airport weather data are considered to be an accurate representation of average weather conditions along the Bay of Fundy coast and in the Saint John airshed.

A selected summary of monthly climate normals and extremes at the Saint John Airport (Environment Canada 2008d) is provided in Table 6.1.

Table 6.1 Selected Summary of Climate Normals (1971-2000) and Extremes at the Saint John Airport

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature													
Daily Mean (°C)	-8.1	-7.3	-2.5	3.6	9.4	14.0	17.1	16.9	12.8	7.3	2.0	-4.7	5.0
Daily Maximum (°C)	-2.7	-1.9	2.3	8.3	14.8	19.5	22.4	22.2	17.7	11.9	6.0	0.3	10.1
Daily Minimum (°C)	-13.6	-12.7	-7.3	-1.2	4.0	8.4	11.7	11.6	7.7	2.7	-2.1	-9.7	-0.1
Extreme Maximum (°C)	14.0	13.3	17.5	22.8	33.0	32.0	32.8	34.4	31.0	25.6	21.7	16.1	--
Date of occurrence (yyyy/dd)	1979/03	1994/21	1999/28	1976/20	1992/22	1983/22	1963/26	1976/22	1999/03	1947/18	1956/01	1973/17	--
Extreme Minimum (°C)	-31.7	-36.7	-30.0	-16.7	-7.8	-2.2	1.1	-0.6	-6.7	-10.6	-16.9	-34.4	--
Date of occurrence (yyyy/dd)	1971/18	1948/11	1948/14	1969/04	1947/15	1949/01	1948/08	1947/28	1947/29	1974/22	1996/30	1989/30	--

Table 6.1 Selected Summary of Climate Normals (1971-2000) and Extremes at the Saint John Airport

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation													
Rainfall (mm)	78.2	48.8	71.7	81.7	115.9	100.9	101.5	89.6	117.4	122.6	121.6	98.2	1,147.9
Snowfall (cm)	66.5	50.0	47.4	22.2	1.4	0.0	0.0	0.0	0.0	2.2	12.5	54.7	256.9
Precipitation (mm)	139.4	94.0	117.9	104.2	117.5	100.9	101.5	89.6	117.4	124.8	133.7	149.4	1,390.3
Extreme Daily Precipitation (mm)	83.0	95.0	74.0	125.5	66.5	108.2	79.4	125.2	83.2	85.3	154.4	105.7	--
Date of occurrence (yyyy/dd)	1978/ 26	1947/ 05	1980/ 18	1962/ 01	1973/ 21	1985/ 01	1990/ 25	1970/ 02	1999/ 22	1963/ 29	1975/ 13	1967/ 04	--
Days With													
Maximum Temperature > 0°C	11.9	11.2	22.0	29.3	31.0	30.0	31.0	31.0	30.0	31.0	26.6	17.2	302.2
Measurable Rainfall (≥ 0.2 mm)	6.9	5.3	8.2	10.6	13.5	13.2	12.0	10.9	11.4	12.1	12.0	9.0	125.1
Measurable Snowfall (≥ 0.2 cm)	13.0	10.7	9.8	5.7	0.57	0.0	0.0	0.0	0.0	0.73	4.0	11.1	55.7
Measurable Precipitation (≥ 0.2 mm)	16.4	13.0	14.8	14.0	13.6	13.2	12.0	10.9	11.4	12.3	14.1	16.6	162.3
Wind													
Mean Wind Speed (km/h)	18.2	17.7	18.6	17.7	16	14.3	12.8	12.1	14.1	15.9	17.4	17.8	16.1
Most Frequent Wind Direction	NW	NW	NW	N	S	S	S	S	S	S	NW	NW	S
Extreme Wind Gust Speed (km/h)	143	146	137	121	132	129	105	93	130	138	126	145	--

Source: Environment Canada (2008d)

The discussion that follows is based on selected observations from the climate normals and extremes presented in Table 6.1. During the winter, the air mass is cold with a January daily mean temperature of -8.1°C. In the summer, the air mass is predominantly warm continental with a July daily mean temperature of 17.1°C. The extreme maximum and minimum temperatures recorded are 34.4°C and -36.7°C, recorded during August and February, respectively.

The average annual precipitation is 1,390.3 mm, of which 82.5% was in the form of rain. Extremes in daily precipitation occurred in April and December and were in the range of 125.5 mm to 154.4 mm.

The average annual wind speed reported at the Saint John Airport weather station was 16.1 km/h. The maximum wind speeds occurred in March with average speeds of 18.6 km/h and the minimum speeds occurred in August at an average of 12.1 km/h. The average monthly wind speeds were higher in the winter than the summer. The prevailing winds were from the south or southwest in summer and from the northwest in winter. Maximum hourly wind speeds (averaged from 1971 to 2000 for each month) ranged from 61 km/h and 111 km/h; while maximum gusts for the same period ranged from 96 km/h to 146 km/h. Occurrences of extreme winds are relatively uncommon at Saint John, as over the last three decades there has been an average of 21.3 and 6.1 days per year with winds ≥52 km/h and 63 km/h respectively (Environment Canada 2008d).

For additional details on existing conditions relating to climate, the reader is referred to Chapter 15.

6.1.2.2 Air Quality

Air quality in a region can be affected by local sources of emissions (either stationary sources such as industrial exhaust stacks or mobile sources such as motor vehicles), from natural sources, or from the long-range transport of air contaminants from other regions to the airshed. Local weather conditions can also exacerbate air quality problems.

The NBENV, in cooperation with Environment Canada and local industry, operates a network of ambient air quality monitoring stations in the province to measure ambient concentrations of several air contaminants as well as weather variables such as wind speed, direction, and temperature. Saint John has the longest history of air quality monitoring in the province, and the greatest number of monitoring stations. Monitoring has historically been conducted at more than 30 different locations in the City since 1961 (NBENV 2008a). Sixteen monitoring stations were active in the City in 2006. Not all sites measured all contaminants; however, there were several locations where sulphur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), and ground-level ozone (O_3) were monitored on a continuous basis.

Ambient air quality monitoring results for the Saint John region are published annually by the NBENV. Some general observations from the most recent report available, entitled "New Brunswick Air Quality Monitoring Results: Report for 2006" (NBENV 2008a), are as follows.

- Trends at sites with long monitoring records indicate that air quality has improved since the 1970s and 1980s for all contaminants currently being measured except ozone, for which no clear trend is apparent.
- The rate of compliance of ambient monitoring results with the ambient air quality standards at all monitoring stations in Saint John in 2006 was generally greater than 95%, and in most cases over 99%, for most contaminants and monitoring stations in the Saint John area.
- In 2006, air quality in Saint John was considered to be "good" (as rated using the Index for the Quality of the Air, or IQUA) more than 98% of the time, in the "fair" range at all monitoring stations for less than 2% of the time. Although ambient air quality can sometimes deteriorate for short periods of time during periods of reduced dispersion, potentially resulting in "poor" or "very poor" air quality ratings, there were no hours recorded in these categories in 2006.
- The ambient air quality standards were occasionally exceeded at some of the monitoring stations, particularly with respect to sulphur dioxide, in 2006 and in previous years. For sulphur dioxide, occasional exceedances occur under infrequent meteorological conditions. Although no exceedances for ozone were observed in 2006, ozone exceedances tend to occur in the summer due to long range transport from outside New Brunswick (NBENV 2008a).

Further details on the existing conditions relating to air quality are provided in Chapter 7.

6.1.3 Marine Environment

The Marine Terminal and Other Marine-Based Infrastructure for the Project will be located in the Bay of Fundy Marine Ecoregion in southern New Brunswick. The Saint John River is the largest river draining to this ecoregion and flows into the Inner Saint John Harbour in the Bay of Fundy.

A brief overview of the marine biophysical environment near the Project is provided below. Further details on the existing conditions are provided in Chapter 10.

6.1.3.1 Currents and Waves

The marine environment near and surrounding Mispec Point is characterized by strong tidal currents. Mispec Point is exposed to strong, long period waves entering the Bay of Fundy from the Atlantic Ocean. The large tidal range and the presence of headlands and inlets promote the formation of eddies. The magnitude and direction of currents are relatively uniform throughout the water column at a particular location, but vary with distance from the shore. Generally, closer inshore the currents are weaker and range from 0.1 m/s to 0.4 m/s, increasing to about 0.6 m/s to 0.9 m/s towards offshore and in deeper water (*i.e.,* greater than 15 m), and at times reaching as high as 1.2 m/s. Surface and bottom currents are not always homogeneous throughout a tidal cycle. Currents flow predominantly west during ebbing tides and east during flood tides off Mispec Point (Jacques Whitford 2008m).

Mispec Bay and the Bay of Fundy are free of sea ice all year, except for small isolated floating ice sheets during very cold winters.

6.1.3.2 Bathymetry and Marine Geomorphology

Situated at the northern boundary of the Gulf of Maine, the Bay of Fundy is a 280 km long slightly funnel shaped Bay, which splits at its northern end into two narrow bays: Chignecto Bay and the Minas Basin (Figure 13.1). The Bay of Fundy was formed as the continental plates parted approximately 350 million years ago (Burzynski and Marceau 1984). It is viewed geologically as a rift valley that has filled with sediment washed in from an eroding land mass. The Bay is relatively deep for a coastal inlet (75 m on average) with a width of approximately 100 km (Jacques Whitford 2008m). Figure 6.1 illustrates the bathymetry of the Bay.

The bathymetry in the marine waters near Mispec Point, where the Marine Terminal and Other Marine-Based Infrastructure will be located, indicates water depths in the area west of Mispec Point/Outer Harbour ranging from 2 to 31 m (lower low water large tide; LLWLT). Water depth surveyed in Inner Mispec Bay ranges between 1 to 32 m (LLWLT). The coastal near shore zone in water depths ranging from 0 m to approximately 10 m in both these survey areas is generally characterized by rugged, exposed bedrock with cobbles and boulders. Shoreface sediments within this range of water depths consist of silty sand and sandy silt. Surficial sands are finer grained in Mispec Bay than in the Outer Harbour. Gravelly mixed sediments are dominant below 24 m water depth within the Outer Harbour. Overburden thickness (on bedrock) is estimated to be <10 m within the Outer Harbour surveyed in the vicinity of the proposed location of the marine terminal, but reaches a maximum measured thickness of 23 m in Mispec Bay. Sub-surface sediments may consist of compact to dense silty sand, with possible glaciomarine clay and localized coarse-grained till at depth (Jacques Whitford 2008m).

6.1.3.3 Water and Sediment Quality

The water is generally cold, ranging from 0°C in the winter to 16°C in the summer. In this high-energy environment, vertical mixing causes the salinity and temperature to be largely uniform throughout the water column. The influence of the Saint John River can be felt in the Outer Harbour primarily during the spring freshet. The less saline and warmer layer at the surface is typically less than 3 m thick, and is often visible from the air. During the freshet, surface salinity can reach values as low as 16 parts per thousand (ppt) in the first few centimetres, 26 ppt at 5 m, and 28-29 ppt for bottom depths (Jacques Whitford 2008m).

Field data show that the water and sediment quality at all of the surveyed stations appeared to be adequate to support aquatic life, including fish populations.

6.1.3.4 Marine Biological Environment

Species of fish that exist in the Outer Saint John Harbour and in Mispec Bay would likely exist and be supported in the vicinity of the proposed location of the Marine Terminal and Other Marine-Based Infrastructure. These may include groundfish, pelagic fish such as herring and mackerel, and migrating fish species that use the Saint John River watershed to complete part of their life cycle (Jacques Whitford 2008m).

Marine mammals noted to frequent the Bay of Fundy were investigated and characterized, including Species at Risk such as North Atlantic right whale, blue whale, and Species of Conservation Concern (*e.g.,* fin whale and harbour porpoise). Others Species of Conservation Concern known to inhabit or frequent the Bay include the leatherback sea turtle, Atlantic salmon, Atlantic wolffish, shortnose sturgeon that is found only in New Brunswick, striped bass, and American eel (Jacques Whitford 2008m).

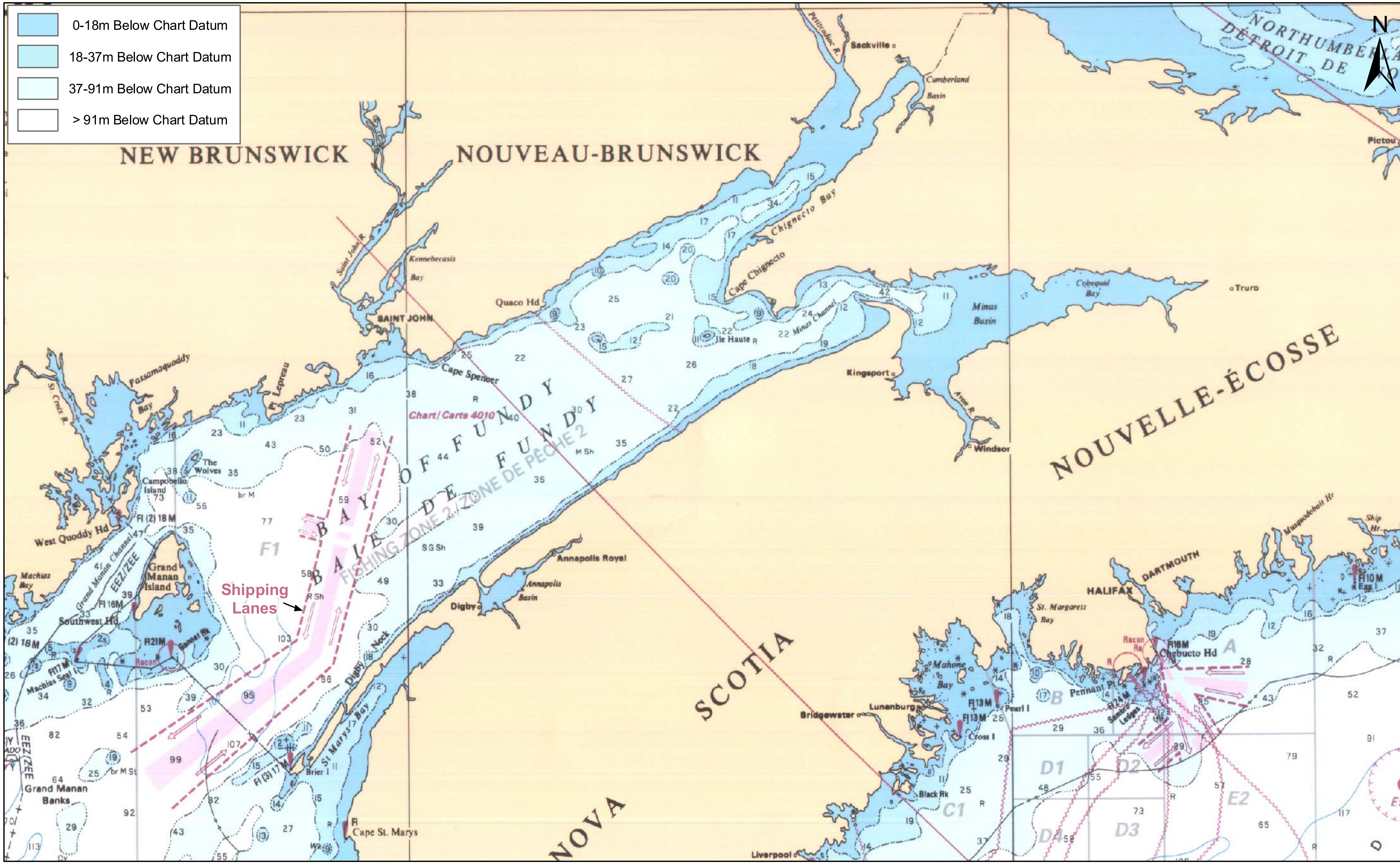
6.1.3.5 Birds

The general area around Saint John is well known to bird watchers and nature enthusiasts. The Bay of Fundy is known for its coastal and pelagic seabirds, with year round residents (*e.g.*, common eider) wintering birds (*e.g.*, harlequin duck and purple sandpiper), and is a major migration route. A total of 146 bird species have been detected in the Mispec and Red Head areas during bird surveys and monitoring carried out during the last seven years, of which 97 species likely nest in these areas (Jacques Whitford 2004, 2006a, 2008f; Fundy Engineering 2005a). Marine birds that would use the near-shore environment are included in this total, as are birds which pass over the survey area while migrating.

In 2006 and 2007, the area was intensively surveyed for owls, hawks, woodpeckers, and songbirds (Jacques Whitford 2008f). During these surveys 105 species were detected, of which 84 were considered as potential nesting (40% were confirmed as breeding). Twenty-three species of water birds have been regularly detected during winter coastal surveys in the survey area. It is unlikely that these wintering species are nesting in the area.

No bird Species at Risk were detected during surveys in 2006 and 2007 but four (bald eagle, peregrine falcon, harlequin duck, and common nighthawk) were detected within the survey area during previous studies for other projects. Common nighthawk was confirmed as nesting in the survey area in 2002. Bald eagle and peregrine falcon have been recorded during migration and/or wintering and are not known to nest in the general vicinity of the Mispec/Red Head. During 2000-2007, harlequin duck have been observed in the area each winter.

A total of 19 bird Species of Conservation Concern have been recorded in the Mispec and Red Head areas by field studies for the Project and other projects (Jacques Whitford 2004, 2006a, 2008f; Fundy Engineering 2005a). During breeding bird surveys in 2006 and 2007, only brown thrasher and purple finch were recorded as possible nesters. Although three species may nest in these areas, they were recorded outside breeding season and in unsuitable habitat. The remaining 14 Species of Conservation Concern were recorded during spring or fall migration (10 species) or while wintering (4 species).



Date: May 30, 2008
Project No.: 1013263.
Data Source: Canadian Hydrographic Service,
Chart No. 4003.
Depths are in Fathoms
1 Fathom = 1.83 Metres

Figure 6.1
Bay of Fundy - Bathymetry

Project Eider Rock

Jacques Whitford

6.2 Socio-Economic Setting

The City is the largest in New Brunswick and a major industrial centre in Atlantic Canada. The industrial heartland of New Brunswick and an important commercial centre, it is home to the largest oil refinery in Canada, a pulp mill, paper mill and Canada's oldest independent brewery (Moosehead Breweries). The Port of Saint John is one of Atlantic Canada's busiest and Canaport is the deepest sea water port in North America, north of Louisiana.

6.2.1 Demographic Overview

6.2.1.1 Population

The Saint John Census Metropolitan Area (CMA) includes the City of Saint John, the Town of Quispamsis, the Town of Rothesay, the Town of Hampton, the Town of Grand Bay-Westfield, the Village of St. Martins, and nearby rural areas (Jacques Whitford 2008n). The population of the CMA was 122,389 in 2006 (Statistics Canada 2006). The population of the CMA declined by approximately 2.5% from 1991 to 2001 (Statistics Canada 2001, 2006). From 2001 to 2006, the population decreased 0.2% (Statistics Canada 2001, 2006). The population of the CMA accounts for 16.8% of New Brunswick's total population.

6.2.1.2 Employment and Income

According to Census 2001 data, the median family income in the CMA was $50,163. (Note, all dollar figures are in Canadian dollars). This was higher than the provincial median and approximately $5,000 less than the national value. Similarly, the CMA had a higher median individual income ($20,284) than the province ($18,257); however, it was lower than that of Canada ($22,120).

6.2.2 Economic Activity and Economic Engines

Historically, the economy of the Saint John area was based around the industrial sector, including the oil refining, paper, and shipbuilding industries on the eastern side of the City.

As of 2006, the largest employers in Saint John include: Atlantic Health Sciences Corporation (3,893 employees); J.D. Irving, Limited (2,565 employees); School District 8 (2,300 employees); School District 6 (1,200 employees); Wyndham Worldwide Canada, previously known as Cendant (1,193 employees); Aliant (1,075 employees); and the Irving Oil Refinery (1,000 employees) (Enterprise Saint John 2006b).

6.2.2.1 Labour Force

According to Census 2001 data, the labour force participation rate (*i.e.,* the ratio of those that are eligible to work or be employed, to the overall working age population) in the CMA was 69.3% for males and 57.1% for females, for a total of 62.9% (Statistics Canada 2001).

In 2001, the unemployment rate in the CMA was 9.2%, which was substantially lower than the provincial rate (Statistics Canada 2001). In more recent years, unemployment in the CMA has continued to fall dramatically, reaching 4.8% in February 2008 (Statistics Canada, CANSIM Catalogue Table 71-001-XIE).

6.2.3 Land Use

6.2.3.1 Zoning and Land Use

Development and building permits in Saint John are regulated under the City of Saint John Municipal Development Plan (MDP), and the relevant Zoning and Building By-laws. Beyond the City limits (on the east side of the Mispec River), planning is regulated by the Royal District Planning Commission.

The Canaport Limited and Canaport LNG facilities are zoned for heavy industry. The Red Head Mountain area is zoned rural. Along Black River Road and Proud Road, the land is primarily zoned residential and contains several dwellings, though the majority of the area is vacant. Along Red Head Road from Rocky Corner to the Mispec River, the land is zoned residential. The existing Harbourview Subdivision is zoned residential, while other areas along Red Head Road, including the Debly Subdivision, are zoned suburban residential. An area near Mispec Bay is currently zoned for park use (Jacques Whitford 2008n).

With respect to industrial development, specific designations in the City By-laws include heavy industrial areas, light industrial areas, and business parks. The area containing the Canaport Limited and Canaport LNG facilities is currently zoned heavy industrial. Other areas that are likely to be developed as part of the Project are largely zoned as residential or forest (Jacques Whitford 2008n), but will be re-zoned for the Project.

6.2.4 Commercial Fisheries Resources

The commercial fishery in the general vicinity of the Project is dominated by the lobster fishery. A much lesser level of fishing effort is focused on scallop, though the area is located within a Conservation Zone that is closed to the scallop fishery for 9 months of the year. No other species support a substantive fishery in the area (Jacques Whitford 2008n).

Currently, DFO issues fishing licenses to commercial fishermen in the Saint John County area for several species, including scallop, groundfish, rockweed, sea urchins, shad, gaspereau, eel, dogfish, herring, lobster, mackerel, and sturgeon. The rock crab fishery is a licensed fishery in the area; however, it has not been actively fished in recent years because market conditions do not make the fishery viable. Licensed lobster fishermen are able to retain rock crab and Jonah crab as a by-catch, which are primarily for personal use (Jacques Whitford 2008n).

Although there are licenses issued for groundfish, pelagic, and estuarine fisheries near the Project, these fisheries declined substantially in recent years and currently contribute very little to the total financial value of the local fisheries. The apparent lack of alternative fishing opportunities that resulted from these declines appears to have increased the local industry dependence on the lobster resource and fishery.

6.2.5 Transportation and Transportation Infrastructure

6.2.5.1 Road

The City is serviced by an extensive modern road transportation network. Access to the City is provided mainly via Route 1 (the Throughway), a four-lane divided Provincial Arterial Highway with full access control that passes east-west through the City between its eastern limits at Rothesay and western limits at Lorneville (ADI 2008).

6.2.5.2 Rail

The Saint John area has an extensive rail network to serve its port and industrial sectors. The City is served by two railways. CN Railway operates a rail line from Saint John to Moncton, where it connects to its main line that operates east to Halifax and west to Québec, Ontario, and the United States. New Brunswick Southern Railway (NBSR), a short line railway, provides Saint John and Southwest New Brunswick with service that extends into the State of Maine (ADI 2008).

6.2.5.3 Marine

The Port of Saint John is Atlantic Canada's largest port and handles an average of 25 million metric tonnes of cargo annually. The Port provides 3,000 direct and indirect jobs, and is essential to New Brunswick's natural resources sector such as petroleum, potash, forestry, and aquaculture industries and to its import and export trade. The Port makes a significant contribution to the provincial tourism sector through cruise ships.

Daily ferry service from Digby, Nova Scotia is provided to the Port of Saint John via the Princess of Acadia, which lands at the ferry terminal located on the City's west side (Bay Ferries 2008).

Further details on the existing conditions with respect to marine safety are provided in Chapter 13.

6.2.5.4 Air

Air transportation service to the Saint John area is via the Saint John Airport, operated by Saint John Airport Inc. since June 1999. The airport operates with three commercial airlines, and currently directly and indirectly employs 200 people. The airport adds approximately $50 million to the Saint John economy annually.

6.2.6 Heritage and Archaeological Resources

There are 16 documented archaeological sites in the Saint John area, from Seely Point (on Taylors Island), Saint John West, along the Saint John River, and in Uptown Saint John. These sites date to the Pre-contact and Historic periods and indicate the long history of human activity in the region.

Further details on Heritage and Archaeological Resources, including consideration of archaeology, palaeontology, and built heritage, are provided in Chapter 14.

7.0 ATMOSPHERIC ENVIRONMENT

The Atmospheric Environment is considered a Valued Environmental Component (VEC) for a number of reasons, as follows.

- The atmosphere has an intrinsic or natural value, in that the atmosphere and its constituents are needed to sustain life and maintain the health and well-being of humans, wildlife, vegetation and other biota.
- The atmosphere is a pathway for the transport of air contaminants to the freshwater, marine, terrestrial and human environments, presenting the contaminants in the form of varying atmospheric concentrations or particle phase or gas phase deposition.
- If not properly managed, releases of air contaminants to the atmosphere from the Project may cause adverse environmental effects on the air, the land and the waterways in the vicinity of the Project.
- Greenhouse gas (GHG) emissions accumulate in the atmosphere and are a major factor in producing the greenhouse effect that may affect climate.
- If not properly managed, sound emissions in the form of noise (unwanted sound) from the Project may cause adverse environmental effects on the sound quality in the vicinity of the Project.

The Atmospheric Environment has therefore been selected as a VEC due to the potential for interactions between the Project and these potential environmental effects.

The Marine Terminal and Other Marine-Based Infrastructure (the Project) will release air contaminant, GHG, and sound emissions, principally from the loading activities at the marine terminal and from intermittent emissions from Project-related marine vessels. Construction and Operation could also release air contaminant, GHG, and sound emissions to the atmosphere (*e.g.,* emissions from heavy construction equipment, fugitive dust, and combustion of fuels).

The emissions from the Project have been identified as a key concern by regulatory agencies, the public and stakeholders. Consequently, initiatives and technologies to mitigate the emissions have been incorporated into the design of the Project. Standard mitigation measures during Construction, such as the use of dust suppressants during construction activities on land and implementation of an idling policy, are also planned. These mitigation measures will ensure that the Project can be carried out in an acceptable manner without adversely affecting ambient air quality, sound quality, or climate in a significant way.

Based on the analyses provided below, the environmental effects on Atmospheric Environment are not significant for the following reasons.

- Project activities and associated emissions will be managed by the Proponent to minimize their magnitude, duration, frequency, and geographic extent such that they do not cause significant adverse environmental effects to the Atmospheric Environment.
- GHG emissions from the marine terminal will be relatively small in a global context, and will be managed in a manner consistent with the regulations and policies that are expected to be implemented by the Government of Canada.

- The estimates of GHG and air contaminant emissions from the Project are conservative, meaning they are higher than they are likely to be during actual Construction or Operation.
- The estimates of background values for the air contaminants are conservative, meaning they are higher than they are likely to be in regions where the Project is expected to cause the greatest change in concentrations.
- Downwind concentrations of air contaminants were predicted based on conservative estimates of the emission rates during Operation. The predicted concentrations are therefore conservative.
- The frequency of occurrence of a Project-related air contaminant emissions causing an ambient objective, guideline or standard to be exceeded, is expected to be very low.
- Project-related noise emissions are not expected to exceed the noise guideline levels, primarily due to large distances from marine terminal noise emission sources to noise sensitive receptors.

As will be demonstrated in the analyses that follow, the potential environmental effects of the Project-related emissions of air contaminants, GHG, and sound during Construction, Operation, and Decommissioning and Abandonment, including cumulative environmental effects, are not significant.

7.1 Scope of Assessment

This environmental assessment of Atmospheric Environment includes consideration of the potential environmental effects associated with the Project.

The potential environmental effects to be assessed are associated with Project-related emissions of air contaminants, GHG, and noise to the atmosphere during Construction, Operation, and Decommissioning and Abandonment of the Project. Potential Accidents, Malfunctions, and Unplanned Events that may result in emissions of air contaminants to the atmosphere are addressed separately in Chapter 16.

In this CSR, the approach is to select the environmental effects, the associated measurable parameters (concentrations and/or emissions rates of GHG or air contaminants) to be considered, establish boundaries for the environmental effects assessment, establish the significance criteria, characterize the environmental effects, assess the residual environmental effects (with mitigation such as emissions control equipment), determine the significance of the environmental effects, and prepare a follow-up monitoring program, as applicable.

7.1.1 Regulatory Setting

The federal requirements related to the CSR of the Project under *CEAA* are described in the EA Track Report and Scoping Document. The CSR must assess the environmental effects of the Marine Terminal and Other Marine-Based Infrastructure on Air Quality, GHG emissions, and Sound Quality.

The main legislative instruments at the federal level in Canada for managing air quality are the *Canadian Environmental Protection Act* (*CEPA*) and from Canada-Wide Standards (CWS) that have been developed under the Canadian Council of Ministers of the Environment (CCME) Canada-Wide Accord on Environmental Harmonization.

For GHG emissions and climate, the existing national guidance is provided by the CEA Agency (CEA Agency 2003) and includes guidance on the environmental assessment of GHG emissions from the Project and from the related industrial sector.

For sound emissions, Health Canada has published Guidance on Noise Assessment for projects requiring an EA under *CEAA*. This includes objectives for noise levels based on day-night average sound levels and percent annoyance.

These regulatory requirements form the basis for the assessment of the potential environmental effects on Atmospheric Environment and are discussed in more detail in the following sections.

7.1.2 Issues and Concerns Identified During Public and Stakeholder Engagement

The main issues arising from the public engagement in relation to the marine terminal are presented in the following table. Responses to the comments are provided in Table 7.1.

Table 7.1 Summary of Comments Relating to Atmospheric Environment Identified During Public and Stakeholder Engagement

Summary of the Question Posed or Comment Made	Response or Action Taken
Will dispersion and deposition modelling take into account what weather conditions will be like in the future as a result of climate change?	Not specifically. Dispersion and deposition modelling relies on actual recent hourly observations to make predictions. Data from the past 5 years is used to ensure that periods of worst-case dispersion are captured in the analysis. Predicted changes in this data for the foreseeable future are not large.
Is there a monitor at Mispec Beach?	VOC concentrations in ambient air were monitored in Mispec, just east of Mispec Beach.
If an exceedance to air quality regulations occurs during operation (upset conditions), how will the public be notified?	There currently is a system in place to notify citizens of air quality conditions through Health advisories and the IQUA system operated by the New Brunswick Department of Environment. It is anticipated that a similar system would be implemented at any future refinery facility.
How will standards and objectives be identified for each contaminant?	The order of preference will be to use Canada-Wide standards first. If standards or objectives for a particular COPC do not exist from these jurisdictions, standards or objectives in other jurisdictions may be used, if they are appropriate.
Air pollution as a result of marine vessel traffic is becoming a concern.	Emissions from vessel traffic are considered at the berth.
Does fog have an effect? Is it included?	The incidence of fog is noted in the weather files used for the modelling. The presence of fog tends to indicate calm wind conditions with low ceilings, which tend to suppress dispersion of contaminants.
Canada has international commitments to greenhouse gas emissions.	Given the Proponents awareness of emerging policy with respect to GHG including the need for continuous improvement, it is intended that the Project would comply with the requirements of greenhouse gas legislation when those regulations are in place.
The EA should include air emissions from marine vessels.	Emissions from marine vessels have been included in air quality modeling.

Table 7.1 Summary of Comments Relating to Atmospheric Environment Identified During Public and Stakeholder Engagement

Summary of the Question Posed or Comment Made	Response or Action Taken
Air quality and sound quality monitoring should be conducted in the local area.	Six months of ambient air quality monitoring has been conducted at five specific locations in the Canaport, Anthonys Cove, Old Black River Road, Red Head, and Mispec areas. Noise monitoring was conducted for 24 hours at nine locations to characterize baseline conditions. Any future monitoring of air quality and/or sound quality that may be required to monitor the environmental effects of the Project during Construction or Operation will be identified, as applicable, in the CSR or subsequently as part of Certificates of Approval issued to the Project.
The Project should comply with regulations and guidelines from other jurisdictions and international treaties, with regards to air quality.	Compliance with laws of other jurisdictions or with international treaties is not a requirement. The Project will comply with the laws of New Brunswick and Canada.

7.1.3 Selection of Environmental Effects

The Atmospheric Environment is a component of the environment that comprises the layer of air near the earth's surface to a height of approximately 10 km. It is divided into three key aspects for consideration in this CSR, reflecting key Project-Atmosphere interactions. These are: Air Quality, Climate, and Sound Quality.

- Air Quality is defined as a measure of the constituents of ambient air, and includes the presence and the quantity of these constituents including air contaminants in the atmosphere. For this CSR, criteria air contaminants and other air contaminants likely to be emitted are included in the environmental effects assessment of Air Quality.
- Climate can be defined as the composite or generally prevailing meteorological conditions of a region, including temperature, air pressure, humidity, precipitation, sunshine, cloudiness, and winds, throughout the seasons, averaged over a series of years (typically a 30 year period). The net emissions of GHG from the Project are used in this CSR as an indicator of potential environmental effects on Climate. The environmental effects of Climate on the Project are addressed in Chapter 15, Effects of the Environment on the Project.
- Sound Quality in the outdoor environment may be adversely affected by the Project. Noise is defined as unwanted sound and is usually present through a range of frequencies. The audible frequencies for humans are in the range of 20-20,000 Hertz (Hz). In this CSR, the environmental effects of sound emissions from the Project on Sound Quality in the area in and surrounding the Project are assessed.

On this basis, the potential environmental effects on Atmospheric Environment associated with the Project-related emissions to the atmosphere are selected as:

- Change in Air Quality;
- Change in GHG Emissions; and
- Change in Sound Quality.

These environmental effects were selected on the basis of the regulatory requirements of the EA Track Report and Scoping Document, to address issues and concerns identified during Consultation, as well as based on the specific nature of the Project's releases that may interact in some measurable way with the Atmospheric Environment.

7.1.4 Selection of Measurable Parameters

The specific constituents, described as measurable parameters, that are used for the assessment of environmental effects are listed in Table 7.2.

Table 7.2 Measurable Parameters for Atmospheric Environment

Environmental Effect	Measurable Parameter	Notes, or Rationale for Selection of the Measurable Parameter
Change in Air Quality	Emissions and ambient concentrations of criteria air contaminants (CAC) and non criteria air contaminants (Non-CAC).	▪ Regulatory objectives, guidelines and/or standards exist provincially and federally for SO_2, NO_x, CO, PM, PM_{10}, $PM_{2.5}$, H_2S, O_3 and selected others including specific VOC, Metals, and PAH.
Change in GHG Emissions	GHG emissions – CO_2, CH_4 and N_2O (in units of CO_2 equivalents or CO_2eq).	▪ This is a key consideration in the CEA Agency guidance document (CEA Agency 2003) for assessing potential Project-related environmental effects on climate. Respecting the importance of climate change as a global issue, the CSR will focus on mitigation and adaptive management strategies to minimize Project-related GHG emissions.
Change in Sound Quality	A-weighted sound pressure levels in decibels (dB_A) for 1 h L_{eq}.	▪ No federal or provincial regulations exist, however, regulatory threshold values are identified in selected Certificates of Approval in New Brunswick; A-weighted decibels (dB_A) is the commonly used unit to evaluate the perception of a sound by the human ear.

7.1.5 Temporal Boundaries

The temporal boundaries for Atmospheric Environment include the time periods for Construction (6-8 years in two sequential phases beginning no earlier than 2010), Operation (30 years or more, extended by refurbishment or maintenance), and Decommissioning and Abandonment of the Project (at the end of its useful life) as defined in Chapter 3.

The temporal boundaries for the establishment of baseline conditions are as noted below.

- For baseline or pre-Project conditions for a Change in Air Quality, the temporal boundary is based on a six year period (2001-2006), as well as field data from the supplementary monitoring conducted in the Canaport/Red Head/Mispec areas over approximately 6-8 months in 2007 and 2008.
- For baseline or pre-Project conditions for a Change in GHG Emissions, the temporal boundary extends back to consider the most recent 18 years (1990-2008) of GHG emissions data from the Province and Canada.

7.1.6 Spatial Boundaries

The spatial boundaries for the assessment of environmental effects on the Atmospheric Environment are comprised of the following.

Project Development Area (PDA): The PDA is defined as the area of physical disturbance for the Project and includes the physical area for the planned Marine Terminal and Other Marine-Based Infrastructure, and extending out approximately 3 km beyond this.

Local Assessment Area (LAA): The LAA is defined as an area that is 15 km (east-west) by 15 km (north-south) and centered approximately on the location of the Project. The LAA is shown in Figure 7.1.

Regional Assessment Area (RAA): The RAA is defined as an area that is 70 km (east-west) by 45 km (north-south) and centered approximately on the location of the Project. The RAA is shown in Figure 7.1.

For a Change in GHG Emissions, since the environmental effect of GHG on the environment is a global concern, the spatial boundary is provincial, national and ultimately global in geographic extent.

7.1.7 Administrative and Technical Boundaries

7.1.7.1 Change in Air Quality

The administrative boundaries for the environmental effects assessment of a Change in Air Quality pertain mainly to regulatory objectives, guidelines and standards as criteria for air contaminants either being emitted from sources (emission rates) or as present in the atmosphere at ground-level (ambient concentrations). These criteria are set by regulatory authorities to be protective of air quality and human and environmental health.

The emissions of air contaminants from the Project and the predicted downwind ground-level concentrations (GLC) are compared to applicable ambient air quality or emissions criteria in New Brunswick (*Clean Air Act* and *Air Quality Regulation)*, as well as to Canada-Wide Standards, where they exist. The ambient objectives, guidelines and/or standards have been developed by the regulatory agencies, including the New Brunswick Department of Environment and Environment Canada, and others such as the Ontario Ministry of Environment (OMOE), to provide threshold values for assessing the extent of the potential environmental effects on air quality, human health and the environment.

A summary of the ambient air quality objectives, guidelines and standards for the CAC is presented in Table 7.3. These are a combination of the provincial and federal values from New Brunswick, Environment Canada, Ontario and British Columbia.

Table 7.3 Objectives, Guidelines and Standards – Criteria Air Contaminants

Criteria Air Contaminant	Averaging Period	Objective/ Guideline/ Standard ($\mu g/m^3$)	Source for Objective/Guideline/Standard
SO_2	1 h	450	NB Air Quality Objectives[1]
	24 h	150	
	Annual	30	
NO_2	1 h	400	NB Air Quality Objectives[1]
	24 h	200	
	Annual	100	
CO	1 h	35,000	NB Air Quality Objectives[1]
	8 h	15,000	
TSP	24 h	120	NB Air Quality Objectives[1]
	Annual	70	

Table 7.3 Objectives, Guidelines and Standards – Criteria Air Contaminants

Criteria Air Contaminant	Averaging Period	Objective/ Guideline/ Standard ($\mu g/m^3$)	Source for Objective/Guideline/Standard
H_2S	1 h	15	NB Air Quality Objectives[1]
	24 h	50	
PM_{10}	24 h	50	BC MOE AQ Objectives[2]
$PM_{2.5}$	24 h	30	CCME Canada-Wide Standards[3]
Ammonia	24 h	100	O. Reg. 419/05, Schedule 3 Standards[4]

Notes:
1 New Brunswick *Air Quality Regulation*, 97-133 (NBENV 2005).
2 BC MOE = British Columbia Ministry of Environment (BC MOE 2008).
3 CCME Canada Wide Standards (CCME 2000).
4 Ontario Regulation 419/05 (OMOE 2008b).

As the Marine Terminal and Other Marine-Based Infrastructure is very unlikely to release substantive quantities of any other contaminants than CAC, the assessment that follows focuses on CAC emissions from the marine terminal.

The technical boundaries for assessment of a Change in Air Quality include:

- The inherent uncertainty in the estimates of emission rates at a preliminary stage of engineering design;
- Scientific limitations in the ability of dispersion models to accurately predict the maximum ground-level concentrations and deposition rates due to the complex physics and chemistry of the atmospheric processes; and
- The ability to measure ambient concentrations of air contaminants.

7.1.7.2 Change in GHG Emissions

The administrative and technical boundaries for consideration of GHG emissions and climate are based on and influenced by the application of CEA Agency guidance that was developed to establish a framework for the consideration of climate change in environmental assessments (CEA Agency 2003). In this guidance, it is recommended that net changes in GHG emissions as a result of a project be assessed. If they are found to be “medium” or “high”, the guidance recommends that a GHG Management Plan be developed to clarify how GHG emission considerations are being and will be addressed.

The CEA Agency guidance recognizes that EA approaches to addressing the issues of climate change will evolve to reflect federal, provincial and international decisions, policy guidance and scientific understanding of the issue. The evolving approaches also reflect the guidance offered by court and regulatory rulings on issues related to climate change and GHG emissions management. Governments take these rulings and policy decisions into account and reflect them in their evolving regulatory guidance and policy.

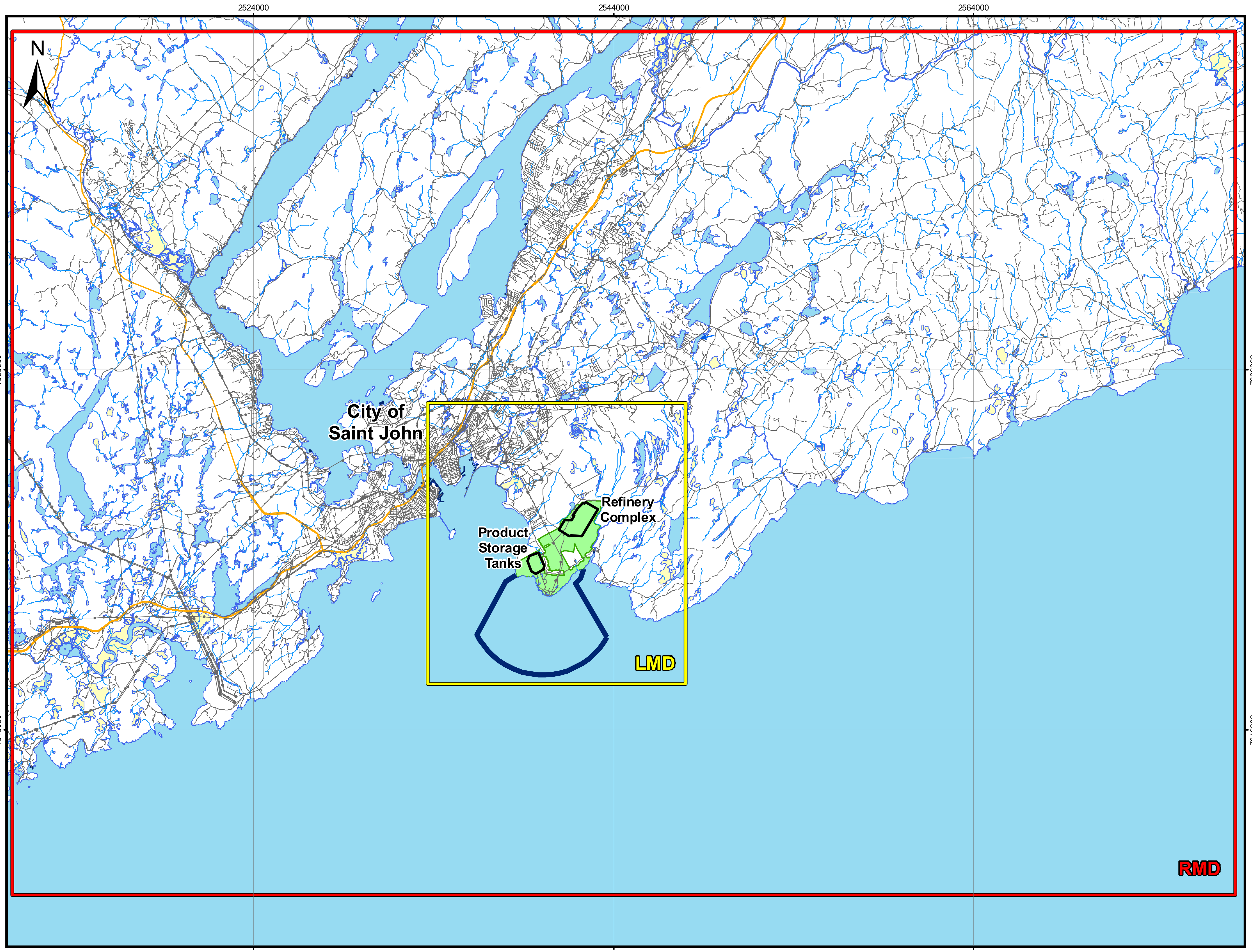


Figure 7.1
Study Domains Considered in Air Quality Technical Study

Project Eider Rock

Map Features

- Project Component
- Local Modelling Domain
- Regional Modelling Domain
- Project Development Area (Marine Terminal Facilities and Infrastructure)
- Major Road
- Secondary Road
- Local Road
- Track
- Rail Line
- Watercourse
- Wharf
- Utility Line
- Waterbody
- Wetland (SNB)
- Project Development Area (Refinery Facilities and Infrastructure Approx. 1132 ha)

Data Source: Service New Brunswick, Fluor

0 1 2 4 6 8 10
Kilometres

Map Parameters
Projection: NB Stereographic
Scale: 1:210,000
Date: August 8, 2008
Project No.: 1013263.

Jacques Whitford

GHG reporting requirements have been established under the *Canadian Environmental Protection Act 1999* (*CEPA*) requiring GHG emissions reporting for large industrial facilities starting in 2004. In December, 2007 under *CEPA* Section 71, a notice was published (Environment Canada 2007c) requiring detailed GHG emission, production, emissions control, and monitoring information be submitted by May 31, 2008 for over 750 industrial facilities in Canada. These reporting requirements do not apply to marine terminals, however. The proposed GHG regulations are to be published as drafts for comment, and may come into effect before January 1, 2010.

The administrative boundaries for the consideration of GHG emissions and climate are, therefore, the relevant statutes, regulations, policies, and guidelines published by the Government of Canada.

The main technical limitation in assessing the environmental effects of a Change in GHG Emissions on climate is associated with the measurement of the change. While the GHG emissions, globally, by country and by an individual source, can be reasonably quantified, it is not yet possible to measure the specific environmental effect (*i.e.,* the change in the environment) of any one individual facility's contribution to a change in climate. A cause and effect relationship cannot be established between emissions from a specific facility and global climate change (CEA Agency 2003).

It is widely recognized, however, that the total anthropogenic emissions of GHG world-wide do cause consequent changes to climate, and these changes are generally considered by many scientific authorities around the world to be a significant cumulative environmental effect. It is also recognized that Project-related GHG emissions, no matter how large or small, will contribute to these significant cumulative environmental effects. As a result, Project-related GHG emissions "will be assessed and considered in the context of local, provincial, national and industry sector normals," (CEA Agency 2003) and Project significance will be based on the quantities of GHG emissions in those contexts. The assessment also considers mitigation and adaptive management strategies aimed at minimizing Project-related GHG emissions with the intention of being in compliance with current regulations, and that the Project will be designed with adaptive management opportunities being taken into consideration to allow compliance with future regulations. This approach is consistent with the CEA Agency guidance (CEA Agency 2003), and is presented in additional detail throughout the remainder of Chapter 7.

A second part of this guidance suggests how the CSR should take into account the regional variations in climate, environment, and jurisdictional practices, and identify and address the potential for changes in climate to cause adverse environmental effects on the Project. These recommendations are addressed in Chapter 15.

7.1.7.3 Change in Sound Quality

With regard to a Change in Sound Quality, there are no specific regulatory criteria in place by the Government of Canada or the Province of New Brunswick regarding acceptable noise levels from specific facilities. Health Canada has established noise guideline levels for construction and operation of projects being assessed under *CEAA*, entitled "Draft Guidance on Noise Assessment for *Canadian Environmental Assessment Act* (*CEAA*) Projects". Under the Health Canada guidance, noise guideline levels during construction and operation of a project are based on day-night average sound levels (L_{DN}) and percent annoyance. L_{DN} is an energy-weighted average, similar to L_{eq} for a full day, except that the night time hour (22:00 to 07:00) levels are incremented by 10 dB_A to reflect increased sensitivity of the community to sound levels during those hours.

The adopted criteria for sound levels, or "noise guideline levels" used in this CSR correspond to those imposed by the New Brunswick Department of Environment in the Certificates of Approval to Operate for industrial facilities in the province. The noise guideline levels considered in this CSR are used as guidelines in Nova Scotia, where they are also imposed in the industrial approvals process. Noise guideline levels are expressed in decibels (dB_A) using the A-weighted system, and equivalent levels (L_{eq}) which are average levels that have the equivalent energy to the time-varying environmental sound. The use of L_{eq} and A-weighted decibels is virtually universal in regulated sound criteria.

The technical boundary for a Change in Sound Quality is the ability to estimate sound emissions from the anticipated sources of noise, and the modelling prediction of sound attenuation as it disperses in a complex environment.

7.1.8 Residual Environmental Effects Rating Criteria

The significance criteria for environmental effects on Atmospheric Environment are described below.

For a Change in Air Quality, a significant adverse residual environmental effect is one that degrades the quality of the ambient air such that the maximum Project-related ground-level concentration plus the conservative background level of the air contaminant being assessed frequently exceeds the respective ambient air quality objective, guideline or standard. "Frequently" is defined as once per week for 1 hour objectives and once per month for 24 hour objectives. "Air contaminant" refers to CAC, as emissions of Non-CAC from the marine terminal are not expected to be substantive.

For a Change in GHG Emissions, following the CEA Agency (2003) guidance, "the environmental assessment process cannot consider the bulk of GHG emitted from already existing developments. Furthermore, unlike most project-related environmental effects, the contribution of an individual project to climate change cannot be measured" (CEA Agency 2003). It is, therefore, recognized that it is not possible to assess significance related to a measured environmental effect on climate change on a project-specific basis. At the same time, it is recognized that a scientific consensus is emerging in respect of global emissions of GHG and consequent changes to global climate as generally representing a significant cumulative environmental effect. Project emissions of GHG will contribute to these significant cumulative environmental effects, but the contribution, although measurable and potentially important in comparison to local and provincial levels, will be small in a global context.

Thus, instead of setting a specific significance criterion for environmental effects on climate change and determining whether and how it can be met, a Change in GHG Emissions is considered by conducting a preliminary scoping of GHG emissions, determining jurisdictional considerations (including GHG policies or plans), and by considering the magnitude and duration of Project emissions as directed by the CEA Agency guidance (CEA Agency 2003). Specifically for this Project, as required by EA Track Report and Scoping Document, the Project-related GHG emissions are compared to provincial, national, and global GHG emissions. Three categories are described in the CEA Agency guidance: low, medium and high. In this CSR, these are attributed to numerical values (on a tonnes CO_2eq per annum basis) of less than 10^5, greater than 10^5 and less than 10^6, and greater than 10^6, for low, medium and high categories, respectively.

For a Change in Sound Quality, in consideration of the accepted practice in New Brunswick for regulating project-related noise in Certificates of Approval, a significant adverse residual environmental effect is one where Project-related sound emissions cause the sound pressure levels at the nearest noise sensitive area or receptor (NSA) to frequently exceed the noise guideline levels of a 1 hour L_{eq} of

65 dB_A during the day (06:00-22:00) and 55 dB_A during the night (22:00-06:00). “Frequently” is defined as once (*i.e.,* one hour) per week. The Health Canada guidance will supplement these significance criteria.

7.2 Existing Conditions

7.2.1 Air Quality

Existing air quality conditions are described both in terms of the meteorological conditions and the general air quality of the RAA. The general air quality of the RAA is characterized in terms of the concentrations of CAC and other airborne contaminants monitored in the local airshed as well as the emissions of contaminants from existing major industrial sources within the region that contribute to those measured concentrations. Meteorological conditions, especially wind speed and wind direction, are used in the modelling to assess Air Quality. Each of these is discussed in the following sub-sections.

7.2.1.1 Meteorological Conditions

A brief summary of overall climatological conditions was presented in Section 6.2. Additional wind speed and wind direction data is presented here for the purpose of establishing wind patterns as they relate to dispersion of emissions released to the atmosphere from industry in the Saint John region.

Wind Speed and Direction – Saint John

The annual average joint frequency distribution of wind speed and direction at the Saint John Airport (2000-2005) is presented in Figure 7.2. The wind direction is reported as the direction from which the wind blows, and is measured at a height of 10 m above grade. The relative length of a particular wind vector indicates the frequency of winds occurring from that direction and the various colours used for each vector are indicative of the range of wind speeds.

As shown in Figure 7.2, winds are most frequently from the southwestern quadrant (approximately 30% of the time), with winds from the northwesterly direction also being frequent (25% of the time). Winds blowing from the east are relatively infrequent.

Overall, the prevailing winds are from the southwest in summer and from the northwest and north in winter.

7.2.1.2 Emissions in the Saint John Area

The regional emissions inventory is a summary of substantive emissions from existing industrial sources in the Saint John area including the existing Saint John refinery, electrical generating plants, pulp and paper mills, and other manufacturing facilities.

The regional point source inventory, based on the NPRI and other available information including source testing reports and published emission factors, is presented in Table 7.4 (Jacques Whitford 2008b).

Table 7.4 Typical Emissions Inventory – Existing Point Sources in the Saint John Region

Source	SO_2 (kg/h)	NO_X (kg/h)	CO (kg/h)	PM (kg/h)	PM_{10} (kg/h)	$PM_{2.5}$ (kg/h)
Irving Oil Limited – Saint John Refinery	569	483	134	49.8	37.6	29.6
Irving Pulp and Paper	389	104	191	38.8	29.2	26.5
Irving Paper (includes Courtenay Bay)	279	66.0	ND	10.5	6.12	3.86
Bayside Power	0.05	28.8	1.49	8.35	2.3	1.43
Moosehead Breweries	50.1	11.8	0.43	3.93	2.98	2.16
Inteplast Bags and Films	n/a	n/a	0.02	0.06	0.06	0.06
Lafarge Asphalt Plant	0.09	2.01	24.5	0.18	0.08	0.06
Coleson Cove	1,720	755	67.0	32.5	20.5	13.3
Maritime Paper Products	n/a	1.23	n/a	0.50	0.50	0.32

Note: Data from various publicly available sources such as the NPRI, environmental assessments, source testing and dispersion modelling reports (Jacques Whitford 2008b), were used to generate this inventory.

7.2.1.3 Ambient Air Quality

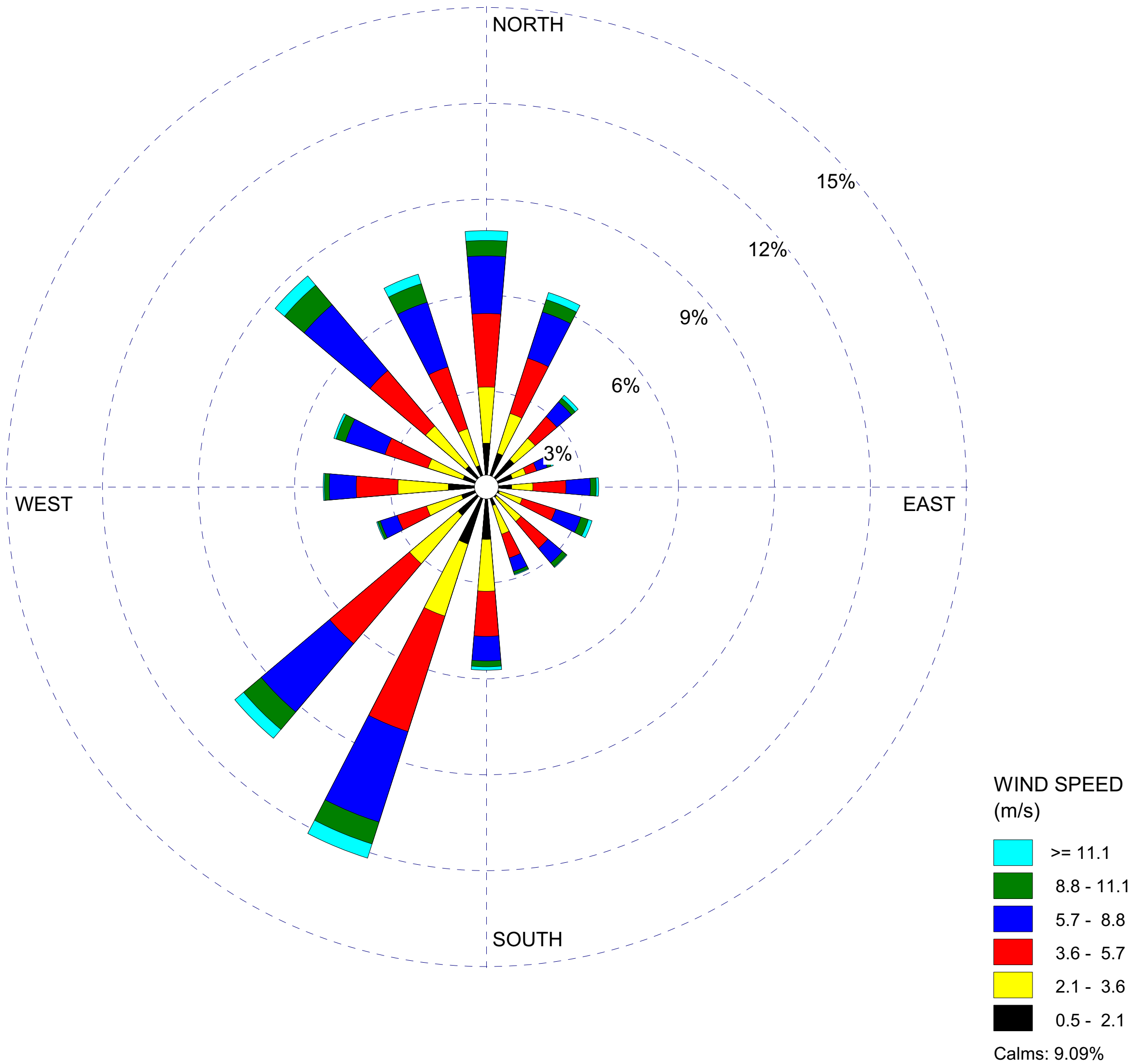
The Province of New Brunswick, through the New Brunswick Department of Environment and in cooperation with Environment Canada, has been operating a network of ambient air quality monitoring (AAQM) stations in the province to measure ambient concentrations of several air contaminants. The Environment Canada National Air Pollutant Surveillance (NAPS) Network is a cooperative program between the federal and provincial governments which measures air quality throughout Canada. The NAPS program, in existence since 1970, supports various air quality programs across Canada designed to protect human health and the environment.

The City of Saint John has the longest history of air quality monitoring in the province and the greatest number of monitoring stations, as discussed in Section 6.2. Ambient monitoring data published from provincial and federal programs for the Saint John area from 2001 to 2006 were used to establish the existing baseline conditions for the Project (Jacques Whitford 2008b). Supplementary monitoring was conducted in the immediate area of the Project over a 6-8 month period in 2007-2008 to confirm the applicability of the long-term monitoring data at Forest Hills to the Project area and to fill specific data gaps related to specific air contaminants. The supplementary monitoring for a variety of compounds was conducted at five locations in the vicinity of the Project site to establish baseline levels in the immediate project area. These locations are:

- Debly Subdivision (represented by the Red Head United Church location);
- Canaport;
- Mispec;
- Anthonys Cove; and
- Old Black River Road.

A full suite of measurements (CAC, metals, VOC, PAH) were made at the Debly Subdivision and Canaport locations. Concentrations of VOC only were measured at Mispec, Anthonys Cove, and Old Black River Road. Summaries of the monitoring data are presented in the following sub-sections.

Figure 7.2 Winds at Saint John Airport (2000-2005)



DATA PERIOD: 2000 - 2005 **2000-2005** **Jan 1 - Dec 31** **00:00 - 23:00**	COMPANY NAME: **Jacques Whitford**	
CALM WINDS: **9.09%**	TOTAL COUNT: **45293 hrs.**	
AVG. WIND SPEED: **4.53 m/s**	DATE: February 16, 2007 **2/16/2007**	PROJECT NO.: 1013263

WRPLOT View - Lakes Environmental Software

Criteria Air Contaminants

A comparison of CAC data collected at the Forest Hills and Champlain Heights stations and the Debly Subdivision and Canaport locations is provided in Table 7.5.

Table 7.5 Comparison of Measured Ambient Air Quality – Existing and Supplementary Data

Contaminant	Averaging Period	Ambient Objective/ Guideline/ Standard (µg/m³)	Existing Saint John Network		Supplementary Monitoring	
			Maximum Value Recorded at Forest Hills (2002-2006) (µg/m³)	Maximum Value Recorded at Champlain Heights (2002-2006) (µg/m³)	Maximum Value Recorded at Debly Subdivision (May 2007-Dec. 2007) (µg/m³)	Maximum Value Recorded at Canaport (Oct. 2007-Apr. 2008) (µg/m³)
SO_2	1 h	450	707	907	64.7	84.5
	24 h	150	183	144	16.2	44.7
	Annual	30	18.3	11.8	0.77	7.5
NO_2	1 h	400	82.7	117	127	113
	24 h	200	45.1	52.6	16.9	20.8
	Annual	100	11.3	9.7	2.2	2.4
PM	24 h	120	NA	NA	43.4	40.7
	Annual	60	NA	NA	16.8	11.4
PM_{10} (TEOM)	24 h[1]	50	68	NA	27.3	42.9
	Annual	NA	7.4	NA	13.4	9.2
$PM_{2.5}$ (BAM)	24 h[2]	30	57.0	50.0	19.7	42.2
	Annual	NA	7.8	11.4	11.4	7.0

Notes:
TEOM = tapered element oscillating microbalance; BAM = beta attenuation mass monitor.
For existing sites (Forest Hills, Champlain Heights) Maximum data based on NAPS annual reports for 2002 to 2004 (Environment Canada 2003, 2005, 2007f) and NBENV reports for the years 2005 and 2006 (NBENV 2007c; 2008a)).
Supplementary data Maximum annual average is the average of approximately 6 months of data.
NA - Not available.
1 BC MOE Guideline (BC MOE 2008).
2 CCME CWS - Canada Wide Standard for $PM_{2.5}$ (CCME 2000).

Particulate matter (including PM_{10} and $PM_{2.5}$) were observed to be similar at the existing Forest Hills and Champlain Heights monitors when compared to data collected at Debly Subdivision and Canaport. Note that total particulate matter has not been monitored in the NAPS or NBENV network in Saint John since 1999.

Sulphur dioxide maximum 1 hour, 24 hour and annual average concentrations measured at the Debly Subdivision and Canaport stations were considerably lower than those measurements at Forest Hills and Champlain Heights.

Annual average and 24 hour nitrogen dioxide concentrations were also lower at the Debly Subdivision and Canaport when compared to the urban Saint John sites; however, the measured maximum 1 hour concentrations were similar to urban Saint John sites.

Volatile Organic Compounds

Generally, the concentrations of measured volatile organic compounds as measured at both the existing Saint John stations and the supplementary stations are considered to be low. In most cases, the speciated VOC concentrations were below the method detection limit. However, the maximum 24 h concentrations of toluene and tetrachloroethylene measured at Canaport were higher than those observed at other locations, on one occasion. Similarly, the maximum 24 h concentration of methylene chloride at Anthonys Cove was higher than at the other locations, on one occasion. The cause of the higher concentrations was investigated by doing a full review of all data validation aspects. No reasons to explain the higher values were identified. It is emphasized that these maximum values occurred infrequently and are therefore not representative of typical concentrations observed at those locations. Specifically, the 90th percentiles of the toluene and tetrachloroethylene concentrations at the Canaport location are 2.5 μg/m^3 and 1.4 μg/m^3, respectively, and the 90th percentile of the methylene chloride concentrations at Anthonys Cove is 2.9 μg/m^3. Thus, the measured concentrations are generally low and below OMOE ambient air quality criteria most of the time.

Except for acrolein and tetrachloroethylene, the OMOE ambient air quality criteria were not exceeded for any of the compounds. Although the maximum 24 h concentrations of acrolein are above the OMOE objective, the 90th percentiles of the monitored values at Forest Hills and Champlain Heights are 0.085 μg/m^3 and 0.10 μg/m^3, respectively. These data and statistics indicate that the measured concentrations of acrolein are near the OMOE ambient air quality criteria most of the time.

Summary of Ambient Air Quality

The air quality in Saint John and in the LAA is considered to be very good most of the time. The rate of compliance of ambient monitoring results with the ambient air quality objectives at all monitoring stations in Saint John is generally greater than 95%, and in most cases over 99%, for most air contaminants and monitoring stations in the Saint John area.

The New Brunswick ambient objectives were not exceeded at the supplementary monitoring stations, and concentrations of SO_2 and NO_x were generally lower than those recorded in urban Saint John.

7.2.2 GHG Emissions

7.2.2.1 Provincial GHG Emissions

The total GHG emissions from New Brunswick sources were relatively constant at about 21 million tonnes per year (Mt CO_2eq/a) from 2000 to 2005 (Environment Canada 2006b), but decreased by 14% in 2006 to 18 Mt (Environment Canada 2008i).

The New Brunswick energy sector (which includes power plants and oil refining) constitutes the largest GHG emissions source sector contributing 92% of provincial GHG emissions in 2005 (Environment Canada 2006b). Local GHG emissions from large Saint John sources are 46% of the New Brunswick total.

7.2.2.2 National GHG Emissions

Canada's GHG emissions are reported in the *National Inventory Report*, published by Environment Canada each year (Environment Canada 2008i). The report contains GHG emission data from 1990 to 2006. National GHG emissions appear to have peaked in recent years at just over 740 Mt, declining to 721 Mt in 2006.

The provincial GHG emissions (18 Mt CO_2eq/a) in 2006 were approximately 2.9% of the national total (Environment Canada 2008i).

Total GHG emissions associated with the production, processing, and transmission of all oil and gas destined for export were about 75 Mt in 2006, up 171% from 1990 (Environment Canada 2008i).

7.2.2.3 Global GHG Emissions

The International Panel on Climate Change (IPCC) was established in 1988 to provide decision-makers and others interested in climate change with an objective source of information about climate change. The IPCC's Fourth Assessment Report (AR4) was released in 2007. The Technical Summary of the Working Group III contribution to AR4 summarizes the global GHG emissions data to 2004 and presents the following analysis of recent trends for each GHG (Barker *et al.* 2007):

> "*Emissions of the GHGs covered by the Kyoto Protocol increased by about 70% (from 28.7 to 49.0 Gt CO_2-eq) from 1970–2004 (by 24% from 1990–2004). With carbon dioxide (CO_2) being the largest source, having grown by about 80%. The largest growth in CO_2 emissions has come from power generation and road transport. Methane (CH_4) emissions rose by about 40% from 1970, with an 85% increase coming from the combustion and use of fossil fuels. Agriculture, however, is the largest source of CH_4 emissions. Nitrous oxide (N_2O) emissions grew by about 50%, due mainly to increased use of fertilizer and the growth of agriculture. Industrial emission of N_2O fell during this period...*"

Canadian total GHG emissions, at 743 Mt CO_2eq, were thus 1.5% of the global total in 2004. Global GHG emissions are forecast to continue to grow (Barker *et al.* 2007).

7.2.3 Sound Quality

The existing Sound Quality within and surrounding the Project site was determined by performing a baseline monitoring study at nine noise monitoring sites as shown in Figure 7.3.

The monitoring sites are considered to be representative of the areas that, because of proximity, might experience the greatest changes in sound quality.

The baseline monitoring, conducted in fall 2007, involved measuring the sound pressure levels at the monitoring sites using Type 1 Integrating Sound Pressure Level Meters (Jacques Whitford 2008c). Sound pressure levels were measured as L_{eq} or equivalent level of energy, which is energy averaged over time. The L_{eq} measurements were logged once a minute over a 24 hour period. The unit of measure for L_{eq} is dB_A or A-weighted decibels. All data were logged on the sound pressure level meters and downloaded to a computer for further processing. This included the computation of 1 hour L_{eq} values for comparison with the significance criteria. The 1 hour L_{eq} measurements for each noise monitoring site are presented in Table 7.6. The baseline sound pressure levels for the LAA, during the day (06:00 to 22:00) and night (22:00 to 06:00) time periods, ranged from 30-56 dB_A and 28-47 dB_A for the day and night times respectively.

Table 7.6 Sound Pressure Level Monitoring Over 24 Hour Period

Time of Day	1 h L_{eq} (dB_A) at Monitoring Location								
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site8	Site 9
8:00	-	-	-	-	-	-	-	45	-
9:00	-	-	-	-	-	-	-	46	45
10:00	-	-	-	-	-	-	-	44	44
11:00	-	-	49	-	-	-	-	45	45
12:00	41	-	50	50	-	50	-	44	44
13:00	44	-	50	48	-	52	-	44	46
14:00	43	-	49	43	-	50	-	45	45

Table 7.6 Sound Pressure Level Monitoring Over 24 Hour Period

Time of Day	1 h L_{eq} (dB_A) at Monitoring Location								
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site8	Site 9
15:00	45	51	49	42	-	52	-	45	44
16:00	47	47	50	41	45	53	44	42	45
17:00	47	39	52	40	43	52	40	41	44
18:00	44	36	53	39	40	52	38	41	36
19:00	53	39	52	38	39	49	40	40	36
20:00	41	37	48	41	38	50	38	45	32
21:00	41	36	42	43	39	46	36	40	30
22:00	44	35	37	36	40	45	41	38	34
23:00	42	35	37	34	42	44	38	37	40
0:00	41	35	37	33	38	37	39	39	29
1:00	40	34	36	34	32	40	31	39	35
2:00	38	30	35	36	30	37	30	38	31
3:00	38	28	32	43	28	39	28	39	41
4:00	38	29	35	42	30	31	33	43	45
5:00	37	33	36	44	33	40	37	41	40
6:00	40	41	42	41	41	47	39	41	41
7:00	43	40	51	42	45	55	42	42	39
8:00	44	41	42	44	46	49	41	43	45
9:00	39	44	42	47	46	47	42	44	41
10:00	42	44	-	46	49	50	46	44	38
11:00	47	45	-	48	48	54	44	-	-
12:00	-	45	-	-	47	52	44	-	-
13:00	-	45	-	-	51	49	43	-	-
14:00	-	-	-	-	49	-	56	-	-
15:00	-	-	-	-	-	-	49	-	-

7.3 Potential Project-VEC Interactions

The potential interactions between the Project and Atmospheric Environment and a ranking of potential environmental effects are presented in Table 7.7.

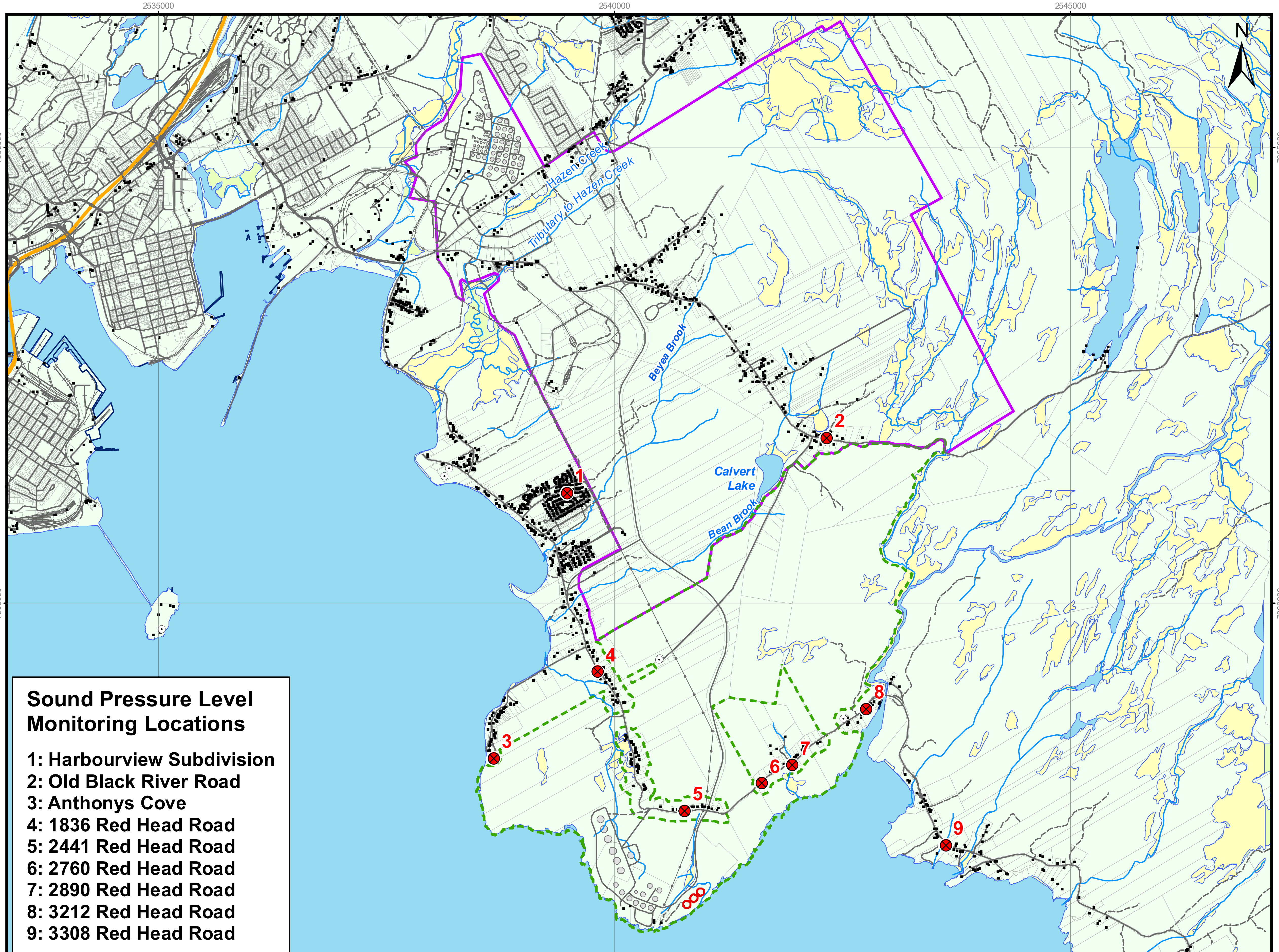


Figure 7.3 Baseline Sound Pressure Level Monitoring Sites

Project Eider Rock

Map Features

- Sound Pressure Monitoring Location
- Building
- Tower
- Tank
- LNG Tank
- Major Road
- Secondary Road
- Local Road
- Track
- Rail Line
- Wharf
- Utility Line
- Watercourse
- Project Development Area (Refinery Facilities and Infrastructure Approx. 1132 ha)
- Linear Facilities Corridors Assessment Area (Approx. 2303 ha)
- Waterbody
- Wetland (NB DNR)
- Wetland (SNB)
- Property Boundary

Data Source: Service New Brunswick, NB DNR

0 250 500 1,000 1,500 2,000

Metres

Map Parameters
Projection: NB Stereographic
Scale: 1:42,000
Date: August 8, 2008
Project No.: 1013263.

Jacques Whitford

Table 7.7 Potential Project Environmental Effects to Atmospheric Environment

Project Activities and Physical Works	Potential Environmental Effects		
	Change in Air Quality	Change in GHG Emissions	Change in Sound Quality
MARINE TERMINAL AND OTHER MARINE-BASED INFRASTRUCTURE			
Construction			
Construction and Installation of Jetty and Other Marine-Based Infrastructure	1	1	1
Marine Vessel Berthing and Deberthing	1	1	1
Operation			
Marine Vessel Berthing and Deberthing	2	1	1
Crude Oil and Finished Product Transfer	2	1	2
Wastewater, Cooling Water, and Storm Water Release	0	0	0
Decommissioning and Abandonment			
Removal of Facilities and Site Reclamation	1	1	1

Project-Related Environmental Effects

Notes: Project-Related environment effects were rated as follows:

0 No interaction, or no substantive interaction contemplated.

1 Interaction occurs; however, based on past experience and professional judgment the interaction would not result in a significant environmental effect, even without mitigation; or interaction would not be significant due to application of codified environmental protection practices that are known to effectively mitigate the predicted environmental effects.

2 Interaction may, even with codified mitigation, result in potentially significant environmental effects and/or is important to regulators and/or the public interest. Potential environmental effects are considered further and in more detail in the CSR.

The activities including Wastewater, Cooling Water and Storm Water Release during Operation are not anticipated to generate any (or nominal) air contaminant, GHG, or sound emissions from any Project component during any phase of the Project. Since the emissions are anticipated to be zero or nominal, the environmental effects of these activities on a Change in Air Quality, Change in GHG Emissions, and a Change in Sound Quality are not expected to be substantive, as a result these activities will not interact with the Atmospheric Environment and thus are not expected to cause significant adverse environmental effects. Therefore, the potential environmental effects of the Project-related activities that were ranked as 0 in Table 7.7 on Atmospheric Environment including a Change in Air Quality, Change in GHG Emissions, and a Change in Sound Quality during all phases of the Project, are rated not significant and are not considered further in the CSR.

Construction and Installation of the Marine Terminal and Other Marine-Based Infrastructure involves land-based site preparation of the barge and trestle landing, some land-based blasting, preparation of the sea bed, limited dredging, installation of jackets and piles, and installation of seawater intake/outfall structures. The major pieces of equipment will be delivered to the marine terminal as packaged units, thus minimizing construction time and effort. Fuel and power will be used in the equipment (*e.g.,* barges, dredge). Small quantities of air contaminants and GHG will be emitted from combustion of the fuel. These will be measurable but are not expected to be substantive. Noise will be generated during blasting. These events will be scheduled to occur during the day to minimize nuisance. Further, the distances from the source of noise at the marine terminal to the nearest residences are large, thus helping to minimize potential nuisance. Based on experience with the construction of the nearby Canaport LNG facility, the noise levels are not expected to frequently exceed the noise guideline levels. Therefore, the interactions between a Change in Air Quality, Change in GHG Emissions, and a Change in Sound Quality and Construction and Installation of the Marine Terminal and Other Marine-Based Infrastructure are all ranked as 1.

Marine Vessel Berthing and Deberthing during Construction of the Marine Terminal and Other Marine-Based Infrastructure involves construction vessels, equipment barges making equipment and materials deliveries to the Marine Terminal and the barge landing facility. The number of vessels and visits to the sites specifically related to the marine-based construction activities is relatively small (approximately 200 in a 6-8 year period). Turnaround times will be short. The emissions of air contaminants, GHG and noise are therefore not expected to be substantive and all of these interactions on a Change in Air Quality, Change in GHG Emissions, and a Change in Sound Quality are ranked as 1.

Marine Vessel Berthing and Deberthing during Operation involves marine vessels transporting crude oil to the marine terminal and products, including coke, from the marine terminal. This activity includes the use of tugboats to assist in manoeuvring to and from the jetty, and hotelling while at the berth during the loading or unloading events. Several different types and sizes of ships will be used to transport crude oil and products. The emissions of air contaminants may be substantive and thus the interactions between these activities and a Change in Air Quality as ranked as 2; these interactions will be assessed in the following section. The emissions of GHG are expected to be low; this interaction with a Change in GHG Emissions is therefore ranked as 1. A Change in Sound Quality during Marine Vessel Berthing and Deberthing is expected to be measurable but due to the large distances between sources and receptors, the changes are not expected to be substantive and thus its interaction with a Change in Sound Quality is ranked as 1.

Crude Oil and Finished Product Transfer involves discharge of tankers at the existing SBM, and loading/unloading of product (refined petroleum products and crude oil), at the marine terminal. The emissions of air contaminants and GHG were estimated for these activities and summaries were presented in Section 3.7.1. The emissions of air contaminants may be substantive and thus the interactions between these activities and a Change in Air Quality as ranked as 2; these interactions will be assessed in the following section. The emissions of GHG are less than 10^5 t of CO_2eq per year and are thus categorized as low; the interaction with a Change in GHG Emissions is therefore ranked as 1. A Change in Sound Quality during the crude oil and finished product transfer may be substantive, and therefore these interactions with a Change in Sound Quality are ranked as 2 and assessed in the following section.

For Decommissioning and Abandonment of the Marine Terminal and Other Marine-Based Infrastructure, the Project will be operated for several decades and its lifetime will be extended by maintenance and refurbishment. A plan would be prepared at that time to minimize the emissions to the extent possible. In considering emissions of air contaminants, GHG, and sound during Removal of Facilities and Site Reclamation for both Project components, the activities involve removal of physical structures (buildings, tanks, pipelines, roads), structure disassembly, management of recyclable materials, disposal of wastes, and rehabilitation and re-vegetation of the site. Some energy and fuel would be used in forklifts, trucks, cutting equipment, and portable generators. The timeframe for this phase is anticipated to be less than that required for Construction. These activities are likely to generate measurable emissions of air contaminants, GHG, and sound for either or both Project components. The activities are likely to consist of several events that are localized to specific sites at the marine terminal. The quantities of fuel and power are expected to be low, relative to Construction. Therefore, the emissions are not considered to be substantive and the interactions with a Change in Air Quality, Change in GHG Emissions, and a Change in Sound Quality are therefore ranked as 1. It is emphasized that further assessment would be done prior to the Project being decommissioned.

There are no activities during Construction, Operation, or Decommissioning and Abandonment of the Marine Terminal and Other Marine-Based Infrastructure that would result in a substantive contribution to a Change in GHG Emissions. As presented in Section 3.7.1, GHG emissions associated with the Operation of the marine terminal are approximately 44,000 t CO_2eq/a, and emissions during

Construction or Decommissioning and Abandonment are expected to be much less than this level. The GHG emissions from the Project are not substantive in comparison to regional, provincial, or national totals. As such, the potential environmental effects of the Project on a Change in GHG Emissions for all Project activities and phases are ranked as either 0 or 1, are rated not significant, and are not considered further.

In summary, the activities described above that are ranked as 1 are not expected to cause significant adverse environmental effects. Therefore, the potential environmental effects of the Project-related activities that were ranked as 1 in Table 7.7 on Atmospheric Environment, including a Change in Air Quality, Change in GHG Emissions, and a Change in Sound Quality during all phases of the Project, are rated not significant and are not considered further in the CSR.

7.4 Environmental Effects Assessment

During Operation, the emissions of air contaminants may be substantive from Marine Vessel Berthing and Deberthing, and during Crude Oil and Finished Product Transfer. Combustion emissions from the marine vessel activities and VOC emissions during product transfer will be released to the environment. Thus the interactions between these activities and a Change in Air Quality are ranked as 2 and are discussed below. The interactions between these activities and a Change in GHG emissions were previously ranked as 1 and are not discussed further.

Similarly, during Operation, sound emissions may be substantive during Crude Oil and Finished Product Transfer activities. These emissions originate from pumps, located on board the marine vessels or pumps located at the Marine Terminal, or from the coke handling system, the enclosed conveyor, or from machinery used to move materials at transfer points. Thus the interactions between these activities and a Change in Sound Quality are ranked as 2 and are discussed below.

These activities are therefore rated as 2 and will be assessed further in this section. The residual environmental effects of the Project-related emissions from the Marine Terminal and Other Marine-Based Infrastructure on Atmospheric Environment are presented and assessed in light of the planned mitigation for the Project activities.

7.4.1 Assessment of the Project-Related Environmental Effects

The Change in Air Quality and Change in Sound Quality are assessed on the basis of baseline data (Section 7.2), emissions inventories (Section 3.7.1), and modelling predictions (Jacques Whitford 2008b).

Based on the discussion of Project interactions with the environment presented in Section 7.3 above, the following interactions have been ranked as 2 in Table 7.7 and have been carried forward in the environmental effects assessment, with all other interactions having been rated not significant:

Operation

- Marine Vessel Berthing and Deberthing (Change in Air Quality only); and
- Crude Oil and Finished Product Transfer (Change in Air Quality and Change in Sound Quality).

The Change in GHG Emissions were not rated as significant and thus not carried further in the Project environmental effects assessment.

The residual environmental effects of these activities during Operation the Project on the Atmospheric Environment are summarized in Table 7.8.

Table 7.8 Summary of Residual Environmental Effects on Atmospheric Environment

Potential Residual Environmental Effects	Proposed Mitigation/Compensation Measures	Residual Environmental Effects Characteristics: Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/Socio-economic Context	Significance	Prediction Confidence	Likelihood	Cumulative Environmental Effects?	Recommended Follow-up and Monitoring
Change in Air Quality												
Operation	▪ Implement idling policy; ▪ Preventative maintenance of equipment; ▪ Minimize length of marine haul routes; ▪ Efficient scheduling of marine vessels arrival and departure; ▪ Vapour recovery systems.	A	M	L	ST/O	R	D	N	M	H	Y	▪ Ambient air quality monitoring during Operation.
Residual Environmental Effect for all Phases								N	M	H	Y	
Change in Sound Quality												
Operation	▪ Use of well-maintained mufflers; ▪ Use of enclosed pumps; ▪ Distances to sensitive receptors are large.	A	L	S	ST/O	R	D	N	M	H	Y	None.
Residual Environmental Effect for all Phases								N	M	H	Y	
Combined Residual Environmental Effects												
Operation	Same as above.							N	M	H	Y	Same as above.
Combined Residual Environmental Effects								N	M	H	Y	

Table 7.8 Summary of Residual Environmental Effects on Atmospheric Environment

Potential Residual Environmental Effects	Proposed Mitigation/Compensation Measures	Residual Environmental Effects Characteristics						Significance	Prediction Confidence	Likelihood	Cumulative Environmental Effects?	Recommended Follow-up and Monitoring
		Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/Socio-economic Context					

KEY

Direction:
P Positive
A Adverse

Magnitude:
L Low: GHG Emissions <10^5 t/a CO_2eq; Air Quality or Sound Quality is not affected or slightly affected but is well below objectives, guidelines or standards.
M Medium: GHG Emissions >10^5 and <10^6 t/a CO_2eq; Air Quality or Sound Quality is affected to values that are near but largely below the objectives, guidelines or standards.
H High: GHG Emissions >10^6 t/a CO_2eq; Air Quality or Sound Quality is degraded to values that may substantively exceed objectives, guidelines or standards.

Geographic Extent:
S Site-including PDA and 200 m beyond
L Local: within the LAA (15 x 15 km)
R Regional: within the RAA (70 x 45 km)
G Provincial, National, or Global scale (GHG Emissions only)

Duration:
ST Short term
MT Medium Term
LT Long Term
P Permanent – will not change back to original condition

Frequency:
O Occasionally, once per month or less.
S Sporadic, once per week
R Regular, more than once per week intervals.
C Continuous.

Reversibility:
R Reversible
I Irreversible

Ecological/Socio-economic Context:
U Undisturbed: Area relatively or not adversely affected by human activity
D Developed: Area has been substantially previously disturbed by human development or human development is still present
N/A Not Applicable

Significance:
S Significant
N Not Significant

Prediction Confidence:
Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation
L Low level of confidence
M Moderate level of confidence
H High level of confidence

Likelihood:
Based on professional judgment
L Low probability of occurrence
M Medium probability of occurrence
H High probability of occurrence

Cumulative Environmental Effects?
Y Potential for environmental effect to interact with other past, present or foreseeable projects or activities in RAA.
N Environmental effect will not or is not likely to interact with other past, present or foreseeable projects or activities in RAA.

7.4.1.1 Change in Air Quality

Project Environmental Effects Mechanisms for Change in Air Quality

A Change in Air Quality associated with Operation may arise from emissions of combustion gases from the ships during Marine Vessel Berthing and Deberthing; and from fugitive emissions of VOC during Crude Oil and Finished Product Transfer.

Mitigation for Change in Air Quality

The planned mitigation measures for Changes in Air Quality during Operation are:

- The implementation of an "idling policy" where possible to minimize the consumption of fuel when the marine vessels and equipment are stationary for extended periods of time;
- Where possible, implement plans to minimize marine travel routes when moving materials and equipment to and within the construction area;
- Development of a detailed energy efficiency program for operation of all marine-based activities;
- The use of vapour recovery units on land to reduce fugitive emissions during loading of product to marine vessels; and
- Efficient scheduling of marine vessels coming and going from the marine terminal to reduce transit and docking time, reducing fuel consumption, and thus reducing combustion emissions.

These mitigation measures will be implemented wherever technically and economically feasible to minimize potential environmental effects of the Operation of the Project on Air Quality.

It is noted that the sulphur content of fuels being burned by marine vessels that transfer crude oil and finished products to and from the marine terminal was conservatively set at 1.5% sulphur by weight. Planned MARPOL regulations relating to the sulphur content of marine fuels at international ports are set to come into effect in the year 2020 (MEPC 2008). These requirements, if adopted in Canada, would see fuel sulphur being reduced to 0.5% sulphur by weight, thus representing a potential three-fold reduction in SO_2 emissions associated with the Operation of the Project. Although this assumption was not carried forward quantitatively in this CSR, once these new requirements are in place, they would further mitigate the potential Change in Air Quality associated with the Operation of the Project.

Characterization of Residual Project Environmental Effects for Change in Air Quality

For Operation, the dispersion of CAC emissions from the Project was modelled with CALPUFF to predict the maximum short-term and long-term (annual) average ground-level concentrations. As emissions from the marine vessels are expected to be intermittent in nature, a conservative yet probable emissions scenario was developed for modelling purposes. The scenario was developed from information on probable ship visits as determined from the schedule required to supply crude to and ship product from the Project. In this scenario, it was assumed that three ships are at berth simultaneously and remain there continuously over the five-year period that was modelled. These consisted of one VLCC at the SBM, one LRII ship at the marine terminal, and one product ship at the marine terminal. Based on a probability analysis of the expected activity of the marine vessels at the marine terminal (Jacques Whitford 2008b), this is a very conservative assumption.

Model predictions were made at locations defined by detailed nested receptor grids covering the LAA. Ambient background values were added to the predicted values for comparison with the relevant regulatory objectives, guidelines and standards.

The results of the modelling are summarized here to indicate the nature of the predictions. This summary is shown in Table 7.9, and Figures 7.4 and 7.5.

Table 7.9 Maximum Predicted CAC Concentrations for Operation of the Project

Criteria Air Contaminant	Averaging Period	Objective/ Guideline/ Standard Used for Comparison (µg/m³)	Background (µg/m³)	Dispersion Modelling Results[1]		
				Maximum Predicted Ground-Level Concentration (Project Alone) (µg/m³)	Maximum Predicted Ground-Level Concentration plus Background (Project + Background) (µg/m³)	Percent of Objective/ Guideline/ Standard (maximum predicted plus background)[2]
SO_2	1 h	450	63	**571**	**634**	**141%**
	24 h	150	52	**247**	**299**	**199%**
	Annual	30	16	19.5	**35.5**	**118%**
NO_2	1 h	400	30	176	206	51%
	24 h	200	21	75.9	96.9	48%
	Annual	100	10	6.61	16.6	17%
CO	1 h	35,000	1,260	87.6	1,348	4%
	8 h	15,000	1,260	55.0	1,315	9%
PM	24 h	120	53	5.94	58.9	49%
	Annual	70	23	0.47	23	34%
PM_{10}	24 h	50	29	5.94	34.9	70%
$PM_{2.5}$	24 h	30	17	5.94	22.9	76%

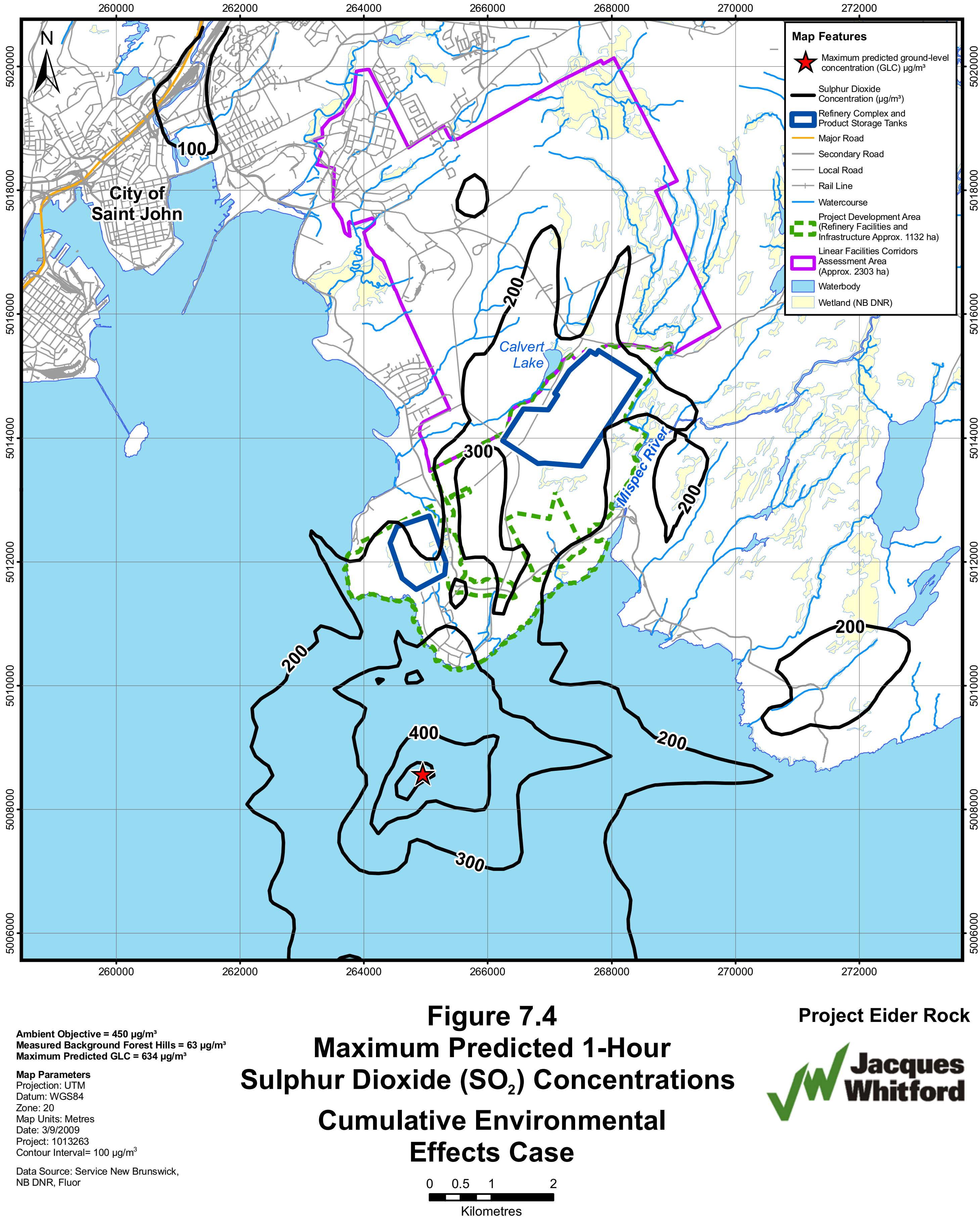
Notes:

1 Note that marine vessel emissions are intermittent (modelling assumed three vessels operating continuously at the marine terminal over the entire 5 year period modelled).

2 SO_2 predicted exceedances occur over water; however, these highest values are below the NAAQO for SO_2 (1 h: 900 µg/m³, 24 h: 300 µg/m³, Ann. avg.: 60 µg/m³).

Note: Numbers in tables may not add up due to rounding for appropriate significant figures.

Bold indicates a value that exceeds the objective, guideline, or standard.



Ambient Objective = 450 µg/m³
Measured Background Forest Hills = 63 µg/m³
Maximum Predicted GLC = 634 µg/m³

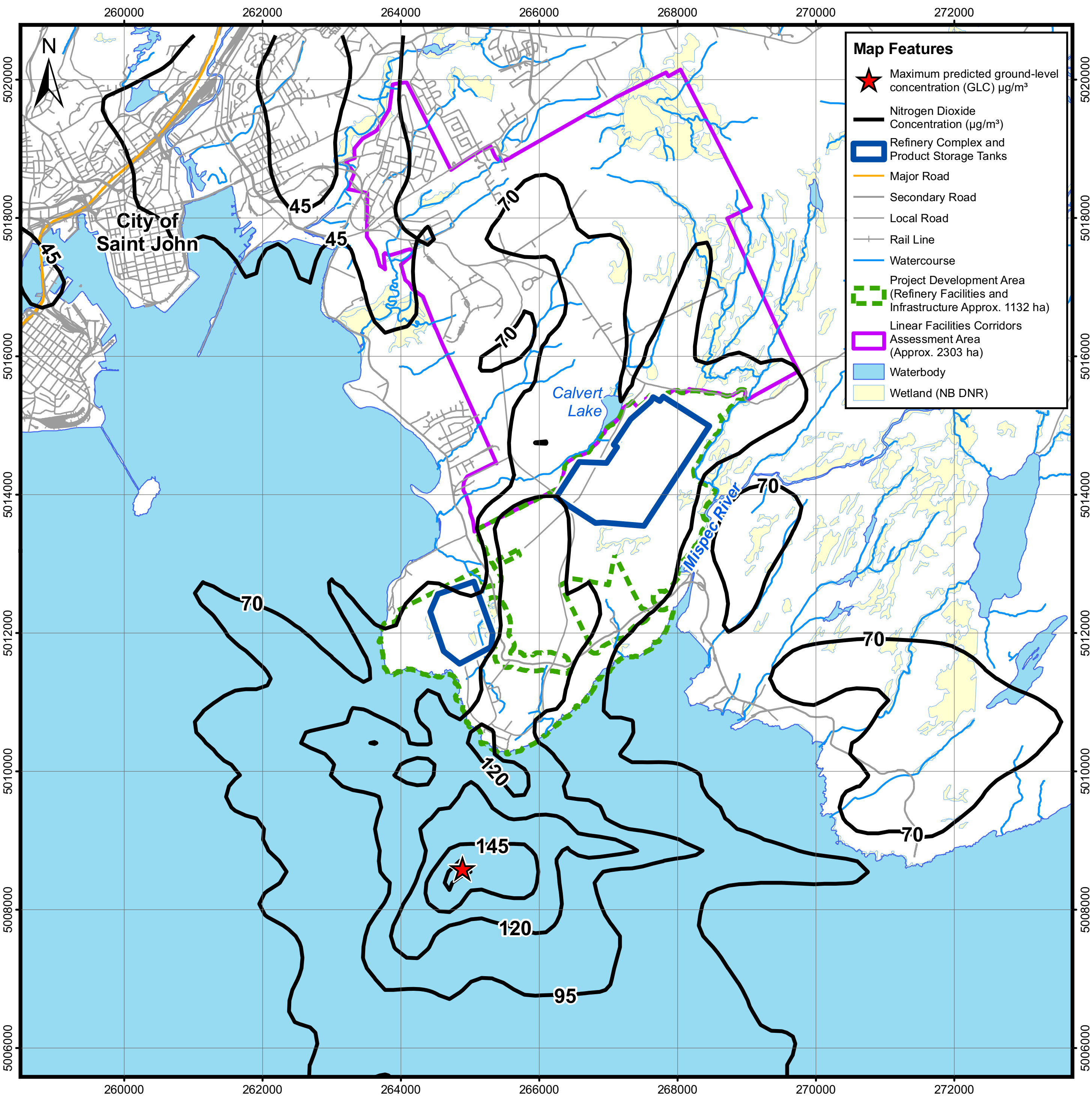
Map Parameters
Projection: UTM
Datum: WGS84
Zone: 20
Map Units: Metres
Date: 3/9/2009
Project: 1013263
Contour Interval= 100 µg/m³

Data Source: Service New Brunswick, NB DNR, Fluor

Figure 7.4
Maximum Predicted 1-Hour Sulphur Dioxide (SO_2) Concentrations
Cumulative Environmental Effects Case

Project Eider Rock

Jacques Whitford



Ambient Objective = 400 μg/m³
Measured Background Forest Hills = 30 μg/m³
Maximum Predicted GLC = 206 μg/m³

Map Parameters
Projection: UTM
Datum: WGS84
Zone: 20
Map Units: Metres
Date: 3/9/2009
Project: 1013263
Contour Interval= 25 μg/m³

Data Source: Service New Brunswick, NB DNR, Fluor

Figure 7.5
Maximum Predicted 1-Hour Nitrogen Dioxide (NO_2) Concentrations
Marine Terminal and Other Marine-Based Infrastructure

0 0.5 1 2
Kilometres

Project Eider Rock

Jacques Whitford

The highest CAC concentrations are reported for SO_2 and these occur over water, south-east of the marine terminal (Table 7.9 and Figure 7.4). Although the modelled 1 hour, 24 hour, and annual average SO_2 ground-level concentrations are predicted to be above the ambient air quality objectives (for Saint John County), the locations of these maximum predicted values occur over water to the south-east of the marine terminal, far enough from land that prolonged human exposure is not likely to occur. It should be noted that as the marine environment is technically not part of Saint John County, and therefore the New Brunswick Department of Environment SO_2 criteria are not necessarily applicable over water in this area. On the other hand, the maximum predicted SO_2 concentrations are below the federal maximum acceptable NAAQO for SO_2 (which are equivalent to the SO_2 criteria for most counties in New Brunswick). It is also noted that control of emissions from marine vessels is being considered by regulatory agencies by reducing the sulphur content in fuel, from 1.5% to as low as 0.5%, in the coming years (MEPC 2008). Furthermore, since the modelled emissions scenario is conservative (*i.e.,* the ship emissions were modeled as three ships at the marine terminal for every hour of the year whereas in reality, less than three vessels will be at the marine terminal for the majority of the time), the actual ground-level concentrations over water are expected to be below the Saint John County SO_2 objectives.

The maximum predicted ground-level concentrations of CAC at all receptors on land are below the relevant objectives, guidelines and standards.

It is noted that emissions of VOC and sulphur compounds from the storage tanks and product transfer at the marine terminal were considered in detail as part of the overall the Development Proposal and are assessed in the Final EIA Report (Jacques Whitford Stantec Limited 2009a). Based on that analysis, the emissions of non-CAC from the Project are small and not expected to cause a significant adverse environmental effect on Air Quality (Jacques Whitford 2008b). Thus, a Change in Air Quality associated with emissions of Non-CAC is expected to be low in magnitude, local in extent, and short term in duration. Similarly, due to the intermittent nature of emissions from the marine vessels, the changes in regional air quality associated with secondary particulate formation, ozone formation, acidic deposition (potential acid input), visible plume formation, and long-range transport are expected to be low in magnitude, local in extent, and short-term in duration. These aspects are rated not significant with respect to the Project and are not discussed further in this CSR.

In summary, on an overall basis, the residual Change in Air Quality as a result of emissions from the Marine Terminal and Other Marine-Based Infrastructure are expected to be medium in magnitude, local in extent, short-term in duration, and are not expected to be substantive. Based on the nature and extent of expected emissions during Operation and the predicted ground-level concentrations from the dispersion modelling conducted, and in consideration of planned mitigation, the potential environmental effects of the Operation of the Marine Terminal and Other Marine-Based Infrastructure on a Change in Air Quality are rated not significant.

7.4.1.2 Change in Sound Quality

Project Environmental Effects Mechanisms for Change in Sound Quality

Changes in Sound Quality during Operation may arise only from activities associated with the Crude Oil and Finished Product Transfer. Potential environmental effects mechanisms include diesel engines, electrical motors, and pumps, all of which may be sources of substantive noise emissions during crude and product transfer activities. The loading and unloading of ships takes several hours to days to complete, thus these noise emissions could occur on a relatively continuous basis for these periods when the ships are berthed to transfer crude oil or finished product.

Mitigation for Change in Sound Quality

Mitigation measures for a Project-related Change in Sound Quality for Crude Oil and Finished Product Transfer include the following:

- Well maintained mufflers on all marine engines and marine equipment;
- Use of enclosures for all motors and pumps used in marine loading and unloading activities; and
- Distances from sources to noise sensitive areas are large.

These mitigation measures will be implemented wherever technically and economically feasible to minimize potential environmental effects of Crude Oil and Finished Product Transfer on Sound Quality.

Characterization of Residual Project Environmental Effects for Change in Sound Quality

While at dock, ships will emit noise emissions from hotelling marine vessel engines if auxiliary power is required. Typically, the sound of ships in port is dominated by the cargo-handling activities, and the ship propulsion noises themselves are barely audible. Experience shows this to be generally true for the existing Canaport terminal and the Port of Saint John.

The largest sources of noise at the loading/unloading terminal are pumps, which for the purposes of the sound modelling were assumed to operate both in unloading and loading mode. Representative pump noise at the marine terminal and storage tank locations onshore was included alongside other Project noise sources in the CADNAA modelling. Thus, the emissions from pumps for marine loading/unloading and seawater cooling intake structure were modelled and included with the land-based sources of noise.

The anticipated sound emission levels from the marine terminal in combination with those associated with the Development Proposal as a whole (*i.e.,* land-based sources) were modeled using CADNAA to determine the potential for significant adverse environmental effects on a Change in Sound Quality. While the land-based sources are not part of the scope of project for this CSR, sound emissions from the marine terminal would overlap with those of the land-based sources and thus their combined contributions to a Change in Sound Quality was modeled—this is in essence a cumulative environmental effects assessment of a Change in Sound Quality potentially associated with the Development Proposal as a whole and is conservative.

The CADNAA noise modelling conducted as part of this EA indicated that noise guideline levels of 65 dB_A for daytime and 55 dB_A for night time, both expressed as a 1 hour L_{eq}, were not predicted to be exceeded during Construction or Operation, neither for day time or night time noise producing activities associated with the Project.

During both Construction and Operation, the Old Black River Road area may experience greater sound pressure levels than the Mispec/Red Head Road areas, as the Mispec/Red Head Road areas are somewhat shielded by the topography.

The results of extensive Sound Quality modelling conducted for the Development Proposal as a whole (which includes the Marine Terminal being assessed herein under *CEAA*) are presented in the Sound Qualtiy Technical Study (Jacques Whitford 2008c).

As presented in the Sound Quality Technical Study (Jacques Whitford 2008c), sound pressure levels ranged from 48 dB_A to 59 dB_A during daytime Construction. The highest sound pressure levels predicted for Construction were located at the Old Black River Road, just past intersection of Old Black River Road and Proud Road (NSA 1). Currently no construction activities are planned to be conducted during the night. Noise levels will thus return to background levels (ranging from 23 dB_A to 50 dB_A) during this time period. Therefore, no exceedances of the day time noise guideline levels or night time noise guideline levels were predicted to occur during Construction of the Project.

Sound pressure levels ranged from 42 dB_A to 53 dB_A and 41 dB_A to 53 dB_A during the daytime and nightime Operation respectively. The highest sound pressure levels predicted were located at the Old Black River Road, just past intersection of Old Black River Road and Proud Road (NSA 1) for daytime and nightime Operation. No exceedances of the day time noise guideline levels or night time noise guideline levels were predicted to occur during Operation of the Project (Jacques Whitford 2008c).

The predicted Sound Quality at each of the the 7 NSAs, both during Construction and Operation of the Project, daytime and nightime, did not exceed the noise guideline levels. The contribution of the marine activities to the acoustic environment is expected to be small, especially at the NSA locations on land. This is primarily because the source-receptor distances are large and because there is likely to be some masking by noise associated with the land-based infrastructure.

Based on this brief analysis, experience, and professional judgment, the Change in Sound Quality during Operation of the Project is not expected to be substantive. Thus, the potential environmental effects of the Operation of the Project on a Change in Sound Quality are rated not significant.

7.4.2 Determination of Significance

7.4.2.1 Change in Air Quality

The residual Change in Air Quality for the Project is expected to be medium in magnitude, local in extent, and short-term in duration.

A residual Change in Air Quality is most likely to occur during Operation when marine vessels transport crude oil to and finished products from the marine terminal. Dispersion modelling predictions for CAC emitted from the marine-based infrastructure are below the regulatory objectives, guidelines and standards at all receptors overland. Some predicted values exceeded the objectives, guidelines and standards over water. It is emphasized, however, that the predicted concentrations of SO_2 over water do not exceed the federal maximum NAAQO for all averaging periods. These values are also equivalent to the ambient air quality objectives for the other counties in New Brunswick. Dispersion modelling results are expected to be conservative and are able to capture maximum GLC values with a moderate level of confidence (Jacques Whitford 2008b).

In light of the planned mitigation measures, the residual environmental effects of a Change in Air Quality on Atmospheric Environment during Operation of the Project are rated not significant, with a moderate level of confidence.

7.4.2.2 Change in Sound Quality

The contribution of noise emissions from the marine-based activities are not expected to cause the noise guideline levels for a Change in Sound Quality to be exceeded, primarily because the distances from the navigational areas and marine terminal to noise sensitive areas are large.

In light of the planned mitigation measures, the residual environmental effects of a Change in Sound Quality on Atmospheric Environment during Operation of the Project are rated not significant, with a moderate level of confidence.

7.5 Assessment of Cumulative Environmental Effects

A listing of the other projects for consideration of Cumulative Environmental Effects is presented in Table 7.10 with a ranking of the potential for each of the other projects to act cumulatively with both Project components to cause adverse environmental effects.

Table 7.10 Potential Cumulative Environmental Effects to Atmospheric Environment

Other Projects and Activities With Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects		
	Change in Air Quality	Change in GHG Emissions	Change in Sound Quality
Project Eider Rock (Land-Based Components)	2	2	1
Industrial Land Use	2	2	1
Planned or Future Industrial/Energy Projects	0	0	0
Infrastructure Land Use	1	1	1
Marine Use	2	1	1

Cumulative Environmental Effects

Notes Cumulative environmental effects were rated as follows:

0 Project environmental effects do not act cumulatively with those of other projects and activities.

1 Project environmental effects act cumulatively with those of other projects and activities, but are unlikely to result in significant cumulative environmental effects or Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects but will not measurably change the state of the VEC.

2 Project environmental effects act cumulatively with those of other projects and activities, and may result in significant cumulative environmental effects or Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC.

A more detailed description of the other projects for consideration of cumulative environmental effects is provided in Section 5.3. From this information, the potential for the other projects to act cumulatively with the Project was considered and ranked.

Project Eider Rock, which includes the proposed petroleum refinery and land-based infrastructure, may overlap with a Change in Air Quality, a Change in GHG Emissions and a Change in Sound Quality associated with the Project. This is to be expected since both the Project and the Development Proposal are to be constructed and operated in close proximity to one another. A Change in Air Quality from the Project may interact with the Development Proposal and have the potential to result in significant cumulative effects to air quality; as such, this interaction is ranked as 2 for a Change in Air Quality, and is assessed in greater detail in the following sub-sections. A Change in GHG Emissions is expected throughout the Construction and Operation of the Project, although the predicted increase in GHG emissions is not expected to be substantive in the national and/or global context. The interaction is nonetheless ranked as 2 and the cumulative environmental effects of the Project overlapping with Project Eider Rock on a Change in GHG Emissions are carried forward in the cumulative environmental effects assessment. Even though an increase in sound emissions is expected throughout the Construction and Operation of Project Eider Rock, the predicted increase in sound levels are not expected to be substantive or exceed the noise guideline levels. Therefore, the interaction of the Project overlapping with Project Eider Rock on a Change in Sound Quality is ranked as 1, its cumulative environmental effects are rated not significant, and this interaction is not carried forward in the cumulative environmental effects assessment.

Industrial Land Use generally refers to Projects at the existing Saint John refinery, the Irving Pulp & Paper Lime Kiln Replacement, the Gypsum Wallboard Manufacturing Plant, the Coleson Cove Generating Station Demonstration Project, the Canaport LNG Marine Terminal and Multi-Purpose Pier, the Irving Paper Mill Long-Term Steam Supply Project, and the Brine Pipeline Replacement Project. It also includes past industrialization of the Saint John and surrounding areas, although the contribution of these past and present projects is incorporated in the existing conditions with respect to the Atmospheric Environment (*e.g.,* existing and past ambient air quality monitoring, historical emission levels, and baseline noise measurements). Each of these industrial projects and activities may overlap with a Change in Air Quality, a Change in GHG Emissions and a Change in Sound Quality. Some of these planned projects and activities may result in emission reductions (*e.g.,* Projects at the existing Saint John refinery, Lime Kiln Replacement, Irving Paper Mill Long-Term Steam Supply Project) and result in a positive Change in Air Quality and Change in GHG Emissions. Others (*e.g.,* wallboard plant, Coleson Cove Demonstration Project, Canaport LNG terminal, Brine Pipeline replacement project) may result in no changes in their anticipated emissions or slight increases in emissions to the airshed. Regardless, a Change in Air Quality and a Change in GHG Emissions from the Project have the potential to result in significant cumulative environmental effects, and as such, these are ranked as 2, and are assessed in greater detail in the following sub-sections. Although a Change in Sound Quality is expected throughout the Construction and Operation of the Project, the predicted increase in sound levels are not expected to be substantive or exceed the noise guideline levels. Therefore, the interaction of the Project is ranked as 1, its cumulative environmental effects are rated not significant, and this interaction is not carried forward in the cumulative environmental effects assessment.

The Planned or Future Industrial/Energy Projects refer generally to Point Lepreau II, other potential future projects, and potential wind and tidal power projects. There is potential for emissions during construction of projects such as Point Lepreau II. However, in the case of Point Lepreau II, the basic infrastructure is already present and would simply need to be expanded. There may be a positive cumulative environmental effect associated with avoided GHG emissions, but this is considered neutral at this time, since the regulations are not yet in place. Emissions from the construction and operation of the wind and tidal projects are likely to be low. As a result, these interactions are ranked as 0, and the potential for Planned or Future Industrial/Energy Projects to act cumulatively with a Change in Air Quality, a Change in GHG Emission or a Change in Sound Quality is low and therefore is rated not significant. These interactions are not carried forward in the cumulative environmental effects assessment.

Infrastructure Land Use generally refers to the Canaport LNG Emergency Access Road, the Operation of Existing Road Transportation Network, the Brunswick Pipeline Project, and the International Power Line Project. It also includes past and present urbanization of the City of Saint John and surrounding areas to their current state in modern times, which is reflected in existing conditions for the Atmospheric Environment. Emissions during the construction and operation of the 525 m Canaport LNG Emergency Access Road on property owned by the Proponent are not expected to be substantive. Emissions from the local network of public roadways are measurable and may act cumulatively with the Project. However, the potential to cause a significant cumulative environmental effect is low. With planned mitigation (activity scheduling and dust suppression), the emissions from the construction, operation and maintenance of the Brunswick Pipeline are expected to be nominal. Similarly, the emissions from the construction and operation of projects under the Infrastructure Land Use category are expected to be nominal. Therefore, the interactions are ranked as 1 and the cumulative environmental effects of Infrastructure Land Use on a Change in Air Quality, a Change in GHG Emissions and a Change in Sound Quality are rated not significant. These interactions are not carried forward in the cumulative environmental effects assessment

Marine Use involves Aquaculture in the Bay of Fundy and Increased Ship Traffic to the Port of Saint John. It also includes the historical development of the Port of Saint John, which is reflected in existing conditions for Atmospheric Environment as a result of existing Port activities and historical emissions from past Port usage. Emissions from LNG shipping (120 LNG Tankers per year) are expected to overlap with a Change in Air Quality. Therefore, the cumulative environmental effect of Marine Use on a Change in Air Quality could overlap with the Project to cause potentially significant environmental effects. As a result this interaction is ranked as 2 and is assessed in greater detail in the following sub-sections. Based on marine vessel traffic estimates, GHG emissions from Marine Use are likely to be less than the Project-related GHG emissions from the Marine Terminal and Other Marine-Based Infrastructure. Therefore, the GHG emissions from other projects are not likely to be substantive. As a result, the interaction of Marine Use on a Change in GHG Emissions is therefore ranked as 1, its cumulative environmental effects are rated not significant, and this interaction is not carried forward in the cumulative environmental effects assessment. Sound emissions, while measurable, are not likely to be substantive and are not likely to act cumulatively since the distances between the Project and the other projects are large. Therefore, the interaction of Marine Use on a Change in Sound Quality is ranked as 1; its cumulative environmental effects are rated not significant, and are not carried forward in the cumulative environmental effects assessment.

In summary, for all projects and activities in Table 7.10 that were ranked as 0 or 1, the potential cumulative environmental effects for those interactions are rated not significant. This is because the Project either does not overlap, or does not substantively interact, with the potential environmental effects of these other projects and activities, or because the Project contribution is such that the cumulative environmental effects could not possibly be significant. There is a high level of confidence in the significance predictions.

The only planned projects and activities which are most likely to act cumulatively with the Project regarding a Change in Air Quality are:

- Project Eider Rock (Land-Based Components);
- Industrial Land Use (*e.g.,* the Gypsum Wallboard Manufacturing Plant and the Canaport LNG Marine Terminal and Multi-Purpose Pier); and
- Marine Use (including marine vessels for LNG, natural gypsum, and petroleum coke shipping in the Port of Saint John).

A summary of the residual cumulative environmental effects on Atmospheric Environment is provided in Table 7.11.

Table 7.11 Summary of Residual Cumulative Environmental Effects on Atmospheric Environment

Cumulative Environmental Effect	Case	Other Projects, Activities and Actions	Proposed Mitigation and Compensation Measures	Residual Cumulative Environmental Effects Characteristics: Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/Socio-economic Context	Significance	Prediction Confidence	Likelihood	Proposed Follow-up and Monitoring Programs
Change in Air Quality	Cumulative Environmental Effects with Project	▪ Project Eider Rock (Land-Based Components); ▪ Industrial Land Use (specifically the Gypsum Wallboard Manufacturing Plant and Canaport LNG Marine Terminal and Pier; and ▪ Marine use.	Refer to Sections 7.4 and 7.5.	A	M	L	ST/O	R	D	N	M	H	None.
	Project Contribution to Cumulative Environmental Effects			A	M	L	ST/O	R	D	N	M	H	
Change in GHG Emissions	Cumulative Environmental Effects with Project	▪ Project Eider Rock (Land-Based Components); and ▪ Industrial Land Use (specifically the Gypsum Wallboard Manufacturing Plant and Canaport LNG Marine Terminal and Pier.	None proposed.	A	H	G	LT/C	R	D	S	M	H	None.
	Project Contribution to Cumulative Environmental Effects			A	L	G	LT/R	R	D	N	H	H	
Combined Residual Cumulative Environmental Effects	Cumulative Environmental Effects with Project									S	M	H	None.
	Project Contribution to Cumulative Environmental Effects									N	M	H	

Table 7.11 Summary of Residual Cumulative Environmental Effects on Atmospheric Environment

Cumulative Environmental Effect	Case	Other Projects, Activities and Actions	Proposed Mitigation and Compensation Measures	Residual Cumulative Environmental Effects Characteristics						Significance	Prediction Confidence	Likelihood	Proposed Follow-up and Monitoring Programs
				Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/Socio-economic Context				

KEY

Direction:
- P Positive
- A Adverse

Magnitude:
- L Low: GHG Emissions <10^5 t/a CO_2eq; Air Quality or Sound Quality is not affected or slightly affected but is well below objectives, guidelines or standards.
- M Medium: GHG Emissions >10^5 and <10^6 t/a CO_2eq; Air Quality or Sound Quality is affected to values that are near but largely below the objectives, guidelines or standards.
- H High: GHG Emissions >10^6 t/a CO_2eq; Air Quality or Sound Quality is degraded to values that may substantively exceed objectives, guidelines or standards.

Geographic Extent:
- S Site-including PDA and 200 m beyond
- L Local: within the LAA (15 x 15 km)
- R Regional: within the RAA (70 x 45 km)
- G Provincial, National, or Global scale (GHG Emissions only)

Duration:
- ST Short term
- MT Medium Term
- LT Long Term
- P Permanent – will not change back to original condition

Frequency:
- O Occasionally, once per month or less.
- S Sporadic, once per week
- R Regular, more than once per week intervals.
- C Continuous.

Reversibility:
- R Reversible
- I Irreversible

Ecological/Socio-economic Context:
- U Undisturbed: Area relatively or not adversely affected by human activity
- D Developed: Area has been substantially previously disturbed by human development or human development is still present
- N/A Not Applicable

Significance:
- S Significant
- N Not Significant

Prediction Confidence:
Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation
- L Low level of confidence
- M Moderate level of confidence
- H High level of confidence

Likelihood:
Based on professional judgment
- L Low probability of occurrence
- M Medium probability of occurrence
- H High probability of occurrence

Other Projects, Activities, and Actions
List of specific projects and activities that would contribute to the cumulative environmental effects.

7.5.1 Change in Air Quality

The cumulative environmental effects of Changes in Air Quality from the Project are assessed in combination with other projects for consideration of cumulative environmental effects in the LAA and the RAA.

Although exceedances of the SO_2 maximum permissible GLC were predicted for the Cumulative Environmental Effects Case, only one exceedance of the objective was predicted at the location of the maximum predicted values, which occurred over water. The predicted ground-level concentrations reduce very quickly, with close to 50% of the predicted values approaching background concentrations (*i.e.*, model predictions of near 0).

7.5.1.1 Project Cumulative Environmental Effects Mechanisms for Change in Air Quality

The main projects or activities in the RAA with the potential to act cumulatively with the Project to bring about a Change in Air Quality are:

- Project Eider Rock (Land-Based Components);
- Industrial Land Use (*e.g.,* the Gypsum Wallboard Manufacturing Plant and the Canaport LNG Marine Terminal and Multi-Purpose Pier); and
- Marine Use (including marine vessels for LNG, natural gypsum, and petroleum coke shipping in the Port of Saint John).

In addition, smaller emission sources such as marine vessels, automobiles, and residential wood burning may also contribute to cumulative environmental effects. Also, long-range transport of air contaminants from other jurisdictions may contribute to cumulative environmental effects.

Base Case

For the Base Case (Existing Environment), the primary mechanisms for a Change in Air Quality arise from emissions of air contaminants from existing and regional sources in the Saint John airshed, and emissions from other regions into the RAA.

Emission sources include existing projects and activities. For the Saint John airshed, an extensive ambient monitoring network exists and the baseline conditions are well-characterized (Section 7.2).

Project Case

The primary mechanisms for a Change in Air Quality for the Project Case arise from emissions of air contaminants from the Marine Terminal and Other Marine-Based Infrastructure (Sections 7.4 and 7.5), as well as existing emission sources (Base Case).

For this case, the emissions of air contaminants from the Project interact cumulatively with the emissions from other existing sources in the RAA. The Change in Air Quality depends on several factors including: the relative proximity of emission sources, differences in air contaminant emission rates, and variance in local meteorology.

Future Case

For the Future (Cumulative Environmental Effects) Case, the primary mechanisms for a Change in Air Quality arise from the cumulative emissions of air contaminants from substantive existing sources, Project sources, and other future sources in the Saint John airshed (*e.g.,* Project Eider Rock land-based components, Canaport LNG, Gypsum Wallboard plant), as well as emissions from other regions into the RAA.

Cumulatively, the sources of emissions include existing power plants, pulp and paper mills, the existing Saint John refinery, the Project sources and other future projects that have been defined at this time. Other future projects and activities in the RAA which have the potential for cumulative environmental effects on a Change in Air Quality include Project Eider Rock, the Gypsum Wallboard Manufacturing Plant and the Canaport LNG Marine Terminal and Pier in Canaport. In this Future Case, the environmental effects from the future projects interact with the environmental effects of the Base Case and the Project Case. The Change in Air Quality depends on the relative proximity of emission sources, differences in air contaminant emission rates, and variance in local meteorology.

7.5.1.2 Mitigation of Cumulative Environmental Effects for Change in Air Quality

Mitigation of cumulative environmental effects for a Change in Air Quality requires participation and cooperation from those facilities that are substantive sources of emissions. The Project mitigation measures that would assist in reducing potential cumulative environmental effects have been presented in Section 7.4 of this CSR and include:

- Use of dust suppressants;
- Implementation of an anti-idling policy;
- Equipment maintenance;
- Minimize haul routes;
- Energy efficiency program;
- Covered material handling facilities (drop points, conveyor, loading) for coke.

Other mitigation measures that could be explored in cooperation with other project proponents, and provincial/federal governments, with input from the public and other stakeholders could include the development and implementation of an air quality response plan for the Saint John airshed to reduce emissions during episodes of poor air quality. Although not in the control or influence of the Proponent, governments and other stakeholders could also develop and implement policies or programs to improve air quality (*e.g.,* improved public transit, international agreements, and emission reductions programs) that could cumulatively result in positive environmental effects. However, though positive, these are not discussed further in the context of this CSR.

The mitigation measures above will help reduce potential cumulative environmental effects of a Change in Air Quality.

7.5.1.3 Characterization of Residual Cumulative Environmental Effects for Change in Air Quality

The residual cumulative environmental effects are assessed by considering a Change in Air Quality from the Base Case, the Project Case, and the Future Case.

Base Case

To characterize the Base Case in the RAA, ambient air quality monitoring data from provincial and federal programs as well as supplementary ambient monitoring data were analyzed (Jacques

Whitford 2008b). Data on the existing air quality conditions (Section 7.2) were used to estimate background air quality concentrations (Base Case) to be used for the dispersion modelling in the Project and Future cases.

In addition to background ambient air quality data, major industrial emission sources in the RAA were modelled with CALPUFF to characterize the Base Case for secondary particulate matter formation and potential acid input.

Project Case

The residual Change in Air Quality for the Project Case is assessed, for the Project in Section 7.4. The potential environmental effects of marine-based infrastructure were assessed individually, in conjunction with the Base Case. The Change in Air Quality is expected to be medium in magnitude, local in extent, and short-term in duration.

The residual cumulative environmental effects of the Base Case plus the Project are less than that of the Future Case, which is discussed below.

Future Case

For the Future (Cumulative Environmental Effects) Case, emissions inventories were developed for CAC from proposed future Industrial Land Use projects as described above. To be conservative, only projects which would result in a net increase of air contaminant emissions into the Saint John airshed were included in the assessment of cumulative environmental effects. The other future projects meeting this criterion which were included in the cumulative environmental effects assessment are:

- Project Eider Rock (Land-Based Components);
- Industrial Land Use (*e.g.,* the Gypsum Wallboard Manufacturing Plant and the Canaport LNG Marine Terminal and Multi-Purpose Pier); and
- Marine Use (including marine vessels for LNG, gypsum, and petroleum coke shipping in the Port of Saint John).

Emissions of Non-CAC from other future projects were not estimated due to limited availability of data for these sources. However, as CAC emissions from proposed future sources are relatively low compared to emissions estimated for the Base Case and Project Case, the related Non-CAC emissions from other future sources are not expected to be substantive.

The dispersion of CAC emissions from the selected future industrial sources was modelled with CALPUFF to predict the maximum short–term (hourly) and long-term (annual) average GLC due to these sources alone. Model predictions were made at locations defined by detailed nested receptor grids for both the LAA and RAA. These results were then combined with predictions from dispersion modelling results for the Project, where applicable (Section 7.4.1) as well as with Project Eider Rock's land-based components, Canaport LNG, and the Gypsum Wallboard Manufacturing Plant). Finally, background concentrations based on ambient monitoring data were added to the combined modelling results to assess the cumulative environmental effects of the Future Case (Jacques Whitford 2008b).

For CAC, the predicted values for the Future Case were compared with regulatory objectives, guidelines and standards to establish the direction, magnitude, geographical extent, duration, frequency, reversibility, and ecological/socio-economic context. The results of the modelling are summarized in Table 7.12 and Figures 7.6 and 7.7.

Table 7.12 Maximum Predicted CAC Concentrations for Cumulative Environmental Effects Case

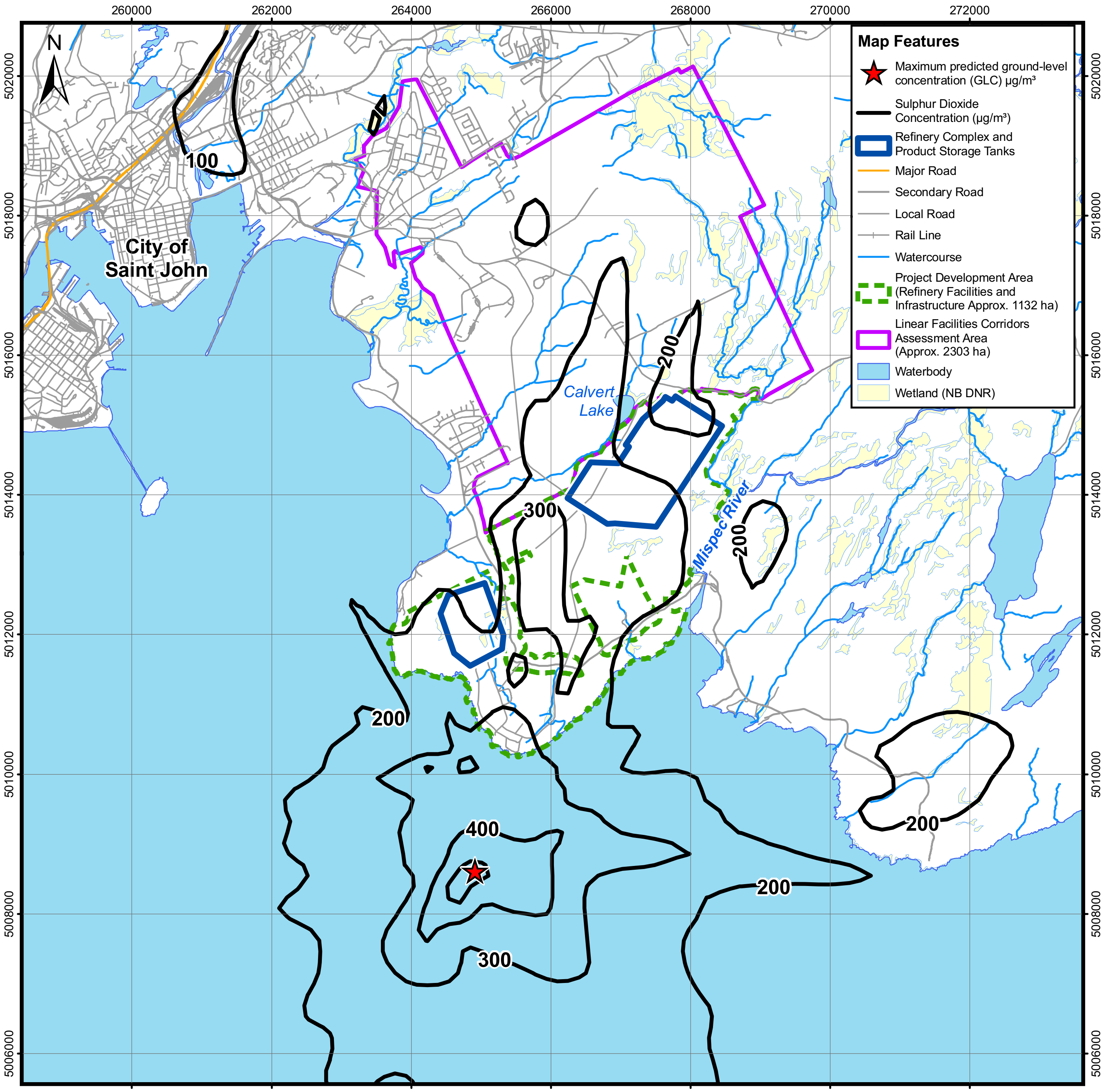
Criteria Air Contaminant	Averaging Period	Objective/ Guideline/ Standard Used for Comparison (µg/m³)	Background (µg/m³)	Dispersion Modelling Results		
				Maximum Predicted Ground-Level Concentration, Project + Future Sources (µg/m³)	Maximum Predicted Ground-Level Concentration plus Background Concentration (Future Case) (µg/m³)	Percent of Objective/ Guideline/ Standard (Maximum predicted plus background)[2]
SO_2	1 h	450	63	**571**	**634**	**141%**
	24 h	150	52	**247**	**299**	**199%**
	Annual	30	16	19.8	35.8	119%
NO_2	1 h	400	30	305	335	84%
	24 h	200	21	81.0	102.0	51%
	Annual	100	10	18.3	28.3	28%
CO	1 h	35,000	1,260	522	1,780	5%
	8 h	15,000	1,260	127	1,390	9%
PM	24 h	120	53	46.1	99.1	83%
	Annual	70	23	5.17	28	40%
PM_{10}	24 h	50	29	13.8	42.8	86%
$PM_{2.5}$	24 h	30	17	4.97	22.0	73%
H_2S	1 h	15	1.4	8.46	10	66%
	24 h	5	1.2	2.43	3.6	73%
Ammonia	24 h	100	-	1.59	1.6	2%

Notes:
1 Highest SO_2 predictions are due to marine vessels emissions (marine terminal + LNG tankers); Note that marine vessel emissions are intermittent (modelling assumed 4 vessels operating continuously over 5 years – a highly conservative assumption).
2 SO_2 predicted exceedances occur over water; these are below the NAAQO for SO_2.
Bold indicates a value that exceeds the objective, guideline, or standard.

The highest CAC concentrations for the Cumulative Environmental Effects Case are reported for SO_2 and occur over water, south-east of the marine terminal (Table 7.12 and Figure 7.6). These maximum GLC are primarily due to emissions from the Project marine-based infrastructure (Section 7.4.1). Although the maximum predictions for 1 hour, 24 hour, and annual SO_2 are above the ambient air quality objectives set by the New Brunswick Department of Environment (for Saint John County), the maximum predicted SO_2 concentrations are below the federal maximum acceptable NAAQO for SO_2 (which are equivalent to the SO_2 criteria for most counties in New Brunswick, as outlined in Schedule B of the New Brunswick *Air Quality Regulation*—the criteria that are most likely applicable in the marine waters of the Bay of Fundy). Further, as the emissions scenario modelled for the marine-based infrastructure is conservative (Section 7.4.1), the potential frequency of exceedances is diminished.

All of the other model predictions of CAC for the Future (Cumulative Environmental Effects Case) are below the regulatory objectives, guidelines, and standards.

The Study Team completed an Addendum to this CSR (Jacques Whitford Stantec Limited 2009b), which concluded that the contribution of the Development Proposal during these poor air quality events was considered to be negligible in comparison to the measured values at each monitoring location in East Saint John, and nominal in absolute magnitude.



Ambient Objective = 450 µg/m³
Measured Background Forest Hills = 63 µg/m³
Maximum Predicted GLC = 634 µg/m³

Map Parameters
Projection: UTM
Datum: WGS84
Zone: 20
Map Units: Metres
Date: 3/9/2009
Project: 1013263
Contour Interval= 100 µg/m³

Data Source: Service New Brunswick, NB DNR, Fluor

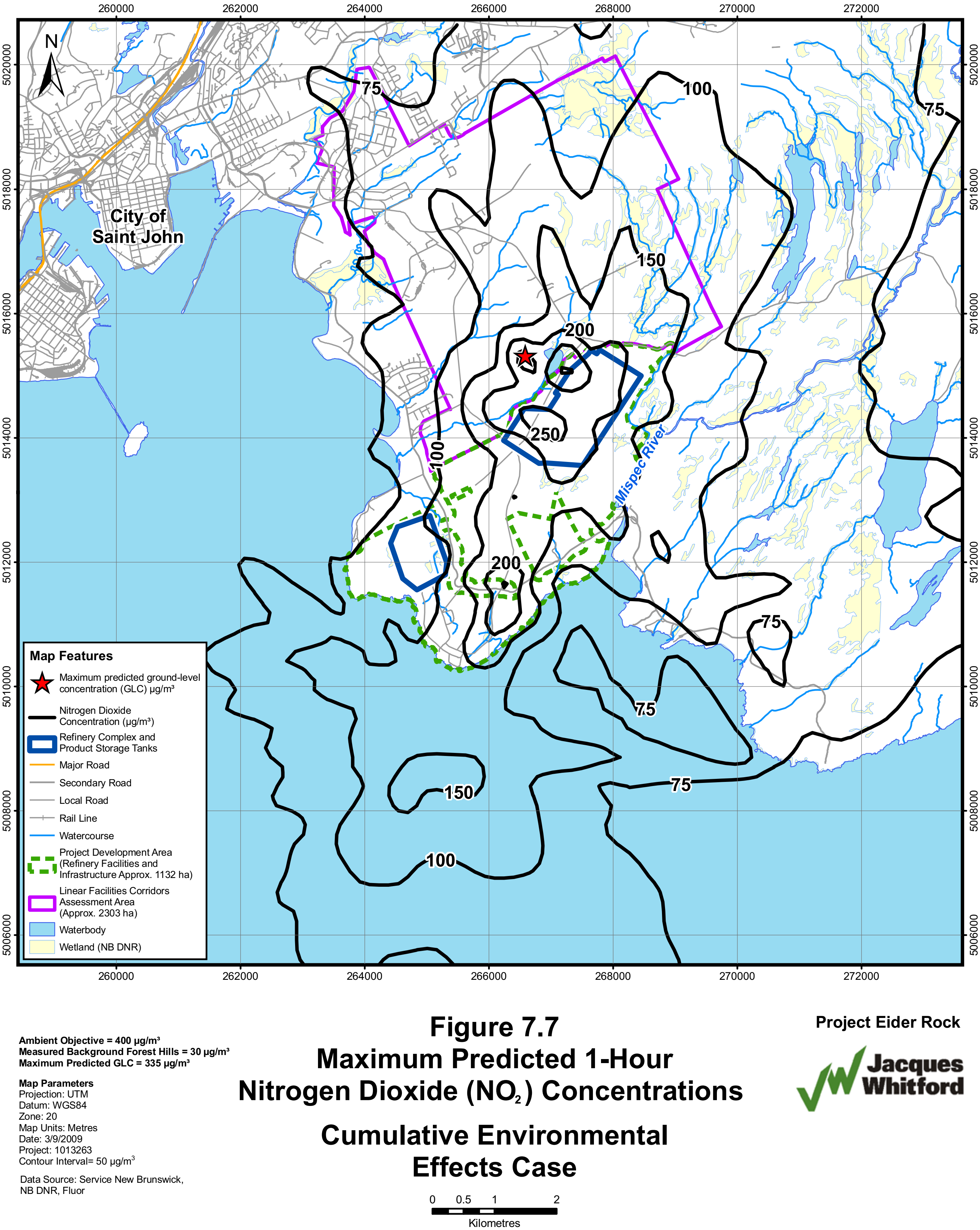
Figure 7.6
Maximum Predicted 1-Hour Sulphur Dioxide (SO_2) Concentrations

Marine Terminal and Other Marine-Based Infrastructure

0 0.5 1 2
Kilometres

Project Eider Rock

Jacques Whitford



Ambient Objective = 400 µg/m³
Measured Background Forest Hills = 30 µg/m³
Maximum Predicted GLC = 335 µg/m³

Map Parameters
Projection: UTM
Datum: WGS84
Zone: 20
Map Units: Metres
Date: 3/9/2009
Project: 1013263
Contour Interval= 50 µg/m³

Data Source: Service New Brunswick, NB DNR, Fluor

Figure 7.7
Maximum Predicted 1-Hour Nitrogen Dioxide (NO_2) Concentrations
Cumulative Environmental Effects Case

0 0.5 1 2
Kilometres

Project Eider Rock

Jacques Whitford

For Non-CAC, residual environmental effects for the Future Case are assessed for Project Eider Rock as a whole in the Final EIA Report (Jacques Whitford Stantec Limited 2009a). A Change in Air Quality due to regional air quality aspects such as secondary particulate matter formation, acidic deposition (potential acid input), and long-range transport are expected to be similar to those estimated for Project Eider Rock (Jacques Whitford Stantec Limited 2009a).

On an overall basis, the residual cumulative environmental effect on a Change in Air Quality is expected to be medium in magnitude, local in extent, and short-term in duration. The Project contribution to the cumulative environmental effect is also expected to be medium in magnitude, local in extent, and short-term in duration. In both cases, the frequency of events where the objectives, guidelines, or standards are exceeded is expected to be, at worst, occasional. The cumulative environmental effects of the Project, during all phases, in combination with other projects and activities that will be carried out is rated not significant. The Project contribution to the cumulative environmental effects is also rated not significant.

7.5.2 Change in GHG Emissions

The cumulative environmental effects of a Change in GHG Emissions from the Project are assessed in combination with other future projects for consideration of cumulative environmental effects in the LAA and the RAA.

7.5.2.1 Project Cumulative Environmental Effects Mechanisms for Change in GHG Emissions

Similar to a Change in Air Quality, the cumulative environmental effects of a Change in GHG Emissions from the Project are assessed in combination with GHG emissions from other future projects. These include the GHG emissions from the land-based components of Project Eider Rock as well as Industrial Land Use (*e.g.,* the Gypsum Wallboard Manufacturing Plant and the Canaport LNG Marine Terminal and Multi-Purpose Pier).

The GHG emissions from the Other Future Projects, based on available information, are summarized in Table 7.13.

Table 7.13 Summary of Annual GHG Emissions from Other Future Projects

Future Project	GHG Emissions (t/a)
Project Eider Rock (Land-Based Components)	5,728,000
Canaport LNG Terminal[1]	339,000
Atlantic Wallboard Limited Partnership[2]	81,300
Total	6,148,300

Sources:
[1] Jacques Whitford (2004)
[2] NBENV (2007c)

7.5.2.2 Mitigation for Change in GHG Emissions

GHG emissions are a global issue. As a result, mitigation, to be effective in reducing the rate of increase of GHG concentrations in the atmosphere, must be undertaken globally. Such an undertaking requires the introduction of transformative technologies that, over time, would result in the displacement of older, inefficient technologies—those which would provide the goods and services of similar quality with lower GHG design intensity.

For other future projects, there is opportunity for mitigation measures to be implemented to reduce GHG Emissions. These measures are not fully known for each specific project but could include, but are not limited to:

- The continued pursuit of innovation, by looking at every potential aspect of the Project during the design process to improve energy efficiency;
- A design approach that allows the refinery to take advantage of options for future carbon capture or sequestration opportunities, should they become available;
- Continuous improvement and adaptive management; and
- Being best-in-class in energy efficiency with as small an environmental footprint as possible.

7.5.2.3 Characterization of Residual Cumulative Environmental Effects for GHG Emissions

As with the cumulative environmental effects assessment for the Change in Air Quality, the cumulative environmental effects for the Change in GHG Emissions are assessed for the Base Case, Project Case and Future Case.

Base Case

As noted in Section 7.2.2, New Brunswick's GHG emissions were approximately 18 Mt CO_2eq/a in 2006 (Environment Canada 2008i); Canadian GHG emissions are approximately 721 Mt CO_2eq/a; and Global GHG emissions are approximately 49,000 Mt CO_2eq/a.

Project Case

Project-related GHG emissions during Operation were estimated at 0.044 Mt CO_2eq/a, and are considered "low" in the context of CEA Agency guidance. The Project (Operation) is predicted to result in a Change in GHG Emissions as follows:

- 0.2% of the total New Brunswick emissions estimated for 2006;
- 0.06% of Canadian total emissions; and
- 9 x 10^{-5} % of total global emissions (based on fossil fuels).

Future Case

The cumulative GHG emissions of the Project in combination with other future sources (Project Eider Rock land-based sources, Canaport LNG, and Gypsum Plant) are estimated to be:

- 28% of the total New Brunswick emissions for 2015;
- 0.8% of Canadian total emissions; and
- 0.02% of global total emissions (based on fossil fuels).

The Project will be scrutinized through the design and the permitting process to ensure that it will be operated with the highest energy efficiency, and lowest GHG emissions, that are technically and economically feasible.

The GHG emissions from other future projects will add cumulatively to those of the Base Case and the Project. According to CEA Agency guidance (CEA Agency 2003), the magnitude of the Change in

GHG Emissions for the Project alone is low (<100,000 tonnes CO_2eq per year). However, the magnitude for the Project in combination with other future projects is high. Nevertheless, the Project contribution of GHG is small as a percentage of national or global emissions (Table 7.13).

The cumulative environmental effects of a Change in GHG Emissions on Atmospheric Environment are thought by many scientific authorities as being significant. The Project in combination with these cumulative environmental effects is thus significant. However, the Project contribution to the residual Change in GHG Emissions is very small relative to global emissions, and because the environmental effect on climate change is not measurable, this contribution is considered to be not substantive.

7.5.3 Change in Sound Quality

A Change in Sound Quality from the Project is not expected to act cumulatively with other future projects and activities. Therefore, the cumulative environmental effects of the Project in combination with other past, present and future projects and activities that have been or will be carried out, during all phases of the Project, on a Change in Sound Quality are rated not significant.

7.5.4 Determination of Significance

7.5.4.1 Change in Air Quality

Overall, the residual cumulative environmental effects of a Change in Air Quality are expected to be medium in magnitude, local in extent, and short-term in duration. The Project contribution to the cumulative environmental effect is also expected to be medium in magnitude, local in extent, and short-term in duration.

The potential Change in Air Quality due to emissions from the Future Case is similar to, or less than, that from the land-based components of Project Eider Rock (including background) (Jacques Whitford Stantec Limited 2009a). Dispersion modelling predictions for CAC emitted from Project Eider Rock (land-based components), the Project, and proposed regional industrial sources (including background) occasionally exceed the regulatory objectives for SO_2 only, at receptors over water. Planned improvements to industrial sources in the airshed and continuous air quality improvement achieved through regulation and policy will continue to result in continuously reduced ambient concentrations of contaminants and odours in the region, even with the Project.

The cumulative environmental effects of the Project in combination with other past, present and future projects and activities that have been or will be carried out, during all phases of the Project, on a Change in Air Quality are therefore rated not significant. Similarly, the Project contribution to the cumulative environmental effects of a Change in Air Quality is rated not significant. Both significance predictions are made at a moderate level of confidence.

7.5.4.2 Change in GHG Emissions

It is the global increase in GHG concentrations since the beginning of the industrial age that is believed by many to be causing overall measurable changes to the climate. While emissions from the Project will add to existing GHG emissions occurring globally and potentially contribute to those increasing concentrations, a potential cause and effect between Project emissions and global climate change cannot be characterized. Emissions from the Project may add approximately 9×10^{-5} % to annual total global GHG emissions, a very small and not measurable fraction of the global total emissions of GHG.

The environmental effect of any net increase in GHG emissions by any one project on global climate change, in and of itself, is not measurable on a national or global scale.

However, increasing GHG emissions and the resulting increase in GHG concentrations in the atmosphere, and the consequent changes to the global climate are believed to be a significant cumulative environmental effect. Therefore, even with the planned mitigation, and the analysis presented in this CSR, the potential environmental effects, including cumulative environmental effects, of a Change in GHG Emissions from the Project in combination with other past, present and future projects and activities that have been or will be carried out during Operation of the Project are rated significant, but they are rated not significant for the Construction and Decommissioning and Abandonment phases as well as during Accidents, Malfunctions, and Unplanned Events. This rating is a result of the fact that the existing environmental effects of GHG emissions on global climate are significant. This would occur with or without the Project; although substantive policy and regulatory instruments have been proposed by governments around the World to address these cumulative environmental effects, including Canada. This significance prediction is made at a moderate level of confidence. However, because the Project's contribution to a net change in global GHG emissions is small, and because the environmental effect of the Project on global climate is not measurable, the Project contribution to cumulative environmental effects on a Change in GHG Emissions is rated not significant. There is a high level of confidence in this significance prediction.

7.6 Follow-up and Monitoring

No specific follow-up or monitoring is recommended as part of this CSR for a Change in Air Quality. However, in addition to the extensive ambient air quality monitoring network already operated by provincial and federal programs in the Saint John region, it is anticipated that the provincial EIA process will result in additional ambient monitoring being required on a continuous basis to monitor the ambient air quality in the nearby communities to the refinery associated with the Development Proposal.

Emissions of GHG will be monitored and/or calculated to quantify annual emissions for reporting to federal requirements, as required, as a follow-up measure to a Change in GHG Emissions.

Although no follow-up and monitoring is recommended in respect of a Change in Sound Quality, the EPP for the construction activities will document procedures to minimize noise emissions as a result of Construction. A noise complaint follow-up and response procedure will also be developed for both Construction and Operation.

8.0 PUBLIC HEALTH

CEAA requires that an EA consider the environmental effects that Project-related changes in the environment may have on health and socio-economic conditions. Health is a condition of the environment that relates to the physical health and well-being of the people living in the vicinity of a project or using the lands in the area of a project.

The Project involves the development of a marine terminal, and associated marine-based infrastructure to support the Development Proposal. The emissions to the atmosphere and the releases to the marine environment need to be carefully controlled and managed to prevent significant adverse environmental effects. Otherwise, the health of people living near the Project and that are exposed to these emissions and releases could be adversely affected. Thus, in addition to the provincial requirements to assess these environmental effects and as reflected in issues and concerns raised during public consultation, public health is important to local stakeholders and the general public as they want to understand and minimize the potential environmental effects on their health that could arise from exposure to chemicals released to the environment from the Project.

The federal EA Track Report and Scoping Document stipulate that the potential environmental effects of the Project on public health be evaluated. A Human Health Risk Assessment (HHRA) is the most appropriate mechanism to assist in the assessment of potential environmental effects on public health. Any chemical, from the most benign to the most toxic of chemicals to which humans can be exposed, has the potential to cause environmental effects in people—it is the concentration, duration of exposure, and route by which people come into contact with a particular chemical that determines if it may cause harm to their health.

The evaluation of potential environmental effects on Public Health relies on predictions of the anticipated concentrations of chemicals released by the Project as determined by analyses conducted for other VECs, mainly from the outputs of the air quality dispersion and deposition modelling conducted to characterize the potential environmental effects to the Atmospheric Environment. Through its knowledge of associated releases as well as from detailed examination and professional judgment, emissions of chemicals of potential concern (COPC) to the atmosphere were determined by the Study Team to be the primary source and pathway through which people would be exposed to releases from the Project.

A Baseline Public Health Assessment was conducted to characterize the existing health status of the communities surrounding the Project, thereby providing an understanding of baseline health conditions in the area prior to undertaking the Project (EOH+Plus 2008). Overall, the findings revealed that the existing health status of Saint John area residents (*i.e.,* the former Health Region 2) is similar to that in the rest of the province. However, there are some exceptions where residents of the former Health Region 2 had differences in their reported disease rate compared to the remainder of the province. This information was used to understand and assess how Project-related emissions could result in a change in this health status. Additionally, soil and biota sampling on land and in the marine environment was carried out to characterize the existing (baseline) conditions of the environment in the vicinity of the Project with respect to the current average concentrations of a variety of COPC in soil, water, forage, produce, and terrestrial and marine biota.

The potential risks to public health resulting from the environmental effects of exposure to chemicals were assessed for existing (baseline) conditions and for Construction, Operation, and Decommissioning and Abandonment of the Project, alone, in combination with baseline conditions, and in combination with baseline and other projects and activities that will be carried out (*i.e.,* known future sources). The HHRA focused on quantitatively evaluating potential changes in health due to short-term exposures (*e.g.,* changes in asthma rates, changes in the occurrence of eye/throat irritations), and potential changes in health due to long-term chemical exposures to chemicals primarily during Operation (*e.g.,* changes in rates of neurological disorders).

Health risks associated with existing (baseline) concentrations of acrolein in the Saint John area were determined to be high in relation to accepted benchmarks (even in the absence of the Project), thus potentially contributing to risks to human receptors in the Saint John area. However, further examination of these data determined that concentrations of acrolein were similar to other communities in the rest of urban Canada.

The results of the HHRA indicate that the potential environmental effects of Project-related releases of COPC on a Change in Public Health, when they were evaluated in isolation of existing concentrations of chemicals in the environment in the Saint John area, are not significant. Although existing baseline concentrations of acrolein are present in the ambient air at levels that may be associated with health risks, there are no emissions of acrolein expected from the Project and the cumulative environmental effects of the Project, in combination with existing conditions and other past, present and future planned projects and activities that have been or will be carried out, are rated not significant.

The Project's environmental effects will be minimized by the application of best available proven technology economically viable and other mitigation and environmental management practices and procedures. Project-related emissions and wastes will be controlled to an extent that they are in compliance with air quality or health-based standards, and as such, the Project is not anticipated to significantly affect the existing health status of residents of the Saint John and surrounding areas as described in the Baseline Public Health Assessment.

8.1 Scope of Assessment

The scope of the environmental assessment for Public Health includes an assessment of the potential environmental effects associated with the releases of chemicals from the marine terminal over its lifetime. The potential environmental effects are assessed for Project-related releases during Construction, Operation, and Decommissioning and Abandonment.

This section defines the scope of the environmental assessment of Public Health in consideration of the nature of the potential interactions between people and Project-related emissions.

8.1.1 Regulatory Setting

In the federal EA Track Report and Scoping Document, the scope of the EA under *CEAA* is focused on the assessment of environmental effects on public health related to emissions from the Project. The Project, as scoped, will include a consideration of environmental effects on health as they relate to changes in the environment.

The federal regulatory authorities have not published guidance for conducting a facilities emission risk assessment in support of an EA, such as that required for the Project. Rather, Canadian HHRA guidance and regulatory benchmarks of acceptable risk exist for assessing contaminated sites, supplemented by methodologies developed by the US EPA or other agencies. Therefore, the risk assessment conducted in this CSR followed industry standard practices and methodologies consistent with those employed in previous HHRA studies in New Brunswick.

8.1.2 Issues Raised During Public and Stakeholder Engagement

A summary of key issues related to Public Health is provided in Table 8.1 as are details as to how they were considered in the CSR. Concerns regarding impairment of air quality and the resulting environmental effects on the health of area residents were common issues of concern.

Table 8.1 Summary of Issues and Concerns Regarding Public Health from Proponent Led Public Engagement Activities

Key Issue/Comment	Influence on the Assessment
How is baseline of local health conditions being assessed?	A Baseline Public Health Assessment Technical Study and a Human Health and Ecological Risk Assessment Technical Study have been undertaken to better understand both the current health status of local residents in the Regional Assessment Area, and the potential Project-related environmental effects on public health.
Is the study of health risk for incremental health risks or for cumulative health risk?	The study evaluated both incremental health risks and cumulative health risks from Project-related chemical exposure.
What about health effects to workers at the facility?	Potential health risks to workers at the Project are protected through the New Brunswick *Occupational Health and Safety Act*. These regulations are set by the Government of New Brunswick to protect worker health and safety.

8.1.3 Selection of Environmental Effect

Even with the most advanced designs and the application of best practices and mitigation, Project-related activities will result in the release of chemicals into the environment. However, the mere presence or emission of a chemical from a source into the environment does not necessarily result in a change of the health status of a community. It is the concentration of these chemicals deposited in various environmental media and the manner by which people may be exposed to these COPC (including the duration of exposure), which dictates their potential to result in an adverse environmental effect on public health.

The Air Quality Technical Study (Jacques Whitford 2008b) details the Project-related emissions to the Saint John airshed and the dispersion of these emissions, which are summarized in Section 3.7.1 (Tables 3.3 to 3.11) of this CSR. An HHRA was also conducted to evaluate how these dispersed emissions could cause a potential risk to human health from short-term and long-term exposure to airborne concentrations. In addition, the HHRA evaluated the potential for the COPC to accumulate and/or persist in the environment. For those COPC that were considered bio-accumulative and/or persistent, the multiple pathway assessment evaluated the exposure of the public to predicted concentrations of COPC deposited in various environmental media (*e.g.,* soil, vegetation, and fish). Only CAC emissions are relevant for the marine terminal, and none of the CAC met the criteria for bioaccumulation or persistence. Therefore, the multiple pathway assessment was not considered further herein.

For Non-CAC, the emissions from the Marine Terminal and Other Marine-Based Infrastructure (Project Alone) are negligible (Jacques Whitford 2008b) and are intermittent. Further, the Change in Air Quality for the marine terminal and associated activities is expected to be low in magnitude, local in extent, and short-term in duration. Since the emissions from the land-based infrastructure resulted in health risk values that are less than the regulatory benchmark criteria, it is expected that health risks associated with the lower overall emissions of Non-CAC from the Operation of the Marine Terminal and Marine-Based Infrastructure will also meet the benchmark criteria. As a result, the emissions of Non-CAC are not considered further in the project-related or cumulative environmental effects assessment.

In recognition of scope provided in the EA Track Report and Scoping Document, a Change in Public Health has been selected as an environmental effect to guide the assessment of Public Health.

The Change in Public Health refers to those people living, working or enjoying recreational activities in the vicinity of the Project, including workers employed by the Project that live or enjoy recreational activities near the Project.

8.1.4 Selection of Measurable Parameters

The measurable parameters used in the assessment of a Change in Public Health are based on the risk characterization predictions derived in the HHRA. Predictions of potential human health risk from chemical exposure are derived by both:

- **Exposure Route** – distinction is made between exposure to chemicals through inhalation and that of exposure by oral (ingestion) and dermal (skin) contact; and
- **Disease Endpoint** – distinction is made between chemicals that cause cancer (carcinogens) and those to which exposure results in non-cancer diseases (non-carcinogens).

The measurable parameters that will be used for the assessment of Change in Public Health, and the rationale for the selection of the measurable parameters, are provided in Table 8.2.

Table 8.2 Measurable Parameters for Public Health

Environmental Effect	Measurable Parameter	Rationale for Selection of the Measurable Parameter
Change in Public Health	Concentration Ratio (CR)	The CR is appropriate for the evaluation of a non-carcinogenic Change in Public Health from short-term and long-term exposures to chemicals in air (*i.e.,* exposure *via* inhalation). The CR is the ratio between the predicted or actual concentration of a chemical in air and its tolerable concentration for humans (as determined by health-based objectives, guidelines and standards established by regulatory agencies).

8.1.5 Temporal Boundaries

The temporal boundaries for Public Health include pre-Project baseline conditions, and each of the Project phases:

- Construction (6-8 years beginning in 2010);
- Operation (30 years or more, extended by maintenance or refurbishment); and
- Decommissioning and Abandonment (at the end of the useful life of the Project).

Pre-Project baseline conditions for Public Health were based on two separate technical studies, each of which encompasses a different time period as noted below.

- The Baseline Public Health Assessment (EOH+Plus 2008) period of study was generally 2000 to 2004, with some survey data included from 2005.

- Baseline air quality data for a six year period (2001 to 2006), as well as field data from Supplementary Monitoring over approximately 6-8 months in 2007 and 2008 (Jacques Whitford 2008b), were evaluated.

The focus of the HHRA was largely on Operation, as air contaminant emissions (the main route of chemical exposure) will be higher in this phase than in any of the other phases (Chapter 7). The HHRA conservatively assumed that individuals would be exposed to emissions from the operation of the Project for a period of 70 years (Jacques Whitford 2008e), corresponding to roughly the average life expectancy of an individual. This also conservatively assumes that no updates or changes in operation would occur during this timeframe, and that emissions from the marine terminal would remain at constant levels throughout this period, even though continuous improvement may result in lower emissions.

Within Operation, a Change in Public Health is assessed based on short-term averaging times (*i.e.*, 1 hour and 24 hour exposures), long-term averaging times (*e.g.*, average annual or 70 year lifetime exposures), and the modelled human life-stages for non-carcinogenic health risks (*e.g.*, 4.5 years for a toddler).

8.1.6 Spatial Boundaries

The spatial boundaries (Figure 8.1) for the environmental effects assessment of Public Health are as follows.

Project Development Area (PDA): The PDA for Public Health includes the physical footprint of the Project in the marine environment (Section 3.2).

Local Assessment Area (LAA): The LAA for Public Health is defined as the maximum area where Project-specific environmental effects for the VEC can be predicted or measured with a reasonable degree of accuracy and confidence, and represents the area within which Project-related air contaminant emissions and resulting environmental effects on Public Health may occur. Similar to Atmospheric Environment (Chapter 7), the LAA is an area 15 km by 15 km and centered approximately on the location of the Project.

Regional Assessment Area (RAA): Similar to Atmospheric Environment, the RAA for Public Health is a 70 km (east-west) by 45 km (north-south) area centered approximately on the location of the Project. The RAA also includes the City of Saint John and Simonds Parish census subdivisions and a sizeable portion of the former Health Region 2, which represent the spatial boundaries of the Baseline Public Health Assessment Technical Study (EOH+Plus 2008).

Specific locations within the LAA were assessed as part of the HHRA, and these incorporated:

- The location of maximum ground-level concentrations (MGLC) of each of the COPC;
- Input from the technical review committee; and
- Input from public consultation, including open houses.

These locations were selected for several reasons, including but not limited to:

- The presence of existing residential developments;
- The presence of institutional developments (*e.g.*, schools, hospitals, community colleges);

- The likelihood or known presence of ecological receptors (*e.g.*, proximity to the PDA, bodies of water, wetlands); and
- Locations of known recreational use (*e.g.*, hiking, swimming).

The locations selected for assessment within the LAA and evaluated in the HHRA are presented in Figure 8.2.

8.1.7 Administrative and Technical Boundaries

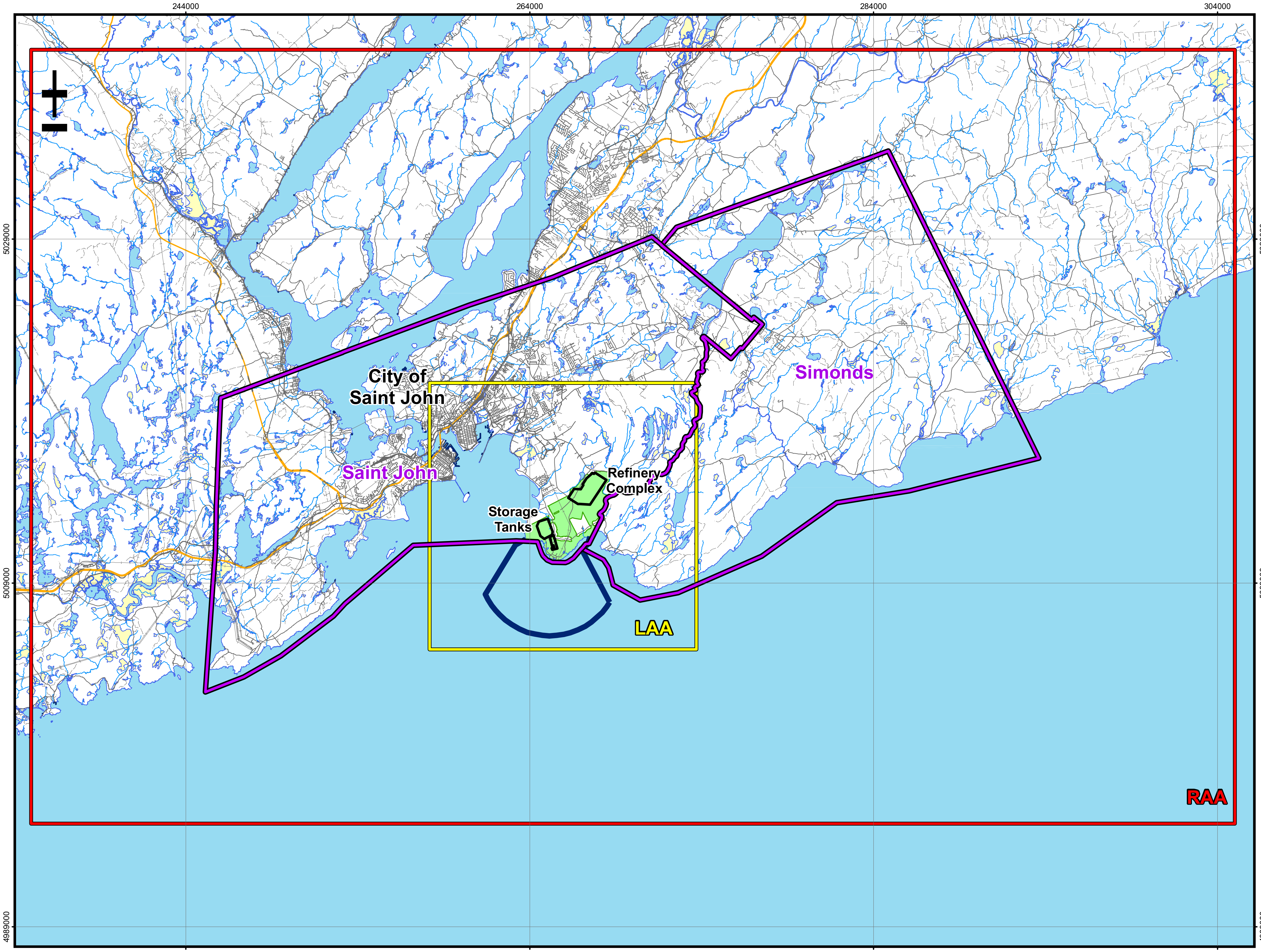
The administrative boundaries for the assessment of a Change in Public Health are governed by the accepted methodologies and guidelines for the conduct of HHRA in Canada. Although there is no specific guidance for emissions risk assessment, the protocols follow a standard risk assessment paradigm accepted by the federal government (Health Canada 2004a; CCME 2006; and the US EPA 1989, 2005d).

The following technical boundaries are part of conducting any HHRA. The HHRA was completed using the following guiding principles, which are common to the study of potential environmental effects on public health from exposure to COPC, regardless of the source.

- All chemicals, regardless of type or source, possess some degree of intrinsic toxicity (*i.e.*, all COPC have the capacity to cause some level of harm or injury).
- The health endpoints elicited by any of the COPC depend on the intrinsic toxicity of the substance and the degree of exposure to, or dose of, the chemical.
- With few exceptions, the toxicity of each of the COPC (*i.e.*, the capacity to produce a harmful endpoint or physiological injury) is only expressed if the dose, as measured by exposure, exceeds a critical threshold level. Below this threshold, health endpoints are not experienced. A possible exception to this principle involves the actions of certain COPC carcinogens that act by altering genetic material to produce certain forms of cancer and are not considered to have a protective threshold. Although there is not a threshold for cancer toxicity, there is a government accepted level of cancer risk of 1 person exposed in a population of 100,000 that is used to assess potential cancer risk.
- If the threshold dose is exceeded, health endpoints can (but do not necessarily) occur. The severity of these health-related environmental effects would depend on the level of exposure received, with more severe health-related environmental effects occurring with increased exposure.
- The toxicity of a chemical largely depends on its molecular structure. Within limits, COPC with similar structures would generally have similar evidence of health endpoints. This principle allows the health endpoints of a chemical for which there may be little toxicity information, to be predicted by comparison with a chemically similar compound for which there is extensive toxicity data.
- The health endpoints produced by a chemical depend on the route, level and duration of exposure. Health endpoints may differ according to the route of exposure (*e.g.*, inhalation *vs.* oral exposure). It is also important to distinguish between the health endpoints that might result from acute exposures of short duration and health environmental effects that might occur following chronic or long-term exposure.

Figure 8.1 Spatial Boundaries for Public Health

Project Eider Rock



Map Features

- Assessment Area for the Baseline Public Health Assessment
- Project Component
- Local Assessment Area
- Regional Assessment Area
- Project Development Area (Marine Terminal Facilities and Infrastructure)
- Major Road
- Secondary Road
- Local Road
- Track
- Rail Line
- Watercourse
- Wharf
- Utility Line
- Waterbody
- Wetland (SNB)
- Project Development Area (Refinery Facilities and Infrastructure Approx. 1132 ha)

Data Source: Service New Brunswick, Statistics Canada, Fluor

0 1 2 4 6 8 10

Kilometres

Map Parameters
Projection: UTM Z20 WGS84
Scale: 1:220,000
Date: April 8, 2009
Project No.: 1013263.

Jacques Whitford

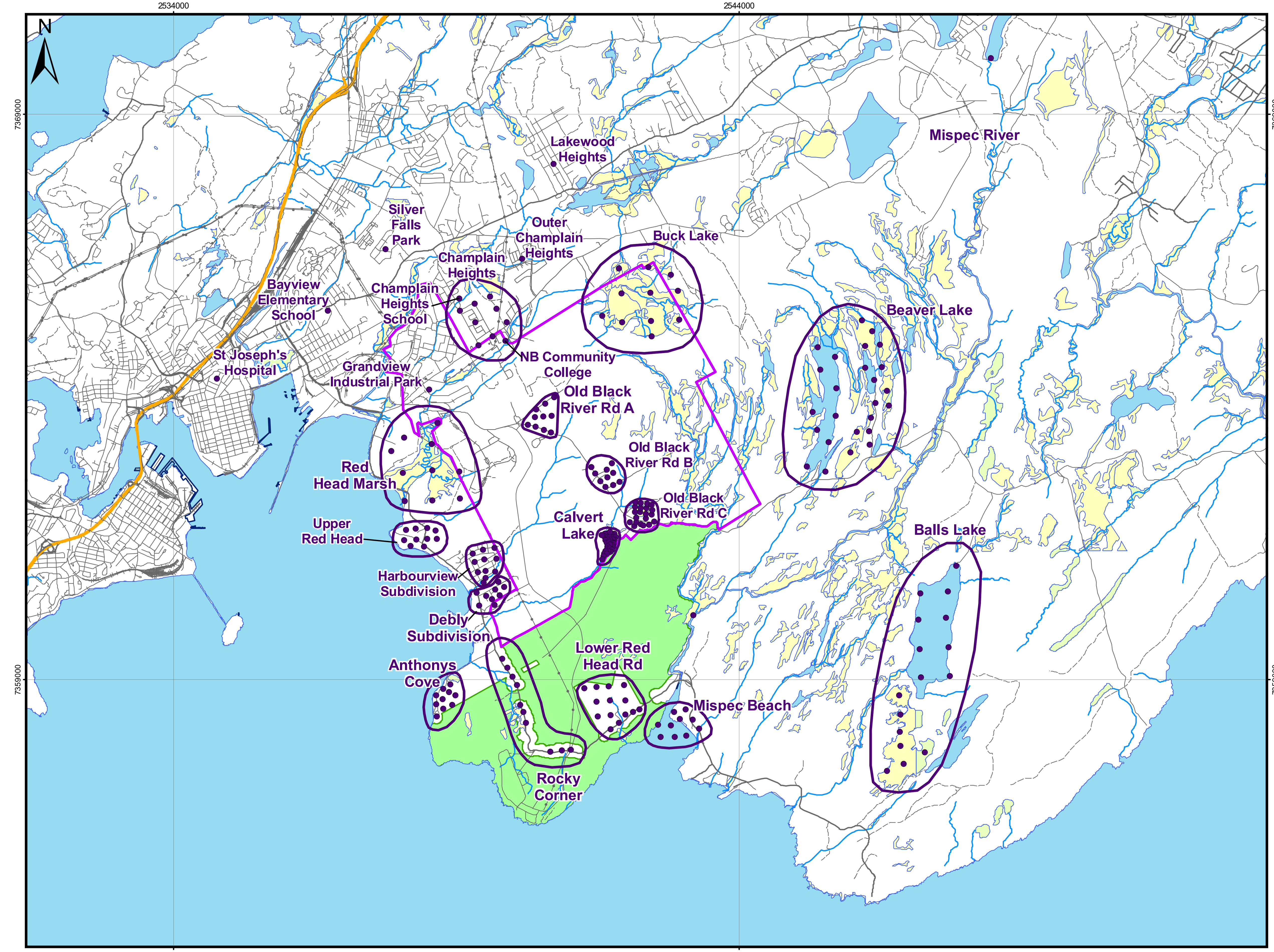


Figure 8.2

Receptor Points and Locations Assessed in the HHERA

Project Eider Rock

Map Features

- Receptor Points
- Receptor Area
- Major Road
- Secondary Road
- Local Road
- Track
- Rail Line
- Wharf
- Utility Line
- Watercourse
- Waterbody
- Wetland (NB DNR)
- Wetland (SNB)
- Linear Facilities Corridors Assessment Area (Approx. 2303 ha)
- Project Development Area (Refinery Facilities and Infrastructure Approx. 1132 ha)

Data Source: Service New Brunswick, NB DNR

0 0.5 1 2 3 4

Kilometres

Map Parameters
Projection: NB Stereographic
Scale: 1:67,000
Date: August 28, 2008
Project No.: 1013263.

Jacques Whitford

Risk evaluation normally includes an element of uncertainty due to the assumptions that are made during the risk assessment process, either because of data gaps or knowledge gaps. One of the cornerstones of risk assessment is the concept of “conservatism”, meant to convey a preference for erring on the side of overstating, as opposed to understating, risk under conditions of limited information, lack of scientific consensus, or uncertainty.

Conservative, accepted methodologies were applied to the selection of the COPC (*e.g.*, those chemicals known to be emitted, those known to persist in the environment over time). The emission data for COPC from petroleum refineries were obtained from reputable government sources or from other health-based organizations (*e.g.,* US EPA, Environment Canada, OMOE).

The HHRA relied on the results of air dispersion modelling to evaluate the health risks from direct inhalation exposure and to predict health risks via exposure from multiple environmental pathways. As noted in Section 7.1.4, the ability of dispersion models to predict ground-level concentrations and deposition rates is a technical boundary. However, substantive review of the available air models and the values used in the model was completed to confirm that the results are appropriate for the assessment of health risks (Jacques Whitford 2008b).

Baseline soil, water, sediment, and air concentrations for some chemicals were not available for the LAA, therefore, supplemental sampling of ambient air quality, as well as sampling of baseline soil, water, sediment, and biota was completed to address this data gap.

The exposure assessment performed as part of HHRA was based on well-understood and generally accepted methods for risk prediction. Given the inherent level of uncertainty and variability associated with both behavioural and physical characteristics from one individual to another, receptor characteristics were selected in an attempt to purposely overestimate potential exposures of all individuals. Similarly protective assumptions were used to estimate the chemical concentrations in the air, soil, water, and food. Maximum predicted short-term (*i.e.*, 1 h and 24 h average) ground-level air concentrations at specific residential locations were used to evaluate acute inhalation risk estimates, and annual average ground-level air concentrations based on an assumption that three marine vessels would be present year-round were used to assess long-term health risks. This is an extremely unlikely scenario and adds a substantive amount of conservatism to the assessment.

Exposure limits (toxicological reference values) were gathered from regulatory agencies such as Health Canada, the US EPA’s Integrated Risk Information System (IRIS), the World Health Organization (WHO) and the Agency for Toxic Substances and Disease Registry (ATSDR). A considerable amount of conservatism is incorporated into the exposure limits. The limits were derived from the most sensitive health risks, and then adjusted to account for differences in sensitivity to chemicals among individuals. The use of uncertainty factors is directed, in part, toward the protection of sensitive individuals.

8.1.8 Residual Environmental Effects Rating Criteria

In the HHRA, potential Project-related environmental effects were evaluated quantitatively by comparing calculated chemical exposure estimates for hypothetical individuals at selected receptor locations to toxicity reference values established by recognized health organizations. Health risk estimates derived in the HHRA inherently incorporate descriptors such as direction, magnitude, geographic extent, duration/frequency, reversibility and the ecological context of the environmental effect. Human health risks are expressed as concentration ratios (CR).

Residual environmental effects for a Change in Public Health will be characterized in terms of predicted human health risk estimates. The use of modelling and worst case scenarios, as well as the presence of numerous sources of contaminants, means that the identification of an exceedance does not necessarily represent a health concern or significant health risk, but is helpful in understanding potential risks for the purposes of the conservatively-based EA process, which is a planning process.

In recognition of these key considerations, a significant adverse residual environmental effect for a Change in Public Health is one that results in the Project-related concentration ratio (CR) greater than 1.0 (Table 8.3). Justification for these criteria is provided in the following sections.

Table 8.3 Summary of Residual Environmental Effects Rating Criteria for a Change in Public Health

Environmental Effect	Measurable Parameter	Residual Environmental Effects Rating Criteria Benchmarks for Significant Environmental Effects to a Change in Public Health
Change in Public Health	Concentration Ratio (CR) – Short-term and Long-term Inhalation Health Risks	CR >1.0

If the risk assessment evaluates risks associated with a single source, the selection of a CR of 1.0 as an indication that predicted exposures do not exceed the toxicity reference values is appropriate. When predicted risks are greater than the benchmark level (*e.g.*, CR greater than 1.0), this may indicate the potential for a significant adverse residual environmental effect for a Change in Public Health.

Concentration Ratio (CR) – The CR is the ratio between the predicted or actual concentration of a chemical in air and its tolerable concentration in humans (as determined by health-based objectives, guidelines, and standards established by regulatory agencies), through inhalation by humans. Acute and chronic CR values less than 1.0 indicate that estimated chemical concentrations in air are less than the selected inhalation reference concentrations (RfC), and thus, significant adverse residual environmental effects would not be expected to occur. As this is usually a straight comparison between predicted air concentrations (*i.e.,* 1 h, 24 h, and annual average) and RfC, the resulting CR value is receptor-independent (*i.e.,* the same value is calculated for all receptor types).

An acute health-based RfC is typically specific to a chemical concentration within a single environmental medium (*e.g.*, air) that can be tolerated without adverse health risks occurring on a short-term basis. These limits are routinely applied to conditions in which exposures extend over several hours or several days. As a result, a portion of any short-term RfC is not typically apportioned for various source attributions, but rather the entire TRV is used as the benchmark (*i.e.*, a CR value of 1.0).

For those COPC that were identified as having a chronic inhalation RfC, chronic CR values were compared to a benchmark of 1.0.

Although none of the CAC are considered carcinogenic, the existing health risks associated with other COPC in ambient air were considered as part of the assessment of existing conditions. These include carcinogenic chemicals. The lifetime cancer risk (LCR) is used to evaluate the probability or likelihood of a population, exposed over a lifetime to carcinogenic chemicals in the ambient air from all sources, to develop cancer. LCR values are calculated by multiplying the ambient air concentration by the unit risk factor for the chemical. The unit risk factors are provided by regulatory agencies and reflect the potential of a given chemical to cause cancer.

8.2 Existing Conditions

The existing conditions with respect to Public Health have been established using two scientific approaches:

- An epidemiological assessment of the current health status of residents in the RAA; and
- A predictive quantitative risk assessment of the potential health risks (*e.g.*, CR, LCR) associated with human exposure to existing concentrations of COPC in the environment.

8.2.1 Current Health Status – Baseline Public Health Assessment

A Baseline Public Health Assessment was completed to describe the current health status of Saint John area residents (specifically Saint John and Simonds Parish), prior to the construction or operation of the Project (EOH+Plus 2008). The study summarizes various health indicators that are commonly used to measure the health status of a population, including:

- Demographic characteristics;
- Birth characteristics;
- Mortality;
- Morbidity;
- Cancer incidence;
- Reproductive experiences;
- Hospital use; and
- Determinants of health.

Health indicators were measured for residents of Saint John and Simonds Parish, and were compared to the rest of the population of New Brunswick.

The NBDOH and Statistics Canada provided access to several population data bases and surveys that formed the basis of the supporting data used in the Baseline Public Health Assessment.

Demographic characteristics were reviewed as part of the Baseline Public Health Assessment, since many diseases occur with a higher degree of frequency in the older age groups and health status is often affected by employment, income, education, and other factors (EOH+Plus 2008).

8.2.1.1 Self Reported Health

Most self-reported characteristics of health in the former Health Region 2 were found to be similar to those of New Brunswick as a whole (EOH+Plus 2008). This includes asthma, diabetes, use of insulin and pills to control diabetes, obesity, current and lifetime smoking habits, alcohol consumption habits, chronic fatigue syndrome, multiple chemical sensitivities, anxiety and mood disorders, self-perceived health, improvements in self-perceived health over one year, satisfaction with life in general, self-perceived stress, and use of illicit drugs in the past year.

However, the former Health Region 2 had higher levels of self-reported mental health issues, exposure to second hand smoke, and learning disabilities, than the rest of New Brunswick. They also had a lower screening rate for colorectal cancer by colonoscopy and fecal occult blood count than the rest of New Brunswick. In addition, women in the former Health Region 2 reported a higher rate of exercise and were more likely to take folic acid supplementation for their pregnancy. Men over the age of 35 in the former Health Region 2 were just as likely as men over the age of 35 in the rest of New Brunswick to have had screenings for prostate cancer (EOH+Plus 2008).

8.2.1.2 Births

Overall, the rate of low birth weight for all live births was similar for the residents of Saint John and Simonds Parish compared to the rest of New Brunswick (EOH+Plus 2008). However, it was noted that mothers 25 years of age and older in Saint John and Simonds Parish are more likely to have low birth weight babies than other mothers of the same age in the rest of New Brunswick (EOH+Plus 2008).

8.2.1.3 Mortality

Infant mortality rate and mortality rate for each individual major cause of death in Saint John and Simonds Parish were similar to the rest of New Brunswick from 2000 to 2004 (EOH+Plus 2008). However, these residents experienced a higher all-cause mortality rate than the rest of New Brunswick. The higher mortality rates of these residents translate into a reduction in life expectancy of 1.6 years of life for women and 2.3 years of life for men (EOH+Plus 2008). The causes of death for which mortality rates are elevated in residents of Saint John and Simonds Parish as compared to all other residents of New Brunswick are:

- Cancer in men and women (*e.g.*, lung cancer for men, kidney cancer);
- Diseases of the nervous system in men and women (primarily Alzheimer’s disease);
- Diseases of the circulatory system in men and women (*e.g.*, heart disease);
- Diseases of the skin and subcutaneous tissue (just beneath the skin) in men; and
- Endocrine (*e.g.*, diabetes), nutritional (*e.g.,* obesity) and metabolic disorders (*e.g.*, thyroid disease) in men (EOH+Plus 2008).

8.2.1.4 Cancer Incidence

Each year, approximately 145,000 Canadians are diagnosed with cancer and approximately 68,000 die from their disease. Based on current cancer incidence and mortality rates, the lifetime probability of developing cancer is 38% for women and 44% for men; one in four Canadians will die from their disease (Canadian Cancer Society 2007). Death due to all cancers represents the leading cause of potential years of life lost in Canada and the Atlantic Provinces. For both men and women, in Saint John and Simonds Parish and the rest of New Brunswick, three sites account for most of all cancers:

- Women: breast, colorectal, and lung cancer; and
- Men: prostate, lung, and colorectal cancer.

The age standardized cancer incidence rate for men and women together in Saint John and Simonds Parish was determined to be higher than the rest of New Brunswick, although this finding was more pronounced in men than in women (EOH+Plus 2008), and include cancers of the:

- Lung, in men and women;
- Bladder, in men;
- Breast cancer, in women;
- Skin (melanoma), in men; and
- “All other” cancers in men.

There was no difference in cancer incidence for either men or women between Saint John and Simonds Parish and the rest of New Brunswick for cancer of the kidney, colon and rectum, prostate, leukemia, lymphoma, non-Hodgkin’s Lymphoma, and brain (EOH+Plus 2008). It was also determined that stomach cancer rates in women from Saint John and Simonds Parish are lower than the rest of New Brunswick.

8.2.1.5 Hospitalization Rates

Residents of Saint John and Simonds Parish were admitted less often to health care facilities than other residents of New Brunswick (EOH+Plus 2008). However, residents of Saint John and Simonds Parish are admitted to hospital more often for diseases of arteries, arterioles and capillaries (mainly atherosclerosis), diseases of the nervous system (mainly carpal tunnel syndrome and Alzheimer’s disease), and diseases of the eye and adnexa (mainly day surgeries for cataracts) (EOH+Plus 2008). Furthermore, men of Saint John and Simonds Parish are admitted more often to health care facilities for chronic lower respiratory diseases (bronchitis and emphysema), other diseases of the upper respiratory tract (mainly day surgery for chronic tonsillitis and day surgery for deviated nasal septum), flu and pneumonia, benign tumours, and endocrine disorders (mainly diabetes); while women in Saint John and Simonds Parish are admitted more often to health care facilities for lung cancer (EOH+Plus 2008).

Rates of hospital admission for asthma in residents of Saint John and Simonds Parish are no different than those for residents of the rest of New Brunswick (EOH+Plus 2008).

8.2.1.6 Psychosocial and Other Health Risks

Several studies have found evidence of self-reported measures of stress in communities surrounding large industrial facilities (EOH+Plus 2008). The authors of these studies explain that more people in heavily industrialized communities generally suffer stress and may have stress-related complaints (such as perception of poorer physical and mental health) than other communities which do not host such industries. Responses to environmental stress have been reported to be affected by uncertainty about the risk and lack of control of these risks, as well as a perception that industry does not respond to these concerns (EOH+Plus 2008). Stress and stress-related complaints may occur in the presence of an industry, regardless of toxicologically significant exposure (EOH+Plus 2008). The Community Health Survey carried out by Statistics Canada (2005a) has explored the prevalence of some of these factors in the general population (*e.g.*, self-perceived stress, mental health, and satisfaction with life in general) in the former Health Region 2, which includes the City of Saint John and Simonds Parish. It was determined that residents of the former Health Region 2 had a higher incidence of self-reported mental health issues than the rest of New Brunswick. However, the survey results did not attribute these self-reported mental health issues to any specific cause or concern. A relationship between these issues and potential psychosocial effects of living in a community with an existing large industrial base could not be determined. At this point it is not possible to quantitatively assess this issue; it should nonetheless be acknowledged that these effects may manifest themselves in some individuals.

8.2.2 Predicted Baseline Human Health Risks – Existing Environmental Chemical Concentrations

Predicted human health risks associated with the exposure of people to existing (background) concentrations of chemicals in the environment within the LAA can be estimated using the same methodology for assessing Project-related health risks for a Change in Public Health, namely the following.

- Use CR to evaluate the non-carcinogenic health risk from exposures to chemicals in air.
- Use LCR to express the carcinogenic health risk from long-term exposures to chemicals in air or via multiple pathways.
- The CR values are calculated as described in Section 8.1.4, and can be compared to the same residual environmental effects criteria described in Section 8.1.8 (*i.e.*, CR less than 1.0).
- The lifetime cancer risk (LCR) is a measure used to assess risks related to chemicals that are capable of producing cancer. As noted previously, LCR values include the consideration of cancer risks from all sources. As such, the LCR values are expressed on a total or “all sources” basis. Since regulators have not recommended an acceptable benchmark LCR for exposure to carcinogens associated with background or baseline conditions, interpretation of the significance of the LCR values is difficult. LCR values have been provided in Table 8.7 for information purposes only.
- Baseline health risks were calculated for each of the COPC (Jacques Whitford 2008e). Because baseline health risks rely on the existing measured concentrations of COPC in the environment, the risk estimates incorporate both the natural background concentrations of chemicals and the accumulation of COPC from anthropogenic sources, such as vehicle emissions and industrial sources in the LAA.

8.2.2.1 Predicted Baseline Health Risks *via* Inhalation

Information for a six year period (2001 to 2006), as well as field data from supplementary ambient air quality monitoring over approximately 6-8 months (2007 and 2008) was used to establish baseline air quality in the LAA and RAA (Section 7.2.1). These concentrations were compared to inhalation toxicity reference values, published by regulatory agencies to determine the individual chemical CR and LCR as appropriate (Jacques Whitford 2008e). The results are described in the following section.

<u>Predicted Baseline Health Risks from Exposure to Criteria Air Contaminants</u>

The health risks related to exposures to the CAC were evaluated for both short-term and long-term exposures (Jacques Whitford 2008e). Short-term exposures were calculated using the maximum 90th percentile 1 hour and 24 hour concentrations and long-term exposures were calculated using the average annual concentrations. The CR values for each of the CAC are summarized in Table 8.4.

Table 8.4 Concentration Ratio (CR) Values for Baseline CAC Exposure

Criteria Air Contaminants	Concentration Ration (CR) Values – Inhalation Health Risk by Averaging Period from Exposure to CAC for the Baseline Case (dimensionless)		
	1 hour	24 hour	Annual Average
Ammonia	-	-	-
Carbon Monoxide	0.084	-	-
Hydrogen sulphide (H_2S as TRS)	0.093	0.24	0.15
Nitrogen dioxide (NO_2)	0.075	0.11	0.17
Particulate matter (PM)	-	0.44	-
Particulate matter (PM_{10})	-	0.58	-
Particulate matter ($PM_{2.5}$)	-	0.57	0.38
Sulphur dioxide (SO_2)	0.14	0.35	0.55

Notes:
"-" indicates either this CAC was not analyzed (ammonia) or there is no regulatory exposure limit (TRV) for the particular exposure period.

The CR for all CAC for each of the exposure periods considered for the Baseline Case were less than 1.0, indicating that the health risks associated with the existing baseline concentrations meet the relevant regulatory benchmark.

Predicted Baseline Health Risks from Exposure to Non-Criteria Air Contaminants

The health risks related to exposures to the remaining Non-CAC COPC were evaluated for short-term exposures using the maximum 90th percentile 1 hour and 24 hour concentrations and for long term exposures using the maximum annual average concentrations (Jacques Whitford 2008e).

As detailed in Jacques Whitord (2008e), with the exception of acrolein, none of the measured baseline 1 hour, 24 hour concentrations of the COPC exceeded their relevant TRV for the Baseline Case. Measured 1 hour and 24 hour concentrations of acrolein both resulted in health risks above the acceptable benchmark (CR = 1.5 in both cases). The measured annual average concentration of acrolein exceeded the relevant regulatory TRV (CR = 2.5).

8.2.2.2 Summary of Baseline Health Risks

The results of the inhalation assessment of the existing (baseline) conditions in the RAA indicated that the concentrations of acrolein may result in current (hypothetical) exposures to residents that exceed the benchmark criteria. Specifically:

- The baseline 1 hour concentration of acrolein in air is 0.29 $\mu g/m^3$, which is higher than the exposure limit of 0.19 $\mu g/m^3$ (CalEPA 1999) and results in a CR of 1.5 *via* the inhalation pathway;
- The baseline 24 hour concentration of acrolein in air is 0.12 $\mu g/m^3$, which is higher than the exposure limit of 0.08 $\mu g/m^3$ (OMOE 2008b) and results in a CR of 1.5 *via* the inhalation pathway; and
- The baseline average annual concentration of acrolein in air is 0.05 $\mu g/m^3$, which is higher than the exposure limit of 0.02 $\mu g/m^3$ (US EPA IRIS 2003) and results in a CR of 2.5 *via* the inhalation pathway.

Acrolein concentrations measured in air in Saint John are considered to be similar to those measured in other Canadian cities (Jacques Whitford 2008e). Small amounts of acrolein can be formed and enter the air when trees, tobacco, other plants, gasoline, or oil are burned (ATSDR 2007a) and studies conducted in the United States estimate that roughly three quarters of ambient acrolein originates from mobile sources (US EPA 1999). Although acrolein may be found in soil, water, or air, it evaporates quickly from soil and water and breaks down fairly rapidly in air (about half will disappear within one day) (ATSDR 2007a).

As shown in Table 8.5, the lowest concentration at which mild eye irritation has been observed in humans (*i.e.*, 140 μg/m^3) is more than 480 times higher than the baseline 1 hour air concentration of acrolein within the LAA (*i.e.*, 0.29 μg/m^3). As such, it is unlikely that the present background concentrations of acrolein in the RAA would cause a Change in Public Health.

Table 8.5 Observed Responses in Humans to Short-Term Exposure to Acrolein

Acrolein Air Concentration[(a)] (μg/m^3)	Acute Health Endpoints	Reference
140[(b)] to 210	mild eye irritation (Note that this study formed the basis of the acute inhalation exposure limit for acrolein of 0.19 μg/m^3).	Darley *et al*. (1960); Weber-Tschopp *et al.* (1977)
230[(c)]	lacrimation and irritation of the eyes, nose and throat	Fassett (1962)
350	nasal irritation	Weber-Tschopp *et al.* (1977)
700	decreased respiratory rate and throat irritation	Weber-Tschopp *et al.* (1977)
20,000	lethality	Einhorn (1975); Kirk *et al.* (1991)

Notes:

[a] On an acute basis, the toxicity of acrolein is determined to a greater extent by the exposure concentration than by duration. As such, the air concentrations were not duration-adjusted. Unless stated otherwise, the air concentrations are based on a 1 hour exposure duration.

[b] Air concentration based on a 5 minute exposure duration.

[c] Air concentration based on a 10 minute exposure duration.

The annual average background airborne concentration of acrolein detected within the RAA was 0.05 μg/m^3. Given that concentrations measured in Saint John are considered to be similar to those measured in other Canadian cities, the 1,000-fold conservative uncertainty factors built into the reference concentration, and the fact this regulatory limit is based upon minor nasal irritation for a very sensitive test species (*i.e.*, in only 1 of 12 studied rats), it is unlikely that prolonged exposure to this baseline ambient concentration of acrolein would result in any appreciable health risk to the overall population.

In summary, although the baseline concentrations of acrolein in air are higher than the regulatory exposure limits, the concentrations are low (less than 1 μg/m^3), similar to concentrations observed in other Canadian cities, and unlikely to result in a significant adverse Change in Public Health.

8.3 Potential Project-VEC Interactions

The interaction between a Change in Public Health and the Project is provided in Table 8.6. Potential interactions between Project activities and physical works and potential for human receptors to be exposed to Project-related emissions are ranked as 0, 1, or 2 (Table 8.6), depending on the nature and extent of the anticipated interaction.

Table 8.6 Potential Project Environmental Effects on Public Health

Project Activities and Physical Works	Potential Environmental Effects
	Change in Public Health
Construction	
Construction and Installation of Jetty and Other Marine-Based Infrastructure	1
Marine Vessel Berthing and Deberthing	1
Operation	
Marine Vessel Berthing and Deberthing	2
Crude Oil and Finished Product Transfer	2
Wastewater, Cooling Water, and Storm Water Release	1
Decommissioning and Abandonment	
Removal of Facilities and Site Reclamation	1

Project-Related Environmental Effects

Notes: Project-Related Environmental Effects were ranked as follows:

0 No interaction, or no substantive interaction contemplated.

1 Interaction occurs; however, based on past experience and professional judgment the interaction would not result in a significant environmental effect, even without mitigation; or interaction would not be significant due to application of codified environmental protection practices that are known to effectively mitigate the predicted environmental effects.

2 Interaction may, even with codified mitigation, result in a potentially significant environmental effect and/or is important to regulatory and/or public interest. Potential environmental effects are considered further and in more detail in the CSR.

Public Health may be affected from direct (*e.g.*, inhalation) and indirect (*e.g.*, ingestion of fish) exposure to chemicals emitted from Project activities and physical works. Emissions of air contaminants will result from combustion gases emitted from the heavy equipment required for the Construction and Installation of the Jetty and Other Marine-Based Infrastructure; however, the scope and extent of construction activities required indicates that these emissions will not be noticeable in the LAA. Also, this marine-based construction will have nominal fugitive dust emissions as activities are conducted over and in the water. While these emissions are likely measurable, they are not substantive and are ranked as 1.

The Marine Vessel Berthing and Deberthing activity during Construction of the Project is expected to generate measurable emissions of air contaminants. However, the marine vessel movements are expected to be limited, of short duration, and local to the barge landing area. Because of this, the emissions are not considered to be substantive and are ranked as 1.

Wastewater, Cooling Water, and Storm Water Release will result in a release of effluent containing residual quantities of COPC in the wastewater (at levels that are in compliance with legislation), even after treatment, to the marine environment through a diffuser pipe into the Bay of Fundy and are thus ranked as 1. Results of marine water modelling and uptake modelling into marine biota determined that chemical concentrations in these environments would not be measurable in the long-term compared to existing conditions. Therefore, human interaction with these low level concentrations of chemicals in water would not be measurable.

The Removal of Facilities and Site Reclamation are likely to occur decades into the future. Some energy and fuel would be used to decommission the facilities, remove the equipment, and restore the sites. These activities are likely to generate measurable emissions of air contaminants, but these are likely to be short-term and localized to the Project site. The emissions and associated health risks are not considered to be substantive and are ranked as 1. Further assessment would be done prior to the Project being decommissioned.

Thus, for those Project activities and physical works for which the interactions with a Change in Public Health were ranked as 1 in Table 8.6, the potential environmental effects of the Project activities and physical works on a Change in Public Health during any phase of the Project are rated not significant and are not considered further in the CSR. There is a high level of confidence in the prediction.

As indicated in Table 8.6, Marine Vessel Berthing and Deberthing, and Crude Oil and Finished Product Transfer activities associated with Operation of the Project are expected to interact with a Change in Public Health were ranked as 2, thereby potentially resulting in an environmental effect on public health that is of potential concern and which requires further evaluation in the CSR. These interactions were ranked as 2 because of the potential for substantive emissions of chemicals to the atmosphere, and as people in the area would be exposed to these chemicals either directly (via inhalation) or indirectly (via ingestion and dermal contact from multiple pathways). The potential environmental effects of these Project activities and physical works on a Change in Public Health are thus assessed further in the sections that follow.

8.4 Environmental Effects Assessment

Residual environmental effects of the Project on Public Health for those Project activities and physical works that were ranked as 2 in Table 8.10 are summarized in this section. Cumulative environmental effects are considered separately (Section 8.5).

A summary of the residual environmental effects of the Project on Public Health is presented in Table 8.11. The assessment that follows is supplemented by data contained in the Human Health and Ecological Risk Assessment Technical Study (Jacques Whitford 2008e).

Table 8.7 Summary of Residual Environmental Effects on Public Health

Potential Residual Environmental Effects	Proposed Mitigation/Compensation Measures	Residual Environmental Effects Characteristics: Concentration Ratio (CR)	Residual Environmental Effects Characteristics: Reversibility	Significance	Prediction Confidence	Likelihood	Cumulative Environmental Effects?	Recommended Follow-up and Monitoring
Change in Public Health								
Operation	All mitigation measures noted in Chapter 7 to reduce air contaminant emissions.	N/QN	R/I	N	H	M	Y	All follow-up monitoring noted in Section 7.6
Residual Environmental Effect for all Phases				N	H	M	Y	

KEY

CR*:
- N Negligible: CR≤1
- PR Potential Risk: CR>1
- QN Qualitatively considered, negligible
- QPR Qualitatively considered, potential risk

**CR values encompass the notions of direction, geographic extent, duration, frequency, and ecological context.*

Reversibility:
- R Reversible
- I Irreversible

Significance:
- S Significant
- N Not Significant

Prediction Confidence:
Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation
- L Low level of confidence
- M Moderate level of confidence
- H High level of confidence

Likelihood:
Based on professional judgment
- L Low probability of occurrence
- M Medium probability of occurrence
- H High probability of occurrence

Cumulative Environmental Effects?
- Y Potential for environmental effect to interact with other past, present or foreseeable projects or activities in RAA.
- N Environmental effect will not or is not likely to interact with other past, present or foreseeable projects or activities in RAA.

8.4.1 Assessment of Project-Related Environmental Effects

Activities associated with the Project have the potential to directly or indirectly expose people in the RAA to air contaminant emissions, thereby interacting with a Change in Public Health. The environmental effects of the Project during Construction and Decommissioning and Abandonment on a Change in Public Health have been previously rated not significant; thus, only environmental effects of selected Project activities and physical works during Operation are assessed below.

8.4.1.1 Project Environmental Effects Mechanisms for a Change in Public Health

During Operation, the Project-related marine vessel activity will not be continuous but will be intermittent, with visits to the marine terminal typically lasting a day or two. However, during this time, the emissions of air contaminants may be substantive from activities including Marine Vessel Berthing and Deberthing and Crude Oil and Finished Product Transfer and therefore have the potential to result in a Change in Public Health.

During Operation, environmental effects that may result in a Change in Public Health may occur from emissions of combustion gases from the marine vessels which will transport crude to and product from the marine terminal. Fugitive emissions of VOC from product loading to marine vessels may also occur during Operation.

A number of mitigation measures will be employed to reduce air emissions during Construction and Operation, including use of dust suppressants, implementation of an idling policy, vapour recovery units on the loading operations. These mitigation measures and others, described in more detail in Section 7.4.1, will reduce people's exposure to the Project-related emissions.

8.4.1.2 Characterization of Residual Project Environmental Effects for a Change in Public Health

The HHRA derived health risk estimates (*i.e.*, CR) associated with air contaminant emissions from the Project (Jacques Whitford 2008e). These health risk estimates inherently incorporate the descriptors such as direction, magnitude, geographic extent, duration/frequency and the ecological/socio-economic context of the environmental effect. The environmental effects on public health from short-term exposures are generally considered to be reversible, while the environmental effects of health risks associated with long-term exposures are generally considered to be irreversible.

The dispersion and deposition of chemicals of potential concern released from the Project during Operation were modelled (Jacques Whitford 2008b). The results of the dispersion and deposition modelling of contaminants in ambient air were used as inputs to the HHRA to estimate potential health risks associated with short-term and long-term inhalation exposures to COPC released from the Project (Jacques Whitford 2008e). As emissions from the marine vessels associated with the marine-based infrastructure are intermittent in nature, a conservative yet probable emissions scenario was developed for modelling purposes. In this scenario, it was assumed that three ships would be at the marine terminal concurrently throughout Operation, a very conservative assumption. The health risk estimates (*i.e.*, CR) were used to establish the significance of the residual environmental effects associated with the operation of the Project alone.

Health Risks Via Inhalation –CR Values for Criteria Air Contaminants – Project Alone

The CR values associated with the maximum concentrations CAC from the Project (Project Alone) are provided in Table 8.8. The CR values are provided for short-term exposures (*i.e.*, 1 hour and 24 hour) and long-term exposures (*i.e.*, annual average). With the exception of SO_2, none of the CR values are greater than the benchmark criteria of CR=1.0. All CR values at locations on land, where people might be exposed to emissions for any appreciable amount of time, were well below the benchmark criteria. The CR value for SO_2 at the point of maximum 1 hour exposure is 1.3, while the CR value for SO_2 at the point of maximum 24 hour exposure is 1.6. As noted in Section 7.4, the highest concentrations of SO_2 occur in the Bay of Fundy, approximately over 1 km offshore. Human receptors would not likely be found at this location for any appreciable length of time.

Table 8.8 Concentration Ratio (CR) Values for Project Alone Exposure at Maximum Ground-Level Concentration

Criteria Air Contaminants	Concentration Ratio (CR) Values – Inhalation Health Risk by Averaging Period for Project Alone Case		
	Exposure from Marine-Based Infrastructure		
Exposure	**1 hour**	**24 hour**	**Annual Average**
Ammonia	NE	NE	NE
Carbon monoxide	0.0058	-	-
Hydrogen sulphide (representing TRS)	NE	NE	NE
Nitrogen dioxide (NO_2)	0.44	0.38	0.11
Particulate matter (PM)	-	0.050	-
Particulate matter (PM_{10})	-	0.12	-
Particulate matter ($PM_{2.5}$)	-	0.20	0.016
Sulphur dioxide (SO_2)	**1.3**	**1.6**	0.67

Notes:
Bold indicates that value exceeds regulatory benchmark (CR = 1.0).
NE indicates that emissions are not expected for this chemical.
"-"indicates that a TRV is not available for this chemical for this exposure period.

To put these short-term exposure risks into context, it is important to evaluate the toxicological basis of the risk predictions, the likelihood of exposure, and the frequency of exposure. Studies had shown that SO_2 in air acts primarily as a respiratory tract irritant in humans following short-term exposures (WHO 2000). The maximum modelled 1 hour concentration of SO_2 is 571 $\mu g/m^3$, which was compared to the NBENV guideline for Saint John County of 450 $\mu g/m^3$. Although the basis for the selection of 450 $\mu g/m^3$ is unknown, an exposure limit of 660 $\mu g/m^3$ has been used in other jurisdictions (CalEPA 2007b). This exposure limit is based on a 1 hour no observed adverse effect level from multiple studies of healthy, asthmatic, and atopic volunteers (CalEPA 2007b). The maximum GLC of SO_2 is less than this 660 $\mu g/m^3$ exposure limit.

The control of emissions from marine vessels is being considered by regulatory agencies by reducing the sulphur content in fuel, from 1.5% to as low as 0.5%, in the coming years (MEPC 2008). Furthermore, since the modelled emissions scenario is conservative in that less than three vessels will be at the marine terminal for the majority of the time, the actual offshore concentrations are expected to be below the Saint John County SO_2 exposure limit of 450 $\mu g/m^3$.

Although it is possible that people could be exposed to these maximum concentrations of SO_2, for example on fishing boats or pleasure craft, it is important to note that these would be very infrequent exposures on the ocean. Given that concentrations of SO_2 are below health-based guidelines, it is unlikely that this would pose an actual risk to individuals' health.

As noted in Section 7.4, the highest values of SO_2 occur over 1 km offshore. Although the maximum predictions for 1 hour and 24 hour SO_2 exceed the ambient air quality objectives, the locations of these exceedances are far enough from land that prolonged human exposure is not likely to occur. The CR values for the human health receptor locations where people live are less than 1.0, indicating that there would be no undue risk from exposure to marine emissions at these locations.

8.4.2 Determination of Significance

Although the 1 hour and 24 hour maximum concentrations of SO_2 result in CR values that exceed the benchmark criteria of 1.0, the maximum concentrations are over 1 km offshore, away from the general public. The emissions scenario modelled is conservative in that less than three vessels will be at the marine terminal for the majority of the time. With mitigation, the Project Alone will result in health risk values that meet the benchmark criteria at each of the human health receptor locations, indicating no unacceptable environmental effects on Change in Public Health from short-term and long-term exposures to releases from the Project.

Therefore, the environmental effects of the Project alone on Public Health during all phases of the Project are rated not significant. There is a high level of confidence in the predictions.

8.5 Assessment of Cumulative Environmental Effects

A listing of the other projects and activities with potential for cumulative environmental effects (Section 5.3) with the combined land-based and marine-based components of the Project is provided in Table 8.9.

Table 8.9 Potential for Cumulative Environmental Effects on Public Health

Other Projects and Activities With Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects
	Change in Public Health
Project Eider Rock (Land-Based Components)	2
Industrial Land Use	2
Planned or Future Industrial/Energy Projects	2
Infrastructure Land Use	1
Marine Use	1

Cumulative Environmental Effects

Notes: Cumulative environmental effects were ranked as follows:

0 Project environmental effects do not act cumulatively with those of other projects and activities

1 Project environmental effects act cumulatively with those of other projects and activities, but are unlikely to result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative effects but will not measurably change the state of the VEC.

2 Project environmental effects act cumulatively with those of other projects and activities, and may result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC.

While past, present and future Infrastructure Land Use and Marine Use projects and activities that have been or will be carried out may have some potential for cumulative environmental effects, and may overlap with the Project, their associated emissions (*i.e.,* the primary pathway for which a Change in Public Health may occur) are not substantive and even despite the overlap, they could not possibly result in a significant cumulative environmental effect on Public Health. As such, residual cumulative environmental effects of the Project in combination with Infrastructure Land Use and Marine Use that are ranked as 1 in Table 8.9 on a Change in Public Health are rated not significant and are not considered further in this CSR.

There is a potential for the residual environmental effects of the Project to overlap with air emissions from Project Eider Rock's land-based components, Industrial Land Use and Planned or Future Industrial/Energy Projects; therefore, they have been carried forward for further assessment.

Of these projects or activities, the only common COPC that are known to overlap with the Project are the CAC emissions. Therefore, only these CAC emissions were modelled and evaluated with respect to their ability to result in a cumulative environmental effect on a Change in Public Health. Smaller sources such as marine vessels, vehicles, and residential wood burning may also contribute to cumulative environmental effects, as could the long-range transport of air contaminants from other jurisdictions. It is noted that the contribution of past and present projects and activities that have been carried out would be incorporated in the existing conditions with respect to air quality as well as within existing water and soil baseline concentrations. Their contribution is thus considered in the context of baselilne (existing) conditions for Public Health.

For the assessment of the potential cumulative environmental effects that the Project would have over baseline conditions, only non-carcinogenic (*i.e.*, CR) health endpoints are evaluated against their respective health benchmarks.

Residual cumulative environmental effects of current and planned projects on Public Health are summarized in Table 8.10.

Table 8.10 Summary of Residual Cumulative Environmental Effects on Public Health

Cumulative Environmental Effect	Case	Other Projects, Activities and Actions	Proposed Mitigation and Compensation Measures	Residual Cumulative Environmental Effects Characteristics: Concentration Ration (CR)	Residual Cumulative Environmental Effects Characteristics: Reversibility	Significance	Prediction Confidence	Likelihood	Proposed Follow-up and Monitoring Programs
Change in Public Health from Project Risk added to Baseline Risk (Project Case)	Cumulative Environmental Effect for Project Case (Project Alone + Baseline)	Industrial Land Use (as represented by Measured Baseline Chemical Concentrations).	Same as those noted in Chapter 7 to reduce air contaminant emissions (Section 7.4.1).	PR	R	N	H	M	All follow-up monitoring noted in Section 7.6.
	Project Contribution to Cumulative Environmental Effect			N	R	N	H	M	
Change in Public Health from Project Case added to Other Planned Projects, Activities and Action (Future Case)	Cumulative Environmental Effect with Project (Future Case for CAC; Project Case for Non-CAC COPC)	Project Eider Rock (land-based components); Gypsum Wallboard Manufacturing Plant; Canaport LNG Marine Terminal and Pier, including marine vessels; projects at the existing refinery; Irving Pulp & Paper Lime Kiln Replacement.	Same as those noted in Chapter 7 to reduce air contaminant emissions (Section 7.4.1).	PR	R	N	H	M	All follow-up monitoring noted in Section 7.6.
	Project Contribution to Cumulative Environmental Effect			N	R	N	H	M	

KEY

CR*:
- N Negligible: CR≤1
- PR Potential Risk: CR>1
- QN Qualitatively considered, negligible
- QPR Qualitatively considered, potential risk

**CR values encompass the notions of direction, geographic extent, duration, frequency, and ecological context.*

Reversibility:
- R Reversible
- I Irreversible

Significance:
- S Significant
- N Not Significant

Prediction Confidence:
Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation
- L Low level of confidence
- M Moderate level of confidence
- H High level of confidence

Likelihood:
Based on professional judgment
- L Low probability of occurrence
- M Medium probability of occurrence
- H High probability of occurrence

Other Projects, Activities, and Actions
List of specific projects and activities that would contribute to the cumulative environmental effects.

8.5.1 Project Cumulative Environmental Effect Mechanisms for a Change in Public Health

As previously noted, there is a potential for the residual environmental effects of the Project to overlap with air emissions from the land-based components of Project Eider Rock, as well as Industrial Land Use projects and activities within the RAA. For the purposes of cumulative environmental effects assessment on Public Health, industrial land uses within the RAA will be considered, with emphasis placed on those activities closest to the Project, or with the largest potential for air contaminant emissions.

Potential cumulative health risks resulting from air contaminant emissions include those associated with short-term exposures and non-carcinogenic long-term exposures. The potential cumulative environmental effects on Public Health resulting from accidents or malfunctions are addressed in Chapter 16.

Base Case

A number of industrial projects and activities currently operating within the RAA may release air contaminants that were also identified as COPC for the Project (Table 8.11). The existing concentrations of these chemicals in the environment incorporate both the natural background concentrations of chemicals and the accumulation of COPC from anthropogenic sources in the RAA.

Table 8.11 Summary of Phases and Cases Assessed in the HHERA

Phase	Case	Description
Existing Conditions	Baseline Case	▪ Evaluation of Baseline involved the quantitative assessment of existing conditions in the RAA. Health risks were assessed using measured concentrations of COPC in air as well as measured concentrations of COPC (Non-CAC) in environmental media (*e.g.,* soil, water, food); however, only those health risks associated with CAC are considered relevant for the assessment of the marine-based components of the Project. ▪ The results of the Baseline Public Health Assessment of the Baseline Case are described in Section 8.2.
Construction	Construction Case	▪ Evaluation of Construction involved the qualitative assessment of air contaminant emissions during Construction and commissioning of the Project. ▪ The results of the Public Health Assessment of Construction are described in Section 8.4.
Operation	Project Alone Case	Marine-Based Facilities: ▪ Evaluation of the Project Alone during Operation for the marine-based components of the Project involved the quantitative assessment of CAC emissions from the marine vessels. The assessment was completed at the maximum GLC as well as at the HHERA receptor locations. ▪ The results of the Public Health Assessment of the Project Alone Case for the marine-based components of the Project are described in Project Environmental Effects Assessment (Section 8.4).
	Project Case (Baseline + Project)	▪ Evaluation of the Project during Operation for the marine vessels involved the quantitative assessment of CAC emissions from the Project Alone in combination with the existing conditions. The assessment was completed at the HHERA receptor locations. ▪ The results of the Public Health Assessment of the Project Case for the marine-based components of the Project are described in Cumulative Environmental Effects Assessment (Section 8.5).

Table 8.11 Summary of Phases and Cases Assessed in the HHERA

Phase	Case	Description
	Future Case	▪ Evaluation of the Future involved the quantitative assessment of CAC emissions from the Project Alone (including the land-based refinery complex and marine vessels) in combination with the existing conditions and future projects and activities in the RAA. The assessment was completed at the HHERA receptor locations. ▪ The results of the Public Health Assessment of the Future Case are described in Cumulative Environmental Effects Assessment (Section 8.6).
	Accidents, Malfunctions and Unplanned Events	▪ The results of the assessment of the health risks associated with loss of containment, hydrocarbon spill in the marine environment, vessel accident, worker accident, introduction of invasive species and the discovery of a heritage or archaeological resource are described in Chapter 16.
Decommissioning and Abandonment	Decommissioning and Abandonment Case	▪ Evaluation of Decommissioning and Abandonment involved the qualitative assessment of air contaminant emissions. It is expected that a full assessment would take place prior to Decommissioning and Abandonment in the future, based on the legislative requirements of the day. ▪ The results of the Public Health Assessment of Decommissioning and Abandonment are described in Project Environmental Effects Assessment (Section 8.4).

Baseline information used to assess the Base Case includes concentrations of COPC in the ambient air (Section 7.2.1).

Project Alone Case

The Project Alone Case for a Change in Public Health includes combustion emissions from marine vessels, and fugitive emissions from Crude Oil and Finished Product Transfer activities associated with the Project. The results of the Project Alone Case are discussed in Section 8.4.

Project Case (Base Case + Project Alone Case)

The environmental effects of the Project on public health are expected to act cumulatively with other existing industrial projects and activities. The Project Case assesses the Project air contaminant emissions (Project Alone Case) in combination with existing chemical concentrations in the environment, which incorporate the environmental effects of the existing industrial projects and activities (Base Case).

Future Case

For the Future Case, the primary mechanisms for Change in Public Health arise from the cumulative emissions of air contaminants from existing and proposed substantive sources in the Saint John air shed, and emissions from other regions into the RAA.

Sources of emissions include existing power plants, pulp and paper mills, the existing oil refinery and others, the Project sources, and other future projects. The future projects and activities in the RAA which have the potential for cumulative environmental effects for a Change in Air Quality include changes in industrial land use such as the land-based components of Project Eider Rock, the Gypsum Wallboard Plant and the Irving Pulp and Paper Lime Kiln replacement.

8.5.2 Characterization of Residual Cumulative Environmental Effects for Change in Public Health

The residual cumulative environmental effects to public health are assessed by considering changes in health risks from the Base Case through the Project Case and into the Future Case.

Base Case

To characterize the Base Case in the RAA, health risk estimates (*i.e.*, CR) were calculated using baseline concentrations of COPC in the ambient air within the LAA. The health risk estimates associated with these baseline conditions are summarized in Section 8.2.2. As previously described, the results indicated that the existing concentrations of the following chemicals in the environment may result in exposures to residents that exceed the benchmark criteria.

- Measured 1 hour and 24 hour baseline concentrations of acrolein exceeded their regulatory exposure limits (CR = 1.5 in both cases).
- Measured annual average baseline concentrations of acrolein exceeded the regulatory exposure limit (CR = 2.5).

As described in Section 8.2.2, the levels of acrolein are comparable to other Canadian cities and well below actual concentrations that have elicited human response of mild eye irritation. However, since acrolein will not be released from the Project, there is no potential for overlapping cumulative environmental effects of the Project over existing background levels or those of other past, present or future sources. Therefore the cumulative environmental effects on Public Health, resulting from acrolein concentrations, are rated not significant with a high level of confidence.

Project Alone Case

The residual Change to Public Health for the Project Alone Case is assessed, for the Project, in Section 8.4.

The health risks associated with the Project are provided in Section 8.4. Although the 1 hour and 24 hour maximum concentrations of SO_2 result in CR values that exceed the benchmark criteria of 1.0, the maximum concentrations are over 1 km offshore, away from the general public and the emissions scenario modelled is conservative. With mitigation proposed as described in Chapter 7, the Project will result in health risk values that meet the benchmark criteria at each of the human health receptor locations, indicating no significant environmental effects on public health from short-term and long-term exposures.

Project Case (Base Case + Project Alone Case)

The Project Case assesses cumulative environmental effects of the Project air contaminant emissions in combination with the environmental effects of the existing industrial projects and activities.

Health Risks via Inhalation – CR Values for Criteria Air Contaminants

The CR values associated with the maximum concentrations of CAC from the Project, in combination with existing ambient air concentrations, are provided in Table 8.12. The CR values are provided for short-term exposures (*i.e.*, 1 hour and 24 hour) and long-term exposures (*i.e.*, annual average).

Table 8.12 Concentration Ratio (CR) Values for CAC Exposure from Project Case at the Maximum Ground Level Concentration

Criteria Air Contaminants	Concentration Ratio (CR) for Project Case (dimensionless)		
	1 hour	24 hour	Annual Average
Ammonia	NE	NE	NE
Carbon monoxide	0.090	-	-
Hydrogen Sulphide (H_2S as TRS)	0.093	0.24	0.15
Nitrogen dioxide (NO_2)	0.51	0.48	0.28
Particulate matter (PM)	-	0.49	-
Particulate matter (PM_{10})	-	0.70	-
Particulate matter ($PM_{2.5}$)	-	0.76	0.40
Sulphur dioxide (SO_2)	**1.4**	**2.0**	**1.2**

Notes:
"-" indicates that a regulatory TRV is not available.
NE indicates that emissions are not expected for this chemical.
CR value for 1 hour, 24 hour, and annual average exposure is value at maximum Ground Level Concentration.
Bold values indicate health risk exceeds benchmark of CR=1.0.

As noted above, the maximum GLC of SO_2 for 1 hour and 24 hour (marine-based) exceeded their benchmark CR of 1.0, based on Project-related emissions. However, these ground-level concentrations are expected to occur infrequently and not occur over inhabited areas. Maximum model-predicted concentrations are intended to be conservative and represent worst-case emissions during rare worst-case meteorological conditions. As indicated in the cumulative frequency distribution plot of maximum 1 hour SO_2 concentrations (Figure 8.3), the model-predicted values decrease rapidly from the maximum predicted concentrations. For example, at the location of the maximum predicted 1 hour SO_2 concentration, the concentration of SO_2 at the 99.9th percentile is 280 μg/m^3 (*i.e.*, 99.9 percent of the time, the concentration is less than 280 μg/m^3 and therefore less than the ambient air quality criteria of 450 μg/m^3), while the concentration at the 90th percentile is 68 μg/m^3 (*i.e.*, similar to background).

Although the maximum annual average concentration of SO_2 results in a CR value that exceeds the benchmark of 1.0, the location of this exceedance is offshore. Since there is no one living or present at this location for any appreciable length of time, there is no one that would be exposed to this concentration on an annual basis. For both short-term and long-term exposures, it is important to evaluate what the health risks are at locations where people would most likely be exposed for extended periods of time.

The CR values for SO_2 for 1 hour, 24 hour, and annual average time periods at the maximum human receptor location (where people live) are shown in Table 8.13. In inhabited areas the concentration of SO_2, from Project-related sources and in combination with baseline concentrations, result in health risks that are below the regulatory benchmark. Therefore, although the predicted health risks associated with levels at the location of the maximum ground-level concentration are higher than the benchmark, people are unlikely to be exposed as these locations are approximately 1 km offshore. Since the predicted health risks from exposure to these COPC in inhabited areas meet the benchmarks, there would not be a significant residual cumulative environmental effect for a Change in Public Health.

Figure 8.3
Frequency Distribution of
Predicted 1-hour SO_2 Concentrations
Cumulative Environmental Effects Case

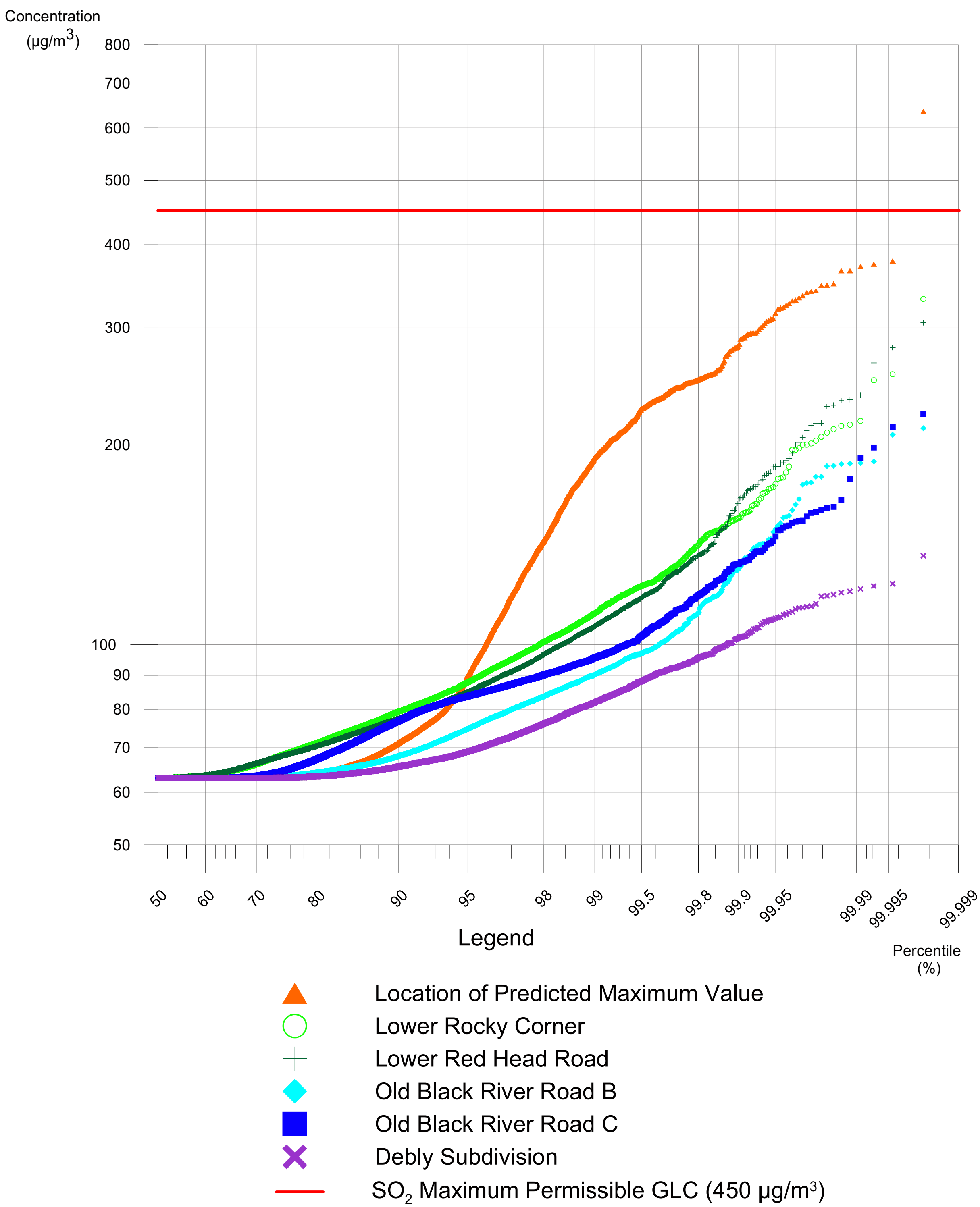


Table 8.13 Concentration Ratio (CR) Values for SO_2 at the Maximum Human Receptor Location

Chemical (Exposure Period)	Location	Baseline Health Risks (CR)	Project Health Risks (CR)	Cumulative Health Risks (CR)	Project Contribution (%)
SO_2 (1 hour)	Maximum GLC[1]	0.14	**1.3**	**1.4**	93%
	Rocky Corner[2]	0.14	0.60	0.74	81%
SO_2 (24 hour)	Maximum GLC[1]	0.35	**1.6**	**2.0**	80%
	Rocky Corner[2]	0.35	0.28	0.63	44%
SO_2 (annual average)	Maximum GLC[1]	0.55	0.67	**1.2**	56%
	Rocky Corner[2]	0.55	0.16	0.71	23%

Notes:
Bold values indicate health risk exceeds benchmark of 1.
1 Maximum GLC occurs over water, approximately 1 km offshore.
2 Of the ten HHRA locations evaluated, this is the location with the highest calculated CR value.

Health Risks Via Inhalation – CR Values for Non-Criteria Air Contaminants

Future Case

For the Future Case, emissions inventories were developed for CAC from proposed future industrial land use projects described in Section 5.3. Only projects which would result in a net increase of air contaminant emissions into the Saint John air shed were included in the assessment of cumulative environmental effects.

The dispersion of CAC emissions from the selected future industrial sources was modelled (Jacques Whitford 2008b). The health risk values (*i.e.*, CR) associated with the short-term and long-term exposure to CAC were calculated based on the combined environmental effects to air quality from the baseline, both components of the Project (*i.e.*, Land and Marine), and selected other future projects. The results are summarized in Table 8.14.

Table 8.14 Concentration Ratio (CR) Values for Inhalation Exposure from Future Case

Criteria Air Contaminants	Future Case	
	Baseline Health Risks (CR)	Cumulative Health Risks (CR)
1 hour Exposures		
Ammonia	-	0.0050
Carbon monoxide	0.084	0.12
Hydrogen sulphide (H_2S as TRS)	0.093	0.66
Nitrogen dioxide (NO_2)	0.075	0.84
Particulate matter (PM)	-	-
Particulate matter (PM_{10})	-	-
Particulate matter ($PM_{2.5}$)	-	-
Sulphur dioxide (SO_2)	0.14	**1.4**
24 hour Exposures		
Ammonia	-	0.016
Carbon monoxide	-	-
Hydrogen sulphide (H_2S as TRS)	0.24	0.24
Nitrogen dioxide (NO_2)	0.11	0.51
Particulate matter (PM)	0.44	0.83
Particulate matter (PM_{10})	0.58	0.86
Particulate matter ($PM_{2.5}$)	0.57	0.73
Sulphur dioxide (SO_2)	0.35	**2.0**
Annual Average Exposures		
Ammonia	-	0.0033
Carbon monoxide	-	-

Table 8.14 Concentration Ratio (CR) Values for Inhalation Exposure from Future Case

Criteria Air Contaminants	Future Case	
	Baseline Health Risks (CR)	Cumulative Health Risks (CR)
Hydrogen sulphide (H_2S as TRS)	0.15	0.30
Nitrogen dioxide (NO_2)	0.17	0.47
Particulate matter (PM)	-	-
Particulate matter (PM_{10})	-	-
Particulate matter ($PM_{2.5}$)	0.38	0.42
Sulphur dioxide (SO_2)	0.55	**1.2**

Notes:
Bold values indicate health risk exceeds benchmark of 1.

Although there are benchmark exceedances of SO_2, these are attributable to the same issues as discussed for the Project Case and are not increased by the addition of the other proposed industrial activities in the RAA. Thus, conclusions drawn above are similarly applicable in the Future Case and are not significant.

8.5.3 Determination of Significance

The cumulative environmental effects of a Change in Public Health on Public Health of all past, present and reasonably foreseeable projects/actions or activities that have been or will be carried out, in combination with the residual environmental effects of the Project, are predicted to be not significant in relation to potential health risk from chemical exposure during all phases of the Project. Although existing concentrations of acrolein in the RAA exceed benchmarks they are no different than other Canadian cities. Additionally, acrolein will not be emitted from the Project and thus there is no overlap between the Project and other existing and/or future projects. In all cases, the Project contribution to potential health risks and associated cumulative environmental effects was predicted to be negligible and thus the Project contribution to the cumulative environmental effects is rated not significant.

8.6 Follow-up and Monitoring

The follow-up and monitoring recommended in Chapter 7, Atmospheric Environment is appropriate for the protection of Public Health. No specific Public Health follow-up and monitoring recommendations are required.

9.0 COASTAL WETLAND ENVIRONMENT

Wetlands provide a number of ecological (physical, chemical and biological) and socio-economic functions that are valued to the regulatory agencies, the public, and ecosystems. These may include, but are not limited to: the provision of habitat to plants and animals (of particular importance for some that are rare or sensitive); groundwater recharge; amelioration of flooding; removal of some contaminants; regulation of various bio-geochemical processes; and provision of recreational and agricultural opportunities. The Coastal Wetland Environment was selected as a VEC in recognition of NBENV's goal for no net loss of wetland function (NBDNR and NBDELG 2002), as well as in recognition of the value placed on their preservation by regulatory agencies, the public, and stakeholders.

In this CSR, the scope of the assessment of wetland environment is focused on coastal wetlands that could be affected by the Project. There are no wetlands on the land that could be affected by the Construction and Operation of the Marine Terminal and Other Marine-Based Infrastructure.

Project activities are not anticipated to have significant environmental effects on coastal wetlands because of planned mitigation for unavoidable loss of wetland function on land. Compensation for loss of wetland function will be negotiated with regulatory authorities. Further compensation may be required as determined through monitoring of potential indirectly affected wetlands that may arise from local changes in drainage pattern.

The Project will not contribute substantively to cumulative environmental effects because of the planned compensation, and mitigation for loss of some functions (*e.g.*, storm water management). There is little spatial overlap with cumulative environmental effects of past and current projects, and most of those projects are assessed federally and/or provincially, requiring compensation for any loss of wetland function.

9.1 Scope of Assessment

This section defines the scope of the CSR for the Coastal Wetland Environment in consideration of the nature of the regulatory setting, issues identified in public engagement, potential Project-VEC interactions, and existing knowledge.

9.1.1 Regulatory Setting

The federal EA Track Report and Scoping Document did not specifically require an assessment of the environmental effects of the Project on the Wetland Environment, with the possible exception of coastal wetlands (addressed in this Chapter).

Wetland conservation is promoted federally by the Federal Policy on Wetland Conservation (Government of Canada 1991), although there is no legislative basis specific to wetlands.

Wetlands are managed provincially by NBENV under the New Brunswick Wetlands Conservation Policy. The primary objective of this policy is to prevent the loss of provincially significant wetlands and achieve no net loss of wetland function for all other wetlands (*i.e.*, wetlands greater than 1 ha in size). Implementation of this policy is achieved through existing legislation including the New Brunswick *Clean Water Act* and New Brunswick *Clean Environment Act*, and specifically the *Watercourse and*

Wetland Alteration Regulation (WAWA Regulation) and *Environmental Impact Assessment Regulation* (EIA Regulation). Water quality in wetlands is protected under the New Brunswick *Clean Water Act* and the *Clean Environment Act*. Section 12(1) of the *Clean Water Act* prohibits the release of any contaminant or waste into the environment which would affect the environment or endanger any wildlife. Permits are required under the WAWA Regulation for activities within 30 m of all wetlands 1 ha or greater in size, or any wetland contiguous to a watercourse. Projects affecting wetlands greater than 2 ha in size require registration under the EIA Regulation. Provisions under provincial wetland regulations allow development to take place in areas of wetlands, provided the mitigation sequence of avoidance, minimization, and as a last resort, compensation are implemented (NBDNR 2003a).

9.1.2 Issues and Concerns Identified During Public and Stakeholder Engagement

Concerns regarding the downstream environmental effects of headwater wetland loss and alteration were identified by some members of the public during public engagement activities. In particular, these issues were raised at the open house #2 in December 2007 as well as at the Terms of Reference workshop held in January 2008. These concerns influenced baseline data collection and were addressed through an analysis of hydrology within potentially affected watersheds.

9.1.3 Selection of Environmental Effect

The Project has the potential to affect the Coastal Wetland Environment through the loss of wetland area and qualitative changes in wetland, including particularly changes in wetland function and potential changes in wetland quality resulting from deposition from air contaminant emissions and from potential spillls. Therefore, the analysis is focused on the following environmental effect:

- Change in Wetland Quality and Quantity.

9.1.4 Selection of Measurable Parameters

Table 9.1 provides the measurable parameters used for the assessment of the selected environmental effect, and the rationale for their selection.

Table 9.1 Measurable Parameters for Coastal Wetland Environment

Environmental Effect	Measurable Parameter	Rationale for Selection of the Measurable Parameter
Change in Wetland Quality and Quantity	Wetland area (ha)	A readily measurable parameter that is considered in the assessment of change in wetland function in determining the requirements for compensation.
	Function of affected wetlands (both direct and indirect)	New Brunswick Wetlands Conservation Policy: No net loss of wetland function.
	Hydrology: Proportion of wetland lost (percent) within drainage area	A measure of the degree to which wetland hydrologic function is lost within catchment areas.
	Ecological Hazard Quotient (EHQ)	To assess the potential toxicological effects on wetland receptors.

Wetland area (ha) is a measure of the amount of wetland that will be lost due to Project activities and is required for determining compensation. The amount of wetland area is a factor in determining compensation in conjunction with change in wetland function. The current knowledge of potentially affected wetlands (Jacques Whitford 2008f) is used for the calculation of wetland area, and will be updated following standard delineations of wetlands to support permitting and compensation negotiation.

9.1.5 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of the Project on the Coastal Wetland Environment include the periods of pre-Project baseline conditions, Construction, Operation, and Decommissioning and Abandonment.

The pre-Project baseline temporal boundary considers present (2006 and 2007) wetland conditions; however, past land use is addressed when considering current wetland function as a benchmark for cumulative environmental effects.

9.1.6 Spatial Boundaries

Three levels of spatial boundaries have been determined for the Coastal Wetland Environment; the Project Development Area; the Local Assessment Area; and the Regional Assessment Area. These boundaries are defined below and shown in Figure 9.1.

Project Development Area (PDA): The PDA for the Coastal Wetland Environment includes the coastline where the Marine Terminal and Other Marine-Based Infrastructure will be located.

Local Assessment Area (LAA): Due to hydrological connectivity of wetlands, Project-environment interactions may occur beyond directly affected wetlands within the PDA. The spatial boundaries for the assessment of the potential environmental effects of the Project on the Coastal Wetland Environment include the location of facilities and Project-related disturbances, and adjacent (*i.e.,* down-gradient or up-gradient) habitat where activities associated with Construction, Operation, and Decommissioning and Abandonment could result in adverse environmental effects on the Coastal Wetland Environment. Together, these areas, and for local context, natural terrestrial environments within 2 to 4 km of the PDA, are referred to as the Local Assessment Area (LAA) (Figure 9.1).

Regional Assessment Area (RAA): Cumulative environmental effects of the Project on wetlands will be assessed at a regional scale. The Regional Assessment Area (RAA) comprises the Fundy Coastal Ecoregion, which extends along the Fundy coast from St. Stephen to Sackville, New Brunswick (inset of Figure 9.1).

9.1.7 Administrative and Technical Boundaries

Wetland conservation is promoted federally by the Federal Policy on Wetland Conservation (Government of Canada 1991), although there is no legislative basis specific to wetlands.

NBENV can designate a wetland as a Provincially Significant Wetland, based on a wetland having provincial, national or international importance, as defined in the New Brunswick Wetlands Conservation Policy (NBDNR and NBDELG 2002). For example, all coastal marshes are considered to be Provincially Significant Wetlands, which represent a remnant of a formerly more widespread wetland type where, historically, impacts to this habitat type have been severe (NBDNR and NBDELG 2002). Provincially Significant Wetlands are assigned greater priority for protection than other wetlands.

There are technical boundaries for the delineation and functional analysis of wetlands. A two-fold approach was employed to conduct the wetland delineation analysis including a review of existing data combined with preliminary wetland field surveys (Jacques Whitford 2008f). Existing sources of data included:

- NBDNR wetland inventory (1994b);
- Depth to water table (available from NBDNR);
- NBDNR forest inventory;
- NBDNR watercourse inventory;
- NBDNR high resolution stereo-pair aerial photographs (2004); and
- City of Saint John high resolution (15 cm) geo-referenced digital aerial photography (2006).

The high resolution photography was interpreted by a qualified wetland specialist (Jacques Whitford 2008f).

9.1.8 Residual Environmental Effects Rating Criteria

A significant adverse residual environmental effect on the Coastal Wetland Environment is one that results in a non-compensated net loss of wetland area and function, or the loss of wetland area or function in a Provincially Significant Wetland.

9.2 Existing Conditions

The Fundy Coastal Ecoregion (*i.e.*, the RAA) has a diverse range of wetland types including coastal bogs, shrub, fen, and freshwater riparian wetlands. The raised coastal bog is a unique wetland type that is found in the ecoregion, mainly occurring west of Saint John to across the border into Maine (NBDNR 2003b). This wetland type is morphologically different than other coastal bogs, as they formed in deep depressions that are topographically restricted.

The topography of the LAA is largely determined by the bedrock geology and structure, but has been influenced by glaciations. There are numerous narrow basins and depressions across the landscape trending in a northeast to southwest direction. These geologically-controlled features can easily be seen on aerial photography and maps of the region.

No wetlands classified as raised coastal bog, have been identified in the PDA. One coastal marsh (*i.e.*, Red Head Marsh, a provincially significant wetland) is included in the western portion of the LAA, and fens classified by NBNDR are located in the wetland-rich areas in the northeastern portion of the LAA.

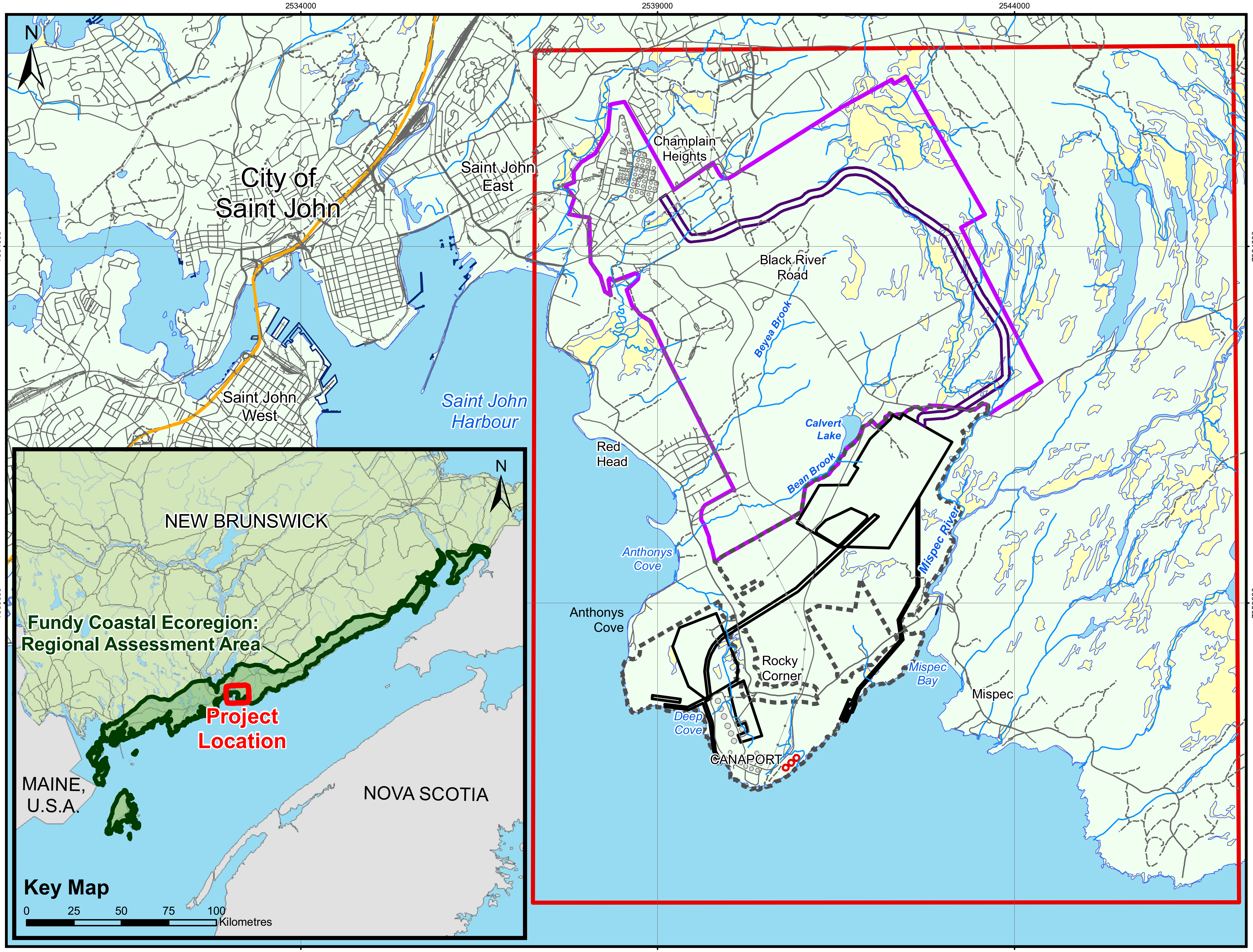


Figure 9.1
Coastal Wetland Environment PDA, LAA, and RAA

Project Eider Rock

Map Features

- Tank
- LNG Tank
- Major Road
- Secondary Road
- Local Road
- Track
- Rail Line
- Wharf
- Utility Line
- Watercourse
- Preferred Linear Corridor
- Project Component
- Local Assessment Area
- Regional Assessment Area
- Project Development Area (Refinery Facilities and Infrastructure Approx. 1132 ha)
- Linear Facilities Corridors Assessment Area (Approx. 2303 ha)
- Waterbody
- Wetland (NB DNR)

Data Source: Service New Brunswick, NB DNR, ESRI, Fluor, Sandwell Engineering Inc.

0 0.5 1 2 3
Kilometres

Map Parameters
Projection: NB Stereographic
Scale: 1:53,000
Date: March 4, 2009
Project No.: 1013263.

Jacques Whitford

9.3 Potential Project-VEC Interactions

Table 9.2 below lists each Project activity and physical work for the Marine Terminal and Other Marine-Based Infrastructure and ranks each interaction as 0, 1, or 2. These rankings are indicative of the level of interaction each activity or physical work will have with the Coastal Wetland Environment.

Table 9.2 Potential Project Environmental Effects to the Coastal Wetland Environment

Project Activities and Physical Works	Potential Environmental Effects
	Change in Wetland Quality and Quantity
MARINE TERMINAL AND OTHER MARINE-BASED INFRASTRUCTURE	
Construction	
Construction and Installation of Jetty and Other Marine-Based Infrastructure	0
Marine Vessel Berthing and Deberthing	0
Operation	
Marine Vessel Berthing and Deberthing	0
Crude Oil and Finished Product Transfer	0
Wastewater, Cooling Water, and Storm Water Release	0
Decommissioning and Abandonment	
Removal of Facilities and Site Reclamation	0

Project-Related Environmental Effects

Notes: Project-Related Environmental Effects were ranked as follows:
- 0 No interaction, or no substantive interaction contemplated.
- 1 Interaction will occur. However, based on past experience and professional judgment, the interaction would not result in a significant environmental effect, even without mitigation, or the interaction would clearly not be significant due to application of codified practices.
- 2 Interaction may, even with codified mitigation, result in a potentially significant environmental effect and/or is important to regulatory and/or public interest. Potential environmental effects are considered further and in more detail in the CSR.

All project activities or physical works associated with the Marine Terminal and Other Marine-Based Infrastructure were ranked as 0 since these Project components will not interact with the Coastal Wetland Environment, including coastal wetlands, in any substantive way and could not be significant. Red Head Marsh, which is not within the PDA, is the nearest coastal wetland. There are no coastal wetlands in the PDA, and any coastal wetlands are suitably distant from the Project location such that significant environmental effects could not possibly occur during Construction, Operation and Decommissioning and Abandonment. Consequently, the potential environmental effects of the Marine Terminal and Other Marine-Based Infrastructure on the Coastal Wetland Environment during all phases of the Project are rated not significant; marine environment activities will not be given further consideration in this chapter. Potential for interaction with coastal wetlands includes accidents, malfunctions, and unplanned events, which are addressed in Chapter 16.

For these Project activities ranked as 0 in Table 9.2, the potential environmental effects of the Project during all phases, including cumulative environmental effects, are rated not significant. There is a high degree of confidence in the environmental effects and significance predictions.

All project activities or physical works associated with the Marine Terminal and Other Marine-Based Infrastructure were ranked as 0 since these Project components will not interact with the Coastal Wetland Environment in any substantive way and could not be significant. Since there are no project environmental effects, it follows that there can be no cumulative environmental effects that could result in an overlap of the Project on other projects and activities that have been or will be carried out. Cumulative environmental effects are thus rated not significant.

As will be the case for the Development Proposal, other projects that have been or will be assessed through the provincial EIA Regulation will be required to adhere to the three principles of wetland management (avoidance, mitigation, and compensation).

9.3.1 Determination of Significance

With the proposed mitigation, and wetland compensation, the residual environmental effects of Construction, Operation, and Decommissioning and Abandonment on the Coastal Wetland Environment are rated not significant. This conclusion has been made with a moderate level of confidence.

With the proposed mitigation, including avoidance and minimization of wetland loss to the extent feasible given the scope of the Project, the cumulative environmental effects of the Construction, Operation, and Decommissioning and Abandonment of the Project in combination with other past, present and future projects and activities that have been or will be carried out are rated not significant. There is a moderate level of confidence in the assessment of environmental effects and significance prediction because of the nature of mitigation outlined in this assessment and the collective professional judgment of the Study Team which has local knowledge based on involvement with other projects within the ecoregion.

9.4 Follow-up and Monitoring

There is no follow-up and monitoring recommended for this CSR. Some follow-up and monitoring measures have been recommended in the Final EIA Report (Jacques Whitford Stantec Limited 2009a) for wetland loss on land.

10.0 MARINE ENVIRONMENT

The Marine Environment refers to all marine fish and fish habitat that may interact with Project activities. The federal *Fisheries Act* defines "fish" to mean all fish, shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals. Therefore, all aquatic organisms in habitats defined as fish habitat are considered as fish in this assessment. The federal *Fisheries Act* defines "fish habitat" as spawning grounds, nursery, rearing, food supply and migration areas on which fish depend directly or indirectly. Fish habitat includes physical (*e.g.,* substrate, temperature, flow velocity and volumes, water depth), chemical (*e.g.,* dissolved oxygen, pH, nutrients) and biological (*e.g.,* fish, benthic invertebrates, plankton, aquatic plants) attributes of the environment that are required by fish to carry out life cycle processes (*e.g.,* spawning, rearing, feeding, overwintering, migration). Marine birds are also considered as a component of the Marine Environment, and while not protected under the *Fisheries Act*, are protected by other legislation (*e.g.,* the *Migratory Birds Convention Act* (*MBCA*)).

Marine species of special status are those species that live for large parts of their life cycle in the Bay of Fundy, and that have been identified by federal or provincial agencies as being endangered, threatened, rare, or otherwise of conservation concern. Species at Risk (SAR) (*e.g.,* North Atlantic right whale and harlequin duck) are protected by legislation (*SARA*, NB *ESA*) and require special attention during the EA process as, by their very definition, populations are more sensitive to anthropogenic stressors. Species of Conservation Concern (SOCC) are species that, unlike SAR, are not afforded direct protection by legislation. SOCC are placed on lists as a precautionary measure that reflects an observed trend in their provincial population status. For the purpose of this CSR, SAR and SOCC are combined and referred to as species of special status. Species of special status are important indicators of ecosystem health and regional biodiversity.

The Bay of Fundy consists of a number of marine habitat types (Buzeta *et al*. 2003), which are home to a diverse array of flora and fauna including over 100 fish species, 2,371 invertebrate taxa (Pohle *et al*. 2004), and at least 40 species of marine mammal and bird species.

Fish occurring in the Bay of Fundy include resident species, which complete their life cycle in the Bay, and those that enter the Bay only during spawning or feeding migrations. Migrating fish species are mainly from the Scotian Shelf and the Gulf of Maine, but do include migrants from as far away as Chesapeake Bay (striped bass, *Morone saxatilis*) and the Sargasso Sea (American eel, *Anguillia rostrata*). The fish fauna is also enriched by a number of occasional migrants and stray fish species from areas to the north and south of the Bay of Fundy (Scott and Scott 1988). A number of invertebrate species found in the Bay of Fundy, such as lobster, rock crab, and sea scallop, are important commercially.

Marine mammals have high ecological and socio-economic importance in the Bay of Fundy. The large baleen whales that frequent the lower Bay of Fundy are the focal point of whale watching activities, promoting tourism and drawing revenue. Upwards of 17 species of marine mammals occur in varying densities throughout the Bay of Fundy.

Twenty-three species of marine birds have been regularly detected during winter coastal surveys in the local Bay of Fundy area. Most of these species nest in northern parts of Canada; however, certain river islands near Reversing Falls and Manawagonish Island are known to be nesting colonies for marine birds.

The Marine Environment was selected as a VEC because of the:

- Specific regulatory requirements of the *Fisheries Act*;
- Specific regulatory requirements of the *MBCA*;
- Potential presence of some species of special status; and
- Intrinsic importance of fish populations and fisheries resources to the socio-economic component of the human environment.

This CSR focuses on key Project activities that may interact with the Marine Environment. These activities include construction and operation of the jetty, barge landing facility, Project-related vessel traffic, seawater cooling intake and release, and any potential anchorage and exclusion zones for Project-related tankers. Cumulative environmental effects are also assessed. Potential environmental effects of accidents, malfunctions and unplanned events on the Marine Environment are discussed separately (Chapter 16).

The Project has the potential to affect the Marine Environment primarily during Construction of the marine terminal including the jetty and other marine-based infrastructure. These environmental effects are largely localized and essentially limited to the physical footprint of these structures in the Marine PDA during the short-term, within one to two years, and which are likely to result in habitat alteration, disruption or destruction (HADD) of fish habitat on the sea bed. However, effective Project planning, design, avoidance, and the application of known and proven mitigation measures during Construction has led to the conclusion that the environmental effects of the Project on the Marine Environment will be not significant. Positive environmental effects in the Marine Environment are likely to occur after Construction and during Operation of the Project as a result of the “reef” effect and attraction of marine species to the jetty and other marine-based infrastructure by colonizing hard surfaces and creating new fish habitat. Mitigation measures established to limit HADD during the construction work include, but are not limited to, the avoidance of biologically sensitive periods, when feasible; disposal of dredged material in the nearby established Black Point ocean disposal site and managed by Environment Canada; implementation of DFO’s guidelines for the use of underwater explosives where appropriate; and fish habitat HADD compensation measures to be developed in consultation with DFO.

During Operation, the potential adverse environmental effects on the Marine Environment include the direct mortality of fish eggs and larval fish withdrawn into the seawater cooling intake, and the release of liquid effluent containing mainly heated seawater through a marine outfall located at a distance from Mispec Point. Other potential adverse environmental effects on the Marine Environment include the potential for increased sound in the acoustic marine environment during Construction and Operation as a result of dredging and blasting in the Marine PDA and vessel traffic in the Bay of Fundy shipping lanes and in the Marine PDA. The environmental effects assessment, however, concluded that these environmental effects are not significant as a result of effective Project design, avoidance, and the application of known and proven mitigation measures. Mitigation measures for the seawater cooling intake will contain barriers and fish screens to minimize impingement and entrainment of fish, and thus any direct mortality of fish eggs and larval fish is not likely to adversely affect a change in marine populations or biodiversity of fish species in the Bay of Fundy. The strong tidal currents in the area of Mispec Point and the use of a diffuser (or similar technology that will be designed to facilitate effluent dispersion) at the outfall location are concluded to be effective mitigation measures to mix and disperse both the heated seawater and effluent from the wastewater treatment plant. This release will not likely be attached to the shore and the Marine Ecological Risk Assessment (Jacques Whitford 2008h) concluded no significant chronic exposure to the water, sediment and marine biota on the long-term. In the case of sound emissions to the marine environment, fish and marine mammals and birds will likely avoid the footprint of the jetty and other marine-based infrastructure within the Marine PDA during Construction. The cumulative environmental effect with the Project on the acoustic environment during Operation was also rated not significant on the North Atlantic right whale, a Species at Risk. These whales exhibit very limited avoidance behaviour because of sound generated by Project-related vessel traffic and are not likely to avoid their feeding habitat in the Grand Manan area with the incremental vessel traffic in the shipping lanes as a result of the Project. There are few species of special status (SOCC and SAR) that have been reported during field investigations for this Project or other recent projects that are known to use the Marine PDA as foraging habitat during a portion of the year; these are limited to the harbour porpoise and harlequin duck. The potential environmental effects on those marine populations that are present are rated not significant because the Marine PDA does not represent important populations or foraging habitat in comparison to other populations and areas within the entire Bay of Fundy.

10.1 Scope of Assessment

This section defines the scope of the environmental assessment of the Marine Environment in consideration of the nature of the regulatory setting, issues identified in public engagement, potential Project-VEC interactions, and existing knowledge.

10.1.1 Regulatory Setting

Marine fish, fish habitat, water quality and sediment quality are protected primarily through federal legislation and to some extent by provincial legislation. With respect to federal legislation, fish habitat is protected under the *Fisheries Act*, and by the DFO *Policy for the Management of Fish Habitat*. This policy applies to all Projects and activities in or near water that could *"alter, disrupt or destroy fish habitat by chemical, physical, or biological means"*. Sections 20, 32, 35, and 36 of the *Fisheries Act* apply to the Project. Section 20 requires that fish passage be maintained at all times during Construction and Operation. Section 32 prohibits the destruction of fish by any means other than fishing. Section 35 protects fish habitat from harmful alteration, disruption or destruction (HADD), and Section 36 prohibits the deposit of a deleterious substance in waters frequented by fish. DFO has overall responsibility for the administration of the federal *Fisheries Act*. Environment Canada administers Section 36 of the *Fisheries Act*.

Other federal legislation that also protects fish habitat indirectly includes the *Canadian Environmental Protection Act* (*CEPA*) and specifically the *Disposal at Sea Regulations*. These regulations (*i.e.,* the Disposal at Sea provisions of Part 7, Division 3 of *CEPA,* administered by Environment Canada), stipulate that dredging and disposal in the marine environment requires a permit and that sediment be screened for potential chemical contaminants. These provisions state that no person shall load a substance for the purposes of disposal at sea, or dispose of a substance at sea unless the loading and disposal is done in accordance with a permit. Further, the purpose of the Disposal at Sea provisions of *CEPA*, in addition to indirectly protecting fish habitat, is also to allow Canada to meet international obligations under the *London Convention* (1972) and the subsequent *Protocol to the*

Convention (1996). Therefore, an environmental assessment of the marine environment in which dredging is to occur must be conducted.

The Marine Environment includes marine bird species, and their habitat located within the vicinity of the Project. Marine birds are protected under the federal *Species at Risk Act* (*SARA*) which generally limits exposure of listed endangered species or critical habitats for listed species to be interfered with, disturbed, or destroyed.

SARA defines a "wildlife species" as a species, sub-species, variety or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and (a) is native to Canada; or (b) has extended its range into Canada without human intervention and has been present in Canada for at least 50 years. *SARA* is co-administered by Environment Canada, the Parks Canada Agency, and DFO. The purposes of *SARA* are to prevent Canadian indigenous species, subspecies and distinct populations of wildlife from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species, and to encourage the management of other species, to prevent them from becoming at risk. General prohibitions include Section 32(1), which states that no person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species as listed in Schedule 1 of *SARA*. No approvals under *SARA* are likely required for marine species with respect to the Project. However, species identified in Schedule 1 will be considered in this EA and mitigation will be developed where an interaction exists. Critical Habitat, as defined under *SARA*, is the habitat that is necessary for the continued survival of a SAR, or for the recovery of a SAR. Critical Habitat that has been identified for a given SAR and is part of an active recovery plan is listed on the Species at Risk webpage (www.sararegistry.gc.ca). No critical habitat for any SAR has been established in Southern New Brunswick.

Species of Conservation Concern (SOCC) are species that are not formally protected under *SARA* but that have been identified by other agencies (*e.g.,* AC CDC) as being sensitive and/or rare. In this chapter, SAR and SOCC are together referred to as species of special status.

Migratory birds are also protected federally under the *MBCA*, administered by Environment Canada. The *MBCA* and regulations afford protection to all birds listed in the Canadian Wildlife Service Occasional Paper No. 1, "Birds Protected in Canada under the *Migratory Birds Convention Act*". The Act and regulations state that no person may disturb, destroy, or take/have in their possession a migratory bird (alive or dead), or its nest or eggs, except under authority of a permit.

Finally the *Oceans Act* is also involved in the sustainability of species and their habitat in the marine environment.

Some legislation is aimed at protecting species groups, (*i.e.,* migratory birds are protected federally under the *MBCA*) while others are focused on the preservation of wilderness and the sustainability of sensitive habitats. The purpose of this legislation is to protect and promote the conservation of habitats and species that occupy those spaces. For example, under the *Oceans Act*, the Musquash Estuary was listed as a Marine Protected Area, thereby conserving one of the last remaining undisturbed estuarine environments in the Bay of Fundy.

The EA Track Report and Scoping Document required an assessment of environmental effects of the Project on marine water and sediment quality and dispersion, currents, tides, waves and ice, marine fish and fish habitat, marine mammals, and migratory birds. Ecologically sensitive or significant areas or other designated areas and SOCC and SAR species and their habitats were also required in the

EA Track Report, as well as an environmental assessment on the underwater acoustic environment as a result of Project-related activities.

10.1.2 Issues and Concerns Identified During Public, Stakeholder, and Aboriginal Engagement

During engagement activities conducted, the main issue raised by stakeholders and community members was in relation to what the environmental effect of increased shipping would be on a marine mammals, in particular the North Atlantic right whale. As a result, a detailed analysis of the potential acoustic-related environmental effects of the Project on marine mammals is included in this CSR.

Aboriginal engagement and engagement of commercial fishermen revealed concerns about the sustainability of fisheries resources, particularly lobster, in the Bay of Fundy and the potential environmental effects that the Project might bring about on these resources. These issues are assessed in Chapters 11 (Commercial Fisheries) and 12 (Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons).

10.1.3 Selection of Environmental Effect

The environmental assessment of the Marine Environment is focused on the following environmental effect:

- Change in Marine Populations.

The Project has the potential to affect the Marine Environment through changes in marine habitat, water quality, and sediment quality. Changes of these aspects of the Marine Environment, if unmitigated, have the potential to change Marine Populations (*e.g.,* adult fish, eggs and larvae, invertebrates, marine mammals, and marine birds) through direct mortality or indirectly through alteration, destruction or disruption of habitat. In light of the value placed on Marine Populations by regulatory agencies, stakeholders, and the public, the EA of the Marine Environment is focused on this key environmental effect.

10.1.4 Selection of Measurable Parameters

Table 10.1 provides the measurable parameters that will be used for the environmental effects assessment, and the rationale for the selection of the measurable parameter.

Table 10.1 Measurable Parameters for the Marine Environment

Environmental Effect	Measurable Parameter	Notes, or Rationale for Selection of the Measurable Parameter
Change in Marine Populations	Mortality (loss of individuals attributable to the Project, as measured by No. of individuals)	▪ Number of fish killed per year can be measured as impingement or entrainment of fish and fish larvae and eggs by the seawater cooling intake structure (if applicable). ▪ Number of marine birds accidentally killed as a result of the Project. ▪ Number of marine mammals accidentally killed as a result of the Project.
	Fish HADD: ▪ Habitat Area (m^2) ▪ ERA EHQ ▪ Water Quality (using CCME aquatic guidelines): ▪ DO (mg/L), Temperature (Celsius),	▪ Direct HADD of fish habitat is measured in area (m^2). ▪ EHQ (Ecological Hazard Quotient) is predictive of future habitat quality. ▪ Release of a deleterious substance or quantity

Table 10.1 Measurable Parameters for the Marine Environment

Environmental Effect	Measurable Parameter	Notes, or Rationale for Selection of the Measurable Parameter
	TSS (mg/L), Nutrients (mg/L), Trace metals (µg/L), PAH (µg/L), and Hydrocarbons (µg/L) ▪ *Petroleum Refinery Liquid Effluent Regulations* release standards: ▪ Oil and grease, phenols, sulphide, ammonia-nitrogen, total suspended matter, and any substance capable of altering the pH of liquid effluent or once-through cooling water. ▪ Sediment Quality ▪ *Disposal at Sea Regulations* Screening Criteria: ▪ Cadmium (mg/kg), Mercury (mg/kg), Total PAH (mg/kg), Total PCBs (mg/kg), and persistent plastics (4 % by volume). ▪ CCME aquatic guidelines ▪ Trace metals (including mercury) (mg/kg), PCBs (mg/kg), and PAH (mg/kg).	not authorized in the *Petroleum Refinery Liquid Effluent Regulations* under the *Fisheries Act.* ▪ Thermal plume and effluent quality from marine outfall can be measured. ▪ *Disposal at Sea Regulations* under *CEPA* specify sediment screening criteria for use in assessing the suitability of material for disposal at sea. ▪ CCME Interim Sediment Quality Guidelines and Probable Effects Level are available and which can be measured against to assess environmental effects.
	Underwater Acoustic Environment ▪ Sound level in decibels, dB re 1 µPa ▪ Presence/absence of marine mammals	▪ Increase in sound levels (magnitude, frequency, duration and character – tonal vs. impulsive) above background levels as a result of increased vessel traffic may affect marine ecosystem in Bay of Fundy shipping lanes and in the Marine Project Development Area (PDA). ▪ Presence or absence of marine mammals (particularly species of special status) in the Marine PDA can be measured. ▪ Potential increased sensitivity of species of special status to changes in the acoustic environment. This is particularly applicable to marine mammals.

10.1.5 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of the Project on the Marine Environment include the periods of pre-Project baseline conditions, Construction, Operation, and Decommissioning and Abandonment.

The pre-Project baseline temporal boundary (for consideration of cumulative environmental effects) is roughly within the last five to ten years for available published information. Information available during this period consists of regulatory documents, governmental organization data sources documents (*e.g.,* the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)), non-governmental organization data sources (*e.g.,* the Saint John Atlantic Coastal Action Plan), and EA's conducted for other projects in the area (*e.g.,* Canaport Liquefied Natural Gas (LNG) terminal (Jacques Whitford 2004)).

The Construction of the Project will be carried out in two sequential phases beginning no earlier than 2010, over approximately 6-8 years. Operation would begin following the completion of Construction of each phase.

Decommissioning and Abandonment would take place following the completion of the operating life of the Project, and would be carried out in accordance with regulations in place at that time. Decommissioning and Abandonment would be a multi-year undertaking.

In general, the potential environmental effects of the Project on the Marine Environment will begin and peak during Construction but diminish during Operation. When the site is eventually decommissioned and abandoned, it may be returned to near baseline conditions.

10.1.6 Spatial Boundaries

This section describes the spatial boundaries for the environmental assessment of the Marine Environment as presented in Figures 10.1 and 10.2. Three levels of spatial boundaries have been determined: the Marine Project Development Area (Figure 10.2); the Local Assessment Area (Figure 10.1); and the Regional Assessment Area (Figure 10.1). These boundaries are defined below.

Marine Project Development Area (Marine PDA)

The Marine PDA includes the marine environment in the immediate vicinity of the proposed Project location for the marine-based infrastructure (marine terminal, seawater cooling intake pipe and structure, wastewater effluent pipe and marine outfall, and barge landing facility).

Local Assessment Area (LAA)

The LAA includes the outer Saint John Harbour up to the entrance of the major shipping lanes in the Bay of Fundy. In practical terms, the LAA is essentially equivalent to the Port of Saint John limits as defined by the Letters Patent issued to the Saint John Port Authority under the *Canada Marine Act*. This area is the maximum area where Project-specific environmental effects for the Marine Environment can be predicted and measured with a reasonable degree of accuracy and confidence.

Regional Assessment Area (RAA)

The RAA is defined as the Bay of Fundy, the area within which cumulative environmental effects for the Marine Environment are likely to occur, depending on physical and biological conditions, and the type and location of other past, present or reasonably foreseeable projects or activities. The determination of the RAA boundaries focused on the habitat requirements of species of conservation concern.

10.1.7 Administrative and Technical Boundaries

Administrative and Technical Boundaries for the characterization of potential environmental effects of the Project on the Marine Environment were discussed in Sections 10.0 and 10.1.

10.1.8 Residual Environmental Effects Rating Criteria

The environmental assessment methodology for the Marine Environment is based on the determination of whether significant adverse residual environmental effects are likely to occur from the Project.

For fish as defined in the *Fisheries Act*, including marine mammals, a significant adverse residual environmental effect on fish is one that results in an unauthorized destruction of fish by any means other than fishing as required in Section 32 of the *Fisheries Act*.

For fish habitat as defined in the *Fisheries Act*, a significant adverse residual environmental effect is one that results in an unmitigated or non-compensated net loss of fish habitat as required in a *Fisheries Act* HADD authorization. It would also occur where there is the release of a deleterious substance released into the Marine Environment that is not authorized under the *Petroleum Refinery Liquid Effluent Regulations* under the *Fisheries Act* or the *Disposal at Sea Regulations* under the *Canadian Environmental Protection Act*.

A significant adverse residual environmental effect on secure marine bird species is one that affects bird populations in such a way as to cause a decline in abundance or change in distribution of common and secure population(s) such that populations will not be sustainable within the RAA.

A significant adverse residual environmental effect on secure (general marine) species is one that results in a Change in Marine Populations in such a way as to cause a decline in abundance or change in distribution of common and secure population(s) such that populations will not be sustainable within the Bay of Fundy Coastal Ecoregion.

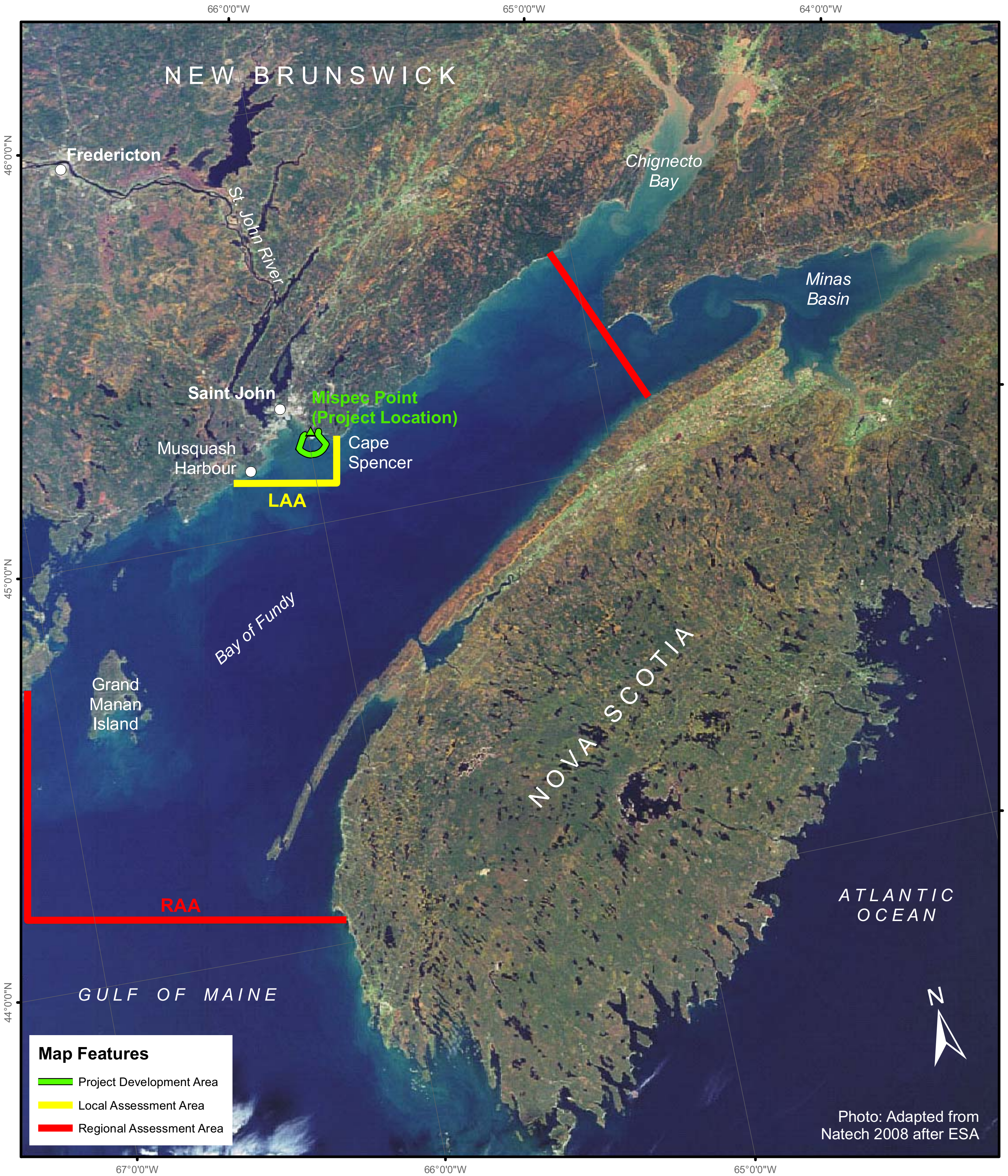
A significant adverse residual environmental effect on any species of special status (SAR, SOCC) is one that results in any of the following.

- A non-permitted contravention of any of the prohibitions stated in Sections 32-36 of *SARA* occurs (*i.e.,* it is an offence to capture, take, possess, collect and sell endangered or threatened species, as well it is illegal to damage or destroy the residence, for example the nest or den, of an endangered or threatened species), or in the case of marine Species of Special Concern listed in Schedule 1 of *SARA*, where the Project activities are not in compliance with the objectives of management plans (developed as a result of Section 65 of *SARA*) that are in place at the time of relevant Project activities.
- Alters the marine habitat within the assessment boundaries physically, chemically, or biologically, in quality or extent, in such a way as to cause a change or decline in the distribution or abundance of a viable marine population of special status that is dependent upon that habitat such that the likelihood of the long-term survival of these populations within the RAA is substantially reduced as a result.
- Or the direct mortality of individuals or communities occurs such that the likelihood of the long-term survival of these rare, uncommon and/or non-secure population(s) within the RAA is substantially reduced as a result.

10.2 Existing Conditions

Characterization of existing baseline conditions for the marine environment is required to support the EA and the environmental effects assessment for this Project. Thus, the purpose of this section is to describe the existing baseline conditions of the Marine Environment within the Marine PDA, LAA, and RAA where applicable and appropriate.

The Saint John Harbour is an estuary and provides habitat for migrating fish to the Saint John and Mispec Rivers. It is also the approach route to the Port of Saint John, an international shipping Port surrounded by a concentration of major industries and commercial activities.



Map Parameters
Projection: UTM, NAD83, Zone 20
Scale: 1:1,300,000
Date: August 8, 2008
Project No.: 1013263.

Figure 10.1
Marine Environment PDA, LAA, and RAA

0 10 20 40 60 80 100
Kilometres

Project Eider Rock

Jacques Whitford

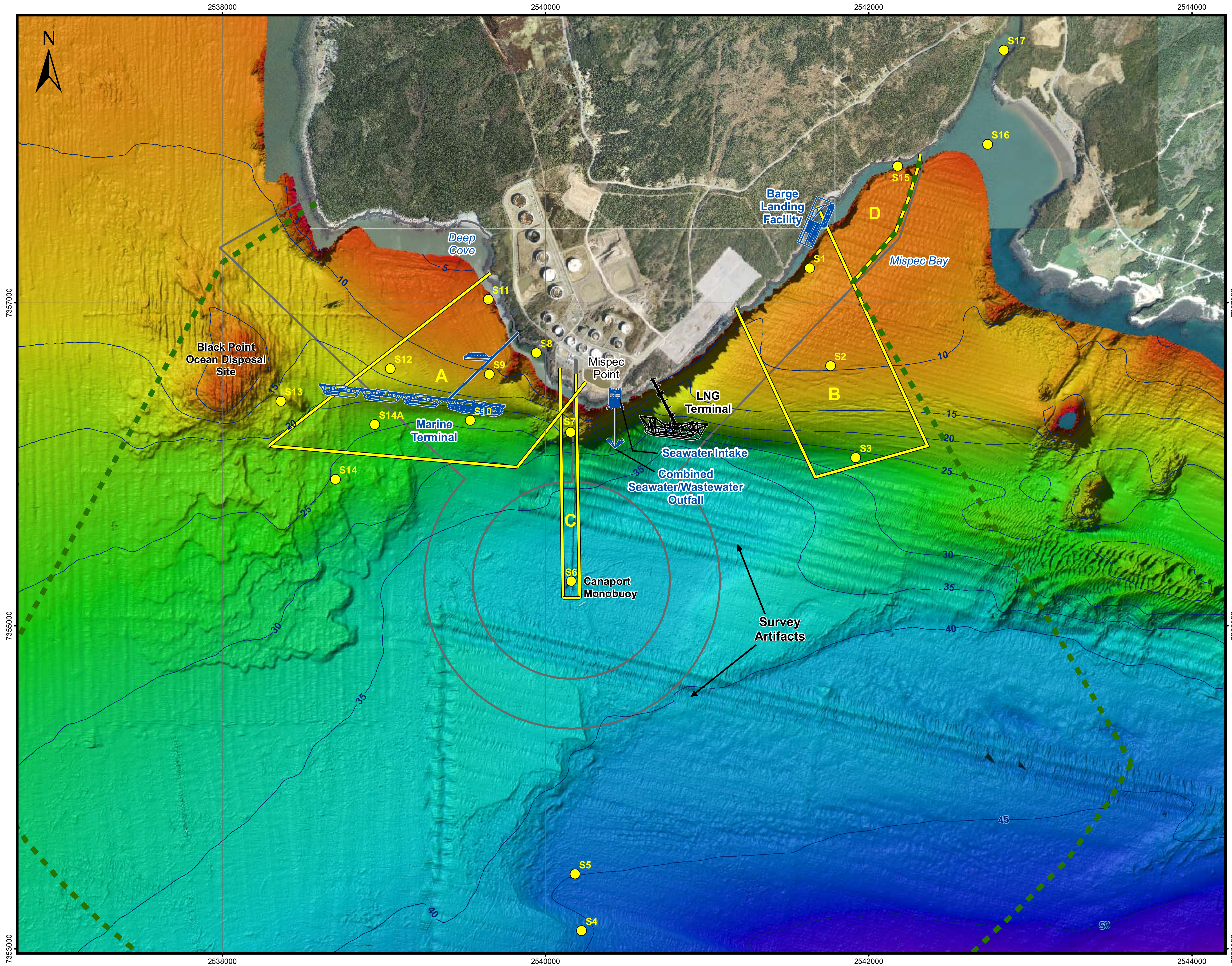


Figure 10.2

Marine Project Development Area (PDA) and Location of Marine Surveys and Sampling Stations for 2006 and 2007

Project Eider Rock

Map Features

- Sample Locations
- Project Component
- Existing Component
- Project Development Area
- Marine Survey Area
- Bathymetry Contour (m)
- Canaport Water Lot

Bathymetry Data Source:
Fugro Jacques Geosurveys Inc. (2007)
Aerial Photography Data Source:
City of Saint John, GIS Division,
Property Boundary Source: Service New Brunswick

0 200 400 600 800 1,000
Metres

Map Parameters
Projection: NB Stereographic
Scale: 1:22,000
Date: August 8, 2008
Project No.: 1013263.

Jacques Whitford

The baseline conditions of the Marine Environment were characterized using existing information, field data collected during 2006 and 2007, and information gathered from public consultation activities. Data were collected for this environmental assessment to characterize existing baseline conditions and in the field to fill gaps for bathymetry, marine geomorphology, marine currents, water quality, sediment quality, fish habitat, fish eggs, larval fish and larval lobster present in the Marine PDA.

10.2.1 Existing Knowledge

Existing information was obtained from various sources including previous environmental assessments conducted for projects in and near the Marine PDA, public consultation, regulatory agencies (*e.g.,* EC, DFO), and from reports produced by government institutions and organizations (*e.g.,* Bedford Institute of Oceanography (BIO), Geological Survey of Canada (Atlantic)), and universities (*e.g.,* Ocean Mapping Group of the University of New Brunswick).

One ongoing activity that is located near the Project is the use of the Black Point ocean disposal site, which is used for disposal of dredge spoils from annual maintenance dredging of the Saint John Harbour. The centre of the disposal site is located approximately 1 km southwest of Black Point and 2.5 km to the west of Mispec Point and the existing Canaport marine terminal. This site is the largest ocean disposal site in Atlantic Canada administered by Environment Canada as part of its Disposal at Sea program. Currently, the average quantity of dredged material deposited at this site is less than 200,000 m^3 per year but has reached 1,000,000 m^3 on occasion (ECL 2003). Environment Canada and Geological Survey of Canada have monitored the Black Point ocean disposal site. The series of multi-disciplinary studies conducted as part of Environment Canada's Disposal at Sea monitoring program include:

- Repeated multi-beam sonar surveys to determine detailed bathymetry and surficial geological features;
- Current measurements;
- Current and sediment transport modelling;
- Monitoring of sediment characteristics;
- Monitoring of contaminant distribution;
- Monitoring of sea bed biological communities, and
- Monitoring of the Saint John Harbour fishery.

The information and data collected for this ocean disposal site provide an exceptional scientific basis that describes the local oceanographic conditions for assessment of potential environmental effects of the Project on fish, fish habitat, and marine mammals and marine birds. An EIA Report was prepared in support of the Irving Oil Liquefied Natural Gas (LNG) Marine Terminal/Multi-purpose Pier Project (Jacques Whitford 2004), now operated by Canaport LNG Limited Partnership. Data were collected by Jacques Whitford in 2001 and in 2003 in support of the LNG project (Jacques Whitford 2004) from the benthic habitat in the area and which were surveyed in support of the Project. Additional information on the estuarine and Marine Environment was also collected in conjunction with the Saint John River Wet Crossing Environmental Assessment (Jacques Whitford 2007c) conducted for Emera Brunswick Pipeline.

10.2.1.1 Identified Data Gaps

Although the review of previous studies and existing information provided some information on the Marine Environment in the Marine PDA, and specifically at the regional and local spatial scales, it was determined additional information and data were required to support this EA. Specifically, bathymetry, marine geomorphology, marine currents, water quality, sediment quality, fish habitat, fish eggs, larval fish and larval lobster data were required in the marine environment in the area of the proposed marine-based components of the Project.

Seasonal field investigations were undertaken in 2006 and 2007 in the Marine PDA to fill these data gaps.

The results of field investigations are summarized below. Raw data and detailed sampling methods are provided in the Marine Biophysical Environment Technical Study (Jacques Whitford 2008m).

10.2.2 Methods

The existing environment for the Project was characterized, depending on the type of investigation being conducted, at three different spatial areas and scales when applicable, as shown in Figure 10.1: the RAA, LAA, and Marine PDA.

The Marine PDA was sub-divided into four focused survey areas (Figure 10.2). Area A includes the marine terminal to the west of Mispec Point, where the marine terminal and jetty for transferring crude, finished products and coke will be located. Areas B and D to the east of Mispec Point and in Mispec Bay cover the area where the barge landing facility will be located. Area C includes the Canaport single buoy mooring (SBM, also referred to as the monobuoy) and the general vicinity of the proposed location for the seawater cooling intake and the combined wastewater treatment plant/seawater effluent outfall.

Bathymetric and geophysical (side-scan sonar and sub-bottom profiling) surveys were conducted in 2007 (Areas A, B and D). Area C was surveyed by Fugro Jacques GeoSurveys Inc. in 2002 (FJGI 2002). Water quality and sediment quality stations sampled in the Marine PDA are shown in Figure 10.2. Seasonal (spring, summer, fall, and winter) sampling for water quality and water column profiling for temperature, salinity, dissolved oxygen (DO), turbidity, and pH was carried out in 2006-2007 at most of the stations identified in Figure 10.2.

Jacques Whitford carried out synoptic field measurements for currents in the Marine PDA. A downward facing Teledyne RDI 600 kHz broadband acoustic doppler current profiler (ADCP) was used from a moving vessel to measure currents throughout the water column. Currents were measured along a pre-determined vessel path to cover the location of the marine terminal, outfall, and barge landing facility. The objective of the surveys was to obtain a synoptic view of the currents and general water circulation patterns in the Marine PDA. Further, data on currents were collected for different tidal stages (*e.g.,* ebbing, flooding, high water and low water), during larger spring tides and smaller neap tides, and in the spring season during higher run-off from the Saint John River and in the drier summer season.

Sampling for fish eggs and larvae and other zooplankton was conducted at stations S2 in Mispec Bay and S12 west of Mispec Point in the Outer Harbour in spring (May 31) and summer (August 23) 2007; refer to Figure 10.2 for location of sampling stations. Samples were collected during an ebbing and flooding tide at each station. A bongo-style plankton net, consisting of two conical nets held side-by-side (allowing for replication), was used to sample fish eggs and larvae throughout the water column by carrying out repeated oblique tows with the net. Each conical net measured 0.6 m in diameter at the opening and 3 m in length, with a sieving mesh size of 0.33 mm.

Marine benthic habitat data were collected using SCUBA divers from the intertidal zone to a water depth of approximately 15 m (the nearshore benthic habitat) on September 21, October 5, and October 6, 2007. Twenty-three, 100 m survey transects were conducted and video recorded to cover the proposed marine-based facilities associated with the Project: ten (T-1 through T-10) west of Mispec Point for the marine terminal; and 13 (T-11 through T-23) east of Mispec Point in Mispec Bay for the barge landing facility. Transects 1-10 were run perpendicular from the shore and spaced in 100 m increments along the shoreline west of Mispec Point. Transects 11-23 were set up in the same manner as Transects 1-10, but encompassed the areas east of Mispec Point (Figure 10.3).

Underwater video images were also collected along transects with a tow operated vehicle (TOV) in deeper waters (offshore benthic habitat) on October 19 and 20, 2007. The location of the diving nearshore and offshore transects are shown in Figure 10.3. The offshore transects overlapped the nearshore transects at several tie points to confirm observations and to maintain continuity and complete the baseline conditions of the benthic habitat in the footprint of the marine-based infrastructure, and in general in the Marine PDA. The late summer-early fall survey period was selected to ensure the peak of the marine growing season was captured and that mature benthic community assemblages would be observed, including the potential presence of benthic marine resources.

Benthic invertebrates living on or in the sediment were collected using a Van Veen grab. A sample of the sediment from the grab was used to conduct sediment quality analyses. The sampling was carried out for three seasons: fall (December 11 and 18, 2006); spring (May 30, 2007); and summer (August 23, 2007). It is important to note that the fall sampling consisted of 12 stations and not all 17 stations that were sampled in spring and summer. In addition, stations S4 and S5 were situated in very close proximity to each other (<100 m apart) and were considered as replicate stations. Those stations were also situated the farthest from the coast (6 km) and in the deepest waters (50 m). The summer sampling included triplicate samples for stations S2, S7 and S9 (Figure 10.2). The level of replication is believed to be sufficient to characterize the existing benthic invertebrate community in the Marine PDA and to establish baseline conditions.

A collaborative effort from several specialized firms in their respective fields contributed to characterizing the existing marine physical environment for the Project. They include:

- Fugro Jacques GeoSurveys Inc., who conducted the multi-beam bathymetric and marine geophysical surveys and interpretation;
- NATECH Environmental Sciences Inc., for the synthesis of the physical oceanography and development of the 2-D hydrodynamic model specifically for this Project;
- JASCO Research Ltd., for the characterization of the acoustic environment; and
- Jacques Whitford, for the characterization of current and water masses in the Marine PDA.

Jacques Whitford also carried out baseline condition characterization for water quality, sediment quality, fish and fish habitat, and fish eggs and larvae.

10.2.3 Physical Environment

10.2.3.1 Bathymetry and Sea Bed Features

A multi-beam echo sounding survey (FJGI 2008) was conducted in October 2007 in the Outer Harbour west of Mispec Point identified as Area A and to cover the anticipated footprint of the new marine terminal (Figure 10.4). Water depths within the Area A survey range from approximately 2 to 31 m (lower low water large tide; LLWLT). Rugged, exposed bedrock occurs in the coastal-nearshore zone. In the northern part of the survey, the bedrock zone is relatively narrow, extending less than 150 m from shore. A prominent bedrock ridge in the east central part of the survey area shoals to 3 m (LLWLT), and extends up to 300 m from shore. The bedrock zone continues to expand eastward toward Mispec Point and the proposed location of the seawater cooling intake, with rugged sea bed topography occurring at water depths greater than 25 m. Bed gradient in the nearshore region exceeds 15° in places.

Numerous sonar contacts larger than 1 m in diameter were mapped from digital side-scan data, with the greatest density occurring in the region of gravel rich, mixed sediments in the southeastern part of the survey (Figure 10.5). The sonar contacts are mainly interpreted to be isolated boulders and boulder accumulations. There were no man-made objects identified in these sonar contacts during the surveys.

A multi-beam echo sounding survey was also conducted in Mispec Bay identified as Areas B and D (Figure 10.6). Surveyed water depths within the combined Areas B and D ranged from approximately 1 to 32 m (LLWLT) (Figure 10.6). Similar to Area A, the nearshore zone is characterized by rugged, exposed bedrock, which extends from coastal cliffs to water depths of approximately 6 to 10 m. Bed gradient in the nearshore zone of Mispec Bay exceeds 10°. Seaward of the bedrock zone, the sea bed descends into a shallow, shore-parallel trough, and then rises onto a broad sandy shoreface platform that shoals to <8 m water depth about 500 m from shore. Sea bed gradients within the shoreface zone are low overall, ranging from approximately 0.1° to 1°. Large-scale, low relief bedforms occur on the slope below 12 m water depth.

Sea bed sonar contacts greater than 1 m and scattered across the shoreface zone in Mispec Bay (Figure 10.7) also mainly indicate the presence of isolated boulders and the absence of man-made objects in these sonar contacts.

10.2.3.2 Geomorphology

<u>Coastline</u>

The coastline in the Marine PDA, in the immediate vicinity of the proposed location of the marine-based infrastructure of the Project, is primarily bedrock (Figures 10.8 and 10.9). Occasional mixed sediment beaches 120 m in length or less occur west of the Project and existing Canaport facility (Figures 10.9 and 10.10). The bedrock shoreline throughout the area is characterized by ledges, boulders and outcrops, and tends to form inclined, ramped or irregular shores (Figure 10.8).

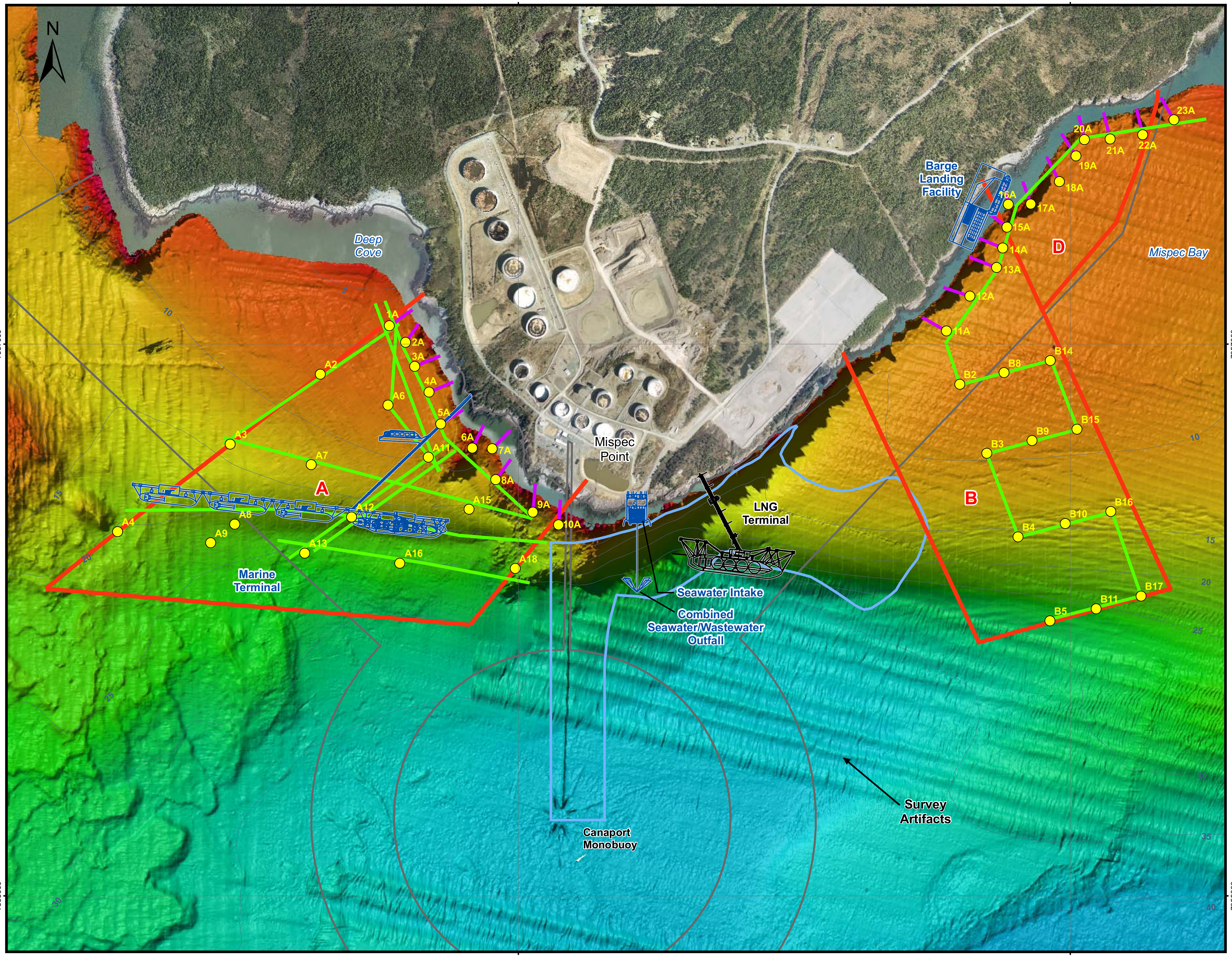


Figure 10.3

Location of Shoreline, Sub-Tidal and Towed Video Transects in 2007 for Marine Benthic Habitat Assessment

Project Eider Rock

Map Features

- Waypoints
- Project Component
- Existing Component
- Shoreline and Diving Sub-Tidal Habitat Transect
- Tow Operated Video Transect of Benthic Habitat
- 2007 Survey Area
- 2003 Survey Area (JW 2004)
- Bathymetry Contour (m)
- Canaport Water Lot

0 200 400 600 800
Metres

Bathymetry Data Source:
Fugro Jacques Geosurveys Inc. (2007)
Aerial Photography Data Source:
City of Saint John, GIS Division,
Property Data Source: Service New Brunswick

Map Parameters
Projection: NB Stereographic
Scale: 1:15,000
Date: August 8, 2008
Project No.: 1013263.

Jacques Whitford

To the east of Mispec Point and along the shoreline of the Canaport LNG facility, the topography and bedrock shoreline are steep, with vertical cliffs 20 to 40 m high (Figure 10.11). These cliffs diminish gradually to a sandy beach shoreline. The inner most point at the head of Mispec Bay is Mispec Beach, a sand tidal flat. Further to the east of Mispec Beach, the shoreline is once again bedrock with coastal segments of small patches of sandy beach. The back shore of the Marine PDA is primarily mixed forest, with areas of tall shrub meadow and an herbaceous understory (Figures 10.8 and 10.10).

Sediments on the Sea Floor Surface

Sediment distribution in the Outer Harbour has been reported extensively by Neu (1960), Carter and MacGregor (1978), Wildish and Thomas (1985), Baird (1987), Stewart and Sam (1993), Tay *et al.* (1997), Land and Sea (2001), and Parrot *et al*. (2002). The sediment on the sea floor surface outside Partridge Island is predominantly sandy silt, grading coarser toward the outer boundary of the Harbour. The consensus of the various studies is that the distribution and composition of sediment on the sea floor surface in the Outer Harbour is relatively stable with time and has not been greatly influenced by material from the Black Point ocean disposal site (ECL 2003). Neu (1960) suggests that the silt component is largely from freshwater sources and the sand from an anti-clockwise circulation gyre around the head of the Bay of Fundy.

The sea bed in the Marine PDA is composed of four types or classes of material as defined from the side-scan survey and mapped within survey Area A (Figure 10.5; west of Mispec Point at the marine terminal location).

- The Class 1 sea bed type is characterized by rugged exposed bedrock with abundant large boulders in the nearshore zone and in shallow water. Isolated patches of mixed sediment occur within bedrock depressions and between boulder accumulations. The bedrock in this zone is deduced by high intensity acoustic reflectance and appearing as dark grey in backscatter and side-scan imagery (Figure 10.5). Local variability in acoustic reflectivity within the bedrock region is related to the presence of patchy mixed sediments, and acoustic shadow effects caused by the steeply dipping, rugged sea bed topography. The mixed sediments consist of gravel and cobbles with varying amounts of sand, silt and mud. Cobbles and boulders in the nearshore zone likely form sea bed armour that is relatively stable. Finer grained sediment accumulations occur mainly along the seaward edge of the bedrock, forming a discontinuous drape ~2 cm to 15 cm thick on the surface (as indicated by SCUBA diver observations). The fine-grained sediments are likely mobile during storm activity.
- The Class 2 sea bed type is mainly comprised of silty sand extending seaward from the bedrock zone within water depths of about 5 m to 24 m, with limited, patchy occurrences in deeper water to the southwest of Area A. The silty sand is characterized by low to moderate intensity acoustic reflectivity, appearing light grey in backscatter and side-scan imagery (Figure 10.5). The surficial sand displays small-scale ripples, indicating periodic sediment mobility caused by wave action and tidal currents.
- The Class 3 sea bed type is predominantly coarse-grained, mixed sediments at approximately 24 m water depth that occur as a sharp transition from the seaward edge of the silty sands (Class 2) and which are well-defined in the south-eastern part of the survey area. The mixed sediments consist of gravel and cobble with varying amounts of interstitial and surface silty sand, as well as occasional shell hash (Figure 10.5). Furthermore, isolated boulders are observed. Coarse sediments are also exposed near the western margin of Area A, in water depths of approximately 12 m to 16 m.

- The Class 4 sea bed type is comprised of silty sands forming a thin discontinuous veneer over gravel and extending to water depths as great as 26 m and most noticeable in the south-western part of the survey Area A. Fine-grained sedimentation in the south-western region of Area A may be related in part to gravity flow dispersal of dredge spoils from the adjacent Black Point ocean disposal site.

Verification of the four types of sea bed material was based on sediment grab sample results (Table 10.8), diver observations and sea floor video imagery. A detailed description of the verification of the sea bed types and using these ground-truthed data are presented in the Marine Biophysical Environment Technical Study (Jacques Whitford 2008m), supported by the comprehensive marine geophysical report by Fugro Jacques GeoSurveys Inc. (FJGI 2008). Overlays of water depth contours, sediment grab sample locations, nearshore video transects, and offshore video survey waypoints that were used for the verification of the sea bed material are shown in Figures 10.5 and 10.7.

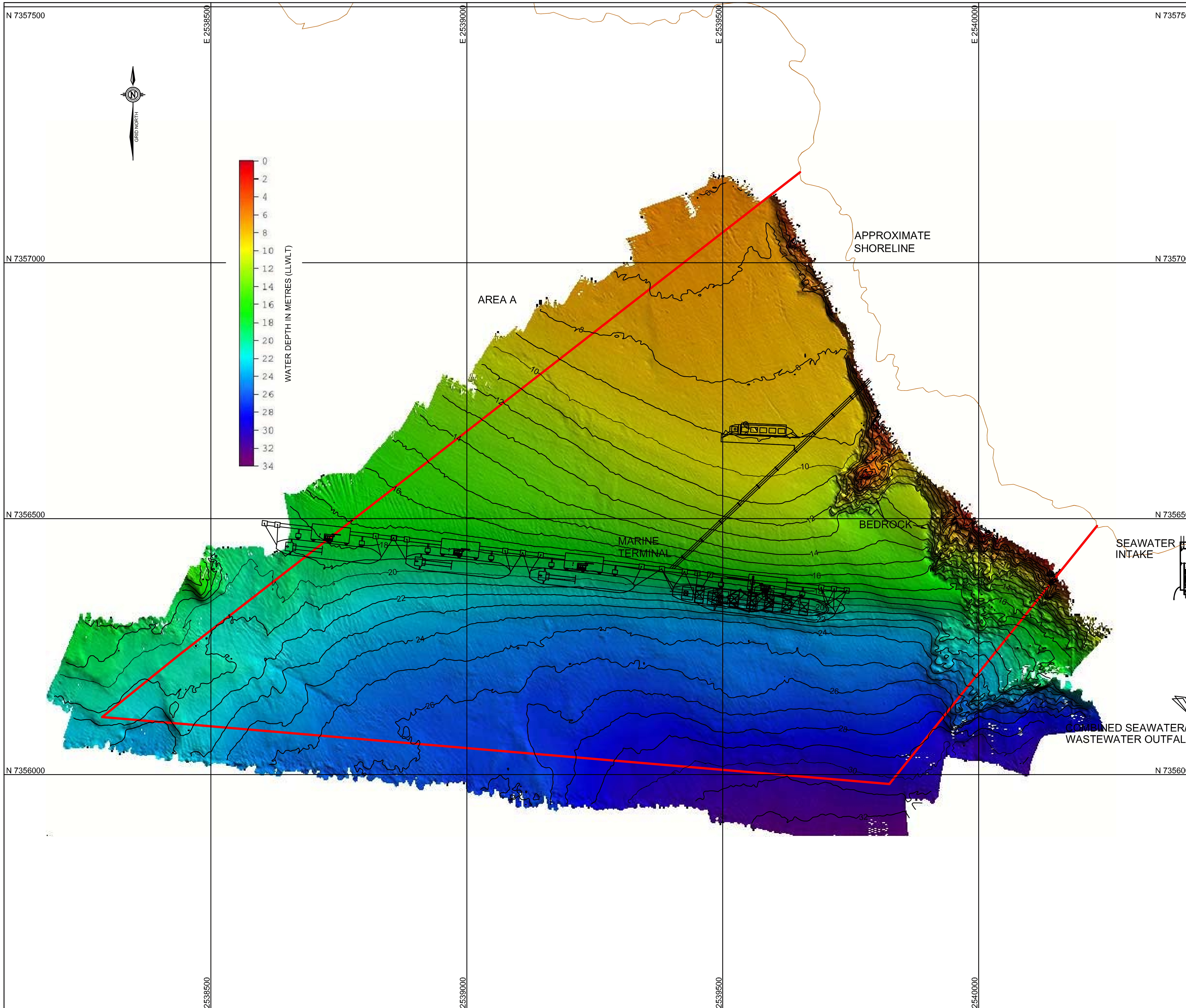
It can be summarized that except for a relatively narrow band of 100 to 200 m of sea bed bedrock adjacent to a shoreline of bedrock, the sea bed at the proposed location of the marine terminal is comprised of predominately a silty sand to sand substrate. The substrate off Mispec Point and at the location of the seawater cooling water intake structure (if it is built) is also composed of predominately bedrock, as well as in the footprint for most of the wastewater effluent outfall location, with the distal end of the proposed outfall lying on a sea bed composed of predominately gravel and mixed sediment (FJGI 2002). Photos of the shoreline near Mispec Point are presented in Figures 10.8 to 10.11

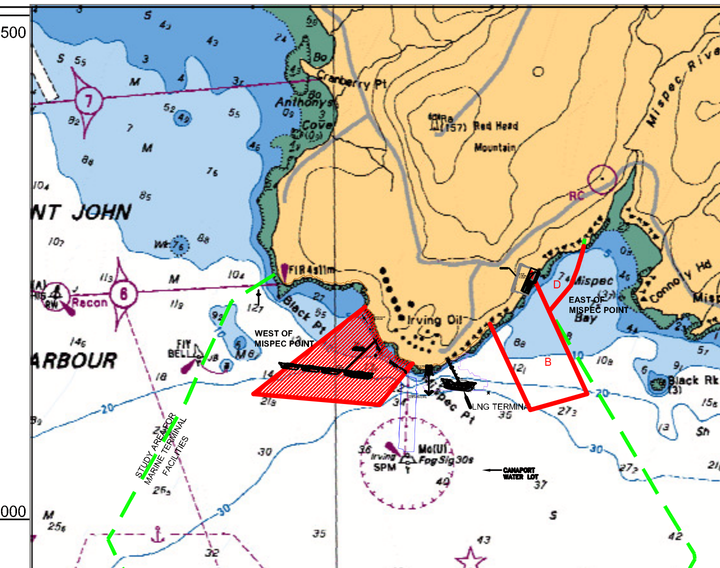
Three sea bed classes have been defined and mapped within Areas B and D in Mispec Bay. The sea bed in the nearshore zone and within shallow water (<10 m) consists of exposed bedrock with common boulders and isolated patches of mixed sediments (sand, gravel and cobbles; Class 1), and similar to Area A and the marine terminal location. The hard bedrock surface produces an overall high intensity acoustic response, appearing dark grey in acoustic backscatter and side-scan imagery (Figure 10.7). Variations in the intensity of acoustic reflectance within the bedrock zone are related to the presence of occasional finer grained mixed sediment accumulations within topographic lows. SCUBA diver observations indicate that a thin, discontinuous veneer of fine-grained sediment occurs at the seaward edge of the bedrock zone. The fine sediments are likely mobile during storm events.

Sediments on the surface within Areas B and D consist predominantly of silty sand and sandy silt (Class 4), which extends from the foot of the bedrock outcrop zone, across the shoreface platform, and onto the slope. The silty sands are characterized by relatively low intensity acoustic reflectance, and appear light grey in backscatter and side-scan imagery (Figure 10.7). Small-scale ripples are observed in sea bed video imagery, indicating periodic sediment mobility due to tidal currents and wave action. Shoreface sediments within Area B and D in Mispec Bay appear to be finer grained overall than in Area A and west of Mispec Point in the Outer Harbour.

The surficial silty sands appear to coarsen on the slope below approximately 24 m water depth, and a gradual downslope increase in acoustic backscatter intensity and side-scan imagery (Figure 10.7). Sands on the surface in the deeper water region appear to be better sorted with varying amounts of shell hash and which constitute a different type of sea bed material (Class 5, sand with shell hash) in the Marine PDA that is not present in survey Area A. The down slope transition from silty sand to sand is gradational, rather than sharp.

The sea bed at the inshore location of the barge landing facility therefore is composed of primarily bedrock.





REGIONAL LOCATION PLAN (not to scale)

LEGEND & NOTES

CO-ORDINATES SHOWN ARE REFERENCED TO THE NEW BRUNSWICK DOUBLE STEREOGRAPHIC NAD83 MAP PROJECTION.

"STARFIX" SOFTWARE WAS USED FOR ALL NAVIGATION AND POSITIONING AND UTILIZED A WEIGHTED DIFFERENTIAL GPS POSITIONING SOLUTION.

SURVEY WAS PERFORMED BETWEEN OCT 29 AND NOV. 2, 2007.

BATHYMETRY DATA ACQUIRED WITH A RESON 8101 MULTIBEAM SYSTEM OPERATING AT A FREQUENCY OF 240 kHz.

SUN ILLUMINATED IMAGE GENERATED USING THE FOLLOWING PARAMETERS: RESOLUTION = 2m, SUN AZIMUTH = 45°, SUN ELEVATION = 45°, EXAGGERATION = 5x.

SOUNDINGS REDUCED TO CHART DATUM USING CHS OBSERVED TIDAL DATA FOR STATION 065, IN SAINT JOHN HARBOUR.

POSITIONS OF PROPOSED STRUCTURES PROVIDED BY SANDWELL (DWG 143005-8001).

BATHYMETRIC CONTOUR (IN METRES) — 12 —

DIGITIZED SHORELINE (CHS NAVIGATION CHART 4117)

STUDY AREA EXTENTS

100 75 50 25 0 100 200 300 400

Metres

1 : 7500

REV.	DESCRIPTION	BY	DATE
1	AS PER CRN 264	CS	MAR. 20, 08
0	INITIAL SUBMISSION	CS	MAR. 10, 08

CLIENT: Jacques Whitford

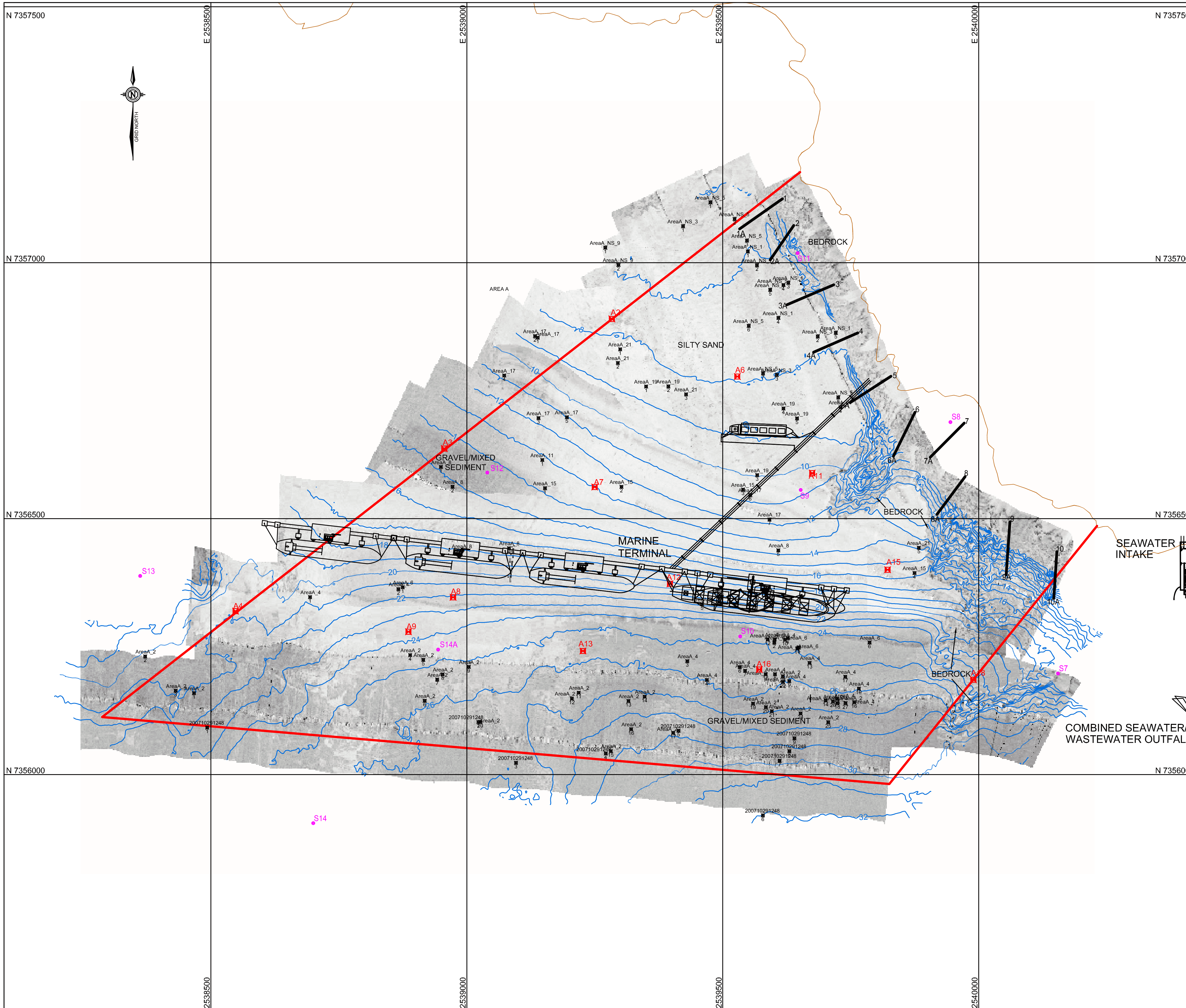
PREPARED BY: Fugro Jacques GeoSurveys Inc.

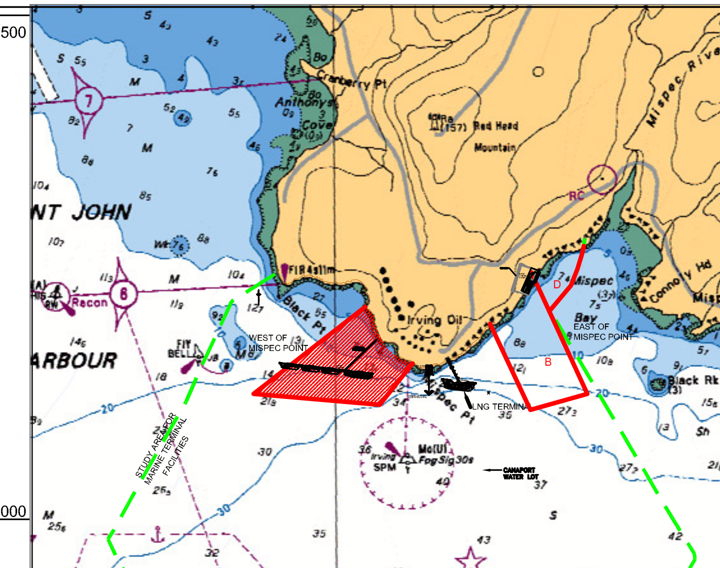
PROJECT: EIDER ROCK MARINE GEOPHYSICAL SURVEY

TITLE: MULTIBEAM BATHYMETRY AREA A - WEST OF MISPEC POINT

DATE : AUGUST 8, 2008 | FJG PROJECT No : 7083DG | REV. 1

DRAWING NO.: 7083DG-001-BTH-WEST-F1-1 | FIGURE 10.4





REGIONAL LOCATION PLAN (not to scale)

LEGEND & NOTES

CO-ORDINATES SHOWN ARE REFERENCED TO THE NEW BRUNSWICK DOUBLE STEREOGRAPHIC NAD83 MAP PROJECTION. "STARFIX" SOFTWARE WAS USED FOR ALL NAVIGATION AND POSITIONING AND UTILIZED A WEIGHTED DIFFERENTIAL GPS POSITIONING SOLUTION.

SURVEY WAS PERFORMED BETWEEN OCT 29 AND NOV. 2, 2007.

BATHYMETRY DATA ACQUIRED WITH A RESON 8101 MULTIBEAM SYSTEM OPERATING AT A FREQUENCY OF 240 kHz. SOUNDINGS REDUCED TO CHART DATUM USING CHS OBSERVED TIDAL DATA FOR STATION 065, IN SAINT JOHN HARBOUR.

SIDE SCAN DATA COLLECTED WITH AN EDGETECH DF-1000 DIGITAL SIDESCAN SONAR OPERATED AT 100 METRE RANGE PER CHANNEL (DEPENDENT ON LINE SPACING). SIDESCAN SONAR SYSTEM OPERATED AT 100kHz AND 500kHz FREQUENCIES SIMULTANEOUSLY (100kHz IMAGERY DISPLAYED HERE).

TOWFISH LAYBACK APPLIED DURING THE MOSAICING PROCESS. MOSAIC RESOLUTION 2m.

POSITIONS OF PROPOSED STRUCTURES PROVIDED BY SANDWELL (DWG 143005-8001).

BATHYMETRIC CONTOUR (IN METRES) — 12

DIGITIZED SHORELINE (CHS NAVIGATION CHART 4117)

STUDY AREA EXTENTS

GRAB SAMPLES (JW) — S8

NEARSHORE VIDEO TRANSECT (JW) — 7A 7

VIDEO SURVEY WAYPOINT (JW) — A6

SONAR CONTACT (LINE NAME AND ID) — AreaA_21 4

100 75 50 25 0 100 200 300 400

Metres
1 : 7500

REV.	DESCRIPTION	BY	DATE
1	AS PER CRN 264	CS	MAR. 20, 08
0	INITIAL SUBMISSION	CS	MAR. 10, 08

CLIENT: Jacques Whitford

PREPARED BY: Fugro Jacques GeoSurveys Inc.

PROJECT

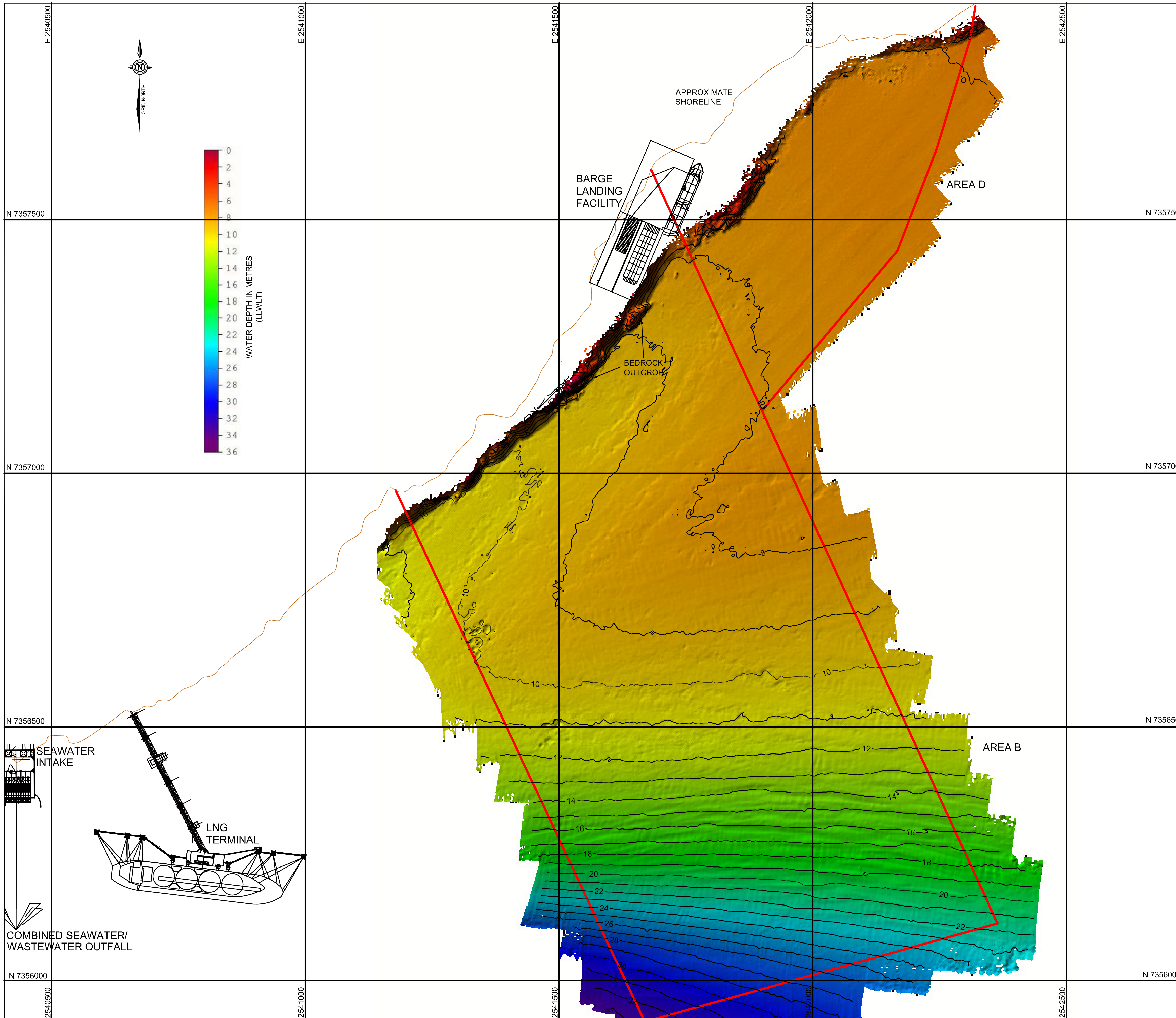
EIDER ROCK MARINE GEOPHYSICAL SURVEY

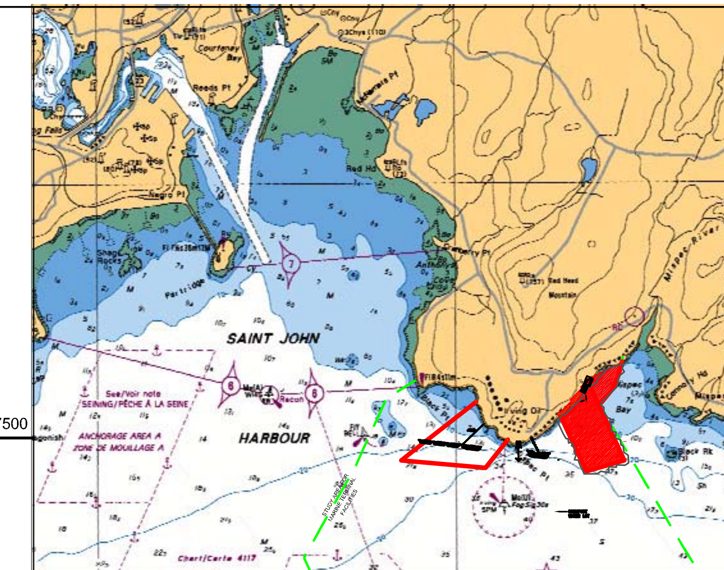
TITLE

SIDE SCAN SONAR MOSAIC AREA A - WEST OF MISPEC POINT

DATE : AUGUST 8, 2008	FJG PROJECT No : 7083DG
DRAWING NO.: 7083DG-001-SSM-WEST-F3-01	FIGURE : 10.5

REV. 1





REGIONAL LOCATION PLAN (not to scale)

LEGEND & NOTES

CO-ORDINATES SHOWN ARE REFERENCED TO THE NEW BRUNSWICK DOUBLE STEREOGRAPHIC NAD83 MAP PROJECTION.

"STARFIX" SOFTWARE WAS USED FOR ALL NAVIGATION AND POSITIONING AND UTILIZED A WEIGHTED DIFFERENTIAL GPS POSITIONING SOLUTION.

SURVEY WAS PERFORMED BETWEEN OCT 29 AND NOV. 2, 2007.

BATHYMETRY DATA ACQUIRED WITH A RESON 8101 MULTIBEAM SYSTEM OPERATING AT A FREQUENCY OF 240 kHz.

SUN ILLUMINATED IMAGE GENERATED USING THE FOLLOWING PARAMETERS: RESOLUTION = 2m, SUN AZIMUTH = 315°, SUN ELEVATION = 45°, EXAGGERATION = 5x.

SOUNDINGS REDUCED TO CHART DATUM USING CHS OBSERVED TIDAL DATA FOR STATION 065, IN SAINT JOHN HARBOUR.

POSITIONS OF PROPOSED STRUCTURES PROVIDED BY FLUOR (DWG A3MB000050001).

BATHYMETRIC CONTOUR (IN METRES) — 12 —

DIGITIZED SHORELINE (CHS NAVIGATION CHART 4117)

STUDY AREA EXTENTS

100 75 50 25 0 100 200 300 400

Metres
1 : 7500

REV.	DESCRIPTION	BY	DATE
1	AS PER CRN 264	CS	MAR. 20, 08
0	INITIAL SUBMISSION	CS	MAR. 10, 08

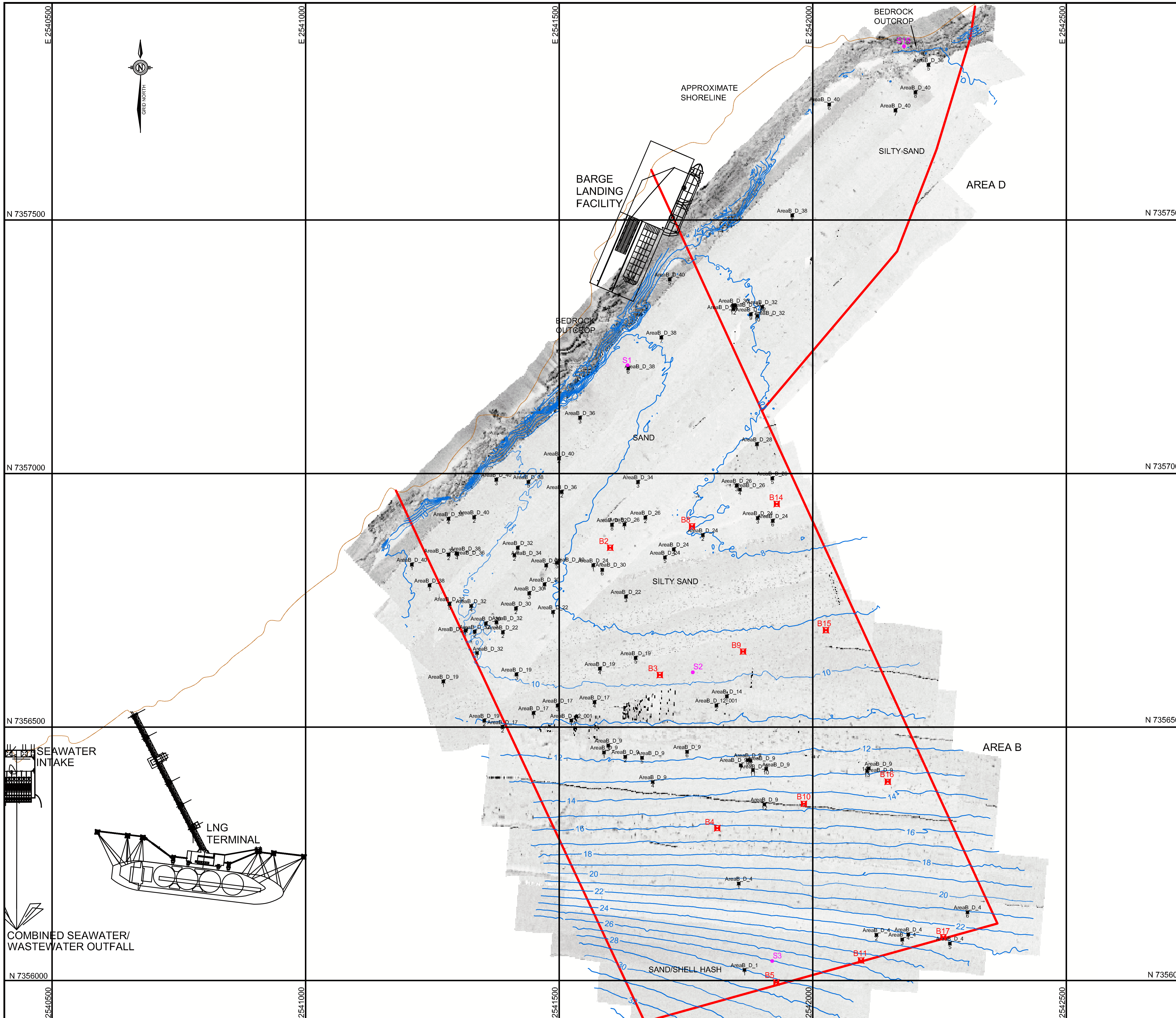
CLIENT: Jacques Whitford

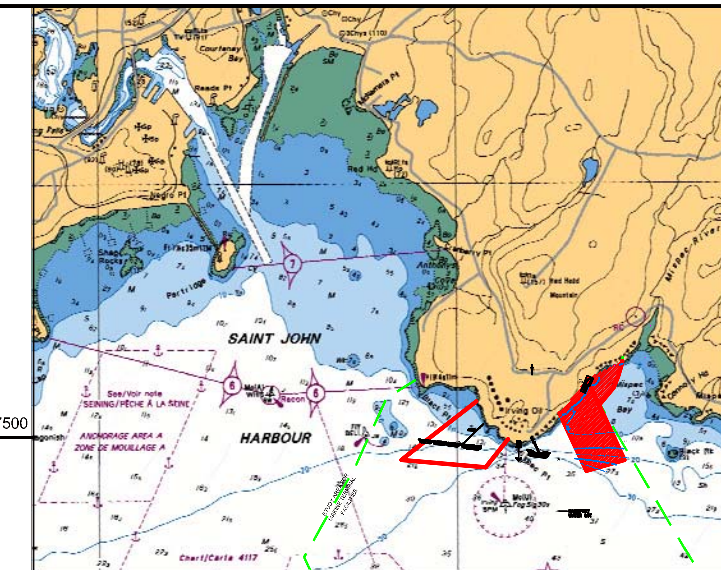
PREPARED BY: Fugro Jacques GeoSurveys Inc.

PROJECT: EIDER ROCK MARINE GEOPHYSICAL SURVEY

TITLE: MULTIBEAM BATHYMETRY AREAS B & D - EAST OF MISPEC POINT

DATE : AUGUST 8, 2008	FJG PROJECT No : 7083DG	REV.
DRAWING NO.: 7083DG-001-BTH-EAST-F6-01	FIGURE : 10.6	1





REGIONAL LOCATION PLAN (not to scale)

LEGEND & NOTES

CO-ORDINATES SHOWN ARE REFERENCED TO THE NEW BRUNSWICK DOUBLE STEREOGRAPHIC NAD83 MAP PROJECTION. "STARFIX" SOFTWARE WAS USED FOR ALL NAVIGATION AND POSITIONING AND UTILIZED A WEIGHTED DIFFERENTIAL GPS POSITIONING SOLUTION.

SURVEY WAS PERFORMED BETWEEN OCT 29 AND NOV. 2, 2007.

BATHYMETRY DATA ACQUIRED WITH A RESON 8101 MULTIBEAM SYSTEM OPERATING AT A FREQUENCY OF 240 kHz. SOUNDINGS REDUCED TO CHART DATUM USING CHS OBSERVED TIDAL DATA FOR STATION 065, IN SAINT JOHN HARBOUR.

SIDE SCAN DATA COLLECTED WITH AN EDGETECH DF-1000 DIGITAL SIDESCAN SONAR OPERATED AT 100 METRE RANGE PER CHANNEL (DEPENDENT ON LINE SPACING). SIDESCAN SONAR SYSTEM OPERATED AT 100kHz AND 500kHz FREQUENCIES SIMULTANEOUSLY (100kHz IMAGERY DISPLAYED HERE).

TOWFISH LAYBACK APPLIED DURING THE MOSAICING PROCESS. MOSAIC RESOLUTION 2m.

POSITIONS OF PROPOSED STRUCTURES PROVIDED BY FLUOR (DWG A3MB000050001).

BATHYMETRIC CONTOUR (IN METRES) — 12

DIGITIZED SHORELINE (CHS NAVIGATION CHART 4117)

STUDY AREA EXTENTS

GRAB SAMPLES (JW) — S1

VIDEO SURVEY WAYPOINT (JW) — B6

SONAR CONTACT (LINE NAME AND ID) — AreaB_D_28 4

100 75 50 25 0 100 200 300 400

Metres
1 : 7500

REV.	DESCRIPTION	BY	DATE
1	AS PER CRN 264	CS	MAR. 20, 08
0	INITIAL SUBMISSION	CS	MAR. 10, 08

CLIENT: Jacques Whitford

PREPARED BY: Fugro Jacques GeoSurveys Inc.

PROJECT: EIDER ROCK MARINE GEOPHYSICAL SURVEY

TITLE: SIDE SCAN SONAR MOSAIC AREAS B & D - EAST OF MISPEC POINT

DATE : AUGUST 8, 2008	FJG PROJECT No : 7083DG	REV. 1
DRAWING NO.: 7083DG-001-SSM-EAST-F8-01	FIGURE : 10.7	

Figure 10.8 Bedrock Shoreline West of the Canaport Facility and Mispec Point near the Marine Terminal

Figure 10.9 Ramped and Irregular Bedrock Shoreline West of Mispec Point at the Canaport Facility

Figure 10.10 Mixed Sediment Beach West of Mispec Point

Figure 10.11 Steep Cliffs to the East of Mispec Point

Stratigraphy and Depth to Bedrock

To assess the thickness of overburden sediment and depth to bedrock, a seismic, or sub-bottom profiling survey in the Marine PDA was carried out in October 2007 (FJGI 2008). Three sub-bottom profiling lines perpendicular to shore and one sub-bottom profiling line parallel to shore at the anticipated location of the marine terminal and jetty as a tie line crossing the three perpendicular lines (for a total of four sub-bottom profiling lines) were conducted for the seismic survey west of Mispec Point. Similarly, four sub-bottom profiling lines were conducted in Mispec Bay (Jacques Whitford 2008m).

Estimated sediment thicknesses are greater overall within the Area B, Mispec Bay region than in Area A, near Deep Cove and west of Mispec Point at the location of the marine terminal. Within survey Area B, shoreface sediments thicken rapidly seaward from the nearshore bedrock zone, reaching a thickness of 10 m about 150 m from shore (Figure 10.12). The thickness of sediment overlying bedrock reaches an estimated maximum of 23 m beneath the shoal area at about 10 m water depth, approximately 500 m from shore.

Sediment thickness measured along the Area A survey lines west of Mispec Point does not exceed 9 m (Figure 10.13). Shoreface sediments thin and thin out against the exposed nearshore bedrock at Mispec Point. Sub-surface sediments within Area A and at the location of the marine terminal are inferred to consist mainly of compact to dense silty sand and sand, with possible gravel, cobbles and boulders with a maximum thickness of approximately 9 m.

10.2.3.3 Physical Oceanography

Tides

Tides from the Atlantic Ocean entering the Gulf of Maine trigger a resonating response in the Bay of Fundy, resulting in a standing wave which produces tidal ranges at its head that are among the largest in the world. The mean tidal range in the Gulf of Maine of approximately 1 m is increased to 12.8 m at the head of the Bay of Fundy. At the head of the Bay the spring tide tidal range increases to 16 m. These extreme ranges can be attributed to the physical dimensions of the Bay, which are those of a quarter-wave resonator with a natural period that is very close to the period of the semi-diurnal tide (Garrett 1972; Godin 1988).

Due to crustal subsidence or rebound from the ice age, the area around Saint John is subsiding at around 23 cm/century. Results from Peltier (2002) demonstrate that amplitude changes are already taking place in the semi-diurnal component (M2) of the tide in the Gulf of Maine-Bay of Fundy-Scotia Shelf region. Analysis from Greenberg *et al.* (2006) demonstrates that the rate of change is greater in areas of higher tidal amplitude. When this is coupled with the anticipated sea level rise that could be due to climate change, the Bay of Fundy tidal response is estimated to result in the high water levels in the vicinity of Saint John increasing by about 0.6 m by 2050, 0.8 m by 2085 and 1 m by 2100, plus or minus about 15% (Greenberg *et. al* 2006). These are half or a third of the values suggested by an earlier publication by Godin (1992).

In their study of conditions at Saint John, Sandwell Engineering Inc. (2007) reported the tidal reference levels about half way along the Bay (relative to the chart datum of 0.0 m) shown in Table 10.2. These figures provide a mean tidal range of 6.49 m, with the largest tide tidal range of 9.08 m being reported for Saint John Harbour. Saint John is one of the primary ports in the Canadian Hydrographic Service's tidal prediction network.

Table 10.2 Characteristics of the Tides in Saint John

Characteristic	Level (in m above chart datum)
Larger tide higher high water level (HHWL)	9
Mean tide higher high water level (MHWL)	7.6
Mean water level (MWL)	4.4
Mean tide lower low water level (MLWL)	1.1
Large tide lower low water level (LLWL)	-0.1

Source: Sandwell Engineering Inc. (2007)

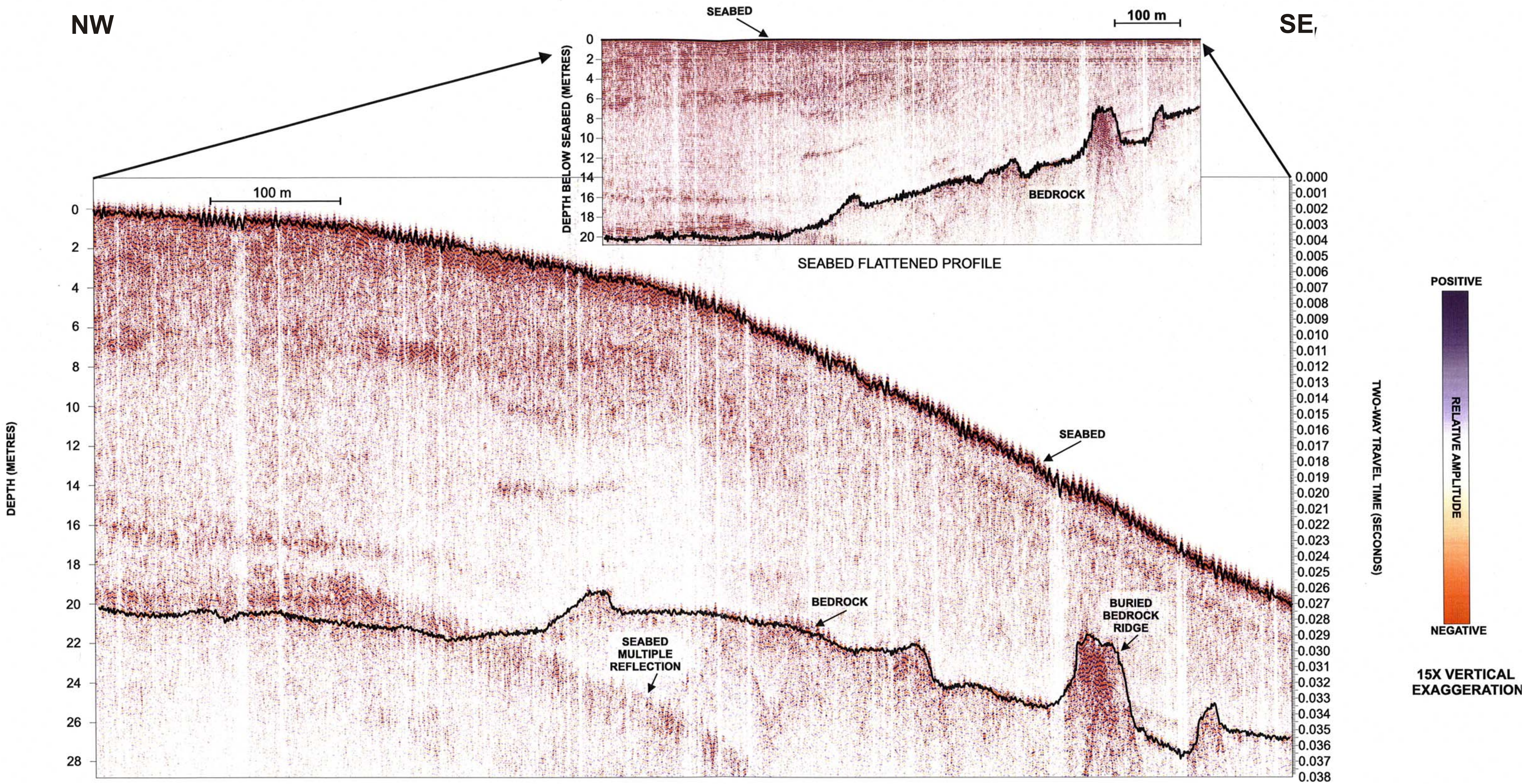


Figure 10.12
Sub-bottom Profile
Line Seistec 006
Survey Area B

Project Eider Rock

Jacques Whitford

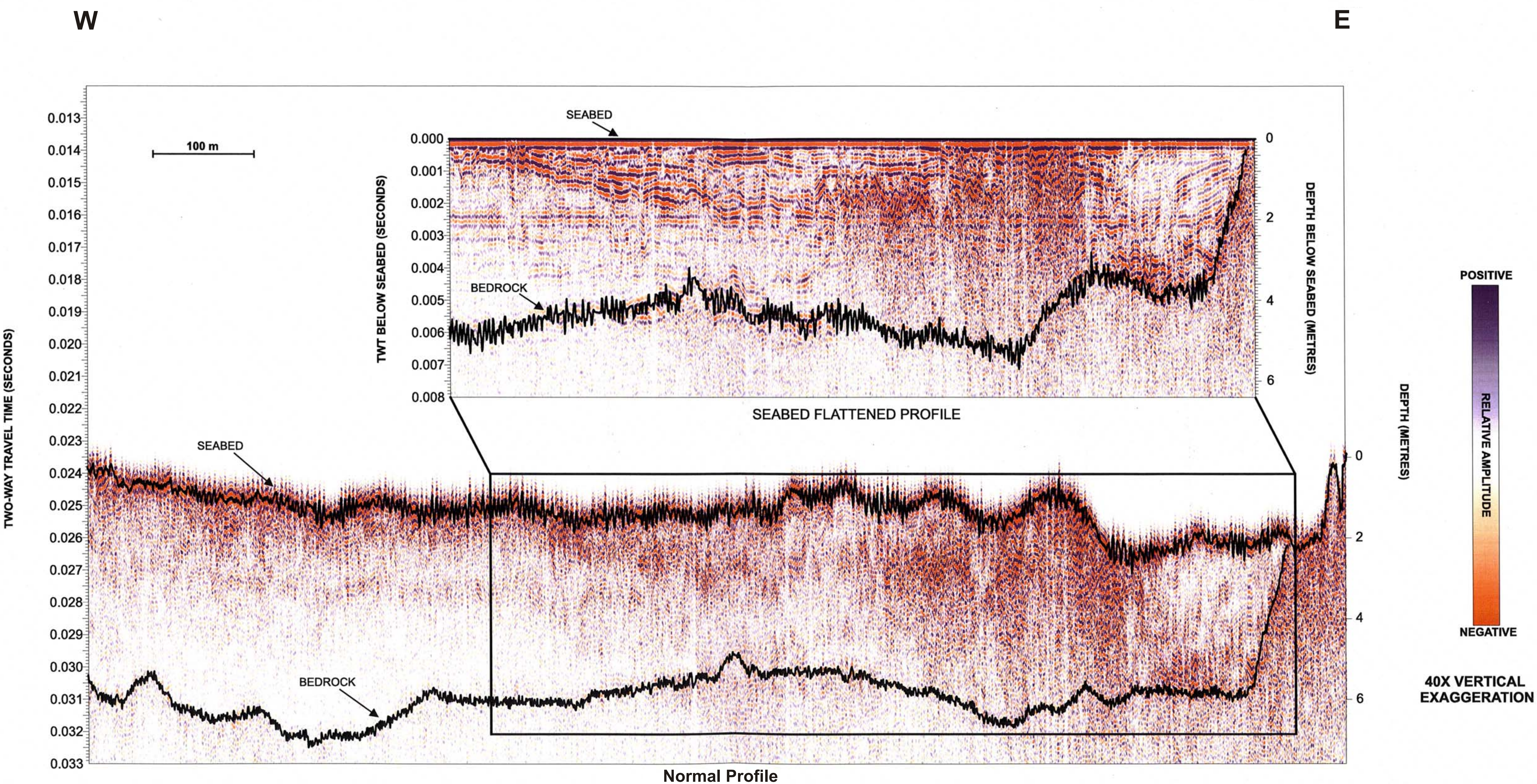


Figure 10.13
Sub-bottom Profile,
Line Seistec 004
Survey Area A

Project Eider Rock

Jacques Whitford

Waves

The headland at Mispec Point is fully exposed to wind and wave action entering the Bay of Fundy from the southwest (at its mouth between Grand Manan Island and Brier Island, Nova Scotia). Neu (1960) obtained data from two wave gauges, one 370 m off Partridge Island, and the other 180 m off the Courtenay Bay breakwater, during the period from November 1959 to February 1960. Analysis determined that waves with periods of 8-9 seconds occurred 19% of the time, and 33% of the waves were higher than 0.3 m. Two percent were higher than 1.5 m, with 2.7 m the highest in the data set. The longest waves had a period of 13 seconds and occurred for 1% of the time. Very little refraction takes place with 8 seconds waves approaching Mispec Point. The longer wavelength (12 seconds) wave causes these waves to refract, and there is a small measurable reduction in wave energy as the wave crest impinges on the headland near the Point. The orbital motion of water particles near the sea bed of these longer period waves can initiate sediment movement for subsequent dispersion by tidal currents. Wave analysis southeast of Mispec Point was carried out by Sandwell Engineering Inc. (2007) (Table 10.3) and provides confirmation of earlier wave analyses.

Table 10.3 Wave Information Southeast of Mispec Point and in the Vicinity of the Canaport LNG Terminal

Return Period	Extreme Significant Wave Heights					
	50 m Off-shore		200 m Off-shore		400 m Off-shore	
(Year)	**HWL (m)**	**LWL (m)**	**HWL (m)**	**LWL (m)**	**HWL (m)**	**LWL (m)**
1	2.9	2.8	3.1	3	3.2	3.1
10	3.9	3.7	4.1	3.9	4.1	4
100	4.6	4.4	5.1	4.7	5.1	4.7
Wave Parameter	**Maximum Wave Heights (50 m off-shore)**					
	100-Year Event			**Annual Event**		
Direction	SE	S	SW	SE	S	SW
H_s (m)	3.6	4.7	3.7	2.3	3	2.4
T_p (s)	6.2	8.3	8.6	5.5	6.4	7.4
H_{max} (m)	6.5	8.5	6.7	4.1	5.4	4.3
Wave Parameter	**Maximum Wave Heights (400 m off-shore)**					
	100-Year Event			**Annual Event**		
Direction	SE	S	SW	SE	S	SW
H_s (m)	3.7	5	4.7	2.4	3.2	2.8
T_p (s)	6.5	7.8	9.3	5.5	6.4	7.4
H_{max} (m)	6.7	9	8.5	4.3	5.8	5

Notes:
H_s = significant wave height (average height (from wave crest to trough) of the one-third highest waves at a location during a wave measurement time period.
T_p = most probable time period of the wave. H_{max} = maximum wave height. Source: After Sandwell Engineering Inc. (2007).

Currents

The Bay of Fundy has a standing wave tidal environment, where currents generated are slack at high and low water and strongest mid-way in between. This is in contrast with the progressive tidal wave moving along an open ocean coast where the maximum horizontal movement occurs at either low water or high water, with negligible movement occurring around the mid-way point (Canadian Tidal Manual 1983).

Saint John is a historical port, and numerous reports document currents and general water circulation in the Bay of Fundy and its numerous inlets. Neu (1960) mentions the presence of a counter-clockwise gyre or rotation of the major residual current that occurs in the Bay of Fundy. Moving inland along the coast of Nova Scotia, this current then flows along the eastern shores, picking up sediment from river outflows and the reddish sediments of the extensive intertidal zones stirred up by wave and tidal action. This sediment-laden stream returns west along the New Brunswick shore. When it reaches a widening of the cross-section past Cape Spencer on the edge of the Outer Harbour, the current velocity suddenly decreases from approximately 1.0 m/s to 0.3 m/s. Sediment, mainly sand, accumulates in the area, under the influence of local currents.

Neu positioned two hydrographic stations off Mispec Point and released several drogues. The results indicated easterly movement during a rising tide and westerly during the ebb. Velocity was relatively uniform throughout the water column during the entire tidal cycle of measurements, with maximum speeds of less than 1 m/s.

Jacques Whitford carried out field measurements of current in the Marine PDA. A downward facing acoustic doppler current profiler (ADCP) was used from a moving vessel to measure current throughout the water column.

A synoptic view of the overall current pattern during a flooding tide in the Marine PDA is presented in Figure 10.14 for the surface water, and in Figure 10.15 for the bottom water. Surface and bottom water circulation patterns are relatively similar. Current generally flows in an easterly direction during a flooding tide, except in Inner Mispec Bay where a counter-clockwise gyre or eddy was observed, with water flowing towards the west in more shallow water and towards the east in water depth greater than 20 m (Figure 10.14). This feature is also noticed west of Mispec Point in Deep Cove but at a smaller scale where direction is towards the northwest in relatively shallow water (<10 m). During an ebbing tide, the current is generally in the west-northwest direction (Figure 10.16). In Mispec Bay, however, the direction of current is different and primarily northeasterly with a much lower velocity of about 0.1 m/s to 0.3 m/s and in contrast to the Outer Harbour. A weak clockwise gyre is evident in Inner Mispec Bay, as well as in Deep Cove during an ebbing tide. These areas represent depositional environments because of the generally weaker current in the gyre, compared to the deeper, more erosive water, especially in the Outer Harbour and west of Mispec Point where the tidal current is more uniform in direction and much stronger.

Major synoptic differences in the current between spring and summer were not apparent, nor between the smaller neap and larger spring tides, except for the higher current velocity associated with a larger spring tide during the flooding and ebbing tidal stages. These were generally in the order of 0.6 m/s to 0.9 m/s for a spring tide compared to approximately 0.3 m/s to 0.7 m/s for a neap tide. During different stages of the tide, and for both a spring and neap tide, current velocity generally decreases during an ebbing tide close to low water and similarly during a flooding tide close to or at high water. During these periods of the tide, current velocity is generally <0.4 m/s and in the order of 0.1 m/s to 0.3 m/s as far as offshore and near the Canaport SBM. In the inshore area, however, current velocity was observed to increase and reaching 0.4 m/s to 0.5 m/s west of Mispec Point in Deep Cove. Furthermore, a clockwise gyre was observed at this location during an ebbing tide approaching low water and which was observed in Inner Mispec Bay but with much weaker current velocity.

Modelled current velocity and directions in the Outer Harbour by NATECH are presented on Figure 10.17. The details for the 2-D hydrodynamic model setup and calibration for the Project are provided in Jacques Whitford (2008m). Eddies in the Mispec area that have been calibrated against the above-noted current measurements collected are observed in Figure 10.17.

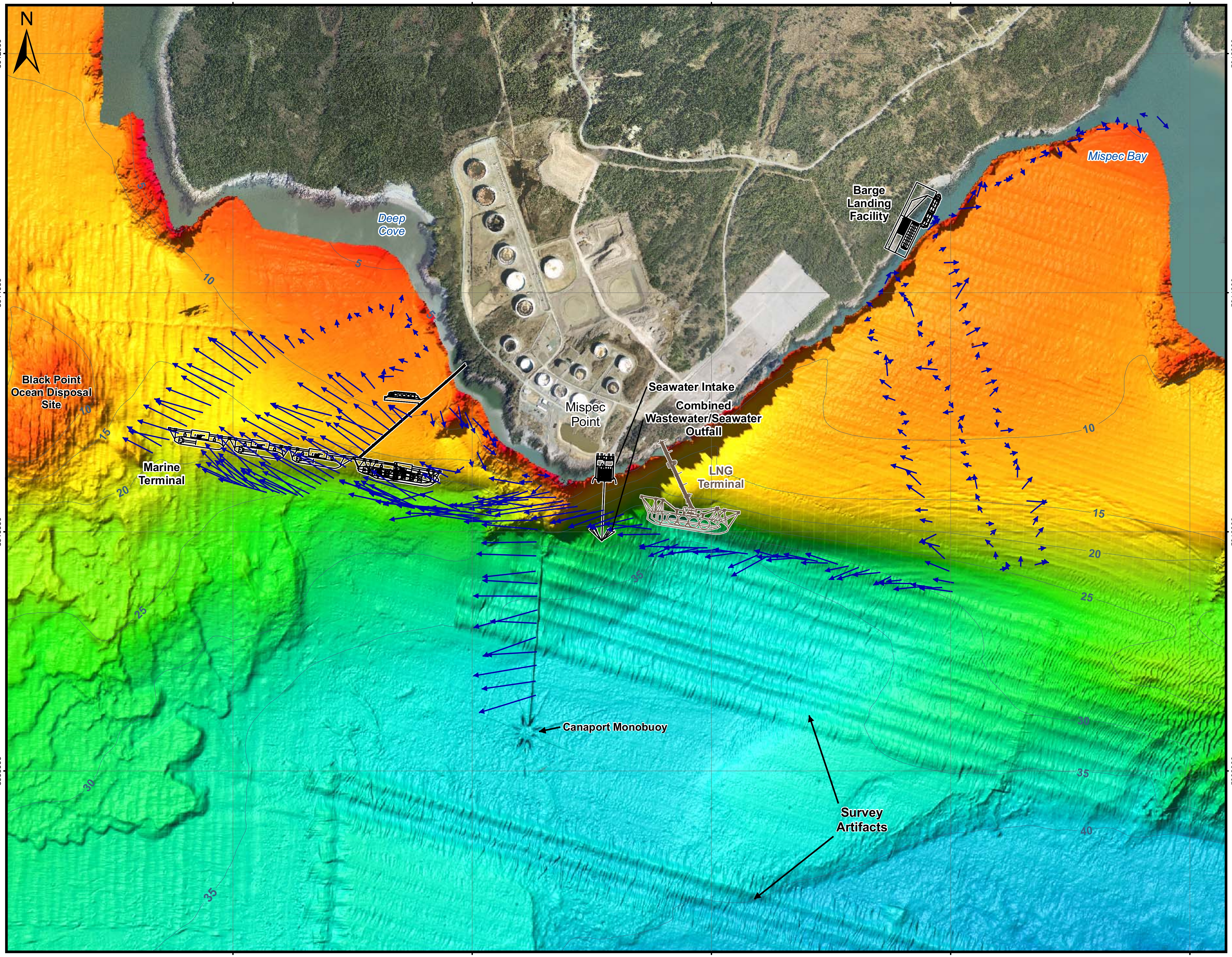


Figure 10.16

Marine Surface Currents: Summer Season Ebbing Spring Tide

Project Eider Rock

Map Features

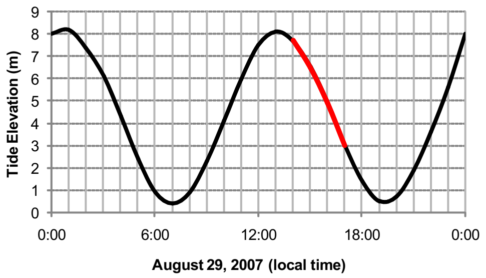
Project Component

Existing Component

10 Bathymetry Contours (m) (After FJGI, 2007)

Current speed (cm/s)

- <10
- 20
- 40
- 60
- 80
- 100



Tidal stage during current measurements with an Acoustic Doppler Current Profiler from a moving vessel

0 100 200 300 400 500

Metres

Map Parameters
Projection: UTM Zone 20, NAD 83
Scale: 1:15,000
Date: August 8, 2008
Project No.: 1013263
Bathymetry Provided By: Fugro Jacques Geosurveys Inc.
2006 Aerial Photography Provided By: City of Saint John, GIS Division

Jacques Whitford

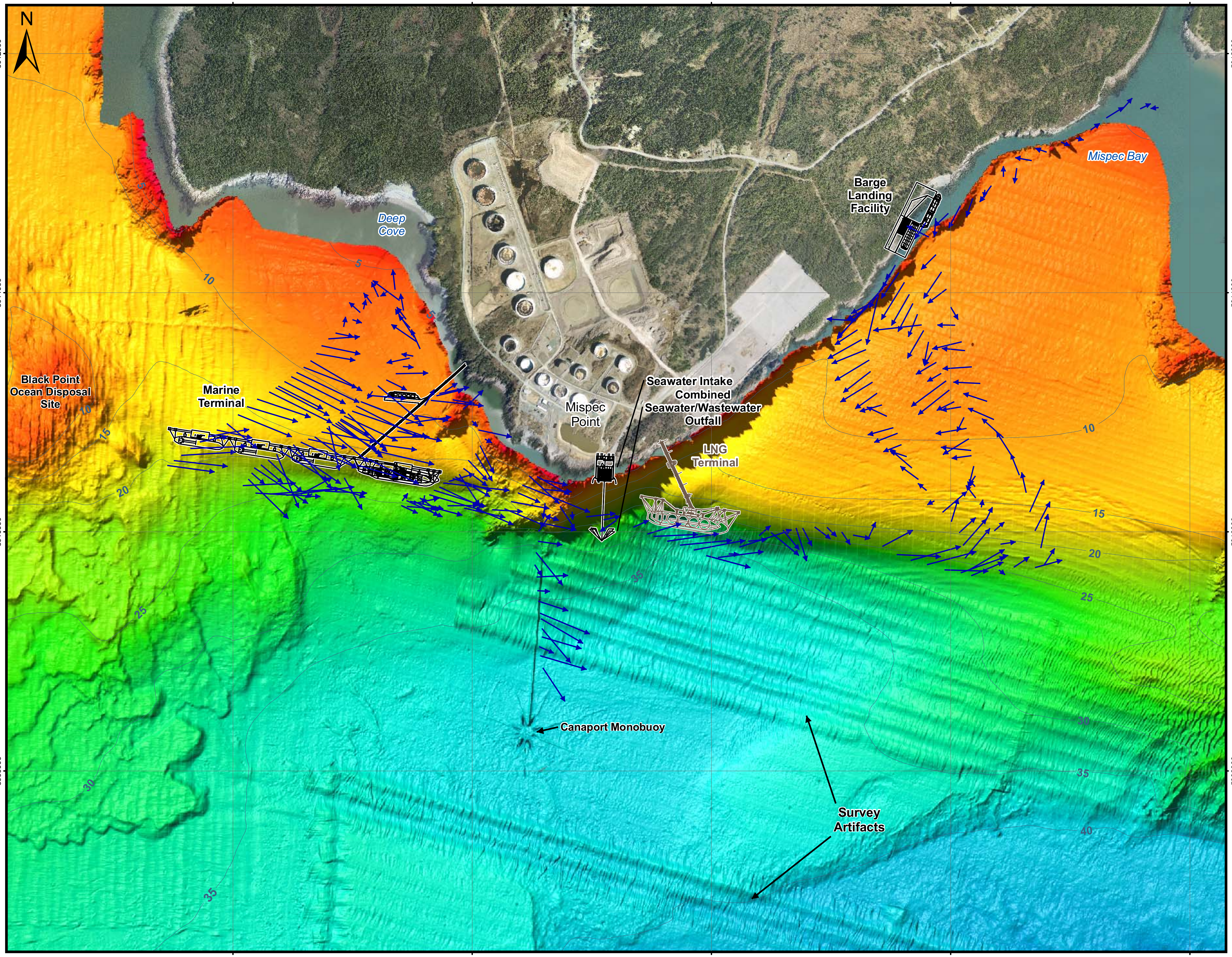


Figure 10.15

Marine Bottom Currents: Summer Season Flooding Spring Tide

Project Eider Rock

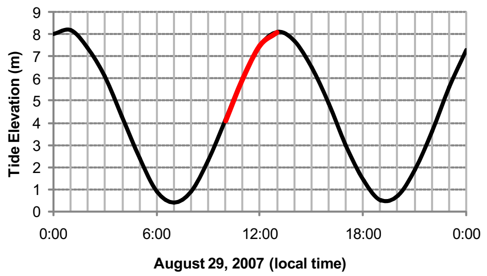
Map Features

Project Component

Existing Component

10 Bathymetry Contours (m)
(After FJGI, 2007)

Current speed (cm/s)
- <10
- 20
- 40
- 60
- 80
- 100



Tidal stage during current measurements with an Acoustic Doppler Current Profiler from a moving vessel

0 100 200 300 400 500
Metres

Map Parameters
Projection: UTM Zone 20, NAD 83
Scale: 1:15,000
Date: August 8, 2008
Project No.: 1013263.
Bathymetry Provided By: Fugro Jacques Geosurveys Inc.
2006 Aerial Photography Provided By: City of Saint John, GIS Division

Jacques Whitford

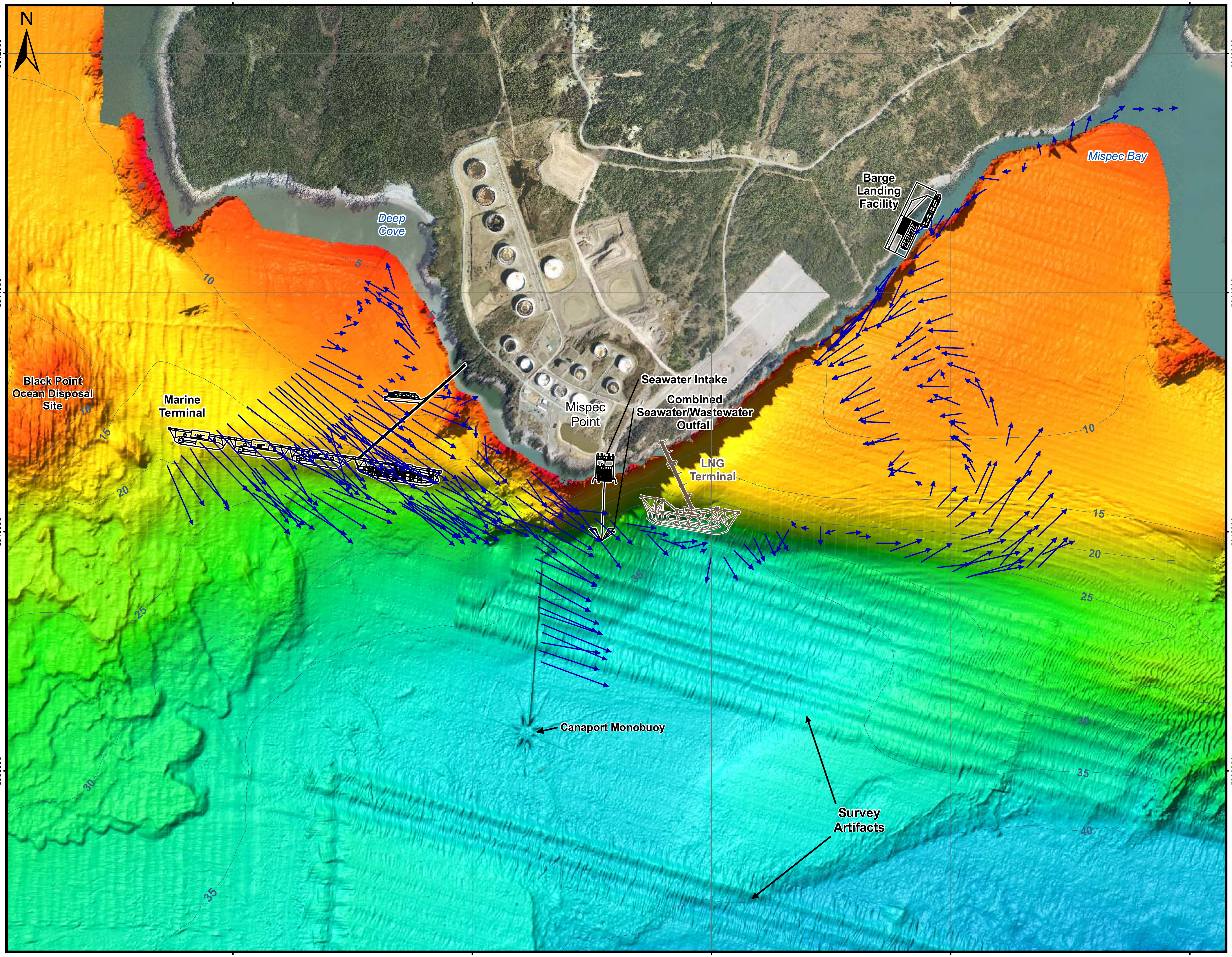


Figure 10.14

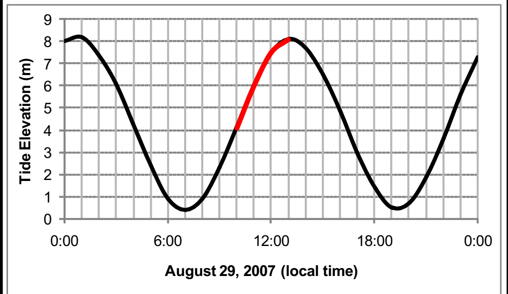
Marine Surface Currents: Summer Season Flooding Spring Tide

Project Eider Rock

Map Features

Project Component
Existing Component
10 Bathymetry Contours (m)
(After FJGI, 2007)

Current speed (cm/s)
<10
20
40
60
80
100
120

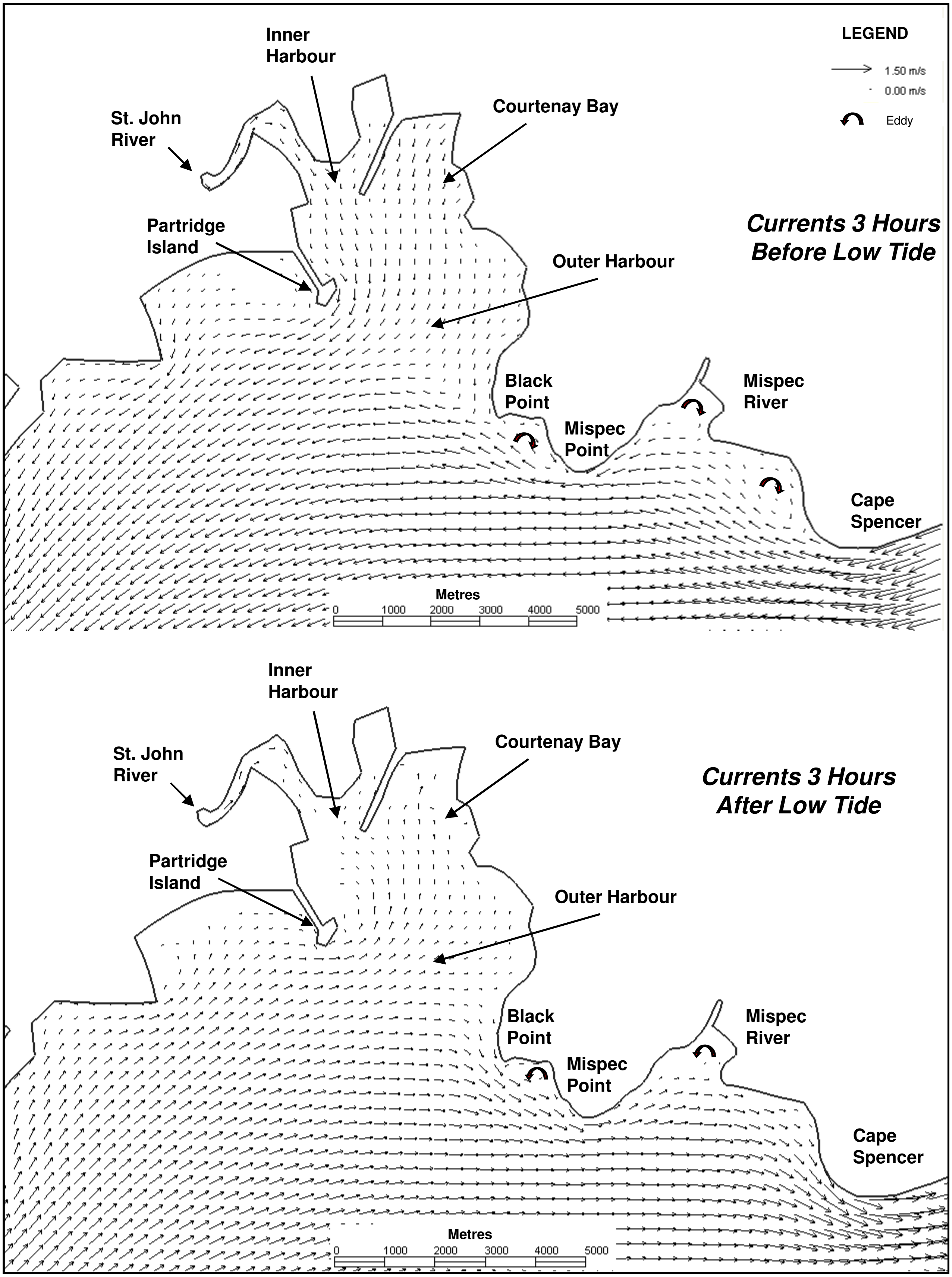


Tidal stage during current measurements with an Acoustic Doppler Current Profiler from a moving vessel

0 100 200 300 400 500
Metres

Map Parameters
Projection: UTM Zone 20, NAD 83
Scale: 1:15,000
Date: August 8, 2008
Project No.: 1013263
Bathymetry Provided By: Fugro Jacques Geosurveys Inc.
2006 Aerial Photography Provided By: City of Saint John, GIS Division

Jacques Whitford



Date: February 22, 2008
Project No: 1013263
After NATECH (2008)

Figure 10.17
NATECH Model of Simulated Currents for the Saint John Harbour

Project Eider Rock

Jacques Whitford

The “Webtide” model from Fisheries and Oceans Canada (2008) demonstrates the anticlockwise gyre in the Bay of Fundy. It has similar circulation patterns in the Outer Harbour, as does the NATECH model. The volume of water required to fill the Outer Harbour and the Saint John River system is small in comparison to the volume circulating east and west in the Bay of Fundy during ebb and flood tides. Why current predominantly flows east and west near Mispec Point and in part of the Outer Harbour is explained by this. While current near Cape Spencer approach 2 m/s, the strongest current in the Outer Bay generally does not often exceed 1 m/s.

In 1996, the Geological Survey of Canada placed bottom mounted current meters down gradient of the Black Point dredge spoil disposal site. Peak current observed within 0.5 m of the bottom was 0.5 m/s to 0.6 m/s, predominantly in an east-west direction (Parrott *et al.* 2002).

Storm Surges

Parkes *et al.* (1997) found that storm surges above 0.6 m in height occur about two to three times per year along the Canadian Atlantic coast. Typically, surges were found to last for an average of 2.2 hours, and occasionally over 12 hours. At Saint John, where the vertical difference between the average high water level and the extreme high water level is in the order of 2.3 m, the risk from storm surge flooding is much less than in areas with lower tidal amplitude.

The two most important storm surges on record happened close to the occurrence of tidal high water and caused considerable damage throughout the Bay of Fundy. The Groundhog Day storm in 1976 caused a surge estimated at 1.6 m. The famous Saxby Gale of 1896 is estimated to have created a storm surge between 1.2 m and 2.1 m. Scientists predict that the frequency and magnitude of storm surges are forecast to increase with climate change. Dynamic tidal information and predictions for the area are available from Fisheries and Oceans Canada (2008).

For additional details on fog, wind, sea spray, and other weather phenomena in the region, the reader is referred to Chapter 15.

Ice

Saint John is viewed as a year-round ice-free Port. Mispec Point and most of Mispec Bay are also ice-free during the winter. In very cold winters, chunks of ice up to 5 m in diameter and 2 m thick can be found floating in the Outer Harbour area (J. McCann, personal communication, February 24, 2008). Some of these ice features originate as shore fast ice in intertidal zones locally, some come from the Saint John River, and some are brought down from the more landward areas of the Bay of Fundy. The heaviest chunks are hazardous to small boats, and can create damage when winter storm waves throw them at structures.

Water Mass Characteristics

A specific seasonal water sampling program was undertaken by Jacques Whitford during late 2006 and most of 2007 to acquire a year’s worth of data in the Marine PDA. This investigation was undertaken to characterize baseline conditions at a number of water sampling stations (Figure 10.2) and the variability of temporal and spatial vertical profiles for temperature, salinity, turbidity, dissolved oxygen (DO) and pH throughout the Marine PDA. In addition, the collected data are intended to confirm and supplement historically available information.

Temperature

Considerable changes occur in water temperature between summer and winter. A change from just above 9°C down to 1.5°C between December and late March was measured. During winter, the temperature difference between the freshwater inflow and the coastal water is very small.

As seen in Figure 10.18 water temperature results from the 2006-2007 Jacques Whitford sampling regime show a relatively homogeneous and well-mixed water column during the fall and winter. Water temperatures vary, but were between 7°C and 9°C in December and between 1°C and 2.5°C in April. The water profile for spring and summer show the establishment of a temperature gradient, or thermocline, with warmer temperatures of up to 15°C measured within the top 1 m of the water column in summer. On average, the surface water temperatures from the Outer Harbour (red lines, Figure 10.18) are warmer than those found in Inner Mispec Bay (blue lines, Figure 10.18). There is still a slight thermocline present in summer, especially within the Outer Harbour. Overall, temperatures ranged from 1°C in winter to 16°C in summer, which is within the range of historical data.

Salinity

Salinity is largely influenced by freshwater flow from rivers. The Saint John River is the dominating river that exerts an influence on salinity in the marine environment near the Marine PDA. The Saint John River, the largest river in the Maritimes, has a drainage basin of 55,000 km^2 (NATECH 2008b). It flows through the State of Maine, Québec, and New Brunswick. The average river flow as measured near the tidal limit at Fredericton is 810 m^3/s. With the inclusion of the Kennebecasis River and other tributaries entering upstream of the Reversing Falls, the estimated average annual discharge from the Saint John River into the Outer Harbour and in the Bay of Fundy is 1,100 m^3/s. This flow at the Reversing Falls is prorated from the flow at the Mactaquac dam gauging station. The freshwater discharge varies considerably during the year with the peak flows occurring during the spring snow melt (3,400 m^3/s on average in April). The highest flow recorded for April is 6,000 m^3/s. At these high flows, the river water plume can be visible well out into the Bay of Fundy, creating substantive stratification at the surface in the Outer Harbour. The vertical density stratification due to the presence of less dense freshwater extends on occasion to the vicinity of Mispec Point (discussed below).

Mispec River enters Mispec Bay on the east side of Mispec Point. It has a mean annual discharge estimated at 1.5 m^3/s. The upper part of the Mispec River watershed drains into Loch Lomond, which is used as a potable water reservoir by the City of Saint John and has very little overflow in the summer. Much smaller rivers (Bean Brook and Anthonys Brook) drain into Anthonys Cove in the Outer Harbour, but their flows are negligible compared to that of the Saint John River or the Mispec River.

From an oceanographic viewpoint, the Outer Harbour can be viewed as part of the estuary of the Saint John River. During average and lower river discharges, the high tidal energy of the area mixes the freshwater of the river system with the coastal waters of the Bay of Fundy. Typically, substantial vertical water mixing occurred seaward of Partridge Island.

The salinity of the bottom coastal water near Mispec Point has been reported by various authors (Neu 1960; Hughes-Clark 2003; ECL 2003; University of Maine 2003). The values given vary between 29 and 32.5 parts per thousand (ppt) depending on the tidal stage and season of the year. At the same time, when low river discharge has been reported or confirmed, the surface salinity is typically within 1 ppt of the bottom waters.

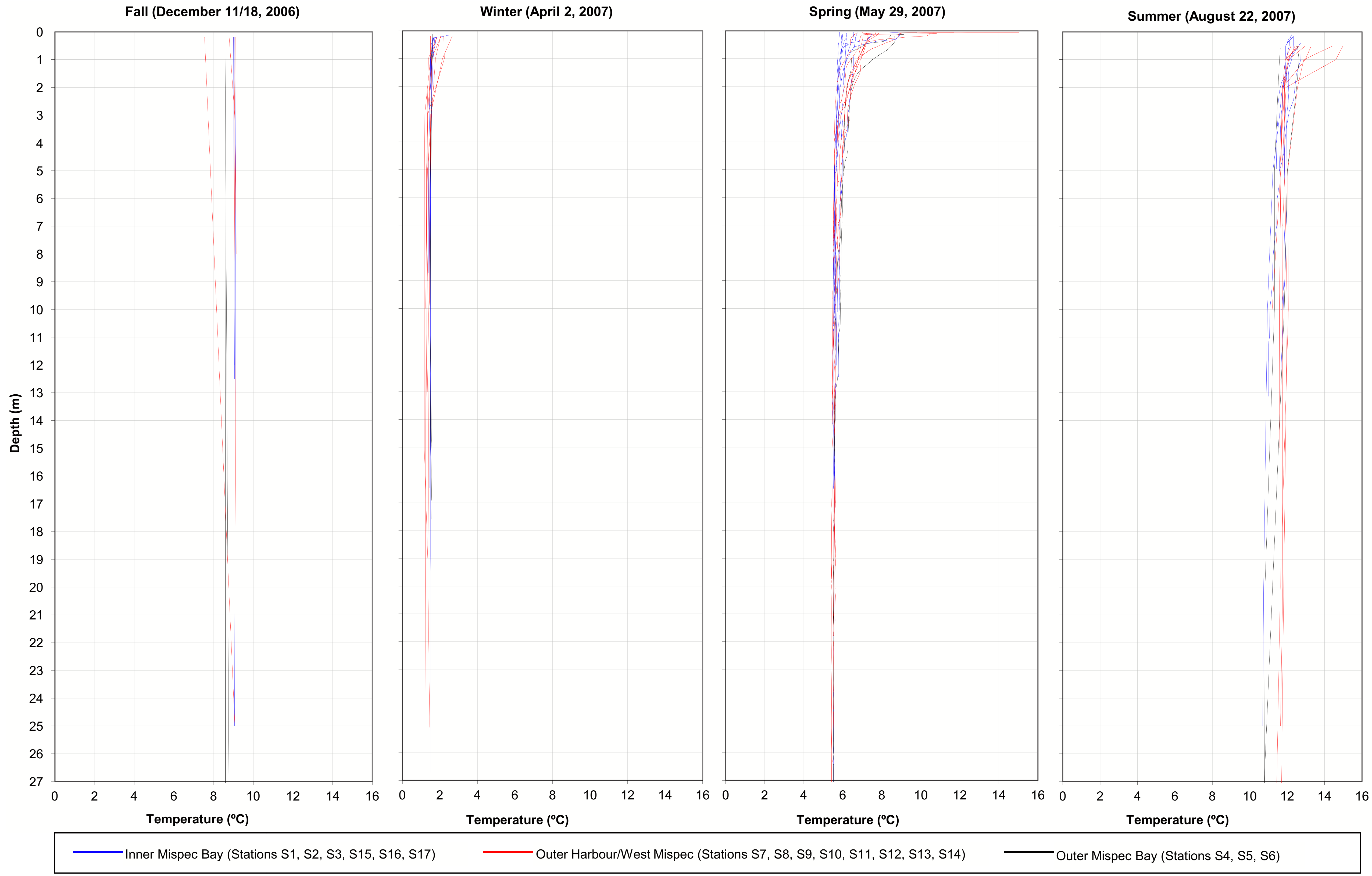


Figure 10.18: Seasonal Profiles for Temperature (ºC) at Various Locations (Refer to Figure 10.2 for Station Locations)

Project Eider Rock

Jacques Whitford

Fall and spring sampling carried out by Jacques Whitford near Mispec Point in 2006-2007 showed salinities at the water surface to the west of Mispec Point to be slightly lower than those to the east in Mispec Bay, particularly on the rising tide. During winter sampling, salinity values around 33 ppt were measured between 3 m and 10 m water depth from the shore in Mispec Bay during the falling tide, which indicates that higher salinity water is penetrating into the Bay from the ebbing tide coming around Cape Spencer. Salinity measurements taken by Jacques Whitford during the 2006-2007 water sampling regime presented a similar pattern to water temperature during the fall (Figure 10.19); the water column is relatively homogenous or well mixed, with salinity ranging between 28 and 33 ppt within the top 30 cm. However, in April and in August, a noticeable pycnocline (salinity stratification) was observed with lower salinity occurring in the top 1 m of the water column. These results suggest that the chemical water gradient establishes itself prior to the temperature gradient.

Turbidity

Turbidity is not anticipated to be a problem for sea bed biological communities throughout the Outer Bay (ECL 2003). The sea bed biological communities present are normally exposed to high natural suspended sediment regimes in the Bay of Fundy, and the periodic elevated suspension caused by wave and current action.

Sampling conducted by Jacques Whitford in 2006-2007 showed relatively homogeneous turbidity throughout the water column in the spring (0 to 5 NTU) and summer (between 16 and 22 NTU), except in the Inner Mispec Bay where highly turbid strata were present close to the sea bed (Figure 10.20). The latter may be caused by the current eddy that was noted earlier in Mispec Bay, more fine-grained sea bed sediment that can easily be placed into re-suspension, and/or because of the proximity to the Mispec River.

Fall and winter turbidity levels tended to be less uniform throughout the water column, probably due to fall and winter storms.

Dissolved Oxygen (DO)

Dissolved oxygen (DO) measurements of the water column were undertaken during the 2006-2007 Jacques Whitford field studies. In the fall, some surface water DO was slightly above saturation, and bottom water DO was slightly below saturation (Figure 10.21). During the March-April winter sampling period, the saturation occasionally dropped close to 80% (9 mg/L) near the sea bed, particularly near the Black Point ocean disposal site. For the most part, however, DO saturation percentages were at least 90% or greater. The marine waters in and around the Marine PDA appear to be well oxygenated along the entire water column and for each season (Figure 10.21); DO varies from 80% (9 mg/L) to well over 160% (16 mg/L) throughout the year. DO values in the Marine PDA are well over the acceptable Canadian Council of Ministers of the Environment (CCME) *Water Quality Guidelines for the Protection of Aquatic Life, Marine Environment* of >8 mg/L (CCME 2007b).

pH

Jacques Whitford measured pH values close to 8 throughout the water column for all sampling stations in the Marine PDA and at a wide range of turbidities. It is characteristic for pH to be very stable in seawater, which is attributable to the calcium carbonate in seawater that acts as a pH buffer.

Variation of Water Characteristics over a Tidal Cycle

The variation of water characteristics over a tidal cycle was measured by Jacques Whitford in 2007. The correlation between temperature, salinity and turbidity during the larger spring tides and smaller neap tides in the spring and summer seasons for the Outer Harbour (West Mispec) and in Inner Mispec Bay were determined.

The influence of the Saint John River during the peak of the freshet in spring (May) for a neap tide is noticeable in the Outer Harbour. This appears as a relatively narrow layer from the surface down to a depth of about 1 m for both temperature and salinity and which is slightly thicker at low tide. This less salty and warmer surface layer in the spring, however, is not visible in Mispec Bay. During a larger spring tide, which was measured in June and after the freshet, the influence of the Saint John River is still detected at low tide but it has diminished substantially.

In the summer and only at low tide, a much thinner and less salty layer indicating the influence of the Saint John River is still noticeable in the Outer Harbour floating at the top of an otherwise homogeneous water column, but again not in Mispec Bay. Temperature is uniform throughout the water column and similar between the Outer Harbour and Mispec Bay for both spring and neap tide cycles.

Contrary to salinity and temperature, the factor that most influences turbidity for the water mass in the Marine PDA is the tide. As seen in Figure 10.22, turbidity follows the tidal cycle; it is high at rising and falling tides and is somewhat low at slack tides. This pattern occurs as a result of sea bed disturbance when the tides are rising and falling and because of stronger current during these tidal stages that stir up bottom sediment.

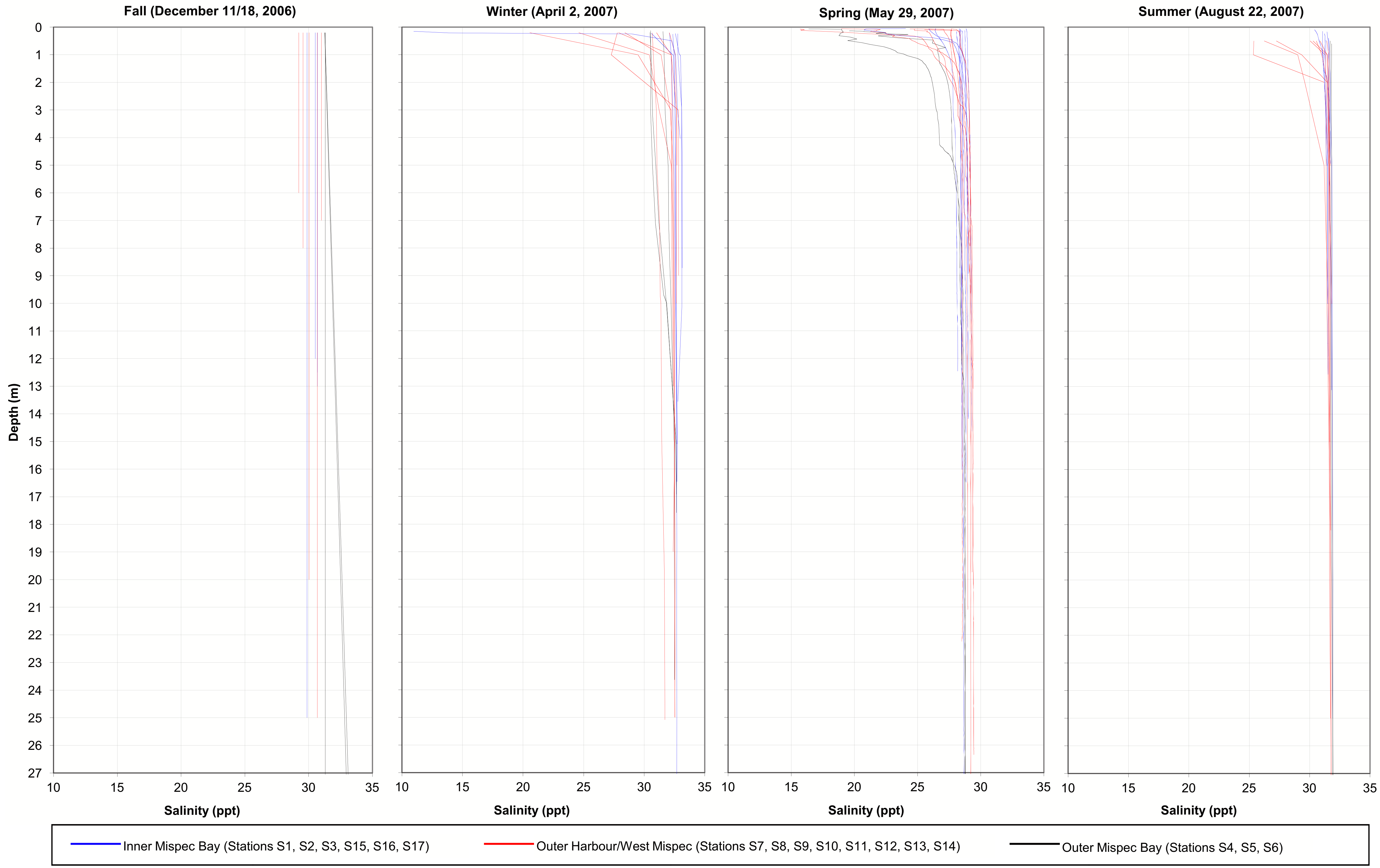
Underwater Acoustic Environment in the Bay of Fundy

Sound is mechanical (acoustic) energy that propagates through matter as a wave. It creates a series of alternating compressions and rarefactions in the medium, which can be expressed as local deviations in pressure (or shear stress for transverse waves in solids) from equilibrium. Liquids (*e.g.,* water) and gases (*e.g.,* air) support only longitudinal waves, also called compression waves. Solids (*e.g.,* bedrock or steel) support both longitudinal and transverse waves. Acoustic energy can be transferred from longitudinal to transverse waves and vice versa at medium interfaces.

Sound waves are characterized by their frequency, amplitude and velocity. Velocity includes speed and direction. Industrial sounds are generally broadband, meaning that acoustic waves of a series of frequencies are superposed. Acoustic energy is the sum of the potential energy of the displacement of the particles of the medium and the kinetic energy of the oscillations of the particles of the medium.

The sound pressure level (SPL) is defined as a logarithmic ratio of the acoustic pressure (p) to a reference pressure (p_{ref}). Under water, the reference pressure is p_{ref} = 1 microPascal (µPa). The unit of the SPL becomes dB re 1 µPa (read as decibels in reference to 1 microPascal). Source levels are sound pressure levels at 1 m range from the source: SL [dB re 1 µPa @ 1 m].

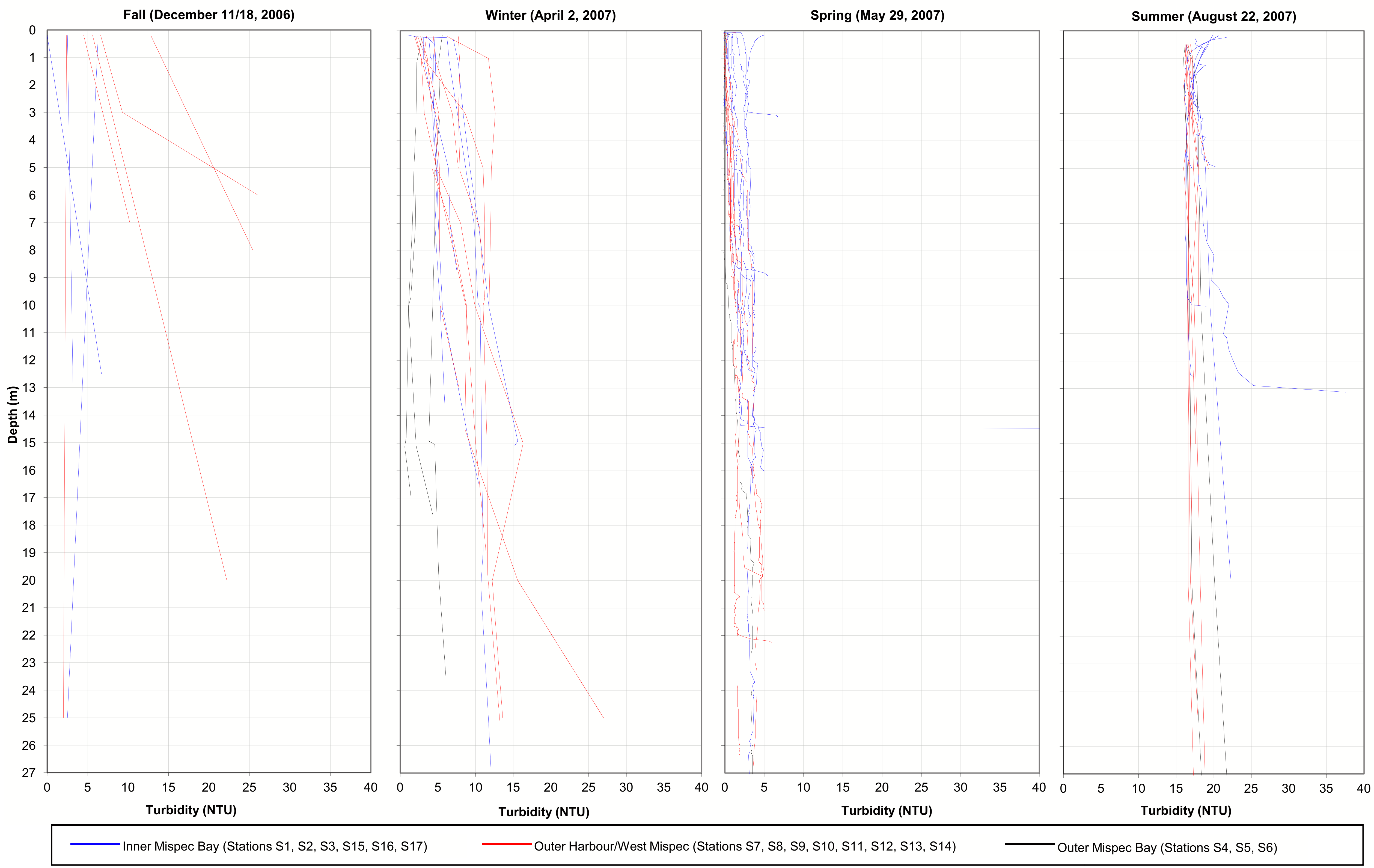
Sound underwater is measured with hydrophones, which are pressure sensors. The result is a recorded time series of pressure p(t). Acousticians distinguish between continuous sound and transient (impulsive) sound. Ships and dredges emit continuous sound. Sound pressure levels of continuous sound are usually mean levels (most commonly root-mean-squared, rms) over a period of time.



Project Eider Rock

Figure 10.19: Seasonal Profiles for Salinity (ppt) at Various Locations (Refer to Figure 10.2 for Station Locations)

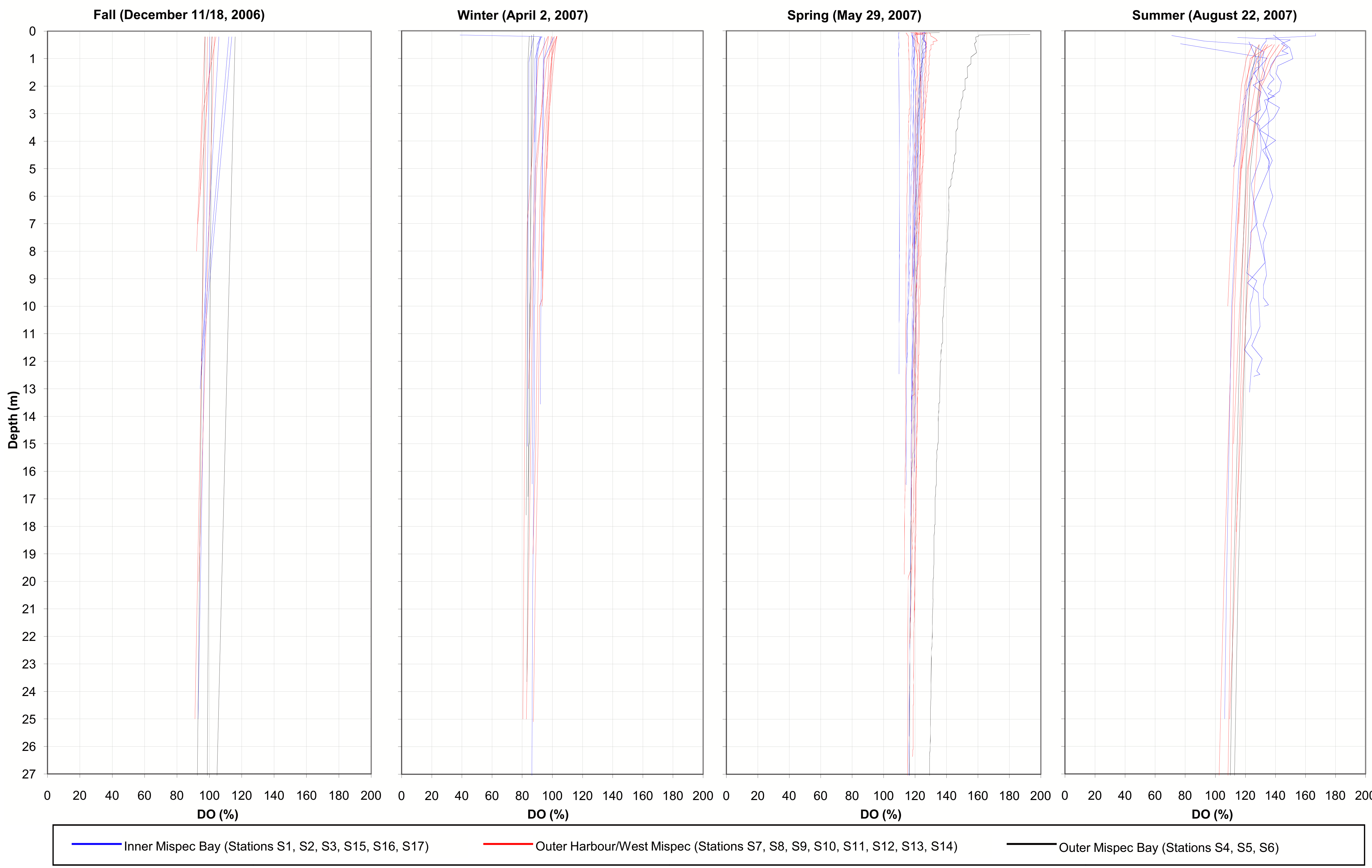
Jacques Whitford



Project Eider Rock

Figure 10.20: Seasonal Profiles for Turbidity (NTU) at Various Locations (Refer to Figure 10.2 for Station Locations)

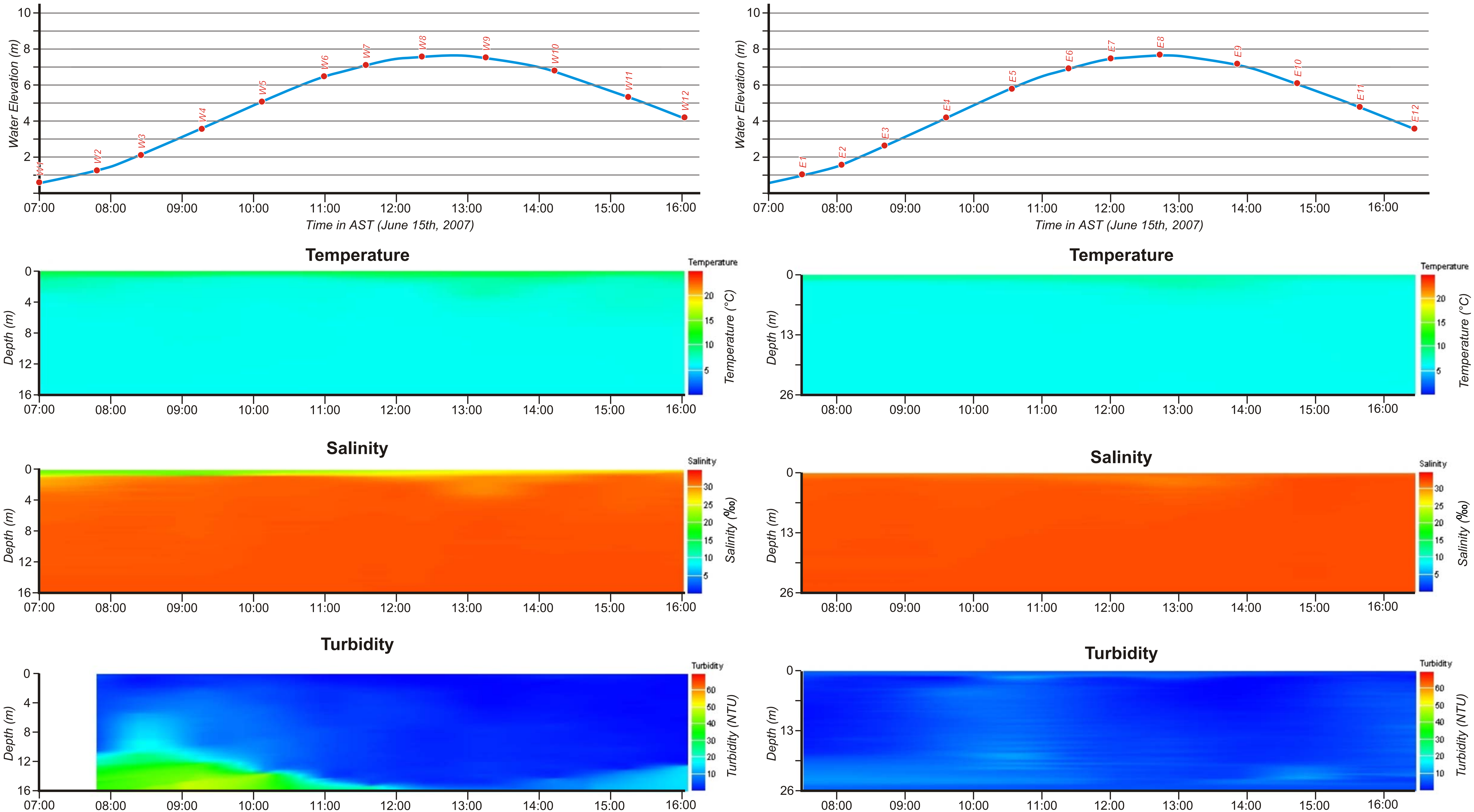
Jacques Whitford



Project Eider Rock

Figure 10.21: Seasonal Profiles for Dissolved Oxygen (%) at Various Locations (Refer to Figure 10.2 for Station Locations)

Jacques Whitford



Outer Harbour, West Mispec
(Station S12)

Inner Mispec Bay
(Station S2)

Project Eider Rock

Jacques Whitford

Figure 10.22 Correlation between Temperature, Salinity and Turbidity during a Spring Tide Cycle in Spring 2007
(Refer to Figure 13.2 for Station Locations)

Explosions and pile driving cause impulsive pressure time series. The characteristics of this sound should be measured only over the duration of the pulse. Impulsive disturbances relax towards equilibrium in a hyperbolic manner, making it difficult to define the end of a pulse. Therefore, pulse duration is defined as the period over which 90% of the acoustic energy is received. In other words, on a cumulative energy plot, the onset of the pulse is defined as the 5% cumulative energy point and the end of the pulse is defined as the 95% cumulative energy point.

The pressure time series recorded from an impulsive event such as an underwater explosion or pile driving has the following general shape. Pressure rises rapidly to a positive peak, then drops below zero to a negative peak, and then follows a damped oscillation towards zero.

Sound propagates well underwater; it propagates even better through the ground, and less efficiently through the air. Basically, any equipment operating underwater, above water or on-shore has the potential to transmit acoustic energy into the marine environment. Generally speaking, ignoring any physical barriers between source and receptor that may attenuate sound levels, the louder the source level, the farther the noise will travel. Obviously, small motors and hand-held tools are much quieter than large equipment, vessels and vehicles. The analysis focuses on loud continuous noise (*e.g.,* vessels, dredges) and impulsive noise (*e.g.,* pile driving).

Ambient Underwater Sound Levels in the Bay of Fundy

The predominant source of anthropogenic underwater sound in the Bay of Fundy marine environment is commercial shipping (Desharnais *et al*. 2000; Hildebrand 2003). The majority of sound produced by an operating marine vessel is generated by propeller cavitation, the creation and collapse of high-pressure voids or bubbles (Ross 1987). Propulsion machinery and hydraulic flow over the hull also generate vessel noise (Hildebrand 2003). In general, the source level of vessel noise increases with vessel size, speed, propeller blade size, number of blades, and rotations per minute (Ross 1976; Gray and Greeley 1980; Scrimger and Heitmeyer 1991; Richardson et al. 1995; Hamson 1997). Source levels for individual ships range from 140 dB re 1 µPa @ 1 m for small fishing vessels, to 195 dB re 1 µPa @ 1 m for fast moving supertankers (Hildebrand 2003; JASCO Research 2008). Most acoustic energy of vessel sound is concentrated at low frequencies (<1,000 Hz). Additional sources of anthropogenic sound in the Bay of Fundy are construction activities (marine- and shore-based), ship-mounted sonars, and acoustic harassment devices.

Desharnais *et al*. (2000) measured ambient sound levels in the Bay of Fundy. On a calm day with light wind, under sea state 1 conditions, they measured 81-93 dB re 1 $\mu Pa^2/Hz$ @ 100 Hz and 75-80 dB re 1 $\mu Pa^2/Hz$ @ 500 Hz. The major source of ambient sound was shipping. The levels reported are very high and might have been biased by the hydrophone locations; sonobuoys were deployed in and near the major shipping lane as well as in the whale-watching region. In the US, various projects are underway to estimate the contribution of shipping to ocean ambient sound in a number of locations. Massachusetts Bay is a heavily trafficked bay, busier than the Bay of Fundy. Ambient sound levels in and near the shipping lanes of the Marine PDA are close to the upper levels reported by Desharnais *et al*. (2000).

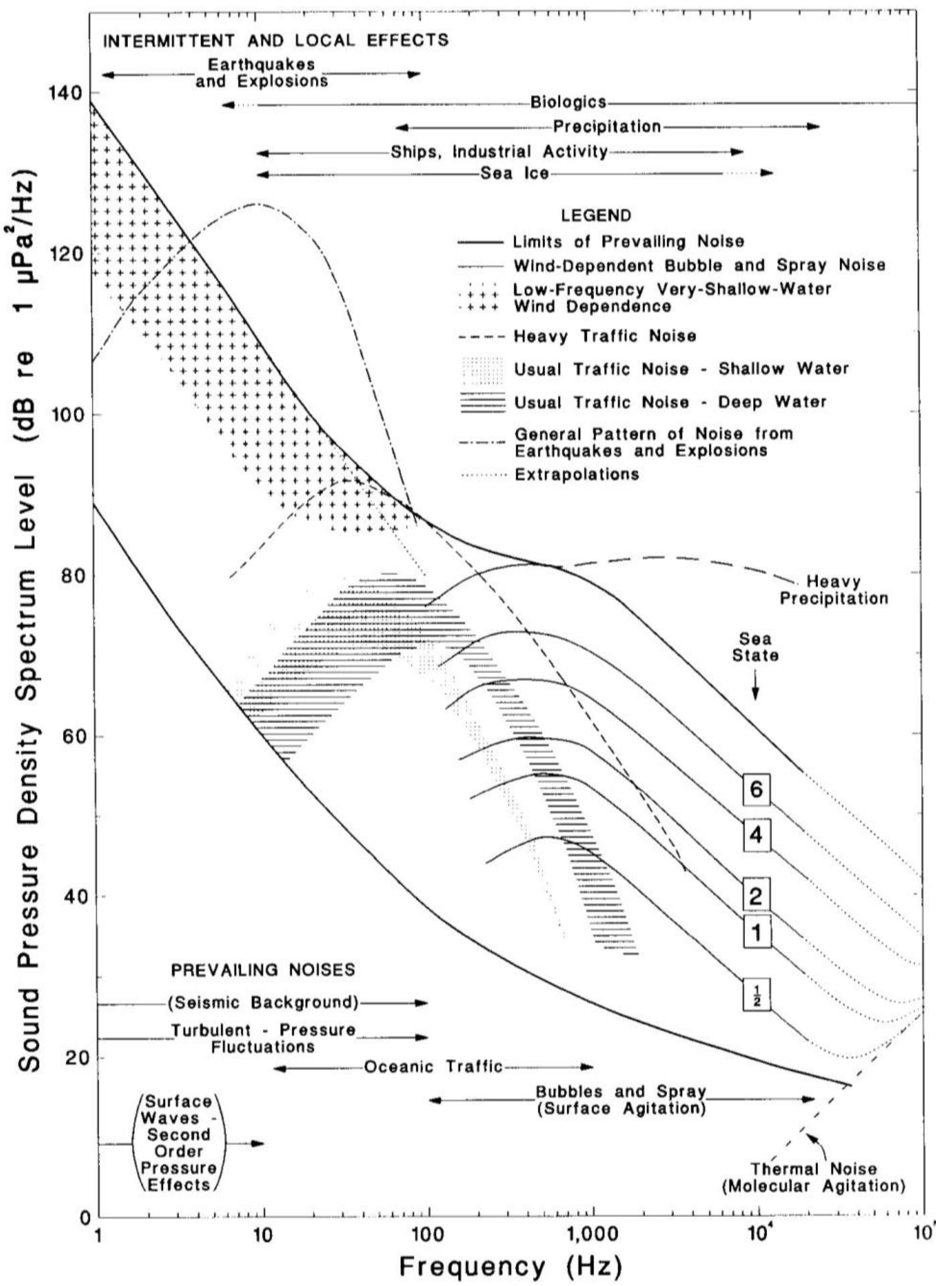
Desharnais *et al*. (2000) pointed out that there is no historical record of ambient sound in the Bay of Fundy. A number of scientists within government, academia and industry have collected ambient sound measurements in the Bay of Fundy in recent years, but none of the ambient sound spectra have been published (*e.g.,* Desharnais *et al.* 2004; LaCour and Linford 2004;

Simard *et al.* 2004). In the absence of ambient sound recordings for the location of interest, one still refers to the Wenz curves (Figure 10.23).

Sound Transmission in the Bay of Fundy

The manner in which anthropogenic sound travels away from a source and through the ocean depends on a number of factors. Sound travels faster in water that is warmer, denser and more salty. The physical properties of ocean water are generally stratified. Density increases with depth. Salinity is high at the surface during the day or at mid-latitudes because of evaporation; salinity decreases below the surface, but then increases again at deep depth due to gravity. Temperature near the surface depends on latitude, polar regions versus equatorial regions, ice-cover or not, day or night. At depth, temperature becomes roughly constant. The variation of temperature, salinity and density in the ocean results in a variation of the speed at which sound travels. When the speed of sound changes, waves bend. Altogether, the varying physical properties of ocean water cause a complex sound transmission pattern.

At the water-air boundary, sound reflects back into the water. If, however, the water is covered by a sheet of ice, acoustic energy is transmitted into the ice, is lost into mechanical vibrations of the ice, partly travels through the ice, and partly radiates back into the water. At the sea floor, the behaviour of acoustic waves is even more complex. If the sea floor consists of bare rock, some of the acoustic energy reflects back into the water, while some of it is transmitted into the bedrock. Acoustic waves travel through the rock faster than through water and eventually radiate back into the water ahead of the water-borne wave. If unconsolidated, water-saturated sediment covers the bedrock, then acoustic energy gets lost relatively fast. All of the above sound transmission phenomena depend on frequency. If the wavelength of the sound is of the order of the size of scattering bodies (*e.g.,* air bubbles, surface ice roughness, sea floor roughness, grain size, *etc.*), then scattering will play an important role in sound transmission as well.

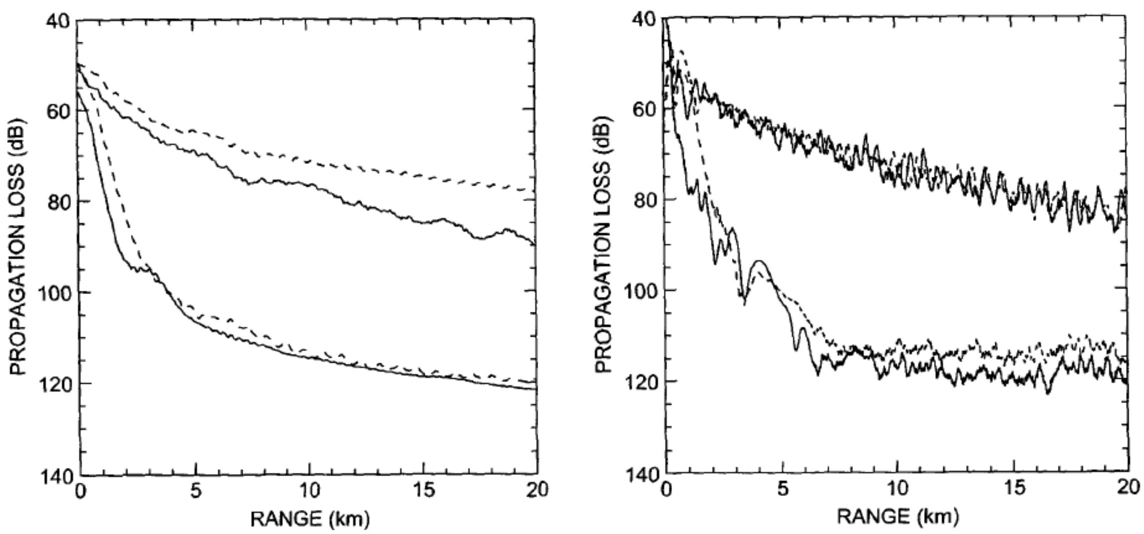


Source: Wenz (1962)

Figure 10.23 Simplified Spectra of Ambient Sound in the Ocean from a Variety of Sources

For rough estimates of sound pressure levels (SPL – measured in dB re 1 μPa) as a function of range, oceanographers ignore the detailed geophysical properties of the water and the sea floor and consider only the geometrical spreading of the sound. Sounds emitted from a point source produce spherical waves, *i.e.,* the wavefront is a sphere expanding underwater. With the location of the source at the water surface, the sound spreads as a hemisphere until it hits the sea floor. Thereafter it spreads cylindrically through the water confined by the upper water-air boundary and the lower water-sea floor boundary. Simple equations that integrate transmission loss, range, and water depth, can be used to estimate sound pressure levels at given distances from a point source.

In the field, the physical properties of the water and the geo-acoustic properties of the sea floor can substantially alter the received levels. Particularly, in the case of a thick sedimentary layer, sound transmission can be greatly reduced in shallow water. The Canadian Hydrographic Service (1977) lists LaHave Clay as the sediment in the north-western (upper) parts of the Bay of Fundy, and Scotian Shelf Drift as the predominant sediment in the southern and eastern (lower) parts of the Bay of Fundy, including the shipping lane. LaHave Clay is a silty sandy clay that is loosely compacted and has a low compressional sound speed. Scotian Shelf Drift is glacial till, a cohesive, poorly sorted sediment containing pebbles, cobbles and boulders. Its acoustic properties support sound propagation much better than LaHave Clay. Desharnais *et al.* (2000) measured transmission loss in the Bay of Fundy with hydrophone receivers at 30 m and 180 m water depth. Transmission loss was less and therefore received sound pressure levels were higher over Scotian Shelf Drift than LaHave Clay (Figure 10.24).



Left: for sound at 100Hz. Right: for sound at 500Hz. Solid lines: hydrophone receiver at 30m depth. Dashed lines: hydrophone receiver at 180 m depth. Upper lines: Over Scotian Shelf Drift. Lower lines: over LaHave Clay. (Desharnais *et al.* 2000)

Figure 10.24 Sound Transmission Loss in the Bay of Fundy

These findings suggest that anthropogenic sounds emitted in the lower Bay of Fundy will propagate over greater distances than sound emitted in the upper Bay of Fundy.

10.2.4 Fish Habitat

The fish habitat section includes a broad-reaching discussion on elements related to fish, fish health, fish distribution, and diversity.

10.2.4.1 Water Quality

Water quality includes all physical and chemical factors of the water contained within a marine environment. These factors are important because they influence what fish species can inhabit the marine environment in question. Results of past studies (Jacques Whitford 2004) and a review of existing information have shown that water quality in the Marine PDA is, in general, adequate for supporting fish populations.

In total, 79 water samples were taken for the Project; 14 in fall, 23 in winter, 27 in spring, and 15 in summer. The weighted end of the hose sampler was lowered to the desired sampling depth (generally mid-water depth for a well-mixed water column), and water was pumped into a clean bottle. Detailed methods for the collection, preservation and laboratory analysis of water samples are provided in Jacques Whitford (2008m).

Samples were analyzed for the following parameters: polycyclic aromatic hydrocarbons (PAH), petroleum hydrocarbons, volatile organic compounds (VOC), phenolic compounds, total dioxins and furans, trace metals, total organic carbon (TOC), major ions and nutrients, alkalinity, pH, total suspended solids (TSS), turbidity, and conductivity. Laboratory blanks and field duplicates were included in the analysis as part of the QA/QC.

The results were compared to the CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life, Marine Environment,* 1999, updated in 2007. For most water quality parameters, guidelines consist of a single maximum value which is not to be exceeded, and is set as the recommended Canadian water quality guideline. This maximum value is generally based on a long-term concentration known as a chronic exposure, which is shown to have no adverse environmental effects on the most sensitive species.

Detailed results for all parameters, including physical and chemical data for all water samples collected in the Marine PDA, were analyzed on a spatial and seasonal basis and are provided in Tables 10.4 to 10.7.

According to the results of the water sampling, the water quality in the Marine PDA is typical of an undisturbed marine environment found in this particular region. There may, however, be a number of compounds of potential concern (*e.g.,* polychlorinated dioxins and furans) found generally in marine waters for which no guidelines are currently available.

Marine waters in the Marine PDA contained levels of polycyclic aromatic hydrocarbons, petroleum hydrocarbons, volatile organic compounds and phenolic compounds that were most often below the detection limit; as a result, only the winter samples were analyzed, as they were the first samples collected. Concentrations of total dioxins and furans were also low overall. Trace metal concentrations were below the applicable criteria, when available. A definitive conclusion could not be made for mercury in water since the minimum reporting limit (limit of detection) was above the CCME guideline of 0.016 µg/L for mercury in marine water. It should be noted that all 79 water samples collected and measured for mercury were below the detection limit of 0.05 µg/L. Aluminum and iron concentrations were higher in water samples collected nearshore, and at water depths closer to the sea floor, suggesting a potential link to more turbid water at these locations. Furthermore, they showed a considerable decrease during the summer. Concentrations of the trace metals antimony, beryllium, copper, selenium, silver, tellurium and thallium were below detection limits in all water samples. Concentrations for all other trace metals were below CCME guidelines. Nutrient levels were low overall. Physico-chemical analyses data showed considerable fluctuation in Total Suspended Solids (TSS) concentrations, and ranged from below the reporting limit (<5 mg/L) to values up to 63 mg/L depending on the sampling period and the depth of sample collection. The highest TSS concentrations were observed for samples collected at stations near the Black Point ocean disposal site. TSS and turbidity levels were considerably higher in December and March samples than in samples collected in May and August, indicating that the waters of the Marine PDA are more stratified and clearer during the spring and summer months, most likely as a result of fewer storms. Alkalinity, hardness and pH values are typical of a common estuarine environment.

Table 10.4 Water Quality Monitoring Results for December 11, 2006

Analytical Parameters	Units	Reporting Limit	CCME Marine Water Quality Guidelines [1]	December 2006 (14 water samples)			
				Mean [2]	Min [2]	Max [2]	SD [2]
Polycyclic Aromatic Hydrocarbons							
Naphthalene	µg/L	0.05	1.4	<0.05	<0.05	<0.05	0
Acenaphthylene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Acenaphthene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Fluorene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Phenanthrene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Anthracene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Fluoranthene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Pyrene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Benzo(a)anthracene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Chrysene/Triphenylene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Benzo(b)fluoranthene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Benzo(k)fluoranthene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Benzo(e)pyrene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Benzo(a)pyrene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Indenopyrene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Benzo(g,h,i)perylene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Dibenz(a,h)anthracene	µg/L	0.01	ng	<0.01	<0.01	<0.01	0
Hexachlorobutadiene	µg/L	0.05	ng	<0.05	<0.05	<0.05	0
Hexachlorobenzene	µg/L	0.05	ng	<0.05	<0.05	<0.05	0
Petroleum Hydrocarbons							
Benzene	mg/L	0.0005	110	<0.0005	<0.0005	<0.0005	0
Toluene	mg/L	0.0005	215	<0.0005	<0.0005	<0.0005	0
Ethylbenzene	mg/L	0.0005	25	<0.0005	<0.0005	<0.0005	0
Xylenes	mg/L	0.0005	ng	<0.0005	<0.0005	<0.0005	0
F1 (C6-C10)	mg/L	0.01	ng	<0.01	<0.01	<0.01	0
F2 (C10-C16)	mg/L	0.01	ng	<0.01	<0.01	<0.01	0
F3 (C16-C34)	mg/L	0.01	ng	<0.01	<0.01	<0.01	0
Total C6-C34	mg/L	0.02	ng	<0.02	<0.02	<0.02	0
Methyl *tertiary*-butyl ether (MTBE)	mg/L	0.0005	5,000	<0.0005	<0.0005	<0.0005	0
Volatile Organic Compounds							
Chloromethane	µg/L	5.0	ng	<5	<5	<5	0
Vinyl chloride	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
Bromomethane	µg/L	5.0	ng	<5	<5	<5	0
Chloroethane	µg/L	5.0	ng	<5	<5	<5	0
Trichlorofluoromethane	µg/L	5.0	ng	<5	<5	<5	0
1,1-Dichloroethylene	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
Methylene chloride	µg/L	5.0	ng	<5	<5	<5	0
1,2-Dichloroethylene (E)	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
1,1-Dichloroethane	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
1,2-Dichloroethylene (Z)	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
Bromochloromethane	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
Chloroform	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
1,1,1-Trichloroethane	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
Carbon tetrachloride	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
Benzene	µg/L	0.5	110	<0.5	<0.5	<0.5	0
1,2-Dichloroethane	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
Trichloroethylene	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
1,2-Dichloropropane	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
Bromodichloromethane	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
1,3-Dichloropropylene (Z)	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
Toluene	µg/L	0.5	215	<0.5	<0.5	<0.5	0

Table 10.4 Water Quality Monitoring Results for December 11, 2006

Analytical Parameters	Units	Reporting Limit	CCME Marine Water Quality Guidelines [1]	December 2006 (14 water samples)			
				Mean [2]	Min [2]	Max [2]	SD [2]
1,3-Dichloropropylene (E)	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
1,1,2-Trichloroethane	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
Tetrachloroethylene	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
Dibromochloromethane	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
1,2-Dibromoethane	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
Chlorobenzene	µg/L	0.5	25	<0.5	<0.5	<0.5	0
Ethylbenzene	µg/L	0.5	25	<0.5	<0.5	<0.5	0
m,p-Xylenes	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
o-Xylene	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
Styrene	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
Bromoform	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
1,1,2,2-Tetrachloroethane	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
1,3-Dichlorobenzene	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
1,4-Dichlorobenzene	µg/L	0.5	ng	<0.5	<0.5	<0.5	0
1,2-Dichlorobenzene	µg/L	0.5	42	<0.5	<0.5	<0.5	0
Acid Extractables Phenolic Compound							
Pentachlorophenol	µg/L	0.1	ng	<0.1	<0.1	<0.1	0
Phenol	µg/L	0.1	ng	<0.1	<0.1	<0.1	0
Total Polychlorinated Dioxins	pg/L		ng	9.4	3.1	15.8	3.2
Total Polychlorinated Furans	pg/L		ng	7.5	5.1	11.6	1.8

Notes:
ng No guideline available.
[1] Canadian Marine Water Quality Guidelines for the Protection of Aquatic Life, Canadian Council of Ministers of the Environment (CCME 2007b).
[2] In calculating the mean, parameters measured as below detection were taken as equal to the reporting limit divided by 2, thus providing a conservative estimate (*i.e.,* <0.01 = 0.005). The same was done when determining minimum and maximum values as well as for calculating the standard deviation (SD).

Summary statistics for polycyclic aromatic hydrocarbons, petroleum hydrocarbons, volatile organic compounds, acid extractable phenolic compounds and total dioxins and furans for 14 water samples collected on December 11, 2006 in the Marine PDA are included in Table 10.4. Refer to Figure 10.2 for the location of sampling stations.

In conclusion, water quality in the Marine PDA is adequate for supporting fish populations.

10.2.4.2 Sediment Quality

Along with water quality, sediment quality influences what fish species can inhabit a marine environment. Marine sediments provide habitat as well as a food source for much aquatic life. Toxic chemicals entering the marine environment often end up trapped in sediments, while others become re-suspended in the water column. Results of past studies (Jacques Whitford 2004) and a review of existing information have shown that sediment quality in the Marine PDA is, in general, adequate for supporting fish populations.

Surface sediment samples were collected in December 2006 and in March-April 2007 at 15 stations within the Marine PDA (Figure 10.2). Sediment samples were a composite of a minimum of two grab samples, up to a maximum of five when partial grabs were collected. Large rocks and debris were removed.

Laboratory analyses on sediment samples included total organic carbon (TOC), polycyclic aromatic hydrocarbons (PAH), petroleum hydrocarbons including fuel range and lube range hydrocarbons, total polychlorinated biphenyls (PCBs), volatile organic compounds (VOC), formaldehyde and acetaldehyde, acid extractables, total dioxins and furans, trace metals, and particle grain size.

Analytical results were compared to the CCME *Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, Marine Sediment,* 1999, updated in 2002. Two levels are included in the CCME tables for sediment quality: the Interim Sediment Quality Guideline (ISQG), and the Probable Effects Levels (PEL). It should be noted, however, that although there are many substances for which no guidelines are available, this does not mean that there are no toxicological concerns associated with these chemicals.

Analytical results for all sediment parameters analyzed are provided in Tables 10.8 and 10.9.

Most of the chemical parameters analyzed were below the limits set by the *CCME Interim Marine Sediment Quality Guidelines* (ISQG) and the *CEPA Disposal at Sea Regulations*. Exceptions were observed at stations S12, S13 and S14A (Figure 10.2) located at or near the Black Point ocean disposal site managed by Environment Canada and where concentrations of polycyclic aromatic hydrocarbons (PAH), total polychlorinated biphenyls (PCB) and arsenic exceeded the ISQG, and reached levels above the Probable Effects Level (PEL) for some compounds. The *CEPA* Disposal at Sea screening criteria for total PAH were also exceeded at stations S12 and S13, and total PCB levels were above the *CEPA* limit at station S13.

The sediment that had the largest number of values exceeding the CCME ISQG and PEL guidelines and *CEPA* disposal at sea screening criteria originated from station S13, which is closest to the Black Point ocean disposal site. That site is also characterized by a high proportion of silt and clay materials. However, except for stations near the Black Point ocean disposal site located west of Mispec Point in the Outer Harbour, analytical results reveal relatively unaffected sediment, either as not detected or below guideline values for all parameters at stations in the Marine PDA. Additional details of sediment quality in this area are provided in ECL (2003). Overall, sediment quality in the Marine PDA is adequate for supporting fish populations.

Further characterization of sediment quality will be conducted in support of the Disposal at Sea permit application, and appropriate means and locations for disposing of the material or for beneficial reuse will be determined in consultation with Environment Canada.

Table 10.5 Summary Statistics for Trace Metal Analyses of Marine Water Samples

Analytical Parameters	Units	Reporting Limit	CCME Marine Water Quality Guidelines [1]	December 2006 (14 samples)				March - April 2007 (23 samples)				May 2007 (27 samples)				August 2007 (15 samples)			
				Mean [2]	Min [2]	Max [2]	SD [2]	Mean [2]	Min [2]	Max [2]	SD [2]	Mean [2]	Min [2]	Max [2]	SD [2]	Mean [2]	Min [2]	Max [2]	SD [2]
Trace Metals																			
Aluminum	µg/L	1	ng	109	13	315	94	196	45	452	121	110	2	257	68	38	13	84	23
Antimony	µg/L	0.5	ng	<0.5	<0.5	<0.5	0	<0.5	<0.5	<0.5	0	<0.5	<0.5	<0.5	0	<0.5	<0.5	<0.5	0
Arsenic	µg/L	10	12.5	<10	<10	<10	0	<10	<10	<10	0	<10	<10	<10	0	<10	<10	<10	0
Barium	µg/L	0.1	ng	8.1	7.4	9.2	0.5	9.4	7.9	11.9	1.2	7.5	7.0	8.6	0.4	7.09	6.2	7.6	0.31
Beryllium	µg/L	0.05	ng	<0.05	<0.05	<0.05	0	<0.05	<0.05	<0.05	0	<0.05	<0.05	<0.05	0	<0.05	<0.05	<0.05	0
Boron	µg/L	10	ng	4228	3960	4370	131	6510	4350	7450	961	6274	3380	6840	8204	4345	4180	4490	74
Cadmium	µg/L	0.02	0.12	0.04	0.02	0.05	0.01	0.03	0.01	0.07	0.02	0.04	0.02	0.07	0.01	0.05	0.04	0.07	0.01
Calcium	µg/L	50	ng	378000	374000	384000	2855	351826	232000	385000	43272	351593	162000	374000	524454	370933	366000	379000	3615
Chromium	µg/L	1	56	<1	<1	<1	0	<1	<1	<1	0	<1	<1	<1	0	<1	<1	<1	0
Cobalt	µg/L	0.5	ng	0.29	<0.5	0.6	0.11	0.31	<0.5	0.6	0.13	<0.5	<0.5	<0.5	0	<0.5	<0.5	<0.5	0
Copper	µg/L	5	ng	<5	<5	<5	0	<5	<5	<5	0	<5	<5	<5	0	<5	<5	18	4
Iron	µg/L	10	ng	181	20	520	166	178	56	409	94	55	16	120	26	34	16	76	16
Lanthanum	µg/L	0.2	ng	0.2	<0.2	0.5	0.2	0.2	<0.2	0.4	0.1	<0.2	<0.2	<0.2	0	<0.2	<0.2	<0.2	0
Lead	µg/L	0.05	ng	0.39	0.1	1.11	0.33	0.32	0.1	0.72	0.17	0.16	0.025	0.58	0.11	0.10	0.06	0.24	0.05
Lithium	µg/L	0.05	ng	127	105	139	11	96	63	105	12	109	54	117	15	80.8	79	83	1.1
Magnesium	µg/L	20	ng	1172143	1160000	1190000	11217	1087522	651000	1240000	146195	1108185	510000	1180000	165659	1136000	1120000	1160000	12421
Manganese	µg/L	0.5	ng	14.1	2.7	39.8	11.6	11.6	3.1	23.8	5.6	6.1	0.8	40.3	7.2	5.1	3.0	9.7	1.8
Mercury	µg/L	0.05	0.016	<0.05	<0.05	<0.05	0	<0.05	<0.05	<0.05	0	<0.05	<0.05	<0.05	0	<0.05	<0.05	<0.05	0
Molybdenum	µg/L	0.05	ng	9.13	8.68	9.56	0.24	11.2	8.8	14.5	1.4	8.9	4.2	9.5	1.3	10.0	9.3	10.3	0.3
Nickel	µg/L	0.5	ng	0.7	<0.5	1.7	0.5	3.6	1.1	7.7	1.9	1.4	<0.5	2.9	0.8	0.6	0.5	1.0	0.2
Potassium	µg/L	10	ng	426214	420000	435000	3847	414261	260000	450000	56087	423148	178000	453000	68408	444933	436000	459000	5910
Selenium	µg/L	10	ng	<10	<10	<10	0	<10	<10	<10	0	<10	<10	<10	0	<10	<10	<10	0
Silver	µg/L	0.02	ng	<0.02	<0.02	<0.02	0	<0.02	<0.02	<0.02	0	<0.02	<0.02	<0.02	0	<0.02	<0.02	<0.02	0
Sodium	µg/L	50	ng	10500714	9700000	11700000	885242	9453913	6310000	10200000	1164161	9482593	4310000	10200000	1438131	9771333	9480000	10100000	171958
Strontium	µg/L	5	ng	7151	7080	7270	56	8348	5490	8940	1070	8133	3560	8660	1270	8343	8230	8490	75
Sulphur	µg/L	50	ng	855214	844000	866000	6079	743609	495000	795000	92904	788037	363000	838000	118351	832533	823000	846000	6968
Tellurium	µg/L	0.5	ng	<0.5	<0.5	<0.5	0	<0.5	<0.5	<0.5	0	<0.5	<0.5	<0.5	0	<0.5	<0.5	<0.5	0
Thallium	µg/L	1	ng	<1	<1	<1	0	<1	<1	<1	0	<1	<1	<1	0	<1	<1	<1	0
Uranium	µg/L	0.1	ng	3.3	3.1	3.5	0.1	3.0	2.0	3.8	0.4	2.6	1.2	2.8	0.4	2.83	3	3	0.24
Vanadium	µg/L	0.1	ng	2.1	1.7	3.2	0.5	2.3	1.7	3.4	0.5	1.6	0.9	2.1	0.3	1.25	1	1	0.11
Zinc	µg/L	2	ng	2	<2	4	1	2	<2	7	2	2	<2	10	2	<2	<2	3	0.6

Notes:
ng No guideline available.
[1] Canadian Marine Water Quality Guidelines for the Protection of Aquatic Life, Canadian Council of Ministers of the Environment (CCME 2007b).
[2] In calculating the mean, parameters measured as below detection were taken as equal to the reporting limit divided by 2, thus providing a conservative estimate (*i.e.,* <0.01 = 0.005). The same was done when determining minimum and maximum values as well as for calculating the standard deviation (SD).
Samples collected on December 11, 2006, March 26 and April 2, 2007, May 29, 2007 and August 22, 2007 in the Marine PDA. Refer to Figure 10.2 for the location of sampling stations.

Table 10.6 Summary Statistics for Nutrient Analyses of Marine Water Samples

Nutrient Analyzed	Units	Reporting Limit	CCME Marine Water Quality Guidelines [1]	December 2006 (14 samples)				March - April 2007 (23 samples)				May 2007 (27 samples)				August 2007 (15 samples)			
				Mean [2]	Min [2]	Max [2]	SD [2]	Mean [2]	Min [2]	Max [2]	SD [2]	Mean [2]	Min [2]	Max [2]	SD [2]	Mean [2]	Min [2]	Max [2]	SD [2]
r-Silica (as SiO_2)	mg/L	0.1	ng	0.6	0.5	0.6	0.1	0.8	0.2	2.1	0.5	0.4	0.2	1.8	0.4	<0.1	<0.1	0.2	0.05
o-Phosphate (as P)	mg/L	0.01	ng	0.02	<0.01	0.04	0.01	0.04	0.01	0.23	0.04	0.025	<0.01	0.05	0.010	0.02	<0.01	0.02	0.01
Total Phosphorus	mg/L	0.002	ng	0.07	0.044	0.11	0.03	0.055	0.03	0.081	0.01	0.042	0.023	0.056	0.007	0.033	0.028	0.040	0.004
Nitrate + Nitrite (as N)	mg/L	0.05	16	0.08	<0.05	0.21	0.04	0.11	<0.05	0.240	0.08	0.12	<0.05	0.16	0.03	<0.05	<0.05	0.06	0.01
Ammonia (as N)	mg/L	0.05	ng	<0.05	<0.05	<0.05	0	<0.05	<0.05	<0.05	0	<0.05	<0.05	<0.05	0	<0.05	<0.05	<0.05	0
Kjeldahl Nitrogen	mg/L	0.25	ng	<0.25	<0.25	0.3	0.05	<0.25	<0.25	0.4	0.08	<0.25	<0.25	0.5	0.10	<0.25	<0.25	0.40	0.07

Notes:
ng No guideline available.
1 Canadian Marine Water Quality Guidelines for the Protection of Aquatic Life, Canadian Council of Ministers of the Environment (CCME 2007b).
2 In calculating the mean, parameters measured as below detection were taken as equal to the reporting limit divided by 2, thus providing a conservative estimate (*i.e.,* <0.01 = 0.005). The same was done when determining minimum and maximum values as well as for calculating the standard deviation (SD).
Samples collected on December 11, 2006, March 26 and April 2, 2007, May 29, 2007 and August 22, 2007 in the Marine PDA. Refer to Figure 10.2 for sampling stations.

Table 10.7 Summary Statistics for Selected Physico-Chemical Analyses of Marine Water Samples

Analytical Parameters	Units	Reporting Limit	CCME Marine Water Quality Guidelines [1]	December 2006 (14 samples)				March - April 2007 (23 samples)				May 2007 (27 samples)				August 2007 (15 samples)			
				Mean [2]	Min [2]	Max [2]	SD [2]	Mean [2]	Min [2]	Max [2]	SD [2]	Mean [2]	Min [2]	Max [2]	SD [2]	Mean [2]	Min [2]	Max [2]	SD [2]
Total Suspended Solids	mg/L	5	Narrative	25	6	63	20	26	<5	59	14	8.4	<5	23	6.4	5.6	<5	10	2.2
Turbidity	NTU	0.1	Narrative	5.3	0.7	16.7	5.4	5.2	1.1	13.5	3.7	2.8	1.3	7.8	1.5	1.5	0.4	3.7	1.0
Conductivity	µS/cm	1	ng	62,757	57,400	66,600	1,965	56,687	18,100	62,500	10,135	56,400	32,200	78,600	8,620	63,307	60,500	65,200	1,462
pH			7.0-8.7	8	7.9	8	0.01	7.8	7.6	7.9	0.1	7.8	7.6	7.9	0.1	7.9	7.9	8	0.1
Alkalinity (as $CaCO_3$)	mg/L	2	ng	118	115	122	2	110	52	125	15	110	16	122	22	115	112	124	3
Hardness (as $CaCO_3$)	mg/L		ng	5,771	5,711	5,854	49	5,357	3,260	6,068	709	5,441	2,505	5,791	813	5,604	5,526	5,723	59
Total Organic Carbon	mg/L	0.5	ng	<0.5	<0.5	1.6	0.4	<0.5	<0.5	1.5	0.4	<0.5	<0.5	1.5	0.3	<0.5	<0.5	<0.5	0

Notes:
ng No guideline available.
1 Canadian Marine Water Quality Guidelines for the Protection of Aquatic Life, Canadian Council of Ministers of the Environment (CCME 2007b).
2 In calculating the mean, parameters measured as below detection were taken as equal to the reporting limit divided by 2, thus providing a conservative estimate (*i.e.,* <0.01 = 0.005). The same was done when determining minimum and maximum values as well as for calculating the standard deviation (SD).
Samples collected on December 11, 2006, March 26 and April 2 2007, May 29, 2007 and August 22, 2007 in the Marine PDA. Refer to Figure 10.2 for the location of sampling stations.

Table 10.8 Grain Size Distribution and Statistics of Surface Sediments and Total Organic Carbon (TOC) Content

Station*	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	TOC (%)	Median Grain Size		Mean Grain Size		Sorting	
							(mm)	(Phi)	(mm)	(Phi)	Standard Deviation (Phi)	Description
S1	15.2	0.0	5.5	66.4	28.1	0.6	0.0146	6.1	0.0110	6.5	1.91	Poorly sorted
S2	17.4	0.0	34.6	59.5	5.9	0.2	0.0442	4.5	0.0412	4.6	1.52	Poorly sorted
S3	30.5	2.6	76.7	15.4	5.3	0.1	0.1649	2.6	0.1340	2.9	1.82	Poorly sorted
S4	46.3	6.1	70.3	14.0	9.7	0.3	0.2895	2.4	0.1340	2.9	2.90	Very poorly sorted
S5	48.8	39.4	39.9	17.8	2.9	0.3	0.2679	1.9	1.2311	-0.3	5.72	Extremely poorly sorted
S6	42.7	39.5	24.4	30.5	5.5	0.4	0.2031	2.3	0.5743	0.8	5.61	Extremely poorly sorted
S9	6.1	0.0	22.0	72.6	5.4	0.2	0.0385	4.7	0.0359	4.8	1.25	Poorly sorted
S10	26.2	14.0	34.3	48.3	3.4	0.5	0.0625	4.0	0.1088	3.2	2.89	Very poorly sorted
S11	8.5	0.2	8.2	83.2	8.5	<0.1	0.1768	2.5	0.1895	2.4	0.67	Moderately well sorted
S12	15.0	40.0	46.7	11.1	2.2	0.32	0.4665	1.1	1.0000	0.0	3.93	Very poorly sorted
S13	21.0	0.4	13.5	66.0	20.1	2.15	0.0156	6.0	0.0136	6.2	2.40	Very poorly sorted
S14A	28.0	28.6	29.5	28.5	13.3	1.46	0.1895	2.4	0.2500	2.0	4.64	Extremely poorly sorted
S15	12.2	0.0	8.2	83.2	8.5	0.4	0.0254	5.3	0.0272	5.2	1.28	Poorly sorted
S16	9.0	0.9	97.5	0.5	1.1	0.14	0.2333	2.1	0.2500	2.0	0.82	Moderately sorted
S17	4.2	0.0	22.7	67.4	9.9	0.92	0.0313	5.0	0.0313	5.0	1.97	Poorly sorted
MEAN	22.1	11.4	35.6	44.3	8.7	0.6	0.1482	3.5	0.2688	3.2	2.62	Very poorly sorted

Notes:
Graphical method after Boggs, S. Jr., 1987. Principles of Sedimentology and Stratigraphy, MacMillan Publishing Company.
* refer to Figure 10.2 for the location of sampling stations.

10.2.4.3 Plankton

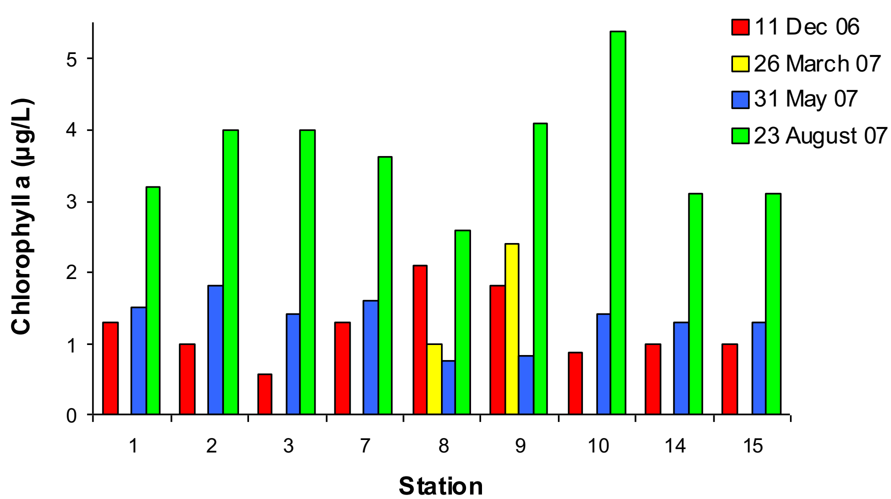
Plankton are the very small (often microscopic), free-floating organisms that live suspended in the water column. Physical processes, such as water currents and turbulent mixing, often control the distribution of plankton. Plankton are the productive base of marine ecosystems. Phytoplankton (often unicellular algae) are the autotrophic component of plankton, whereas zooplankton are the heterotrophic component of plankton. Plankton are an integral part of the ocean food chain; phytoplankton are eaten by zooplankton, which are, in turn, eaten by larger organisms. Plankton are therefore a major factor in influencing the biodiversity and productivity of marine habitats.

Phytoplankton

Phytoplankton consist of free-floating algae, protists, and cyanobacteria. Phytoplankton form the beginning of the food chain for aquatic animals and fix large amounts of carbon through photosynthesis. Chlorophyll is the green molecule in plant cells that carries out the bulk of energy fixation in the process of photosynthesis. Besides its importance in photosynthesis, chlorophyll is probably the most commonly used estimator of algal biomass in marine systems.

Total annual primary production in the Bay of Fundy has been reported as 1,112,400 tonnes of carbon take-up and is considered to be provided primarily by phytoplankton (MacLaren Atlantic Limited 1977). The Outer Bay (the area to the southwest of Saint John) provides 85.6% of the total production in the Bay of Fundy, 98% of which is contributed by phytoplankton. The remaining production is contributed by seaweeds and marine plants (2% by macrophytic algae; 0.4% by benthic microalgae; and 0.4% by saltmarsh plants) (Jacques Whitford 2004).

The concentration of chlorophyll *a* (Chl *a*) in seawater is used as a relative indicator of phytoplankton abundance. Chl *a* concentrations for mid-depth water samples collected at stations in the Marine PDA during seasonal surveys are presented graphically in Figure 10.25. Chl *a* levels recorded in fall and winter were relatively low at most stations. A two to three-fold increase in Chl *a* concentrations was generally observed at all stations during summer (Figure 10.25), with a mean concentration of 3.7 µg/L. Since samples were not taken between May 31 and August 23, 2007 the beginning of the phytoplankton bloom cannot be determined.



Note: Detection limit is 0.5 µg/L.

Figure 10.25 Mid-depth Chlorophyll *a* Concentrations

Table 10.9 Summary of Physico-Chemical Marine Data for Sediment Samples

Analytical Parameter	Units	Reporting Limit	CCME Sediment Quality Guidelines[1] ISQG [2]	CCME Sediment Quality Guidelines[1] PEL [3]	Date / Depth (m) / *CEPA* Disposal At Sea Limits[4]	S1	S2	S3	S4	S5	S6	S9	S10	S11	S12	S13	S14A	S15	S16	S17	Summary Statistics All Stations Mean[6]	Min[6]	Max[6]	SD[6]
					Date	11-Dec-06	11-Dec-06	11-Dec-06	18-Dec-06	18-Dec-06	18-Dec-06	11-Dec-06	11-Dec-06	11-Dec-06	26-Mar-07	26-Mar-07	26-Mar-07	11-Dec-06	2-Apr-07	2-Apr-07				
					Depth (m)	15.2	17.4	30.5	46.3	48.8	42.7	6.1	26.2	8.5	15.0	21.0	28.0	12.2	9.0	4.2				
						Station*																		
Polycyclic Aromatic Hydrocarbons (PAH)																								
Acenaphthene	mg/kg	0.01	**0.00671**	**0.0889**	**nl**	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.13	0.56	0.02	<0.01	<0.01	<0.01	0.052	0.005	0.560	0.144
Acenaphthylene	mg/kg	0.01	**0.00587**	**0.128**	**nl**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.005	0.005	<0.01	<0.01	<0.01	0.006	0.005	0.020	0.004
Anthracene	mg/kg	0.01	**0.0469**	**0.245**	**nl**	<0.01	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.49	0.41	0.06	<0.01	<0.01	<0.01	0.071	0.005	0.490	0.156
Benzo(a)anthracene	mg/kg	0.01	**0.0748**	**0.693**	**nl**	0.02	0.06	0.02	<0.01	0.01	0.01	0.03	0.05	<0.01	0.4	1.1	0.12	<0.01	<0.01	0.02	0.124	0.005	1.100	0.288
Benzo(a)pyrene	mg/kg	0.01	**0.0888**	**0.763**	**nl**	0.01	0.03	0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.03	<0.01	0.33	0.35	0.11	<0.01	<0.01	0.01	0.062	0.005	0.350	0.116
Benzo(b)fluoranthene	mg/kg	0.01	**ng**	**ng**	**nl**	0.02	0.04	0.02	<0.01	<0.01	<0.01	0.02	0.05	<0.01	0.31	0.4	0.16	<0.01	<0.01	0.01	0.071	0.005	0.400	0.123
Benzo(e)pyrene	mg/kg	0.01	**ng**	**ng**	**nl**	0.01	0.02	0.01	<0.01	<0.01	<0.01	0.01	0.03	<0.01	**0.18**	**0.26**	**0.09**	<0.01	<0.01	0.01	0.043	0.005	0.260	0.076
Benzo(g,h,i)perylene	mg/kg	0.01	**ng**	**ng**	**nl**	0.01	0.02	0.01	<0.01	<0.01	<0.01	0.01	0.02	<0.01	0.17	0.13	0.07	<0.01	<0.01	<0.01	0.032	0.005	0.170	0.051
Benzo(k)fluoranthene	mg/kg	0.01	**ng**	**ng**	**nl**	0.01	0.02	0.01	<0.01	<0.01	<0.01	0.01	0.02	<0.01	0.17	0.4	0.08	<0.01	<0.01	0.01	0.051	0.005	0.400	0.106
Chrysene/Triphenylene	mg/kg	0.01	**0.108**	**0.846**	**nl**	0.02	0.05	0.02	<0.01	0.01	0.01	0.03	0.05	<0.01	0.38	0.78	0.12	<0.01	<0.01	0.02	0.101	0.005	0.780	0.211
Dibenz(a,h)anthracene	mg/kg	0.01	**0.00622**	**0.135**	**nl**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	0.03	0.02	<0.01	<0.01	<0.01	0.011	0.005	0.050	0.013
Fluoranthene	mg/kg	0.01	**0.113**	**1.494**	**nl**	0.04	0.12	0.03	<0.01	0.02	0.03	0.06	0.07	<0.01	0.92	4.7	0.24	0.02	<0.01	0.03	0.420	0.005	4.700	1.207
Fluorene	mg/kg	0.01	**0.0212**	**0.144**	**nl**	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.07	0.85	0.04	<0.01	<0.01	<0.01	0.069	0.005	0.850	0.217
Hexachlorobenzene	mg/kg	0.05	**ng**	**ng**	**nl**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	<0.05	-	-	0.025	0.025	0.025	0.000
Hexachlorobutadiene	mg/kg	0.05	**ng**	**ng**	**nl**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	<0.05	-	-	0.025	0.025	0.025	0.000
Indenopyrene	mg/kg	0.01	**ng**	**ng**	**nl**	0.01	0.02	0.01	<0.01	<0.01	<0.01	0.01	0.02	<0.01	0.17	0.15	0.07	<0.01	<0.01	0.01	0.033	0.005	0.170	0.054
Naphthalene	mg/kg	0.01	**0.0346**	**0.391**	**nl**	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	<0.01	0.005	0.11	0.005	<0.01	<0.01	<0.01	0.015	0.005	0.110	0.028
Phenanthrene	mg/kg	0.01	**0.0867**	**0.544**	**nl**	0.02	0.14	0.02	<0.01	0.01	0.02	0.04	0.04	<0.01	0.71	3.6	0.14	0.01	<0.01	0.02	0.319	0.005	3.600	0.925
Pyrene	mg/kg	0.01	**0.153**	**1.398**	**nl**	0.03	0.11	0.03	<0.01	0.02	0.02	0.05	0.07	<0.01	0.78	3.1	0.46	0.01	<0.01	0.03	0.315	0.005	3.100	0.800
Total PAH[5]	mg/kg	-	**ng**	**ng**	**2.5**	0.28	0.78	0.27	0.14	0.18	0.2	0.37	0.57	0.14	5.3	16.9	1.8	0.16	0.085	0.21	1.827	0.085	16.935	4.386
Total Polychlorinated Biphenyls (PCB)	mg/kg	0.05	**0.0215**	**0.189**	**0.1**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.57	<0.05	<0.05	<0.05	<0.05	0.061	0.025	0.570	0.141
Petroleum Hydrocarbon-BTEX																								
Benzene	mg/kg	0.005	**ng**	**ng**	**nl**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.0025	0.00
Toluene	mg/kg	0.05	**ng**	**ng**	**nl**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.025	0.025	0.025	0.00
Ethylbenzene	mg/kg	0.01	**ng**	**ng**	**nl**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.005	0.005	0.005	0.00
Xylenes	mg/kg	0.05	**ng**	**ng**	**nl**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.025	0.025	0.025	0.00
Petroleum Hydrocarbon Fractions																								
F1 (C6-C10)	mg/kg	1	**ng**	**ng**	**nl**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	4.2	<1.0	<1.0	<1.0	<1.0	0.747	0.500	4.200	0.96
F2 (C10-C16)	mg/kg	1	**ng**	**ng**	**nl**	<1.0	1.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	26	1.4	<1.0	<1.0	<1.0	2.320	0.500	26.000	6.56
F3 (C16-C34)	mg/kg	1	**ng**	**ng**	**nl**	5.3	11	1.4	1.5	4.7	3.1	6.3	4.8	<1.0	2.4	51	7.1	5	<1.0	5.5	7.340	0.500	51.000	12.40
Total C6-C34	mg/kg	1.7	**ng**	**ng**	**nl**	5.3	12	<1.7	<1.7	4.7	3.1	6.3	4.8	<1.7	2.4	81	8.5	5	<1.7	5.5	9.467	0.850	81.000	20.03
Methyl *tertiary*-butyl ether	mg/kg	0.05	**ng**	**ng**	**nl**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	<0.05	-	-	0.025	0.025	0.025	0.00
Volatile Organic Compounds (VOC)																								
1.1.1-Trichloroethane	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
1.1.2.2-Tetrachloroethane	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
1.1.2-Trichloroethane	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
1.1-Dichloroethane	mg/kg	0.8	**ng**	**ng**	**nl**	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	-	-	-	<0.8	-	-	0.4	0.4	0.4	0.0
1.1-Dichloroethylene	mg/kg	0.8	**0.00207**	**0.374**	**nl**	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	-	-	-	<0.8	-	-	0.4	0.4	0.4	0.0
1.2-Dibromoethane	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
1.2-Dichlorobenzene	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
1.2-Dichloroethane	mg/kg	0.2	**0.00122**	**0.00781**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
1.2-Dichloroethylene (E)	mg/kg	0.8	**ng**	**ng**	**nl**	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	-	-	-	<0.8	-	-	0.4	0.4	0.4	0.0
1.2-Dichloroethylene (Z)	mg/kg	0.8	**ng**	**ng**	**nl**	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	-	-	-	<0.8	-	-	0.4	0.4	0.4	0.0
1.2-Dichloropropane	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
1.3-Dichlorobenzene	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
1.3-Dichloropropylene (E)	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
1.3-Dichloropropylene (Z)	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0

Table 10.9 Summary of Physico-Chemical Marine Data for Sediment Samples

Analytical Parameter	Units	Reporting Limit	CCME Sediment Quality Guidelines[1] ISQG [2]	PEL [3]	CEPA Disposal At Sea Limits[4]	S1	S2	S3	S4	S5	S6	S9	S10	S11	S12	S13	S14A	S15	S16	S17	Summary Statistics All Stations Mean[6]	Min[6]	Max[6]	SD[6]
					Date	11-Dec-06	11-Dec-06	11-Dec-06	18-Dec-06	18-Dec-06	18-Dec-06	11-Dec-06	11-Dec-06	11-Dec-06	26-Mar-07	26-Mar-07	26-Mar-07	11-Dec-06	2-Apr-07	2-Apr-07				
					Depth (m)	15.2	17.4	30.5	46.3	48.8	42.7	6.1	26.2	8.5	15.0	21.0	28.0	12.2	9.0	4.2				
						Station*																		
1.4-Dichlorobenzene	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
Benzene	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
Bromochloromethane	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
Bromodichloromethane	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
Bromoform	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
Bromomethane	mg/kg	0.8	**ng**	**ng**	**nl**	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	-	-	-	<0.8	-	-	0.4	0.4	0.4	0.0
Carbon tetrachloride	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
Chlorobenzene	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
Chloroethane	mg/kg	0.8	**ng**	**ng**	**nl**	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	-	-	-	<0.8	-	-	0.4	0.4	0.4	0.0
Chloroform	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
Chloromethane	mg/kg	0.8	**ng**	**ng**	**nl**	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	-	-	-	<0.8	-	-	0.4	0.4	0.4	0.0
Dibromochloromethane	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
Ethylbenzene	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
m,p-Xylenes	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
Methylene chloride	mg/kg	0.8	**ng**	**ng**	**nl**	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	-	-	-	<0.8	-	-	0.4	0.4	0.4	0.0
o-Xylene	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
Styrene	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
Tetrachloroethylene	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
Toluene	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
Trichloroethylene	mg/kg	0.2	**ng**	**ng**	**nl**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	<0.2	-	-	0.1	0.1	0.1	0.0
Trichlorofluoromethane	mg/kg	0.8	**ng**	**ng**	**nl**	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	-	-	-	<0.8	-	-	0.4	0.4	0.4	0.0
Vinyl chloride	mg/kg	0.8	**ng**	**ng**	**nl**	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	-	-	-	<0.8	-	-	0.4	0.4	0.4	0.0
Trace Metals																								
Aluminum	mg/kg	1	**ng**	**ng**	**nl**	15200	8330	6980	9170	8950	11200	7790	9330	9290	7900	17700	13000	9830	9600	11600	10391	6980	17700	2942
Antimony	mg/kg	0.1	**ng**	**ng**	**nl**	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.1	0.1	0.1	0.1	0.0
Arsenic	mg/kg	1	**7.24**	**41.6**	**nl**	6	3	4	4	4	5	3	4	4	5	7	**8**	4	6	5	5	3	8	1
Barium	mg/kg	1	**ng**	**ng**	**nl**	66	64	44	56	60	66	42	52	34	57	69	55	69	6	52	53	6	69	17
Beryllium	mg/kg	0.1	**ng**	**ng**	**nl**	0.8	0.4	0.4	0.5	0.5	0.6	0.3	0.5	0.4	0.5	0.8	0.8	0.4	0.4	0.6	0.5	0.3	0.8	0.2
Bismuth	mg/kg	10	**ng**	**ng**	**nl**	<1	<1	<1	1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0.6	0.5	1.0	0.2
Boron	mg/kg	1	**ng**	**ng**	**nl**	29	13	12	17	18	18	11	16	7	8	27	20	17	6	24	16	6	29	7
Cadmium	mg/kg	0.1	**0.7**	**4.2**	**0.6**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	0.07	0.05	0.30	0.06
Calcium	mg/kg	50	**ng**	**ng**	**nl**	11900	9820	9220	9020	9780	10900	8760	8710	8100	7510	5600	8140	10700	4170	10500	8855	4170	11900	2017
Chromium	mg/kg	1	**52.3**	**160**	**nl**	23	13	11	15	16	18	12	15	21	14	28	22	16	11	19	17	11	28	5
Cobalt	mg/kg	0.1	**ng**	**ng**	**nl**	9.5	5.5	7.0	7.4	8.0	8.9	4.8	6.6	7.2	7.6	11.3	10.5	6.2	7.7	8.4	7.8	4.8	11.3	1.8
Copper	mg/kg	1	**18.7**	**108**	**nl**	11	6	4	6	7	8	5	7	6	8	**21**	17	7	6	10	9	4	21	5
Iron	mg/kg	20	**ng**	**ng**	**nl**	25000	15600	16300	18200	17900	20800	14000	17000	27100	17600	29500	24300	17100	19000	20200	19973	14000	29500	4517
Lead	mg/kg	0.1	**30.2**	**112**	**nl**	11.6	6.5	6.4	9.2	10.9	10.0	5.4	8.1	8.0	9.9	34.4	16.8	6.4	4.8	9.4	10.5	4.8	34.4	7.3
Lithium	mg/kg	0.1	**ng**	**ng**	**nl**	28.4	15.2	13.5	15.8	16.2	20.2	14.3	18.2	17.7	16.5	32.9	25.6	18.0	22.8	24.6	20.0	13.5	32.9	5.7
Magnesium	mg/kg	10	**ng**	**ng**	**nl**	8080	4770	5180	5540	5530	6450	4370	5430	6970	5240	9630	7590	5540	6390	6900	6241	4370	9630	1406
Manganese	mg/kg	1	**ng**	**ng**	**nl**	501	299	336	359	312	375	297	297	327	278	389	356	402	288	531	356	278	531	75
Mercury	mg/kg	0.01	**0.13**	**0.70**	**0.75**	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	0.06	<0.01	<0.01	<0.01	0.01	0.010	0.005	0.060	0.014
Molybdenum	mg/kg	0.1	**ng**	**ng**	**nl**	0.6	0.2	0.2	0.3	0.3	0.4	0.1	0.4	0.2	0.6	1.5	1	0.1	0.3	0.7	0.5	0.1	1.5	0.4
Nickel	mg/kg	1	**ng**	**ng**	**nl**	20	12	13	12	13	15	10	13	12	13	26	21	14	13	17	15	10	26	4
Potassium	mg/kg	20	**ng**	**ng**	**nl**	3920	1800	1340	2170	2160	2520	1630	1920	820	1260	4580	2940	2110	850	2570	2173	820	4580	1046
Rubidium	mg/kg	0.1	**ng**	**ng**	**nl**	20.6	9.5	6.6	11.2	11.4	13.3	8.9	10.8	4.9	7.2	22.2	16.6	11.7	4.5	13.8	11.5	4.5	22.2	5.2
Selenium	mg/kg	1	**ng**	**ng**	**nl**	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0.5	0.5	1.0	0.1
Silver	mg/kg	0.1	**ng**	**ng**	**nl**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	0.06	0.05	0.20	0.04
Sodium	mg/kg	50	**ng**	**ng**	**nl**	9240	4380	2640	3820	4320	4630	3820	3930	1620	2620	10600	6430	5460	1860	6930	4820	1620	10600	2567
Strontium	mg/kg	1	**ng**	**ng**	**nl**	52	30	26	28	32	39	29	32	29	22	32	31	36	13	41	31	13	52	9

Table 10.9 Summary of Physico-Chemical Marine Data for Sediment Samples

Analytical Parameter	Units	Reporting Limit	CCME Sediment Quality Guidelines[1]		Date	11-Dec-06	11-Dec-06	11-Dec-06	18-Dec-06	18-Dec-06	18-Dec-06	11-Dec-06	11-Dec-06	11-Dec-06	26-Mar-07	26-Mar-07	26-Mar-07	11-Dec-06	2-Apr-07	2-Apr-07	Summary Statistics All Stations			
					Depth (m)	15.2	17.4	30.5	46.3	48.8	42.7	6.1	26.2	8.5	15.0	21.0	28.0	12.2	9.0	4.2				
					CEPA Disposal At Sea Limits[4]	Station*																		
			ISQG [2]	PEL [3]		S1	S2	S3	S4	S5	S6	S9	S10	S11	S12	S13	S14A	S15	S16	S17	Mean[6]	Min[6]	Max[6]	SD[6]
Tellurium	mg/kg	0.1	**ng**	**ng**	**nl**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.05	0.05	0.05	0.00
Thallium	mg/kg	0.1	**ng**	**ng**	**nl**	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	0.06	0.05	0.20	0.04
Tin	mg/kg	1	**ng**	**ng**	**nl**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	0.5	0.5	1.0	0.1
Uranium	mg/kg	0.1	**ng**	**ng**	**nl**	0.7	0.6	0.6	0.6	0.8	0.9	0.4	0.7	0.6	0.6	0.9	1	0.6	0.3	0.6	0.7	0.3	1.0	0.2
Vanadium	mg/kg	1	**ng**	**ng**	**nl**	36	22	22	26	28	29	20	26	68	27	41	37	23	27	32	31	20	68	12
Zinc	mg/kg	1	**124**	**271**	**nl**	57	28	35	36	39	42	32	33	39	42	82	70	34	47	47	44	28	82	15
Ammonia (as N)	mg/kg	2	**ng**	**ng**	**nl**	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	8	<2	<2	<2	15	2	1	15	4
Formaldehyde and Acetaldehyde																								
Formaldehyde	µg/g	0.5	**ng**	**ng**	**nl**	4	1.9	2.2	2	2.6	1.8	1.1	0.71	0.25	-	-	-	0.89	-	-	1.75	0.25	4.00	1.08
Acetaldehyde	µg/g	1	**ng**	**ng**	**nl**	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	<1	-	-	0.5	0.50	0.50	0.00
Acid Extractables																								
Pentachlorophenol	mg/kg	0.1	**ng**	**ng**	**nl**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	<0.1	-	-	0.05	0.05	0.05	0.00
Phenol	mg/kg	0.1	**ng**	**ng**	**nl**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	<0.1	-	-	0.05	0.05	0.05	0.00
Total Dioxins	pg/g dw[7]		**ng**	**ng**	**nl**	92.6	51.2	29.3	40	53.6	56.7	53	39.3	3.64	11.4	368	130	60.1	2.17	138	47.90	3.64	92.60	22.94
Total Furans	pg/g dw		**ng**	**ng**	**nl**	19.7	11.5	8.31	8.51	12	9.95	11.1	10.8	0.86	9.37	124	63.9	11.6	0.64	36.6	10.40	0.86	19.70	4.61
Particle Grain Size																								
Gravel	%	-	**ng**	**ng**	**nl**	0.0	0.0	2.6	6.1	39.4	39.5	0.0	14	0.2	40	0.4	28.6	0	0.9	0	11.4	0.0	40.0	16.5
Sand	%	-	**ng**	**ng**	**nl**	5.5	34.6	76.7	70.3	39.9	24.4	22	34.3	97.3	46.7	13.5	29.5	8.2	97.5	22.7	41.5	5.5	97.5	30.2
Silt	%	-	**ng**	**ng**	**nl**	66.4	59.5	15.4	14	17.8	30.5	72.6	48.3	1.7	11.1	66	28.5	83.2	0.5	67.4	38.9	0.5	83.2	28.5
Clay	%	-	**ng**	**ng**	**nl**	28.1	5.9	5.3	9.7	2.9	5.5	5.4	3.4	0.9	2.2	20.1	13.3	8.5	1.1	9.9	8.1	0.9	28.1	7.5
Total Organic Carbon	%	-	**ng**	**ng**	**nl**	0.6	0.2	0.1	0.3	0.3	0.4	0.2	0.5	<0.1	0.32	2.15	1.46	0.4	0.14	0.92	0.5	0.1	2.2	0.6
Moisture Content	%	-	**ng**	**ng**	**nl**	39	43	23	28	30	28	29	22	17	17	41	26	31	18	41	29	17	43	9

Notes:

* Refer to Figure 10.2 for the location of sampling stations.

ng No guideline available.

nl No limit available.

1 Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, Canadian Council of Ministers of the Environment (CCME 2002).

2 +

2 Interim Marine Sediment Quality Guidelines (CCME), below which there is a low likelihood of adverse biological effects.

3 Probable Effects Level (PEL), above which there is a strong likelihood of adverse biological effects.

4 Limits for Ocean Disposal established under the *Canadian Environmental Protection Act* (*CEPA*, 1999, Schedule 6).

5 Sum of polycyclic aromatic hydrocarbons (PAH) analyzed in the sample; for samples where PAH were below the reporting limit, the reporting limit divided by 2 was used in calculating the sum as a conservative estimate (*i.e.,* <0.01 = 0.005).

6 In calculating the mean, parameters measured as below detection were taken as equal to the reporting limit divided by 2, thus providing a conservative estimate (*i.e.,* <0.01 = 0.005). The same was done when determining minimum and maximum values as well as for calculating the standard deviation (SD).

7 dry weight.

\- Not analyzed.

Result above the ISQG CCME guideline.

Result above the PEL CCME guideline.

Result above *CEPA* Disposal at Sea guideline.

Results obtained for the 2006-2007 surveys conducted by Jacques Whitford are comparable to results from previous studies. Chlorophyll *a* data obtained in 2004 and 2005 for the Atlantic Zone Monitoring Program (AZMP) show that the phytoplankton growth cycle in the Bay of Fundy (Prince 5 fixed station) during those years was characterized by a relatively sustained burst of growth beginning in early summer and lasting until fall (DFO 2005; DFO 2006a). Chlorophyll *a* concentrations from November 2006 to April 2007 were generally below 0.5 µg/L, with a significant increase observed during summer, with concentrations ranging from 1.10 to 6.22 µg/L, but averaging around 3 µg/L. Chlorophyll *a* profiles obtained along two offshore transects within the Bay showed that in stratified, deeper waters at the mouth of the Bay, the phytoplankton-rich layer is limited to the uppermost 20 m, while chlorophyll *a* concentrations were lower and vertically distributed in the well-mixed zone in the upper Bay (Wildish and Fader 1998). The vigorous tidal water movement in the Bay of Fundy brings the deep, nutrient-rich water to the surface, but the heavy load of sediment stirred up into suspension limits the penetration of light. As a result, the Bay's upper reaches typically have rather low productivity (Smith and Mann 2007). Hargrave *et al.* (1983) also reported that the swift tidal currents in the inner Bay keep the waters vertically mixed and highly turbid, creating a light-limited environment that impedes the production of plankton. Maximum concentrations of phytoplankton are generally observed in the deeper offshore and stratified waters at the mouth of the Bay of Fundy (Townsend *et al.* 2001).

<u>Ichthyoplankton</u>

Results for ichthyoplankton (fish eggs and larval fish) sampled at stations S2 in Mispec Bay and S12 west of Mispec Point in the Outer Harbour in spring (May 31) and summer (August 23) 2007 are presented in Tables 10.10 and 10.11. Ichthyoplankton abundance at stations S2 and S12 represent a range of potential abundance that are likely an overestimation of the density that may be entrained in the seawater cooling intake at Mispec Point, which is located closer to the shoreline. The water depth at stations S2 and S12 during sampling was generally >10 m and they are located in the vicinity of the gyres or eddies discussed previously in Mispec Bay and west of Mispec Point, respectively, that are likely to concentrate the ichthyoplankton and zooplankton in these areas.

There was a pattern of increasing density and diversity for both fish eggs and larvae per m^3 between the spring (May 31) and late summer (August 23) surveys at both sites: S2 (west of Mispec Point in the Outer Harbour) and S12 (east of Mispec Point in Mispec Bay); refer to Figure 10.2 for station locations. In the spring, the total number of eggs and larvae collected was 0.14/m^3 from the Outer Harbour and 0.35/m^3 from Mispec Bay. In the summer, the total number of eggs and larvae collected increased to 1.08/m^3 in the Outer Harbour and 2.28/m^3 in Mispec Bay. This pattern has also been observed in other parts of the Bay of Fundy. For example, in a study where samples were taken monthly from May to November, fish egg and larvae density in the Point Lepreau area of the Bay was determined to be the highest in the month of August (Washburn and Gillis 1990).

In the spring, capelin was the only species identified by the presence of larvae in the Outer Harbour, whereas the Mispec Bay samples contained both capelin and longhorn sculpin larvae. Eggs in the Outer Harbour spring samples were categorized as CYT (cunner/yellowtail; two species which cannot be distinguished during early stages) and CHW (a designation for the group of species cunner, haddock and witch flounder, which cannot be distinguished during early stages), while eggs in the Mispec Bay spring samples all fell into the CYT category. The presence of capelin larvae found in the spring samples for both sites is unusual as this is outside of their normal distribution range. However, some literature does report capelin occurring within the Bay of Fundy. Between 1965 and 1968, unusually high numbers of capelin were recorded in the Bay, and it was suggested that they were reproducing (Tibbo and Humphreys 1966; Jangard 1974). This occurrence of capelin coincided with lower than normal ocean temperatures. Capelin then reappeared on the Scotian Shelf in the early 1980s and increased in numbers throughout the 1990s, concomitant with anomalous hydrographic conditions (DFO 1997).

Table 10.10 Density of Fish Eggs in Samples Collected during Spring and Summer 2007 Surveys at Stations S2 and S12*

Eggs	Date of Sampling							
	31 May 2007				23 August 2007			
	Station**							
	S2		S12		S2		S12	
	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood
Fourbeard rockling *Enchelyopus cimbrius*		-	-	-	-	0.017	-	-
Yellowtail flounder *Limanda ferruginea*	-	-	-	-	0.025	-	-	-
Butterfish *Peprilus triacanthus*	-	-	-	-	0.025	-	-	0.010
Mackerel *Scomber scombrus*	-	-	-	-	-	-	0.05	-
Cunner *Tautogolabrus adspersus*	-	-	-	-	0.013	-	-	0.010
Hake *Urophycis* sp.	-	-	-	-	0.025	-	-	0.010
CHW egg *** (cod, haddock, witch flounder)	-	-	0.032	-	-	0.017	0.025	-
CYT egg *** (cunner, yellowtail)	0.311	-	0.032	-	0.076	0.122	0.125	0.029
H4B egg *** (hake, fourbeard rockling)	-	-	-	-	0.178	0.209	0.399	0.067

Notes:
* Density expressed as number of individuals per m^3.
** Refer to Figure 10.2 for the location of sampling stations.
*** These species cannot be differentiated until the eggs are in late stages.

Table 10.11 Density of Fish Larvae in Samples Collected During Spring and Summer 2007 Surveys at Stations S2 and S12*

Larvae	Date of Sampling							
	31 May 2007				23 August 2007			
	Station**							
	S2		S12		S2		S12	
	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood
Fourbeard rockling *Enchelyopus cimbrius*	-	-	-	-	-	0.052	-	-
Herring *Clupea harengus*	-	-	-	-	0.025	0.070	-	0.058
Cunner *Tautogolabrus adspersus*	-	-	-	-	-	-	0.050	-
Haddock *Melanogrammus aeglefinus*	-	-	-	-	-	-	-	0.010

Table 10.11 Density of Fish Larvae in Samples Collected During Spring and Summer 2007 Surveys at Stations S2 and S12*

Larvae	Date of Sampling							
	31 May 2007				23 August 2007			
	Station**							
	S2		S12		S2		S12	
	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood
Longhorn sculpin *Myoxocephalus octodecemspinosus*	-	-	-	0.034	-	-	-	-
Capelin *Mallotus villosus*	-	0.032	0.032	0.011	-	-	-	-
Lobster *Homarus americanus*	-	-	-	-	0.013	0.017	-	-
Sand lance *Ammodytes* sp.						1.000		

Notes:
* Density expressed as number of individuals per m^3.
** Refer to Figure 10.2 for the location of sampling stations.

In the summer, both larvae and eggs in samples represented seven identified species from Mispec Bay: fourbeard rockling; yellowtail flounder; butterfish; cunner; herring; hake, and sand lance, along with CYT, CHW and H4B. (A designation for the group of species hake (*Urophysis* sp.), butterfish (*Peprilus* sp.) and fourbeard rockling (*Enchelyopus* sp.) cannot be distinguished during early fish egg stages.) Sand lance was the most dominant species found in Mispec Bay (44% of total abundance), followed by unidentified species within the H4B category (17% of total abundance), and unidentified species within the CYT category (9% of total abundance). All other species fell within the range of 0.01-0.025 eggs and larvae/m^3 (0.004-1.0% of total abundance), with cunner having the lowest density. In the Outer Harbour, both larvae and eggs in the summer samples represented six identified species: butterfish; cunner; herring; hake; mackerel; and haddock. Most of the eggs collected in the Outer Harbour were unidentified and fell into the H4B category (43% of total abundance) or the CYT category (14%). Positively identified dominant species in the Outer Harbour during the summer included herring (5.5% of total abundance), cunner (5.5% of total abundance) and mackerel (4.6% of total abundance). All other species were represented by 0.01 to 0.025 eggs and larvae/m^3 (0.01-2.0% of total abundance). It should be noted that lobster larvae were observed only in Mispec Bay and were in low abundance (1.0% of total abundance).

Capelin and longhorn sculpin were the only species identified to spawn earlier in the season, whereas butterfish, white hake, fourbeard rockling, mackerel and lobster appear to spawn later in the season. These spawning times coincide with the data available (DFO 1997; DFO 1998; Graham *et al.* 2002; Markle *et al.* 1982). Several fish species found in the Bay of Fundy, including herring, haddock and pollock, have their reproduction centred at the mouth of the Bay of Fundy or outside the Bay (Iles 1979; Kohler 1979). For example, haddock spawn in three principal areas in the northwest Atlantic (Western Bank, Browns Bank and Georges Bank), and do not spawn in nearshore areas (Shackell *et al.* 1999). Similarly, adult fourbeard rocklings and hake typically spawn offshore during the summer months (Markle *et al.* 1982; Fahay and Able 1989). It is therefore likely that a high percentage of the eggs and larvae collected in this study during the spring and summer surveys were products of offshore spawning being carried into the Marine PDA by tidal influx.

Overall, while Mispec Bay appears to be somewhat more productive than the Outer Harbour, possibly due to weaker currents and the presence of an eddy (Section 10.2.3), the total numbers of eggs and larvae collected at both sites, even during the summer, were low (1.08/m^3 in the Outer Harbour and 2.28/m^3 in Mispec Bay compared, for example, to 13 eggs/m^3 sampled in Chaleur Bay in northern New Brunswick (A. Bielecki, personal communication, April 11, 2008). This low level of productivity is directly correlated with the low levels of primary production observed throughout the Marine PDA, and is supported by existing literature (DFO 1998; Frank *et al*. 1989; Lazzari 2001).

In summary, the biological processes within the Bay are strongly influenced by physical processes, the most dominant of which is tidal mixing. Pelagic primary production is controlled largely by light availability, which is controlled by vertical stratification and turbidity. Levels of phytoplankton found within the Marine PDA are low in relation to those found in the Outer Bay, as swift tidal currents keep waters vertically mixed and highly turbid, creating a light-limited environment that impedes the production of plankton. Consequently, the low levels of ichthyoplankton are directly correlated with the low levels of primary production observed.

In conclusion, productivity in the Marine PDA is relatively low due to physical processes, but still adequate for supporting fish populations.

10.2.4.4 Benthic Habitat

A general description of the benthic habitat in the Marine PDA is provided below and is based primarily on the work conducted for this Project.

Intertidal Zone

The extreme tides in the Bay of Fundy result in extensive intertidal zones, particularly in shallow-water regions at the head of the Bay of Fundy and at certain locations along both the New Brunswick and the Nova Scotia coasts. The predominant intertidal seaweed in the Bay of Fundy is the knotted wrack (*Ascophyllum nodosum*) fucoid alga. The remainder of the seaweed community is comprised of other fucoid algae such as bladder wrack (*Fucus vesiculosus*) and spiral wrack (*F. spiralis*) (Jacques Whitford 2003).

The intertidal habitat of Area A within the Marine PDA and at the proposed location of the marine terminal west of Mispec Point is representative of a semi-exposed marine ecosystem. Shelter is provided to the east and north by the back shore land mass. The back shore land mass also provides some protection to the west, particularly the northwestern portion of the survey area. The shoreline consists primarily of boulder and bedrock margins (20 to 60 m in width) which rise on occasion to steep rock cliffs in the back shore (Figure 10.26). The bedrock shoreline in this area is characterized by ledges, boulders, and outcrops, and apt to form inclined, ramped or irregular shores. The intertidal zone is narrow in this area and is almost completely covered and dominated by a brown algal community comprised mainly of knotted wrack and bladder wrack (Figure 10.27), with the presence of barnacles (*Balanus* sp.; Figure 10.28) and red algae (*e.g., Polysiphonia* sp.). A similar intertidal habitat is found at the location of the seawater cooling intake.

The marine habitat of Area B and Area D and at the location of the barge landing facility is also representative of a semi-exposed marine ecosystem. Shelter is provided to the west, north and east by the back shore land mass. As for the marine terminal location, the shoreline consists of predominantly boulder and bedrock margins (20 to 100 m in width), transitioning into forest in the back shore throughout the area (Figure 10.29). The cover in the narrow intertidal zone of the barge landing facility is similar to the marine terminal location in that it is dominated by a brown algal community, mainly knotted wrack and bladder wrack with the presence of barnacles and red algae.

Figure 10.26 Typical Shoreline and Intertidal Zone Observed in Area A and West of Mispec Point

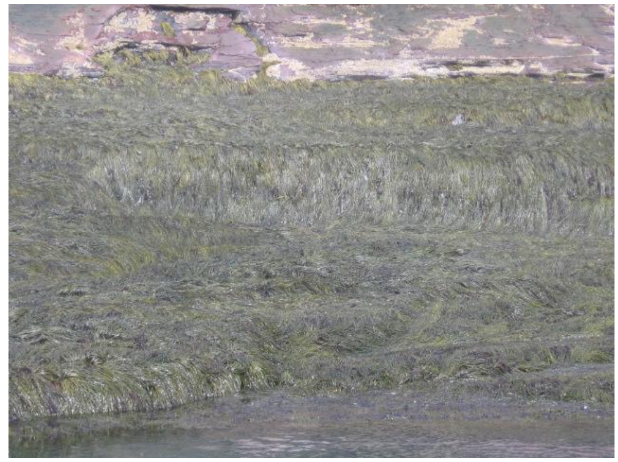


Figure 10.27 Complete Fucoid Cover in the Intertidal Zone and Typical Along the Project Shoreline

Figure 10.28 Barnacles in the Intertidal Zone Along the Project Shoreline

Figure 10.29 Intertidal Zone in Area D Towards the Northwest in Mispec Bay

Subtidal Zone

The distribution of substrate and benthic habitat types in the Marine PDA are shown in Figure 10.30. Characterization of the substrate type was also based on the marine geophysical results described in Section 10.2.3 and on diver and offshore video observations. The bedrock subtidal zone contains a high level of benthic biodiversity and reflects a healthy ecosystem. Nearshore benthic habitat throughout the Marine PDA consists of large and small boulders and bedrock interspersed with cobble, mixed sediment and silty sand (Figure 10.31). On larger substrate, colonial organisms like leafy bryozoans, barnacles, sponges and hydroids are the dominant species (Figure 10.32). Leafy bryozoans are particularly common west of Mispec Point in the footprint of the proposed marine terminal in shallower water. On silty sand substrate, west and east of Mispec Point, New England dogwhelk snails and sand shrimp are dominant, as are the sea squirt tunicates commonly called sea potatoes or sea grapes (Figure 10.33). Molluscs such as lamp shells (*Terebratulina septentrionalis*), blue mussels (*Mytilus* sp.) and jingle shells (*Anomia simplex*) occur in dense patches on larger substrate throughout the Marine PDA, and periwinkle snails are common just west of Mispec Point in the footprint of the existing SBM pipeline, as well as within Inner Mispec Bay. The invasive green crab was also present within Inner Mispec Bay, but was not present to the west of Mispec Point. Species that were sporadically encountered throughout the Marine PDA include lobster, toad crab, mysid shrimp, hermit crab, rock crab, juvenile flatfish, rock gunnel, sea raven, *Asterias* seastar, fat bloodstar, sea slug, Mermaid's glove, maned nudibranch, northern red anemone, northern cerianthid, sea scallop, Northern shrimp, and common green sea urchin.

Dominant seaweed species in the nearshore throughout the Marine PDA include sea oak, red encrusting coralline algae and sour weed. Rockweed and knotted wrack are common in the intertidal/shallow subtidal zones. Fingered kelp is encountered relatively frequently, and sea lettuce, laver, sea colander (*Cladophora* sp.), brown kelp and other species of red, green and brown algae are encountered sporadically throughout the Marine PDA.

The offshore benthic habitat of the Marine PDA is dominated by silty sand (Figure 10.30), with a small area of sand with shell hash to the east of Mispec Point and occasional rubble outcrops throughout (Figure 10.34). The benthic community found on this type of substrate is comprised primarily of infaunal organisms living in the soft sediment, such as burrowing tube-building worms, and siphon-bearing organisms, like clams and other similar bivalves. Epifaunal animals living on the surface sediment are uncommon or absent, but include occasional *Asterias* seastars, lobster, hermit crabs, flatfish and sculpin. Sand dollars are also common in the sand with shell hash habitat in Inner Mispec Bay, and sand shrimp are observed throughout the Inner Mispec Bay. Various red, green and brown algae are also observed on rubble outcrops throughout the Inner Mispec Bay.

In general, the results from the benthic invertebrate grab sampling were similar to those of previous studies conducted in 2002 and 2003 for Environment Canada. As documented in those reports, the stations surrounding the Black Point ocean disposal site support a diverse benthic invertebrate community dominated by deposit feeding organisms (worms) but also include some suspension feeders such as polychaete fan worms, clams and tunicates. Furthermore, the results of the field work suggest that the community appears to be similar to natural communities in other locations on the east coast of North America with respect to supporting benthic invertebrate communities based on the type of substrate. The results from the spring and summer benthic invertebrate sampling field work were similar. However, the summer samples offered a greater number of identifiable individuals of different taxa as well as higher abundance values.

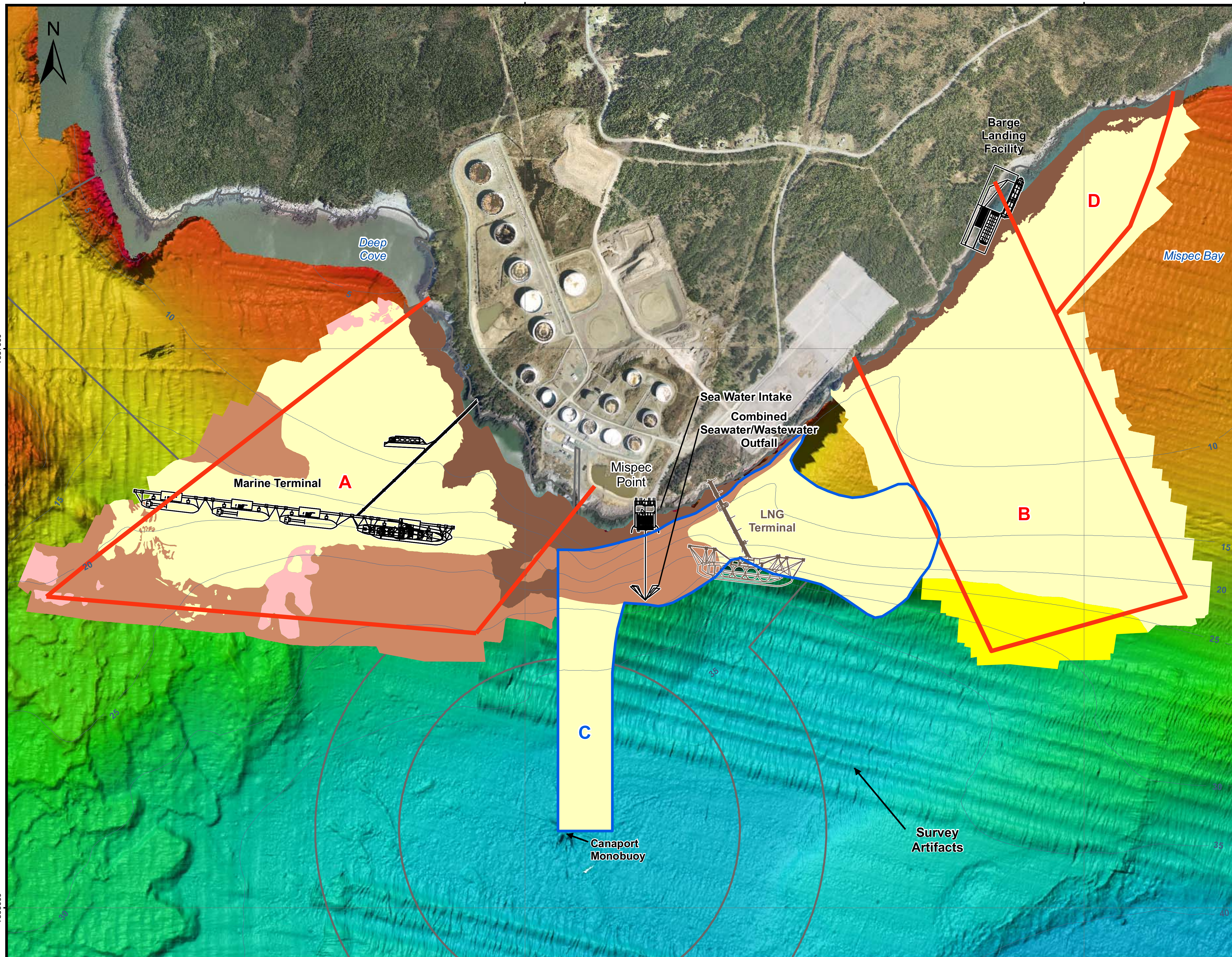


Figure 10.30

Schematic of the Distribution of Substrate and Benthic Habitat Types

Project Eider Rock

Map Features

- 2003 Survey Area (JW 2004)
- 2007 Survey Area
- Project Component
- Existing Component
- Bathymetry Contour (m)
- Bedrock with Discontinuous Mixed Sediment - Diverse Epifaunal Organisms (e.g. Branching Bryozoans, Barnacles, Hydroids, Sponges, Seastars, Algae, Crabs, Mussels, Lobsters)
- Gravel/Mixed Sediment - Epifaunal Organisms (e.g. Seastars, Crabs, Lobsters)
- Thin Sand Veneer on Gravel - Epifaunal Organisms (e.g. Seastars, Crabs, Lobsters)
- Silty Sand - Mainly Infaunal Organisms (e.g. Tunicates, Clams, Polychaetes, Mobile Lobsters)
- Sand with Shell Hash - Mainly Infaunal Organisms (e.g. Tunicates, Clams, Polychaetes, Sand Dollars, Mobile Lobsters)
- CanaportWaterLot

Bathymetry Data Source:
Fugro Jacques Geosurveys Inc. (2007)
Aerial Photography Data Source:
City of Saint John, GIS Division,
Property Data Source: Service New Brunswick

0 200 400 600 800
Metres

Map Parameters
Projection: NB Stereographic
Scale: 1:15,000
Date: August 8, 2008
Project No.: 1013263.

Jacques Whitford

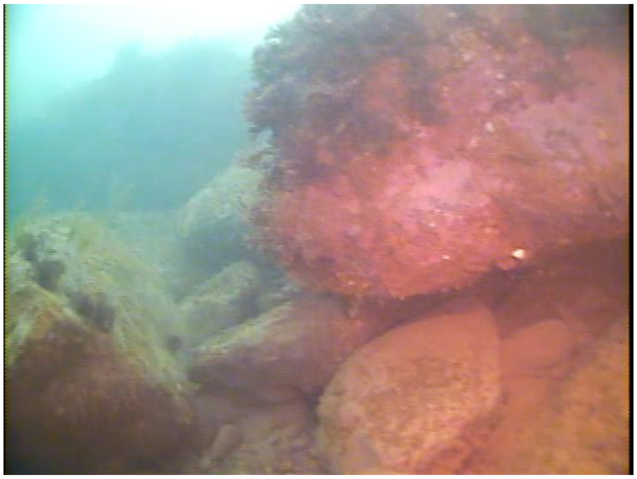


Figure 10.31 Substrate in Area A

Boulder in upper right quadrant of figure is covered in pink encrusting coralline algae (*Lithothamnion* sp.) and the red seaweed, sea oak (*Phycodrys rubens*). This figure is typical of this type of substrate found in all of the survey areas and at varying water depths.

Figure 10.32 Mermaid's glove (*Haliclona oculata*)

Sour weed (*Desmarestia* sp.; filamentous algae growing on top of rock), lamp shells (*Terebratulina septentrionalis*; open white/yellow bivalves), Mytilus mussels (dark grey/blue bivalve centre-right), and jingle shells (*Anomia simplex*; white nodules upper right) are noted species in the figure.

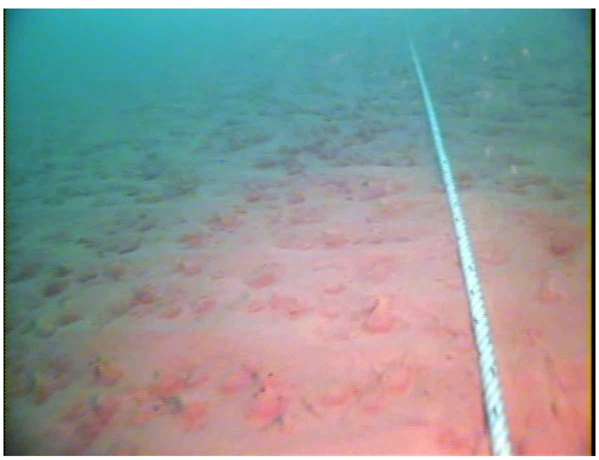


Figure 10.33 Tunicates (sea potatoes; *Bostrichobranchus pilularis*) in Area B

Also found in Area A. Silty sand substrate was found in all survey areas.

Figure 10.34 Large and Small Boulder Outcrops with Leafy Bryozoan (*Flustra foliacea*)

Colonies located around waypoint A18 in Area A off Mispec Point (~25 m water depth, chart datum). (Refer to Figure 10.3 for location of waypoint.)

10.2.4.5 Fish

The Bay of Fundy, which is the RAA for the Marine Environment for this Project, is characterized by a wide variety of habitat types (Buzeta *et al.* 2003). Over 100 fish species can be found in the Bay of Fundy (Figure 10.1). Many of these species occur near Mispec Point and the Marine PDA (Figure 10.2). The list of fish found most commonly or that are most commercially important in the Bay of Fundy as well as species of special status are listed in Tables 10.12 and 10.13, respectively.

Fish occurring in the Bay of Fundy include resident species, which complete their entire life cycle in the Bay, and those that enter the Bay only during spawning or feeding migrations. Migrating fish species are mainly from the Scotian Shelf and the Gulf of Maine, but do include migrants from as far away as Chesapeake Bay (striped bass, *Morone saxatilis*), the Sargasso Sea (American eel, *Angullia rostrata*), and the coast of Labrador (Atlantic salmon, *Salmo salar*).

With respect to commercially important species, herring (*Clupea harengus*), cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), and pollock (*Pollachius virens*) captured in the Bay are part of stocks that have centres of reproduction at the mouth of the Bay or just outside the Bay (Iles 1979; Kohler 1979).

Table 10.12 Commercially Important Species Found in the Bay of Fundy and the LAA

Common Name	Scientific Name	Additional information
Groundfish (cod, haddock, pollock, halibut, winter flounder)	*Gadus morhua, Melanogrammus aeglefinus, Pollachius virens, Hippoglossus hippoglossus, Pseudopleuronectes americanus*	Fished commercially
Spiny dogfish	*Squalus acanthias*	Fished commercially
Herring	*Clupea harengus*	Fished commercially
Mackerel	*Scomber scombrus*	Fished commercially
American shad	*Alosa sapidissima*	Fished commercially
Alewife	*Alosa pseudoharengus*	Fished commercially
Blueback herring	*Alosa estivalis*	Fished commercially
Atlantic sturgeon	*Acipenser oxyrhynchus*	Rare, Migratory
Lobster	*Homarus americanus*	Fished commercially
Scallop	*Placopecten magellanicus*	Fished commercially
Sea urchin	*Strongylocentrotus droebachiensis*	Fished commercially, 1 licence

Table 10.13 Species of Special Status in the Bay of Fundy

Common Name	Scientific Name
Atlantic salmon	*Salmo salar*
Striped bass	*Morone saxatilis*
Atlantic wolffish	*Anarchichas lupus*
Atlantic cod	*Gadus morhua*
Shortnose sturgeon	*Acipenser brevirostrum*
American eel	*Anguilla rostrata*

The Saint John River freshwater environment is not considered within the spatial boundaries of the LAA for the Marine Environment (Figure 10.1). However, it is important to note that many of the fish found in the Marine PDA are estuarine or anadromous species and thus migrate further into the Saint John River watershed. These include American shad (*Alosa sapidissima*), alewife (*Alosa pseudoharengus*), tomcod (*Michragadus tomcod*), shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrhynchus*), blueback herring (*Alosa estivalis*), and smelt (*Osmerus* spp.).

While the fish included above are by no means an exhaustive list of all fish present in the Bay of Fundy, they are considered the most important, either because of their commercial importance or for conservation reasons.

The lobster (*Homarus americanus*) is perhaps the most commercially important species in New Brunswick. Lobsters are found in coastal waters from southern Labrador to the coast of Maryland. Along the east coast of Canada, lobsters make short-distance seasonal movements from relatively deep waters (15 m to 18 m) in winter to shallower waters (7 m to 9 m) in summer. Adult lobsters in the Bay of Fundy may participate in long distance (>50 km) seasonal migrations to the Gulf of Maine (DFO 2001). Lobsters prefer any habitat where shelter is readily available such as rocky bottoms or on sand and mud where there are larger rocks for hiding. Lobsters are commercially fished in and around the Marine PDA and LAA.

Both juvenile and adult lobster tolerates water temperatures ranging from -1°C to 30.5°C. However, water temperatures of less than 8°C to 10°C are required during winter for proper synchrony of moulting and reproductive cycles. Lobsters mate between July and September. Females extrude ("birth") the eggs one year after mating and carry the eggs on their abdomen for another year. Lobster larvae are planktonic for a period of 30 to 60 days before settling on the bottom and seeking shelter. Lobsters can live 40 to 50 years.

Atlantic sea scallop (*Placopecten magellanicus*) is also a highly important commercial species in New Brunswick and is also fished in the LAA.

Similarly, the green sea urchin (*Strongylocentrotus droebachiensis)* is the most widely distributed of all echinoderms (Pearce 1998). It is found in the Atlantic Ocean from New Jersey to the Arctic, extending east to Britain and in the Pacific Ocean from Washington to Alaska.

Sea urchin is most plentiful in shallow waters less than 10 m deep, although it may be found down to 1,200 m. Urchin can be found on virtually any type of substrate, but it generally prefers harder surfaces. In New Brunswick, it is more commonly found attached to rocky surfaces, but has also been found attached to seaweed and wharf pilings.

The fish species discussed above either are considered commercially important (*e.g.,* lobster, scallop), scarce (*e.g.,* cod), or migrate in rivers and which are not listed in the federal *SARA* or the NB *ESA*. These species are common and known to be present in the LAA, as well as in the entire Bay of Fundy, and are likely to be present in the Marine PDA.

Green sea urchins and Atlantic sea scallops were observed on occasion and in relatively low numbers during nearshore and offshore underwater video transect surveys in the Marine PDA. They are, however, more abundant in other areas of the Bay of Fundy and where the substrate contains less silty sand. Lobsters were also observed occasionally in both the nearshore and offshore video transect surveys in the Marine PDA, and is relatively common in the LAA and throughout the Bay of Fundy.

Five marine fish species of special status may be present within the LAA, although their presence in the LAA has not been confirmed in this EA: the Atlantic salmon (possibly), Atlantic wolffish, shortnose sturgeon, striped bass, and American eel. (Atlantic cod, while listed in Table 10.13, is not likely to be present in large numbers in the LAA—it is thus not discussed further in this CSR). None of these five species were observed in the Marine PDA during the field investigations conducted in support of this CSR. The most likely residents are the American eel and the striped bass. The shortnose sturgeon and Atlantic salmon, if present, would only remain in the area for a short period of time during their migratory period. If present in the Bay of Fundy, it would more likely be found on the Nova Scotia side of the Bay.

10.2.4.6 Marine Mammals

Up to 17 species of marine mammals occur in varying density throughout the Bay of Fundy (Table 10.14). The majority of these species occur in the lower Bay of Fundy between June and

October, although some of the smaller species, including the harbour porpoise (*Phocoena phocoena*) and harbour seal (*Phoca vitulina*), are considered year-round residents and have been reported in the shallow waters of the upper Bay.

Four species of marine mammals listed on the federal *Species at Risk Act* (*SARA*) occur in the Bay of Fundy. These species are harbour porpoise (Special Concern); fin whale (Special Concern); North Atlantic right whale (Endangered); and blue whale (Endangered). Within the LAA, harbour porpoise is the most abundant *SARA*-listed marine mammal. Although widely distributed in the Bay of Fundy, harbour porpoise is more abundant in the lower Bay of Fundy than it is within the LAA. Fin whale, North Atlantic right whale and blue whale are not known to occur in the LAA. These species are more common in the lower Bay of Fundy where they congregate during the summer months to feed. Blue whale is very rarely observed in the Bay of Fundy, while fin whale and right whale are commonly observed. The distribution of North Atlantic right whale is well documented (Figure 10.35), with peak abundance occurring in the Grand Manan Right Whale Conservation Area between the months of August and October.

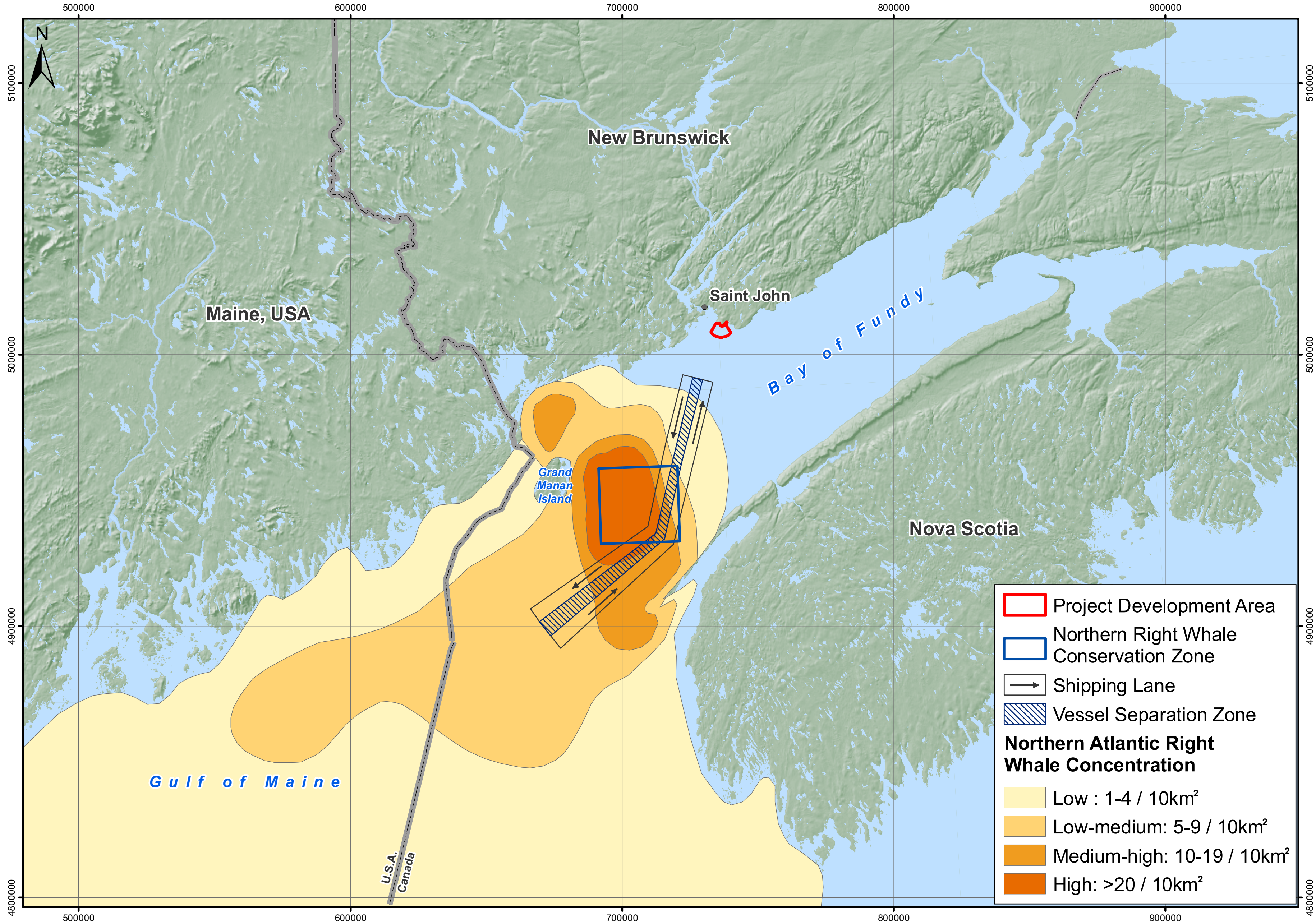
Although not a marine mammal *per* se, the leatherback sea turtle has been observed in the Bay of Fundy, but mostly along the west coast of Nova Scotia and offshore of Atlantic Canada. The principal activity of leatherback sea turtles in Canadian waters is feeding and primarily on jellyfish. Therefore, their distribution can be expected to be closely tied to where abundant concentrations of jellyfish are present, during the summer months.

Marine mammals have high ecological and socio-economic importance in the Bay of Fundy; they represent key components of the marine food web and provide a focus for ecotourism activities.

Table 10.14 Marine Mammal Species of the Bay of Fundy

Common Name	Latin Name	Status under *Species at Risk Act / COSEWIC*	Occurrence in Bay of Fundy*
North Atlantic right whale	*Eubalaena glacialis*	Endangered	Common
Fin whale	*Balaenoptera physalus*	Special Concern	Common
Northern minke whale	*Balaenoptera acutorostrata*	Not at Risk	Common
Harbour porpoise	*Phocoena phocoena*	Special Concern	Common
Humpback whale	*Megaptera novaeangliae*	Not at Risk	Occasional to Common
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Not at Risk	Occasional to Common
Long-finned pilot whale	*Globicephala melas*	Not at Risk	Occasional
Sei whale	*Balaenoptera borealis*	Data Deficient	Occasional
Sperm whale	*Physeter macrocephalus*	Not at Risk	Occasional
Blue whale	*Balaenoptera musculus*	Endangered	Rare
Pygmy sperm whale	*Kogia breviceps*	Not at Risk	Rare, sporadic visitor
White-beaked dolphin	*Lagenorhynchus albirostris*	Not at Risk	Rare, but previously common
Northern bottlenose whale	*Hyperoodon ampullatus*	Endangered	Extremely rare
Harbour seal	*Phoca vitulina*	Data Deficient	Common
Grey seal	*Halichoerus grypus*	Not at Risk	Occasional but increasing
Hooded seal	*Cystophora christata*	Not at Risk	Rare
Harp seal	*Phoca groenlandica*	Not at Risk	Rare
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	Rare

*As defined by the Bay of Fundy Species Information System



Map Parameters
Projection: UTM, NAD83, Zone 19
Scale: 1:2,000,000
Date: August 8, 2008
Project No.: 1013263.
Data Sources:
- Chart adapted from the Canadian Hydrographic Service, Minister of Fisheries and Oceans 2002, Chart Number 4011
- Read et al. 2008 (OBIS - SEAMAP)
- Smedbol et al. 2005
- Right Whale Consortium (2008). North Atlantic Right Whale Consortium Sightings Database 04/16/2008 (New England Aquarium, Boston, MA, U.S.A.)
Base Data Provided By: ESRI, SNB

Figure 10.35 Northern Atlantic Right Whale Observations in the Bay of Fundy, 1967 - 2007

Project Eider Rock

Jacques Whitford

During public communication events conducted to date for the Project, members of the public and stakeholders have raised concerns about the potential environmental effects of the Project on marine mammals and especially the North Atlantic right whale, which is further discussed below.

Population Status of the North Atlantic Right Whale

The North Atlantic right whale was first listed as endangered in 1970 under the United States *Endangered Species Act* (Federal Register 1970) and has since been listed under both COSEWIC and Schedule 1 of *SARA* as Endangered in May 2003 (COSEWIC 2003) and internationally on the IUCNs (World Conservation Union) Red List of Threatened Species. The population was recently estimated at 322 individuals (COSEWIC 2003). The causes of North Atlantic right whale decline are unknown, however, ship-strikes, entanglement with fishing gear, and changes in food availability have been suggested as possibilities (Kraus 1990). Other potential threats to right whale includes habitat loss and degradation, infectious disease, contaminants, marine biotoxins, disturbance from tourism, and an inadequacy of prey due to changes in ocean climate (Environment Canada 2008e).

Although the North Atlantic right whale is prevalent in the RAA (particularly off Grand Manan Island), it is not known to use the waters in the LAA or Marine PDA. However, its scarcity and vulnerability requires special attention when assessing the environmental effects of any project in the Bay of Fundy.

Distribution and Habitat Use of the North Atlantic Right Whale

In early spring, North Atlantic right whale migrates northward from its wintering grounds in the coastal waters of the southeastern United States and arrives in the lower Bay of Fundy in June and July. The whale remains in the Bay of Fundy throughout the summer and fall and is generally found distributed over the Grand Manan basin (Figure 10.35), and in the vicinity of Roseway Basin between Browns and Baccaro banks on the western Scotian Shelf. It is also seen in small numbers in the summer and fall elsewhere on the Scotian Shelf and in the Gulf of St. Lawrence along the lower north shore and east of the Gaspé Peninsula (Environment Canada 2008e). Most individual whales move southward beginning in October (Winn *et al.* 1986), though some may remain in the lower Bay of Fundy as late as December (Mellinger *et al.* 2007). No records of right whale in the upper Bay were located during the research for this EA. Distribution of North Atlantic right whale in Figure 10.35 is also based on the North Atlantic Right Whale Consortium (NARWC) latest sightings database of April 2008 (Right Whale Consortium 2008). It should be noted that raw sighting data from the NARWC database are not effort-corrected and the management documents in which they are used are not peer reviewed. Distributional patterns based on these data are likely to be biased by where, and when, surveys were conducted.

The principal activity of North Atlantic right whale in the Bay of Fundy is foraging (Winn *et al.* 1986; Baumgartner and Mate 2003). The right whale feeds primarily on the small, crustacean copepod (*Calanus finmarchicus*) in its oil-rich development stage, although they may also feed on smaller zooplankton such as *Pseudocalanus mintus*, *Centropages* spp. and barnacle larvae (Mayo and Marx 1990). The distribution of stage-V *C. finmarchicus* prey seems to be the main determinant of right whale distribution in the lower Bay of Fundy during the summer months (Environment Canada 2007e) and is thought to result in the right whale congregating at depths of 100-200 m around Grand Manan Basin where *C. finmarchicus* tend to be in high abundance (Baumgartner and Mate 2005). The specific location of prey concentration tends to vary annually within the lower Bay of Fundy, as a result, right whale distribution has also been noted to vary on a scale of approximately 50 km from one year to the next (Baumgartner *et. al* 2003). Although localized use of the lower Bay of Fundy is unpredictable, this area presents an important habitat for the North Atlantic right whale (Baumgartner and Mate 2005).

The lower Bay of Fundy is the only known nursery area for North Atlantic right whale (Knowlton *et al.* 1992; Schaeff *et al.* 1993). The majority of mother-calf pairs have been observed to the east of Grand Manan Island in the months of July to mid-October (Kenney *et al.* 2001). Birthing does not occur in the Bay of Fundy; however, it is likely that courtship and mating do as these behaviours occur between August and October when right whales are known to be in the area (Kraus and Hatch 2001). Females give birth to a single calf starting at approximately ten years of age. In 1995, the expected number of reproductive events during a female's lifetime was 1.26; this is down from an estimated 5.27 in 1980 (Fujiwara and Caswell 2001).

In 1993, two North Atlantic right whale conservation areas were established by DFO: the Grand Manan in the lower Bay of Fundy (Figure 10.35), and the Roseway Basin off the southern Scotian Shelf (Brown *et al.* 1995). The main purpose of these conservation areas is to raise right whale awareness, to alert ship captains of right whale presence in shipping lanes in the lower Bay of Fundy, and to provide guidance to mariners when in the vicinity of right whales. The Canadian Right Whale Recovery Plan was produced in 2000 and placed heavy focus on the movement of shipping with the hope of reducing the probability of vessel-whale collisions (NARWRP 2000). In the United States, three coastal areas along the Eastern seaboard have been designated as "critical habitat" under the *Endangered Species Act* (National Marine Fisheries Service 2005). In 2006, the National Marine Fisheries Service proposed regulations to implement speed restrictions on vessels in certain locations and at certain times of the year along the US Atlantic seaboard, with the intention of reducing ship strikes to North Atlantic right whale (Federal Register 2006).

Transport Canada permanently diverted the shipping lanes away from the Grand Manan Basin conservation area for right whale on July 1, 2003, by approximately 5.5 km to the east towards Nova Scotia. The vessel traffic lane change in this area was adopted as part of the North Atlantic Right Whale Recovery Plan (2000), led by DFO, to reduce collisions with right whales nursing and feeding in this area during late summer. Irving Oil was a key participant in the process that led to this change. As a result, this reduced the relative potential for accidental collisions by approximately 80% (Environment Canada 2008e).

Dr. Moira Brown, New England Aquarium in Boston, MA, and Dr. Jerry Conway, DFO in St. Andrews, NB, co-chair the Canadian Recovery Team for the North Atlantic right whale (Environment Canada 2008e). The Recovery Team is currently preparing a new recovery strategy to be compliant with *SARA* that will incorporate new findings and will review and update the recovery objectives and strategies (Environment Canada 2008e). All right whale research, monitoring, and recovery activities in Canadian waters are approved through DFO, who is responsible under *SARA* and the *Marine Mammal Regulations*. Currently, a key priority of the Recovery Team to reduce accidental collisions and disturbance to right whale is to promote outreach to marine vessel operators. This objective is being accomplished by providing educational brochures and seasonal Canadian Coast Guard whale alerts in the two areas in which the North Atlantic right whale congregates in Canadian waters (Bay of Fundy and Roseway Basin on the western Scotian Shelf). "The intention is to raise awareness of right whales, to avoid these areas if possible, and to provide guidance to the marine vessel community while in the presence of whales. Compliance with the guidelines is voluntary" (Environment Canada 2008e). Other recovery activities include the issue of reducing the number of right whales that become entangled in fishing gear and outreach of the Recovery Team to increase mariner awareness of the right whale.

10.2.4.7 Marine Birds

The Project is located entirely within the Fundy Coastal Ecoregion, which includes the entire coastline of southern New Brunswick from the east side of Passamaquoddy Bay to the east side of Shepody Bay. The Fundy Coastal Ecoregion includes the Fundy Isles of Grand Manan, Deer, Campobello, and Machias Seal. The Marine PDA includes the nearshore habitat between Mispec Beach and Anthonys Cove seaward to the entrance of the major shipping lanes. The LAA includes the seacoast between Cape Spencer and Anthonys Cove and extends out to the major shipping lanes that enter the Saint John Harbour (Figure 10.1). Few bird species of special status (either SAR or SOCC) have been recorded in this area of the Bay of Fundy.

The Bay of Fundy has been known for many years by birdwatchers and ornithologists as an important part of the Atlantic Flyway, and is located on a major migration route (Dietz and Chiasson 2000). The Bay of Fundy is particularly known for its tidal amplitude which can peak at 12 m in the upper Bay. This creates large expanses of mudflats where thousands of migrating shorebirds feed to accumulate fat reserves for their migration flights (Dietz and Chiasson 2000). Nutrient sources entering the lower Bay, in combination with the large tidal exchange, create feeding areas where upwelling events bring nutrients and plankton to the surface that produce abundant food resources for consumers from zooplankton to whales. Some seabirds consume large quantities of zooplankton, while others rely on fish that are consuming zooplankton. Besides the mudflats and the open bay feeding areas, the rocky coastlines also offer feeding opportunities for shellfish-eating waterfowl such as common eider (*Somateria mollissima*), the only sea duck to breed in the Bay of Fundy, and the harlequin duck (*Histrionicus histrionicus*), which winters there. Harlequin duck is observed along the coast between St. Martin’s and Grand Manan Island, while the common eider can be observed higher in the Bay, towards Cape Enrage and the Petitcodiac River.

The eastern population of harlequin duck is an endangered species under the NB *ESA* and listed as “special concern” on Schedule 1 of *SARA* since May 2001. Harlequin duck mostly breed throughout much of Labrador, along eastern Hudson Bay, and the northern peninsula of Newfoundland. There are also known breeding populations along the north shore of the Gulf of St. Lawrence, the Gaspé Peninsula, northern New Brunswick, and southeastern Baffin Island in Nunavut (Environment Canada 2008f).

Harlequin duck migrates and spends the winter on the east and south coasts of Newfoundland, in southeastern Nova Scotia, in southern New Brunswick, in Maine, and at a few locations south of Cape Cod. Small groups may also spend the winter along the Gaspé Peninsula and Anticosti Island of Québec, and a few individuals may spend the winter in Prince Edward Island. Approximately half the wintering population can be found in New England (Environment Canada 2008f). During the winter, the harlequin duck is often associated with offshore islands, headlands, and rocky coastline where the surf breaks against rocks and ice build-up is minimal. These ducks feed close to rocky shorelines.

The eastern North American wintering population of harlequin duck has declined from historical estimates of 5,000-10,000, to fewer than 1,500 individuals. However, its numbers appear to be increasing in North America over the last ten years to an estimated 3,700 individuals, with less than 2,000 individuals in Canada (Environment Canada 2008f). The reasons for the decline of the harlequin duck is not clearly known, but over-hunting is believed to be an important cause; harlequin duck hunting has not been permitted since 1990. In addition, the contamination, destruction, and alteration of their habitat for breeding and wintering grounds and the food supply are considered important factors for the decline of the eastern population of the harlequin duck, likely because of industrial activities and spills threatening its wintering habitat (Environment Canada 2008f). A Management Plan for the harlequin duck eastern population has been prepared (Environment Canada 2007d). The Management Plan is intended to address maintaining population levels and protecting important habitat by assessing threats and to develop an approach for addressing and mitigating environmental effects.

The only marine protected area (MPA) designated under the *Oceans Act* in the Bay of Fundy is the Musquash Estuary, which is located 20 km southwest from Saint John. It was officially designated as Canada's sixth MPA on March 7, 2007. This estuary supports high biological productivity with a variety of coastal habitats and a fully functioning estuary and salt marsh complex, supporting a diversity of migrating marine birds (Deichmann 2001). The spring migration of marine birds, particularly the sea ducks, consists of the common eider and three species of scoter (the black scoter is the most common, followed by the surf scoter and the white-winged scoter).

In the upper Bay of Fundy (approximately 100 km northeast from the Project) Cape Enrage Nature Preserve, the Shepody National Wildlife Area, and Mary's Point Ramsar Site preserve habitat necessary for large flocks of migrating shorebirds and waterfowl. However, this Project will not encroach on areas within the Bay of Fundy Coastal Ecoregion that have been designated for protection/management. There are few bird species of special status that have been reported during field investigations for this Project or other recent projects that are known to inhabit or are thought to use the Marine PDA during the breeding season.

Aerial surveys indicate that the Quoddy region (including Grand Manan Island and the Wolves Archipelago) was the most important staging area for sea ducks during spring and fall migration in the Bay of Fundy (Percy *et al.* 1997). The black scoter (*Melanitta nigra*) is the most abundant species observed during migration (Dietz and Chiasson 2000). The majority of the spring migration takes place over a period of 5-6 weeks between late March and early May (Saint John Naturalists' Club 2007). Fall migration extends over a longer period between September and November, with about one third fewer birds passing by the observatory at Point Lepreau. The main species include black scoter, surf scoter (*Melanitta perspicillata*), white-winged scoter (*Melanitta fusca*), common eider, common loon (*Gavia immer*), and red-throated loon (*Gavia stellata*). Based on the counting protocols that have been in place since 1996, the average estimate of black scoter spring migration is 143,000 birds. This is by far the most numerous species to pass the observatory.

Harlequin duck were observed each year by CWS during coastal surveys and were also observed during coastal monitoring. As indicated above, harlequin duck feed close to rocky shorelines on ledges and/or underwater shoals. Harlequin duck are typically recorded at a number of locations along the lower Bay of Fundy between Martin's Point and Machias Seal Island (off Grand Manan), generally in relatively low numbers, especially in the LAA. The primary and longest standing wintering locations for harlequin duck in New Brunswick include Point Lepreau, the Wolves Archipelago, White Head Island, and Machias Seal Island, where flocks consistently range between 8-12 at Point Lepreau, to more than 120 at White Head Island (P. Giasson, personal communication, March 19, 2008).

In Christmas bird counts, harlequin duck has been noted in small numbers at St. Martins (1 in 1997-1998; 9 in 1998-1999), and Saint John (1 in 1989-1990 and 1992-1993) (Jacques Whitford 2004).

In a New Brunswick email listserv, bird watchers have reported harlequin duck (a single sighting), resting and foraging at Anthonys Cove between 1996 and 1999 (NatureNB Archives 1996; 1998; 1999 in Jacques Whitford 2004).

In support of the Canaport LNG project, winter surveys targeting harlequin duck were conducted at Mispec Point, with other observations noted at other accessible locations permitting views of the coast between Anthonys Cove and Cape Spencer. Two 1 hour surveys were conducted starting 1 hour before high tide, on January 21 and February 3, 2004. An additional 30-minute survey was conducted on January 28. A single female harlequin duck was observed at Canaport on January 19, foraging in the intertidal area near the fire pond, and later flew towards Anthonys Cove. Another two (a male and female) were spotted at Cape Spencer. None were noted during the January 27 survey; however, two males and a female were spotted February 3 between Cape Spencer and Black Rock, off the mouth of McKenzie Brook.

Coastal monitoring in winter 2005/2006 and early spring 2006 resulted in records of between 2 and 6 harlequin ducks on 6 occasions out of 9 site visits to Black Point, between December 22, 2005 and March 29, 2006.

The continued observation of low numbers of harlequin duck in the Mispec/Canaport area indicates that this feeding area is a regular wintering location, although for a small number of ducks, and not unique to the Bay of Fundy. The potential feeding habitat area of harlequin duck in the Marine PDA in winter is shown in Figure 10.36. This was generated from high resolution digital aerial photos, which permit a good view of coastal habitat, by a biologist with experience studying harlequin duck in the Bay of Fundy.

Bird SOCC encountered in the LAA include coastal birds such as greater scaup (*Aythya marila*), Barrow's goldeneye (*Bucephala islandica*), listed as "special concern" on Schedule 1 of *SARA* since November 2000, red-necked grebe (*Podiceps grisegena*), and black scoter. Black scoter was observed migrating past the LAA during coastal spring surveys, usually several hundred metres to >1 km offshore (Jacques Whitford unpublished data). During the winter, these birds may be rarely seen (*i.e.,* one bird seen during an entire wintering period). The wintering populations of black-legged kittiwake (*Rissa tridactyla*) and razorbill (*Alca torda*) are Secure. Breeding populations of these two species are Sensitive, but the nearest nesting colonies are the Wolves, and Machias Seal Island, respectively. Greater scaup migrating population is listed as Secure, the wintering population is listed as Sensitive, and the breeding population is listed as May be at Risk. The wintering population of Barrow's goldeneye and red-necked grebe are listed as Sensitive and the breeding population of northern pintail is listed as Sensitive. These species were recorded during coastal wintering or migration surveys, and it is unlikely that any of these species are nesting in the LAA. Therefore, only the wintering or migrating populations of these species may occur in the marine environment.

Observations of Barrow's goldeneye during coastal winter surveys in 2006 were of single birds flying over the Marine PDA; this species is typically observed in low numbers by local birders outside of the LAA, in the Saint John River between Reversing Falls and Marble Cove, and Marsh Creek at Courtenay Bay (NatureNB Mailing List Archives 2008), which is included in CWS Coastal Block 20.

10.2.4.8 Summary of Existing Conditions

The information presented indicates that the marine environment in the Marine PDA supports populations of various species of fish, as defined in the federal *Fisheries Act,* and marine birds. This is based on information obtained from literature and past studies in the Marine PDA, as well as data collected to fill data gaps in the Marine PDA and specifically to provide background information for the EA for the Project. Overall, there is a healthy level of biodiversity in the LAA and RAA.

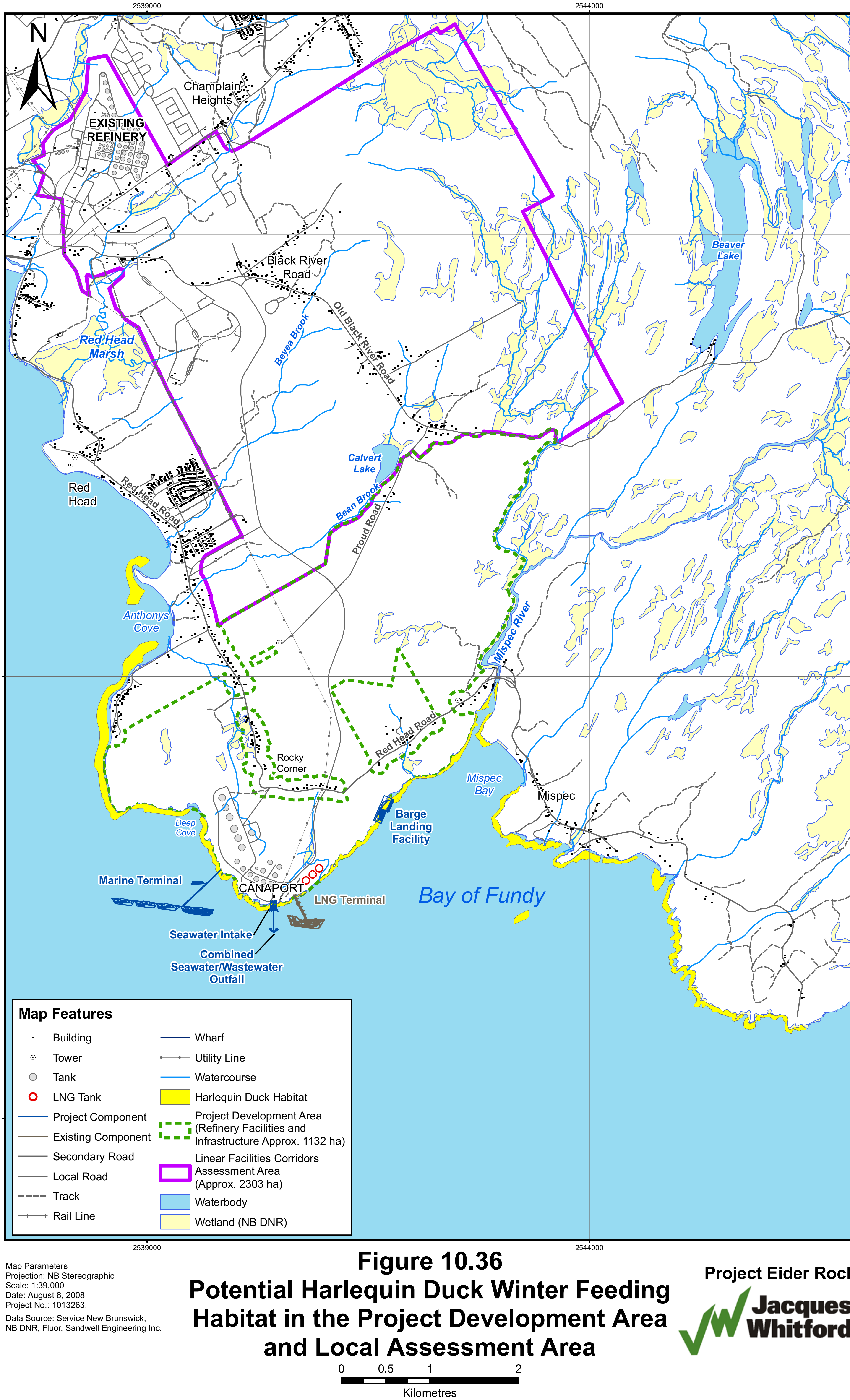
The substrate in the marine environment of the Marine PDA is comprised of a relatively narrow band of a few hundred metres of bedrock and boulders adjacent to a predominantly bedrock shoreline and small intertidal zone. This substrate type supports a diverse epifaunal benthic habitat and seaweed community, including marine resources such as lobster in the deeper subtidal zone. The substrate transitions in the nearshore area to that of a silty sand sea bottom and extends seaward. Mixed sediment containing gravel is more frequently encountered in the offshore area and only west of Mispec Point. The benthic habitat offshore is less diverse and supports more infaunal invertebrates. The substrate in Mispec Bay is mainly silty sand and contains primarily infaunal invertebrates, except closer to the shoreline where bedrock is present and similar to the west of Mispec Point in the Outer Saint John Harbour.

The sediment layer over bedrock is observed to be much thicker to the east of Mispec Point and in Mispec Bay (estimated at a maximum of 23 m), in comparison to the west of Mispec Point in the Outer Harbour and at the location of the marine terminal (not exceeding 9 m). This could partly be explained by the presence of weaker currents measured in Mispec Bay and the eddy that was observed, as well as relatively stronger currents measured in the Outer Harbour that favours scouring and erosion. Currents in the Marine PDA are influenced by the tide and as a result of the large tidal amplitude in the Bay of Fundy. These swift tidal currents keep waters vertically mixed and highly turbid, creating a light-limited environment that impedes plankton production. Consequently, the low levels of ichthyoplankton (fish larvae and eggs) and mesozooplankton found are directly correlated with the low levels of primary production observed.

Water quality and sediment quality sampling conducted as part of the Project indicates that the water quality and sediment quality in the Marine PDA is generally good and adequate for fish to survive if reproduction takes place. It is not unexpected that sediment quality in the immediate vicinity of the Black Point ocean disposal site exceeded CCME guideline values for some chemicals and based on the historical use of this site. Water quality is influenced by the Saint John River primarily during the spring freshet, with the change in water quality being most noticeable in the upper 2-3 m of the water column.

Species of fish that exist in the Outer Saint John Harbour and in the LAA would also likely exist and be supported in the Marine PDA and include groundfish, pelagic fish such as herring and mackerel, and migrating fish species that use the Saint John River watershed to complete part of their life cycle. Marine mammals that have been noted to frequent the Bay of Fundy were also investigated to characterize baseline conditions, including SAR (*e.g.,* the Endangered North Atlantic right whale and blue whale), and SOCC (*e.g.,* fin whale and harbour porpoise). Other species of special status include the leatherback sea turtle, Atlantic salmon (possibly), Atlantic wolffish, shortnose sturgeon that is found only in New Brunswick, striped bass, and American eel.

Harlequin duck is the only likely marine bird species of special status with suitable feeding habitat area in the Marine PDA and a regular wintering location, although for a small number of ducks. The rocky shoreline feeding habitat of harlequin duck found in the Marine PDA is relatively common throughout the Bay of Fundy and has not been designated as Critical Habitat.



Map Parameters
Projection: NB Stereographic
Scale: 1:39,000
Date: August 8, 2008
Project No.: 1013263.

Data Source: Service New Brunswick, NB DNR, Fluor, Sandwell Engineering Inc.

Figure 10.36
Potential Harlequin Duck Winter Feeding Habitat in the Project Development Area and Local Assessment Area

Project Eider Rock

Jacques Whitford

10.3 Potential Project-VEC Interactions

Table 10.15 below lists each Project activity and physical work for the Marine Terminal and Other Marine-Based Infrastructure and ranks each interaction as 0, 1 or a 2. These rankings are defined in Table 10.15 and are indicative of the level of interaction each activity will have with Change in Marine Populations (*e.g.,* invertebrates, fish, marine mammals and marine birds).

Table 10.15 Potential Project Environmental Effects

Project Activities and Physical Works	Potential Environmental Effects
	Change in Marine Populations
MARINE TERMINAL AND OTHER MARINE-BASED INFRASTRUCTURE	
Construction	
Construction and Installation of Jetty and Other Marine-Based Infrastructure	2
Marine Vessel Berthing and Deberthing	2
Operation	
Marine Vessel Berthing and Deberthing	2
Crude Oil and Finished Product Transfer	0
Wastewater, Cooling Water, and Storm Water Release	2
Decommissioning and Abandonment	
Removal of Facilities and Site Reclamation	1

Project-Related Environmental Effects

Notes: Project-Related Environmental Effects were ranked as follows:

0 No interaction, or no substantive interaction contemplated.

1 Interaction will occur. However, based on past experience and professional judgment, the interaction would not result in a significant environmental effect, even without mitigation, or the interaction would clearly not be significant due to application of codified practices.

2 Interaction may, even with codified mitigation, result in a potentially significant environmental effect and/or is important to regulatory and/or public interest. Potential environmental effects are considered further and in more detail in the CSR.

Several activities and physical works undertaken during Construction and Operation of the Marine Terminal and Other Marine-Based Infrastructure, including Crude Oil Unloading and Finished Petroleum Product Loading, were ranked as 0 as there is no anticipated interaction between these activities and the Marine Environment. Potential accidental releases of deleterious substances and potential environmental effects on the Marine Environment are assessed in Chapter 16.

Construction, Operation, and Decommissioning and Abandonment of marine-based infrastructure may result in an environmental effect on fish and fish habitat. Project activities that have been ranked as 2 may change water quality, cause direct or indirect mortality of marine organisms, or destruction or alteration of physical habitat. These include construction activities such as underwater blasting, pile driving and dredging, and operational activities such as wastewater treatment plant effluent discharge, and seawater cooling intake and discharge.

Construction, Operation, and Decommissioning and Abandonment of marine-based infrastructure may result in an environmental effect to marine mammals. Project activities that have been ranked as 2 may produce underwater acoustic emissions that may adversely affect marine mammals. These include construction activities such as underwater/nearshore blasting, pile driving and dredging, and operational activities such as vessel berthing and deberthing.

Construction, Operation, and Decommissioning and Abandonment of marine-based infrastructure may result in environmental effects to marine birds. Project activities that have been ranked as 2 may cause changes (loss) in available habitat and potential degradation in surrounding habitat quality. These include construction activities such as Construction and Installation of Jetty and Other Marine-Based Infrastructure and dredging, operational activities such as marine vessel berthing and deberthing and lighting, wastewater treatment plant effluent discharge, seawater cooling intake and discharge.

Decommissioning and Abandonment activities ranked as 1 in Table 10.15 will result in no significant environmental effect on Marine Populations due to the nature and scope of the work, and the effectiveness of mitigation (*i.e.,* the application of well established and proven mitigation measures). It is anticipated that the measurable parameters presented in Section 10.1.5 will be maintained to support Marine Populations and habitat in the Marine PDA, LAA and RAA during Project activities. Therefore overall, no significant adverse residual environmental effects on Change in Marine Populations are anticipated due to Project activities that are ranked as 0 or 1. Therefore, for all Project activities ranked as 0 or 1 in Table 10.15, the potential environmental effects of the Project on the Marine Environment, including cumulative environmental effects, for all phases of the Project, are rated not significant. There is a high level of confidence in these predictions.

10.4 Environmental Effects Assessment

A summary of environmental effects assessment and prediction of residual environmental effects resulting from interactions ranked as 2 on the Marine Environment is provided in Table 10.16. Only the interactions ranked as a 2 were considered in this table. They include the following interactions broken down by phase, previously identified in Table 10.15:

Construction

- Construction and Installation of Jetty and Other Marine-Based Infrastructure (including underwater and nearshore blasting);
- Marine Vessel Berthing and Deberthing.

Operation

- Marine Vessel Berthing and Deberthing; and
- Wastewater, Cooling Water Intake and Discharge, and Storm Water Release.

To recall, all of the interactions listed above were ranked as a 2 due to the potential interaction with Change in Marine Populations. All other interactions ranked as 0 or 1 were determined to be not significant due to no interaction with the Marine Environment or planned implementation of mitigation of well established and proven effectiveness (Section 10.2), and as such will not be discussed further in this CSR.

Table 10.16 Summary of Residual Environmental Effects on the Marine Environment

Potential Residual Environmental Effects	Proposed Mitigation/Compensation Measures	Residual Environmental Effects Characteristics: Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/Socio-economic Context	Significance	Prediction Confidence	Likelihood	Cumulative Environmental Effects?	Recommended Follow-up and Monitoring
Change in Marine Populations												
Construction	▪ Follow Environmental Codes of Practice and implementation of an Environmental Protection Plan. ▪ Use best management practices for reducing impingement and entrainment, related to intake design and siting. ▪ Geotechnical investigations to minimize drilling and pile driving activities. ▪ Prefabrication of structures brought to location for placement. ▪ Habitat compensation to offset the loss of productive capacity due to jetty structures, side casting and/or dredging, and blasting. ▪ Follow applicable mitigation stipulated in DFO's *Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters*. ▪ Drill cuttings for piling installation to be disposed at sea at the drilling locations, under authorization from DFO and/or Environment Canada. The Proponent will provide rock drilling samples to demonstrate that it will not cause a significant environmental effect. The Proponent will consult with DFO to identify biologically sensitive periods and will develop adequate mitigation or compensation plans as appropriate. ▪ The precise schedule for dredging and construction activities will be determined during detailed engineering design. The schedule will be developed in consideration of fishing seasons as well as spawning periods.. If works are	A	L	L	ST/S	R	D	N	H	H	Y	None.

Table 10.16 Summary of Residual Environmental Effects on the Marine Environment

Potential Residual Environmental Effects	Proposed Mitigation/Compensation Measures	Residual Environmental Effects Characteristics						Significance	Prediction Confidence	Likelihood	Cumulative Environmental Effects?	Recommended Follow-up and Monitoring
		Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/Socio-economic Context					
	required in or near waters during sensitive periods in the fish life cycle, DFO may require additional mitigation and the Proponent will consult with DFO and local fishers. ▪ Use best management practices for reducing interaction with marine birds, including: ▪ Restriction of boat traffic to construction zone; ▪ Minimizing the use of ship's whistles; and ▪ Restricting night lighting where practical. ▪ Compliance with all provincial and federal legislation, permits, approvals and guidelines.											
Operation	▪ Use best management practices for reducing interaction with marine populations, including: ▪ Minimizing the use of ship's whistles; and ▪ Restricting night lighting where practical. ▪ Compliance with all provincial and federal legislation, permits, approvals and guidelines.	A	L	R	LT/ R	R	D	N	M	H	Y	▪ Effluent from the Development Proposal will be monitored to check that contaminant levels are within acceptable ranges. ▪ Water discharged from the outfall will be monitored to check that contaminant levels are within acceptable ranges. ▪ Sediments in the Marine PDA will be monitored

Table 10.16 Summary of Residual Environmental Effects on the Marine Environment

Potential Residual Environmental Effects	Proposed Mitigation/Compensation Measures	Residual Environmental Effects Characteristics						Significance	Prediction Confidence	Likelihood	Cumulative Environmental Effects?	Recommended Follow-up and Monitoring
		Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/Socio-economic Context					
												during the initial stage of Operation. ▪ Monitor abundance and re-colonization of benthic habitat in the Marine PDA early in Operation ▪ Monitor fish screens performance to verify effectiveness of mitigation and confirm environmental effects predictions.

Table 10.16 Summary of Residual Environmental Effects on the Marine Environment

Potential Residual Environmental Effects	Proposed Mitigation/Compensation Measures	Residual Environmental Effects Characteristics						Significance	Prediction Confidence	Likelihood	Cumulative Environmental Effects?	Recommended Follow-up and Monitoring
		Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/Socio-economic Context					
Residual Environmental Effects for all Phases								N	H	L	Y	None.

KEY

Direction:
P Positive
A Adverse

Magnitude:
L Low: Change in marine populations that do not affect the sustainability or biodiversity of populations within the LAA
M Moderate: Change in marine populations that affect the sustainability of populations or results in the loss of biodiversity within the LAA.
H High: Change in population that affects their sustainability within the Bay of Fundy Coastal Ecoregion, and/or results in a loss of regional biodiversity within the Bay of Fundy Coastal Ecoregion.

Geographic Extent:
S Site-specific: Marine PDA
L Local: LAA
R Regional: RAA

Duration:
ST Short term: During Project Phase
MT Medium term: Duration of Project
LT Long term: Duration of Project Plus 10 years
P Permanent: In Perpetuity

Frequency:
O Occurs once.
S Occurs sporadically at irregular intervals.
R Occurs on a regular basis and at regular intervals.
C Continuous.

Reversibility:
R Reversible
I Irreversible

Ecological/Socio-economic Context:
U Undisturbed: Area relatively or not adversely affected by human activity.
D Developed: Area has been substantially previously disturbed by human development or human development is still present.
N/A Not Applicable

Significance:
S Significant
N Not Significant

Prediction Confidence:
Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation
L Low level of confidence
M Moderate level of confidence
H High level of confidence

Likelihood:
Based on professional judgment
L Low probability of occurrence
M Medium probability of occurrence
H High probability of occurrence

Cumulative Environmental Effects?
Y Potential for environmental effect to interact with other past, present or foreseeable projects or activities in RAA.
N Environment effect will not or is not likely to interact with other past, present or foreseeable projects or activities in RAA.

10.4.1 Assessment of Project-Related Environmental Effects

The following discussion of environmental effects is organized under the following sections: fish; fish habitat; marine mammals; and marine birds.

10.4.1.1 Fish

Project Environmental Effects Mechanisms for Change in Marine Populations (Fish)

For the purposes of this discussion, "fish" is defined as marine and anadromous fin-fish and invertebrates. The potential for fish mortality due to construction activities (*i.e.,* dredging, placing of marine infrastructure, and blasting) is ranked as 2 in Table 10.15, and requires further investigation. The potential for entrainment and impingement of larvae, juvenile and adult fish as well as fish eggs in the cooling water system, is ranked as 2 in Table 10.15, and thus also requires further investigation. This section addresses direct environmental effects on fish. Changes in fish habitat are addressed in Section 10.4.1.2.

Dredging and underwater/nearshore blasting may result in the loss of fish. Mobile pelagic and demersal fin-fishes will likely avoid dredging activities due to the associated noise and direct mortality will be low; however, sessile or slow moving invertebrates will likely be unable to avoid dredging activities and will suffer mortality as a result. Dredged material may be disposed of at sea (*i.e.,* at the Black Point ocean disposal site managed by Environment Canada) smothering benthic communities. Dredging may also result in temporary deterioration of water quality by increasing TSS levels. The mechanisms of the environmental effects of TSS are addressed in Fish Habitat (Section 10.4.1). In addition, marine communities within the footprints of marine infrastructure will be lost.

Underwater/nearshore blasting will take place at two locations within the Marine PDA: the barge landing facility in Mispec Bay; and the seawater cooling intake structure at Mispec Point (if required). Fish occurring within close proximity of explosive detonations may incur physical damage or damage to gas-containing organs, causing death. Shock waves produced by blasting are relatively short-propagating; therefore, severe injuries are expected to occur over a limited spatial area. Safe ranges from underwater explosions for fish are dependent on both the size and depth of the fish and type of explosive charge. Sedentary marine organisms within the footprint of blasting activities will likely be killed or injured. Mortality of limited numbers of commercially valuable species such as lobster may result due to blasting.

"Entrainment" is when a marine organism is taken up by the intake water flow for the Project's cooling water system. "Impingement" is when a marine organism is held up against the screening on the water intake end-of-pipe screen and cannot free itself. Entrainment and impingement will be discussed separately as they are distinct environmental effects with different susceptibility on the type of marine organism and life stages, and potentially different environmental effects on fish populations and requirements for further analysis.

Zooplankton such as fish eggs and larvae are susceptible to entrainment due to their small size and poor swimming ability. Organisms that are entrained are subject to a number of thermal and physical stresses that may lead to mortality. Mortality attributable to thermal stress may result from thermal shock or prolonged exposure to water temperatures above the preferred temperature range. Therefore, the environmental effect of elevated water temperature on entrained organisms will depend on both the temperature gradients within the cooling water system and the duration of exposure. In addition, the lethal thresholds of thermal stresses are dependent on species and life stage.

Physical stress may result from collisions with pump equipment and walls of the system as well as pressure changes in the system (Cada *et al.* 1980). Research has suggested that physical stress is the major contributor of fish larvae entrainment mortality (Cada *et al.* 1980). The total potential entrainment mortality of marine organisms in the Marine PDA is the sum of mortality due to thermal and physical stresses.

Entrainment is likely to cause loss of fish and invertebrate eggs and larvae during operation of the Project. The degree to which entrainment will affect fish populations in the Marine PDA and the LAA depends on several factors that include abundance, distribution, size and behaviour of fish and their eggs and larvae population, as well as the location, depth, pumping rate, and screen mesh size of the intake (Federenko 1991).

Impingement is most likely to involve juvenile and adult fish that are too large to pass through the mesh at the end-of-pipe water intake of the cooling system. Impingement can lead to death if the fish is unable to free itself and even those fish that do free themselves may be more susceptible to infections and predation due to injury. The susceptibility of fish to impingement is related to the behaviour of fish, environmental factors such as water clarity and attractants such as warm water, shade or presence of food organisms (New York Power Authority 2005). Impingement susceptibility is largely species dependent with thin-bodied, pelagic species (*e.g.,* the clupeid fish such as herring and gaspereau) being the most vulnerable (New York Power Authority 2005). Monitoring study results from the seawater cooling intakes at the nearby Point Lepreau Generating Station (Jacques Whitford 2003) indicate that Atlantic herring was the most commonly impinged species. No lobster, or species of conservation concern (including the Atlantic salmon), were identified during fish screen monitoring at Point Lepreau.

As discussed in Section 10.2, the Marine PDA may provide habitat for five fish species of special status, including Atlantic salmon, Atlantic wolffish, shortnose sturgeon, striped bass and American eel. It is unlikely that individuals of the aforementioned species of concern will be subject to entrainment or impingement. Atlantic salmon, shortnose sturgeon, and striped bass spawn in fresh or brackish water (Scott and Scott 1988), thus life stages susceptible to entrainment (*i.e.,* eggs, larvae and small juveniles) are likely not present in the Marine PDA. Similarly, American eels spawn in deep waters near Bermuda and thus eggs and larvae are not likely to be present in the Marine PDA. American eel juveniles (known as elvers) return to freshwater when water temperatures reach about 10°C and may occur at high densities at the mouths of rivers during these times (Scott and Scott 1988). Elvers will migrate past the general area of the seawater cooling water intake; however, the density and frequency of passing in proximity to the intake are expected to be low as the seawater cooling intake is approximately 4 km away from the mouth of the Mispec River and sufficiently removed from the Saint John River estuary.

Research vessel surveys have determined that there are concentrations of Atlantic wolffish in the approaches to the Bay of Fundy; however, these fish are not known to spawn within the Bay of Fundy (DFO 2000b). Spawning takes place in deeper water and the entire pelagic larval stage is spent near the spawning area (Bigelow and Schroeder 1953, in DFO 2000b). As young wolffish are rarely found in shallow waters, it is thought that they remain in deeper waters (>30 m) until sexual maturity (>50 cm). Therefore, life stages of wolffish susceptible to entrainment (*i.e.,* eggs and larvae) are not expected to be present in the Marine PDA.

Adult Atlantic salmon, shortnose sturgeon, striped bass, Atlantic wolffish, and American eel are large, relatively powerful fish that are likely to occur infrequently and in low density in the vicinity of water intake structure(s) and therefore unlikely that individuals of these species will be impinged. They are also sufficiently strong swimmers to avoid impingement.

Characterization of Residual Project Environmental Effects of a Change in Marine Populations (Fish)

Loss of fish due to dredging and blasting is expected to be minimal as these activities are one-time events and will occur within a small area. Habitat that is destroyed due to blasting and dredging activities will be compensated for as described in Section 10.4.

To minimize the likelihood of injury and direct mortality of fish due to blasting, a detailed explosives environmental protection plan will be developed. The following mitigation strategies will be included in the explosives environmental protection plan:

- The potential zone of environmental effects on fish will be calculated based on blasting specifics;
- Efforts will be made during the blasting design to reduce overpressure;
- Where feasible, bubble curtains and other acoustic absorbent technology will be used to contain shock waves;
- Benthic habitat that is destroyed by blasting will be considered a HADD and compensated; and
- Proponent abiding to the required guidelines and applicable mitigation stipulated in DFO's *Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters*.

To quantify the potential environmental effect of the possible entrainment of fish eggs and larvae on fish populations in the Marine PDA in the event that a seawater cooling water intake structure is used to supply the cooling needs of the refinery, an entrainment model was developed. Information on the density of fish eggs and larvae was obtained from field surveys conducted in spring and summer 2007 (Section 10.2). Fish egg and larvae samples were collected on the ebb and flood at the two sampling locations; the densities of eggs and larvae for the ebb and flood were averaged for the purposes of the entrainment model to simplify calculations. Several other assumptions were made in calculating mortality rates, and are as follows:

- No exchange of water from the intake and the outfall;
- Entrainment mortality is 100%; and
- Uniform distribution of fish eggs and larvae throughout the water column.

If seawater cooling is used, the volume for the seawater cooling intake will be 25.2 m^3/s and will occur 24 hours a day, 365 days of the year; therefore 67,495,680 m^3 of seawater per month (based on a 31 day month) will be pumped by the seawater cooling system. Although this is a large volume of water, it represents less than 0.000001% of the estimated volume of water in the Bay of Fundy. The fish eggs and larvae contained in this volume of water were used to calculate the mortality rates (per month) due to entrainment. The results of the modeling for predicted mortality rates of fish eggs and larvae are presented below in Tables 10.17 and 10.18, respectively. It is difficult to accurately predict egg and larvae mortality on a yearly basis as fish egg and larvae densities in the Marine PDA are unknown during the early spring, late fall and winter. However, most fish and invertebrate species that likely spawn in the Marine PDA do so during the spring and summer, and thus the mortality of eggs and larvae due to entrainment during the late fall, winter and early spring would be substantially less. Correspondingly, the calculated mortality of fish eggs and larvae based on the August sampling is likely representative of peak mortality rates. The assumption that egg and larvae densities are highest in August is based on Washburn and Gillis (1990); the authors monitored fish egg and larvae density in the Point Lepreau area of the Bay of Fundy between May and November and found the highest densities in the month of August (Washburn and Gillis 1990).

Table 10.17 Predicted Mortality Rates of Fish Eggs Due to Entrainment

Eggs	31-May-07		23-Aug-07	
	Mispec Bay Station S2 (per m^3)	Outer Harbour Station S12 (per m^3)	Mispec Bay Station S2 (per m^3)	Outer Harbour Station S12 (per m^3)
Fourbeard rockling *Enchelyopus cimbrius*	0	0	0.0085	0
Yellowtail flounder *Limanda ferruginea*	0	0	0.0125	0
Butterfish *Peprilus triacanthus*	0	0	0.0125	0.005
Mackerel *Scomber scombrus*	0	0	0	0.025
Cunner *Tautogolabrus adspersus*	0	0	0.0065	0.005
Hake *Urophycis sp.*	0	-	0.0125	0.005
CHW egg (cod, haddock, witch flounder)	0	0.016	0.0085	0.0125
CYT egg (cunner, yellowtail)	0.1555	0.016	0.099	0.077
H4B egg (hake, fourbeard rockling)	0	0	0.1935	0.233
Density per m^3 of all species	0.1555	0.032	0.3535	0.3625
Mortality per month, all species, separate sampling locations	10,495,578	2,159,861	23,859,722	24,467,184
Mean monthly mortality of all species (both sampling locations)	6,327,720		24,163,453	

Table 10.18 Predicted Mortality Rates of Fish Larvae Due to Entrainment

Larvae	31-May-07		23-Aug-07	
	Mispec Bay Station S2 (per m^3)	Outer Harbour Station S12 (per m^3)	Mispec Bay Station S2 (per m^3)	Outer Harbour Station S12 (per m^3)
Fourbeard rockling *Enchelyopus cimbrius*	0	0	0.026	0
Herring *Clupea harengus*	0	0	0.0475	0.029
Cunner *Tautogolabrus adspersu*	0	0	0	0.025
Haddock *Melanogrammus aeglefinus*	0	0	0	0.005
Longhorn sculpin *Myoxocephalus octodecemspinosus*	0	0.017	0	0
Capelin *Mallotus villosus*	0.016	0.0215	0	0
Lobster	0	0	0.015	0

Table 10.18 Predicted Mortality Rates of Fish Larvae Due to Entrainment

Larvae	31-May-07		23-Aug-07	
	Mispec Bay Station S2 (per m^3)	Outer Harbour Station S12 (per m^3)	Mispec Bay Station S2 (per m^3)	Outer Harbour Station S12 (per m^3)
Homarus americanus				
Sand lance *Ammodytes* sp.	0	0	0.5	0
Density per m^3 of all species	0.016	0.0385	0.5885	0.059
Mortality per month, all species, separate sampling locations	1,079,930	2,598,583	39,721,207	3,982,245
Mean monthly mortality of all species (both sampling locations)	1,839,257		21,851,726	

The mortality rate of fish eggs per month ranges from 6.3 to 24.1 million and from 1.8 to 21.8 million for fish larvae of all species. The uncorrected mortality rates of fish eggs and larvae are high; however, once natural mortality figures are considered (*i.e.,* the proportion of larvae and eggs that would have died due to natural causes in the period from egg or larvae to adulthood), the mortality rates are greatly reduced. Natural survival figures (*i.e.,* the proportion of eggs and larvae that will survive to adulthood) that were used in the calculations were 0.0001 for eggs and 0.001 for larvae of all species combined. These rates are considered conservative: gadoids (cod-like) and schooling pelagic fish generally produce large numbers of eggs and only a tiny proportion (estimated at close to 0.00001 for Atlantic cod) of eggs will reach adulthood (DFO 2006a). Furthermore, larvae also have very high mortality rates, for instance, Chenoweth *et al.* (1989) estimated that the mortality rate of herring larvae is approximately 4% per day. Applying the above natural mortality rates, monthly mortality rates due to entrainment are greatly reduced and range from 632 to 2,416 for fish eggs and from 1,839 to 21,851 for fish larvae. Put into perspective, if only yellow tail flounder eggs were entrained and the density was the same as those observed, and if only 0.0001 of eggs released by a female reach adulthood, then the losses due to entrainment in August in excess of natural mortality would be 2,416 fish. As mentioned above, these rates would be high relative to the monthly mortality rates in the late fall, winter and early spring when egg and larvae density is expected to be very low and where the actual density of eggs and larvae at the location of the intake structure closer to shore may also be expected to be lower and compared to the deeper water where the field surveys were conducted in 2007. Further, the density of eggs and larvae are also expected to be higher at the sampling locations for the field surveys because of the close proximity to the gyres that are present west of Mispec Point and in Mispec Bay and which would concentrate their abundance. The seawater cooling intake will be located at Mispec Point where at this location the flow is higher because of the stronger tidal currents that generally move in an east-west direction, and depending on the tidal stage (refer to measured currents in sub-section 10.2.3), and as a result are likely to contain a lower density of eggs and larvae than those measured at the sampling locations.

The above estimates are composite estimates for all fish egg and larvae species found in the Marine PDA. Commercially valuable fish and invertebrate species made up the minority of larvae sampled in the Marine PDA and thus larvae that are likely to be destroyed. As such, the environmental effects on commercially valuable species due to entrainment are rated not significant. Furthermore, no eggs or larvae of fish species of special status were found or believed to be routinely present in the Marine PDA and thus mortality of fish species of concern are predicted not to occur due to entrainment. The Marine PDA does not provide important spawning or rearing habitat for fish or invertebrates and productivity is low, thus further diminishing the risk of substantive environmental effects. Fish eggs and larvae populations are subject to natural stochastic mortality (*i.e.,* currents that may carry large numbers of larvae offshore) and the mortality of eggs and larvae due to entrainment is likely not outside the natural fluctuations of the populations of the potentially affected fish species in the greater Bay of Fundy.

The potential for impingement will also be greatly reduced and mitigated by the intake screen design. The details of the screen design have not been decided upon; however, screens will be similar to the self-cleaning screens currently used at the Point Lepreau cooling water intake. Data that were obtained from the fish screen monitoring program at the Point Lepreau cooling water intake (which has a similar intake volume as that predicted for the Project) indicate that numbers of impinged fish and invertebrates are low. Numbers of impinged fish and invertebrates will be monitored early in Operation to gauge the effectiveness of mitigation and verify these predictions, and affording an opportunity for adaptive management should it be necessary.

Mitigation to minimize fish mortality (at all life stages) due to entrainment and impingement include:

- Intake area to be selected where field studies indicate low abundance of organisms during most time of the year for most species;
- Avoiding subtidal rock reefs with growth of macrophytes, since they are nurseries for juvenile stages;
- Avoiding siting of seawater cooling water intake at or near the shoreline;
- Avoiding known spawning area;
- Locating intake away from topographical features that promote eddies where zooplankton may physically be concentrated;
- Locating screened stationary intake at a minimum depth of 25 m, if practical;
- Intake to be elevated 2 m above the seabed;
- Stainless steel unpainted screen material should be used to reduce biofouling;
- Intake structure to be designed to allow a uniform flow distribution through the total screen area; and
- Velocity caps to be used as a behaviour barrier.

In summary, construction activities (*i.e.,* dredging and blasting) will result in small losses of marine organisms. Similarly, if required, the seawater cooling water intake associated with the Project will result in mortality rates per month (corrected for natural mortality) in the range of 632 to 2,416 for fish eggs and from 1,839 to 21,851 for fish larvae. This environmental effect would occur continuously during Operation. Based on past evidence, this environmental effect is reversible and will not affect a change in populations of marine organisms in the LAA or RAA. This environmental effect is thus rated not significant as this level of egg and larval mortality, and direct mortality due to Construction, could not possibly affect the viability of these species in the LAA or RAA.

10.4.1.2 Fish Habitat

Project Environmental Effects Mechanisms for Change in Marine Populations (Fish Habitat)

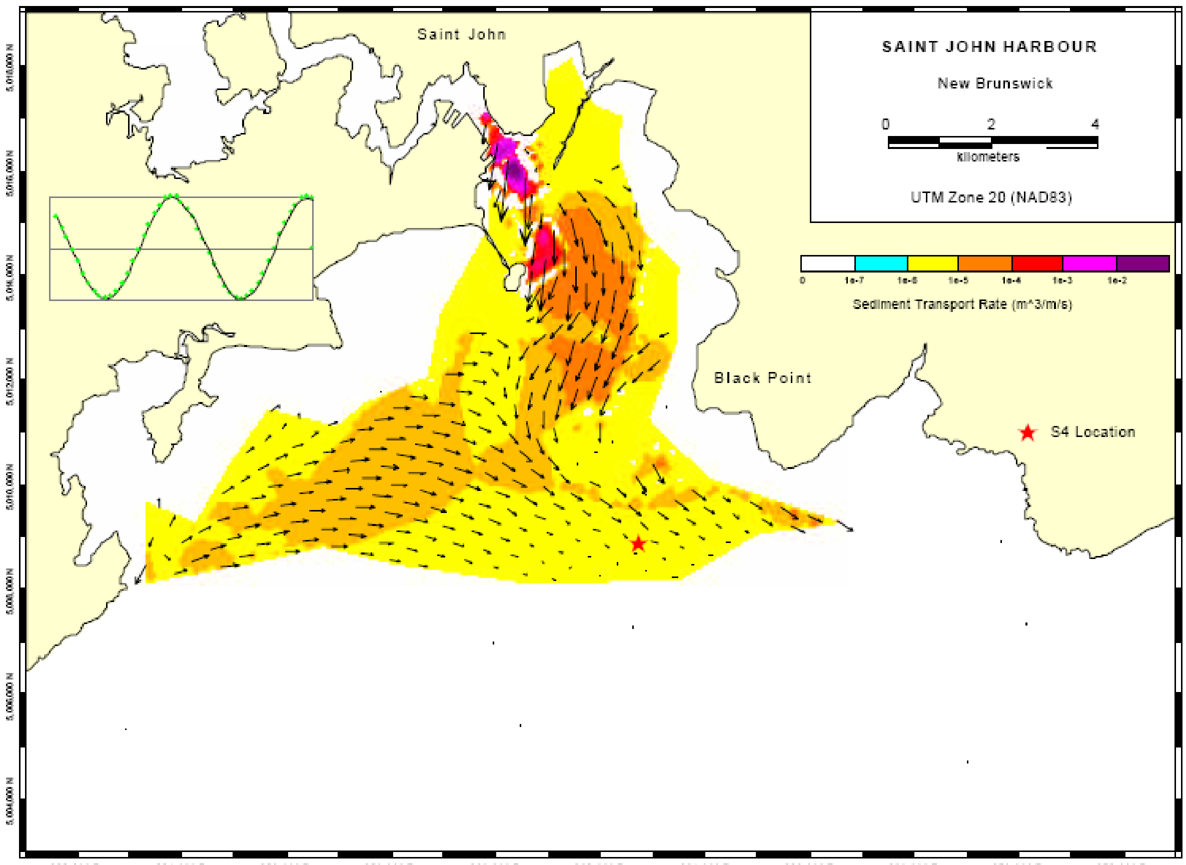
Construction and Installation of Jetty and Other Marine-Based Infrastructure is ranked as a 2 in Table 10.15 as it may alter, disrupt or destruct marine habitat, which could lead to environmental effects on marine populations. Construction of marine-based infrastructure (pile, caisson and/or jackets), underwater/nearshore blasting, and dredging may affect water quality through light penetration, TSS, or acoustic qualities. Cooling water may be discharged to the marine environment during Operation and is ranked as 2 as it may change marine populations by altering fish habitat and migration routes. Treated wastewater will be discharged to the marine environment during Operation and is ranked 2 as it may elicit acute or chronic toxic environmental effects on marine populations. The mechanisms of these potential environmental effects are discussed below within the context of the measurable parameters identified in Table 10.1.

Habitat Area

Construction and Installation of the Jetty and Other Marine-Based Infrastructure will have localized environmental effects on benthic habitat. Underwater/nearshore blasting will also have localized environmental effects on benthic habitat. Benthic habitat within the footprint of the jetty and other marine-based infrastructure will be altered, disrupted or destructed. In addition, other activities that will occur during the Construction including dredging and side casting of the sea bed will cause destruction or disturbance of benthic habitat. The jetty may also block the movements of fish and marine mammals (*e.g.,* harbour porpoise). It is not anticipated, however, that the jetty and supporting structures will adversely affect the predominant flow pattern of currents or seabed sediment mobility and bedforms in the Marine PDA. This is a result of the jetty/trestle design and inter-spacing of jetty structures such as the piles, jackets or caissons, with exposure to open ocean among and in between structures that will not obstruct water circulation or sediment transport on a large scale. Any interactions between the jetty structures and currents that may generate current acceleration and subsequently enhanced sediment transport and seabed scouring would likely occur at a local or site-specific scale, and because the marine structures will be anchored to bedrock, would therefore not result in a significant environmental effect.

If dredging is required in the footprint of the jetty for the marine terminal and/or the barge landing facility, it will cause destruction of benthic habitat. The SEDTRANS model has been used to estimate patterns of sediment transport in and around the Black Point ocean disposal site by the Geological Survey of Canada, Atlantic Geoscience Centre (Parrott *et al.* 2002 in ECL 2003). The model, using actual sediment grain size and distribution, predicts that net sediment transport is out of the Harbour and to the southeast (Figure 10.37). The modeling predictions are further supported with the geophysical data collected for the Black Point ocean disposal site where the direction of slumping and movement of the dredge spoil was determined to be towards the south (Parrott *et al.* 2002 in ECL 2003). This suggests that bottom sediment dispersion of side cast material and disposal of dredged material for the marine terminal is likely to be transported towards the offshore direction in the long term. However, it should be noted that sediment transport during an ebbing tidal flow will be towards the west and northwest as a result of the tidal currents during this stage of the tide and at a local scale to the immediate vicinity of the marine terminal location.

Side casting and levelling of the sea bed and/or disposal of dredged material will be mitigated by following the *Fisheries Act*, the *CEPA* and obtaining authorization to dredge, dispose and/or side cast as per a Disposal at Sea Permit in full compliance with the requirements of DFO's and Environment Canada's legislation, respectively. DFO has advised the Study Team that side casting and levelling of the sea bed and dredging constitutes a HADD, pursuant to Section 35(2) of the *Fisheries Act*, and therefore a habitat compensation plan will be developed by the Proponent for acceptance by DFO and in consultation with DFO and local stakeholders and in accordance with the DFO Policy for the Management of Fish Habitat and the no net loss guiding principle, if side casting and/or dredging is required. Preliminary considerations for HADD compensation are outlined in Appendix C of this CSR. DFO has also advised the Study Team that disposal activities of the dredge material may constitute a HADD and which will be determined once final design plans have been completed for the Construction of the Marine Terminal and Other Marine-Based Infrastructure.



Adapted from Parrott *et al.* 2002 in ECL 2003.

Figure 10.37 Net Sediment Transport Predicted by SEDTRANS Model in the Saint John Harbour

Side casting and dredging of the sea bed and installation of jacket, pile or caisson structures will physically remove benthic habitat. However, habitat loss is reversible as the disturbed sea bed and surface area of pile, jackets and caissons will be re-colonized by benthic organisms within a year or two. A HADD assessment under the *Fisheries Act* will be undertaken by DFO for the disturbance of sea floor in the footprint of jetty structures. Potential mitigation may include habitat compensation to offset the loss of productive capacity as a result of disturbance to the sea bed, as indicated above.

Wastewater Treatment Plant Effluent Discharge

Effluent from the wastewater treatment plant will be discharged into the marine environment through an outfall. This effluent would have the potential to affect the health of marine populations. The risks include adverse ecological health environmental effects on aquatic and sediment communities (*e.g.,* fish, benthic invertebrates, shellfish, and lobster) as well as avian (*e.g.,* spotted sandpiper, common eider, herring gull) and mammalian (*e.g.,* mink, harbour porpoise, harbour seal) receptors from all relevant exposure pathways (*e.g.,* water, sediment and food ingestion). The discharge of effluent over Operation increases the risk of an additive environmental effect on marine populations. The risk posed by effluent discharge to marine populations was evaluated in the Marine ERA (Jacques Whitford 2008h) using an Ecological Hazard Quotient (EHQ) as the measurable parameter. An EHQ is based on the ratio of exposure concentrations to the Toxicity Benchmarks or Toxicity Reference Values (TRV), where an EHQ less than 1.0 is considered acceptable.

Additionally, long-term exposure of fish to contaminants in treated wastewater within the mixing zone of the wastewater discharge could result in tainting of fish tissues and possible changes in the population of the fisheries resource.

Water Quality

Light Penetration

Lighting will be required during Construction and Installation of the Jetty and Other Marine-Based Infrastructure and during the operational life of the marine terminal. The environmental effects of natural and artificial light on different fish species has been examined in the literature although findings have often been contradictory. For many species of fish, light is an aid for orientation, foraging, maturation, breeding, and avoiding predators (Marchesan *et al.* 2005).

Artificial lighting during jetty construction and operation may hinder migration of fishes. Studies (Prinslow *et al.* 1979, Nightingale and Simenstad 2002) in the Pacific Northwest report potential changes in fish migration behaviour and the distribution of fishes in night-lighted areas. Such changes potentially increase mortality risks for salmon, herring, and sand lance. Juvenile chum salmon and their predators, such as hake, dogfish, sculpin, large chinook and coho, appear to congregate below night security lights with increased light intensities attracting the chum and potentially delaying out-migration; however, predator stomach analyses did not demonstrate heavy chum salmon consumption in those conditions. In contrast, night lighting has also been found to attract juvenile herring and sand lance along with their predators, with heavy predation occurring on the herring and sand lance populations. Similarly, small fishes may be attracted to artificial night lighting, making them more vulnerable to predatory fish found in the PDA, such as spiny dogfish, sculpin, cod and pollock.

It is anticipated that artificial lights associated with the Project may result in a localized behaviour modification for fish. However, the magnitude of the potential environmental effects is low and the geographic extent is limited. Mitigation will be provided to the extent possible to further reduce the environmental effects of artificial light on fish species. Mitigation measures to reduce or prevent potentially adverse environmental effects of jetty lighting at night during Construction could include the use of directional and fully shielded light fixtures, depending on safety and navigational requirements. This type of light fixture would illuminate only the immediate working area below the lamp, with little or no diffusion of light laterally and above the lamp.

Total Suspended Solids (TSS)

TSS is a water quality measurement for organic and mineral particles in a water column (Park 2007). A number of activities associated with Construction and Installation of the Jetty and Other Marine-Based Infrastructure may increase levels of TSS in the water column. These activities include dredging, pile driving and side casting of the sea bed.

TSS levels vary naturally in coastal marine environments with lowest levels found in quiescent conditions and highest during high rainfall conditions, as the wind and rain mixes the water column (Birch and O'Hea 2007). High TSS levels are also associated with nearshore areas, and lower production values (Aumack *et al.* 2007). TSS levels have a profound influence on the structure and function of marine ecosystems.

While suspended sediments are important in the marine environment for benthic organisms, high levels of TSS can decrease habitat quality (Park 2007). There is generally a lower amount of dissolved oxygen associated with high TSS values (Ntengwe 2006). High TSS values have also been associated with high levels of stress in benthic invertebrates (Norton *et al.* 2002). It is also possible for elevated TSS levels to cause direct mortality due to smothering of gills and feeding organs. For instance, TSS values greater than 200 mg/L have been shown to cause elevated mortality rates in some benthic invertebrates (Dodds and Whiles 2004). Elevated levels of TSS can also affect fish. At high concentrations or during extended periods of exposure, environmental effects of suspended sediments on fish include: decreased feeding success, reduced ability to see and avoid predators, damaged gills, reduced growth rates, decreased resistance to disease or impaired development of embryos.

An increase in TSS will also reduce the amount of light reaching any submerged vegetation (Park 2007), thereby decreasing photosynthesis. Waters with a high TSS levels have also been found to have significantly reduced amount of periphyton, a benthic organism indicator (Birkett *et al.* 2007). In the Marine PDA, higher TSS and turbidity values are noted for most seasons because of storm activity and dredge disposal at the Black Point ocean disposal site (Section 10.2).

Mitigation will be provided to reduce the environmental effects of TSS on fish species and fish habitat. Mitigation measures to reduce or prevent potentially adverse environmental effects could include the use of silt curtains, booms and coffer dams if a persistent turbidity plume exists and the high tidal currents are not sufficiently strong to disperse this plume. This mitigation may not be practical or effective in the currents and tidal environment at the marine terminal, and will be re-assessed during further Project development.

Thermal plume

If a seawater cooling intake structure is ultimately used to supply the cooling needs of the Development Proposal, warmed cooling water will be discharged to the marine environment during Operation. Increased seawater temperature may cause avoidance behaviour of mobile marine organisms, shifts in ecosystem structure and function, and health effects on sessile marine organisms. In addition, discharged cooling water may have levels of contaminants that could cause acute or chronic health effects on fish. The discharge of cooling water may also disrupt the movements of migrating fish species. Salmonids are well known for the ability to return to their natal streams for spawning. The mechanics of this process are poorly understood; however, this ability likely arises in part from the ability of young fish to learn specific odours during freshwater residence and seaward migration and seek out these odours as mature fish. It is thought that most anadromous fish locate natal streams using similar olfactory cues. Thus, the migratory movements of anadromous fish, such as Atlantic salmon, in the Mispec River are closely linked to the unique odours imparted by dissolved organic and inorganic matter in the water and could be affected by the discharge of water that may be altered in terms of temperature and materials suspended or dissolved in it.

Sediment Quality

Most of the parameters analyzed in sediments of the Marine PDA were below the limits set by the CCME Interim Marine Sediment Quality Guidelines (ISQG) and the *CEPA* Disposal at Sea Limits (Table 10.6). Exceptions were observed at stations S12, S13 and S14A located near the Black Point ocean disposal site where concentrations of polycyclic aromatic hydrocarbons (PAH), total polychlorinated biphenyls (PCB) and arsenic exceeded the ISGQ, and reached levels above the Probable Effects Level (PEL) for some compounds. The *CEPA* Disposal at Sea limits for total PAH were also exceeded at stations S12 and S13, and total PCB levels were above the *CEPA* limit at station S13. ISQG generally indicate levels below which there is a low likelihood of adverse biological environmental effects, while the PEL represents the concentrations frequently associated with adverse biological environmental effects. The guidelines should be regarded as interpretative tools, and local conditions such as assimilative capacity, sensitivity of endangered species and habitat should be taken into account when evaluating sediment quality at a specific site (CCME 1995). The sediment that exceeded the CCME ISQG and PEL values and *CEPA* Disposal at Sea Limits the most, originates from station S13 and closest to the Black Point ocean disposal site. That site has a high proportion of silt and clay materials that have more exchange sites to adsorb contaminants. However, except for stations near the Black Point ocean disposal site located west of Mispec Point in the Outer Harbour, analytical results reveal relatively non-affected sediment either as non-detected or below guideline values for all parameters at stations in the Marine PDA. The risk of acute or chronic toxicity on marine populations due to re-suspended sediments is low given the low baseline levels. Any adverse environmental effect associated with sediment quality would primarily affect the proximal benthic communities.

Underwater Acoustic Environment

Construction and Installation of the Jetty and Other Marine-Based Infrastructure and Operation will generate sound. The majority of anthropogenic sound in the marine environment generated through the Construction and Operation will originate from underwater/nearshore blasting, pile driving, dredging and shipping. Underwater'/nearshore blasting, pile driving and dredging will generate sound-related environmental effects only during Construction, whereas sound-related environmental effects of shipping will occur during both Construction and Operation. The potential environmental effects of sound that is generated by the Project, is of scientific, regulatory and public concern. This subject is treated separately below.

To understand the environmental effects of Project-generated sound on marine populations, it is important to describe existing, background sound levels in the Marine Environment. On a calm day with light wind, sea state 1, Desharnais *et al.* (2000) measured background underwater sound levels of 81-93 dB re 1 μPa^2/Hz @ 100Hz and 75-80 dB re 1 μPa^2/Hz @ 500Hz. The major source of ambient sound was shipping. The levels reported are extraordinarily high and might have been biased by the hydrophone locations; sonobuoys were deployed in and near the major shipping lane as well as in the whale-watching region. Without anthropogenic inputs, ambient sound levels in the Bay of Fundy would likely be in the range of 20-40 dB re 1 μPa^2/Hz (Wenz 1962). The majority of this sound would be from wind, waves, and precipitation. Sounds emitted to the marine environment during Construction and Operation could possibly reduce the quality of fish habitat in the Bay of Fundy, leading directly or indirectly to changes in fish health and ultimately, if serious, a Change in Marine Populations. The environmental effects of sound on marine mammals are discussed below. There have been few studies on environmental effects of high levels of ambient sound on fish (Smith *et al*. 2004). Fish take advantage of the rapid propagation of sound through water to perceive and discriminate sounds in the marine environment. Fish use sound for communication and for predators and prey detection (Smith *et al*. 2004). Most fish species have the ability to detect low frequency sounds over great distances (Chapman 1973).

Behavioural responses to loud noises may include swimming away from the sound source which could result in leaving a primary feeding or spawning area (Popper 2003). Altering these behaviours could affect long-term behaviour patterns, reproductive success and survival. Alternatively, loud noises could result in the fish "freezing" and staying in place which could leave the animal open to further hearing damage (Popper 2003). Hearing damage can increase risk of predation and alter reproduction or feeding behaviours (Laughlin 2005). In general, measurable harm to fish starts at exposure levels of approximately 190 dB re 1 µPa rms for 1 hour, with hearing being the most sensitive physiological element (Hastings 2002, Hastings *et al.* 1996). Lethal conditions result from trauma to other organs and tissues in the range of 200 to 225 dB re 1 µPa and greater (LAHD 2006). Enger (1981) showed that Atlantic cod (*Gadus morhua*) sustained damage to ear hair cells when continuously exposed to 180 dB µPa rms for 1 to 5 hours. Furthermore, studies have shown that high levels of ambient sound can result in reduced egg survival and reduced reproductive and growth rates in aquaculture species (Smith *et al*. 2004; Banner and Hyatt 1973; Lagardère 1982).

Characterization of Residual Project Environmental Effects on a Change in Marine Populations (Fish Habitat)

Specific measurable parameters that will be considered further include: habitat area, EHQ, water quality, and the acoustic environment. These environmental effects are quantified where feasible.

Habitat Area

It is unlikely that the jetty will act as a barrier to fish and marine mammal movements. Fish would likely swim under the jetty and in between the supports of the jetty that have open access to the sea. Marine mammals, most notably harbour porpoise, would likely navigate around the structures. The additional swimming distance to navigate around structures is small and would not cause health effects. Moreover, harbour porpoise occur in low densities in the LAA and Marine PDA.

Driving, drilling or grouting of piles may cause loss of benthic habitat in the footprint of the piles or jackets. However, the total area of lost benthic habitat as a result of the footprints of all piles and jackets or caissons as options for the jetty supports will be compensated for by the creation of additional habitat on infrastructure surfaces and is presented in Table 10.19. The two options being considered for the jetty (concrete caisson and hybrid jacket, which are described in more detail in Chapter 3) will both result in an overall net gain of fish habitat (Table 10.19). All options will include a piled access trestle due to shallow water depth at the shore end of the trestle. Both options for the jetty include two alternative construction methods for caissons that will use either a rock-placed ring left permanently on the sea bed or a temporary steel caisson to dredge the area within for placing the permanent caisson (the barge loading berth for the jacket jetty option will also be built with caissons). Either of the two alternative construction methods for the caissons will minimize the amount of dredging required to a smaller footprint and consequently reduce the adverse environmental effects associated with dredging. For the temporary steel caisson construction method, the steel caisson will be floated into position and will remain in place until dredging and rock filling inside the caisson is completed. It will then be removed and used for the installation of remaining caissons. Further design evaluation is required to determine the proposed jetty structure and construction method. Thus all options are considered and assessed in the CSR.

Positive environmental effects may occur as a result of the so-called "reef effect" of underwater structures which act as a substrate for the development of epibenthic biota, which in turn attracts other more mobile species. The caisson alternative construction method using a rock-placed ring on the sea bed (to dredge inside for placing the caisson) will create interstitial spaces between the rocks and will provide overall good to prime lobster habitat. In addition, the armour stone each weighing in the range of about 500 kg will be placed around the base of the permanent caissons for scour protection in both alternative construction methods for the caisson jetty option. These armour stones will also provide good benthic habitat for lobster and many other marine species and will create a diverse ecological community similar to that observed on boulders in the existing marine environment of the Marine PDA. The stones will be layered with smaller stones under the main armour layer which could also provide habitat for a range of lobster sizes, including juvenile lobsters, as well as fish species of varying lengths. The vertical concrete wall of the caissons will also create fish habitat by providing a hard substrate for marine organisms to attach to and which will also likely attract free-swimming species. The pilings and jacket option of the marine terminal will also provide a hard substrate for colonization of epiphytic marine organisms and macrophytes as well as provide shelter for lobsters and other marine fish, thereby increasing fish biomass. This may also have the positive environmental effect to enhance biodiversity in the Marine PDA.

Underwater/nearshore blasting will result in the destruction of a limited area of benthic habitat. Underwater/nearshore blasting is likely to occur within the footprint of the barge landing facility and the seawater cooling intake structure; however, the exact area and extent of blasting will not be known until the detailed engineering design is completed. Blasting is a one-time event and will occur within a small area, which is estimated in Table 10.19. If the refinery uses cooling towers instead of seawater for the cooling system, then the requirement for blasting and the affected marine fish habitat will be much less than the worst-case estimates for the seawater cooling intake and outfall presented in Table 10.19. In addition, the footprint will be considerably smaller for the wastewater effluent pipeline and outfall in the marine environment with the cooling tower option. Thus, the estimates provided in Table 10.19 are conservative.

Complete re-colonization of the habitat with seaweeds and a mature benthic community is expected to occur within two to three years following Construction. The vertical and benthic habitat created by the pilings, jackets or caissons (Table 10.19) will result in a change in benthic community assemblage in a localized area. Numerous sessile organisms that do not exist on fine grained sediment such as anemones, tunicates, sponges, bryozoans, hydroids and other species will colonize the underwater structures. Marine seaweeds, which are important components of lobster and other commercially valuable marine organism habitat, will also quickly colonize the hard substrate of in-water structures. The re-colonization will attract other mobile species (*e.g.,* fish) for feeding and refuge, ultimately creating a “reef effect”, with potentially enhanced biodiversity. Consequently, although the HADD as described in Table 10.19 would occur, it remains that upon re-colonization, the environmental effects of the Project may be positive. If required by DFO, additional mitigation for a HADD authorization would include a habitat compensation plan that will be developed by the Proponent for acceptance by DFO and in consultation with DFO and local stakeholders. This plan may include habitat compensation measures similar to placing rocks or armour stone on the sea floor for caisson construction of the jetty.

This would create new fish habitat on preferred hard surfaces that may be shaped in the form of an artificial reef and located in the vicinity of the Marine Terminal and Other Marine-Based Infrastructure in the Marine PDA or LAA.

In summary, with mitigation, the Project will result in environmental effects on benthic habitat within the footprint of dredging and blasting activities, the jetty and other marine infrastructure and side cast material. This environmental effect would occur continuously during Construction. The hard substrate that will be introduced into the Marine PDA will be colonized by benthic organisms and will result in an overall net gain of fish habitat, regardless of the option chosen for the jetty (Table 10.19). Based on Project design, planned mitigation, and habitat compensation, the environmental effects of the Project on populations of marine organisms due to alteration, disruption, or destruction of benthic habitat are rated not significant.

Table 10.19 Summary of Direct Environmental Effects on Benthic Fish Habitat from the Construction[1]

Marine-Based Infrastructure		Loss of Benthic Fish Habitat		Gain of Benthic Fish Habitat		Net Gain (+) or Loss (-) of Benthic Fish Habitat (m^2)	Gain (+) of Fish Habitat on Vertical Infrastructure Surfaces (m^2)	Total Net Gain (+) or Loss (-) of Fish Habitat (m^2)
		Adverse Project Environmental Effect	Area (m^2)	Positive Project Environmental Effect	Area (m^2)			
Structural Jetty Option for Marine Terminal [2]								
Caisson	Construction Alternative A – Rock-Placed Ring	Dredging/Side Casting (250,541 m^3) and Jetty Footprint	118,457	Bottom Jetty Surfaces (Armour Stone and Rock Ring)	120,105	+1,648	+65,461	**+67,109**
	Construction Alternative B – Temporary Steel Caisson	Dredging/Side Casting (250,541 m^3) and Jetty Footprint	52,607	Bottom Jetty Surfaces (Armour Stone)	29,697	-22,910	+65,461	**+42,551**
Hybrid Jacket	Construction Alternative A – Rock-Placed Ring	Dredging/Side Casting (59,409 m^3) and Jetty Footprint	19,815	Bottom Jetty Surfaces (Armour Stone and Rock Ring for Caissons)	20,759	+944	+27,561	**+28,505**
	Construction Alternative B – Temporary Steel Caisson	Dredging/Side Casting (59,409 m^3) and Jetty Footprint	10,425	Bottom Jetty Surfaces (Armour Stone for Caissons)	6,183	-4,242	+27,561	**+23,319**
Seawater Cooling Intake and Outfall (intake and outfall located in same corridor 17 m wide by 250 m long)		Nearshore Blasting and Side Casting	4,250	Rip-rap/Armour Stone and Pipe Surfaces	1,315	-2,935	0	**-2,935**
Barge Landing Facility (80 m wide by 300 m long)		Nearshore Blasting	24,000	-	-	-24,000	0	**-24,000**

Notes:

[1] Loss of benthic habitat immediately after construction and which does not account for re-colonization of disturbed areas by benthic organisms.

[2] Caissons will be used to construct the protected coke barge loading berth at the marine terminal location for either jetty option and which will require dredging approximately 59,409 m^3 over a surface area of 10,112 m^2. Disposal of dredged material will be a combination of side casting and disposal at the Black Point ocean disposal site managed by Environment Canada.

Wastewater Treatment Plant Effluent Discharge

The potential for adverse environmental effects on the Marine Environment due to Project releases of Chemicals of Potential Concern (COPC) was assessed using standard ERA protocols and approaches (Jacques Whitford 2008h). All Project discharges will meet *Petroleum Refinery Liquid Effluent Regulations* under the *Fisheries Act* and the CCME Water Quality Guidelines for the Protection of Marine Aquatic Life. The likely characteristics of process effluent were determined, and the expected concentrations of COPC in marine water and sediment resulting from liquid effluent discharges and air contaminant emissions depositing in the marine environment were modelled. The risks of adverse environmental effects on the ecological health of aquatic and sediment communities (*e.g.,* fish, benthic invertebrates, shellfish, and lobster) as well as avian (*e.g.,* spotted sandpiper, common eider, herring gull) and mammalian (*e.g.,* mink, harbour porpoise, harbour seal) receptors from all relevant exposure pathways (*e.g.,* water, sediment and food ingestion) were evaluated. Overall, there were no hazard quotients for birds and mammals or community receptors exceeding thresholds for adverse environmental effects as a result of COPC concentrations in the Baseline, Project Alone, or Project Case scenarios (Jacques Whitford 2008h). As an example, no EHQ exceeded the threshold value (EHQ < 0.1) for risk of adverse environmental effects to either community receptors or birds and mammals (Table 10.20). Because of the conservative assumptions and data used in the effluent characterization process, Exposure Assessment and Hazard Assessment steps, it is highly unlikely that the risk of adverse environmental effects on the Marine Environment is under-estimated. This conclusion is underscored by the very small relative change in concentrations of COPCs that are estimated to be caused by the incremental contributions from the Project, when added to the measured baseline conditions (Table 10.21 and Table 10.22). There was always less than a 5% increase in COPC concentrations when comparing the Baseline COPC and Project-caused COPC concentrations in water and sediment. Estimated concentrations in plants, fish and invertebrates increased from Baseline to Project Case as well, but these increases were always less than 2%, and in practical terms would not be detectable.

Table 10.20 Summary of Maximum Receptor-specific Ecological Hazard Quotients (EHQ) from all Model Compartments for the Project Alone Scenario

COPC	Aquatic Receptors	Sediment Receptors	Spotted Sandpiper	Common Eider	Coastal-dwelling Herring Gull	Coastal-dwelling Mink	Harbour Seal	Harbour Porpoise
BTEX								
Benzene	4.1E-07	4.2E-07	--[a]	--[a]	--[a]	2.4E-09	1.5E-08	1.6E-08
Ethylbenzene	1.0E-07	1.0E-07	--[a]	--[a]	--[a]	7.0E-10	2.2E-09	1.3E-09
Toluene	1.4E-06	1.9E-06	--[a]	--[a]	--[a]	4.5E-09	1.6E-08	1.6E-08
Xylenes	1.6E-06	1.2E-06	--[a]	--[a]	--[a]	2.8E-09	8.5E-09	9.6E-09
TPH - CCME CWS								
Aliphatic>C06-C08 - F1	1.9E-04	5.2E-05	2.5E-06	1.5E-06	6.0E-06	2.2E-06	5.8E-06	5.8E-06
Aliphatic>C08-C10 - F1	4.9E-06	1.4E-06	9.0E-08	5.5E-08	2.3E-07	8.3E-08	2.2E-07	2.2E-07
Aromatic>C08-C10 - F1	2.2E-08	6.0E-09	1.8E-10	1.0E-10	4.0E-10	1.5E-10	4.0E-10	4.0E-10
Aliphatic>C10-C12 - F2	3.3E-04	9.4E-05	1.6E-06	9.7E-07	4.2E-06	1.5E-06	4.0E-06	4.0E-06
Aliphatic>C12-C16 - F2	5.2E-03	9.2E-04	3.2E-05	1.8E-05	9.6E-05	3.5E-05	9.2E-05	9.3E-05
Aromatic>C10-C12 - F2	3.1E-07	1.4E-07	6.3E-09	4.3E-09	1.3E-08	4.7E-09	1.3E-08	1.3E-08
Aromatic>C12-C16 - F2	1.0E-05	6.4E-06	2.6E-07	1.9E-07	4.9E-07	1.8E-07	4.8E-07	4.8E-07
Aliphatic>C16-C21 - F3	--[b]	--[b]	1.1E-06	1.1E-06	2.0E-07	7.5E-08	6.2E-07	1.1E-07
Aliphatic>C21-C34 - F3	--[b]	--[b]	4.6E-06	4.3E-06	7.8E-07	3.3E-07	2.6E-06	4.1E-07
Aromatic>C16-C21 - F3	5.9E-05	3.8E-05	2.0E-06	1.5E-06	3.8E-06	1.4E-06	3.7E-06	3.7E-06
Aromatic>C21-C34 - F3	2.9E-04	1.8E-04	1.3E-05	9.6E-06	2.7E-05	9.9E-06	2.6E-05	2.6E-05

Table 10.20 Summary of Maximum Receptor-specific Ecological Hazard Quotients (EHQ) from all Model Compartments for the Project Alone Scenario

COPC	Aquatic Receptors	Sediment Receptors	Spotted Sandpiper	Common Eider	Coastal-dwelling Herring Gull	Coastal-dwelling Mink	Harbour Seal	Harbour Porpoise
Polycyclic Aromatic Hydrocarbons								
Low Molecular Weight PAH								
Acenaphthene	8.2E-07	4.3E-06	--[a]	--[a]	--[a]	2.7E-09	2.3E-09	1.9E-09
Acenaphthylene	7.9E-07	4.1E-06	--[a]	--[a]	--[a]	2.5E-09	2.1E-09	1.8E-09
Anthracene	3.5E-08	2.2E-07	--[a]	--[a]	--[a]	1.5E-10	1.3E-10	9.9E-11
Fluoranthene	1.3E-08	7.9E-08	--[a]	--[a]	--[a]	6.8E-11	6.4E-11	3.5E-11
Fluorene	3.3E-08	1.6E-07	--[a]	--[a]	--[a]	1.2E-10	1.2E-10	6.9E-11
1-Methylnaphthalene	2.2E-08	6.7E-08	--[a]	--[a]	--[a]	5.6E-11	4.9E-11	4.5E-11
2-Methylnaphthalene	2.4E-08	7.3E-08	--[a]	--[a]	--[a]	6.1E-11	5.4E-11	4.9E-11
Naphthalene	3.2E-08	1.2E-07	--[a]	--[a]	--[a]	7.6E-11	7.8E-11	4.5E-11
Phenanthrene	9.8E-08	6.5E-07	--[a]	--[a]	--[a]	4.3E-10	4.2E-10	2.2E-10
Total Low Molecular Weight PAH EHQ	1.8E-06	9.5E-06	--[a]	--[a]	--[a]	6.0E-09	5.3E-09	4.3E-09
High Molecular Weight PAH								
Benzo(a)anthracene	2.4E-07	1.1E-06	--[a]	--[a]	--[a]	1.3E-08	1.1E-08	9.4E-09
Benzo(a)pyrene	6.1E-05	2.9E-04	--[a]	--[a]	--[a]	3.4E-06	3.1E-06	2.7E-06
Benzo(e)pyrene	5.8E-07	1.3E-06	--[a]	--[a]	--[a]	3.3E-08	2.8E-08	2.7E-08
Benzo(b)fluoranthene	1.0E-06	3.5E-06	--[a]	--[a]	--[a]	5.7E-08	4.8E-08	4.7E-08
Benzo(g,h,i)perylene	5.8E-07	1.4E-06	--[a]	--[a]	--[a]	3.8E-08	3.4E-08	2.2E-08
Benzo(j)fluoranthene	3.6E-07	7.6E-07	--[a]	--[a]	--[a]	1.9E-08	1.6E-08	1.7E-08
Benzo(k)fluoranthene	6.0E-08	2.1E-07	--[a]	--[a]	--[a]	3.3E-09	2.8E-09	2.7E-09
Chrysene	4.1E-07	2.4E-06	--[a]	--[a]	--[a]	2.4E-08	2.3E-08	1.6E-08
Dibenzo(a,h)anthracene	1.0E-07	2.0E-07	--[a]	--[a]	--[a]	6.1E-09	5.0E-09	5.1E-09
Dibenzo(a,i)pyrene	5.3E-05	2.2E-05	--[a]	--[a]	--[a]	3.4E-06	2.8E-06	3.2E-06
Dibenzo(a,j)acridine	1.9E-06	1.1E-05	--[a]	--[a]	--[a]	1.3E-07	1.1E-07	9.4E-08
7H-Dibenzo(c,g)carbazole	2.2E-06	9.3E-06	--[a]	--[a]	--[a]	1.3E-07	1.1E-07	1.0E-07
Indeno(1,2,3-cd)pyrene	7.5E-06	1.5E-05	--[a]	--[a]	--[a]	4.3E-07	3.6E-07	3.9E-07
Perylene	1.2E-07	3.4E-07	--[a]	--[a]	--[a]	6.8E-09	5.7E-09	5.5E-09
Pyrene	7.9E-08	8.3E-07	--[a]	--[a]	--[a]	4.7E-09	4.6E-09	2.2E-09
Total High Molecular Weight PAH EHQ	1.3E-04	3.6E-04	--[a]	--[a]	--[a]	7.7E-06	6.4E-06	6.7E-06
Dioxins and Furans								
1,2,3,4,6,7,8-HpCDD	2.2E-08	6.4E-10	2.0E-08	1.5E-08	2.4E-10	3.1E-08	1.7E-07	2.8E-08
OCDD	7.4E-09	2.2E-10	1.1E-08	7.9E-09	6.1E-11	2.3E-09	1.3E-08	2.2E-09
2,3,4,7,8-PeCDF	1.3E-05	3.2E-07	4.2E-06	5.9E-06	4.4E-07	2.0E-06	9.9E-06	1.5E-06
2,3,7,8-TCDF	1.4E-06	2.8E-08	5.2E-06	7.9E-06	5.8E-07	9.9E-07	4.4E-06	6.7E-07
Total Dioxins/Furans TEQ	1.5E-05	3.5E-07	9.4E-06	1.4E-05	1.0E-06	3.1E-06	1.4E-05	2.2E-06
VOC								
bis(2-ethylhexyl) phthalate	4.5E-04	4.0E-06	4.1E-04	3.2E-04	2.1E-03	6.1E-06	1.6E-05	1.6E-05
Octachlorostyrene	2.4E-07	4.2E-08	--[a]	--[a]	--[a]	1.5E-05	3.9E-05	4.0E-05
Chlorinated Monocyclic Aromatics								
1,2,3,4-Tetrachlorobenzene	8.1E-10	1.3E-09	--	--	--	2.0E-09	5.3E-09	4.9E-09
Hexachlorobenzene	2.8E-09	1.1E-08	2.6E-08	4.5E-08	3.8E-08	5.9E-08	1.5E-07	1.3E-07
Pentachlorobenzenethiol	1.7E-07	1.3E-07	--[a]	--[a]	--[a]	--[a]	--[a]	--[a]
Total VOC EHQ	4.5E-04	4.1E-06	4.1E-04	3.2E-04	2.1E-03	2.1E-05	5.6E-05	5.7E-05
Inorganics								
Chromium (total)	6.1E-05	1.8E-05	3.5E-04	3.3E-04	5.7E-05	5.0E-05	7.1E-05	2.0E-05
Cobalt	6.2E-07	5.2E-06	3.5E-06	3.0E-06	4.7E-07	3.0E-07	1.2E-06	3.0E-07
Copper	3.2E-05	5.2E-05	7.9E-06	9.1E-06	1.3E-06	2.2E-06	2.7E-06	8.5E-07
Cyanide	4.1E-03	--[a]	1.7E-02	8.2E-03	1.5E-03	1.0E-05	1.7E-05	2.5E-06
Manganese	2.3E-06	8.0E-05	1.0E-06	8.7E-07	2.0E-07	4.5E-07	7.5E-07	2.3E-07
Molybdenum	2.8E-08	5.0E-07	1.5E-05	1.7E-05	1.3E-06	5.6E-05	1.8E-04	2.6E-05

Table 10.20 Summary of Maximum Receptor-specific Ecological Hazard Quotients (EHQ) from all Model Compartments for the Project Alone Scenario

COPC	Aquatic Receptors	Sediment Receptors	Spotted Sandpiper	Common Eider	Coastal-dwelling Herring Gull	Coastal-dwelling Mink	Harbour Seal	Harbour Porpoise
Silver	1.1E-04	1.5E-03	--[a]	--[a]	--[a]	7.8E-06	3.1E-05	5.1E-06
Vanadium	1.8E-04	1.2E-04	1.7E-04	1.1E-04	7.3E-05	1.4E-05	3.8E-05	2.6E-05
Zinc	8.1E-05	4.4E-04	1.4E-04	1.8E-04	2.9E-05	1.2E-05	4.2E-05	1.5E-05

Notes:
[a] An ecological hazard quotient could not be calculated because no Toxicity Reference Value or Toxicity Benchmark was available for this chemical and receptor combination.
[b] F3 aliphatics are insufficiently soluble in water to pose a risk to aquatic receptors when free product is not present.

Table 10.21 Maximum Baseline Case Exposure Point Concentration of MERA COPC

COPC	CAS-Number	Seawater (mg/L)	Marine Sediment (mg/kg dw)	Marine Plant (mg/kg ww)	Marine Benthic Invertebrate (mg/kg ww)	Marine Fish Tissue (mg/kg ww)
BTEX						
Benzene	71-43-2	ND (< 0.0005)	ND (< 0.005)	NA	NA	NA
Ethylbenzene	100-41-4	ND (< 0.0005)	ND (< 0.01)	NA	NA	NA
Toluene	108-88-3	ND (< 0.0005)	ND (< 0.05)	NA	NA	NA
Xylenes	8026-09-3	ND (< 0.0005)	ND (< 0.05)	NA	NA	NA
TPH - CCME CWS						
Aliphatic>C06-C08 - F1	--[a]	NA	NA	NA	NA	NA
Aliphatic>C08-C10 - F1	--[a]	NA	NA	NA	NA	NA
Aromatic>C08-C10 - F1	--[a]	NA	NA	NA	NA	NA
Aliphatic>C10-C12 - F2	--[a]	NA	NA	NA	NA	NA
Aliphatic>C12-C16 - F2	--[a]	NA	NA	NA	NA	NA
Aromatic>C10-C12 - F2	--[a]	NA	NA	NA	NA	NA
Aromatic>C12-C16 - F2	--[a]	NA	NA	NA	NA	NA
Aliphatic>C16-C21 - F3	--[a]	NA	NA	NA	NA	NA
Aliphatic>C21-C34 - F3	--[a]	NA	NA	NA	NA	NA
Aromatic>C16-C21 - F3	--[a]	NA	NA	NA	NA	NA
Aromatic>C21-C34 - F3	--[a]	NA	NA	NA	NA	NA
Polycyclic Aromatic Hydrocarbons						
Low Molecular Weight PAH						
Acenaphthene	83-32-9	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
Acenaphthylene	208-96-8	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
Anthracene	120-12-7	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
Fluoranthene	206-44-0	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
Fluorene	86-73-7	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
1-Methylnaphthalene	90-12-0	NA	NA	NA	NA	NA
2-Methylnaphthalene	91-57-6	NA	NA	NA	NA	NA
Naphthalene	91-20-3	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
Phenanthrene	85-01-8	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
High Molecular Weight PAH						
Benzo(a)anthracene	56-55-3	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
Benzo(a)pyrene	50-32-8	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
Benzo(e)pyrene	192-97-2	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
Benzo(b)fluoranthene	205-99-2	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
Benzo(g,h,i)perylene	191-24-2	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
Benzo(j)fluoranthene	205-82-3	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	207-08-9	ND (< 0.01)	NA	NA	ND (< 0.01)	NA

Table 10.21 Maximum Baseline Case Exposure Point Concentration of MERA COPC

COPC	CAS-Number	Seawater (mg/L)	Marine Sediment (mg/kg dw)	Marine Plant (mg/kg ww)	Marine Benthic Invertebrate (mg/kg ww)	Marine Fish Tissue (mg/kg ww)
Chrysene	218-01-9	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
Dibenzo(a,h)anthracene	53-70-3	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
Dibenzo(a,i)pyrene	189-55-9	NA	NA	NA	NA	NA
Dibenzo(a,j)acridine	224-42-0	NA	NA	NA	NA	NA
7H-Dibenzo(c,g)carbazole	194-59-2	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	193-39-5	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
Perylene	198-55-0	NA	NA	NA	NA	NA
Pyrene	129-00-0	ND (< 0.01)	NA	NA	ND (< 0.01)	NA
Dioxins and Furans						
1,2,3,4,6,7,8-HpCDD	35822-46-9	1.2E-09	2.3E-05	NA	5.1E-07	6.4E-08
OCDD	3268-87-9	6.7E-09	1.7E-04	NA	2.3E-06	2.1E-07
2,3,4,7,8-PeCDF	57117-41-6	5.0E-10	1.6E-06	NA	8.0E-08	3.6E-08
2,3,7,8-TCDF	51207-31-9	2.8E-09	4.1E-06	NA	2.9E-07	1.2E-07
VOC						
bis(2-ethylhexyl) phthalate	8033-53-2	NA	NA	NA	NA	NA
Octachlorostyrene	29082-74-4	NA	NA	NA	NA	NA
Chlorinated Monocyclic Aromatics						
1,2,3,4-Tetrachlorobenzene	634-66-2	NA	NA	NA	NA	NA
Hexachlorobenzene	118-74-1	ND (< 0.05)	ND (< 0.05)	NA	NA	NA
Pentachlorobenzenethiol	133-49-3	NA	NA	NA	NA	NA
Inorganics						
Chromium (total)	7440-47-3	5.0E-04	1.8E+00	NA	8.9E-01	9.3E-01
Cobalt	7440-48-4	2.8E-04	2.9E+00	NA	2.8E-01	2.6E-02
Copper	7440-50-8	8.0E-04	5.7E+00	NA	2.2E+01	3.7E+00
Cyanide	57-12-5	NA	NA	NA	NA	NA
Manganese	7439-96-5	9.2E-03	1.4E+02	NA	1.7E+00	3.7E+00
Molybdenum	7439-98-7	9.8E-03	4.8E-01	NA	1.3E+00	3.5E-02
Silver	7440-22-4	1.0E-05	1.5E-01	NA	1.5E+01	5.3E-02
Vanadium	7440-62-2	1.8E-03	1.4E+01	NA	7.0E-01	4.2E-01
Zinc	7440-66-6	1.8E-03	1.7E+01	NA	2.8E+01	1.4E+01

Notes:
[a] TPH fractions do not have CAS Numbers.
dw = dry weight.
ww = wet weight.
ND Not detected (estimate of quantification limit).
NA Not analysed, usually due to matrix interferences or lack of analytical techniques to distinguish between normal biological chemicals (*e.g.,* lipids) and potential COPC (*e.g.,* petroleum hydrocarbons).

Table 10.22 Maximum Project-related Incremental Concentrations of MERA COPC

COPC	CAS-Number	Seawater (mg/L)	Marine Sediment (mg/kg dw)	Marine Plant (mg/kg ww)	Marine Benthic Invertebrate (mg/kg ww)	Marine Fish Tissue (mg/kg ww)
BTEX						
Benzene	71-43-2	2.2E-06	2.7E-06	3.9E-06	3.9E-07	1.4E-06
Ethylbenzene	100-41-4	9.0E-08	9.7E-07	1.6E-06	1.3E-07	5.7E-07
Toluene	108-88-3	2.5E-06	1.5E-05	1.8E-05	2.1E-06	6.3E-06
Xylenes	8026-09-3	1.1E-06	1.2E-05	2.5E-05	1.5E-06	8.7E-06
TPH - CCME CWS						
Aliphatic>C06-C08 - F1	--[c]	2.2E-05	5.1E-04	3.1E-03	6.1E-05	1.1E-03
Aliphatic>C08-C10 - F1	--[c]	1.1E-07	1.9E-05	1.2E-04	2.1E-06	4.1E-05

Table 10.22 Maximum Project-related Incremental Concentrations of MERA COPC

COPC	CAS-Number	Seawater (mg/L)	Marine Sediment (mg/kg dw)	Marine Plant (mg/kg ww)	Marine Benthic Invertebrate (mg/kg ww)	Marine Fish Tissue (mg/kg ww)
Aromatic>C08-C10 - F1	--[c]	7.4E-09	6.8E-08	4.1E-07	8.4E-09	1.4E-07
Aliphatic>C10-C12 - F2	--[c]	1.2E-06	1.7E-03	1.1E-02	1.8E-04	3.8E-03
Aliphatic>C12-C16 - F2	--[c]	1.4E-06	2.4E-02	0.25	2.2E-03	8.8E-02
Aromatic>C10-C12 - F2	--[c]	7.4E-08	1.8E-06	6.5E-06	2.2E-07	2.3E-06
Aromatic>C12-C16 - F2	--[c]	1.4E-06	9.5E-05	2.5E-04	1.1E-05	8.8E-05
Aliphatic>C16-C21 - F3	--[c]	3.6E-06	0.14	NA[a]	NA[a]	NA[a]
Aliphatic>C21-C34 - F3	--[c]	8.9E-06	0.52	NA[a]	NA[a]	NA[a]
Aromatic>C16-C21 - F3	--[c]	3.6E-06	7.4E-04	2.0E-03	8.4E-05	6.9E-04
Aromatic>C21-C34 - F3	--[c]	3.1E-06	5.0E-03	1.4E-02	5.2E-04	4.8E-03
Polycyclic Aromatic Hydrocarbons						
Low Molecular Weight PAH						
Acenaphthene	83-32-9	9.9E-08	3.5E-05	1.1E-05	4.3E-06	4.0E-06
Acenaphthylene	208-96-8	7.4E-08	3.3E-05	1.1E-05	3.9E-06	3.7E-06
Anthracene	120-12-7	1.3E-09	2.2E-06	5.9E-07	2.5E-07	2.1E-07
Fluoranthene	206-44-0	1.8E-10	9.4E-07	2.6E-07	1.0E-07	9.2E-08
Fluorene	86-73-7	2.2E-09	1.5E-06	5.0E-07	1.7E-07	1.7E-07
1-Methylnaphthalene	90-12-0	2.6E-09	5.1E-07	2.7E-07	6.2E-08	9.6E-08
2-Methylnaphthalene	91-57-6	2.9E-09	5.5E-07	3.0E-07	6.7E-08	1.0E-07
Naphthalene	91-20-3	1.2E-08	7.5E-07	3.4E-07	9.6E-08	1.2E-07
Phenanthrene	85-01-8	3.7E-09	6.5E-06	1.7E-06	7.5E-07	5.9E-07
High Molecular Weight PAH						
Benzo(a)anthracene	56-55-3	8.6E-10	1.5E-05	6.2E-06	1.6E-06	2.2E-06
Benzo(a)pyrene	50-32-8	1.2E-07	4.7E-03	1.8E-03	4.8E-04	6.2E-04
Benzo(e)pyrene	192-97-2	4.6E-10	2.2E-05	1.8E-05	2.1E-06	6.3E-06
Benzo(b)fluoranthene	205-99-2	1.6E-09	5.7E-05	3.1E-05	5.7E-06	1.1E-05
Benzo(g,h,i)perylene	191-24-2	4.3E-10	2.5E-05	2.0E-05	2.4E-06	6.9E-06
Benzo(j)fluoranthene	205-82-3	2.9E-10	1.3E-05	1.1E-05	1.2E-06	3.9E-06
Benzo(k)fluoranthene	207-08-9	9.9E-11	3.5E-06	1.8E-06	3.5E-07	6.3E-07
Chrysene	218-01-9	1.5E-09	3.5E-05	1.0E-05	3.6E-06	3.7E-06
Dibenzo(a,h)anthracene	53-70-3	7.6E-11	3.7E-06	3.5E-06	3.6E-07	1.2E-06
Dibenzo(a,i)pyrene	189-55-9	8.0E-09	4.7E-04	2.2E-03	4.2E-05	7.7E-04
Dibenzo(a,j)acridine	224-42-0	7.9E-09	2.0E-04	6.1E-05	2.0E-05	2.1E-05
7H-Dibenzo(c,g)carbazole	194-59-2	8.2E-09	1.6E-04	6.6E-05	1.6E-05	2.3E-05
Indeno(1,2,3-cd)pyrene	193-39-5	4.6E-09	2.8E-04	2.6E-04	2.7E-05	9.1E-05
Perylene	198-55-0	1.4E-10	5.7E-06	3.6E-06	5.6E-07	1.3E-06
Pyrene	129-00-0	1.4E-09	9.8E-06	1.6E-06	1.1E-06	5.7E-07
Dioxins and Furans						
1,2,3,4,6,7,8-HpCDD	35822-46-9	2.1E-13	1.6E-08	3.1E-07	1.0E-09	4.6E-12
OCDD	3268-87-9	7.4E-13	5.4E-08	1.7E-06	2.0E-09	1.6E-11
2,3,4,7,8-PeCDF	57117-41-6	2.7E-13	1.6E-08	1.2E-08	2.7E-09	5.7E-12
2,3,7,8-TCDF	51207-31-9	2.7E-13	1.4E-08	4.9E-09	3.9E-09	5.8E-12
VOC						
bis(2-ethylhexyl) phthalate	8033-53-2	5.7E-08	1.2E-04	2.6E-02	1.0E-05	9.0E-03
Octachlorostyrene	29082-74-4	3.3E-11	1.2E-06	1.3E-05	1.1E-06	4.7E-05
Chlorinated Monocyclic Aromatics						
1,2,3,4-Tetrachlorobenzene	634-66-2	3.9E-11	1.7E-08	1.8E-08	1.9E-09	6.2E-09
Hexachlorobenzene	118-74-1	3.1E-11	2.1E-07	8.8E-08	2.2E-07	3.1E-07
Pentachlorobenzenethiol	133-49-3	5.0E-10	2.5E-06	5.8E-06	2.5E-07	2.0E-06
Inorganics						
Chromium (total)	7440-47-3	1.3E-06	7.6E-02	7.7E-04	2.4E-03	3.1E-04
Cobalt	7440-48-4	4.7E-08	1.7E-03	1.8E-04	6.1E-05	7.2E-06
Copper	7440-50-8	9.8E-08	5.1E-03	1.8E-04	6.5E-04	6.0E-05
Cyanide	57-12-5	4.1E-06	6.9E-02	NA[b]	NA[b]	NA[b]
Manganese	7439-96-5	2.8E-06	0.23	8.3E-03	2.6E-03	7.8E-04

Table 10.22 Maximum Project-related Incremental Concentrations of MERA COPC

COPC	CAS-Number	Seawater (mg/L)	Marine Sediment (mg/kg dw)	Marine Plant (mg/kg ww)	Marine Benthic Invertebrate (mg/kg ww)	Marine Fish Tissue (mg/kg ww)
Molybdenum	7439-98-7	1.5E-07	3.5E-03	2.2E-07	2.4E-03	7.0E-07
Silver	7440-22-4	1.3E-07	8.0E-03	1.4E-03	3.4E-02	1.4E-04
Vanadium	7440-62-2	1.8E-06	1.2E-02	6.4E-04	3.1E-04	4.6E-04
Zinc	7440-66-6	6.6E-06	0.34	1.0E-02	9.4E-02	1.3E-02

Notes:
[a] Aliphatic F3 fractions were not modelled in marine plants, invertebrates, and fish as they are insufficiently soluble and bioavailable.
[b] Cyanide does not bioaccumulate and is readily metabolized, therefore an EPC was not calculated for marine biota.
[c] TPH fractions do not have CAS Numbers.
dw = dry weight.
ww = wet weight.

Offshore discharge of effluent typically has less potential to cause environmental effects than discharge at shore because of the immediate and more effective dilution of the effluent. Effluent discharge into turbulent systems improves dispersion and dilution, which reduces the exposure concentrations and likelihood of adverse environmental effects (Wake 2005). In addition to treating liquid effluent, the Project will discharge the treated effluent at Mispec Bay with favourable mixing and dilution characteristics (*e.g.*, steady ambient flow at right angles to the discharge pipe, either east or west during the rising or falling tide; the area is clear of extensive jetty structures with moored ships that could modify local currents and affect the spreading of the plume; wave and wind action that tends to increase the mixing process), which will further mitigate the risk of adverse environmental effects on the marine environment (Jacques Whitford 2008h).

In summary, all EHQs values for Baseline, Project Alone and Project Case (Baseline + Project) were far less than 1 for water, sediments, marine mammals and birds. In addition, all Project effluent releases will meet the *Petroleum Refinery Liquid Effluent Regulations* and CCME Water Quality Guidelines for the Protection of Marine Aquatic Life. Therefore, environmental effects due to Project wastewater releases are rated not significant.

During Operation, the release of treated wastewater and accidental events (*e.g.,* spills) have the potential to cause taint of fishery resources within the Marine PDA. Treated effluent will meet the *Petroleum Refinery Liquid Effluent Regulations* and CCME Water Quality Guidelines for the Protection of Marine Aquatic Life. The Marine PDA contains no important habitat for known species of special status. Although commercial fishing activity does occur within and near the Marine PDA, it is expected that any residual contaminants in treated wastewater would be rapidly diluted by the strong tidal currents in the Outer Saint John Harbour (Jacques Whitford 2008h). The commercially important fish species that are present in or near the Marine PDA are not species of special status, and are migratory (*e.g.,* lobster); thus their long-term exposure to treated effluent within the mixing zone at concentration levels that could cause taint is unlikely. It is thus highly unlikely that residual concentrations of contaminants within treated wastewater released to the Marine PDA would cause taint of marine populations. Any individuals of secure species that could be affected (as an accidental event) would not cause an adverse Change in Marine Populations at the population level in the RAA. As such, the environmental effects of potential taint associated with treated wastewater release on a Change in Marine Populations are rated not significant.

Potential Changes to Marine Populations as a result of accidental events (*e.g.,* spills) including tainting of fishery resources are assessed in Chapter 16.

Water Quality

An elevated level of TSS could cause adverse change in water quality that could potentially result in a Change in Marine Populations in the Marine PDA. Change in TSS will be limited to Construction. Dredging, side casting and levelling of the sea bed will likely create a near-bottom turbidity plume comprised of fine silts and clays. Under existing baseline conditions, turbidity was measured generally higher near the bottom for all seasons surveyed (Section 10.2), and highest during the fall and winter seasons because of storm conditions and in the summer because of dredge disposal activity at the Black Point ocean disposal site. Further, during the marine benthic video surveys that were conducted for this EA, silt was often observed in suspension immediately above the sea bed, and at times when the TOV would occasionally hit bottom, a cloud of silt would form above the bottom that would immediately disperse in the direction of the bottom current. The survey of the sea bed in the Marine PDA (Section 10.2.3.2) suggests that the footprint of the jetty is primarily in silty sand substrate where dredging, side casting and levelling of the sea bed will mainly re-suspend the lower fraction of fine silt from a predominant sand composition. Sub-lethal environmental effects have been reported (Appleby and Scarratt 1989) for a variety of fish species continually exposed for a period of several days in waters with suspended sediment concentrations of approximately 650 mg/L or greater. For this Project, similarly high concentrations of suspended sediments will likely be localized to the footprint of the jetty and could be achieved only at the site of actual sea bed disturbance, with the dissipation of any persistent plume that may develop after side casting/levelling activities or dredging have terminated. In addition, the environmental effects from potentially higher TSS concentrations in the water column during the actual dredging activity will be further reduced by the use of a hydraulic suction dredge. The Marine PDA is located in the coastal zone and therefore is characterized by relatively high and variable levels of TSS in a strong tidal current environment. The marine populations in nearshore areas of the Bay of Fundy have evolved to cope with variable and relatively high TSS levels. For instance, many of the fish species found in the LAA are also found in the sediment-laden waters of the upper Bay of Fundy, such as the Petitcodiac River estuary, Minas Basin and Cobequid Bay.

In summary, with mitigation, the Project will result in elevated TSS within the footprint of and immediately adjacent to the marine infrastructure. This environmental effect would occur intermittently during Construction while dredging is undertaken. This environmental effect is reversible, transient and of limited geographic scope to the Marine PDA and thus will not affect populations of marine organisms in the LAA or RAA, and is hence not significant.

A variety of scenarios for the discharge of cooling water were considered during Project design, including the option for discharging only effluent from the wastewater treatment plant (NATECH 2008a). The CCME Guideline for temperature in aquatic environments (an interim guideline) states "Human activities should not cause changes in ambient temperature of marine and estuarine waters to exceed ±1 C° at any time, location, or depth." The Guideline further states that "It is recognized that, in implementing the recommended interim guideline for temperature, allowance may be made for the existence of mixing zones." In deciding upon a discharge design for cooling water the aforesaid principles of the CCME Guideline were considered to attempt to reduce the volume of water where the temperature is more than 1 C° above the ambient seawater temperature and to minimize the extent of the mixing zone.

The worst-case design plan is to discharge heated cooling water continuously through a diffuser system in about 23 m water depth and at a distance of 250 m from the shore of Mispec Point (Chapter 3). Cooling water will be discharged at a rate of 25.2 m^3/s (400,000 USgal/min) and will be 10 C° above ambient sea temperature. This discharge scenario will minimize the size of the mixing zone. Modelling of the effluent dispersion and estimation of the mixing zone, or initial dilution zone for the cooling water discharge, was conducted by NATECH (2008a), including that for only the wastewater discharge (without cooling seawater in the event that cooling towers only are used); this configuration would have less of a footprint in the marine environment and is therefore not discussed any further. The initial dilution zone of the thermal plume for the cooling water discharge was modelled under various tidal conditions and worst-case scenarios. In general the plume is expected to decay rapidly. On an average tide the dimension of the thermal plume at the edge of the 1 C° above ambient sea temperature will be approximately 200 m by 100 m, and have an area of 2 ha. On a neap tide, and worst-case scenario because of lower current speeds, the thermal plume will be approximately 800 m by 100 m, and have an area of 8 ha at the 1 C° above ambient sea temperature boundary limit for the dilution zone. During spring tides, the plume is expected to be smaller than that modelled for an average tide as higher tidal currents will rapidly disperse the plume. Modelled results suggest that the plume and 1 C° boundary limit will not become shore attached and extend to the mouth of the Mispec River and will not cover the mouth of Mispec Bay.

Water temperatures in the Marine PDA are naturally variable in time and space; therefore, marine organisms in the Marine PDA have evolved to cope with fluctuating temperatures by using behavioural or physiological strategies. Discharged cooling water will not exceed 10°C above the ambient sea temperature, and discharged cooling water will be rapidly mixed with the surrounding seawater such that the area of water that exceeds 1°C above ambient and within this boundary limit will not be greater than 800 m by 100 m. Therefore no direct mortality or substantive avoidance behaviour is expected by resident fish species. The area potentially affected by the thermal plume does not provide important spawning habitat for Marine Populations, thus further reducing the risk of environmental effects. No acute or chronic toxicity on marine populations is expected as discharged cooling water will comply with CCME Guidelines in respect to levels of potential contaminants in the effluent not being acutely toxic to fish. It can be concluded, therefore, that the extent of the thermal plume is appropriate for the site-specific conditions at Mispec Point with respect to CCME Guidelines to establish an initial dilution zone of approximately 8 ha.

The risk of migrating fish becoming disoriented due to the presence of a weak thermal plume in the Marine PDA is difficult to gauge given the lack of information regarding this behaviour. However, the risk of the weak thermal plume causing disruptions to migratory fish movements is minimized by several Project design features. The first is that locally sourced seawater will be used for cooling water, and discharged water will comply with CCME guidelines. In addition, a diffuser system will be used (with precise configuration to be developed during detailed design) so that the thermal plume is weak and decays more rapidly than if an open-pipe design was used. Lastly, under no modelled conditions will the mixing zone of the plume spread across the mouth of Mispec Bay, and therefore a corridor for migrating fish to the Mispec River and Saint John River will be maintained.

In summary, with mitigation, the Project will result in environmental effects on water temperatures in the Marine PDA in proximity to the discharge of cooling water. This environmental effect would occur continuously during the Operation. Based on Project design, modelling results for assumed worst case conditions, and the nature of potentially affected habitats, the cooling water discharge will not affect populations of marine organisms in the LAA. Furthermore, due to the limited geographic scope of the modelled thermal plume and the rapid decay of the plume, there will be no environmental effects on migrating fish if and when present, and overall the environmental effects are rated not significant.

Underwater Acoustic Environment

The sound emissions from pile driving may cause fish to move out of the affected areas close to the source. There is considerable variation in the hearing ability of fish; therefore it is difficult to make general statements about behaviour of many fish species relative to this activity.

Turnpenny and Nedwell (1994) summarized the following physiological environmental effects of sound on fish:

- Transient stunning at 192 dB re 1 μPa;
- Internal injuries at 200 dB re 1 μPa;
- Egg/larval damage at 220 dB re 1 μPa; and
- Fish mortality at 230-240 dB re 1 μPa.

Based on these anticipated underwater sound pressure levels, no adverse environmental effects are expected on adult, juvenile or eggs and larvae of commercial or non-commercial species from pile driving or other Project-generated sound in the LAA and RAA. The area immediately around the pile driving area may be subject to sound levels that would have the potential to cause physiological harm to fish; however, the brief period of pile driving, the localized area of potential environmental effects in the Marine PDA and the ability of fish to actively move away from intense sounds reduce the risk of environmental effects on the fish populations in the LAA and RAA.

Underwater sound pressure levels produced during Construction and Operation have the potential to negatively affect the American lobster. In a related species, brown shrimp (*Crangon crangon*), Lagardère (1982) found that excessive noise (frequencies above 20 Hz and sound pressures 15 to 60 dB higher than those recorded in the soundproof tanks) caused metabolic abnormalities, such as difficulty in preserving physiological and metabolic balance. Furthermore, populations kept in excessive noise tanks had lower survival rates, consumed less food and spawned later. Popper (2003) showed that impact pile driving will produce underwater sound pressure levels of 227 dB at a distance of 5 m and 204 dB at a distance of 100 m. It is expected that underwater sound pressure levels produced during pile driving for the marine terminal will be comparable to those described above. However, the brief period of pile driving, the localized area of potential environmental effect, and the ability of lobsters to actively move away from intense sounds reduce the risk of environmental effects on the lobster population in the Marine PDA, LAA and RAA.

During Construction and Operation there will be increased underwater sound in the RAA; however, the consequential environmental effects on fish populations are expected to be greatest during Construction. Based on existing underwater sound levels in the RAA as well as the transient and low magnitude nature of Project-generated sound, the environmental effects of Project generated sound on fish populations is rated not significant.

10.4.1.3 Marine Mammals

<u>Project Environmental Effects Mechanisms for Change in Marine Populations (Marine Mammals)</u>

The potential for underwater/nearshore blasting during Construction and vessel traffic during Construction and Operation to have environmental effects on marine mammals require further investigation. The parameter that will be used for measuring potential change to marine mammal populations is the acoustic environment.

Changes in marine mammal populations may result from: a change in marine mammal habitat quality; a change in marine mammal health; or the direct mortality of marine mammals.

Sound pressure levels (SPL) capable of inflicting lethal injuries to marine mammals are generally produced only as a result of underwater explosions (Ketten 1995; Richardson *et al.* 1995). Underwater/nearshore blasting will take place at two locations within the Marine PDA: the barge landing facility in Mispec Bay; and the seawater cooling intake structure at Mispec Point. Marine mammals occurring within close proximity of explosive detonations may incur damage to gas-containing organs (Keevin and Hempen 1997). Shock waves produced by blasting are relatively short-propagating; therefore, severe injuries are expected to occur over a limited spatial area. It has been calculated that slight injuries to lungs and intestines of marine mammals may occur at distances of up to 500 m under certain blasting conditions (Wright and Hopky 1998). Safe ranges from underwater explosions for marine mammals are dependent on both the size and depth of the marine mammal and type of explosive charge (Richardson *et al.* 1995).

Underwater/nearshore blasting for the Project has the potential to adversely affect harbour seals and/or harbour porpoises that might be present in the Marine PDA. Physical injuries and/or direct mortality may occur if an animal is within close proximity to the detonated explosives (*e.g.,* <500 m). Behavioural responses in animals further afield may include avoidance responses, decreased foraging activity, and increased energy expenditure. However, as blasting is expected to occur over a short time frame, behavioural responses will be limited.

To minimize the likelihood of injury or direct mortality to marine mammals, the Proponent will develop a detailed explosives protocol in the EPP. This protection plan will adhere to the DFO guidelines for the use of underwater explosives (Wright and Hopky 1998). Marine mammal observers will be on-site during all blasting activities to help ensure that no detonation takes place while a marine mammal is observed or known to be inside the pre-determined danger zone or buffer area. The danger zone and buffer area will be calculated based on the specifics of the blasting (*e.g.,* charge, delay, depth).

During Construction of the marine terminal, various activities (*e.g.,* pile driving, dredging) will produce high-intensity sound in the audible ranges of marine mammals (Richardson *et al.* 1995; Nowacek *et al.* 2004). At close proximity, these sounds have the potential to result in permanent threshold shifts (PTS); temporary threshold shifts (TTS); behavioural avoidance; and auditory masking (Richardson *et al*. 1995; Nowacek *et al.* 2004). Each of these changes may compromise marine mammal feeding efficiency, predator detection, and/or migratory success, and lead to reduced health and possibly death (Richardson *et al*. 1995).

PTS occur when high-intensity sounds cause irreversible physiological injury to the auditory apparatus (Ward 1997; Southall *et al.* 2007). Depending on the level of exposure, PTS may represent partial or total hearing loss (Ward 1997; Southall *et al.* 2007). By comparison, TTS, also commonly referred to as auditory fatigue, do not involve physiological injury (Ward 1997; Southall et al. 2007). TTS occur when sounds of sufficient intensity and/or duration cause a temporary increase in the absolute auditory threshold (Ward 1997; Southall *et al*. 2007). TTS may last for several seconds to several minutes depending on the source level (Ward 1997; Southall *et al*. 2007).

Marine mammals depend highly on their ability to perceive and discriminate between sounds in the marine environment. Sound production and audition play instrumental roles in spatial orientation and migration, communication, predator and prey detection, courtship displays and mating, and locating conspecifics (Richardson *et al*. 1995; Nowacek *et al.* 2004). Depending on the species in question, TTS and PTS may lead to: reduced foraging efficiency; increased predation; reduced fecundity; and increased energy expenditure (Richardson *et al*. 1995; Nowacek *et al.* 2004). Reduced hearing ability may also hamper a marine mammal's ability to detect approaching vessels, leading to an elevated risk of vessel strikes (Terhune and Verboom 1999).

Sound levels capable of inducing TTS and PTS in marine mammals are not well established. TTS has only been observed in a few species of seals and small-toothed whales (Southall *et al.* 2007). PTS has not been observed in any marine mammal (Southall *et al.* 2007). Estimates of TTS- and PTS-inducing sound levels (also known as noise exposure levels) are often obtained by extrapolating from known or predicted marine mammal auditory thresholds (Richardson *et al*. 1995; Southall *et al*. 2007). However, as much of our knowledge of PTS and TTS is based on research of hearing in terrestrial mammals, estimated marine mammal noise exposure levels are largely speculative (Richardson *et al*. 1995; Southall *et al.* 2007). The most recent estimates of TTS- and PTS-inducing sound levels are those proposed by Southall *et al*. (2007). These values are based on a comprehensive analysis of existing research and are intentionally conservative. For cetaceans, sound pressure levels (SPL_{peak}) capable of inducing TTS and PTS are 224 and 230 dB re 1 µPa, respectively. For seals in water, SPL_{peak} capable of inducing TTS and PTS are 212 and 218 dB re 1 µPa, respectively. Exposure to sound levels below those capable of inducing TTS are unlikely to affect auditory thresholds but may elicit significant behavioural changes (Richardson *et al.* 1995; Nowacek *et al*. 2004; Southall *et al*. 2007). These behavioural changes may adversely affect the health of marine mammals.

During Construction and Operation, the majority of anthropogenic sound in the marine environment will originate from three activities: pile driving; dredging; and shipping. Shipping is not part of the scope of the Project, and is not assessed in this CSR; it will be addressed via a TERMPOL review process. Sound produced from pile driving and dredging may affect marine mammals in the proximity of construction activities within the Marine PDA, out to a distance of several tens of kilometres from the source. Sounds originating from vessels, including tugs, barges, supply vessels and tankers, may affect marine mammals throughout the RAA, including those distributed within or adjacent to the Bay of Fundy shipping lanes.

Construction of the marine terminal may require driving steel piles into bedrock. The main component of noise from pile driving comes from the physical impact of the hammer on the pile. Acoustic energy travelling down the pile is coupled into the water and into the sediment and bedrock. Acoustic energy travelling through the sea floor radiates back into the water. The acoustic waveform of a single hammering event has an impulsive shape. Most energy is concentrated at low frequencies (<1,000 Hz). The source level of the acoustic impulse created during pile driving depends on factors such as the size (diameter, wall thickness) of the pile, its material, the material of the bedrock, and the type of hammer. Hastings and Popper (2005) provide measurements of SPL_{peak} at varying distances from cast in steel shell (CISS) piles (96-inch diameter) driven with an impact hydraulic hammer. At a distance of 5 m from the pile, SPL_{peak} was 227 dB re 1 µPa. At 100 m from the pile, SPL_{peak} was reduced to 204 dB re 1 µPa. It is expected that sound levels produced during pile driving for the marine terminal will be comparable to those described here.

Construction of the marine terminal may require dredging. Underwater sound emissions from dredges are highly variable and changes with the mode of operation. The sound is continuous and broadband, with most energy concentrated at low frequencies (<1,000 Hz). Richardson *et al*. (1995) compared underwater sound levels produced by operating dredges. A typical transfer dredge had a broadband source level of 187 dB re 1 µPa @ 1 m, while a clamshell dredge had a maximum broadband source level of approximately 167 dB re 1 µPa @ 1 m (Richardson *et al*. 1995). The sounds produced by these dredges generally diminished below the typical broadband ambient noise level (approximately 100 dB re 1 μPa) within 25 km of the dredges (Richardson *et al*. 1995).

Throughout the Project, a variety of vessels will contribute sound to the marine environment. During Construction of the marine terminal, tugboats, barges, and supply vessels will operate within the Marine PDA. During Operation, large tankers will transport crude oil and refined products to and from the Marine Terminal. It is anticipated that approximately 354 tankers of various sizes will use the Marine Terminal each year. Vessel traffic in the Bay of Fundy shipping lanes is currently monitored by the Canadian Coast Guard's Marine Communications and Traffic Services (MCTS) Centre. In 2007, the MCTS recorded 1,680 vessels transiting in the Bay of Fundy shipping lanes, bound for the ports of Saint John, New Brunswick, and Hantsport, Nova Scotia. These vessels ranged in length from 11 m (35 feet) to over 335 m (1,100 feet) in length, with an average length of approximately 140 m (460 feet). Based on the 2007 MCTS data, the addition of approximately 354 Project-related tankers to existing vessel traffic in the Bay of Fundy shipping lanes represents an approximate increase of 21%.

The majority of sound produced by an operating vessel is generated by propeller cavitation, the creation and collapse of high-pressure voids or bubbles (Ross 1987). Propulsion machinery and hydraulic flow over the hull also generate vessel sound emissions (Hildebrand 2003). In general, the source level of ship sound emissions increases with ship size, speed, propeller blade size, number of blades, and rotations per minute (Ross 1976; Gray and Greeley 1980; Scrimger and Heitmeyer 1991; Richardson *et al*. 1995; Hamson 1997). As with pile driving and dredging, vessels produce broadband sound emissions with the most energy at low frequencies (5-500 Hz; Hildebrand 2003). JASCO Research (2008) has measured source levels of a variety of vessels during previous projects (Table 10.23).

Table 10.23 Broadband Source Levels of Various Vessel Types

Vessel Type	Activity	Speed	Broadband Source Level (dB re 1 μPa @ 1m)
Barge	Pipe-laying	Stationary	168
Tug	Pushing/pulling	Slow	193
Tug	Transiting	Half-speed	185
Bulk Cargo (173 m length)	Transiting	Full-speed	192
Bulk Cargo (243 m length)	Transiting	Half-speed	185

Source: Table adapted from JASCO Research (2008).

Based on the distribution of marine mammals in the Bay of Fundy, sound produced during construction activities is most likely to affect harbour seal and harbour porpoise. Pile driving, dredging, and vessels produce low-frequency sounds with most acoustic energy below 1 kHz. As harbour seals and harbour porpoises are most sensitive to mid-frequency sounds (>1 kHz), much of the acoustic energy produced by construction activities will not be audible to these marine mammals. Based on the Southall *et al.* (2007) exposure criteria, neither dredging nor vessels will produce sounds intense enough to induce TTS or PTS in any marine mammal. At very close proximity (<100 m), pile driving may induce PTS in seal and TTS in porpoises. However, given the low abundance of harbour seals and harbour porpoise in the Marine PDA, it is expected that very few animals will be exposed to high-intensity sounds from pile driving activities.

To further reduce the likelihood of auditory injury to a marine mammal during Construction of the marine terminal, a safety radius of 200 m will be imposed around construction activities that produce intense underwater acoustic emissions (*i.e.,* pile driving, dredging). This safety radius will be monitored by a marine mammal observer. If a marine mammal is observed within the safety radius, the construction activity will be temporarily stopped until the animal moves beyond the safety radius.

Sound produced during construction activities will not affect the North Atlantic right whale in the Grand Manan Basin. The bathymetric and geophysical properties of the upper Bay of Fundy are not conducive to sound propagation over large distances (Desharnais *et al.* 2000). The predominant sediment type in the upper Bay of Fundy is LaHave Clay, a loosely compacted, sandy clay that has a low compressional sound speed (Canadian Hydrographic Service 1977; Desharnais *et al.* 2000). Desharnais *et al.* (2000) measured low-frequency sound transmission in the upper Bay of Fundy over LaHave clay, and observed a 120 dB propagation loss over a range of 20 km. Based on these findings, it is expected that construction sounds will attenuate to intensities below ambient sound levels within 20 to 30 km. The Grand Manan right whale conservation area is located approximately 80 km from the Marine PDA.

Tanker traffic transiting in the Bay of Fundy shipping lanes will produce sounds in the range of 180 to 200 dB re 1 µPa @ 1m, with most acoustic energy below 1 kHz. Simple equations can be employed to determine sound pressure levels at given distances from a vessel. These equations integrate transmission loss, range, and water depth, but do not account for the physical properties of water or the geoacoustic properties of the seafloor. JASCO Research (2008) computed sound propagation around a vessel in the major shipping lane east of Grand Manan Island at a water depth of 200 m (Table 10.24). The vessel used in this calculation was a 173 m cargo vessel with a broadband source level of 192 dB re 1 µPa @ 1 m (Arveson and Bendettis 2000). Based on the Southall *et al.* (2007) exposure criteria, vessel source levels are incapable of inducing TTS or PTS in any marine mammal, even at very close proximity (<100 m). It is possible, however, that marine mammals exposed to increased levels of vessel sound emissions will exhibit behavioural avoidance of the transiting vessels.

Table 10.24 Estimated Sound Propagation Around a 173 m Cargo Vessel [1]

Range (m)	SPL (dB re 1 µPa)	Range (m)	SPL (dB re 1 µPa)
1	192	500	142
2	186	1,000	139
5	178	2,000	136
10	172	5,000	132
20	166	10,000	129
50	158	20,000	126
60	156	50,000	122
100	152	100,000	119
200	146		

Notes:
[1] Vessel transiting at full speed in the Bay of Fundy shipping lanes; sound propagation levels at a water depth of 200 m.
Source: Table adapted from JASCO Research (2008).

Anthropogenic sounds may interfere with the ability of marine mammals to hear natural sounds of similar frequencies, a phenomenon known as auditory masking (Richardson *et al.* 1995; Nowacek *et al.* 2004). Certain natural sounds are important for the survival and health of marine mammals. These include calls from conspecifics and predators, echolocation clicks from odontocetes (*e.g.,* harbour porpoises) and environmental sounds from sources such as ice and waves. Constant anthropogenic sounds, such as that arising from vessel traffic, are more likely to cause masking than intermittent sounds, such as impact pile driving (Richardson *et al.* 1995; Nowacek *et al.* 2004). Intermittent sounds allow a certain degree of hearing and communication between sound pulses (Richardson *et al.* 1995; Nowacek *et al.* 2004).

Various studies have investigated the environmental effects of construction activities on the distribution of seals. These studies generally suggest that seals exhibit only limited behavioural avoidance of anthropogenic sound (*e.g.,* Harris *et al.* 2001; Koschinski *et al.* 2003; Blackwell *et al.* 2004a,b; Miller *et al.* 2005). For example, Blackwell *et al.* (2004a) investigated the responses of ringed seals to pile driving sounds at an oil production island in the Alaskan Beaufort Sea. The authors observed little or no reaction to mean SPL_{peak} reaching 157 dB re 1 µPa @ 63 m. In another study, Koschinski *et al.* 2003 investigated surfacing behaviour of harbour seals during exposure to low-frequency (≤800 Hz) wind farm sounds. The authors found that seals surfaced slightly farther from the sound source during sound treatments (median = 284 *vs.* 239 m), although no other behavioural responses were noted. Additional studies have investigated avoidance behaviour of ringed seals in response to operating seismic vessels (*e.g.,* Harris *et al.* 2001; Miller *et al*. 2005). These studies conclude that ringed seals encountered during seismic surveys do not significantly alter their behaviour to avoid the seismic emissions. Sound pressure levels associated with seismic surveys (220-255 dB re 1 µPa @ 1m; Nowacek *et al.* 2004) are higher than those associated with pile driving, dredging, or construction vessels. Based on these findings, it is expected that harbour seals will exhibit very limited behavioural avoidance of construction works in the Marine PDA. It is unlikely that these minimal behavioural changes will affect harbour seal health.

Behavioural studies suggest that harbour porpoises are more reactive to sounds from construction activities than harbour seals (*e.g.,* Koschinski *et al.* 2003; Henriksen *et al.* 2004; Tougaard *et al.* 2004; Herr *et al.* 2005). For example, Henriksen *et al.* (2004) reported decreases in harbour porpoise activity during construction of an offshore wind farm in the Danish Baltic Sea. In another study, Tougaard *et al.* 2004 investigated harbour porpoise activity during construction works similar to those of the Project. During periods of construction, the harbour porpoise spent less time foraging and displayed reduced acoustic activity compared to periods of no construction. These differences were observed at distances of up to 15 km from the site of construction. Acoustic activity of the harbour porpoises resumed to normal levels several hours after the completion of construction activities (Tougaard *et al.* 2004). Harbour porpoises are also known to be relatively sensitive to vessel sound emissions, exhibiting local avoidance behaviour (Richardson *et al.* 1995). In a study comparing harbour porpoise distribution with vessel traffic density in the German North Sea, Herr *et al.* (2005) found a statistically significant negative correlation. Based on these findings, it is expected that harbour porpoises will exhibit localized avoidance of construction works in the Marine PDA. However, because the Marine PDA does not represent important foraging habitat for harbour porpoises, it is unlikely that localized avoidance of this area will affect harbour porpoise health.

It is unlikely that sounds produced during the Construction of the marine terminal will mask sounds produced by either the harbour seal or the harbour porpoise. The harbour seal generally produces sounds only during courtship and breeding (Hangii and Schusterman 1994; Ralls *et al.* 1985). As there are no known seal breeding or pupping sites in the Marine PDA, auditory masking of harbour seal sounds is unlikely. The harbour porpoises produce sounds in the range of 2 to 150 kHz (Mohl and Andersen 1973). These sounds are much higher in frequency than those associated with construction activities, making auditory masking unlikely.

Increased vessel traffic in the Bay of Fundy shipping lanes may locally displace harbour porpoises from their foraging habitat. Despite their low sensitivity to sounds below 1 kHz, harbour porpoises are capable of detecting sounds produced by marine vessels (Richardson *et al.* 1995). Behavioural avoidance has been documented for harbour porpoises at distances of up to 800 m from vessels (Barlow 1988). Avoidance behaviour includes rapid, sharp-angled changes in swimming direction and increased swimming speeds (Barlow 1988; Richardson *et al.* 1995). This behaviour may increase energy expenditure and reduce foraging efficiency, thereby decreasing the fitness of affected individuals. As harbour porpoises are relatively abundant near the Bay of Fundy shipping lanes, increased tanker traffic has the potential to affect them. However, it is expected that behavioural avoidance of tankers will be small in spatial scale (<1km; Barlow 1988; Richardson *et al.* 1995) and thus not result in substantial adverse energy expenditure by harbour porpoises.

Acoustic emissions from tankers transiting in the Bay of Fundy shipping lanes may impinge on the habitat of large baleen whales in the lower Bay of Fundy. Tanker traffic in the shipping lanes will increase due to the Project; however, the increase in sound will be not be linear, *i.e.,* sound increase based on vessel traffic increase is not cumulative but increases on a logarithmic scale. Of particular concern is the endangered North Atlantic right whale, which congregates in the Grand Manan Basin during the summer and early fall (Winn *et al.* 1986; Murison and Gaskin 1989; Kenney *et al.* 2001; Baumgartner and Mate 2003). The Grand Manan Basin, located to the immediate northwest of the Bay of Fundy shipping lanes, is one of two important foraging habitats used by right whales in Canadian waters (Brown *et al.* 1995; NARWRP 2000). Like other baleen whales, the North Atlantic right whale is most sensitive to sounds below 1 kHz (Richardson *et al.* 1995; Nowacek *et al.* 2007; Southall *et al.* 2007). Morphometric analyses of inner ears from 13 stranded right whales indicate a functional hearing range of 15 Hz to 18 kHz (Parks *et al.* 2007). Sounds produced by the North Atlantic right whale are generally in the range of 300 and 600 Hz (Vanderlaan *et al*. 2003). Given the low-frequency hearing sensitivity of the North Atlantic right whale, sounds produced by tankers will be audible to these whales. Although few studies have investigated the reactions of the right whale to approaching vessels, existing research suggests that the right whale exhibits very limited avoidance behaviour (Mayo and Marx 1990; Terhune and Verboom 1999; Nowacek *et al.* 2004). For example, Nowacek *et al.* 2004 exposed right whales in the Bay of Fundy to recorded sounds of passing vessels and observed no avoidance behaviour. Actual vessels transiting within 1.85 km (one nautical mile) of these whales also elicited no avoidance response. Other studies have reported observations of right whales turning directly into the paths of approaching vessels (Mayo and Marx 1990; Terhune and Verboom 1999). Collectively, these studies suggest that right whales are not highly reactive to approaching vessels, possibly because they are habituated to the sounds of vessels in the lower Bay of Fundy (Nowacek *et al.* 2004). Based on the existing literature, it is unlikely that acoustic emissions from the proposed increase in tanker traffic will displace right whales from their critical foraging habitat.

Auditory masking of sounds produced by North Atlantic right whales may occur as a result of increased vessel traffic. Masking of low-frequency right whale calls by vessels has been documented indirectly in acoustic surveys of right whales in the lower Bay of Fundy (Matthews *et al*. 2001). Acoustics produced by Southern right whale populations are believed to be used for communication calls across long distances allowing congregation of individuals (Richardson *et al*. 1995). Low-frequency calls in the Bay of Fundy during the summer may serve as contact calls, but are not thought to be involved in feeding (Spero 1981). Based on the present understanding of the importance of North Atlantic right whale calls, the environmental effects of masking on this population are expected to be limited.

The risk of habitat avoidance and auditory masking on right whales is further reduced by existing mitigation that has been supported by regulatory agencies (*e.g.,* Transport Canada) and stakeholders in the Bay of Fundy such as the Proponent. The shipping lanes in the Bay of Fundy have been moved to avoid the Grand Manan Basin, and therefore, the centre of right whale activity in the Bay. Furthermore, the right whale population is monitored by a *SARA* Recovery Team Committee and is the focus of a number of ongoing research initiatives. Ongoing research and interpretations by the

Recovery Team Committee will continue to provide insight into potential environmental effects on right whales and the need for further mitigation.

Characterization of Residual Project Environmental Effects on a Change in Marine Populations (Marine Mammals)

It is unlikely that any Project activity will result in the direct mortality of marine mammals. Shock waves from underwater/nearshore blasting have the greatest potential to injure marine mammals; however, the development and implementation of a detailed explosives environmental protection plan will effectively mitigate this risk.

Acoustic emissions from activities associated with the Project are not likely to induce auditory injury (PTS) or auditory fatigue (TTS) in any species of marine mammal within the Marine PDA, LAA, or RAA. A small number of harbour seals and harbour porpoises may be locally displaced from areas within the Marine PDA during Construction of the marine terminal. However, because the Marine PDA does not represent important foraging or breeding habitat for either species, localized behavioural avoidance is not likely to adversely affect the health of these marine mammals.

The shipping lanes in the Bay of Fundy have been selected to avoid the important habitat of the North Atlantic right whale, and thus the potential for interaction between tanker traffic and right whales is reduced. Increased tanker traffic outside of the important right whale habitat in the Bay of Fundy may lead to localized avoidance of high traffic areas by marine mammals. This behavioural avoidance will likely reduce the incidence of vessel strikes to marine mammals (Chapter 16), but is unlikely to displace marine mammals from important foraging habitat. Reduced foraging efficiency and increased energy expenditure are expected to be minimal. Masking of sounds produced by marine mammals, particularly baleen whales, may occur but are expected to be minor as the increase in tanker traffic will not lead to a proportional increase in audible sound (*i.e.,* sound does not increase in a linear fashion).

In summary, with mitigation the environmental effects of acoustic emissions from the Project on marine mammals during all phases of the Project are rated not significant.

10.4.1.4 Marine Birds

Project Environmental Effects Mechanisms for Change in Marine Populations (Marine Birds)

The Project environmental effects mechanism for change in marine bird populations will include a small loss of suitable foraging habitat. Marine sea birds such as harlequin duck, common eider, greater scaup and Barrow's goldeneye consume shellfish and other small invertebrates that they collect while diving over ledges. This habitat is found between the intertidal zone to subtidal, but usually along the shoreline. There are approximately 83 ha of intertidal and sub-tidal ledge in the LAA, which includes the Marine PDA, as outlined in Figure 10.36. Another Project environmental effect mechanism is increased sound levels or other forms of disturbance, especially during Construction.

There are two SAR (harlequin duck and Barrow's goldeneye, botyh listed as "special concern" on Schedule 1 of *SARA*), and one SOCC marine bird (greater scaup) that regularly winter in the LAA.

Mitigation to reduce/eliminate the potential adverse environmental effects on marine bird habitat and increased sound levels include:

- Minimizing the construction activity to the footprint of the marine-based facilities; and

- Limiting the use of ship whistles or horns.

Mitigation to reduce the potential for adverse environmental effects on lighting on marine birds includes:

- Design lighting so as to reduce potential attraction by birds, such as strobe lights on towers and use of down-lighting; and
- Monitoring for the presence of harlequin duck in the Project area during Construction activities (particularly blasting) and extending into the initial phase of Operation (Jacques Whitford Stantec Limited 2009c).

Characterization of Residual Project Environmental Effects on a Change in Marine Populations (Marine Birds)

The residual environmental effect of this Project will result in a decrease of an estimated 3.8 ha of winter foraging habitat for harlequin duck within the LAA of 83 ha (which includes the Marine PDA). This is a result of the footprint of the marine terminal, seawater cooling intake structure and barge landing facility along the shoreline in the Marine PDA, and which is approximately 4.5% of the potential harlequin duck feeding habitat area in the LAA.

The total winter feeding habitat area in the LAA is only a very small fraction (considerably less than 1%) of similar winter feeding habitat within the Bay of Fundy. A study of harlequin duck wintering site-fidelity concluded that wintering birds significantly underutilized the available habitat at a winter site in British Columbia (Robertson *et al.* 1999). The actual amount of lost habitat to harlequin duck is far less than 1% of the RAA. It is not likely that this small portion of habitat is limiting to harlequin duck, and has not been designated as such by the Recovery Team for harlequin duck.

The loss would stem from the Construction of the marine terminal, seawater cooling intake and the barge landing areas. This loss of habitat would last the life of the Project plus an estimated 10 years after decommissioning, to provide sufficient time for the algal beds to re-establish. However, within the life of the Project the marine infrastructure may provide suitable substrate for the ecosystem to re-establish. Algal beds will grow on sub-tidal rocks, jetties or at the base of piers. This artificial “reef” habitat would provide the basic ingredients to recover some of the lost habitat. The algal community, once established, will provide the habitat necessary for food items. This artificial habitat may not be attractive to all displaced species, but it may ameliorate some of the potential habitat loss or degradation.

Based on wintering habitat preferences, Barrow’s goldeneye, though identified in CWS Block surveys, and observed (twice, singly) during winter bird surveys conducted in Winter 2006 flying over water near Black Point, would not be expected to use habitat within the Marine PDA. Rather, they are typically found up the Saint John River, in areas between Reversing Falls and Marble Cove further upstream, as well as at Marsh Creek and Courtenay Bay, which is located just outside the LAA. These areas match the typical habitat preferences of estuaries, coastal lakes and rivers. As such, the potential for interaction with the Project, including Accidents, Malfunctions and Unplanned Events is low. Nonetheless, any winter monitoring of harlequin duck would also capture other species such as Barrow’s goldeneye if they were found in the area. A monitoring and mitigation plan will be developed by the Proponent specifically to monitor the potential environmental effects of blasting and construction activities on the harlequin duck and other migratory birds, prior to beginning Construction.

Currently, there is ongoing ship traffic into the Port of Saint John and ships off-loading crude oil at the existing Canaport SBM. This Project will increase the ship traffic in the LAA, especially during

Construction (*i.e.,* as materials are brought in to the barge landing area) and also during Operation (*i.e.,* as products are loaded and raw material unloaded at the marine jetty). It is uncertain exactly how much ship traffic will increase during Construction and Operation. Despite the current disturbance from operation and construction of the Canaport LNG terminal, and ship traffic to the Canaport SBM, harlequin duck continue to use this coastline as a wintering site. Mortality (loss of individuals attributable to the Project) is not expected due to the low overall numbers of wintering birds and given the nature of the Project perturbations. The mortality of marine birds associated with vessel collisions is considered an accidental event and is discussed in Chapter 16.

Operation will introduce concentrations of Chemicals of Potential Concern (COPC) to the environment (Table 10.20). Background concentrations during the Operational Phase of the Project did not result in any Hazard Quotient (HQ) exceedance (HQ>1 are indicative of possible risk). The Marine ERA study indicates no unacceptable risk to Marine receptors from Project emissions. The highest predicted HQ for the project emissions assessment was generally less than 0.0001 (Table 10.20).

Light sources, especially at night and/or during inclement weather have been shown to be an attractant to migrating birds (Avery *et al.* 1976, Evans Ogden 1996, Wiese *et al.* 2001, and Rich and Longcore 2006). The attraction of birds to lights on structures in the marine environment raises the issue of the increased potential for bird kills due to collisions. Additional attraction of lights is the main concern. Transport Canada is the governmental regulatory organization overseeing air navigation. Studies suggest that bird mortalities may be decreased by using strobe lights and/or less intense lights for Construction lighting. Light fixtures that direct light towards the ground and eliminate excess stray light in the vertical or horizontal directions; can be an effective method to reduce the potential for adverse environmental effects, and these will be used wherever possible.

Installing down-lighting on all permanent and night time lighting systems, will reduce the interaction between migrating birds and the Project. Mitigation in the form of lighting standards which will reduce the amount of light pollution, and reduce sky glow, which can attract nocturnal migrating birds.

Lighting design will consider design that reduces attraction of birds, including compliance with API RP 540 and the guidelines of the Commission Internationale de l'Eclairage (CIE). Potential environmental effects to birds from lighting will be monitored during Construction and Operation, and if it becomes apparent that there is an elevated risk or incidence of these collisions, a plan developed in consultation with the appropriate regulatory authorities as part of permitting activities will be implemented.

The magnitude of change in measurable parameters related to marine birds is captured in Table 10.25. With mitigation, the Project will result in a decrease of 3.8 ha in habitat within the LAA. This environmental effect would occur only during Construction. Increased ship traffic, which will potentially increase disturbance to local marine birds in winter, will occur during Construction and Operation. Based on past evidence and the continued use of this area by harlequin duck, this potential residual environmental effect would be reversible within a few years of the habitat returning to its present status and condition. Consequently, the environmental effects on marine birds during all phases of the Project are rated not significant.

Table 10.25 Magnitude of Change in Measurable Parameter

Measurable Parameter	Magnitude of Change in Measurable Parameter
% Habitat Loss (Ecoregion)	Loss of 3.8 ha of marine habitat in LAA. A small fraction of a percent for RAA
Environmental Hazard Quotient (EHQ) from Marine ERA Results	<1.0

Table 10.25 Magnitude of Change in Measurable Parameter

Measurable Parameter	Magnitude of Change in Measurable Parameter
Loss of SAR/SOCC (# of wildlife individuals)	Low; if disturbance is too high, may avoid, or stop using immediate area as a wintering site. Habitat is not limiting or critical. Potential SAR/SOCC present during winter, but mortality is not likely to occur
Sound Levels (dB_A)	Increased ship traffic may cause disturbance, but not at levels that would be considered significant to fish, marine mammals, or marine birds.

10.4.2 Determination of Significance

Overall, in consideration of the existing conditions, Project activities and planned mitigation, the residual environmental effects of all Project activities during all phases on the Marine Environment are rated not significant. There is a high level of confidence in the predictions.

10.5 Assessment of Cumulative Environmental Effects

Residual cumulative environmental effects of past, current and planned marine use on a Change in Marine Populations are summarized in Table 10.26.

Groups of activities will have an interaction ranked as 0 if Project environmental effects do not act cumulatively with those of other projects and activities. Groups of interactions ranked as 1 are Project environmental effects that act cumulatively with those of other projects and activities, but are unlikely to result in significant cumulative environmental effects or will not measurably change the state of the Marine Environment. Interactions ranked as 2 are those situations where Project environmental effects act cumulatively with those of other projects and activities, and could potentially result in significant cumulative environmental effects or at least a measurable change in the state of the Marine Environment. As shown in Table 10.26, residual environmental effects on the Marine Environment resulting from the Project only have the potential to act cumulatively with other projects and activities in the RAA as a result of Planned Marine Use.

Table 10.26 Potential Cumulative Environmental Effects

Other Projects and Activities With Potential for Cumulative Environmental Effects	Potential Environmental Effects
	Change in Marine Populations
MARINE TERMINAL AND OTHER MARINE-BASED INFRASTRUCTURE	
Project Eider Rock (Land-Based Components)	0
Industrial Land Use	0
Planned Future Industrial/Energy Projects	0
Infrastructure Land Use	0
Marine Use	2
Cumulative Environmental Effects	

Notes: Cumulative environmental effects were ranked as follows:
- 0 Project environmental effects do not act cumulatively with those of other projects and pctivities.
- 1 Project environmental effects act cumulatively with those of other project and pctivities, but are unlikely to result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects but will not measurably change the state of the VEC.
- 2 Project environmental effects act cumulatively with those of other projects and activities, and may result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC.

Projects and activities that will potentially overlap with the environmental effects of the Marine Terminal and Other Marine-Based Infrastructure ranked as 2 are limited to Marine Use (including aquaculture). Interactions between these projects and activities and the Marine Environment have the potential to result in cumulative environmental effects with the Project through increased acoustic emissions to the marine environment, increased TSS, artificial light, and habitat alteration, disruption and/or destruction.

To address the potential cumulative interactions listed above, a cumulative environmental effects assessment for a Change in Marine Populations was conducted in relation to the Marine Terminal and Other Marine-Based Infrastructure. The cumulative environmental effect mechanisms, mitigation measures and characterization of residual cumulative environmental effects are presented in Table 10.27 below and in the subsequent text.

Table 10.27 Summary of Cumulative Environmental Effects on the Marine Environment

Cumulative Environmental Effect	Case	Other Projects, Activities and Actions	Proposed Mitigation and Compensation Measures	Residual Cumulative Environmental Effects Characteristics						Significance	Prediction Confidence	Likelihood	Proposed Follow-up and Monitoring Programs
				Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/Socio-economic Context				
Change in Marine Populations	Cumulative Environmental Effect with Project	▪ Development of Port of Saint John ▪ Canaport SBM ▪ Canaport LNG ▪ Black Point Ocean Disposal Site managed by Environment Canada ▪ City of Saint John Eastern Wastewater Treatment Facility ▪ Aquaculture ▪ Commercial fishing activities ▪ Point Lepreau II ▪ Potential Tidal Power Projects	▪ Use of the shipping lanes to avoid important habitat of North Atlantic right whale and ongoing work of Recovery Team. ▪ Mitigation and compensation proposed for the Project and for the Canaport LNG Project and approval and permits to construct and operate. ▪ Future development in the RAA will be required by the EIA Regulation and/or *CEAA* to conduct a project-specific environmental assessment. ▪ Clauses of current ocean disposal licenses. ▪ Conditions of aquaculture licenses. ▪ Operating procedures at SBM. ▪ Conditions of approval for eastern wastewater treatment facility.	A	M	L	LT /R	I	D	N	H	M	None.

Table 10.27 Summary of Cumulative Environmental Effects on the Marine Environment

Cumulative Environmental Effect	Case	Other Projects, Activities and Actions	Proposed Mitigation and Compensation Measures	Residual Cumulative Environmental Effects Characteristics: Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/Socio-economic Context	Significance	Prediction Confidence	Likelihood	Proposed Follow-up and Monitoring Programs
	Project Contribution to Cumulative Environmental Effect	▪ Construction: ▪ Dredging Activities ▪ Construction of barge landing facility ▪ Jetty installation ▪ Underwater/ nearshore blasting ▪ Operation: ▪ Cooling Water Intake and Discharge ▪ Wastewater treatment plant effluent discharge	▪ See mitigation in Table 10.15	A	L	S	LT /R	R	D	N	H	M	None.

KEY

Direction:
P Positive
A Adverse

Magnitude:
L Low: No or negligible Change in Marine Populations.
M Moderate: Measurable change that does not result in a change in the sustainability of Marine Populations.
H High: Measurable change that results in a change in the sustainability of Marine Populations.

Geographic Extent:
S Site-specific: Within PDA
L Local: Within LAA
R Regional: Within RAA

Duration:
ST Short term: Occurs and lasts for short periods (*e.g.,* days/weeks) during Construction.
MT Medium term: Occurs and lasts for extended periods of time (*e.g.,* years) during Construction and Operation.
LT Long term: Occurs during Construction and/or Operation and lasts for the life of Project.
P Permanent: Occurs during Construction and Operation and beyond.

Frequency:
O Occurs once.
S Occurs sporadically at irregular intervals.
R Occurs on a regular basis and at regular intervals.
C Continuous.

Reversibility:
R Reversible
I Irreversible

Ecological/Socio-economic Context:
U Undisturbed: Area relatively or not adversely affected by human activity.
D Developed: Area has been substantially previously disturbed by human development or human development is still present.
N/A Not Applicable

Significance:
S Significant
N Not Significant

Prediction Confidence:
Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation
L Low level of confidence
M Moderate level of confidence
H High level of confidence

Likelihood:
Based on professional judgment
L Low probability of occurrence
M Medium probability of occurrence
H High probability of occurrence

Other Projects, Activities, and Actions
List of specific projects and activities that would contribute to the cumulative environmental effects.

Base Case

The Base Case includes past projects, and current projects that have received some level of environmental approval and/or are in some form of planning, construction and/or commissioning.

Past projects, activities and actions contributing to this Base Case are:

- Past development of the Port of Saint John; and
- Past commercial fishing and whaling activities.

The development of the Port of Saint John, initially as a shipbuilding centre in the 18th and 19th Centuries and later followed by its development into a modern commercial port has likely altered the Marine Environment compared to those that may have existed prior to modern times—this cannot be characterized in any meaningful way. Nevertheless, any changes that may have occurred in this regard are implicitly incorporated and addressed in the existing conditions of the Marine Environment as established for this CSR. Addititionally, fishing is a key environmental effect generating activity in the RAA. Fishing permanently removes fish from populations, thus decreasing spawning biomass and potentially disrupting food-web structure. In addition, some fishing methods (*i.e.,* bottom trawling) adversely affect benthic habitat (Barnes and Thomas 2005). Bycatch has contributed significantly to the decline of several large demersal fish groups in the RAA, including the Atlantic wolffish (DFO 2000b). Similarly, commercial whaling for large baleen whales severely affected populations in the late 19th and early 20th Centuries (NARWRP 2000).

Current projects, activities and actions contributing substantively to this Base Case are the:

- Existing Canaport SBM;
- Existing operation of the Port of Saint John;
- Canaport LNG;
- Black Point ocean disposal site managed by Environment Canada;
- City of Saint John Eastern Wastewater Treatment Facility;
- Aquaculture; and
- Commercial fishing activities.

The largest marine construction project currently underway in the RAA is the Canaport LNG facility at Mispec Point. This project is a partnership between Irving Oil and Repsol YPF, S.A., and involves the construction of a multi-purpose pier to unload LNG from marine tankers. The footprint of marine components of the Canaport LNG Project has resulted in the alteration of a limited amount of benthic habitat and this has been compensated through the HADD authorization process. Conversely, marine infrastructure associated with the Canaport LNG terminal could have a positive cumulative environmental effect in the Marine PDA due to the additive presence of hard bottom habitat. Hard bottom benthic habitats create more surface area to be colonized by sessile marine plants and invertebrates as compared to flat, sandy or silty bottoms, and may attract mobile macrofauna, such as fish and lobster.

There will likely be a temporary, localized reduction in water quality due to the construction of the Canaport LNG Terminal marine facilities. Reduction in water quality will be due to increases in TSS and potential contaminants (*e.g.,* metals) in disturbed sediment.

Sound produced during the construction of the Canaport LNG Terminal marine facilities are expected to be similar in intensity and duration to those associated with Construction of the Project. The majority of sound will originate from pile driving, dredging, and the activity of support vessels. Additionally, vessels using the existing Canaport SBM will contribute sound to the LAA. These sounds are likely to affect marine mammals that could visit the Mispec Point area, namely harbour seal and harbour porpoise, but this will not be significant as previously determined.

Environment Canada manages the use of the Black Point ocean disposal site where dredged material from the Saint John Harbour is disposed. Dredging occurs between July 1 and the second Tuesday in November and prior to the fall lobster fishing season. Dredging is not permitted to occur during lobster fishing season. The typical volume of material dredged each year and disposed at the Black Point ocean disposal site is 150,000 m^3; however, in 2006, approximately 375,000 m^3 of materials were dredged. The historical disposal of dredged material at the Black Point ocean disposal site has led to the presence of contaminated sediments at this site (ECL 2003). The environmental effects of this activity are increased TSS levels and potential exposure of marine populations to contaminated sediments within the disposal area.

The City of Saint John maintains Eastern Wastewater Treatment Facility. Treated sewage is discharged to Saint John Harbour Discharge of treated sewage sludge may affect the health of marine organisms through acute and chronic toxic effects. Toxins may also be sequestered to marine sediments and released gradually to the marine environment. Furthermore, high nutrient levels may cause localized eutrophication of the marine environment.

Aquaculture operations, specifically those for Atlantic salmon currently exist in the Bay of Fundy although there are no sites near the Marine PDA. DFO has identified the spread of disease and competition from escapees from aquaculture operations as contributing to the collapse of the Atlantic salmon stock (DFO 2004). Commercial fishing activity in the RAA continues to remove biomass from the Marine Environment.

Small numbers of harlequin duck (SAR), Barrow's goldeneye (SAR), and greater scaup (SOCC), spend the winter feeding in the Marine PDA and LAA. A small loss of feeding habitat is expected due to the Canaport LNG terminal.

Project Case

The following text discusses ways in which the projects and activities identified in the Base Case and the Project may cumulatively affect Marine Populations in the Marine PDA, LAA and RAA.

The Project will result in a cumulative disturbance/loss of benthic habitat in combination with construction and operation of the Canaport LNG marine facilities. A permanent loss of benthic habitat for both Projects will be addressed separately through a habitat compensation program associated with the required *Fisheries Act* authorization to ensure no net loss of fish habitat.

The Project and the Canaport LNG terminal will add to existing safety and fishing exclusion zones. Fishing activity within these zones is restricted, possibly resulting in a minor positive cumulative environmental effect on recruitment into marine fish populations, by providing a larger refuge area for breeding and spawning individuals.

The Construction of the Project will generate similar, localized environmental effects on water quality as those of the Canaport LNG marine facilities. Mitigation measures for both projects will reduce the potential for adverse cumulative environmental effects.

The Canaport LNG facility and the Project are located very near one another (within 1 km); therefore, the combined spatial extent of perceived sound levels in the marine environment will not be substantially greater than for either project on its own. Given the low abundance of harbour seal and harbour porpoise in the upper Bay of Fundy, very few animals will be affected. Acoustic emissions from construction activities are not likely to cause permanent or temporary threshold shifts to any marine mammals unless at very close proximity. Some localized avoidance of the Marine PDA by harbour seals and harbour porpoises may occur, but this is not expected to affect the health of these animals. The area around Mispec Point has not been identified as an important foraging habitat for either species. In addition, there are no known harbour seal haul-outs within this area. Thus, while acoustic emissions from the construction of the Canaport LNG facility may act cumulatively with sounds produced during Construction, the combined environmental effect on marine mammals in the upper Bay of Fundy is predicted to be minimal and is rated not significant.

Acoustic emissions from the construction of both the Canaport LNG and the Project are expected to attenuate quickly in the shallow waters of the upper Bay of Fundy. Based on the findings of Desharnais *et al.* (2000) who measured acoustic propagation in the Bay of Fundy, it is expected that construction sounds will attenuate to intensities below ambient sound levels within 20 to 30 km. It is therefore unlikely that combined construction sounds will be perceived by the large baleen whales that concentrate in the lower Bay of Fundy. For example, the Grand Manan right whale conservation area is located approximately 80 km from the Marine PDA.

The cumulative loss of habitat or degradation of habitat due to noise caused by the Project and the Canaport LNG terminal will be small when considered within the context of total available wintering habitat in the Bay of Fundy for harlequin duck, greater scaup and Barrow's goldeneye. Furthermore, these bird species shift their feeding areas depending on such factors as food availability and weather and are not tied to a specific area. The occasional harlequin duck, greater scaup or Barrow's goldeneye displaced from the Marine PDA due to the Project and the Canaport LNG terminal will find adjacent, suitable feeding habitat and no health effects on displaced birds are expected.

The Project and the Black Point ocean disposal site may cumulatively to affect the marine environment by way of increased TSS and smothering of benthic habitat in the Marine PDA. The increase in TSS due to Project Construction will be localized and of short duration. If dredge spoils from the Project (which are known to have contaminant levels below CCME Guidelines) are disposed of at the Black Point disposal site, they would likely cap existing contaminated sediments at the Black Point ocean disposal site that were historically deposited there This can be considered as a positive residual cumulative environmental effect by improving surface sediment quality for benthic habitat and minimizing the transport of contaminated sediments beneath the capping layer at the disposal site. Recent evidence suggests that the risk of environmental effects from sediment loads to organisms close to the Black Point ocean disposal site is low. Lawton *et al.* (2005) evaluated exposure risk of dredge materials on lobsters by placing lobsters in traps (with closed escape vents and entrances) at four sites near the disposal permit area boundaries. Traps remained in place for 2 days during which dredge disposal was underway. Upon retrieval, none of the lobsters were moribund or exhibited external indications of sub-lethal exposure to high sediment loads.

Further characterization of the dredged material will be conducted during the permitting stage, and preferred options for re-use or disposal of the material will be identified during permitting, in consultation with Environment Canada.

Discharges from the proposed City of Saint John Eastern Wastewater Treatment Facility, given the relatively close spatial proximity, have the potential to interact with discharges from the Project. However, discharges from the Project will abide to CCME Guidelines. In addition, the strong flushing action of the Bay of Fundy tidal currents will rapidly dilute discharges of both projects, reducing the risk of substantive cumulative environmental effects on the Marine Environment.

Aquaculture activity in the lower Bay of Fundy may contribute to cumulative environmental effects on remaining Atlantic salmon stocks. However, as no important marine salmon habitat will be destroyed and no salmon mortality is expected due to impingement and entrainment, the environmental effects of the Project in combination with past and present Projects is rated not significant.

The mortality of fish due to impingement and entrainment in the Project's cooling water system has the potential to act cumulatively with fishing to reduce fish populations in the RAA. However, relatively few fish will be affected by impingement and entrainment and rates of loss will likely be within natural variation of these populations. Therefore, the residual cumulative environmental effects of impingement and entrainment with commercial fishing activity are rated not significant.

Future Case

Future projects and activities may take place in the region that may interact with the cumulative environmental effects as documented in the Base Case and the Project Case. The projects and activities that may proceed at some time in the future that may cause cumulative environmental effects with the Project include:

- Expansion of the City of Saint John Eastern Wastewater Treatment Facility;
- Point Lepreau II;
- Potential Tidal Power Projects; and
- Increased Aquaculture in Bay of Fundy.

The City of Saint John is proposing to expand the Eastern Wastewater Treatment Facility. This facility will treat an average daily flow of 35,000 m^3 of activated sewage sludge. The outfall pipe will extend 1,100 m into the Saint John Harbour. Discharge of treated sewage sludge may affect the health of marine organisms through acute and chronic toxic effects. Toxins may also be sequestered to marine sediments and released gradually to the marine environment. Furthermore, high nutrient levels may cause localized eutrophication of the marine environment

If it proceeds, Point Lepreau II may contribute to the cumulative environmental effects on marine birds due to the importance of Point Lepreau as a migratory landmark for thousands of migrating sea ducks (Dietz and Chiasson 2000) and wintering habitat for harlequin duck (P. Giasson, personal communication, March 19, 2008). The cumulative loss of habitat or degradation of habitat due to noise caused by the Project and a future Point Lepreau II will be small when considered within the context of total available wintering habitat for harlequin ducks and other marine birds available in the RAA. Furthermore, marine bird species shift their feeding areas depending on such factors as food availability and weather and are not tied to a specific area. The occasional harlequin duck, greater scaup or Barrow's goldeneye that may be displaced due to the Project and Point Lepreau II would find adjacent, suitable feeding habitat and no health effects on displaced birds are expected.

Tidal power projects may be developed in the upper Bay of Fundy in the future. Although the details of such projects are unknown, they would likely have environmental effects similar to the Project, such as increased sound, destruction of benthic habitat, and limited mortality of fish due to intakes or moving underwater parts. Therefore, marine populations that travel through the Bay, such as marine fish, harbour porpoise and harbour seal, may be affected. Various projects planned for future operation in the Bay of Fundy will require the use of marine vessels. These projects are listed in Table 10.28. All vessels associated with these projects will produce acoustic emissions that have the potential to act cumulatively with acoustic emissions from tankers serving the Project.

Table 10.28 Future Projects in the Bay of Fundy and Expected Marine Vessel Requirements

Project Description	Project Location	Vessel Requirements	Number of Vessels
Gypsum Wallboard Manufacturing Plant	Saint John Harbour	Transport vessels to deliver natural gypsum	41 barges per year
Coleson Cove Generating Station	Saint John Harbour	Transport vessels to deliver petroleum coke	12 ships per year
Canaport LNG Facility	Mispec Point	Transport tankers to deliver LNG	80-120 per year
Cruise Ship Industry	Saint John Harbour	Cruise ships using the Port of Saint John	83 per year

Acoustic emissions from existing vessel traffic in and around the Saint John Harbour (and throughout the Bay of Fundy) may act cumulatively with acoustic emissions from vessels serving the Project. The Port of Saint John is one of the busiest ports on the Canadian East Coast, handling an average of 27 million metric tonnes of cargo annually. Current vessel traffic in and around the Saint John Harbour (including anchorages) includes crude oil carriers, petroleum products tankers, potash tankers, cruise ships, tug boats and other support vessels, commercial fishing vessels, recreational vessels, and container ships. According to the MCTS, over 1,680 vessels transited in the Bay of Fundy shipping lanes in 2007. All of these vessels contribute anthropogenic sound to the marine environment, which act cumulatively to produce high background ambient sound levels.

Vessels associated with the Construction and Operation of the Project will emit low-frequency sounds to the marine environment. The intensity of these sounds varies according to a variety of factors, including the type of vessel and the vessels speed. Most vessels serving the Project will be very large oil and finished product tankers. These vessels will produce sounds in the range of 180 to 200 dB re 1 μPa @ 1 m, with most acoustic energy below 1 kHz. Acoustic emissions from Project tankers will act cumulatively with acoustic emissions from other vessels operating within the Marine PDA, LAA, and RAA. Sound levels for other vessels operating within the Marine PDA, LAA and RAA range from 140 dB re 1 μPa @ 1 m distance for small fishing vessels, to 195 dB re 1 μPa @ 1 m for fast moving supertankers (Hildebrand 2003; JASCO Research 2008). The cumulative environmental effect of acoustic emissions from vessels associated with the Project and other imminent and future projects in the Bay of Fundy will be an overall increase in ambient underwater sound levels. Cumulative acoustic emissions will be greater in intensity, longer in duration, and will affect more marine mammals over a greater spatial extent than acoustic emissions from Project vessels alone.

Elevated sound levels from the collective input of acoustic emissions from a greater number of vessels may trigger increased behavioural responses of marine mammals. Behavioural avoidance of high-intensity sounds has been demonstrated for a variety of marine mammals (Richardson *et al.* 1995;

Nowacek *et al.* 2007; Southall *et al.* 2007). This behaviour may have negative consequences to the health of a marine mammal if it displaces the animal from important foraging habitat.

Increased tanker traffic in the Bay of Fundy may lead to localized avoidance of high traffic areas by marine mammals. This behavioural avoidance will likely reduce the incidence of vessel strikes to marine mammals (Chapter 16), but is unlikely to displace marine mammals from important foraging habitat. Reduced foraging efficiency and increased energy expenditure are expected to be minimal. Masking of sounds produced by marine mammals, particularly baleen whales, may occur, although this is not expected to have adverse environmental effects on marine mammal populations.

For the North Atlantic right whale, the Grand Manan Basin constitutes one of two important summer foraging habitats (Brown *et al.* 1995; NARWRP 2000). High abundance of copepods in the deep waters of this area is critical to the survival of the right whale (Baumgartner and Mate 2003; 2005). Displacement of right whales from the Grand Manan Basin by elevated ambient sound levels would have significant energetic consequences to this species. Although the right whale can perceive the sounds produced by marine vessels, existing research suggests that they are not highly reactive to these anthropogenic emissions (Mayo and Marx 1990; Terhune and Verboom 1999; Nowacek *et al.* 2004). It has been speculated that right whales may be habituated to the sounds of vessels, given that their important habitat is adjacent to the Bay of Fundy shipping lanes, an area of heavy vessel traffic (Mayo and Marx 1990; Terhune and Verboom 1999; Nowacek *et al.* 2004). Based on the existing literature, it is not expected that acoustic emissions from vessels serving the Project will act cumulatively with acoustic emissions from other vessel traffic to adversely affect the habitat quality or health of North Atlantic right whales (Mayo and Marx 1990; Terhune and Verboom 1999; Nowacek *et al.* 2004). Shipping lanes have been moved in the Bay of Fundy to avoid the important feeding habitat of right whales, thus lessening the risk of cumulative effects on this species due to increased vessel traffic. Furthermore, the Recovery Committee has committed to monitoring the right whale population and re-assessing the need for other special protection measures based on population trends and research findings.

Mitigation measures that can be implemented by the Project proponent to reduce potential cumulative environmental effects are the same as those described for Project construction in the marine environment (Table 10.15). Mitigation measures for the Project Case are provided in Section 10.4.1. The mitigation measures proposed for the Project-related environmental effects are anticipated to be effective in mitigating any cumulative environmental effects.

Overall, acoustic emissions from Project activities are not likely to have adverse cumulative environmental effects on the habitat quality or health of marine mammals in the Bay of Fundy. The cumulative environmental effect of changes in marine mammal populations is low in probability and magnitude, reversible, regional, and long-term (~50 years). Based on the above assessment, combined acoustic emissions from the Project and other eminent and future projects in the Bay of Fundy are also unlikely to adversely affect marine mammal habitat quality or health.

10.5.1 Determination of Significance

Consequently, in light of the above and the proposed mitigation, the cumulative environmental effects of the Project in combination with past, present and future projects and activities that have been or will be carried out, during all phases of the Project, on a Change in Marine Populations in the Marine Environment are rated not significant.

Future development in the RAA will be required by the EIA Regulation and/or *CEAA,* if triggers are present, to conduct a project-specific environmental assessment that will address future potential cumulative environmental effects at that time. Existing conditions currently supportive of marine populations will be maintained throughout Project and the development of future projects.

The characterization of the potential cumulative environmental effects and associated mechanisms, combined with the proposed mitigation measures demonstrate that the residual cumulative environmental effects of a Change in Marine Populations as a result of past, present and reasonably foreseeable projects and activities that have been or will be carried out, in combination with the environmental effects of the Project during all phases, on the Marine Environment can be rated not significant. This determination has been made with a high level of confidence.

Additionally, the proposed mitigation measures demonstrate that the Project contribution to a cumulative environmental effect on a Change in Marine Populations in the Marine Environment is rated not significant. This determination has been made with a high level of confidence.

10.6 Follow-up and Monitoring

Follow-up and monitoring programs will be implemented for the Marine Environment as already presented in Table 10.15. The following monitoring programs are suggested.

- Effluent from the Project will be monitored to check that contaminant levels are within acceptable ranges. Water discharged from the outfall will be monitored to check that contaminant levels are within acceptable ranges.
- Monitor the potential for adverse environmental effects on harlequin duck during Construction and the initial phase of Operation of the Project.
- Sediments in the Marine PDA will be monitored during the initial stage of Operation.
- Monitor abundance and re-colonization of benthic habitat in the Marine PDA early in Operation.
- Monitor fish screens performance to verify effectiveness of mitigation and confirm environmental effects predictions.

11.0 COMMERCIAL FISHERIES

Commercial Fisheries are important to the local and regional economy, and are a valued way of life for some residents of southeastern New Brunswick. The Bay of Fundy, including the near shore areas proximal to the Project, supports commercial fisheries that provide an important source of income for local fishermen. As part of the environmental assessment the Proponent is required to evaluate the potential interactions of the Project with Commercial Fisheries in light of potential concerns of the local fishermen and regulatory agencies.

As Project-related activities are planned to occur within the near shore marine environment, proximal to an area where commercial fishing is known to occur, there is the potential for interactions between the Project and Commercial Fisheries. The presence of marine infrastructure (including the jetty, the barge landing facility, the seawater cooling intake structure and the effluent release structure) and Project-related vessel traffic in the Assessment Area are expected to result in interaction with activities of the commercial fishery. With proposed mitigation and recognizing that the majority of Project activities will occur within the Proponent's water lot and within the Saint John Harbour as administered by the Saint John Port Authority on behalf of the Government of Canada, it is predicted that the residual environmental effects of the Project on Commercial Fisheries will be not significant. Recommended mitigation includes compensation to established commercial fishermen that operate out of the Mispec wharf where Project infrastructure and associated safety exclusion zones may at times interfere with the pursuit of commercial fisheries due to a confirmed disruption of traditional travel routes. The establishment of clear practices and procedures for marine terminal operations in a Marine Terminal Manual, the delineation of Project vessel zones of operation during Construction, and encouragement of the use of established approaches by Project-related vessels will further mitigate potentially adverse environmental effects on commercial fishermen operating out of the Mispec wharf. The Proponent will continue to work through the Port of Saint John Traffic Committee as a formal line of communication between fishermen and operators of the Project.

It is noted that although the term commercial fishermen is used throughout this chapter for brevity, this term is intended to be gender neutral and represents all persons fishing for commercial purposes in the Assessment Area.

11.1 Scope of Assessment

This section defines the scope of the environmental assessment of the Commercial Fisheries in consideration of the nature of the potential interactions.

11.1.1 Regulatory Setting

The scope of factors to be considered in the federal EA includes fisheries, as defined by the EA Track Report and Scoping Document. The potential environmental effects on fisheries are to be assessed as they may relate to changes in the environment resulting from the construction, operation, decommissioning and/or abandonment of the Project's marine infrastructure, including the use of the jetty and berths, the seawater cooling intake structure and discharge structure, the barge landing facility, and the incremental use of the existing SBM for the Project.

11.1.2 Issues and Concerns Identified During Public, Stakeholder, and Aboriginal Engagement

Engagement of local fishermen and the Fundy North Fishermen's Association (FNFA) was undertaken as part of the assessment of Commercial Fisheries. Early engagement of these stakeholders was important to gain information held by those commercial fishermen harvesting in the local assessment area (LAA). Early in the environmental assessment process, local fishermen and the FNFA were contacted individually by members of the Study Team and invited to participate. A concerted effort was made to contact fishermen known to be based at the Mispec wharf and those fishing regularly in the LAA, though not all of those contacted chose to participate in the discussions. During a series of individual meetings, Project information was shared with fishermen and the concerns or comments expressed about the Project and its interactions with Commercial Fisheries were recorded. Fishermen were also asked to provide information regarding others fishing in or around the LAA, other fishermen who they felt would have an interest in the Project and/or other individuals who could provide additional information relevant to the CSR. Fishermen were asked a set of questions using an interview guide designed to gather baseline information, including types and areas of fishing activity, methods of fishing and effort. Meetings were informal to allow for the unconstrained discussion of any matters of concern raised by fishermen.

In addition to the initial series of individual meetings, several local fishermen and representatives of the FNFA attended the public open houses and workshops (Chapter 4). In March 2008, the FNFA and fishermen operating out of Mispec and Saint John Harbour were invited to attend a meeting dedicated to sharing information on the Project's marine activities, discuss current fishing activities in the area, and provide input on potential interactions between Commercial Fisheries and the Project.

Table 11.1 contains a summary of comments received on Commercial Fisheries through the engagement activities, as well as the influence of those comments on the assessment. Potential loss of access to areas currently fished, potential increased travel time to reach fishing areas and potential accidental gear loss were common issues raised by stakeholders. Potential loss of access to areas currently fished was also identified as a concern due to a change in the area of bottom available for fishing within the Proponent's water lot and Saint John Harbour; however, this concern must be balanced with the recognition that the pursuit of fishing within these areas may be restricted to support the development and safe operation of marine infrastructure and port activities. Potential accidental gear loss is an accidental or unplanned event and is assessed in Chapter 16.

Potential environmental effects on harvested species, which would have the potential to lower fish abundance or decrease the quality of the catch, were also expressed as a concern. This matter is assessed in Chapter 13 where the environmental effects of the Project on the Marine Environment, including the resources that comprise the fishery, were determined to be not significant.

Table 11.1 Summary of Comments Received through Commercial Fisheries Engagement Activities

Comment	Influence on the Assessment
A large amount of lobster fishing activity occurs in the area surrounding the location of the marine terminal and barge landing facility.	The LAA was expanded and modified to include area indicated by local fishermen to be important areas currently fished.
Some scallop fishing activity occurs within the LAA when the Conservation Zone is open.	Local scallop fishermen were solicited as part of the engagement.
If access to areas currently fished is altered by exclusion zones or otherwise, increased steaming time will lead to increased operational costs for fishermen.	Increased steaming time is included as a measurable parameter in the environmental effects assessment for Commercial Fisheries.

Table 11.1 Summary of Comments Received through Commercial Fisheries Engagement Activities

Comment	Influence on the Assessment
The Mispec wharf, the home port to several local fishermen who fish within the LAA, is tidal and access to the port is dependent on the tide. Boats can only enter or exit the port within a few hours either before or after each high tide.	Consideration for the tidal nature of Mispec wharf was incorporated into the calculation of increased steaming time as a measurable parameter in the environmental effects assessment for Commercial Fisheries.
Local fishermen would like to see traffic lanes established between the Bay of Fundy Shipping Lanes and industrial areas such as the Project. This would help to reduce fishing gear loss.	Issues concerning vessel traffic have been assessed and included in Chapter 13. The delineation of vessel zones of operation during Construction is considered in this Chapter as a potential mitigation measure. However, the establishment and location of shipping lanes is the responsibility of the government agencies responsible for marine shipping and safety. The Proponent will continue to support the work of the Port of Saint John Traffic Committee, and will encourage the use of established approaches by Project-related vessels.
Gear loss can occur with increased vessel traffic in areas where lobster traps have been set. Barges and tugs can especially be a problem, as they seem to be more prone to entanglement with lobster trap marker buoys.	Gear loss has been included as an accidental event and has been assessed in Chapter 16. This recognizes that a majority of the Project activities shall occur within the Proponent's water lot and vessel traffic will occur within the Harbour as controlled by the Saint John Port Authority and established shipping lanes, where fishing gear should not be deployed. The Proponent will encourage the use of established approaches by Project-related vessels.
Increased industrial activity in the area may cause lobsters to leave the area, or may directly harm lobster in the area.	Potential biophysical environmental effects on marine resources are assessed in Chapter 10.

Although not elaborated in this Chapter, concerns were raised during First Nations engagement activities regarding the potential for the Project to affect the Aboriginal fishery, both the commercial fishery and the subsistence food fishery, in the Bay of Fundy. The issues raised during Aboriginal engagement activities were similar to those in Table 11.1 above (Chapter 12).

11.1.3 Selection of Environmental Effect

The principal concern for fishermen to be assessed in relation to routine activities of the Project is the change in steaming time to areas currently fished and the related potential interruption of fishing schedules for fishermen operating out of Mispec wharf. The potential environmental effect of a change in the available areas currently fished is also assessed.

These potential interactions could lead to a Change to Net Income of Local Commercial Fishermen as a result of Project activities. As a result, a Change to Net Income of Local Commercial Fishermen is selected as an environmental effect to be carried through the environmental assessment on Commercial Fisheries to address these potential issues.

11.1.4 Selection of Measurable Parameters

Table 11.2 provides the measurable parameters that will be used for the environmental effects assessment on Commercial Fisheries, and the rationale for the selection of the measurable parameters.

Table 11.2 Measurable Parameters for Commercial Fisheries

Environmental Effect	Measurable Parameter	Rationale for Selection of the Measurable Parameter
Change to Net Income of Local Commercial Fishermen	Change in steaming distance	Indicator for the environmental effects on operating costs. Change in fishing vessel steaming distance primarily means a change in vessel fuel costs, maintenance costs and the opportunity cost of labour.
	Change in steaming time for Mispec commercial fishermen as a proportion of available fishing time in a tidal cycle	Indicator for the environmental effects on operating costs and revenues to Mispec fishermen. Change in steaming time relative to the time available due to tidal access restrictions for Mispec wharf (vessels can only enter or leave port during a six hour window each tide cycle), means a potential change in both costs and revenues (through a reduction in available fishing time).
	Change in available fishing area where currently fished	Indicator for the environmental effects on both operating costs and revenues. The placement of marine infrastructure and safety exclusion zones may change the current fishing area that is available. This may result in a change in catch (*e.g.,* through less fishable area) or a change in operating costs (*e.g.,* increase in fuel costs and opportunity cost of labour to travel to other fishing areas).

11.1.5 Temporal Boundaries

Baseline conditions for Commercial Fisheries were established from 2000 to 2007, although secondary statistical data were not available for 2007 at the time of writing. The temporal boundaries of the environmental effects assessment for Commercial Fisheries include Construction and Operation of the marine components of the Project. Within a given year, environmental effects to the lobster and scallop fisheries are likely to occur only within the regulated fishing seasons. For lobster, the fishing seasons within Lobster Fishing Area (LFA) 36 are from April 1 to June 29, and from the second Tuesday in November until January 14 of the following calendar year, unless otherwise adjusted by DFO. For scallop, fishing occurs year round, except within a near shore Conservation Zone in which the fishing season is from the second Tuesday in January to the last day of March.

11.1.6 Spatial Boundaries

This section describes the following spatial boundaries for the environmental assessment of the Commercial Fisheries:

- The Project Development Area (PDA);
- A Local Assessment Area (LAA); and
- Two Regional Assessment Areas (RAAs), discussed below.

The PDA is the physical footprint of the Marine Terminal and Other Marine-Based Infrastructure and their safety exclusion zones (Figure 11.1).

The LAA for Commercial Fisheries is defined to include the area starting at Anthonys Cove near Saint John Harbour, extending southwest and then east, and ending at Cape Spencer (Figure 11.1). The LAA encompasses the locations of all Project-related marine infrastructure, including the marine terminal, the barge landing facility, the seawater cooling intake structure and the effluent release structure. The LAA includes the entrance to the Mispec River, the location of the wharf from which several local fishermen are based. The LAA was selected to include the areas of high concentration of near shore lobster fishing activities, as determined by weekly surveys of lobster trap markers, conducted in the 2007 spring lobster season (Figure 11.2) (Jacques Whitford 2008n), and engagement of local fishermen and the FNFA.

Two RAAs are defined for Commercial Fisheries, one for the lobster fishery and one for the scallop fishery. The Lobster RAA is defined as the boundaries of the local LFA 36 (Figure 11.3). The Scallop RAA is defined as the boundaries of the local Scallop Fishing Area (SFA) 28B (Figure 11.4). Both LFAs and SFAs are set forth in the *Atlantic Fishery Regulations, 1985* under the federal *Fisheries Act* and form the geographical management units for which licences are issued. Holders of licences for these fishing areas are entitled to fish throughout the licensed fishing area, with the exception of any other regulated limitations to fishing, such as conservation zones or area closures.

11.1.7 Administrative and Technical Boundaries

Provisions under the *Fisheries Act* protect fish and fish habitat, including fisheries resources. Regulations under the *Fisheries Act* include the *Maritime Provinces Fishery Regulations*, which contains regulations respecting fishing in the provinces of Nova Scotia, New Brunswick and Prince Edward Island and in adjacent tidal waters, and the *Atlantic Fishery Regulations, 1985*, which contains regulations respecting the management and allocation of fishery resources on the Atlantic coast of Canada. Fish resources are protected by legislating area closures, fishing quotas, fishing seasons, and gear and vessel restrictions for fishing activities. For example, the lobster fishery is protected by fishing seasons and gear restrictions, including a maximum number of traps permitted per licensed fisherman, which is currently set as a licensing restriction of 300. Other broad mechanisms for the protection of marine resources are provided under the federal *Oceans Act*.

With respect to marine planning, the Southwest New Brunswick Marine Resources Planning Initiative is currently underway (Parker 2008). The spatial boundaries for this initiative exclude the LAA for Commercial Fisheries, but include portions of the RAAs as defined in Section 11.1.6. Work on the initiative continues, but to date has developed a mission statement, guiding principles, and baseline information on resources and their use. Through a consultative process, the ultimate goal is to develop a marine resource use plan for the area that helps ensure that competing demands are addressed while acknowledging community needs and access to resources (Parker 2008).

Within the LAA, the Proponent is the lease holder of the water lot surrounding the Mispec Point area, including the physical location of the proposed Marine Terminal and Other Marine-Based Infrastructure. Fishing presently occurs within the water lot, but may be restricted to support the development and safe operation of marine infrastructure and port activities. The Saint John Harbour is administered by the Saint John Port Authority under the authority of the *Canada Marine Act* (1998, c.10) and Regulations.

The assessment of Commercial Fisheries takes into consideration not only the fisheries resources harvested within the LAA, but also the resources within the larger licensed fishing areas that define the RAA. The DFO licensed units are LFA 36 for lobster and SFA 28B for scallop (Figures 11.3 and 11.4). Fishermen holding a license to fish in these areas have the discretion to fish at their risk wherever they so choose within their licence area, except within defined area closures regulated under the *Fisheries Act* or within other exclusion zones otherwise defined under federal regulation.

Detailed quantitative information on the characteristics of fishing activities, the target species, and the economic value of the total catch within the LAA cannot always be determined, resulting in technical constraints on the analysis. DFO reports statistics on landings by Statistical District. The two Statistical

Districts closest to the Project (Statistical Districts 48 and 49) together extend to the east as far as Fundy National Park and to the west to Point Lepreau. Landings are recorded according to where the catch is brought to shore, but as license holders are permitted to fish anywhere within their licensed area and may hold a license for an area at considerable distance from their home port, it is not possible only from the statistics to determine the amount of catch within the LAA. For scallop, catch statistics are available for the Scallop Production Areas (SPA) (Jacques Whitford 2008n); no similar catch statistics are available for lobster. This technical boundary was overcome by conducting a lobster trap marker buoy survey (Jacques Whitford 2008n) and engagement of local fishermen to share information. This allowed the Study Team to define current fishing activities and amounts within the LAA.

11.1.8 Residual Environmental Effects Rating Criteria

A significant adverse residual environmental effect is one that results in an unmitigated or non-compensated net financial loss to Commercial Fisheries as a result of the Project. This may consist of a residual environmental effect that alters commercial fishing activities to an extent that results in the following, and cannot be mitigated or compensated:

- Fisheries license holders being displaced, unable to use areas traditionally or currently fished for all or most of a fishing season (or more); and/or
- Fisheries license holders experiencing a demonstrated net income loss from fishing activities due to Project-related environmental effects for one year or more.

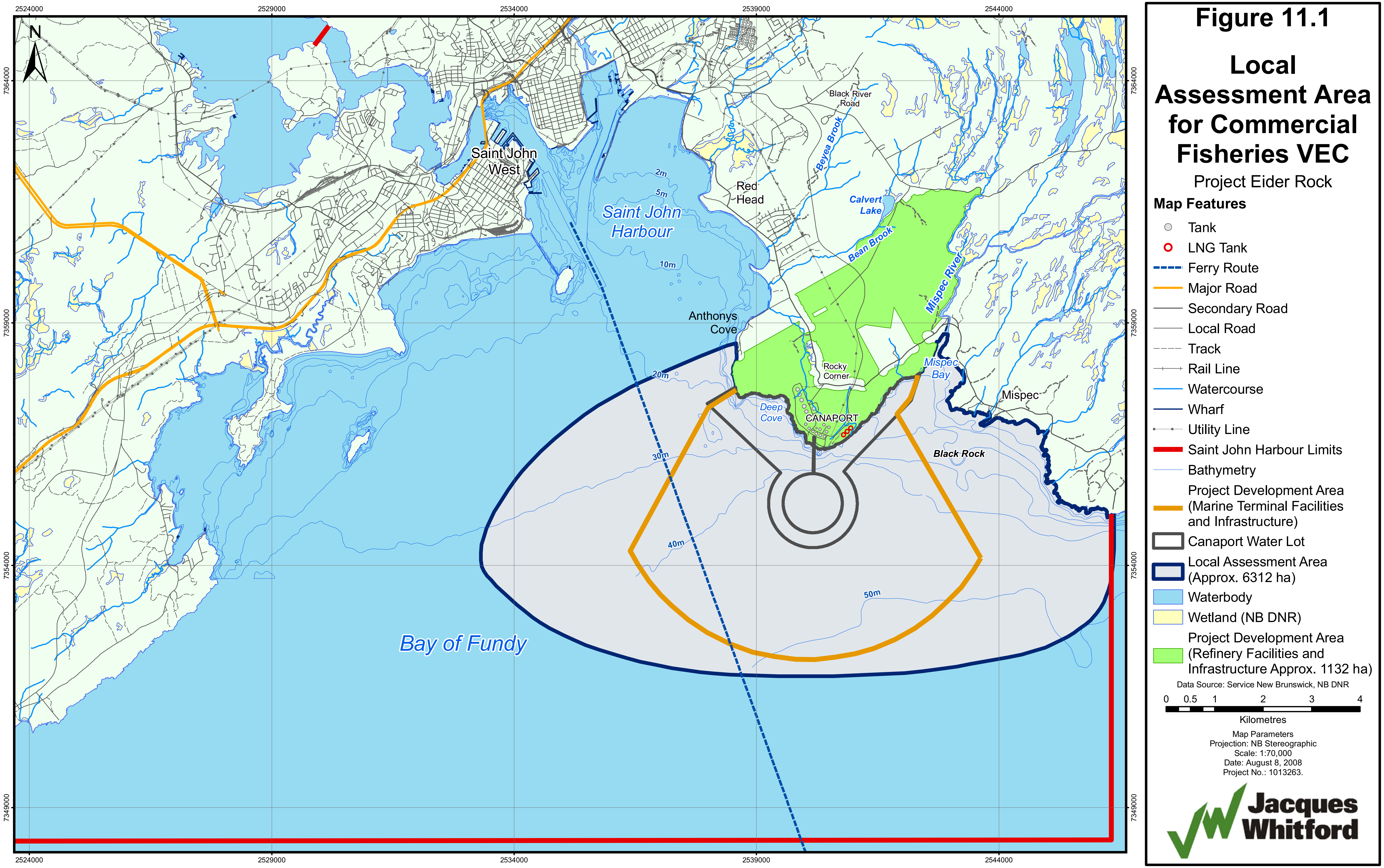


Figure 11.1

Local Assessment Area for Commercial Fisheries VEC

Project Eider Rock

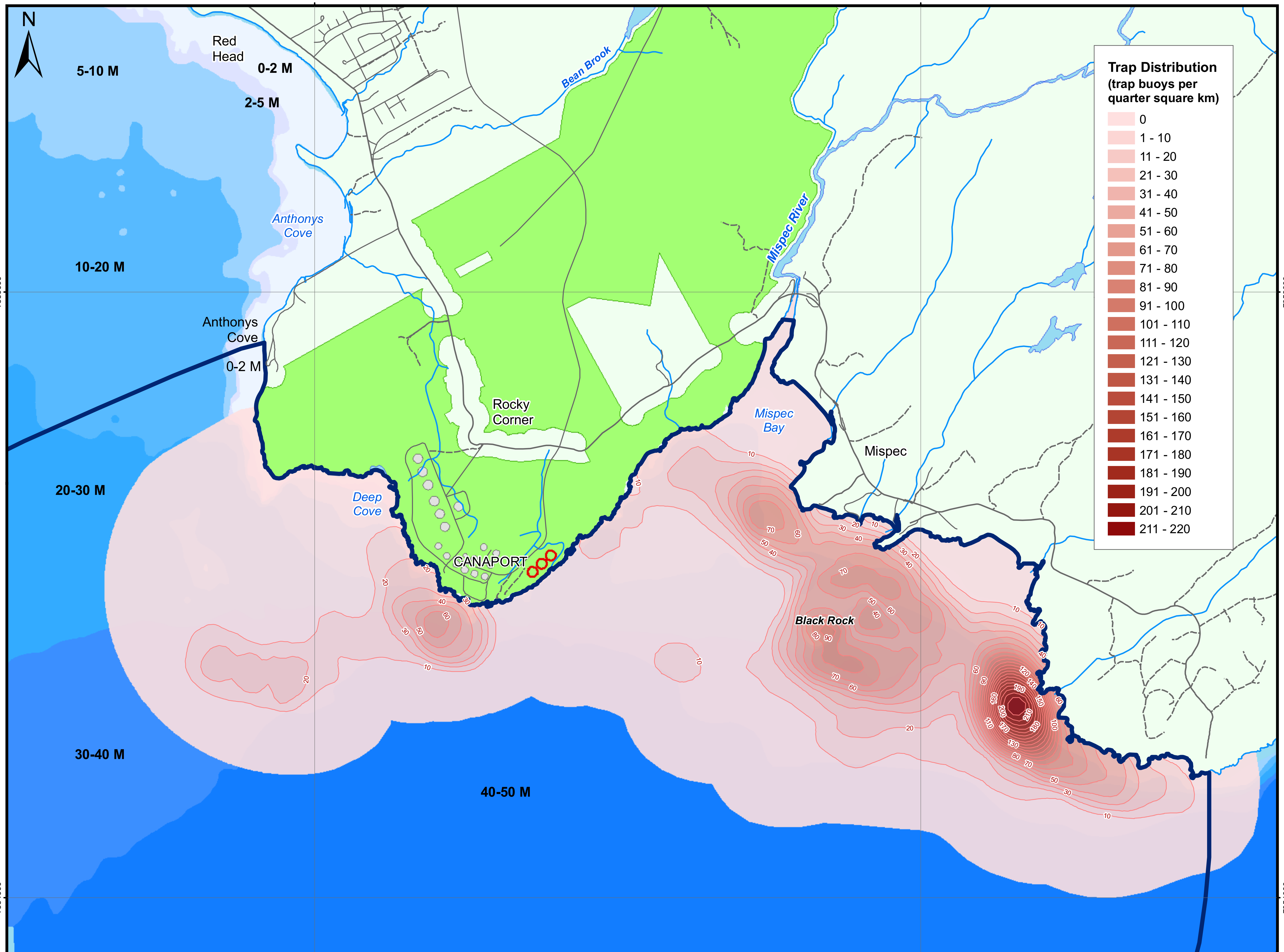


Figure 11.2

Survey of Lobster Trap Buoy Locations During the 2007 Spring Lobster Season

Project Eider Rock

Map Features

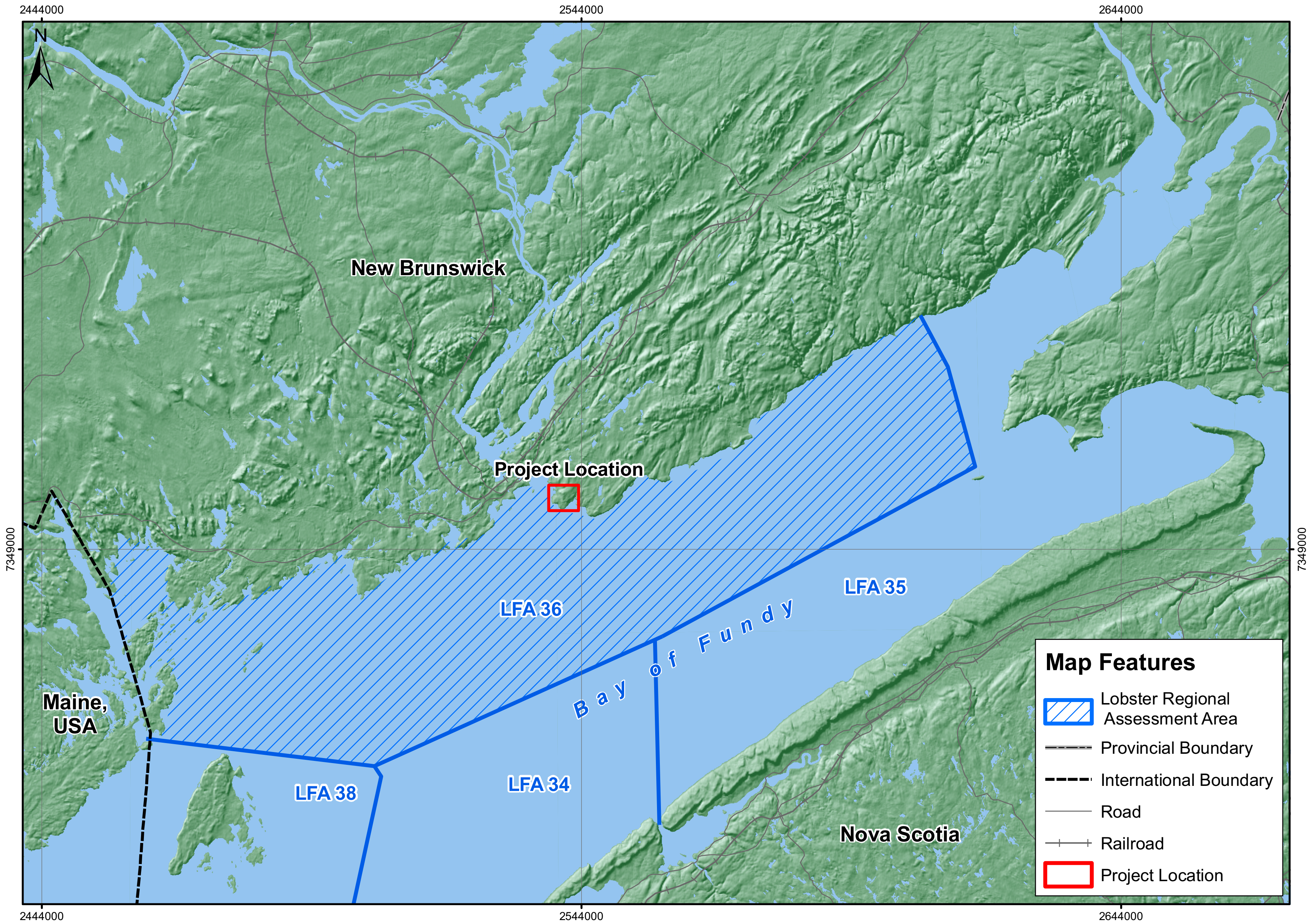
- Tank
- LNG Tank
- Secondary Road
- Local Road
- Track
- Rail Line
- Lobster Trap Distribution (trap buoys per quarter square km)
- Waterbody
- Local Assessment Area (Approx. 6312 ha)
- Project Development Area (Refinery Facilities and Infrastructure Approx. 1132 ha)

Data Source: Service New Brunswick, NB DNR

0 0.25 0.5 1 1.5
Kilometres

Map Parameters
Projection: NB Stereographic
Scale: 1:32,000
Date: February 17, 2009
Project No.: 1013263.

Jacques Whitford



Map Parameters
Projection: NB Stereographic
Scale 1:1,000,000
Date: August 8, 2008
Project No.: 1013263
Data Provided By: ESRI, DFO

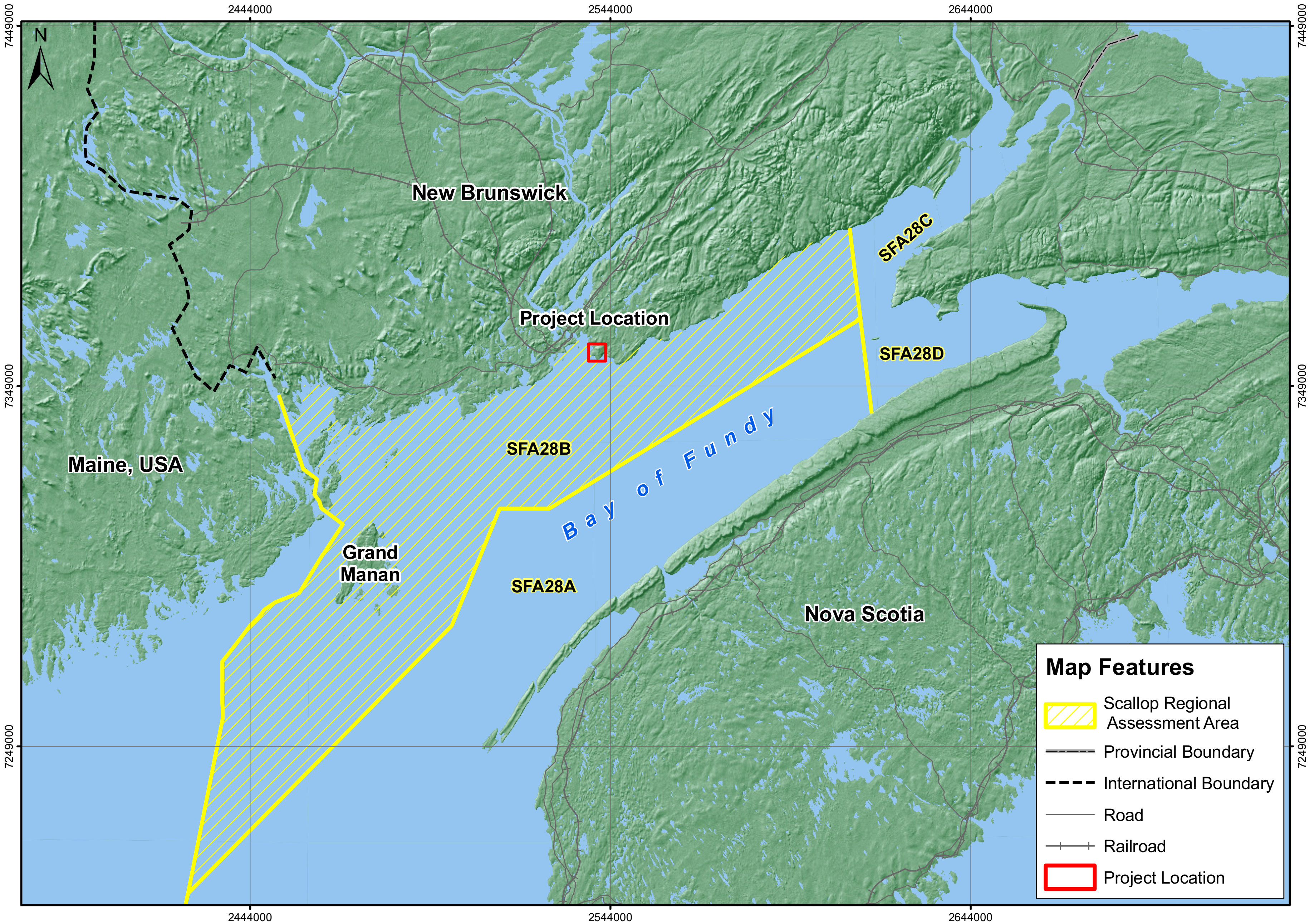
Figure 11.3

Lobster Fishery Regional Assessment Area

Project Eider Rock

Jacques Whitford

0 10 20 40 60 80 100
Kilometres



Map Parameters
Projection: NB Stereographic
Scale 1:1,500,000
Date: August 8, 2008
Project No.: 1013263.
Data Provided By: ESRI, DFO

Figure 11.4

Scallop Fishery Regional Assessment Area

Project Eider Rock

Jacques Whitford

11.2 Existing Conditions

The near shore fishery in and near the LAA is not particularly diverse and is dominated by the lobster fishery and, to a lesser extent, the scallop fishery (Jacques Whitford 2008n). Though the area has traditionally not been home to important levels of groundfish harvesting, this fishery has greatly declined in recent years and currently accounts for less than 0.2% of the total estimated value of landings for all of DFO Statistical Districts 48 and 49. Although there are licenses issued for pelagic and estuarine fisheries in the LAA, even though fishermen may derive their incomes from fishing different species, these fisheries have also seen substantial declines recently and currently contribute very little, even combined, to the total financial value of the local fisheries.

Fishing licenses are issued for the Saint John County area for several species, including scallop, groundfish, rockweed, sea urchins, shad, gaspereau, eel, dogfish, herring, lobster, mackerel, and sturgeon. The rock crab fishery is also a licensed fishery in the area; however, it has not been actively fished in recent years because market conditions do not make the fishery viable.

The LAA is a concentrated area of lobster fishing activity. Fishermen from the Mispec wharf, the Port of Saint John and, during peak times, lobster fishing vessels from other areas fish in the LAA (M. Recchia, personal communication, March 12, 2008) (Jacques Whitford 2008n). The lobster fishery is the most abundant and economically valuable fishery in the LAA, which is located within LFA 36. There are two lobster seasons each year in LFA 36. The spring lobster season opens on April 1 and closes June 29. The fall lobster season opens on the second Tuesday in November and closes January 14 of the following calendar year. Fishing seasons are mandated by the *Atlantic Fishery Regulations, 1985*. Adjustments to the season made necessary by weather or other factors are made by the local DFO office. The peak amount of fishing activity within the LAA occurs late in the spring season (*i.e.,* late May and June) and early in the fall season (*i.e.,* November). Average annual lobster landings per license holder within Statistical Districts 48 and 49 for the years 2000 to 2006 were approximately 14.8 t, with an average gross value of approximately $183,000.

Lobsters migrate seasonally, primarily in response to seasonal changes in water temperature. In spring, lobsters move toward shallow waters to moult, reproduce, or hatch eggs, returning to deeper water in the fall (FRCC 2007). Accordingly, as the fall lobster season progresses, lobsters move from close to shore to much deeper waters offshore. During the spring season, the opposite occurs as lobster move closer to shore as the season proceeds. As a result, fishing activity moves with the lobster populations throughout the season. There are generally three main areas within and near the LAA that are habitually the site of a relatively high level of fishing activity (Figure 11.2). The waters surrounding Cape Spencer and Black Rock are concentrated with lobster traps, particularly at peak season when, at times, navigation can become difficult due to the number of marker buoys. The area between the Black Point ocean disposal site and the Canaport LNG marine terminal, including the existing Canaport SBM area, has traditionally been heavily fished with substantial catch amounts reported. Although not likely indicative of any long-term trends in the fishery, several fishermen interviewed reported that the catches during the spring 2007 lobster season were less plentiful than in 2006, and not typical of other years.

Lobster traps are usually placed in lines in the water to minimize steaming time required to haul traps. Depending on preferences and location, individual fishermen will use singles (one trap attached to one marker buoy), doubles (two traps attached to one marker buoy), or trawls (a string of three or more traps on a single line, with a marker buoy on either end). In high traffic areas, fishermen will often modify their gear and the configuration of their traps in an attempt to minimize gear loss.

Vessels fishing for lobster in the LAA originate from several ports, including the Port of Saint John and the Mispec wharf. License holders are free to fish anywhere within the LFA but do so at their risk; therefore, it is difficult to predict what or how many vessels will fish in a particular area each season. A license holder may choose to relocate his efforts to different areas for a number of reasons, including increased boat traffic, changes in lobster stock mobility, and changes in concentration locations. However, several local vessels routinely frequent the area each season. The Mispec wharf is the closest port, located on the mouth of the Mispec River, in close proximity to the Project. Five lobster fishing vessels use the Mispec wharf as their home port, both to dock their vessels and to sell their catches to commercial purchasers. The Mispec wharf is tidal, and that movement in and out of port is only possible at or near high tide. As a result, movement of vessels to and from the wharf is limited to the time between approximately three hours before and three hours after high tide. Thus, the daily schedules of the Mispec fishermen are highly dependent on the tidal schedule, which limits the amount of time each day during lobster season they can spend on the water for fishing.

A substantial portion of the fishing activity in and near the LAA is conducted by five vessels from the Mispec wharf. Surveys in the area conducted to monitor and track the location of lobster trap marking buoys revealed that there are up to 15 different fishermen working in the area, based on the different marker colours observed by the Study Team during the 2007 lobster marker buoy surveys conducted (although an individual fisherman may use more than one combination of colours). As the spring lobster season progressed, more fishermen placed traps in the area, following the lobster as they migrated toward shore. Those marker buoys in the LAA early in the season belonged almost exclusively to Mispec-based fishermen. Several buoy colours dominated the LAA, especially those buoys placed by fishermen based out of Mispec. These five Mispec-based fishermen have stated that they expend up to 100% of their lobster harvesting efforts within or adjacent to the LAA.

Scallop fishing in the general vicinity of the Project occurs in SFA 28B (Figure 11.4). SFA 28B includes the New Brunswick side of the Bay of Fundy, from the Mid Bay Line to the Upper Bay Line. The LAA is very close to the boundary between SPA 1b and SPA 6c (Jacques Whitford 2008n). Fishermen in the region fish both SPA.

The waters in and around the LAA are fished by Full Bay and Mid-Bay licensed fleets. Full Bay vessels are 13.7 to 19.8 m (45 to 65 ft) in length, and Mid-Bay vessels are generally between 9.1 and 13.7 m (30 and 45 ft) in length (DFO 2007b). Full Bay licensed vessels are permitted to fish the entire Bay of Fundy. Mid-Bay license holders fish only the portion of SFA 28B that is north of the Mid-Bay line in SPA 1b and most of SPA 6. There are also several Upper Bay licenses restricted to the upper reaches of the Bay of Fundy (SFA 28C and SFA 28D), which is located east of the Upper Bay Line in SPA 1b.

Scallop harvesting vessels generally use draggers or rakes as the primary form of fishing gear in the area. The size of the gear is restricted by regulation to a maximum width of 5.5 m with a ring size of not less than 82 mm inside diameter (DFO 2007b). Scallop fishing by diving, dip-netting or by tongs is permitted; however, these forms of scallop harvesting account for very little, if any, of total catches in the area.

A designated Conservation Zone exists in part of the activity area closer to shore (Jacques Whitford 2008n). This zone is only open to scallop fishing from the second Tuesday in January until the end of March each year. An important scallop bed is reportedly located at the boundary of the Conservation Zone near the LAA. As a result, many scallop fishermen harvest in the area, moving closer to shore when the Conservation Zone is open to fishing. In meetings held as part of the public and stakeholder engagement program, fishermen have indicated that there is some amount of scallop fishing in and near the LAA, although many scallop boats fish over a considerable portion of the Bay of Fundy, including waters 10 km or more offshore.

The scallop harvest is the second most dominant and lucrative fishery in and near the LAA, second only to the considerably more valuable lobster harvest (Jacques Whitford 2008n). Although variations in landings between years and Statistical Districts have been considerable, between 2000 and 2006 the average annual landing per license was approximately 8 t, with an average gross value of approximately $16,000.

11.3 Potential Project-VEC Interactions

The potential interactions between Project-related activities during each phase of the Project and Commercial Fisheries are shown in Table 11.3.

Table 11.3 Potential Project Environmental Effects to Commercial Fisheries

Project Activities and Physical Works	Potential Environmental Effects
	Change to Net Income of Local Commercial Fishermen
MARINE TERMINAL AND OTHER MARINE-BASED INFRASTRUCTURE	
Construction	
Construction and Installation of Jetty and Other Marine-Based Infrastructure	2
Marine Vessel Berthing and Deberthing	2
Operation	
Marine Vessel, Berthing and Deberthing	2
Crude Oil and Finished Product Transfer	2
Wastewater, Cooling Water, and Storm Water Release	1
Decommissioning and Abandonment	
Removal of Facilities and Site Reclamation	1

Project-Related Environmental Effects

Notes: Project-Related Environmental Effects were ranked as follows:

0 No interaction or no substantive interaction contemplated.

1 Interaction will occur. However, based on past experience and professional judgment, the interaction would not result in a significant environmental effect, even without mitigation, or the interaction would clearly not be significant due to application of codified practices.

2 Interaction may, even with codified mitigation, result in a potentially significant environmental effect and/or is important to regulatory and/or public interest. Potential environmental effects are considered further and in more detail in the CSR.

Potential environmental effects to Commercial Fisheries include environmental effects of the following marine-based activities and physical works associated with the Project (Table 11.3):

- Construction and Installation of the Jetty and Other Marine-Based Infrastructure;
- Marine Vessel, Berthing and Deberthing; and
- Crude Oil and Finished Product Transfer.

The assessment of environmental effects on Commercial Fisheries includes potential interactions with the lobster and scallop fisheries. Through consultation and a review of available information from DFO, it has been determined that, within the LAA, groundfish, rockweed, sea urchins, shad, gaspereau, eel, dogfish, herring, mackerel, and sturgeon do not support important harvests. Though some fishing activity of these species may occur in limited quantities within the LAA, these fisheries are not expected to result in interactions with the Project or its activities. Thus, the groundfish, rockweed, sea urchins, shad, gaspereau, eel, dogfish, herring, mackerel and sturgeon fisheries will not be considered further in the assessment of environmental effects on Commercial Fisheries, and the potential environmental effects of the Project including all phases and activities on the commercial fishing of these species are rated not significant. There are fishing licences issued for rock crab in the Saint John area; however, in recent years this species has not been fished because current market conditions do not make the fishery viable. Licensed lobster fishermen are permitted to retain rock crab and Jonah crab as a by-catch, which they use primarily for personal use. Therefore, crab species are also not considered further in this assessment. In all cases, the potential environmental effects of the Project to Commercial Fisheries, including cumulative environmental effects, on these components of the commercial fisheries during all phases of the Project are rated not significant.

Dredging activities have the potential to interact with Commercial Fisheries. Project-related dredging will occur under authorization in a manner that is considered acceptable by regulatory authorities through post-EA permitting activities, and dredge spoils will be disposed at approved disposal sites. Habitat compensation will be provided as applicable. Consequently, the potential for interactions between dredging activities and Commercial Fisheries is very low, given that such dredging activity would only occur as authorized. Project-related dredging activities will not specifically be considered further in this assessment and are rated not significant due to the limited interaction and the planned mitigation. Potential biophysical environmental effects on the fisheries resource due to dredging activities are assessed in Chapter 10.

During Construction, Project activities may interact with Commercial Fisheries and result in an environmental effect. Construction and installation of the jetty and other marine infrastructure will lead to an increase in vessel traffic in the LAA to carry units and construction materials. Construction-related traffic and marine vessel transportation is likely to consist mostly of tugs and barges, and these types of vessels, along with the placement of infrastructure within the marine environment, will occupy space within the LAA. As a result, these areas of Project activity would not be accessible for fishing. Construction activities and the location of the new jetty and other marine-based infrastructure, including the barge landing facility and the seawater cooling intake structure, may require that fishing vessels travel around these areas to reach areas currently fished within the LAA and will be determined during the detailed engineering design phase. This has the potential to interrupt and lengthen travel routes for commercial fishermen based at the Mispec wharf, which may increase their operational costs.

During Operation, activities within the LAA will include berthing and deberthing from the jetty, and crude oil unloading and finished petroleum product loading at the jetty. Safety exclusion zones established around the new jetty, the barge landing facility and the seawater cooling intake structure will reduce access to these areas, potentially resulting in a loss in the available areas currently fished by Mispec-based fishermen. The safety exclusion zones around the jetty and the seawater cooling intake structure may cause Mispec-based fishermen to alter their travel routes (if they exceed current exclusion zones) to take a longer path, skirting the exclusion zones, to reach their areas currently fished. A demonstrated increase in steaming time may result in an increase in operational costs.

Decommissioning and Abandonment activities will not be considered further due to implementation of standard mitigation measures and environmental protection procedures. During Decommissioning and Abandonment, the Project will adhere to all applicable environmental regulations and laws in place at that time. Accordingly, environmental effects to Commercial Fisheries are not foreseen during Decommissioning and Abandonment. Thus, the environmental effects of the Project during Decommissioning and Abandonment are rated not significant and, thus, not considered further.

11.4 Environmental Effects Assessment

Residual environmental effects of the Marine Terminal and Other Marine-Based Infrastructure on Commercial Fisheries are summarized in Table 11.4.

Table 11.4 Summary of Residual Environmental Effects on Commercial Fisheries

Potential Residual Environmental Effects	Proposed Mitigation Measures	Residual Environmental Effects Characteristics: Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/ Socio-economic Context	Significance	Prediction Confidence	Likelihood	Cumulative Environmental Effects?	Recommended Follow-up and Monitoring
Change to Net Income of Local Commercial Fishermen												
Construction	▪ Encouragement of the use of established approaches by Project-related vessels and delineation of Project vessel zones of operation during the Construction phase. ▪ Establishment of practices with respect to marine terminal operations. ▪ Compensation to established Mispec fishermen for confirmed increased steaming distance. ▪ Working through the Port of Saint John Traffic Committee as a formal line of communication between fishermen and operators of the Project.	A	L	L	MT/ R	R	D	N	H	H	Y	None.
Operation		A	L	L	LT/ R	R	D	N	H	H	Y	
Residual Environmental Effects for all Phases								N	H	H	Y	

KEY

Direction:
P Positive
A Adverse

Magnitude:
L Low: 10% or less change in net income of commercial fishermen operating within the LAA.
M Moderate: From 10-50% change in net income of commercial fishermen operating within the LAA.
H High: Greater than 50% change in net income of commercial fishermen operating within the LAA.

Geographic Extent:
S Site-specific: Within the Marine PDA, including exclusion zones.
L Local: Within the LAA.
R Regional: Within the RAA.

Duration:
ST Short term: One fishing season or less
MT Medium term: Greater than one fishing season, but not lasting for more than five years.
LT Long term: Greater than five years, as long as the life of the Project.
P Permanent: Greater than the life of the Project.

Frequency:
O Occurs once
S Occurs sporadically at irregular intervals
R Occurs on a regular basis and at regular intervals
C Continuous

Reversibility:
R Reversible
I Irreversible

Ecological/ Socio-economic Context:
U Undisturbed: Area relatively or not adversely affected by human activity.
D Developed: Area has been substantially previously disturbed by human development or human development is still present.
N/A Not Applicable.

Significance:
S Significant
N Not Significant

Prediction Confidence:
Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation.
L Low level of confidence
M Moderate level of confidence
H High level of confidence

Likelihood:
Based on professional judgment.
L Low probability of occurrence
M Medium probability of occurrence
H High probability of occurrence

Cumulative Environmental Effects?
Y Potential for environmental effect to interact with other past, present or foreseeable projects or activities in RAA.
N Environmental effect will not or is not likely to interact with other past, present or foreseeable projects or activities in RAA.

11.4.1 Assessment of Project-Related Environmental Effects

Without mitigation, the potential interactions of the Project with Commercial Fisheries would result in a decrease in net income to local commercial fishermen. The main concern relates to the increased steaming distance and, therefore, increased operating expenses and lost fishing time, for established Mispec-based fishermen. The principal mitigation for this environmental effect is to compensate those fishermen for confirmed increased steaming time, the specifics of which would be negotiated once the final engineering design of the Project is complete. Other mitigation measures are proposed and are discussed in Section 11.4.1.3.

As a result of the placement of the new jetty, barge landing facility and seawater cooling intake structure, as well as the addition of safety exclusion zones around this infrastructure, some additional area that could be fished would effectively unavailable. However, this area lies within Saint John Harbour and the existing water lot owned by the Proponent; fishing is already restricted by existing Canaport operations and construction of the Canaport LNG project on the water lot. Within this area, fishing activity may be restricted to support the development and operation of marine terminals and must not interfere with safe facility operations.

11.4.1.1 Existing Conditions for Change to Net Income of Local Commercial Fishermen

Local commercial lobster fishermen based at the Mispec wharf currently fish for lobster to the south, east and west of Mispec Bay. To reach areas currently fished to the west, they currently travel close to the shore, skirting out to avoid infrastructure and/or safety exclusion zones (*i.e.,* the Canaport LNG jetty and the existing SBM, when occupied by a vessel). The Mispec wharf is a tidal port; vessels can only enter or leave port during a six hour window surrounding each high tide. Commercial lobster fishermen not based at the Mispec wharf may also fish within the LAA; however, the marine PDA is not within important travel routes for non-Mispec based fishermen, as other approaches to the fishing areas are used.

The LAA (Figure 11.1) covers an area of approximately 6,300 ha. All bottom within the LAA is currently made available for lobster fishing, except for the location of the Canaport LNG terminal and the existing SBM safety exclusion zone when a vessel is docked (which currently occurs approximately 32% of the time). Commercial fishing activity and vessel movement occurs within the water lot where it does not interfere with the safe operation of Canaport.

The marine PDA is not located within any established steaming routes for scallop fishermen. The marine PDA is also not known to contain scallop areas currently fished. Some scallop fishing activity occurs within the southern-most portion of the LAA, during only the period that the scallop Conservation Zone is open, which starts the second Tuesday in January and ending the last day of March.

11.4.1.2 Project Environmental Effects Mechanisms for Change to Net Income of Local Commercial Fishermen

Project activities within the marine environment may interact with Commercial Fisheries. The barge landing facility, seawater cooling intake structure and the marine terminal and jetty are located close to or within travel routes commonly taken by Mispec fishermen between their wharf and lobster areas currently fished to the west of the PDA. The Project will require fishing vessels to deviate from these routes to avoid Project components, including any safety exclusion zones around the marine terminal and seawater cooling intake structure (the specific characteristics of any safety exclusion zones will be determined at a later date in consultation with the Saint John Port Authority, Atlantic Pilotage Authority, the Coast Guard, and Transport Canada). The barge landing facility, the seawater cooling intake and discharge structures, and related activity should not interfere substantively with fishing vessel routes or areas currently fished.

When they occur, demonstrated increased traveling distances and, thus, increased steaming times lead to increased operating costs to Mispec-based fishermen. Because the Mispec wharf is tidal with a limited window within which a vessel can be away from port each tidal cycle, a confirmed increase to steaming time may also result in a decrease in fishing effort and potentially lower catch amounts.

The placement of marine infrastructure and safety exclusion zones will change the area of bottom available for fishing in the LAA. The potential loss of areas currently fished is within the existing Proponent's water lot; fishing activity presently occurs there, provided that it does not interfere with the safe operation of the facilities. Additional vessel traffic associated with the Project may also restrict fishing vessel activity within the LAA.

11.4.1.3 Mitigation for Change to Net Income of Local Commercial Fishermen

Mitigation for adverse environmental effects on the net income of local commercial fishermen is proposed to include the following.

- Compensation for established Mispec-based fishermen for demonstrated loss of net income as a result of confirmed increased steaming distance and, therefore, increased operating expenses and lost fishing time (discussions regarding compensation will begin once the final Project engineering design is complete).
- Encouragement of the use of established approaches by Project-related vessels and delineation of Project vessel zones of operation during the Construction phase (note that the final decisions regarding approaches are at the discretion of vessel captains and pilots, and can be affected by environmental conditions including weather and currents).
- Establishment of practices and procedures for marine terminal operations as defined in a Marine Terminal Manual to ensure that all commitments, and applicable rules and regulations are met to help minimize interactions with fishing vessels.
- Continue working through the Port of Saint John Traffic Committee as a formal line of communication between fishermen and operators of the Project during Construction and Operation.

11.4.1.4 Characterization of Residual Project Environmental Effects for Change to Net Income of Local Commercial Fishermen

For Mispec-based fishermen, travel patterns will vary depending on where fishing activity is occurring. The fishing areas to the west of the marine PDA, for which travel routes and steaming distances may be affected, are estimated to be fished no more than half of the time. The additional time required to travel from Mispec wharf to the western fishing areas is also small relative to the total available fishing time in a given high tide of approximately 6 hours, or the approximately 18 hours available when fishing between high tides (given that wharf access is possible up to three hours before and after a high tide).

The change in available fishing area due to the footprint of the marine terminal jetty, barge landing facility and seawater cooling intake structure, as well as the associated safety exclusion zones, is a very small proportion (less than 1%) of the total area within the LAA.

As noted previously, fishing activities within the Proponent's water lot and Saint John Harbour may be restricted to support the placement and safe operation of marine infrastructure and port activities. This authority is vested in the *Canada Marine Act* (1998, c.10) (the Act) and applicable regulations. The objectives of the Act (s.4) are, among others, to:

- Implement a National Marine Policy that provides Canada with the marine infrastructure that it needs and that offers effective support for the achievement of local, regional and national social and economic objectives and will promote and safeguard Canada's competitiveness and trade objectives;
- Ensure that marine transportation services are organized to satisfy the needs of users and are available at a reasonable cost to the users;
- Provide for a high level of safety and environmental protection; and
- Provide a high degree of autonomy for local and regional management of components of the system of services and facilities and be responsive to local needs and priorities.

Thus, the establishment of the Proponent's water lot anticipates and is in support of the further development of the area as a marine terminal.

In summary, any potential change in steaming time from Mispec wharf is very small relative to the available fishing time in a tidal cycle, and the confirmed environmental effects of this on fishing time and costs will be compensated if they are demonstrated to result directly and solely from the Project. The residual environmental effects of the Project on the net income from Commercial Fisheries could occur primarily to Mispec-based lobster fishermen during Construction and Operation. The residual environmental effect will only occur during the lobster fishing seasons (*i.e.,* April 1 to June 29, and the second Tuesday in November to January 14). Given that any potential change in steaming time from Mispec wharf is very small relative to the available fishing time in a tidal cycle, and there will be compensation for confirmed increased steaming time by Mispec-based fishermen, the magnitude of the residual environmental effect on net income is predicted to be of low magnitude.

11.4.2 Determination of Significance

With the proposed mitigation, including compensation for confirmed increased steaming time, the potential Change to Net Income of Local Commercial Fishermen on Commercial Fisheries during Construction and Operation are rated not significant. There is a high level of confidence in the environmental effects and significance predictions because of the extent of the available information, confirmed through stakeholder engagement, and understanding of the key environmental effects mechanisms.

11.5 Assessment of Cumulative Environmental Effects

The potential for the Project to overlap with other projects and activities that have been or will be carried out, as defined in Table 5.2, is the key consideration for the assessment of cumulative environmental effects. The potential residual cumulative environmental effects of current and planned projects and activities on Commercial Fisheries are summarized in Table 11.5.

Table 11.5 Potential Cumulative Environmental Effects to Commercial Fisheries

Other Projects and Activities With Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects
	Change to Net Income of Local Commercial Fishermen
MARINE TERMINAL AND OTHER MARINE-BASED INFRASTRUCTURE	
Project Eider Rock (Land-Based Components)	0
Industrial Land Use	0
Planned or Future Industrial/Energy Projects	0
Infrastructure Land Use	0
Marine Use	2

Cumulative Environmental Effects

Notes: Cumulative environmental effects were ranked as follows:

0 Project environmental effects do not act cumulatively with those of other projects and activities.

1 Project environmental effects act cumulatively with those of other project and pctivities, but are unlikely to result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects but will not measurably change the state of the VEC.

2 Project environmental effects act cumulatively with those of other projects and activities, and may result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC.

With respect to other projects and activities with potential for cumulative environmental effects, the identified Industrial Land Use, Planned or Future Industrial and Energy Projects, and Infrastructure Land Use are all land-based and, thus, it is expected that no interaction with, or direct or indirect environmental effects to, Commercial Fisheries will occur.

11.5.1 Assessment of Cumulative Environmental Effects

Residual cumulative environmental effects of Marine Use on Commercial Fisheries are assessed in Table 11.6.

Table 11.6 Summary of Residual Cumulative Environmental Effects on Commercial Fisheries

Cumulative Environmental Effects	Case	Other Projects, Activities and Actions	Proposed Mitigation Measures	Residual Cumulative Environmental Effects Characteristics						Significance	Prediction Confidence	Likelihood	Proposed Follow-up and Monitoring Programs
				Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/ Socio-economic Context				
Change to Net Income of Local Commercial Fishermen	Cumulative Environmental Effect with Project	▪ Development of Port of Saint John; ▪ Existing Canaport operations and future operations of the Canaport LNG terminal; ▪ Aquaculture in the Bay of Fundy; ▪ Increased ship traffic to the Port of Saint John.	Compensation to established Mispec fishermen affected cumulatively by the Project with respect to confirmed increased steaming time.	A	L	R	LT/R	R	D	N	H	H	None.
	Project Contribution to Cumulative Environmental Effect			A	L	L	LT/R	R	D	N	H	H	None.

KEY

Direction:
P Positive
A Adverse

Magnitude:
L Low: 10% or less change in net income of commercial fishermen operating within the LAA.
M Moderate: From 10-50% change in net income of commercial fishermen operating within the LAA.
H High: Greater than 50% change in net income of commercial fishermen operating within the LAA.

Geographic Extent:
S Site-specific: Within the Marine PDA, including exclusion zones.
L Local: Within the LAA.
R Regional: Within the RAA.

Duration:
ST Short term: One fishing season or less.
MT Medium term: More than one fishing season, but not lasting for the life of the Project.
LT Long term: For the life of the Project.
P Permanent: An end is not foreseen.

Frequency:
O Occurs once.
S Occurs sporadically at irregular intervals.
R Occurs on a regular basis and at regular intervals.
C Continuous.

Reversibility:
R Reversible
I Irreversible

Ecological/ Socio-economic Context:
U Undisturbed: Area relatively or not adversely affected by human activity.
D Developed: Area has been substantially previously disturbed by human development or human development is still present.
N/A Not Applicable.

Significance:
S Significant
N Not significant

Prediction Confidence:
Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation.
L Low level of confidence
M Moderate level of confidence
H High level of confidence

Likelihood:
Based on professional judgment.
L Low probability of occurrence
M Medium probability of occurrence
H High probability of occurrence

Other Projects, Activities and Actions:
List of specific projects and activities that would contribute to the cumulative environmental effects.

For the purposes of cumulative environmental effects assessment on Commercial Fisheries, all projects or activities within both the Lobster RAA and the Scallop RAA will be considered, with emphasis placed on those activities closest to the Project. Projects and activities included in this assessment include those with potential to, in combination with the Project, substantively interfere with usual traveling routes of fishing vessels and/or result in a loss of available fishing area for areas currently fished. The initial development of the Port of Saint John and its existing operations, as well as historical fishing activities in the Bay of Fuundy, would be incorporated in the established existing conditions for Commercial Fisheries.

Within the RAA, there are existing operations at the existing Canaport SBM and the new Canaport LNG marine terminal. Each year on average, 70-75 crude oil carrying vessels of various sizes and capacities moor at the existing SBM to unload their product. The average mooring time for a vessel at the SBM is approximately 37 hours, resulting in the SBM being occupied approximately 32% of the time over the course of an average year. When a ship is attached to the SBM, a navigational exclusion zone is in place for safety. This exclusion zone has a radius of 925 m or area of approximately 269 ha, and all vessels, including fishing vessels, must remain outside of the zone while a vessel is moored to the SBM. Construction of the Canaport LNG marine terminal has been completed and operation will begin soon. While it was being constructed, all vessels including fishing vessels travelled around the construction site to avoid the possibility of colliding with construction components and vessels actively working at the site; however, there is no formal exclusion zone during construction. Most activities and infrastructure are located on the Proponent's water lot.

The existing Canaport marine terminal currently interacts cumulatively with Commercial Fisheries within the LAA due to the potential increased steaming time around the installations when exclusion zones are in effect. The current Canaport vessel traffic also has an environmental effect on the travel and movement of fishing vessels, particularly within the LAA.

Currently, all crude oil for the existing refinery is unloaded at the existing SBM, regardless the size of the crude oil carrier. Once the Project is operational, it is expected that only very large crude carriers (VLCCs) will moor at the SBM for unloading. Smaller vessels will berth at the Project's marine terminal. It is expected that once the Project is operational, approximately 30 to 35 VLCC crude tankers, 25 to 45 Suezmax tankers, and 3 to 15 Aframax tankers are anticipated to arrive per year to deliver crude oil for the Project. The actual number of such vessels may vary depending on the type, origin of the crude, and the volume transported, and the carrier.

The number of product tankers and coke vessels per typical year will vary, depending on the composition of the crude oil and resulting products that are refined. However, on average, approximately 280 product tankers and 22 to 30 coke vessels are anticipated to transport finished products to markets each year.

The Project is expected to act cumulatively with existing Canaport operations. For LFA 36 lobster fisheries, the Project will have more vessels in Saint John Harbour.

An exclusion zone around the Canaport LNG jetty for safety purposes is expected to be established for operation, but has yet to be defined (the specific exclusion zone will be determined in consultation with the Saint John Port Authority, Atlantic Pilotage Authority, the Coast Guard, and Transport Canada). This has the potential to act cumulatively with the Project by the potential loss of access to additional lobster fishing areas. This exclusion is likely to include area that is a part of the Proponent's water lot only.

For Mispec-based fishermen, the Canaport LNG marine terminal may also affect the steaming distance required for the fishermen to reach lobster fishing areas to the west. It also has the potential to affect fishing effort as a result of an adverse environmental effect on steaming time relative to the available fishing time in a tidal cycle. It is important to note that the SBM and Canaport LNG terminal exclusion zones border one another in such a way that when both are in effect, fishing vessels cannot pass between them and must travel around the southern edge of the SBM safety exclusion zone. In this situation, there will be no cumulative environmental effect of the Project on fishing vessel steaming time because the Project's components do not represent additional obstacles along the path that fishing vessels must travel to go to fishing areas.

But with the Project and assuming possible vessel berthing overlap for either the SBM and the Canaport LNG terminal, there is the potential for a cumulative environmental effect on fishing vessel steaming distance and travel time, depending on the specific timing of vessel berthing at the SBM and the Canaport LNG terminal (*i.e.,* vessel at the Canaport LNG terminal and not the SBM, resulting in a cumulative environmental effect due to the Project's marine terminal).

Lobster fishermen from other ports do not routinely travel through the PDA to reach their fishing areas; thus, travel is not expected to be substantially affected due to Project-related marine infrastructure and safety exclusion zones. Commercial scallop fishing occurs very infrequently through the majority of the LAA, and it is a highly mobile fishery, with most fishing vessels covering a large area within the RAA each fishing season.

Elsewhere in LFA 36, there are other planned marine uses that have the potential to act cumulatively on Commercial Fisheries. Specifically, there are plans for expansion of salmon aquaculture in the Doctors Cove area in Charlotte County. The placement of aquaculture operations removes areas of sea bottom that were previously available for fishing, but these are well outside the LAA. There are also planned increases in ship traffic to the Port of Saint John as a result of additional cruise ship activity, the importation of petroleum coke to the Coleson Cove Generating Station, and gypsum and potash shipping. There is also expected to be a safety exclusion zone around LNG tankers while navigating the waters of the Bay of Fundy. This additional vessel traffic, particularly in and near the Port of Saint John, may further interfere with commercial fishing activities (Chapter 13).

Cumulative environmental effects for Change to Net Income of Local Commercial Fishermen centre on impediments to fishing vessel travel created by the installation and operation of Project-related marine infrastructure, including safety exclusions zones, as well as the associated demonstrated loss of available fishing area. The focus is on the local lobster fishery, as the LAA is home to an important local commercial lobster fishery during both spring and fall lobster seasons each year. Cumulative environmental effects to the scallop fishery as a result of the Project are not foreseen, as scallop fishing is not known to currently occur in the marine PDA, or the areas adjacent to it, including the Canaport LNG terminal. Scallop fishing vessels harvest throughout a large area within the Bay of Fundy and are highly mobile. Any area within the LAA that is occasionally fished for scallop would be a very small fraction of the Scallop RAA, SFA 28B.

With compensation for the Project for confirmed increased steaming time, it is predicted that there will be no residual cumulative environmental effects on Commercial Fisheries with respect to Change to Net Income of Local Commercial Fishermen due to confirmed increased steaming time for Mispec-based fishermen.

There are estimated to be residual cumulative environmental effects on net income associated with effects on the timing of fishing activities to maintain access to Mispec wharf. But the time required to travel the additional distance for each round trip from Mispec wharf to the western areas currently fished is small relative to the total available fishing time in a given high tide of approximately 6 h, or the approximately 18 h available when fishing between high tides (given that wharf access is possible up to three hours before and after a high tide). This residual cumulative environmental effect attributable to the Project, however, is only predicted to occur a small percentage of the time. Any confirmed change in steaming time relative to available fishing time in a tidal cycle does represent an additional inconvenience to local lobster fishermen, and can be expected to have an effect on their fishing patterns. But overall, the magnitude of the environmental effect is predicted to be low, occur relatively infrequently and be localized to the Mispec-based fishermen operating within the LAA (Table 11.6).

Cumulatively, the total area available for fishing that is effectively lost to local lobster fishermen due to existing Canaport terminal activities, the Project, and Canaport LNG terminal operation is estimated to be small relative to the total area of the LAA. The Project's primary contribution to this cumulative environmental effect is estimated to be very small (less than 1% of the area of the LAA), particularly with respect to the larger RAA (Figure 11.2).

A summary of residual cumulative environmental effects is provided in Table 11.6. The residual cumulative environmental effects of the Project on the net income of local commercial fishermen from Commercial Fisheries will be adverse, but their magnitude attributable to the Project is predicted to be low particularly in the context of the area that includes the licensed lobster fishing area LFA 36. The residual cumulative environmental effects of the Project will occur primarily during Construction and Operation.

11.5.2 Determination of Significance

With the proposed mitigation, including compensation for established Mispec-based fishermen that can confirm increased steaming time, the residual cumulative environmental effects of Change to Net Income of Local Commercial Fishermen on Commercial Fisheries of all past, present and reasonably foreseeable projects and activities that have been or will be carried out, in combination with the environmental effects of the Project, during Construction, Operation, and Decommissioning and Abandonment are rated not significant.

Similarly, with the proposed mitigation, including for established Mispec-based fishermen for confirmed increased steaming time, the Project contribution to cumulative environmental effects of Change to Net Income of Local Commercial Fishermen on Commercial Fisheries during Construction, Operation, and Decommissioning and Abandonment are rated not significant. There is a high level of confidence in the cumulative environmental effects and significance predictions because of the extent of the available information, confirmed through stakeholder engagement activities, and understanding of the key environmental effect mechanisms.

11.6 Follow-up and Monitoring

No follow-up or monitoring for the environmental effects of Change to Net Income of Local Commercial Fishermen is recommended.

12.0 CURRENT USE OF LAND AND RESOURCES FOR TRADITIONAL PURPOSES BY ABORIGINAL PERSONS

Aboriginal people have occupied and used the lands and some of the resources of New Brunswick for millennia, and documented use of the lands has been reported since before first European contact in the 16th Century (Jacques Whitford and ARC 2008). Recent legislation and Supreme Court decisions have recognized and protected the treaty rights of Aboriginal peoples in New Brunswick. The *Constitution Act, 1982* enshrines constitutional protection from Crown infringement of Aboriginal Rights. The Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons has been selected as a VEC in recognition of the unextinguished rights of Aboriginal peoples to use the land and resources for traditional purposes, and to assess the potential environmental effects of the Project on the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons as required by *CEAA*.

Although the lands between east Saint John and Mispec may have been used in past centuries by Aboriginal persons for traditional fishing, hunting, trapping, gathering, and subsistence purposes, as determined through a Current Use Study (Jacques Whitford and ARC 2008), there is no documented current use of land and resources for traditional purposes by Aboriginal persons on land in the Project Development Area (PDA) or in the area between the Project and east Saint John. However, the Current Use Study confirmed that there is a known Aboriginal fishery in the Bay of Fundy, and thus the potential for interactions between the Project and the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is evaluated further in this environmental effects analysis. These interactions may include the construction of marine infrastructure in the near shore area of the Marine PDA, including the jetty and barge landing facility, as well as from Project-related marine movements during Construction and Operation of the Project. These potential interactions of the Project with the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons may be of concern to Aboriginal communities in New Brunswick because, without appropriate mitigation, they could result in a loss of access to areas currently fished (if they currently fish near the Marine PDA) and accidental gear loss for Aboriginal fishermen.

Despite these potential interactions, the residual environmental effects of the Project on the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, including cumulative environmental effects, have been rated not significant. There are currently no documented Aboriginal fishing activities in the near shore environment where the marine-based components of the Project will be built, indicating that any potential loss of areas currently fished in the Marine PDA will not affect the current use of fisheries resources by Aboriginal fishermen. While there is the potential for residual environmental effects to the existing Aboriginal fishery in the Bay of Fundy due to Project-related vessel traffic, they will not be significant because there is no known Aboriginal fishery in the areas where marine-based construction and operation activity will occur, and because Project-related vessel traffic is small relative to the physical capacity of the established shipping lanes.

12.1 Scope of Assessment

This section defines the scope of the EA of Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, in consideration of the nature of the potential interactions and the issues and concerns raised by regulatory agencies, members and leaders of First Nations communities, stakeholders, and the general public with respect to the Project.

12.1.1 Regulatory Setting

The definition of environmental effect in *CEAA* includes "... *(b)(iii) the current use of lands and resources for traditional purposes by Aboriginal persons...*". The EA must therefore determine if the Project will affect such current use, and if so, the EA must also describe mitigation or accommodation (if appropriate) for these demonstrated adverse environmental effects. Unless explicitly required by the RAs, past use of land and resources is not a factor that requires consideration by proponents under *CEAA* and thus the focus of this EA is on the current use of land and resources for traditional purposes by Aboriginal persons.

12.1.2 Issues and Concerns Identified During Public, Stakeholder and Aboriginal Engagement

The Current Use of Land and Resources for Traditional Purposes by Aboriginal persons was raised by the public only as a general concern to be assessed in the CSR. Specifically, some members of the public highlighted the importance of initiating a dialogue with New Brunswick First Nations communities in respect of the Project, as well as with any other First Nations whose traditional territories could be affected (*e.g.,* the Passamaquoddy First Nation in Maine).

New Brunswick Aboriginal communities were engaged through individual meetings and discussions with First Nation leadership, community Open Houses, and interviews with key individuals, as well as through dialogue with Aboriginal umbrella organizations (Jacques Whitford and ARC 2008) (Chapter 4). A number of issues were raised by New Brunswick Aboriginal communities during these sessions, many of which have been addressed in the CSR. The potential presence or absence of Aboriginal archaeological sites, raised during Aboriginal engagement activities, has been investigated in the Current Use Study (Jacques Whitford and ARC 2008), and archaeological resources are addressed in Chapter 14. With the possible exception of the archaeological site BhDI-2, discussed in Chapter 14, the archaeological work conducted in support of this CSR did not reveal any known sites of potential importance to Aboriginal persons or the presence of ancient burial grounds. Any aboriginal archaeological sites that might exist in the LAA would, upon their discovery, be appropriately managed and environmental effects on them mitigated.

Another issue identified during the First Nations engagement process was the potential for the Project to interact with Aboriginal commercial and subsistence fishing activities, in particular the potential for loss of fishing gear and the perceived potential for changes in lobster quality and quantity. The potential environmental effects of the Project on Commercial Fisheries (which includes the Aboriginal fishery) have been assessed in Chapter 11. The potential for accidental commercial fishing gear loss has been assessed in Chapter 16.

Other issues raised during engagement sessions included the following.

- It was stressed that First Nations consultation may only occur between the First Nations leadership and the Crown. While the information sessions provided by the Proponent are helpful and appreciated, they were not characterized as consultation by the First Nations leadership.
- Aboriginal peoples assert that they have never relinquished their ownership of the land and resources, and claim unextinguished Aboriginal and treaty rights to land and natural resources,

including those associated with the Project. This view was represented by several First Nations community members, but should be considered within the legal framework of the Crown's duty to consult (and accommodate as required) as defined by legislation and as held by the Courts.

- First Nations leadership recommended that a protocol be established with respect to the management of any Aboriginal archaeological resources discovered during the Project.
- A series of commercial fisheries workshops should be undertaken with the affected First Nation representatives to discuss increased vessel traffic and any potential conflicts.

These issues and concerns have been addressed as applicable in the mitigation developed for the EA. It is anticipated that the Crown will evaluate the comments and claims made above in light of the findings of this CSR, and determine the appropriate level of consultation (and accommodation as appropriate) for each of the identified adverse environmental effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons.

12.1.3 Selection of Environmental Effect

Based on the regulatory requirements and the concerns raised by New Brunswick Aboriginal persons during engagement of First Nation communities, and in recognition of the Aboriginal and treaty rights of Aboriginal peoples, the environmental effect selected for this VEC is as follows:

- Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons.

An assessment of the change in current use of land and resources for traditional purposes by Aboriginal Persons is mandated under *CEAA*. The assessment and mitigation of changes to the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons as a result of the Project will assist in carrying out the Project in a manner that recognizes and respects Aboriginal and treaty rights of Aboriginal persons.

12.1.4 Selection of Measurable Parameters

Table 12.1 provides the measurable parameters that will be used for the assessment of the above-noted environmental effect, and the rationale for the selection of the measurable parameters.

Table 12.1 Measurable Parameters for Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Environmental Effect	Measurable Parameter	Rationale for Selection of the Measurable Parameter
Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons	Documented current use of land and resources for traditional purposes by Aboriginal persons	A key consideration in the assessment of environmental effects of the Project on this VEC is whether or not the land and resources are currently used by Aboriginal persons for traditional purposes, including fishing, hunting, trapping, gathering, cultural, spiritual, or ceremonial purposes. The focus is on current use, not past use.
	Presence or absence of Aboriginal archaeological resources	Indicator for the environmental effects on the access to and/or integrity of Aboriginal archaeological or heritage sites of importance. Mitigation is required only if a resource is known to be present.
	Change in available areas currently fished	Indicator for the environmental effects on both operating costs and revenues of Aboriginal fishermen. The placement of marine infrastructure and safety exclusion zones may change the availability of areas currently fished, potentially affecting catch or operating costs for Aboriginal fishermen if they fish in the immediate vicinity of the marine-based components of the Project.

12.1.5 Temporal Boundaries

The temporal boundaries of the assessment of the environmental effects of the Project on the Current Use of Land and Resources for Traditional Purposes by Aboriginal persons include the Construction, Operation, and Decommissioning and Abandonment of the Project.

The temporal boundaries for the establishment of existing (baseline) conditions for the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons were for the period of 2007-2009, during which First Nations engagement and the Current Use Study were carried out through research, engagement of, and dialogue with First Nations community members, leadership, and Elders. However, it is understood that dialogue may have considered a broader temporal range considering current use to be in the recent or living memory of the engaged persons.

12.1.6 Spatial Boundaries

The spatial boundaries for the environmental assessment of Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons are:

- The Project Development Area (PDA);
- A Local Assessment Area (LAA); and
- A Regional Assessment Area (RAA).

These areas are shown in Figure 12.1.

12.1.7 Administrative and Technical Boundaries

All Aboriginal and treaty rights to land and resources held by New Brunswick's First Nation peoples are protected by Section 35(1) of the *Constitution Act, 1982*. The Government of Canada has a fiduciary responsibility in respect of Aboriginal rights and interests pursuant to the *Constitution Act*, *1982* and a duty to consult with potentially affected First Nations leadership in respect of decisions to be made by the Crown that might affect Aboriginal or treaty rights, including the current use of land and resources for traditional purposes by Aboriginal persons.

Courts in Canada have held that the actions of the Crown, including those that affect third parties, that are inconsistent with First Nation rights are invalid unless they can be justified according to the test established by the Supreme Court of Canada in *R. v. Sparrow*. In this landmark case, the Court held that Aboriginal rights that had not been extinguished prior to 1982, such as fishing, are protected under the *Constitution Act, 1982* and cannot be infringed upon without justification by the Crown.

Further to the *R. v. Sparrow* decision, the decision of the Supreme Court of Canada in *R. v. Marshall* recognized treaties signed in 1760 and 1761 by Mi'kmaq and Maliseet communities, granting them the right to fish, hunt, and gather in pursuit of a moderate livelihood.

Aboriginal peoples in New Brunswick thus have constitutionally-affirmed and protected Aboriginal and treaty rights to use land and resources within their historical territories to fish, hunt, and gather. The Maliseet and Mi'kmaq groups consider the entire province of New Brunswick, as well as the Bay of Fundy, as their historical territories.

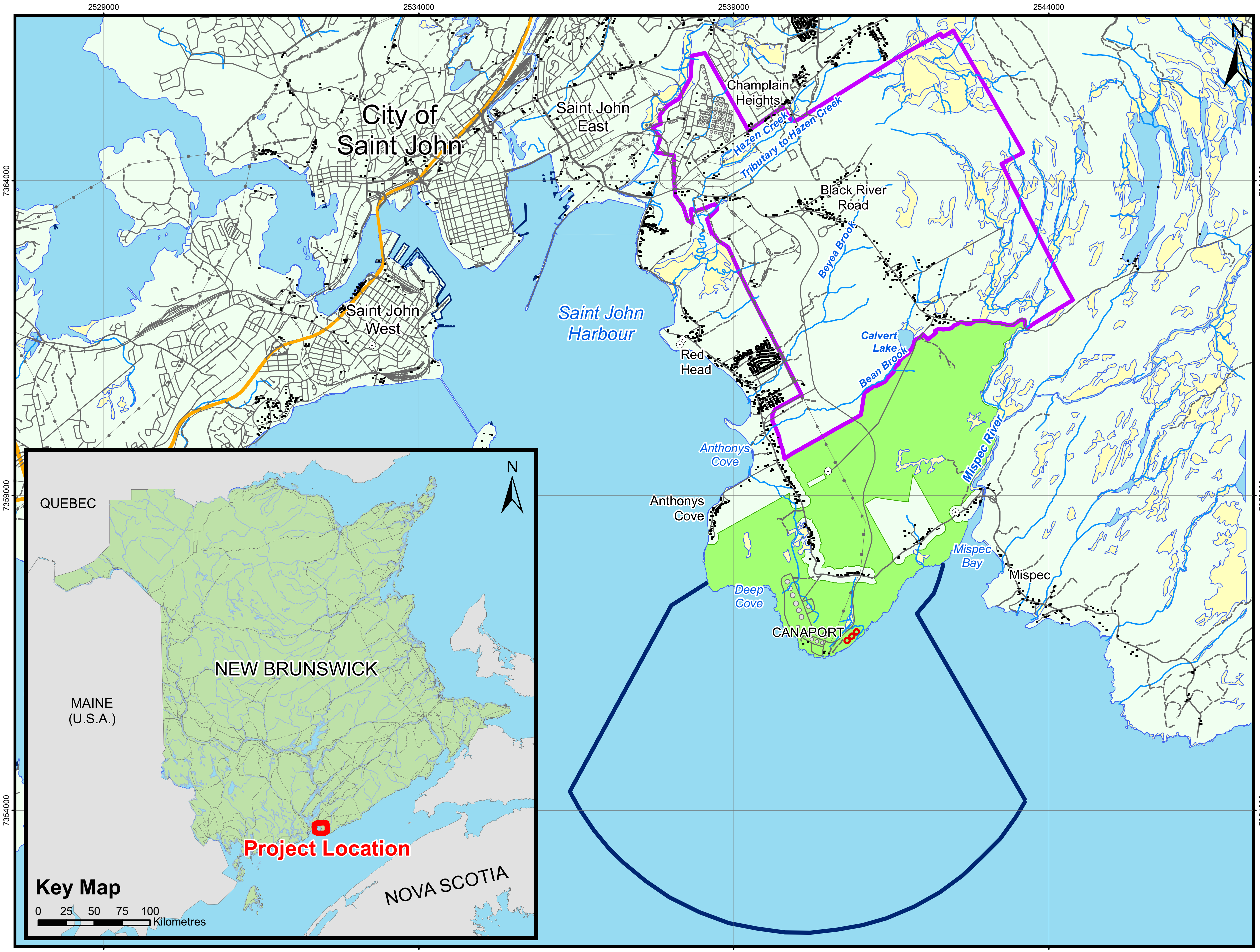


Figure 12.1 Assessment Area for the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Project Eider Rock

Map Features

- Tank
- LNG Tank
- Building
- Tower
- Major Road
- Secondary Road
- Local Road
- Track
- Rail Line
- Wharf
- Utility Line
- Watercourse
- Waterbody
- Wetland (NB DNR)
- Project Development Area (Marine Terminal Facilities and Infrastructure)
- Linear Facilities Corridors Assessment Area (Approx. 2303 ha)
- Project Development Area (Refinery Facilities and Infrastructure Approx. 1132 ha)

Data Source: Service New Brunswick, NB DNR, ESRI

0 0.5 1 2 3
Kilometres

Map Parameters
Projection: NB Stereographic
Scale: 1:60,000
Date: August 8, 2008
Project No.: 1013263.

Jacques Whitford

There is a known Aboriginal fishery in the Bay of Fundy. Several First Nations communities have commercial fishing licenses issued by DFO and fish in the lobster fishing areas of the Bay of Fundy. In these fishery activities, Aboriginal commercial fishers are subject to the same rules and legislation as non-Aboriginal people (Chapter 11).

Formal consultation with First Nations is to be conducted by the federal Crown at some time during the conduct of an EA, as upheld by various Supreme Court of Canada decisions. Some recent Supreme Court decisions that affirm these requirements include *Taku River Tlingit First Nation v. British Columbia (Project Assessment Director)*, *Haida Nation v. British Columbia (Minister of Forests)*, and *Mikisew Cree First Nation v. Canada (Minister of Canadian Heritage)*, to name a few. In these cases, the Supreme Court held that the Crown has a legal duty to consult and, where appropriate, to accommodate affected First Nation communities in respect of decision making that may affect Aboriginal and treaty rights.

Based on the Supreme Court decisions, and in compliance with the requirements of *CEAA*, the EA must provide the Crown with available and appropriate information to decide whether Project-related activities will infringe upon these Aboriginal and treaty rights by causing a change in the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons. The Crown will then decide whether its duty to consult, and possibly to accommodate, has been met or if further actions are necessary.

Technical boundaries relating to the assessment of Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons include the lack of a defined body of knowledge into what lands and resources are currently being used by Aboriginal persons and communities for traditional purposes. Since this knowledge is obtained largely through engagement of, and discussion with, Aboriginal persons through engagement activities (*e.g.,* open houses) or through interviews with Aboriginal leaders and elders, the word of mouth nature of the information obtained to document the current use of land and resources for traditional purposes by Aboriginal persons presents a technical limitation to the collection of comprehensive and accurate information. The collection of such traditional knowledge has the technical limitation of, in some instances, not knowing the extent to which information provided by engaged Aboriginal persons relates to current versus past use.

Further administrative and technical boundaries for commercial fishing in the Bay of Fundy are described in Chapter 11. Administrative and technical boundaries relating to Aboriginal archaeological resources are described in Chapter 14.

12.1.8 Residual Environmental Effects Rating Criteria

A significant adverse residual environmental effect on the Current Use of Land and Resources for Traditional Purposes by Aboriginal persons is defined as a long-term (more than 1 year), non-compensated loss of the availability or access to land and resources that are currently used by Aboriginal persons for traditional purposes, such that these lands and resources cannot continue to be used by Aboriginal persons at current levels within the PDA.

12.2 Existing Conditions

In addition to the general historical setting described in Chapter 6, existing conditions for the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons were established in the period of mid-2007 to early 2009 through research and engagement of the Aboriginal communities and their leadership, as documented in a Current Use Study (Jacques Whitford and ARC 2008) conducted jointly by Jacques Whitford and Aboriginal Resource Consultants (ARC). ARC is a New Brunswick based and Maliseet-owned corporate Aboriginal relations consulting firm that specializes in Aboriginal relations and engagement in the Maritime Provinces. The Current Use Study was intended to describe current land and resource use for traditional purposes by Aboriginal Persons within the area surrounding the Project, as well as to document and report on Aboriginal engagement activities conducted in respect of the Project.

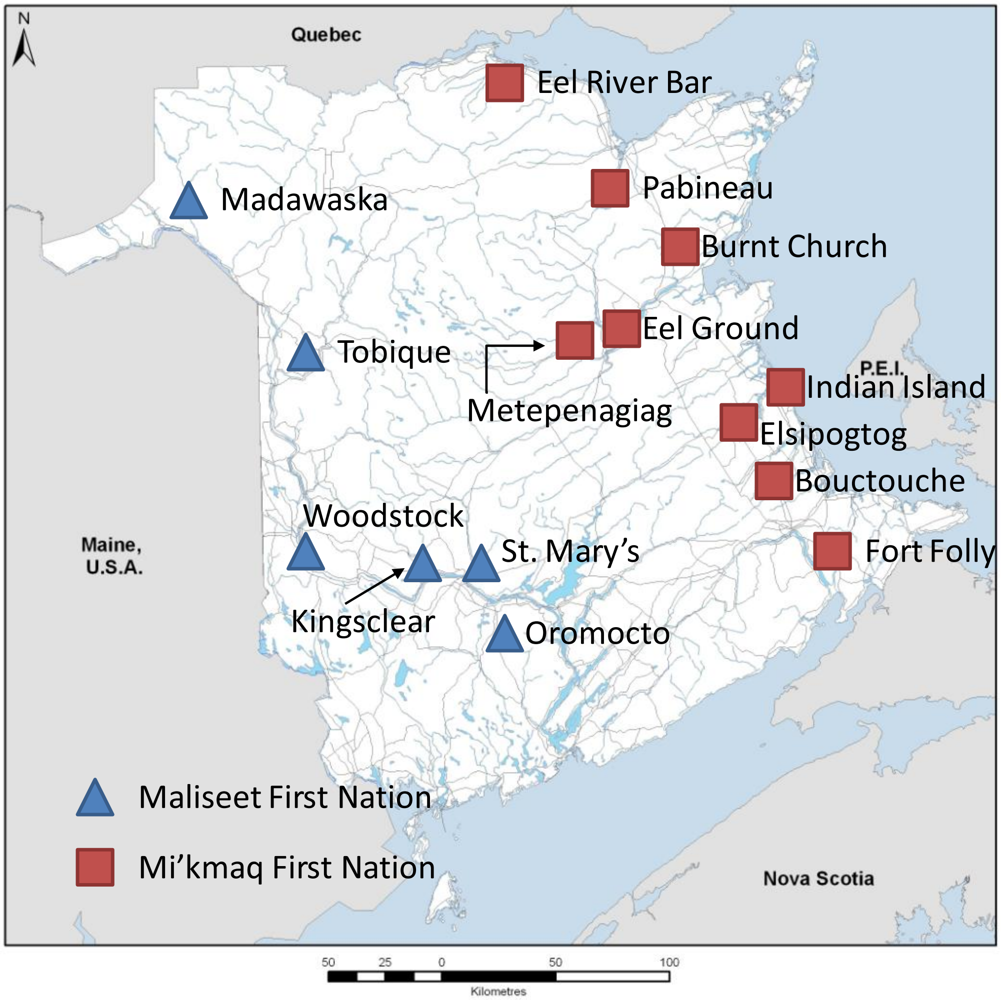
As shown in Figure 12.2, there are 15 First Nations communities in the province of New Brunswick, consisting of 9 Mi'kmaq Nation communities and 6 Maliseet Nation communities. Mi'kmaq communities are predominantly located along the eastern coastal regions of the Province, while the Maliseet populations are located along the Saint John River valley from Edmundston to Oromocto (ARC 2007). Additionally, although located in Maine, the Passamaquoddy First Nation generally considers New Brunswick to be part of its traditional territory.

As of December 2007, the total First Nations population (on-reserve) in New Brunswick was 8,326 (INAC 2008). The 2006 Census reported a total declared Aboriginal population (on- and off-reserve, but excluding Métis and Inuit) of New Brunswick at 12,385 (Statistics Canada 2008b). The populations of each New Brunswick First Nation as of December 31, 2007 are summarized in Table 12.2 (INAC 2008).

Table 12.2 Population of New Brunswick Mi'kmaq and Maliseet First Nations, 2007 (On-Reserve Only)

First Nation	Population (2007)
Mi'kmaq First Nations	
Elsipogtog (Big Cove) First Nation	2,215
Esgenoopetitj (Burnt Church) First Nation	1,167
Eel Ground First Nation	527
Metepenagiag (Red Bank) First Nation	410
Eel River Bar First Nation	326
Pabineau First Nation	99
Indian Island First Nation	88
Buctouche First Nation	72
Fort Folly First Nation	27
Sub-total	4,931
Maliseet First Nations	
Tobique First Nation	1,373
Saint Mary's First Nation	734
Kingsclear First Nation	627
Woodstock First Nation	282
Oromocto First Nation	259
Madawaska First Nation	120
Sub-total	3,395

Source: INAC (2008)



Source: Jacques Whitford and ARC (2008)

Figure 12.2 Location of New Brunswick First Nations Communities

The closest First Nation community to the Project area is the Oromocto First Nation, located approximately 80 km to the north of the Project location. The Brothers Island Indian Reserve, consisting of two islands of importance to New Brunswick First Nations as a traditional gathering place, is located in the Kennebecasis River, approximately 4 km north of the City of Saint John.

Archaeological records confirm that there were Aboriginal campsites in New Brunswick dating back approximately 11,000 years. The Metepenagiag area (near Miramichi) is thought to have been continuously inhabited by Aboriginal persons for over 3,000 years (Jacques Whitford and ARC 2008). Starting in the late 1600s and well into the early 1700s, a series of peace and friendship treaties were signed between the English and various Aboriginal peoples of the northeastern parts of North America. These treaties provided Aboriginal peoples with rights to fish, hunt, and gather for trade or personal use on their traditional lands. Despite the fact that there are currently no First Nations communities located in the vicinity of the Project, the entire province of New Brunswick is claimed to be a traditional territory of the Mi'kmaq and Maliseet peoples. Therefore Aboriginal persons assert a constitutional right to access Crown land and resources to fish, hunt, and gather and are not to have those treaty rights infringed upon without reasonable accommodation.

The land in the vicinity of the Project consist of privately-owned land held in fee simple by the Proponent or other private owners and does not encompass any federal or provincial Crown land.

As determined from a Current Use Study conducted specifically for the EA of the Project, there is currently no known fishing, hunting, or gathering for trade of personal use by Aboriginal persons in the vicinity of the Project (Jacques Whitford and ARC 2008). This may be due to several factors, including the generally unfavourable topography of the area, the lack of navigable watercourses, and the proximity to the city centre of Saint John. Similarly, there is no known current use of forestry resources by Aboriginal communities within the vicinity of the Project, and forestry activities were not mentioned as a matter of concern to First Nations leadership or participants at any of the engagement meetings, community Open Houses, or interviews conducted as part of the Current Use Study. Although there was general reference made to Aboriginal sweet grass gathering at Peck Point and Peck Beach during the engagement sessions, these areas are located in Rockport, near Cape Maringouin, well over 100 km from the Project (Rayburn 1975).

The closest known social, ceremonial, or spiritual site of importance to Aboriginal peoples is The Brothers 18, a First Nations reserve located on Goat and Indian Islands in the Kennebecasis River north of the City of Saint John, several kilometres outside the LAA. The environmental effects of the Project on this site due to emissions are considered in Chapter 7. Though no important sites are known to exist within the LAA, it was noted during some of the Aboriginal engagement activities that the Saint John area in general was a traditional gathering point for Historic period meetings with the Wabanaki and later with the British.

During archaeological field surveys conducted by Jacques Whitford in 2006 (Chapter 14), 12 pieces of lithic debitage were found at a terrace above the cobble beach near Mispec Bay, located in the PDA. This discovery of stone flakes likely indicates that the site was used at some point in the distant past by one or more Aboriginal persons. Although it is not likely that burial grounds exist at this location (Jacques Whitford and ARC 2008), in recognition of the importance of such sites to First Nations communities in New Brunswick, a further assessment and mitigation procedures (to involve Aboriginal participation) have been developed for this site and are described in Chapter 14.

A review of available information, including reports from DFO and information gathered through Aboriginal engagement activities, confirms that although First Nations currently carry out commercial fishing activities within the Bay of Fundy under license from DFO, there are no known occurrences of Aboriginal fishermen currently fishing in or near the PDA.

The targeted species for the Aboriginal commercial fishery in the Bay of Fundy are largely focused on lobster but also include scallops, sea urchin, tuna, swordfish, rock crab, Jonah crab, and assorted fin fish. At present, DFO has issued commercial fishing licenses to the Kingsclear, Oromocto, Woodstock, St. Mary's, and Tobique First Nations. Jacques Whitford (2004) indicated that the majority of these First Nations are based out of ports at Chance Harbour, Dipper Harbour, and Lepreau. This does not mean that they are restricted from fishing in the Mispec Point area, but rather it is reflective of a longer transit from their home port to go fishing there (Jacques Whitford 2004).

The Current Use Study also indicated that there may be other Aboriginal people fishing in the Bay of Fundy for subsistence purposes (Jacques Whitford and ARC 2008). It was mentioned generally by the New Brunswick Aboriginal Peoples' Council representing Aboriginal persons living off-reserve in New Brunswick that Aboriginal persons living outside of First Nations communities also have fishing rights and may be fishing in the Bay of Fundy. However, the Study Team could not obtain any specific confirmation from interviews conducted that such activities were indeed occurring in the PDA.

Further information on commercial fishing activities in general, including Aboriginal and non-Aboriginal commercial fisheries, is found in Chapter 11.

12.3 Potential Project-VEC Interactions

The potential interactions between Project-related activities during each phase of the Project and potential environmental effects to Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, based on the results of the Current Use Study and as documented from information and interviews obtained during First Nations engagement activities, are shown in Table 12.3.

Table 12.3 Potential Project Environmental Effects to Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Project Activities and Physical Works	Potential Environmental Effects
	Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons
MARINE TERMINAL AND OTHER MARINE-BASED INFRASTRUCTURE	
Construction	
Construction and Installation of Jetty and Other Marine-Based Infrastructure	1
Marine Vessel Berthing and Deberthing	1
Operation	
Marine Vessel Berthing and Deberthing	2
Crude Oil and Finished Product Transfer	0
Wastewater, Cooling Water, and Storm Water Release	0
Decommissioning and Abandonment	
Removal of Facilities and Site Reclamation	1

Project-Related Environmental Effects

Notes: Project-Related Environmental Effects were ranked as follows:

0 No interaction or no substantive interaction contemplated.

1 Interaction will occur. However, based on past experience and professional judgment, the interaction would not result in a significant environmental effect, even without mitigation, or the interaction would clearly not be significant due to application of codified practices.

2 Interaction may, even with codified mitigation, result in a potentially significant environmental effect and/or is important to regulatory and/or public interest. Potential environmental effects are considered further and in more detail in the CSR.

As documented in the Current Use Study (Jacques Whitford and ARC 2008), there is no known current use of land and resources for traditional purposes by Aboriginal persons on land in the vicinity of the Project, and therefore land-based Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is not assessed further in this CSR.

During Construction and Operation of the Marine Terminal and Other Marine-Based Infrastructure, Project activities may interact with the current use of marine resources by Aboriginal persons. However, only the movement of vessels is considered further in this CSR. While the marine terminal will be constructed and operated in an area that could potentially be used for current use, there is no known or documented Aboriginal fishery activity in that area either for commercial or subsistence purposes, as documented in the Current Use Study (Jacques Whitford and ARC 2008). The Marine PDA is far removed from the home ports for current Aboriginal fishermen. Thus, the potential environmental effects of the Construction and Decommissioning and Abandonment of the Marine Terminal and Other Marine-Based Infrastructure on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, including cumulative environmental effects, are rated not significant and are not considered further in the assessment. There is a high level of confidence in the significance prediction.

The only substantive interaction would be due to vessel traffic in the shipping lanes during Operation, primarily further out into the Bay of Fundy. These interactions are ranked as 2 and are considered further in the assessment.

12.4 Environmental Effects Assessment

Residual environmental effects of the Marine Terminal and Other Marine-Based Infrastructure on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons are summarized in Table 12.4.

Table 12.4 Summary of Residual Environmental Effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Potential Residual Environmental Effects	Proposed Mitigation/Compensation Measures	Residual Environmental Effects Characteristics						Significance	Prediction Confidence	Likelihood	Cumulative Environmental Effects?	Recommended Follow-up and Monitoring
		Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/ Socio-economic Context					
Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons												
Operation	▪ Use of established shipping lanes and anchorages in compliance with all applicable legislation, codes and standards of practice for shipping ▪ Establishment of practices and procedures with respect to marine terminal operations	A	M	R	LT/ R	R	D	N	H	L	Y	None.
Residual Environmental Effects for all Phases								N	H	L	Y	

KEY

Direction:
P Positive
A Adverse

Magnitude:
L Low: No net loss of current use of land and resources for traditional purposes by Aboriginal persons.
M Moderate: A nominal loss, or a substantive loss that is compensated, in the availability or access to land and/or resources currently used for traditional purposes by Aboriginal persons.
H High: A non-compensated substantive and permanent loss in the availability or access to land and/or resources currently used for traditional purposes by Aboriginal persons.

Geographic Extent:
S Site-specific: Within the PDA
L Local: Within the LAA
R Regional: Within the RAA

Duration:
ST Short term: < 1 year
LT Long term: > 1 year
P Permanent

Frequency:
O Occurs once.
S Occurs sporadically at irregular intervals.
R Occurs on a regular basis and at regular intervals.
C Continuous.

Reversibility:
R Reversible
I Irreversible

Ecological/ Socio-economic Context:
U Undisturbed: Area relatively or not adversely affected by human activity.
D Developed: Area has been substantially previously disturbed by human development or human development is still present.
N/A Not Applicable

Significance:
S Significant
N Not Significant

Prediction Confidence:
Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation
L Low level of confidence
M Moderate level of confidence
H High level of confidence

Likelihood:
Based on professional judgment
L Low probability of occurrence
M Medium probability of occurrence
H High probability of occurrence

Cumulative Environmental Effects?
Y Potential for environmental effect to interact with other past, present or foreseeable projects or activities in RAA.
N Environmental effect will not or is not likely to interact with other past, present or foreseeable projects or activities in RAA.

12.4.1 Assessment of Project-Related Environmental Effects

As there are no known or documented occurrences of any Aboriginal fishing activity (for commercial or subsistence purposes) in the immediate vicinity of the Project where the Marine Terminal and other Marine-Based Infrastructure will be located, the only Project-related activity that has the potential to result in an adverse residual environmental effect on the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is from Project-related vessel traffic in the Bay of Fundy shipping lanes during the Operation phase of the Project. It is expected that once the Project is operational, approximately 30 to 35 VLCC crude tankers, 25 to 45 Suezmax tankers, and 3 to 15 Aframax tankers will arrive per year to deliver crude oil for the Project. Approximately 280 product tankers and 22 to 30 coke vessels are also expected to transport finished products to markets each year. These vessels, in addition to the tug boats and pilot ships required to ensure their safe navigation, will increase vessel traffic in the shipping lanes and anchorage areas of the Bay of Fundy and in the near shore area of the PDA (Chapter 13).

Fishermen typically avoid fishing in and around the shipping lanes and areas of high vessel traffic in an effort to avoid interactions with larger vessels and to avoid the potential for demonstrated accidental gear loss as a result of other vessels potentially navigating over marker buoys. Traps set too close to the shipping lanes may be lost if a larger vessel goes off course (an unplanned event) and ends up outside the shipping lane.

Although not significant, increased marine vessel traffic will have a long-term adverse environmental effect on the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, as the period of greatest vessel activity will be throughout Operation. It is not known precisely where Aboriginal fishermen are currently fishing within the Bay of Fundy, and fishermen frequently change their areas currently fished based on a number of variable conditions (*e.g.* stock status, vessel traffic, weather conditions). General reference to commercial fishing licenses held by First Nations individuals from several communities was made during the engagement activities and interviews conducted as part of the Current Use Study, but none of these discussions identified any specific instances of documented Aboriginal commercial or subsistence fishery in the Marine PDA or in the vicinity of the Project. In general, the environmental effect may be felt by Aboriginal fishers, as with other commercial fishers, in the Bay of Fundy, but by and large only the fishermen that currently fish in or near the Mispec Bay area would be most affected; other commercial and Aboriginal fishermen that fish in other parts of the Bay of Fundy would be largely unaffected. As was concluded in Chapter 11, though, other than in the vicinity of Mispec Point (where there is no known Aboriginal fishing activity), there will be no substantive loss of access to or availability of areas currently fished in the Bay of Fundy as a result of the Project. In the unlikely event that a loss of an area currently fished were to occur due to increased vessel movement, the total area lost would be very small relative to the total areas available for fishing in the Bay of Fundy. The increased vessel activity is expected to be well within the physical capacity of the existing shipping lanes, and is expected to be safely and effectively managed by the practices and procedures of MCTS and the Saint John Port Authority (Chapter 13). As a result, Project-related vessel activity will not adversely affect the commercial or Aboriginal fishery in the Bay of Fundy, as concluded in Chapter 11. Importantly, vessel traffic will be within established shipping lanes that are already avoided for fishing activity.

Mitigation procedures to address any adverse environmental effects that could be caused by increased vessel activity in the Bay of Fundy include:

- Use of established shipping lanes and anchorages, and the following of all applicable shipping legislation, practices and codes.

12.4.1.1 Determination of Significance

The residual environmental effects of the Project on the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons will occur only during Operation of marine-based activities associated with the Project. Although these residual environmental effects are considered to be adverse as there may be some nominal loss of available areas where fishing could be practised (*i.e.,* in the Marine PDA), there is no documented Aboriginal fishing activity in the areas that will be directly affected by the Construction or Operation of the marine terminal. Increased traffic in the Bay of Fundy during Operation is not expected to affect commercial fishing as traffic is expected to be limited to the shipping lanes (where little fishing occurs) and the traffic will be well within the physical capacity of the shipping lanes.

With the proposed mitigation, the potential environmental effects of a change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons during all phases of the Project are rated not significant. There is a high level of confidence in these predictions because of the extent of the available information, confirmed through Aboriginal community engagement, and understanding of the key environmental effects mechanisms.

12.5 Assessment of Cumulative Environmental Effects

Residual cumulative environmental effects of past, current and planned future projects and activities that have been or will be carried out on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons are summarized in Table 12.5.

Table 12.5 Potential Cumulative Environmental Effects to Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Other Projects and Activities With Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons
MARINE TERMINAL AND OTHER MARINE-BASED INFRASTRUCTURE	
Project Eider Rock (Land-Based Components)	0
Industrial Land Use	0
Planned or Future Industrial/Energy Projects	0
Infrastructure Land Use	0
Marine Use	1

Cumulative Environmental Effects

Notes: Cumulative environmental effects were ranked as follows:

0 Project environmental effects do not act cumulatively with those of other projects and activities.

1 Project environmental effects act cumulatively with those of other project and activities, but are unlikely to result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects but will not measurably change the state of the VEC.

2 Project environmental effects act cumulatively with those of other projects and activities, and may result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC.

For the purpose of cumulative environmental effects assessment on the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, all projects or activities within the RAA were considered including those with potential to, in combination with the Project, result in a loss of available areas where fishing currently occurs. The key environmental effects of concern in respect of the Project are discussed in Section 12.4.1. Potential cumulative environmental effects on the fisheries resource through potential direct harm to commercial fish species or their habitat were assessed in Chapter 10 and were rated not significant. The potential cumulative environmental effects on Aboriginal fisheries that could result in demonstrated accidental commercial fishing gear loss are addressed, along with those that may affect other commercial fishermen, in Chapter 16.

There are no significant land-based Project-related environmental effects on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons. As such, other projects and activities noted in Table 12.5 including Industrial Land Use, and Planned Future Industrial and Energy Projects, and Infrastructure Land Use will not have any direct or indirect overlapping environmental effects with those of the Project on the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons and therefore are rated not significant.

Marine use, particularly the operation of the Canaport LNG project, has the potential to interact cumulatively with the Project due to the vessel traffic associated with the LNG facility which could affect Aboriginal fishing activities (*e.g.,* from exclusion zones or from confirmed damage to fishing gear). However, as noted previously, other than in the vicinity of Mispec Point (where there is no known Aboriginal fishing activity), there will be no substantive loss of access to or availability of access to areas currently fished in the Bay of Fundy as a result of the Project, and as such there is no substantive overlap with Marine Use including the vessel traffic associated with the Canaport LNG project. The cumulative environmental effects of the Project with other projects and activities in terms of increased vessel activity are expected to be well within the physical capacity of the existing shipping lanes and will not adversely affect the commercial fishery in the Bay of Fundy, either alone or cumulatively (Chapter 11). The same mitigation applied in Section 12.4.1 will minimize cumulative environmental effects to Aboriginal commercial fishing activity and the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons.

12.5.1 Determination of Significance

Given the proposed mitigation for addressing the potential environmental effects of increased vessel traffic on available areas currently fished, and that the residual environmental effects of increased vessel traffic from the Project were rated not significant, the cumulative environmental effects of the Project in combination with other projects and activities that have been or will be carried out, on the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons during all phases of the Project are also rated not significant. There is a high level of confidence in these predictions.

12.6 Follow-Up and Monitoring

No follow-up or monitoring for the environmental effects of Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is recommended.

13.0 MARINE SAFETY

Marine Safety has been selected as a VEC in consideration of the Project-related vessel movements in Saint John Harbour for berthing and deberthing activities, and because of Project-related infrastructure to be constructed in the marine environment where berthing and deberthing activities will take place. The Project will result in vessel movements near the marine terminal as a result of deliveries of pre-fabricated units and construction materials during Construction of the Development Proposal, as well as for the receipt of crude oil and shipping of finished products during Operation of the Development Proposal. Fishing vessels, cruise ships, a commercial ferry, existing tankers, and cargo and container vessels currently operate in the marine waters of the Bay of Fundy, and their effective and safe operation is essential to the economic success of the individuals and industries in the Saint John region.

Project-related vessel movements are expected to increase shipping activity in Saint John Harbour and the Marine Project Development Area (PDA), particularly during Operation. The increased vessel traffic within the jurisdiction of the Saint John Port Authority will result in increased economic activity for the Port in addition to added demand on Port resources, such as tug boats, Harbour Pilots, and anchorage areas.

While there is the potential for these interactions to result in residual environmental effects to Marine Safety as a result of increased vessel movements, they will be safely and effectively accommodated for Project-related vessel traffic by the use of existing or additional resources (Pilots, tugs, and anchorages) and adapting practices and procedures where required. With proposed mitigation and adaptation by the authorities responsible for vessel traffic management in the Port, the residual environmental effects of the Project on Marine Safety are rated not significant and will be balanced by increased economic opportunities for the Port of Saint John.

13.1 Scope of Assessment

This section defines the scope of the CSR of Marine Safety in consideration of the nature of the potential interactions and the issues and concerns raised by regulatory agencies, stakeholders, and the general public in respect to the Project.

13.1.1 Regulatory Setting

The movement of vessels in Canadian waters is governed by the *Canada Shipping Act, 2001* and Regulations and the *Canada Marine Act*, which are administered by Transport Canada, and the *Oceans Act* administered by the Department of Fisheries and Oceans Canada. The construction and operation of the marine terminal is subject to the *Navigable Waters Protection Act* (*NWPA*) due to its potential environmental effects on navigation in the marine PDA. Approvals under *NWPA* trigger the need for an EA under *CEAA*. However, environmental effects of the Project on navigation are taken into consideration as part of the EIA only when the environmental effects are indirect (*i.e.,* resulting from a change in the environment affecting navigation). Direct environmental effects on navigation are not considered in the EA under *CEAA*; any measures to mitigate direct environmental effects are considered as possible conditions of the *NWPA* approval that will need to be obtained.

The federal EA Track Report and Scoping Document require that the management of vessel traffic in the Bay of Fundy be described, ant that the environmental effects of increased vessel movements as a result of the Project be assesed. The scope of factors to be considered in the EA Track Report and Scoping Document for the EA under *CEAA* include the docking (berthing) and deberthing of vessels, but do not include shipping activities. Shipping activities will be addressed as part of a TERMPOL review process to be conducted by the Proponent under guidance of Transport Canada Marine Safety.

> Approvals under Sections 5(1)(a), 6(4), 16, and 20 of the *Navigable Waters Protection Act* (*NWPA*) trigger the need for an environmental assessment to be conducted under *CEAA*. However, environmental effects of the Project on navigation have been taken into consideration as part of the CSR only when the environmental effects are indirect, *i.e.,* resulting from a change in the environment affecting navigation. Direct environmental effects on navigation are not considered in the CSR; however, mitigation will be considered as part of the permitting process through the *NWPA* approval process as well as via a TERMPOL review process. Accordingly,
>
> ☑ Only direct environmental effects were identified; therefore the environmental effects of the Project on navigation are not addressed in this environmental assessment; or
>
> ~~☐ Indirect environmental effects were identified and have been addressed in this environmental assessment.~~

The Proponent has committed to completing a TERMPOL review process (2001 edition) for the Project at the appropriate time, when sufficient design information is available. TERMPOL is a voluntary process managed by Transport Canada to evaluate operational ship safety, route safety, and management and environmental concerns associated with the location, construction and operation of a marine terminal handling bulk petroleum products and other navigation concerns. The federal EA Track Report recognizes the commitment by the Proponent that a TERMPOL review will be completed. Many aspects of this CSR will ultimately satisfy or complement the requirements of the TERMPOL review process (*e.g.,* evaluation of potential environmental effects on the fishery and navigation as well as oil spill risk management). Further details on the TERMPOL review process can be found at http://www.tc.gc.ca/marinesafety/tp/tp743/menu.htm (Transport Canada 2001).

The environmental effects of accidents, malfunctions, and unplanned events related to Marine Safety is included in Section 16.3 of this CSR.

13.1.2 Issues and Concerns Identified During Public and Stakeholder Engagement

Concerns about increased shipping activity in the Saint John Harbour, and particularly the perceived increased risk of accidents and spills that could result from such increased shipping, were raised by members of the public and stakeholders during public engagement activities conducted as part of the EA of the Project. ENGOs, the Fundy North Fishermen's Association (FNFA), and members of the public highlighted the need for proper management of Project-related vessel traffic in the Harbour to minimize disruption to current Port operations and potential accidents that could lead to adverse environmental effects on marine mammals, the commercial fishery, and the marine environment in general.

Engagement of the public, stakeholders, and several key experts and regulatory agencies was undertaken. Meetings were held with the Saint John Port Authority, the Atlantic Pilotage Authority, local commercial fishers (Chapter 11), the FNFA, Transport Canada, and the Canadian Coast Guard's

Marine Communications and Traffic Services (MCTS) centre. These engagement activities highlighted potential issues and opportunities that assisted the Study Team in confirming its understanding of navigational practices and standard operating procedures within the Bay and Saint John Harbour. Table 13.1 contains a summary of comments received on Marine Safety during public and stakeholder engagement, as well as the influence of those comments on the CSR. Common issues raised by stakeholders included the potential for increased demand for anchorage areas, Harbour Pilots, and tugs, and potential need for changes to traditional traveling routes that may result from an increase in vessel traffic in the Harbour.

Table 13.1 Summary of Comments Received through Engagement Activities

Comment	Influence on the Assessment
With increased levels of vessel traffic in the Harbour, the current anchorage areas may not be sufficient.	The use of anchorage areas was selected as a measurable parameter.
Dredging of the inner Harbour and channels is integral to Port operations.	Dredging in the Harbour is discussed in Sections 13.2 and 13.4.
Extra traffic could place extra demand on the Saint John Harbour Pilots. Between two and two and a half years are required to train a Pilot.	The number of vessels movements per year requiring a Harbour Pilot was selected as a measurable parameter.
Vessels in and around the marine PDA can damage lobster fishing gear.	This issue has been discussed in Chapter 11 and assessed in Chapter 16.
The tide limits the movement of many large vessels to a window of opportunity around each high tide. With increased traffic, this tidal limitation may increase the amount of time vessels must wait in anchor.	The use of anchorage areas was selected as a measurable parameter.

A summary of public, stakeholder, and First Nations engagement for the Project was provided in Chapter 4, which provided details on the comments received at open houses, workshops, and meetings.

13.1.3 Selection of Environmental Effect

Based on the regulatory requirements and the issues raised by the public and key stakeholders, the environmental effect selected for the assessment of Marine Safety is:

- Change in Marine Safety.

The assessment of a Change in Marine Safety will be focused on berthing and deberthing activities associated with the Project, but does not include shipping (which will be addressed via a TERMPOL review process to be conducted at an appropriate time, when sufficient design information is available).

The Project-related vessel traffic will also put greater demand on pilotage services, anchorage areas, and tug boat services, and increased usage of the shipping lanes in the Bay of Fundy. This could lead to environmental effects on vessels currently operating in the Bay of Fundy and Saint John Harbour if the regulatory authorities responsible for navigation were unable to safely and effectively manage the increased traffic.

13.1.4 Selection of Measurable Parameters

Table 13.2 provides the measurable parameters that will be used for the environmental effects assessment, and the rationale for the selection of the measurable parameters.

Table 13.2 Measurable Parameters for Marine Safety

Environmental Effect	Measurable Parameter	Rationale for Selection of the Measurable Parameter
Change in Marine Safety	Number of vessel movements per year requiring a Saint John Harbour Pilot	Vessels subject to compulsory pilotage require a Harbour Pilot to move within the Saint John Harbour. The availability of Pilots and can therefore be a limiting factor to vessel movement.
	Number of vessel movements per year in Saint John Harbour requiring a tug	Tugs are used to assist most large vessels in navigation of the Harbour, including petroleum, LNG, and bulk and cargo carriers but not cruise ships. The availably of tugs can therefore be a limiting factor to vessel movement.
	Use of anchorage areas	Vessels are often required to wait in one of four existing anchorage areas in Saint John Harbour until the tide allows for berthing, a berth is available, and/or tugs or Harbour Pilots are available to assist with manoeuvring and berthing. Harbour Pilots are required for movements to and from anchorage areas located within the compulsory pilotage area. The availability of anchorage areas affects waiting times and navigation schedules and can therefore be a limiting factor to vessel movement.

13.1.5 Temporal Boundaries

The temporal boundaries of the assessment of the environmental effects of the Project on Marine Safety include the Construction, Operation, and Decommissioning and Abandonment of the Project as defined in the Project Description (Chapter 3).

The temporal boundaries for the establishment of existing (baseline) conditions for Marine Safety were the period of 2007-2008, during which information on vessel movements, and practices and procedures in Saint John Harbour were gathered from literature reviews and interviews with key experts and stakeholders.

13.1.6 Spatial Boundaries

The spatial boundaries for the environmental assessment of Marine Safety are:

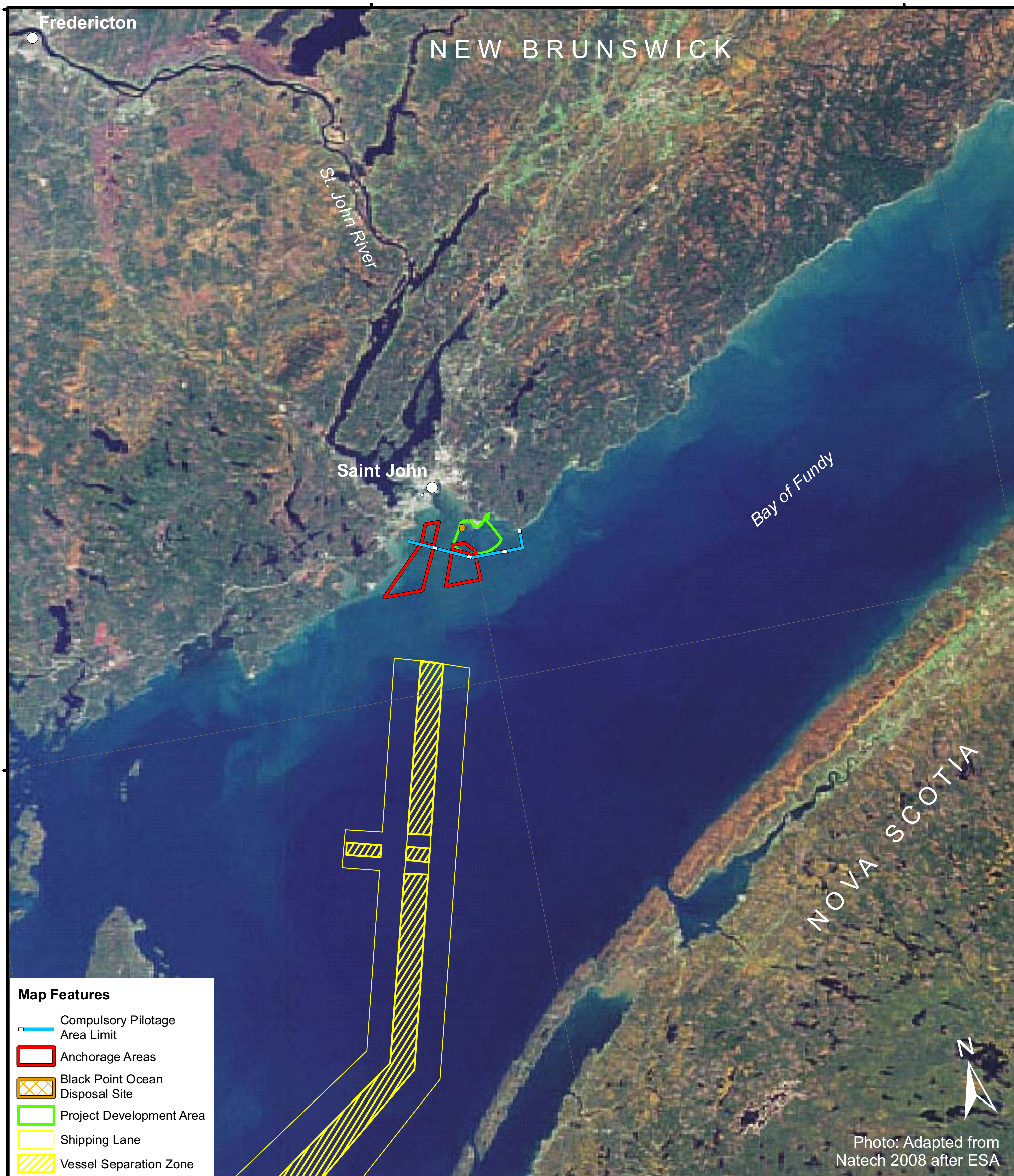
- The Project Development Area (PDA), in particular the Marine PDA as discussed in Chapter 10;

The Marine PDA, shown in Figure 13.1, is defined as the physical footprint of the Marine Terminal and Other Marine-Based Infrastructure (described in Section 3.2), the Proponent’s water lot, and adjacent areas which were studied for the purpose of characterizing the marine environment.

Because the assessment of Marine Safety as part of the scope of project defined in the EA Track Report and Scoping Document includes berthing and deberthing activities but excludes shipping activities, it is not necessary to define a Local Assessment Area (LAA) or a Regional Assessment Area (RAA) for the purpose of this VEC.

13.1.7 Administrative and Technical Boundaries

The Project will comply with regulations and standards of various jurisdictional authorities that oversee marine vessel movements, prevention of hydrocarbon spills, protection of marine mammals. They include, but are not limited to:



Map Parameters
Projection: UTM, NAD83, Zone 20
Scale: 1:750,000
Date: May 26, 2009
Project No.: 1013263.

Figure 13.1

Spatial Boundaries for Marine Safety

0 5 10 20 30 40 50
Kilometres

Project Eider Rock

Jacques Whitford

- Canadian-ratified international agreements (*e.g.,* through the International Maritime Organization);
- The *Canada Shipping Act, 2001*, including associated Regulations;
- The *Canada Marine Act*, including associated Regulations and Letters Patent for the establishment of the Saint John Port Authority;
- The *Navigable Waters Protection Act*, including associated Regulations;
- The *Pilotage Act*, including associated Regulations; and
- Notice to Mariners Annual Edition.

Transport Canada has the primary responsibility for administration of the *Canada Shipping Act, 2001*, *Canada Marine Act*, *Navigable Waters Protection Act*, and associated regulations. The Canadian Coast Guard has the primary responsibility for emergency response in the Bay of Fundy and Canadian waters. The movement of vessels in the Bay of Fundy and the Port of Saint John is monitored by the Canadian Coast Guard's MCTS centre. The Saint John Port Authority has responsibility for navigation and activities in the defined limits of the Port of Saint John, identified in Letters Patent under the *Canada Marine Act*. The authority of the Saint John Port Authority includes the management of navigation and lands (including submerged lands) within the Harbour.

Transport Canada Marine Safety will review the Project with respect to potential environmental effects on marine safety through the TERMPOL review process. Transport Canada Marine Safety is aware of the Project and is prepared to activate the TERMPOL Review Committee when sufficient design information is available. Meetings between the Proponent and the Committee will define the scope of the TERMPOL review following the TERMPOL Review Process 2001 (TP 743 E) (Transport Canada 2001).

There are no substantive technical limitations for the assessment of Marine Safety.

13.1.8 Residual Environmental Effects Rating Criteria

The safe management of marine vessel traffic in the Port of Saint John and in the Bay of Fundy is a well established practice, and is governed by shipping policies and procedures that manage marine vessel movements in the region. Management authorities, including MCTS, the Saint John Port Authority, and the Atlantic Pilotage Authority, have the ability to add resources (*i.e.,* Pilots and anchorage space) and to adapt existing practices and procedures in order to accommodate any changes in vessel traffic.

In recognition of these essential but well established programs, procedures, and infrastructure for the safe and effective management of vessel traffic and navigation in the Bay of Fundy and Saint John Harbour, a significant adverse residual environmental effect on Marine Safety is defined as a long-term change in marine safety arising from navigation activities that cannot be safely and effectively managed within the current authorities of responsible agencies. Specifically, under *CEAA*, such long-term change is only considered if it is due to an indirect environmental effect. The need for additional resources to support execution of these authorities and/or changes to existing practices and procedures would not factor into the determination of significance, but are rather considered as mitigation measures to minimize environmental effects.

13.2 Existing Conditions

The Port of Saint John is an international sea port, the largest in New Brunswick, opening into the Bay of Fundy. The Port is of great strategic importance to Canada's trade and economy and is essential to New Brunswick's natural resource industries, including the potash, petroleum, and forestry industries. The Port provides over 3,000 direct and indirect jobs to the City of Saint John (Saint John Port Authority 2007a) and plays a key role in the regional tourism industry by hosting an increasing number of international cruise ships and by accommodating the twice daily passenger ferry between Saint John and Digby, Nova Scotia. In addition to these industrial and tourism functions, the Harbour is also home to an active commercial fishery, consisting primarily of lobster and some scallop fishing.

The Port of Saint John is the fourth largest harbour in Canada as measured by tonnage of cargo handled. In 2007, there were 27,074,531 metric tonnes of cargo handled in the Port of Saint John (J. McCann, personal communication, May 13, 2008). This was a 9% increase over 2006 levels, and a 31% increase over 1997 levels (Statistics Canada 2005b). Some of the major commodities shipped in and out of the Harbour include crude oil, petroleum products, potash, and forest products. In 2007, shipments of crude oil and petroleum products accounted for just over 88% of all cargo handled in the Port (J. McCann, personal communication, May 13, 2008).

All vessel traffic in the Bay of Fundy is monitored by the Canadian Coast Guard's MCTS and is handled along two established shipping lanes (one for entry to and one for departure from the Bay) (J. McCann, personal communication, May 13, 2008) (Figure 3.15). The existing shipping lanes were established for the navigational safety of vessels within the Bay of Fundy transiting between Saint John and the Atlantic Ocean. Currently, there are four anchorage areas in Saint John Harbour (Figure 3.15). Vessels entering the Bay of Fundy shipping lanes and scheduled to enter the Port of Saint John must remain in contact with MCTS by calling the traffic control centre at each of the designated call-in points along the shipping lanes and reporting details on their location, course, speed, and the estimated time to the next call-in point.

Pursuant to the *Pilotage Act*, the Port of Saint John is a compulsory pilotage area managed by the Atlantic Pilotage Authority. Pilotage is the process of directing and controlling the movement of a vessel through near shore and in-shore waters unfamiliar to the ship's master or providing navigation advice to the Harbour Master for this purpose. Vessels are required to comply with the stipulations of the *Pilotage Act* and associated Regulations. According to the *Pilotage Act*, no person can conduct a vessel within a compulsory pilotage area unless that person is a licensed Pilot or holds a pilotage certificate allowing him or her to navigate in that area. Vessels may not enter the compulsory pilotage area without a Pilot onboard unless directed to do so by the Pilot or authorized to do so by the Atlantic Pilotage Authority. According to the *Atlantic Pilotage Authority Regulations* under the *Pilotage Act*, the following types of ships require a Pilot onboard to travel in a compulsory pilotage area:

- Canadian registered ships of over 1,500 gross tonnes;
- Ships not registered in Canada, including floating cranes;
- Oil rigs;
- Any combination of tug and tow, if more than one unit is being towed, regardless of gross tonnes;
- Pleasure craft over 500 gross tonnes; and

- Ferries that are entering or leaving a port that is not one of their regularly scheduled terminals.

There are a number of exceptions that do not require pilotage in compulsory areas, including Canadian government vessels, Canadian registered fishing vessels, and Canadian registered off-shore supply vessels of 5,000 gross tonnes or less with a base of operations within a compulsory port.

When pilotage services are required, marine pilots are dispatched to meet and board vessels at the Pilotage Boarding Station as they enter the designated compulsory pilotage areas. According to the *Atlantic Pilotage Authority Regulations*, a ship arriving in a compulsory pilotage area must give notice of the estimated time of arrival at least 12 hours in advance of arrival, and must also give notice confirming or correcting the estimated time of arrival within a timeframe set out by the Atlantic Pilotage Authority. When departing or moving within a compulsory pilotage area, a ship must notify the Atlantic Pilotage Authority within a timeframe specified by the Authority.

Vessels entering the waters of the Port while awaiting a Pilot may be advised by MCTS to wait in one of the designated anchorage areas. At the discretion of the Saint John Port Authority, all vessels entering Saint John Harbour for the first time may be required to employ the services of a tug (Saint John Port Authority 2004).

All vessels entering, berthed, departing, manoeuvring, or at anchor in the waters of the Port must follow the Practices and Procedures of the Saint John Port Authority, pursuant to clause 56(1)(b) of the *Canada Marine Act*. The following are key current practices and procedures that will affect Project vessel navigation activities (Saint John Port Authority 2004).

- Exclusion zones or navigational restrictions on the movement of vessels may be permanently or periodically established in the interest of safe navigation. The Manager of Port Operations, through MCTS or through the Port Authority, will promulgate these exclusion zones or navigational restrictions.
- A vessel intending to anchor in the anchorage areas shall not anchor within 1.85 km (1 nautical mile) of another vessel at anchor if either vessel is a tanker; or a vessel secured at the existing Canaport SBM. MCTS will advise approaching vessels of the location of tankers anchored in the anchorage areas.
- As crude carriers approach the existing Canaport SBM from the outer Harbour, they are required to be assisted by tug boats. These tug boats must remain attached to the crude carrier throughout the period of time that the vessel is moored to the SBM.

According to the Saint John Port Authority Practices and Procedures, a safety exclusion zone is in place surrounding the existing Canaport SBM at all times that a crude carrier is berthing, unloading, or deberthing at the SBM. This safety exclusion zone includes the limit of the swing of the maximum length of the vessels using the SBM, including tugs and towline, and is defined as a circle centred at the SBM with a radius of 925 m (Saint John Port Authority 2004).

The Black Point ocean disposal site (Figure 13.1) has a limited potential to be a navigational impediment to the Project-related vessel traffic because of the shallow bottom that has been built up by the accumulation of dredge spoils (P. Gates, personal communication, May 22, 2008). This site will be included in navigational simulations and models used to determine appropriate berthing and deberthing procedures and routes as part of the TERMPOL review process.

The Saint John Port Authority tracks vessel traffic in the Port, and in 2007 there were 897 vessel calls in the Port of Saint John (J. McCann, personal communication, May 13, 2008). This was a 21% increase in vessel calls relative to 2006 vessel traffic (743) and a 9% increase over the number of vessel calls in 2005 (826). Statistics Canada tracks the number of vessel movements in Canadian harbours. A vessel movement consists of a transit from one designated point to another designated point (*e.g.,* from the Pilot boarding station to an anchorage area and the anchorage area to a berth are two separate movements). Data from 1996 to 2005 indicate that the number of vessel movements in the Port of Saint John has fluctuated considerably, with the highest number of vessel movements reaching 1,962 in 2002 (Statistics Canada 2002). In 2005, there were 1,628 vessel movements, which marked a 1% decrease from 2004 levels (1,649) (Statistics Canada 2005b) and a 7% decrease compared to the number of vessel movements in 1996 (1,758) (Statistics Canada 1996).

These vessel movement data excludes the movements of vessels not subject to compulsory pilotage, including many other vessel types that are actively using the Harbour such as fishing vessels, tugs, Atlantic Pilot Authority ships, maintenance and service ships, passenger ferries, and cargo vessels under 15 tonnes. Of note from these excluded vessels are the Princess of Acadia passenger ferry, which currently sails between Digby and the Port of Saint John twice daily, and the movements of commercial fishing vessels. Potential changes to the ferry service may occur as Bay Ferries continues its rationalization of operations and its business case at this location.

The practices and procedures described in this section are employed to promote the safe and efficient management of vessel traffic at all times. Discussions with the Saint John Port Authority and the Atlantic Pilotage Authority indicate that the current level of vessel traffic in the Port is well within the physical and management capacity of the Harbour and that these responsible authorities would welcome additional business and vessel traffic in Saint John Harbour (J. McCann, personal communication, May 13, 2008).

13.3 Potential Project-VEC Interactions

The potential interactions between Project-related activities during each phase of the Project and potential environmental effects to Marine Safety are shown in Table 13.3.

Table 13.3 Potential Project Environmental Effects to Marine Safety

Project Activities and Physical Works	Potential Environmental Effects
	Change in Marine Safety
MARINE TERMINAL AND OTHER MARINE-BASED INFRASTRUCTURE	
Construction	
Construction and Installation of Jetty and Other Marine-Based Infrastructure	1
Marine Vessel Berthing and Deberthing	1
Operation	
Marine Vessel Berthing and Deberthing	2
Crude Oil and Finished Product Transfer	1
Wastewater, Cooling Water, and Storm Water Release	0

Table 13.3 Potential Project Environmental Effects to Marine Safety

Project Activities and Physical Works	Potential Environmental Effects
	Change in Marine Safety
Decommissioning and Abandonment	
Removal of Facilities and Site Reclamation	1
Project-Related Environmental Effects Notes: Project-Related Environment Effects were ranked as follows: 0 No interaction, or no substantive interaction contemplated. 1 Interaction will occur. However, based on past experience and professional judgment, the interaction would not result in a significant environmental effect, even without mitigation, or the interaction would clearly not be significant due to application of codified practices. 2 Interaction may, even with codified mitigation, result in a potentially significant environmental effect and/or is important to regulatory and/or public interest. Potential environmental effects are considered further and in more detail in the CSR.	

For clarity, the assessment of Marine Safety associated with the Project is focused on berthing and deberthing activities within the Marine PDA.

During the construction and installation of the jetty and other marine infrastructure, the presence of barges, cranes, and supply vessels could potentially interact with existing vessel traffic in the marine PDA; however, there will not be large numbers of these vessels, and there is limited existing vessel traffic in this area (most of which is under the care and control of the Proponent to supply crude oil to Canaport for the existing Saint John refinery), and therefore the interactions will be minimal. Similarly, during Decommissioning and Abandonment, the activities of tugs and barges in the marine PDA are expected to have only minimal interactions with existing vessel traffic. Marine Vessel Transportation of construction modules is anticipated to require approximately 150-200 vessels to travel into the PDA over the 6-8 year Construction period. This volume of vessel traffic is very small relative to existing traffic levels (less than 1% of existing levels) and can easily be managed by MCTS and the Saint John Port Authority with existing resources and procedures. Phasing the pace and sequence of Construction to two distinct phases may assist in mitigating the potential environmental effects of increased vessel movements delivering equipment to the Project site. Therefore, the potential environmental effects of the Construction and Decommissioning and Abandonment of the Marine Terminal and Other Marine-Based Infrastructure on Marine Safety for all activities that were ranked 0 or 1 in Table 13.3, including cumulative environmental effects, are rated not significant and are not considered further in the CSR. There is a high level of confidence in the significance prediction.

During Operation, the release of wastewater, cooling seawater (if built) and storm water will be limited to the near shore areas of the marine PDA and will not interact with Marine Safety as they will be carried out at depth in the marine environment such that they do not interfere with navigation. The unloading of crude oil at the existing Canaport SBM will require the assistance of tugs and the setting of a safety exclusion zone around the tanker, but this activity is conducted currently by the Proponent, is well managed and understood, and is demonstrated to be carried out with no significant environmental effects to Marine Safety. The utilization of the SBM is not expected to change substantively from current levels due to the displacement of smaller crude oil ships currently unloaded at the SBM to the jetty. As a result, although these activities will interact with existing vessel traffic, given the low levels of vessel traffic in the PDA and the existence of mature practices and procedures for these unloading activities, these interactions will be not significant.

The availability of anchorage areas is a limiting factor to Port activity (J. McCann, personal communication, May 13, 2008). Vessels may anchor for several reasons that may include waiting for tide or weather conditions to allow berthing and waiting for tugs, Pilots and/or a berth to become available. The Saint John Port Authority has indicated that despite the possibility that Anchorage C may be removed at the request of the Atlantic Pilotage Authority, if future activity in the Port leads to any congestion in the anchorage areas, they will direct vessels to remain in the Bay where they will be managed by MCTS until anchorage space is available (J. McCann, personal communication, July 8, 2008). Because the Saint John Port Authority has indicated that they will accommodate all foreseeable future demands on anchorage areas, there will be no shortage in anchorage capacity as a result of the Project under these current plans.

Because of the small size and quantity of the dredges and scows used in Saint John Harbour, and the mobile nature of their work, the Project will not have any significant environmental effects on dredging activities within the inner Harbour. As a result of the navigational simulations and modelling to be conducted, and the training and experience of Harbour Pilots that will guide vessels to and from berths, the Project will not have any significant environmental effects on the Black Point ocean disposal site. Groundings of vessels on the disposal site or elsewhere would be considered an accidental event, and are addressed in Chapter 16.

Saint John is the second largest Port in Atlantic Canada based on tonnage; however, there are several ports throughout North America that are considerably larger and handle much higher volumes of vessel traffic. For example, in 2005, the Port of Vancouver, British Columbia had 2,677 foreign vessel arrivals (Port of Vancouver n.d.), compared to the Port of Saint John which had 826 total vessel arrivals in 2005 (J. McCann, personal communication, May 13, 2008). The Port of Saint John has a well-managed traffic control system in place, which is operated by the MCTS, a service of the Canadian Coast Guard, in conjunction with the Saint John Port Authority and the Atlantic Pilotage Authority. Discussions with experts from these regulatory authorities indicate that they would welcome the increase in business and vessel traffic from the Project, and that they will be able to safely manage the increase in vessel traffic by adding resources and adapting existing practices and procedures where required (J. McCann, personal communication, May 13, 2008; P. Gates, personal communication, May 22, 2008).

In consideration of the above, the potential environmental effects of the Operation of the Project on Marine Safety for all activities that were ranked 0 or 1 in Table 13.3, including cumulative environmental effects, are rated not significant and will not be considered further in the assessment. There is a high level of confidence in the prediction.

The only potentially significant Project interaction with Marine Safety during Operation would be due to berthing and deberthing activities at Canaport. These interactions are ranked as 2 and are considered further in the assessment.

13.4 Environmental Effects Assessment

Residual environmental effects of the Marine Terminal and Other Marine-Based Infrastructure on Marine Safety are summarized in Table 13.4.

Table 13.4 Summary of Residual Environmental Effects on Marine Safety

Potential Residual Environmental Effects	Proposed Mitigation/Compensation Measures	Residual Environmental Effects Characteristics: Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/Socio-economic Context	Significance	Prediction Confidence	Likelihood	Cumulative Environmental Effects?	Recommended Follow-up and Monitoring
Change in Marine Safety												
Operation	▪ Completion of TERMPOL review and implementing mitigation and measures that arise from that process. ▪ Establishment of practices and procedures with respect to marine terminal operation. ▪ Use of established anchorages in compliance with all applicable legislation, codes, and standards of practice for shipping. ▪ Hiring of additional Saint John Harbour Pilots, if required. ▪ Commissioning of additional tug boats, if required.	A	M	S	LT/R	R	D	N	H	H	Y	None.
Residual Environmental Effect for all Phases								N	H	H	Y	

KEY:

Direction
P Positive
A Adverse

Magnitude:
L Low: A change in marine safety that can be safely and effectively managed by regulatory authorities with existing practices, procedures, and resources.
M Moderate: A change in marine safety that can be safely and effectively managed by regulatory authorities with additional resources and/or changes to existing practices and procedures.
H High: A change in marine safety that cannot be safely and effectively managed by regulatory authorities despite additional resources and/or changes to existing practices and procedures.

Geographic Extent:
S Site-specific: Within the marine PDA

Duration:
ST Short term: Less than one year
LT Long term: Greater than one year
P Permanent

Frequency:
O Occurs once.
S Occurs sporadically at irregular intervals.
R Occurs on a regular basis and at regular intervals.
C Continuous.

Reversibility:
R Reversible
I Irreversible

Ecological/Socio-economic Context:
U Undisturbed: Area relatively or not adversely affected by human activity.
D Developed: Area has been substantially previously disturbed by human development or human development is still present.

Significance:
S Significant
N Not Significant

Prediction Confidence:
Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation
L Low level of confidence
M Moderate level of confidence
H High level of confidence

Likelihood:
Based on professional judgment
L Low probability of occurrence
M Medium probability of occurrence
H High probability of occurrence

Cumulative Environmental Effects?
Y Potential for environmental effect to interact with other past, present or foreseeable projects or activities in RAA.
N Environmental effect will not or is not likely to interact with other past, present or foreseeable projects or activities in RAA.

13.4.1 Assessment of Project-Related Environmental Effects

The berthing and deberthing of ships at the jetty for unloading crude oil and loading finished products onto ships will require tugs and specialized manoeuvres to facilitate these activities. These activities will be subjected to a TERMPOL review process to evaluate operational ship safety, route safety, and management and environmental concerns associated with the location, construction and operation of a marine terminal that handles bulk petroleum products, and other navigability concerns.

Irving Oil has committed to a Technical Review of Marine Terminal Systems and Transshipment sites ("TERMPOL"), which is a voluntary process to objectively appraise operational ship safety, route safety, and to assess management and environmental concerns associated with the location, construction and operation of a marine terminal administered by Transport Canada.

Although TERMPOL is separate process that exists outside the scope of a federal EA, it remains an important Code for the guidance of proponents that transport pollutants or hazardous cargoes in bulk. It is expected that once the Project is operational, approximately 30 to 35 VLCC crude tankers, 25 to 45 Suezmax tankers, and 3 to 15 Aframax tankers will arrive per year to deliver crude oil for the Project. Approximately 280 product tankers and 22 to 30 coke vessels are also expected to transport finished products to markets each year. This represents a 40 to 45% increase in annual vessel calls relative to 2007 vessel traffic. These vessels, in addition to the tug boats and Pilot ships required for safe navigation, will place additional demands on the four anchorage areas and the services of Harbour Pilots and tugs. The increase in vessel traffic could also potentially lead to a change in navigation routes for existing traffic, such as commercial fishermen (Chapter 11).

Project tankers entering the Port of Saint John will require the services of Harbour Pilots and tug boats. It is estimated that each vessel will require a minimum of two Pilot-assisted movements per visit; one movement to berth, and one movement to deberth. Some vessels may also visit anchorage areas before or after berthing, though this occurs less frequently, and vessels often anchor in the outer anchorage areas outside of the compulsory pilotage area.

Between 2004 and 2007, there were approximately 1,639 Pilot-assisted vessel movements (on average) within the Port of Saint John each year (Atlantic Pilotage Authority 2007 and 2008). At present there are six Harbour Pilots in Saint John, and one in training. The Atlantic Pilotage Authority is also considering hiring an additional Pilot, for a total of eight in Saint John (P. Gates, personal communication, May 22, 2008). On average, each Pilot completes approximately 260 to 270 vessel movements per year. The general capacity of the Saint John Harbour Pilots, assuming the eighth Pilot is hired and trained, is therefore between 2,080 and 2,160 vessel movements per year. Accordingly, with eight Harbour Pilots, the existing capacity would allow for approximately 520 additional Pilot-assisted vessel movements within the Port each year.

Assuming a minimum of two Pilot-assisted movements per vessel, during the Operation of the Project there will be a need for approximately 720 to 810 additional Pilot-assisted vessel movements each year. These additional vessel movements will exceed the current capacity of the Harbour Pilots. It is possible that one or two additional Harbour Pilots, for a total of up to ten in Saint John, could be required once the Project is operational. The Atlantic Pilotage Authority plans to hire and train at least two additional Harbour Pilots in preparation for the Project to meet this additional demand (P. Gates, personal communication, May 22, 2008). Under these current plans, there will therefore be enough Harbour Pilots to safely and effectively accommodate the increase in vessel traffic as a result of the Project.

Tug boats are required to guide vessels in and out of berths and to assist with other manoeuvring. As such, the availability of tug boats also limits vessel movement in the Harbour. The increase in tanker traffic associated with the Project will place an increased demand on tug services; however, in anticipation of increased vessel traffic from the Project, more tugs will be added in order to meet the increased demand. Under these current plans, there will therefore be enough tugs to safely and effectively accommodate the increase in vessel traffic as a result of the Project.

The safe and effective management of the increased vessel traffic in the Port of Saint John will be assisted by several mitigation measures, including:

- The completion of a TERMPOL review process for the Project and the implementation of any mitigation identified to be required through that process; and
- Establishment of practices and procedures for marine terminal operations as defined in a Marine Terminal Manual.

Additionally, the use of established anchorages in compliance with all applicable legislation, codes and standards of practice for shipping, as well as the increased capacity of the tug boat fleet and/or hiring of additional Harbour Pilots by the Atlantic Pilotage Authority, if so determined to be required, will assist in minimizing environmental effects of the Project on Marine Safety.

13.4.1.1 Determination of Significance

The residual environmental effects of the Project on Marine Safety will occur only during Operation of marine-based activities associated with the Project. Although the increase in vessel traffic will affect existing vessel traffic and management, MCTS, the Saint John Port Authority, and the Atlantic Pilotage Authority, will be able to safely and effectively manage the increase in traffic by adding resources (*i.e.,* tugs, Pilots, and anchorages) and adapting existing practices and procedures.

With the proposed mitigation, the potential environmental effects of the Change in Marine Safety resulting from the Operation of the Project are rated not significant. There is a high level of confidence in the environmental effects and significance prediction because of the extent of the available information, confirmed through expert stakeholder engagement, and understanding of the key environmental effect mechanisms.

13.5 Assessment of Cumulative Environmental Effects

Residual cumulative environmental effects of past, present and future projects and activities that have been or will be carried out on Marine Safety are summarized in Table 13.5.

Table 13.5 Potential Cumulative Environmental Effects to Marine Safety

Other Projects and Activities With Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects
	Change in Marine Safety
MARINE TERMINAL AND OTHER MARINE-BASED INFRASTRUCTURE	
Project Eider Rock (Land-Based Components)	0
Industrial Land Use	0
Planned of Future Industrial/Energy Projects	0
Infrastructure Land Use	0
Marine Use	1

Cumulative Environmental Effects

Notes: Cumulative environmental effects were ranked as follows:

0 Project environmental effects do not act cumulatively with those of other projects and activities.

1 Project environmental effects act cumulatively with those of other projects and activities, but are unlikely to result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects but will not measurably change the state of the VEC.

2 Project environmental effects act cumulatively with those of other projects and activities, and may result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC.

For the purposes of cumulative environmental effects assessment on Marine Safety, all projects or activities within the PDA were considered including those with potential to, in combination with the Project, result in a change to Marine Safety – the key environmental effect that may result from the Project as discussed in Section 13.4.1. Past development of the Port of Saint John and historical and current shipping activity in the Bay of Fundy would be implicitly addressed in the establishment of existing conditions for this CSR.

Marine use, particularly the operation of the Canaport LNG project, has the potential to interact cumulatively with the Project due to the vessel traffic associated with the operation of the LNG facility and marine terminal. Construction of the Canaport LNG marine terminal has been completed and operation will begin soon. The associated vessel traffic with construction of the Canaport LNG facility and jetty is finished. Accordingly, no cumulative environmental effects between the Project and the construction of the LNG marine terminal are predicted.

Once the Canaport LNG marine terminal is operational, approximately 120 LNG tankers are expected each year. Because of the unique nature of the LNG tankers and marine terminal, three tug boats will be commissioned to be stationed at the marine terminal exclusively to assist LNG vessel movements. The Canaport LNG project will therefore not place additional demands on tug boat resources within the Harbour. The LNG tankers will act cumulatively with the Project to increase the demand for Pilots and for anchorages; however, the Atlantic Pilotage Authority and the Saint John Port Authority have indicated that they will be able to safely accommodate increases in vessel traffic by adding resources and adapting existing practices and procedures. There are other planned shipping activities in the Port of Saint John (*e.g.,* increased cruise ship activity, potential shipping of natural gypsum via barge for the Atlantic Wallboard Limited Partnership operation, and shipping of petroleum coke for the Coleson Cove Generating Station), but these other activities amount to only a few ships per year and could not possibly be the cause of significant cumulative environmental effects by overlapping with those of the Project. The gypsum plant estimates approximately 41 barges per year for shipping natural gypsum to its operation (Jacques Whitford 2005), and NB Power estimates approximately 12 ships per year for shipping petroleum coke to the Saint John region (NB Power 2006). The same mitigation applied in Section 13.4.1 will minimize cumulative environmental effects to Marine Safety, in addition to similar mitigative measures taken for the Canaport LNG project (Jacques Whitford 2004).

13.5.1 Determination of Significance

With the proposed mitigation, the Project contribution to cumulative environmental effects on Marine Safety during Construction and Operation of the Project are rated not significant. There is a high level of confidence in the prediction.

Given the proposed mitigation for addressing the potential environmental effects on Marine Safety, and that the residual environmental effects of increased vessel traffic from the Project were rated not significant, the cumulative environmental effects of the Project in combination with other past, present and future projects and activities that have been or will be carried out, during all phases of the Project, on Marine Safety are also rated not significant. There is a high level of confidence in the predictions.

13.6 Follow-up and Monitoring

No follow up or monitoring for the environmental effects of Marine Safety is recommended.

14.0 HERITAGE AND ARCHAEOLOGICAL RESOURCES

Heritage and Archaeological Resources has been selected as a VEC in recognition of the interest of potentially affected First Nations, the general public as a whole, and provincial and federal regulatory agencies who assure the effective management of these resources.

Heritage and archaeological resources are defined as any physical remnants found on top of and/or below the surface of the ground, including on or below the sea floor, that inform us of past human use of, and interaction with, the physical environment. These resources may be from the earliest times of human occupation to more recent times. Heritage and archaeological resources are relatively permanent features of the environment; however, the integrity of these resources is highly susceptible to construction and ground disturbing activities. In keeping with the *CEAA* definition of environmental effect, Heritage and Archaeological Resources also includes consideration of resources of historical, paleontological and architectural significance.

Potential interactions between the Project and Heritage and Archaeological Resources that may cause potential environmental effects are discussed in this chapter. For example, any surface or sub-surface ground disturbing Project-related activities (*e.g.,* dredging), occurring in the marine environments, that have the potential for interaction with Heritage and Archaeological Resources. There are no interactions with Heritage and Archaeological Resources on land that are within the scope of this CSR. Construction represents the greatest potential for interaction with Heritage and Archaeological Resources, as it is during this phase that the majority of the ground disturbing activities will take place. The potential for shipwrecks in the marine environment, noted by regulatory agencies and anecdotally by some stakeholders during public engagement activities, may also cause an interaction between the Project and Heritage and Archaeological Resources if such features are present in the vicinity of the Marine Terminal and Other Marine-Based Infrastructure.

Despite these interactions, as the analysis that follows demonstrates, the residual environmental effects of the Project on Heritage and Archaeological Resources are rated not significant.

14.1 Scope of Assessment

This section defines the scope of the environmental assessment of the Heritage and Archaeological Resources in consideration of the nature of the potential interactions.

14.1.1 Regulatory Setting

The definition of environmental effect in *CEAA* includes *"… (b)(iv) any structure, site, or thing that is of historical, archaeological, paleontological, or architectural significance…*".

Some archaeological sites as well as other heritage sites (*e.g.*, buildings) can be assigned a "protected" status under the New Brunswick *Historic Sites Protection Act* if so designated by the New Brunswick Minister of Wellness, Culture and Sport. Archaeological sites are considered to be non-renewable resources and are the property of the Crown. Thus, the disturbance of such resources is only authorized under strictly controlled conditions imposed by terms of an Archaeological Field Research License, issued to qualified personnel under the *Historic Sites Protection Act*.

14.1.2 Issues and Concerns Identified During Regulatory, Public, Stakeholder, and Aboriginal Engagement

Potential interactions of the Project with Heritage and Archaeological Resources were mentioned by several stakeholders during engagement activities as a general concern that needed to be appropriately addressed in the EA. Heritage and Archaeological Resources were also mentioned several times during First Nations engagement to be a key concern requiring consideration and mitigation as applicable.

The possibility of encountering unexploded ordnance (UXO) in the Bay of Fundy was raised by a member of the public during engagement activities. Although UXO is not a direct Heritage and Archaeological Resources concern, this possibility was investigated.

Comments from the regulatory agencies included noting that the spatial boundaries of the Heritage and Archaeological Resources assessment should include areas underwater due to the potential to contain shipwrecks. This was also noted by some members of the public. Further comments from regulatory agencies underscored the importance of considering built heritage, which was addressed in the Heritage and Archaeological Resources Technical Study (Jacques Whitford 2008j).

14.1.3 Selection of Environmental Effect

The following environmental effect has been selected for the characterization of Project-related and cumulative environmental effects on Heritage and Archaeological Resources:

- Change in Heritage or Archaeological Resources.

This environmental effect reflects the *CEAA* requirements for the assessment according to the definition of environmental effect in *CEAA* of "any structure, site, or thing that is of historical, archaeological, paleontological, or architectural significance".

14.1.4 Selection of Measurable Parameters

Table 14.1 provides the measurable parameter that will be used for the assessment of the selected environmental effect, and the rationale for the selection of the measurable parameter.

Table 14.1 Measurable Parameters for Heritage and Archaeological Resources

Environmental Effect	Measurable Parameter	Rationale for Selection of the Measurable Parameter
Change in Heritage or Archaeological Resources.	Presence/absence of a heritage or archaeological resource.	Mitigation required only if a heritage or archaeological resource is known to be present and is deemed significant by regulatory agencies.

14.1.5 Temporal Boundaries

In general, the temporal boundaries of the assessment of Heritage and Archaeological Resources include the periods of Construction, Operation, and Decommissioning and Abandonment of the Project.

Construction activities carried out at any time of the year can affect the integrity of any archaeological or heritage resource encountered. Ground disturbances associated with Construction of the marine terminal will be relatively short-term. However, any potentially adverse environmental effects on

Heritage and Archaeological Resources will be permanent, as no archaeological site can be returned its original location or state and no built heritage resource that is removed can be replaced.

The Operation and Decommissioning and Abandonment phases of the Project are not anticipated to involve ground breaking activities, including disturbances of the sea floor, in previously undisturbed areas or the addition of Project-related infrastructure near heritage resources. Thus, these phases of the Project have very limited potential to cause adverse environmental effects to these resources. Therefore, the Project phase during which environmental effects to Heritage and Archaeological Resources are most likely to occur is the Construction phase.

14.1.6 Spatial Boundaries

This section describes the spatial boundaries for the environmental assessment of Heritage and Archaeological Resources. These are:

- The Project Development Area (PDA);
- A Local Assessment Area (LAA); and
- A Regional Assessment Area (RAA).

With respect to Heritage and Archaeological Resources for this CSR, the PDA is defined as the physical footprint of the physical footprint of the Marine Terminal and Other Marine-Based Infrastructure below the ordinary high water mark of the Bay of Fundy (including the intertidal zone but excluding land beyond the ordinary high water mark). There are no interactions of the marine terminal with Heritage and Archaeological Resources on land – these are addressed in the Final EIA Report (Jacques Whitford Stantec Limited 2009a).

The LAA includes the outer Saint John Harbour up to the entrance of the major shipping lanes in the Bay of Fundy. In practical terms, the LAA is essentially equivalent to the Port of Saint John limits as defined by the Letters Patent issued to the Saint John Port Authority under the *Canada Marine Act*. This area is the maximum area where Project-specific environmental effects for the Marine Environment can be predicted and measured with a reasonable degree of accuracy and confidence.

The RAA is defined as the Bay of Fundy, the area within which cumulative environmental effects for the Marine Environment are likely to occur, depending on physical and biological conditions, and the type and location of other past, present or reasonably foreseeable projects or activities. The determination of the RAA boundaries focused on the habitat requirements of species of conservation concern.

14.1.7 Administrative and Technical Boundaries

Heritage and Archaeological Resources are relatively permanent features of the environment; however, their integrity is highly susceptible to ground disturbing activities, including disturbances of the sea floor, and the environmental effects of Construction.

There is no specific federal agency that is responsible for Heritage and Archaeological Resources on private land. Archaeological resources in New Brunswick are administered by Archaeological Services, within the Heritage Branch of the New Brunswick Department of Wellness, Culture and Sport. Built heritage resources (*e.g.,* architecture) generally fall under the Historic Places Section (HPS), within the same Branch and Department. The New Brunswick Museum, of the same Branch and Department, is responsible for the inventory of paleontological sites, and is the primary source for obtaining baseline information on those resources.

Some archaeological and heritage sites can be assigned a "protected" status under the *Historic Sites Protection Act* if so designated by the New Brunswick Minister of Wellness, Culture and Sport. There are no protected sites in the LAA or PDA. Archaeological sites are considered to be non-renewable resources and the disturbance of such resources is only authorized under strictly controlled conditions imposed by terms of an Archaeological Field Research License. These licenses are only issued to qualified personnel by the provincial government through the Minister responsible for the administration of the *Historic Sites Protection Act*. The studies completed under these licenses are referred to an Heritage Resource Impact Assessments (HRIA).

The Cultural Policy of New Brunswick defines heritage as "…the tangible and intangible aspects of our natural and cultural past, from prehistory to the present. Tangible aspects include buildings and structures, archaeological sites, cultural landscapes, cemeteries, sacred places, monuments, artifacts, specimens and collections. Intangible aspects include beliefs, ideas, customs, language, religion, stories and many others." Therefore, built heritage resources include but are not limited to buildings, other structures, landscapes, and districts. That is, a building may have intrinsic value because of unique architecture and/or it may have value because of events that took place therein.

With respect to paleontological resources, there is no legislative protection for fossil localities in the Province and there is no permit system for excavating such sites. Minerals and fossils are typically not owned by the surface landowner; as such, fossils could be considered property of the Crown. Paleontological significance is typically rated based on relative abundance. In general, the opinion of bedrock geologists is used to establish the potential presence of paleontological resources and there is little precedence or systematic means for its determination.

The assessment of Heritage and Archaeological Resources has technical limitations. These pertain mainly to the methodology of field testing implementation and to the determination of elevated potential for encountering heritage and archaeological resources. The models for determining archaeological potential are designed based on the professional judgment and experience of the archaeologist and the general knowledge of the archaeological community in the Maritimes. The testing strategies are determined by the professional archaeologist applying for the license to conduct any required field work in consultation with Archaeological Services, based on available data on the location and configurations of known archaeological sites within the general area of the Project. No published standards or guidelines currently exist with respect to the assessment of built heritage resources, in particular, the assessment of potential contextual environmental effects within the EA process, thus presenting another technical boundary.

14.1.8 Residual Environmental Effects Rating Criteria

For Heritage and Archaeological Resources, a significant adverse residual environmental effect is one that results in a permanent Project-related disturbance to, or destruction of, all or part of an archaeological or heritage resource (including paleontological and architectural resources of significance) considered by the provincial heritage and archaeological regulatory agencies to be of major importance due to factors such as rarity, undisturbed condition, context, spiritual importance, or research importance, and that cannot be mitigated or compensated.

14.2 Existing Conditions

In addition to the general historical setting described in Chapter 6 and general existing conditions with respect to Heritage and Archaeological Resources in the LAA presented in Section 6.3.7, existing conditions for Heritage and Archaeological Resources were established through research and field work conducted from 2006 to 2008 (Jacques Whitford 2008j). A brief summary of existing conditions for Heritage and Archaeological Resources, with emphasis on the PDA in the marine environment where the Marine Terminal and Other Marine-Based Infrastructure is located, is provided below.

14.2.1 Archaeological Resources

A HRIA conducted for the EIA of the Canaport Liquefied Natural Gas Marine Terminal and Multi-Purpose Pier (“LNG”) Project (Jacques Whitford 2004), now nearing completion of construction by Canaport LNG Limited Partnership, generally indicated low archaeological potential for the area. Field work for the Canaport LNG EIA focused on Fort Mispec, the areas around Bean Brook and Beyea Brook, a rock bluff (Figure 14.1) between these two watercourses, and a tributary of Hazen Creek. The archaeological potential of the Mispec Point shoreline area was considered to be low due to a high and very steep shoreline (5-25 m asl). The interior of the Canaport LNG site was rugged and rocky with many low-lying wet areas (Jacques Whitford 2004). One area to the northeast of the Canaport LNG project site was identified as having elevated archaeological potential (Jacques Whitford 2004:639), which when revisited and shovel tested in 2006 as part of the Project revealed the archaeological site BhDl-2 (Jacques Whitford 2007d).

In 2006 and 2007, field work was undertaken for the Development Proposal within certain portions of the PDA, to investigate areas of elevated archaeological potential as identified from previous studies (Jacques Whitford 2007e). As with previous studies, the literature review and predictive modelling conducted in 2006 in accordance with regulatory guidelines (Ferguson 2004) determined that the LAA generally has low potential for Pre-contact period archaeological resources due to rugged, rocky, wet areas in the PDA, the lack of navigable watercourses, and the steep coastline.

Field investigations in 2006 included visual surveys and subsurface testing for archaeological resources by standard test pits (STPs). STPs were undertaken in three areas (Figure 14.1):

- At the top of the terrace above Deep Cove, where the watercourse begins its descent from the Canaport property into Deep Cove;
- At the southwest corner of the confluence of the Mispec River and Brandy Brook; and
- On the terrace above the cobble beach at the entrance to Mispec Bay.

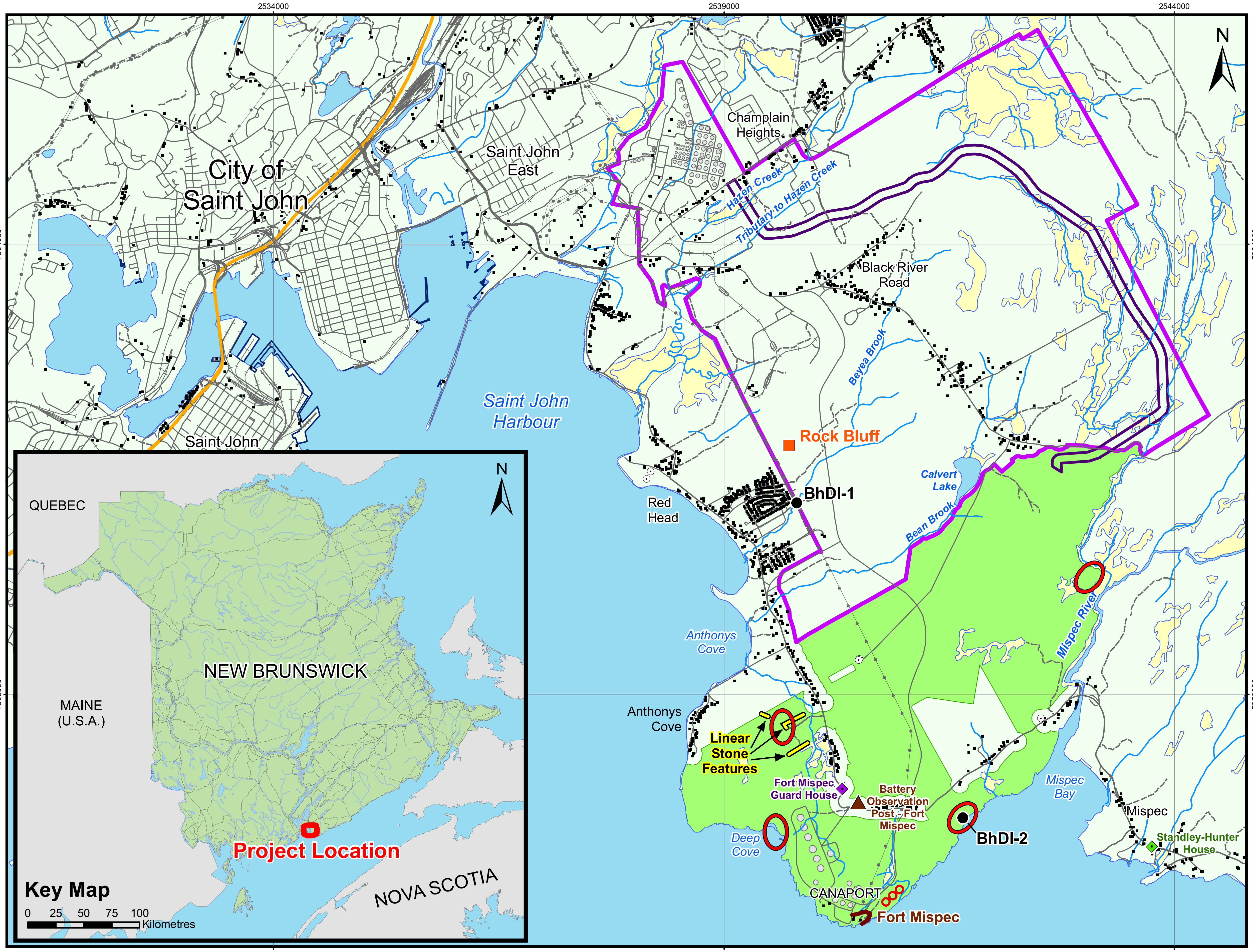


Figure 14.1 Assessment Area and Key Locations for Heritage and Archaeological Resources

Project Eider Rock

Map Features

- Tank
- LNG Tank
- Archaeological Site
- Rock Bluff
- Battery Observation Post - Fort Mispec
- Fort Mispec Guard House
- Standley-Hunter House
- Building
- Tower
- Fort Mispec
- Linear Stone Feature
- Major Road
- Secondary Road
- Local Road
- Track
- Rail Line
- Wharf
- Utility Line
- Watercourse
- Preferred Linear Corridor
- Linear Facilities Corridors Assessment Area (Approx. 2303 ha)
- Waterbody
- Wetland (NB DNR)
- Project Development Area (Refinery Facilities and Infrastructure Approx. 1132 ha)
- Shovel Test Pit Locations

Data Source: Service New Brunswick, NB DNR, ESRI

0 0.25 0.5 1 1.5 2 Kilometres

Map Parameters
Projection: NB Stereographic
Scale: 1:42,000
Date: March 13, 2009
Project No.: 1013263.

Jacques Whitford

No archaeological resources were found in any of these areas, with the exception of the terrace near the entrance to Mispec Bay, where stone flakes were recovered in STPs. These flakes indicate the presence of a Pre-contact period archaeological site. The site is, at present, unnamed, but a Borden Number (BhDl-2) was assigned by Archaeological Services. (The Borden Number is a national designation system for identifying archaeological sites in Canada). On the terrace above the cobble beach near Mispec Bay, nine test pits were dug, of which three contained chipped quartz debitage, with 12 pieces recovered in total. No time period could be assigned to the site, although it is believed to date to the Pre-contact period as no Historic period artifacts were found. The materials recovered and the stratigraphy, indicate that the site was likely occupied for only a brief time. The site is currently eroding due to its shoreline location. However, this site is beyond the ordinary high water mark and is thus not part of the PDA. It is mentioned here for interest and information, but it is not assessed or discussed further in this CSR.

According to records of Archaeological Services, there have been 22 shipwrecks reported in Bay of Fundy (B. Suttie, personal communication, February 6, 2009; Jacques Whitford 2008j) in relative proximity to the Project. There is also anecdotal evidence to suggest that UXO might be found in the marine waters in the general vicinity of the Project. A local history expert, Mr. Harold Wright, who has completed research on UXO in the Saint John area, was contacted to further determine the potential for UXO in the Bay of Fundy. Anecdotal evidence from Mr. Wright (personal communication, May 28, 2008 and June 10, 2008) would suggest that UXO may have been dumped illegally in the marine waters near Anthonys Cove near the Black Point ocean disposal site and proximally to the planned Project marine facilities, after the Second World War.

Table 14.2 presents information provided by Archaeological Services (2009) on potential shipwreck incidents in the Mispec area. This information is drawn from a database maintained by Archaeological Services. The information in the Archaeological Services shipwrecks database is compiled from a variety of sources, including: archived newspaper accounts, the Lloyds of London Registry, the Northern Shipwrecks Database, historic maps from various sources, archival accounts of various lighthouse keepers and wharfingers, the Parks Canada database, original research by various divers, an extensive underwater research program funded by the New Brunswick Museum, list of missing and crashed aircraft from the Canadian Department of National Defence, original research by avocational archaeologists, and published local histories. Many of these sources include subsets of data from other sources. Finally, a small amount of the data is from original research undertaken by Archaeological Services over the years (B. Suttie, personal communication, February 6, 2009).

Records of shipwrecks in the Bay of Fundy are generally not complete enough to allow for an accurate determination of where exactly these incidents happened. In addition, a shipwreck incident, even if it resulted in the sinking of an entire vessel, does not mean that a wreck would exist on the sea floor today. A review of data gathered and plotted by Fugro Jacques Geosurveys (2008) was undertaken by the Study Team and Archaeological Services staff. Documents reviewed consisted of data gathered in Area A and Areas B & D (Figure 10.2) and included multibeam bathymetry, backscatter mosaic, and side scan mosaic images of the sea floor. No areas indicating potential shipwreck locations were identified in this review. A few sonar contact locations were identified as potential areas of interest. Subject to confirmation with technical experts, the potential for these sonar contacts to represent shipwreck locations is considered low. Any additional requests for information will be undertaken in consultation with Archaeological Services.

Given the studies undertaken for the Project and for previous projects in the area, the sea floor in the Mispec area has been thoroughly studied with respect to its potential to contain underwater heritage resources and none have been identified. Underwater survey transects undertaken for the Project (Jacques Whitford 2008m) were visually inspected by divers and revealed no shipwrecks. Previous work undertaken in the area for the Canaport LNG EIA (Jacques Whitford 2004), which also included visual surveys in the Mispec area did not reveal the presence of any wreckage on the sea floor. The scouring of the marine bottom by Bay of Fundy tides and currents (Jacques Whitford 2008m) would make it very unlikely that any historic wrecks would remain today, if any had ever existed in the area. In any case, if any historic wrecks remained today, they would be expected to be in a state of deterioration because of these environmental factors.

Table 14.2 Known Shipwreck Incidents in the Mispec Area

Information from Archaeological Services Shipwrecks Database				Comment
Vessel Name	**Approximate Recorded Date of Incident**	**Vessel Type**	**Other Information (*e.g.*, location, vessel weight, cargo, vessel size)**	
Revenge	November 23, 1835	Schooner	Wrecked in shallows when slipped from anchor at Mispec, NB. Cargo of beef and oatmeal. Length 41 ft, breadth 14 ft, draft 4.9 ft.	--
London	1841	Barque	Stranded and broken up along shore at Mispec, NB. 648 gross tons.	--
William Thomas	June 1843	Schooner	Lost at Mispec, NB. 97 gross tons.	--
Friendship	September 17, 1845	Schooner	Stranded in a gale and wrecked at Mispec, NB. Carrying a cargo which among other things included currency amounting to 200 Pounds Sterling.	--
Mary Ann Melancey	December 11, 1845	Schooner	Stuck in a gale and filled with water, lost? off Mispec, NB.	--
R. Scoles	July 1866	Brigantine	Stranded ashore at Mispec, NB. Partial loss of structure, vessel condemned and sold. Later repaired.	--
Rosalie	September 4, 1869	Schooner	Stranded in a gale ashore at Mispec, NB. Partial loss of structure, later broken up. Cargo of fish. 49 net tons.	This vessel is one of the three referenced in the Canaport LNG EIA Report (Jacques Whitford 2005).
Viola	January 26, 1872	Schooner	Stranded from anchor at entrance to Mispec Bay. Wrecked. 41.6 gross tons.	This vessel may be one of the three vessels referenced in the Canaport LNG EIA Report (Jacques Whitford 2005), in which a 1827 vessel was noted. As no 1827 wrecks have been identified in subsequent research, it is possible that 1827 was a typographical error for 1872. Parks Canada was the original source of information for the Canaport LNG EIA; this information could not be re-verified with Parks Canada.
Sons	July 1877	Schooner	Stranded ashore in fog near Mispec Beach. 18 net tons. Total value of vessel claimed suggesting vessel may have been a complete loss.	--

Table 14.2 Known Shipwreck Incidents in the Mispec Area

Information from Archaeological Services Shipwrecks Database				Comment
Vessel Name	Approximate Recorded Date of Incident	Vessel Type	Other Information (*e.g.*, location, vessel weight, cargo, vessel size)	
Rothesay	December 4, 1879	Schooner	Stranded and wrecked in Mispec Bay, NB. 60.5 gross tons. Vessel built in 1868.	--
Only Son	September 24, 1883	Schooner	Stranded ashore in heavy fog. Partial loss of structure. 27 net tons	--
Ethel	March 25, 1886	Schooner	Collided with an unknown schooner at Moosepec or Mispec, NB. Partial loss of structure. 78.2 gross tons.	
Don Pedro	September 8, 1886	Schooner	Stranded in fog and wrecked at Mispec, NB. 61.2 gross tons.	--
Secret	May 19, 1887	Side-wheeler	Stranded in Fog at Mispec, NB. Partial Loss of Structure. Length 231 ft, width 26 ft, draft 11 ft. 467 gross tons.	--
John Bird	June 10, 1888	Schooner	Stranded in fog near Mispec Point, NB. Whole value of the vessel claimed. 336 gross tons.	--
Bessie	August 27, 1890	Schooner	Stranded and wrecked in gale at Mispec, NB. 40.2 gross tons. Vessel Value: $250, cargo Value: $320	--
Gertie	December 27, 1890	Schooner	Blown into mouth of Mispec Stream, NB during gale. Total loss. 98 net tons. Remains of vessel can still be seen at low tide. Potentially observed by B. Suttie in 2006 from the air and the bridge on the Red Head Road at approximately 45º13'30.69"N 65º57'19.98"W.	--

Table 14.2 Known Shipwreck Incidents in the Mispec Area

Information from Archaeological Services Shipwrecks Database				Comment
Vessel Name	Approximate Recorded Date of Incident	Vessel Type	Other Information (*e.g.*, location, vessel weight, cargo, vessel size)	
Free Toad	March 6, 1900	--	Vessel lost in a snow storm at Mispec, possibly off point. 77 net tons.	This vessel appears to be one referenced in the Canaport LNG EIA Report (Jacques Whitford 2005). Sources differ as to the name of this vessel. A vessel identified by Parsons (2006) called *Free Trade* was involved in an incident near Saint John. Transport Canada (n.d.) identifies this vessel as *Free Toad* as does the Archaeological Services database. According to Parsons (2006:114) "On March 6, 1900, another vessel came to grief on the shores near Saint John. The schooner *Free Trade*, a 77-ton schooner owned in Parrsboro, Nova Scotia, was sailing to Saint John with a cargo of coal. Captain Conlon was attempting to work his way up the coast to the city during a snowstorm. *Free Trade* struck the rock near Mispec Point, located a few miles east of Saint John. Three of the crew jumped from the jib boom to the shore and the fourth crewman went ashore in the vessel's boat. Within fifteen minutes *Free Trade* slipped off the rocks where it had grounded and disappeared from sight. Captain Conlon and his men found accommodations at Mispec. On the following day they went down to the Point to see what had happened to the schooner. It was still below water, but the spars were gone and Conlon determined that the bottom was torn out of it. While another good ship was soon reduced to debris along the Mispec shore, Captain Conlon and his crew steamed up to Saint John on the tug *Flushing*."
Lena	December 5, 1902	Schooner	Partial loss of structure of a schooner after collision. Vessel length 62.2 ft, width 20.5 ft, draft 7.2 ft. 54.6 gross tons. Gas engine powering screw for auxiliary power on board.	--
Silver Cloud	May 5, 1906	Schooner	Stranded east of Mispec Point, Wrecked. 45 net tons.	--
J.S. Lamprey	May 17, 1913	Schooner	Foundered off Mispec, NB. Length 130 ft, width 31 ft, draft 12 ft.	--
David Mark	July 24, 1971	Fishing boat	Collided with the Irving Tamarack off of Mispec Point. Unknown damage.	--

14.3 Potential Project-VEC Interactions

The potential interactions between Project-related activities during each phase of the Project and potential environmental effects to Heritage and Archaeological Resources are shown in Table 14.3.

Table 14.3 Potential Project Environmental Effects to Heritage and Archaeological Resources

Project Activities and Physical Works	Potential Environmental Effects
	Change in Heritage or Archaeological Resources
MARINE TERMINAL AND OTHER MARINE-BASED INFRASTRUCTURE	
Construction	
Construction and Installation of Jetty and Other Marine-Based Infrastructure	1
Marine Vessel Berthing and Deberthing	0
Operation	
Marine Vessel Berthing and Deberthing	0
Crude Oil and Finished Product Transfer	0
Wastewater, Cooling Water, and Storm Water Release	0
Decommissioning and Abandonment	
Removal of Facilities and Site Reclamation	0

Project-Related Environmental Effects

Notes: Project-Related Environmental Effects were ranked as follows:

0 No interaction, or no substantive interaction contemplated.

1 Interaction will occur. However, based on past experience and professional judgment, the interaction would not result in a significant environmental effect, even without mitigation, or the interaction would clearly not be significant due to application of codified practices.

2 Interaction may, even with codified mitigation, result in a potentially significant environmental effect and/or is important to regulatory and/or public interest. Potential environmental effects are considered further and in more detail in the CSR.

The potential Project-related environmental effects to Heritage and Archaeological Resources could occur primarily from ground disturbance activities associated with Construction. Ground disturbance could lead to a change in the integrity of a heritage or archaeological resource as a result of Project activities. By definition, Heritage and Archaeological Resources are on the surface of the ground, buried underground, including the marine floor, or are part of the built environment. As such, most activities associated with the Project other than Construction, will not interact with Heritage and Archaeological Resources. Thus, only those project activities that are anticipated to result in substantive physical ground disturbance or earth moving activities are anticipated to interact with known Heritage and Archaeological Resources. Other than for these activities, any discovery of an archaeological or heritage resource as part of any other activity during any phase of the Project would be considered an Accident, Malfunction, or Unplanned Event, and is assessed in Chapter 16. Operation and Decommissioning and Abandonment do not involve ground disturbing activities, construction near built heritage resources, or disturbance to built heritage resources, so these phases cannot interact with Heritage and Archaeological Resources.

There are no anticipated substantive interactions between the Marine Terminal and Other Marine-Based Infrastructure and Heritage and Archaeological Resources during any phase of the Project. Although Construction in the marine environment near Fort Mispec has a potential environmental effect on the context of Fort Mispec and viewscapes from Fort Mispec, any potential environmental effects are considered to be land-based and therefore not assessed further in this CSR. While there was anecdotal evidence from stakeholders that suggests that UXO could be present in the Bay of Fundy near the proposed location of the marine terminal, it would appear from consultation with a local history expert that while such dumping appears to have occurred after the Second World War, the most likely location from his research for UXO would be near the Black Point Ocean Disposal Site (H. Wright, personal communication, May 28, 2008 and June 10, 2008). Side scan sonar and other surveys in the marine environment near the planned location of the marine terminal and other marine-based facilities found no anthropogenic features (Jacques Whitford 2008m). UXO, if present, would not be considered a Heritage and Archaeological resource but rather a potential construction hazard.

There is little recorded information to determine if any of the recorded potential shipwreck incidents in the Mispec area are within the Marine PDA. However, side scan sonar and other surveys in the Marine PDA did not identify shipwrecks (Jacques Whitford 2008m). Further, it is unlikely that wrecks, if any had ever existed in the area, would remain today based on the scouring of the marine bottom by Bay of Fundy tides and currents (Jacques Whitford 2008m). No archaeological field work was undertaken in the Marine PDA as the potential for unknown archaeological sites to be present was considered low (Sections 14.1.2, 14.2.2, and 14.3). The PDA in the marine environment is relatively small and therefore the physical environmental effects on the sea bottom are in a very small area near the barge landing facility, the seawater cooling intake structure (if built) and the wastewater outfall, and the jetty (Figure 3.1). Given that the area has been thoroughly studied and the physical environmental effects to the sea floor are limited in spatial extent, no substantive interaction is anticipated between the Project and underwater heritage or archaeological resources.

Since there is no Project-related interaction of the Marine Terminal and Other Marine-Based Infrastructure with Heritage and Archaeological Resources (Table 14.3), it follows that there cannot be any cumulative environmental effects to Heritage and Archaeological Resources from the Construction and Operation of the Marine Terminal and Other Marine-Based Infrastructure as there are no Project-related environmental effects that would overlap with the other projects and activities that will be carried out.

14.3.1 Determination of Significance

Thus, the potential environmental effects of the Construction, Operation, and Decommissioning and Abandonment of the Marine Terminal and Other Marine-Based Infrastructure, on Heritage and Archaeological Resources are rated not significant due to the lack of interaction between Project activities and any known significant marine-based resources.

The potential environmental effects of Construction, Operation, and Decommissioning and Abandonment on Heritage and Archaeological Resources are rated not significant. Any adverse environmental effects are counterbalanced by some positive outcomes, such as the preservation of information that will result from the excavation of BhDl-2.

Further cumulative environmental effects of Construction, Operation, and Decommissioning and Abandonment of the Project in combination with other projects and activities that have been or will be carried out on Heritage and Archaeological Resources are rated not significant. There is a high level of confidence in the environmental effects and significance predictions because of the nature of mitigation of archaeological resources by a licensed professional archaeological team.

14.4 Follow-up and Monitoring

No follow-up or monitoring is recommended.

15.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Section 2(1) of *CEAA* defines effects of the environment as *"any change to the project that may be caused by the environment…whether any such change or effect occurs within or outside Canada"*. Typically, potential effects of the environment on any project are a function of project or infrastructure design and the risks of natural hazards and influences of nature. These effects may result from physical conditions, land forms, and general site characteristics which may act on the Project such that Project components, schedule and/or costs could be substantively and adversely changed.

In general, environmental conditions that can affect Project construction, infrastructure or operational performance will be communicated to the Design Team and addressed through engineering design and industry standards. Good engineering design involves the consideration of environmental effects and loadings or stresses (from the environment) on the project. The planning and engineering design for this Project are no exception.

Long term environmental management and Project longevity are inherent considerations in the best management practices of project design and development. As a matter of accepted engineering practice, responsible and viable engineering designs consistently overestimate and account for possible forces of the environment, and thus inherently incorporate several factors of safety to ensure that a project is designed in a safe, reliable, and diligent manner. The very nature of the Development Proposal requires that the design and construction materials that will be used as part of the Project facilities are able to withstand considerable environmental stresses.

Mitigation strategies for minimizing the likelihood of a significant effect of the environment on the Project occurring are inherent in the planning process, engineering design codes and standards, construction practices, and monitoring. As such, and in consideration of the best management practices that will be applied throughout the design, Construction, Operation, and Decommissioning and Abandonment of the Project, the effects of the environment on the Project during all phases of the Project will be managed through responsible design and thus have been rated not significant.

15.1 Environmental Attributes

The environmental attributes that were considered for the potential to have an effect on the Project were determined based on the federal EA Track Report, regulatory consultation, public and stakeholder input, a review of the known past and existing conditions, and knowledge gained through projections of potential future conditions (*e.g.,* potential effects of climate change). Based on the issues and concerns identified, the environmental attributes selected for consideration include:

- Climate conditions, including:
  - Temperature and precipitation;
  - Fog;
  - Wind;
  - Severe weather events;
  - Tidal conditions; and
  - Storm surges and waves.
- Climate change (including sea-level rise);

- Seismic activity;
- Coastal erosion;
- Salt spray; and
- Acid rain/acid fog.

Climate conditions and climate change are presently the focus of much concern globally. *"In the past year, climate change has become among the most publicized issues in Canada and one of the main sources of debate in Canadian politics"* (Koval *et al.* 2008). The Project is located at or near the land/sea interface where extreme weather and sea conditions can occur, and where a substantive change in climate and/or sea level could affect the Project if not mitigated or accounted for in its design and construction. As a result, a more thorough investigation of the effects of climate and climate change on the Project was undertaken as compared to that undertaken for the other environmental attributes listed above, to assess the potential effects of the environment on the Project from this emerging global environmental threat.

15.2 Selection of Effects

The environmental attributes listed in Section 15.1 have the potential to affect the Project in several ways; for example:

- Reduced visibility and inability to manoeuvre construction equipment and marine vessels safely ;
- Delays in receipt of raw materials and/or feedstocks, or in shipping of products;
- Damage to infrastructure;
- Increased structural loading;
- Corrosion of exposed oxidizing metal surfaces and structures, perhaps weakening structures and potentially leading to malfunctions; and/or
- Loss of electrical power resulting in potential loss of the ability to transfer crude oil and/or finish products.

These and other effects of the environment on the Project generally fall into one of two categories. As a result, the effects analysis for Effects of the Environment on the Project is focused on the following effects:

- Delays in Construction and/or Operation; and
- Damage to Infrastructure.

Some of these effects of the environment on the Project, such as a loss of electrical power, can also have effects on the environment—these environmental effects are addressed in Chapter 16.

15.3 Environmental Assessment Boundaries

15.3.1 Spatial Boundaries

The spatial boundaries (Assessment Area) for the assessment of the effects of the environment on the Project include all areas where Project-related activities are expected to occur. For the purpose of this CSR, these areas are focused on the Project location and are comprised of the following:

- The location of the marine terminal including the jetty and barge landing facility; and
- The Port of Saint John, anchorages and adjacent areas in the Bay of Fundy (in relation to potential accidents, malfunctions and unplanned events).

15.3.2 Temporal Boundaries

The temporal boundaries include Construction, Operation, and Decommissioning and Abandonment of the Project.

Decommissioning and Abandonment will not occur for several decades. A Decommissioning and Abandonment Plan will be developed in accordance with the regulations applicable at that time. While environmental attributes listed above may have an effect on Decommissioning and Abandonment, the variability and uncertainty in the projections of such activities require a decommissioning plan to consider the environmental conditions current to that time period. As a result, Decommissioning and Abandonment is not considered further in this assessment, and the effects of the environment on the Project during Decommissioning and Abandonment are rated not significant. That being said, effects of the environment on the Project described for Construction and Operation will persist in Decommissioning and Abandonment. Those that are variable due to long term variation or climate change are difficult to project.

15.4 Residual Effects Rating Criteria

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

- A substantial loss of the Project schedule (*e.g.,* a delay resulting in the construction period being extended by one season);
- An interruption in service (*e.g.,* supply of raw materials delayed by more than 6 days, such that there would not be enough crude oil in storage to meet production demands);
- Damage to the Project infrastructure resulting in a substantial increase in a health and safety risk to the public or business interruption;
- Damage to the Project infrastructure resulting in repairs that could not be technically or economically implemented; or
- Failed mitigation causing environmental damage that could not be technically or economically corrected or compensated in a feasible manner.

15.5 Effects Analysis

The Project will be designed, constructed, and operated in compliance with various codes, standards, best practices, acts and regulations that govern the required structural integrity, safety, reliability, and environmental and operating performance of the various Project components to minimize the potential for adverse effects of the environment on the Project. Adherence to these codes, standards, acts and regulations will help to carry out the Project in a manner that minimizes the potential effects of the environment on the Project, including damage to infrastructure that could result from their occurrence.

As outlined in the introduction to this chapter, the Project will be designed in accordance with several best management and engineering design practices. As a factor of safety, and a matter of reliable engineering practice, the design and materials chosen for construction of the Project will be selected so that the Project will withstand extreme environmental stressors. Accounting for these stressors in the design and construction of the Project will also inherently ensure that the potential effects of the environment on the Project that could occur from various natural and environmental phenomena (*e.g.,* sea level rise and other factors arising from climate change, and acid rain) are minimized. The results of this CSR and the mitigation identified herein to minimize the potential for significant adverse effects of the environment on the Project will be communicated to the Project Design Team and its engineers so that they can incorporate measures to address any residual concerns that might not be explicitly accounted for in their engineering design processes.

A sampling of specific codes and standards in the National Building Code of Canada, the Canadian Standard Association (CSA) and Acts and Regulations that address specific issues related to environmental activities was presented in Table 3.1. To minimize the potential effects of environmental extremes on the Project, the design of structures and equipment will be compliant with the National Building Code of Canada 2005, Volumes 1 and 2 and the User's Guide – NBC 2005 Structural Commentaries Part 4 of Division B. Furthermore, the National Building Code of Canada also lists design requirements specifically for Saint John, New Brunswick. Design requirements address such environmental extremes as:

- Lateral wind loads;
- Weight of snow and ice, and associated water;
- Lateral earthquake loads;
- Erosion protection of slopes, embankments, ditches and open drains; and
- Waves, storm surge and tidal extremes.

To account for potential weather extremes, engineering specifications of the National Building Code of Canada contain design specific provisions, such as:

- Critical structures and piping, steel selection to prevent brittle fracture at low ambient conditions;
- Piping designed to prevent overpressure due to volumetric expansion as a result of solar heat gains;
- Electrical grounding of vessels and structures for lightening protection; and
- Winterization and freeze protection.

Compliance with this and other Codes will minimize the likelihood of a significant adverse effect of the environment on the Project. Other mitigation measures implemented as part of the planning process including adherence to engineering design codes and standards, use of good engineering judgment and careful construction practices, care in selection of appropriate construction materials and equipment, careful planning of operation activities (*e.g.,* crude oil deliveries), and the implementation of a proactive monitoring, maintenance and process safety management program will minimize the potential for adverse effects of the environment on the Project to such an extent that they are not significant.

Codes and standards are set in legislation as minimum requirements. They are continuously reviewed as new information becomes available. In addition to complying with codes and standards, the Design Team will adopt a proactive approach to incorporate climate change considerations and adaptation measures into the Project.

- An assessment of the effects of the environment on the Project with respect to the various environmental attributes outlined in Section 15.1 is provided in the subsections that follow.

15.5.1 Effects of Climate on the Project

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

"Climate change" is an acknowledged change in climate documented over two or more periods, each with a minimum of 30 years (Catto 2006). The United Nations Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (IPCC 2007a).

The definition of climate change dictates the context in which the effects of those changes are discussed. While it is appropriate to examine the effects of projected climate change on Operation over the next 50 to 100 years, it is not fitting to consider the effects of climate change projections on the activities that will be conducted during Construction which will take place over a relatively short period of time (6 to 8 years) in the near future. In this case, where Construction will occur over the first eight years, it is more appropriate to consider the effects of recent climatological conditions, especially the potential adverse effects of weather variability and weather extremes on Construction. It is also important to note that, as part of responsible engineering design, all Project components will be constructed in adherence to building codes, standards, acts and regulations to minimize the potential for adverse effects of the environment on the Project.

To assess the environmental effects of climate on the Project, current climate and climate change must both be considered. Current climate conditions are established by compiling relevant historical data and establishing a climatological background for the Saint John region. Climate change effects projected over the life of the Project are determined through review of climate modelling research to establish the current state of understanding of trends likely in the Saint John region over the next 50 to 100 years. Projections vary among these global and downscaled model results, mainly as a result of varying levels of precision in data used to run climate models and because of variations in the projections of future greenhouse gas (GHG) emission scenarios. A consensus has evolved regarding the climate change-related effects most likely to affect Atlantic Canada, New Brunswick, Saint John and, in turn, the Project (Vasseur and Catto 2008; Reeves 2008).

Numerous climate-related conditions, linked primarily to global warming, have been observed across Atlantic Canada, the entire country and globally. Many believe that these changes to the climate regime will accelerate over the next century, as has been the case with global temperatures over the past two decades (IPCC 2007a). For example, increased temperatures, receding glaciers and melting of permafrost, rising sea levels and coastal flooding, changing precipitation patterns and intensity, as well as increasing drought and lowering water levels are all conditions that are being studied and measured. Of these, several have been projected to affect coastal infrastructure in Atlantic Canada, New Brunswick, Saint John (Vasseur and Catto 2008) and the Project. Those most relevant to Operation over the next 50 to 100 years are:

- Increasing temperatures;
- Changing precipitation patterns;
- Rising sea level; and
- More severe storm surges and flooding.

15.5.1.1 Existing Conditions: Climatological Background (1971 to 2000)

The current climate conditions are generally described by the most recent 30 year period for which Environment Canada has developed statistical summaries—generally referred to as climate normals. The most recent period for which climate normals data are available from the Saint John Airport weather station (the closest to the Project) is for 1971 to 2000, and has been chosen as the appropriate period for summarizing current climate conditions for the Project. Current climate condition summaries for sea state, storm surges and other phenomena related to the Bay of Fundy are for approximately the same period, 1970 to 2008.

Temperature and Precipitation

As discussed in Chapter 6, Saint John has a rather moderate climate, which tends to have mild winters and cooler temperatures for the spring, summer and fall seasons. This is mostly due to the moist Atlantic air year-round and the cool waters of the Bay of Fundy that never completely freeze (Environment Canada 2004a).

Through the most recent 30-year climate averaging period (1971-2000), the average annual temperature was 5°C. The daily mean temperature for January was -8.1°C. Summers are cool to moderately warm, with a daily mean temperature for July of 17.1°C. From 1971 to 2000, Saint John experienced relatively few annual days with extreme temperatures. On average, there have been 71 and 0.79 annual days with instantaneous maximum temperatures greater than 20°C and 30°C respectively, and 15.2 and 0.23 days a year with instantaneous minimum temperatures less than -20°C and -30°C respectively. Taking humidity into consideration, humidex temperatures are, on average, greater than 30°C and 35°C for 9.8 and 0.98 days of the year respectively (Environment Canada 2004a; Environment Canada 2004b).

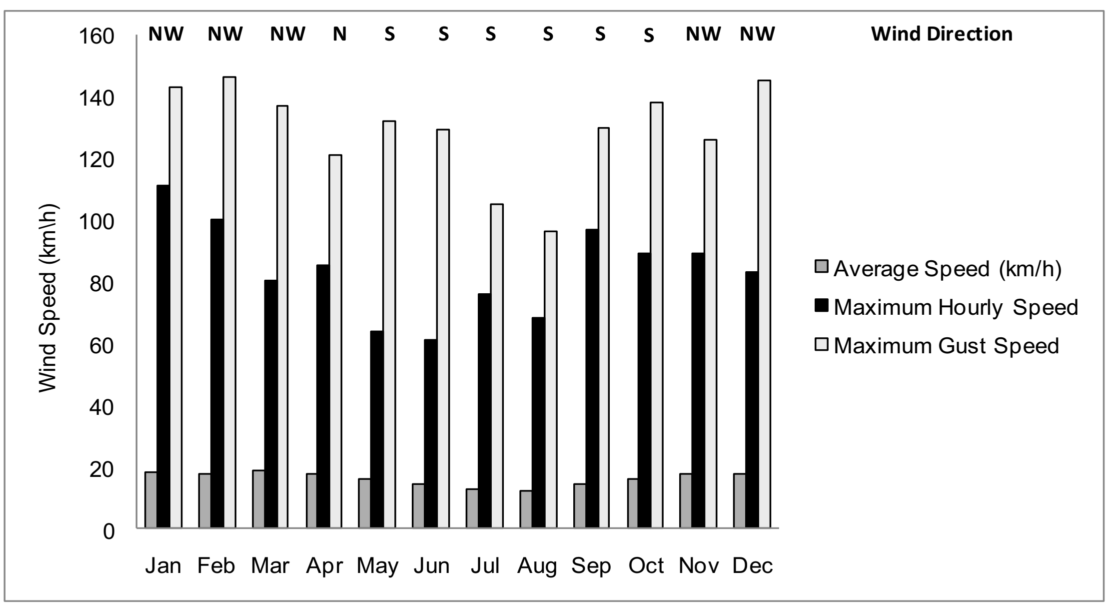
Precipitation in Saint John has been, on average, abundant and well distributed throughout the year, although the late fall and early winter are generally the periods during which the highest precipitation amounts are experienced. From 1971 to 20000, Saint John received an average of 1,390.3 mm of precipitation a year, of which 1,147.9 mm and 256.9 mm were rain and snowfall (as water equivalent), respectively. As with temperature, there were relatively few extreme precipitation events during the period. On average, there have been 45.8 and 13.9 annual days with precipitation greater than 10 mm and 20 mm, respectively, in Saint John. Of these events, rainfall accounts for more than 80% and snowfall less than 20% of the total precipitation. This is consistent with 37.7 and 12.5 days a year with rainfall greater than 10 mm and 25 mm, as well as 7.8 and 0.73 days a year with snowfall greater than 10 cm and 25 cm (Environment Canada 2004b).

Fog

Fog is defined as a visible mass of condensed water vapour at ground level, caused when relative humidity of the air reaches 100% at the surface (Ford 2004). "Days with fog" are days when fog occurs and horizontal visibility is less than 1 km (thick fog) and 10 km (fog) (Environment Canada 1990). The area around the Bay of Fundy experiences a considerable number of days with fog (approximately 120 d/a) (Environment Canada 1990), especially during the summer months when the contrast in temperature is greatest between sea surface (Bay of Fundy) and the surrounding air (Environment Canada 2004a). This is consistent with the measured increase in hours of reduced visibility (< 1 km) between May and September (Environment Canada 2004b). At Saint John, fog occurs on more than one quarter of the year, and 36% of the time in July. Fog is more common during the night and early morning, and generally dissipates by 14:00 (Environment Canada 2004a).

Wind and Sea Spray

As outlined in Section 6.2.3, monthly average wind speeds for Saint John measured at the Saint John Airport, range from 12.1 to 18.6 km/h with an annual average wind speed of 16.1 km/h (Figure 15.1). From May to October, the dominant wind direction is from the south, with a shift to winds predominantly from the northwest from November to April (Environment Canada 2004b). Maximum hourly wind speeds, averaged from 1971 to 2000 for each month, range from 61 km/h to 111 km/h; while maximum gusts for the same period range from 96 km/h to 146 km/h. Occurrences of extreme winds are relatively uncommon at Saint John—over the last three decades there has been an average of 21.3 and 6.1 days per year with winds greater than or equal to 52 km/h and 63 km/h respectively (Environment Canada 2004b).



Source: Environment Canada (2004b)

Figure 15.1 Predominant Monthly Wind Direction, Monthly Mean, Maximum Hourly and Maximum Gust Wind Speeds (1971 to 2000) at Saint John, New Brunswick

Sea spray, fairly common in the Bay of Fundy, results when high winds carry water droplets suspended in air when waves break over rocks. The effects of sea spray would potentially be felt in the PDA at the marine terminal and the refinery complex located at the cliff headlands on the Bay of Fundy.

Severe Weather Events

Storms can occur in New Brunswick throughout the year but tend to be more common and severe during the winter. Winter storms generally bring high winds and a combination of snow and rain. Freezing rain has been observed on approximately 12 days a year in New Brunswick, ranging from an average of 34 hours to 59 hours a year at Fredericton and Moncton, respectively. The Groundhog Day storm in February 1976 was an intense winter storm that caused a great deal of damage in southern New Brunswick, particularly to Saint John. In the summer and fall, storm centres often pass across the Bay of Fundy and move northeast through the Strait of Belle Isle. Southern New Brunswick tends to have at least one heavy rainstorm every one to two years (Environment Canada 2004a).

Winter storms are often classical “nor’easters”, where the cyclonic centre passes south of southern New Brunswick, and is then subsequently subject to strong northeast winds and heavy precipitation over one to several days. Thunderstorms, which are more frequent in New Brunswick than the rest of Atlantic Canada, occur on average 10 to 20 times a year. Generally, only one of these is extreme enough to produce hail. Thunderstorms can produce extremes of rain, wind, hail and lightning; however, most of these storms are relatively short-lived.

Tornadoes are rare, but can occur in New Brunswick. Of Canada’s ten worst tornadoes on record, one occurred in eastern New Brunswick at Bouctouche on August 6, 1879 (Environment Canada 2007j). There are no recorded tornadoes in the Saint John area, based on the reported threshold limits of less than 0.5 per year (Natural Resources Canada 2007a).

Tidal Conditions

In their study of conditions at Saint John, about half way along the Bay, Sandwell Engineering Inc. (Chapter 10) reported the tidal reference levels (relative to the chart datum of 0.0 m). These figures provide a mean tidal range of 6.49 m, with the largest tide tidal range of 9.08 m being reported for Saint John Harbour. Saint John is one of the primary ports in the Canadian Hydrographic Service’s tidal prediction network.

Storm Surges and Waves

Increasing sea level and more frequent and severe weather has also brought about an increased frequency of storm surges. Storm surges are defined as the elevation of water resulting from meteorological effects on sea level. During the past 15 years, storm surges have resulted in property destruction in all four Atlantic Provinces (Vasseur and Catto 2008). In Atlantic Canada, storm surges have been higher in coastal waters and highest in the Gulf of St. Lawrence, with Saint John at the lower end of the scale having observed a storm surge of 0.6 m every 40 years (Bernier *et al.* 2006). In southeastern New Brunswick, storm surges range from 0.6 m to 2 m in height and surges of 0.6 m or more occur about two to three times per year along the Canadian Atlantic coast (Parkes *et al.* 1997). Typically, surges were found to last for an average of 2.2 hours, and occasionally over 12 hours. At Saint John, where the vertical difference between the average high water level and the extreme high water level is in the order of 2.3 m, the risk from storm surge flooding is much less than in areas with lower tidal amplitude. Two important storm surges that happened close to the occurrence of tidal high water caused considerable damage throughout the Bay of Fundy. The Groundhog Day storm in 1976 caused a surge off the coast of Saint John estimated at 1.6 m, with maximum wave heights (trough to crest) of 12 m with swells as high as 10 m. The famous Saxby Gale of 1869 is estimated to have created a storm surge between 1.2 m and 2.1 m (Parkes *et al.* 1997), with the higher surges occurring in the upper Bay of Fundy between Moncton and Burncoat, Nova Scotia.

Wind speed on a spatial scale of the Bay of Fundy or more is the greatest determining factor for generation of waves in the area of the Marine Terminal and Other Marine-Based Infrastructure.

At Saint John, the headland at Mispec Point is fully exposed to wind and wave action entering the Bay of Fundy from the southwest (at its mouth between Grand Manan Island and Yarmouth, Nova Scotia). Analysis of data from two wave gauges (370 m off Partridge Island and 180 m off the Courtenay Bay breakwater) during the period from November 1959 to February 1960 indicates that waves with periods of 8-9 seconds occurred 19% of the time, and 33% of the waves were higher than 0.3 m (Neu 1960). Two percent were higher than 1.5 m, with 2.7 m the highest in the data set. The longest waves had a period of 13 seconds and occurred for 1% of the time.

Run-up waves are produced from wind blowing over the surface of water. Maximum wave height is primarily a function of wind strength, wind duration and the length of exposed water ("fetch"). Substantial run-up waves usually occur during extreme storm events such as tropical cyclones and nor'easters. At nearby Point Lepreau, waves with a characteristic height of 6.7 m were observed at a wave-rider buoy stationed in 91 m of water. This particular storm was estimated to be a 50-year storm. Evidence of 9 m storm run-up waves was recorded along the New Brunswick coast in 2000 and 2001 (Jacques Whitford 2004).

In Transport Canada's "Wind and Wave Climate Atlas" (MacLaren Plansearch Ltd. 1991), the significant wave height and wave period of a typical storm off Saint John, with a one year return interval, are given as 5.2 m and 13.9 seconds. The required combination of the fetch and likelihood of wind duration and direction makes it probable that waves with periods much greater than 8 seconds originate outside the Bay of Fundy.

There is potential that a tsunami could occur in the region. Two tsunamigenic events, on November 18, 1755 and November 18, 1929, listed in the eastern Canadian earthquake catalogue of Smith (1962), were reviewed and it was concluded that there was no evidence that either of these two events had caused tsunami effects in the Bay of Fundy. A study of the effects of the November 18, 1929 event in New Brunswick by Burke *et al.* (1987) also did not find mention of tsunami effects in reports from the coastal communities of the province. The recent establishment of the Atlantic Tsunami Warning System, which allows tsunami warnings and improved capacity to predict storm surges (Forbes 2007), will likely be an invaluable tool in predicting extreme storms along the southern coast of New Brunswick.

15.5.1.2 Climate Change

The climate as a "natural" phenomenon is extremely complex. Weather observations are perhaps the oldest and most reliable form of environmental monitoring. Typical and extreme weather events are well documented with reasonably good spatial coverage existing in Canada with a combination of fully instrumented, manned or automated, observation stations supplemented by a wider coverage of climatological stations. This monitoring forms the basis for the historic and present day predicted climate conditions and trends.

Predicting future environmental effects of climate change for a specific area using global data sets can be problematic due to generic data and larger scale model outputs which do not take into account local climate. Accurate regional and local projections require the development of specific regional and local climate variables and climate change scenarios (Lines *et al.* 2005). As a result, downscaling techniques have emerged, over the last decade, as an important advancement in climate modelling. Downscaling is used to introduce micro-scale interactions by including local climate variables. Downscaling techniques are particularly important for Atlantic Canada due to the inherent variability associated with this predominantly coastal climate. Statistical downscaling uses global climate model (GCM) projections as well as historical data from weather stations across the region, and studies the relationship between these sets of data. Downscaling produces more detailed predictions for each of these weather stations (Lines *et al.* 2005) and has allowed for a better understanding of future climate scenarios based on precise and accurate historic data sets (D. Burton, personal communication, March, 30, 2008).

Results tend to differ between a Statistical Downscaling Model (SDSM) and Global Climate Model (GCM). According to Lines *et al.* (2005), monthly, seasonal and annual results for SDSM values not only differed from, but were typically higher than, those of the Canadian coupled Global Climate Model version 1 (CGCM1). The overall mean annual maximum temperatures increase projected for Atlantic Canada between years 2020 and 2080 ranged from 1.6 C° to 4.7 C° and 1.1 C° to 3.6 C° for the SDSM and CGCM1 model results, respectively (Lines *et al.* 2005). This is consistent with predicted mean annual maximum temperature for the same time period at Saint John, predicted to range from 1.8 C° to 4.2 C° and 1.1 C° to 3.9 C° for the SDSM and CGCM1 model results, respectively (Lines *et al.* 2005) (Table 15.1).

Table 15.1 Projected Mean Annual Maximum (T_{max}) and Minimum (T_{min}) Temperature Change and Precipitation Percent Change for both SDSM and CGCMI Model Results

Period	T_{max}		T_{min}		% Precipitation	
	SDSM	CGCM1	SDSM	CGCM1	SDSM	CGCM1
2020s	1.8	1.1	1.5	1.6	18	2
2050s	2.9	2.1	2.2	2.9	20	-2
2080s	4.2	3.9	3.8	4.2	21	2

Source: Lines *et al.* 2005.

The Statistical Downscaling Model projections for maximum temperature for 2050 at Saint John are for summer, fall and winter increases (2.9 C° to 4.3 C°), while for the spring, slight cooling is anticipated (-0.6 C°) (Lines *et al.* 2005). By the year 2080, temperatures are projected to increase in all seasons, with greater warming in the summer, fall and winter (4.5 C° to 5.7 C°) than the spring (1.6 C°) (Lines *et al.* 2005). This average temperature change will be gradual over the period and will change precipitation types and patterns.

The warmer fall and winter temperatures could mean later freeze up; wetter, heavier snow; more liquid precipitation occurring later into the fall; and possibly more freezing precipitation during both seasons. With little change in spring temperatures, differences in fresh water ice formation and breakup patterns will likely be slight over the next century. Changes to precipitation patterns due to warmer weather over the fall and winter months, on the other hand, could lead to stronger spring run-off (Natural Resources Canada 2007b). There is less agreement among the global circulation and regional downscaling models regarding changes in precipitation. Annual precipitation increases projected for Atlantic Canada between the years 2020 and 2080 range from 18% to 21% and -2% to

2% for the SDSM and CGCM1 model results, respectively (Lines *et al.* 2005). Precipitation trends are of more interest when taken together with the temperature increases and the seasonality of the predicted changes. Statistical Downscaling Model trends for the years 2020 to 2080 indicate a 8% to 12% and 21% to 35% increase for the winter and summer months, respectively (Lines *et al.* 2005). It is generally considered that the increased precipitation being projected for portions of western Atlantic Canada may be the result of continued landfall of dying hurricanes and tropical storms reaching into this area in the summer and fall months (G. Lines, personal communication, March 5, 2006).

While statistical downscaling model results highlight an increase in summer and fall precipitation, the Canadian Global Climate Model (CGCM1) results range from no change in the 2020s to a reduction in precipitation over the summer season for the years 2050 to 2080 (Lines *et al.* 2005). This is inconsistent with trends projected by Environment Canada (2008h), where global model results highlight a reduction in summer precipitation for the 2080s. This discrepancy in seasonal results highlights the variability inherent in climate modelling, a technical boundary. Due to the increased precision of localized data used in downscaled modelling, relative to global modelling, confidence is considered to be greater in the downscaled results relative to global model results.

Regardless of the differences in the projected temperature and precipitation changes between global climate and statistically downscaled models, there is a consensus in the climatological community concerning the overall anticipated environmental effects of climate change. This is especially true since many of the changes are documented as already occurring. For example, over the next 100 years, Atlantic Canada will likely experience warmer temperatures, more storm events, increasing storm intensity, rising sea level, storm surges, coastal erosion and flooding (Vasseur and Catto 2008).

Severe weather is predicted to be more frequent and more intense over the next 100 years. Many reports indicate the likelihood of growing insurance claims and other measures of the destructive nature of these changes. For instance, in Canada, the insured catastrophe losses totalled $1.7 billion between 1985 and 1995, and increased to $6.7 billion since 1995 (Leadbetter *et al.* 2006) both as a result of more developed infrastructure, more frequent severe weather, and a lack of climate adaptation considerations in the construction of new infrastructure.

While advances in modelling science over the last decade have improved confidence in long-term, projections, like all modelling projections, the results and guidance they provide are not meant as absolutes, but rather are intended to allow for preparations, for design considerations, and to facilitate adaptation.

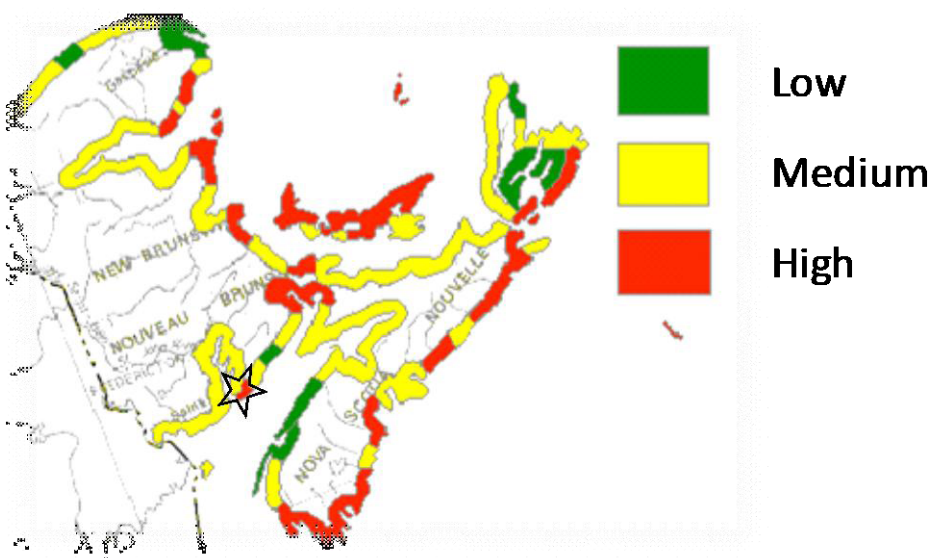
Sea Level Rise and Storm Surges

Global sea levels have risen 1.8 mm/a from 1961 to 2003, and 3.1 mm/a between 1993 and 2003 (Bindoff *et al.* 2007). The sea level has been slowly and steadily rising in most of Atlantic Canada for centuries due to crustal subsidence, warming trends, and the melting of polar ice caps (Government of Newfoundland and Labrador 2003). In particular, the sea level has been gradually rising along the southeastern coast of New Brunswick for several thousand years and the changes associated with that rise have become especially evident along the Northumberland Strait over the last several decades (Daigle *et al.* 2006) due to the low coast profile and substantive development near the coast line and on lands near mean sea level.

Most of Atlantic Canada is also experiencing crustal subsidence in coastal areas, thus compounding the rise in sea level (Vasseur and Catto 2008). In the Bay of Fundy, the rate of sea level rise has been even greater than in other areas of Atlantic Canada, about 400 mm in 100 years, largely because the coastal lands have been simultaneously subsiding by about 300 mm during this time (Percy 2001). During the latter phases of the last ice age, the weight of ice over land resulted in a hinge effect that caused coastal areas to rise relative to inland areas in the Bay of Fundy area of New Brunswick. Upon melting of the ice caps, coastal areas are subsiding while inland areas are rising.

Saint John, New Brunswick, is projected to have a moderate to high sensitivity to the impacts of sea level rise, especially induced by climate change (Geological Survey of Canada Bulletin 1998). Sensitivity is defined as the degree to which a coastline may experience physical changes such as flooding, erosion, beach migration, and coastal dune destabilization (Natural Resources Canada 2007c) (Figure 15.2).

Sea levels are expected to continue to rise at a greater rate in the 21st Century than was observed between 1961 and 2003 due to more rapid warming and ice cap and glacier melting. By the mid-2090s global sea levels are projected to rise at a rate of approximately 4 mm/a, and reach 0.22 m to 0.44 m above 1990 levels (Bindoff *et al.* 2007). Near Saint John, sea levels are anticipated to rise 0.7 m over the next 100 years (Reeves 2008). When crustal subsidence is coupled with the anticipated sea level rise due to global warming, the Bay of Fundy tidal response is estimated to result in the high water levels in the vicinity of Saint John increasing by about 0.6 m by 2050, 0.8 m by 2085, and 1 m by 2100, plus or minus about 15% (Greenberg *et. al* 2006). These are half or a third of the values suggested by an earlier publication by Godin (1992). It is generally understood that a rise in sea level, coupled with more frequent and severe weather, are likely to bring about storm surges that could flood areas in Atlantic Canada that were once unlikely to flood (Conservation Corps of Newfoundland and Labrador 2008). However, sea level rise is not expected to permanently flood any part of Saint John due to its steep rocky shorelines (Reeves 2008).



Source: Geological Survey of Canada Bulletin 1998.

Figure 15.2 Sensitivity of Coastal Areas in the Maritime Provinces to Sea Level Rise

As the sea level continues to rise, the frequency of higher storm surges will increase (Vasseur and Catto 2008). At the present rate of sea-level rise, extreme water levels of 3.6 m above chart datum are anticipated annually in the southern Gulf of St. Lawrence by 2100 (Parkes *et al.* 2006). Over the next 100 years storm surges in excess of 4.0 m above chart datum are anticipated to occur once every 10 years (Vasseur and Catto 2008). At Saint John, extreme water levels are also anticipated to increase over the same time period (Environment Canada 2006d). Storm surge return periods are forecasted as:

- 1:10 year extreme water levels at 4.6 m above mean sea level (MSL);
- 1:20 year extreme water levels at 4.7 m above MSL;
- 1:50 year extreme water levels at 4.9 m above MSL; and
- 1:100 year extreme water levels at 5.2 m above MSL (Drisdelle 2007 as cited in Reeves 2008).

Climate systems are highly variable, reducing the certainty with which climate projections can be made. While the directions of some climate conditions are nearly certain, there is greater uncertainty in the projected magnitude or extent of the conditions. For example, while it is expected that temperatures will increase over the next 80 years, determining the extent of that temperature increase becomes progressively more difficult. When investing in infrastructure and industries of the future that will be subject to sea level rise and storm surges, precautions must be taken in their design to ensure their long-term viability and sustainability in the face of the projected the environmental effects of climate change.

15.5.1.3 Assessment of Effects of Climate on the Project

The environmental attributes of climate, as earlier defined, are important considerations in Construction and Operation. While current climate conditions and weather variability may affect Construction, projected longer term climate change scenarios may affect Operation. The potential effects that these climate conditions may have on the Project are described and predicted where possible. To address these environmental effects, adequate design, Construction and planning of Operation and maintenance are required that consider the potential normal and extreme conditions that might be encountered in this southern New Brunswick setting. As outlined in the introduction to this chapter (Section 15.0) and in Section 15.5, the nature of the Project requires that the design and construction materials be able to withstand the extreme conditions of the refining process itself By following accepted building codes and standards, selecting the right construction materials, designs and practices, environmental stressors on the Project such as those that could arise as a result of climate change, severe weather, and other factors would be expected to be more than adequately addressed.

Effects of Climate on Construction

The intended relatively short period of construction of even a large project is generally not considered as a period over which the effects of climate change can be considered. For activities that will be conducted during Construction, it is most important to consider recent climate trends (1971-2000 averages and extremes) as well as the consideration and incorporation of climate change projections to assess the likelihood and effect of severe and extreme weather events on the Project so that they may be accounted for in the design and construction of the Project. The historical and projected extremes in temperature, fog, intense precipitation or other storm events, storm surges, erosion and flooding, form important considerations in the design and Construction of the Project.

Extreme temperature and reduced visibility due to fog are not anticipated to bring about significant adverse residual effects of the environment on Construction. Extreme low temperatures have the potential to reduce the ductility of construction materials used to construct the Project components (*e.g.*, marine terminal, ancillary facilities), and increase susceptibility to brittle fracture. The materials specified for the Project will be in compliance with all applicable codes and will maintain structural integrity at the anticipated minimum and ambient temperatures in the Assessment Area to prevent adverse effects of the environment on the Project.

Reduced visibility due to fog could make manoeuvring of equipment and vessels difficult in the early part of the day. However, these short delays are anticipated, can be predicted and disruption of the construction activities avoided by scheduling tasks that require precise movements (*e.g.,* positioning pipes in place with cranes) for periods when the fog has lifted.

Weather conditions of greatest concern of causing a significant adverse effect on Construction are wind storm events, severe precipitation events, high waves and storm surges, erosion and flooding. Each of these could potentially cause:

- Increased structural loading;
- Construction delays;
- Reduced visibility and inability to manoeuvre safely; and
- Damage to structures already built.

Wind, snow and ice, for instance, have the potential to increase loadings on buildings. Extreme snowfall can also affect winter construction by causing delay in construction, delay in delivery of materials, and resulting in additional work for snow clearing and removal. Extreme snowfall contributing to unusual flooding during snowmelt and extreme rainfall events could potentially lead to flooding and erosion on the construction site. Extreme precipitation events, however, are an expected work condition and the construction schedule allows for weather conditions typical for the region.

Coastal erosion, as a result of extreme precipitation and potential flooding, is not anticipated to have an adverse effect on Construction. The rugged and rocky coastline of the Bay of Fundy near the Project is less sensitive to erosion relative to sandy coastlines in Atlantic Canada which are known to be eroding and are the focus of many scientific studies (Bernier *et al.* 2006). Erodible soils on the construction sites will be carefully mitigated using appropriate site drainage and sedimentation and sedimentation control measures, as will be described in the Environmental Protection Plan (Section 2.9.5). As such, the effects of erosion on Construction are anticipated to be not significant, and are thus rated as such.

The effects from maximum current speeds and shear stresses on the sea bed as a result of the interaction of tidal currents and waves on the design and construction of the Marine Terminal and Marine-Based Infrastructure, will be determined and incorporated by the Design Team for the Project using data from a moored ADCP current meter and wave gauge at the location of the marine terminal. This information will be considered in the development of design mitigation for the Project and to minimize the potential effects of the environment on the Project.

Potential effects of climate and climate change on Construction will be communicated to the Design Team. These potential effects will be considered in the planning and design of construction site infrastructure and the scheduling of Construction activities to limit delays, prevent damage to infrastructure and the environment, and to maximize the safety of construction staff. Although it is possible for Saint John to experience extreme weather conditions resulting in Construction delays, a substantive delay (*e.g.,* a delay for more than one season) is not anticipated. The Project will be designed and constructed in agreement with codes, standards, best practices, acts and regulations that insure the required structural integrity, safety, reliability, and environmental and operating performance of the Project to minimize the potential for adverse effects of the environment on the Project.

Therefore, a significant adverse residual effect of climate on Construction of the Project is not anticipated, and is thus rated not significant.

Effects of Climate on Operation

A wide range of climate effects on Operation, on marine-based infrastructure, must be considered in the design of this Project. Forecast climate changes may affect Operation in both positive and negative ways, and vary from nominal to extreme effects. Those climate changes that could potentially have residual environmental effects on Operation are:

- Increased frequency of heavy precipitation events;
- Increased frequency of extreme storms accompanied by heavy and/or freezing precipitation, thunderstorms, strong winds, and salt spray;
- Increased incidence of flooding and erosion;
- Increased sea level rise; and
- Increased frequency and intensity of storm surges.

Each of these effects must be considered in terms of how they may adversely affect the Project if they are not planned, engineered and designed to account for such effects. Such effects could cause:

- Delays in receipt of raw materials and feedstock;
- Increased structural loading;
- Flooding and erosion;
- Loss of electrical power resulting in potential loss of the ability to transfer crude oil and/or finished product;
- Damages to infrastructure that are not feasible to fix, or that may put staff at risk.

As such it is important that the residual effects of climate change, and their anticipated resulting adverse effects on the Project, be carefully taken into account in the planning, design, and construction activities; the selection of materials to be used; and the operating plans for the Project to ensure the long-term viability and sustainability of the Project.

Saint John could, for example, experience heavy rain, snowfall and/or freezing rain events that are capable of, for example, delaying the receipt of raw materials, production and shipping; causing an interruption of services such as electrical power, natural gas or water supply for extended periods of time; or increased structural loading on the Project components. Such potentially adverse environmental effects are unlikely to occur due to the design of the Project. By selecting construction materials, designs and practices that withstand the environmental stressors potentially associated with climate change and severe weather would be more than adequately addressed by engineering design and materials selection. As a result, structures will be designed such that they will be able to withstand extremes of temperature, wind, snow, and ice events. Qualified professional engineers, well acquainted with the climate of southern New Brunswick, will design the structures and foundations to withstand these weather-related factors and loads, in compliance with applicable codes and standards. Design factors of safety, inherently conservative, will likely exceed the projected range of extremes that will be clearly outlined for the Design Team.

Coastal erosion, as a result of extreme precipitation and potential flooding, is not anticipated to have an adverse effect on Operation. The rugged nature of the coastline and the planned implementation of the EPP during Construction mitigate the risk of erosion on the Project, and thus an adverse effect of erosion on Operation is not expected. As such, the potential for erosion to cause an adverse effect on Operation of the Project is rated not significant.

Lightning strikes can result in local or regional power outages that may cause temporary outages within the Marine Terminal and Other Marine-Based Infrastructure. Contingency plans, including emergency back-up power for necessary operations and fail-safe systems, will be in place to manage temporary power outages.

Extreme wind events could affect the berthing of ships and the transfer of fuel at the marine terminal. The TERMPOL review process to be conducted (Chapter 13) will evaluate and simulate navigational procedures and safety under various weather conditions, and these outcomes will be described in a Marine Terminal Manual. Tankers will not be allowed to dock or remain at the facility if sea conditions do not allow safe operation of the fuel transfer facilities. In the event of an extreme weather event during a transfer, the activities would be postponed, and tankers would be dispatched to Port of Saint John anchorages. Vessels in transit within the Bay of Fundy shipping lanes will follow the directions of the Canadian Coast Guard MCTS during extreme weather events. The scheduling and completion of a crude or finished product transfer, even after it has been initiated, is very flexible and can be halted at any time in the interests of safety for the personnel and equipment. Accidental events that could result from severe weather causing interruptions in crude oil and finished product transfer will be prevented by the uses of quick disconnects on transfer arms, such that minimal if any spills would result in such events.

Sea spray, often accompanied with high winds, contains salt that may lead to long-term corrosion on exposed oxidizing metal surfaces and structures of the Project, perhaps weakening these structures, potentially leading to malfunctions, and possibly disrupt electrical connections. This is, however, unlikely as materials used in Construction will be, by design, tolerant of these effects. Further, salt spray effects can be mitigated with operational procedures that include cleaning and the use of protective coatings as required.

Rising sea levels and storm surges will be accounted for in the engineering of and design plans for near sea-level structures. The marine terminal will be built to meet the current and anticipated extreme future environmental loads. Weather warning systems (*e.g.,* Atlantic Tsunami Warning System) will also be consulted on a regular basis as a part of normal Operation and factors of safety will envelope potential changes due to climate change.

As with Construction, the effects from maximum current speeds and shear stresses on the sea bed as a result of the interaction of tidal currents and waves on operation of the Marine Terminal and Marine-Based Infrastructure will be determined by the Design Team to minimize the potential susceptibility of the Project to be adversely affected by effects of the environment.

Potential effects of climate and climate change on Operation will be considered and incorporated in the planning and design of Project infrastructure to minimize the potential for long-term damage to infrastructure, taking into account the existing climate conditions and the reasonably foreseeable future climate conditions. Inspection and maintenance programs will prevent the deterioration of the infrastructure and will help to maintain it in compliance with applicable building codes. Although it is likely that southern New Brunswick will experience extreme weather conditions during Operation, the likely adverse effects on Operation will have been taken into consideration in the planning and design of the Project such that substantive damages are not anticipated. Therefore, a significant adverse residual effect of climate on Operation is not anticipated. Thus the potential effects of climate on the Operation of the Project are rated not significant.

15.5.2 Effects of Seismic Activity on the Project

The Geological Survey of Canada maintains a National Earthquake Database containing information on Canadian earthquakes. Historical information, including location *(i.e.*, epicentres) and magnitude, for the North Appalachian Seismic Zone, within which the Project is located, is available on line at http://earthquakescanada.nrcan.gc.ca/index_e.php .

In New Brunswick, earthquake epicentres occur in three regions: Passamaquoddy Bay, Central Highlands (Miramichi), and Moncton (Natural Resources Canada 2008c). Seismic events have been more frequent in these regions and occasionally of a magnitude to be potentially damaging to structures (*e.g.,* greater than magnitude 5 on the Richter scale), such as the magnitude 5.7 earthquake in the Miramichi Region in January 1982. The seismicity (characterization of seismic event, likelihood and magnitude) of the Assessment Area is discussed in Chapter 6.

The Project, and all related facilities, will be designed to the applicable standard for earthquakes in this area. The intent of these design standards is to maintain the integrity of the facilities based on the level of risk for an earthquake in the area. An earthquake with a magnitude substantively greater than the design-base earthquake could result in damage to the Project. However, design-base earthquake magnitude values are elected based on probability, and it would therefore be very unlikely that the design-base earthquake would be exceeded during the life of the Project. As a result, seismicity is not considered a significant factor with respect to Construction or Operation. With design mitigation including compliance with applicable codes and standards such as the National Building Code of Canada 2005, the potential effects of seismicity on the Project during all phases are rated not significant.

15.5.3 Effects of Acid Rain/Acid Fog on the Project

As discussed in Chapter 7, emissions of sulphur dioxide and nitrogen oxides to the atmosphere contribute to the formation of acid fog and acid precipitation. These acidic particles, once transformed in the atmosphere, can become acid deposition. In New Brunswick, acid deposition is affected by local emissions of sulphur dioxide and nitrogen oxides, as well as by emissions from several large industrial regions located upwind (*i.e.*, the American Midwest, southern Ontario and Québec, and the Washington-Boston region). The effects of acid fog and acid deposition have been recognized, and have been the focus of many studies over the past several decades. As a result, there has been an extensive acid precipitation monitoring network in New Brunswick since the early 1980s.

Acid deposition has generally and slowly declined in the province since the early 1990s (NBENV 2008a). Sulphate in precipitation, a key indicator of acid rain and acid deposition, was moderately higher in 2006 (the most recent year of data available) compared to 2005. However, there has been little change in the overall sulphate and nitrate concentrations in precipitation during the past decade.

In the southern half of the province and in the Saint John region, exceedances of critical loads for acid rain may occur. Critical loads for southern New Brunswick, which range from less than 8 kg/ha/a up to

11 kg/ha/a, are set to protect the most sensitive ecosystems. For instance, the mean annual sulphate wet deposition for the period of 1997 to 2006 was 14.75 kg/ha/a at the Lakewood Heights site in Saint John. While this deposition rate may have an effect on these most sensitive ecosystems, acid deposition beyond critical loads is not likely to affect the Project because of the construction materials that will be used to withstand acidity effects within highly corrosive environments, such as those that are typically found within a refinery. As a result, acid rain/acid fog are not considered an important factor with respect to Construction or Operation, and acid rain/acid fog will result in effects on the Project that are rated not significant for all Project phases.

15.6 Determination of Significance

To summarize, upon consideration of the potential effects of the environment on the Project, professional engineers will design the Project to withstand these conditions by applying good engineering practices and various codes and standards from the National Building Code and other sources. The environment could potentially have an effect on the Project, specifically during Construction and Operation, but this will be mitigated through careful design in accordance with factors of safety, best engineering practice, and adherence with standards and codes. The mitigation measures and strategies described in this CSR and the selection of materials that are able to withstand high pressures, temperatures, corrosion, and loads will more than adequately address these concerns.

Additional mitigation to the selection of materials that withstand these and other potential environmental stressors (*e.g.,* climate, sea spray, seismicity, and other effects of the environment) will include engineering specifications that contain design specific provisions, such as:

- Critical structures and piping, that will be constructed with resilient materials to prevent brittle fracture at low ambient temperature conditions;
- Piping designed to prevent overpressure due to volumetric expansion as a result of solar heat gains;
- Materials selected and designed to withstand or be protected from acid corrosion; and
- Winterization and freeze protection.

In consideration of the significance criteria (Section 15.4), the Project will be mitigated such that the environment will not affect the Project to the extent that there is:

- A substantial loss of the Project schedule;
- A substantive interruption in service;
- Damage to the Project infrastructure resulting in a substantial increase in public health and safety risk or business interruption;
- Damage to the Project infrastructure resulting in repairs that could not be technically or economically implemented; or
- Failed mitigation causing environmental damage that could not be technically or economically corrected or compensated in a feasible manner.

Planning, design, and construction strategies intended to minimize the potential effects of the environment on the Project reduce the risk of serious damage or interruption of service to acceptable levels. Mitigation measures include, among other things, designing structures to relevant codes and standards and applying conservative factors of safety to mitigate the potential effects of the environment (*e.g.,* earthquakes, climate change, global sea level rise, extreme weather, and other environmental phenomena), and scheduling of activities to allow for weather disruptions. A significant effect of the environment on the Project would be one that would result in a catastrophic interruption in service or damage to infrastructure that would persist for greater than three months or that would result in repairs that could not be economically implemented.

Therefore, based on a consideration of the various mitigation measures and strategies described in the Project Description and other sections of this CSR, it is concluded that the effects of the environment on the Project during any phase of the Project are not significant and will be managed by responsible design. Similarly, the effects of the environment on the Project are cumulatively rated not significant.

16.0 ACCIDENTS, MALFUNCTIONS, AND UNPLANNED EVENTS

Accidents, Malfunctions, and Unplanned Events are accidents or upset events or conditions that are not planned as a part of routine Project activities during any Project phase. Even with the best planning and application of mitigation, Accidents, Malfunctions, and Unplanned Events could occur during any phase of the Project as a result of wear and tear, acts of nature, extreme weather events, human error, equipment failure, and other possible causes. Many accidents, malfunctions, and unplanned events are, however, preventable and can be readily addressed or prevented by good planning, design, equipment selection, hazards analysis and corrective action, emergency response planning, and mitigation.

The Development Proposal is being designed and will be constructed and operated with the utmost regard for health, safety and environmental protection to minimize its potential environmental effects that could result during the normal course of Construction, Operation, and Decommissioning and Abandonment as well as those that could result from Accidents, Malfunctions, and Unplanned Events. Prevention and mitigation measures will be accomplished by adhering to the following general principles:

- Use of best available proven technology economically viable for controlling and minimizing releases to the environment;
- Implement effective emergency planning and preparedness; and
- Develop and apply procedures and training aimed at safe operation of the facilities in a manner that prevents or avoids Accidents, Malfunctions and Unplanned Events.

Chapter 3 provided detailed discussion of the elements and assets that have been selected to accomplish the safe, reliable, and environmentally responsible implementation of the Project, as well as how it will be carefully constructed, operated, and ultimately decommissioned in a manner that minimizes the potential for Accidents, Malfunctions, and Unplanned Events to occur. Project components will be inherently safe by design and will follow strict codes and standards. A Quality Assurance system will be implemented to ensure that final design is in accordance with safety standards with considerable factors of safety. These and other measures, implemented as part of the planning and design stages of the Project, are inherently intended to minimize the potential for accidents, malfunctions, and unplanned events to occur, and with their development and implementation, the probability of or potential for such events to occur will be greatly reduced. In the unlikely event of an accident, malfunction, or unplanned event, emergency response plans and corrective action procedures will be implemented to minimize the resulting environmental effects. Employees will be trained in operational procedures and environmental emergency response procedures, including safety measures to prevent and respond to Accidents, Malfunctions, and Unplanned Events.

In this chapter, the potential credible Accidents, Malfunctions, and Unplanned Events that could occur during any phase of the Project and potentially result in adverse environmental effects are described, discussed, and assessed to meet the requirements of the federal EA Track Report and Scoping Document. The focus of the assessment is on credible accidents or scenarios that have a reasonable probability of occurrence and for which the resulting environmental effects could be significant in relation to the identified thresholds of significance for each VEC. Those accidents that would have potential environmental effects that could not possibly be significant on the basis of significance criteria established in Chapters 7 to 14, even without mitigation, are not necessarily explicitly discussed except where required in the EA Track Report/Scoping Document. While not all accidents, malfunctions and upset conditions can reasonably be reviewed or assessed, scenarios have been conservatively selected to represent higher consequence events that would tend to address the consequences of less likely or lower consequence scenarios. The focus of environmental effects assessment will be on the consequences of the environmental effects resulting from the accident or scenario, rather than on the mechanism by which the accident or scenario could occur. Accidents, Malfunctions and Unplanned Events identified as credible were evaluated in isolation, as the probability of a series of accidental events occurring in combination with each other is highly unlikely.

Necessarily, the environmental effects assessment of Accidents, Malfunctions, and Unplanned Events presented in this chapter differs from the EA methodology described in Chapter 5 for routine Project activities with respect to the following key issues.

- Only Project-related environmental effects of Accidents, Malfunctions and Unplanned Events are assessed. The cumulative environmental effects of Accidents, Malfunctions and Unplanned Events with existing or other planned or future projects and activities that have been or will be carried out will not be evaluated. Given that accidents are inherently unplanned events and for the most part are very unlikely to occur, it is not reasonable to assess their cumulative environmental effects as potentially overlapping with those environmental effects of projects or activities that are planned and will reasonably occur from the Project in combination with other existing or planned future projects. Also, given that accidents and their associated environmental effects would be expected to be unlikely to occur, infrequent, and of short duration, any cumulative environmental effects that could occur from accidents that overlap with those of other projects and activities would be short-lived and would be expected to be largely encompassed within the cumulative environmental effects assessment of the Construction, Operation, and Decommissioning and Abandonment of the Project as planned.
- Other than for incident investigation and corrective action implemented following an Accident, Malfunction, or Unplanned Event, follow-up and monitoring is not further addressed in this chapter, as any Project-related accidental event would be one that is, by its very nature, unplanned and thus would require specific measures to be developed in the unlikely event that it should occur.

With this context established, and based on the Project Description (Chapter 3) and the mitigation proposed, various credible accidents, malfunctions, or unplanned events and associated scenarios have been carefully selected by the Study Team (in consultation with the Proponent and its Design Team) to address the requirements of the EA Track Report in respect of Accidents, Malfunctions, and Unplanned Events. Since it is impossible to review and assess all possible accidents, malfunctions and upset conditions, the Study Team has conservatively selected scenarios which represent higher consequence events that would more than adequately address the consequences of less likely or lower consequence scenarios. The Accidents, Malfunctions, and Unplanned Events of the Project, along with the scenarios whereby such Accidents, Malfunctions, and Unplanned Events may occur, are summarized in Table 16.1. A discussion of each accident, malfunction, and unplanned event and the credible scenarios identified in Table 16.1 is provided in the sections that follow the table.

Table 16.1 Potential Accidents, Malfunctions, and Unplanned Events and Scenarios Evaluated

Potential Accident, Malfunction, or Unplanned Event	General Description	Credible Potential Scenarios Evaluated
1. Loss of Containment	Loss of containment of mitigation, sedimentation and erosion control measures.	Loss of containment resulting from: a) Failure of erosion and sedimentation control measures; b) Breach of secondary containment for tank; and c) Breach of wastewater treatment systems.
2. Hydrocarbon Spill in the Marine Environment	Spill of crude oil or finished product (diesel) at various locations in the Bay of Fundy. Mechanism of spill is considered not relevant for the most part. A gasoline spill is less of a concern and as such is not evaluated.	A small (500-1,000 m^3) spill of diesel or heavy crude at the marine terminal, and a large (10,000 m^3) spill of diesel or heavy crude at the anchorage and along the shipping lanes (*i.e.,* key locations in the Bay of Fundy where the risk of spills could be considered highest), evaluated by season.
3. Vessel Accident	An accident occurring as a result of vessel navigation in the Bay of Fundy, without spills.	a) Collision with marine Species at Risk or Species of Conservation Concern; b) Vessel grounding; c) Ship to ship collision involving no release of hydrocarbons (a collision with hydrocarbon spills already evaluated as part of a Hydrocarbon Spill in the Marine Environment); d) Damage to commercial fishing gear from vessel movements in the Bay of Fundy; and e) Fires and/or explosions in the marine environment.
4. Introduction of Invasive Species	Introduction of invasive species in the terrestrial, wetland, freshwater aquatic, or marine environments. The focus is on the consequence of the introduction of invasive species in these environments, not on how these species may have been introduced.	a) Introduction of invasive species in the Marine Environment.
5. Discovery of a Heritage or Archaeological Resource	Discovery of a previously undiscovered heritage or archaeological resource during Construction, Operation, or Decommissioning and Abandonment.	a) Discovery of a Heritage or Archaeological Resource in the marine environment.

16.1 Loss of Containment

Loss of Containment has potential to occur primarily due to failure of erosion and sedimentation control measures, breach of secondary containment for tanks, or breach of wastewater treatment systems. These accidents have the potential to spill hazardous substances such as petroleum products (gasoline, diesel, and oil), industrial chemicals, or water containing suspended solids into the environment, which may result in potentially adverse environmental effects. Although other minor accidents may occur that have lesser environmental effects, the accidents described below are considered to be the worse case scenarios.

Construction, Operation, and Decommissioning, and Abandonment phases of the Project will be conducted in a manner as to minimize the potential for adverse environmental effects from Loss of Containment. Preventive programs and policies, design, and a well developed emergency response plan will be developed for the Project.

As conceived, planned and designed, the Project will inherently provide a high level of mitigation for the potential environmental effects caused by loss of containment. Therefore, as will be described below, the potential environmental effects of Loss of Containment on all VECs are rated not significant.

16.1.1 Description of Scenarios

Loss of containment resulting in a release to the marine environment has been selected as a credible accident, malfunction or unplanned event that may occur throughout the Project.

A loss of containment could occur due to material flaws in the collection ponds/tanks, a rupture in the ponds/tanks due to a heavy rainfall event or a hurricane, or an unplanned discharge of untreated wastewater due to the WWTP treatment capacity being exceeded. This could result in the ponds/tanks spilling their contents onto the surrounding land, or a discharge of untreated or partially treated wastewater to the Marine Environment. Untreated effluent could potentially contain petroleum hydrocarbons, oil and grease, phenols, sulphide, suspended sediment, and other contaminants.

The potential environmental effects of such an accident could include interactions with a Change in Marine Population, and/or Change in Coastal Wetland Quality and Quantity.

16.1.2 Environmental Effects Assessment

The potential interactions between these scenarios and the selected VECs for this CSR are summarized in Table 16.2.

Table 16.2 Potential Interactions Between VECs and Loss of Containment

Valued Environmental Component (VEC)	Loss of Containment
	Breach of Wastewater Treatment Systems or Tank Rupture
Atmospheric Environment	0
Public Health	0
Coastal Wetland Environment	1
Marine Environment	1
Commercial Fisheries	0
Marine Safety	0

Table 16.2 Potential Interactions Between VECs and Loss of Containment

Valued Environmental Component (VEC)	Loss of Containment
	Breach of Wastewater Treatment Systems or Tank Rupture
Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons	0
Heritage and Archaeological Resources	0

Notes: Interactions between Accidents/Scenarios and the respective VECs were ranked as follows:
0 No interaction, or no substantive interaction contemplated.
1 Interaction may occur. However, based on past experience and professional judgment, the interaction would not result in a significant environmental effect, even without mitigation, or the interaction would clearly not be significant due to application of codified practices.
2 Interaction may, even with codified mitigation, result in a potentially significant environmental effect and/or is important to regulatory and/or public interest. Potential environmental effects are considered further and in more detail in the CSR.

No interaction (ranked as 0 in Table 16.2) is foreseen between Loss of Containment and a number of VECs. These include Atmospheric Environment, Public Health, Commercial Fisheries, Marine Safety, Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, and Heritage and Archaeological Resources. Potential environmental effects of Loss of Containment on these VECs ranked as a 0 are not likely to occur and are rated not significant. There is a high degree of confidence in this prediction.

The Loss of Containment scenario has the potential to interact with Coastal Wetland Environment, and Marine Environment, which have been ranked as 1 in Table 16.2. Tanks and wastewater storage units will not be located in important habitat for SAR or SOCC. Loss of Containment due to a breach of wastewater treatment systems or tank rupture would likely be contained and remediated through the implementation of emergency spill response procedures. Wastewater released due to the capacity of the WWTP being exceeded would be temporary and rapidly dispersed in the marine environment due to strong tidal currents and turbulent mixing forces from wind, current and waves. Breach of secondary containment for tanks would be quickly responded to via emergency spill response procedures. Hydrocarbon spills to the Marine Environment are addressed in Section 16.2 and are not considered further in this section.

Based on the above, the potential environmental effects of Loss of Containment on the VECs ranked as 1 for all phases of the Project are rated not significant. There is a high level of confidence in the prediction.

16.2 Hydrocarbon Spill in the Marine Environment

A Hydrocarbon Spill in the Marine Environment has the potential to occur primarily due to an accident during loading or unloading activities at the marine terminal, or due to tanker collision or grounding in the Bay of Fundy. If they occurred, these accidents have the potential to spill diesel (and other products) or heavy crude oil into the marine environment. This assessment focuses on crude oil and diesel, the two persistent oils that will be refined or produced by the Project of the most concern from a spill perspective. Although other smaller spills or spills of other types of products (*e.g.,* gasoline) may occur that may have lesser environmental effects than those discussed in this section, the emphasis in this section is on larger spills that are considered to be the worse case credible scenarios.

The information provided in this section is based on the results of spill probability calculations and fate and trajectory modelling detailed in the document entitled “Marine Oil Spill Probability, Response Planning, and Fate and Trajectory Modelling Technical Study” conducted by SL Ross Environmental

Research Ltd. (SL Ross 2008) on behalf of the Proponent. The firm is a widely known scientific authority for such technical studies.

A review of international oil tanker spill statistics reveals that spill rates have been declining steadily since the 1970s, and that spill rates in the 2000s are about half the spill rates recorded prior to 1999. A review of the ship sourced spill history provided by ALERT Inc. for Saint John shows that there has been only one ship sourced spill since 1999, and none greater than 1 bbl.

Spill probabilities calculated for the Project indicate that small spills (1 to 49 bbl) (SL Ross 2008) are likely to occur during the life of the Project, but that the likelihood of larger spills is extremely low. These conservative spill rates were calculated using more complete data from 1985-1999 for average international oil tankers. It is essential to recognize in this section however, that international spill rates for oil tankers since 1999 are about half the spill rates of previous years. This is because tankers, procedures and regulations that apply to and will be used for the Project will be much safer than the assumed tanker technology in the spill rate calculations. For example, all ships operated by Irving Oil are double-hulled, and third parties carrying crude oil or products for the Project will be encouraged to use double-hulled ships. The analyses in this regard are consequently very conservative. In the past few decades there has been international focus and effort on the improvement of hydrocarbon shipping safety and the newer but incomplete data sets indicate a very substantial trend towards fewer spills. This is coupled with other improved mitigation in relation to an increasing trend in the industry of double-hulled ship use and improved emergency response which in Canada, is very well regulated under the *Canada Shipping Act, 2001*.

The behaviour of oil spills is dependent on a number of factors, including the size of the spill, the type of oil spilled (heavy crude versus diesel), the location of the spill, the time of year, the wind speed and direction, the air temperature, the tidal cycle, and the timing and level of emergency response and clean-up. Depending on the specific conditions at the time, a large spill could potentially affect several VECs in the Bay of Fundy.

Through all phases of the Project, preventative measures will be implemented to avoid Hydrocarbon Spills to the Marine Environment, in regard to environmental management, including the following:

- HSE Management System;
- Standard Operating Procedures;
- TERMPOL review process;
- Marine Terminal Manual; and
- Environmental Protection Plan for Construction.

The prevention of and response to oil spills in the Marine Environment are very strictly regulated in Canada to prevent and minimize their consequences. Prior to commencement of Operation, an Oil Handling Facility Oil Pollution Emergency Plan (OPEP) will be prepared in accordance with the *Response Organizations and Oil Handling Facilities Regulations* under the *Canada Shipping Act, 2001.* The Proponent will be responsible to have a contractual arrangement with the Response Organization for the Bay of Fundy. ALERT Inc. is the Response Organization in the Bay of Fundy responsible under the regulations to have the oil spill procedures, equipment and resources to respond to an oil spill of >50 bbl and <10,000 t. Similarly, ships entering the Bay of Fundy must be in full compliance with the *Regulations for the Prevention of Pollution from Ships and for Dangerous Chemicals* under the *Canada*

Shipping Act, 2001, and must have a Shipboard Oil Pollution Emergency Plan and the capability to respond to small spills. Ships must also have an arrangement with a Response Organization for larger spills. The regulations outline the requirements for extensive mitigation measures for the prevention of oil spills from ships.

Containment and recovery equipment to deal with small and modest-sized spills will be pre-staged in the area of the marine terminal such that it can be quickly deployed in the event of a spill. For larger spills at the marine terminal, or for those that may result from a tanker incident away from the marine terminal, the response will require the activation of additional resources, as prescribed in the Response Organization Standards outlined in the *Canada Shipping Act, 2001* and regulations.

As will be further elaborated in the subsections that follow, the probability of a large Project-related spill occurring during the life of the Project is extremely low, as determined by probabilistic predictions of Project spills and as evidenced by the spill history at Canaport and elsewhere. Should a spill occur in the Bay of Fundy, the potential environmental effects of such a spill could potentially be significant for several VECs, but it will be demonstrated that these spills are not likely to occur, and the consequences mitigated by emergency planning and preparedness.

16.2.1 Spill Probability

16.2.1.1 Worldwide Spill History

There have not been many large marine oil spills in Canadian waters; therefore, SL Ross (2008) has used a database on large tanker spills that have taken place on a worldwide basis to estimate large-spill frequencies. For relatively small spills, SL Ross (2008) has used the Canadian government database to estimate probability.

Based on worldwide traffic data from 1974 to 1999, the average crude oil tanker size in the world (*i.e.*, average oil delivery per voyage) is approximately the same size of the tankers that will be used to transport crude oil for the Project (SL Ross 2008). Bercha *et al*. (1983) calculated that the average voyage length of a crude oil tanker operating worldwide is approximately 8,000 km, which is similar to the transit distances for crude oil when shipped from Middle East sources (SL Ross 2008).

<u>Large Spill Frequency</u>

Major spills considered by SL Ross (2008) fall into the following spill size categories:

- Extremely large spills: >100,000 bbl (13,300 t);
- Very large spills: >10,000 bbl (1,330 t); and
- Large spills: >1,000 bbl (133 t).

Spills in the large category include very large and extremely large spills. Similarly, very large spills include those in the extremely large spills category.

Based on 1974 to 1999 worldwide data from the US Materials Management Service (USMMS 2000), SL Ross (2008) shows the spill frequency has decreased dramatically since the 1980s (Table 16.3). The dataset includes spills in all three large spill categories that have occurred during this 26-year period, both in port (*i.e.*, in harbours or at piers) and at sea (*i.e.*, away from ports either in restricted waters or in open water).

Table 16.3 Number of Worldwide Crude Oil Spills Greater Than or Equal to 1,000 bbl from Tankers, and Crude Oil Movements, 1974-1999

Year	All Spills[1]	------Spills in Port (bbl)------			------Spills At Sea (bbl)------			Crude Oil Movements[1] (10^9 bbl)	Spills Per 10^9 bbl of Crude Oil Moved
		1,000-9,999	10,000-99,999	100,000 or greater	1,000-9,999	10,000-99,999	100,000 or greater		
1974	21	7	2	1	6	3	2	10.17	2.07
1975	21	2	2	2	6	6	3	9.33	2.25
1976	19	6	2	1	2	2	6	10.51	1.81
1977	16	2	2	1	3	3	5	10.69	1.50
1978	17	3	2	1	3	4	4	10.48	1.62
1979	23	4	2	3	4	5	5	10.96	2.10
1980	11	1	1	1	3	2	3	9.66	1.14
1981	8	3	1	0	4	0	0	8.54	0.94
1982	8	3	1	1	3	0	0	7.32	1.09
1983	13	4	1	0	1	4	3	6.86	1.90
1984	8	2	3	0	1	2	0	6.84	1.17
1985	6	1	2	0	0	2	1	6.35	0.95
1986	6	2	0	0	1	3	0	7.19	0.83
1987	15	5	1	0	5	4	0	6.76	2.22
1988	9	3	3	0	2	0	1	7.41	1.22
1989	13	2	1	0	1	6	3	8.04	1.62
1990	11	5	0	0	2	4	0	8.71	1.26
1991	9	3	0	1	2	1	2	9.18	0.98
1992	7	3	0	1	1	2	0	9.30	0.75
1993	6	0	1	0	2	1	2	9.87	0.61
1994	6	1	1	1	1	0	2	10.08	0.60
1995	6	3	0	0	3	0	0	10.29	0.58
1996	7	3	0	1	3	0	0	10.62	0.66
1997	6	1	0	1	2	2	0	11.32	0.53
1998	3	3	0	0	0	0	0	11.62	0.26
1999	3	1	0	0	1	1	0	11.57	0.26
Total	278	74	28	16	62	57	42	239.67	1.16

Notes:
[1] 278 spills totalling 26,091,500 bbl spilled; excludes in-land spills.
Largest tanker spill was 1,869,000 bbl
Sources: BP Amoco (2000); BP (1998); USMMS (2000)
Note: 28 spills were added to 1974 to 1992 data since Anderson and LaBelle (1994)

Worldwide oil spill frequencies for the three different spill size categories are summarized in Table 16.4. Average and median spill sizes are provided in Table 16.5. The average size spill is derived by dividing the total volume spilled by the total number of spills. The median spill size in a given category means that 50% of the spills were smaller than the median size and 50% were larger. The average size is much larger than the median size because the former number is heavily skewed by the small number of historical supertanker spills that have resulted in a total loss of cargo, in the range of 100,000 t (720,000 bbl) and more (SL Ross 2008).

Table 16.4 Worldwide Tanker Spill Rates

Spill Source	Old Rate, 1974-1992[1]			Updated Rate, 1974-1999			Last 15 Year Rate, 1985-1999		
	Volume (10^9 bbl)	Number of Spills	Spill Rate	Volume (10^9 bbl)	Number of Spills	Spill Rate	Volume (10^9 bbl)	Number of Spills	Spill Rate
Spills Greater Than or Equal to 1,000 bbl									
All Spills	164.40	213	1.30	239.67	278	1.16	138.31	113	0.82
In Port		77	0.47		117	0.49		50	0.36

Table 16.4 Worldwide Tanker Spill Rates

Spill Source	Old Rate, 1974-1992[1]			Updated Rate, 1974-1999			Last 15 Year Rate, 1985-1999		
	Volume (10^9 bbl)	Number of Spills	Spill Rate	Volume (10^9 bbl)	Number of Spills	Spill Rate	Volume (10^9 bbl)	Number of Spills	Spill Rate
At Sea		136	0.83		161	0.67		63	0.46
Spills Greater Than or Equal to 10,000 bbl									
All Spills	164.40	119	0.72	239.67	143	0.59	138.31	51	0.37
In Port		31	0.19		44	0.18		14	0.10
At Sea		88	0.53		99	0.41		37	0.27
Spills Greater Than or Equal to 100,000 bbl									
All Spills	164.40	52	0.31	239.67	58	0.24	138.31	16	0.12
In Port		12	0.07		16	0.07		5	0.04
At Sea		40	0.24		42	0.17		11	0.08

Notes:
Spill Rate = Spills per 10^9 bbl handled.
Crude oil spills only, excludes barges and in-land spills.
[1] Anderson and LaBelle (1994).
Sources: BP Amoco (2000); BP (1998); USMMS (2000).

Table 16.5 Worldwide Tanker Spill Sizes, 1985-1999

Tanker Spills[a]	Number of Spills	Average Spill Size (bbl)	Median Spill Size (bbl)
Spills > 1,000 bbl			
In Port	117	56,300	3,600
At Sea	161	81,000	14,300
All Spills	278	70,100	7,900
Spills > 10,000 bbl			
In Port	14	192,300	43,000
At Sea	37	135,000	60,000
All Spills	51	150,800	56,900

Notes:
[a] Crude oil spills only, excludes barge and inland spills (1 bbl = 0.159 m^3).
Source: Anderson and LaBelle (2000).

The 1985 to 1999 at sea spill statistics have been further categorized (Table 16.6): spills in restricted waters, defined as waters less than 93 km (50 nautical miles) from land; and spills in the open sea, that is, beyond 93 km of land. Spills in the open sea represent about 19% of the total number of large spills (SL Ross 2008). Most tanker spills occur during loading and unloading in port, or as a result of collision and grounding accidents (Table 16.7), which generally take place in harbours and restricted waters (SL Ross 2008). Large tanker spills in the open sea are most likely to result from hull failures during poor weather, or fires and explosions (SL Ross 2008).

Table 16.6 Worldwide Tanker Spill Rates for Large Spills (>1,000 bbl) in Port, Restricted Waters and Open Sea, 1985-1999

Location	Number of Spills	Spill Rate (spills per 10^9 bbl)
In Port	50	0.36
Restricted Waters (< 50 nautical miles)	51	0.37
Open Sea (> 50 nautical miles)	12	0.088
All Locations	113	0.82*

Notes:
* based on number of spills divided by total volume of oil transported in the period.

Table 16.7 Incidence of Tanker Spills[a] by Cause, 1974-2007

Cause	<50 bbl (<7 t)	50 to 5,000 bbl (7 to 700 t)	>5,000 bbl (>700 t)	Total
Operation				
Loading/discharging	2,823	333	30	3,186
Bunkering	548	26	0	574
Other operations	1,178	56	1	1,235
Accidents				
Collisions	175	300	98	573
Groundings	235	226	119	580
Hull failures	576	90	43	709
Fires and explosions	88	15	30	133
Other/Unknown[b]	2,186	150	25	2,361
Total	7,809	1,196	346	9,351

Notes:

[a] Database includes crude oil spills and product oil spills.

[b] “Other” includes spills “for which the relevant information is not available or where the cause was not one of those given”. Note that 93% of the spills in this category are less than 50 bbl.

Source: International Tanker Owners Pollution Federation Ltd. (ITOPF 2008).

Recent Trends

A summary of spill statistics from the International Tanker Owners Pollution Federation Ltd. (ITOPF) indicate a general decline in the rate of tanker spills over the past three decades (Table 16.8).

Table 16.8 Spill Volume by Decade

Decade	Spill Quantity (t)	Average Spill Quantity per Year (t/a)
1970s	3,142,000	314,200
1980s	1,176,000	117,600
1990s	1,138,000	113,800
2000 – 2006 (latest year available)	192,000	24,000

Source: ITOPF (2008).

A very few large spills are responsible for a high percentage of the total spill volume (SL Ross 2008). For example, in 2002, the Prestige spill (off the coast of Spain) of 63,000 t, a spill of heavy fuel oil from a product tanker, accounts for 33% of the total spilled in the years 2000 to 2007. The reduction in annual spill volume over the period displayed is mainly a result of a near-elimination of extremely large and very large spills resulting from total or near-total losses. The decline in annual spill volume is even more notable when compared with the increase in the exposure variable, the annual volume of oil shipped by tanker which has increased from an average of 9.2×10^9 bbl/yr in 2000 to 16.9×10^9 bbl/yr in 2006 (UN 2006).

The frequency of spills in the ITOPF size ranges is shown in Table 16.9, but is not directly comparable with the USMMS data due to the difference in size categories. The most dramatic decline in spill frequency is from the 1970s to the 1980s, but the data show a continued decline through the 1990s and 2000s and current rates appear to be less than half the rates evident in the mid 1980s and 1990s.

Table 16.9 Frequency of Spills by Decade

Decade	Number of Spills per Year	
	7 to 700 tonnes	>700 tonnes
1970s	54	25
1980s	36	9
1990s	28	8
2000-2007	15	4

Source: ITOPF (2008)

Small and Medium Spills

Small and medium sized spills occur much more frequently than spills larger than 1,000 bbl. These smaller spills can occur due to leaking or broken pipes or hoses during transfer operations, leaking fittings, ill-timed opening of valves, and overfilled tanks. Spill frequencies for small and medium size oil spills have been calculated by SL Ross (2008) using Canadian spill statistics (Table 16.10).

Table 16.10 Medium and Small Crude Oil Spills from Tankers in Canadian Waters (1973-1996)

Spill Size Range (bbl)	Number of Spills	Average Spill Size (bbl)
1 to 49	31	10.4
50 to 999	6	233

SL Ross (2008) converted these statistics into spill frequencies per billion barrels (10^9 bbl) transported (Table 16.11) by considering the oil volumes transported in Canada. The volume of crude oil traffic in Canada over the given time period was about 22 million tonnes per year, or about 0.165 x 10^9 bbl per year. This crude oil was generally imported to the east coast of Canada or exported from the west coast of Canada by tanker.

Table 16.11 Frequencies of Medium and Small Crude Oil Spills from Tankers in Canadian Waters (1973-1996)

Spill Size Range (bbl)	Spills per 10^9 bbl Transported
1 to 49	15
50 to 999	3.0

16.2.1.2 Spill History for the Canaport Marine Terminal

SL Ross (2008) has compiled a history of ship sourced spills for the Port of Saint John based on data provided by ALERT Inc. (Table 16.12). Not all of the spills reported are related to Irving Oil's operation. Of the 23 incidents recorded for the period 1989 to present, 15 are recorded as unknown volume of oil spilled. If it is assumed that these spills are in the 1 to 49 bbl size range (and this may be conservative as some may be smaller than 1 bbl), there have been 18 spills in the 1 to 49 bbl range, two in the 50 to 999 bbl range, and none larger. The volume of oil handled by Canaport in this 19-year period was approximately 2 billion bbl, so the spill frequency for the marine terminal is actually somewhat lower than the frequencies listed for Canadian waters (Table 16.11). The spill frequency for Irving Oil is summarized as follows:

- 9 spills per billion barrels transported in the 1 to 49 barrel size range; and
- 1 spill per billion barrels transported in the 50 to 999 barrel size range.

Table 16.12 Recorded Ship Sourced Spills, Saint John Harbour, 1989-2007

Vessel Name	Date	Location	Product	Volume Spilled	Comments
Camargue	Jun 1989	Canaport SBM	IFO	40 bbl	Spill during fuelling
Ensor	Dec 1989	Anchorage	Crude	unknown	Ship arrived with crack in hull
Barbo	Nov 1990	unknown	unknown	unknown	None
Glenville	Dec 1990	unknown	unknown	unknown	None
Torm	Jan 1992	Pier 1 west	unknown	unknown	None
Shark VII	Mar 1992	Pier 13 west	unknown	unknown	Crack in hull, clean up effected
Titio Tapas	Jan 1994	unknown	Bunker	900 bbl	fuel spill (reported as 120 t)
Irving Arctic	Jan 1994	East Saint John, Irving Oil	unknown	unknown	None
Nunki	Oct 1994	East Saint John, Irving Oil	unknown	unknown	Crack in hull
Katana	Nov 1994	East Saint John, Irving Oil	MTBE	unknown	None
Argus	May 1995	East Saint John, Irving Oil	unknown	4 bbl	clean up effected
Boree	Sep 1995	Canaport SBM	Bunker	230 bbl	Ship internal settling tank overflowed, clean up effected (reported as 31 t)
(unknown)	Feb 1996	East Saint John, Irving Oil	MTBE	15 to 20 bbl	None
Wellington Kent	Feb 1996	East Saint John, Irving Oil	unknown	unknown	None
Farandale	Apr 1997	East Saint John, Irving Oil	Bunker	unknown	None
Irving Timber	Jul 1997	Pier 1 west	unknown	unknown	None
Sea Spirit	Sep 1997	unknown	Bunker	unknown	None
Irving Eskimo	Apr 1999	East Saint John, Irving Oil	Gasoline	unknown	no clean up required
Concord	May 1998	East Saint John, Irving Oil	Hydraulic Oil	unknown	none
Polls Roberson	Jul 1998	East Saint John, Irving Oil	unknown	unknown	None
Thelasa Desgagnes	Jul 1999	East Saint John, Irving Oil	Bunker	less than 50 gal.	clean up effected
Atlantic Beech	Oct 1999	East Saint John, Irving Oil	Diesel	19 gal.	None
Ocean Echo II	Sep 2007	Container Terminal	Diesel	2 to 3 gal.	Transport Canada required no clean-up

Source: D. Case, personal communication, April 10, 2008.

Spill Probability Predictions for the Project

Using the spill frequencies described in the previous sections, the probability of spills from the Project Operation have been predicted by SL Ross (2008) for five size categories (Table 16.13), based on the estimated annual average throughput of the Project of 300,000 bbl of crude oil per day (1.1×10^8 bbl/year). The predicted frequency for each size range and location category is reported as spills/year (the average number of spills that would occur in a given year), and years/spill (the average number of years between spills).

Table 16.13 Predicted Frequency of Tanker-Related Crude Oil Spills as Part of the Project

Size Category (bbl)	Location Category	Historical Rate (spills per 10^9 bbl transported)	Average Spill Size (bbl)	Median Spill Size (bbl)	Predicted Frequency for the Project	
					Spills/Year	Years/Spill
1 to 49		15	10.4	-	1.7	0.59
50 to 999		3.0	233	-	0.33	3.0
>1,000	All	0.82	70,100	7,900	0.090	11
	Port	0.36	56,300	3,600	0.040	25
	Restricted	0.37	--	--	0.041	25
>10,000	All	0.37	150,800	56,900	0.041	25
	Port	0.10	192,300	43,000	0.011	91
	At Sea	0.27	--	--	0.030	34
>100,000	All	0.12	--	--	0.015	76

SL Ross (2008) calculates that spills of 1 to 49 bbl may occur one to two times every year, and spills of 50 to 999 bbl may occur approximately once every three years, making them a distinct possibility within the lifetime of the Project. Spills greater than 1,000 bbl are predicted to occur approximately once every 25 years. Spills greater than 10,000 bbl are unlikely events, and increasingly unlikely as the size range increases. It is important to note that spill frequencies calculated in this study were based on the conservative assumption that the tankers used for the Project will be as safe, but no safer, than the average tankers that have been used internationally over the past 20 years. This is a conservative assumption since tankers of the current generation have far more safety and spill-control features than conventional tankers of the past. The recent spill statistics produced by ITOPF indicate that the operation of tankers is much safer in recent years, and rate of spills since 1999 are about half those used to calculate the spill probabilities for the Project.

16.2.2 Spill Fate and Trajectory Modelling

This section provides an overview of the parameters used in the spill fate and trajectory modelling conducted by SL Ross (2008) and the results of the modelling conducted for the Project. The objective of this modelling is to assess the behaviour and trajectory of oil spills that might occur during the marine shipping activities proposed for the Project. The spills of concern are vessel-based batch spills of heavy crude oil shipped into the refinery and diesel fuel shipped out of the marine terminal. The approach is to select a number of hypothetical oil spills that cover the main concerns and to describe their behaviour and trajectory in detail. These spill scenarios, involving various spill types and sizes, serve subsequently as the basis for environmental effects assessment and the development of mitigation.

The modelling results presented assume that no spill countermeasures have been implemented. The implementation of spill countermeasures in the event of a spill may significantly alter the ultimate fate of the spilled oil. Spill countermeasures are regulated under the *Canada Shipping Act, 2001*.

- For spills in port, there will be an immediate and active on-water spill response capability. The type of response will be dictated by the nature of the incident and the weather and sea conditions at the time of the spill. Containment and recovery equipment to deal with small and modest-sized spills will be pre-staged in the area of the marine terminal and at ALERT Inc. such that it can be quickly deployed in the event of a spill.

For larger spills at the marine terminal, or for those that may result from a tanker incident away from the marine terminal, the response will require the activation of additional resources, as prescribed in the planning standards outlined in the *Canada Shipping Act, 2001*, Sections 168 and 169. These standards mandate a tiered response capability through a Transport Canada-certified Response Organization. The volume of oil handled at the refinery will lead to the location being classified as a Primary Area of Response, so the response time standards will be:

- 150 t response capability: within 6 h, equipment to be deployed on-site;
- 1,000 t response capability: within 12 h;
- 2,500 t response capability: within 18 h; and
- 10,000 t response capability: within 72 h.

16.2.2.1 Model Parameters

SL Ross (2008) considered two basic spill types in the modelling:

- Large tanker spills of either incoming heavy crude oil or outgoing diesel fuel due to tanker collision or grounding; and
- Smaller spills of either heavy crude or diesel fuel as a result of accidental spillage during unloading or loading at the marine terminal.

For the model, SL Ross (2008) has assumed that maximum credible spills of diesel fuel and heavy crude due to collision or grounding events would be most of one full vessel compartment or about 10,000 m^3 of oil. It also has been assumed that the tanker accidental discharges will occur over a 2 hour period in four discrete parcels ("spillets") of 2,500 m^3. At the port facility, 500 m^3 diesel fuel and 1,000 m^3 heavy crude oil spills have been modelled as the maximum credible spills from loading and unloading. The oil is assumed spilled instantaneously in a single batch.

A number of meteorological and physical oceanographic conditions influence the fate and trajectory of oil spills in the marine environment, including water currents and tidal regime, air and water temperatures, and wind speed and direction. The SL Ross Oil Spill Model (SLROSM) incorporates these environmental conditions into fate and trajectory modelling. Seasonal average wind speeds for summer and winter have been used to model the fate and trajectory of Project-related oil spills in the Bay of Fundy. Average wind data have been used in the modelling to provide an indication of the most likely trends in the fate and movement of oil spills. The trajectories resulting from the use of average wind directions do not reflect what will happen in an actual spill where the wind direction and speed can change dramatically over the length of the spill simulation and cause the oil slick to move in a more circuitous path than that predicted using average wind data. The use of average wind speeds and predominant wind directions in trajectory modelling generally results in the prediction of shorter time-to-shore estimates and is therefore conservative for spill response planning purposes. The actual winds on any given day could move the spilled oil in virtually any direction from the spill location, but more often will move the spilled oil in the direction of the predominant wind direction. For this reason the use of average wind speeds and predominant wind directions in spill trajectory modelling is useful for both illustrative and planning purposes. However, to illustrate further what could happen, discrete historical data have also been used in winter and summer for the various scenarios.

The monthly average air and water temperatures used for the modelling are provided in Table 16.14. Average seasonal air temperatures were obtained from Environment Canada's Climate Normals for Saint John for the period of 1971 to 2000 (www.climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html). Surface water temperatures were obtained from the DFO data (www.mar.dfo-mpo.gc.ca/science/ocean/scotia/ssmap.html and www.mar.dfo-mpo.gc.ca/ocean/coastal_temperature/coastal_temperature.html). The average monthly wind speeds and directions from the Saint John airport weather station for the period of 2000 to 2008 are provided in Table 16.15.

Table 16.14 Seasonal Air and Water Temperatures Used in Spill Modelling

Average Temperatures (°C)							
Winter		Spring		Summer		Fall	
Air[1]	Water[2]	Air	Water	Air	Water	Air	Water
-7	3	7	5	16	11	3	10

Sources:
[1] Canadian Climate Normals Saint John 1971-2000.
[2] DFO Scotian Shelf / Gulf of Maine Climatology.

Table 16.15 Average Wind Speeds and Wind Directions: Saint John Airport

Average Wind Speeds (m/s) and Wind Directions[1]							
Winter		Spring		Summer		Fall	
Speed	Direction	Speed	Direction	Speed	Direction	Speed	Direction
5.01	NW	4.71	SSW	3.65	SSW	4.74	SSW/NW

Notes:
Source: Jacques Whitford (2008b).
[1] "Direction" indicates the direction from which the wind is blowing.

16.2.2.2 Spill Locations

The following locations (Figure 16.1) have been identified by the Proponent as having the highest potential for risk of larger tanker spills occurring within the RAA (D. Case, personal communication, March 11, 2008):

- The turning point in the shipping lanes near Brier Island;
- The Brier Island shoals;
- The anchorage location just offshore the marine terminal location;
- The existing SBM at Canaport; and
- The shipping lane approach to Saint John Harbour.

Due to the proximity of locations, spills occurring at the turning point and Brier Island shoals are represented by the shipping lane results, while the anchorage, SBM, and Saint John Harbour approaches are represented by the anchorage location. Limited spill trajectory modelling has been completed at the other locations to show the similarity in spill movement from spill sites in close proximity (SL Ross 2008). Small transfer spills have been modelled only at the marine terminal location.

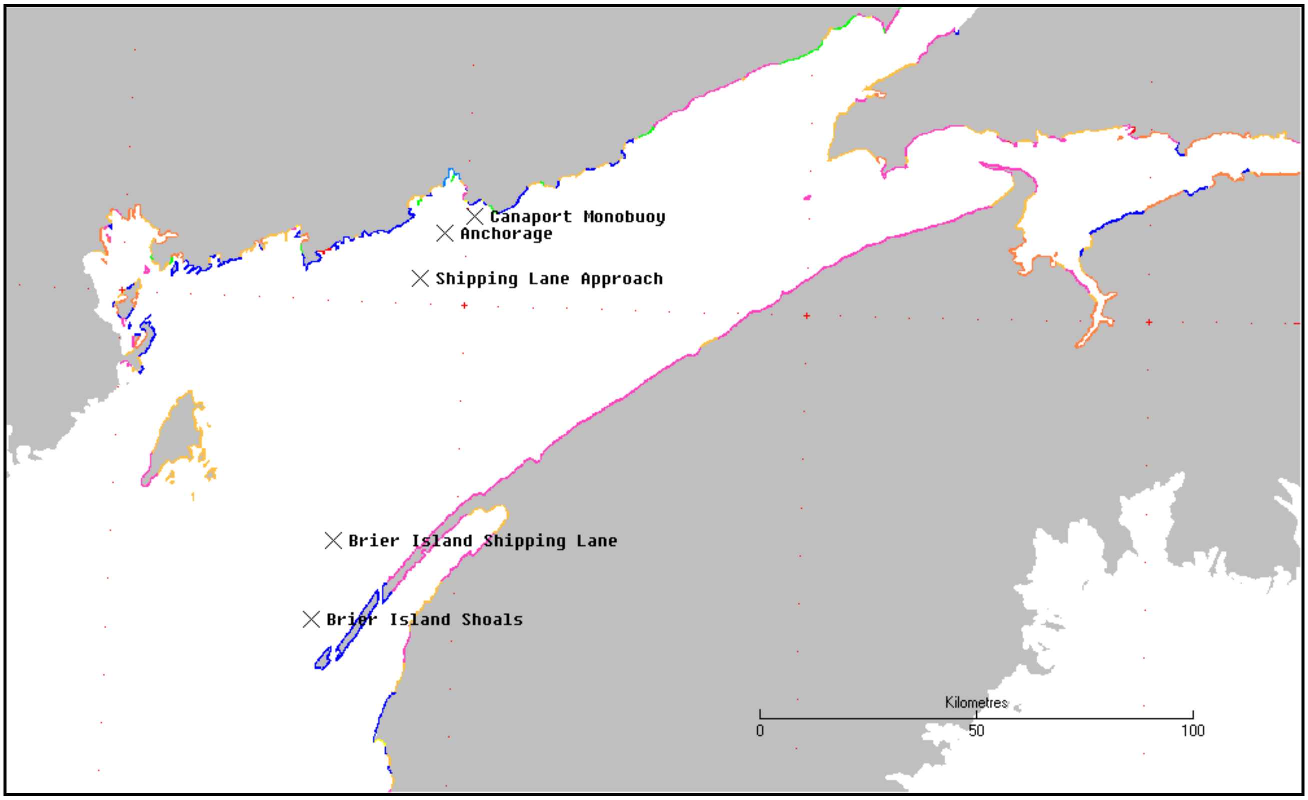


Figure 16.1 Assumed Locations of Spills for Oil Spill Modelling

16.2.2.3 Diesel Spills

Two diesel fuel spill volumes have been considered: 10,000 m^3 released in four 2,500 m^3 spillets released over a 2 hour period; and a 500 m^3 instantaneous fuel transfer spill at the marine terminal. Table 16.16 shows the fate of these batch spills for summer and winter environmental conditions (Tables 16.14 and 16.15) to demonstrate the influence of temperature and wind conditions on the likely fate of the oil. The modelling shown in Table 16.16 assumes that the oil is not stranded on shore in the time periods indicated. From the standpoint of environmental effects and mitigation there is not a substantial difference in the behaviour of the spills in the different seasons. Spills in summer lose about 10% more product through evaporation due to higher seasonal temperatures (*i.e.,* 40% evaporative loss in summer versus 30% loss in winter). The higher winter winds and colder temperatures result in more rapid dispersion and reduced evaporation. A 2,500 m^3 spillet of diesel that does not travel to shore will disperse or evaporate from the surface within about 150 to 200 hours. A 500 m^3 spill of diesel from a marine terminal transfer operation would last on the surface for about 110 to 140 hours. The distance that these slicks will travel will be a function of the prevailing water currents, wind velocity and direction, and the spill location.

Table 16.16 Diesel Spill Characteristics (30 m Mixing Depth)

Season	Air Temp. (°C)	Water Temp. (°C)	Initial Slick Width (m)	Slick Survival Time (h)	Max. Thick Slick Width (m)	Total Evap. (%)	Total Disp. (%)	Peak Disp. Oil Conc. (ppm)	Time to Peak Conc. (h)	Time to 0.1 ppm (h)	Cloud Width at 0.1 ppm (km)	Max. Oil Viscosity (cP)	Time to Max. Viscosity (h)
Tanker Accident: 10,000 m^3 Spill of Diesel (four 2,500 m^3 spillets)													
Summer	16	11	400	198	1,035	41	59	0.6	8	204	25	4,986	198
Winter	-7	3	400	154	1,090	29	71	1.6	11	224	27	1,420	154
Transfer Spill at Marine Terminal: 500 m^3 Spill of Diesel													
Summer	16	11	180	142	550	41	59	0.4	7	61	6	4,900	142
Winter	-7	3	180	109	590	29	71	1.1	7	109	12	1,380	109

The peak diesel concentration in the upper 30 m of the water column is estimated to be 0.6 to 1.6 ppm for the four 2,500 m^3 spillets, and 0.4 to 1.1 ppm for the 500 m^3 release. Higher concentrations will occur in the winter due to higher winds and more rapid dispersion and because less oil evaporates. Within 204 to 224 hours, the oil clouds from the four 2,500 m^3 spillets will grow to a width of 24 to 27 km and diffuse to 0.1 ppm oil concentration (assuming a conservative 30 m mixing depth). The concentration of 0.1 ppm of total petroleum hydrocarbon is the exposure concentration below which no significant biological environmental effects are expected. The dispersed oil clouds from the 500 m^3 spills will diffuse to 0.1 ppm within 60 to 110 hours and reach a diameter of 6 to 12 km. The viscosity of the diesel oil will reach about 1,500 centipoise (cP) in the winter and 5,000 cP in the summer just prior to final loss of the surface oil. The higher summer viscosity is due to the increased evaporation of the oil in the warmer temperatures.

16.2.3 Heavy Crude Oil Spills

Two heavy crude oil spill volumes have been considered: 10,000 m^3 discharged in four 2,500 m^3 spillets released over a 2 hour period as a result of a collision or grounding event; and a 1,000 m^3 instantaneous crude oil transfer spill at the marine terminal. Table 16.17 shows the fate of these batch spills for summer and winter conditions (Tables 16.14 and 16.15) to demonstrate the influence of temperature and wind conditions on the likely fate of the crude oil. The results in Table 16.17 assume that the oil is not stranded on shore in the time periods indicated. There will be very little difference in the behaviour of these crude oil spills over the range of seasonal average temperatures and wind conditions expected. A larger quantity of oil will evaporate in the warmer seasons (25 to 27% evaporative loss in warm seasons, versus 21 to 23% in colder months). In all cases, the crude oil and crude oil emulsion is viscous, persistent, and will remain on the water surface for an extended time until it contacts shore. There will be very little dispersion of the oil or emulsion into the water column resulting in negligible (<0.1 ppm) oil-in-water concentrations. The viscosity of the emulsion will reach 10,000 cP within 7 or 8 hours and 100,000 cP within 26 to 72 hours, depending on the spill size and season.

Table 16.17 Heavy Crude Oil Spill Characteristics

Season	Air Temp. (°C)	Water Temp. (°C)	Initial Slick Width (m)	Slick Survival Time (h)	Max. Thick Slick Width (m)	Total Evap. (%)	Total Disp. (%)	Peak Disp. Oil Conc. (ppm)	Time to Peak Conc. (h)	Time to 0.1 ppm (h)	Cloud Width at 0.1 ppm (km)	Time to 10,000 cP (h)	Time to 100,000 cP (h)
Tanker Accident: 10,000 m^3 Spill of Heavy Crude (four 2,500 m^3 spillets)													
Summer	16	11	400	>480	600	25	<1	0.04	3	na	na	7	55
Winter	-7	3	400	>480	600	21	<1	0.04	3	na	na	8	72
Transfer Spill at Marine Terminal: 1,000 m^3 Spill of Heavy Crude													
Summer	16	11	250	>480	430	27	<1	0.03	2	na	na	8	26
Winter	-7	3	250	>480	450	23	<1	0.04	2	na	na	7	45

Spill Trajectories

Once spilled, oil will move by currents and wind until it evaporates, disperses into the water, or contacts land. As noted in the previous sections, spills of heavy crude oil will tend to be highly persistent and, in the relatively narrow confines of the Bay of Fundy, the heavy crude oil that does not evaporate will eventually come to shore. Diesel oil will evaporate and disperse more quickly and surface oil slicks will likely persist for about four days under average environmental conditions if they do not reach shore before this time. SLROSM estimates the losses of oil from the water surface through evaporation, dispersion and shoreline retention.

The shoreline mapping in Environment Canada's e-Map product (http://www.e-map.gc.ca/) was used to assess approximate shoreline smearing extents. The shoreline type and approximate extents from this source were transcribed into SLROSM. When oil comes to shore in the model the shoreline type, being oiled, can be identified and oil retention is calculated. The shore classification presented on the maps reproduced from the SLROSM modelling should not be used for precise shore type identification for other uses. The original product should be consulted for accurate shoreline data. Permission to use the shoreline classification data from this online database was granted by the data owners Eastern Canada Response Corporation (ECRC).

The shore types in the Bay of Fundy and the oil retention values used for each (m^3 oil per m of beach) included (Figure 16.1): bedrock (0.02 dark blue shore on maps), man-made solid (0.02 light blue), boulder beach (0.25 bright green), pebble-cobble beach (1.2 pink), mixed sand and gravel beach (2.0 tan), sand beach (3.0 yellow), sand tidal flat (0.25 orange), mud tidal flat (0.25 orange), and salt marsh (0.6 red). The most common shore types found in the Bay of Fundy are sand-gravel and pebble-cobble mix beaches. The oil retention values are based on the work of Gundlach (1987). His estimates for oil retention, based on a 4 m tidal range, were doubled for use in this modelling exercise to account for the wider tidal range of the Bay of Fundy. When an oil slick contacts land, a portion (or all) of the oil is retained on shore based on the slick width and shoreline retention value. If more oil is present in the slick than can be retained by the shore, the slick is moved back offshore and allowed to move under the influence of the wind and water currents until it dissipates or moves back to shore.

Water current data developed by NATECH Environmental Services for this EA (NATECH 2008b) were used in most of the trajectories. The results are mapped in subsequent sections using black for spring tidal currents used in the trajectories and red for neap tide. The primary difference in trajectories with the different tidal currents is a slight "widening" of the swath of the oil as it moves. In some figures, only the spring tidal current results are shown for visual clarity, as these are the more conservative results. Slick movements as predicted by the Canadian Department of Fisheries and Oceans WebDrogue software are provided for the Brier Island area, as the NATECH (2008b) dataset does not extend this far to the south and west.

Spill Trajectories – Marine Terminal

Two different sets of wind data were used in the trajectory assessments. Seasonal average summer and winter wind speeds and predominant wind directions (Tables 16.14 and 16.15) were used in the modelling to show likely trends in the movement of spills. Randomly selected, historical, hourly wind records from Saint John Airport were also used in spill trajectory modelling to illustrate the more realistic variable nature of a slick's movement when actual wind patterns are used in the trajectory rather than seasonal average values. The wind data from July 11-31 and February 8-28, 2007, were randomly selected as example summer and winter wind conditions that have been experienced in the past. The trajectory results using the two different wind data sets have been presented on the same page to allow for a quick assessment of the similarities and differences in the results. It must be recognized that although there are seasonal prevailing wind directions, at the time of a spill, the wind velocity and direction can be at any speed (within the range of experience) and any direction. The data presented are merely intended to be illustrative.

Oil slick trajectories were modelled for hypothetical spills of both diesel fuel and heavy crude oil from the proposed marine terminal at Mispec Point. The time to shore or time to loss of surface slick, length of shoreline oiled and type of shore oiled when seasonal average wind speeds and predominant wind directions used in the simulations are provided in Table 16.18. Spill trajectories for various scenarios are shown in Figures 16.2 to 16.9. Average and historical simulations are juxtaposed for the same spill scenarios to show hypothetical average and actual events.

Under average seasonal summer winds, spills of either diesel or heavy crude oil from the marine terminal will move to shore within less than 2 hours and oil a minimum of about 2 kilometres of the shore zone near the marine terminal (Figures 16.2 and 16.6). With average winter winds, slicks from the marine terminal will travel to the southeast. The heavy crude oil slicks will reach the northern shore of Nova Scotia and initially oil a minimum of about 15 kilometres of the shore (Figure 16.8). The diesel spills modelled will follow the same trajectory but are expected to disperse just prior to reaching Nova Scotia (Figure 16.4).

The oil trajectories predicted using the historical hourly wind records are shown in Figures 16.3, 16.5, 16.7 and 16.9. The July historical wind results (Figures 16.3 and 16.7) are quite different from the summer average results (Figures 16.2 and 16.6), as the oil does not go quickly to shore but travels to the southeast more like a winter trajectory. This is not surprising since the second most prominent wind direction in the summer is from the NW (SL Ross 2008). The winter historical wind trajectories are quite similar to the average wind trajectories (Figures 16.4 and 16.5 and 16.8 and 16.9). Winter winds are very prominent from the NW quadrant, so it is also not surprising that the historical wind trajectory and the average wind trajectory are similar. The historical wind trajectory has the more variable movement, as would be expected.

Table 16.18 Trajectory and Shoreline Oiling for Marine Terminal Spills: Seasonal Average Winds

Spill Location Description	Time to Shore or Loss of Surface Slick (hr)		Volume Deposited On Shore (m^3)	% Evap.	% Disp.	Shore Types[1] Oiled	Estimated Length of Shoreline Oiled (km)	Trajectory Figure #
	Neap tide	Spring tide						
500 m^3 Spill of Diesel at Marine Terminal								
Summer	1.5	1.75	475	5	<1	S, PC, Bed	2	Figure 16.2
Winter	109	109	0	29	71	na	na	Figure 16.4
1,000 m^3 Spill of Heavy Crude at Marine Terminal								
Summer	1.64	1.5	940	6	<1	S, PC, Bed	2	Figure 16.6
Winter	116	118	800	19	<1	PC	15	Figure 16.8

Notes:
[1] Bed=bedrock, B=boulder, M=man made, S=sand, PC=pebble cobble, SG=sand gravel, TF=tidal flat, M=marsh.

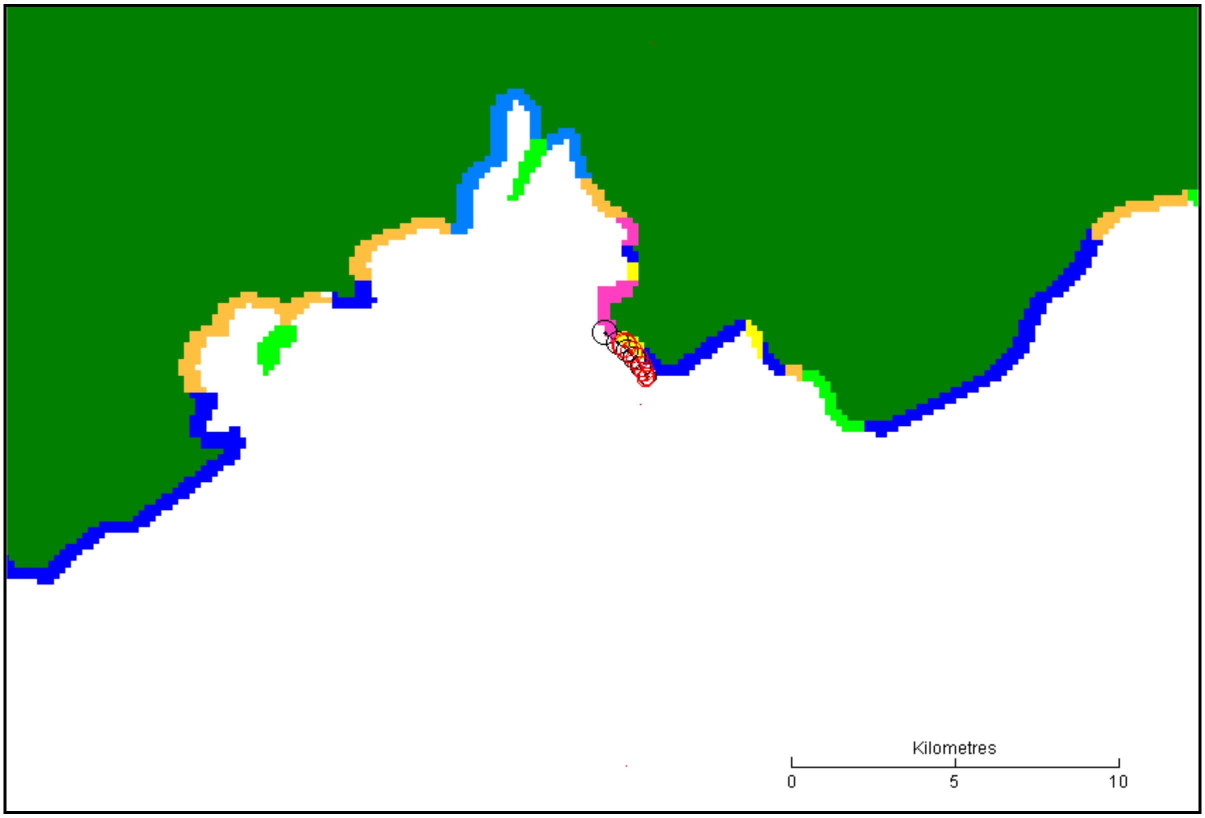


Figure 16.2 500 m^3 Diesel Spill at Marine Terminal: Summer Average Winds

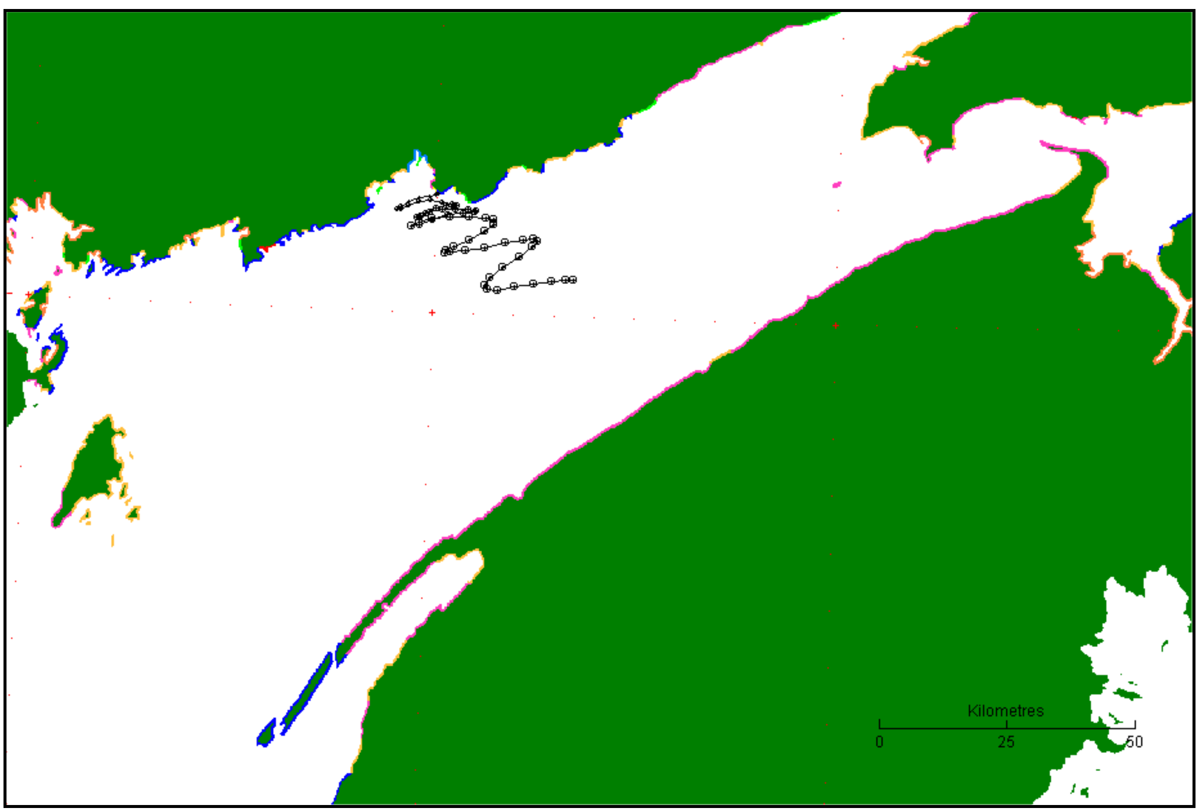


Figure 16.3 500 m^3 Diesel Spill at Marine Terminal: July, 2007 Historical Winds

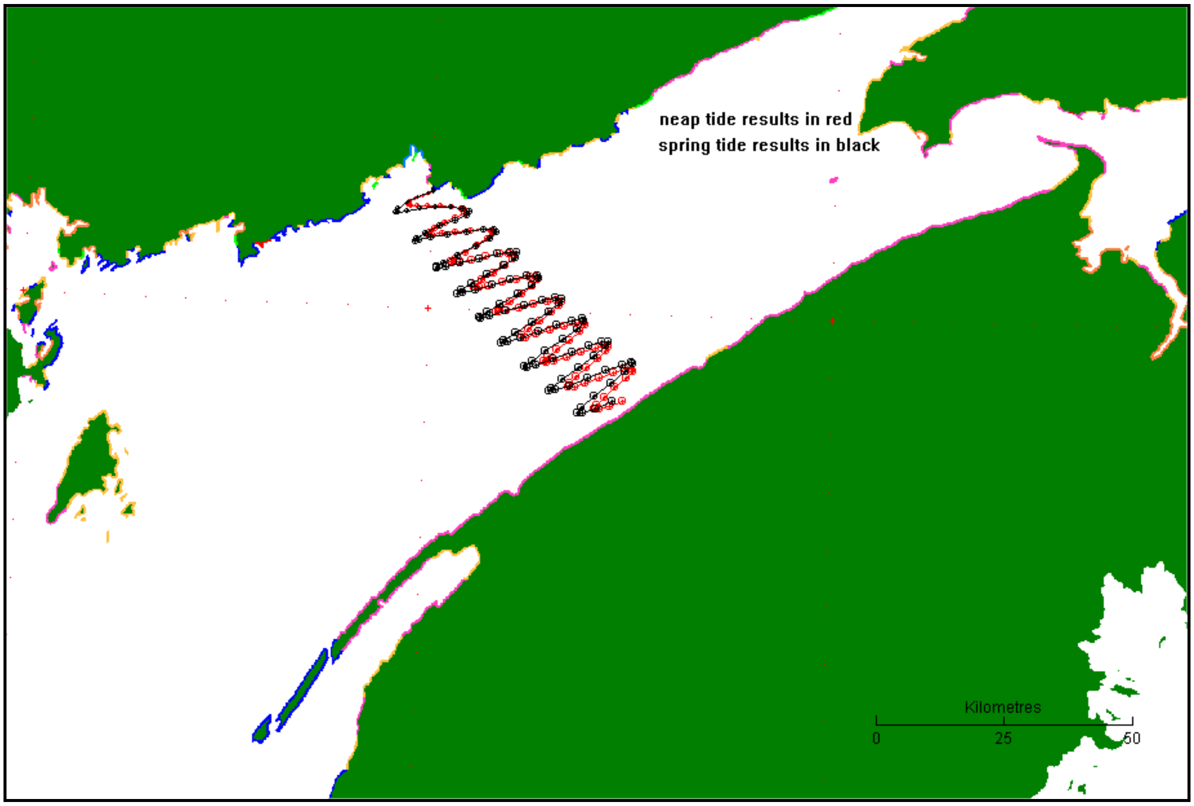


Figure 16.4 500 m^3 Diesel Spill at Marine Terminal: Winter Average Winds

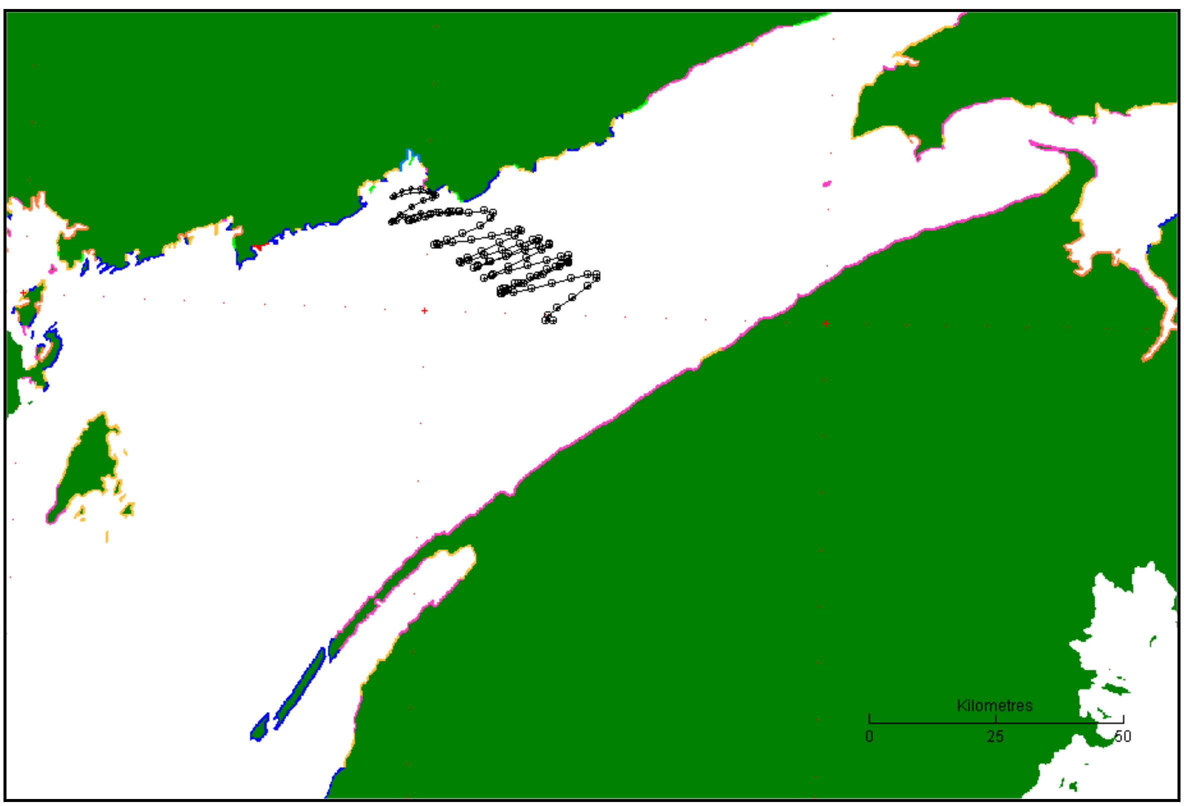


Figure 16.5 500 m^3 Diesel Spill at Marine Terminal: February 2007 Historical Winds

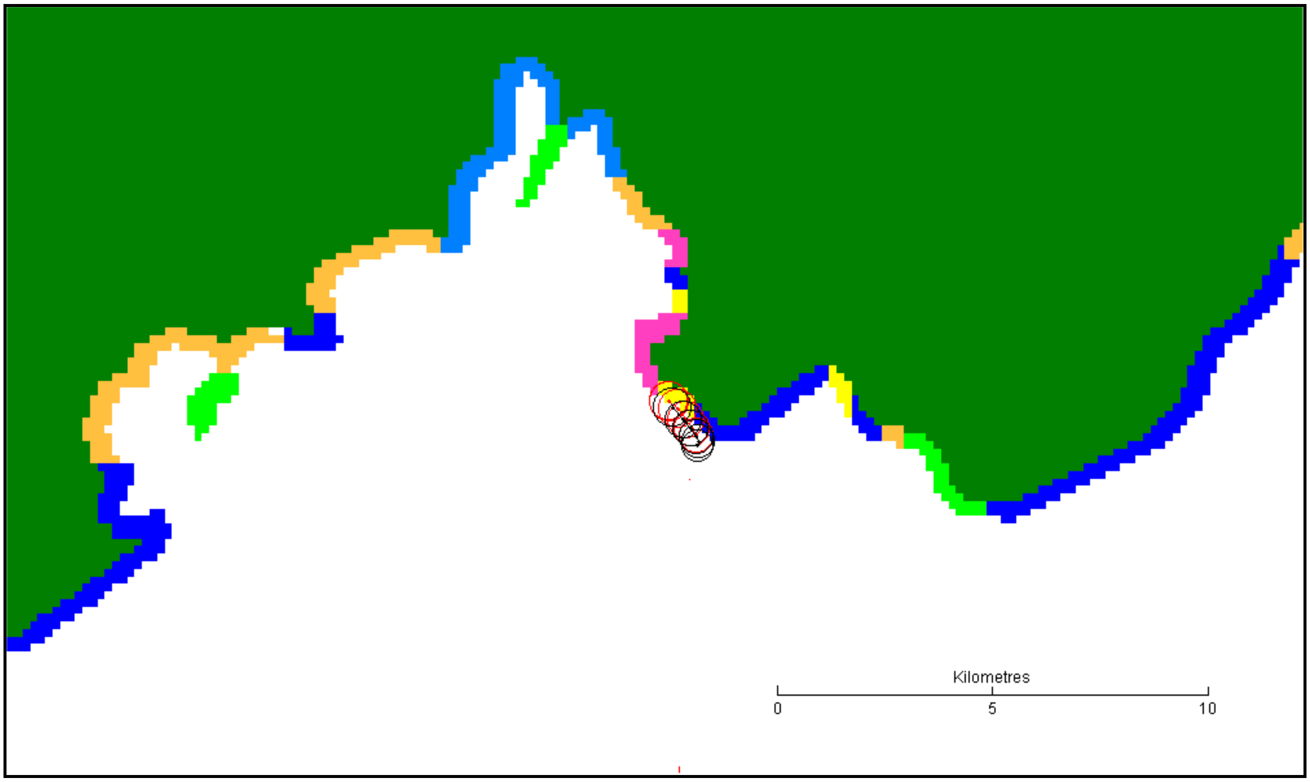


Figure 16.6 1,000 m^3 Heavy Crude Spill at Marine Terminal: Summer Average Winds

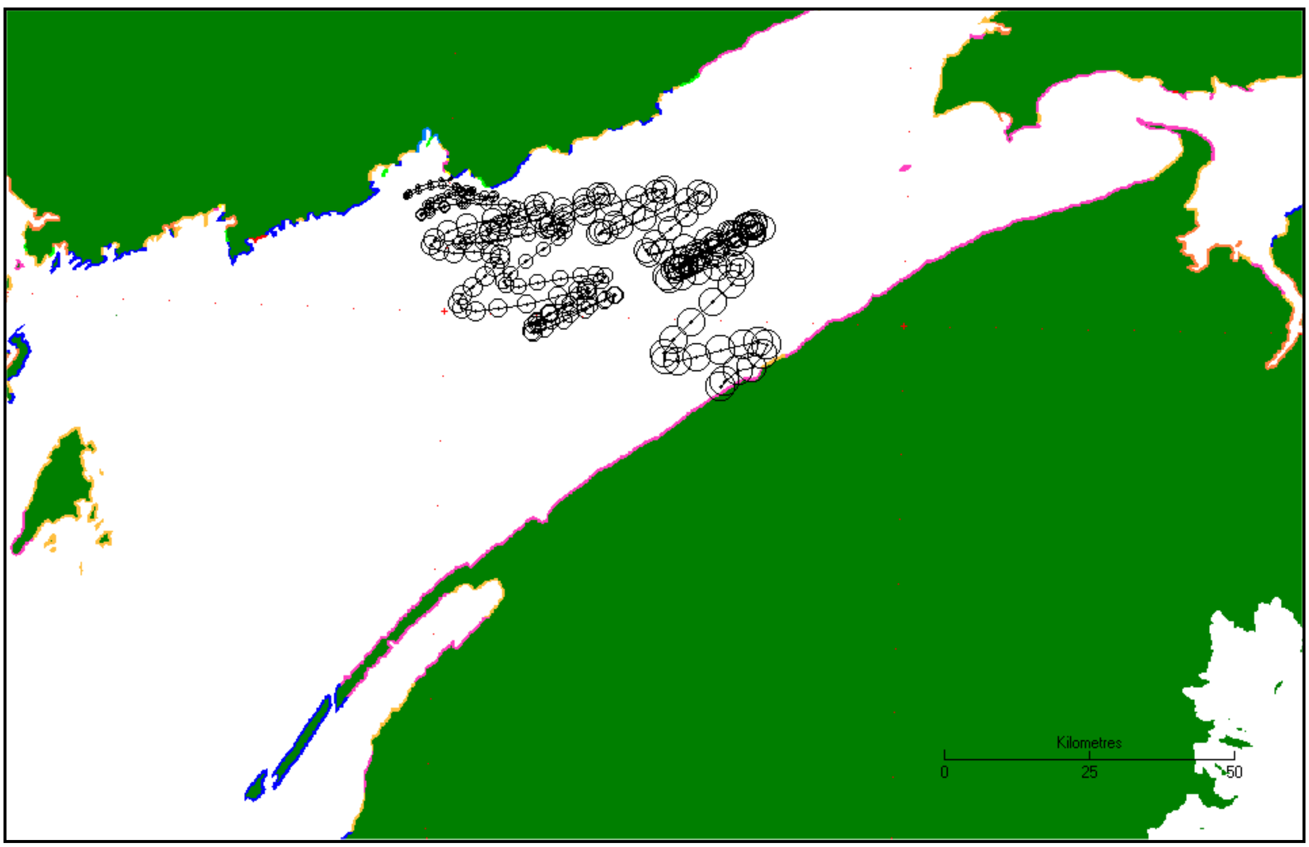


Figure 16.7 1,000 m^3 Heavy Crude Spill at Marine Terminal: July 2007 Historical Winds

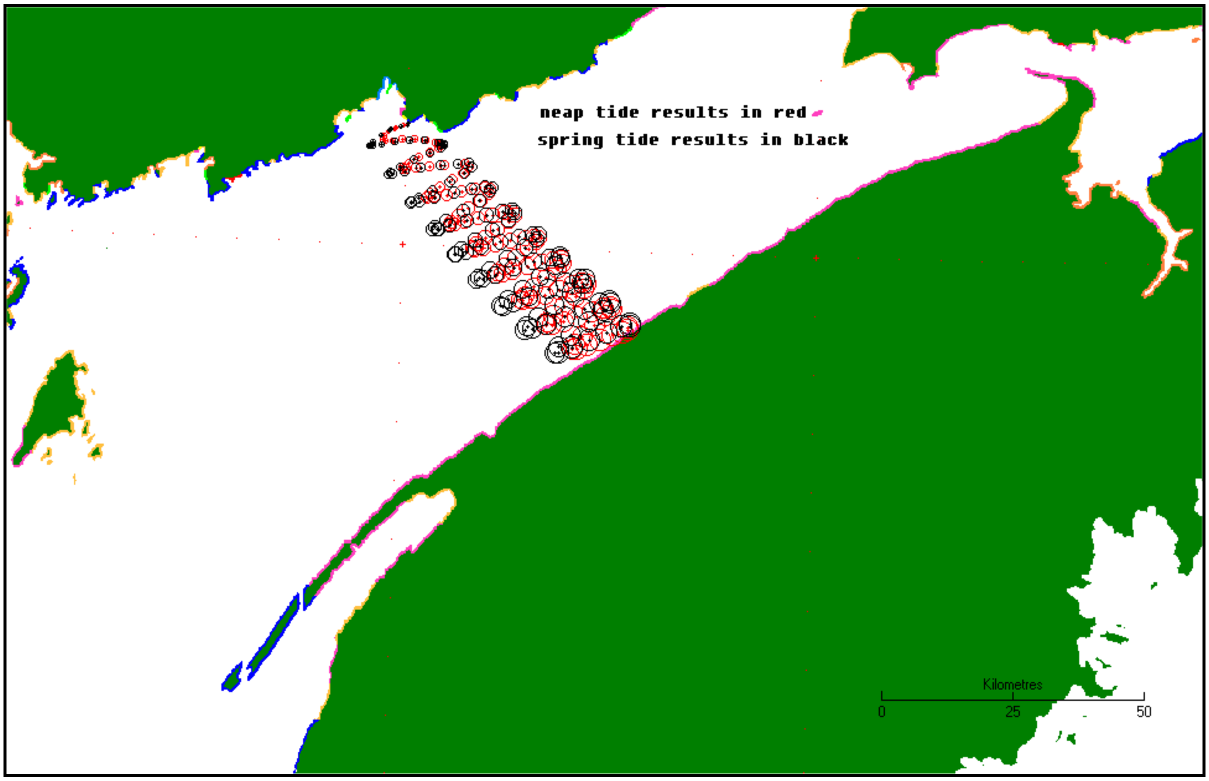


Figure 16.8 1,000 m^3 Heavy Crude Spill at Marine Terminal: Winter Average Winds

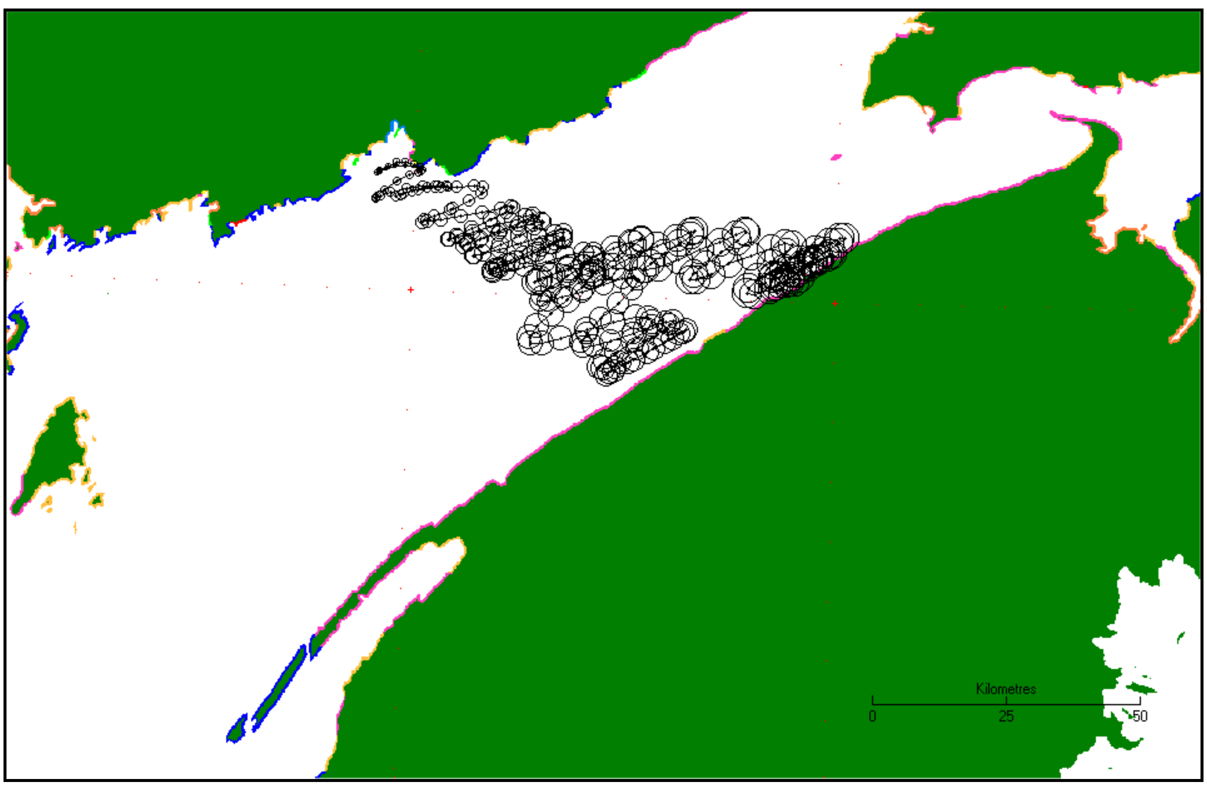


Figure 16.9 1,000 m^3 Heavy Crude Spill at Marine Terminal: February 2007 Historical Winds

Spill Trajectories – Anchorage, Shipping Lane Approach to Saint John, and Existing Canaport SBM

Preliminary modelling of oil slick trajectories was completed from three spill locations just offshore the proposed marine terminal location: at the shipping lane approach to Saint John Harbour, at the anchorage location off Saint John, and at the existing Canaport single buoy mooring (SBM) (Figure 16.1). The preliminary work identified that the general trajectories of spills from these three sites are not very different. The three sites are relatively close to each other and, due to the direction of the predominant winds, spills from the three sites generally move to similar shore locations and were not considered for further modelling.

Spill trajectories from the anchorage site were selected for illustration and detailed discussion. These results are generally applicable to spills from all three sites. The spill scenarios considered are shown in Figures 16.10 to 16.14.

Summer spills from the existing Canaport SBM site will reach the New Brunswick shore sooner than releases from the anchorage site, whereas spills from the shipping lane approach to Saint John will take longer to reach shore than the anchorage site. In all cases, similar shore areas will be affected by spills from these sites.

Figure 16.10 shows the predicted trajectories from the three sites using summer average winds and spring tides. The shipping lane approach site may oil more shore to the west of Saint John Harbour but spills from all three of these sites will threaten the shores from Barbours Point to Mispec Point. The trajectories for the winter average winds all travel to the southeast and hit land along a similar stretch of the Nova Scotia shore as represented by the trajectory results at the anchorage, discussed below.

Only 10,000 m^3 spills of heavy crude oil were considered from the anchorage location. The likelihood of large diesel spills is very low in this vicinity due to the short time that the outgoing tankers will be in the area and their proposed transit route.

Seasonal average summer and winter wind speeds and predominant wind direction were used in the modelling shown in Figure 16.11 and Figure 16.13 to illustrate the general trends in the movement of these spills. The time to shore or time to loss of surface slick, length of shoreline oiled and type of shore oiled using average wind conditions are provided in Table 16.19.

Under average seasonal summer winds, the spills from the anchorage location will move northeast to the New Brunswick shore within about 33 to 46 hours and oil a minimum of about 25 kilometres of the shore zone in Saint John Harbour and its surroundings (Figure 16.11). With average winter winds, slicks from the anchorage will travel to the southeast (Figure 16.13). The heavy crude oil slicks will reach the northern shore of Nova Scotia within about 105 hours and initially oil a minimum of about 20 kilometres of the shore.

The trajectories predicted using the historical hourly wind records are shown in Figures 16.12 and 16.14. As noted in the marine terminal trajectories, the July results (Figure 16.12) are quite different from the summer average results (Figure 16.11) as the oil does not go quickly to shore but travels to the southeast more like a winter trajectory. The winter average and historical wind trajectories (Figures 16.13 and 16.14) result in similar landfall locations but the variability of the historical wind direction is evident when comparing the two trajectories. In the historical wind case, oil comes close to shore and then with a dramatic wind shift moves back offshore and eventually grounds somewhat further to the north.

Table 16.19 Trajectory and Shoreline Oiling for Spills at Anchorage: Seasonal Average Winds

Spill Location Description	Time to Shore or Loss of Surface Slick (hr)		Volume Deposited On Shore (m^3)	% Evap.	% Disp.	Shore Types[1] Oiled	Estimated Length of Shoreline Oiled (km)	Trajectory Figure #
	Neap tide	Spring tide						
10,000 m^3 Spill of Heavy Crude at Anchorage								
Summer	46	33	8,000	20	<1	M, B, SG, PC	25	Figure 16.11
Winter	105	107	8,400	16	<1	PC	21	Figure 16.13

Notes:
[1] Bed=bedrock, B=boulder, M=man made, S=sand, PC=pebble cobble, SG=sand gravel, TF=tidal flat, M=marsh.

Spill Trajectories – Vicinity of Brier Island

Preliminary modelling of oil slick trajectories was completed from two spill locations just offshore Digby Neck, Nova Scotia: at the centre of the shipping lane convergence in these waters, and at the shoals near Brier Island (Figure 16.1). The preliminary work identified that the general trajectories of spills from these two sites are not very different. The two sites are very close to each other and, due to the direction of predominant winds, spills from the sites generally move to similar shore locations in both summer and winter. In the winter, the winds from the northwest will quickly move spills to nearby Digby Neck. Spills from the Brier Island Shoal release point will ground on Brier Island or the western extremity of Digby Neck. Winter spills from the shipping lane site will ground about 20 km west of Brier Island on Digby Neck near the break in the peninsula. The western extent of the peninsula is vulnerable to spills from these two locations. The SSW summer winds will move slicks towards the NE across the Bay of Fundy and finally contact the New Brunswick shore near the proposed marine terminal. As a result, detailed modelling was not completed at both sites. Spill trajectories from the shipping lane convergence site have been selected for detailed discussions and the results generally apply to both locations. Modelling results for various scenarios are shown in Figures 16.15 to 16.20.

The western extent of the tidal water current data set developed by NATECH (2008b) stops very close to the shipping lane spill location; based on professional experience, however, the modelled currents at the extreme extent of the vector field are likely to be somewhat less accurate. Because of this, DFO’s WebDrogue software also was used to map spill trajectories from this spill site to validate the results from SLROSM (Figures 16.16 and 16.19).

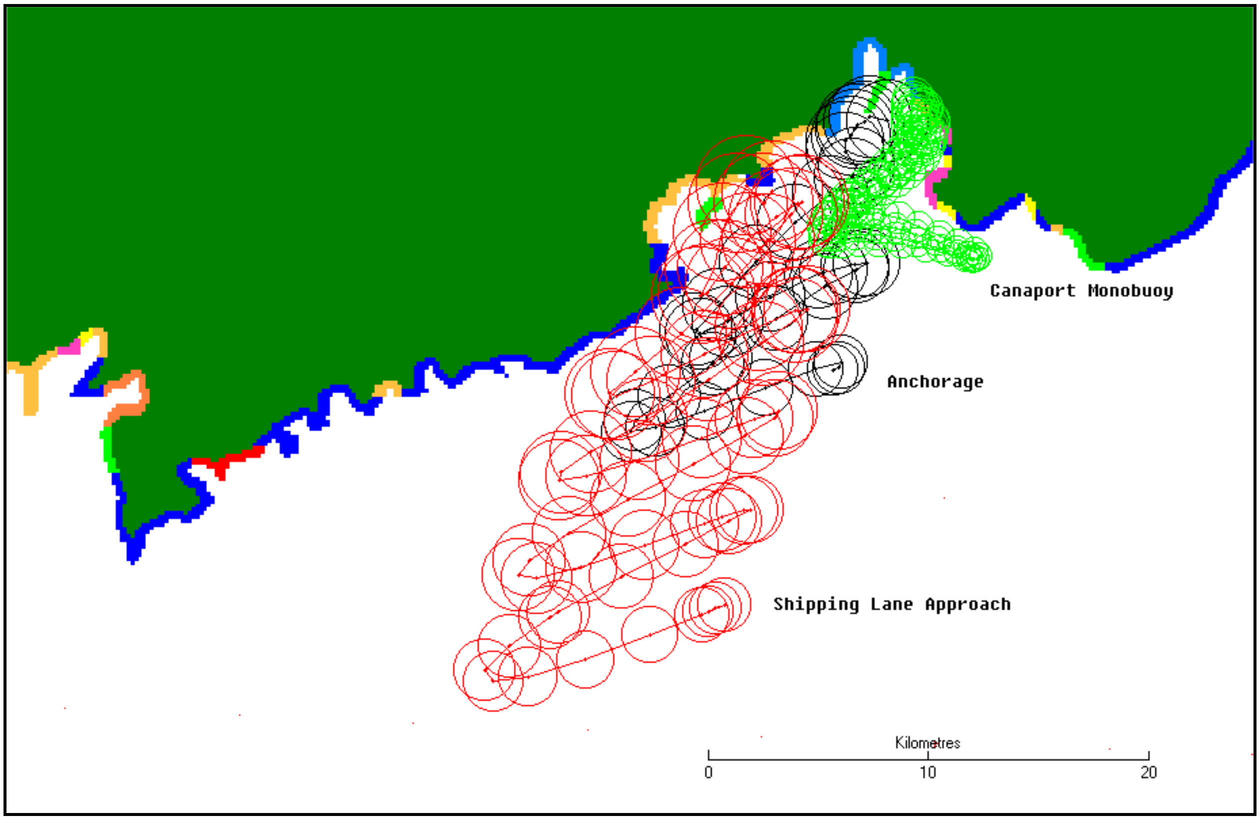


Figure 16.10 10,000 m^3 Heavy Crude Spills from Three Sites Offshore of Marine Terminal: Average Winds and Spring Tides

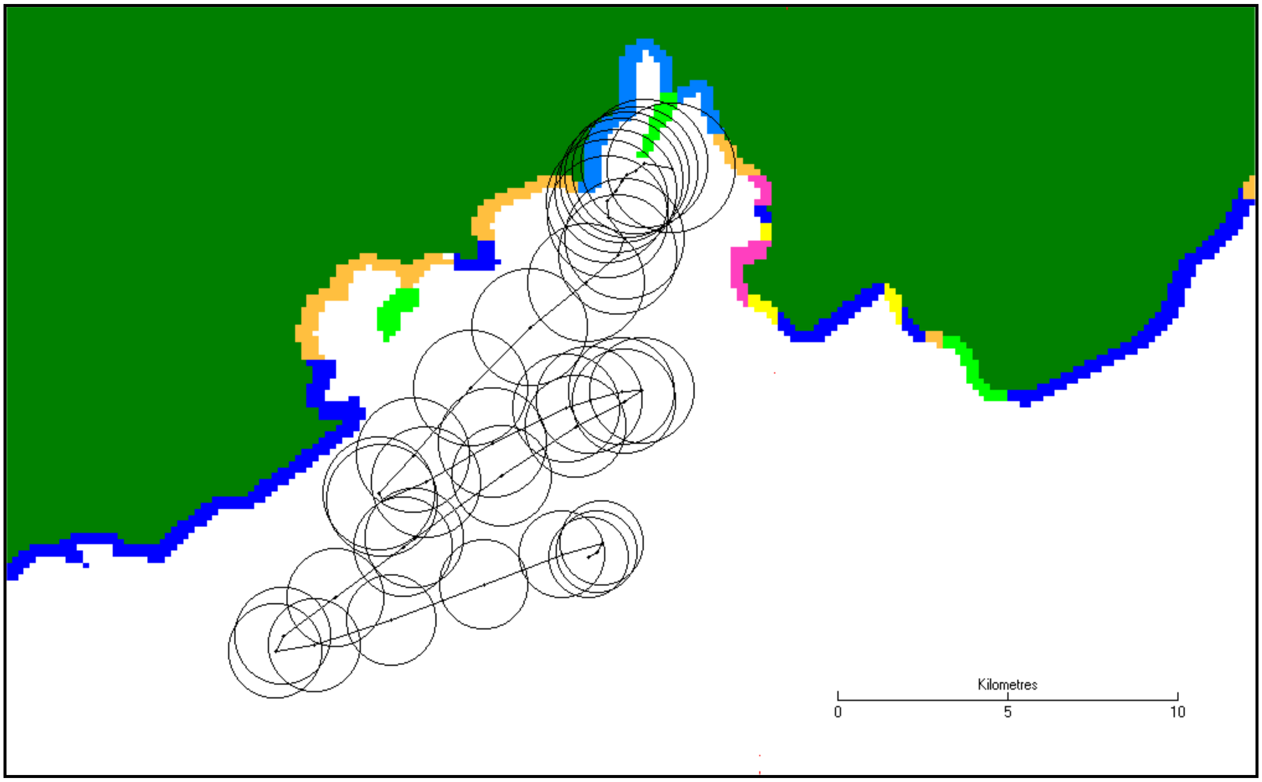


Figure 16.11 10,000 m^3 Heavy Crude Spill at Anchorage: Summer Average Winds

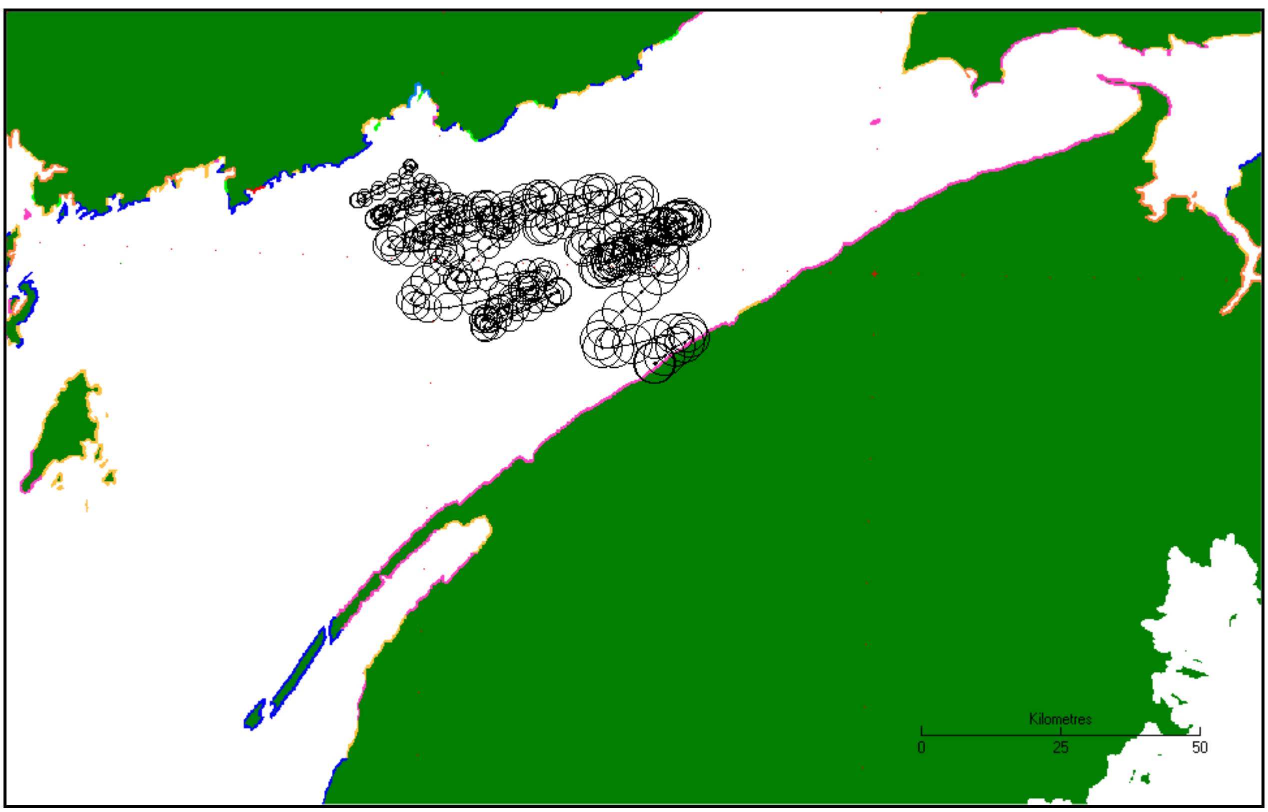


Figure 16.12 10,000 m^3 Heavy Crude Spill at Anchorage: July 2007 Historical Winds

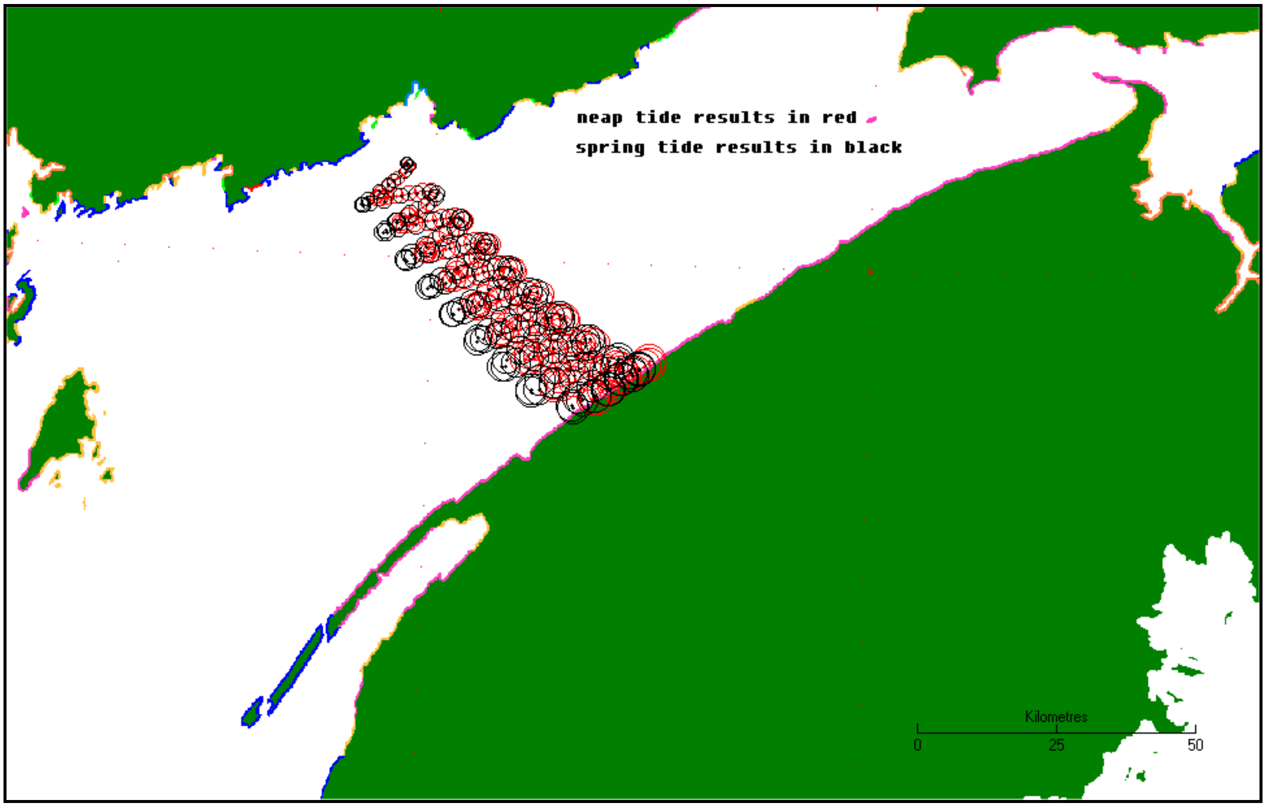


Figure 16.13 10,000 m^3 Heavy Crude Spill at Anchorage: Winter Average Winds

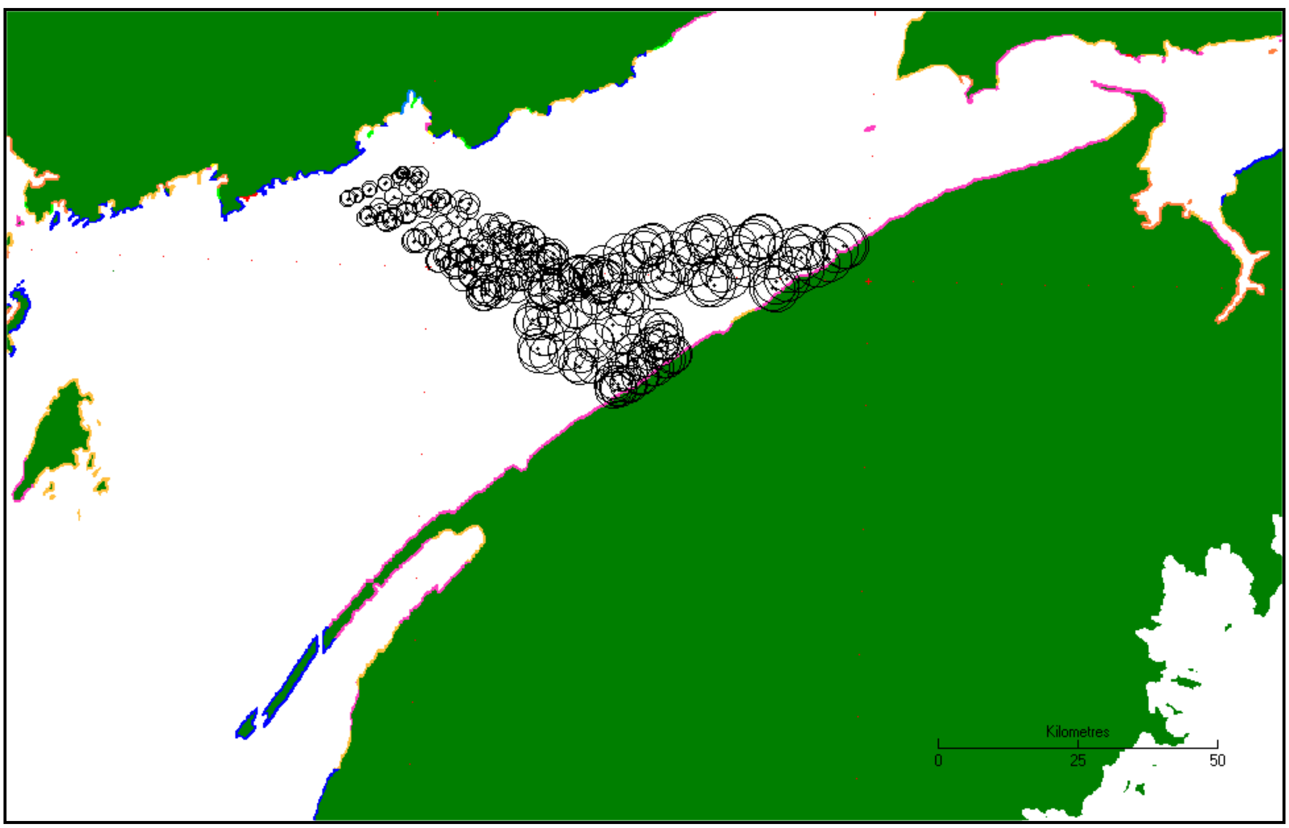


Figure 16.14 10,000 m^3 Heavy Crude Spill at Anchorage: February 2007 Historical Winds

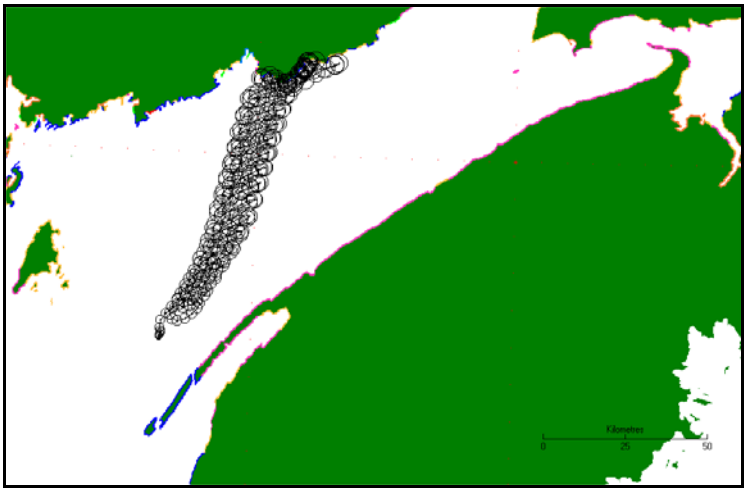


Figure 16.15 10,000 m^3 Diesel or Heavy Crude Spill in Shipping Lane: Summer Average Winds

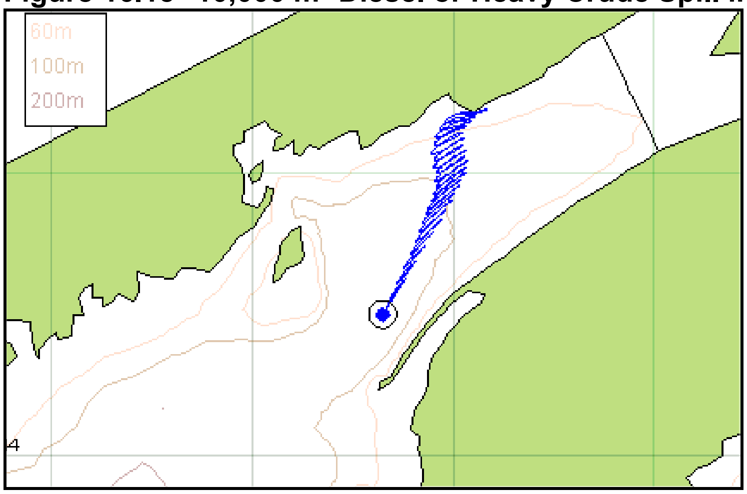


Figure 16.16 10,000 m^3 Diesel or Heavy Crude Spill in Shipping Lane: Summer Average Winds: DFO WebDrogue

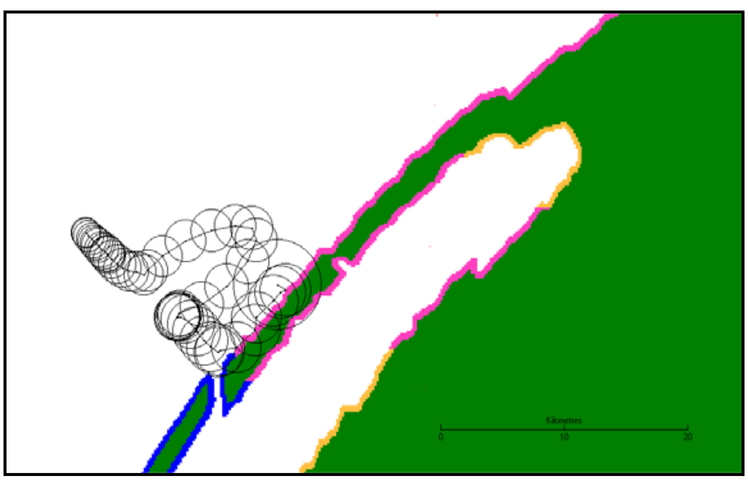


Figure 16.17 10,000 m^3 Diesel or Heavy Crude Spill in Shipping Lane: July 2007 Historical Winds

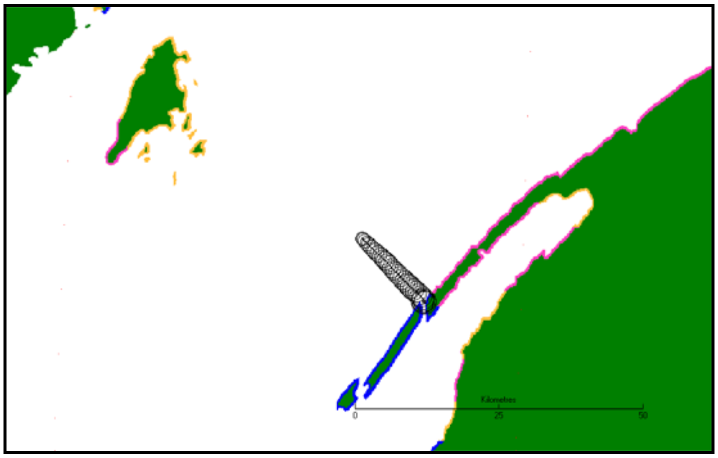


Figure 16.18 10,000 m^3 Diesel or Heavy Crude Spill in Shipping Lane: Winter Average Winds: No Tidal Current

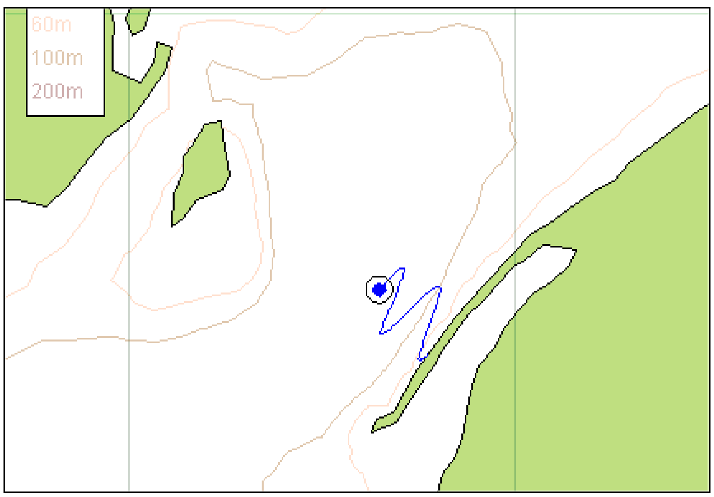


Figure 16.19 10,000 m^3 Diesel or Heavy Crude Spill in Shipping Lane: Winter Average Winds: DFO WebDrogue with Tidal Currents

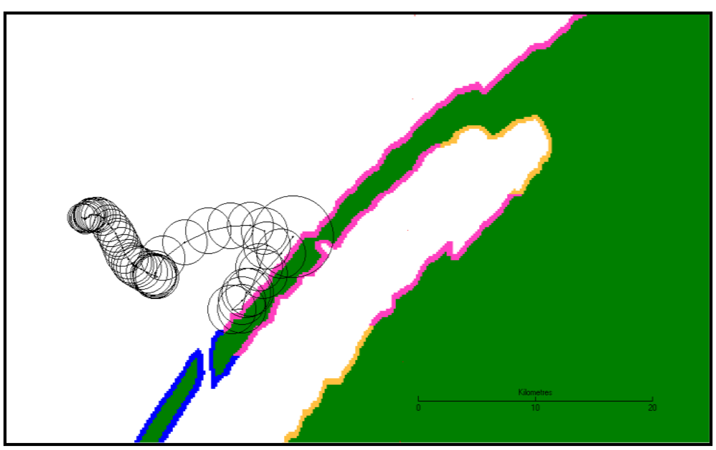


Figure 16.20 10,000 m^3 Diesel and Heavy Crude Spill in Shipping Lane: February 2007 Historical Winds: No Tidal Currents

Large spills (10,000 m^3) of both diesel fuel and heavy crude oil were considered from the shipping lane location. Seasonal average summer wind speeds and predominant wind direction were used in the modelling shown in Figure 16.15 to illustrate the likely typical movement of these spills. Figure 16.16 shows spill trajectories as predicted by DFO's WebDrogue software. The time to shore or time to loss of surface slick, percent of oil evaporated and dispersed, length of shoreline oiled and type of shore oiled are provided in Table 16.20. The trajectories of the diesel and crude oil spills will be identical in this case as both oil types survive until they reach shore. The WebDrogue results show a much smaller tidal influence at the mouth of the Bay of Fundy and this is likely the reason for the longer transit time to shore for this prediction (285 hours, versus 206 hours for SLROSM and the NATECH tidal currents). The WebDrogue result may be more accurate as the NATECH tidal currents are less accurate at the outer extent of their domain. Both methods have the oil stranding on shore in the same general location near the proposed marine terminal.

Under average seasonal summer winds, the spills from the anchorage location will move north east to the New Brunswick shore within about 206 hours and oil a minimum of about 40 kilometres of the shore zone from Black Point in the west to past Spencer Point in the east. With average winter winds, slicks from this spill location will travel to the southeast and reach Digby Neck within about 28 hours after release. The oil from these spills will likely oil the bedrock shores to the west down to Brier Island and about 10 kilometres of the pebble-cobble beach to the east. Substantial quantities of oil will likely pass through the opening in Digby Neck and reach the back side of the Neck and the Nova Scotia mainland shore, although this is not shown on the modelled trajectories. Figure 16.18 shows the trajectory results for these winter spills using SLROSM. These trajectories do not account for tidal current influence because the NATECH (2008b) data set do not extend to this area. Figure 16.19 shows spill trajectories from this site using winter winds and DFO's WebDrogue software. The results are very similar to the SLROSM results, except the influence of the tidal currents is evident in Figure 16.19. The WebDrogue application has the oil reaching land within about 23 hours and SLROSM has it arriving within approximately 29 hours.

The trajectories predicted using the summer and winter historical hourly wind records are shown in Figures 16.17 and 16.20, respectively. The July results (Figure 16.17) are quite different from the summer average results (Figures 16.15 and 16.16), as the oil does not travel northeast through the Bay of Fundy but travels to the southeast more like a winter trajectory and grounds on Digby Neck.

Table 16.20 Trajectory and Shoreline Oiling for Spills in the Vicinity of Brier Island: Seasonal Average Winds

Spill Location Description	Time to Shore or Loss of Surface Slick (hr)		Volume Deposited On Shore (m^3)	% Evap.	% Disp.	Shore Types[1] Oiled	Estimated Length of Shoreline Oiled (km)	Trajectory Figure #
	SLROSM	Web Drogue						
10,000 m^3 Spill of Diesel in the Vicinity of Brier Island								
Summer	206	285	2,200	40	38	SG, Bed, B, S	40	Figure 16.15
Winter	29	23	7,000	17	13	Bed, PC	30 to 40	Figure 16.18
10,000 m^3 Spill of Heavy Crude in the Vicinity of Brier Island								
Summer	206	285	7,700	23	<1	SG, Bed, B, S	40	Figure 16.15
Winter	29	23	8,900	11	<1	Bed, PC	30 to 40	Figure 16.18

Notes:
[1] Bed=bedrock, B=boulder, M=man made, S=sand, PC=pebble cobble, SG=sand gravel, TF=tidal flat, M=marsh.

16.2.4 Environmental Effects Assessment

This section describes the interactions between the selected VECs and a Hydrocarbon Spill in the Marine Environment as outlined in Table 16.21. Based on predicted interactions, an environmental effects assessment is provided, with a focus on modelled spill scenarios at the marine terminal, the anchorage areas, and the shipping lanes in the Bay of Fundy. The environmental effects assessment is based on the Technical Study prepared by SL Ross (2008) that was summarized in Sections 16.2.1 and 16.2.2, in addition to existing knowledge about the VECs in the Bay of Fundy, a number of peer-reviewed studies on marine species, and environmental effects assessment work conducted by SL Ross in the context of the Project.

16.2.4.1 Considerations for Assessing the Environmental Effects of Oil Spills

The oil spill scenarios described in SL Ross (2008) are selected to be representative of the reasonable worse-case outcome of a large tanker spill at the locations of probable highest risk of occurrence within the Bay of Fundy and proximal to planned shipping activity, as well as a large transfer spill which could occur at the marine terminal. In the very unlikely event that an oil spill was to occur during Operation, it would not necessarily have the same location, discharge volume, fate and trajectory as the modelled scenarios. However, these scenarios do provide general information about the behaviour of a large oil spill in the Bay of Fundy and the general types of receiving environments that may be affected by similar Project-related oil spills.

The fate and behaviour of an oil spill depends on a number of factors, including: the size of the spill; the type of oil spilled (*e.g.*, heavy crude versus diesel); the location of the spill; the time of year; the wind speed and direction; the air temperature; currents, waves, and tides; and the timing and level of emergency response and clean-up (SL Ross 2008). The trajectories modelled in Section 16.2.4 are only intended to be illustrative of average and selected historical conditions. Actual fate and transport will vary. The environmental effects of an oil spill will also vary depending on the receiving environment of the spill, the level of spill dispersion, and seasonal and spatial distribution of the VEC (including associated habitats). Given the influence of these variables, it is difficult to predict the potential environmental effects of a large spill with a high level of precision and certainty. In the unlikely event of a large Project-related spill in the Bay of Fundy, oil that does not evaporate or is not contained is likely to reach the shoreline in either New Brunswick or Nova Scotia. The Proponent will have contingency, oil spill response plans, and arrangements in place to rapidly respond to spills, contain the spill, and mitigate the environmental effects of the spill. The *Canada Shipping Act, 2001* is aimed at managing oil shipment in Canadian waters so that it is safe and conducted in a manner that prevents and minimizes the consequences of an oil spill.

When assessing the environmental effects of a large oil spill in the Bay of Fundy, it is important to consider the probability of such an event occurring. The likelihood of a large Project-related oil spill occurring is extremely low. Based on calculated spill frequency for the Project (Section 16.2.2), the probability of a 500 m^3 or 1,000 m^3 spill at the marine terminal is conservatively only once every 25 years, and the probability of a 10,000 m^3 spill at sea (anchorage or shipping lane areas) is conservatively only once every 34 years or more. These conservative rates of spill were calculated using data from 1985-1999 for average international oil tankers; however, international spill rates for oil tankers since 1999 are about half the spill rates of previous years (Section 16.2.1), and the tankers used for the Project will be much safer than the assumed tanker technology in the spill rate calculations. Therefore, the actual probability of a large spill occurring over the life of the Project is likely to be much lower than the frequencies predicted here (with actual frequencies of spills likely at least half those presented).

For a spill in port, there will be an immediate and active spill response, depending on the nature of the incident and the weather and sea conditions at the time. Containment and recovery equipment to deal with small and modest-sized spills will be pre-staged in the area of the marine terminal such that it can be quickly deployed in the event of a spill. The general response strategy is described in Section 3.2.5.

For larger spills at the marine terminal, or for those that may result from a tanker incident away from the marine terminal, the response will require the activation of additional resources, as prescribed in the Response Organization Standards outlined in the *Canada Shipping Act*. These standards mandate a tiered response effort.

16.2.4.2 Interactions Between VECs and a Hydrocarbon Spill in the Marine Environment

The potential interactions between a Hydrocarbon Spill in the Marine Environment and the selected VECs for this CSR are summarized in Table 16.21.

Table 16.21 Potential Interactions between VECs and a Hydrocarbon Spill in the Marine Environment

Valued Environmental Component (VEC)	Hydrocarbon Spill in the Marine Environment
Atmospheric Environment	1
Public Health	0
Coastal Wetland Environment	2
Marine Environment	2
Commercial Fisheries	2
Marine Safety	1
Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons	2
Heritage and Archaeological Resources	0

Notes: Interactions between Accidents/Scenarios and the respective VECs were ranked as follows:
0 No interaction, or no substantive interaction contemplated.
1 Interaction may occur. However, based on past experience and professional judgment, the interaction would not result in a significant environmental effect, even without mitigation, or the interaction would clearly not be significant due to application of codified practices.
2 Interaction may, even with codified mitigation, result in a potentially significant environmental effect and/or is important to regulatory and/or public interest. Potential environmental effects are considered further and in more detail in the CSR.

As was discussed in Section 16.2.2, smaller spills of a few barrels in size (1 to 49 bbl) are likely to occur during the life of the Project. In the event of a small spill, the Proponent's ability to contain the spill and mitigate environmental effects with safe practices and oil spill response plans is greatly enhanced by regulated procedures. Therefore, the potential environmental effects of these smaller spills, although adverse, are rated not significant and will not be discussed further in this assessment.

The environmental effects of a spill will be limited to the Bay of Fundy and its shorelines. Thus, no interaction is foreseen between a Hydrocarbon Spill in the Marine Environment and Public Health, and Heritage and Archaeological Resources and the interaction with Hydrocarbon Spills in the Marine Environment were ranked as 0 in Table 16.21 therefore, the environmental effects are thus rated not significant. Although there are reported shipwrecks and unexploded ordinance (UXO) in the Bay of Fundy, hydrocarbon spills will not interact with any of these potential sites as, in the event of a spill, most of the oil would evaporate, or land on the shoreline. One important shoreline archaeological site was identified in the Mispec area (Chapter 14), however this site is scheduled to be carefully excavated under expert supervision during Construction; therefore, in the unlikely event of an oil spill during

Operation, there will be no interactions with this site since it will no longer be present and as such the potential environmental effects of a Hydrocarbon Spill in the Marine Environment on Heritage and Archaeological Resources are rated not significant.

A Hydrocarbon Spill in the Marine Environment will have interactions with Marine Safety. In the event of a spill, vessels may be required to alter their steaming route to avoid the spill site and the associated clean-up effort, particularly for spills that occur in the anchorage area or in the shipping lanes. The environmental effects will be not significant as the disruption to Marine Safety will be temporary and any changes to vessel steaming routes will be safely and effectively managed by MCTS.

A Hydrocarbon Spill in the Marine Environment may also have interactions with the Atmospheric Environment if there are temporary increases in emissions of air contaminants due to evaporation of the oil slick; thus a ranking of 1 was assigned to this interaction. Air emissions resulting from a marine spill of hydrocarbons may or may not exceed air quality standards depending on the type of material spilled, the size of the spill, and the environmental conditions at the time of the spill; however the potential environmental effects would be not significant given that the increase in emissions would be infrequent (low probability of spill), temporary (*e.g.* day or two) and rapidly dispersed and thus are considered not significant.

Based on the above, the potential environmental effects of a Hydrocarbon Spill in the Marine Environment on the Atmospheric Environment, Public Health, Heritage and Archaeological Resources, and Marine Safety during all phases of the Project are rated not significant and will not be considered further in this assessment. There is a high level of confidence in these predictions.

A large Hydrocarbon Spill in the Marine Environment, although considered highly unlikely, could potentially have significant environmental effects on the following VECs, should one occur: Coastal Wetland Environment; Marine Environment; Commercial Fisheries; and the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons. These interactions are ranked as 2 and therefore considered further in the following sections.

The fate and transport of a large spill will depend upon a range of factors including the type of spill, quantity, location, weather, and sea state. Modelling undertaken by SL Ross (2008) illustrates typical examples but cannot represent the range of possible consequences that are influenced by these many influencing factors. In the analysis of an unlikely accident such as a large oil spill, it is important to note that depending upon those factors, a spill could behave in a range of possible ways that could result in spills reaching shore in New Brunswick or Nova Scotia.

The Response Organization uses preparedness and planning in combination with models to evaluate fate and transport in response to the specific conditions and factors that exist in relation to a spill. This strategy reflects the importance of readiness and pro-active response as the key tool for mitigating the consequences of a large spill.

Consequently, the following analyses are hypothetical and include consideration of potential environmental effects that could occur as a result of a large spill in the Bay of Fundy. While it remains that mitigation strategies are key for mitigating potential environmental effects, it is important to understand which resources may be at risk in the unlikely event that a large spill was to occur in relation to the Project. This knowledge will be essential in preparing for and developing the Oil Pollution Emergency Plan for the Marine Terminal and to assist the Response Organization, ALERT Inc. in their preparation of response to a larger potential spill.

16.2.4.3 Coastal Wetland Environment

There is a potential for a Hydrocarbon Spill in the Marine Environment to affect coastal wetlands and salt marsh environments in the Bay of Fundy due to shoreline oiling in the unlikely event of a spill. An oil spill could result in coating, toxicity, and dislodging of plants, intertidal algae and marsh grasses, and cause damage during shoreline clean-up activities. The extent of these environmental effects would largely depend on the type of oil spilled, the level of exposure, and the rate of clean-up efforts. Since heavy crude is viscous, a heavy crude spill would only pose a risk to the above ground parts of marsh grasses. Lighter, less-viscous oils such as diesel fuel can penetrate the substrate and damage root systems.

In the unlikely event of a large oil spill in the Bay of Fundy, there is the potential for oiling of the shoreline, both in New Brunswick and Nova Scotia, depending on environmental conditions at the time of the spill. As a result of the tidal and wind regimes in the Bay of Fundy, an oil slick could land on areas of the coast that are currently used for various purposes, such as beaches and recreational areas, within a few days of an unlikely spill.

Mispec Park, Mispec Beach, New River Beach, and other coastal areas along the Bay of Fundy could be adversely affected in the event of a large oil spill. Similarly, this could occur at any number of shoreline locations that are currently in use, depending on the location of the spill and the environmental conditions. While an oil spill that reaches the shore could restrict or degrade the present land uses in the area to a point where activities could not continue at current levels while clean-up effort is undertaken, these areas could be restored to conditions that permit such land uses to continue. As such, largely because of the reversibility of the environmental effect following clean-up activities, the potential environmental effects of a Hydrocarbon Spill in the Marine Environment on Land Use are rated not significant. Regardless, the likelihood of a large spill occurring is extremely low, as demonstrated by the probabilistic analysis.

A spill of heavy crude oil in the anchorage area or the shipping lanes that is not contained could potentially reach salt marshes on the southern coast of New Brunswick, particularly in the area of Saints Rest Marsh and Red Head Marsh near the marine terminal and anchorages, or possibly, but less likely, in Nova Scotia. Because heavy crude is viscous, it is not likely to penetrate into marsh soil and damage the roots of shoreline plants, and thus the marsh vegetation would likely intercept, or quickly recover provided clean-up efforts do not damage the underground parts of the plants. Such a spill could also lead to mortality or damage to intertidal algae in these areas; however affected areas would be expected to recover. A summer spill of diesel fuel in the shipping lanes would likely dissipate prior to reaching shore in the southern New Brunswick and therefore the potential environmental effects to salt marsh vegetation or intertidal algae are rated not significant.

Project-related spills occurring elsewhere in the Bay of Fundy could conceivably affect other salt marsh areas than those described here. The environmental effects of such an occurrence would vary depending on the location of the spill and the environmental conditions at the time of the spill, and the ability to respond and/or intercept the spill. Despite these limitations, if a Hydrocarbon Spill in the Marine Environment alters salt marsh habitat and coastal wetlands (provincially significant in New Brunswick), the environmental effects of that spill could, without mitigation, possibly be significant. The affected wetland would take several months or years to recover depending on the type of spill and effectiveness of cleanup. The environmental effects of a spill that is demonstrated to adversely affect a wetland, even after restoration, would likely have to be compensated; with compensation, there should be no residual adverse environmental effects that are significant. Therefore, the potential residual environmental effects of a Hydrocarbon Spill in the Marine Environment on the Coastal Wetland Environment during all phases of the Project are rated not significant.

16.2.4.4 Marine Environment

A Hydrocarbon Spill in the Marine Environment could contribute to habitat alteration, disruption or destruction (HADD), and could lead to mortality of individual members of flora and fauna populations within the marine environment. In particular, marine birds, sea ducks, shorebirds, and marine mammals would be at risk in the event of a marine spill. Considering the residual environmental effects rating criteria for Marine Environment (Chapter 10), the residual environmental effects on the Marine Environment as a result of a Hydrocarbon Spill in the Marine Environment may be significant; however, given the implementation of codified practices and emergency response, the likelihood of such an environmental effect is reduced.

Birds

In the unlikely event of an oil spill in the marine environment, marine birds, sea ducks, and shorebirds could be exposed to oil either through direct contact or by ingestion of oil or oil-contaminated prey. Eggs and nestlings can also be affected when adult birds are exposed and return to the nest. Mortality of birds that are protected under the *Migratory Birds Convention Act* would be unauthorized and thus would technically be considered a significant environmental effect. Species of secure populations of birds that are not so protected would likely experience environmental effects that are not significant because the potential environmental effects, although clearly adverse, would not occur at the population level. Environmental effects on SAR (mortality or habitat loss) would be significant if they occurred, and on SOCC may be significant, depending upon the number of individuals or extent of habitat affected.

In the unlikely event of a large spill of heavy crude occurring in the summer from the marine terminal, in the anchorage area, or in the shipping lanes, several bird species in the Bay of Fundy could be potentially affected. The trajectory of a spill could result in oil reaching the shoreline near the Marine PDA and could affect locally nesting marine birds such as the double-crested cormorant and gulls of Manawagonish Island, a bird sanctuary located near west Saint John. Shoreline contamination from a spill of heavy crude could also pose a risk to migrating shorebirds (*i.e.*, semipalmated sandpiper and semipalmated plover) that use areas such as Saints Rest Marsh as feeding grounds during their southward migration.

Three species of marine bird SAR or SOCC are known to frequent the Bay of Fundy: harlequin duck (SAR), roseate tern (SAR), and Barrow's goldeneye (SAR, "special concern"). Harlequin duck are found primarily in the lower Bay of Fundy around Grand Manan Island, Point Lepreau, and Wolf Islands, but are generally only present in the Bay of Fundy in the winter and are found proximal to the proposed location of the marine terminal on occasion. The roseate tern is found primarily in the lower Bay of Fundy in summer. There has been historic nesting near Machias Seal Island by a pair of roseate tern, but not for some time, and there are no known colonies in the Bay of Fundy. The probability of environmental effects to harlequin duck or roseate tern is extremely low due to their seasonality or preferred location. However, a spill could occur elsewhere in the Bay of Fundy and depending on the nature of the spill and the environmental conditions at the time of the spill, there is the potential for harlequin duck and roseate tern to be exposed to hydrocarbons. Environmental effects that result in habitat loss or direct mortality of SAR, or species protected by the *Migratory Birds Convention Act* would be significant, but are considered to be very unlikely to occur.

Barrow's goldeneye is not present in the Bay of Fundy in the summer, and in the winter they are widely distributed and the risk of an oil spill affecting them is small, but could potentially be significant in the worst case. The razorbill (not a species of special status) is present in relatively low numbers (estimated population 2,000) in the Bay of Fundy during the summer; however, thousands of razorbill spend the winter in the outer Bay of Fundy, and in the unlikely event of a large oil spill in the shipping lanes during the winter, there could be adverse environmental effects on razorbill in the Brier Island and Digby Neck area. However, as they are abundant and not a species of special status, the potential environmental effects on razorbill, although adverse, are rated not significant.

Marine Mammals

The majority of marine mammals are found in the lower Bay of Fundy between June and October, although some of the smaller species, including harbour porpoise and harbour seal, are considered year-round residents and have been reported in the shallow waters of the Upper Bay. Four species of marine mammal SAR or SOCC are known to frequent the Bay of Fundy on occasion: harbour porpoise, fin whale, North Atlantic right whale, and blue whale. These species are generally known to be present in the lower Bay of Fundy in the Grand Manan Island area. All marine mammals are considered to be fish under the *Fisheries Act*.

The harbour seal is a secure species that is present year-round in the Bay of Fundy. The area around the marine terminal does not support high concentrations of seals and therefore the risk of significant environmental effects on these seals is low due to their population status and relatively low concentrations. Areas of highest potential for the harbour seal to be present are around Grand Manan Island. These areas are well removed from the marine terminal. The harbour porpoise is occasionally found in the Bay of Fundy, but would be less at risk with an oil spill because it is agile.

The North Atlantic right whale is primarily a subsurface feeder, and thus it has a lower risk of ingesting oil from a potential spill than other baleen whales that feed at the surface. North Atlantic right whale populations are typically not present in the Bay of Fundy in the winter, and during the summer they are typically found in the lower Bay of Fundy near Grand Manan Island. A summer spill in the shipping lanes could cause adverse environmental effects to their summer feeding areas.

For the blue whale, the shipping lanes traverse part of the summer range of the species, but do not pass near any area of concentration. There is a small risk that oil from a spill would make contact with an individual blue whale. Therefore, the likelihood of an adverse environmental effect is low. The humpback whale population is present in the Bay of Fundy from spring through autumn, and therefore is not vulnerable to winter spills. When present, it is distributed over the Gulf of Maine, Bay of Fundy, and Scotian Shelf over an area of over 300,000 km^2. Only a small number of individuals are likely to be present in areas traversed by the largest of the potential crude oil or diesel spills. The likelihood of adverse environmental effects on these exposed individuals is low.

The fin whale is present in the RAA year-round. In summer months the population is distributed throughout its summer feeding range. In winter, the majority of the population migrates to lower latitudes leaving only a small proportion of the population in the Bay of Fundy/Gulf of Maine area. At any time of year only a small proportion of the population remains in the lower Bay of Fundy. This species is at a low level of risk to exposure to an unlikely spill.

There are no documented cases of baleen whale mortalities resulting from an oil release. Following the Exxon Valdez release, in which over 40 million litres of crude oil were released into Prince William Sound, the movements and behaviour of the humpback whale were monitored (von Ziegasear *et* *al.* 1994), but no changes in their abundance or movement were observed (Loughlin 1994). In the year following the release, there were no reports of baleen whale mortalities (von Ziegasear *et al.* 1994). In addition, there was no reported evidence of physical oiling or toxicological effects on any baleen whale (von Ziegasear *et al.* 1994).

Overall, however, there is a risk that a marine mammal (protected under the *Fisheries Act*) could have adverse environmental effects on its habitat or even result in mortality, should an oil spill occur and affect it. Further, although unlikely, a SAR or SOCC marine mammal could be adversely affected. Therefore, although very unlikely, the potential environmental effects of a spill on marine mammals is rated significant, but is considered to be not likely to occur.

Marine Fish

As discussed in Chapter 10, over 100 marine fish species can be found in the Bay of Fundy, including commercially important species such as herring, cod, haddock, pollock, lobster, and scallops. Both fish and their fish habitat are protected under the *Fisheries Act*. Marine species of special status that may be present include Atlantic salmon, Atlantic wolffish, and striped bass (Threatened under *SARA*). Striped bass populations spawn in the Shubenacadie River, and are known to be present in the Bay of Fundy during times of migration and feeding. Atlantic wolffish are a large bottom-dwelling predatory fish, and are generally not at risk due to the depth at which they reside in the water column. As such, these two species are not discussed further. Commercially important fish species will be discussed in the next sub-section.

Due to the climate and oceanographic conditions in the Bay of Fundy, spills of heavy crude or diesel are expected to evaporate and/or migrate to shore quite rapidly. In the unlikely event of a heavy crude spill, only a very small amount of oil would become entrained in the water column. Diesel is less viscous and could become entrained in the water column and interact with marine fish depending on the nature and the environmental conditions at the time of the spill.

Atlantic salmon smolts are found in saltwater throughout the Bay of Fundy from May through December each year, and winter in the Grand Manan Island area. In the unlikely event of a diesel spill, Atlantic salmon in the area could be exposed to hydrocarbon entrained in the water column. Considering the variability of spill possibilities and the wide dispersion of individual salmon in the Bay of Fundy, the probability of the Atlantic salmon population being adversely exposed to oil spills is extremely low.

In summary, based on the modelling conducted and the knowledge of the Bay of Fundy and its inhabitants, if a hydrocarbon spill were to occur in the marine environment, the consequences to Marine Environment could potentially be significant. The environmental effects of a large hydrocarbon spill in the marine environment on SAR would be significant as the injury or death of an individual SAR is significant to the survival of the population. However, in consideration of the significance criteria for the Marine Environment, even though a large hydrocarbon spill in the marine environment (if it were to occur) could cause injury or death to SOCC or one or more individuals of other secure species of fish, mammals, or other constituents of the Marine Environment that are not SAR, it would not be likely to alter habitat or affect these secure species at the population level or cause a loss of regional biodiversity. However, as all fish are protected also under the *Fisheries Act*, any HADD or mortality arising from a spill would be unauthorized and could be considered to be potentially significant. Mitigation and response to any spill will reduce environmental effects. The *Canada Shipping Act* and DFO policy would contemplate that an oil spill could occur as an accidental event and must be responded to in full compliance with the laws and regulations, and with due diligence, as planned by the Proponent.

Therefore, the potential environmental effects of an unlikely large Hydrocarbon Spill in the Marine Environment on the Marine Environment overall are rated significant. However, in light of the predicted very low likelihood of such spills occurring, and in consideration of the significance criteria, the likelihood of significant environmental effects to these populations is actually very low.

16.2.4.5 Commercial Fisheries

As discussed in Chapter 14, the Bay of Fundy, including the nearshore areas around the Marine PDA, supports Commercial Fisheries that provide an important source of income for local fishermen. Environmental effects of a Hydrocarbon Spill in the Marine Environment on Commercial Fisheries could adversely affect these fisheries if they were to occur.

A spill of heavy crude oil in the anchorage areas during the fishing season would disrupt local shellfish fisheries (*e.g.*, scallop, lobster) due to the presence of slicks in the nearshore area of the Bay of Fundy. In addition, the oiled shorelines and shallow sub-tidal areas could pose a long-term source of hydrocarbon contamination for demersal shellfish fisheries. A summer spill might pose some risk to the New Brunswick herring weir fishery. A winter spill in the anchorage area poses similar types of risks, but on the Nova Scotia side of the Bay. In addition, depending on the degree to which oil moves toward the outer Bay, a winter spill might disrupt the Nova Scotia herring fishery in the lower Bay of Fundy.

The oil slick from a potential oil spill moving westward poses some risk to the nearest of the New Brunswick aquaculture operations, but not to the centre of the aquaculture industry in the lower Bay of Fundy. The level of risk posed to Nova Scotia aquaculture can vary depending on the degree to which oil might penetrate the protected Nova Scotia bays, where aquaculture installations are located.

A summer spill of heavy crude oil at the marine terminal would pose little toxicological risk to in-water species as little is likely to be entrained into the water column, but might cause a temporary and localized disruption to local commercial fisheries due to the presence of slicks and potential for contamination of nearby areas of the sea bed with re-distributed oil. There may also be the risk of taint that could affect the commercial sale of fish. In the diesel spill, elevated hydrocarbons in the water column would cause localized mortality to water column and sea bed species in the immediate area of the spill. However, the size of the area involved is small and the risk to Bay of Fundy populations, as a whole, are small. Therefore, the potential environmental effect on Commercial Fisheries in the Bay of Fundy as a whole is small. Winter spills of heavy crude oil and diesel could cause closures of groundfish fisheries in the central Bay of Fundy, but they would be localized and temporary so the environmental effect on annual yields to fisheries would be limited.

A spill of heavy crude oil in the shipping lanes would pose very little toxicological risk to in-water species as little oil is likely to become entrained in to the water column. A diesel spill may cause mortality to pelagic, young-of-the-year life stages of fish (*e.g.*, haddock) in the water column, but the proportion of the population at risk is small because these pelagic life stages can be expected to be broadly dispersed over a large area. Shipping lanes spills can be expected to cause reductions in the lobster and scallop and perhaps groundfish fisheries due to the closures if caused during their respective seasons. Winter spills could pose a risk to the Nova Scotia herring fishery.

A spill could cause these fishermen to be displaced and not be able to fish in their areas normally fished for an extended period of time. This, in turn, could result in a loss of income for these fishermen, which could at some later time be compensated but not likely in a timely manner that would reduce the resulting loss of income. As a result, the potential environmental effects of a Hydrocarbon Spill in the Marine Environment on Commercial Fisheries are rated significant, although highly unlikely to occur as evidenced by the probabilistic analysis conducted and in view of compensation that would be negotiated should environmental effects on the fishery were documented to have occurred.

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

As discussed in Chapter 12, there is a known Aboriginal fishery in the Bay of Fundy. As such, in the unlikely event of a large spill, the environmental effects of a Hydrocarbon Spill in the Marine Environment on the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons will be similar to those experienced by other commercial fishers, as outlined in Section 16.2.3.5. As with Commercial Fisheries, the potential environmental effects of a Hydrocarbon Spill in the Marine Environment on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons are rated significant; however the likelihood of a large spill occurring is extremely low and would be compensated where documented to have occurred.

16.2.5 Determination of Significance

The potential environmental effects of a Hydrocarbon Spill in the Marine Environment on the Coastal Wetland Environment during Operation are rated not significant. However, despite a very low likelihood of occurrence as demonstrated by the probabilistic analysis, the potential environmental effects of a Hydrocarbon Spill in the Marine Environment on Commercial Fisheries, and the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons during Operation are rated significant. However, the likelihood of the large spill scenarios potentially causing significant adverse environmental effects is extremely low. The spill frequencies calculated in this CSR were based on the assumption that oil tankers used in conjunction with the Project would be as safe or safer, than the average tankers that have been used internationally over the past 20 years. The recent spill statistics produced by ITOPF indicate that tanker operations in recent years are much safer, and spill rates in the 2000s are about half the rates in the late 1980s and 1990s, the most recent years used to calculate historical frequencies for this study. Based on the conservative spill frequencies calculated for this analysis, a spill similar to the marine terminal spill of 500 m^3 of diesel or a 1,000 m^3 spill of heavy crude oil is only predicted to occur once every 25 years or more. A large spill similar to those modelled for the anchorage area and the shipping lanes is only predicted to occur once every 34 years or more. Given that the Proponent will be using safer tankers than those accounted for in the model assumptions, and given that spill rates in the 2000s have been shown to be only half of the spill rates assumed in the model, then the spill scenarios modelled in this analysis and associated environmental effects are considered highly unlikely. Furthermore, the Proponent has a history of ensuring safe transportation of products and crude oil for the existing Saint John refinery; since 1999, only one ship-sourced spill has been reported and it was considerably less than one barrel of oil. So, while the potential environmental effects of the hydrocarbon spills modelled in this analysis would be significant for the VECs outlined, these spills are considered highly unlikely to occur.

Capacity of Renewable Resources to be Significantly Affected

The capacity of renewable resources associated with unlikely but significant environmental effects on the above noted VECs is discussed in Chapter 11 (Commercial Fisheries), Chapter 12 (Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons), and Chapter 10 (Marine Environment, for SAR only). Significant environmental effects on renewable resources are limited to the highly unlikely event of a large hydrocarbon spill in the marine environment as discussed in Section 16.2.1. A large oil spill would significantly affect the capacity of the renewable resource for SAR and possibly SOCC, as injury or death of an individual SAR or SOCC could to varying degree potentially jeopardize the survival of the population. However, as demonstrated by the probabilistic analysis, such a spill is not likely to occur.

Thus, the primary renewable resource of concern is the Bay of Fundy fishery, which is used for both commercial and traditional Aboriginal purposes. In the highly unlikely event of a large oil spill in the Bay of Fundy, some closures of commercial fisheries and the temporary exclusion of commercial fishers from traditional fishing grounds due to mitigation and clean-up efforts or due to potential contamination of fish habitat, may occur. Although these environmental effects could be considered significant but likely compensated where documented, they would be temporary, with recovery time contingent on a number of factors, such as the type and location of the spill, the environmental conditions at the time of the spill, and the intensity of fishing activity in the area. It is thus expected that the long-term use of the resource, including use by future generations, will not be significantly affected by a Hydrocarbon Spill in the Marine Environment.

16.3 Vessel Accident

A Vessel Accident that does not result in a release of petroleum hydrocarbons could occur at any time during Construction, Operation, and Decommissioning and Abandonment. A Vessel Accident may occur through the following credible scenarios that have been selected to capture potential worse case consequences: collision with marine SAR or SOCC; vessel grounding; ship to ship collision; damage to commercial fishing gear; and a fire or explosion on ships in the marine environment.

As discussed in Chapter 13, Construction, Operation, and Decommissioning and Abandonment will add vessel traffic to Saint John Harbour and the shipping lanes. While this increased traffic could lead to an increase in vessel accidents in terms of total number of accidents, there are no features of the Project that would cause the rates of such accidents to increase. The shipping lanes, anchorages, and Port of Saint John have sufficient capacity to handle the increased vessel traffic resulting from the Project during Construction, Operation, and Decommissioning and Abandonment. During Construction and Operation, exclusion zones will be in place around the Construction activity and the marine terminal operation to minimize interaction with non-Project vessels.

To operate within Saint John Harbour, the majority of Project vessels, such as barges, crude carriers and product tankers, must have a licensed Saint John Harbour Pilot on board to move within the limits of the Saint John Compulsory Pilotage Area, including in and out of anchorage areas which are located in this area, and while berthing and deberthing. Vessels may also be assisted by tugs, which are piloted by experienced captains. Close monitoring of vessel traffic by the Canadian Coast Guard's Marine Communications and Traffic Services (MCTS) centre, and the recent movement of the shipping lanes to avoid known areas inhabited or frequented by the North Atlantic right whale, will assist in minimizing the potential for vessel accidents and marine mammal strikes. The safe management of marine vessel traffic in the shipping lanes and in Saint John Harbour is a well-established practice, and is governed by shipping policies and procedures that ensure marine vessel movements in the region are managed effectively. Harbour Pilots are well-trained and highly skilled in navigating vessels within the harbour, and are familiar with current, tidal, and weather patterns in the area.

The Proponent has volunteered to completing a TERMPOL review process (2001 edition) following the EA of the Project and after sufficient engineering design has been completed. The TERMPOL review will evaluate operational ship safety, route safety, and management and environmental concerns associated with the location, construction and operation of a marine terminal handling bulk petroleum products and other navigation concerns, primarily including vessel accidents.

With this mitigation, it is expected that, in general, a Vessel Accident (collision with marine SAR or SOCC, vessel grounding, ship to ship collision, fire or explosion) is not likely to occur given the implementation and adherence to the above mentioned policies, practices and procedures. A Project-related Vessel Accident resulting in damage to commercial fishing gear would be addressed via continued participation by the Proponent in the Port of Saint John Traffic Committee, whereby the Port users discuss and implement suitable parameters for viable vessel operations and commercial fishing with the goal of reducing ship/gear interactions. These and other measures will help ensure that, should a vessel accident occur, the resulting environmental effects will be not significant.

16.3.1 Description of Scenarios

Potential Vessel Accidents that could occur include the following: collision with marine SAR or SOCC; vessel grounding; ship to ship collision; damage to commercial fishing gear; and a fire and/or explosion in the marine environment.

16.3.1.1 Collision with Marine Species at Risk (SAR) or Species of Conservation Concern (SOCC)

Serious injury or direct mortality of marine mammals of special status may occur as a result of a collision with Project vessels. Four species of marine mammals listed in *SARA* are known to frequent the Bay of Fundy. They are: the harbour porpoise (Special Concern); the fin whale (Special Concern); the North Atlantic right whale (Endangered); and the blue whale (Endangered).

A collision with SAR or SOCC only has the potential to cause an interaction with a Change in Marine Populations.

16.3.1.2 Vessel Grounding

A grounding of a vessel may occur when it comes into contact with the ocean floor or the shore. Contact may occur with a charted and marked obstruction, or an uncharted and unmarked obstruction. This could potentially occur as a result of human error, a mechanical malfunction, or extreme weather conditions. A vessel grounding may cause environmental damage to the sea bed, including damage to ocean flora and fauna. The grounding of a vessel is also a risk to worker health and safety, and may result in damage to vessels and other property.

The grounding of a vessel has the potential to cause interactions with a Change in Public Safety, Change in Marine Populations, and a Change in Marine Safety.

16.3.1.3 Ship to Ship Collision

A ship to ship collision involving no release of hydrocarbons (marine spills of hydrocarbons were assessed in Section 16.2) may occur if a vessel deviates from its designated shipping lane or travel route to come into contact with another vessel, either travelling or stationary. This could potentially occur as a result of human error, a mechanical malfunction, or extreme weather conditions. A ship to ship collision may result in damage to vessels and is a potential risk to health and safety.

In a manner similar to a vessel grounding, a ship to ship collision has the potential to cause interactions with a Change in Public Safety, Change in Marine Populations, and a Change in Marine Safety.

16.3.1.4 Damage to Commercial Fishing Gear

Project-related vessel activity during Construction or Operation has the potential to result in damage to commercial fishing gear.

Damage to commercial fishing gear has the potential to cause interactions with a Change to Net Income of Local Commercial Fishermen, and a Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons.

16.3.1.5 Fire or Explosion

A Project-related fire and explosion primarily during Operation of the Project, has the potential to cause damage to the Marine Terminal and Other Marine-Based Infrastructure, and/or marine vessels.

A fire or explosion has the potential occur as a result of human error or mechanical malfunction, and may result in a Change in Air Quality, a Change in Public Health, a Change in Marine Populations, and a Change in Marine Safety due to the release of air contaminants as a result of the fire or blast or by run-off from extinguishing materials.

16.3.2 Environmental Effects Assessment

The potential interactions between Vessel Accidents and the selected VECs for this CSR are summarized in Table 16.22.

Table 16.22 Potential Interactions Between VECs and a Vessel Accident

Valued Environmental Component (VEC)	Vessel Accident				
	Collision with Marine SAR or SOCC	Vessel Grounding	Ship to Ship Collision	Damage to Commercial Fishing Gear	Fire or Explosion
Atmospheric Environment	0	0	0	0	1
Public Health	1	1	1	0	1
Coastal Wetland Environment	0	0	0	0	0
Marine Environment	2	1	0	0	1
Commercial Fisheries	0	0	0	2	0
Marine Safety	1	1	1	0	1
Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons	0	0	0	2	0

Table 16.22 Potential Interactions Between VECs and a Vessel Accident

Valued Environmental Component (VEC)	Vessel Accident				
	Collision with Marine SAR or SOCC	Vessel Grounding	Ship to Ship Collision	Damage to Commercial Fishing Gear	Fire or Explosion
Heritage and Archaeological Resources	0	0	0	0	0

Notes: Interactions between Accidents/Scenarios and the respective VECs were ranked as follows:
0 No interaction, or no substantive interaction contemplated.
1 Interaction may occur. However, based on past experience and professional judgment, the interaction would not result in a significant environmental effect, even without mitigation, or the interaction would clearly not be significant due to application of codified practices.
2 Interaction may, even with codified mitigation, result in a potentially significant environmental effect and/or is important to regulatory and/or public interest. Potential environmental effects are considered further and in more detail in the CSR.

No interaction between five of the scenarios of Vessel Accidents and two of the VECs is foreseen (Table 16.22). These include Coastal Wetland Environment, and Heritage and Archaeological Resources. The interactions between Vessel Accidents and these VECs have been ranked as 0 because there are no foreseeable circumstances where these interactions would occur. Accidental events that may involve a release of hydrocarbons to the Marine Environment are assessed as a Hydrocarbon Spill in the Marine Environment (Section 16.2) and are not considered further in this section. Therefore, the potential environmental effects of a Vessel Accident on Coastal Wetland Environment, and Heritage and Archaeological Resources, are rated not significant, with a high level of confidence, and are not discussed further in this CSR.

A Vessel Accident (collision with marine SAR or SOCC, vessel grounding, and/or ship to ship collision) may interact with Public Health (due to potential injury to ship personnel) as well as with Marine Safety (due to potential damage to public or private property, or injury or mortality of a marine SAR or SOCC), thus potentially causing adverse environmental effects to these VECs. The interactions of Vessel Accident and Public Health as well as on Marine Vessel Safety were ranked as 1. The Transportation Safety Board of Canada (TSBC) maintains statistics on occurrences of marine accidents throughout Canada, and within the various regions including the Maritimes Region. Statistics available for Canada include total shipping accidents by type of incident and type of vessel involved, and total injuries as a result of shipping accidents. Statistics available for the Maritime region include total shipping accidents by type of vessel. Total shipping accidents for all of Canada and for the Maritimes Region as recorded by the TSBC are shown in Table 16.23.

Table 16.23 Transportation Safety Board of Canada Recorded Shipping Accidents in Canada and in the Maritimes Region

Jurisdiction	Total Number of Recorded Shipping Accidents in Jurisdiction by Year (All Types and Causes)		
	2008	2007	2003-2007 Average
Canada	341	395	437
Maritimes Region	62	64	98

Source: TSBC (2008a) and TSBC (2008b)

The occurrence of shipping accidents has steadily declined in recent years. This may be in part attributable to advances in safety technology and navigational controls. Of the 341 shipping accidents recorded in Canada during 2008, 62 of which were recorded in the Maritimes. This represented a decrease from total shipping accidents recorded in 2007 as well as for the average of the years 2003-2007.

Sixty-eight of the 341 shipping accidents in Canada during 2008 were vessel groundings and 15 were vessel to vessel collisions. Twenty-one injuries were recorded by TSBC as a result of all shipping accidents in Canada (TSBC 2008a).

Each year there are approximately 850,000 vessel movements in Canadian waters (DFO 2002). Thus, of the vessels completing these movements, only approximately 0.04% could be expected to be involved in accidents of all kinds (based on 2008 shipping accident statistics), and only 0.002% would be expected to result in injuries according to 2008 shipping accident statistics. The likelihood and frequency of a Vessel Accident occurring as a result of the Project is thus very low.

A Fire and Explosion in the marine environment may have interactions with the Atmospheric Environment if there is a Change in Air Quality as a result the release of air contaminants in the form of smoke or ash from a fire or explosion. This may or may not exceed air quality standards depending on the type of materials involved, the size of the fire or explosion, and the environmental conditions at the time of the event; however the potential environmental effects would be not significant given that the increase in emissions would be temporary and rapidly dispersed.

A Change in Public Health as a result of a Fire or Explosion would be primarily due to atmospheric emissions, such as smoke and ash, and would primarily result in short-term health effects, mostly limited to the period of time that a fire burned and released associated emissions; thus the ranking of 1 in Table 16.22. Such an accident would be of primary concern to emergency response personnel who would be equipped with respirators. However, given the temporary nature of the event in relation to Air Quality, a Fire of Explosion is also considered not significant for Public Health.

Residual environmental effects of a Fire or Explosion on Public Health could be experienced during both Construction and Operation, but with the planned mitigation and response procedures and the extremely low anticipated frequency and duration of such events occurring because of the extensive safety, prevention, design, and mitigation measures to be taken in respect of each phase of the Project is not likely to occur. In addition, a Fire or Explosion is not likely to occur because of the planned mitigation, safety control devices, emergency response procedures, and thorough safety training for employees. Thus, the potential environmental effects of a Fire or Explosion on a Change in Public Health are rated not significant. There is a moderate level of confidence in the prediction.

A potential interaction exists between a Fire or Explosion and the Marine Environment, therefore assigning a ranking of 1 in Table 16.22. Run-off from water used to extinguish a fire would likely contain sediment and chemicals, including hydrocarbons. Should this fire water run-off reach the marine environment, it could affect marine water quality such that marine species could be harmed or mortality could result. Based on emergency response plans, safety procedures and training for emergency situations on vessels and those to be developed as part of the EPP for the Marine Terminal, it is unlikely that a release of run-off will affect the Marine Environment, therefore the potential environmental effects of a Fire or Explosion on the Marine Environment are rated not significant and are not discussed further.

There are established policies, practices and procedures in place to mitigate potential adverse environmental effects of a Vessel Accident on Public Health. The safe management of marine vessel traffic in the Port of Saint John and in the Bay of Fundy is a well-established practice, and is governed by shipping policies and procedures that ensure marine vessel movements in the region are managed routinely. Management authorities include the Canadian Coast Guard MCTS, the Saint John Port Authority, and the Atlantic Pilotage Authority, who have established health and safety emergency response plans, protocols and procedures. Harbour Pilots are well-trained and highly skilled in navigating vessels within the Harbour, and are familiar with current, tidal, and weather patterns in the area. In addition, the Proponent has volunteered to completing a TERMPOL review (according to 2001 edition guidance (TP 743 E) (Transport Canada 2001)), a process directed by Transport Canada to evaluate operational ship safety, route safety, and management and environmental concerns associated with the location, construction and operation of a marine terminal handling bulk petroleum products. Based on existing health and safety, vessel traffic management, and emergency response procedures; highly-trained personnel; and the history of a relatively small number of vessel accidents in the Maritimes region each year, potential environmental effects of a Vessel Accident on Public Health and Marine Safety are rated not significant. There is a high degree of confidence in this significance prediction.

Thus for all activities which were ranked 0 or 1 in Table 16.22, the environmental effects are rated not significant with a moderate to high level of confidence, and are not considered further.

The interaction between a Vessel Accident (collision with marine SAR or SOCC) and Marine Environment was ranked as 2 in Table 16.22. Also, the interactions between a Vessel Accident (damage to commercial fishing gear) and Commercial Fisheries as well as with Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons were also ranked as 2 in Table 16.22. These interactions are evaluated further below.

16.3.2.1 Marine Environment

Potential environmental effects to the Marine Environment from a Vessel Accident may occur solely as a result of a possible collision with marine SAR or SOCC.

During Construction, tugs, barges, and supply vessels will be operating within the Marine PDA. The risk of these vessels striking a baleen whale is considered low as these large whales are very seldom observed in the shallow waters of the Marine PDA and are rather more commonly found near the Outer Bay of Fundy. Harbour seals and harbour porpoise are more at risk of a vessel strike because they have been observed within this area; however, both species are fast-swimming and agile, and can effectively modify their behaviour (*i.e.*, swim away, dive) to avoid approaching vessels and there are very few documented cases of vessel strikes to any species of seal or small toothed whale (Richardson *et al.* 1995). Therefore, a vessel strike within the Marine PDA is considered unlikely and will not be assessed further.

Of all species of baleen whales known to occur in the lower Bay of Fundy, the North Atlantic right whale is the most susceptible to a vessel strike (Laist *et al.* 2001; Vanderlaan and Taggart 2003). Of 45 right whale deaths reliably documented between 1970 and 1999, 16 (35.5%) were due to vessel strikes (Knowlton and Kraus 2001). Vessel strikes are the leading anthropogenic cause of right whale mortality, and are a major factor in the apparent lack of recovery of this population (Kraus 1990; Terhune and Verboom 1999; International Whaling Commission 2001; Knowlton and Kraus 2001).

In the Bay of Fundy, the right whale congregates in the Grand Manan Basin during the summer and early fall (Winn *et al.* 1986; Murison and Gaskin 1989; Kenney *et al.* 2001; Baumgartner and Mate 2003). The Grand Manan Basin, located to the immediate northeast of the Bay of Fundy shipping lanes, is one of two important foraging habitats used by the right whale in Canadian waters (Brown *et al.* 1995; NARWRP 2000). Data obtained from the North Atlantic Right Whale Consortium (NARWC) indicate that areas of highest right whale concentration are located just outside of the designated shipping lanes in the Bay of Fundy (Right Whale Consortium 2008). However, there are still regular right whale sightings within the shipping lanes (Vanderlaan *et al.* 2008). Although few studies have investigated the reactions of the right whale to approaching vessels, existing research suggests that right whale exhibits very limited avoidance behaviour (Mayo and Marx 1990; Terhune and Verboom 1999; Nowacek *et al.* 2004). This limited avoidance behaviour places it at risk of a vessel strike, particularly in areas of high vessel traffic (Terhune and Verboom 1999; Nowacek *et al.* 2003).

Though the right whale is considered susceptible to a vessel strike, the calculated probability of such a strike occurring in the Bay of Fundy shipping lanes is extremely low. Using vessel-tracking radar data and right whale survey data, Vanderlaan *et al.* (2008), estimated the mean relative probability of a right whale-vessel encounter within the shipping lanes to be 0.0049 ± 0.00098, and the average relative risk of a lethal vessel strike to be 0.0034 ± $7.3x10^{-4}$. (Note: probabilities and mortality rates are dimensionless and are expressed as a number between 0 and 1; the higher the number, the more probable an event). These low probabilities are somewhat in contrast to the expected number of lethal strikes as determined from available whale death data in the Bay of Fundy. Prior to the Traffic Separation Scheme change in the Bay of Fundy (1990-2003) the average annual mortality rate was 0.24 (three right whale deaths; approximately one whale every four years). With this information, Vanderlaan *et al.* (2008) determined that the change to the 2003 Traffic Separation Scheme reduced the expectation of annual lethal vessel strikes to 0.081 (approximately one every 12 years). Given that no struck whales have been reported from the Grand Manan area since the 2003 Traffic Separation Scheme change, this latter estimate appears to be somewhat validated.

From the above information, at current vessel frequencies in the Bay of Fundy, it is therefore equally conceivable that right whale is:

- Unlikely to be struck (low calculated probability of 0.0049); or,
- On average, two and a half lethal vessel strikes may occur in the Bay of Fundy during Operation (one lethal strike per 12 years; 30 year project life; 30/12 = 2.5).

Vessel traffic in the Bay of Fundy is expected to increase by approximately 17% as a result of the Project and may result in an increased probability for a right whale-vessel strike (non-lethal or lethal). Therefore, it is not presently known if, or to what degree, the increase of vessel traffic resulting from the Project will affect the North Atlantic right whale population.

To reduce the probability of a North Atlantic right whale-vessel strike (non-lethal or lethal), the following mitigation measures will be considered.

- Project-related vessels will follow the 2003 Traffic Separation Scheme to avoid the North Atlantic right whale. As discussed earlier, this Traffic Separation Scheme was adopted by stakeholders primarily to reduce risk of vessel strikes to the North Atlantic right whales. This successful mitigation measure has resulted in a 62% decrease in the relative risk of a lethal vessel-North Atlantic right whale strikes in Grand Manan/Bay of Fundy region (Vanderlaan *et al.* 2008).
- To further reduce risk to the North Atlantic right whale, and in addition to the MCTS notification system, all hydrocarbon transport vessel captains and pilots will be provided with education materials on right whale-vessel strike information, and known options to avoid a North Atlantic right whale strike.

In addition, a recovery plan focused on the North Atlantic right whale is currently being developed by the federal government. Based on the above, and with proposed mitigation, the potential environmental effect of a Vessel Accident on the Marine Environment is rated not significant. This determination of significance carries a low to moderate level of confidence primarily due to the uncertainty in the likelihood of a lethal or non-lethal vessel strike (*i.e.,* calculated probability of vessel-whale encounter of 0.0049 and the possibility that the Project may increase the number of lethal strikes above the present estimates of one whale every 12 years).

16.3.2.2 Commercial Fisheries, and Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Potential environmental effects to Commercial Fisheries and to Current Use of Land and Resource for Traditional Purposes by Aboriginal Persons from Vessel Accidents could occur due to potential for damage to commercial fishing gear. The potential environmental effects from such accidents will thus be evaluated together.

Damage to commercial fishing gear could occur with respect to either the Aboriginal or non-Aboriginal fishery. Although there is an active Aboriginal fishery in the Bay of Fundy (Chapter 12), there are currently no documented Aboriginal fishing activities in the nearshore environment within or near the water lot owned by the Proponent. Several First Nation communities have commercial fishing licenses issued by DFO and fish within the general region (Chapter 11) (*i.e.,* towards the Outer Bay of Fundy).

A nearshore commercial lobster fishery and, to a lesser extent, a commercial scallop fishery occurs in and near the Commercial Fisheries LAA (Chapter 11) shown in Figure 11.1. Commercial scallop fishing is relatively infrequent in the Commercial Fisheries LAA and involves the use of submerged mobile fishing gear (draggers and rakes). Lobster fishing involves setting traps along the sea bed attached to markers buoys. Marine vessels transiting in the Bay of Fundy may on occasion run over marker buoys, resulting in either the buoy being cut from its line (with loss of the attached trap(s) and associated catch) or entangled (with damage to the attached trap(s)). If this occurs, it may result in a loss of net income for commercial fishermen (including Aboriginal fishermen) due to the reduction in catch and the additional costs associated with replacing lost or damaged traps.

It is estimated that there are up to 15 different fishermen working in and near the Commercial Fisheries LAA (Figure 11.1), though a substantial portion of this activity is conducted by vessels out of the Mispec wharf (Chapter 11). Each commercial lobster fishing license is allotted the use of 300 traps. As regulated by DFO, each license holder is provided 15 tags a year to replace lost traps. If a license holder loses more than 15 traps is a year, a special application for additional tags must be made to DFO.

Given the location of currently known lobster fishing activities (primarily by Mispec-based commercial fishermen, Figure 11.2), near the placement of marine infrastructure (including the jetty and the barge landing facility), Vessel Accidents may occur that result in the loss of or damage to lobster traps. However, a number of mitigation measures have been recommended (Chapter 11) to reduce the likelihood of this potential environmental effect, including:

- The use of established shipping lanes and anchorages in the Bay of Fundy by Project vessels, even though this does not prevent fishing or the presence of fishing gear in the shipping lanes and anchorages;
- The establishment of safety exclusion zones around the new jetty, the barge landing facility and the seawater cooling intake structure, preventing fishing gear from being set in these high risk areas when exclusions are in effect (*e.g.,* when ships are at the existing SBM, the jetty, or the barge landing facility);

- The establishment of practices and procedures with respect to marine terminal operations as defined in a Marine Terminal Manual to ensure that all applicable rules and regulations are met to help minimize interactions with fishing vessels; and
- The continued discussion with commercial fishermen using existing processes, in particular as part of the Port of Saint John Traffic Committee (Chapter 11).

It should be emphasized that the Proponent is the lease holder of a water lot surrounding the Mispec Point area. This area and the approach zone in the Harbour limits is currently an area fished for lobster, and is the area where damage to commercial fishing gear is expected to mostly occur. Fishing currently occurs within and near the Proponent's water lot, when ships are not present. Fishing activity will likely be restricted in some areas through safety exclusion zones when ships are present, to support the development and safe operation of marine infrastructure and port activities. Fishers will be requested to abide by the restrictions of the exclusion area, while they are in place, and advance notice of vessel arrivals and departures will be made available to fishers. The area is also within Saint John Harbour, which is administered by the Saint John Port Authority under the authority of the *Canada Marine Act* (1998, c.10) and Regulations with a view to facilitating national commerce and shipping. Thus, the establishment of the Proponent's water lot anticipates and is in support of the further development of the area as a marine terminal.

Although fishing may be conducted in the established shipping lanes in the Bay of Fundy, because of frequent marine vessel traffic in the shipping lanes and the high potential for damage to fishing gear to occur in these areas, any commercial fishers that do fish there would knowingly acknowledge and accept such risks, and as such fish there at their own peril; the environmental effects resulting from such use would thus be considered not significant.

The pursuit of commercial fishing within and near the Proponent's water lot (especially within safety exclusion zones), as well as within Saint John Harbour, the anchorages, the shipping lanes, and elsewhere in the Bay of Fundy is undertaken at the risk of commercial and Aboriginal fishermen in respect of shipping. Building on past experience of the Proponent over almost 40 years of operating a commercial port in co-existence with commercial fishing activity in the area, the Proponent will, in respect of the Project:

- Continue its active participation on the Port of Saint John Traffic Committee;
- Encourage or require its contractors to participate in the Committee;
- Establish marine vessel traffic routes in consultation with other stakeholders on the Committee; and
- Ensure that its contractors meet their commitments to the Port users.

The planned and existing mitigation will minimize the potential for damage to commercial fishing gear. Where it occurs, the extent of the loss and its cause would be challenging to determine, but is not expected to be frequent, particularly outside of the areas where mitigation is in place. A Project-related Vessel Accident resulting in damage to commercial fishing gear would be addressed via continued participation by the Proponent in the Port of Saint John Traffic Committee, whereby the Port users discuss and implement suitable parameters for viable vessel operations and commercial fishing with the goal of reducing ship/gear interactions. Working together with the fishermen and other stakeholders, such damage to commercial fishing gear is anticipated to be minimized and within the range of current activity (*i.e.,* normal course of business when fishing in areas of established shipping), not likely to increase, and is rated not significant.

16.3.3 Determination of Significance

Based on the above, and considering the residual environmental effects rating criteria for Marine Environment in Chapter 10, the potential environmental effects of all types of Vessel Accident on the Marine Environment during all phases of the Project are rated not significant, with a high level of confidence.

Based on existing and planned mitigation, including continued participation by the Proponent in the Port of Saint John Traffic Committee, and in consideration of the nature of the commercial fishery and established shipping activity in the Bay of Fundy, Saint John Harbour, and water lot, the potential environmental effects of a Vessel Accident on Commercial Fisheries during all phases of the Project due to potential damage to commercial fishing gear are rated not significant. There is a moderate level of confidence in the significance prediction.

For the same reasons, and because notable Aboriginal fisheries have not been documented to occur within the area that is most likely to result in an interaction between Project vessels and commercial fishing gear, the potential environmental effects of a Vessel Accident on Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons during all phases of the Project due to potential damage to commercial fishing gear are rated not significant. There is a high level of confidence in the significance prediction.

16.4 Introduction of Invasive Species

The Introduction of Invasive Species has the potential to occur primarily due to transfer of invasive species on or in equipment or materials transported to the Project site. Although other minor accidents may occur that may have lesser environmental effects, the incidents described below are considered to be the worst case credible scenarios.

Construction, Operation and Decommissioning and Abandonment will be conducted in a manner as to minimize the potential for adverse environmental effects from invasive species. All care and due attention will be provided to minimize introduction of invasive species in the marine environment

As conceived, planned and designed, the Project will inherently provide a high level of mitigation for the potential environmental effects caused by the Introduction of Invasive Species. Therefore, as described below, the potential environmental effects of the Introduction of Invasive Species are rated not significant and are not likely to occur.

16.4.1 Description of Scenarios

The following sections describe the different scenarios by which the introduction of invasive species in the marine environment could potentially occur.

16.4.1.1 Introduction of Invasive Species in the Marine Environment

Marine invasive species can be a threat to biological productivity, biodiversity, and commercial and recreational fisheries in the Marine LAA. Introduction of invasive species in the Marine Environment could occur through ballast water discharge. Although species-specific surveys for invasive species were not carried out during the Marine Biophysical Environment Technical Study (Jacques Whitford 2008m), the green crab (*Carcinus maenus*) occurs in the Marine LAA and in the Bay of Fundy. From a review of the relevant literature, other invasive species are not known to occur within the Marine LAA. However, there are invasive species with potential to establish within the Marine LAA, given their occurrence in similar habitats along the east coast of Canada and the United States.

The invasive species of particular concern are the lace bryozoan, oyster thief, Asian shore crab and the tunicate, *Didemnum* species. These species could eventually spread into the Marine LAA by natural reproduction and distribution. The lace bryozoan (*Membranipora membranacea*) has devastated entire kelp beds in the Gulf of Maine. They are found on the coast of Maine, New Hampshire, and the south coast of Nova Scotia. Distribution in the Bay of Fundy is unknown.

Oyster thief (*Codium fragile* spp. *tomentosoides*), also known as Japanese sputnik weed or dead man's fingers, is a green algae that has been introduced through shellfish aquaculture, boating, and fouling on ship hulls. It occurs in Maine, and the south coast of Nova Scotia, but it has not been recorded in the Bay of Fundy.

Asian shore crab (*Hemigrapsus sanguineous*) is present in Maine and is considered likely to spread to the Bay of Fundy.

The tunicate (*Didemnum* spp.) is a colonial sea squirt that covers a wide variety of substrates and materials. It is found in coastal Maine and Massachusetts and in Georges Bank, and is rapidly expanding along the East Coast.

As part of normal Operation of the Project during loading of finished products onto a vessel, ballast water will be discharged from the vessel. Ballast water is carried in tanks that are segregated from all other tanks and void spaces on board, and are designed only for the carriage of water ballast. The piping from the tanks is dedicated for this purpose. Vessels arriving to discharge crude oil will have no ballast aboard upon arrival. Ballast water will only be discharged from vessels that are arriving to receive finished products.

16.4.2 Environmental Effects Assessment

The potential interactions between Introduction of Invasive Species and the selected VECs for this CSR are summarized in Table 16.24.

Table 16.24 Potential Interactions between VECs and Introduction of Invasive Species

Valued Environmental Component (VEC)	Introduction of Invasive Species
	Introduction of Invasive Species in the Marine Environment
Atmospheric Environment	0
Public Health	0
Coastal Wetland Environment	0
Marine Environment	2
Commercial Fisheries	1
Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons	0
Marine Safety	0
Heritage and Archaeological Resources	0

Notes: Interactions between Accidents/Scenarios and the respective VECs were ranked as follows:
0 No interaction, or no substantive interaction contemplated.
1 Interaction may occur. However, based on past experience and professional judgment, the interaction would not result in a significant environmental effect, even without mitigation, or the interaction would clearly not be significant due to application of codified practices.
2 Interaction may, even with codified mitigation, result in a potentially significant environmental effect and/or is important to regulatory and/or public interest. Potential environmental effects are considered further and in more detail in the CSR.

No interactions (ranked as 0 in Table 16.24) between Introduction of Invasive Species and a number of VECs are foreseen. These include Atmospheric Environment, Public Health, Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, Heritage and Archaeological Resources, and Marine Safety. Potential environmental effects of Introduction of Invasive Species on these VECs during all phases of the Project are not likely to occur and are rated not significant. There is a high level of confidence in this significance prediction.

Although ranked as 1, Commercial Fisheries resources are included in the interaction with the Marine Environment and are not discussed further. Accordingly, potential environmental effects of an Introduction of Invasive Species on Commercial Fisheries for all phases of the Project are rated not significant.

Equipment will be cleaned and inspected for plants/seeds to reduce the spread of invasive plant species. Therefore, although there is a potential interaction, the potential environmental effects of the Introduction of Invasive Species on the Coastal Wetland Environment are unlikely and are rated not significant for all phases of the Project. Thus for all interactions ranked as 0 or 1 in Table 16.24, the potential environmental effects of Introduction of Invasive Species during all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

The only interaction with Introduction of Invasive Species that was ranked as a 2 is with the Marine Environment; therefore the potential environmental effects of this interaction are evaluated below.

16.4.2.1 Marine Environment

The Introduction of Invasive Species to the Marine Environment has the potential to disrupt the Marine Environment, including commercial fisheries resources that are used by Aboriginal and non-Aboriginal fishermen. To prevent the possible introduction of invasive species from ballast water, all ships going to the marine terminal will be required to follow internationally accepted standards and guidelines, and undergo audits of the ship’s ballast water by Transport Canada. This audit may include the requirement of ships to have on board and implement a Ballast Water Management Plan, and inspection of the Ballast Water Record Book, and/or collecting a sample of the ballast water. The ship can then be prevented from discharging its ballast if it is deemed to present a threat to the environment. These ballast water management requirements will reduce the risk of introducing harmful aquatic organisms into the marine environment through a ship's ballast water.

In 2000, the Shipping Federation of Canada introduced the Canadian Ballast Water Management Guidelines. These guidelines are intended to apply to all vessels entering Canada's exclusive economic zone, including those arriving from US ports. These guidelines were developed by Transport Canada and DFO under the auspices of the Canadian Marine Advisory Council, and as such, reflect wide consultation with groups such as ship owners, environmental organizations, various government departments, and the US Coast Guard. Ships travelling to and from Saint John will fall under Annex V of these guidelines: "Ballast Water Procedures for Vessels Proceeding to Ports on the East Coast of Canada". The annex states that the delineation of suitable alternative ballast water exchange zones and the determination of possible exemptions are subject to scientific studies and consultation with the appropriate scientific authorities.

Locations for Alternative Ballast Water Exchange Zones (ABWEZ) are being investigated and may be included in the Annex at a future date. Section 9 of the guidelines states that vessels using ballast exchange should conduct ballast exchange in locations where water depths are not less than 2,000 m, unless otherwise provided in the appropriate Regional Annex. Ballast water exchange therefore occurs in offshore waters in areas of low marine organism population density, which minimizes the uptake or organisms in ballast water. Offshore waters are also less likely to contain organisms that are viable in coastal, brackish waters.

Any dumping of ballast water is to be conducted in accordance with the *Ballast Water Control and Management Regulations* under the *Canada Shipping Act*, *2001,* which include measures to protect against harmful aquatic organisms and pathogens. All vessels must comply with these regulations as part of normal operations. These regulations are specific as to the requirement for vessels to have exchanged or to treat ballast water to be discharged into the marine environment. At this time, there is no approved treatment, and consequently, vessels will only be permitted to discharge ballast water in Canadian waters in accordance with the regulations.

Vessels used for the Project will be required to have a Ballast Water Control Management Plan that establishes safe and effective procedures for ballast water management. The Ballast Water Control Management Plans are inspected and enforced by Transport Canada for compliance with the regulations during compliance visits. Under the regulations, ships must take one of the following measures to minimize discharge of harmful organisms to Canadian waters as well as to minimize the uptake of organisms that may be unintentionally released elsewhere:

- Exchange of ballast water (outside the Exclusive Economic Zone where possible);
- Treatment of ballast water;
- Discharge of ballast water to an appropriately licensed receiving and treatment facility; and
- Retention of ballast water on board the ship.

Failure to comply with these measures will make the pumping of the ballast an offence. A record of the ballast management procedures undertaken is required to be maintained aboard all vessels. A requirement is in place for vessels to carry and implement a Ballast Water Management Plan. The plan must include the logging of the events of taking on ballast, exchanging ballast, and pumping ballast. These events are required to be reported to the Minister of Transport on an approved form. The

Introduction of Invasive Species in the Marine Environment could only occur if the ship does not follow these regulations, is negligent with implementing a Ballast Water Management Plan and/or reporting procedures, or a failure with the ballast water exchange system onboard the vessel. However, with planned compliance, the potential for Introduction of Invasive Species in the Marine Environment is very low.

Additional mitigation measures are being planned and implemented. Newly constructed vessels are being finished with organotin-free antifouling paint and/or biocide-free non-stick coatings that are re-applied at dry dock. This impedes the attachment and growth of organisms on ship's hulls. Vessels also have a Marine Growth Prevention System (MGPS) installed on all water intakes to limit the spread of alien invasive species. DFO has proposed legislative amendments to the *Fisheries Act* in Bill C-32 to facilitate development of aquatic invasive species regulation and control measures. DFO is also conducting enhanced surveillance and monitoring of aquatic invasive species consistent with Canada's Invasive Species Strategy.

The primary mitigation against the introduction of invasive species currently is enforcement of the *Ballast Water Control and Management Regulations* and the Canadian Ballast Water Management Guidelines as discussed above. However, potential future ballast water treatment technologies that could be considered in Canada or by the Proponent (should they be mandated) include:

- Filtration;
- Hydro-cyclone;
- Ultraviolet light irradiation;
- Ultrasound;
- Heat treatment;
- Chemical treatment;
- De-oxygenation;
- Copper ion release; and
- Shore-based treatment.

Although the overall consequence of the Introduction of Invasive Species in the Marine Environment could result in adverse environmental effects on the Marine Environment, it is unlikely for this accidental event to occur given the above-noted regulations and guidelines as mitigation. If a ship's ballast water exchange system has malfunctioned, then it would not likely be allowed to release its ballast water under the regulations, or physically cannot undergo a ballast water exchange. An unplanned event in the release of ballast water is also unlikely because of ship safety issues and the strict protocol and procedures that are required by more than one person onboard the vessel to carry out a ballast water exchange.

<u>Determination of Significance</u>

Given the current level of shipping activity and the low number of invasive species currently present within the LAA, ballast water regulations and guidelines appear to be effective against the introduction of invasive species in the Saint John Harbour area. Further, this area may not be suitable habitat for many alien invasive species. Current regulations and practices and potential future ballast water treatments may therefore be considered effective mitigation measures against the introduction of alien invasive species to the Assessment Area and the Saint John Harbour, thereby reducing the likelihood of a new species being introduced.

Based on this and with the proposed mitigation, and considering the residual environmental effects rating criteria for Marine Environment in Chapter 10, the potential environmental effects of the Introduction of Invasive Species on the Marine Environment during all phases of the Project are not likely to occur and are rated not significant. There is a high level of confidence in this prediction.

16.5 Discovery of a Heritage or Archaeological Resource

A Discovery of a Heritage or Archaeological Resource could potentially occur during Construction because Construction involves ground disturbance, including disturbance of the sea floor, and heritage and archaeological resources are often encountered under the ground's surface. A Discovery of a Heritage or Archaeological Resource is not likely to occur during Operation and Decommissioning and Abandonment because these activities do not typically involve disturbance of previously undisturbed areas.

Although Discovery of a Heritage or Archaeological Resource may result in an environmental effect (*i.e.,* Change in Heritage or Archaeological Resources), the potential for adverse environmental effects from this unplanned event has been minimized by the completion of an extensive review of shipwrecks, documentary research on the potential presence of unexploded ordnance (UXO) in the PDA, and from side scan sonar in the marine environment, which was designed to locate and document previously unknown heritage and archaeological resources. There is little potential for the presence of currently undiscovered heritage resources in the PDA. Therefore, the probability that Construction will result in the Discovery of a Heritage or Archaeological Resource is low and the potential environmental effects are rated not significant.

16.5.1 Description of Scenarios

As was discussed in Chapter 14, the potential for discovering a heritage or archaeological resource in the marine environment is very low. There are no such resources that are known to exist in the marine waters in the vicinity of the Project and there is a relatively limited area of development planned in the marine environment.

16.5.2 Environmental Effects Assessment

The potential interactions between the Discovery of a Heritage or Archaeological Resource and the selected VECs for this CSR are summarized in Table 16.25.

Table 16.25 Potential Interactions between VECs and Discovery of a Heritage or Archaeological Resource

Valued Environmental Component (VEC)	Discovery of a Heritage or Archaeological Resource
Atmospheric Environment	0
Public Health	0
Coastal Wetland Environment	0
Marine Environment	0

Table 16.25 Potential Interactions between VECs and Discovery of a Heritage or Archaeological Resource

Valued Environmental Component (VEC)	Discovery of a Heritage or Archaeological Resource
Commercial Fisheries	0
Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons	0
Marine Safety	0
Heritage and Archaeological Resources	1

Notes: Interactions between Accidents/Scenarios and the respective VECs were ranked as follows:
0 No interaction, or no substantive interaction contemplated.
1 Interaction may occur. However, based on past experience and professional judgment, the interaction would not result in a significant environmental effect, even without mitigation, or the interaction would clearly not be significant due to application of codified practices.
2 Interaction may, even with codified mitigation, result in a potentially significant environmental effect and/or is important to regulatory and/or public interest. Potential environmental effects are considered further and in more detail in the CSR.

With the exception of the Heritage and Archaeological Resources VEC, no interaction (ranked as 0 in Table 16.25) between Discovery of a Heritage or Archaeological Resource and all of the other VECs is foreseen and therefore no environmental effects will result. Therefore, the potential environmental effects of Discovery of a Heritage or Archaeological Resource on the Atmospheric Environment, Public Health, Coastal Wetland Environment, Marine Environment, Commercial Fisheries, Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, and Marine Safety during all phases of the Project are rated not significant. There is a high degree of confidence in this prediction.

The only interaction with Discovery of a Heritage or Archaeological Resources that was ranked as a 1 is the potential interaction with Heritage and Archaeological Resources. There is little potential for discovering a heritage or archaeological resource in the marine environment, including a shipwreck, during all phases of the Project. Although there has been ancedotal reports of UXO released near the Black Point disposal site, and shipwrecks within the Marine RAA, there is no evidence to suggest that they would be found at the site of the marine terminal. During previous field surveys of the area of the marine terminal, using side scan sonar showed that the potential for the discovery of a UXO or shipwreck would be highly unlikely, and therefore the interaction between Heritage and Archaeology and the Discovery of a Heritage and Archaeological Resources is rated not significant.

In the event that a heritage and archaeological resource is discovered during construction of the marine terminal, mitigation measures that are protective of Heritage and Archaeological Resources include:

- Development of a Project-specific EPP for Construction (including response protocols for the discovery of a heritage or archaeological resource) based on the implementation of well established and proven practices for work that may encounter heritage and archaeological resources;
- Monitoring of Construction activities by a licensed archaeologist; and
- Compliance with applicable provincial and federal legislation, permits, approvals, and guidelines.

Protocols to be developed in the Project-specific EPP will vary depending on the nature of the accidental discovery. Any heritage and archaeological resources encountered will be the property of the Crown. Response protocols typically include the following elements, which will be considered for incorporation into the EPP.

- All construction personnel are responsible for reporting any unusual materials unearthed during construction activities to the Construction Supervisor.
- If the material encountered is potentially a heritage or archaeological resource, all work in the immediate area of the discovery will be halted immediately.
- The Supervisor should record information such as the nature of the activity resulting in the discovery, the nature of the material discovered, the precise location of the discovery, and the names of the people who witnessed the discovery.
- The Supervisor will immediately notify an NBENV Environmental Inspector who will contact a qualified archaeologist to investigate the find if an archaeologist is not already on site.
- Archaeological work, including site visits, monitoring using licensed SCUBA divers and side-scan sonar as appropriate, and archaeological responses to unplanned events, are carried out under licence from the Province, through Archaeological Services.
- Appropriate mitigation strategies are designed and implemented in consultation with Archaeological Services and input from First Nations, where appropriate.
- Work only resumes in the vicinity of the find once permission from Archaeological Services has been received.

Additional elements and details of well-established and proven practices (*e.g.,* appropriate responses to artefacts and features of a variety of types and time periods) will be detailed in the Project-specific EPP. Given the mitigation and EPP, the response to the Discovery of a Heritage or Archaeological Resource during Construction would be an authorized activity, conducted under license from the Province. The potential for the environmental effect Change in Heritage or Archaeological Resources is therefore reduced.

16.5.3 Determination of Significance

Based on the above, the potential environmental effects of the Discovery of a Heritage or Archaeological Resource on Heritage and Archaeological Resources during all phases of the Project are rated not significant. There is a high degree of confidence in this significance prediction.

17.0 CONCLUSION AND CLOSING

In this Comprehensive Study Report (CSR), Jacques Whitford Stantec Limited has described the elements, and assessed the potential environmental effects, of the marine terminal and associated marine-based infrastructure for Project Eider Rock, proposed by Irving Oil Company, Limited in Saint John Harbour, New Brunswick. In accordance with the requirements of the EA Track Report and Scoping Document issued under the *Canadian Environmental Assessment Act*, this CSR has included the following elements.

- A discussion of the regulatory framework applicable to the marine terminal to be built as part of the Project was provided, and a summary of the scope of the environmental assessment (EA) as determined by the federal Responsible Authorities (RAs) pursuant to their discretion under Section 15(1) of *CEAA* was provided (scope of project, factors to be considered, and scope of factors to be considered).
- A detailed Project Description of the proposed marine terminal was provided, including a description of the facilities that will be built, a discussion of how the Project will be constructed, operated, and ultimately decommissioned and abandoned, the schedule for the Project, and the environmental management initiatives and practices that will be implemented as part of the Project to minimize its environmental effects. Project alternatives, including alternatives to the Project and alternative means of carrying out the Project, were outlined. Emissions and wastes, and a summary of key technical studies undertaken as part of the EA of Project to assist in characterizing its potential environmental effects, were also provided.
- A summary of public and stakeholder consultation and Aboriginal engagement efforts conducted by the Responsible Authorities as well as by the Proponent in respect of the EA was provided.
- The methodology used to conduct the EA to meet the requirements of the EIA Regulation and *CEAA* was described. Additionally, the selection of valued environmental components was described, and a list of other projects and activities that are considered for the assessment of cumulative environmental effects was provided.
- A summary of the existing environmental setting of the Saint John Region was provided, including the historical setting, ecological context, and socio-economic context of the region.
- An assessment of potential environmental effects of the Project on each VEC of relevance and importance to this EA was provided, as well as the cumulative environmental effects of the Project in combination with other projects that have been or will be carried out, and the effects of the environment on the Project.
- An assessment of potential credible accidents, malfunctions, and unplanned events that are of potential concern as part of the construction, operation, and decommissioning and abandonment of the marine terminal as part of the Project was provided.

Based on the results of this EA, it is concluded that, with planned mitigation, the residual environmental effects (including cumulative environmental effects) of the Project are rated not significant, except in the event of certain worse case accident scenarios that would be very unlikely to occur.

This CSR has been prepared by Jacques Whitford Stantec Limited with the input and assistance of Irving Oil Company, Limited (Irving Oil), as delegated to Irving Oil by the Responsible Authorities (Fisheries and Oceans Canada, Transport Canada, and Environment Canada) pursuant to their authority under Section 17(1) of *CEAA*. Except for Responsible Authorities who shall use the CSR to assist in carrying out its duties in respect of Section 22(1) of *CEAA* and for exercising its discretion pursuant to Section 37(1) of *CEAA*, the report may not be relied upon by any other person or entity, other than for its intended purposes, without the express written consent of Jacques Whitford Stantec and Irving Oil.

This report was undertaken exclusively for the purpose outlined herein and is limited to the scope and purpose specifically expressed in the report. This report cannot be used or applied under any circumstances to another location or situation or for any other purpose without further evaluation of the data and related limitations. Any use of this report by a third party, or any reliance on decisions made based upon it, are the responsibility of such third parties. Jacques Whitford Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

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This report presents the best professional judgment of Jacques Whitford Stantec personnel available at the time of its preparation. Jacques Whitford Stantec reserves the right to modify the contents of this report, in whole or in part, to reflect any new information that becomes available. If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the information and conclusions provided herein.

This report has been prepared by a team of Jacques Whitford Stantec professionals on behalf of Irving Oil.

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Appendix A
Glossary

GLOSSARY

Term	Definition
acute exposure limit	The amount or dose of a chemical that can be tolerated by humans without evidence of adverse health risks on a short-term basis.
additive interaction	Additive interactions apply to chemicals that are structurally similar, act toxicologically through similar mechanisms or affect the same target tissue in the body (*i.e*., share common health endpoint).
adolescent	12 years – 19 years old.
adult	20 years and older.
Agency, the	The Canadian Environmental Assessment Agency.
air contaminant emissions	For stationary sources, the release or discharge of a contaminant from a facility or operation into the ambient air either by means of a stack or as a fugitive dust, mist or vapour.
airshed	The atmospheric environment above some reference point
ambient sound	All-encompassing sound that is associated with an outdoor environment, usually a composite of sounds from many sources near and far. Ambient noise is the unwanted component of this sound.
anadromous	Describes the migration pattern of certain fish, such as salmon, that spend most of their life in oceanic waters before travelling to reproduce in the upper reaches of rivers and streams.
anthropogenic	Resulting from the influence of humans on nature.
Archaeological Field Research Licence	A licence granted to a professional archaeologist, through application to ASU, and necessary under legislation to undertake archaeological field work and HRIAs in the Province of New Brunswick.
Assessment Area	The geographic area that may be affected by the Construction or Operation of the Project facilities, directly or indirectly.
attenuation	The reduction of sound intensity by various means (*e.g.,* absorption in air, geometrical spreading, or topographic barriers).
avian	Pertaining to or derived from birds.
A-weighted decibel (dB_A)	Logarithmic unit of sound intensity; 10 times the logarithm of the ratio of the sound intensity to the reference A-weighted scale, which has the same frequency response as the human ear.
A-weighting	The weighting network used to account for changes in level sensitivity as a function of frequency, with the objective of simulating human sensitivity to different frequencies. The A-weighting network de-emphasizes the high (6.3 kHz and above) and low (below 1 kHz) frequencies, and emphasizes the frequencies between 1 kHz and 6.3 kHz, in an effort to simulate the relative response of the human ear.
background sound	All-encompassing sound of a given environment without the sound source of interest.

Term	Definition
baseline	Background, existing, pre-activity, pre-Construction, or pre-Project environmental conditions.
Baseline Case	The existing environment potentially affected or baseline conditions that were measured or reported analytical data.
bedrock	A general term for rock that underlines soil or other unconsolidated material.
bedrock outcrop	A general term for rock that is exposed at the earth's surface.
benchmark	A regulatory agency target against which predictions of risks are assessed.
benthic	Of, or relating to, the bottom or floor of a water body.
benthivore	Feeding on organisms found in or on the seabed.
bioaccumulation	A term used to describe the process by which chemicals are accumulated in an organism directly from exposure to water or soil.
bioavailability	The amount of an exposure dose that reaches the circulatory system.
biodiversity	The number and variety of organisms found within a specified geographic region.
biomagnification	The term generally refers to the sequence of processes that result in higher concentrations of chemicals in organisms at higher levels in the food chain (at higher trophic levels). These processes result in an organism having higher concentrations of a chemical than is present in the organism's food.
biota	The organisms, including animals, plants, fungi, and micro-organisms, found in a given area.
bioturbation	The mixing of sediment by biological organisms.
Borden No.	Borden Number, a catalogue number system designed by Charles Borden in the 1950s. In this system, a number is assigned to an archaeological site following a latitude and longitude based grid system used throughout Canada. Each grid square is 16 km x 16 km (based on 10 minute latitude/longitude segments). A Borden Number consists of four letters and a number. The first two letters refer to the latitude position and the second two letters refer to the longitude position. The number portion (*e.g.* 1 or 5) is assigned consecutively as sites are documented and indicates that the archaeological site was, for example, the first (*e.g.,* BhDm-1) or fifth (*e.g.,* BhDm-5) site found within that Borden grid square.
CALPUFF	California Puff Model. A non-steady-state Gaussian puff dispersion model which can simulate the effects of time and space-varying meteorological conditions on pollutant transport, transformation, and removal.
carcinogen	A chemical directly involved in the promotion of cancer.
catadromous	Describes the migration pattern of certain fish, such as American eel, that spend most of their life in freshwater before travelling to deep oceanic waters to reproduce.
Chemicals of Potential Concern (COPC)	Chemicals which have the potential to be released in substantive quantities or elevated concentrations from sources associated with the Project, or which, because of their toxicological properties, are considered to be of concern.
child	5 years – 11 years old.

Term	Definition
chronic exposure limit	Amount or dose of a chemical that people can be exposed to without experiencing ill health, even when exposure occurs continuously or regularly over extended periods (*e.g*., longer than a year).
circa	About (with respect to an approximate date)
climate	Defined as a description of the regularities and extremes in weather conditions in a particular geographical location over a certain period. Usually refers to long term trends in weather for time periods which may range from months to centuries, or the more widely recognised 30-year timeframe as advocated by the World Meteorological Organisation (WMO)
climate change	The term climate change is used to refer to changes in the earth's climate, which can be caused both by natural forces and human activities. Most commonly associated with global warming and the global greenhouse effect, which highlight discernable changes to the earth's climate, (*i.e.,* increasing temperatures, due to man-made activities and processes).
Comprehensive Review	A detailed environmental impact assessment to assess the nature and significance of potential environmental impacts of an undertaking under the New Brunswick *Environmental Impact Assessment Regulation – Clean Environment Act*. A Comprehensive Review is undertaken following a Determination Review, when it is determined that a more detailed environmental impact assessment is required.
Comprehensive Study	Refers to an assessment that is conducted pursuant to sections 21 and 21.1 of the *Canadian Environmental Assessment Act* (*CEAA*), and that includes a consideration of the factors required to be considered pursuant to subsections 16(1) and (2). Comprehensive study is the type of environmental assessment conducted for projects that are likely to have significant adverse environmental effects. Such projects are prescribed in the *Comprehensive Study List Regulations*.
Comprehensive Study Report (CSR)	Refers to a report that summarizes the results of a comprehensive study under *CEAA* and provides conclusions and recommendations. A responsible authority has the responsibility to ensure that a comprehensive study report is prepared and provided to the Minister of the Environment and to the Agency.
Construction phase	The time during which the Project would be constructed and commissioned (beginning in quarter 2 of 2010, will last for a period of about 8 to 10 years and will be carried out in two phases).
Criteria Air Contaminants (CAC)	A group of eight common air contaminants released into the air from various processes including industrial production and fuel combustion. They include total particulate matter (PM), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), sulphur dioxide (SO_2), nitrogen oxides (NO_x, expressed as NO_2), carbon monoxide (CO), and ammonia (NH_3). Abbreviated in this document as CAC.
cumulative environmental effects	As defined in the *Canadian Environmental Assessment Act* (*CEAA*), the environmental effects that are likely to result from a project in combination with other projects or activities that have been or will be carried out.
cyprinid	Fish belonging to the family *Cyprinidae*, which includes carp and some of the fish known as minnows.

Term	Definition
debitage	Stone debris from the making of stone tools, such as waste materials like chips, chunks, and flakes. These waste materials may sometimes have been used themselves as tools.
decibel	One tenth of a bel. A logarithmic measure of the ratio of any measured physical quantity to a reference quantity, commonly used in the measurement of sound. The decibel provides the possibility of representing a large span of signal levels in a simple manner as opposed to using the basic unit of linear pressure, Pascal. The difference between the sound pressure level for silence versus a loud sound is a factor of 1,000,000:1 or more, therefore it is less cumbersome to use a small range of equivalent values: 0 to 130 decibels.
deciduous	Sheds all leaves annually.
Decommissioning and Abandonment	Refers to the activities associated with the decommissioning and deconstruction of the Project and the restoration of the land to pre-development conditions or the chosen end-use.
Development Proposal	Refers to Project Eider Rock – Proposed Petroleum Refinery and Marine Terminal in Saint John, New Brunswick". The Development Proposal in its entirety is an undertaking under the New Brunswick *Environmental Impact Assessment Regulation*. The marine terminal to be built as part of the Development Proposal (the Project) is a project under the *Canadian Environmental Assesment Act*.
diadromous	Fish that migrate between freshwater and salt water.
dilution	The process of making weaker or less concentrated.
diurnal	Relating to or occurring in a 24-hour period; daily.
easting	A term used to describe a location within a Universal Transverse Mercator (UTM) zone. The midline of each zone is given an easting value of 500,000 m. A point to the west of the midline has an easting value less than 500,000 m, and a point to the east of the midline has an easting value greater than 500,000 m.
ebb (tide)	A falling tide. The transition from high tide to low tide.
Ecological Risk Assessment (ERA)	A scientific method used to examine the nature and magnitude of risks from the exposure of plants and animals to contaminants in the environment.
ecosystem	A spatially defined system including all biological organisms and abiotic media.
eddies	Circular movements of water.
emission factor	A representative value that relates the quantity of pollutant released to the atmosphere with an activity or input associated with the release of that pollutant.
emissions	Technically, all solid, liquid, or gaseous discharges from a processing facility, but normally referring to gaseous and particulate air emissions (with solids referred to as residue and liquids as effluent).
Endangered	A species facing imminent extirpation or extinction.
Energy Equivalent Sound Level (L_{eq})	The level of a constant sound over a specific time period that has the same sound energy as the actual (unsteady) sound over the same period, *e.g.,* over a 1 hour period, L_{eq} (1 h) or over a 24 hour period, L_{eq} (24 h).

Term	Definition
environment	As defined under *CEAA*, environment "*means the components of the Earth, and includes:* *(a) air, land and water, including all layers of the atmosphere;* *(b) all organic and inorganic matter and living organisms; and* *(c) the interacting natural systems that include components referred to in paragraphs (a) and (b).*" As defined under the New Brunswick *Clean Environment Act*, environment "*means the air, water or soil*."
Environmental Assessment	A process to evaluate the potential environmental effects of proposed projects before they are carried out to meet the requirements of the federal *Canadian Environmental Assessment Act (CEAA*). An EA identifies possible environmental effects, proposes measures to mitigate adverse environmental effects, predicts whether or not there will be significant adverse environmental effects after the mitigation is implemented, and considers the requirements for follow-up. In relation to the Project, the federal EA to be conducted under *CEAA* shall assess the potential environmental effects of the Construction, Operation, and Decommissioning and Abandonment of the Marine Terminal and Other Marine-Based Infrastructure to be built and operated in support of the Development Proposal.
environmental effect	As defined under *CEAA*, in respect of a project: *(a) "any change that the project may cause in the environment, including any change it may cause to a listed wildlife species, its critical habitat or the residences of individuals of that species, as those terms are defined in subsection 2(1) of the Species at Risk Act,* *(b) any effect of any change referred to in paragraph (a) on* *i). health and socio-economic conditions,* *ii). physical and cultural heritage,* *iii). the current use of lands and resources for traditional purposes by aboriginal persons, or* *iv). any structure, site or thing that is of historical, archaeological, paleontological or architectural significance, or* *(c) any change to the project that may be caused by the environment whether any such change or effect occurs within or outside Canada."* For convenience in this HHERA, environmental effect shall be taken to be synonymous to impact as defined below.

Term	Definition
Environmental Impact Assessment (EIA)	New Brunswick's *Environmental Impact Assessment Regulation* (Regulation 87-83) under the *Clean Environment Act* provides the legislative framework for proactive environmental planning of proposed undertakings. The purpose of an EIA is to identify the environmental effects associated with development proposals at the planning stages, well in advance of their implementation, so that the potential environmental effects can be considered, avoided or reduced to acceptable levels before they occur. An EIA gives technical specialists from government agencies, including the federal departments of Fisheries and Oceans Canada (DFO), Transport Canada (TC), and Environment Canada (EC), as well as local residents and the general public, a chance to provide their input in the decision-making process regarding specific development proposals. An EIA review (either a Determination Review or Comprehensive Review) must be completed before any undertaking subject to EIA can proceed. In relation to the Project, the provincial EIA to be conducted shall assess the potential environmental effects of the construction, operation, and decommissioning and abandonment of the refinery, marine terminal, and other land-based and marine-based infrastructure to be built and operated as part of the Development Proposal.
equivalent sound pressure level (L_{eq})	The equivalent continuous level which is a measure of the energy content of a sound over a time period. It gives a single figure expressing the equivalent of a varying level.
estuarine environment	The aquatic environment where a river meets the sea. See estuary.
estuary	That part of a river or stream or other body of water having unimpaired connection with the open sea, where the sea water is measurably diluted with freshwater derived from land drainage.
existing ambient	All sounds in a given area (includes all natural sounds as well as all mechanical, electrical and other human-caused sounds).
exposure limit	Maximum dose or amount of chemical that a person or ecological receptor can be exposed to for a specified period without experiencing an adverse health outcome.
extinction	In biology and ecology, extinction is the ceasing of existence of a species or group of taxons. The moment of extinction is generally considered to be the death of the last individual of that species.
extirpation	To eliminate completely from a region.
fauna	Animal species.
Final Guidelines	The Final Guidelines for an environmental impact assessment issued by the New Brunswick Minister of Environment that establish the issues and environmental components that the environmental impact assessment must address.
fish	Under Section 2 of the *Fisheries Act*, includes (a) parts of fish; (b) shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals; and (c) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals.
fish habitat	As defined under the *Fisheries Act*, fish habitat includes the spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes.
flora	Plant species

Term	Definition
flow (tide)	A rising tide. The transition from low tide to high tide.
fossils	Preserved traces or remains of a pre-existing organism of a past geologic age.
fugitive emission	Result from small leaks that while individually very small, can collectively be substantial for large, complex facilities
Future Case	The evaluation that covers the emissions of the Project and all existing, current and future planned projects together
geomorphology	The study of landforms and the processes that created them.
glaciomarine	The sediments or processes involving areas in which marine water and glacial ice were in contact.
glare	A potential environmental effect where intense, harsh, or contrasting lighting conditions reduce human, birds, and other organisms' ability to see. The unit of measure for glare is lumens per steradian, which is equal to a candela.
greenhouse gases (GHG)	Gaseous compounds that inhibit the release of heat from the atmosphere. The greenhouse gases considered in this Study are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).
gyre	A circular or spiral motion, especially a circular ocean current.
heritage and archaeological resources	Any physical remnants found on top of and/or below the surface of the ground, including the sea floor, that inform us of past human use of and interaction with the physical environment. This includes resources of historical, cultural, archaeological, palaeontological, and architectural significance.
Heritage Resource Impact Assessment (HRIA)	An assessment completed under licence following guidelines from the Province of New Brunswick (Ferguson 2004) and designed to determine the presence or absence of heritage resources within the area of a project and what effect, if any, a project may have on heritage resources
historic period	The period after European arrival in Canada, referring to the time for which written history records are available.
hydraulic conductivity (K)	The volume of water that is transmitted through a unit area of aquifer under a unit decline in hydraulic head (expressed as metres per day per metre of drawdown (m/d or cm/s), and is the transmissivity divided by the aquifer thickness contributing to the well.
hydrodynamics	Relates to the motion of fluids (usually water) and the forces that act on solid bodies immersed in fluids.
hydrology	Study of the properties, distribution and circulation of water.
hydrophytic vegetation	Plant life growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content.
illuminance	The density of incident luminous flux on a surface and is measured in lux.
illumination	The use of light to see objects or tasks at particular location and/or job site.
indigenous	Originating and living or occurring naturally in an area or environment.

Term	Definition
infant	0 months – 6 months old.
intertidal	The region between the high tide mark and the low tide mark.
invertebrates	Animals lacking a backbone or spinal column
ISO 9613	The specific ISO Standard dealing in part 1 with the absorption of sound energy in the air, and in part 2 with the transmission of sound energy through the air.
K_{ow}	The octanol-water partition coefficient. The ratio of the concentration of a chemical in octanol and in water at equilibrium and at a specified temperature.
ks	A soil loss term, accounting for the loss of COPC by several mechanisms, including leaching, erosion, runoff, degradation (biotic and abiotic), and volatilization.
LC_{50}	Median lethal concentration of a toxic substance or radiation. The concentration required to kill half the members of a tested population.
L_D	L_D is an average sound pressure level over the day time period. In this study the day time period was set at 6:00 to 22:00.
LD_{50}	Median lethal dose of a toxic substance or radiation. The dose required to kill half the members of a tested population.
lithology	Refers to both the bulk characteristics or the microscopic description and classification of a rock mass or formation.
littoral	Shallow shore area (less than 6 m) of a water body where light can usually penetrate to the bottom.
L_N	L_N is an average sound pressure level over the night time period. In this study the night time period was set at 22:00 to 6:00.
Local Modelling Domain (LMD)	The 15 km by 15 km area in which the most substantive changes in air quality due to Project activities are expected to occur.
long-range transport (LRT)	The transport of air contaminants released in distant locations to the region of interest by prevailing winds.
Lowest Observed Adverse Effect Level (LOAEL)	The lowest concentration or dose of a chemical where specifically defined adverse effects have been observed in test organisms.
Marine Environment Assessment Area	The coastal waters of the Bay of Fundy from Cape Spencer, west to include the outer Saint John Harbour up to the entrance of the major shipping lanes in the Bay of Fundy.
marine terminal	The infrastructure where crude oil is unloaded and finished petroleum products are loaded into marine vessels.
Marine-based Infrastructure	The part of the Project consisting of the marine terminal and associated physical works.
Maximum Acceptable Level	As part of the federal National Ambient Air Quality Objectives (NAAQO), this is a long-term goal for air quality and provides a basis for anti-degradation policy for unpolluted parts of the country, and for the continuing development of control technology.

Term	Definition
Maximum Desirable Level	As part of the federal NAAQO, this criterion is intended to provide adequate protection against environmental effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being.
Measured Baseline	Measured concentrations of COPC in the LSA were used to predict existing potential risk to humans and the environment.
meteorology	The science of weather and weather forecasting.
microclimate	The local climate or weather conditions of usually a small site of habitat, such as higher temperatures in urban areas of a city due to heat release and reflection from vehicles, roads and buildings, and strong winds channelling through gaps at the base of tall buildings.
Mitigation	With respect to a project, refers to the elimination, reduction or control of the adverse environmental effects of the project, including restitution for any damage to the environment caused by such environmental effects through replacement, restoration, compensation or other means.
model calibration	The method by which an independent variable or a number of independent variables are varied in a computer model in order to calibrate a dependant variable.
Monitoring	Periodic or continuous surveillance or testing to determine the characteristics of a substance or the level of compliance with statutory requirements and/or contaminant levels in various media or in humans, plants, and animals.
neap tide	A less than average tide occurring near the first and third quarters of the moon.
No Observed Adverse Effect Level (NOAEL)	The highest tested dose of a substance that has been reported to have no adverse health effects on laboratory animals.
noise	Noise is defined as unwanted, undesired, or unpleasant sound. A subjective term, as sounds that may be unwanted and undesired by some may be wanted and desirable by others.
Non-CAC	Non-criteria air contaminants, that is chemicals of potential concern which are neither criteria air contaminants nor greenhouse gases (*e.g.,* metals).
non-carcinogen	A chemical that does not cause cancer.
northing	A term used to describe a location within a UTM zone. Northing values are measured in metres relative to the Equator.
Operation Phase	The time after the Construction Period during which the refinery would be operated, expected to be approximately 50 years. This lifetime could be extended by maintenance or refurbishment as determined feasible by the Proponent.
order of magnitude	The expression “an order of magnitude” refers to a value that is roughly ten times greater than the value against which it is being compared.
overburden	Material in the top later of the earth’s surface.
parameter	A variable that defines a system and can be varied in an experiment to determines its behaviour.
potential acid input (PAI)	The difference between deposited acidic anions and basic cations.

Term	Definition
Pre-contact period	The period before European arrival in Canada.
probability density function	A mathematical function that describes the probability of failure ocurring over time. This function can be utilized to determine the probability that a failure takes place in a given time interval.
Project	As described herein, the Project is the Marine Terminal and Other Marine-Based Infrastructure to be built as part of the Development Proposal in Saint John, New Brunswick. The Project is a project as defined under *CEAA* and an Undertaking under the New Brunswick *Environmental Impact Assessment Regulation.*
Project Case	Baseline conditions plus emissions from the Marine-based Infrastructure.
Proponent	In the context of the Project, the Proponent is Irving Oil Company, Limited.
receptor	The person, plant or wildlife species that may be affected due to exposure to a contaminant.
Regional Assessment Area	The Regional Study Area consists of an area that is beyond the limits of the local study area that may be affected by the Project. For the purposes of this technical study, the regional study area was defined to be an area 70 km by 45 km spanning the Saint John airshed. The regional study area was used for modelling regional emissions sources and to assess transport to sensitive receptors for the HHERA modelling.
Regional Modelling Domain (RMD)	A 70 km by 45 km area in which changes in air quality due to Project activities may occur.
Responsible Authority	In relation to a project, means a federal authority that is required, pursuant to Subsection 11(1) of *CEAA*, to ensure that an environmental assessment of the Project is conducted.
salmonid	A species of fish belonging to the family *Salmonidae* – a group of fish including salmon and trout.
scour	To clear, dig, or remove by a powerful current of water.
secchi depth	Used to assess light penetration in water as an indication of trophic state of the water body.
Secondary Particulate Matter (SPM)	Particles, formed after release to the atmosphere, which result from a series of chemical and physical reactions involving different precursor gases. In terms of this Project, SPM shall be considered to consist of sulphate, nitrate, and ammonium that are formed by secondary reaction of the emissions of sulphur, nitrogen oxides, and ammonia.
Secure Species	A secure species is one that is listed or known to be secure (including those designated S4 or S5 by AC CDC, or designated as “Secure” by NBDNR).
sediment	Fragmented material from weathered rocks and organic material that is suspended in, transported by and eventually deposited by water or air.
sedimentary rock	One of the three main rock groups (including metamorphic and igneous rock).
shovel test pit	A 50 cm by 50 cm hand dug hole, dug in areas of elevated archaeological potential, to confirm the presence or absence of archaeological materials.

Term	Definition
significance	A measure of the degree to which an environmental effect may be adverse or beneficial.
sky glow	The illumination of the clouds, and haze in the atmosphere that replaces the natural nighttime sky with a translucent to opaque lighted dome. The unit of measure for sky glow is in magnitudes per square arcsecond ($mag/arcsec^2$).
soil half-life	The length of time required for the concentration of a compound to decrease to half of its initial value in soil.
sound	A wave motion in air, water, or other media. It is the rapid oscillatory compressional changes in a medium that propagates to distant points.
sound power level (L_W)	The total sound energy radiated by a source per unit time. The unit of measurement is the decibel expressing the ratio of power of the source, in watts to a reference level (conventionally 10^{-12} watts).
sound pressure level (L_p, SPL)	The logarithmic form of sound pressure. In air, 20 times the logarithm (to the base 10) of the ratio of the actual sound pressure to a reference sound pressure (which is 20 micropascals, and by convention has been selected to be equal to the approximate threshold of human hearing). It is also expressed by attachment of the word decibel to the number.
Species at Risk	Species at Risk include species that are listed under Schedule 1 of the *Species at Risk Act* (*SARA*) as "extirpated", "endangered", or "threatened" and/or listed under the New Brunswick *Endangered Species Act* as "endangered" or "regionally endangered".
Species of Conservation Concern	Species of conservation concern includes those listed species that are not currently under the protection of *SARA* of the New Brunswick *Endangered Species Act* (*i.e.*, are listed as "special concern" in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*; or ranked as S1, S2, or S3 by AC CDC; and/or ranked as "May Be At Risk" or "Sensitive" in the New Brunswick *Endangered Species Act*).
species rank (srank)	A provincial rarity ranking assigned for the purpose of setting protection priorities for a species and/or ecological community. This ranking system is used by conservations data centres (CDCs) and natural heritage programs.
spill	An accidental loss of containment.
spring tide	Tide with large amplitude occurring twice a lunar month, near full moon and new moon.
stratified	To form, arrange, or deposit in layers.
stratigraphy	The layering of deposits in archaeological sites.
sub-chronic	Intermediate between acute and chronic, typically of duration between 30 and 90 d.
sub-lethal	Long-term growth or survival effects.
synchronization	To occur at the same time; be simultaneous.
Threatened	A wildlife species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction.
tidal inlet	An opening along the shoreline where water extends at high tide.

Term	Definition
tidal marshes	A marsh found along coasts and estuaries in which the characteristics of the marsh are determined by the tidal movements (of the adjacent sea, ocean or estuary).
wetland	Land that is transitional between aquatic and terrestrial ecosystems and is covered with water for at least part of the year.

AC CDC Status Rank Definitions (AC CDC 2007)

S1	Extremely rare: May be especially vulnerable to extirpation (typically 5 or fewer occurrences or very few remaining individuals).
S2	Rare: May be vulnerable to extirpation due to rarity or other factors (6 to 20 occurrences or few remaining individuals).
S3	Uncommon, or found only in a restricted range, even if abundant at some locations (21 to 100 occurrences).
S4	Usually widespread, fairly common, and apparently secure with many occurrences, but of longer-term concern (*e.g.*, watch list) (100+ occurrences).
S5	Widespread, abundant, and secure, under present conditions.
S#S#	Numeric range rank: A range between two consecutive ranks for a species/community. Denotes uncertainty about the exact rarity (*e.g.*, S1S2).
SH	Historical: Previously occurred in the province but may have been overlooked during the past 20-70 years. Presence is suspected and will likely be rediscovered; depending on species/community.
SU	Unrankable: Possibly in peril, but status is uncertain - need more information.
SX	Extinct/Extirpated: believed to be extirpated from its former range.
S?	Unranked: not yet ranked.
SA	Accidental: Accidental or casual, infrequent and far outside usual range. Includes species (usually birds or butterflies) recorded once or twice, or only at very great intervals, hundreds or even thousands of miles outside their usual range.
SE	Exotic: An exotic established in the province (*e.g.*, Purple Loosestrife or Coltsfoot); may be native in nearby regions.
SE#	Exotic numeric: An established exotic that has been assigned a rank.
SP	Potential: Potentially occurs, but no occurrences have been reported.
SR	Reported but without persuasive documentation (*e.g.*, misidentified specimen).
SRF	Reported falsely: erroneously reported and the error has persisted in the literature.
SZ	Zero: not of practical conservation concern because there are no definable occurrences, although the species is native and appears regularly. An SZ rank is generally used for long distance migrants that pass through the province occasionally.

Qualifiers

B	Breeding (Migratory species)
N	Non-breeding (Migratory species)
?	Inexact or uncertain (the "?" qualifies the character immediately preceding it in the S-rank)
C	Captive or cultivated

Appendix B
List of Acronyms and Units

LIST OF ACRONYMS AND UNITS

Acronym/Unit	Definition
%	percent
µg/kg bw/d	micrograms per kilogram of body weight per day
µg/L	microgram per litre
$\mu g/m^3$	micrograms per cubic metre
µS	microsiemens
‰	salinity of water expressed as parts per thousand and ranges from 0 for fresh water to about 35 for oceanic water
1E+0	scientific notation – neutral power indicates a number greater than one and less than ten and in this case 1.0
1E-01	scientific notation – negative power indicates a number less than 1.0 and in this case 0.1
2,3,7,8-TCDD	2,3,7,8 tetrachlorodibenzo-para-dioxin
2,3,7,8-TCDF	2,3,7,8 tetrachlorodibenzo-para-furan
95^{th} UCLM	95^{th} upper confidence limit of the mean
AAQC	ambient air quality criteria
AAQM	ambient air quality monitoring
AC CDC	Atlantic Canada Conservation Data Centre
ADCP	acoustic doppler current profiler
ADD	average daily dose
AF	absorption factor
AFRL	archaeological field research licence
AHSC	Atlantic Health Sciences Corporation
am	morning
API	American Petroleum Institute
As(III)	trivalent arsenic
As(V)	hexavalent arsenic
asl	above sea level
ATSDR	Agency for Toxic Substances and Disease Registry
B[a]P	benzo[a]pyrene
BAF	bio-accumulation factor

Acronym/Unit	Definition
bbl	barrel (oil US, equal to 159 L)
bbl/d	barrels per day
BC MOE	British Columbia Ministry of Environment
BCF	bioconcentration factor
BIO	Bedford Institute of Oceanography
BM	body mass
BOP	battery observation post
BSAF	biota-sediment accumulation factor
BTEX	benzene, toluene, ethylbenzene and xylenes (meta-xylene, ortho-xylene, para-xylene)
BW	body weight
C$	Canadian dollars
CAC	criteria air contaminants
CADNAA	Computer Aided Noise Abatement model
CalEPA	California Environmental Protection Agency
CAS	chemical abstracts service
CATEF	California air toxics emission factors
CCME	Canadian Council of Ministers of the Environment
CCME CWS	Canadian Council of Ministers of the Environment – Canada Wide Standards
CEAA	*Canadian Environmental Assessment Act*
CEM	continuous emissions monitor
CEPA	*Canadian Environmental Protection Act, 1999*
CH_4	methane
CHS	Canadian Hydrographic Services
CIE	Commission Internationale de l'Éclairage (International Commission on Illumination)
CIOC-NB	Community Information Online Consortium-New Brunswick
cm	centimetre
CMA	census metropolitan area
CMHC	Canada Mortgage and Housing Corporation
CO	carbon monoxide
CO_2	carbon dioxide

Acronym/Unit	Definition
CO_2eq	carbon dioxide equivalent
cogen	cogeneration
COPC	chemicals of potential concern
COSEWIC	Committee on the Status of Endangered Species in Canada
CPPI	Canadian Petroleum Products Institute
Cr	chromium
CR	concentration ratio
CSQG	Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (2002)
CWS	Canadian Wildlife Service of Environment Canada
CWS PHC	Canada wide standard for petroleum hydrocarbons
d	day
dB_A	decibel, A-weighting
DFO	Department of Fisheries and Oceans Canada
DL	detection limit
DO	dissolved oxygen
dwt	deadweight tonne
e.g.,	for example
EA	environmental assessment
EC	environment Canada
Eco-SSL	ecological soil screening level
EHQ	ecological hazard quotient
EIA	environmental impact assessment
EPC	exposure point concentration
EPH	extractable petroleum hydrocarbon
EPM	equivalents per million
EQL	estimated quantification limit
ERA	ecological risk assessment
ERP	emergency response plan
ESA	environmentally sensitive area
ET	evapotranspiration

Acronym/Unit	Definition
F1 (C_6-C_{10})	CWS Petroleum hydrocarbon fraction 1
F2 (C_{10}-C_{16})	CWS Petroleum hydrocarbon fraction 2
F3 (C_{16}-C_{32})	CWS Petroleum hydrocarbon fraction 3
F4 (C_{32}-C_{50})	CWS Petroleum hydrocarbon fraction 4
FNFA	Fundy North Fishermen's Association
f_{site}	the fraction of the total ingestion rate from the site
ft	feet
g	gram
g/km	grams per kilometre
$g/m^2/a$	grams per square metre per year
gal	US gallons (3.79 L)
Gbbl	billion barrels
GHG	greenhouse gases
GIS	geographic information system
GLC	ground-level concentrations
GNB	Government of New Brunswick
GPS	global positioning system
Gt	giga-tonnes
GVW	gross vehicle weight
h	hour
h/tug	hours of operation per tugboat
h/visit	hours per visit
H_2S	hydrogen sulphide
ha	hectares (10,000 square metres, or 2.47 acres)
HADD	Harmful Alteration, Disruption or Destruction (of fish habitat)
HAZOP	hazards and operability
HCB	hexachlorobenzene
HCBD	hexachlorobutadiene
HD_5	high dose effect at 5%
HDD	horizontal directional drilling

Acronym/Unit	Definition
Hg^0	elemental mercury
HHERA	human health and ecological risk assessment
HHRA	human health risk assessment
HHRAP	human health risk assessment protocol
hp	horsepower
HpCDD	heptachlorodibenzo-*p*-dioxin
hp-h	horsepower-hour
HQ	hazard quotient
HRIA	heritage resource impact assessment
HSE	Health, Safety and Environment
i.e.,	that is/in other words
IF	intake factor
ILCR	Incremental Lifetime Cancer Risk
IMAC	interim maximum acceptable criteria
IR	ingestion rate
IRIS	Integrated Risk Information System
ISO	International Standards Organization
ISQG	CCME Interim Sediment Quality Guideline
I-TEF	international toxicity equivalency factor
ITOPF	International Tanker Owners Pollution Federation Ltd.
Jacques Whitford	Jacques Whitford Stantec Limited
JSL	jurisdictional screening levels (OMOE)
K	degree Kelvin
K_d	water-sediment partition coefficient
kdwt	one thousand deadweight tonnes
kg	kilogram (1,000 grams)
kg H^+ eq/ha/a	kilograms of hydrogen ion equivalent per hectare per year
kg/h	kilograms per hour
kg/m^3	kilograms per cubic metre
km	kilometre (1,000 metres)

Acronym/Unit	Definition
km/h	kilometres per hour
km^2	square kilometre
K_{ow}	The octanol-water partition coefficient is the ratio of the concentration of a chemical in octanol and in water at equilibrium and at a specified temperature.
kPa	kilopascal
ks	soil loss constant
kW	kilowatt
kWh	kilowatt-hour
L	litre
L/d	litres per day
LAA	local assessment area
LADD	lifetime average daily dose
lb	pound
LC_{50}	Median lethal concentration of a toxic substance or radiation is the concentration required to kill half the members of a tested population.
LCR	lifetime cancer risk
L_D	night average sound level
LD_{50}	Median lethal dose of a toxic substance or radiation is the dose required to kill half the members of a tested population.
LDAR	leak detection and repair program
L_{eq}	equivalent sound level
LFA	lobster fishing area
LLWLT	lower low water large tide
LMD	local modelling domain
L_N	day average sound level
LNG	liquefied natural gas
LOAEL	lowest observed adverse effect level
LOPA	layers of protection analysis
L_p	sound pressure level
LPG	liquid petroleum gas
LRII	crude oil marine vessel transportation (carries 150 kdwt)

Acronym/Unit	Definition
LRT	long-range transport
LSF	linear stone feature
L_w	sound power level
m	metre
m/s	metres per second
m^3	cubic metre
m^3/d	cubic metres per day
m^3/h	cubic metres per hour
m^3/s	cubic metres per second
mag/arcsec^2	magnitudes per square arcsecond
Max	maximum
MCTS	Marine Communications and Traffic Services, a division of the Coast Guard
MeHg	methyl mercury
meq/L	milli-equivalents per litre
MFA	mackerel fishing area
mg	milligram
mg/kg	milligrams per kilogram
mg/kg bw/d	miligrams per kilogram of body weight per day
mg/kg-d	miligram per kilogram per day
mg/L	miligram per litre
min	minimum
MMA	monomethyl arsenic
MtBE	methyl tert-butyl ether
n	number of samples
N_2O	nitrous oxide
NAAQO	national ambient air quality objectives
NAFO	Northwest Atlantic Fisheries Organization
NAPS	National Air Pollutant Surveillance
NARWC	North Atlantic Right Whale Consortium
NB	New Brunswick

Acronym/Unit	Definition
NB *ESA*	New Brunswick *Endangered Species Act*
NB Power	New Brunswick Power Corporation
NBDNR	New Brunswick Department of Natural Resources
NBEMO	New Brunswick Emergency Measures Organization
NBENV	New Brunswick Department of Environment
ND	non-detect values
NEB	National Energy Board
ng/kg	nanogram per kilogram
NH_3	ammonia
NO	nitric oxide, also named nitrogen monoxide
NO_2	nitrogen dioxide
NOAEL	No observed adverse effect level- The highest tested dose of a substance that has been reported to have no adverse health outcomes on laboratory animals.
NO_X	nitrogen oxides (sum of NO and NO_2)
NPRI	National Pollutant Release Inventory
NSA	noise sensitive area
NTU	nephelometric turbidity units
O_3	ozone
^oC	degree Celsius
OC	organic carbon
OCDD	octachlorodibenzo-*p*-dioxin
OCDF	octachlorodibenzofuran
OMOE	Ontario Ministry of the Environment
P	precipitation
PAH	polycyclic aromatic hydrocarbons
PAI	potential acid input
PCB	polychlorinated biphenyl
PCDD	polychlorinated dioxins
PCDD/PCDF	polychlorinated dibenzo-p-dioxins and dibenzofurans
PCDF	polychlorinated furans

Acronym/Unit	Definition
PCP	pentachlorophenol
PDA	project development area
PDO	property damage only
PeCDF	pentachlorodibenzo-*p*-furan
PEL	probable effects level guidelines
pg	pictograms (equal to 10^{-12} g)
pH	potential hydrogen (a measure of the acidity or alkalinity of a solution)
PHC	petroleum hydrocarbons
pm	evening
PM	total suspended particulate matter
PM_{10}	particulate matter with aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with aerodynamic diameter of 2.5 microns or less
ppb	parts per billion
ppm	parts per million
PPRTV	provisional peer reviewed toxicity value
ppt	parts per thousand
PQRA	preliminary quantitative risk assessment
QA/QC	quality assurance/quality control
Q_B	groundwater discharge via baseflow to surface water body
Q_s	groundwater discharge via springs
RAA	regional assessment area
RCMP	Royal Canadian Mounted Police
RDL	reportable detection limit
RfC	reference concentration
RFCCU	residue fluid catalytic cracking unit (at the existing Saint John refinery)
RfD	reference dose
RHA	Regional Health Authority
RIVM	The Netherlands National Institute for Public Health and the Environment
RMD	regional modelling domain
RME	reasonable maximum exposure

Acronym/Unit	Definition
ROW	right-of-way
RPC	Research and Productivity Council
RPD	relative percent difference
RRPF	Rothesay Regional Police Force
R_s	surface run-off
RSA	regional study area
s	second
SARA	*Species At Risk Act*
SBM	single buoy mooring
SCC	source classification codes
scf	standard cubic feet (at 298 K and 101.3 kPa)
SF	slope factor
SFA	scallop fishing area
SJEMO	Saint John Emergency Measures Organization
SJPD	Saint John Police Department
SJRH	Saint John Regional Hospital
SNB	Service New Brunswick
SO_2	sulphur dioxide
SPA	scallop production areas
SPM	secondary particulate matter
SPMT	self propelled module transporter
SQT	Sediment Quality Triad
SRANK	species rank
SRU	sulphur recovery unit
steradian	SI unit for a solid angle
STP	shovel test pit
SUV	sport utility vehicle
sVOC	semi-volatile organic compounds
SWMM	storm water management model
t	metric tonne (1,000 kg)

Acronym/Unit	Definition
t/a	tonnes per year
TAC	total allowable catch
TC	Transport Canada
TCDF	tetrachlorodibenzo-*p*-furan
TDI	tolerable daily intake
TDS	total dissolved solids
TEF	toxic equivalency factor
TEQ	toxic equivalent quotient
TOC	total organic carbon
TOV	tow operated vehicle
TPH	total petroleum hydrocarbons
TRI	toxic release inventory
TRS	total reduced sulphur
TRV	toxicity reference value
TSBC	Transportation Safety Board of Canada
TSP	total suspended particulate
TSS	total suspended solids
UCL	upper confidence limit
UF	uncertainty factor
ULCC	ultra large crude carrier
UP	uptake factor
UR	unit risk factor
US	United States
US EPA	United States Environmental Protection Agency
US EPA IRIS	United States Environmental Protection Agency, Integrated Risk Information System
USgal	US gallon
USgpm	US gallon per minute
UXO	unexploded ordnance
VEC	valued environmental component
VLCC	very large crude carrier

Acronym/Unit	Definition
VOC	volatile organic compounds
W	watt
WHO	World Health Organization
WWTP	wastewater treatment plant
μS/cm	micro siemens per centimetre

Appendix C

Preliminary Considerations for Marine Habitat Compensation for the Project

1.0 INTRODUCTION

This purpose of this document is to present a conceptual plan to compensate for harmful alteration, disruption or destruction (HADD) of marine fish habitat occurring as a result of construction in the marine environment for Project Eider Rock (the "Project"). The Project Description is presented in detail in Chapter 3 of the Comprehensive Study Report (CSR), with specific reference to environmental effects on marine fish habitat presented in Chapter 10. Although the design process for marine-based structures is still ongoing, they will generally include:

- A marine terminal for receiving crude oil or other petroleum products from tankers, loading finished products and loading coke onto tankers and barges;
- A barge landing facility for use during construction;
- A wastewater treatment outfall; and
- A seawater cooling intake (potentially).

Fisheries and Oceans Canada (DFO) has overall responsibility for the administration of the federal *Fisheries Act*, which establishes the necessary provisions to protect fish and fish habitat in Canadian fresh and marine waters. This responsibility includes the issuance of authorizations for HADD of fish habitat associated with construction of marine-based structures.

Fish, as defined under the *Fisheries Act*, includes *"(a) parts of fish, (b) shellfish, crustaceans, marine animals and any parts of fish, shellfish, crustaceans or marine animals and (c) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals*".

Fish habitat, as defined under the *Fisheries Act,* includes "*spawning grounds and nursery, rearing, food supply, and migration areas on which fish depend directly or indirectly in order to carry out their life processes*".

Section 35(1) of the *Fisheries Act* protects fish habitat from HADD while Section 35(2) allows DFO to authorize activities that will result in a HADD of fish habitat under specific conditions. Fish habitat is further protected by the Policy for the Management of Fish Habitat (DFO 1986). This policy applies to all projects and activities in or near water that could "*alter, disrupt or destroy fish habitats, by chemical, physical, or biological means*", or in other words projects and activities that could constitute HADD of fish habitat. The Decision Framework for the Determination and Authorization of Harmful Alteration, Disruption or Destruction of Fish Habitat (1998) was developed to support DFO staff in making decisions associated with HADD of fish habitat under the above Policy and the *Fisheries Act*.

Other federal legislation that protects fish habitat indirectly includes the *Canadian Environmental Protection Act* (*CEPA*) and specifically the *Disposal at Sea Regulations*. These regulations (*i.e.,* the Disposal at Sea provisions of Part 7, Division 3 of *CEPA*, administered by Environment Canada), stipulate that dredging and disposal in the marine environment requires a permit and that sediment be screened for potential chemical contaminants. These provisions state that no person shall load a substance for the purposes of disposal at sea, or dispose of a substance at sea unless the loading and disposal is done in accordance with a permit. This legislation is applicable due to the potential need for dredging and disposal of dredged spoils for construction of marine-based structures for the Project.

The habitat Policy and Directive listed above are based on the guiding principle of "no net loss" of fish habitat with a focus on the productive capacity of existing or potential fishery resources. In applying this principle, the first preference of DFO is to maintain avoidance of any HADD of fish habitat or loss of productive capacity. Minimization of HADD is required for fish habitat that cannot be avoided. Residual HADD of fish habitat experienced after habitat has been avoided to the greatest extent possible can be accommodated by implementing a habitat compensation plan.

The construction of structures in the marine environment for the Project will constitute a HADD of fish habitat under the *Fisheries Act* to some degree after all avoidance and minimization opportunities have been exhausted. Therefore, as per the legislative requirements outlined above, it is likely that fish habitat compensation will be required for HADD of fish habitat.

Irving Oil has committed to developing an effective fish habitat compensation plan, in consultation with DFO and input from stakeholders, to address HADD of fish habitat experienced as a result of Project Construction activities in the marine environment. However, the final design of the marine-based structures that will actually be constructed is not known at this time, as there are several options being considered. The timing of Construction is also yet to be determined. Therefore, the habitat compensation options and plan presented in the following sections are conceptual and subject to change as the final design of the Project evolves.

2.0 DESIGN MITIGATION

Irving Oil has strived to avoid and minimize potential HADD of fish habitat in the marine environment since the outset of the Project. Marine-based structures identified for potential construction (marine terminal, barge landing facility, wastewater outfall and seawater intake) are being designed with consideration of avoidance and minimization of HADD of fish habitat as a design principle.

Multiple design scenarios have been considered for the marine terminal and jetty, by the Design Team. These scenarios have included different locations and configurations for the marine terminal. Multiple design options, including caissons, piers, and causeways, have also been considered. In each case the footprint of the structure on the ocean bottom and the associated HADD of fish habitat due to infilling, dredging, and/or side-casting was one of the factors in whether the design option was considered further. Other factors were also considered including the availability of suitable locations in and around Canaport, and the water depths required for the types and sizes of vessels expected at the new facility.

For example, all of the scenarios and construction methods listed below were considered and abandoned in part because of potential environmental effects on benthic fish habitat:

- A breakwater was considered as part of several design configurations. However, the use of this type of structure was not considered further once the benthic habitat footprint and the resultant potential HADD of fish habitat, and the changes to current patterns and sediment transport processes were determined.
- A traditional dredging/side casting method for caisson construction was considered early in the design process but dismissed because it would have resulted in a potential area of fish habitat HADD approximately three times, and a total volume of dredged spoils approximately six times, that of the rock-placed ring method currently being considered (Table C1).
- Marine terminal components on the east side of Mispec Point in Mispec Bay were included in several design configurations. However, this option was abandoned due to the length of the trestle structure that would be required to reach water of sufficient depth offshore, the larger area that would be required to be dredged to accommodate the draft of tanker vessels, and navigation safety concerns.
- An additional single buoy mooring (SBM) for crude oil unloading was considered in various design configurations in combination with marine terminal and jetty components. However the additional SBM had to be located approximately 2 km south of the existing SBM to allow for the tanker vessel swing circle. This would have resulted in pipeline infrastructure extending up 3 km out from shore.

In addition to the design configurations described above, multiple construction methods have also been considered including the use of a rock-placed ring versus a temporary steel caisson for the caisson option. The potential use of proposed structures to provide fish habitat, such as integrating construction material and protective structures to provide suitable substrate and create artificial reefs around caissons has also been considered in evaluating construction methods.

The ongoing analysis inherent to the design process has resulted in one general location with two design options currently being carried forward for the marine terminal and jetty. Both jetty options are described briefly below. The barge landing facility and wastewater outfall/seawater intake design details are still being finalized but their general locations have been identified as shown on Figure C1.

The first design option for the jetty involves the use of concrete caissons at the location of the vessel berths and for the section of the trestle located in deeper water, with piles used to support the trestle structure connecting it to shore. Dredging and seafloor preparation would be required with this option. Dredged spoils would be disposed of at the existing Black Point Ocean Disposal site managed by Environment Canada. Construction of the caissons would require a rock-placed ring or a temporary steel caisson as mentioned previously. The second design option involves the use of jackets and piles (*i.e.,* the hybrid jacket option). No dredging would be required for this design option and the only benthic habitat loss that would occur would be a result of the cross-sectional area of the piles themselves.

A preliminary summary of the potential direct environmental effect on benthic habitat for both jetty options and the wastewater outfall and seawater intake has been provided in Table C1. The final design is still not confirmed; however Irving Oil is committed to choosing a design with consideration of potential environmental effects on marine fish habitat incorporated into the decision-making process.

Table C1 Summary of Potential Direct Environmental Effects on Benthic Fish Habitat from the Construction[1]

Marine-Based Infrastructure Component		Loss of Benthic Fish Habitat		Gain of Benthic Fish Habitat		Net Gain (+) or Loss (-) of Benthic Fish Habitat (m^2)	Gain (+) of Fish Habitat on Vertical Infrastructure Surfaces (m^2)	Total Net Gain (+) or Loss (-) of Fish Habitat (m^2)
		Potential Adverse Project Environmental Effect	Area (m^2)	Potential Positive Project Environmental Effect	Area (m^2)			
Structural Jetty Option for Marine Terminal [2]								
Caisson	Construction Alternative A – Rock-Placed Ring	Dredging/Side Casting (250,541 m^3) and Jetty	118,457	Bottom Jetty Surfaces (Armour Stone and Rock Ring)	120,105	+1,648	+65,461	+67,109
Caisson	Construction Alternative B – Temporary Steel Caisson	Dredging/Side Casting (250,541 m^3) and Jetty	52,607	Bottom Jetty Surfaces (Armour Stone)	29,697	-22,910	+65,461	+42,551
Hybrid Jacket	Construction Alternative A – Rock-Placed Ring	Dredging/Side Casting (59,409 m^3) and Jetty Footprint	19,815	Bottom Jetty Surfaces (Armour Stone and Rock Ring for Caissons)	20,759	+944	+27,561	+28,505
Hybrid Jacket	Construction Alternative B – Temporary Steel Caisson	Dredging/Side Casting (59,409 m^3) and Jetty Footprint	10,425	Bottom Jetty Surfaces (Armour Stone for Caissons)	6,183	-4,242	+27,561	+23,319
Seawater Cooling Intake and Outfall (intake and outfall located in same corridor 17 m wide by 250 m long)		Nearshore Blasting and Side Casting	4,250	Rip-rap/Armour Stone and Pipe Surfaces	1,315	-2,935	0	-2,935
Barge Landing Facility (80 m wide by 300 m long)		Nearshore Blasting	24,000	-	-	-24,000	0	-24,000

Notes:

1. Loss of benthic habitat immediately after construction and which does not account for re-colonization of disturbed areas by benthic organisms.
2. Caissons will be used to construct the protected coke barge loading berth at the marine terminal location for either jetty option and which will require dredging approximately 59,409 m^3 over a surface area of 10,112 m^2. Disposal of dredged material will be a combination of side casting and disposal at the Black Point ocean disposal site managed by Environment Canada.

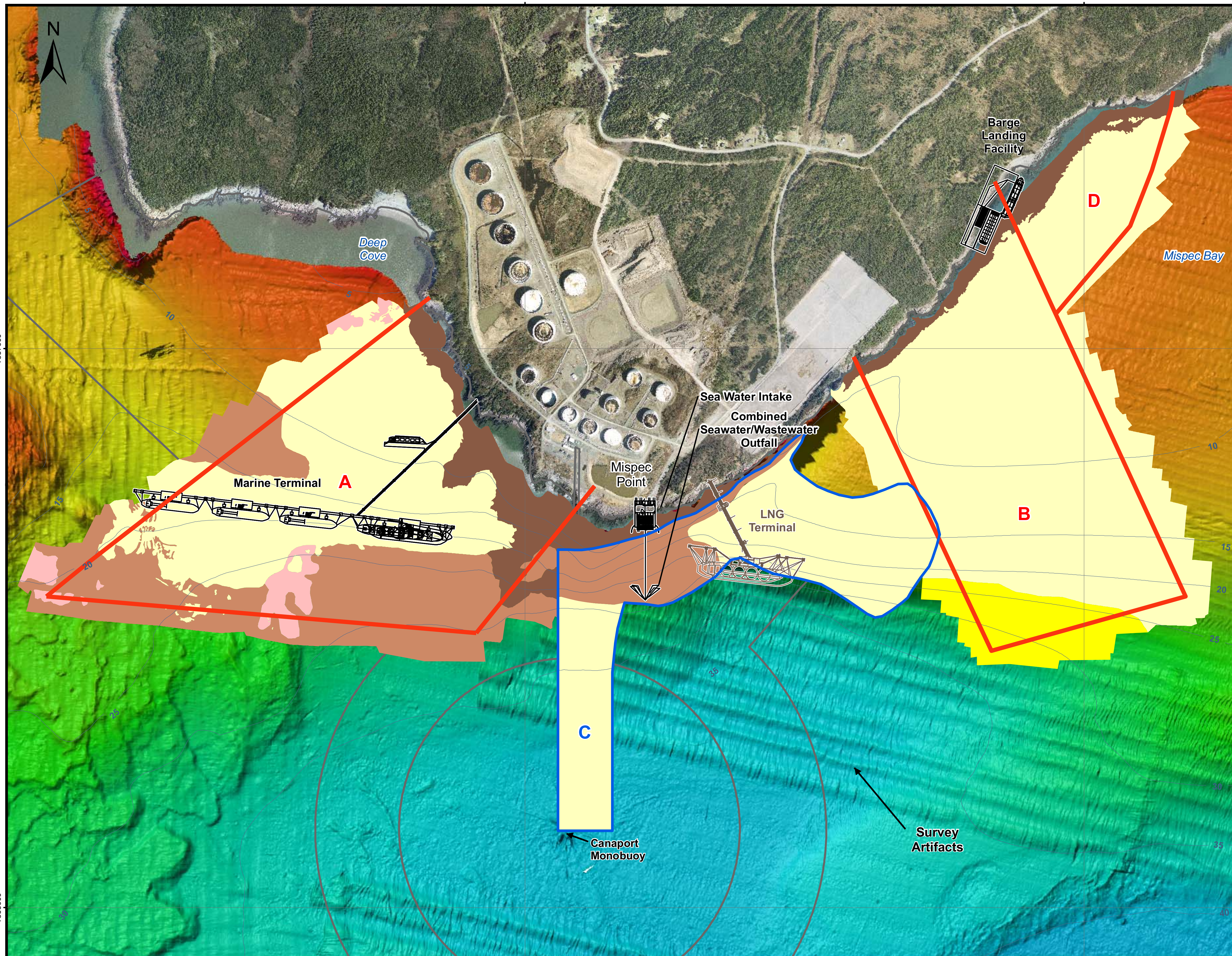

Figure C1

Schematic of the Distribution of Substrate and Benthic Habitat Types

Project Eider Rock

Map Features

- 2003 Survey Area (JW 2004)
- 2007 Survey Area
- Project Component
- Existing Component
- Bathymetry Contour (m)
- Bedrock with Discontinuous Mixed Sediment - Diverse Epifaunal Organisms (e.g. Branching Bryozoans, Barnacles, Hydroids, Sponges, Seastars, Algae, Crabs, Mussels, Lobsters)
- Gravel/Mixed Sediment - Epifaunal Organisms (e.g. Seastars, Crabs, Lobsters)
- Thin Sand Veneer on Gravel - Epifaunal Organisms (e.g. Seastars, Crabs, Lobsters)
- Silty Sand - Mainly Infaunal Organisms (e.g. Tunicates, Clams, Polychaetes, Mobile Lobsters)
- Sand with Shell Hash - Mainly Infaunal Organisms (e.g. Tunicates, Clams, Polychaetes, Sand Dollars, Mobile Lobsters)
- CanaportWaterLot

Bathymetry Data Source:
Fugro Jacques Geosurveys Inc. (2007)
Aerial Photography Data Source:
City of Saint John, GIS Division,
Property Data Source: Service New Brunswick

0 200 400 600 800
Metres

Map Parameters
Projection: NB Stereographic
Scale: 1:15,000
Date: August 8, 2008
Project No.: 1013263.

Jacques Whitford

3.0 STAKEHOLDER ENGAGEMENT PROGRAM

A critical part of any fish habitat compensation plan is engagement of stakeholders, including governmental and non-governmental groups. Governmental groups include DFO and provincial departments such as the New Brunswick Department of Natural Resources (NBDNR). Non-governmental groups include fishing associations, conservation organizations and watershed groups. Engagement of First Nations is also required for areas where the fishing resource is currently being used for traditional First Nation purposes. However, it has been determined that there is no current use of the marine environment in the Project area by First Nations communities, therefore engagement of First Nations is not planned.

Irving Oil is committed to meeting with and/or providing information to stakeholders to discuss the fish habitat compensation plan for the Project and seeking their input on potential compensation projects. This engagement will begin with the public release of the CSR for the Project. Subsequently, meetings may be planned with specific stakeholder groups to discuss potential compensation projects and options. The final compensation plan will incorporate stakeholder input as much as possible and will be submitted to DFO for review once the final design of marine-based structures is available. Potential non-governmental stakeholder groups that may be contacted include:

- ACAP Saint John;
- Fundy North Fishermens' Association;
- Fundy Baykeeper (a subsidiary of the Conservation Council of New Brunswick);
- Mispec fishermen;
- Watershed and Water Interest Groups:
    - Hammond River Angling Association;
    - Little River Reservoir Association;
    - Balls Lake Fishing Club;
    - Ducks Unlimited;
    - Beaver Lake Sporting Club;
    - Saint John River Society;
    - Atlantic Salmon Federation; and
    - Saint John Naturalists' Club Inc.

4.0 OPTIONS FOR FISH HABITAT COMPENSATION PROJECTS

Extensive habitat mapping has been conducted for the area in which marine-based structures will be constructed for the Project. These habitat areas are described in Chapter 10 of the CSR and shown graphically in Figure C1. In conjunction with these areas a preliminary summary of the direct environmental effect on benthic habitat has been provided in Table C1, with confirmation of these environmental effects to take place once the final design is known. The combination of habitat types affected with the actual area of environmental effect will form the basis for the development of the compensation plan.

4.1 Consideration for Potential Fish Habitat Compensation

In determining fish habitat compensation requirements, DFO not only considers the area and type of habitat affected but also the productive capacity of that habitat. Due to the challenges in effectively compensating for fish habitat loss, DFO typically requires compensation to be provided at a ratio of more than 1:1 for the area affected, dependent on the type of fish habitat affected and whether habitat is actually altered, disrupted or destroyed (*i.e.,* how severe the HADD is). The goal in requiring this ratio is to maintain the productive capacity of affected fish habitat that supports local fishery resources.

For the Project, assuming the loss of benthic habitat corresponding to the rock-placed ring caisson design option from Table C1, it appears that:

- Approximately 146,707 m^2 of benthic fish habitat may be affected by construction of the caissons (118,457 m^2), seawater cooling intake (4,250 m^2) and the barge landing facility (24,000 m^2).
- Approximately 121,420 m^2 of benthic habitat may be created by this design option including the armour rock and rock-placed ring (120,105 m^2) and the combination of the seawater cooling intake rip rap/armour stone and pipe surfaces (1,315 m^2).
- An additional 65,461 m^2 of vertical surface will be created by the caisson's themselves which may be considered as compensation for colonization of aquatic species and potentially applied to the compensation requirement.
- As stated above, DFO will apply a range of compensation ratios up to 3:1 to the original area(s) of HADD of fish habitat (*i.e.,* to the original 146,707 m^2 in the example above). This scale of this ratio applied by DFO will be based on the type of HADD of fish habitat that takes place and will dictate the final outstanding fish habitat compensation requirement.

In selecting fish habitat compensation projects, DFO's first preference is to compensate like habitat for like habitat in the immediate area of the where the HADD of fish habitat occurs. If insufficient compensation opportunities are available then the area of potential compensation is expanded as necessary to other areas. In the case of the Project, habitat compensation will focus on opportunities to provide compensation in the near shore marine environment, most likely with an emphasis on benthic species (*e.g.,* American lobster) with other pelagic species (*e.g.,* herring) also considered.

Several options exist for the enhancement or creation of fish habitat for the Project. The first is the use of the proposed structures to provide habitat as mentioned previously. For example, in preparing the seabed for the laying of caissons, specific sizes and configurations of rocks can be chosen to provide suitable habitat for various life stages of lobster. As well, artificial or rock reefs can be constructed under or near the trestle to use this structure as cover.

While the fish habitat HADD compensation is likely to focus on lobster habitat, providing a diversity of habitat types will be a key consideration for developing the HADD compensation plan. Factors including size and location of artificial reefs as well as the importance of the convergence of habitat types will be considered to ensure an appropriate level of fish habitat diversity.

The physical oceanographic characteristics of the compensation areas will also require consideration. Currents and tides will have a large influence on whether habitat creation structures will be viable for the long term. For example, it will be important to consider whether areas proposed for habitat creation work are subject to sediment deposition or erosion, or whether the structure will be able to withstand the strong tidal currents in the area.

4.2 Conceptual Options for Compensation Projects

Conceptual options for fish habitat compensation projects to address fish habitat HADD requirements are discussed below. This is not an exhaustive list of potential projects and more options are likely to come forward during stakeholder engagement.

4.2.1 Caisson Design

If the caisson design option is chosen for the marine terminal, several potential projects exist to use this proposed structure to provide fish habitat:

- Potential design modifications to the caissons themselves, for example indentations or extrusions to provide cover along the vertical concrete face;
- Amour rock within and around the perimeter of the caisson, specifically in regards to the rock-placed ring construction option (Figure C2), versus the use of a temporary steel caisson (Figure C3), with a focus on optimum sizes for lobster and other shellfish species; and
- Use of the “lee” area created between the caisson and the shore to create sheltered habitat for fish species.

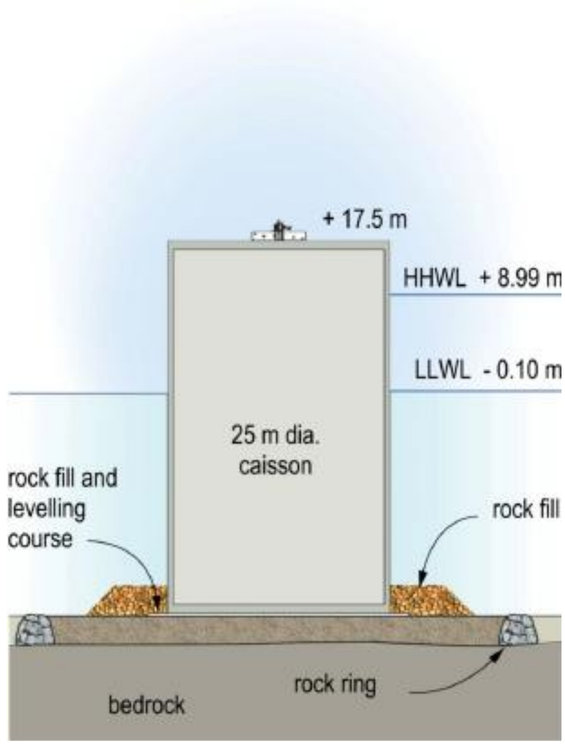

Figure C2 – Caisson Design Option showing Rock Placed Ring (Sandwell 2009)

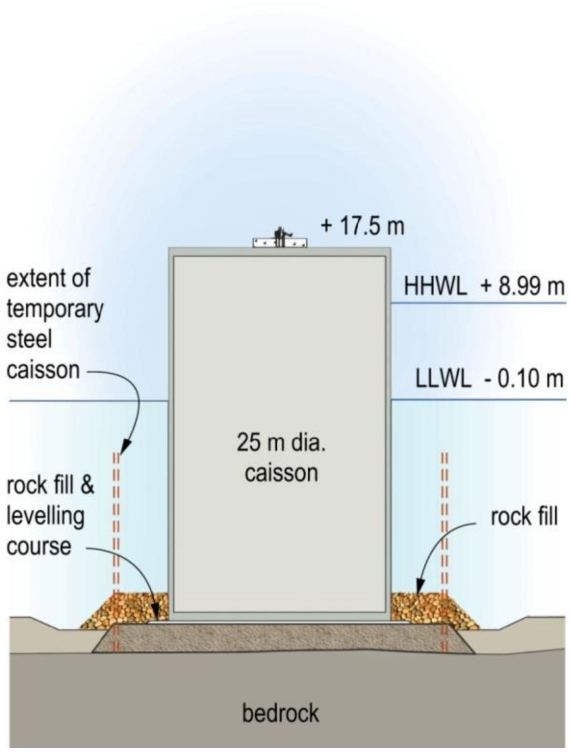

Figure C3 – Caisson Design Option showing Temporary Steel Caisson (Sandwell 2009)

4.2.2 Marsh Creek Improvements

Tidal flow into and out of Marsh Creek to Courtney Bay is currently controlled by an antiquated flood gate system. It has been proposed that modification of these flood gates could provide improved passage for migratory fish species into this watershed. There are also multiple other potential compensation opportunities throughout the Marsh Creek watershed.

4.2.3 Red Head Shore Cleanup

Tractor tires had previously been used to re-enforce eroding shorelines in the Red Head area. Many of these tires have been swept from the shore out into the intertidal zone by wave action. It has been suggested that these tires could be recovered to clean the shore area and restore habitat.

4.2.4 Improving Fish Passage for Marine Migratory Fish Species

There are several rivers and streams near the Project area including the Mispec River, Anthony's Cove Brook and Bean Brook. The downstream reaches of these watercourses could be surveyed to determine if any barriers to fish passage exist that could be removed or modified.

4.2.5 Recovery of Ghost Fishing Gear

The Mispec/Red Head area is used by local lobster fishermen. It is not uncommon to lose traps during routine fishing activity. However these traps can continue to "fish" after being lost, commonly known as ghost fishing gear. Since the advent of metal and plastic traps this has become a more critical problem resulting in unnecessary mortality of shellfish. Methods are available to recover these "ghost" traps and prevent further unnecessary losses of shellfish.

4.2.6 Sub-tidal Reef

The creation of sub-tidal artificial reefs are a well established and proven technique to create fish habitat. There are likely many locations in the Mispec/Red Head/Saint John River estuary area where artificial reefs could be created to provide or improve habitat for a number of fish species. Artificial reefs can be created using armour rock or concrete structures specifically designed to provide fish habitat.

4.2.7 Pre-cast Lobster Reef

In conjunction with the creation of artificial reefs as described above, concrete pre-cast lobster reef modules are available for reef creation. These modules focus specifically on providing lobster habitat and have been used successfully in other habitat compensation plans.

4.2.8 Enhancement of Black Point Ocean Disposal Site

Dredged spoils disposal areas have been shown to be particularly productive for lobster populations, most likely due to the added nutrients that dredged spoils provide. The Black point disposal site, managed by Environment Canada, is proximal to the proposed marine terminal site and will likely be used for the disposal of dredge spoils from the Project, if required, and as authorized by Environment Canada. Potential lobster habitat enhancement opportunities could be investigated at this site.

4.2.9 Other Compensation Project Options Potentially Identified through the Stakeholder Engagement Program

As discussed earlier in the document, stakeholder engagement will be conducted to seek input on potential habitat compensation projects. Viable and feasible options obtained from this process will be considered for use in the habitat compensation plan for the Project.

4.3 Additional Considerations

Operational considerations for environmental effects on fish and fish habitat include the potential entrainment of fish associated with seawater cooling intake, if constructed. In this case, while not considered HADD of fish habitat, Irving Oil has committed to developing an effective monitoring and measuring program to evaluate the level of entrainment that may be occurring. Once data is available, DFO will be consulted on whether the entrainment results warrant further monitoring or additional mitigation.

5.0 HABITAT COMPENSATION SUMMARY

Project Eider Rock will include the construction of a marine terminal and other marine facilities including a wastewater treatment outfall, a barge landing facility and potentially a seawater cooling intake. Although final design plans are not available, the construction of several or all of these facilities will result in some level of HADD of fish habitat. Consequently, a compensation plan for HADD of fish habitat will be required under the *Fisheries Act* and DFO's Policy for the Management of Fish Habitat. Irving Oil has committed to developing an effective fish habitat compensation plan in consultation with DFO and in consideration of input from stakeholders.

Potential compensation options include artificial reef development, restoration/improvement of fish passage in local streams and rivers, and recovery of ghost fishing gear, among others. Although both pelagic and benthic fish species will be considered in the development of this plan, the targeted species will be American lobster due to the active lobster fishery in the area. Stakeholder engagement will be carried out and options for HADD compensation projects will be submitted to DFO once final design information is available.

Appendix D

Environmental Assessment Track Report and Scoping Document

Environmental Assessment Track Report

Submitted to the Minister of Environment
Pursuant to Subsection 21(2) of the
Canadian Environmental Assessment Act

Eider Rock Project, Marine Terminal, Irving Oil Company, Limited
Saint John, New Brunswick
Canadian Environmental Assessment Registry # 07-03-28779

Prepared by:
Environment Canada
Fisheries and Oceans Canada
Transport Canada

September 24, 2007

Table of Contents **Page**

1.0 Introduction

This Environmental Assessment Track Report was prepared by Transport Canada ("TC"), Fisheries and Oceans Canada ("DFO"), and Environment Canada ("EC") pursuant to paragraph 21(2)(a) of the *Canadian Environmental Assessment Act* (the "CEAA"). TC, DFO and EC each have an obligation to ensure that an environmental assessment ("EA") in relation to the proposed Eider Rock development proposal is conducted.

Consistent with the requirements of paragraph 21(2)(a), this report to the Minister of the Environment (the "Minister") describes the following matters:

- the scope of the project;
- the factors to be considered, and the scope of those factors;
- public concerns in relation to the project;
- the potential of the project to cause adverse environmental effects; and,
- the ability of the comprehensive study to address issues related to the project.

The information contained in this report, and the recommendation to the Minister provided under paragraph 21(2)(b), are intended to assist the Minister in making a determination under subsection 21.1(1) of the CEAA. The Minister must decide whether to continue the EA by means of a comprehensive study, or to refer the project to a mediator or review panel in accordance with section 29 of the CEAA.

2.0 Background

2.1 Development Proposal Summary

Irving Oil Company, Limited ("Irving Oil") proposes to construct and operate a petroleum refinery development in Saint John, New Brunswick. This development, and its various land and marine-based components, is referred to collectively in the EA Track Report as the development proposal.

2.2 Requirement for a Federal EA

On January 25, 2007, Irving Oil submitted a project description to the Canadian Environmental Assessment Agency (the "Agency"). On January 26, the Agency, pursuant to the *Regulations Respecting the Coordination by Federal Authorities of Environmental Assessment Procedures and Requirements*, circulated the project description to federal authorities and asked them to determine if they would be required to exercise a power, or perform a duty or function pursuant to section 5(1) of the CEAA that would necessitate an EA. Federal authorities were also asked to confirm if they were in possession of expertise that would be pertinent to such an EA. Specifically, the project description and Agency request was circulated to EC, DFO, Health Canada, Indian and Northern Affairs Canada, Industry Canada, National Energy Board, Natural Resources Canada, TC and the Canadian Transportation Agency.

Under section 5 of the CEAA, a federal EA may be required when, in respect of a project, a federal authority proposes to:

- be the proponent;
- make or authorize payment or any other form of financial assistance to a proponent;
- sell, lease or otherwise dispose of land; or,
- issue a permit, or licence or other form of approval pursuant to a statutory or regulatory provision identified in the *Law List Regulations* under the CEAA.

These planned actions of federal authorities are commonly called “triggers”. Federal authorities that have a trigger are known as responsible authorities (“RAs”) and they are required to ensure that an EA is conducted, pursuant to the CEAA, prior to taking their respective decisions.

TC, DFO, and EC have each determined that certain components of the Irving Oil development proposal are likely to require approvals that trigger the CEAA. The following specific triggers have been identified:

- issuance of authorizations by DFO pursuant to subsection 35(2) of the *Fisheries Act* for the harmful alteration, disruption or destruction of fish habitat and/or section 32 of the *Fisheries Act* for the destruction of fish;
- issuance of a permit by EC for the disposal of dredged material at sea under subsection 127(1) of the *Canadian Environmental Protection Act*; and,
- issuance of an approval to allow for an interference to navigation from TC paragraph 5(1)(a) of the *Navigable Waters Protection Act* (“NWPA”).

TC, DFO, and EC are therefore RAs and must ensure an EA is completed pursuant to the CEAA.

Natural Resources Canada and Health Canada, as federal authorities under the CEAA, have identified areas of expertise they can make available to the RAs upon request.

2.3 Interim Approach to Scoping

The *Cabinet Directive on Implementing the Canadian Environmental Assessment Act* (the “Directive”) sets out a policy for determining an appropriate scope of project for EA. Section 3, Part II of the Directive, states the following:

> If components of the proposal other than the component directly related to the powers, duties or functions referred to in section 5 of the [CEAA] might cause adverse environmental effects on areas of federal jurisdiction, a scope of project determination

> that includes as much as possible these other components, so that the potential adverse environmental effects on areas of federal jurisdiction can be considered.

Application of the Directive is guided by the "Interim Approach for Determining Scope of Project for Major Development Proposals with Specific Regulatory Triggers under the *Canadian Environmental Assessment Act*" (the "Interim Approach"), which was released in November 2006 (http://www.ceaa-acee.gc.ca/012/016/index_e.htm). The interim approach includes structured processes for identifying components of a development proposal for inclusion in the project scope, obtaining the information required to support federal EA decisions, and ensuring implementation of mitigation measures and follow-up programs.

The Interim Approach includes the following statement:

> Determination of which non-trigger components should be included in the project scope will be based on a balanced, risk-management approach and consideration of three criteria:
>
> - the nature of the federal interests in question and potential environmental risk to them;
> - the operational inter-connectedness between the non-trigger components in question and the trigger components; and
> - the extent to which the potential adverse environmental effects related to matters within federal jurisdiction to be caused by the component will be considered and mitigated through other regulatory and environmental assessment processes.

2.3.1 Canada-New Brunswick Coordination

Under Regulation 87-83 of the New Brunswick *Clean Environment Act*, Irving Oil was required to register the development proposal as an undertaking for review. On January 25, 2007, Irving Oil registered the development proposal with the New Brunswick Department of Environment ("NB ENV"). On February 7, 2007, the provincial Minister of Environment ("provincial Minister") determined that a comprehensive environmental impact assessment ("EIA") would be required for the entire Irving Oil development proposal. The comprehensive EIA process described at http://www.gnb.ca/0009/0377/0002/11-04-e.pdf is managed by NB ENV, with input from the public and a technical review committee ("TRC"). The TRC is composed of federal and provincial authorities with pertinent expertise, along with other experts as required. DFO, TC, EC, and Health Canada are all members of the TRC for the Irving Oil development proposal.

The comprehensive EIA process begins with the drafting of guidelines for the preparation of the EIA. Draft guidelines are released by NB ENV for a 30-day comment period following which the guidelines are finalized. In the specific case of the Irving Oil development proposal, draft guidelines for the provincial EIA were released for comment on April 5, 2007. The guidelines were finalized by NB ENV on July 5, 2007 (http://www.gnb.ca/0009/0377/0002/0005-e.asp) based on a consideration of input from the public and the TRC.

At this point in the provincial process, Irving Oil must draft terms of reference which describe in greater detail the approach to be used in the EIA. The public and the TRC will be provided with an opportunity to review the draft terms of reference which are ultimately approved by NB ENV subject to any revisions that may be required.

Based on the final guidelines, and approved terms of reference, Irving Oil will prepare a draft EIA report. The draft EIA report will be evaluated by the TRC. Based on the evaluation, NB ENV will direct the proponent to address any identified deficiencies.

If, on the advice of the TRC, the provincial Minister is satisfied that the EIA is adequate, a final EIA report will be provided to the public for further review and comment. A summary of the final EIA report is prepared by NB ENV on behalf of the provincial Minister to assist the public in the review. The TRC also prepares a General Review Statement summarizing its perspective on the final EIA report. These documents are made available for public review and comment for at least 30 days.

Following review of the written documents, NB ENV announces open house/public meeting events at which anyone can make comments, or raise issues or concerns. Following the public meeting, any interested parties have an additional fifteen days to submit written comments regarding the proposal. At the end of the meetings, a summary of the public participation is prepared for the provincial Minister (this is publicly available). At any time after this date, the Lieutenant-Governor in Council may issue a decision to issue or deny an approval for the development proposal.

In the case of the Irving Oil development proposal, specifically, the federal EA will be coordinated, to the extent possible, with the provincial process. As with any project subject to both federal and provincial legislation, the federal and provincial governments will each make decisions on matters within their own legislative authorities.

2.3.2 TERMPOL

Irving Oil has committed to a Technical Review of Marine Terminal Systems and Transshipment sites (“TERMPOL”), which is administered by TC. The purpose of TERMPOL is to objectively appraise operational ship safety, route safety, and to assess management and environmental concerns associated with the location, construction and operation of a marine terminal.

Although TERMPOL is separate process that exists outside the scope of a federal EA, it remains an important Code for the guidance of proponents that transport pollutants or hazardous cargoes in bulk. Detailed information on the

TERMPOL process can be found at
www.tc.gc.ca/marinesafety/tp/tp743/part1.htm

3.0 Scope and Type of the Federal EA as Proposed in the Comprehensive Study Scoping Document (May 17, 2007)

3.1 Scope of Project

In consultation with the Agency, the RAs (i.e., TC, DFO, and EC) prepared a document entitled, Comprehensive Study Scoping Document (the "Scoping Document"), which is dated May 17, 2007, and attached as Appendix 1. The Scoping Document sets out the proposed scope of the project (section 5.1), the factors to be considered in the EA (section 5.3) and the scope of the factors to be considered (section 5.4). The Scoping Document was made available for review and comment by the public, as per subsection 21(1) of CEAA, for the period from May 23rd to June 30th, 2007.

As outlined in CEAA, subsection 15(1), the scope of the project to be assessed is determined by the RAs. In the specific case of the Irving Oil development proposal, DFO, EC, and TC, as the RAs, proposed in the Scoping Document that the scope of the project for the federal EA would be the construction, operation, decommissioning and/or abandonment of the following triggered components of the development proposal, and the related activities (e.g. blasting, dredging, infilling, disposal at sea):

- the pier or monobuoy for crude tanker unloading, and or the use of the existing monobuoy at Canaport;
- the pier and associated breakwater for loading of petroleum coke products onto ships and for shipping the refined petroleum products to their intended markets; and,
- the barge landing facility, constructed on either a temporary or permanent basis, for unloading large equipment during the construction phase or as required thereafter.

In the Scoping Document, the RAs also proposed that the scope of project would include docking and deberthing of vessels.

Refer to section 4.4 of this report for a discussion of the scope of the project and scope of assessment in the context of submissions received during the public comment period.

3.2 Type of EA

DFO, EC, and TC determined that the proposed scope of project includes components that are subject to a comprehensive study under the CEAA.

Specifically, the *Comprehensive Study List Regulations* under the CEAA include the following paragraph:

> 28(c) a marine terminal designed to handle vessels larger than 25000 DWT unless the terminal is located on lands that are routinely and have been historically used as a marine terminal or that are designated for such use in a land-use plan that has been the subject of public consultation.

4.0 Public Participation

In accordance with subsection 55(1) of the CEAA, a Canadian EA Registry (the "Registry") must be established for each EA. The Registry consists of an Internet Site and a project file. The Registry provides notice of the EA and facilitates public access to records related to the EA.

DFO is taking a lead role in managing the Registry. The EA was registered on the Internet Site on May 7, 2007. It can be found by conducting a search using the Registry number (No. 07-03-28779) from the following addresses:

English - http://www.ceaa.gc.ca/050/index_e.cfm
French - http://www.ceaa.gc.ca/050/index_f.cfm

The CEAA requires that public consultation be conducted at three points during a comprehensive study:

- during the preparation of the Scoping Document [subsection 21(1)];
- during the conduct of the comprehensive study (section 21.2); and,
- during a review of the completed comprehensive study report prior to the Minister's issuance of an EA decision statement (section 22).

4.1 Consultation on the Scoping Document

The Scoping Document was made available by the RAs for public review and comment, as per subsection 21(1) of the CEAA, for the period from May 23 to June 30, 2007. A public notice and the Scoping Document were placed on the Registry internet site to initiate the public comment period.

Notices were placed in the following daily and weekly papers:

- New Brunswick Telegraph Journal – May 24, 2007
- The Daily Gleaner – May 24, 2007
- L'Acadie Nouvelle – May 24, 2007
- Journal Dieppe - June 1, 2007
- The Valley Viewer - May 29, 2007
- West Tides - May 29, 2007

Physical copies of the Scoping Document were available for public review at the following locations:

- NB ENV – Saint John Office
- City of Saint John City Hall
- Saint John Regional Public Library
- Saint John Public Library – East Branch
- Service New Brunswick Centre – Saint John
- Bayview Convenience – Saint John
- Petro-Canada – Saint John

The Scoping Document was also provided to NB ENV for comment. As well, the document was circulated to the 15 Mi'kmaq and Maliseet communities in NB, the Union of NB Indians, North Shore Mi'kmaq District Council, Saint John River Valley District Tribal Council, MAWIW Tribal Council, the NB Aboriginal Peoples Council, the Atlantic Policy Congress of First Nations Chiefs and the Maritime Aboriginal Aquatic Resources Secretariate.

In response to the public notice, approximately 30 submissions (a combination of letters and e-mails) were received by DFO during the comment period. Additionally, approximately 30 submissions (a combination of letters and e-mails) were received directly by the Minister during the comment period. In total, approximately 60 submissions were considered by the RAs in preparing the EA Track Report.

Submissions originated from local residents, from residents of other parts of Canada, and from individuals living outside of Canada. The following organizations provided comments: New Brunswick Conservation Council, Atlantic Salmon Federation, Ecology Action Center – Nova Scotia, Fundy Bay Keeper, Fundy North Fishermen's Association, Climate Action Now – Nova Scotia, Conservation Law Foundation - Maine Advocacy Center, Sierra Legal Defence Fund, Saint John Citizen Clean Air Coalition, Environment Northeast – USA, and Natural Resources Council of Maine.

All submissions directed to the DFO were photocopied and forwarded to TC, EC, and the Agency. All submissions received directly by the Minister during the comment period were forwarded by the Agency to the RAs. The submissions were reviewed by each RA. It was recognized that each submission typically identified more than one issue.

4.2 Concerns Identified During Scoping Document Consultation

The following summary observations are noted based on approximately 60 letters and e-mails submitted during the comment period:

- approximately 30 requested that the refinery component of the development proposal be included in the scope of project;

- approximately 20 requested that shipping be included in the scope of project;
- a few requested a “full” EA; and,
- a few expressed concern about “exemptions” from federal EA.

TABLE 4.1. PUBLIC COMMENTS ON THE PROPOSED SCOPE OF PROJECT

PUBLIC COMMENT	RA COMMENTARY
Include refinery	• no federal trigger • proposed approach consistent with the Directive, Interim Approach and federal EAs of similar development proposals in Canada involving similar circumstances • refinery will be assessed through provincial EIA process that includes involvement of federal departments
Include shipping	• no federal trigger • scope of project includes vessel movements associated with construction of the marine infrastructure, and docking and deberthing of vessels as operational components of the marine infrastructure • proposed approach consistent with the Directive, Interim Approach and federal EA of similar development proposals in Canada involving similar circumstances • shipping activity will be assessed through provincial EIA process that includes involvement of federal departments • a TERMPOL review will be conducted
“Full” EA	• “full” EA is not a term that corresponds with any type of federal or provincial EA; it is assumed that the authors wanted all components of the development proposal to be included in the scope of the federal EA (see responses to requests to include refinery and shipping) or a panel review (see section 6).
Concerned about “EA exemption” given to project	• A federal EA is required; an exemption is not possible under the CEAA. Components of the development proposal are triggered by the CEAA, and therefore, will be examined through the federal EA.

In addition to commenting on the proposed scope of project, submissions also discussed factors, and the scope of those factors, which should be included in an EA. The following factors were identified by members of the public as of specific concern to them:

- air quality including transboundary issues
- greenhouse gases
- fish & fish habitat
- mammals and birds
- water quality
- health and socioeconomic issues
- accidents/malfunctions
- cumulative effects

Air Quality

EC and Health Canada will be working with the provincial government in addressing air quality issues associated with the Irving Oil development proposal. The provincial EIA guidelines for the development proposal set out specific requirements related to the assessment of effects on air quality including transboundary effects. These requirements are consistent with EC expectations and were developed with EC input to the EIA guidelines as a member of the TRC. The EIA guideline requirements are also consistent with the *Canada-United States Air Quality Agreement*.

In conjunction with the provincial EIA, the federal EA of the project as scoped will include a consideration of effects on air quality. In assessing cumulative effects, attention will be given to how emissions related to marine components of the development proposal will interact with other existing and proposed emissions sources within the airshed.

Greenhouse Gases

EC will be working with the provincial government in addressing greenhouse gas issues associated with the development proposal. The provincial EIA guidelines set out specific requirements related to the consideration of greenhouse gases. These requirements are consistent with EC expectations and were developed with EC input to the EIA guidelines as a member of the TRC. In conjunction with the provincial EIA, the federal EA will consider how the project as scoped will contribute to greenhouse gases.

Fish and Fish Habitat

The provincial EIA guidelines for the development proposal include requirements for the assessment of effects in both the freshwater and marine environments, with specific requirements to evaluate the effects on Atlantic Salmon. Federal departments on the TRC will be working with the provincial government on this issue.

In conjunction with the provincial EIS, the federal EA will consider the interactions of the project as scoped with fish and fish habitat. The proposed scope of project is focused on marine components of the development proposal. Therefore, the federal EA would not directly consider the potential for interactions with freshwater fish and fish habitats such as the Atlantic Salmon in the Mispec River, which was specifically identified by the public as an area of concern.

Mammals
The provincial EIA guidelines for the development proposal include requirements related to the consideration of mammals, including specific requirements for evaluation of potential effects on the North Atlantic Right Whale which is listed as endangered under Schedule 1 of the *Species at Risk Act* (SARA)   In conjunction with the provincial EIA, the federal EA of the project as scoped will consider potential effects on mammals with a likely focus on marine mammals..

Birds
EC will be working with the provincial government in addressing wildlife issues associated with the Irving Oil development proposal, including potential impacts on migratory birds. The provincial EIA guidelines for the development proposal set out specific requirements related to the assessment of effects on migratory birds, such the Harlequin Duck. These requirements are consistent with EC expectations and with EC input to the EIA guidelines as a member of the TRC. In conjunction with the provincial EIA, the federal EA of the project as scoped will include a consideration of effects on migratory birds, including the Harlequin Duck, which is a listed wildlife species of special concern under Schedule 1 of the SARA.

Water quality
Federal departments on the TRC will be working with the provincial government in addressing water quality issues associated with the Irving Oil development proposal. The provincial EIA guidelines set out specific requirements related to the assessment of potential effects on marine and freshwater water quality. In conjunction with the provincial EIA, the federal EA of the project as scoped will include a consideration of effects on water quality with a likely focus on marine water quality.

Health and Socioeconomic Issues
Based on the definitions of environment and environmental effect in the CEAA, it is important to note that the following effects can only be considered in a federal EA when they relate to a change in the environment: health and socio-economic conditions; physical and cultural heritage; the current use of lands and resources for traditional purposes by aboriginal persons; and any structure, site or thing that is of historical, archaeological, paleontological or architectural significance. Specific issues raised by the public in relation to these matters were the fishery, health, property values, navigation, and certain tourism and recreation values.

DFO will be working with the provincial government in addressing fisheries issues related to the development proposal. The provincial EIA guidelines include requirements for the assessment of whether the development proposal will result in environmental and/or socio-economic effects that alters commercial fishing activities, including by NB Aboriginal communities, or fishing resources. In conjunction with the provincial EIA, the federal EA of the project as scoped will include a consideration of effects on the fishery as they relate to changes in the environment.

Federal departments on the TRC, including Health Canada, will be working with the provincial government in addressing health issues related to the development proposal. A Human Health and Ecological Risk Assessment is a specific requirement of the provincial EIS guidelines. In conjunction with the provincial EIA, the federal EA of the project as scoped will include a consideration of effects on health as they relate to changes in the environment.

Federal departments on the TRC, including TC, will work with the provincial government on navigation issues related to the development proposal. The provincial EIA guidelines require an explanation of the management of vessel traffic in the Bay of Fundy, as well as a prediction of the effects of increased ship traffic in the Bay of Fundy and Saint John Harbour. In conjunction with the provincial EIA, the federal EA of the project as scoped will include a consideration of effects on navigation as they relate to changes in the environment.

The public also identified potential effects on property value, use of Mispec Beach and effects on the cruise ship industry as concerns. The provincial EIA guidelines require an evaluation of the effects on property values, tourism and recreational activities. In conjunction with the provincial EIA, the federal EA of the project as scoped will include a consideration of effects on these factors as they relate to changes in the environment.

<u>Accidents / malfunctions</u>
Federal departments on the TRC will be working with the provincial government in addressing potential effects related to accidents and malfunctions that could be associated with the Irving Oil development proposal. The provincial EIA guidelines set out specific requirements related to a consideration of accidents and malfunctions that are consistent with federal government expectations.

In conjunction with the provincial EIA, the federal EA will include a consideration of accidents and malfunctions, which is mandatory under the CEAA. In terms of the project as scoped for the federal EA, this could include accidents and malfunctions, such as spills, involving vessels engaged in the construction of the marine terminal or vessels docking and deberthing during the operational phase

Cumulative environmental effects

The proposed project has the potential to result in cumulative environmental effects. Under the CEAA, the RAs must evaluate any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out. The RAs will ensure a cumulative effects assessment for the project is undertaken in a manner that is consistent with Agency guidelines.

4.3 Correspondence Submitted to the Minister Prior to the Release of the Scoping Document

Prior to the release of the Scoping Document and commencement of the comment period, approximately 55 pieces of correspondence (a combination of letters and e-mails) were submitted by the public directly to the Minister. Correspondence began arriving shortly after Irving Oil's announcement of the development proposal and submission of a project description to federal and provincial governments. Comments focused on the following matters:

- the type of EA, requesting the Minister immediately refer the development proposal to a panel review
- the scope of the EA, requesting the Minister to ensure all components of the development proposal are included in the EA
- concern about the provincial EIA process
- concern that the Minister had endorsed the project prior to the conclusion of an EA
- concern related to potential effects on various environmental components, including air quality, greenhouse gas emissions, fish and fish habitat, marine mammals, water quality
- concern related to effects on health and socioeconomic factors
- concern about effects related to accidents and malfunctions
- concern related to the cumulative and transboundary nature of effects

4.4 Proposed Amendments and Clarifications to the Scope of Project and Scope of Assessment

As a result of the feedback received, the RAs revisited the rationale supporting the proposed scope of project and factors for assessment as identified in the Scoping Document. Based on the information provided by Irving Oil to date, the triggers for the federal EA are directly related to project components and activities in the marine environment. As well, the triggers for all three RAs are associated with permits of a very specific nature and scoping under these circumstances is guided by the Directive and Interim Approach.

Based on information provided in the project description, the RAs propose to increase the scope of project to include a fourth component:

- in-water physical structures, constructed on either a temporary or permanent basis, in the marine environment, and any navigational dredging that may be required.

As well, the RAs clarify that the inclusion of the existing monobuoy within the scope of project is only in the context to any proposed modifications to the structure, not to the existing use of the structure.

The RAs acknowledge the concerns of the public about specific components of the environment and appreciate their identification. The RAs will include the majority of the factors identified by the public in the context of the components of the development proposal proposed for the scope of project. As described in section 4.2, however, socioeconomic factors can only be considered in the context of change in the environment.

4.5 Future Public Consultation on a Comprehensive Study Type EA

If the Minister determines under paragraph 21.1(1)(a) of the CEAA that the project will continue to be assessed as a comprehensive study, the RAs and the Agency are required to ensure that the public is provided with two further opportunities to participate in the comprehensive study. Specifically, the public must have an opportunity to participate during 1) the preparation of the comprehensive study, and 2) the review of the final comprehensive study report.

The Agency administers a Participant Funding Program that supports individuals and non-profit organizations interested in participating in certain types of federal EA. The Agency will provide up to a total of $60,000 in participant funding, should this particular EA proceed as a comprehensive study. Notification of the availability of participant funding was provided by the Agency in conjunction with the RAs' advertisement of the Scoping Document comment period. The closing date for applications was June 30, 2007.

5.0 Potential of the Project to Cause Adverse Environmental Effects

Adverse environmental effects of the construction, operation and decommissioning of marine structures could include interactions summarized in tables 5.1, 5.2, and 5.3. The tables reflect preliminary project information and the RAs' experience with these types of developments.

The adverse environmental effects identified in tables 5.1, 5.2, and 5.3 are examples of what could occur should mitigation measures not be put in place. Potential adverse environmental effects will be determined, and technically and economically feasible mitigation measures will be identified over the course of the EA. Also, the CEAA requires that a follow-up program be designed and implemented as part of a comprehensive study to help ensure mitigation measures are effective and any necessary adaptive management actions are identified and implemented.

Table 5.1. Examples of Potential Adverse Environmental Effects – Construction Phase

Examples of Project Activities	Valued Ecosystem Components and Socio-economic Components	Examples of Potential Environmental Effects
Construction		
• Vessel transportation, • Barging, • Assembly and placement of offshore structures, • Delivery of construction materials and equipment • Construction of pier, • Dredging, • Side casting of spoils, • Driving or drilling / grouting, of piles, • Placement of decking • Pier deck equipment installation • Site preparation of terrestrial components – clearing, grubbing, blasting, grading	Marine water quality	• Accidental spills, and the release of bilge and ballast waters, could contaminate marine water • Land-based erosion could impact receiving fish habitat • Pile-driving and other in-water activities could affect marine water quality
	Sediment quality	• Accidental spills could contaminate marine sediment • Pile-driving and other in-water activities could affect sediment quality
	Marine fish and marine fish habitat	• Destruction of fish Harmful alteration, disruption or destruction of fish habitat including spawning, nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes from physical structures • Land based erosion could impact receiving fish habitat • Pile-driving and other in-water activities could affect fish • Accidental spills could result in contamination
	Migratory birds	• Harmful interactions with birds (noise, lighting, accidental spills, habitat destruction and alteration)
	Wetlands	• Accidental spills could contaminate coastal wetlands
	Air quality	• Contribution to an increase in ambient air quality concentrations of certain

		pollutants
	Greenhouse gases	• Contribution of greenhouse gases
	Species at risk	• Harmful interactions with species at risk (e.g., direct or indirect mortality, accidental spills, habitat loss or alteration)
	Marine mammals	• Accidental collisions with marine mammals could result in mortalities • Accidental spills could harm marine mammals
	Health and socio-economic factors	• Changes to marine water quality and habitat could impact fisheries, including Aboriginal fisheries • Changes to air quality from construction vessel emissions could effect human health

Table 5.2. Examples of Potential Adverse Environmental Effects – Operation Phase

Examples of Project Activities	Valued Ecosystem Components and Socio-economic Components	Examples of Potential Environmental Effects
Operation		
• Vessel transportation, • Vessel loading and unloading, • Delivery of maintenance materials and equipment (via land or barge), • Maintenance of pier, • Maintenance dredging - side casting of spoils and disposal at sea, • Maintenance and replacement of decking • Maintenance and repair of terrestrial components	Marine water quality	• Accidental spills and release of ballast and bilge waters could contaminate marine water • Land based erosion could impact receiving fish habitat
	Sediment quality	• Accidental spills could contaminate marine sediment
	Marine fish and marine fish habitat	• Land based erosion could impact receiving fish habitat
	Migratory birds	• Harmful interactions with birds (noise, lighting, accidental spills, habitat destruction and alteration)
	Wetlands	• Accidental spills could contaminate coastal wetlands
	Air quality	• Contribution to an increase in ambient air quality concentrations of certain pollutants
	Greenhouse gases	• Contribution of greenhouse gases
	Species at risk	• Harmful interactions with

		species at risk (e.g., direct or indirect mortality, accidental spills, habitat loss or alteration)
	Marine mammals	• Accidental collisions with marine mammals could result in mortalities • Accidental spills could harm marine mammals
	Health and socio-economic factors	• Marine structures could alter current and wave patterns which could effect navigation • Changes to air quality from berthing and deberthing vessels could effect human health

Table 5.3. Examples of Potential Adverse Environmental Effects – Decommissioning Phase

Examples of Project Activities	**Valued Ecosystem Components and Socio-economic Components**	**Examples of Potential Environmental Effects**
Decommissioning		
• Vessel transportation, • Barging, • Removal of offshore structures, • Delivery of decommissioning equipment • Decommissioning or removal of pier, • Removal of piles, • Marine and terrestrial based site reclamation	Marine water quality	• Accidental spills, and release of ballast and bilge waters could contaminate marine water • Land based erosion could impact receiving fish habitat
	Sediment quality	• Accidental spills could contaminate marine sediment
	Marine fish and marine fish habitat	• Decommissioning land based erosion could impact receiving fish habitat • Accidental spills could result in contamination
	Air quality	• Contribution to an increase in ambient air quality concentrations of certain pollutants
	Greenhouse gases	• Contribution of greenhouse gases
	Wetlands	• Accidental spills could contaminate coastal wetlands
	Migratory birds	• Harmful interactions with birds (noise, lighting, accidental

		spills, habitat destruction and alteration)
	Species at risk	• Harmful interactions with species at risk (e.g., direct or indirect mortality, accidental spills, habitat loss or alteration)
	Marine mammals	• Accidental collisions with marine mammals could result in mortalities • Accidental spills could harm marine mammals

Under the CEAA, an assessment of environmental effects must also include a consideration of effects of the environment on the project. The potential influence of climate conditions (e.g., wind, waves, ice), including climate change processes and extreme events, will be among the factors considered in this regard.

6.0 Ability of a Comprehensive Study to Address Issues Relating to the Project

In addition to information on the scope of project, factors to be considered and the scope of the factors for consideration in the comprehensive study, the Scoping Document also sought public comments on the ability of the comprehensive study to address issues relating to the project. Of the approximately 60 submissions made during the comment period approximately 20 requested the project be referred to a review panel rather than remain as a comprehensive study type EA. Reasons cited include:

- the scale of the development proposal and the high level of public interest in the refinery component
- concern about the environmental effects of the refinery, particularly on air quality, greenhouse gas contributions, watersheds and human health, and ship traffic, particularly on the North Atlantic Right Whale
- concerns about the transboundary nature of air emissions and effluents
- the need to understand current environmental legislation and government commitments related to a refinery
- opportunity to harmonize with the provincial EIA process
- concern about the capacity of the provincial EIA process to adequately review the development proposal
- a panel review provides an open forum for the public to hear about and discuss the project and its rationale with unbiased panel members while a comprehensive study has few opportunities for public participation
- ensure gaps between various regulatory and policy contexts are filled

As well, there was a request for the project to be referred to a mediator.

The RAs were guided by the Directive and Interim Approach to determine the proposed scope of project relative to the federal EA triggers. Based on the specific federal decision-making authorities triggering a federal EA in this case, the proponent's commitment to TERMPOL, and the provincial EIA requirements, the scope of project for the federal EA is limited to the marine components of the development proposal. The approach taken to scoping the Eider Rock development proposal is consistent with the approach adopted for scoping other major development proposals in Canada under similar circumstances.

The provincial EIA process will assess construction, operational and decommissioning matters associated with the overall Eider Rock development proposal. DFO, EC, and TC, as well as Health Canada will participate in the provincial TRC and will continue to contribute expertise related to areas of federal interest accordingly.

The RAs have considered the views and concerns received from public. Participation of the federal government in the provincial TRC will help ensure public concerns related to the development proposal are fully considered. The provincial EIA process includes public participation and the province has shared with the RAs copies of all public comments. As well, a comprehensive study level EA requires two further stages of public involvement. All public comments and concerns will continue to be shared by both Provincial and Federal Governments.

DFO, TC and EC will work together to ensure a single federal EA is undertaken in a manner that allows all three RAs to fulfill their respective responsibilities under the CEAA, in a unified non-duplicative manner. This includes each RA meeting its respective requirements to report to the Minister under paragraph 21(2)(a) using this EA Track Report, and to make recommendations to the Minister on the EA track in accordance with paragraph 21(2)(b).

Given the anticipated environmental effects and issues of the federally scoped project, the RAs are of the opinion that a comprehensive study has the ability to address the issues relating to the project.

Appendix 1 – Scoping Document

FOR PUBLIC COMMENT

Comprehensive Study Scoping Document
Pursuant to Section 21(1) of the
Canadian Environmental Assessment Act

Eider Rock Development, Irving Oil Company, Limited

Saint John, New Brunswick

Prepared by:
Environment Canada
Fisheries and Oceans Canada
Transport Canada

Canadian Environmental Assessment Registry # 07-03-28779

May 17, 2007

Table of Contents

Please note that underlined words are defined in Appendix 1, Glossary of Terms.

1.0 Introduction

The purpose of this document is to seek the views of the public on the scope of the federal environmental assessment for the proposed Eider Rock development in Saint John, New Brunswick. Fisheries and Oceans Canada (DFO), Environment Canada (EC) and Transport Canada (TC) are responsible for ensuring the federal environmental assessment is conducted. Pursuant to Section 21(1) of the Canadian *Environmental Assessment Act* (CEAA), the public are invited to provide comments on:

- the proposed scope of the project,
- the proposed factors to be considered in the assessment,
- the proposed scope of those factors, and
- the ability of the comprehensive study to address issues relating to the project.

The following sections of the document provide a summary of the Eider Rock development as proposed by Irving Oil Company, Limited (Irving Oil or the proponent), a description of the federal environmental assessment process, the scope of the environmental assessment proposed by the federal government and details on the public consultation.

2.0 Development Proposal Summary

Irving Oil proposes to construct and operate a petroleum refinery development in Saint John, New Brunswick. This development, and its various land and marine-based components, is referred to collectively in this document as the development proposal. Refer to Appendix 2. Irving Oil's description of the development proposal can be found at http://www.irvingoil.com/dloads/EIA.pdf.

Appendix 2 – Study Area for Marine Terminal Facilities

3.0 Requirement for a Federal Environmental Assessment

Under section 5 of the CEAA, a federal environmental assessment may be required when, in respect of a project, a federal authority proposes to:

- be the proponent;
- make or authorize payment or any other form of financial assistance to a proponent;
- sell, lease or otherwise dispose of land; or

• issue a permit, or licence or other form of approval pursuant to a statutory or regulatory provisions identified in the Law List Regulations.

These planned actions of federal authorities are commonly called "triggers". Federal authorities that have a "trigger" are known as responsible authorities (RAs) and they are required to ensure that a federal environmental assessment is conducted, pursuant to the CEAA, prior to taking their respective decisions.

DFO, EC and TC have each determined that certain components of the Irving Oil development proposal are likely to have a "trigger". The following specific triggers have been identified:

- issuance of authorizations by DFO pursuant to section 35(2) and or section 32 of the *Fisheries Act* for the harmful alteration, disruption or destruction of fish habitat, or the destruction of fish.

- issuance of a permit by EC for disposal of dredged material at sea under subsection 127(1) of the *Canadian Environmental Protection Act*

- issuance of an approval to allow for an interference to navigation from Transport Canada section 5(1)(a) of the *Navigable Waters Protection Act* (NWPA)

DFO, EC and TC are therefore RAs and are required to ensure an environmental assessment is completed pursuant to the CEAA.

Natural Resources Canada (NRCan), and Health Canada (HC), as federal authorities under the CEAA, will provide specialist or expert information and knowledge in support of the environmental assessment process.

4.0 Interim Approach to Scoping

The "Cabinet Directive on Implementing the *Canadian Environmental Assessment Act*" (the Directive) sets out a policy for determining an appropriate scope of project for environmental assessments. Section 3, Part II of the Directive, states the following:

> If components of the proposal other than the component directly related to the powers, duties or functions referred to in section 5 of the [CEAA] might cause adverse environmental effects on areas of federal jurisdiction, a scope of project determination that includes as much as possible these other components, so that the potential adverse environmental effects on areas of federal jurisdiction can be considered.

Application of the Directive is guided by the "Interim Approach for Determining Scope of Project for Major Development Proposals with Specific Regulatory Triggers under the

Canadian Environmental Assessment Act", which was released in November 2006 (http://www.ceaa-acee.gc.ca/012/016/index_e.htm). The interim approach includes structured processes for identifying components of a development proposal for inclusion in the project scope, obtaining the information required to support federal environmental assessment decisions, and ensuring implementation of mitigation measures and follow-up programs.

4.1 Canada-New Brunswick Coordination

The development proposal is subject to a provincial environmental assessment in accordance with the New Brunswick *Clean Environment Act*. The federal environmental assessment will be coordinated, to the extent possible, with the provincial environmental assessment. However, the federal and provincial governments will each make decisions on matters within their own legislative authorities.

The New Brunswick Department of Environment received an environmental assessment registration for the development proposal on January 25, 2007. On February 7, 2007 the provincial Minister of Environment determined that a comprehensive environmental impact assessment would be required for this proposal. The Minister of Environment issued draft guidelines for the provincial environmental assessment on April 5, 2007. These guidelines can be viewed at http://www.gnb.ca/0009/0377/0002/0005-e.asp.

DFO, EC, TC, HC, and NRCan are all members of the New Brunswick Technical Review Committee and will participate with provincial departments in the provincial environmental assessment.

4.2 TERMPOL

Irving Oil has committed to completing a TERMPOL review, which is a Technical Review of Marine Terminal Systems and Transshipment sites. The purpose of a TERMPOL review is to objectively appraise operational ship safety, route safety, and management and environmental concerns associated with the location, construction and operation of a Marine Terminal.

A TERMPOL review is administered by Transport Canada. The TERMPOL review process is not limited to the scope of the environmental assessment and is not exclusive from the review of an NWPA application. Detailed information on the TERMPOL process can be found at **www.tc.gc.ca/marinesafety/tp/tp743/part1.htm**

5.0 Scope and Level of the Federal Environmental Assessment

5.1 Scope of the Project

DFO, EC, and TC each have a responsibility to ensure that an environmental assessment is conducted in accordance with the CEAA. As outlined in section 15(1) of the CEAA, the scope of the project to be assessed is determined by the RA.

DFO, EC, and TC propose that the scope of the project for the federal environmental assessment will be the construction, operation, decommissioning and/or abandonment of the following "triggered" components of the development proposal, and the related activities (e.g., blasting, dredging, infilling, disposal at sea):

- the pier or monobuoy for crude tanker unloading, and or the use of the existing monobuoy at Canaport
- the pier and associated breakwater for loading of petroleum coke products onto ships and for shipping the refined petroleum products to their intended markets, and
- the barge landing facility, constructed on either a temporary or permanent basis, for unloading large equipment during the construction phase or as required thereafter.

Scope of project does not include shipping but does include docking and deberthing of vessels.

5.2 Level of the Environmental Assessment

DFO, EC, and TC have determined that components of the development proposal that are included within their proposed scope of project are subject to a comprehensive study under the Act pursuant to paragraphs to paragraph 28(c) of the Comprehensive Study List Regulations, which reads:

28(c) a marine terminal designed to handle vessels larger than 25 000 DWT unless the terminal is located on lands that are routinely and have been historically used as a marine terminal or that are designated for such use in a land-use plan that has been the subject of public consultation.

5.3 Factors to be Considered in the Environmental Assessment

The comprehensive study will consider those factors required pursuant to section 16 of the CEAA:

- the environmental effects of the project, including the environmental effects of <u>malfunctions or accidents</u> that may occur in connection with the project and any <u>cumulative environmental effects</u> that are likely to result from the project in combination with other projects or activities that have been or will be carried out;
- the significance of the environmental effects referred to above;

- comments from the public that are received in accordance with the CEAA and the regulations;
- measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project;
- the purpose of the project;
- alternative means of carrying out the project that are technically and economically feasible and the environmental effects of any such alternative means;
- the need for, and the requirements of, any follow-up program in respect of the project;
- the capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and those of the future.

In accordance with subsection 16(1)(e) of the CEAA, the comprehensive study will also include a consideration of the “need for” the project and “alternatives to” the project.

As stated in the CEAA, “environmental effect” means, in respect of a project:

a) *any change that the project may cause in the environment, including any change it may cause to a listed wildlife species, its critical habitat or the residences of individuals of that species, as those terms are defined in subsection 2(1) of the Species at Risk Act*
b) *any effect of any change referred to in paragraph (a) on*
   i) *health and socio-economic conditions*
   ii) *physical and cultural heritage*
   iii) *the current use of lands and resources for traditional purposes by aboriginal persons, or*
   iv) *any structure, site or thing that is of historical, archaeological, paleontological or architectural significance, or*
c) *any change to the project that may be caused by the environment*

In relation to c) above, environmental effects, specifically effects of the environment on the project, could occur as a result of events such as the following:

- seismic activity;
- fire
- extreme meteorological conditions and associated erosion, flooding, icing, and storm surges; and
- climate change.

Under section 79 of the *Species at Risk Act*, the RAs must identify adverse effects of the project on listed species and their critical habitat or residences. The RAs must also ensure that measures are taken to avoid or lessen adverse effects and that effects are monitored. Mitigation measures must be consistent with recovery strategies and action plans for the species.

5.4 Scope of the Factors to be Considered

The environmental assessment should account for the following environmental components. This list is not intended to be limiting.

Physical environment	• marine water quality; • sediment quality and dispersion; • air quality; • climatic conditions; • ocean currents, tides, waves and ice; • acoustic environment.
Biological environment	• vegetation; • wetlands; • ecologically sensitive or significant areas or other designated areas; • species of conservation concern, including species at risk, and their habitats; • fish and fish habitat; • migratory birds and their habitats especially areas of concentration; • marine mammals.
Human environment[1]	• current use of lands and resources for traditional purposes by Aboriginal persons; • navigation; • fisheries; • human health; • physical and cultural heritage; • structures/sites of archaeological, paleontological or architectural significance;

Temporal and spatial boundaries will be determined for each environmental

[1] As per the definition of environmental effect, the following effects can only be considered when they relate to a change in the environment: health and socio-economic conditions; physical and cultural heritage; the current use of lands and resources for traditional purposes by Aboriginal persons; and any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

component, early in the assessment. Temporal bounding refers to the determination of the time period during which an environmental component could be impacted by the project (e.g., during the construction phase). Spatial bounding refers to the determination of the geographical area within which an environmental component could be impacted by the project (e.g. footprint of a building). The study area for the environmental assessment should encompass the area within which effects on the environmental components are measurable. In considering effects on wildlife in the study area, it is also important to consider the changing use of the area over time (e.g., during different seasons).

6.0 Overview of the Comprehensive Study Environmental Assessment Process

As stated in Section 1.0, the purpose of this document is to provide information to the public on the federal environmental assessment process, and to seek public comment on the federal assessment to be conducted in relation to the development proposal. Specifically, this document provides an opportunity for the public to comment, in accordance with section 21(1) of the CEAA, on the following:

- proposed scope of the project for the purposes of a federal environmental assessment;
- the factors proposed to be considered;
- the proposed scope of those factors; and
- the ability of a comprehensive study to address issues relating to the components of the development proposal subject to the CEAA.

Information on the deadline for comment, and how to submit comments, are found in Section 6.1.

Following the public comment period, in accordance with Section 21(2) of the CEAA, DFO, EC, and TC will provide a report to the federal Minister of the Environment with a recommendation on whether to continue with the environmental assessment by means of a comprehensive study or to refer the project to a mediator, or a review panel.

After considering the subsection 21(2) report and recommendation, the Minister of the Environment must decide whether to refer the project back to the RAs to continue with the comprehensive study process, or refer the project to a mediator or review panel. If the Minister of the Environment decides that the project should continue as a comprehensive study, the project cannot be referred to a mediator or review panel at a later date.

If the Minister of the Environment determines that the environmental assessment will continue as a comprehensive study, an environmental assessment will be undertaken. The RAs will delegate the preparation of the comprehensive study report (CSR) to the Proponent. The CSR will be prepared, and then submitted to the Minister of the Environment and to the Canadian Environmental Assessment Agency (Agency).

Following submission of the CSR, the Agency will invite the public to comment on the report prior to the Minister of the Environment making his environmental assessment decision. The Minister of the Environment also has the power to request additional information or require that public concerns be addressed before issuing the environmental assessment decision statement. Once the environmental assessment decision statement is issued, the Minister of the Environment will refer the project back to the RAs for appropriate action.

If after considering the subsection 21(2) report and recommendation, the Minister of the Environment refers the project to a mediator or review panel, the project will no longer be subject to a comprehensive study under the CEAA. The Minister of the Environment, after consulting the RAs and other appropriate parties, will set the terms of reference for the review, and appoint the mediator or review panel members.

Whether the environmental assessment proceeds by means of a comprehensive study or is referred to a review panel, participant funding will be made available by the Agency to facilitate public participation.

6.1 Ability of the Comprehensive Study to Address Issues Relating to the Project

Comments are also being solicited on the ability of the comprehensive study to address issues relating to the project. The public is encouraged to identify any reasons why issues, associated with the project that are considered within a federal environmental assessment, can or cannot be properly addressed within the comprehensive study process.

7.0 Public Participation

7.1 Submission of Comments

In consideration of information contained in this document, the public is invited to provide their views and opinions in the following areas:

- the proposed scope of the project;
- the factors proposed to be considered in the assessment
- the proposed scope of those factors; and
- the ability of the comprehensive study to address issues relating to the project.

Persons wishing to submit comments may do so in writing to the Senior Environmental Analyst, Mr Ted Currie. Comments must be received no later than June 30, 2007. Comments may be sent to:

Ted Currie
Senior Environmental Analyst
Fisheries and Oceans Canada

Maritimes Region
P.O. Box 5030
Moncton, N.B.
E1C 9B6
Facsimile – 506-851-2565
curriet@mar.dfo-mpo.gc.ca

Clearly reference the Project Eider Rock on your submission.

Please note that all submissions are considered public and will become part of the registry.

Should a comprehensive study be conducted for the project, DFO, EC and TC will provide the public with an additional opportunity for input into the comprehensive study process. Once the comprehensive study report has been submitted to the Agency, the public will be provided an opportunity to review and provide comments during the Agency's public comment period, prior to final recommendation to the Minister of Environment. The public will also have opportunities to participate in the review, should the project be referred to a mediator or a review panel.

7.2 Participant Funding

The Agency has made $60,000 available under its participant funding program to assist groups and/or individuals to take part in the environmental assessment.

To receive funding, successful applicants must participate in the environmental assessment. Funding applications received by the Agency at the address indicated below by June 30, 2007 will be considered.

Information on the program, including the Participant Funding Program Guide, the application form and the contribution agreement, are available on the Agency's Web site at www.ceaa-acee.gc.ca.

For additional information on the funding program, please contact:

Participant Funding Program
Canadian Environmental Assessment Agency
160 Elgin Street, Place Bell Canada, 22nd Floor
Ottawa, ON
K1A 0H3

7.3 Canadian Environmental Assessment Registry (CEAR)

Pursuant to the CEAA, section 55, a CEAR has been established to provide notice of the environmental assessment, and facilitate public access to records related to the environmental assessment. The CEAR consists of a project file and an internet site.

The internet component of the CEAR can be accessed at http://www.ceaa.gc.ca/050/index_e.cfm.

Anyone wishing to obtain copies, or view records, from the CEAR project file should contact.

DFO - CEA Registry Office - Maritimes Region
P.O. Box 1006
5th Floor Polaris Bldg, B505
Dartmouth NS
B2Y 4A2
Telephone: (902) 426-5154
Email: CEAR/RCEEMar@mar.dfo-mpo.gc.ca

If you have general questions in relation to the CEAA, you can access the Agency website at www.ceaa-acee.gc.ca or contact the Atlantic Region office at 902-426-0564.

Appendix 1
Glossary of Terms

Alternative Means of Carrying Out the Project – the various ways, that are technically and economically feasible, that the project can be carried out. This could include, for example, alternative locations, routes and methods of development, implementation and mitigation.

Alternatives to the Project – functionally different ways to meet the project need and achieve the project purpose. Analysis of "alternatives to" should serve to validate that the preferred alternative is a reasonable approach to meeting need and purpose of the project.

Comprehensive Study – federal environmental assessment that is conducted in accordance with the CEAA, sections 21 and 21.1, and that requires a consideration of the factors required to be considered pursuant to subsections 16(1) and (2).

Cumulative Environmental Effects – changes to the environment that are caused by an action in combination with other past, present and future actions. The CEAA, section 16(1)(a) specifies that cumulative effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out must be considered in a federal environmental assessment.

Environment – This is defined within the CEAA as the components of the earth and includes:

a. land, water, and air, including all layers of the atmosphere,
b. all organic and inorganic matter and living organisms, and
c. the interacting natural systems that include components referred to in paragraphs (a) and (b).

Follow–up Program – as defined within the CEAA, a program for

(a) verifying the accuracy of the environmental assessment of a project, and
(b) determining the effectiveness of any measures taken to mitigate the adverse environmental effects of the project

Malfunctions or Accidents – the probability of malfunctions or accidents associated with the project, and the potential adverse environmental effects associated with these events must be identified and described. The description would include such things as accidental spills, contingency measures for responding to emergencies, and risks of facility malfunctions.

Mediation – An environmental assessment that is conducted with the assistance of a mediator, appointed pursuant to section 30 of the CEAA, and that includes a consideration of the factors required to be considered under subsections 16(1) and (2).

Mitigate\Mitigation - For the purposes of the CEAA, mitigation means, in respect of a project, 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.

Review Panel – An environmental assessment that is conducted by a review panel established pursuant to section 33 of the CEAA and that includes a consideration of the factors required to be considered under subsections 16(1) and (2) of the CEAA.

Appendix 2
Study Area for Marine Terminal Facilities

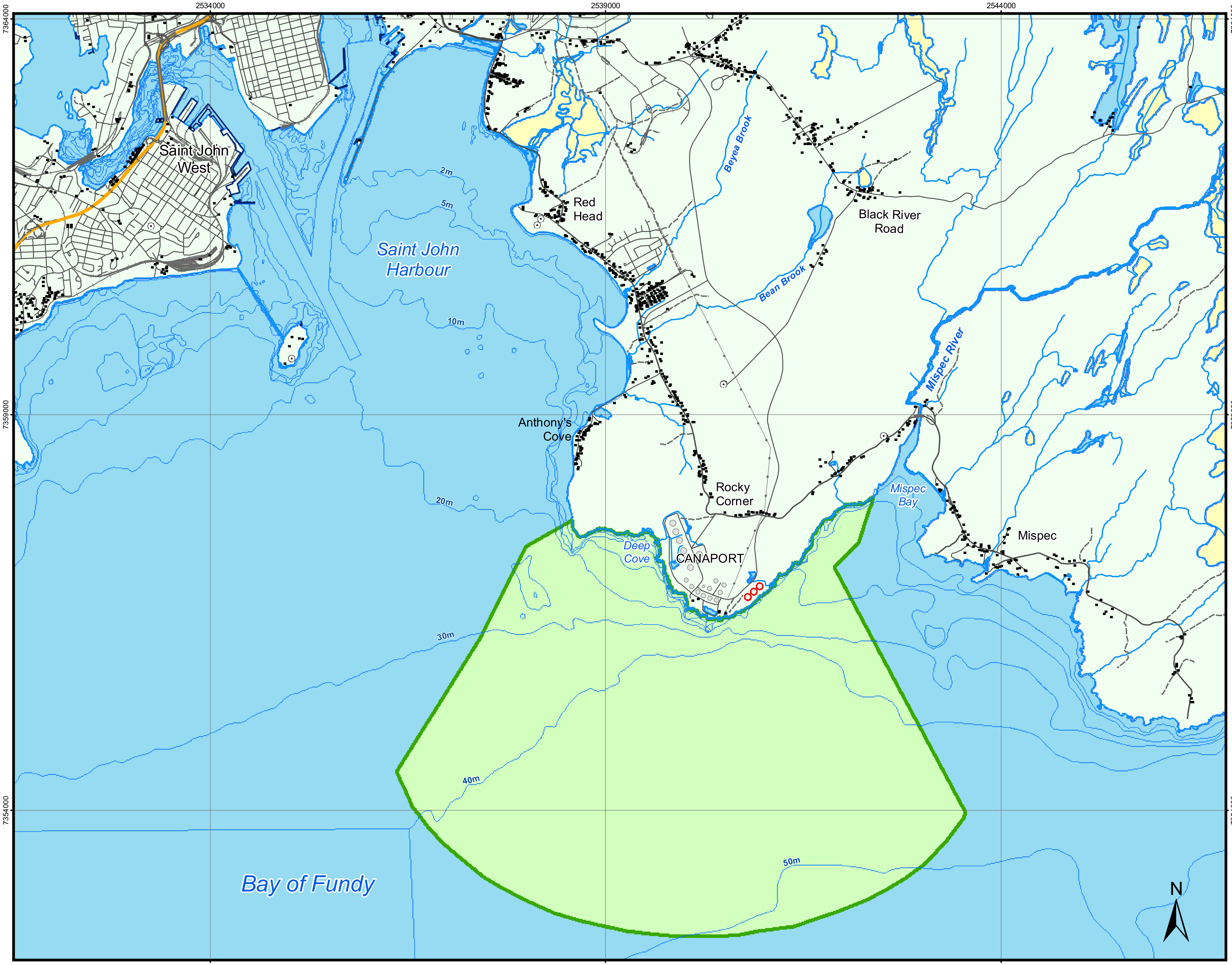

Figure 2.2

Study Area for Marine Terminal Facilities

Project Eider Rock

Map Features

- New-Bldg
- Building
- Tower
- Wharf
- Utility Line
- Major Road
- Secondary Road
- Local Road
- Bridge
- Track
- Rail Line
- Watercourse
- Canaport LNG Facility
- Bathymetry
- Study Area for Marine Terminal Facilities
- Waterbody
- Wetland

Data Source: Service New Brunswick

0 0.25 0.5 1 1.5 2

Kilometres

Map Parameters
Projection: NB Stereographic
Scale 1:45,000
Date: April 11th, 2007
Project No.: 1013263.

Jacques Whitford

Appendix E

Summary of Federal Coordination Results

Summary of Federal Coordination Results

Project Eider Rock, Saint John, New Brunswick

CEAR Reference # 07-03-28779

On January 26, 2007, the Canadian Environmental Assessment Agency distributed the project description for Project Eider Rock to Environment Canada, Fisheries and Oceans Canada, Health Canada, Indian and Northern Affairs Canada, Industry Canada, National Energy Board, Natural Resources Canada, the Canadian Transportation Agency, the Saint John Port Authority and Transport Canada, in accordance with the requirements of the *Regulations Respecting the Coordination by Federal Authorities of Environmental Assessment Procedures and Requirements*. The determinations of the canvassed departments are summarized in the table below:

Department	**Response**
Environment Canada	Likely to require an environmental assessment; and in possession of specialist or expert information
Fisheries and Oceans Canada	Likely to require an environmental assessment; and in possession of specialist or expert information
Transport Canada	Likely to require an environmental assessment; and in possession of specialist or expert information
Health Canada	In possession of specialist or expert information
Natural Resources Canada	In possession of specialist or expert information
Saint John Port Authority	In possession of specialist or expert information
Industry Canada	Not likely to require an environmental assessment
National Energy Board	Not likely to require an environmental assessment
Indian and Northern Affairs Canada	Not likely to require an environmental assessment
Canadian Transportation Agency	Not likely to require an environmental assessment

Appendix F

List of Tables and Figures

List of Tables

List of Figures